Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

and what you can do about it

August 2017

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Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
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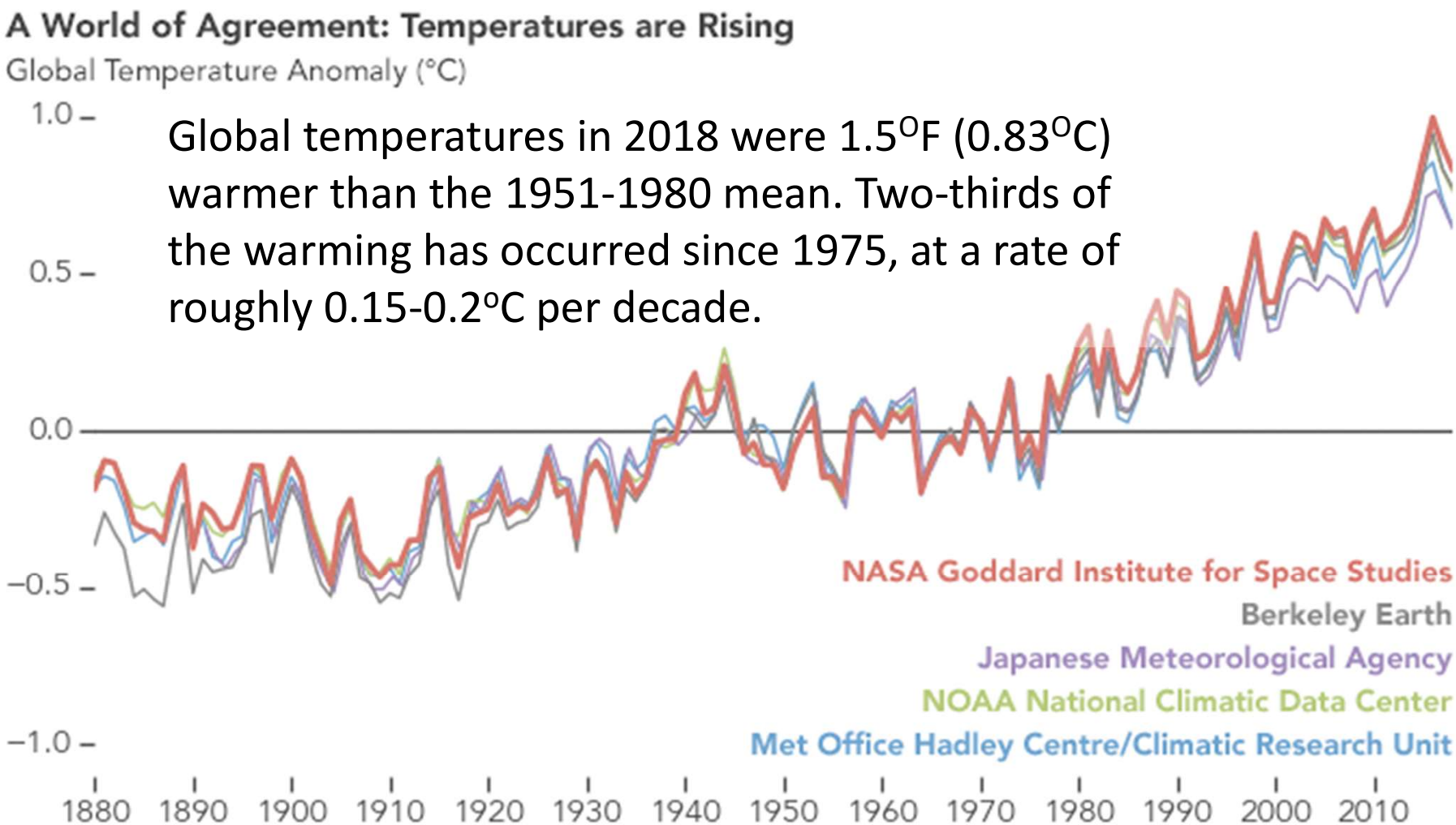
Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

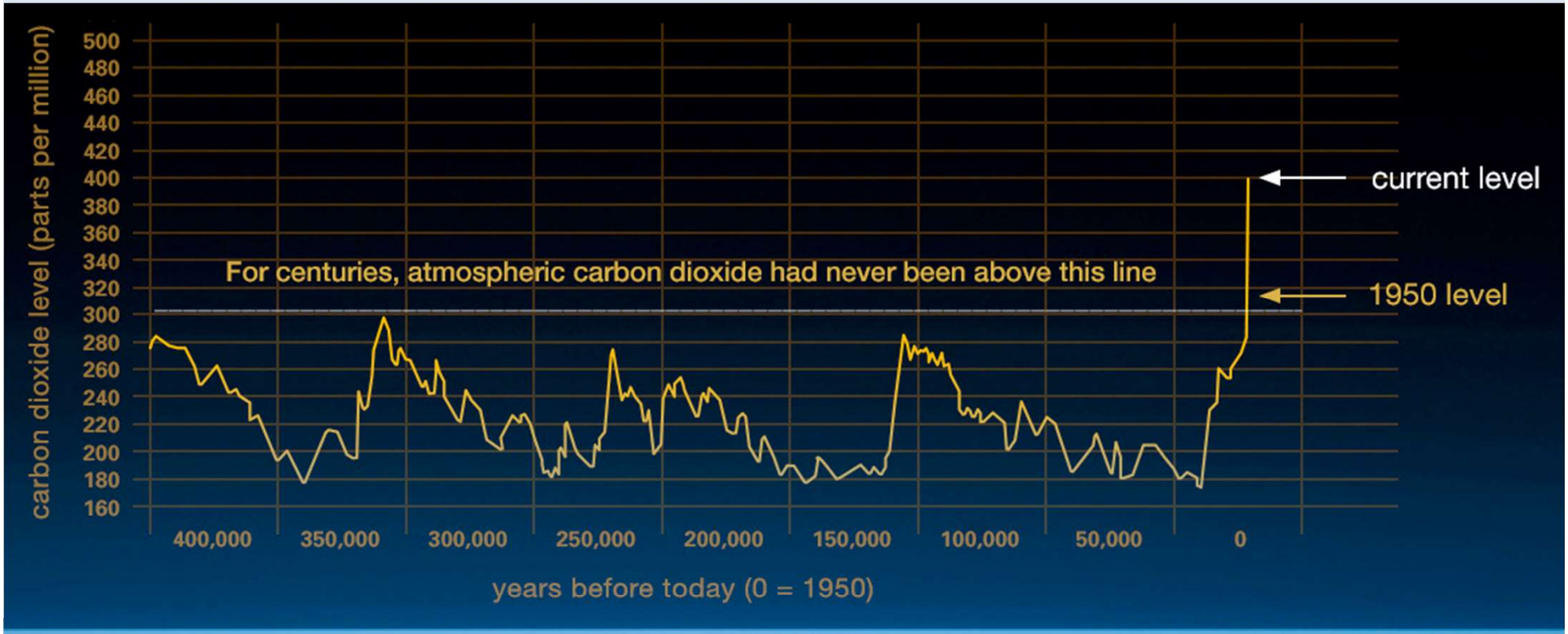


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

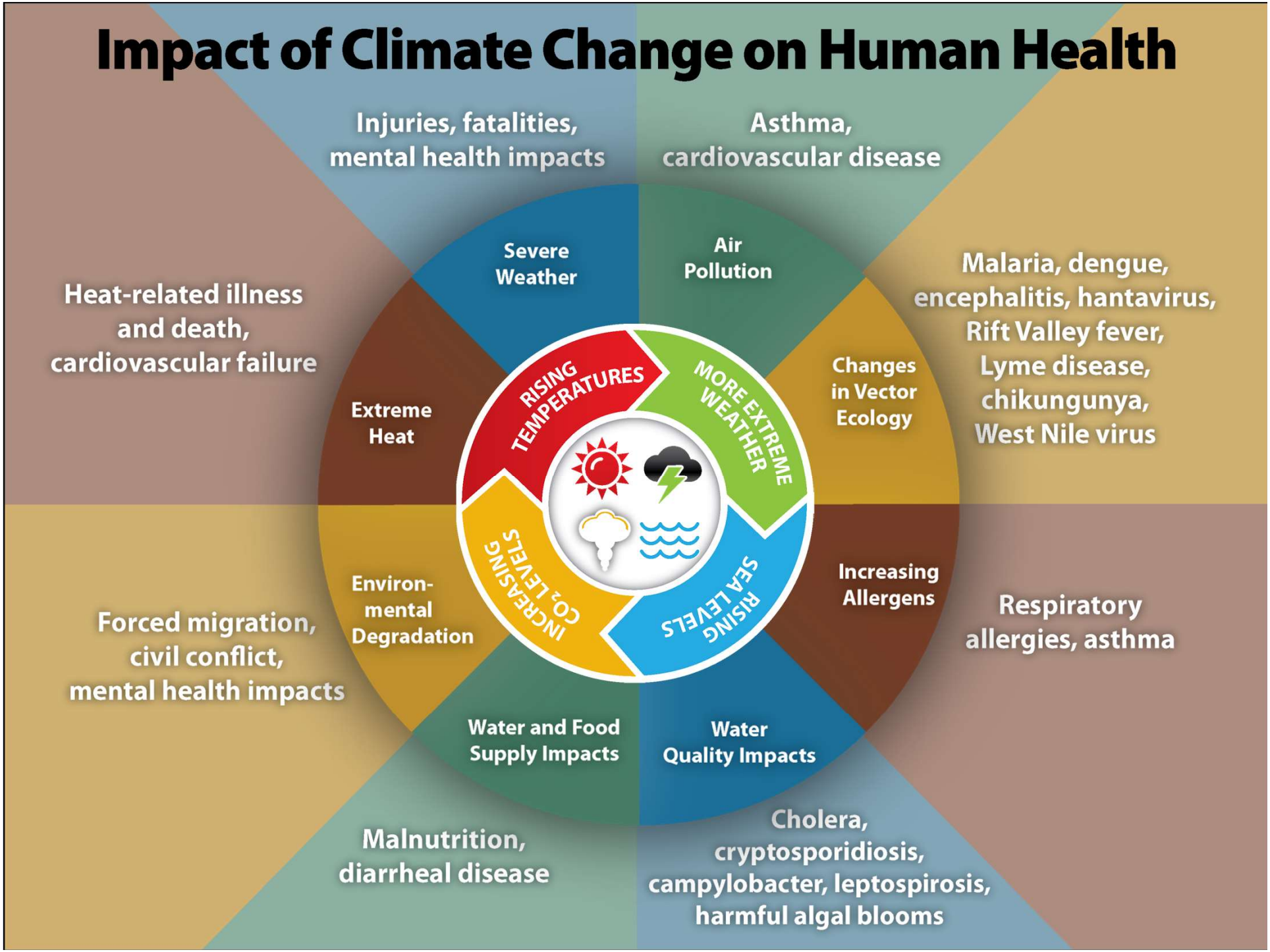
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

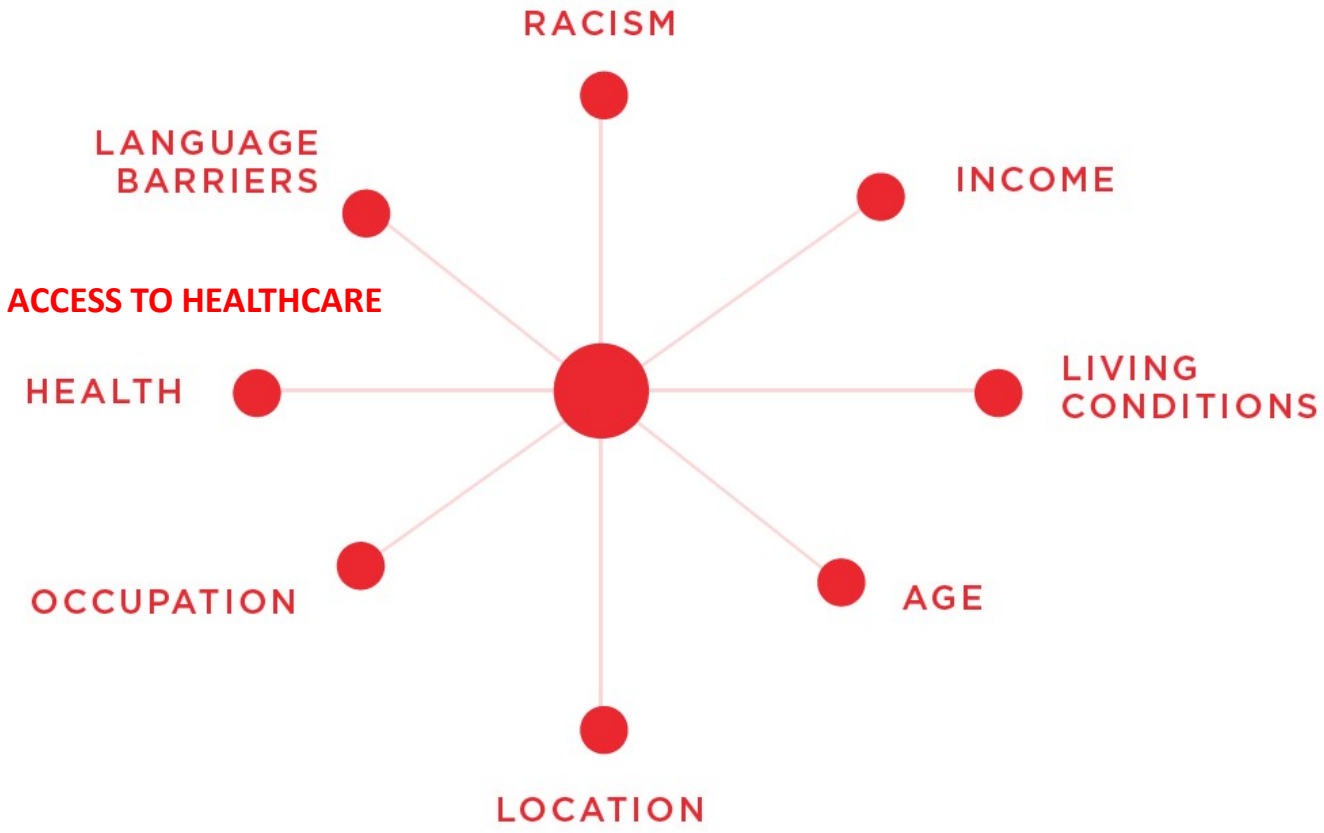
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

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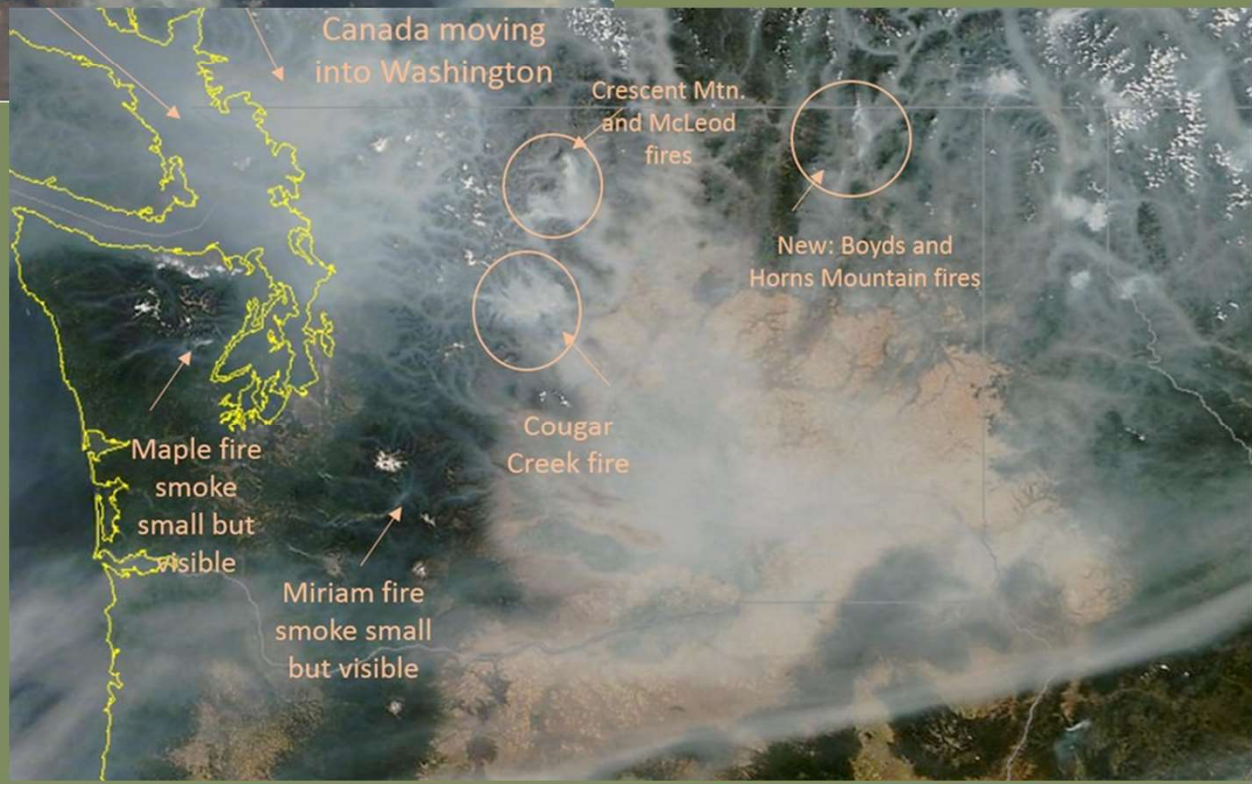
Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

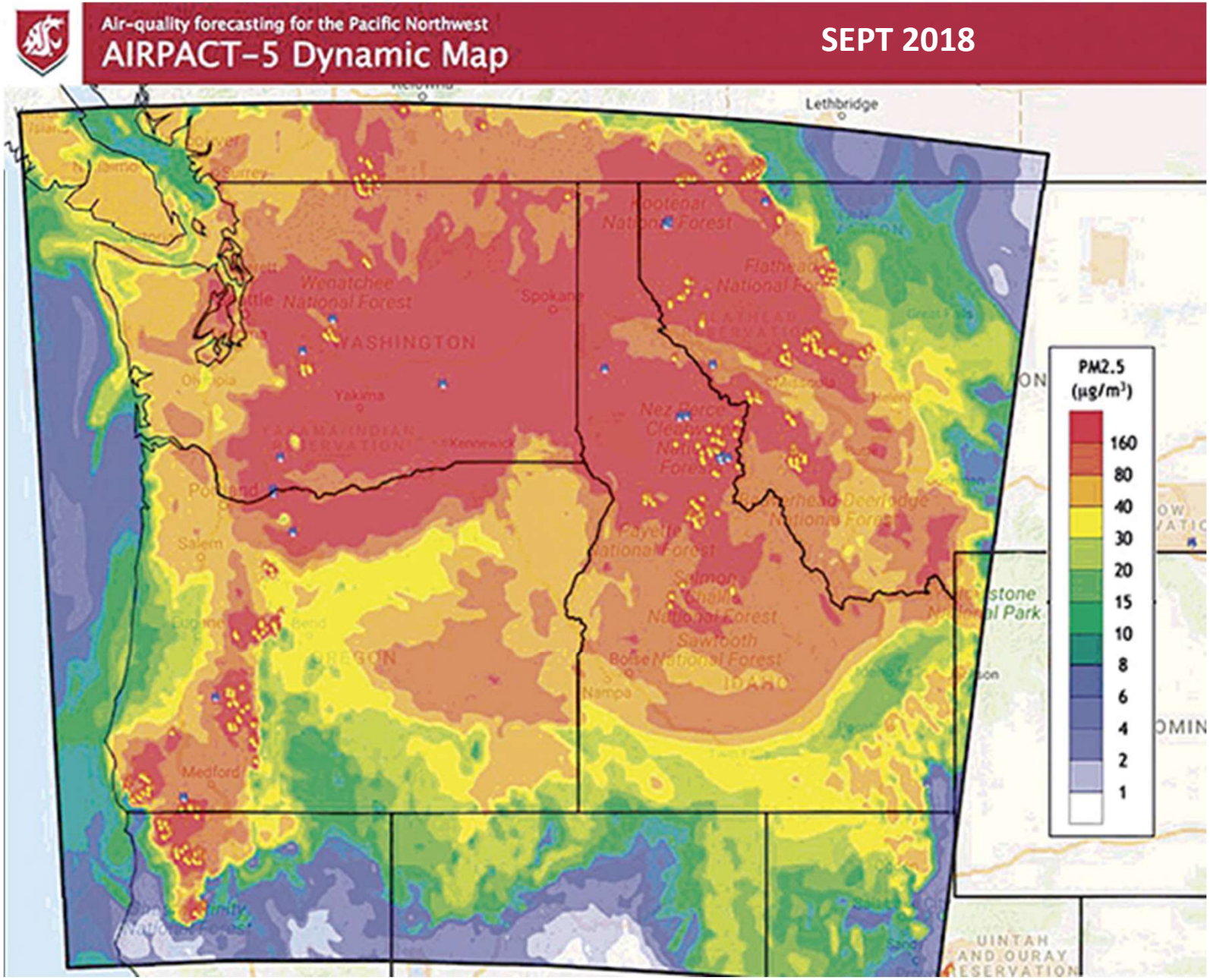
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

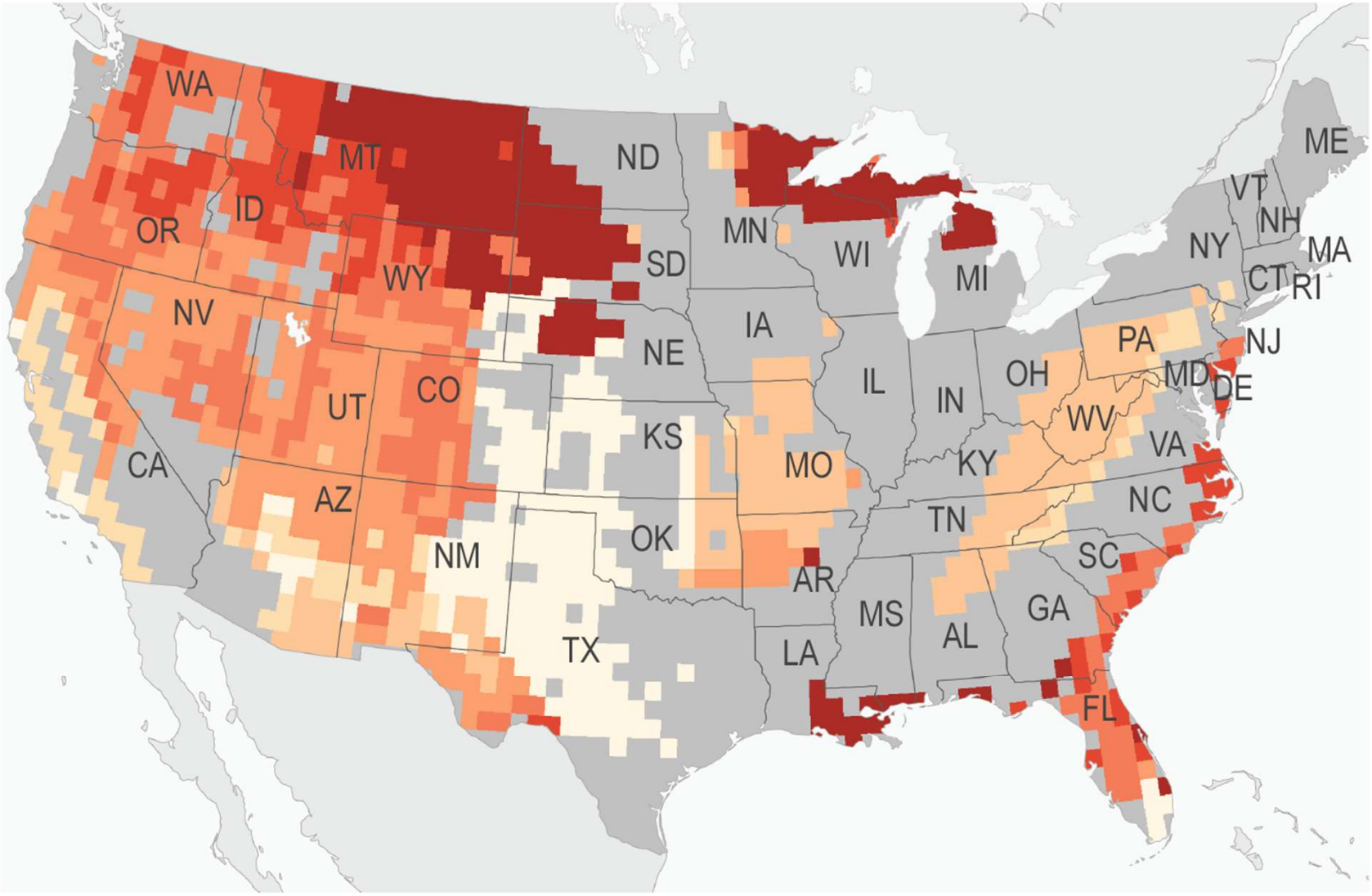
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

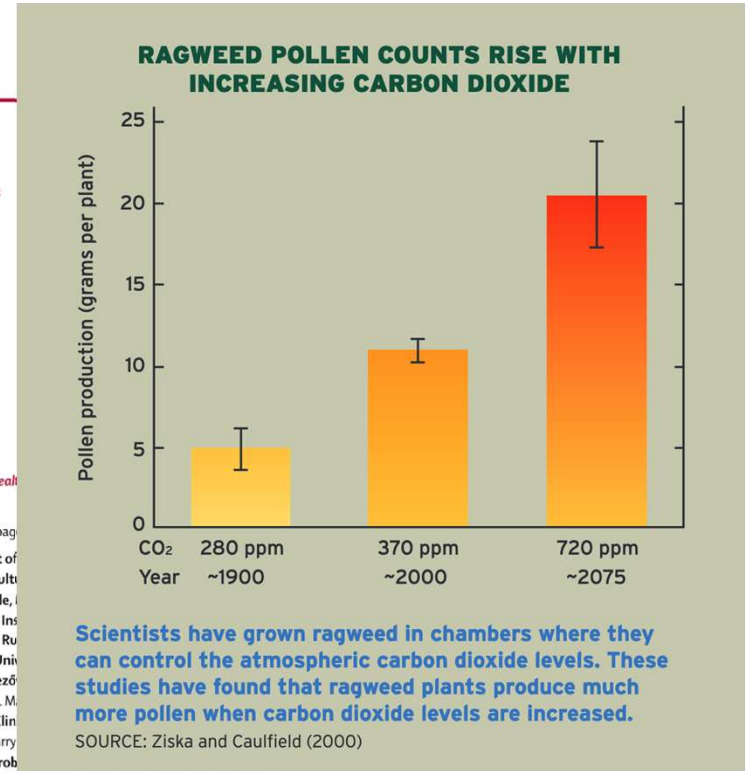
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

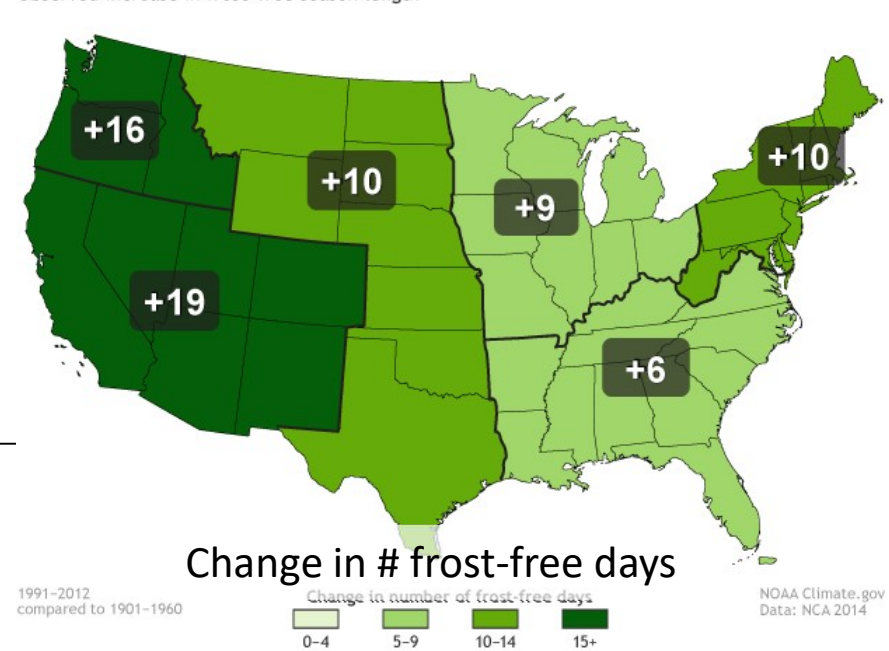
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

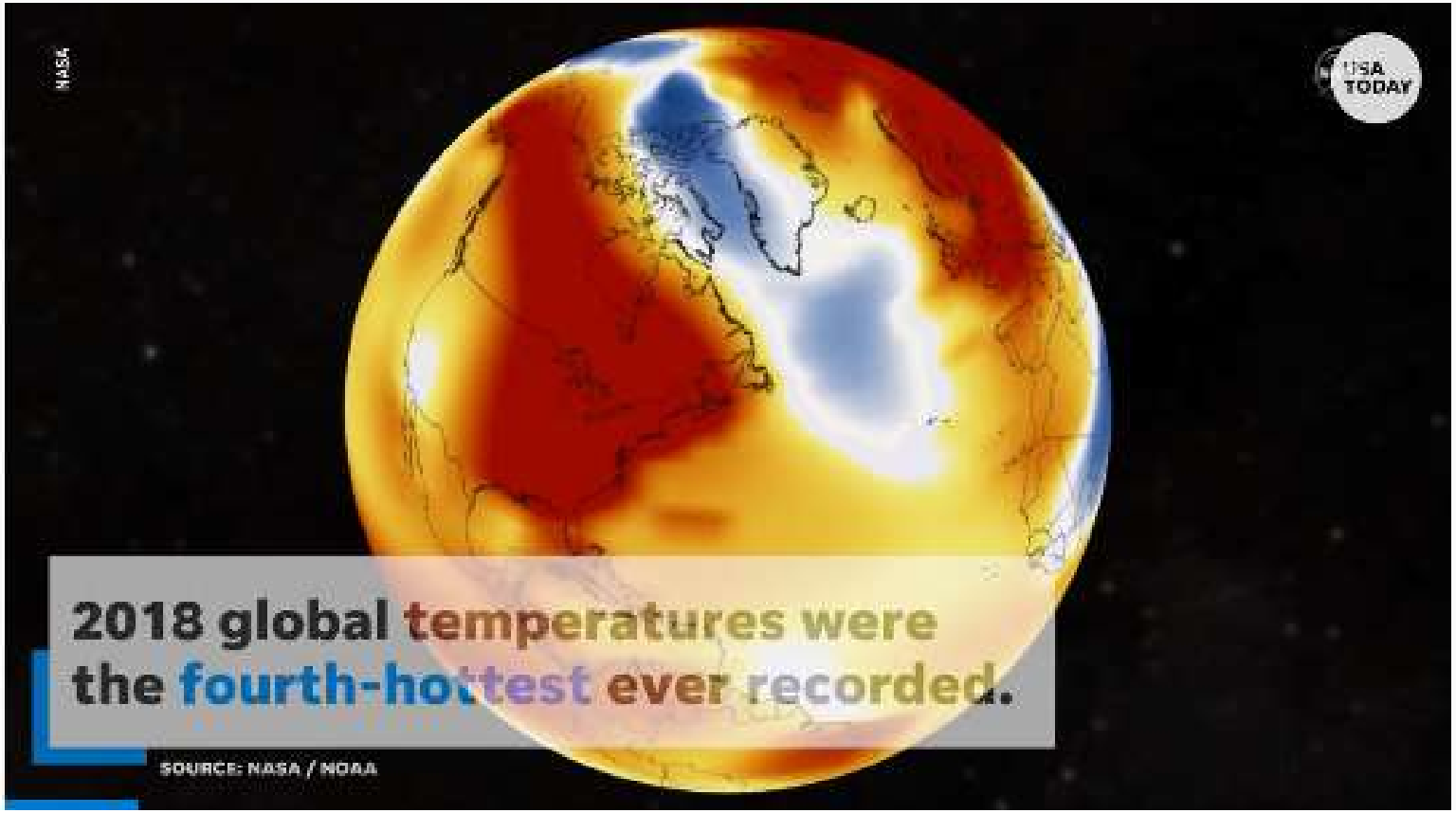
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



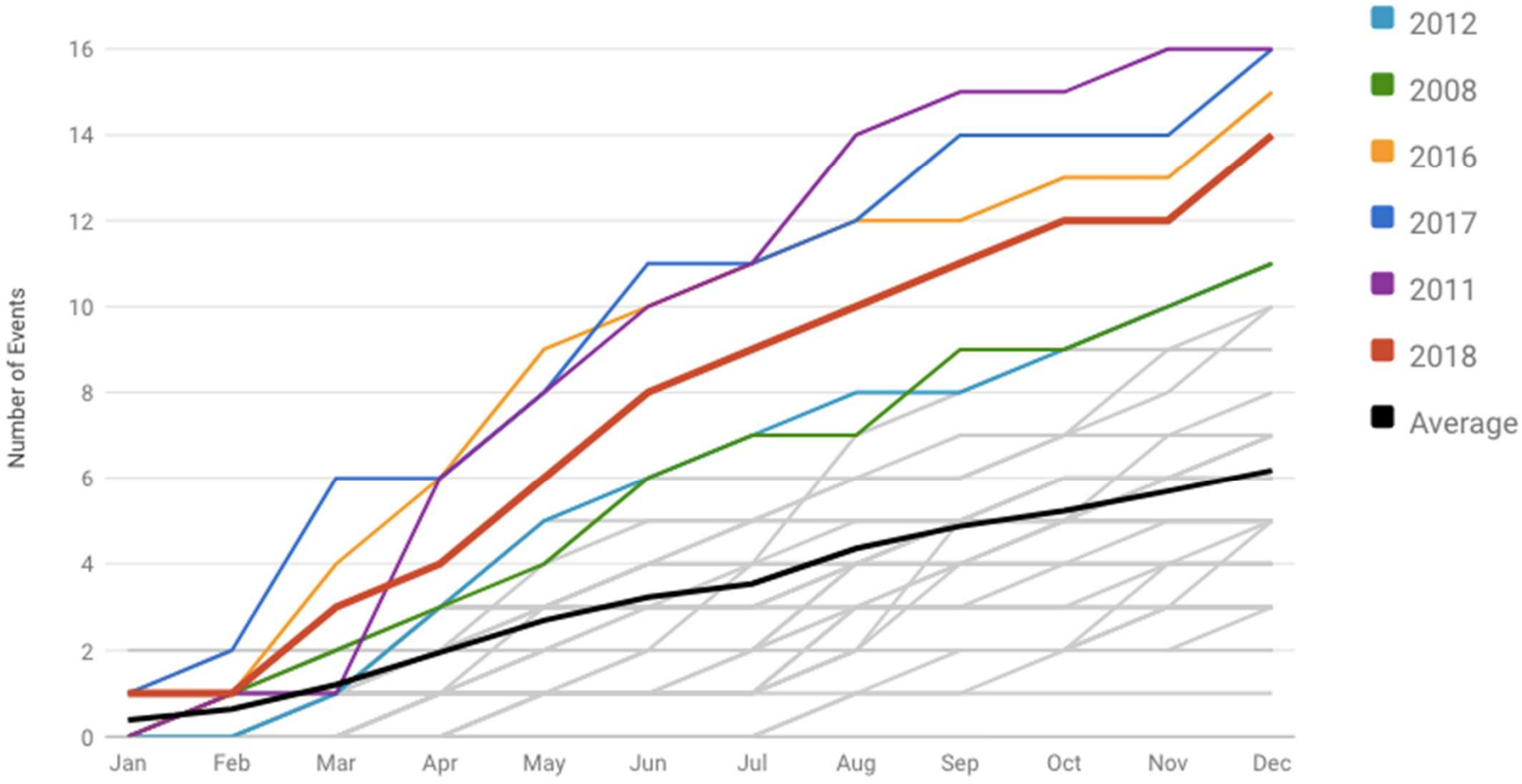
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



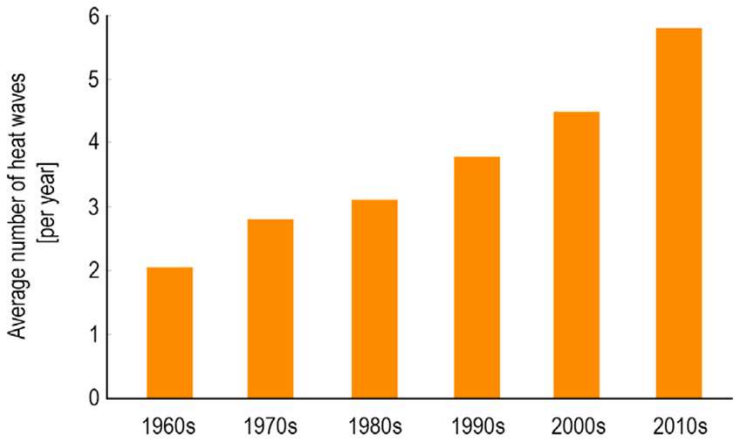
NOAA: National Centers for Environmental Information

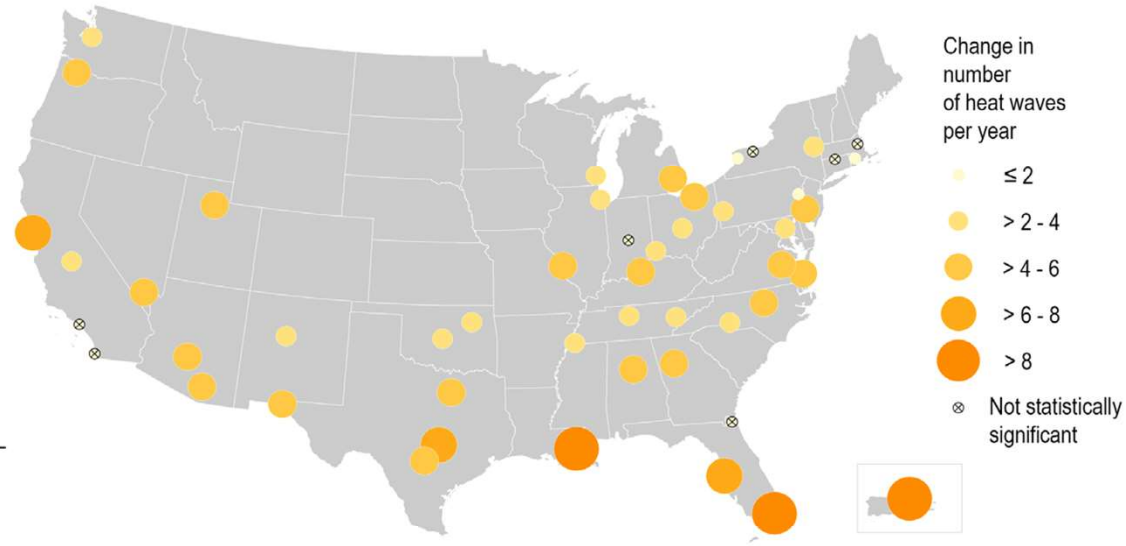
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

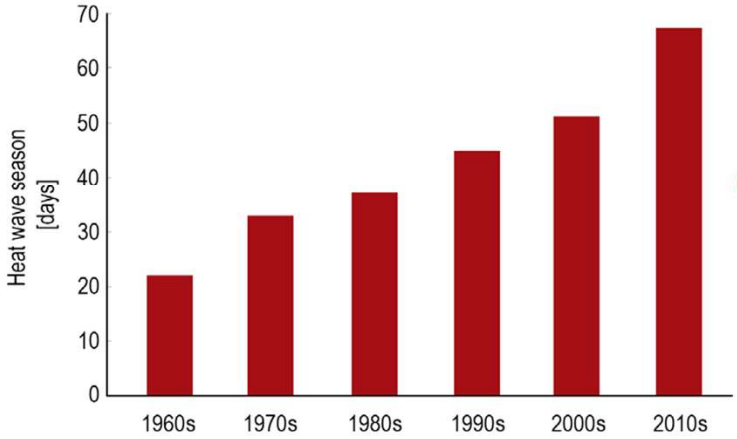
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

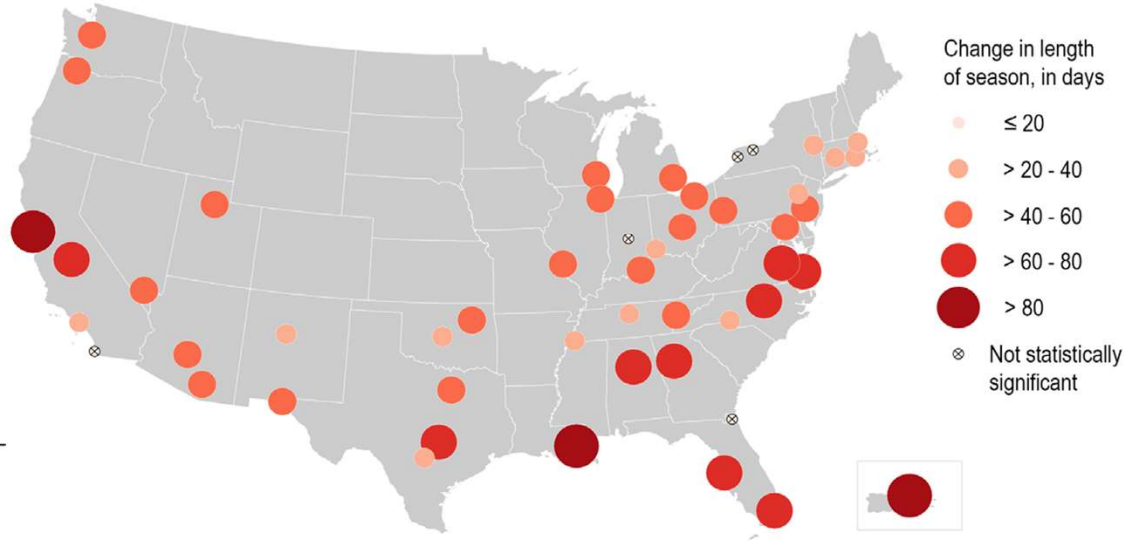
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

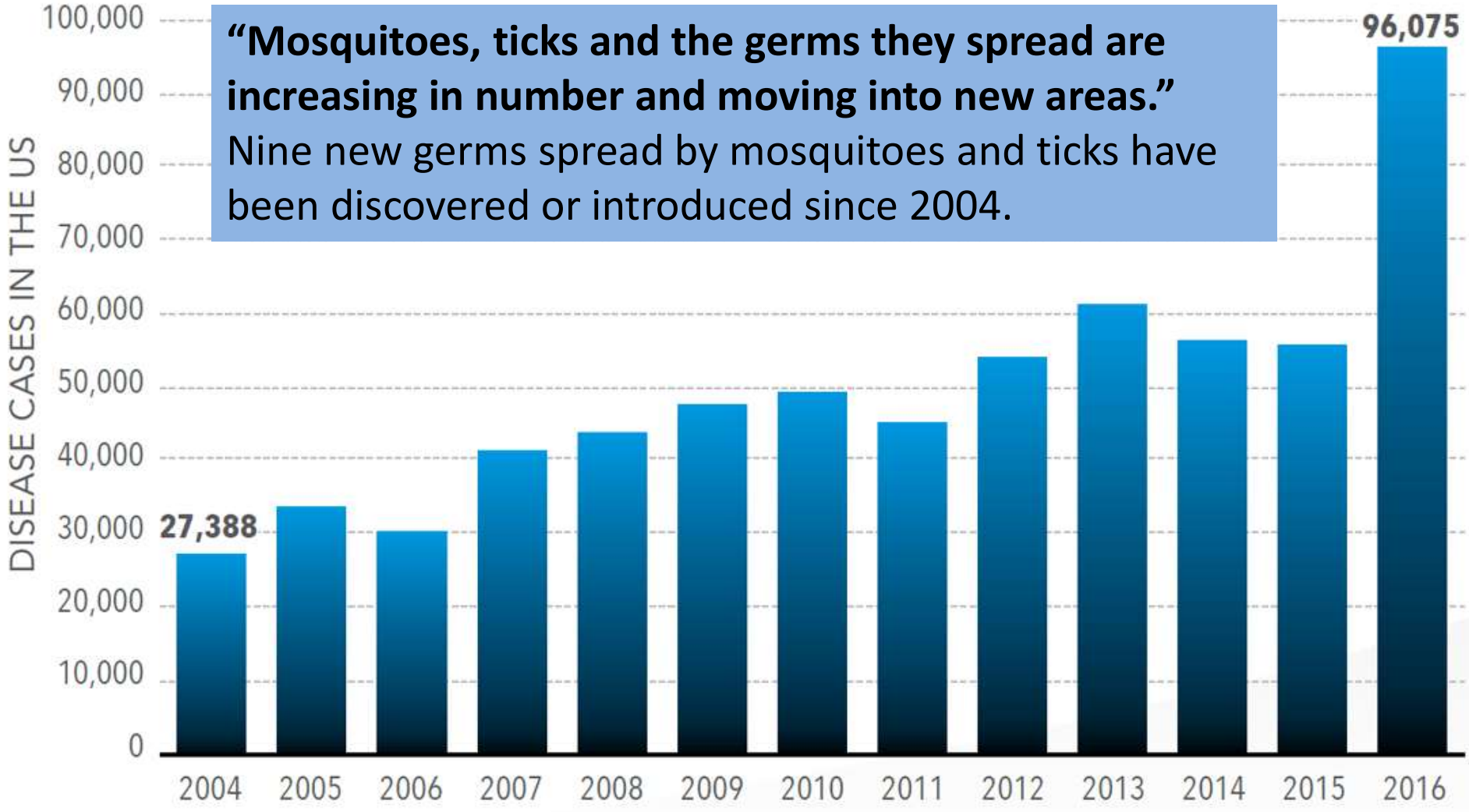
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

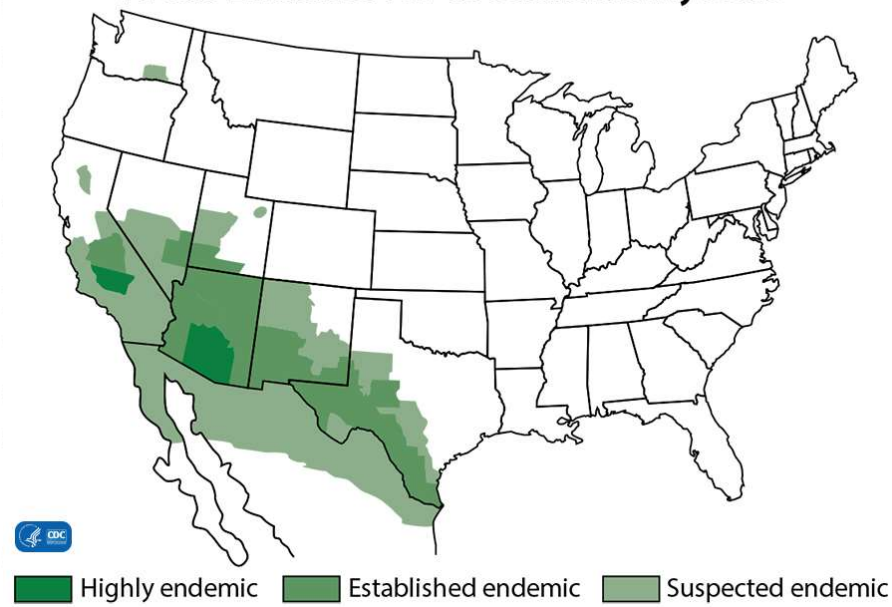
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

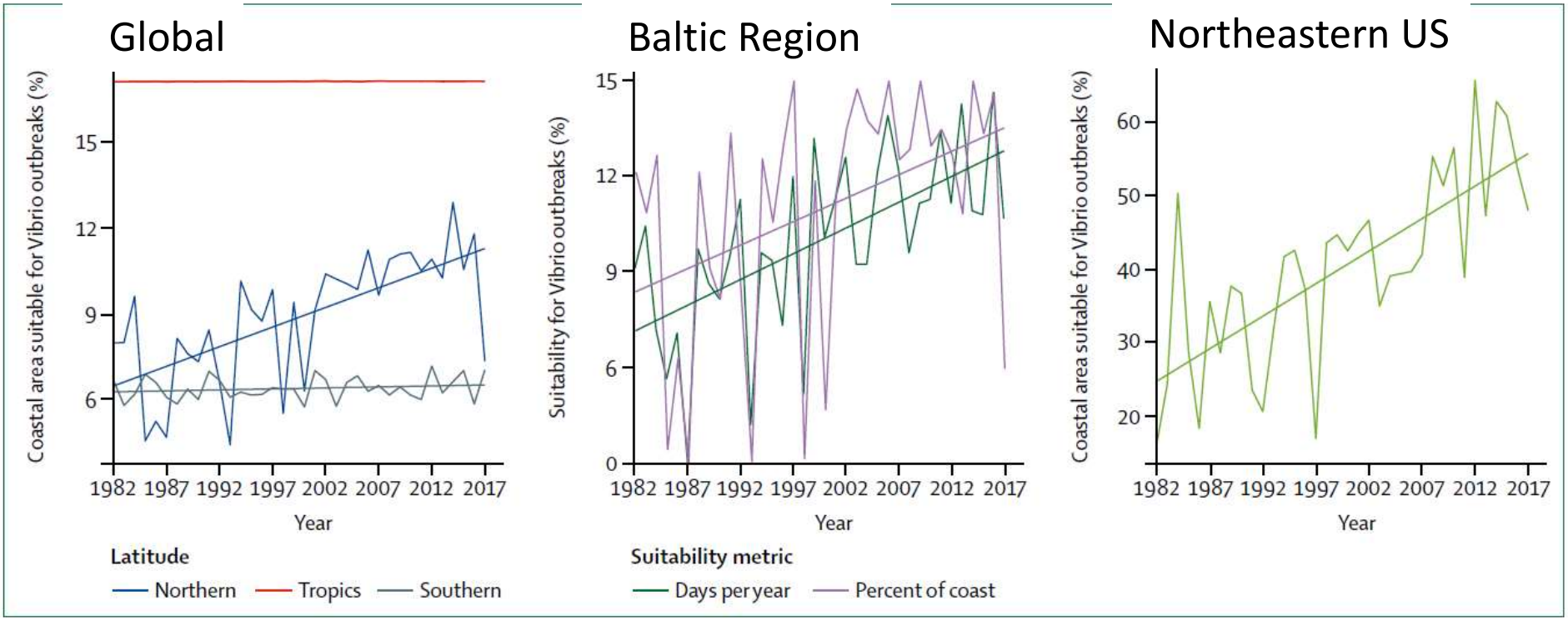
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

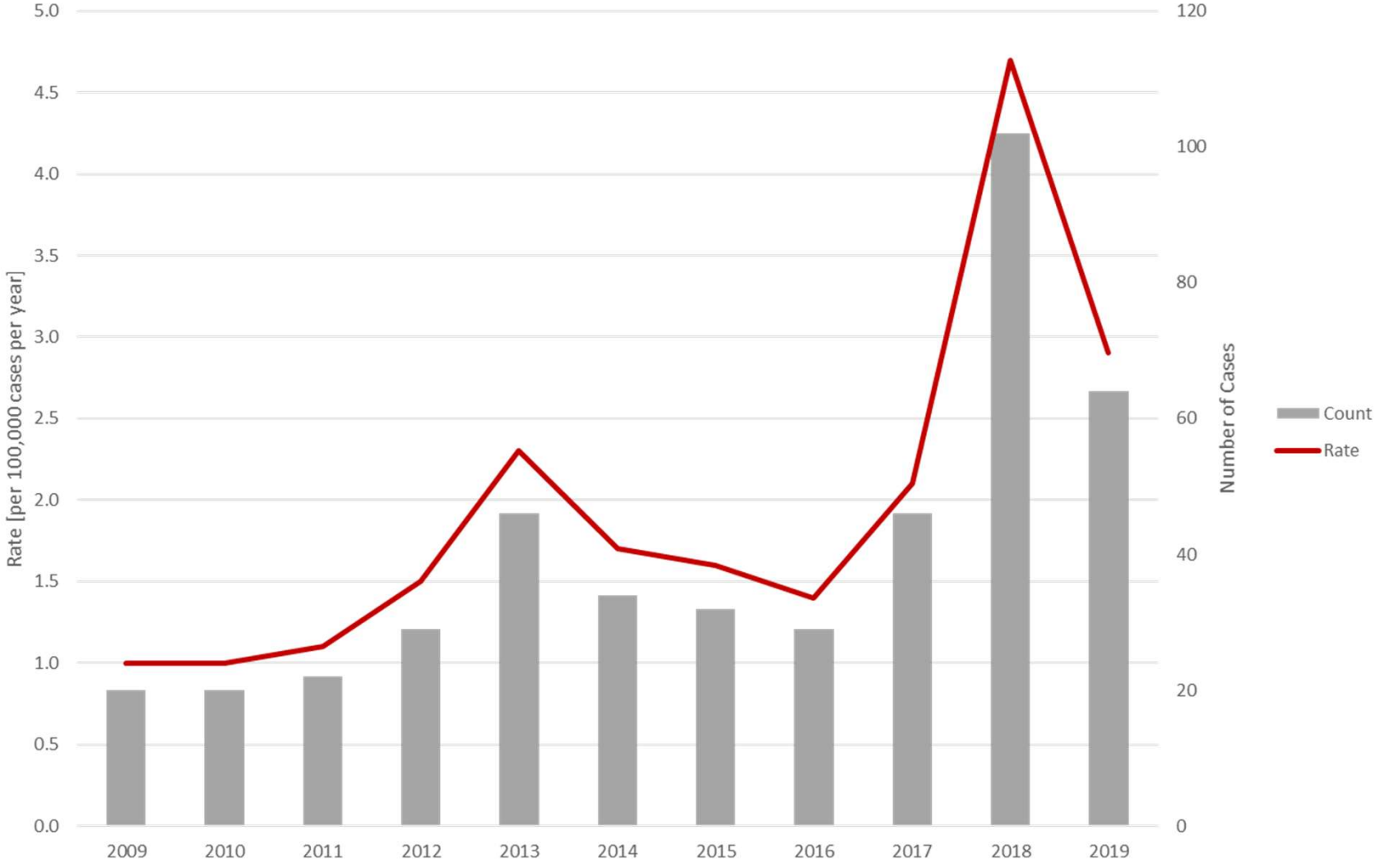
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

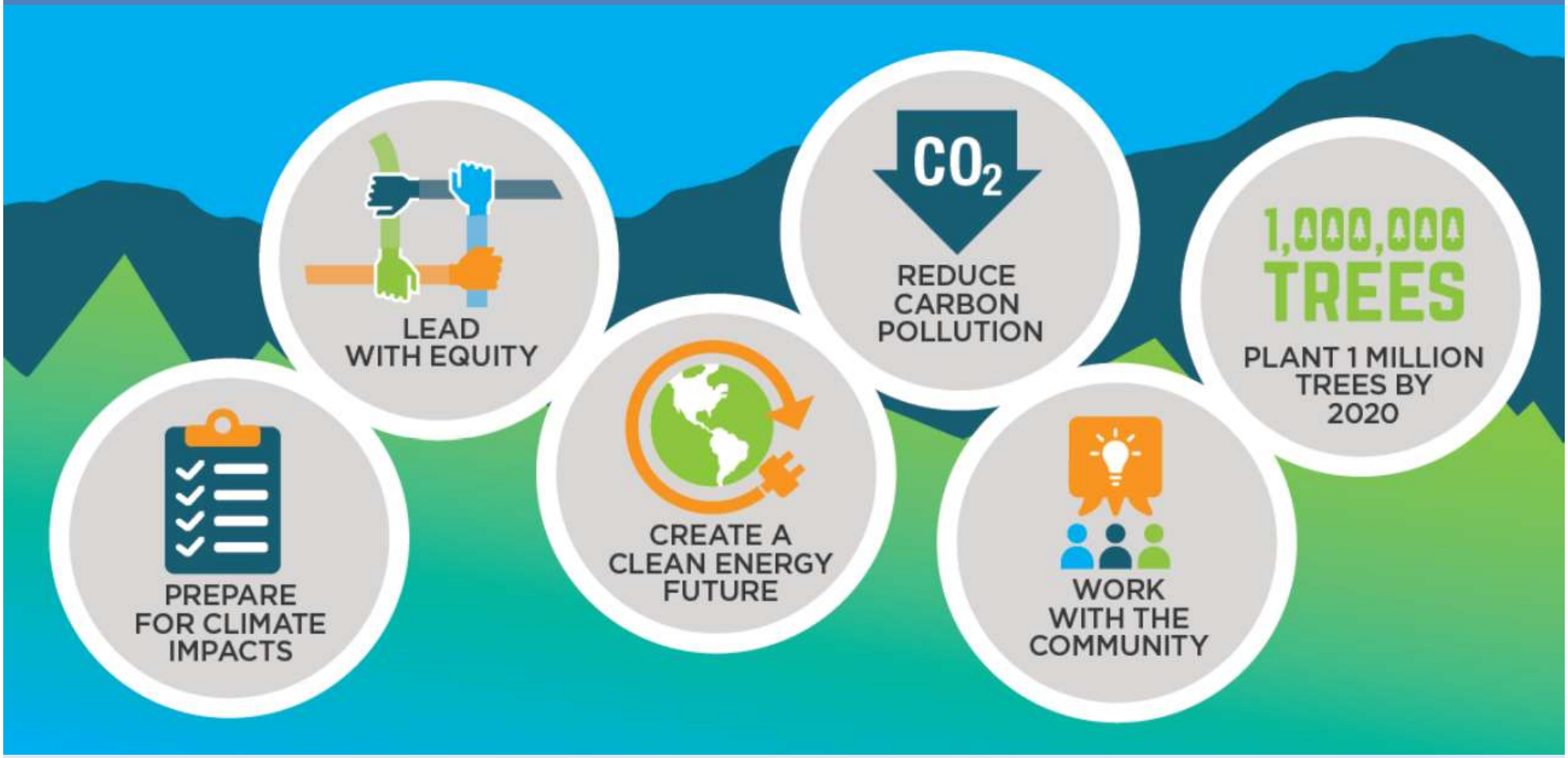
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

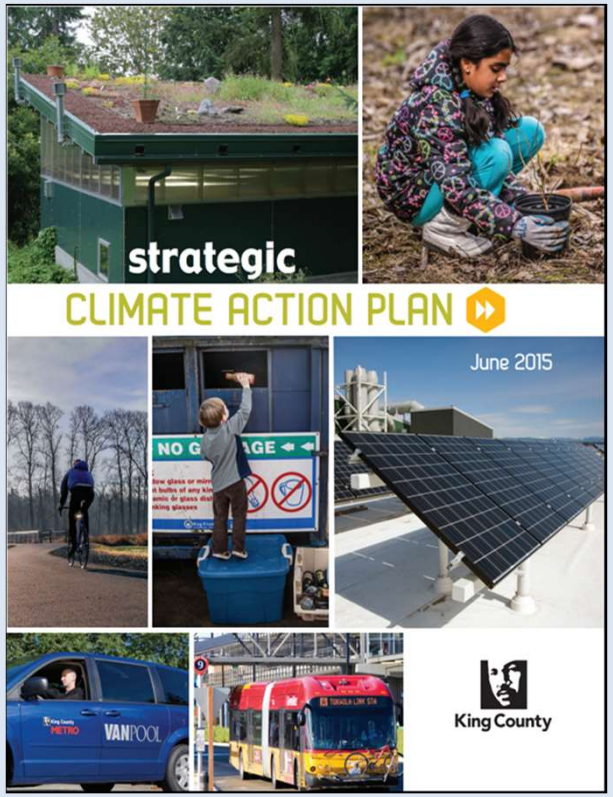


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

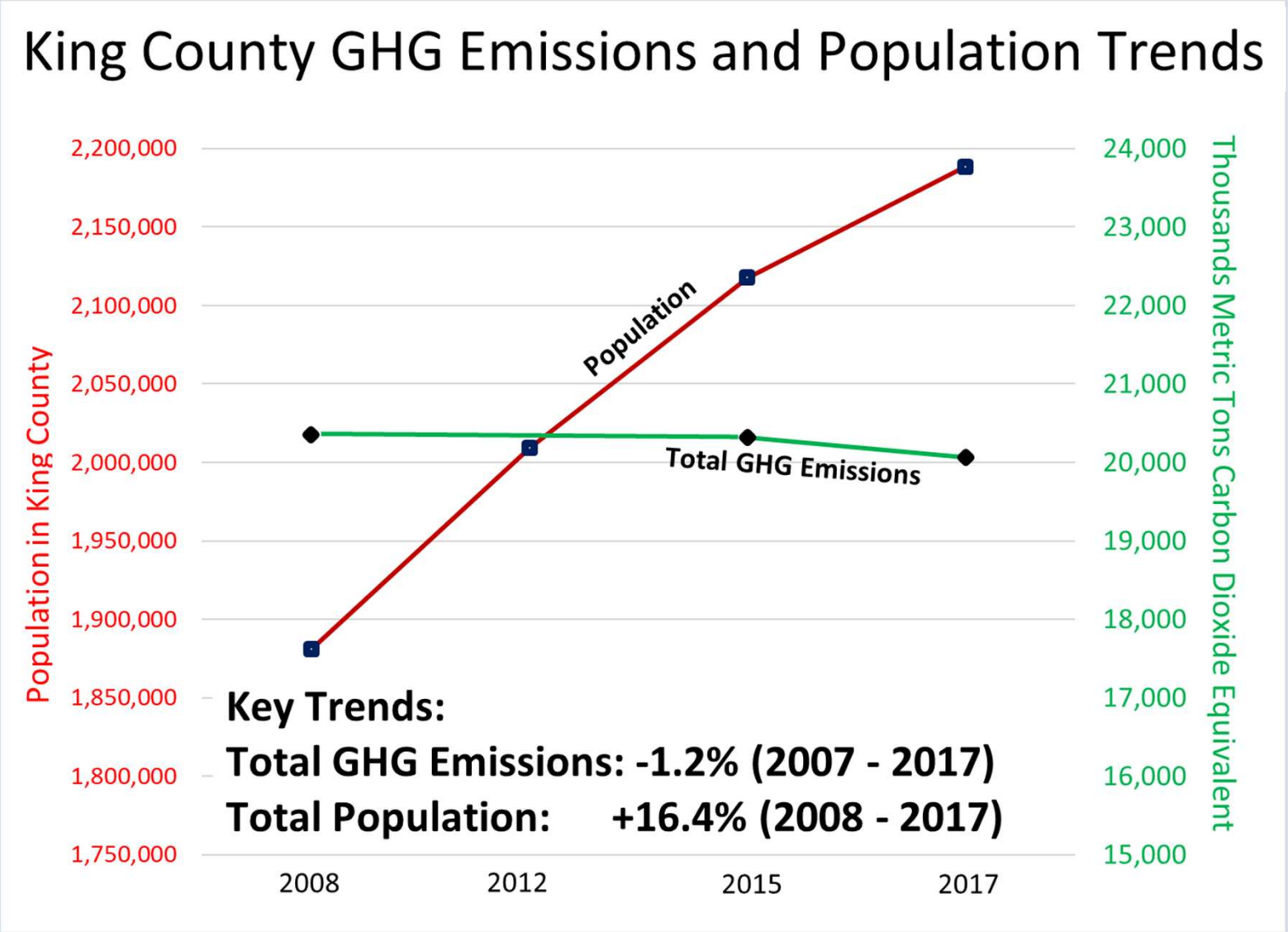
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



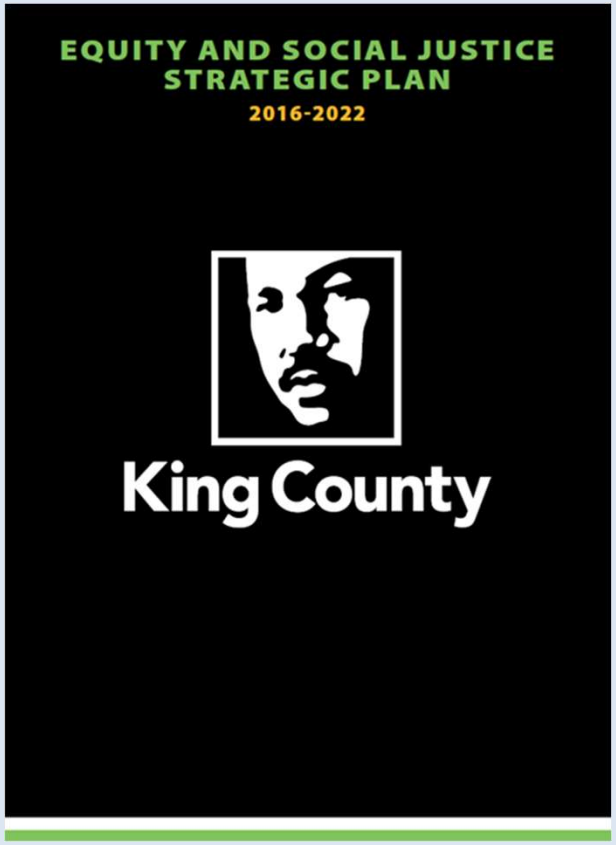
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

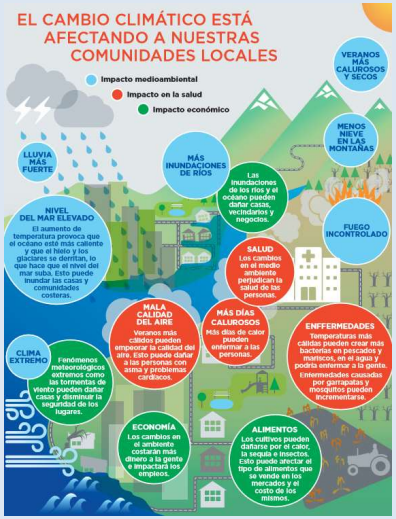
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

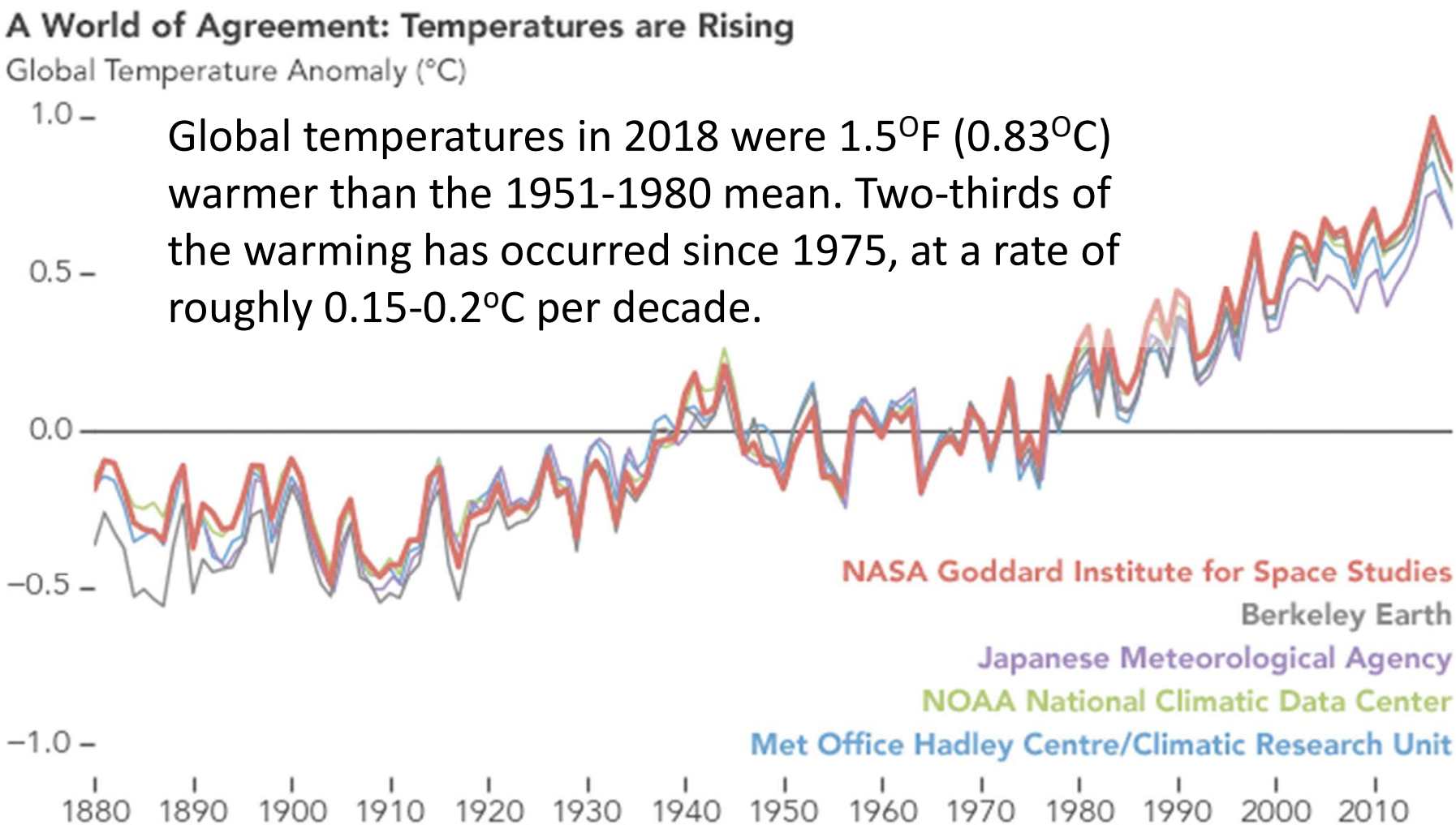
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

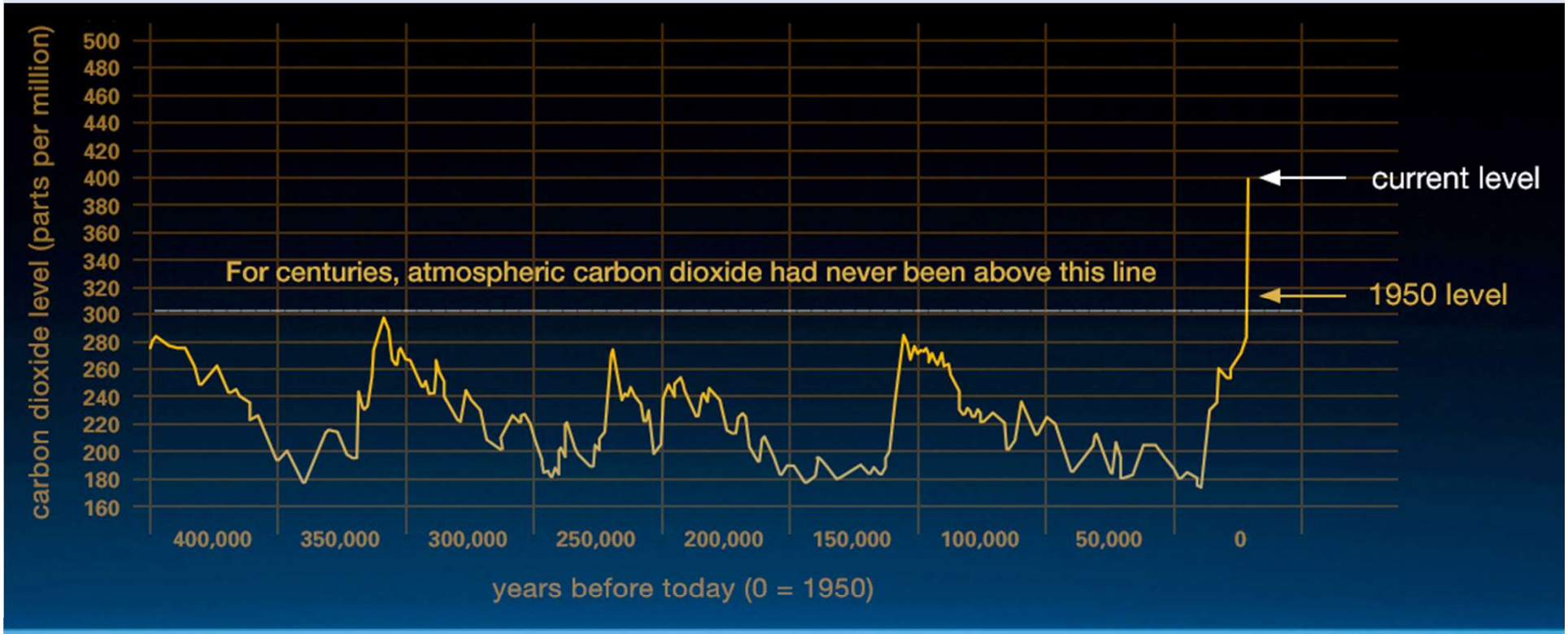


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

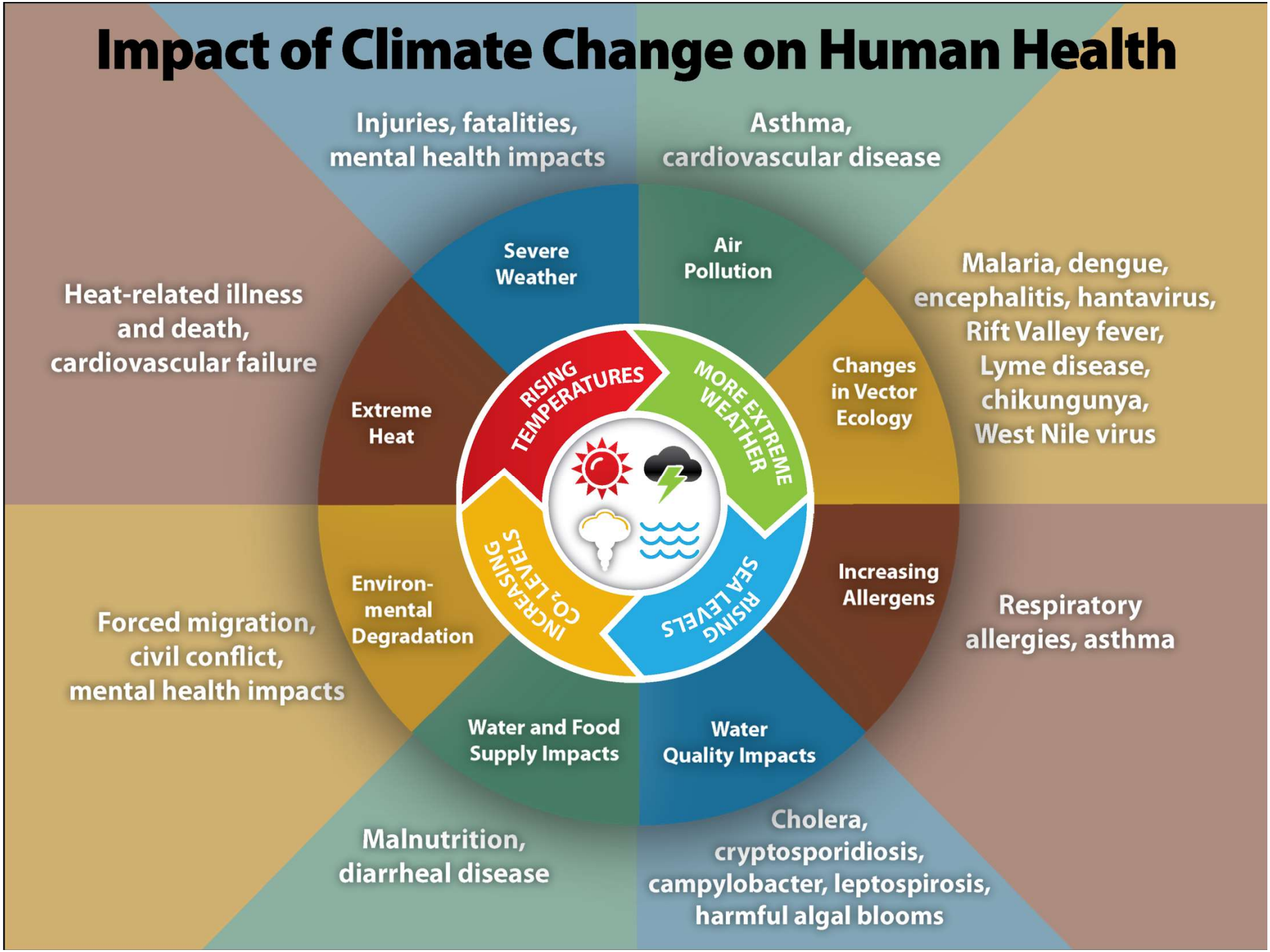
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

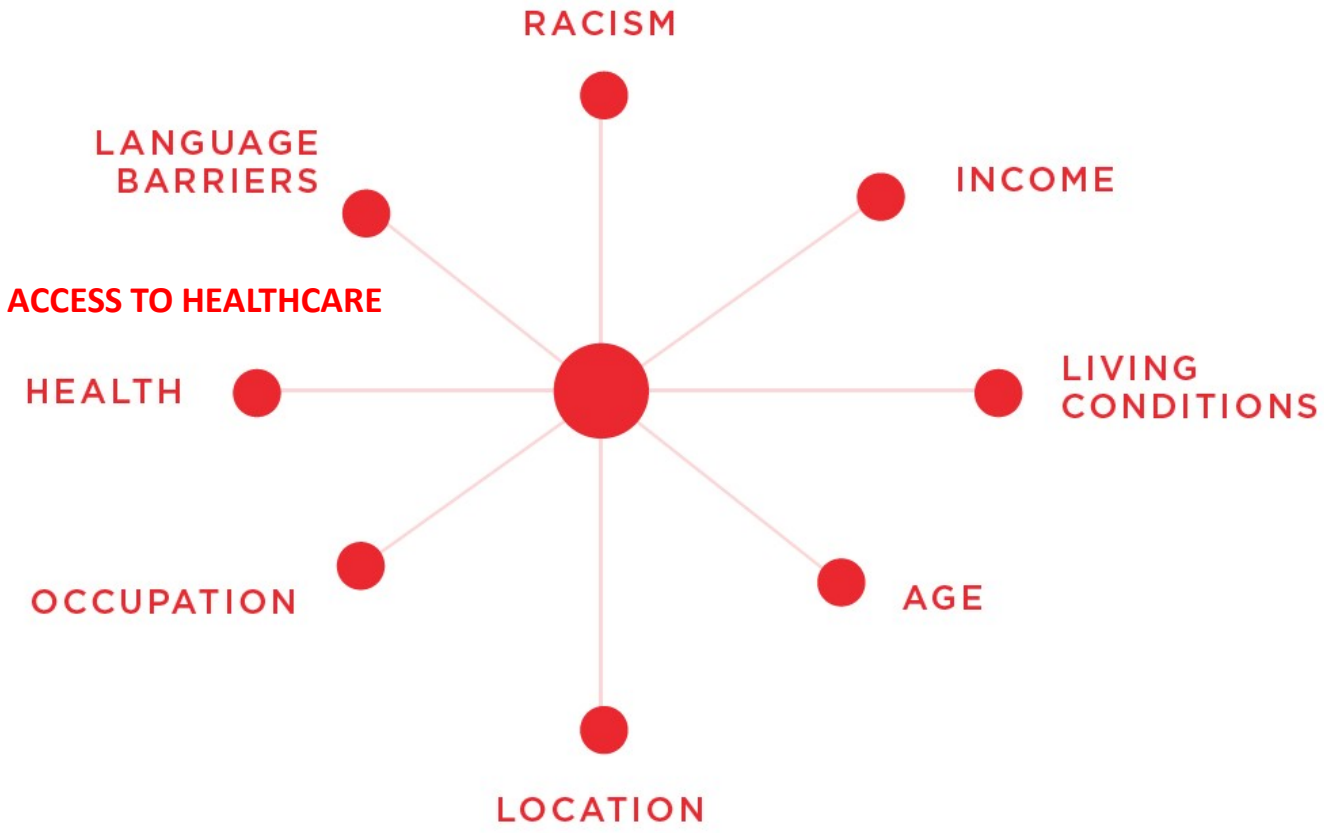
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

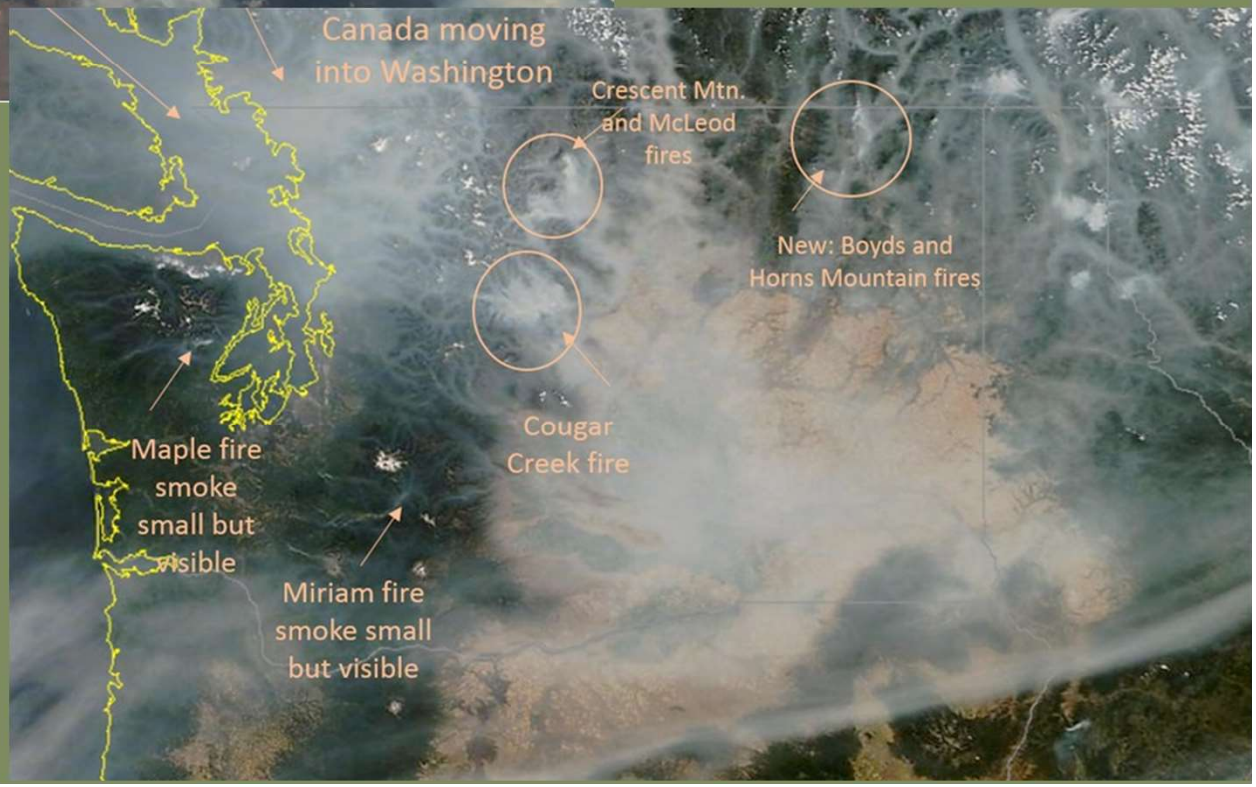
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

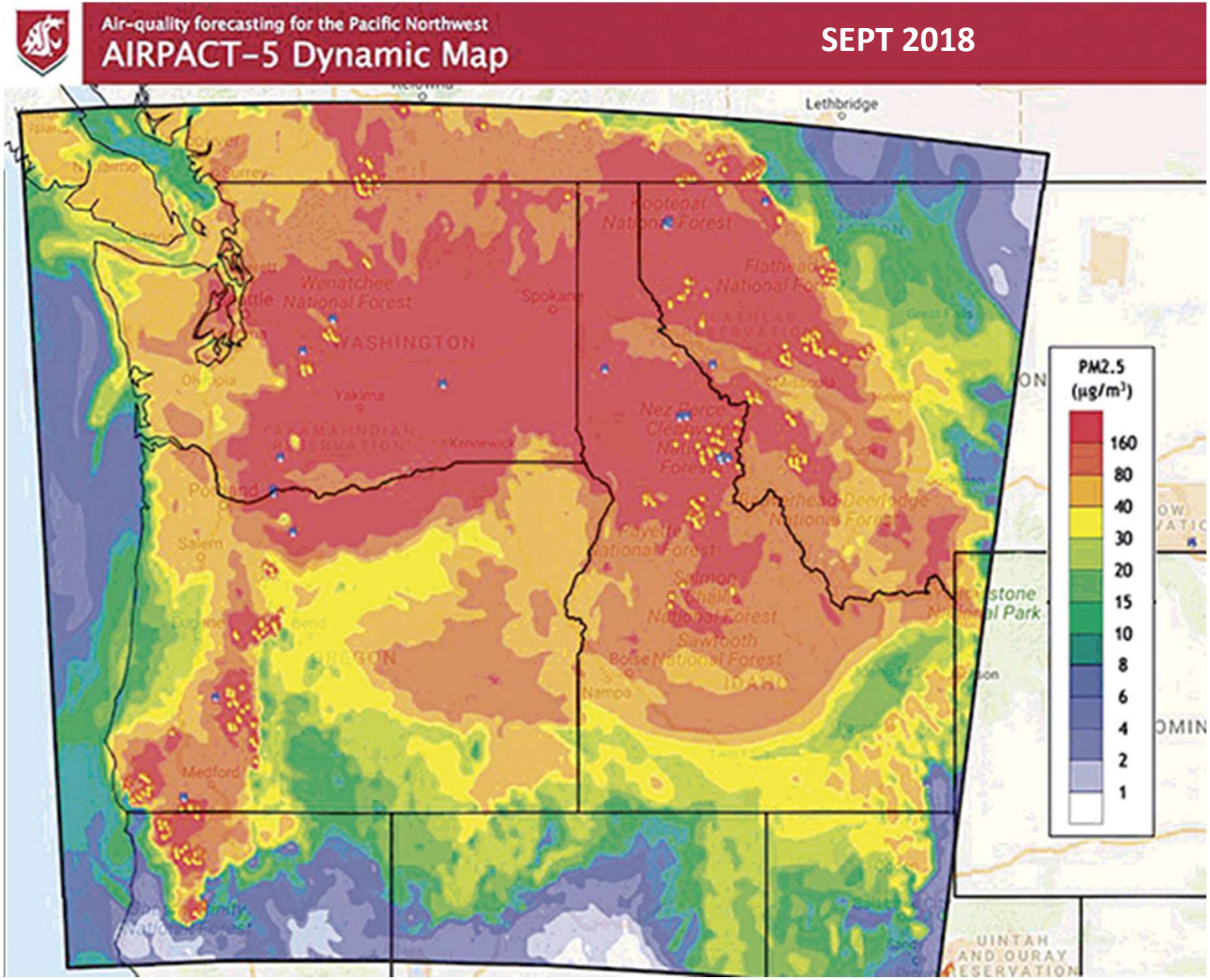
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

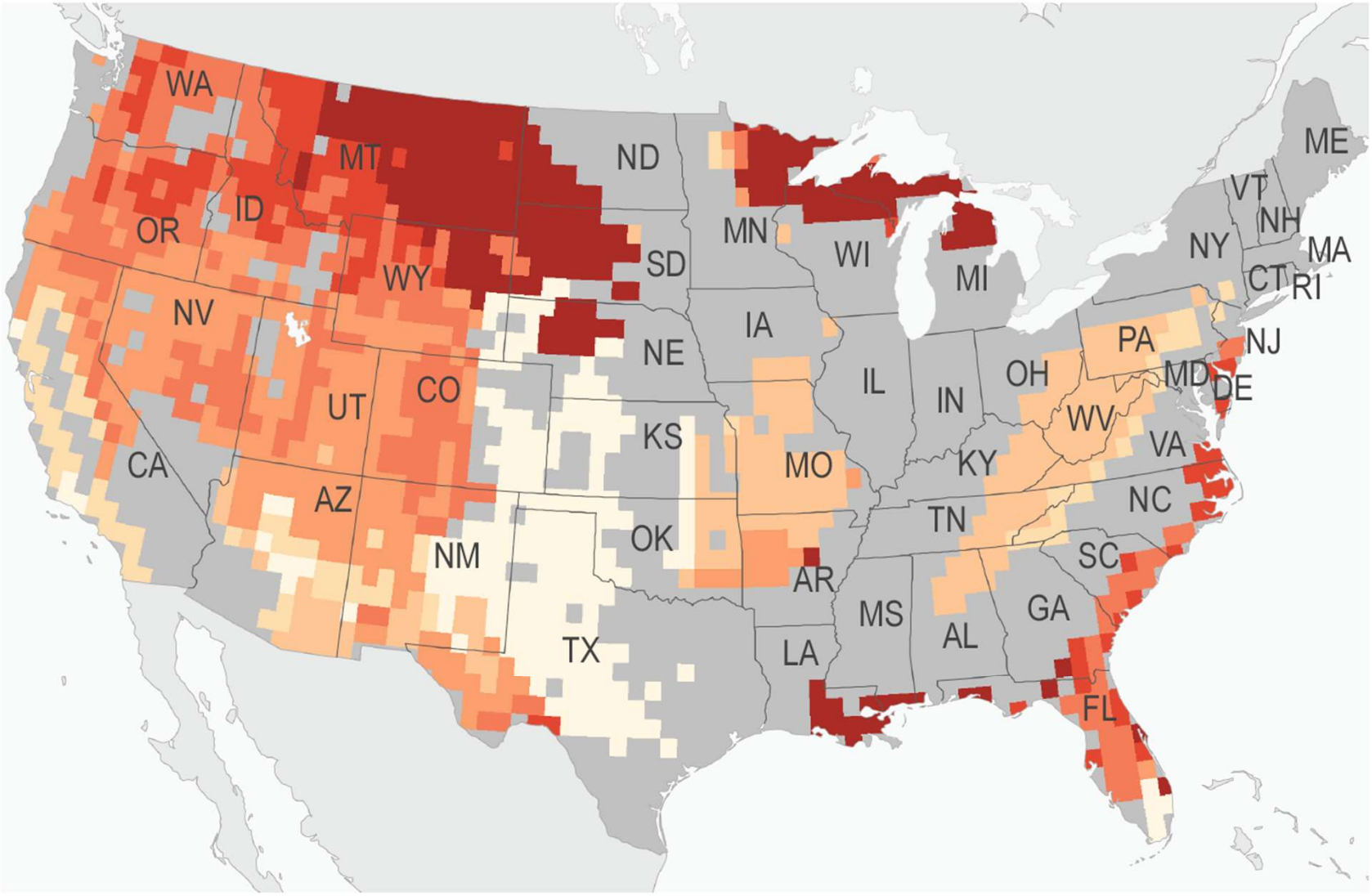
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

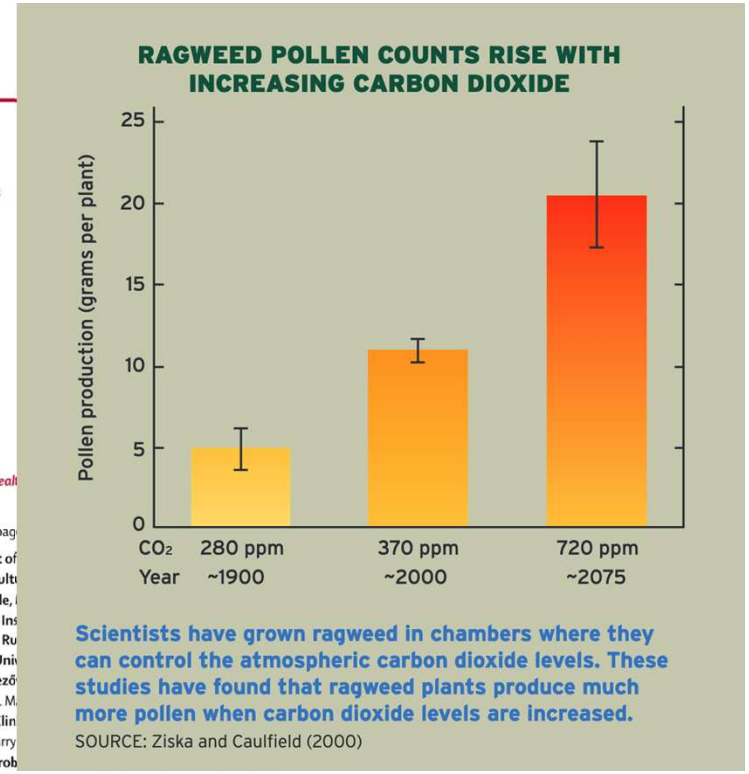
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

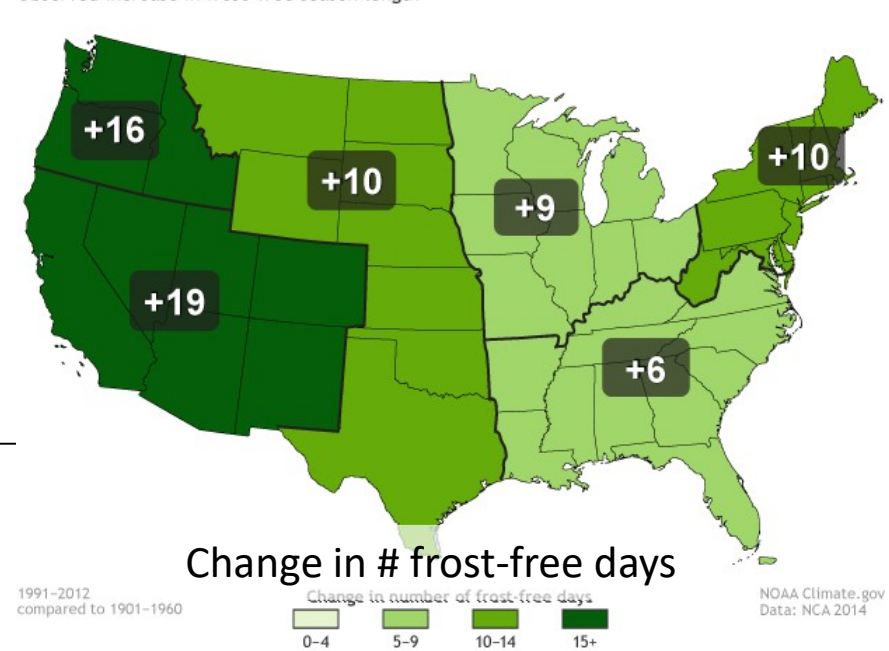
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

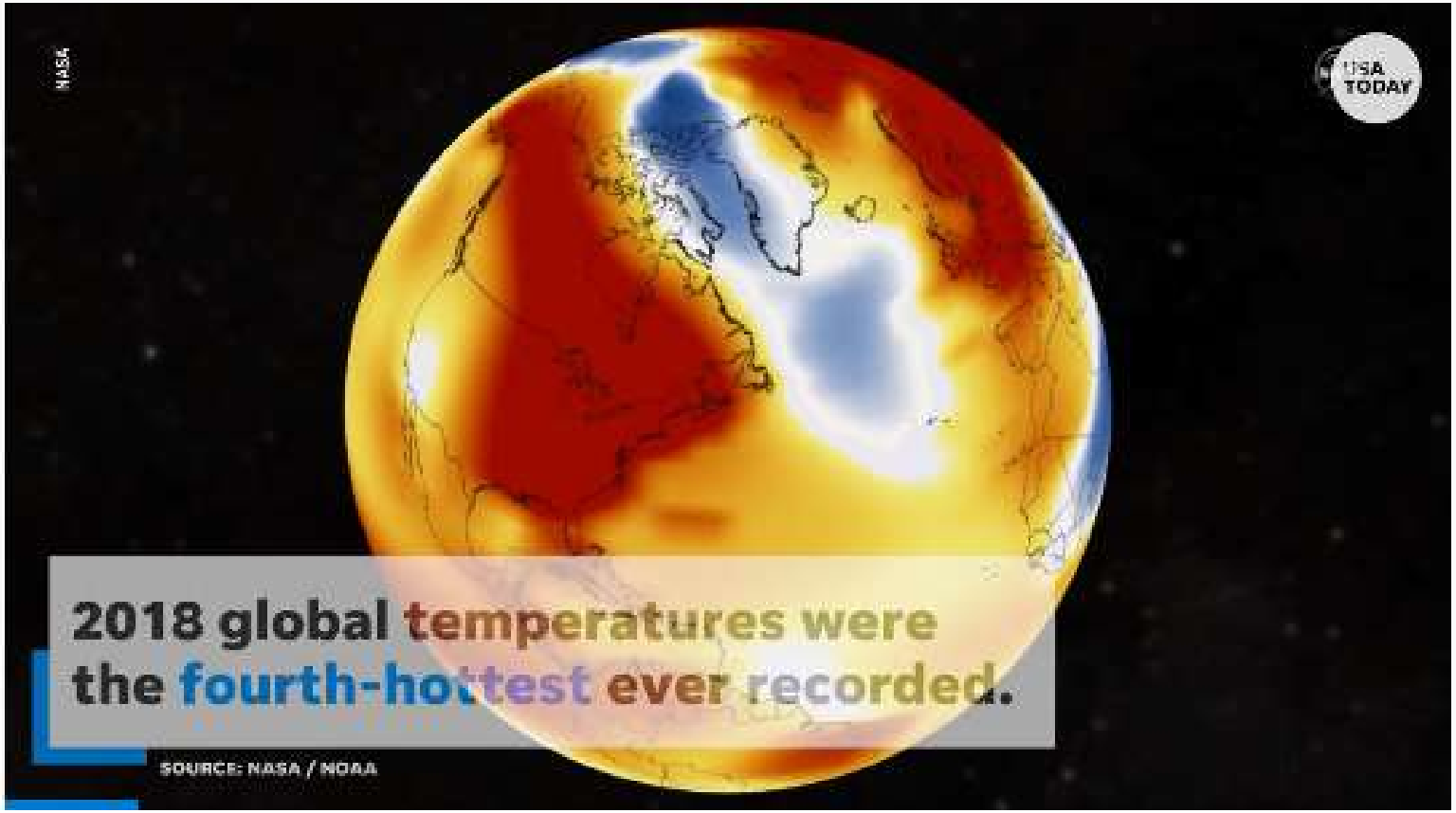
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



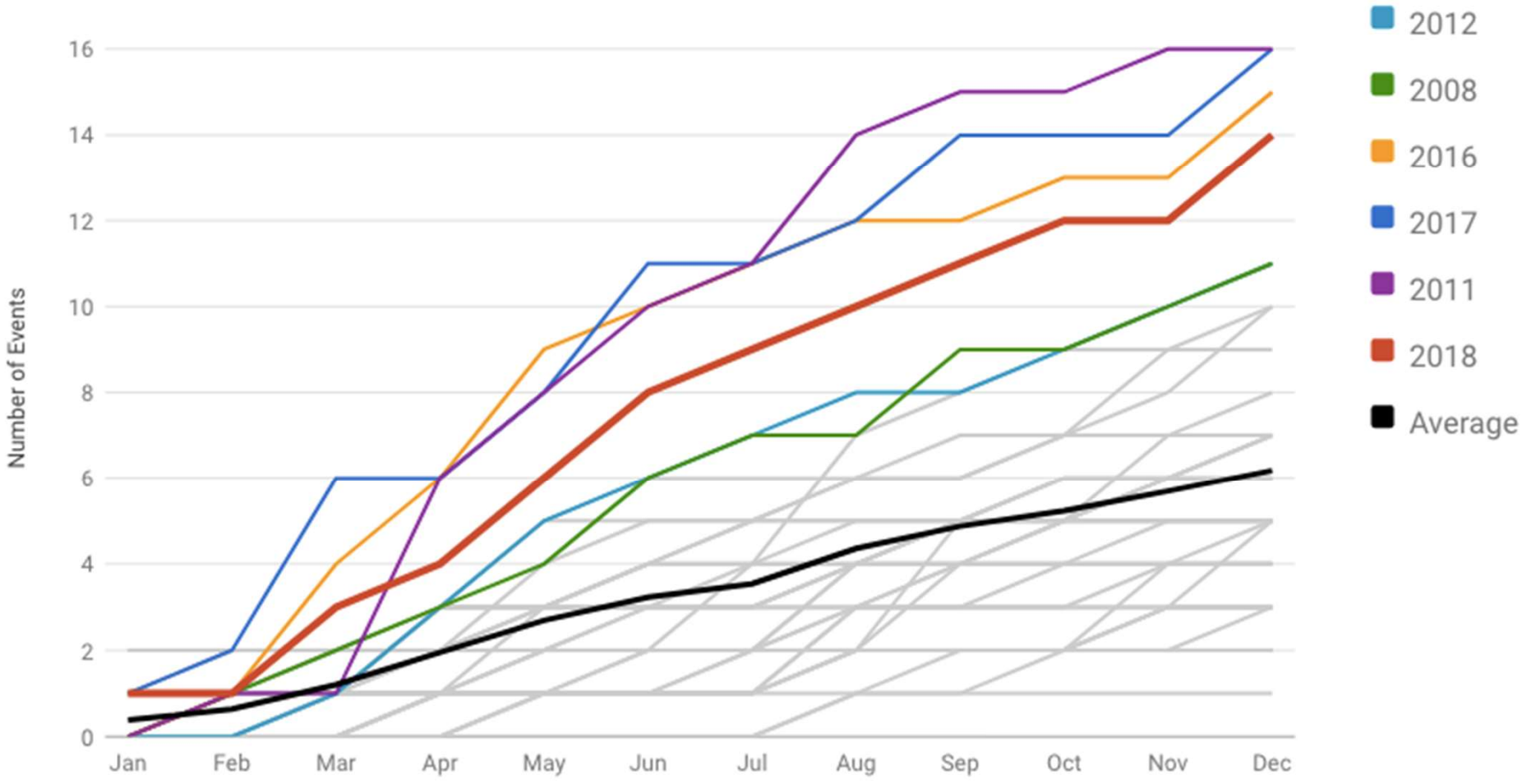
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



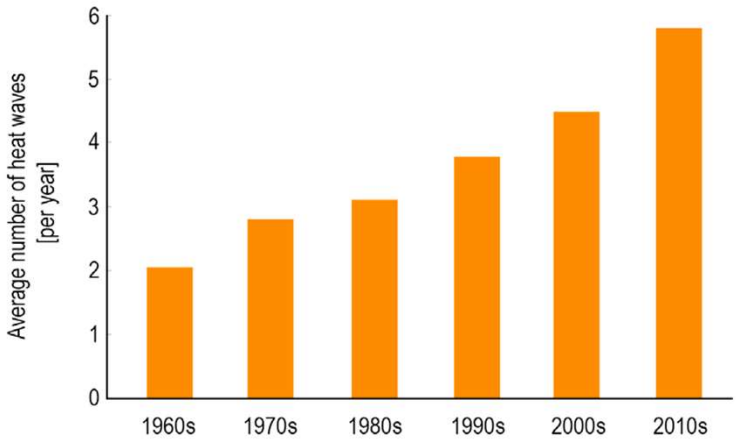
NOAA: National Centers for Environmental Information

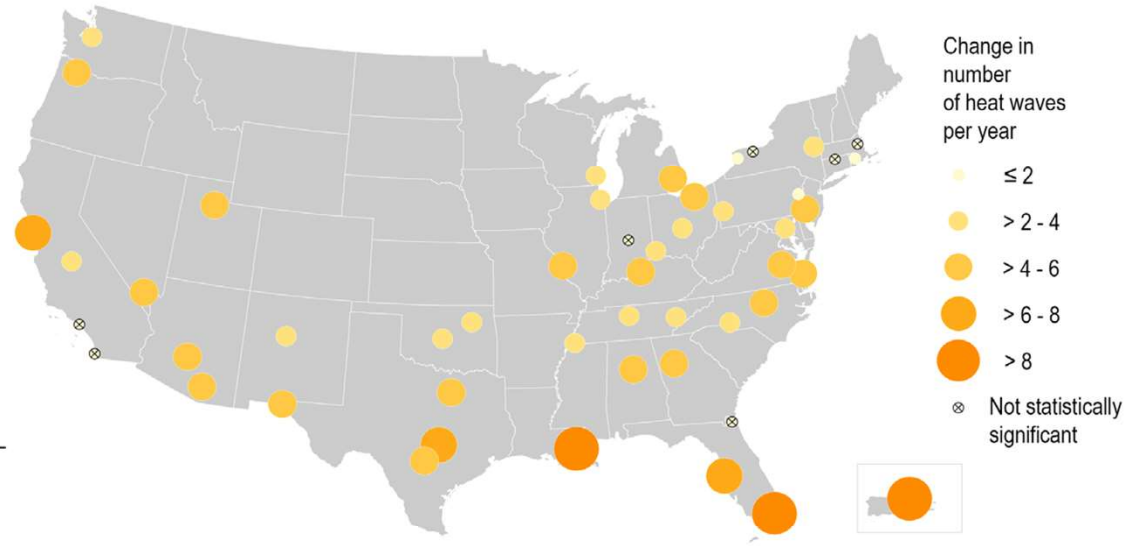
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

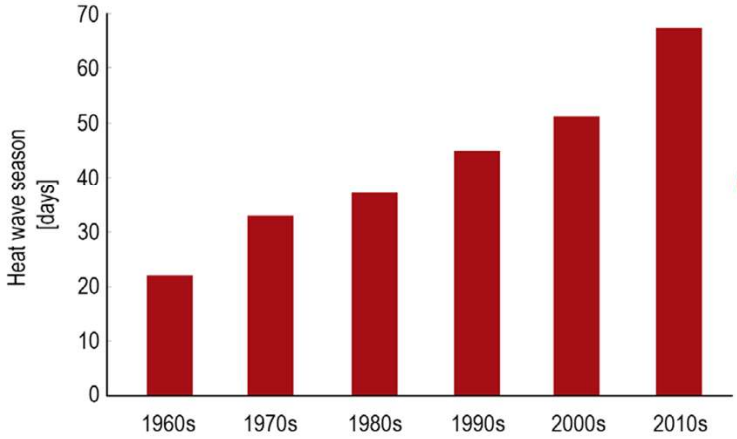
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

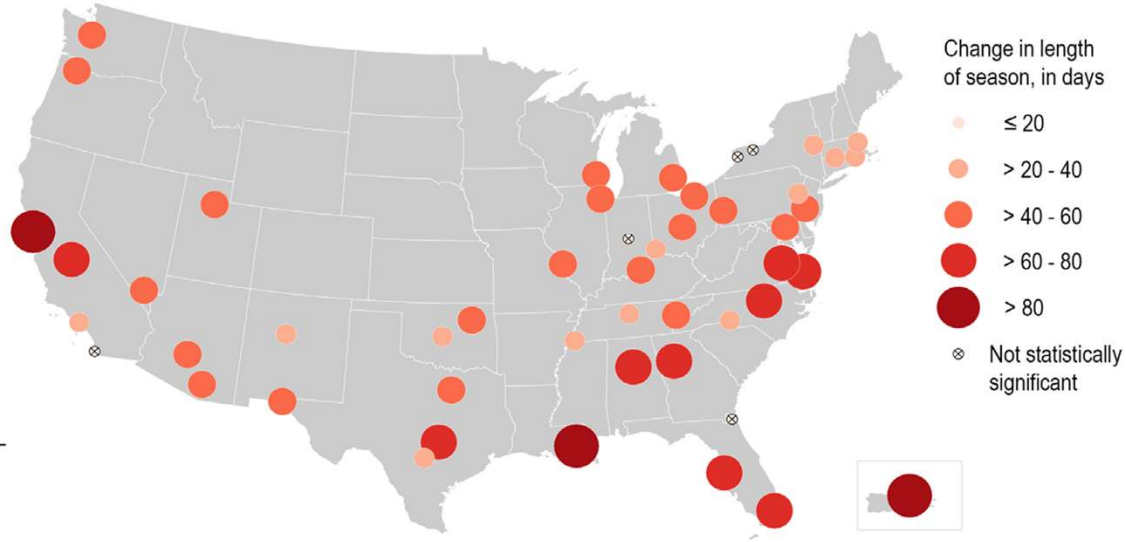
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

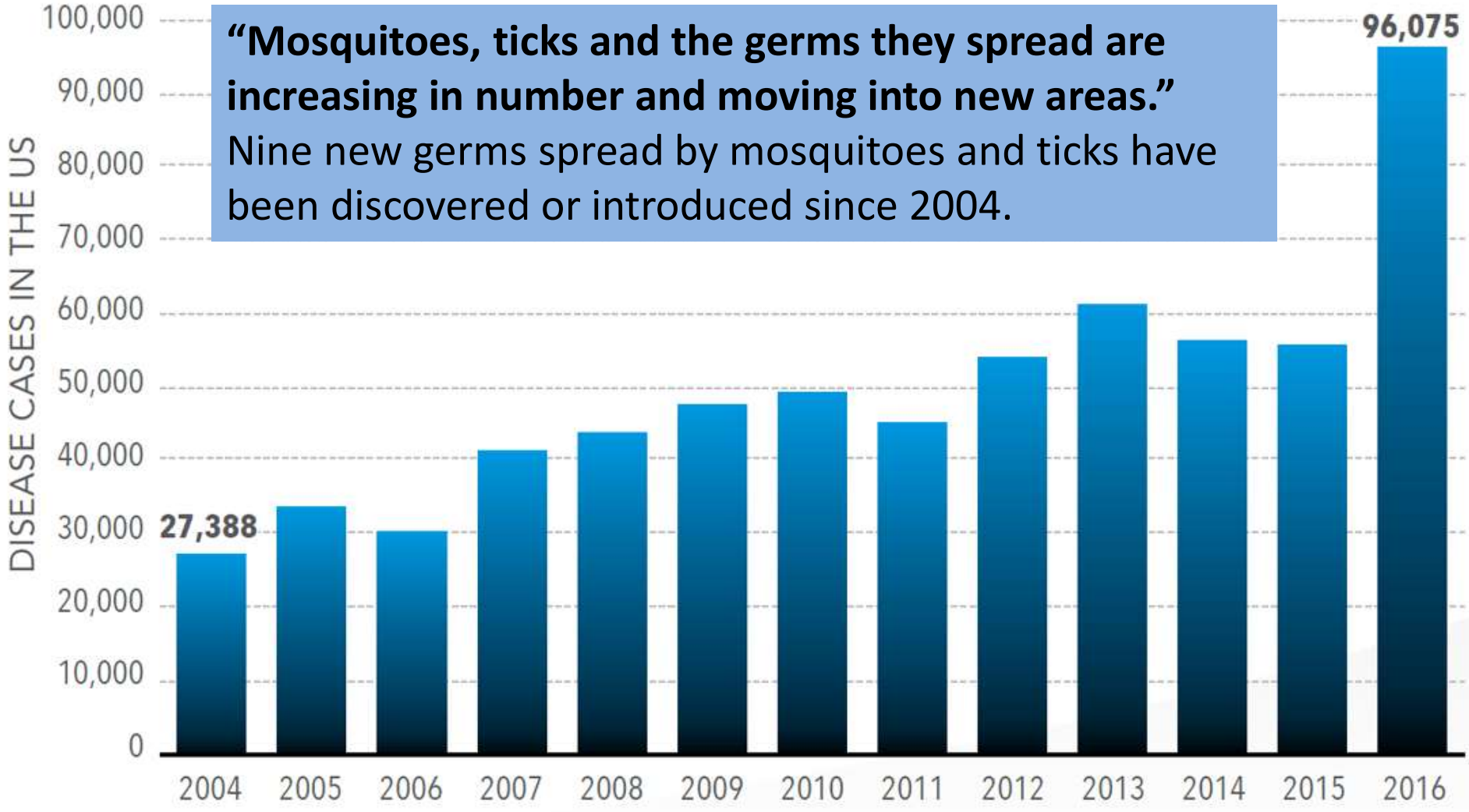
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

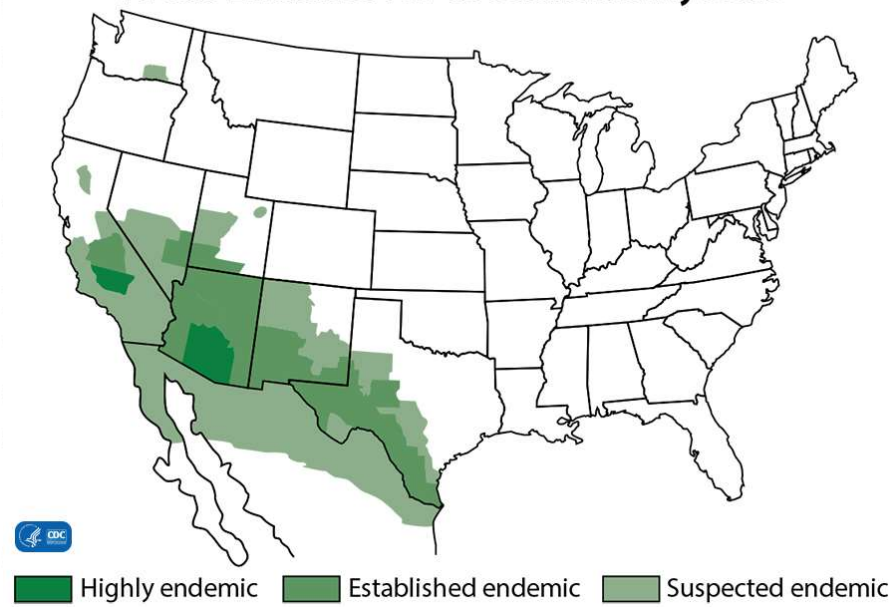
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

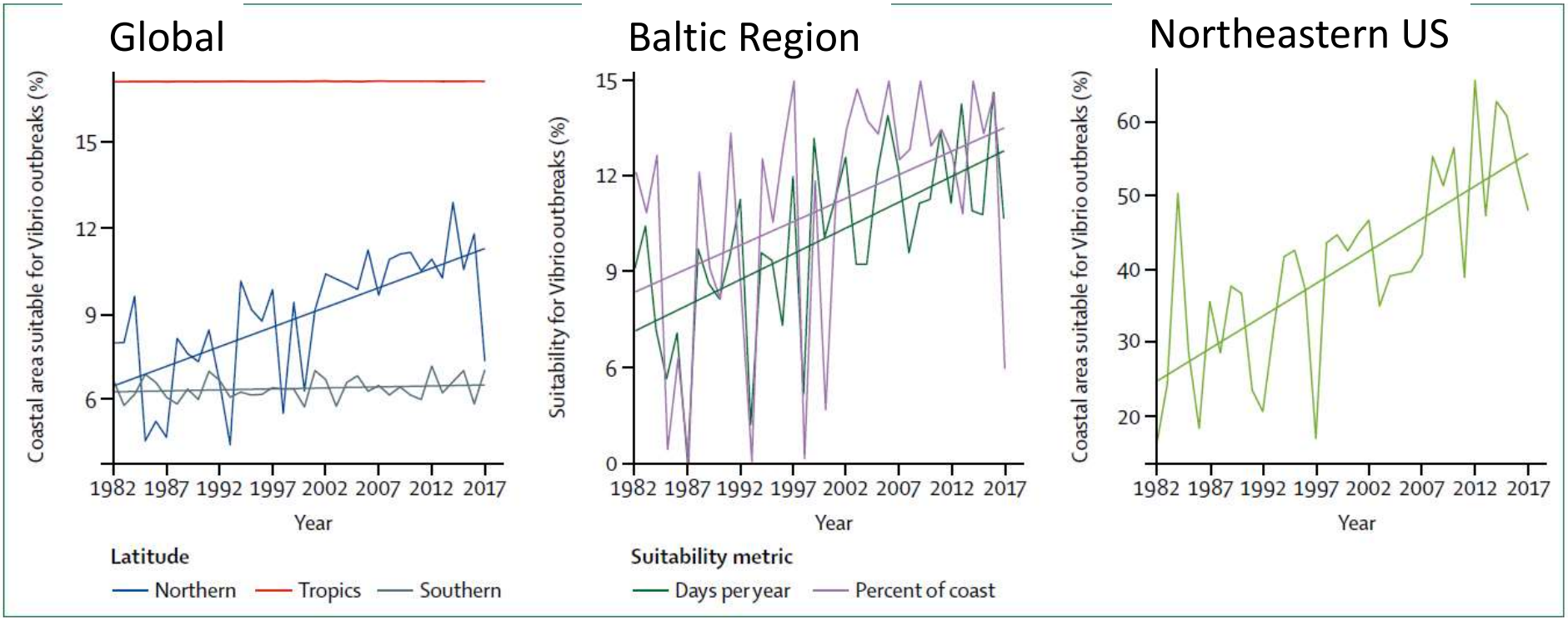
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

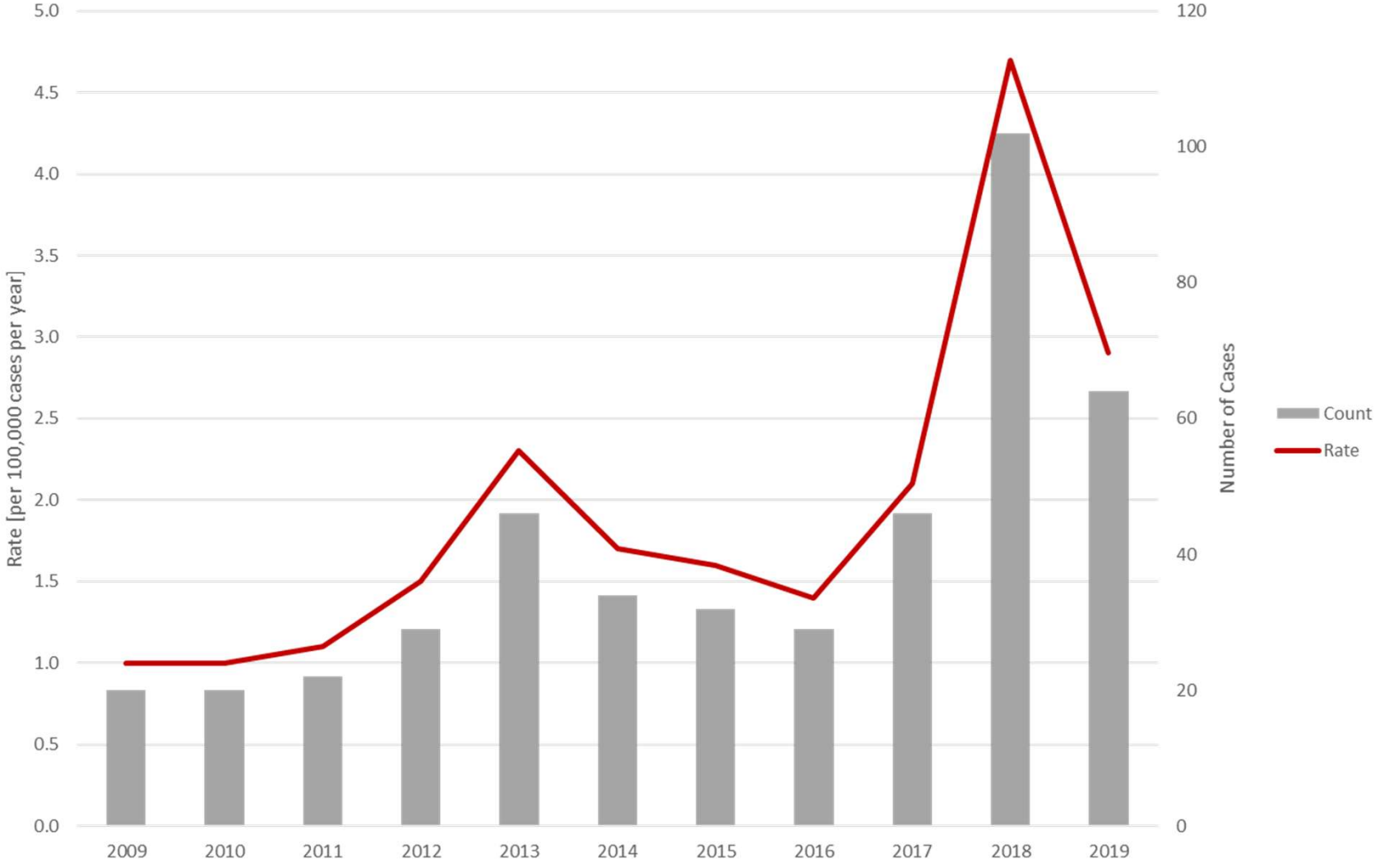
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

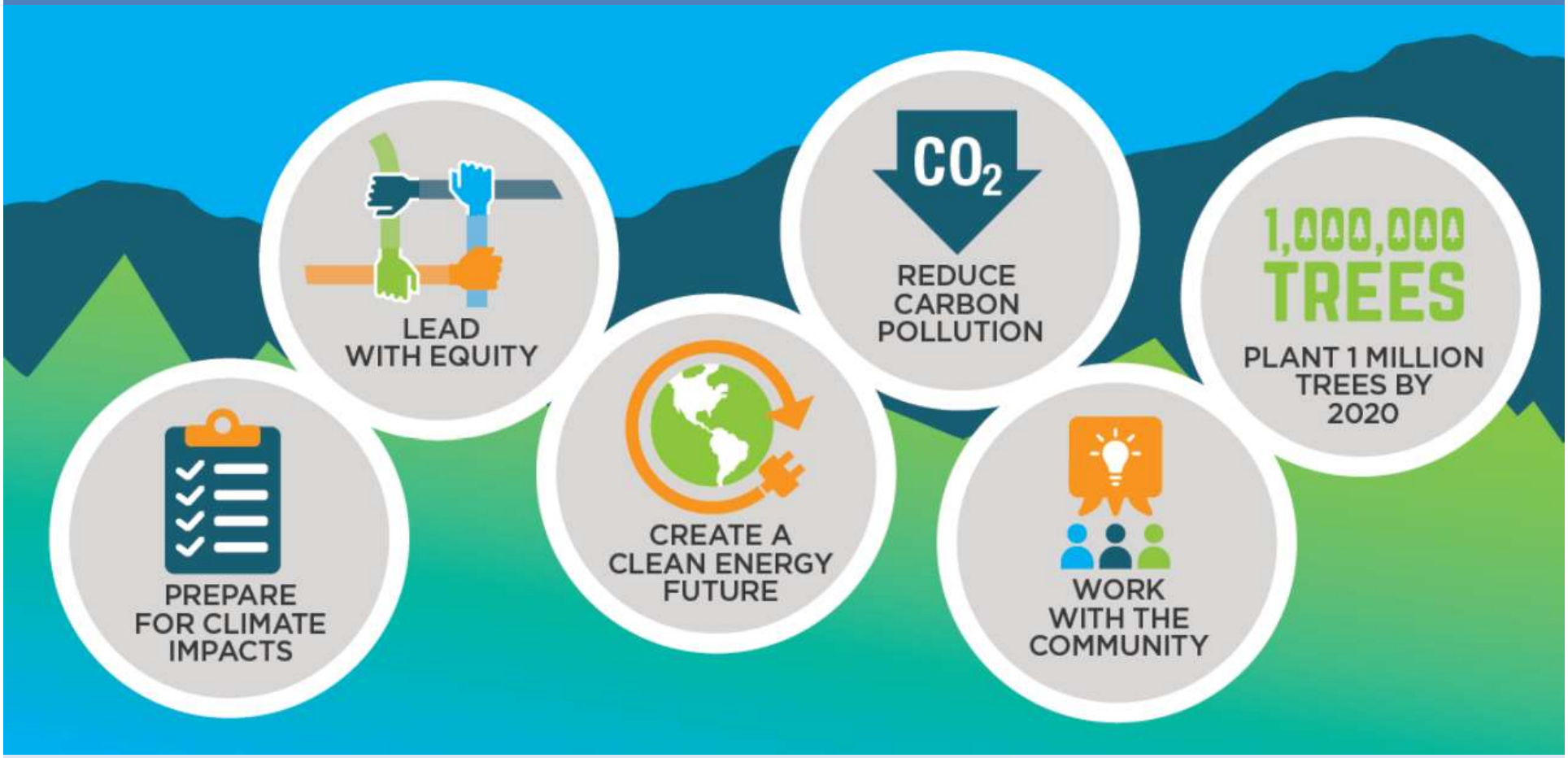
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

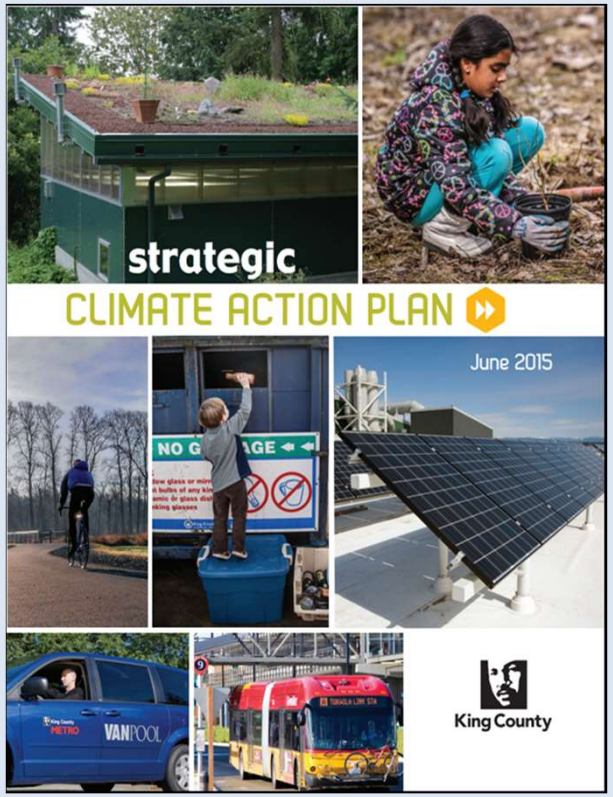


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

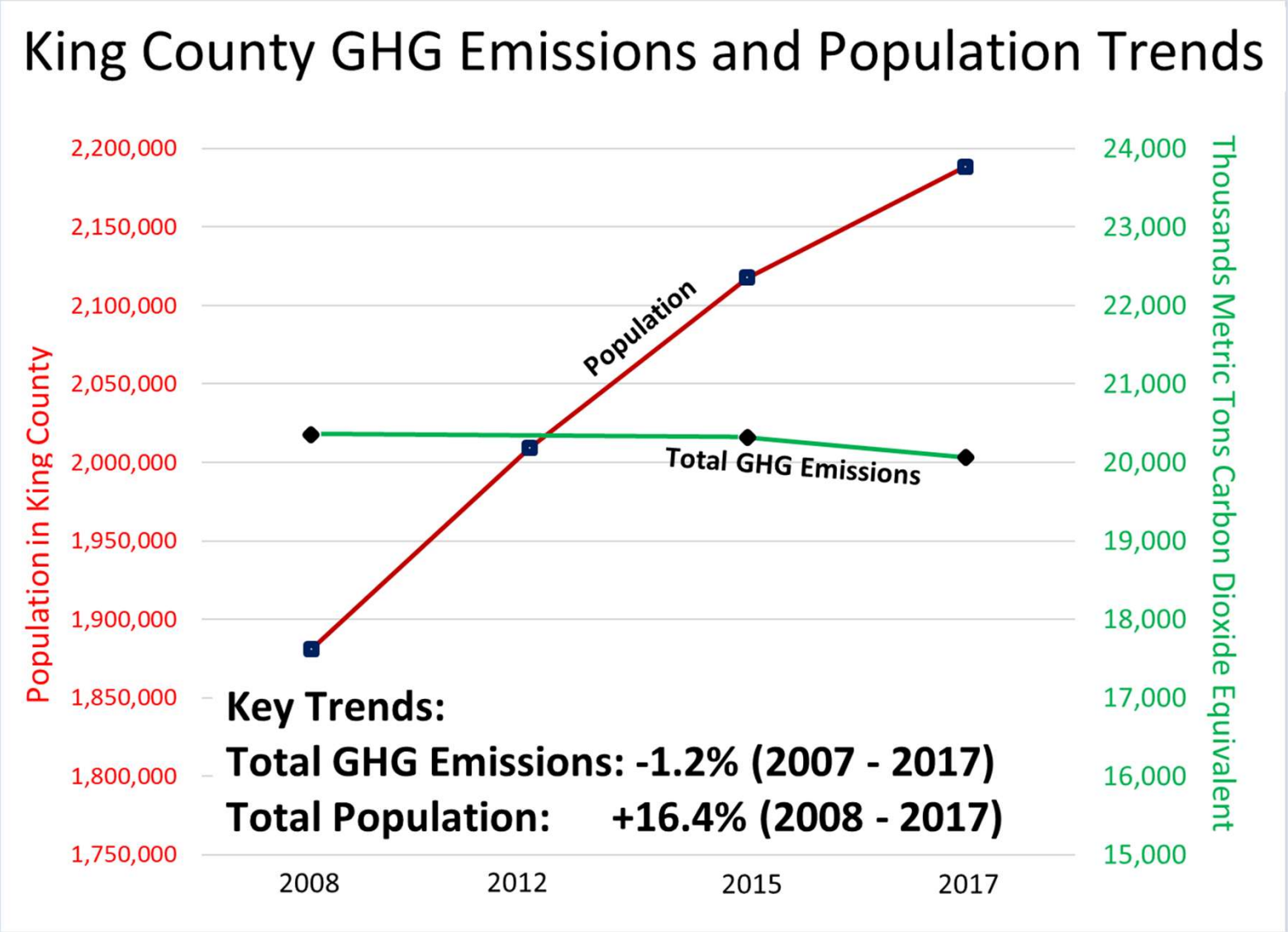
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



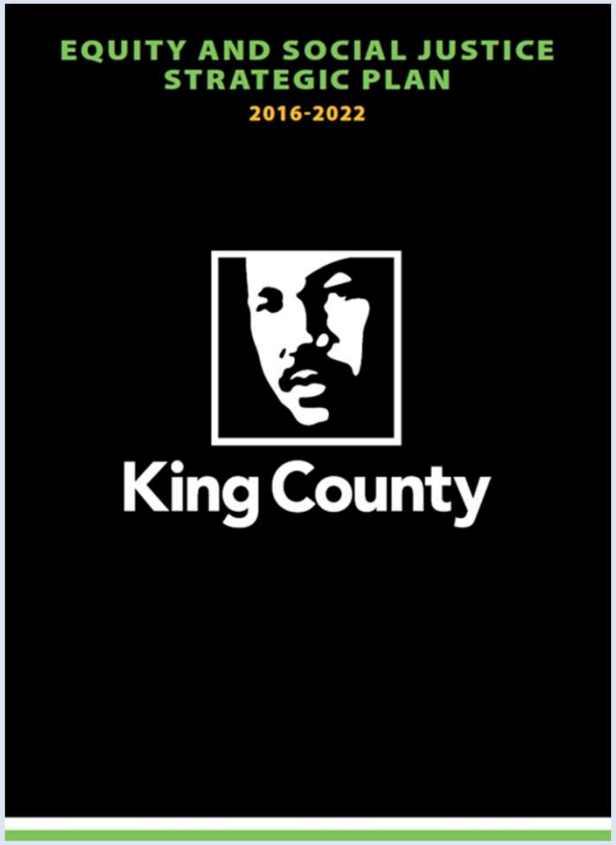
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

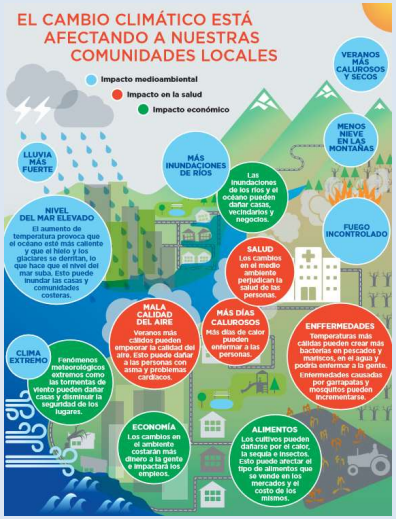
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

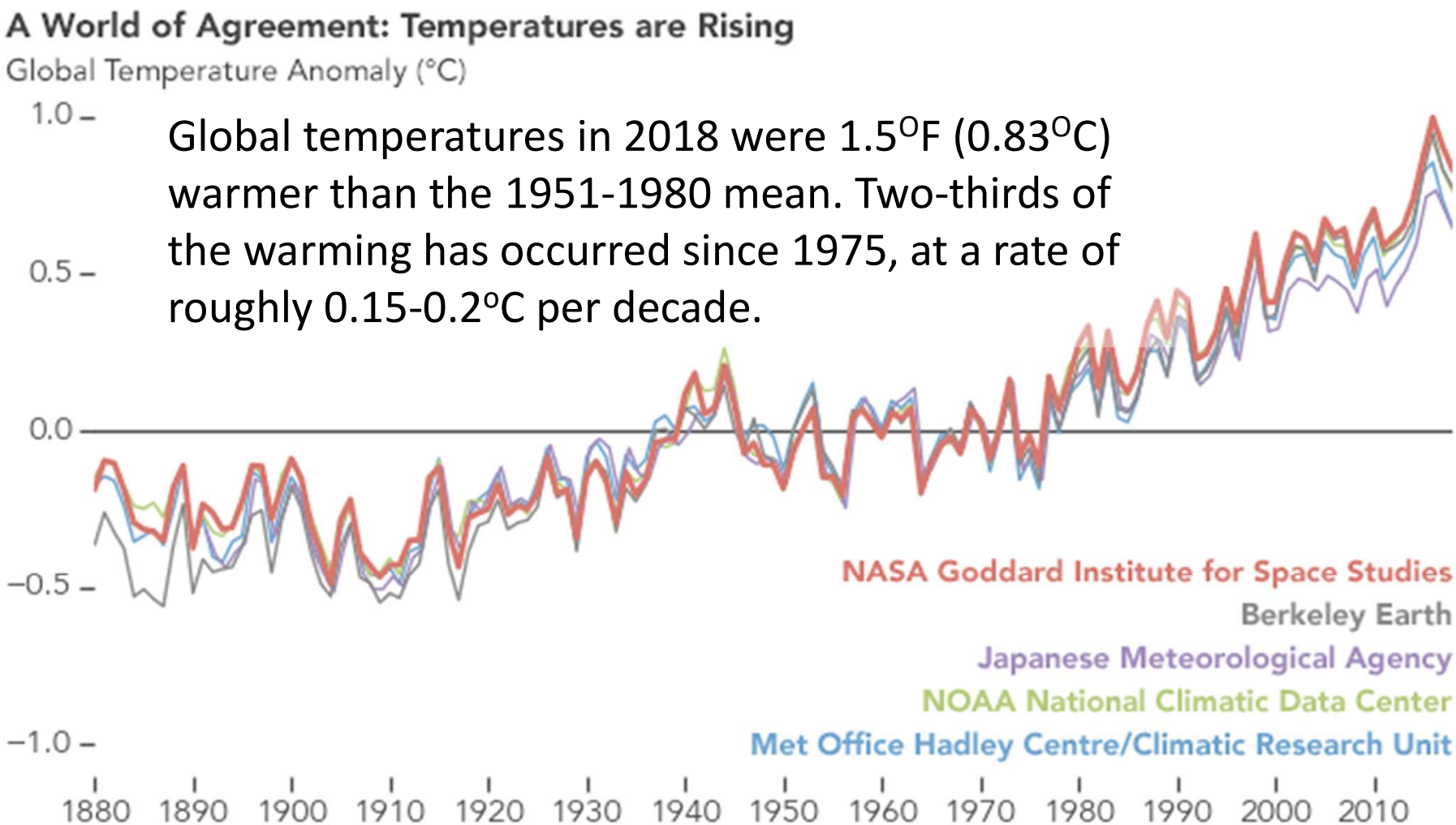
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

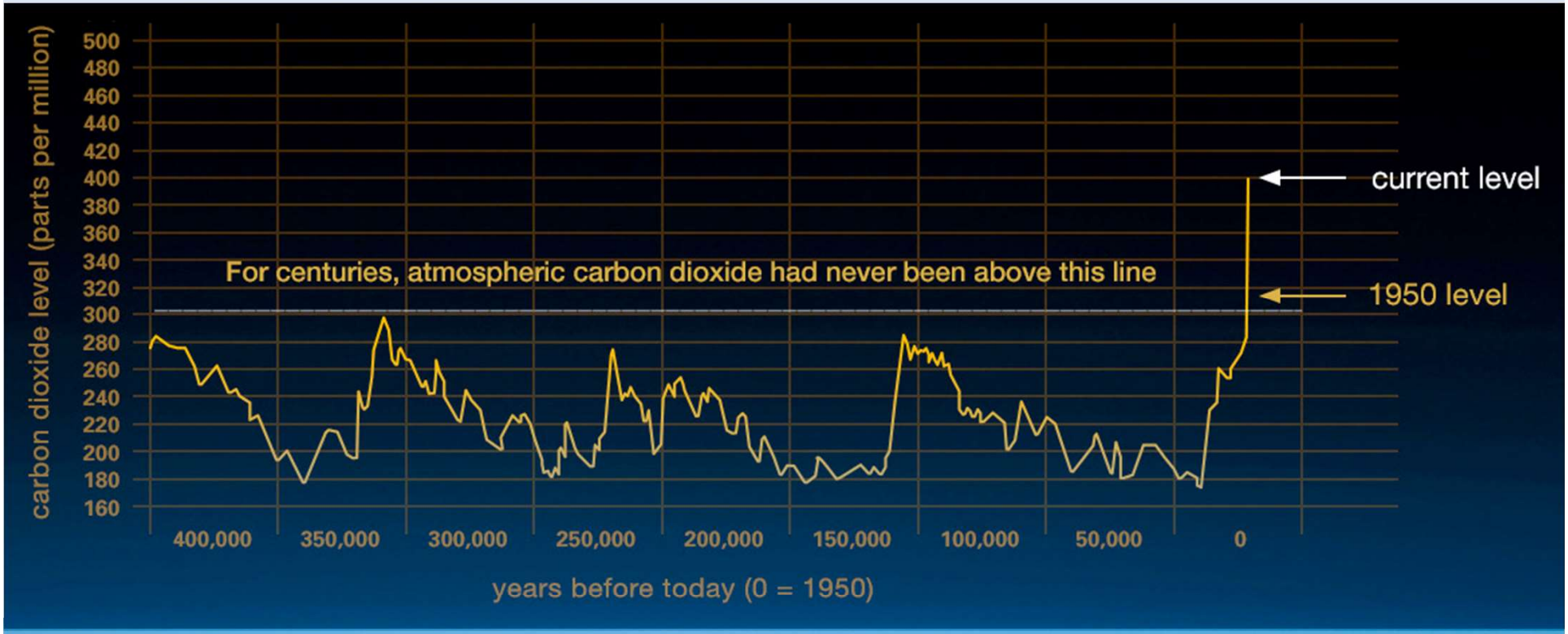


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

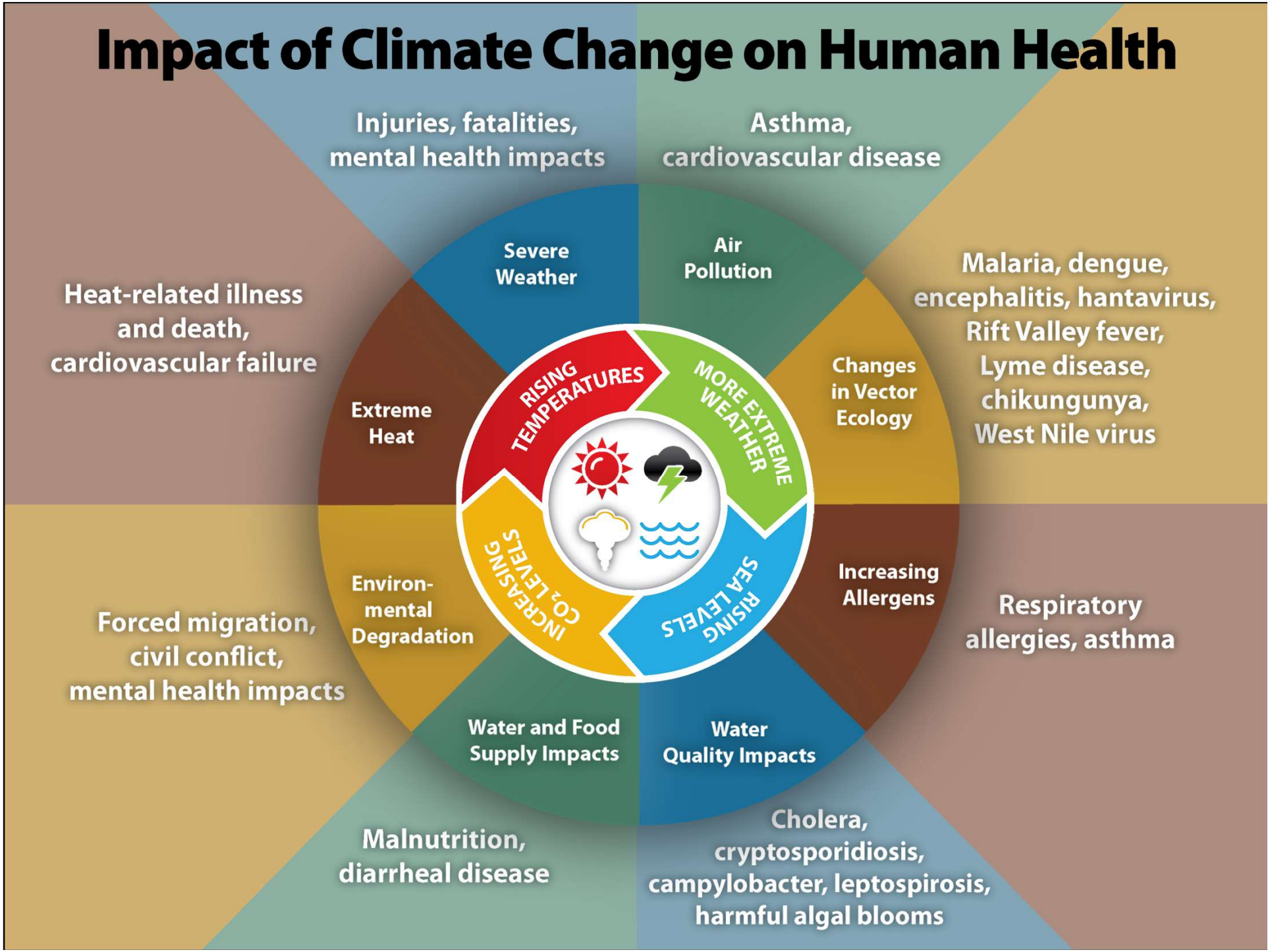
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

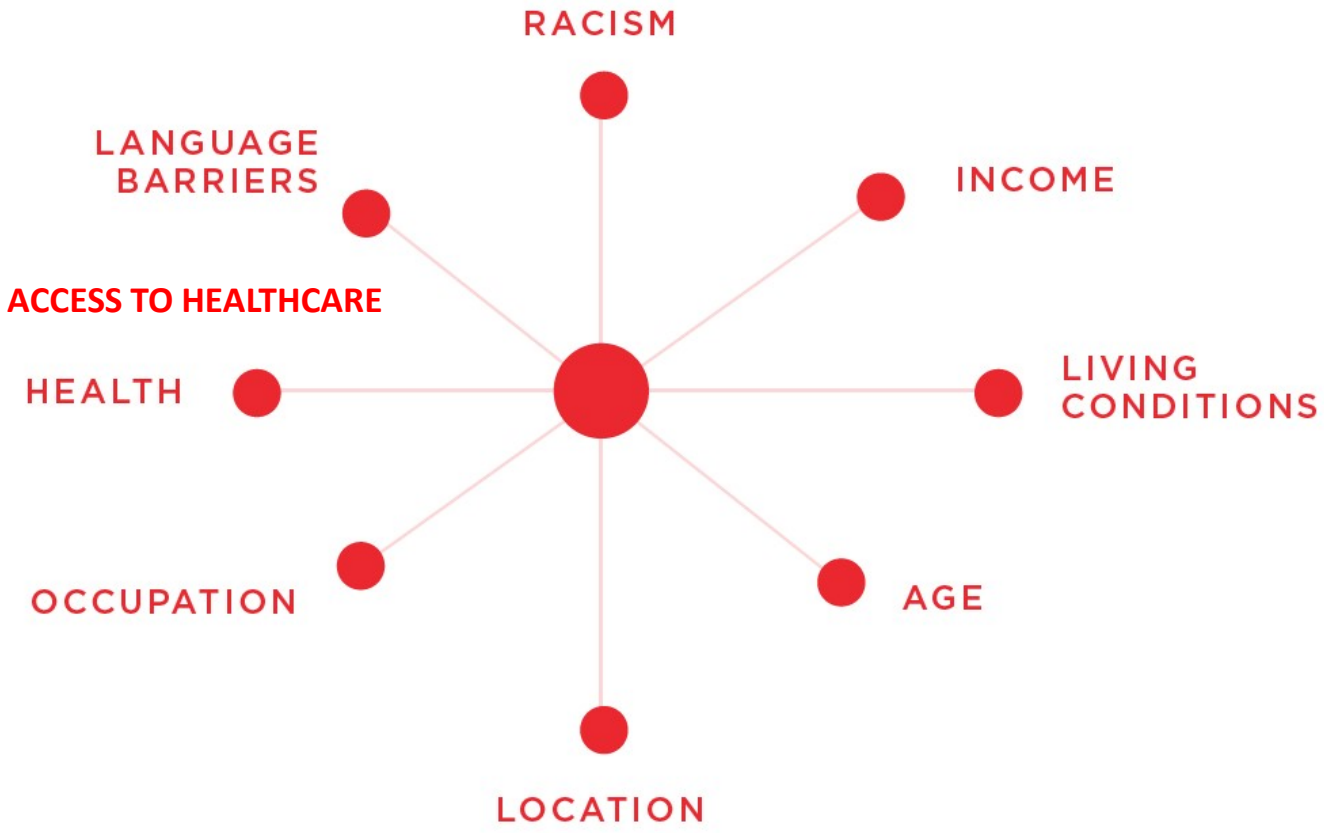
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

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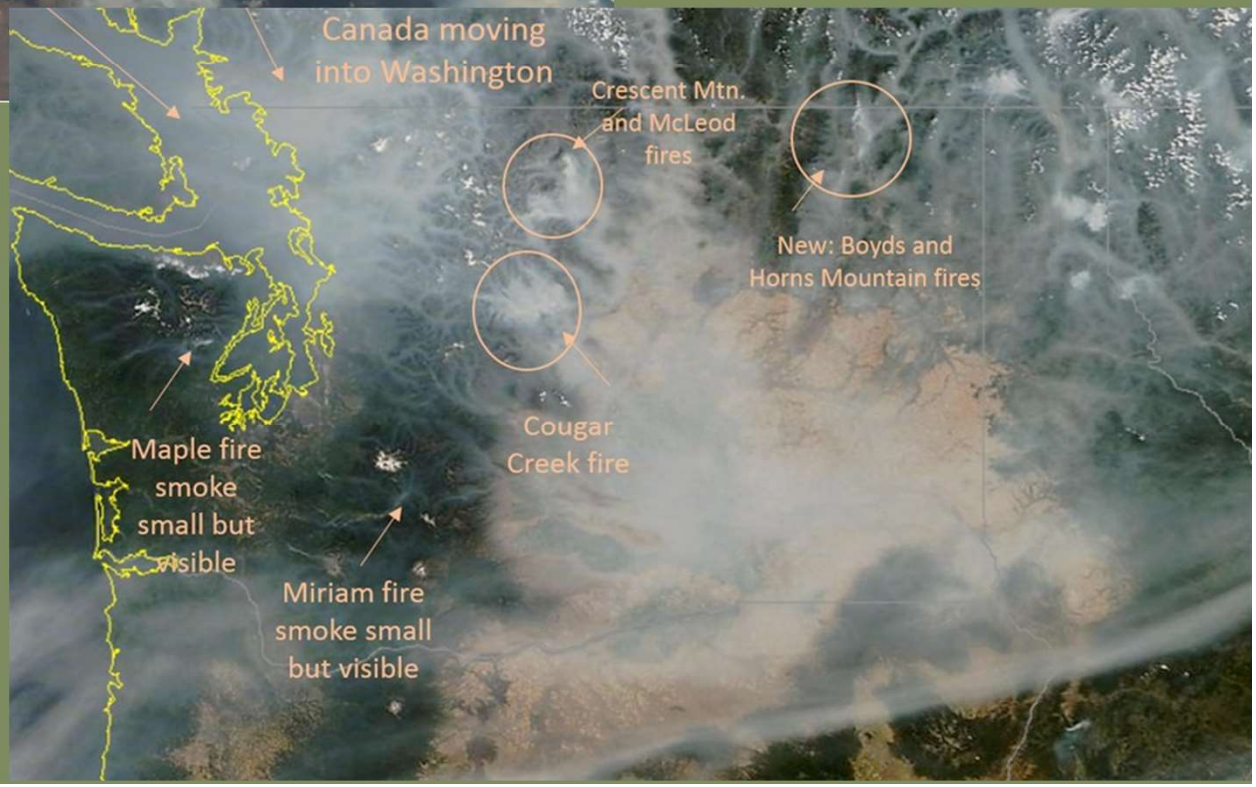
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

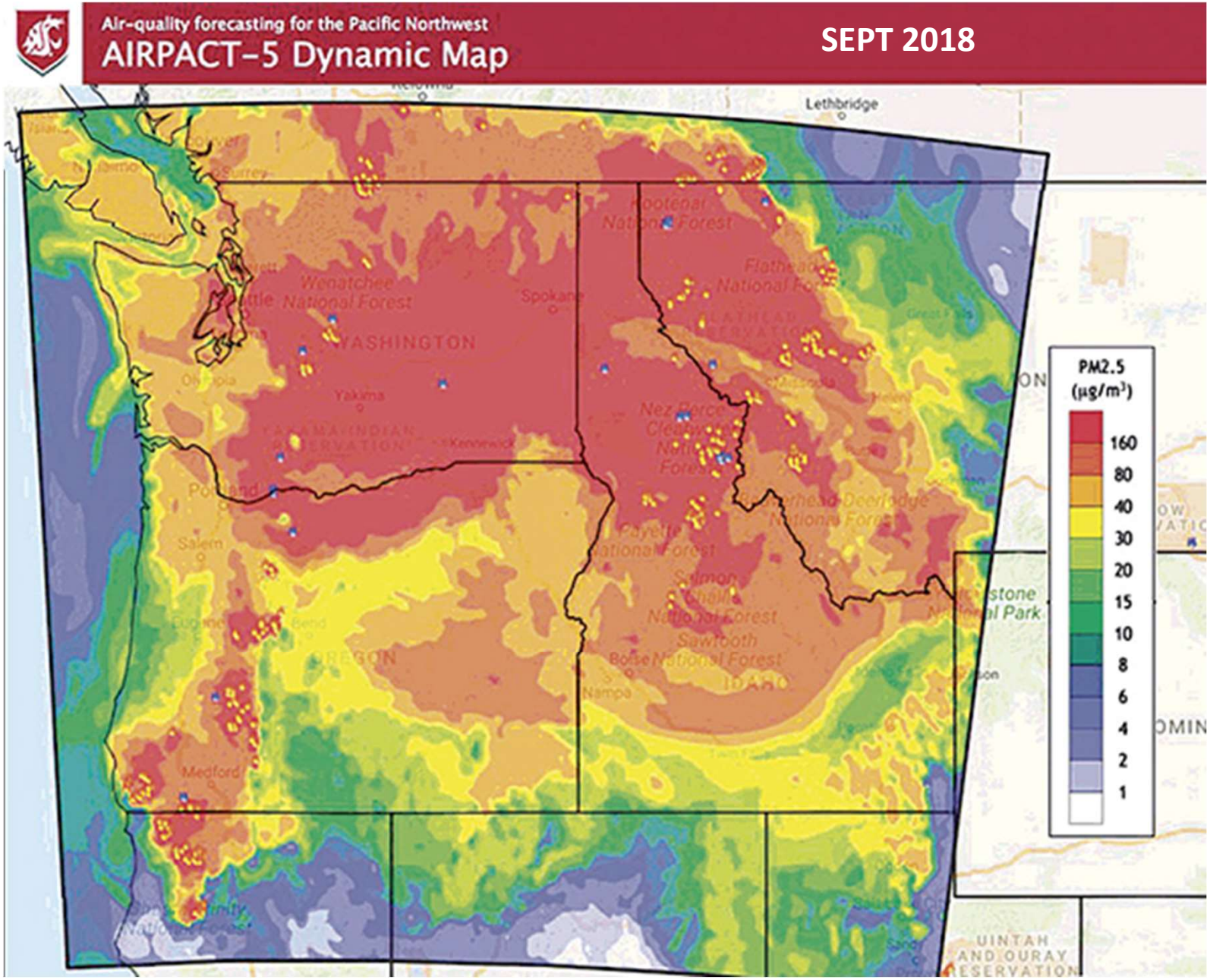
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

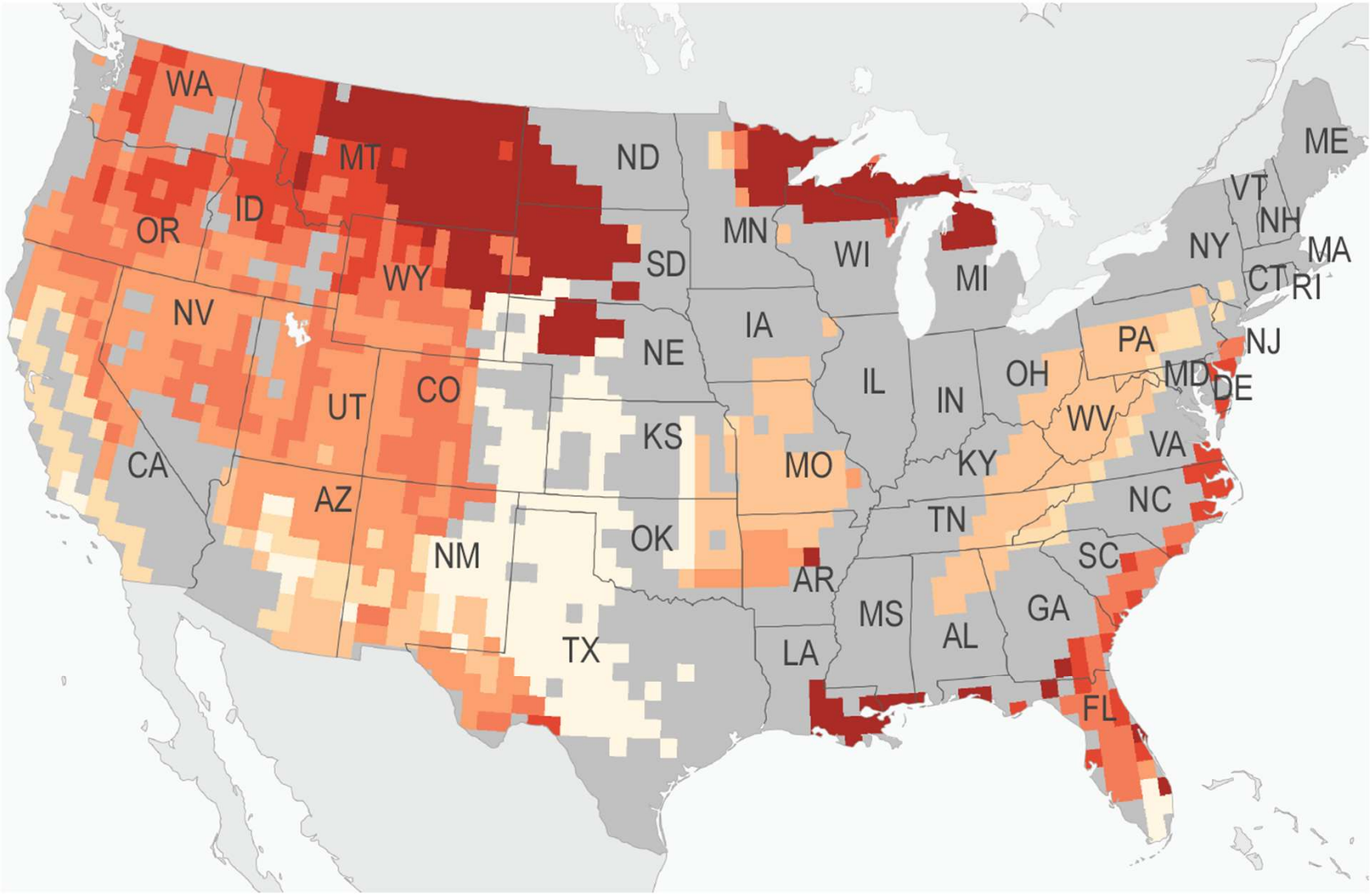
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

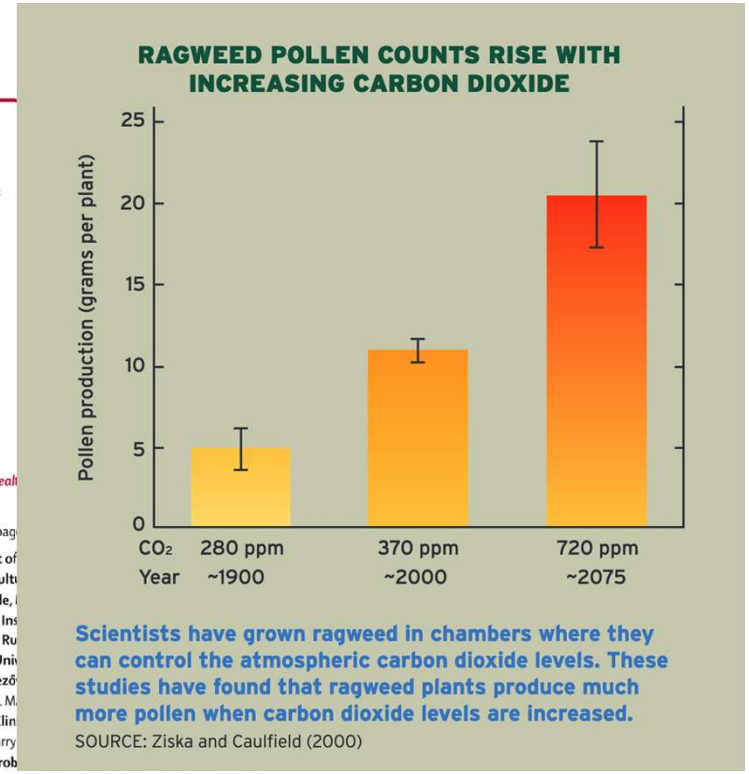
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

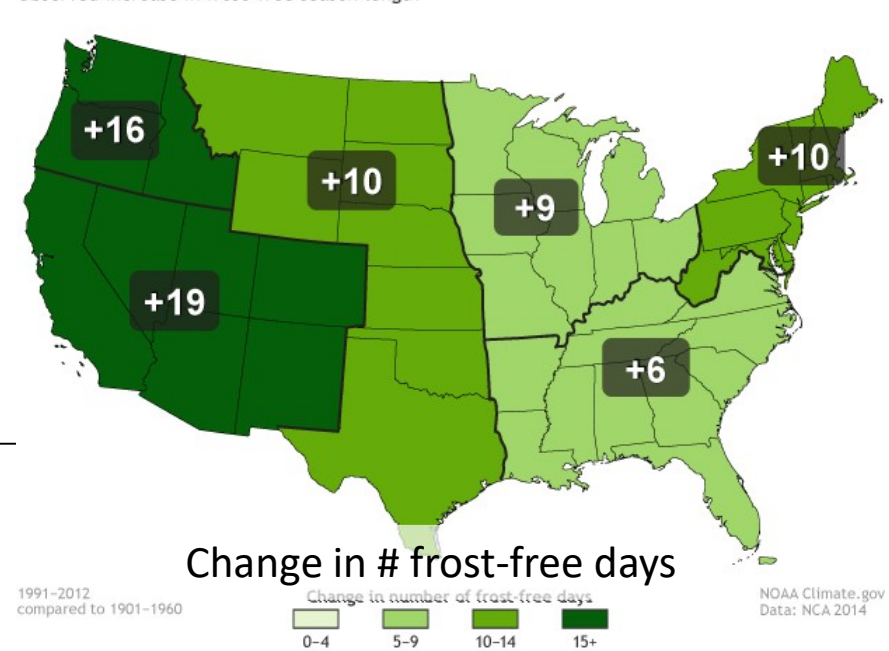
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

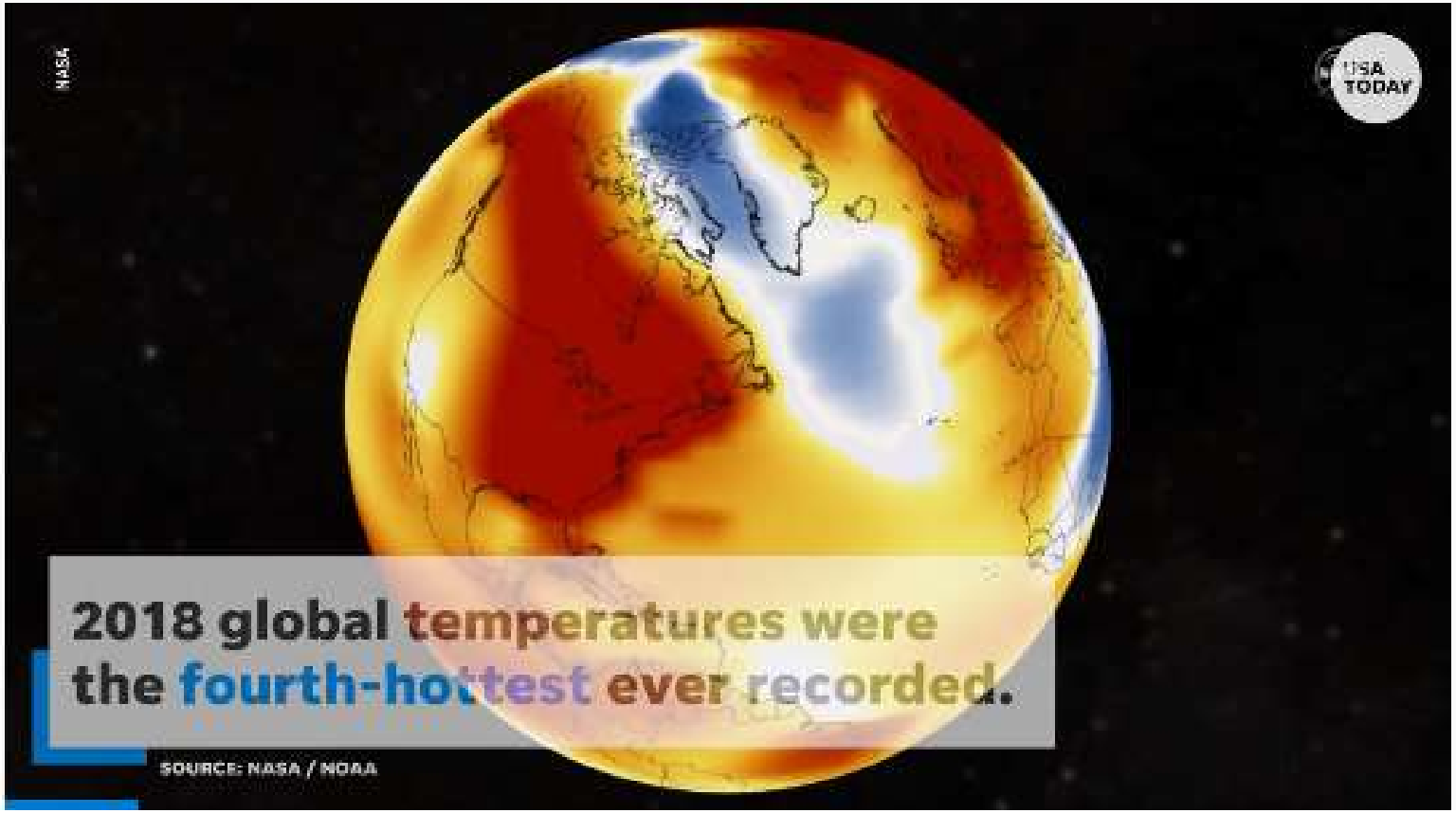
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



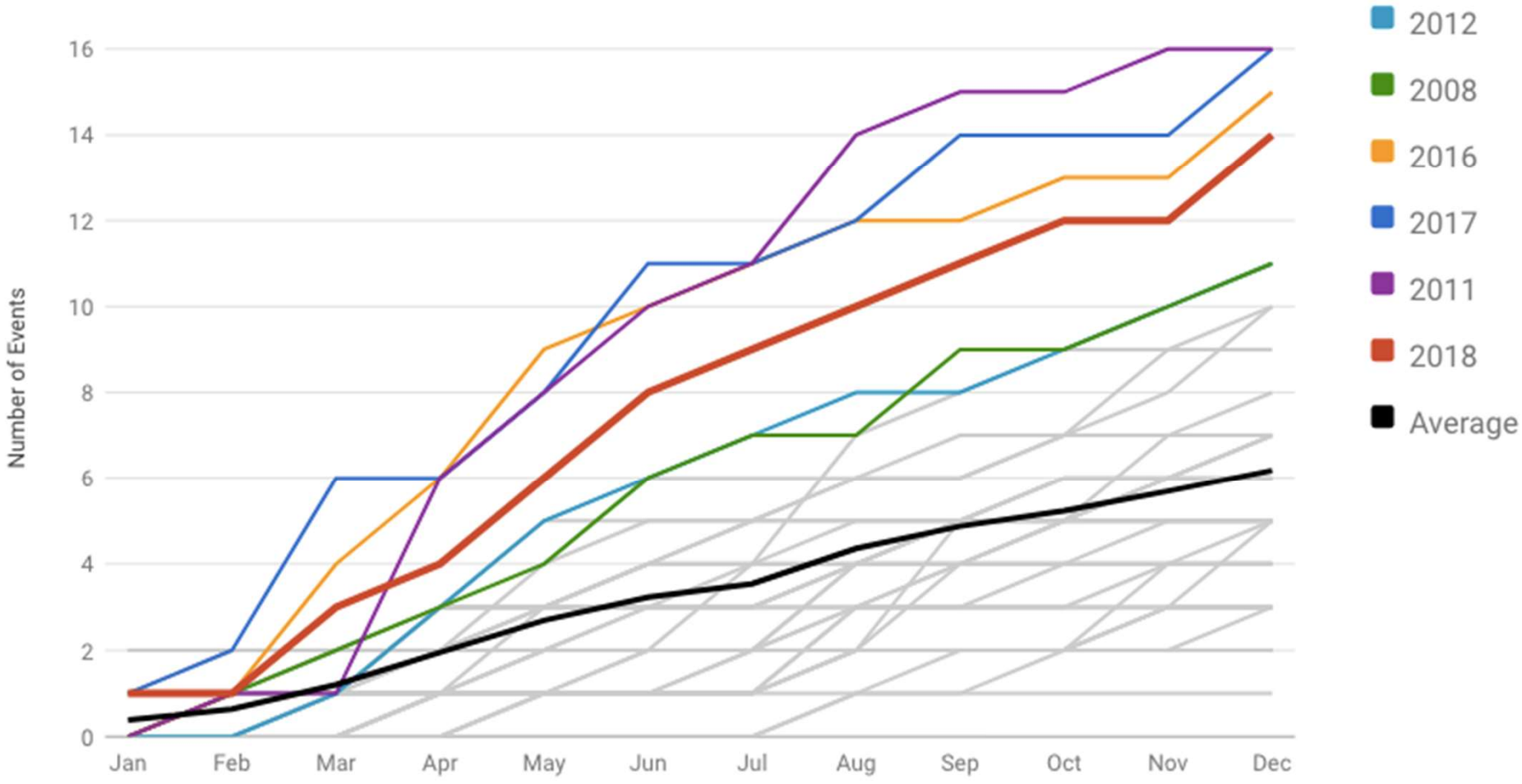
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



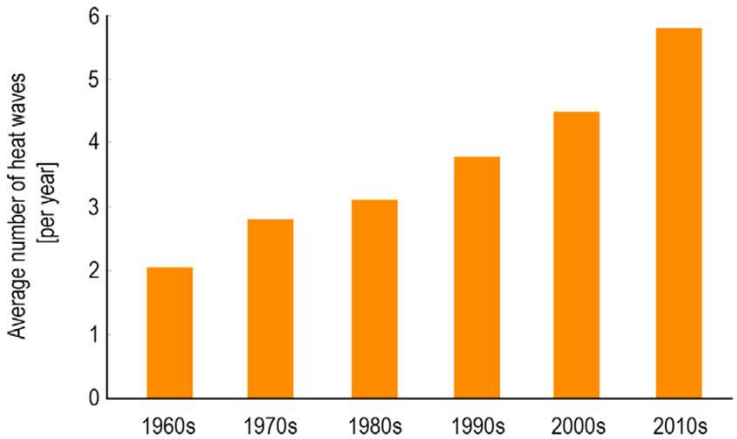
NOAA: National Centers for Environmental Information

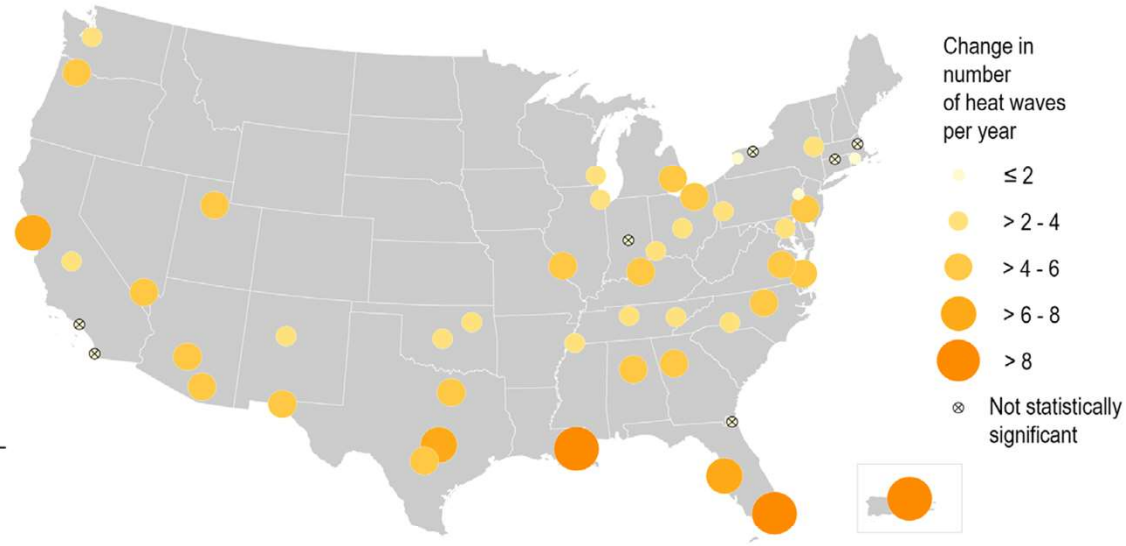
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

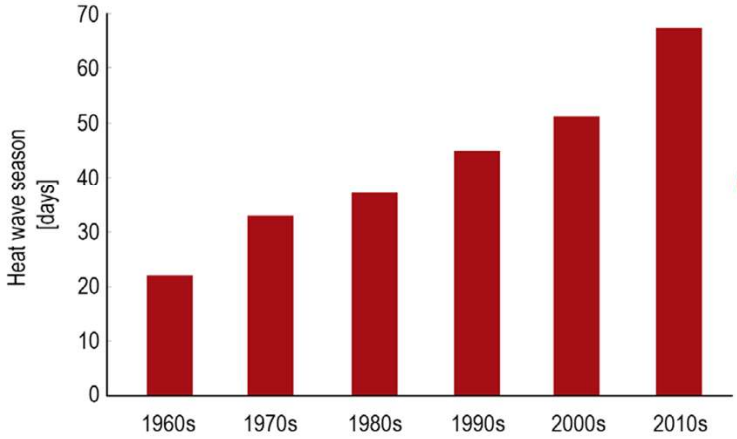
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

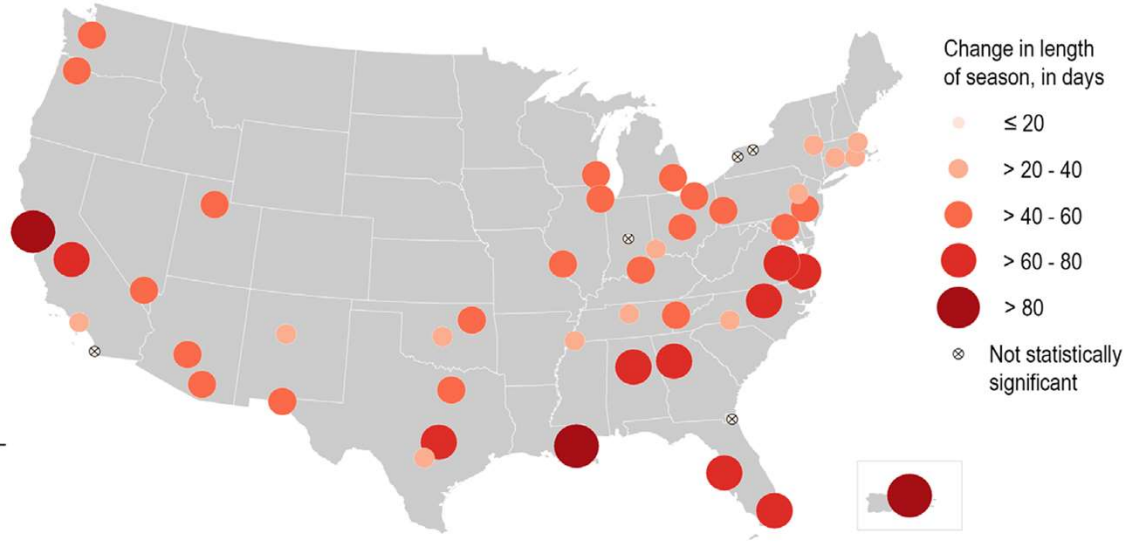
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

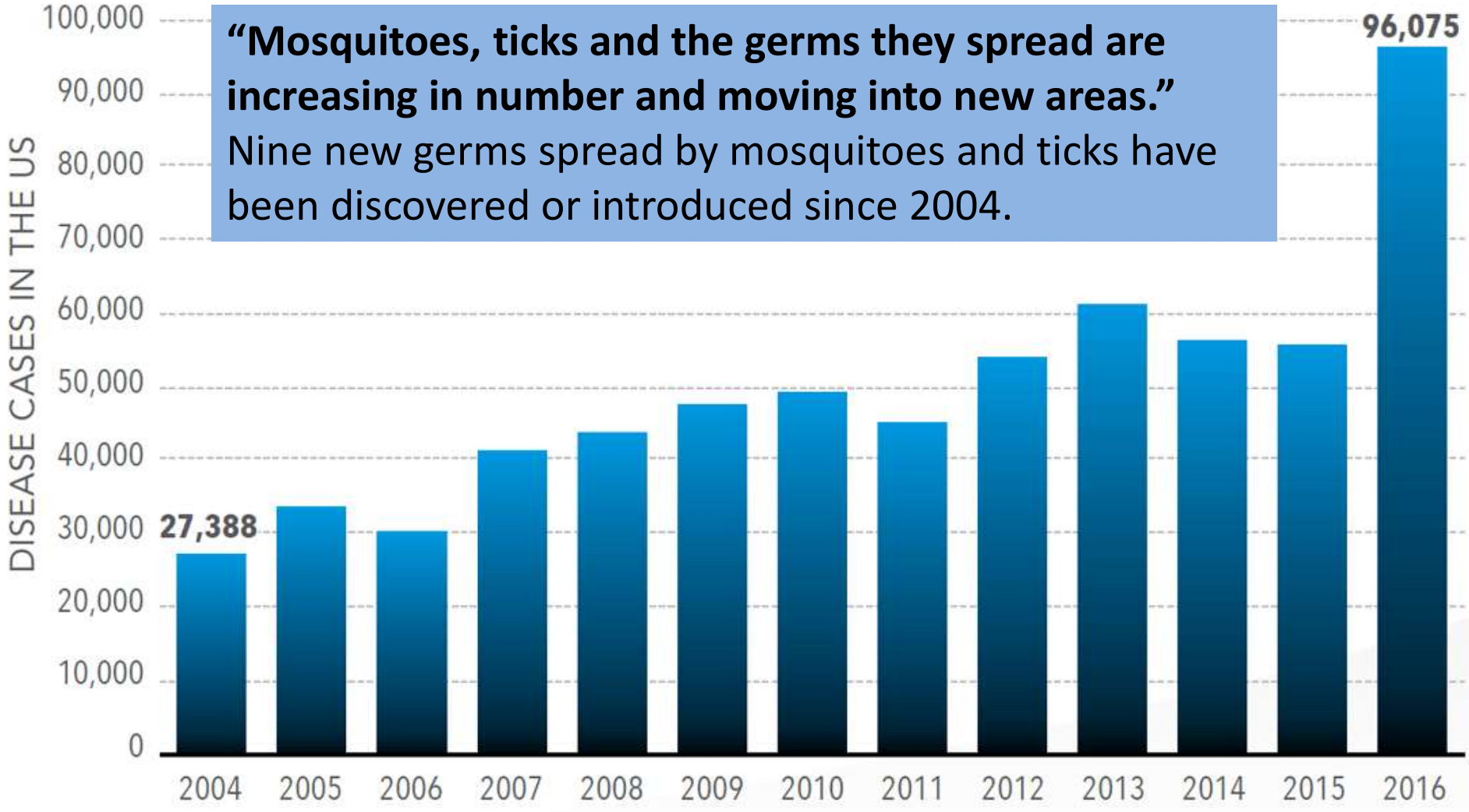
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

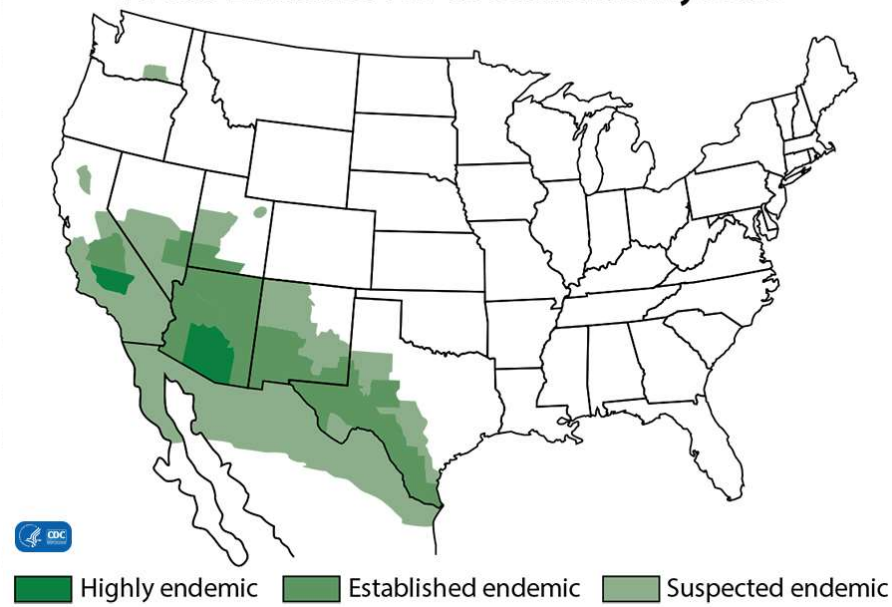
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

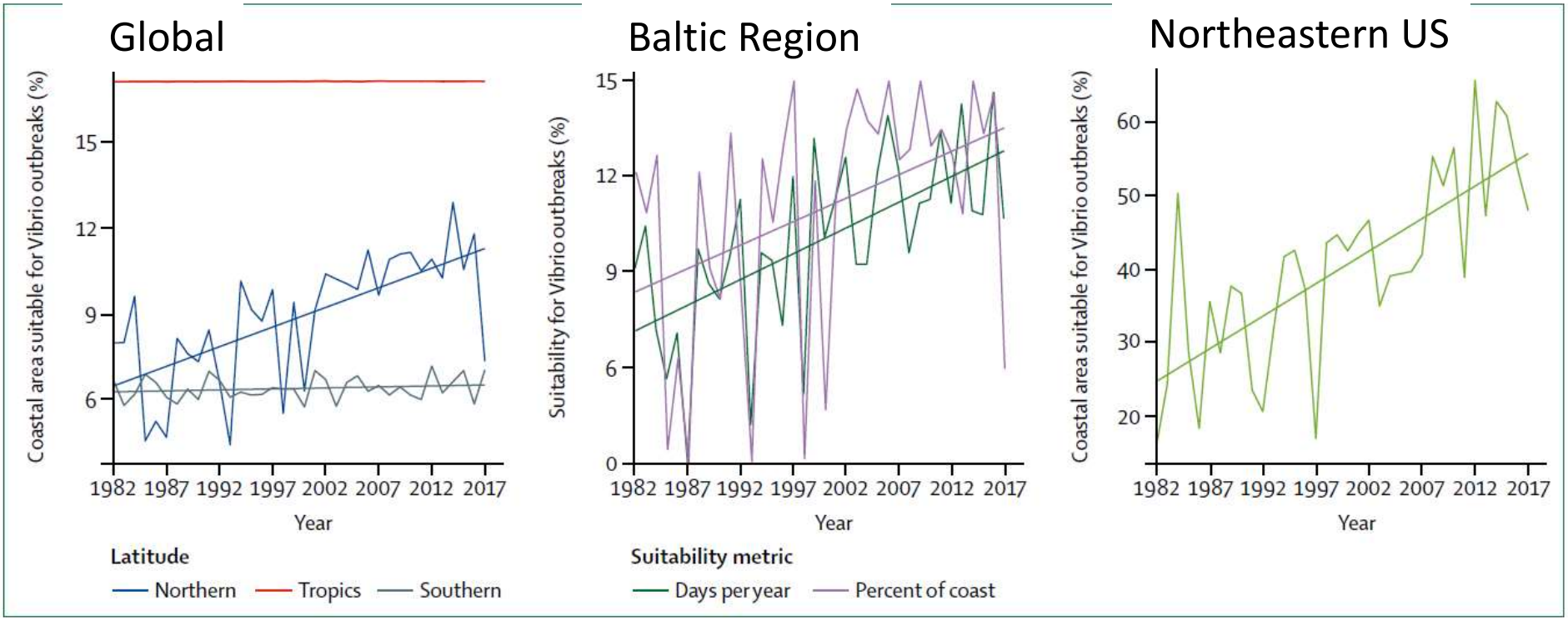
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

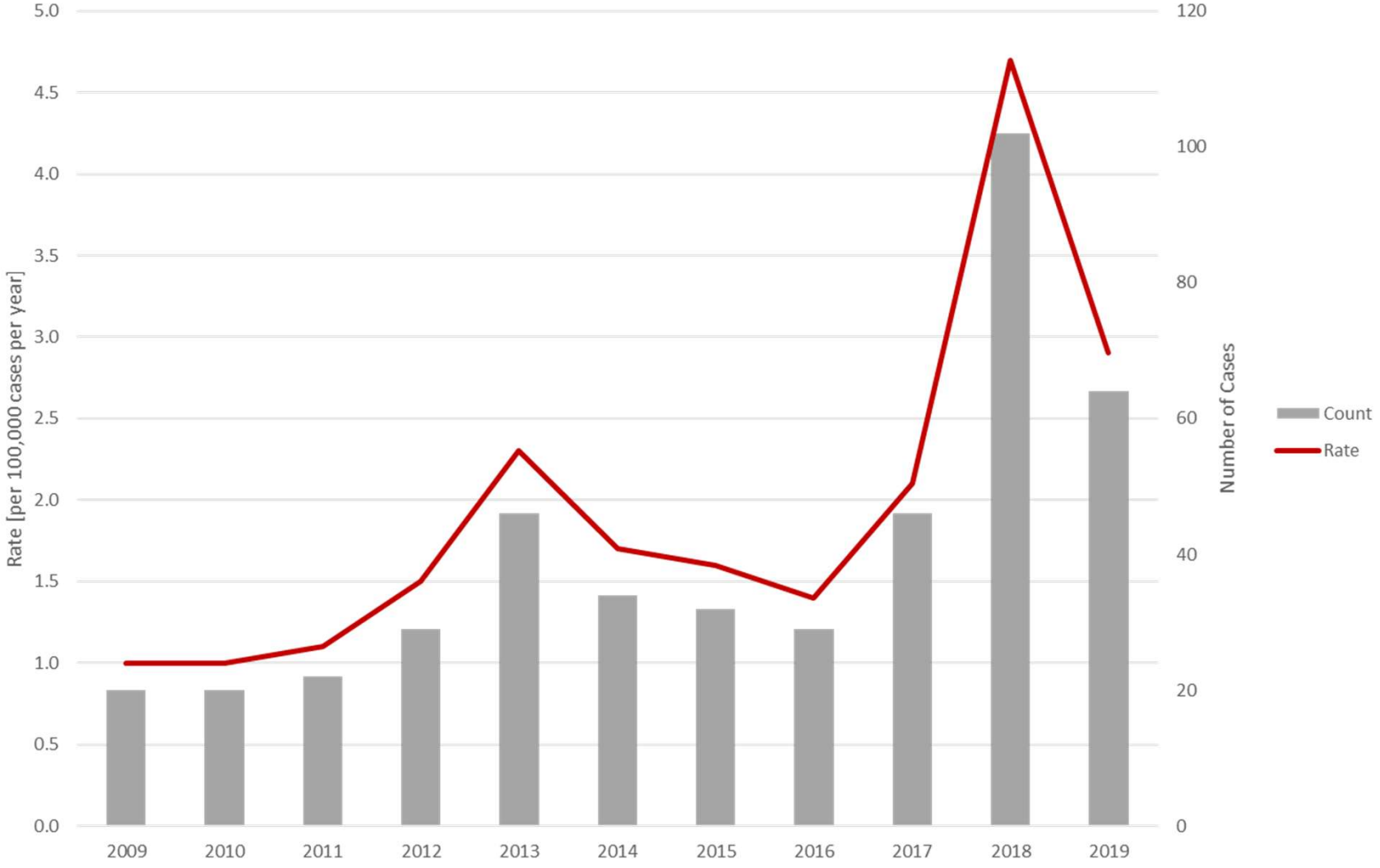
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

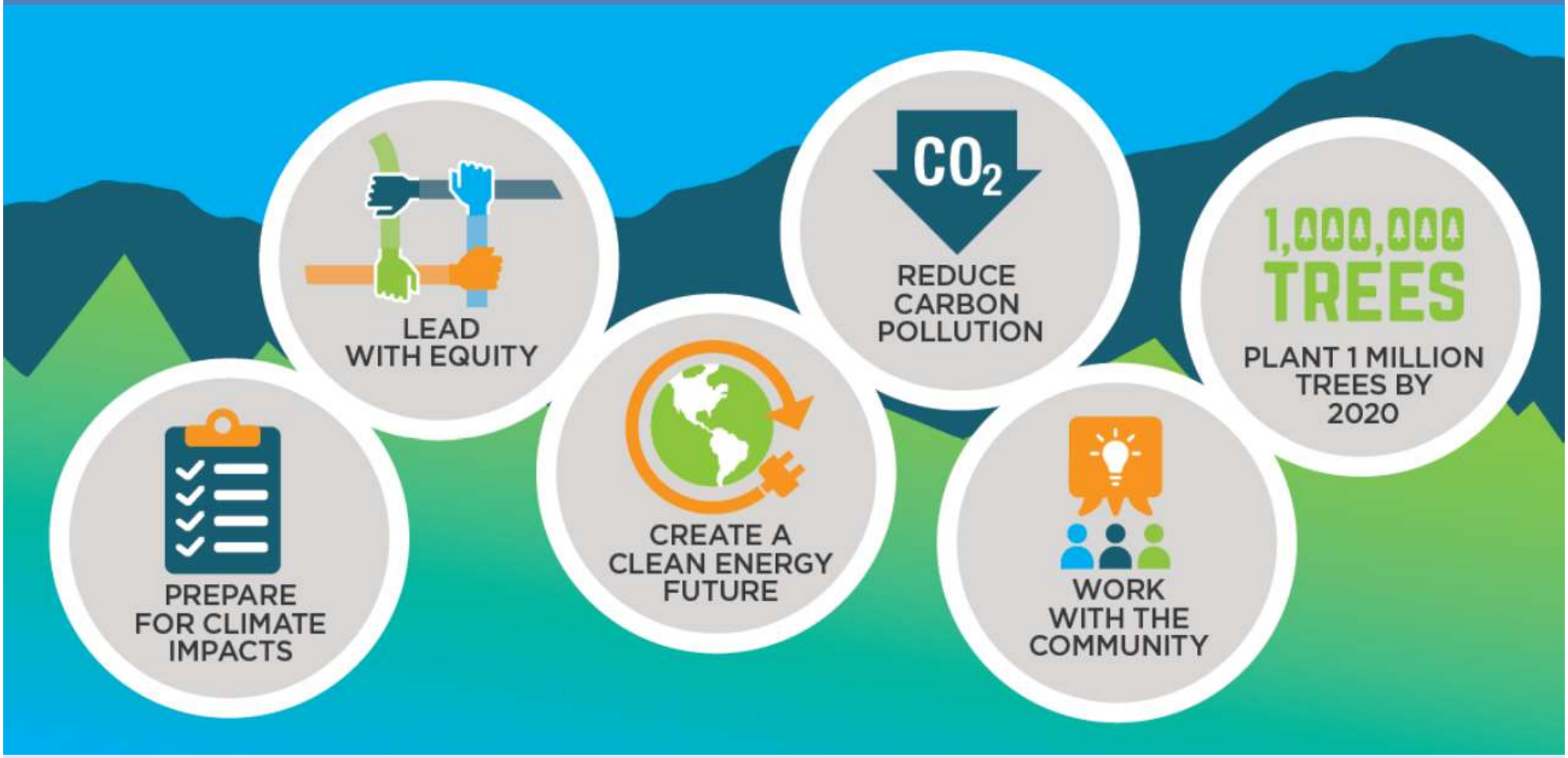
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

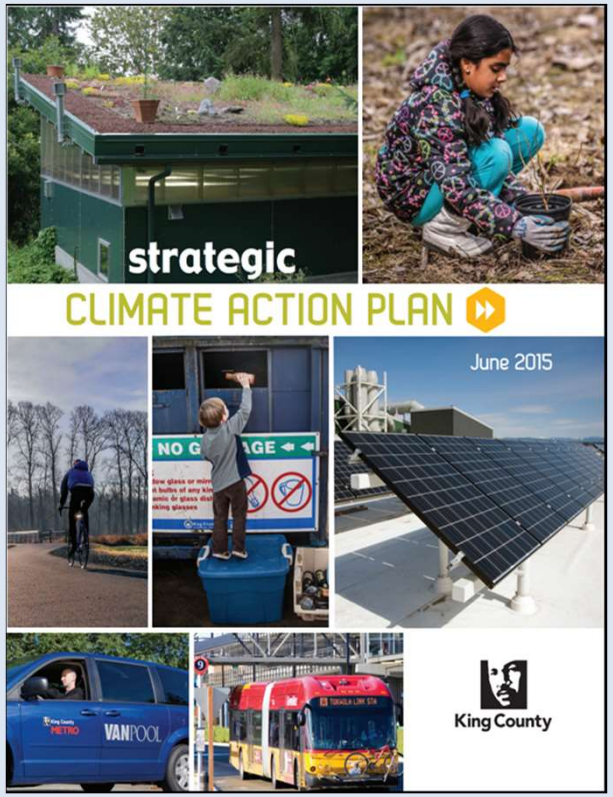


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

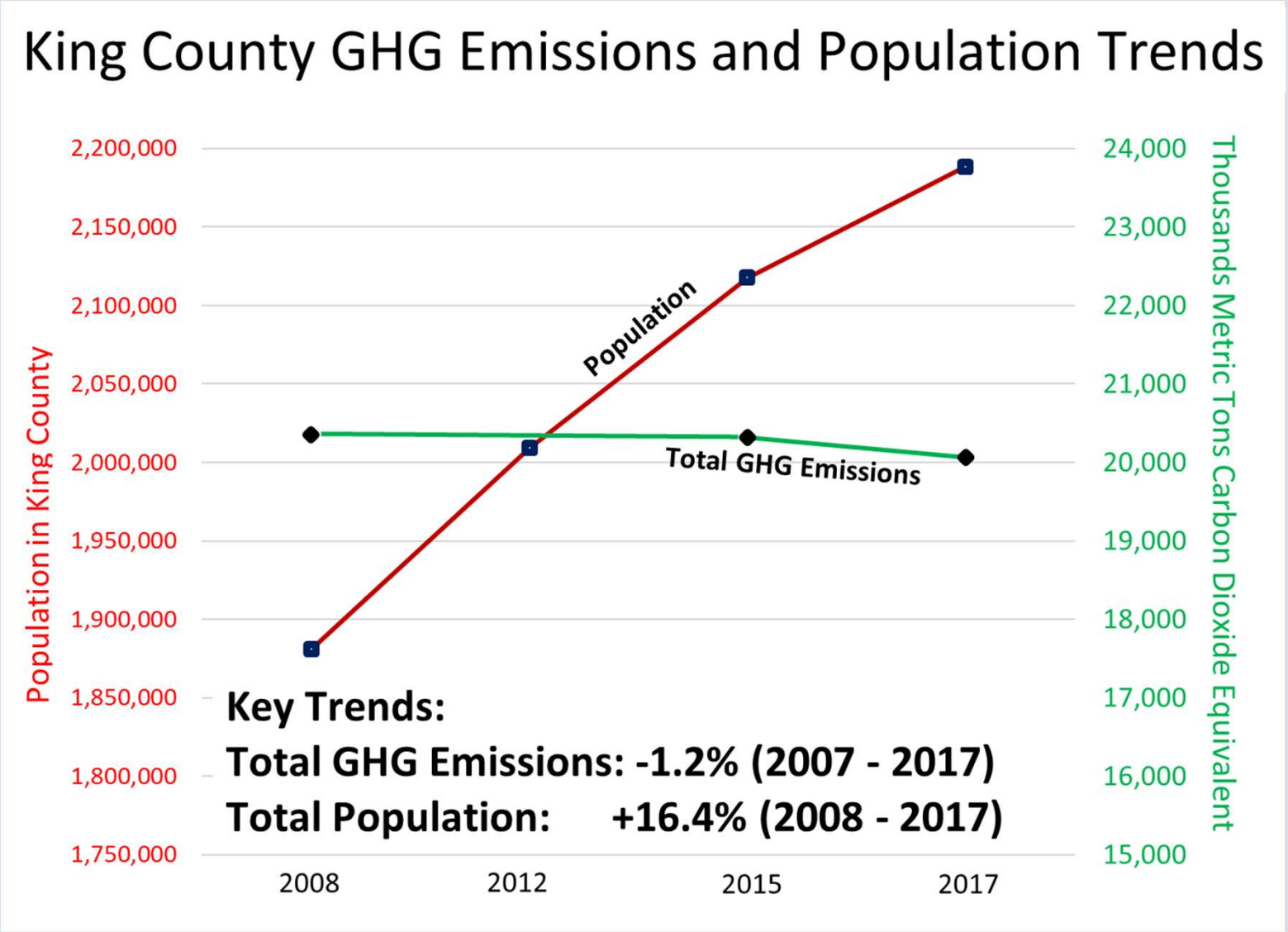
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



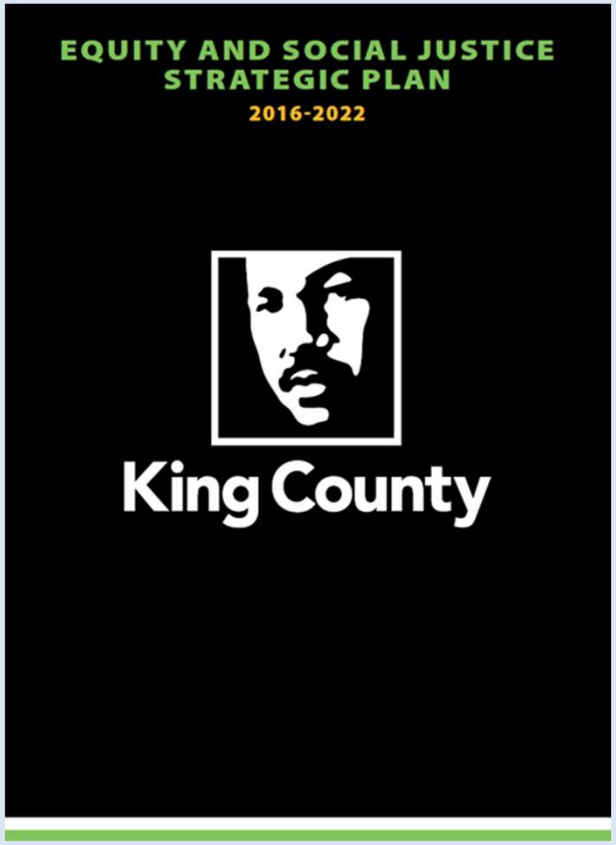
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

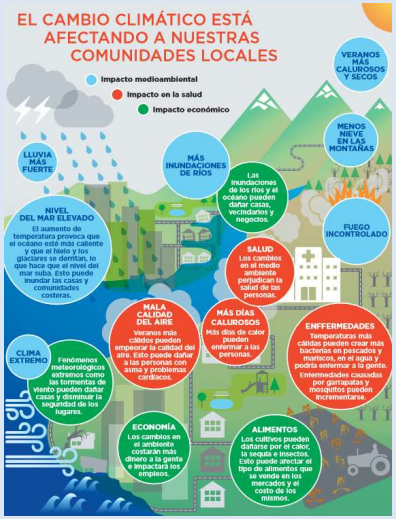
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

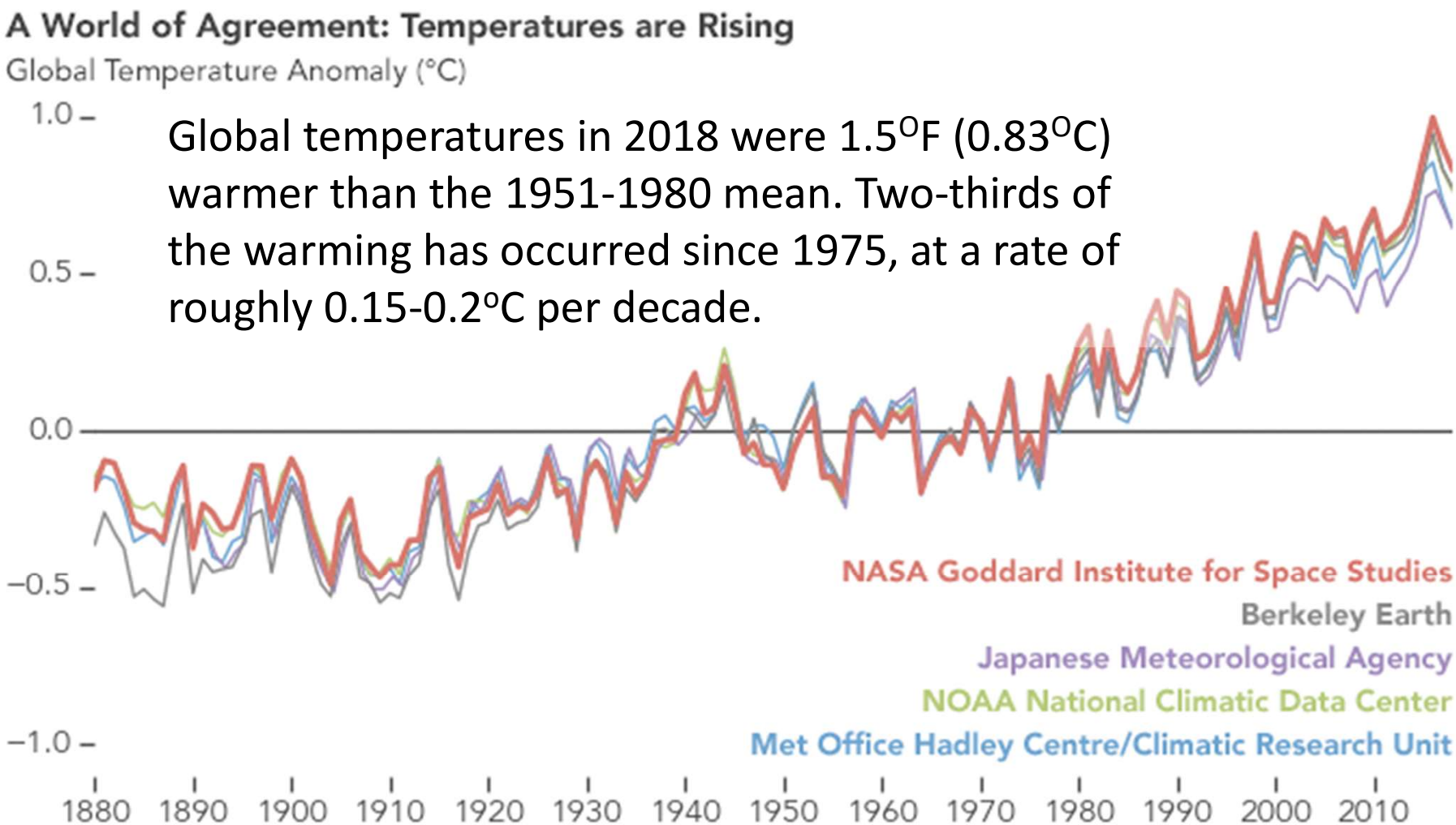
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

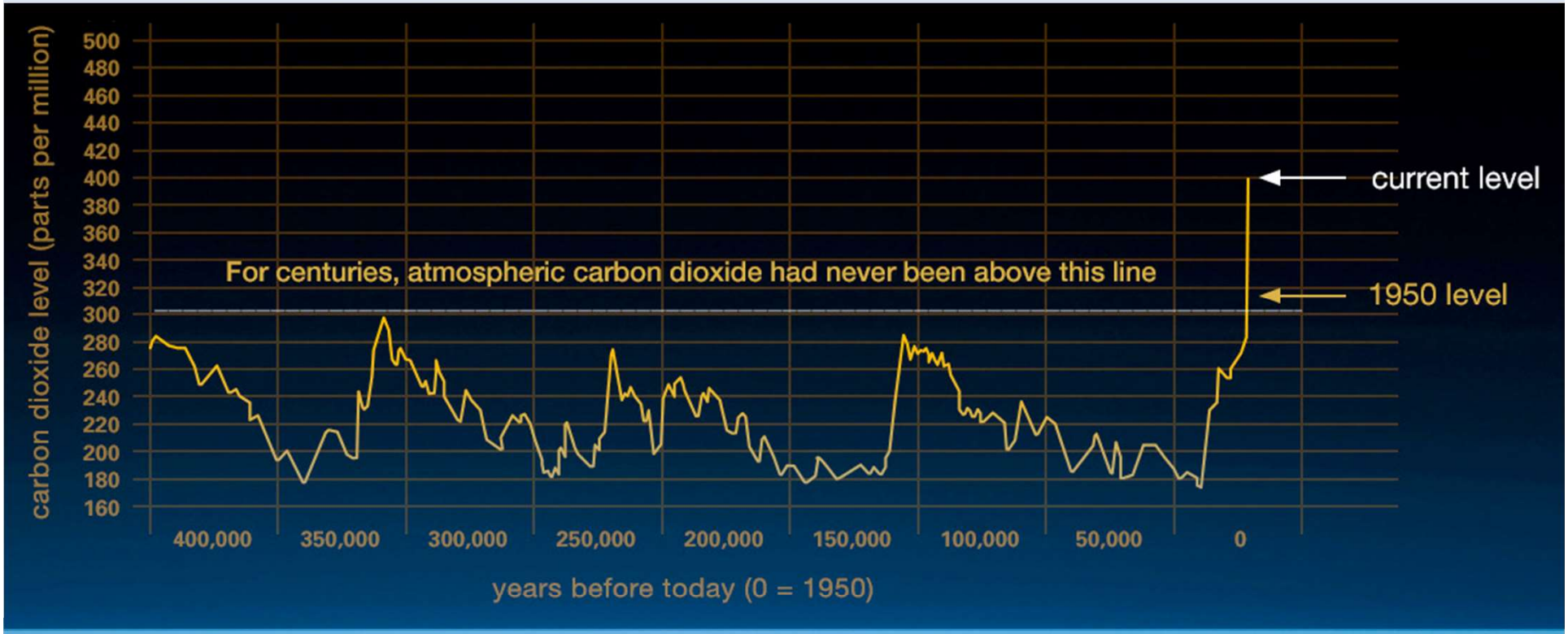


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

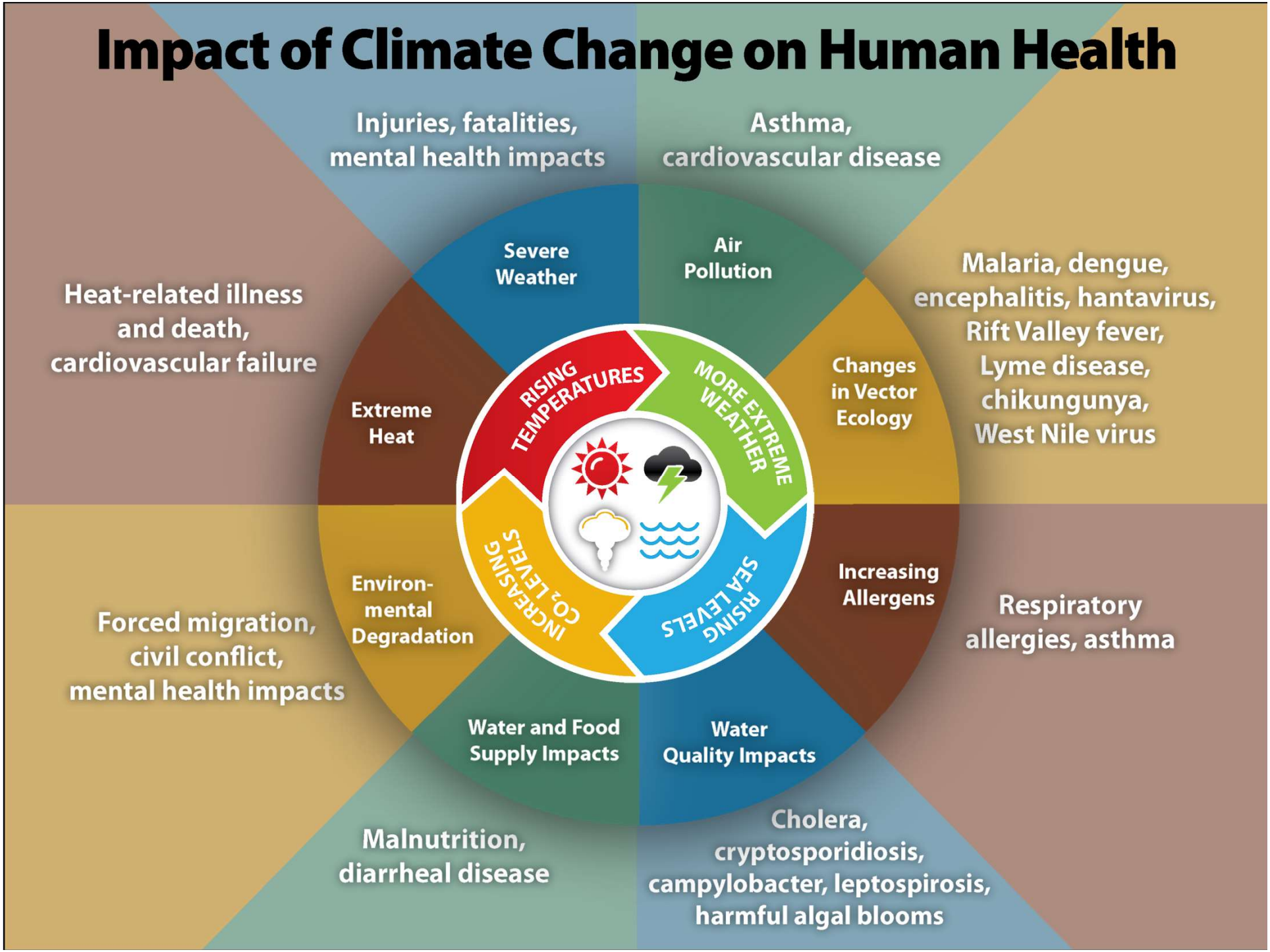
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

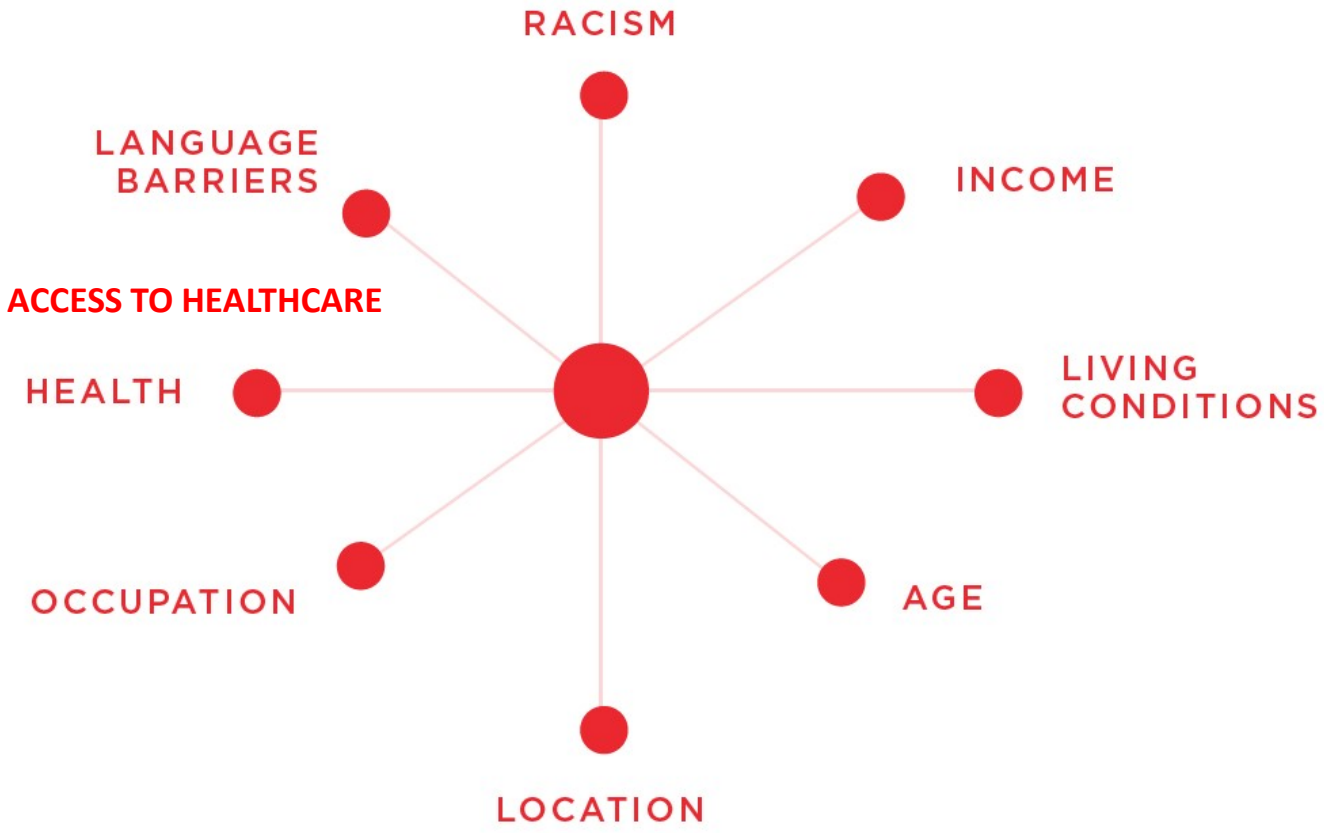
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

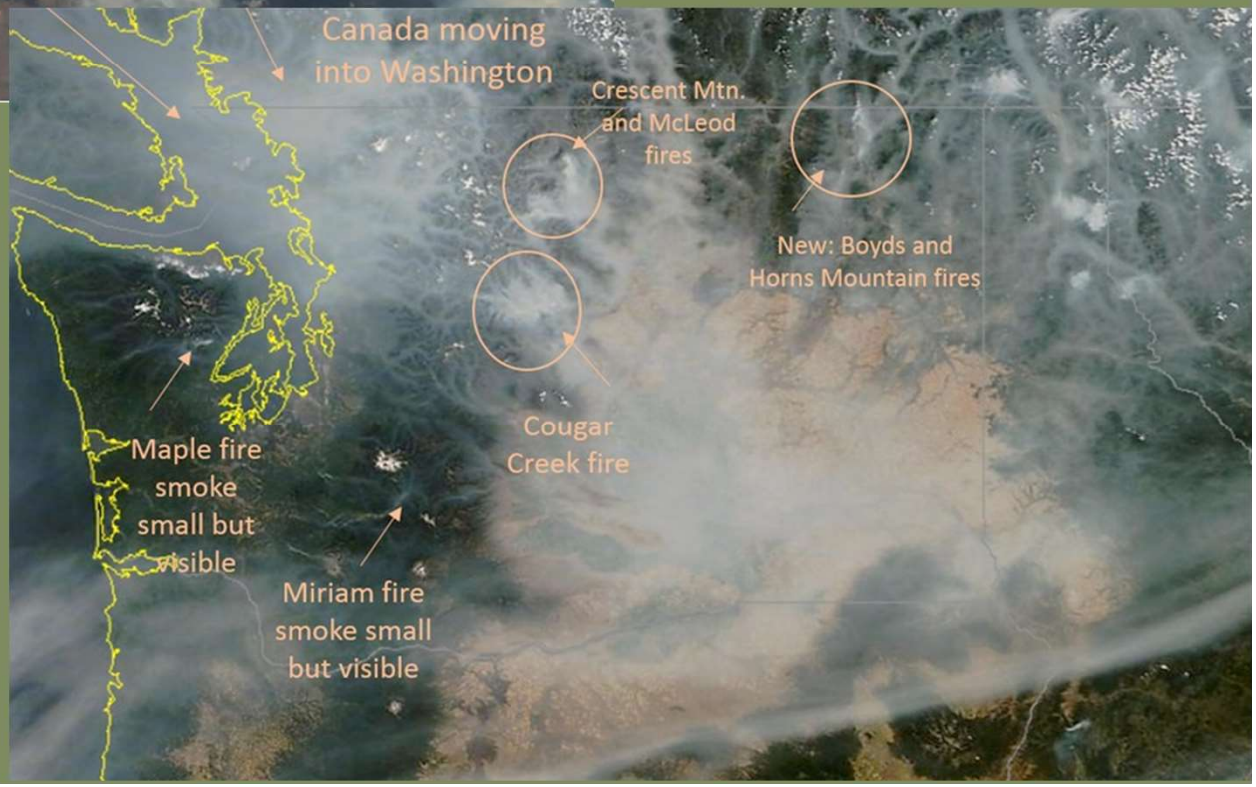
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

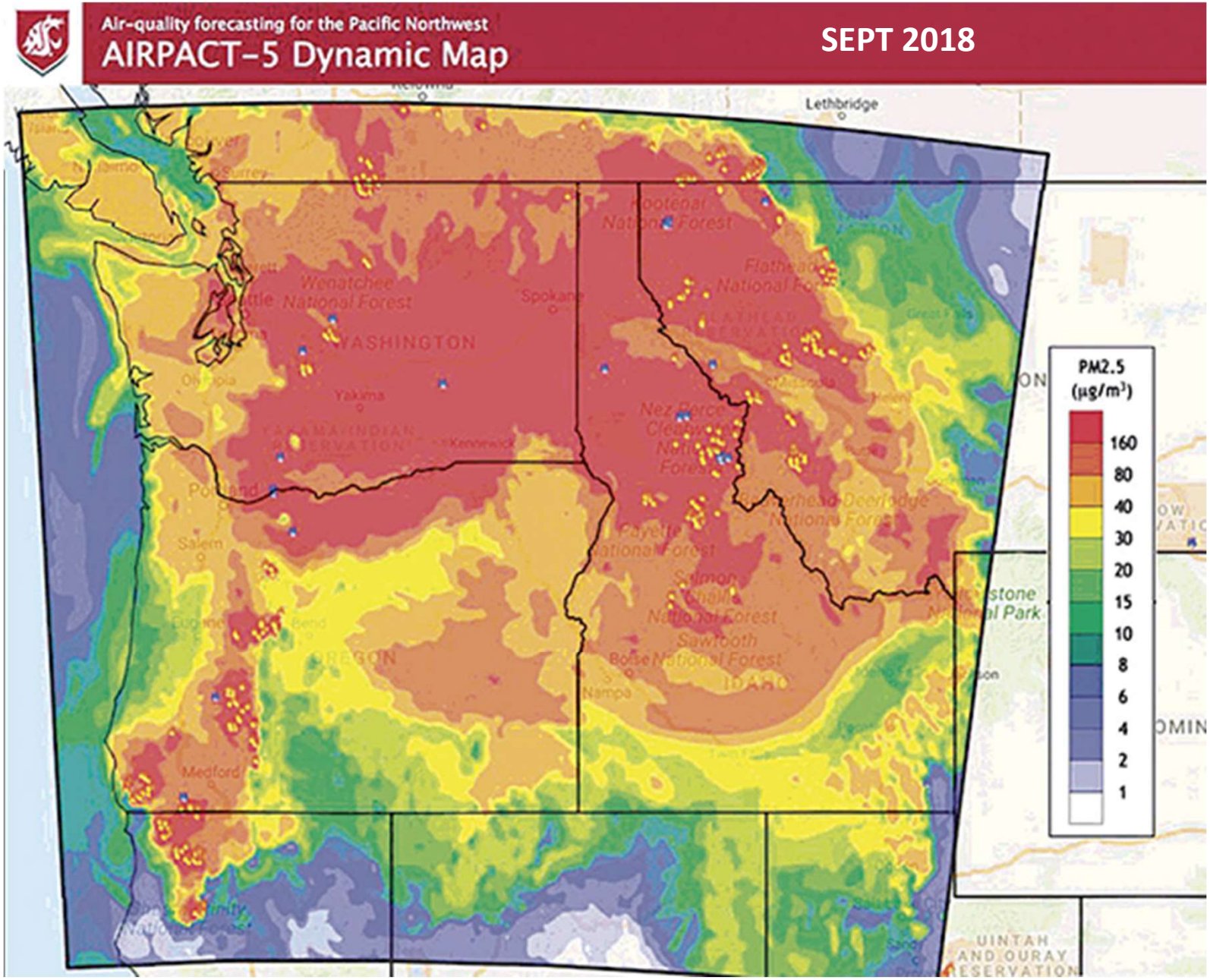
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

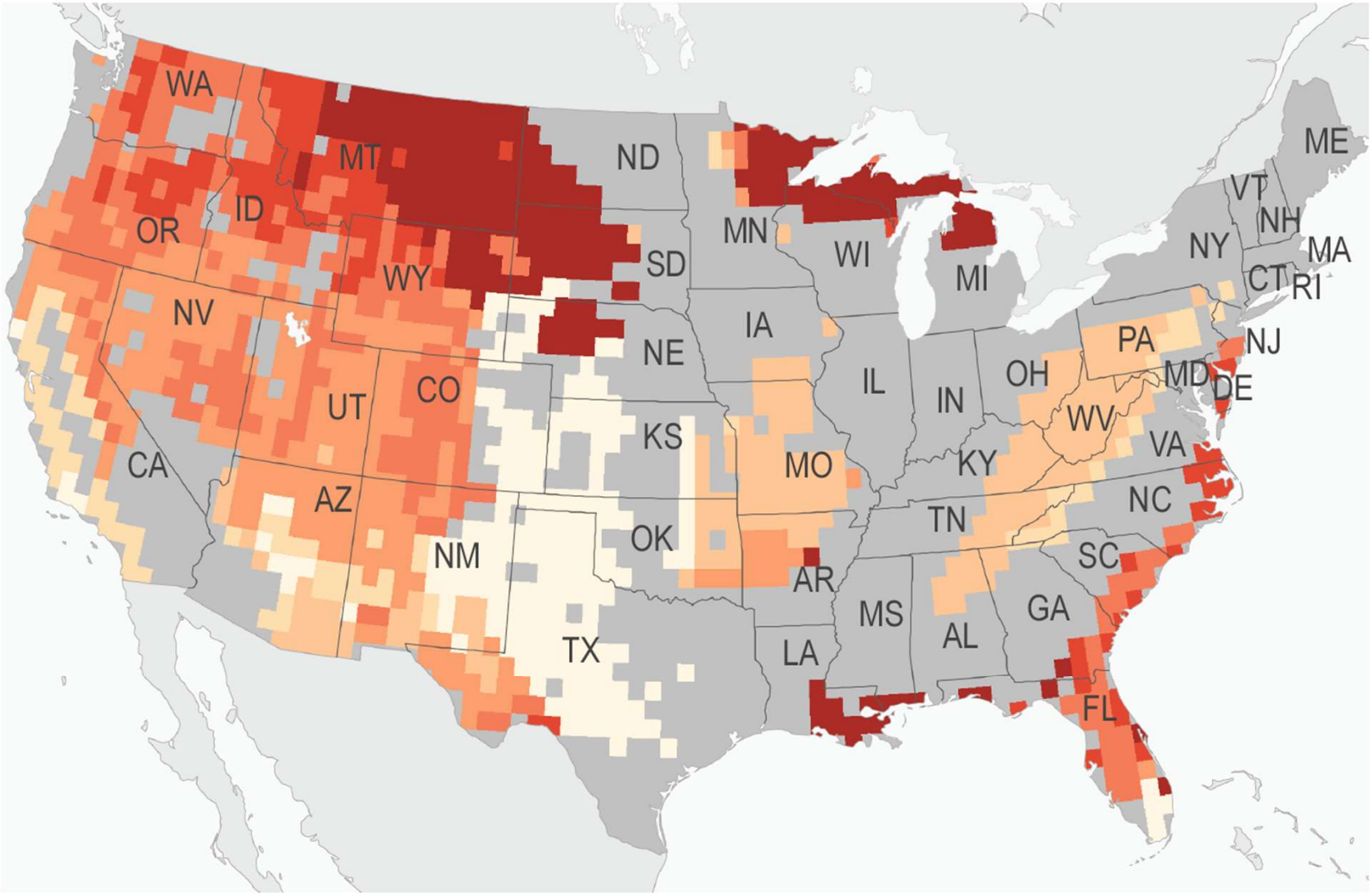
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

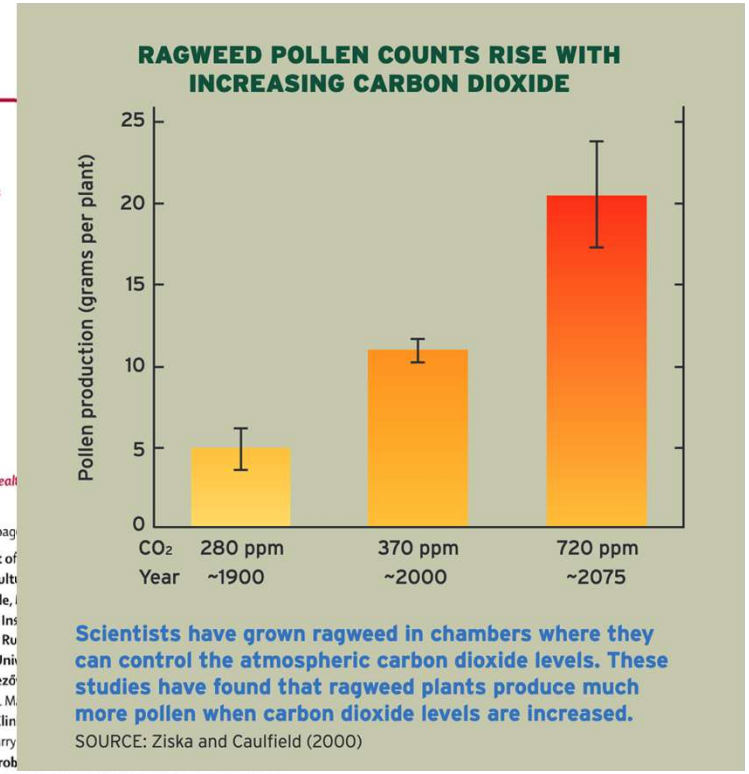
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

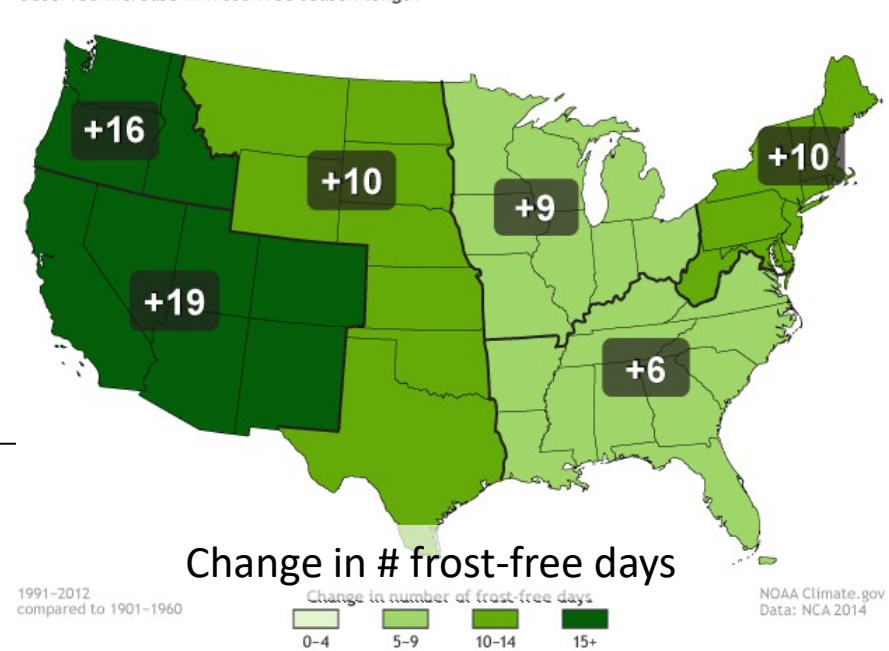
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

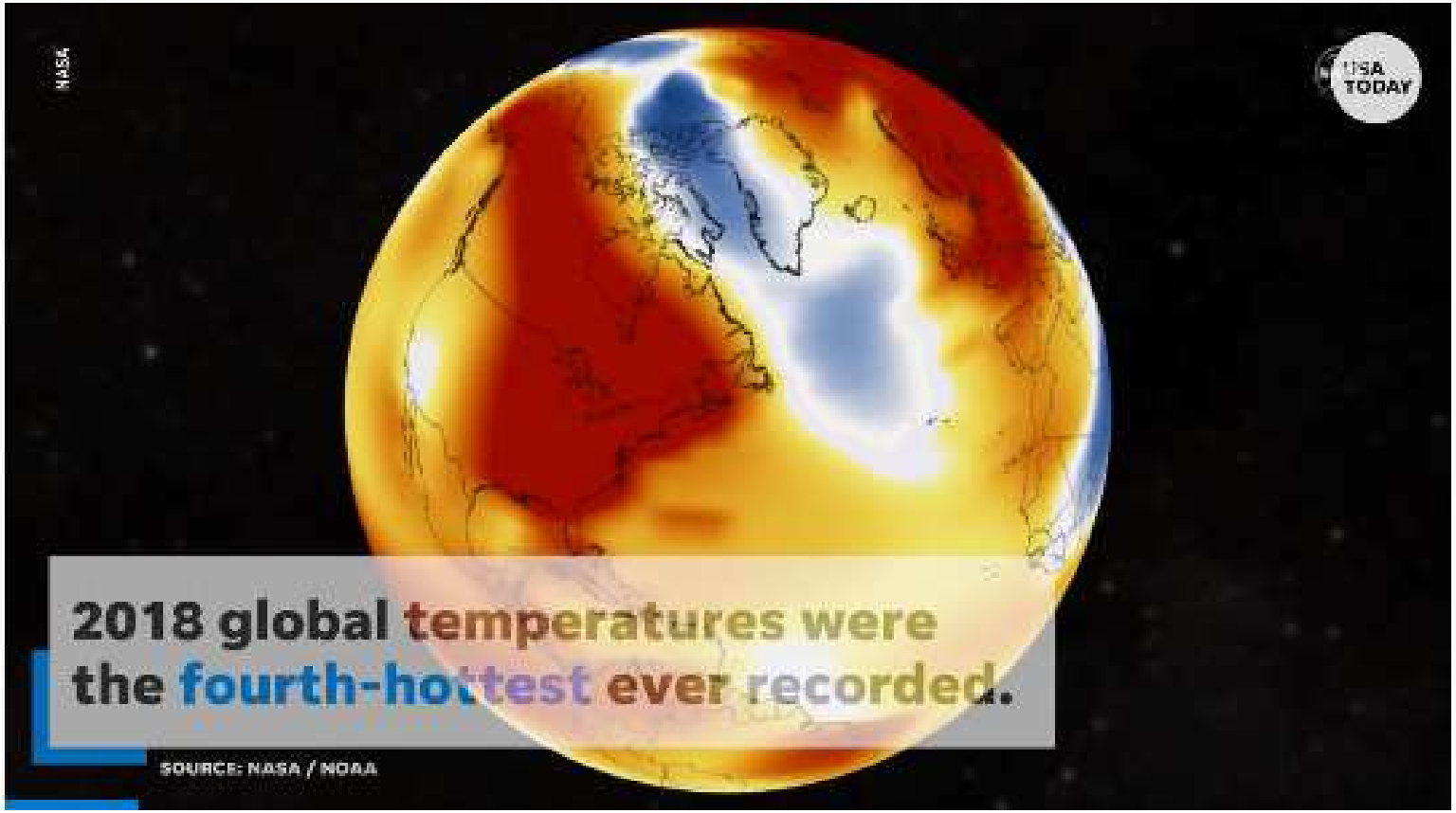
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



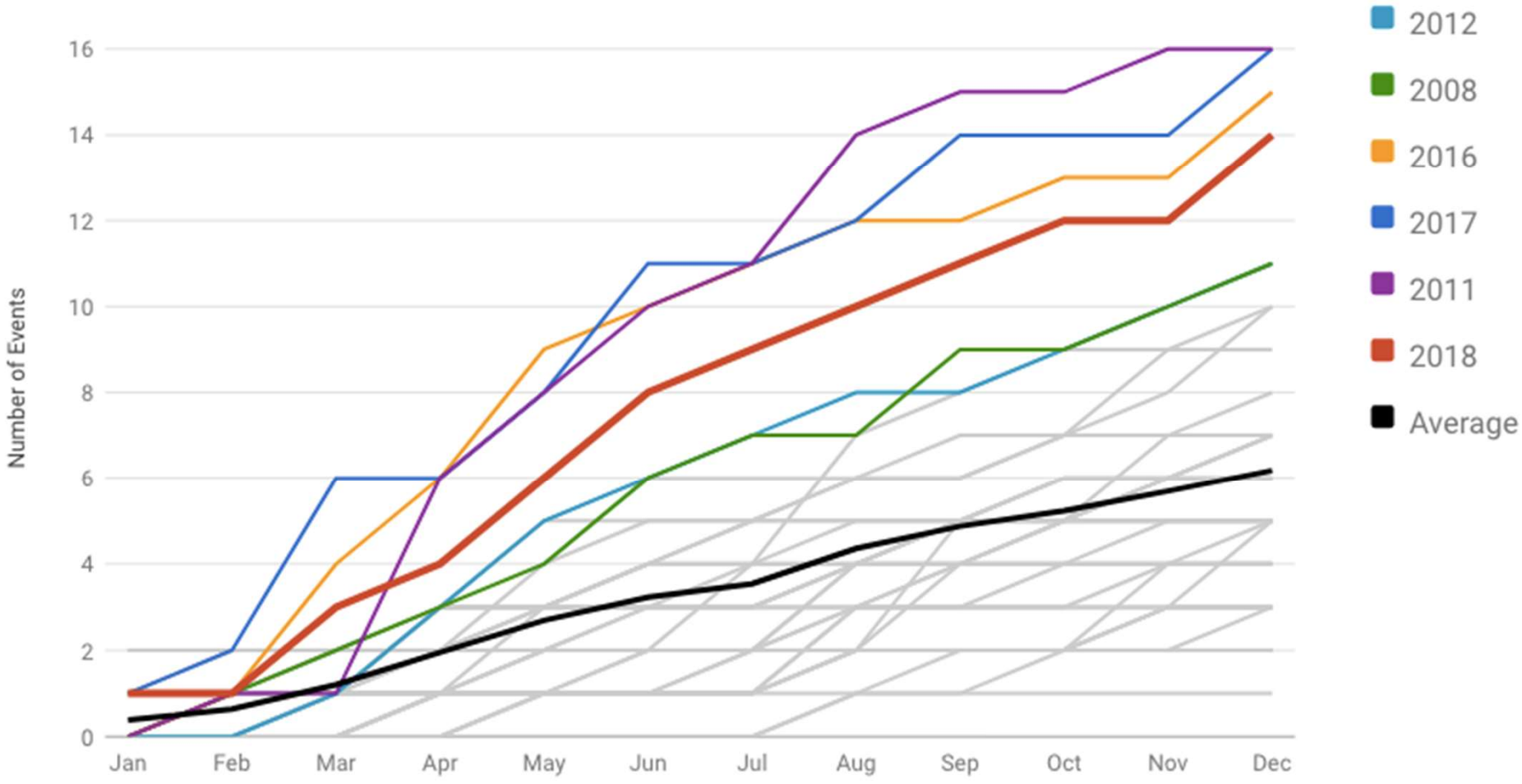
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



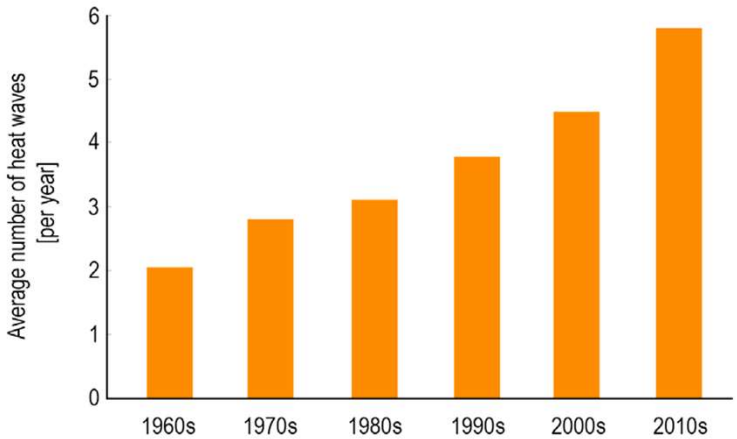
NOAA: National Centers for Environmental Information

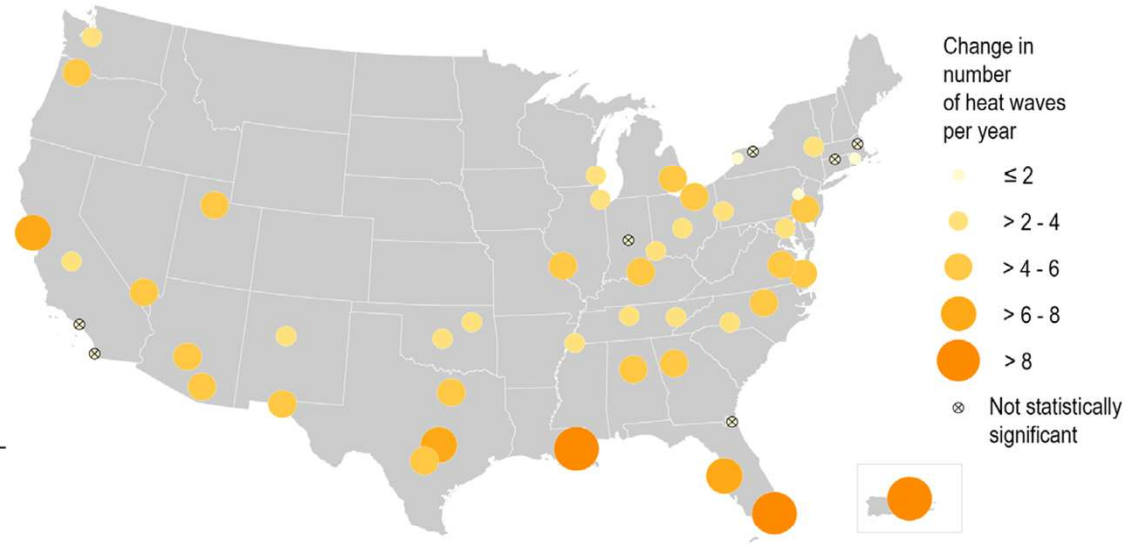
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

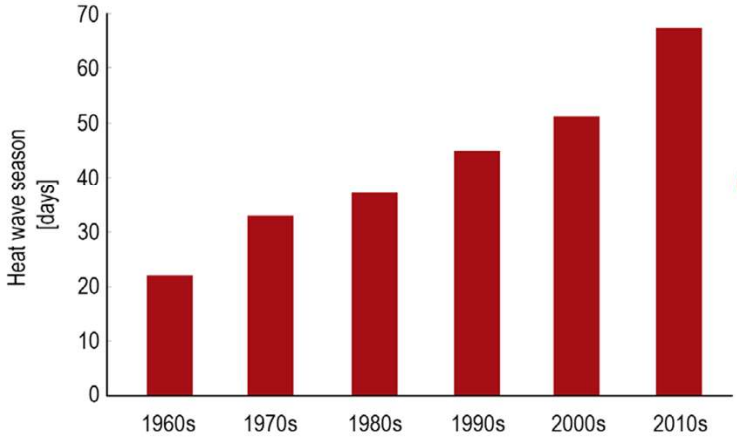
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

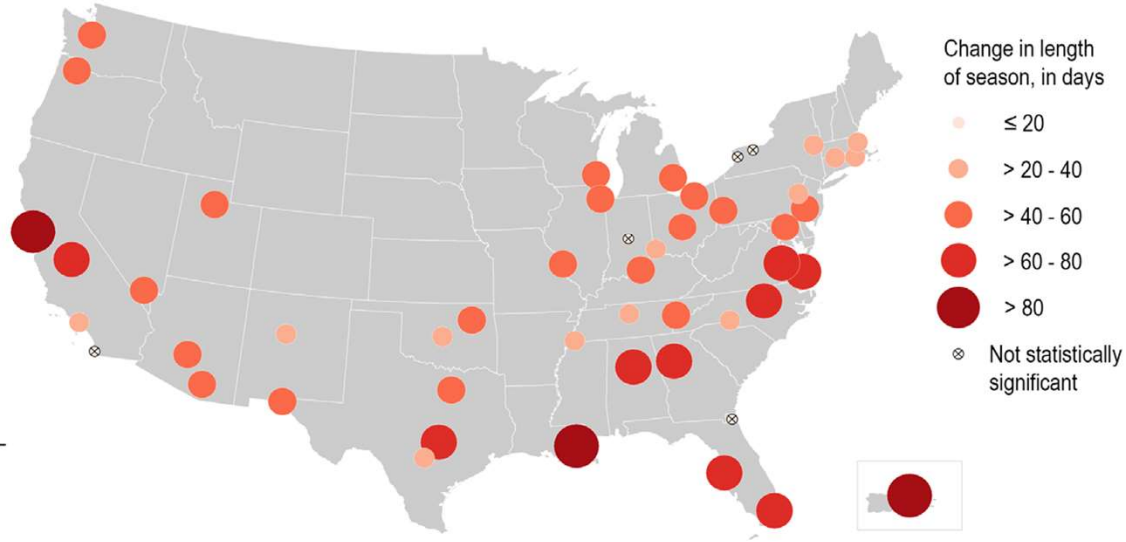
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

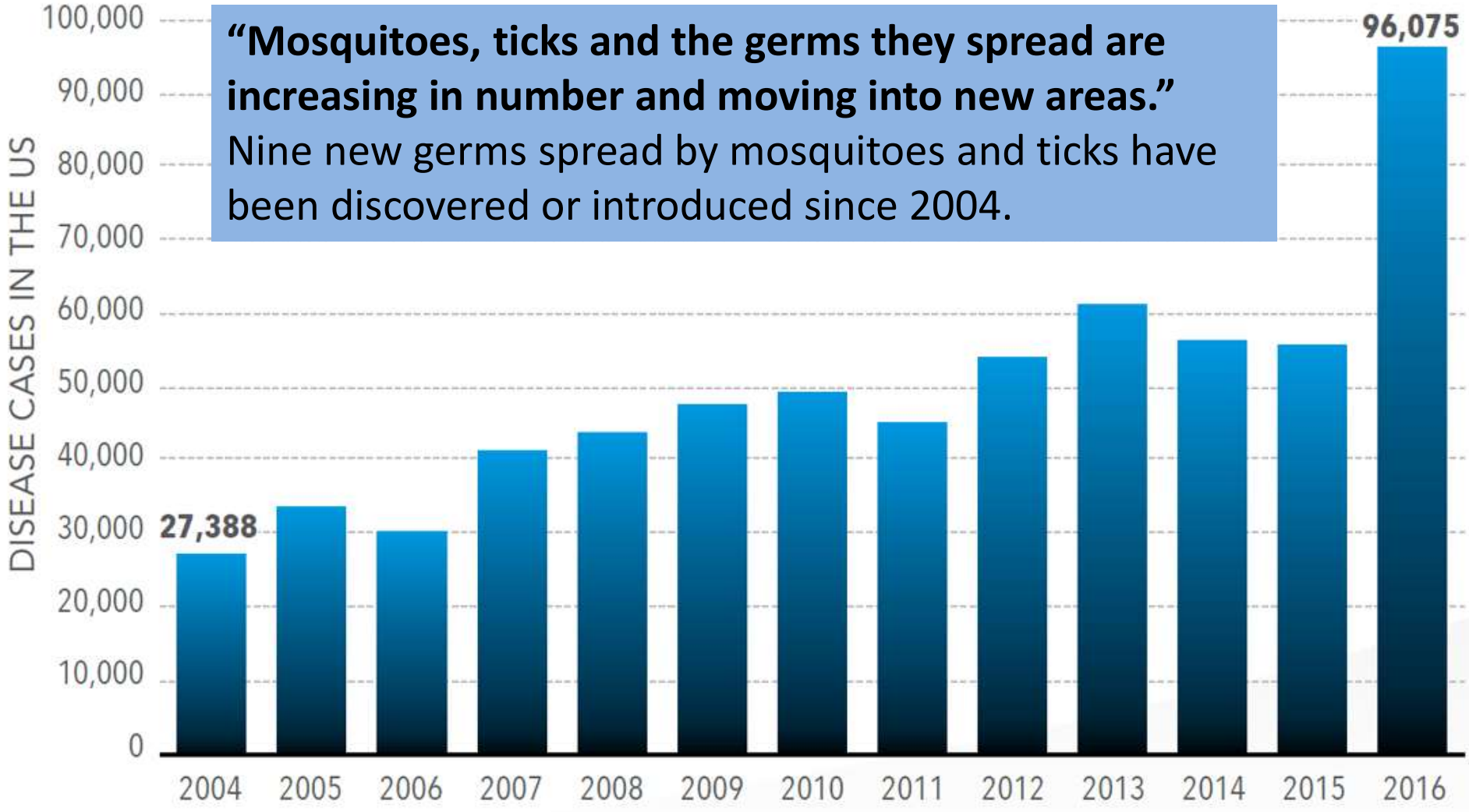
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

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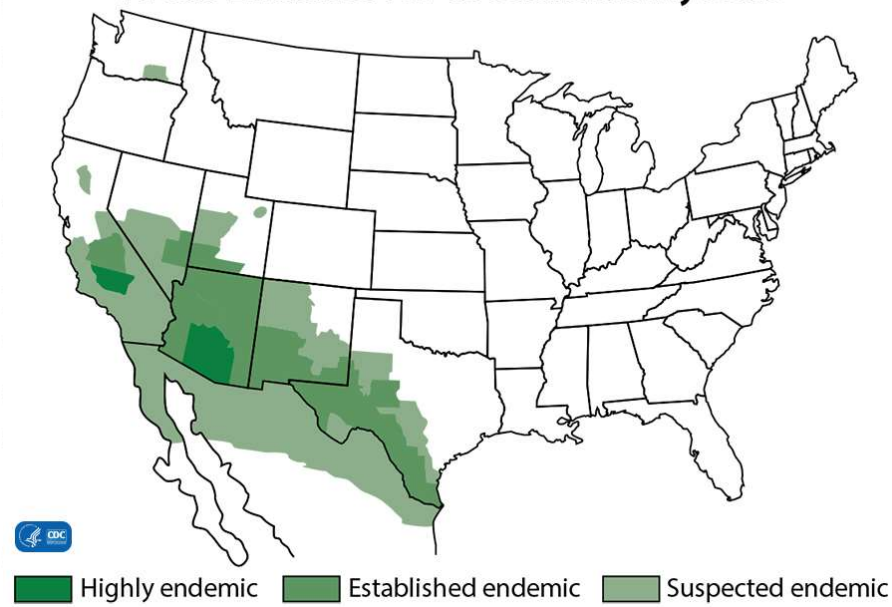
Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

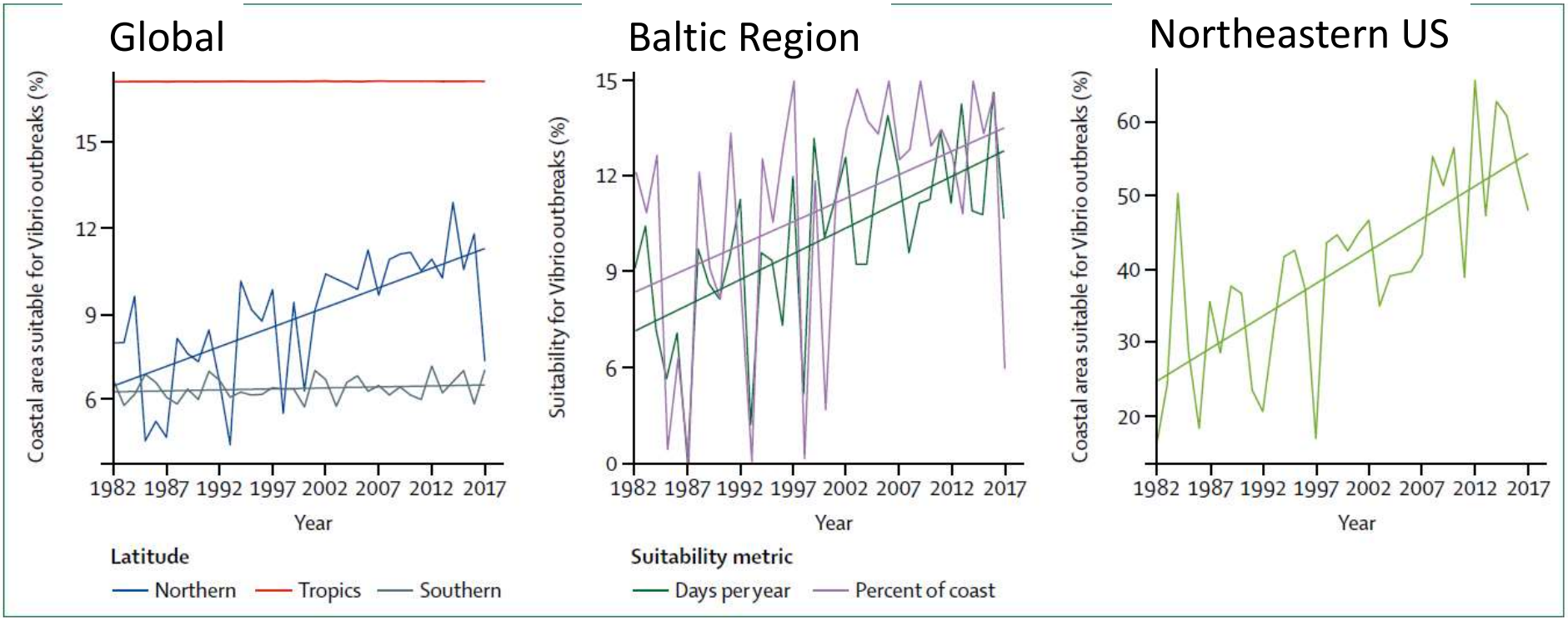
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

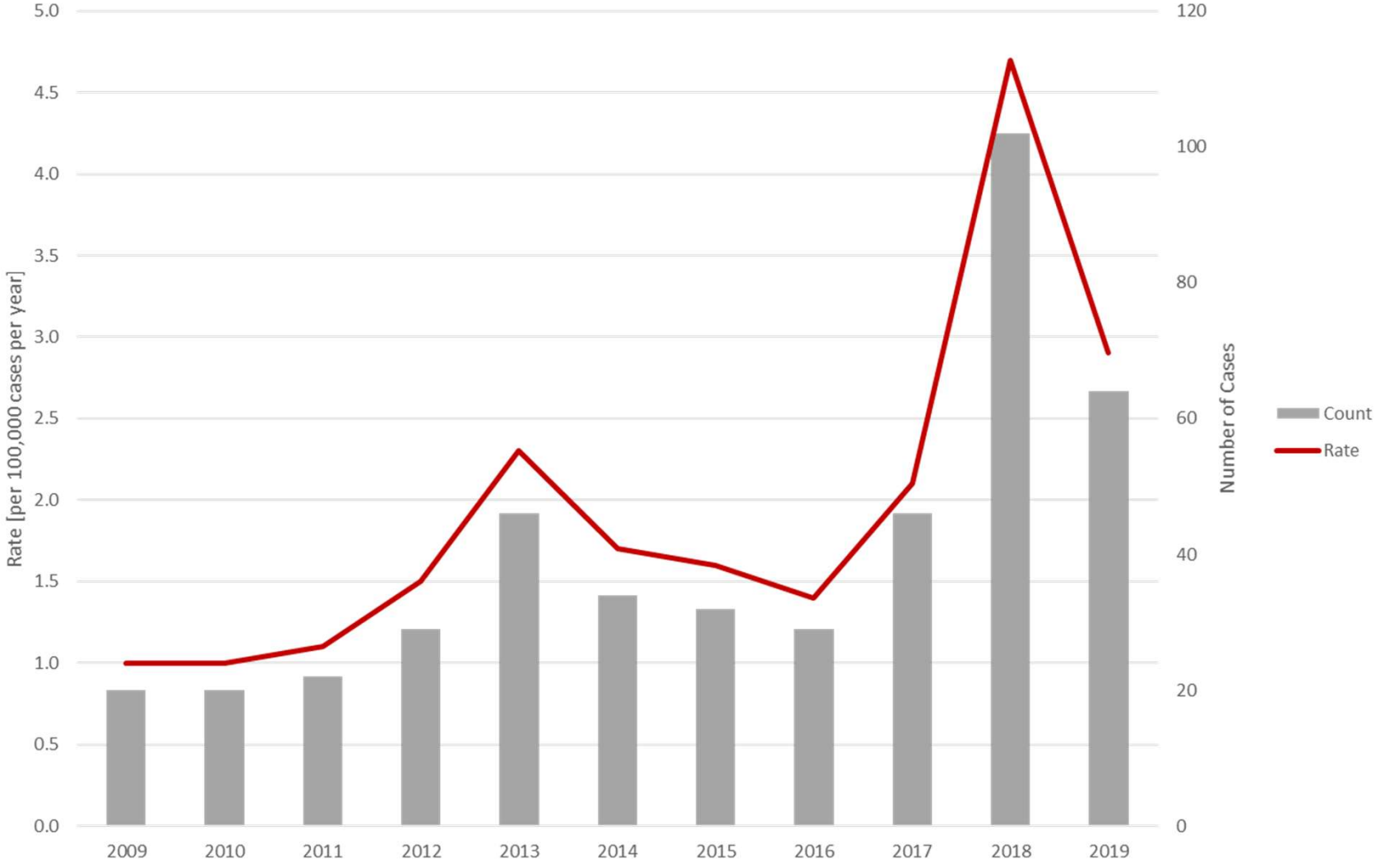
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

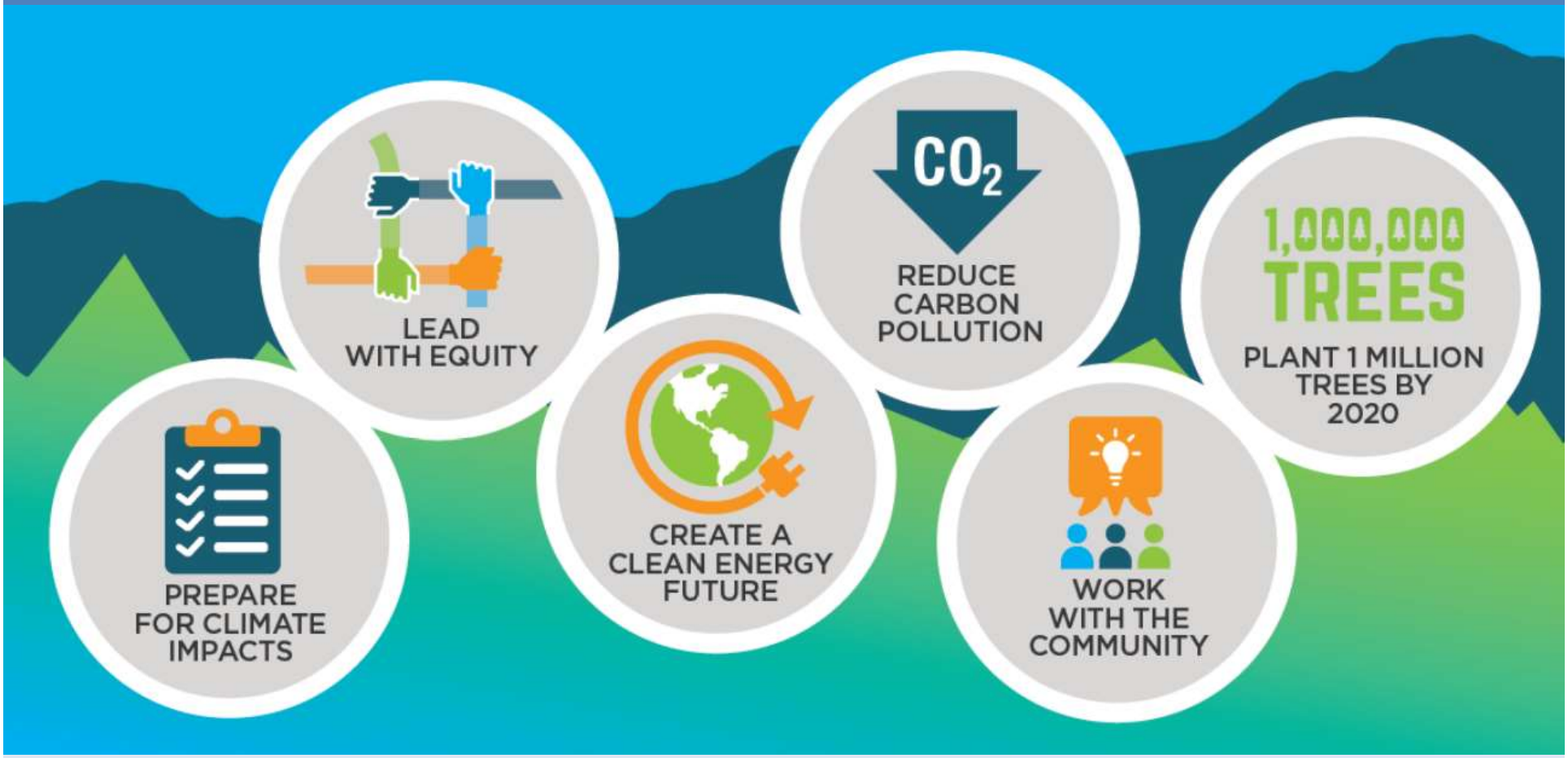
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

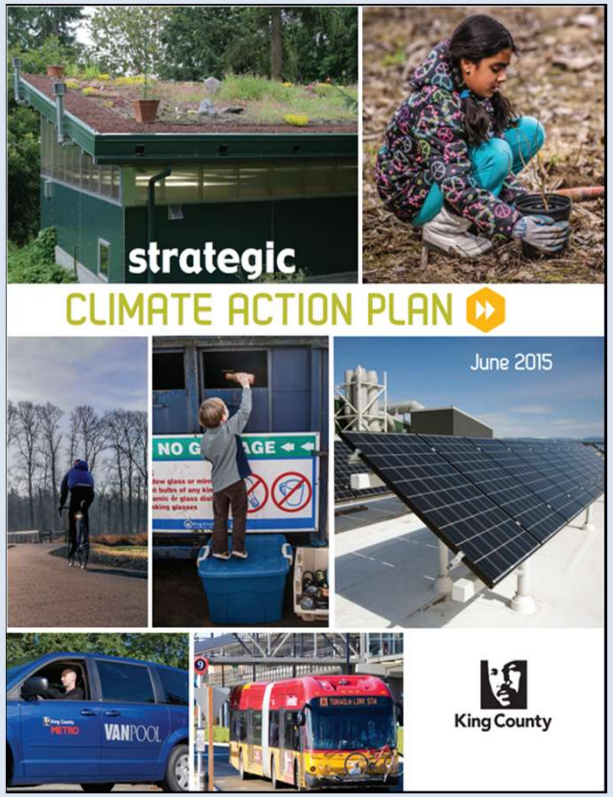


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

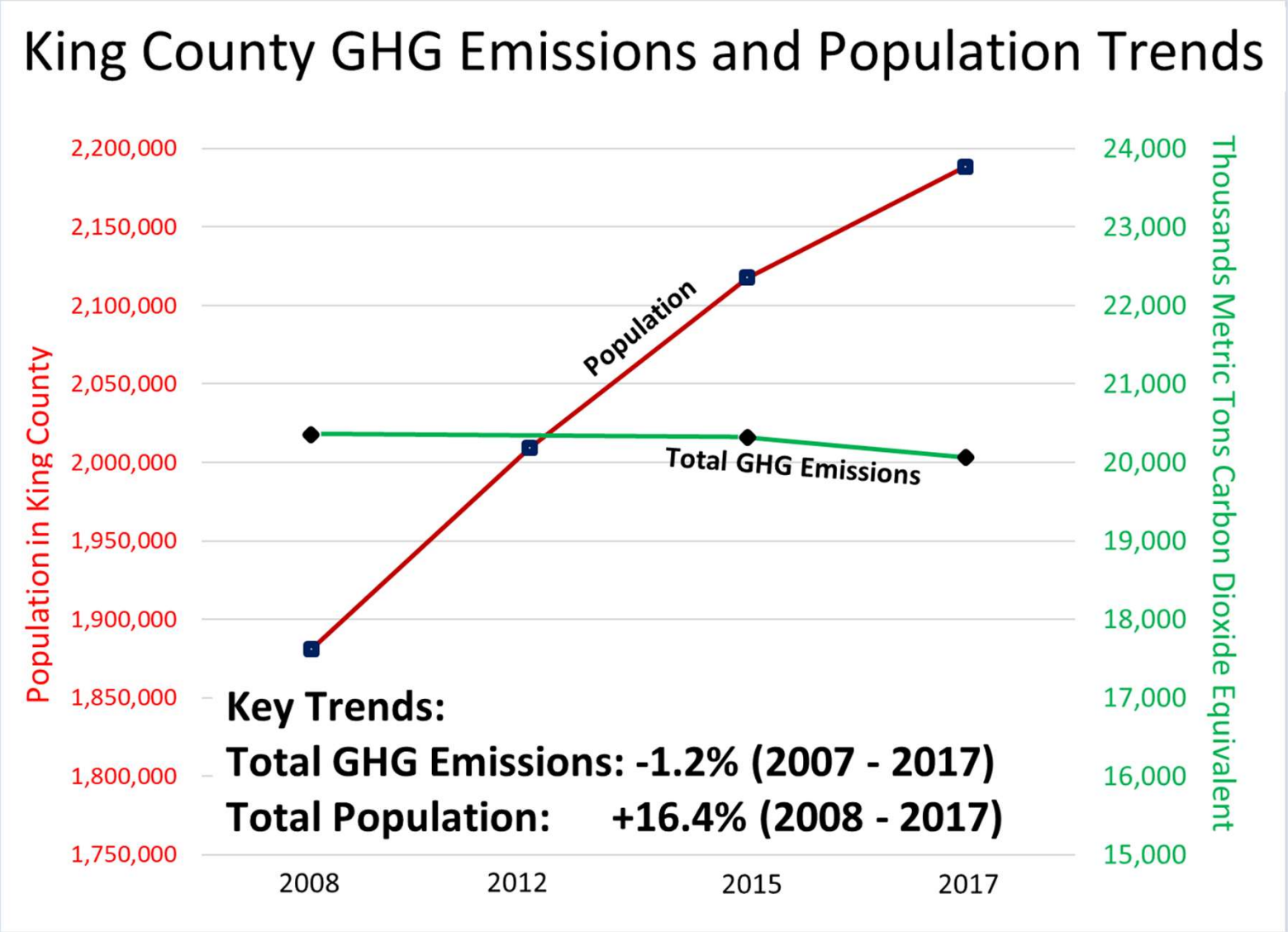
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



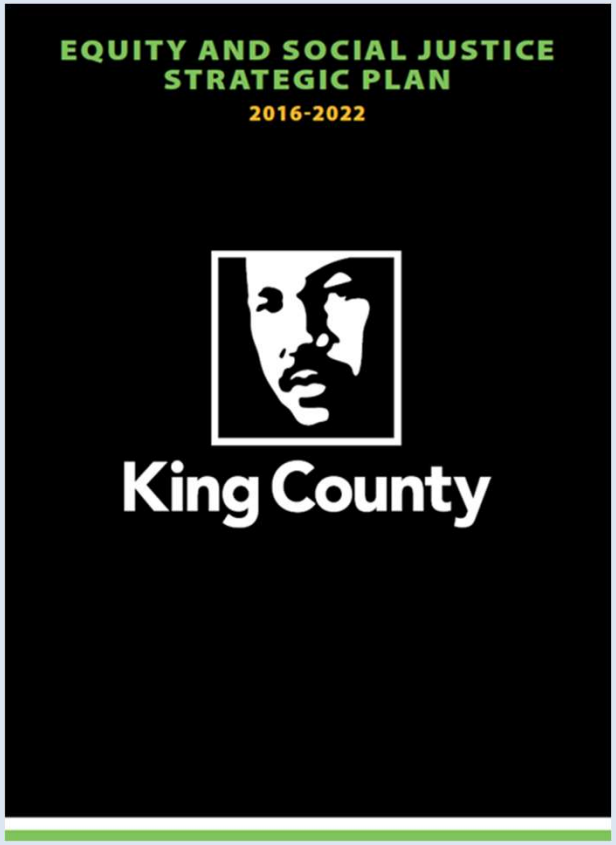
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

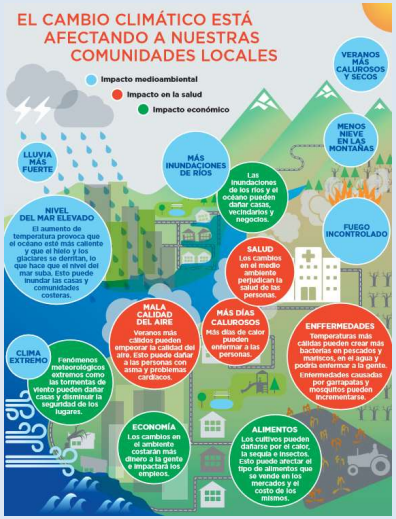
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

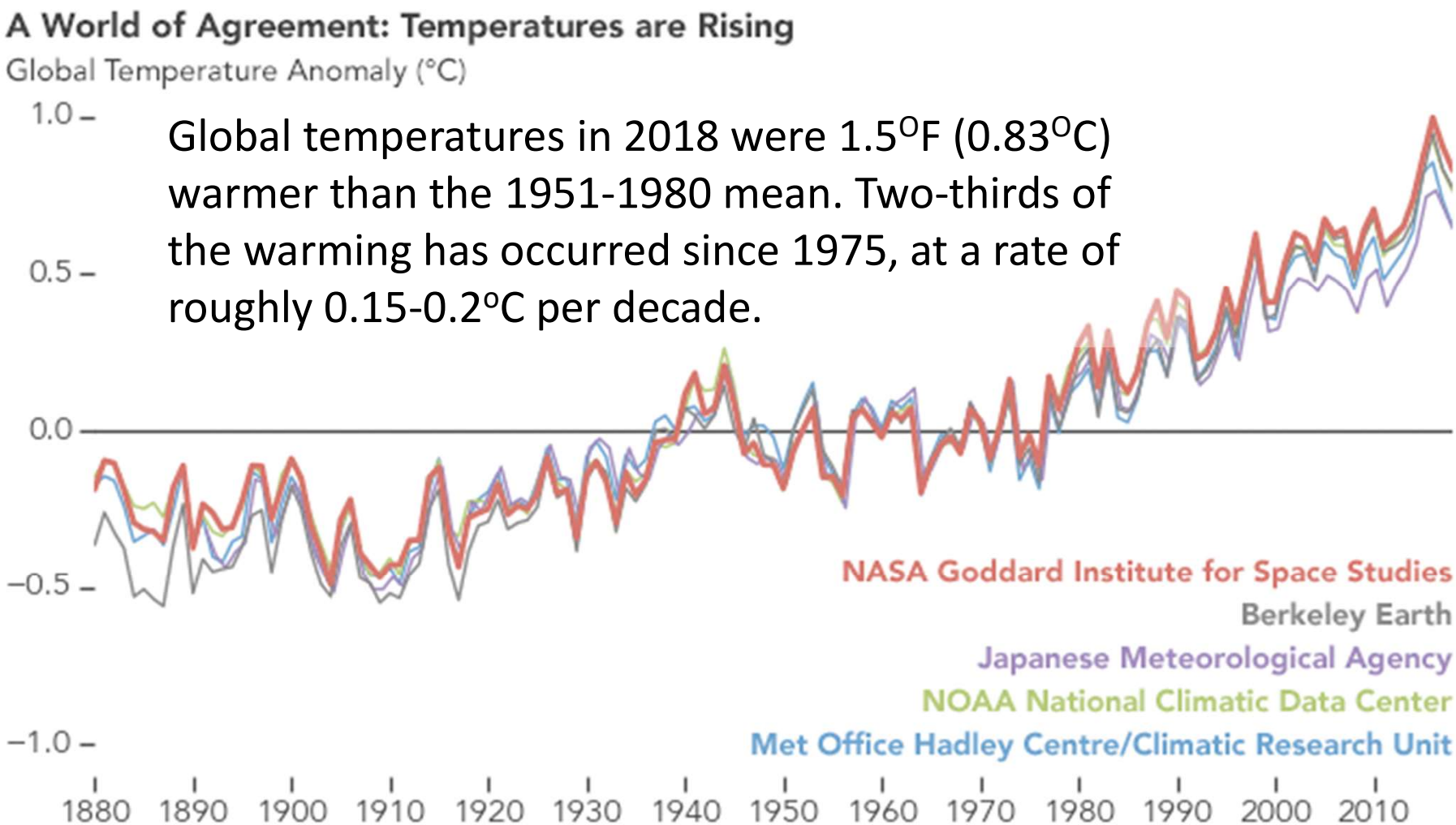
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

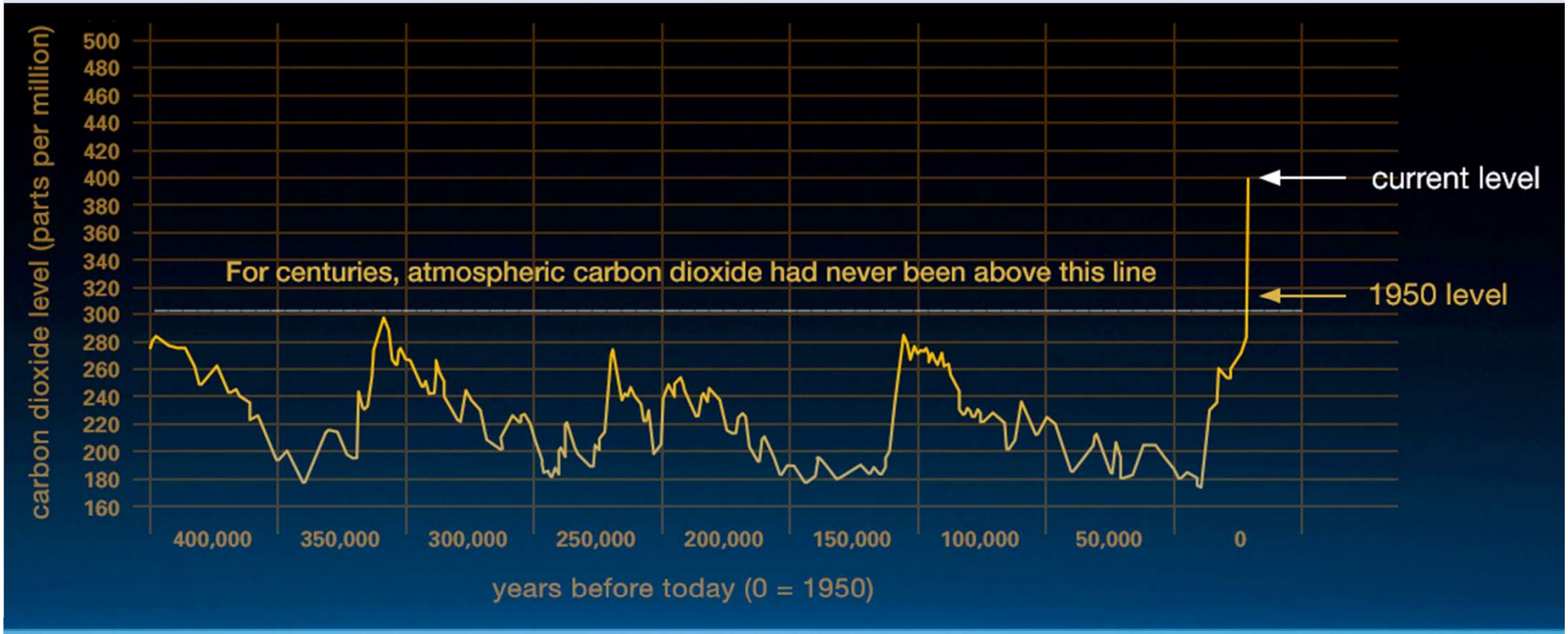


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

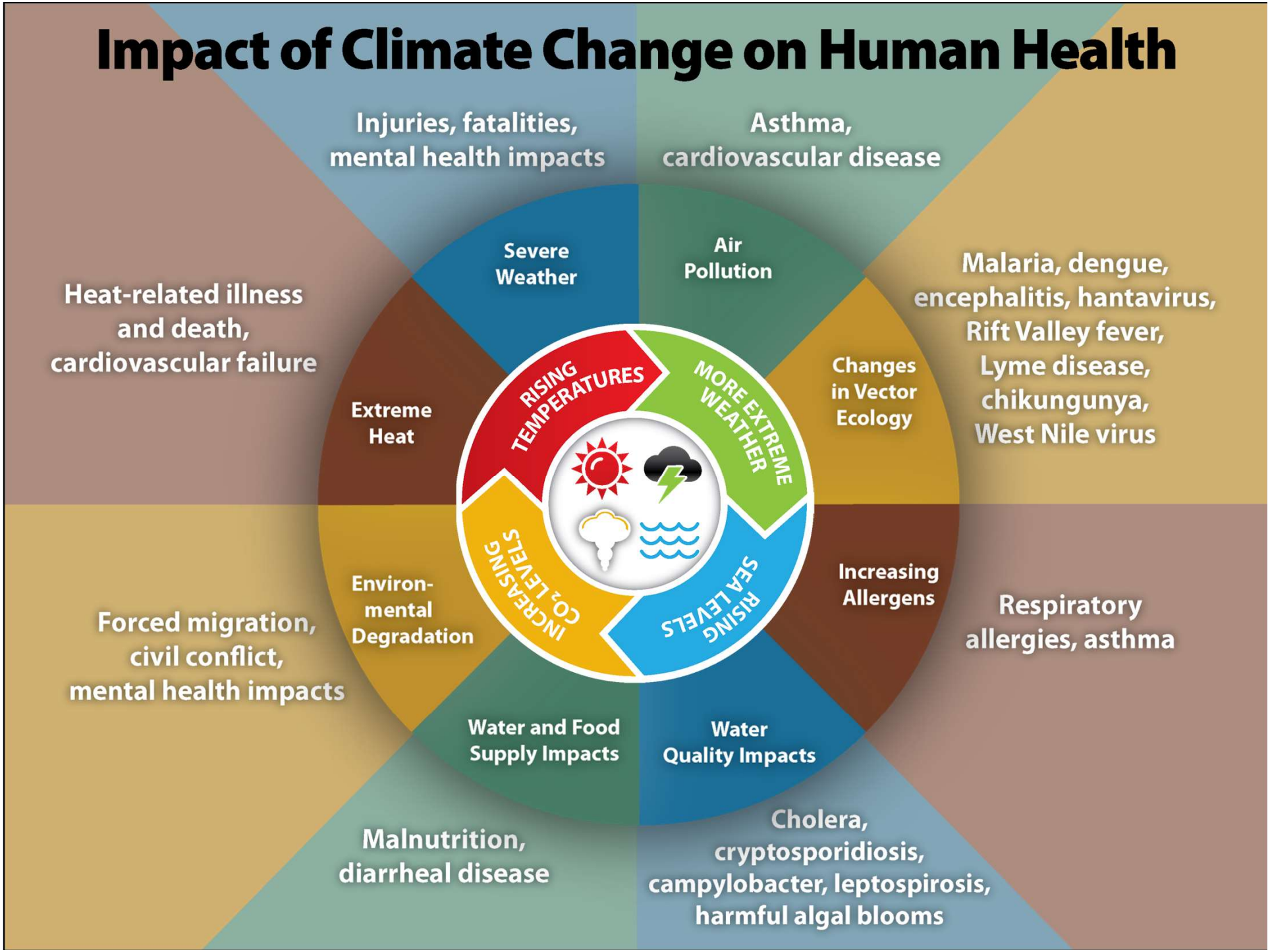
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

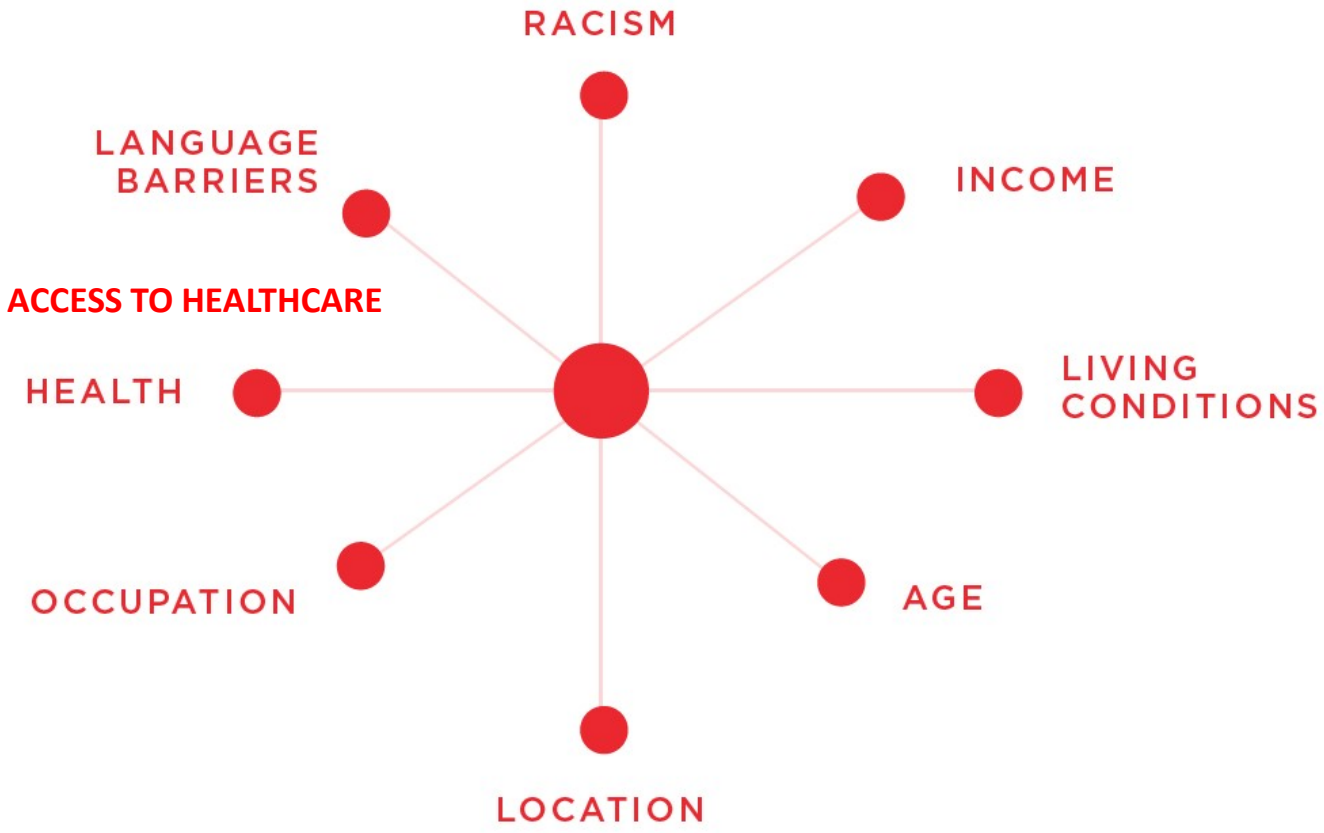
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

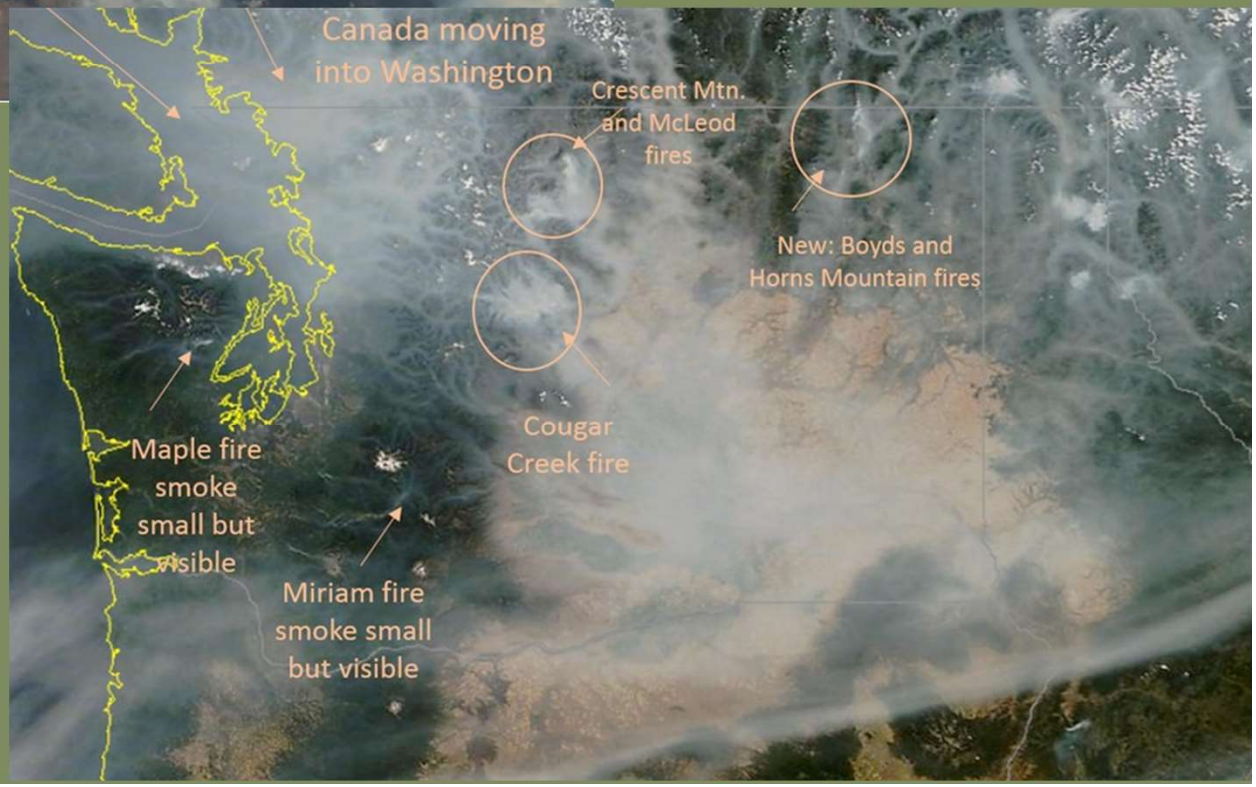
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

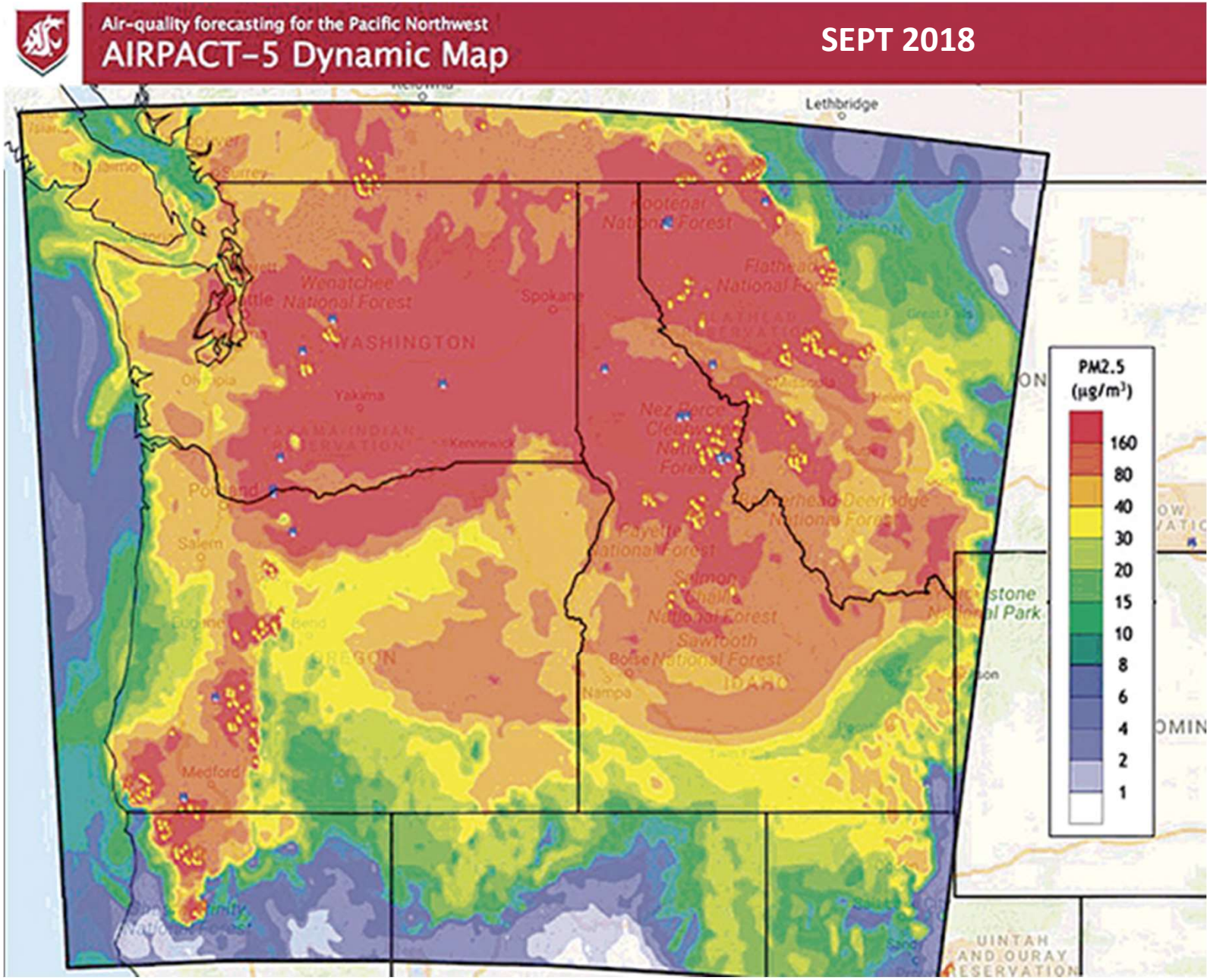
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

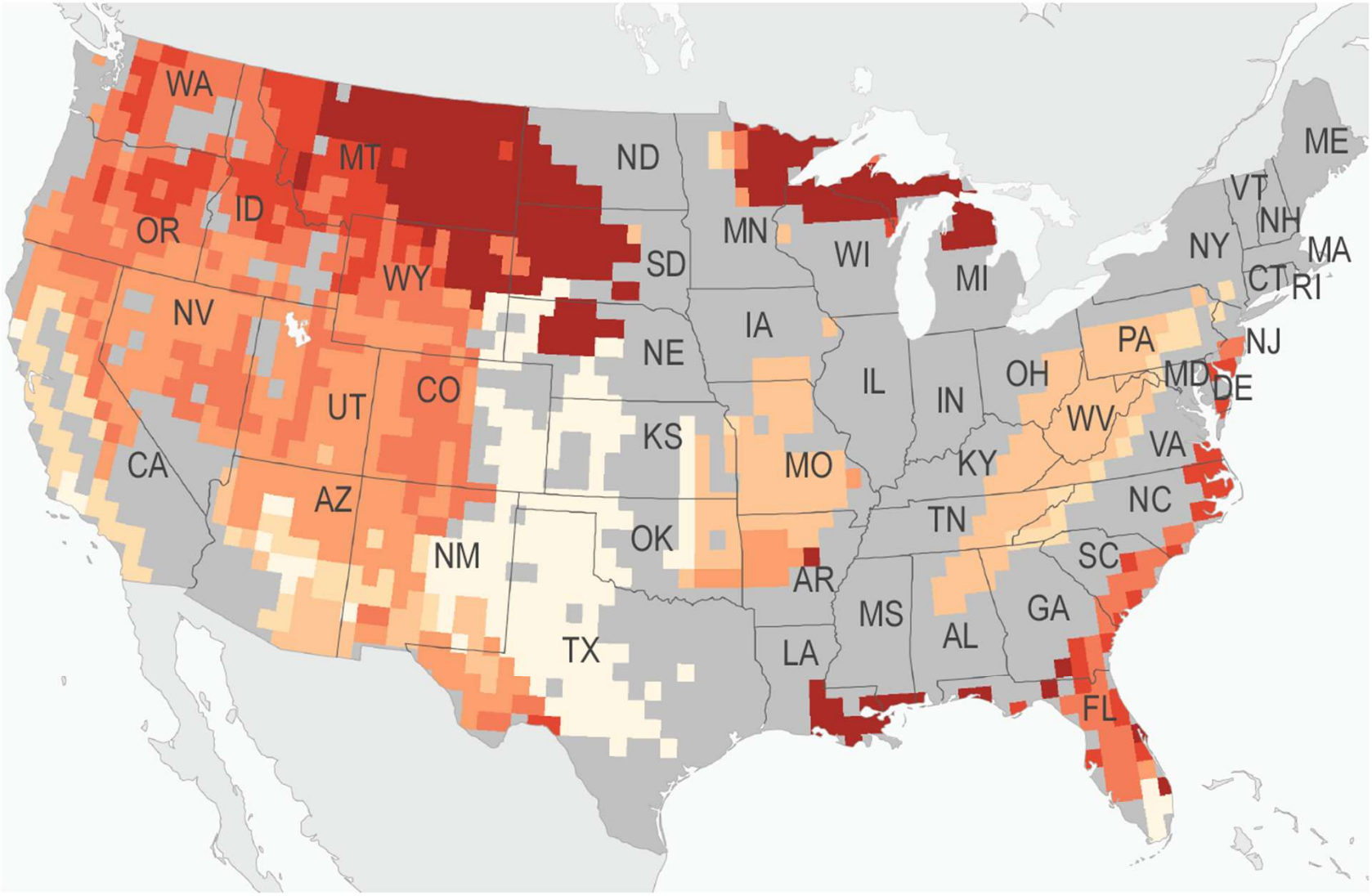
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

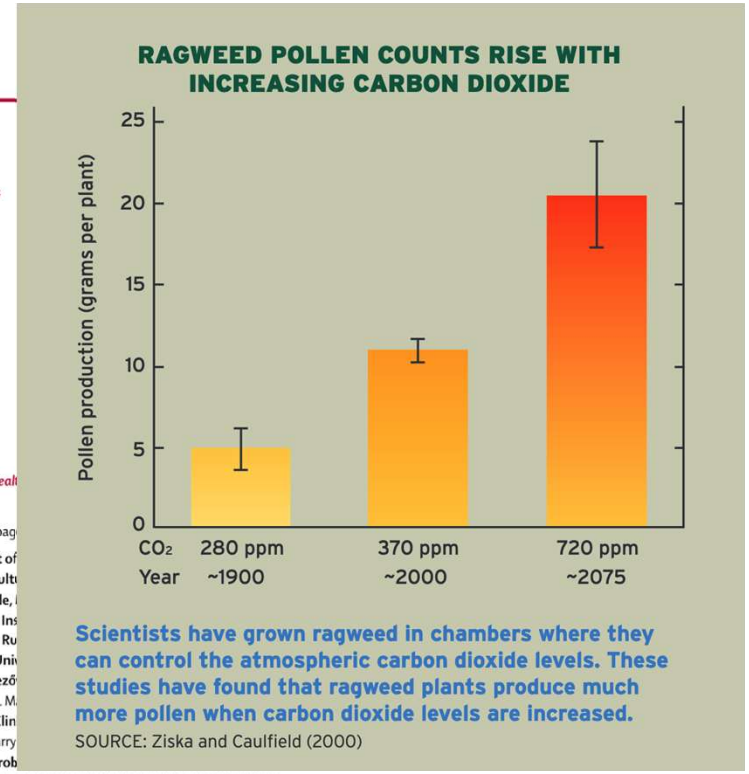
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

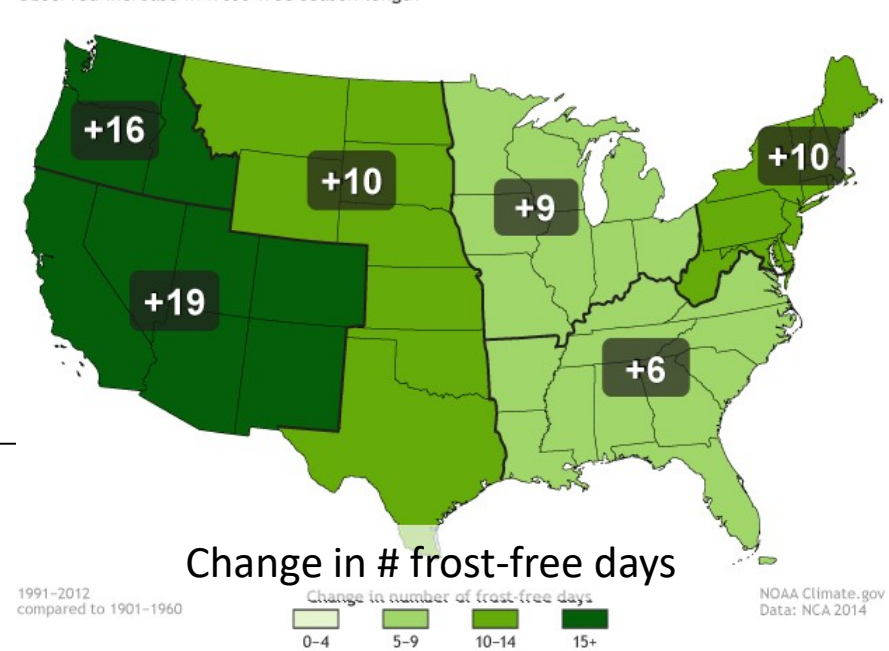
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

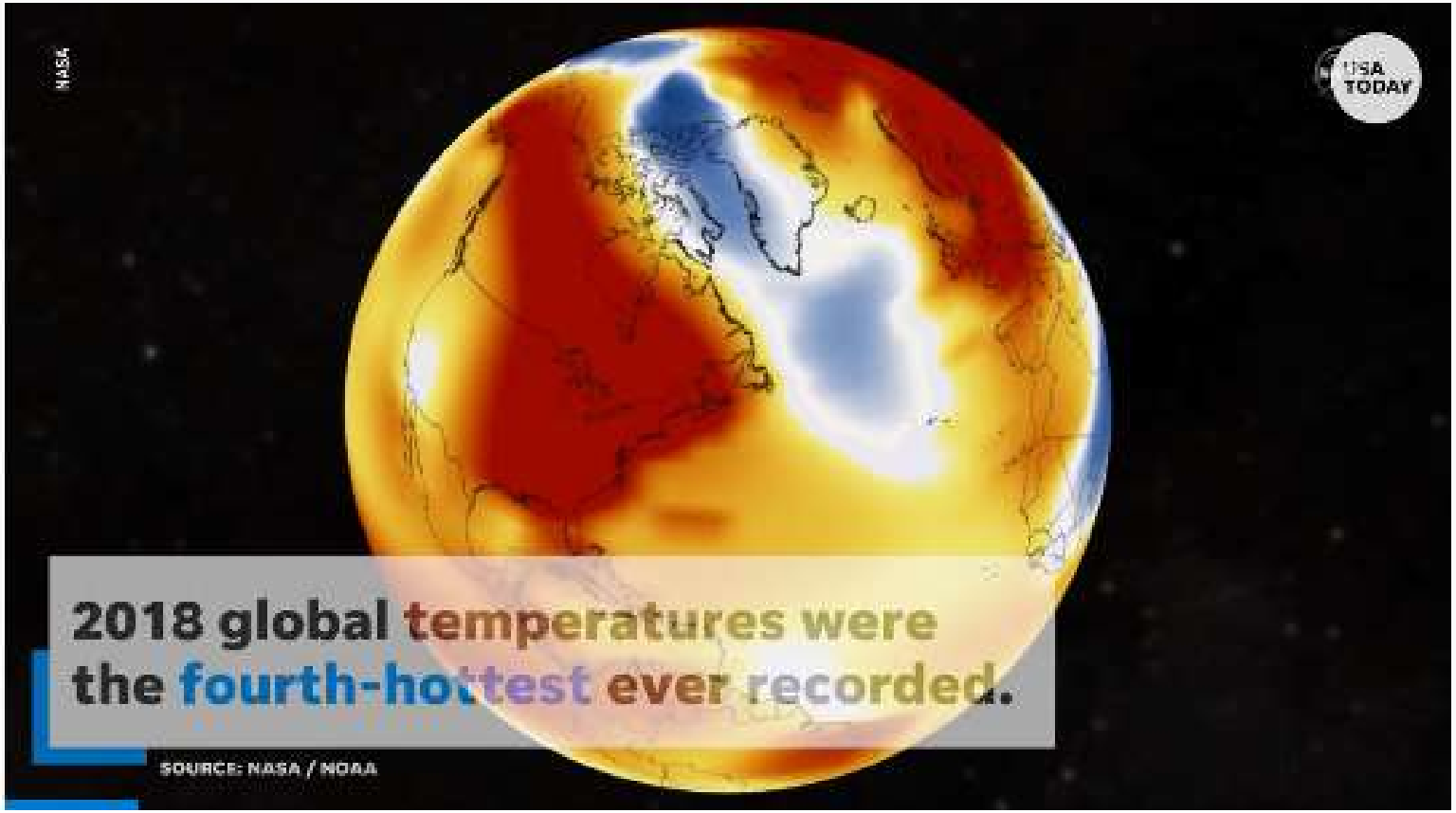
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



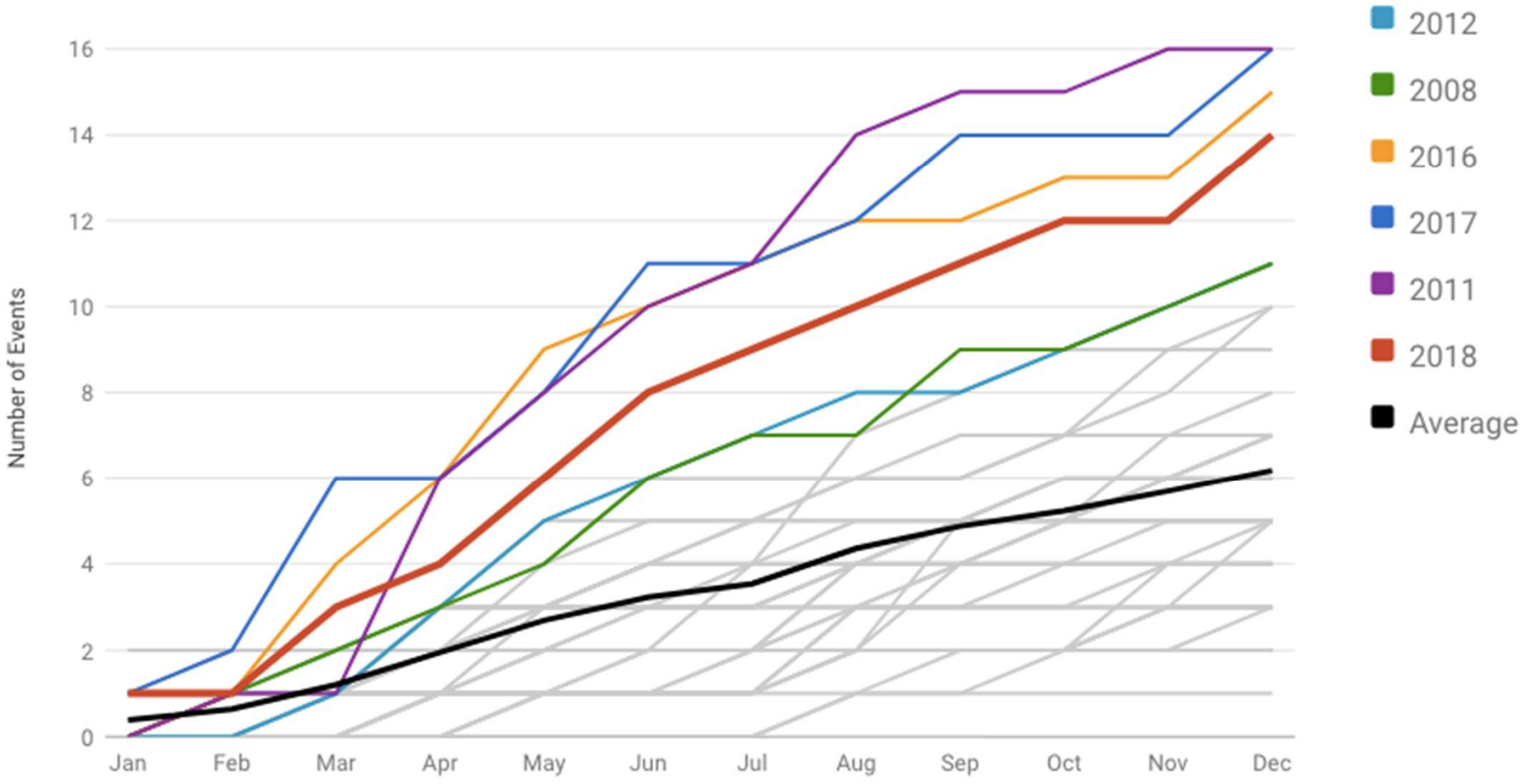
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



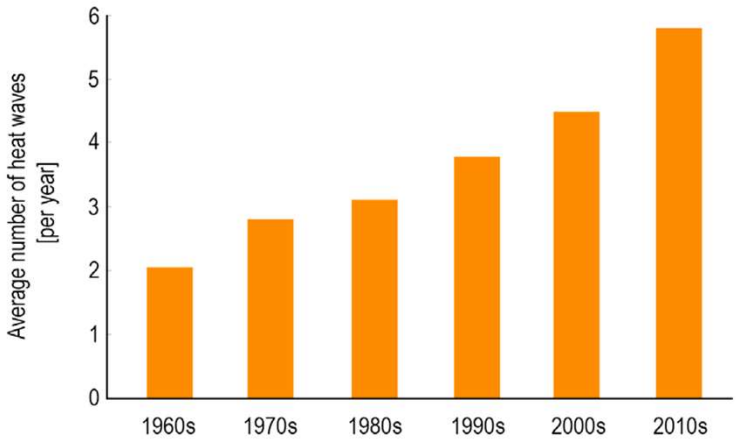
NOAA: National Centers for Environmental Information

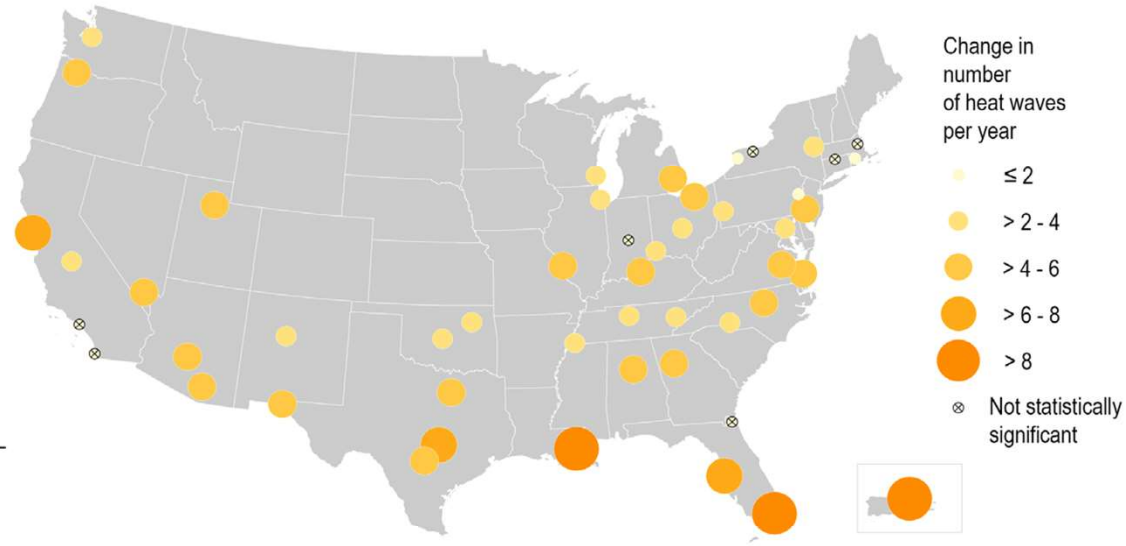
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

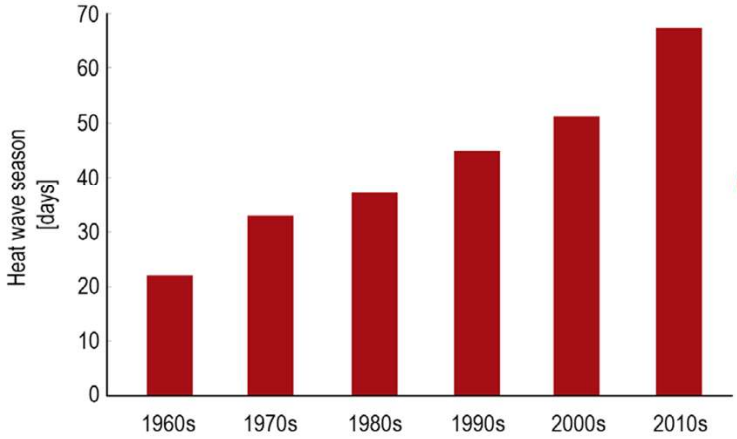
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

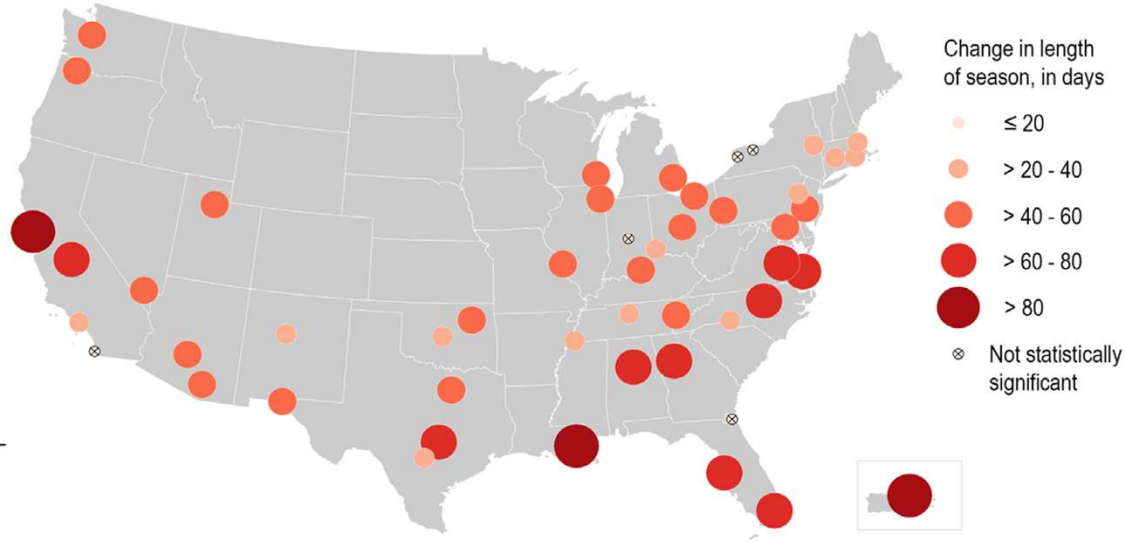
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

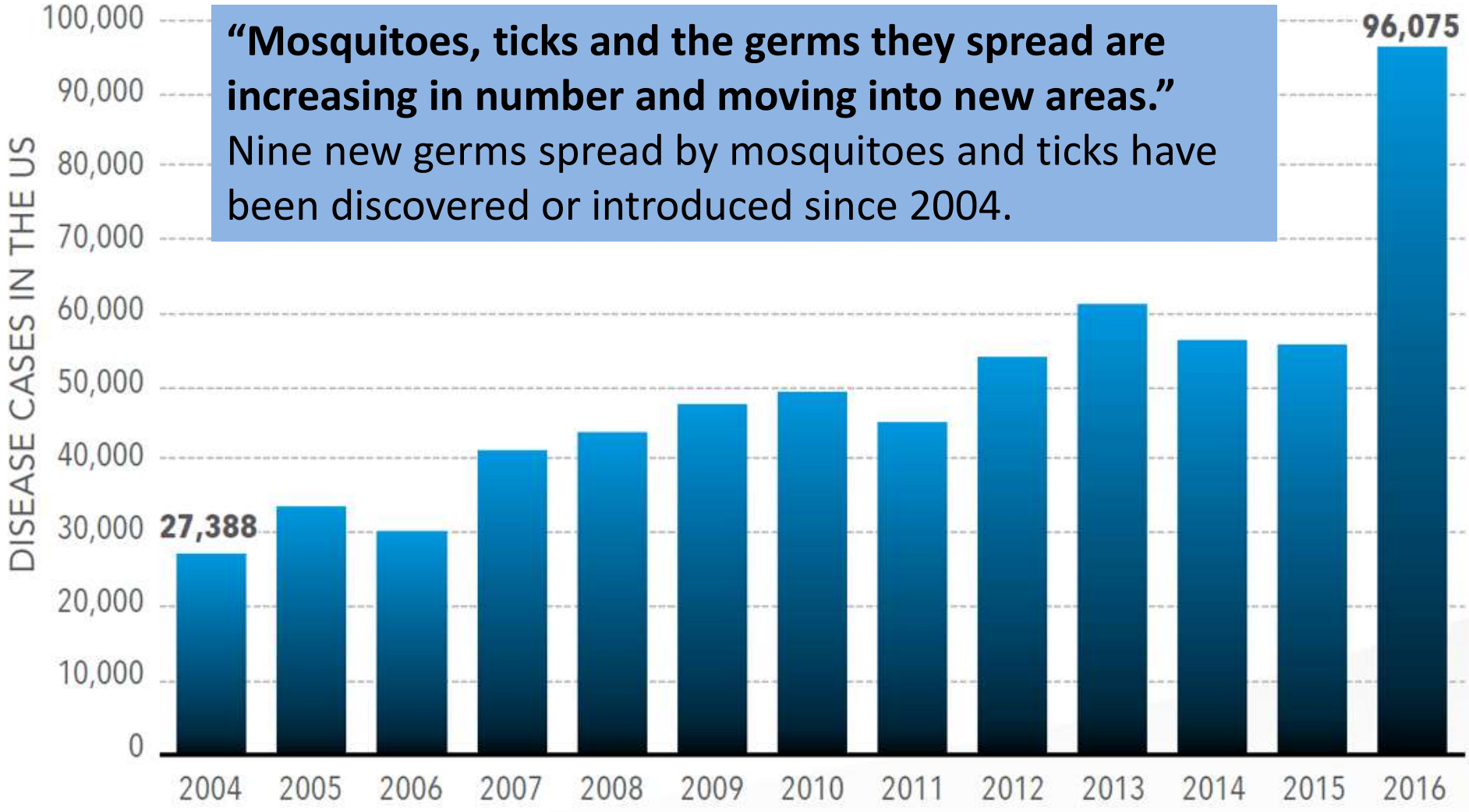
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

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PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

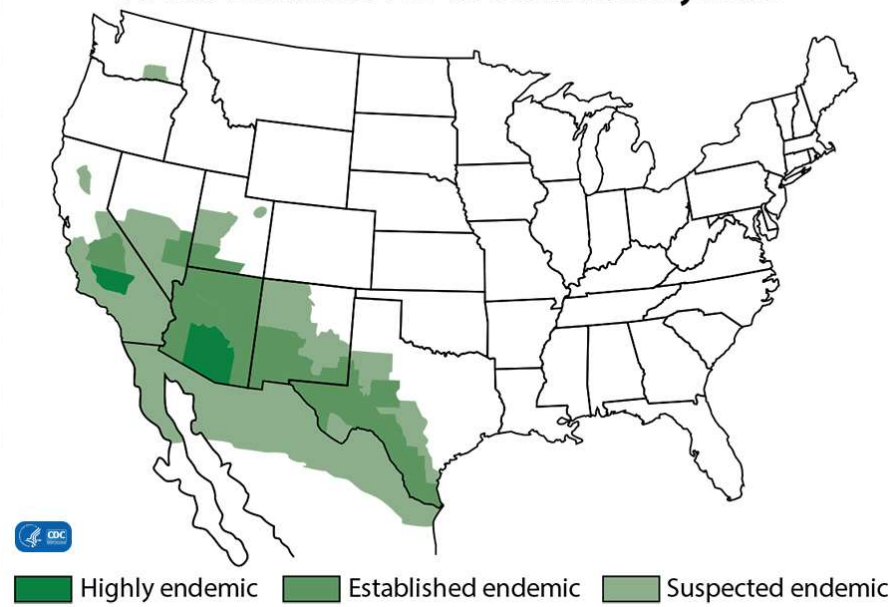
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

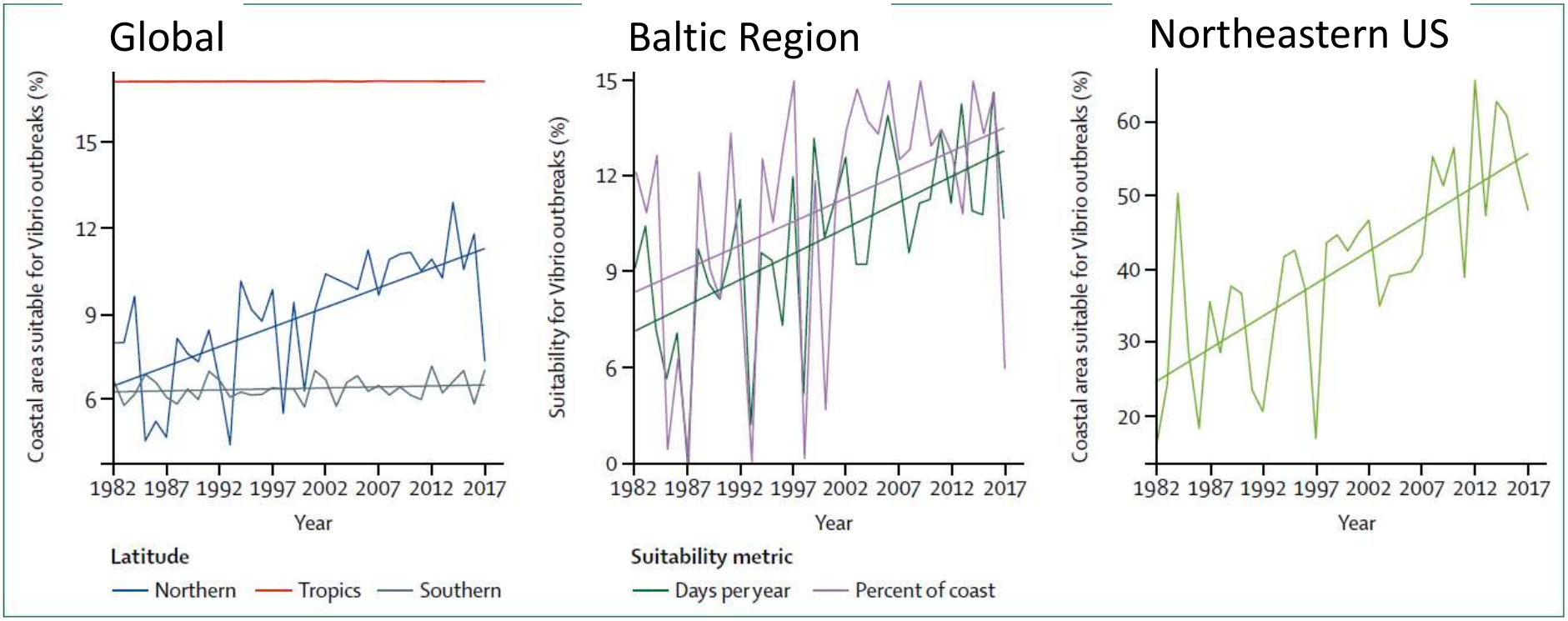
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

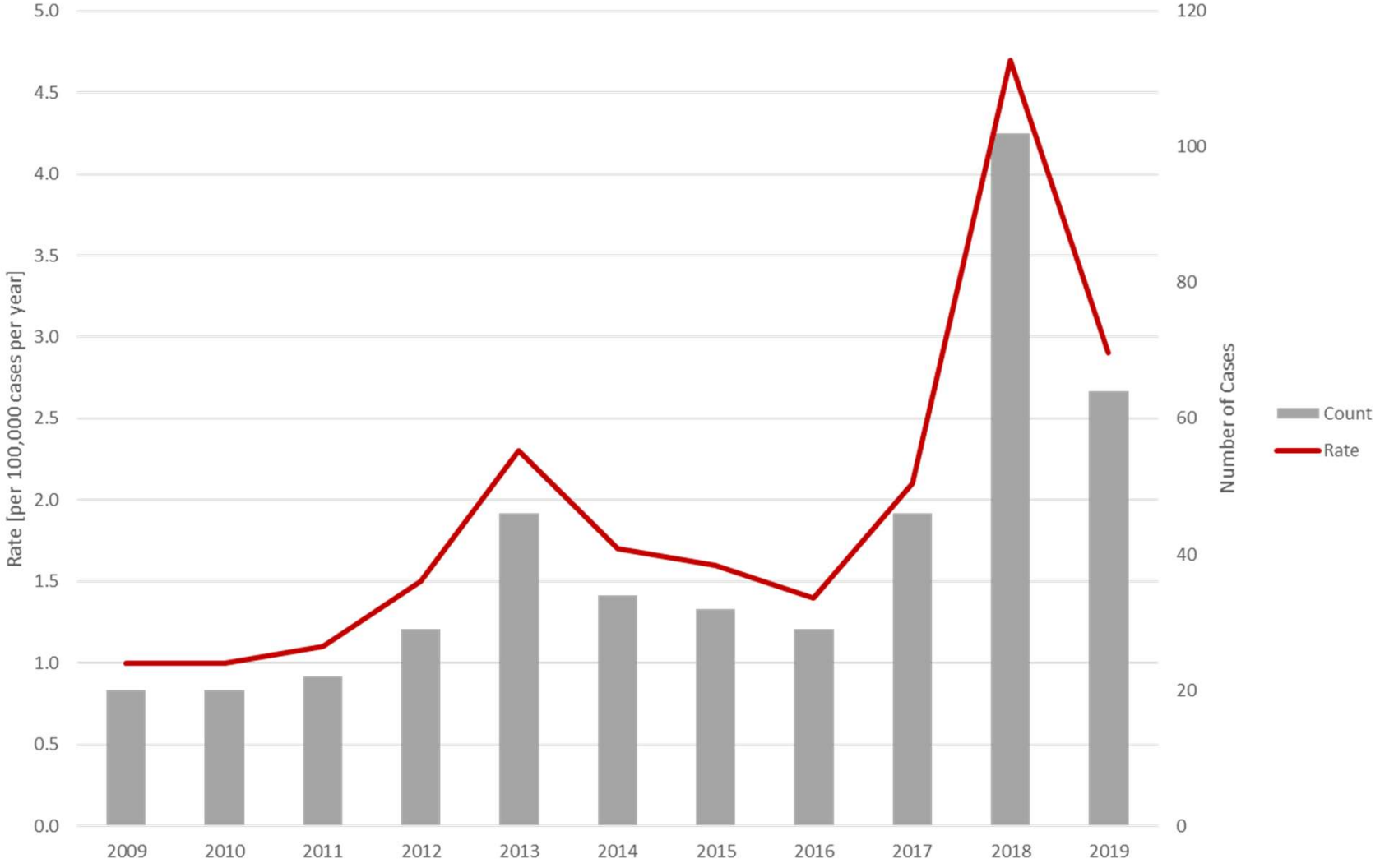
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

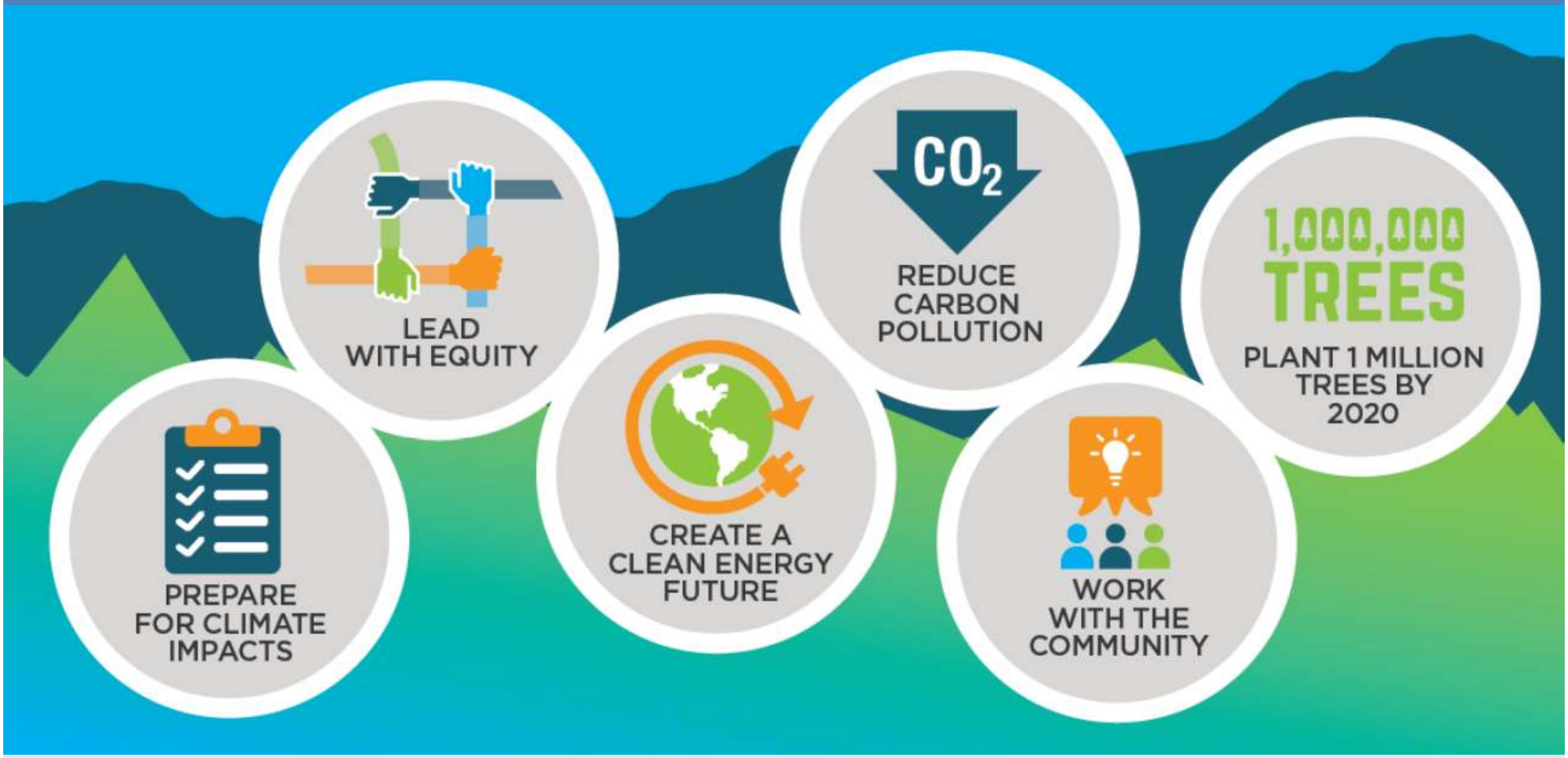
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

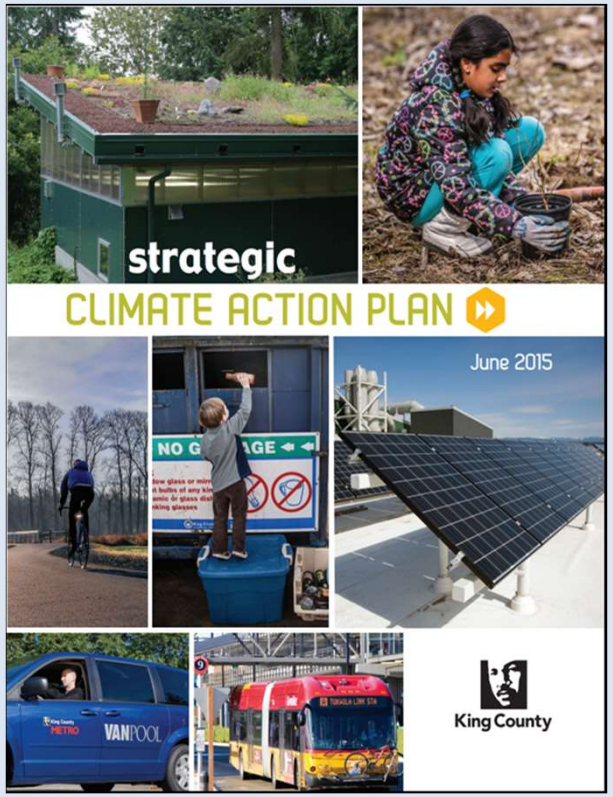


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

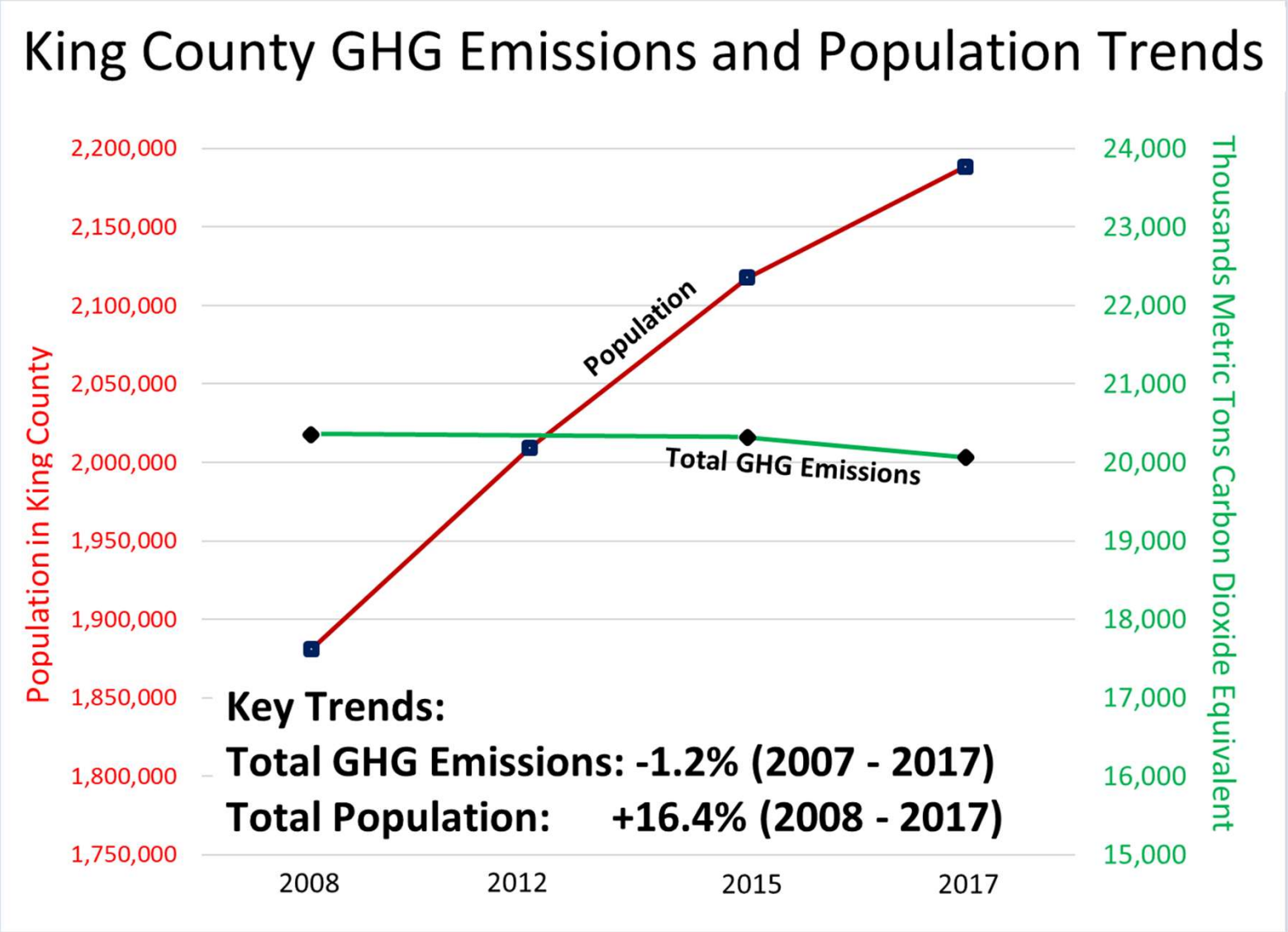
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



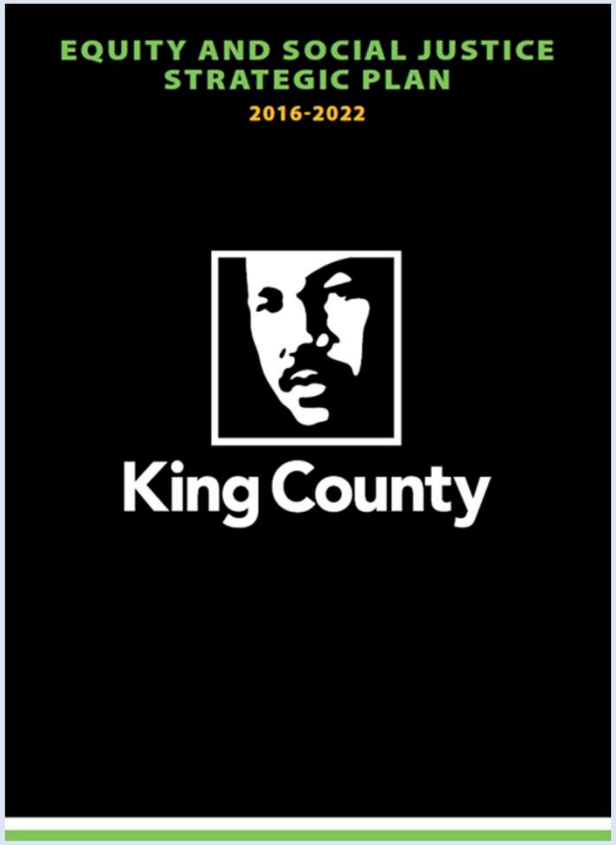
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

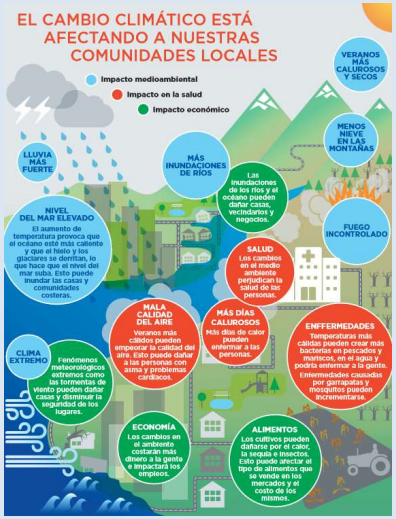
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

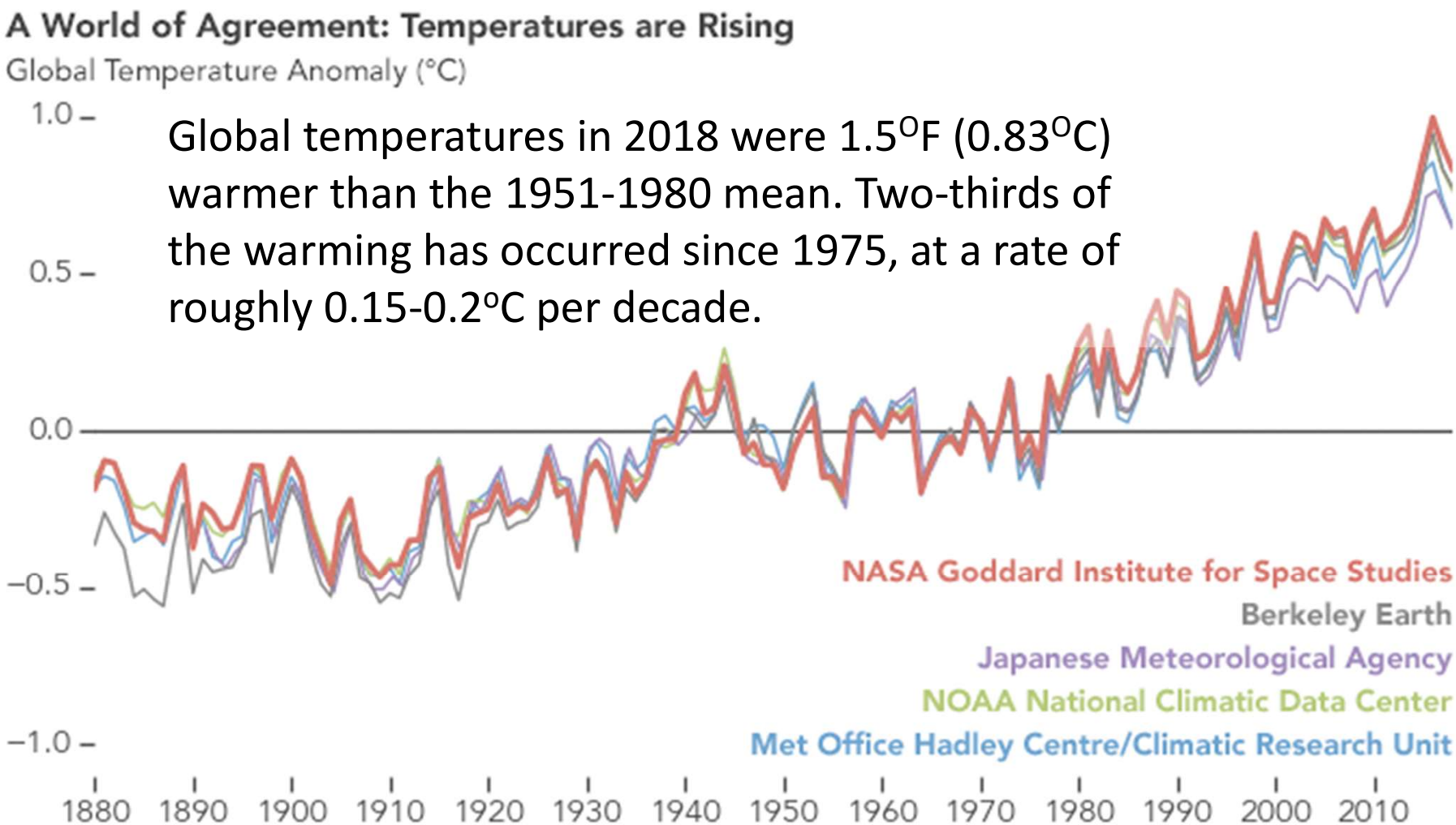
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

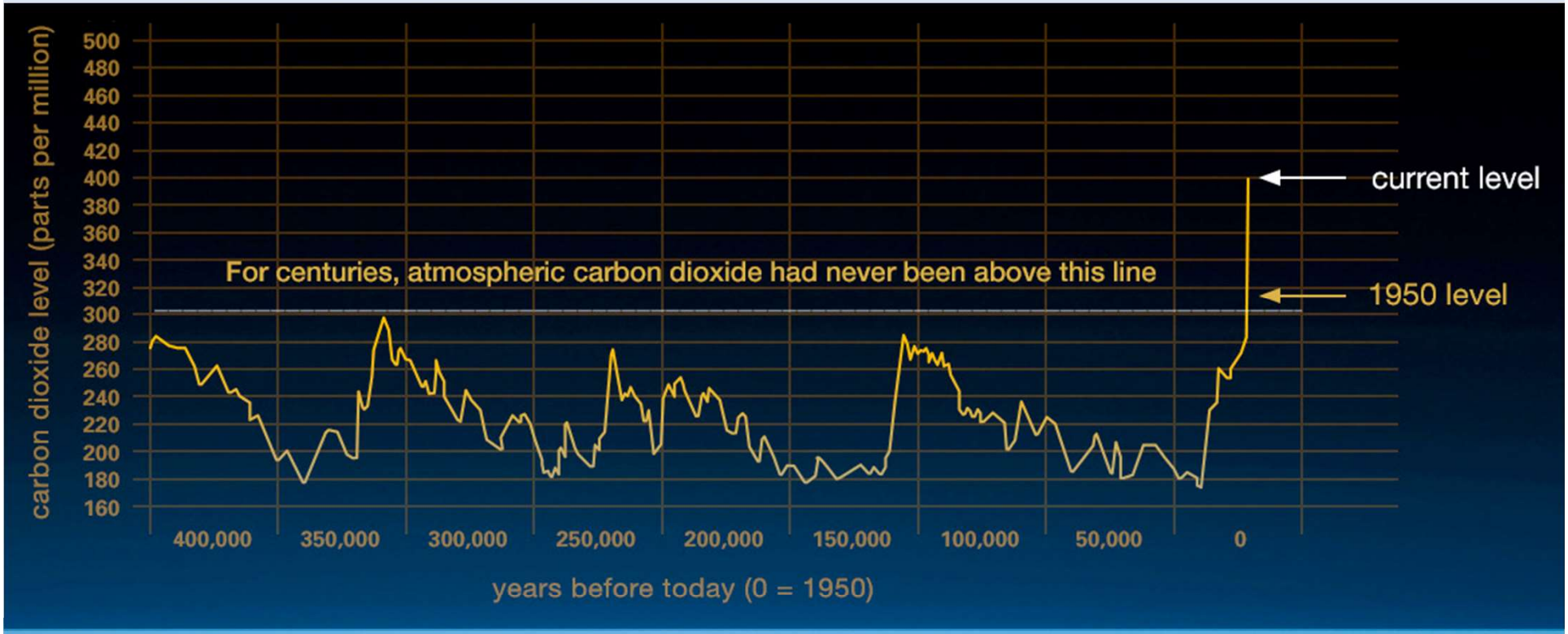


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

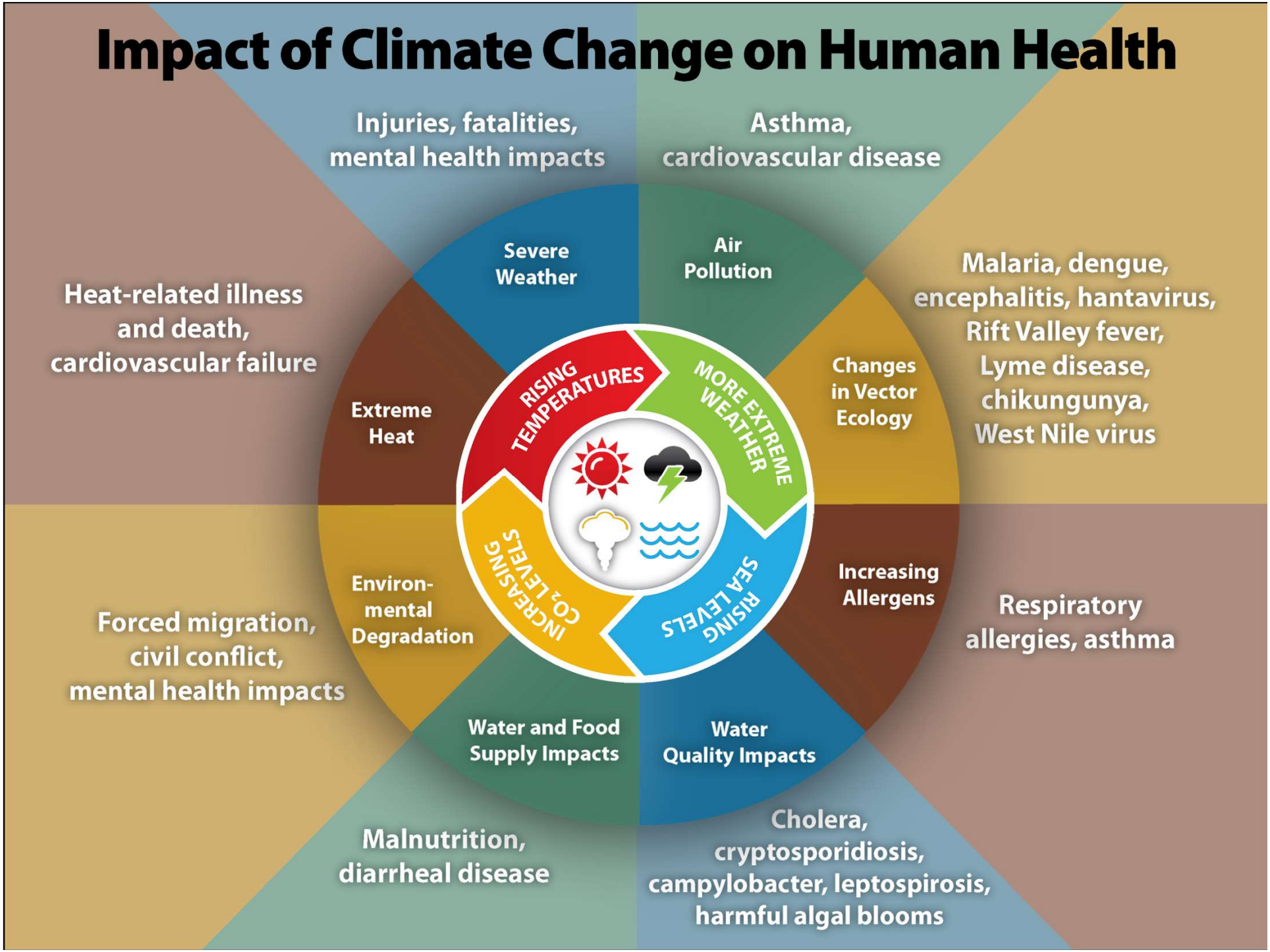
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

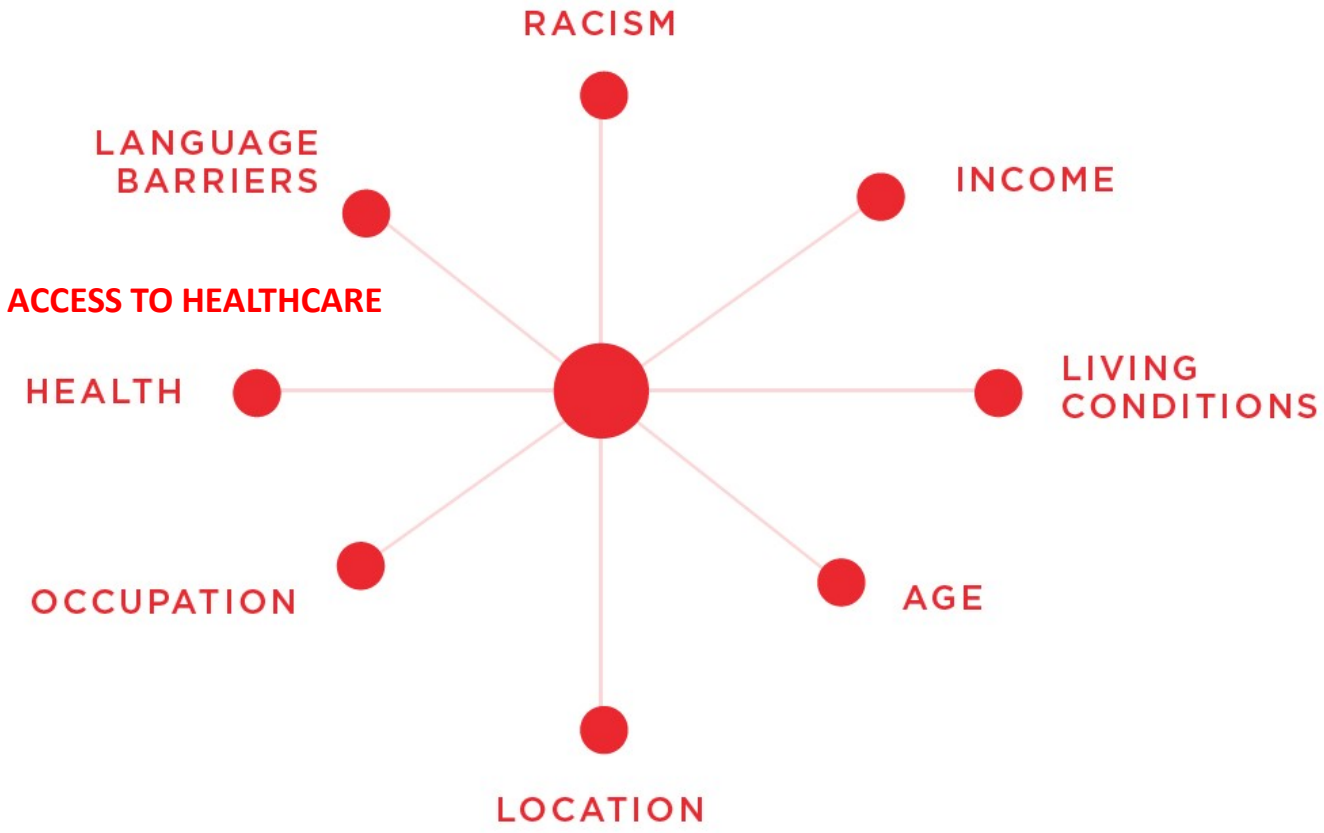
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

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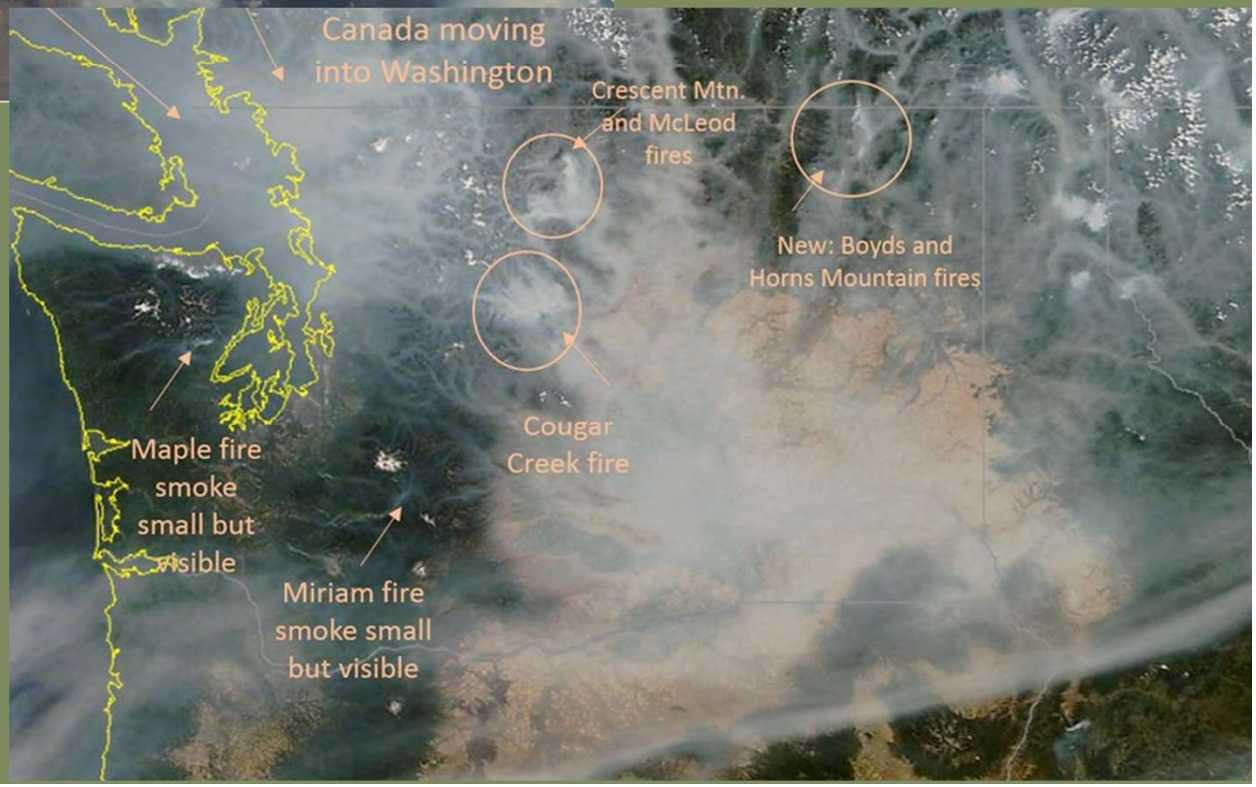
Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

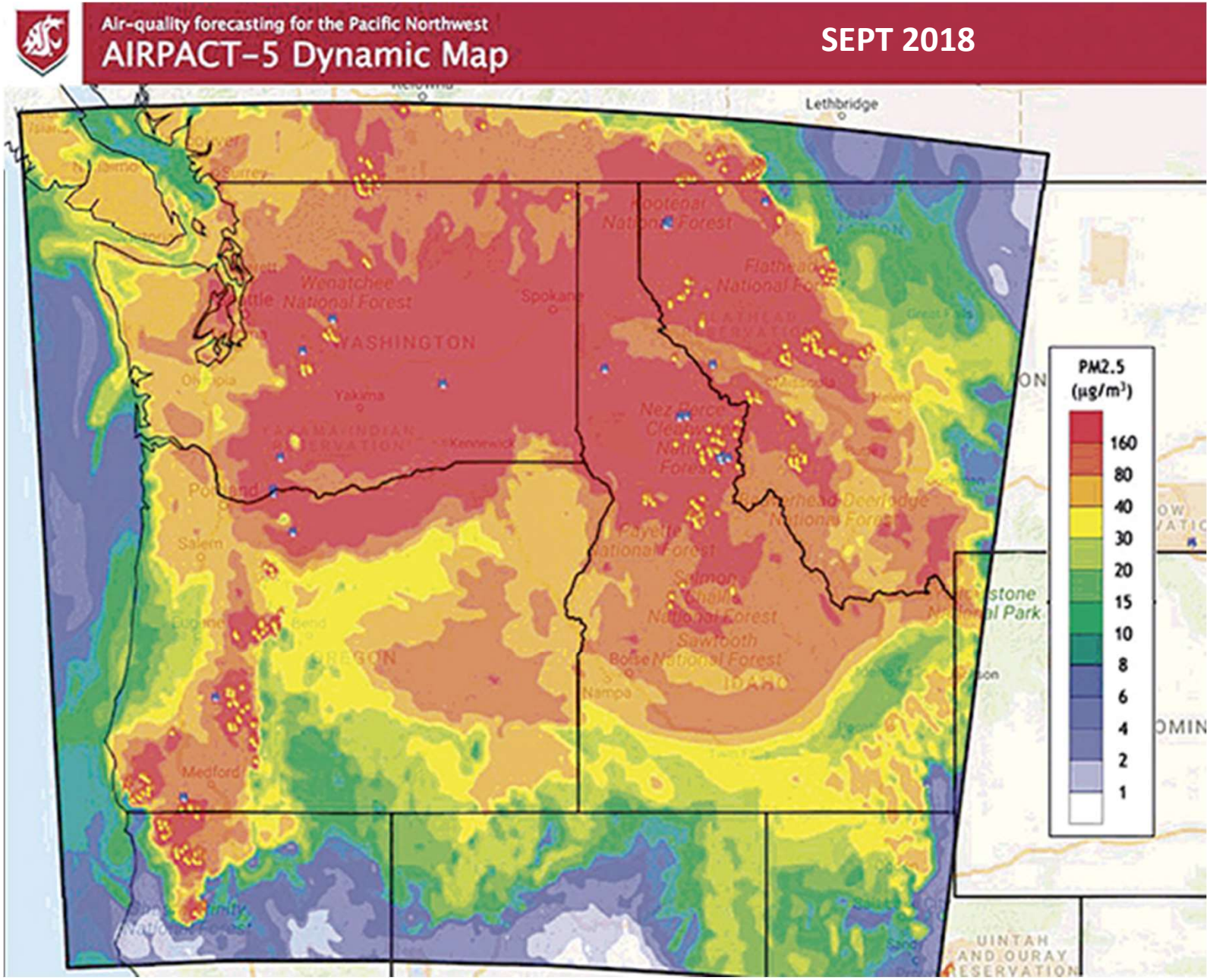
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

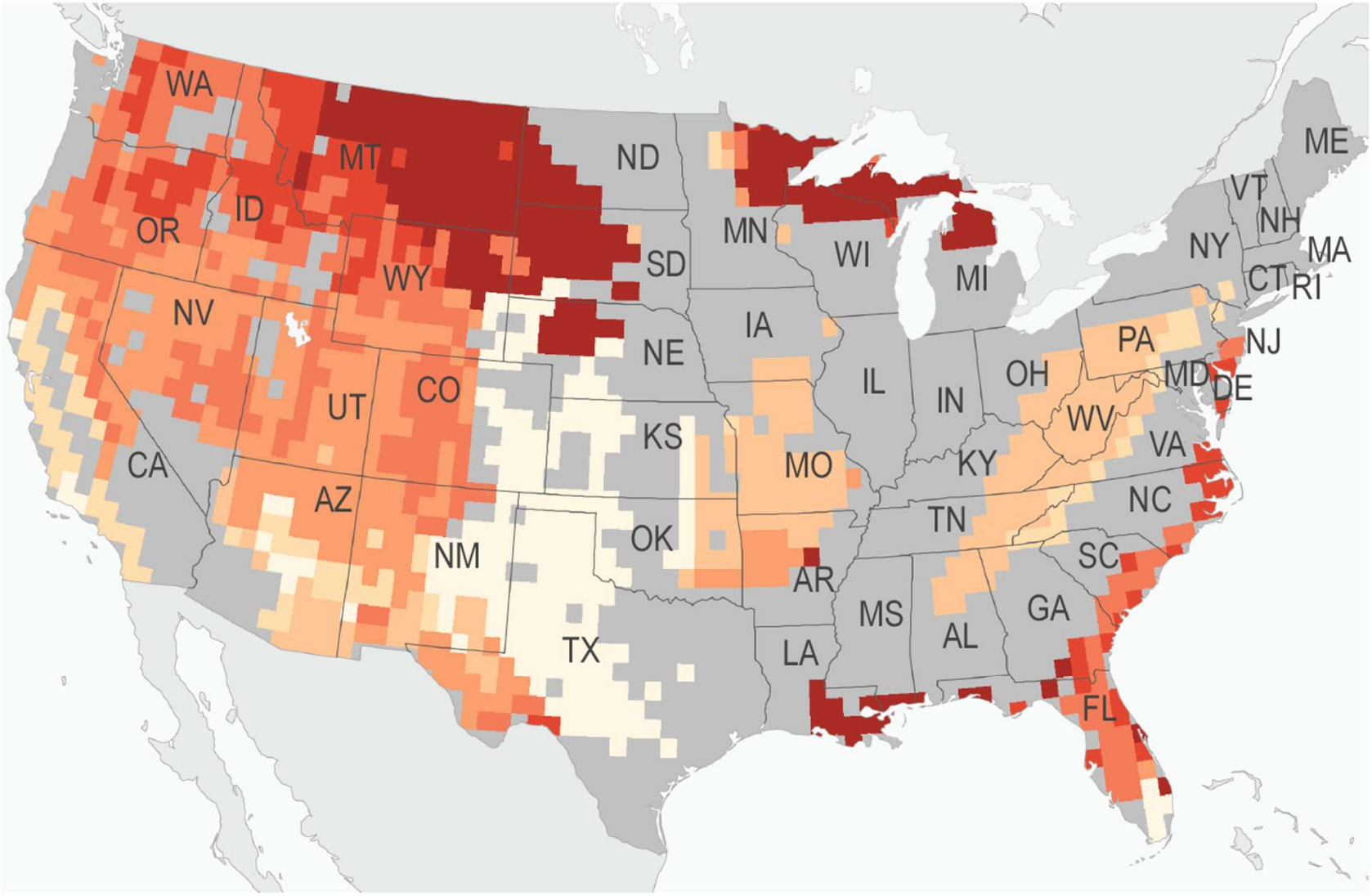
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

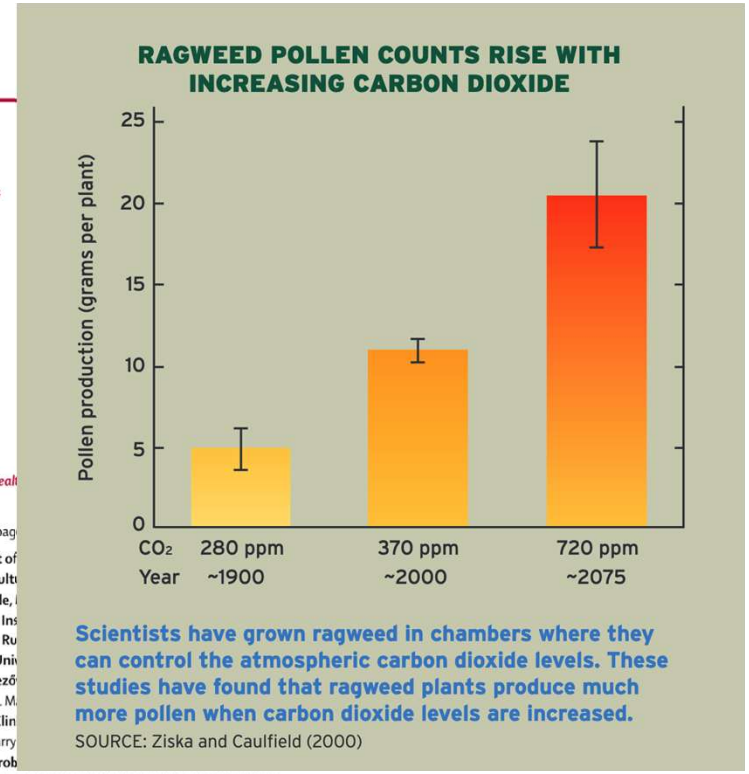
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

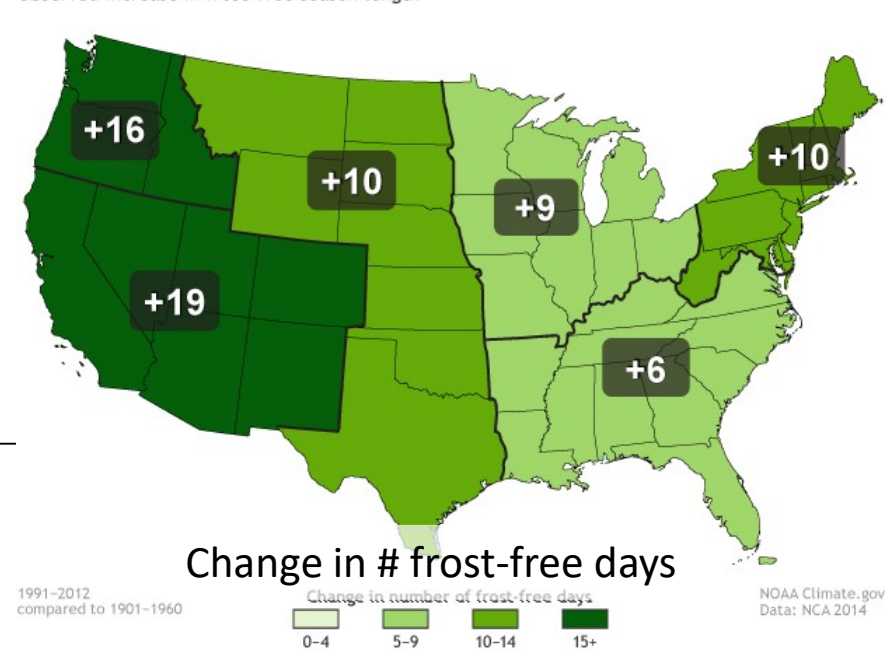
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

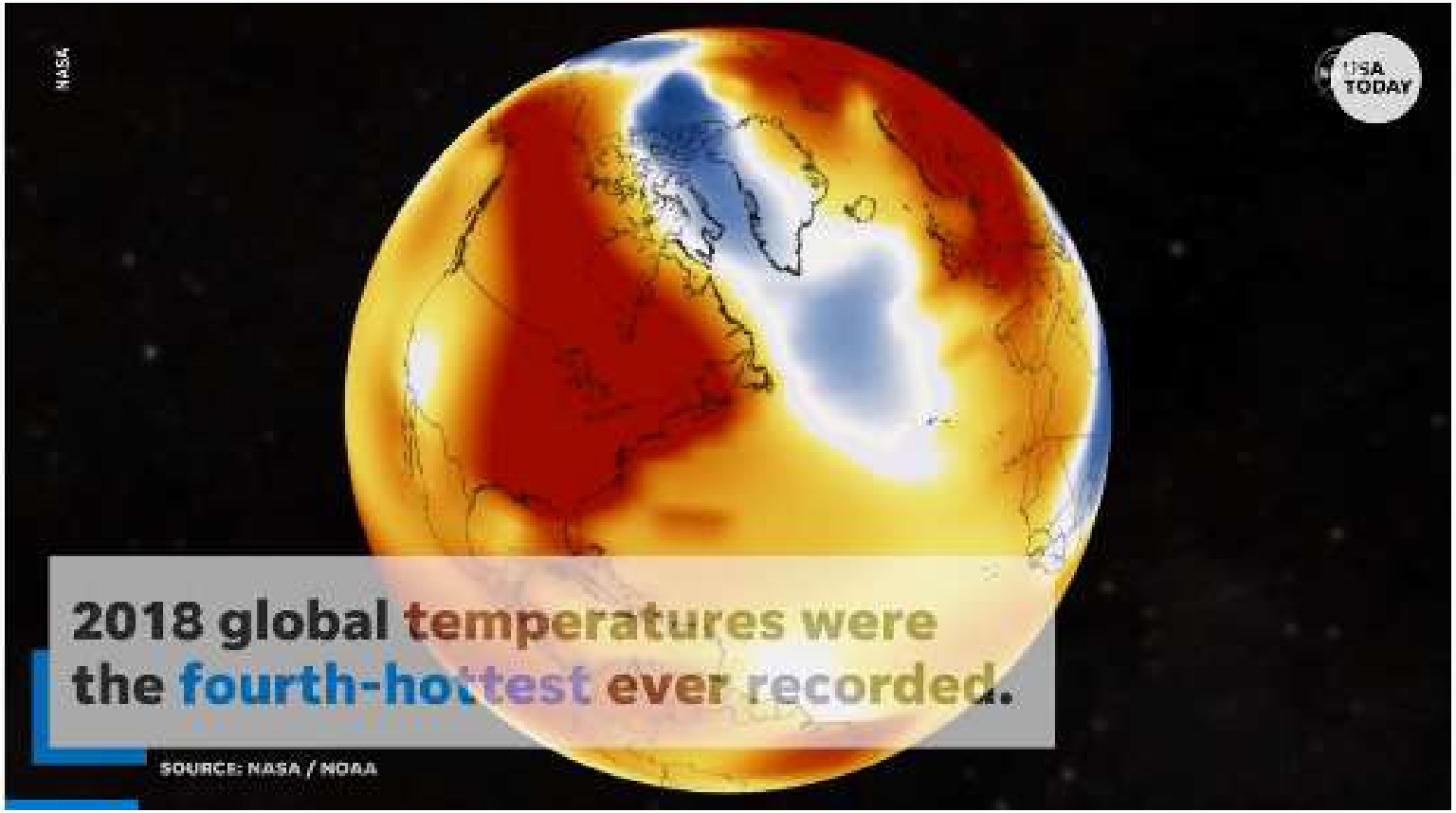
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



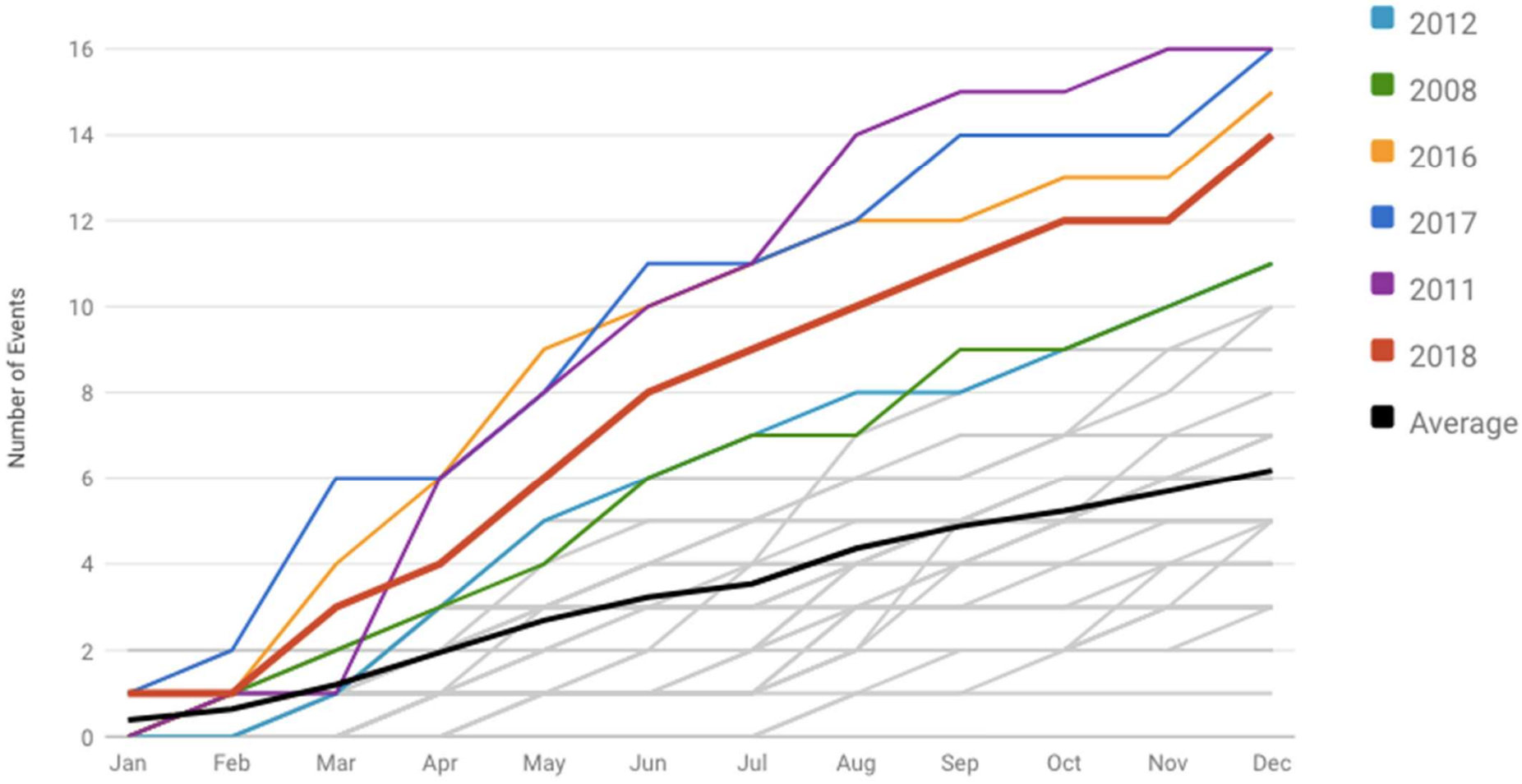
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



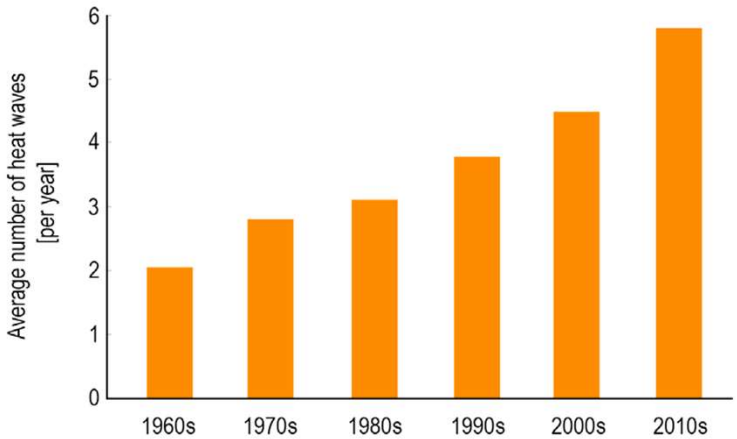
NOAA: National Centers for Environmental Information

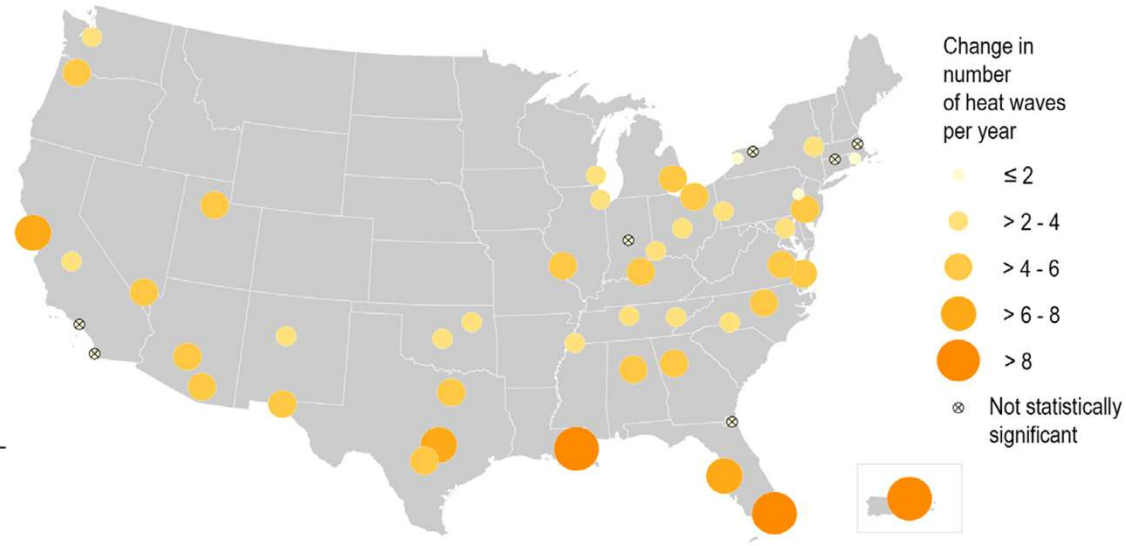
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

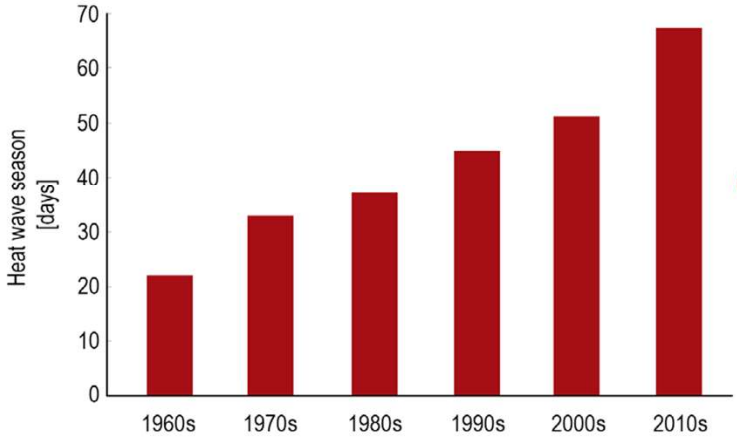
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

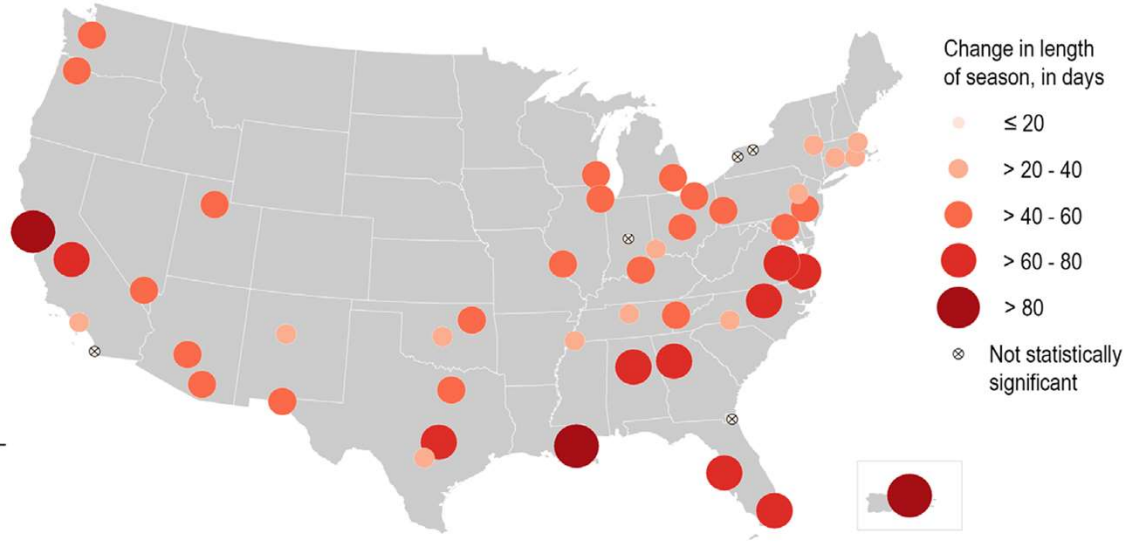
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

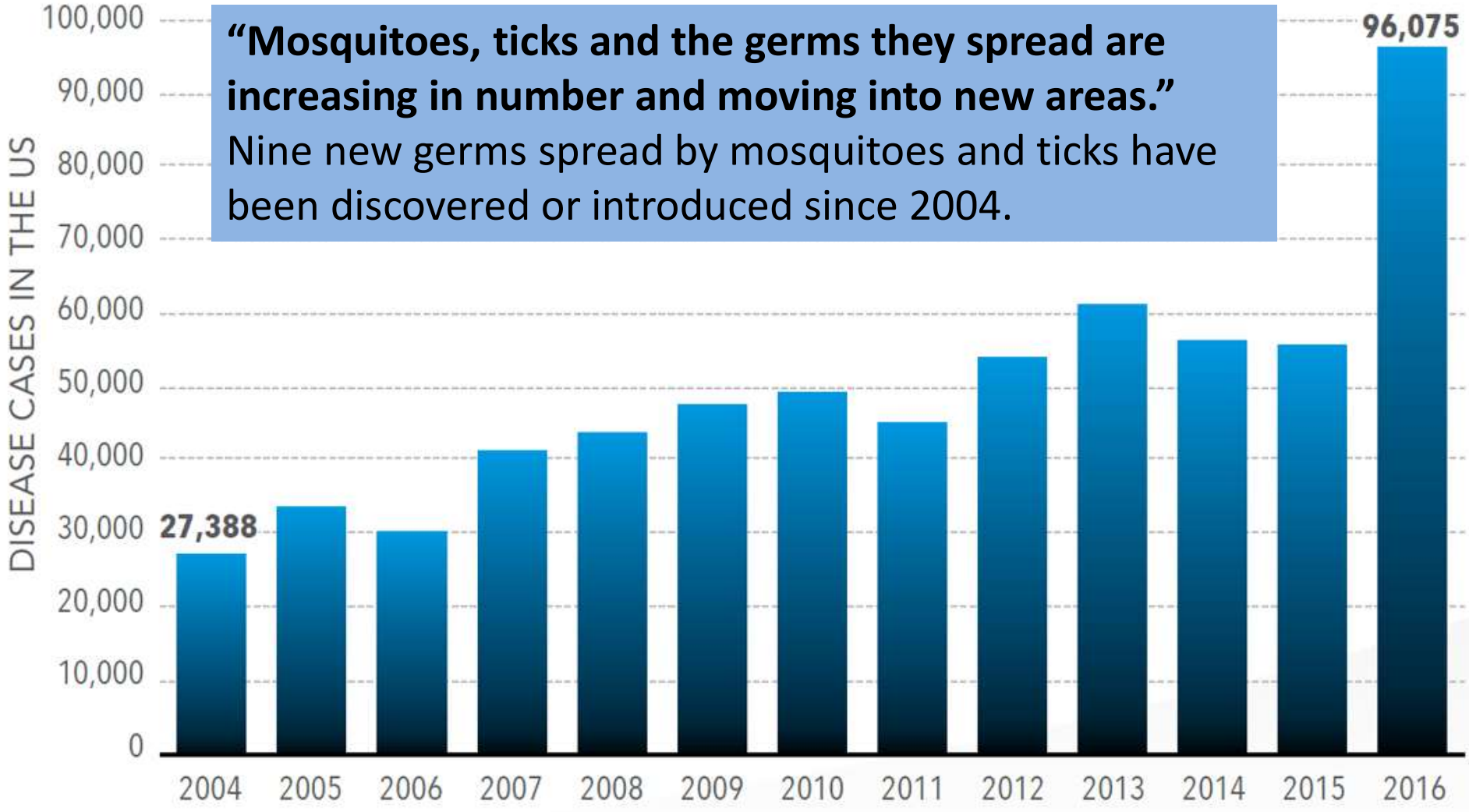
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

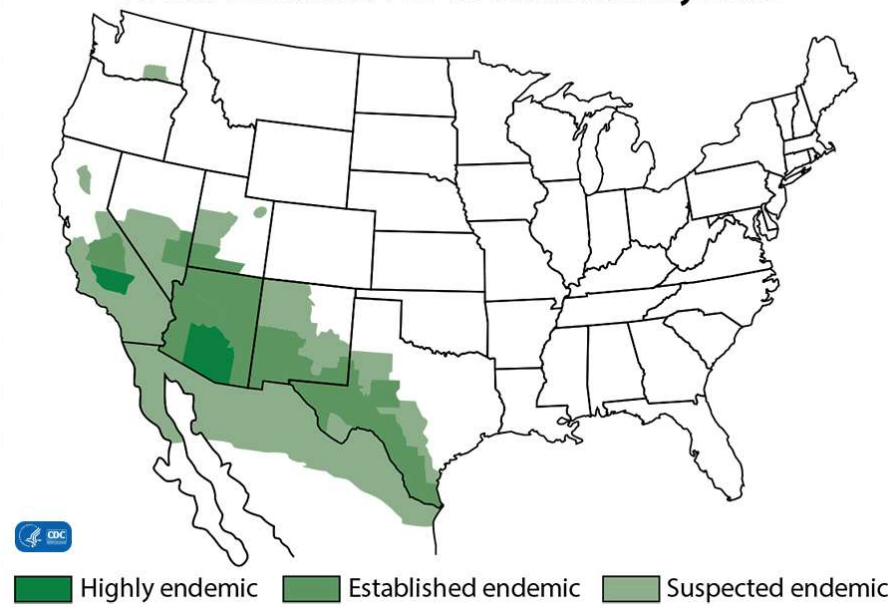
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

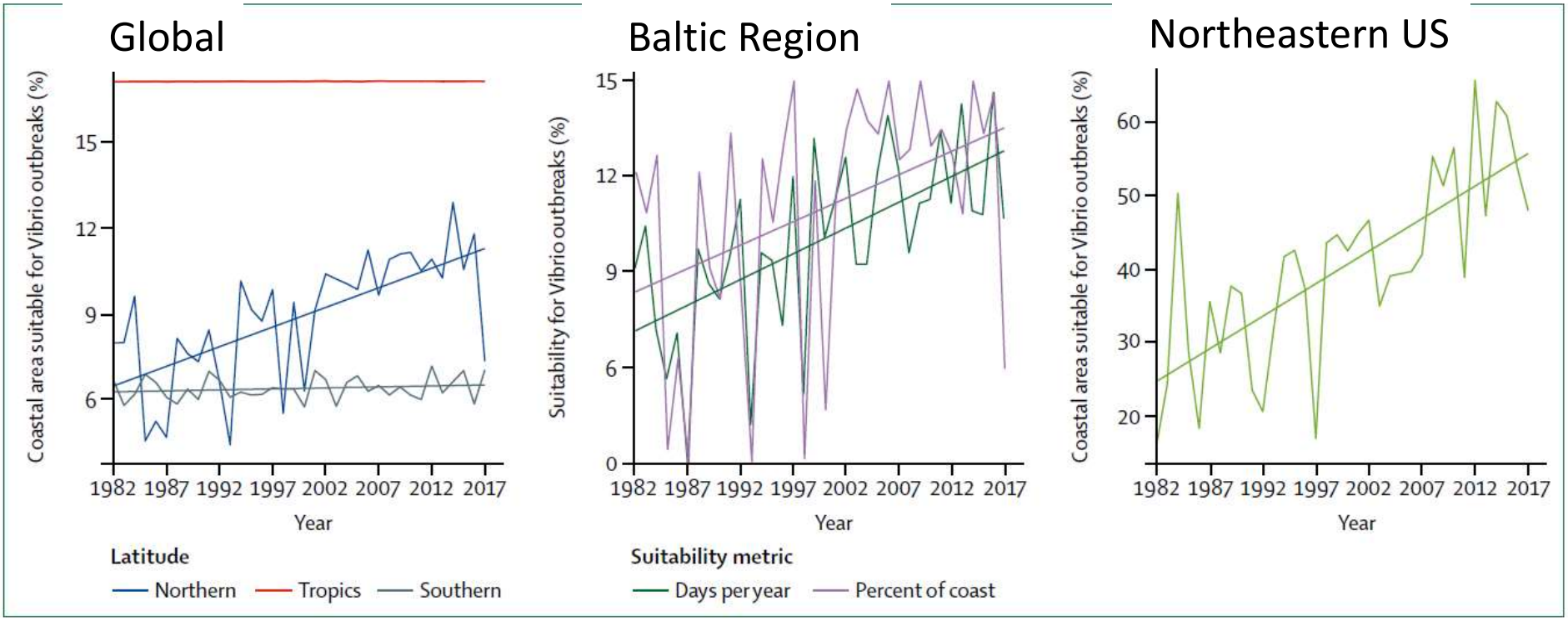
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

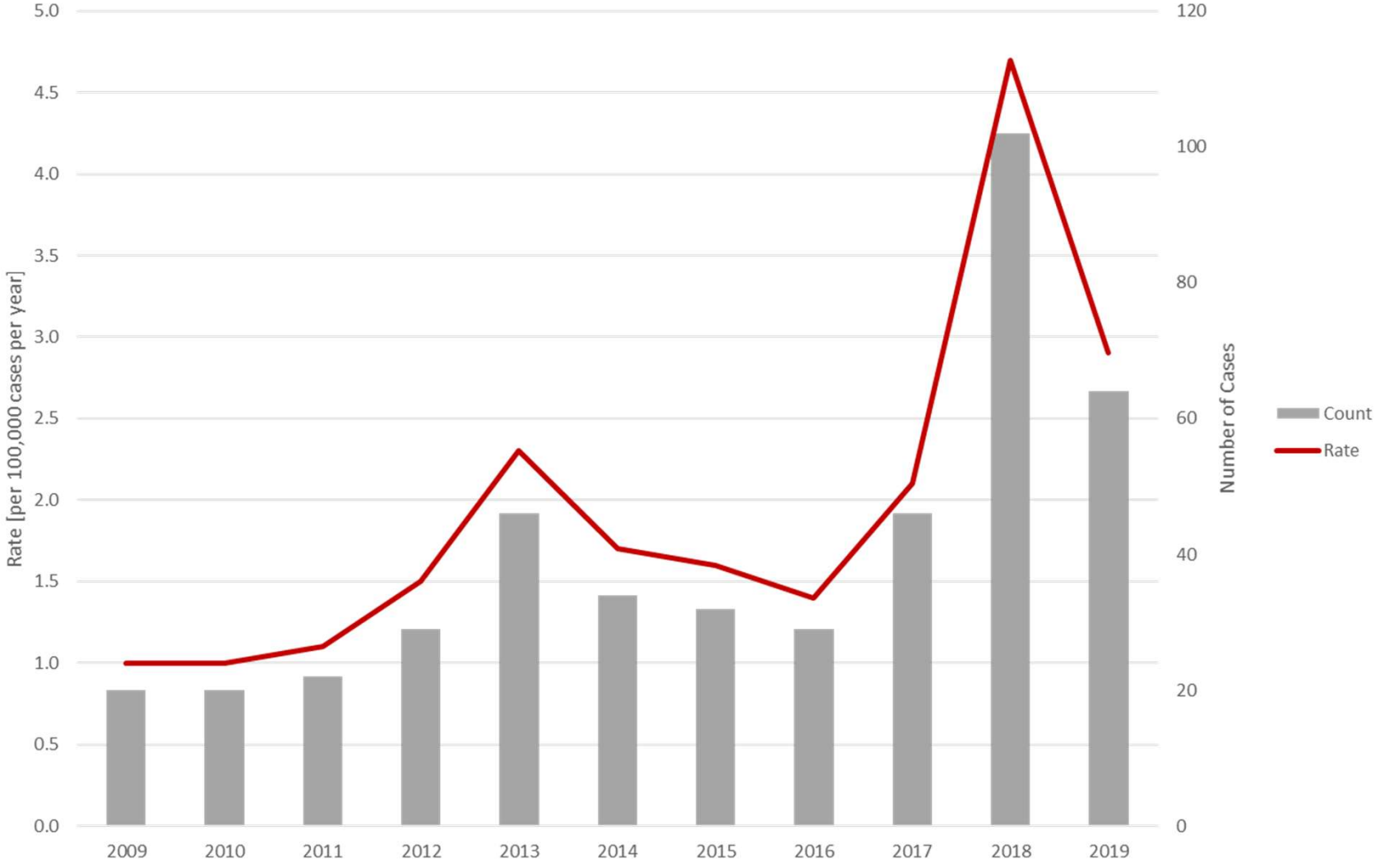
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

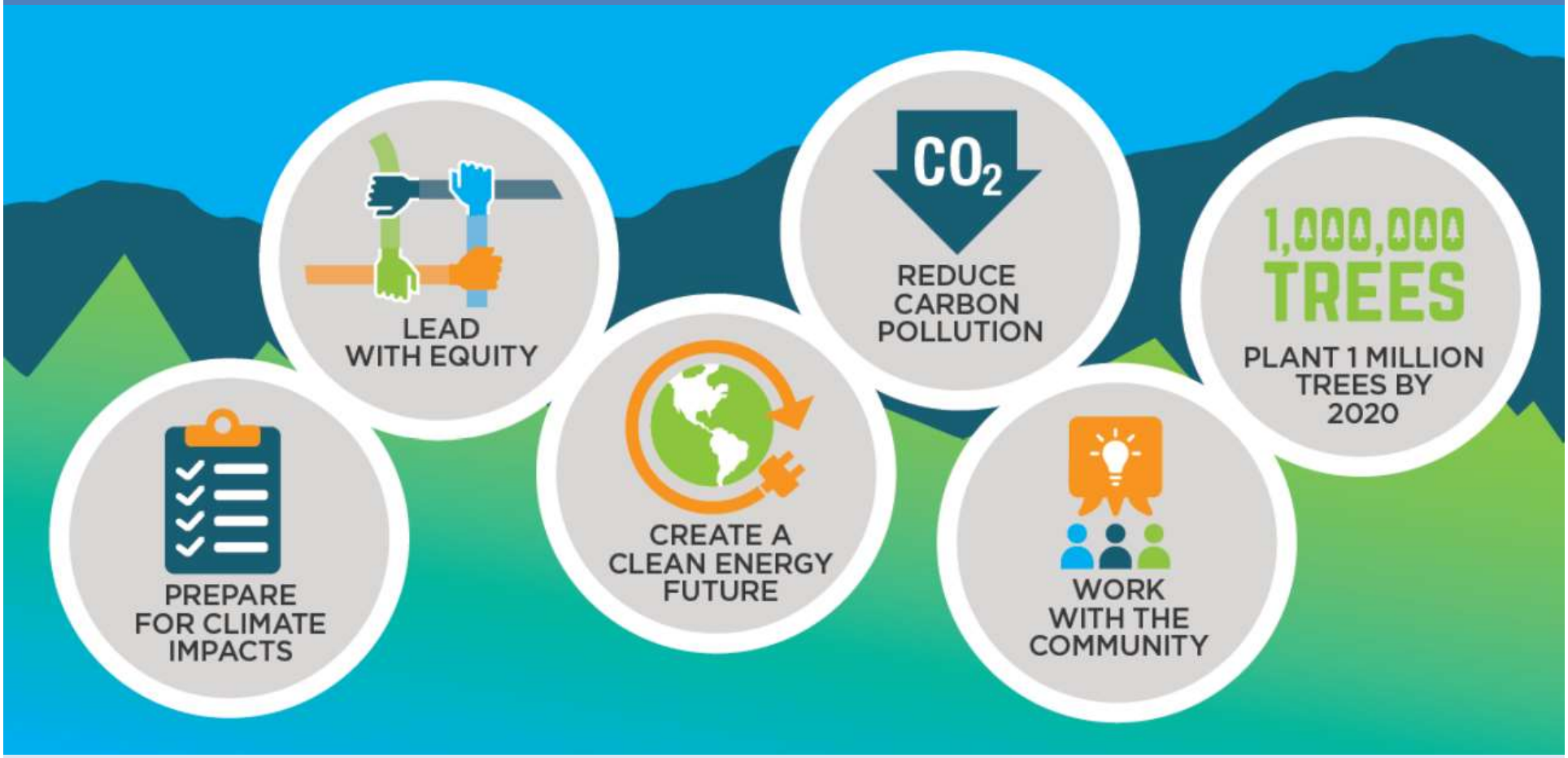
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

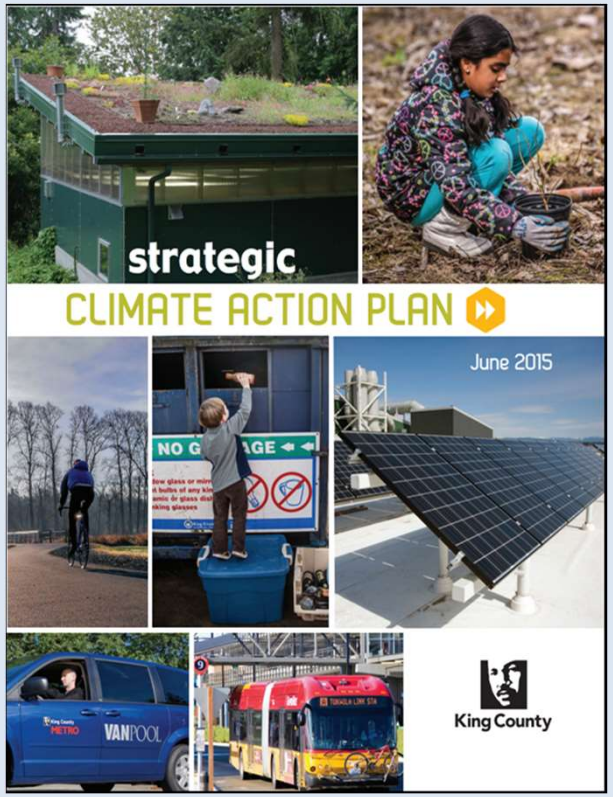


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

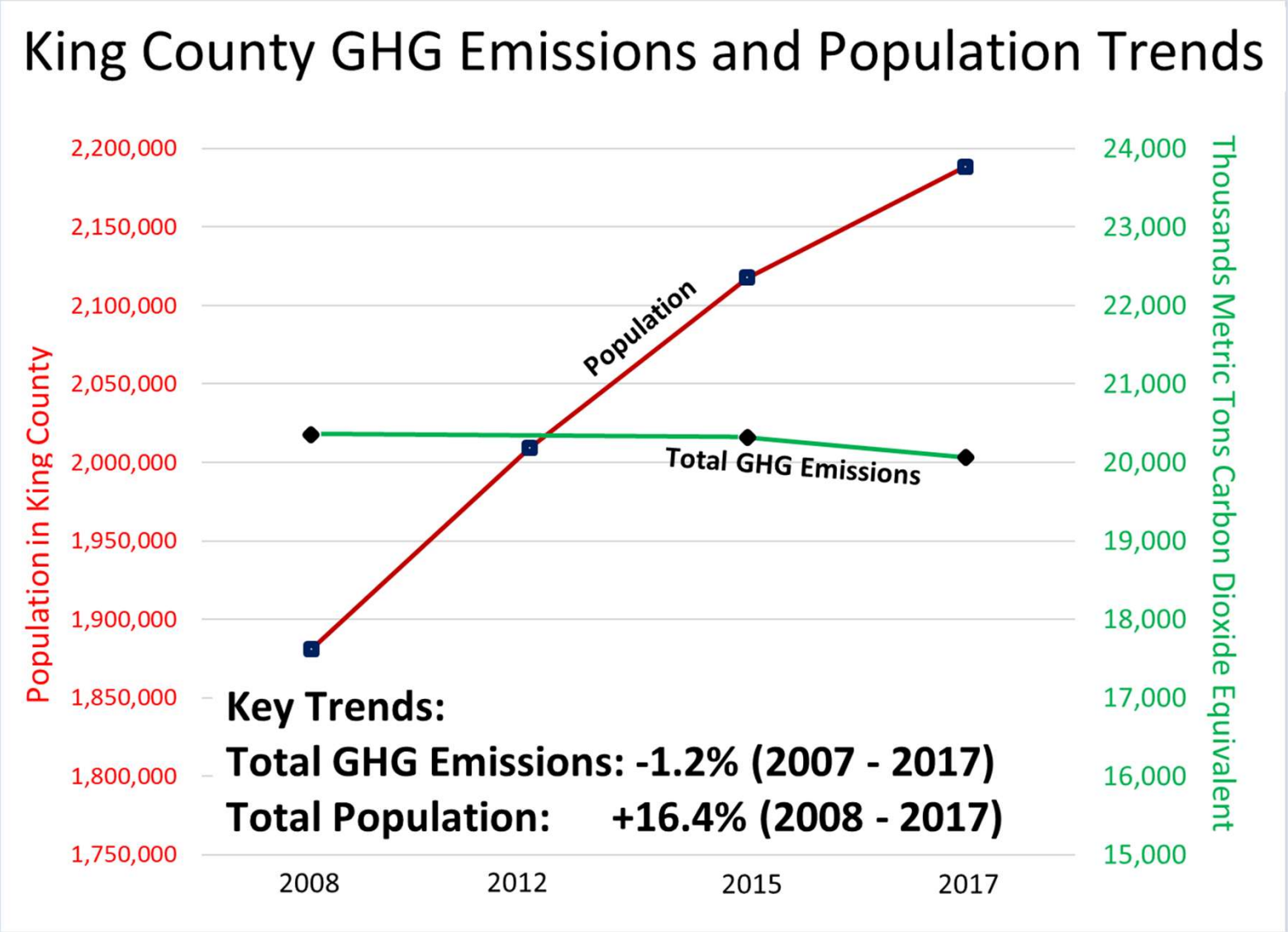
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



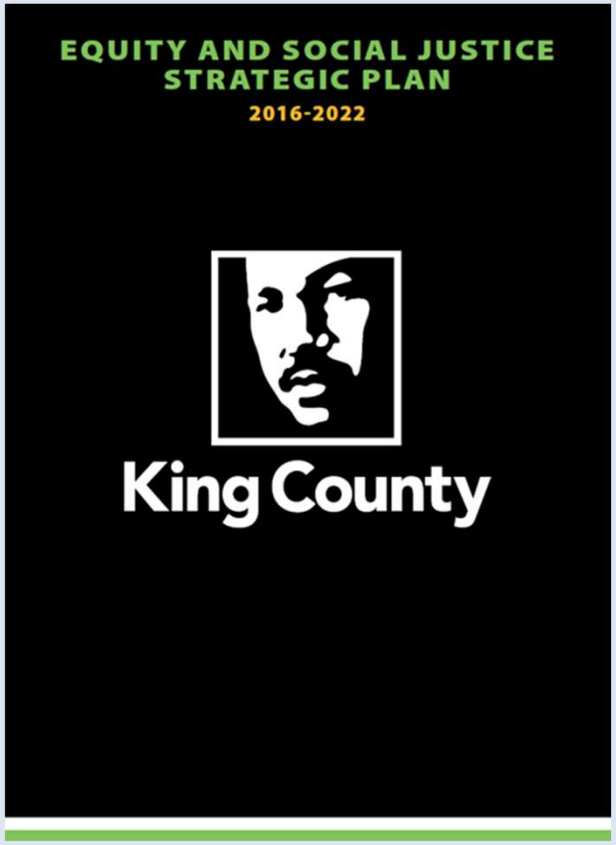
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

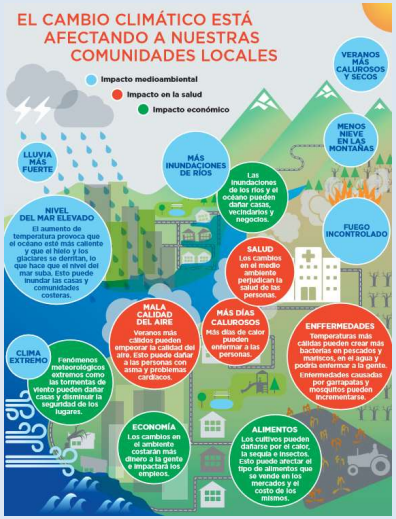
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

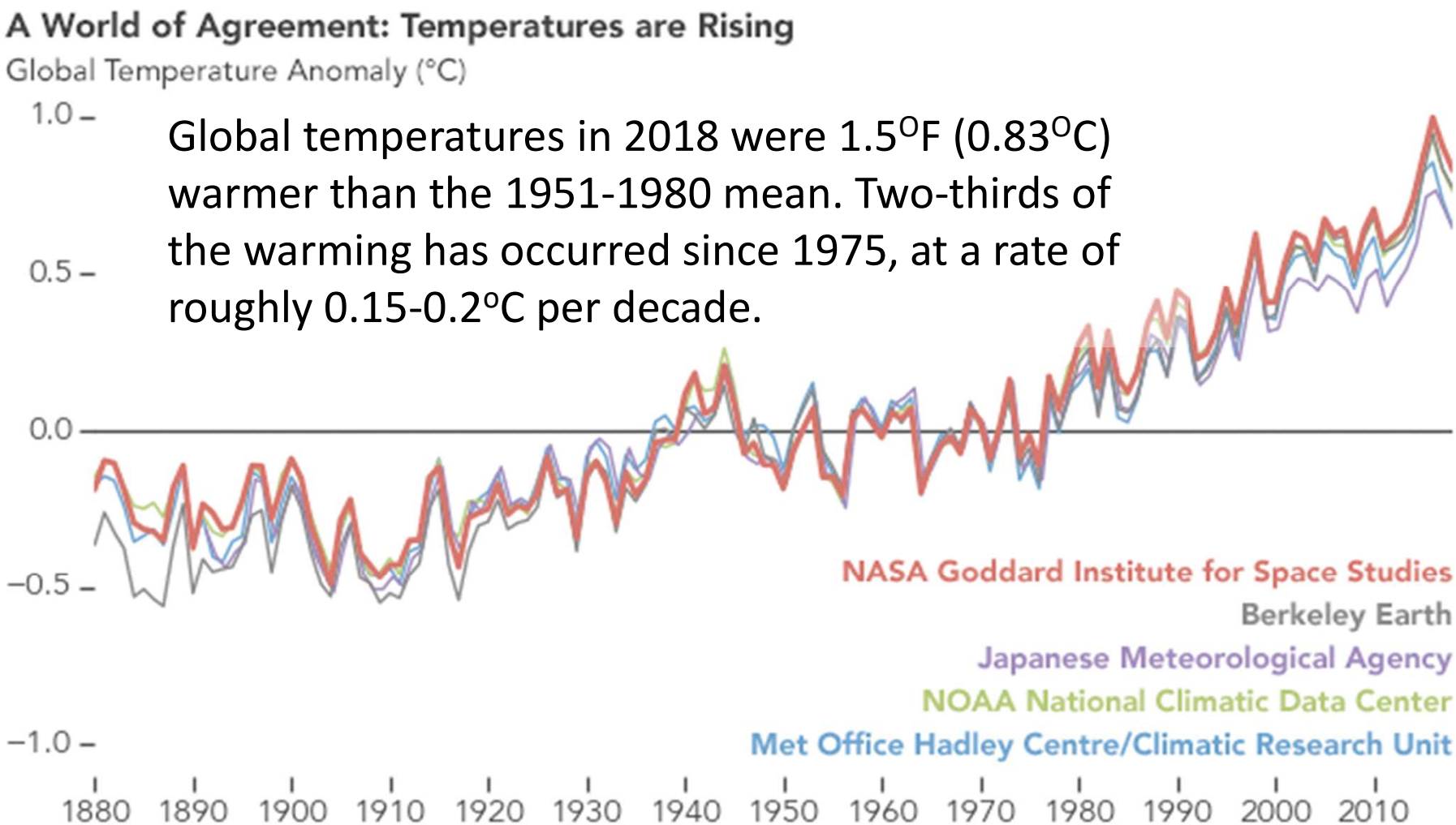
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

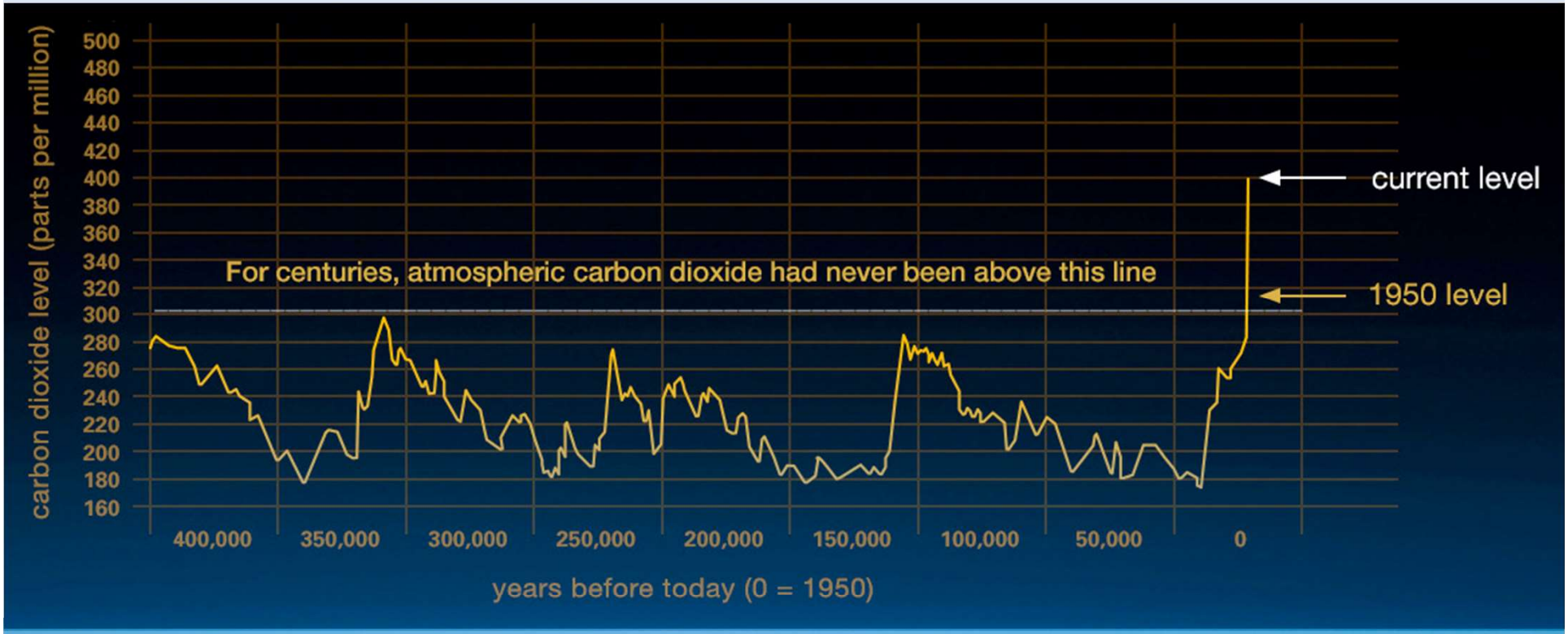


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

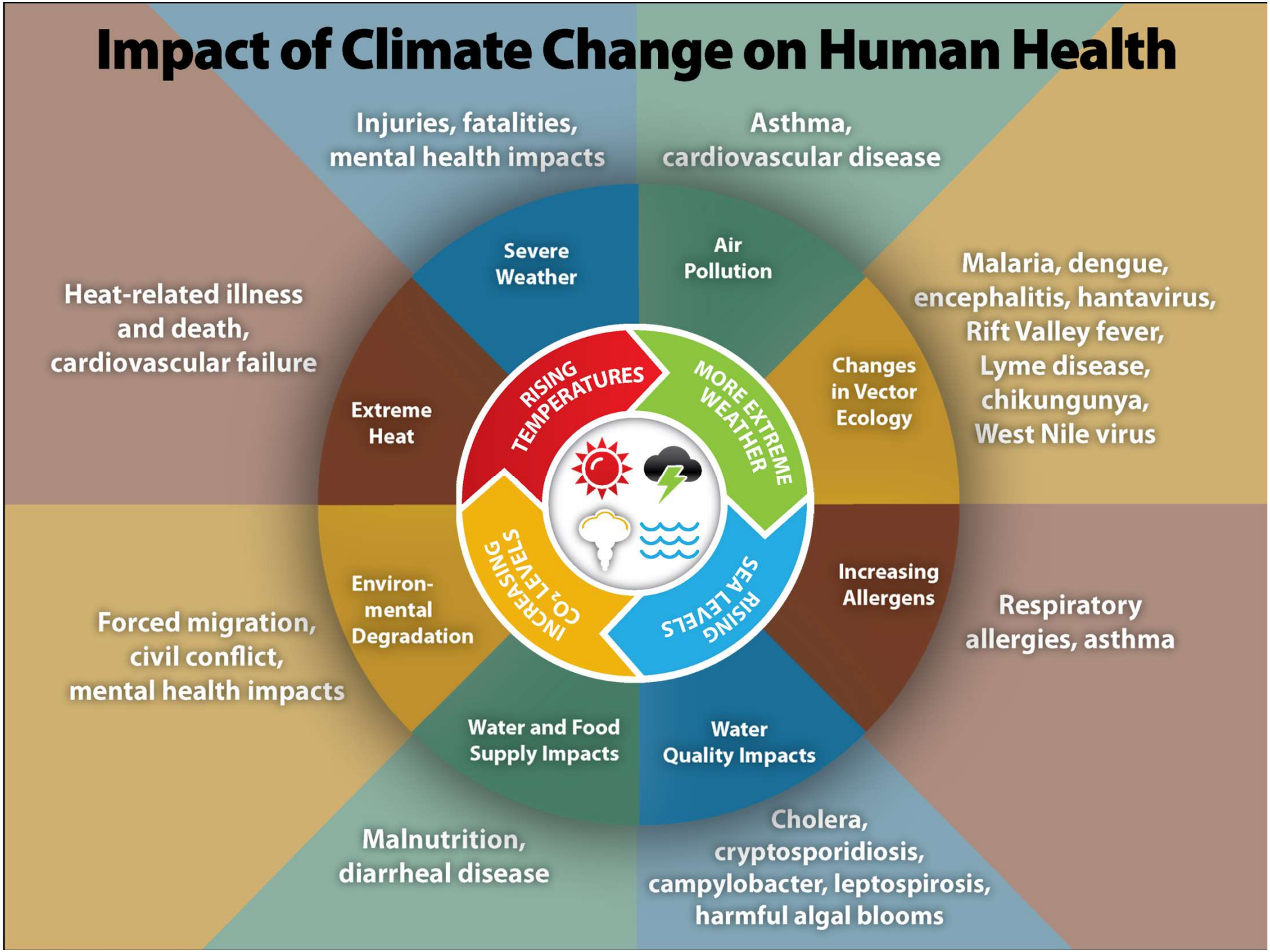
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

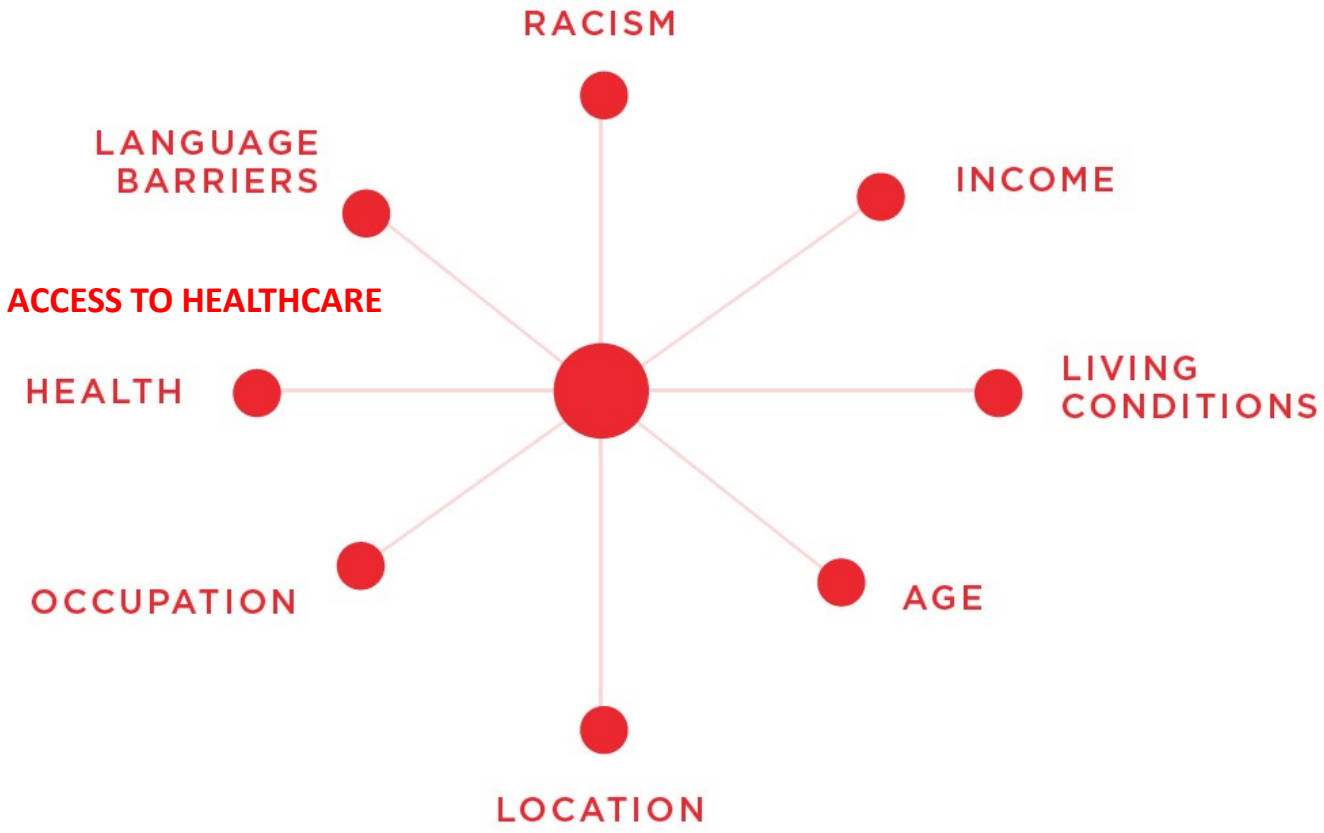
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

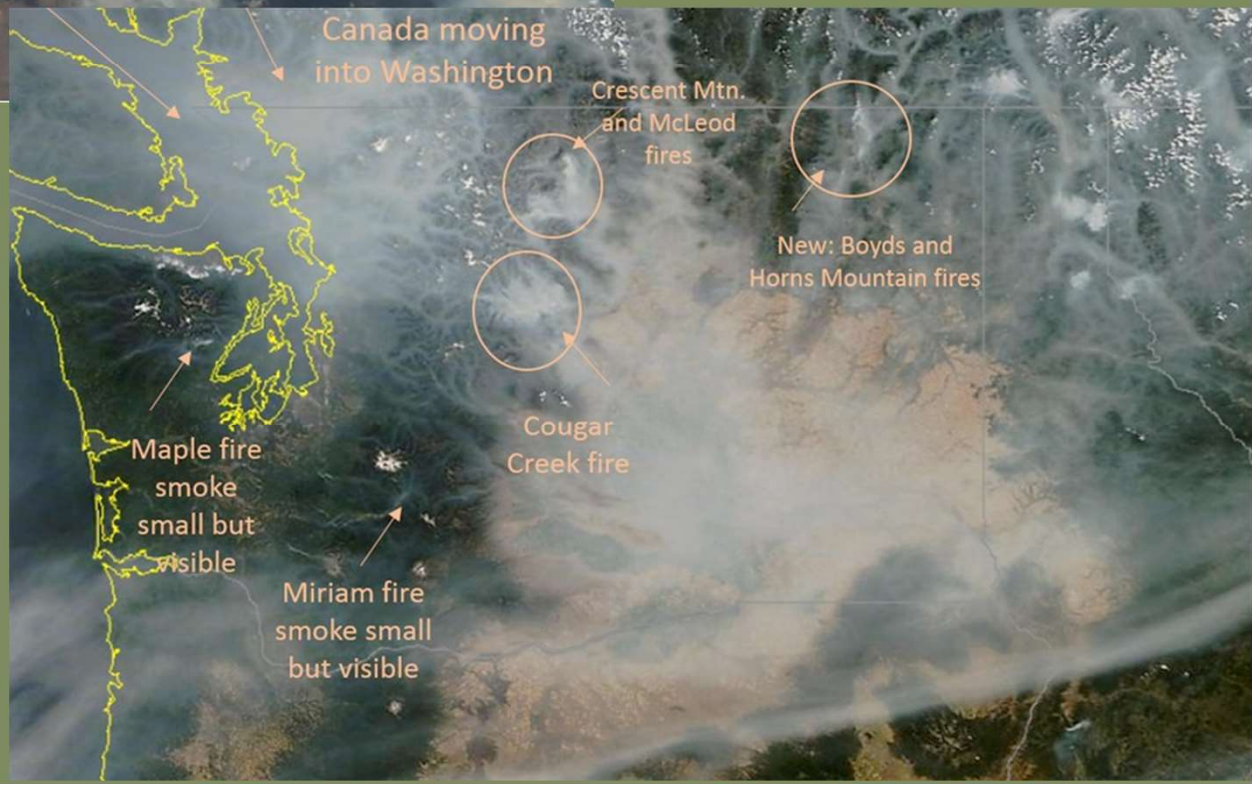
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

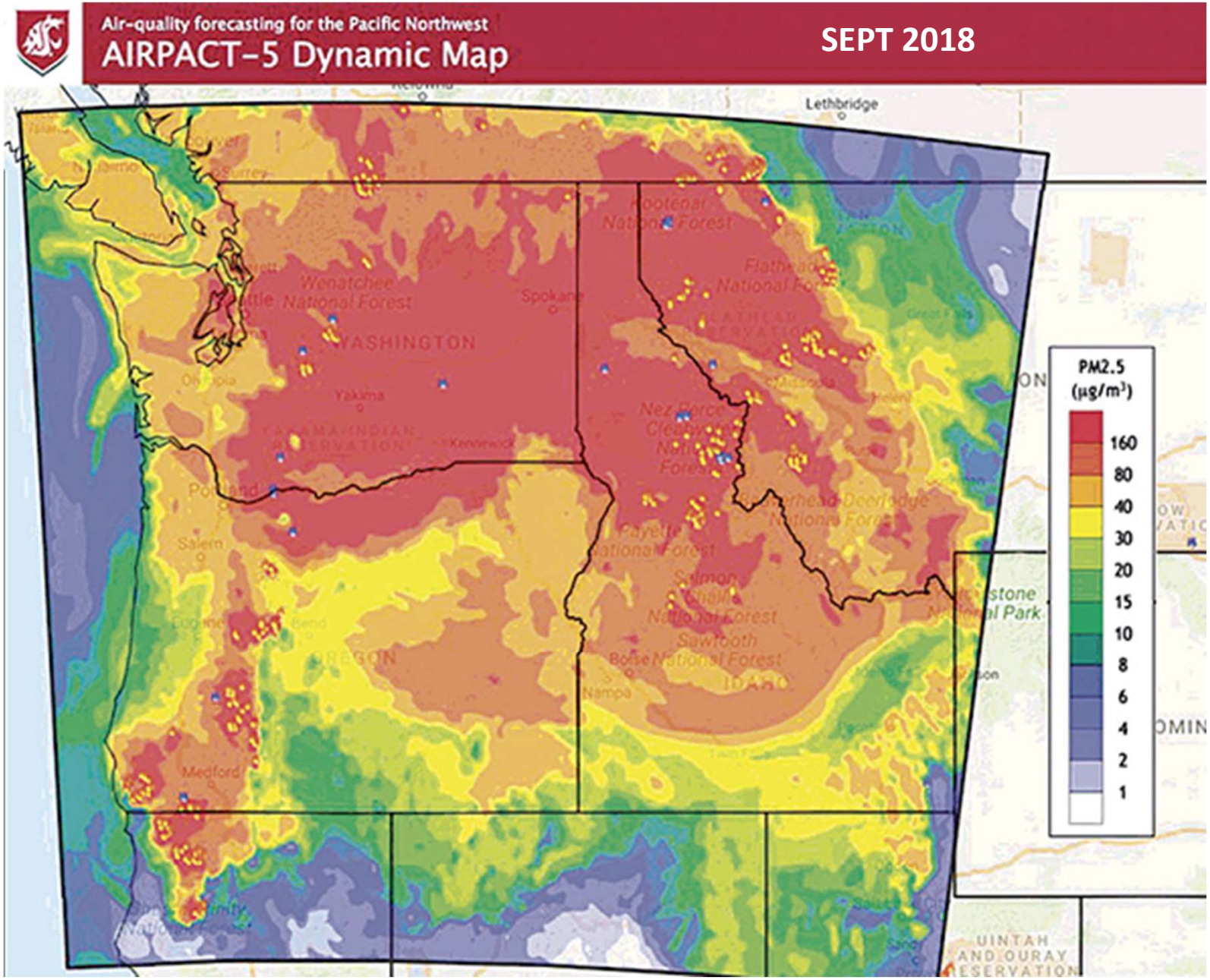
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

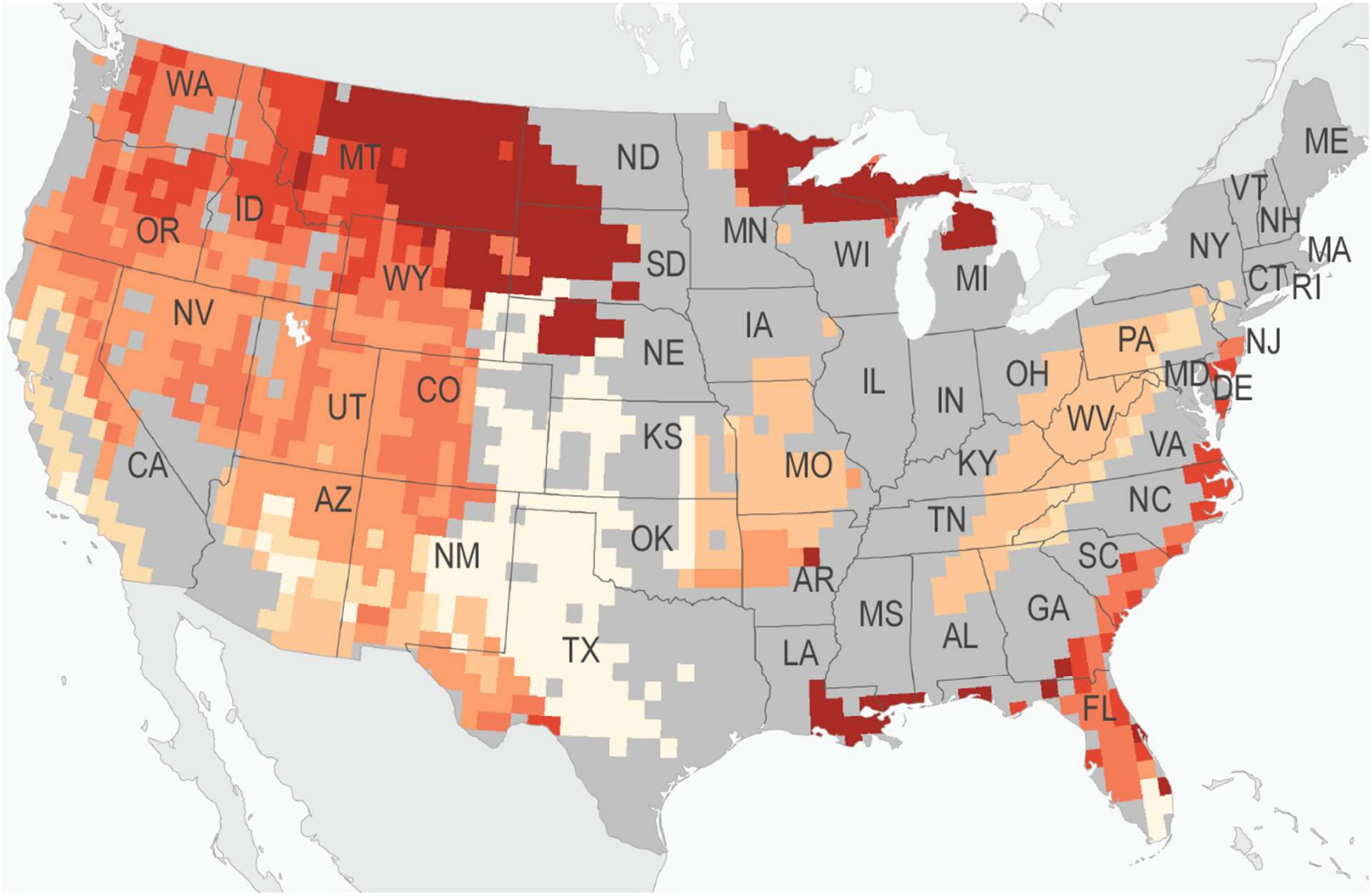
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

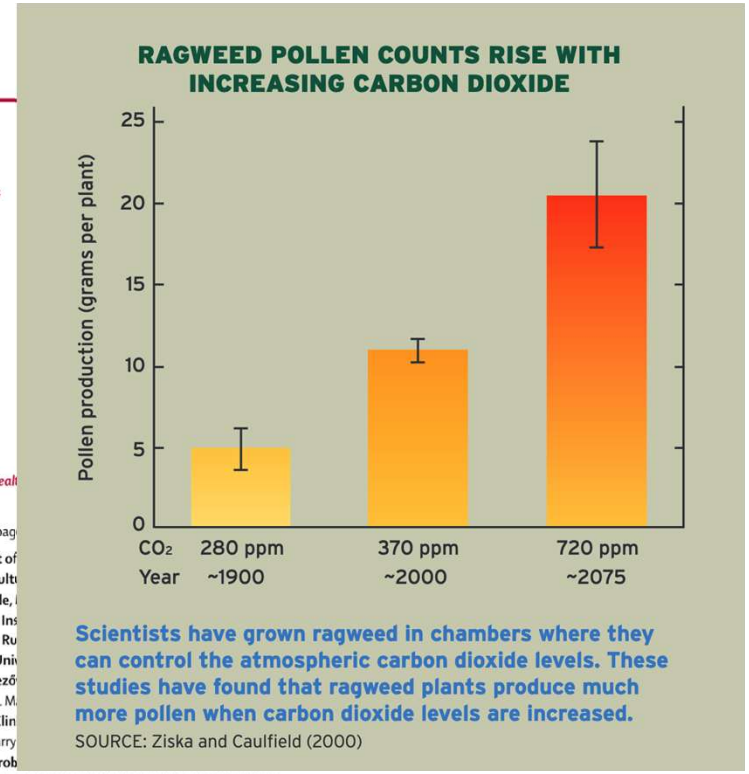
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

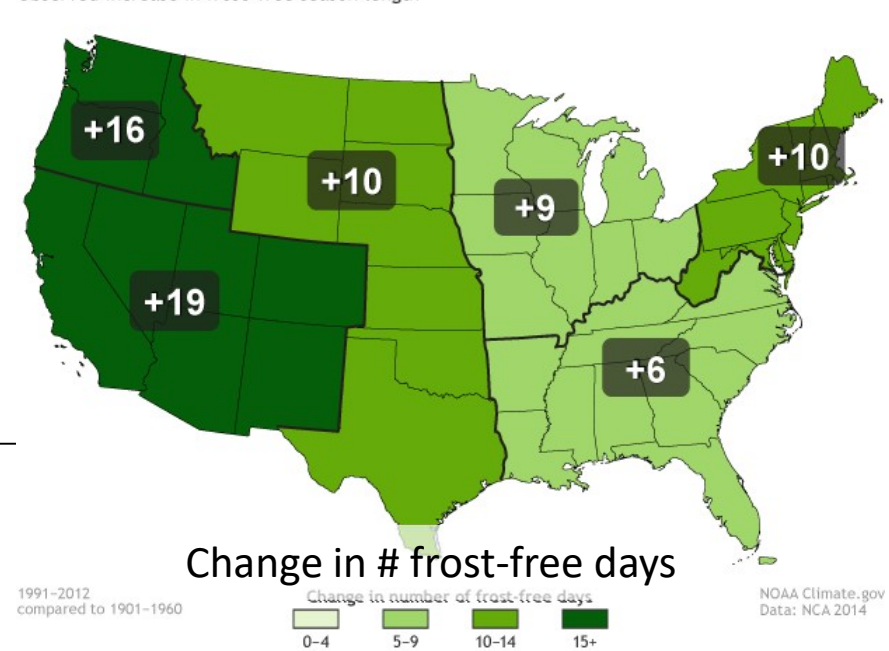
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

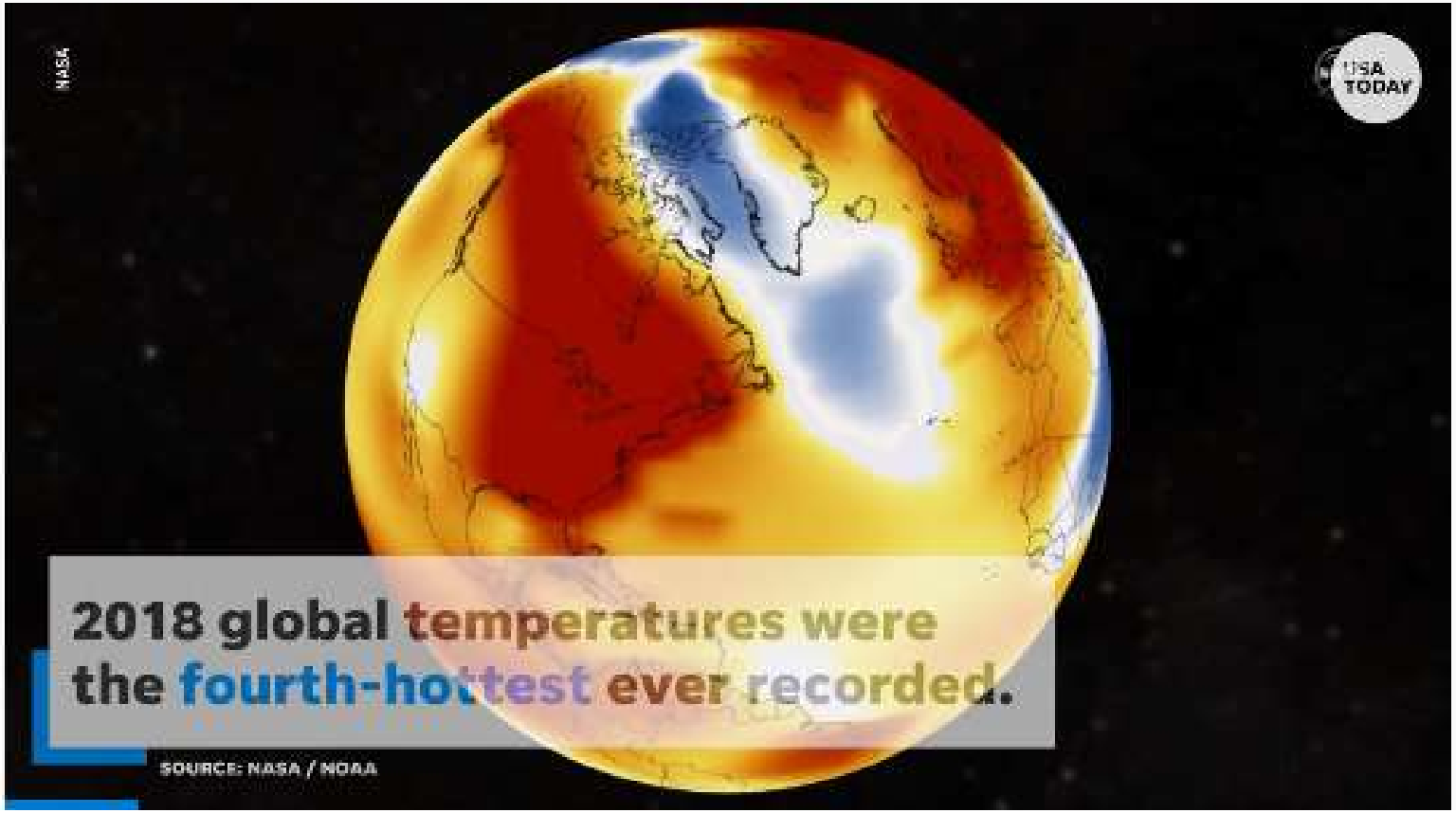
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



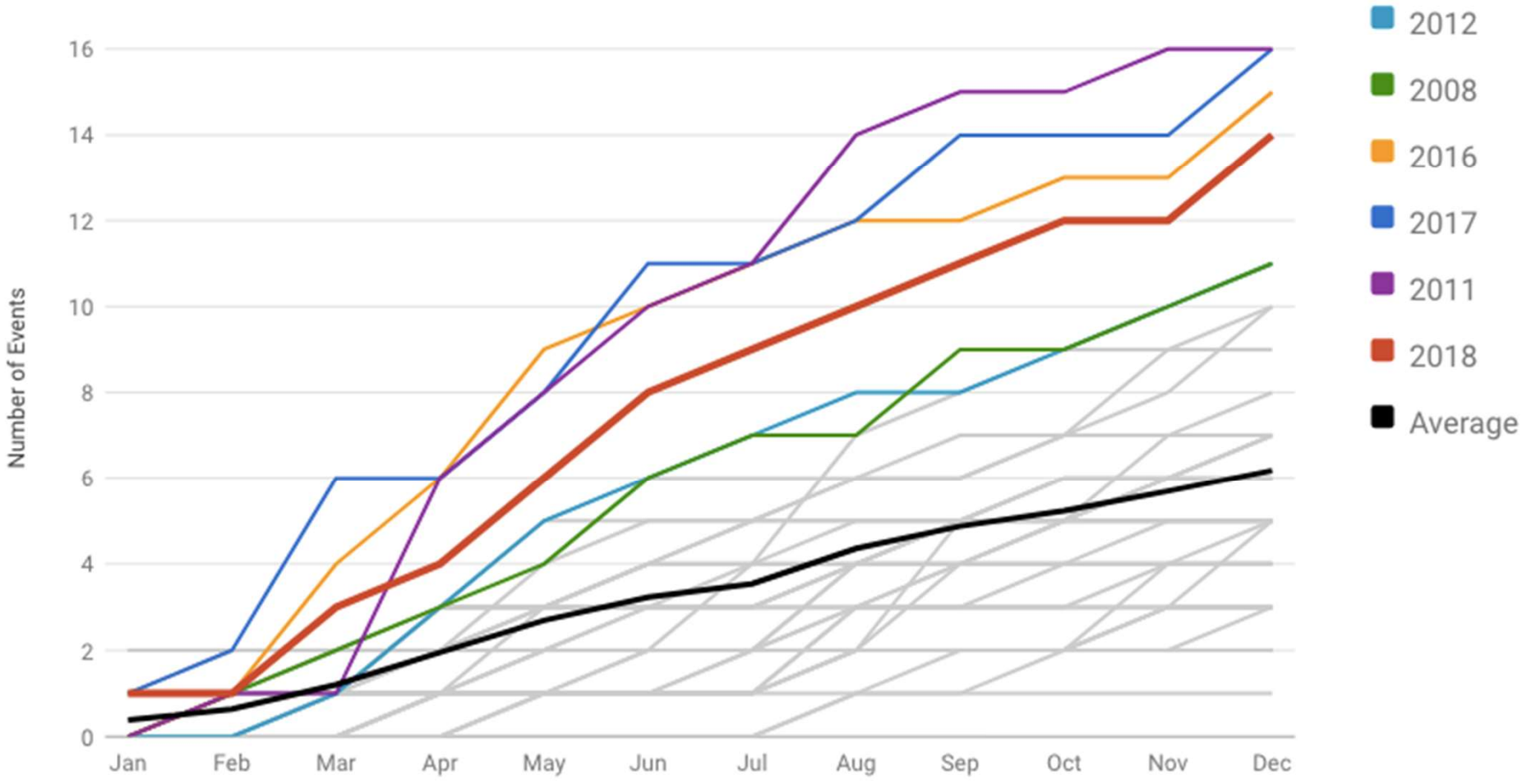
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



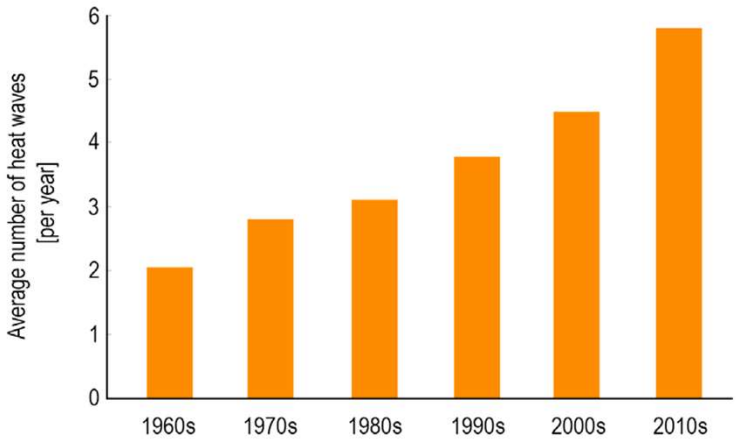
NOAA: National Centers for Environmental Information

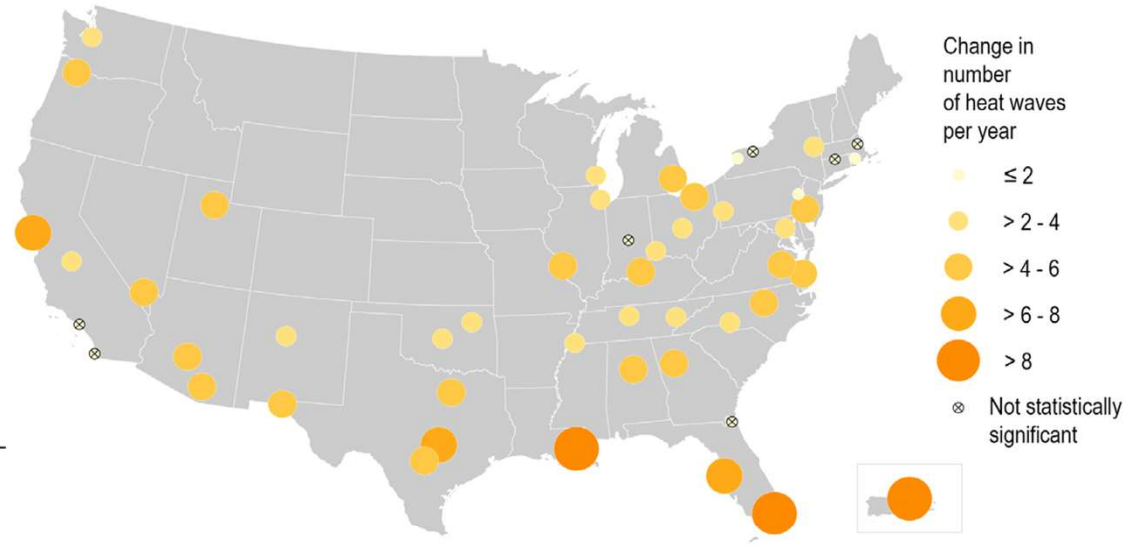
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

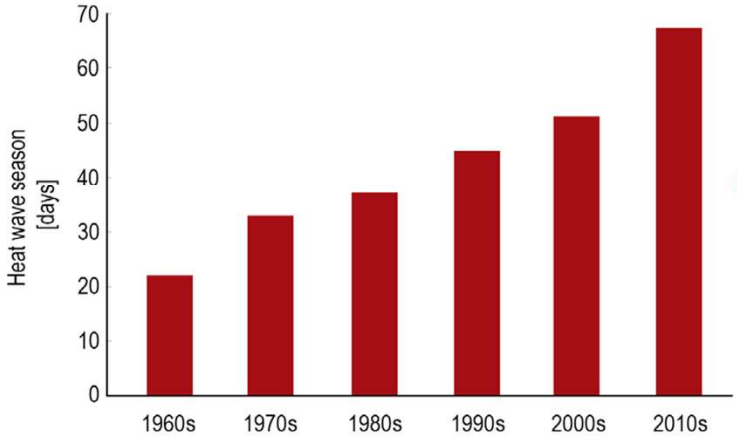
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

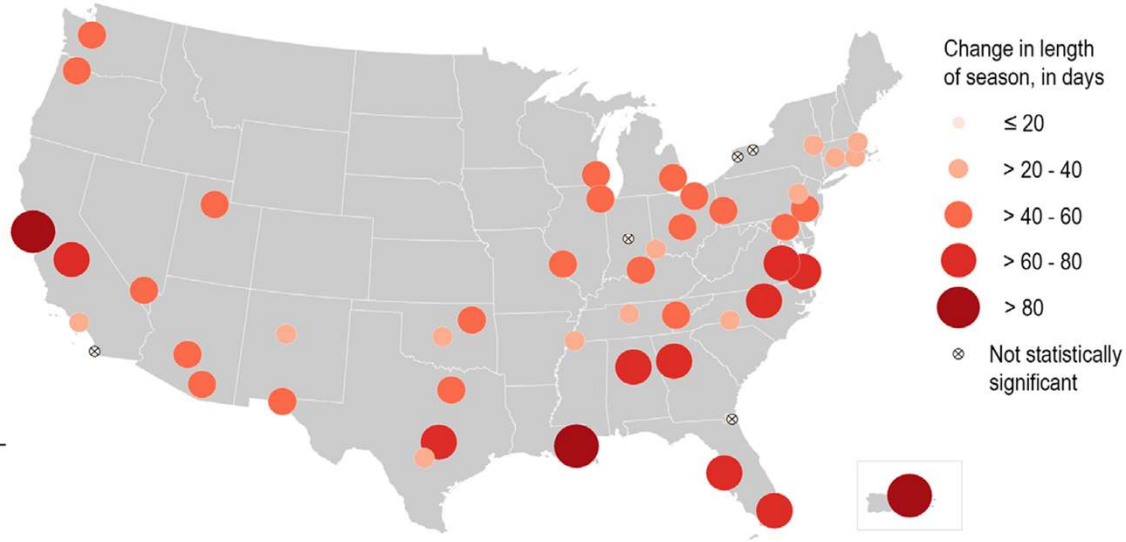
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

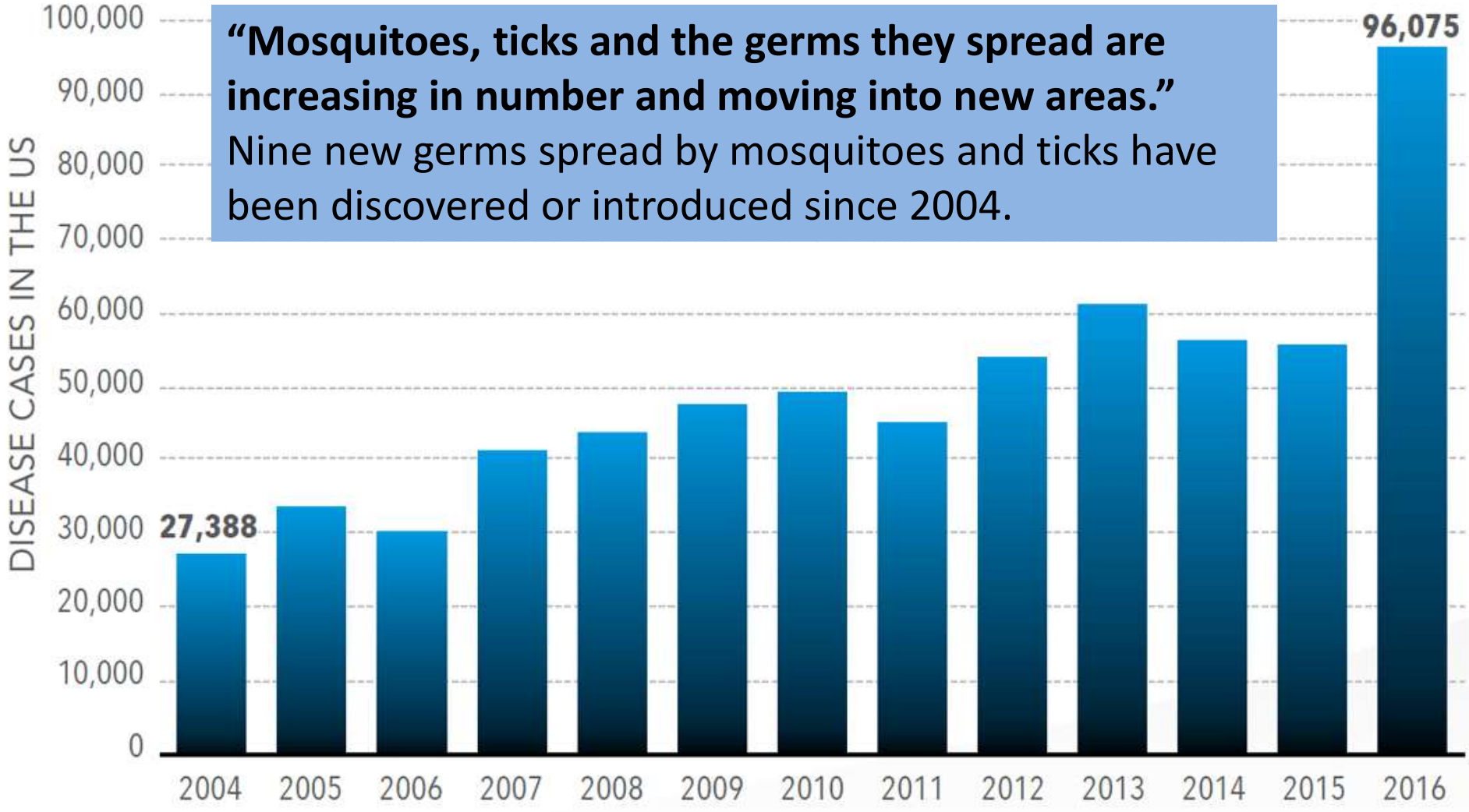
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

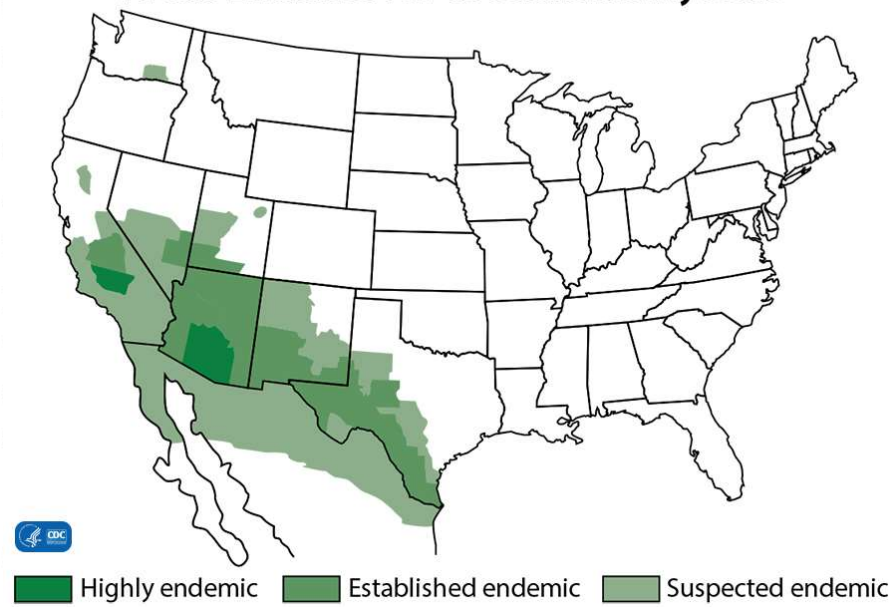
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

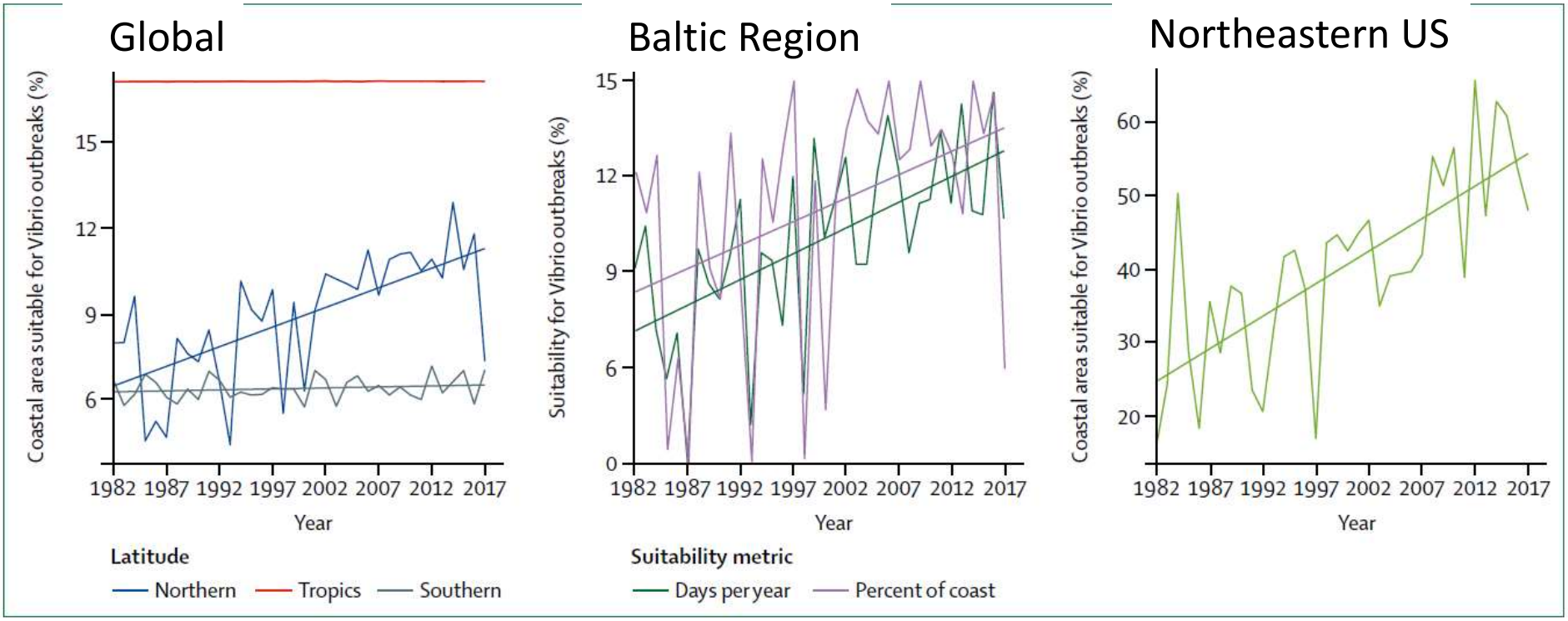
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

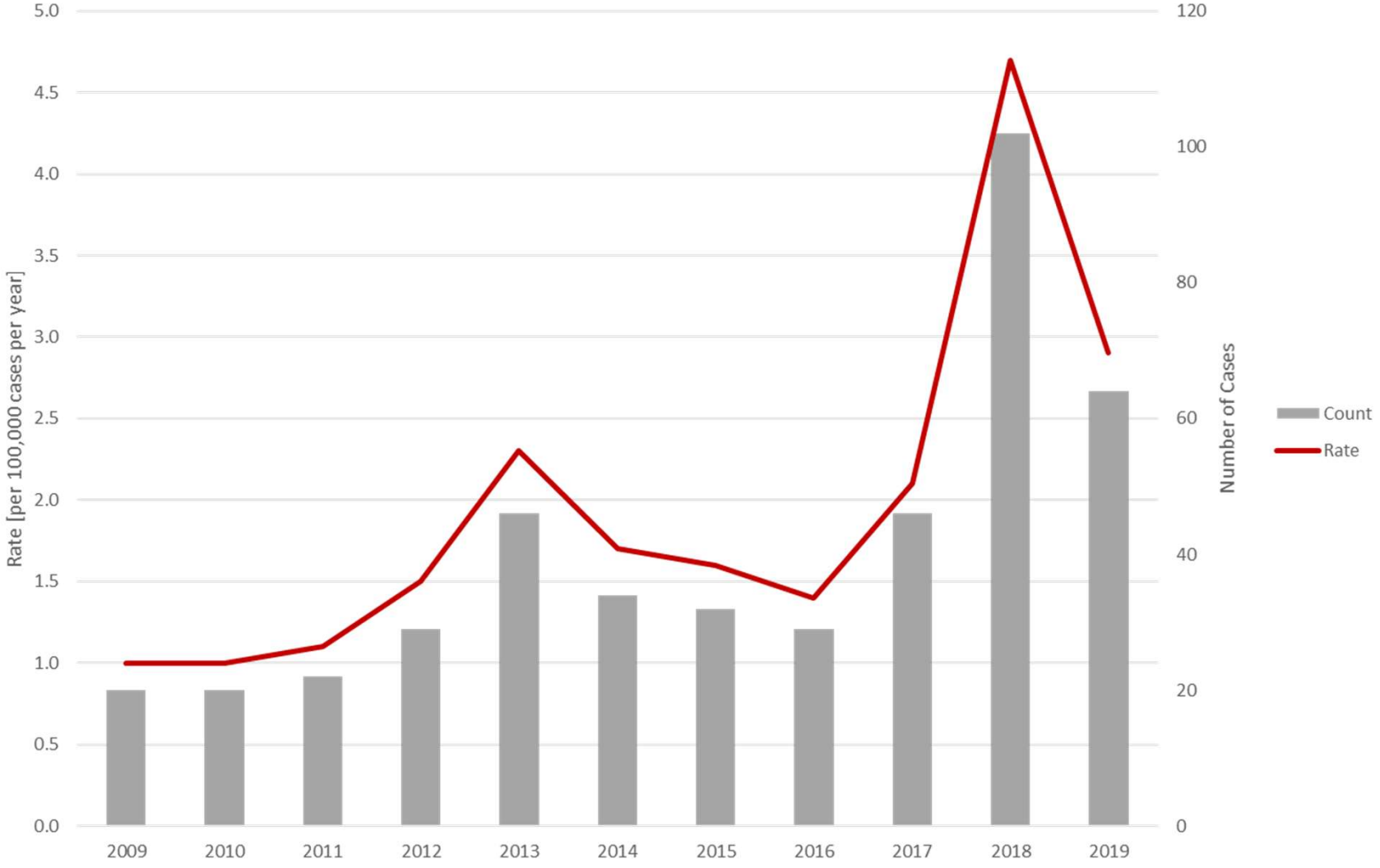
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

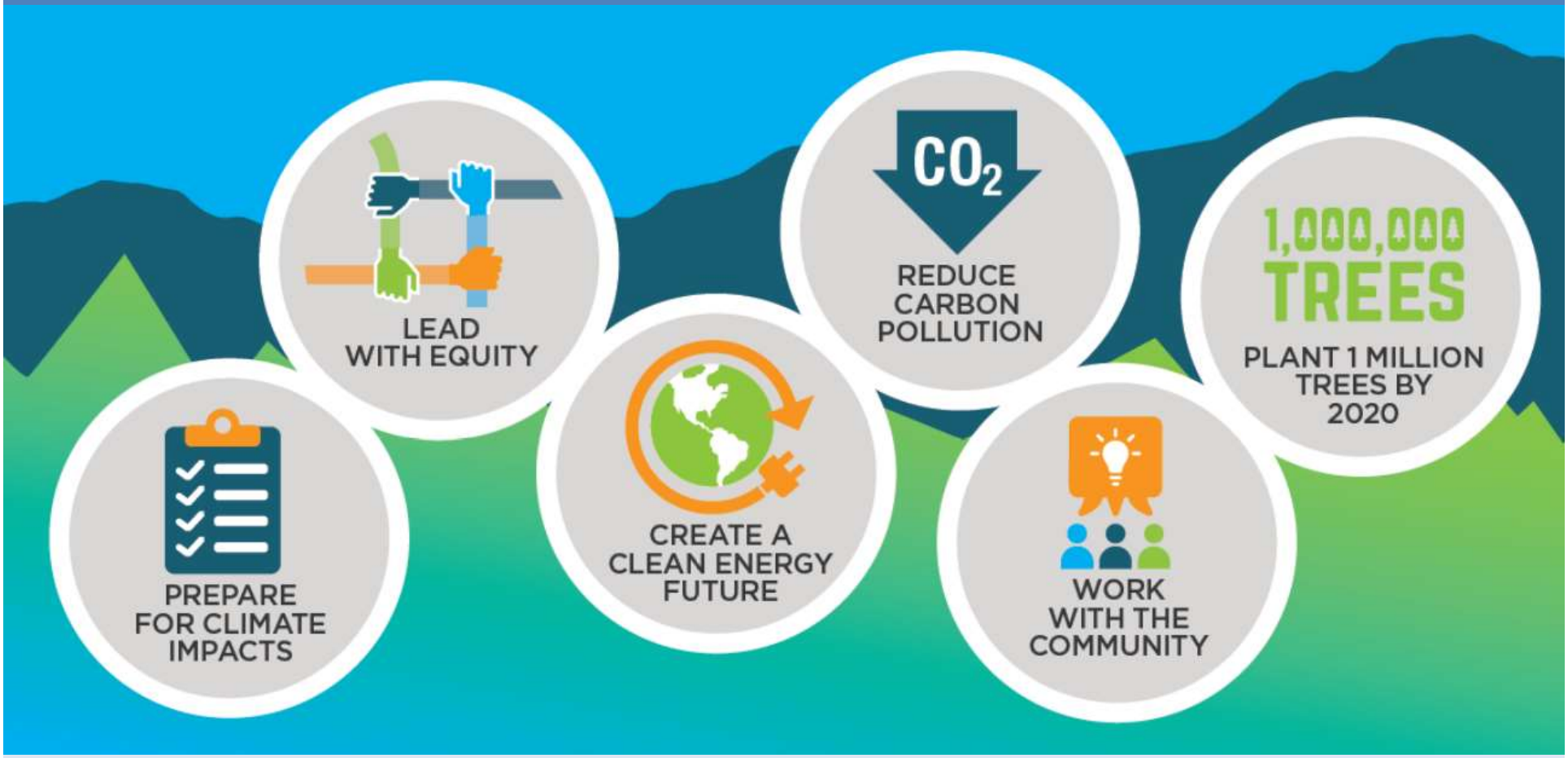
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

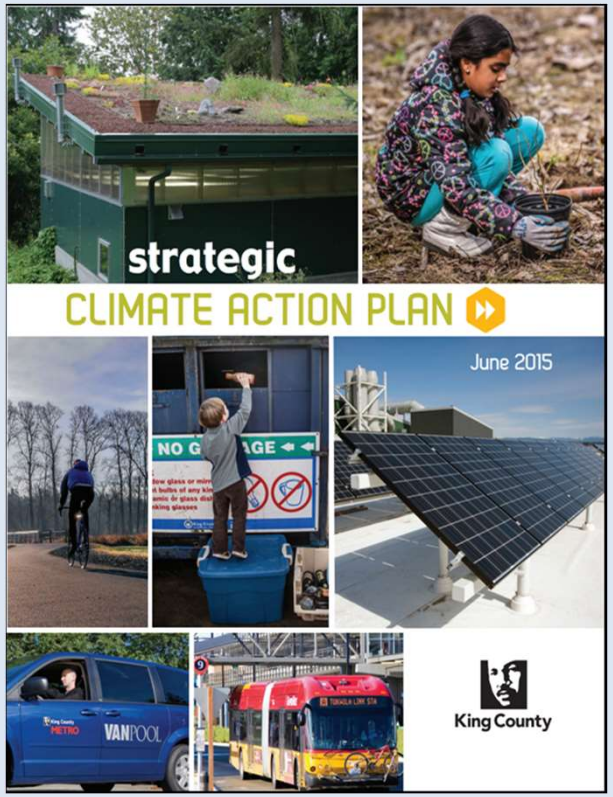


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

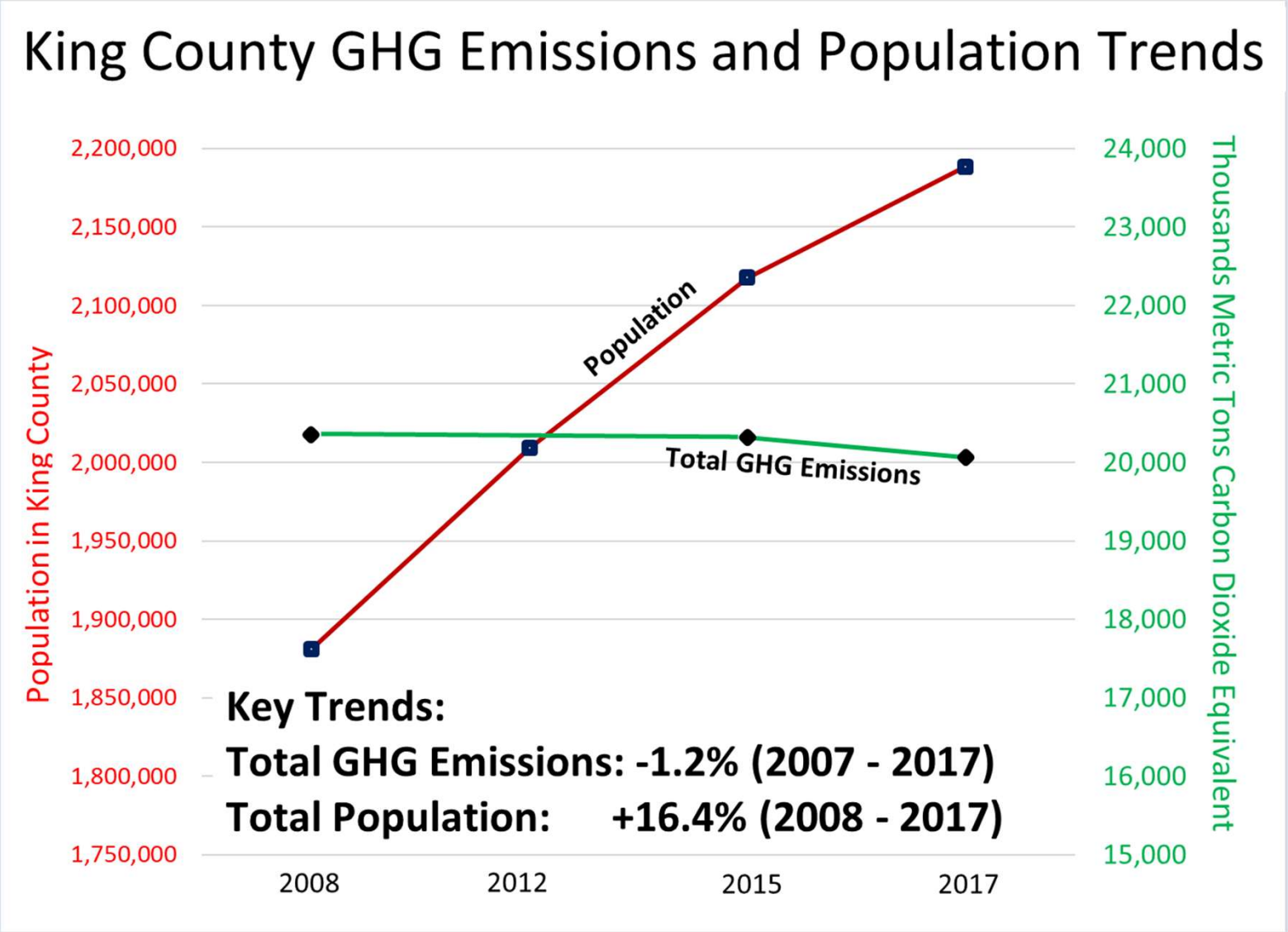
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



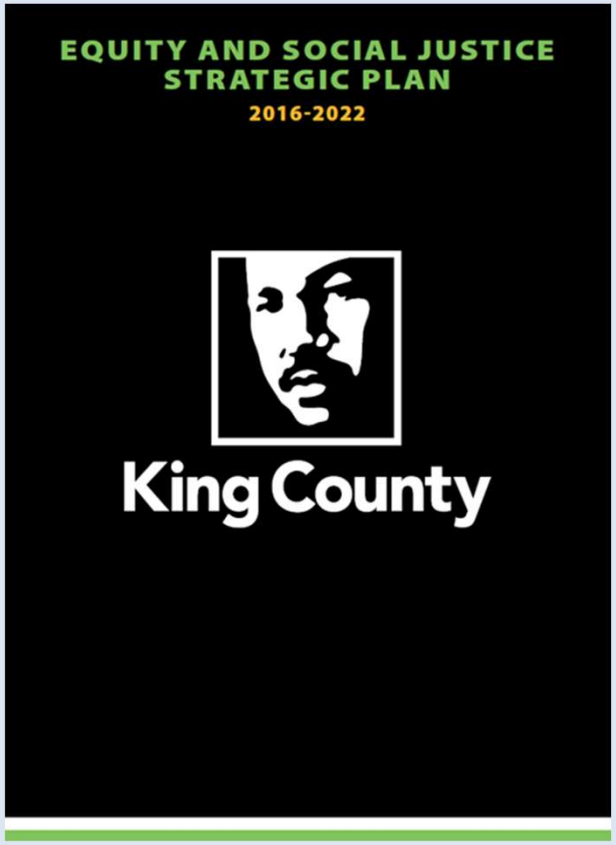
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

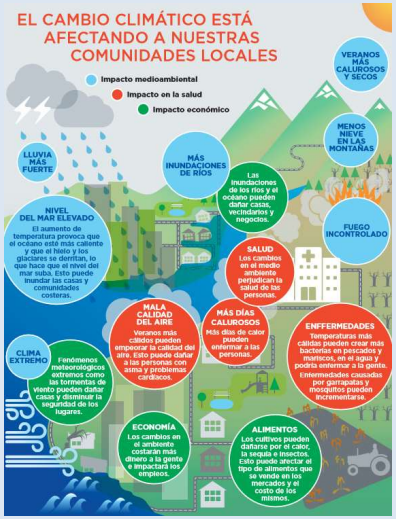
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

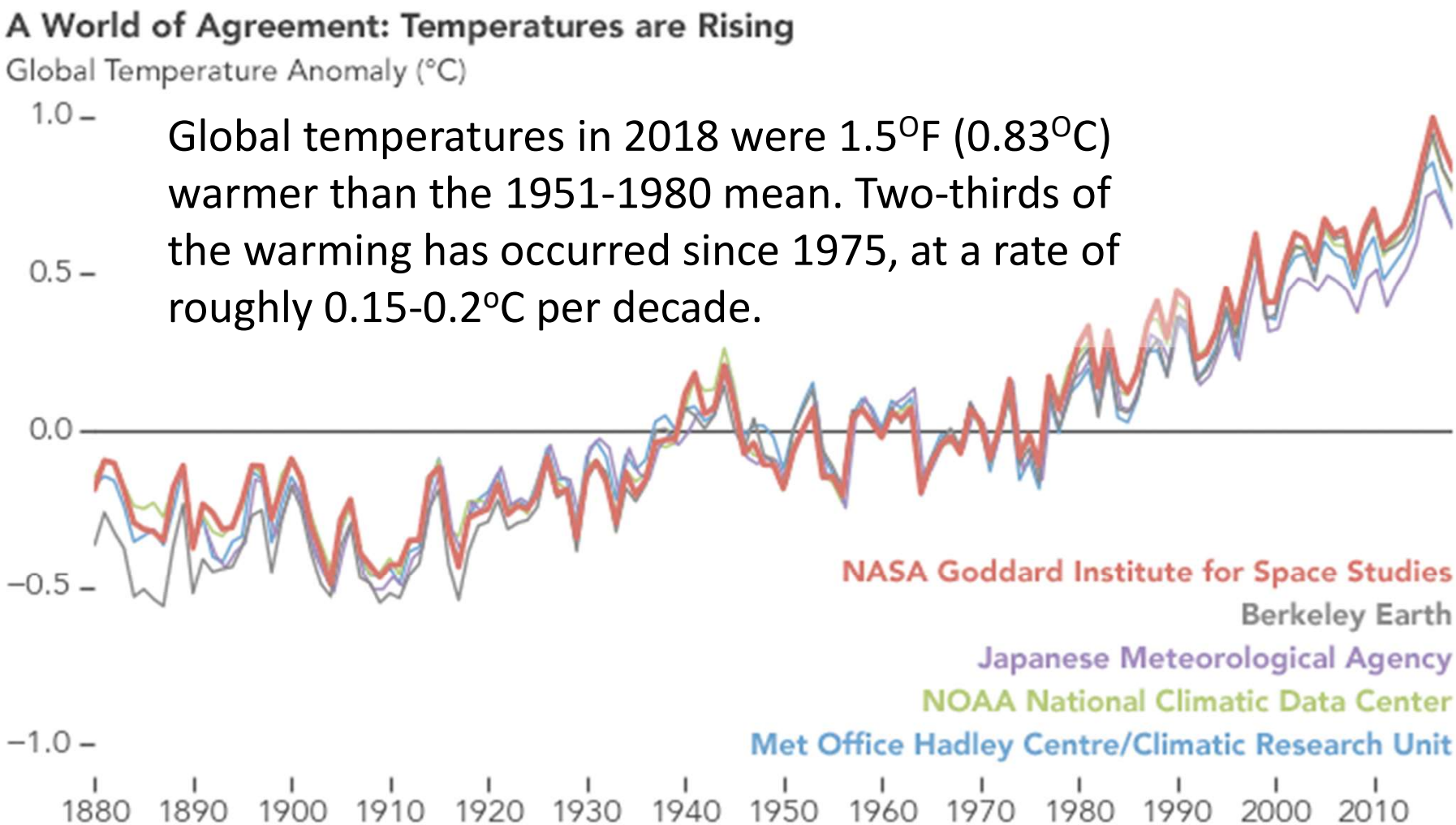
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

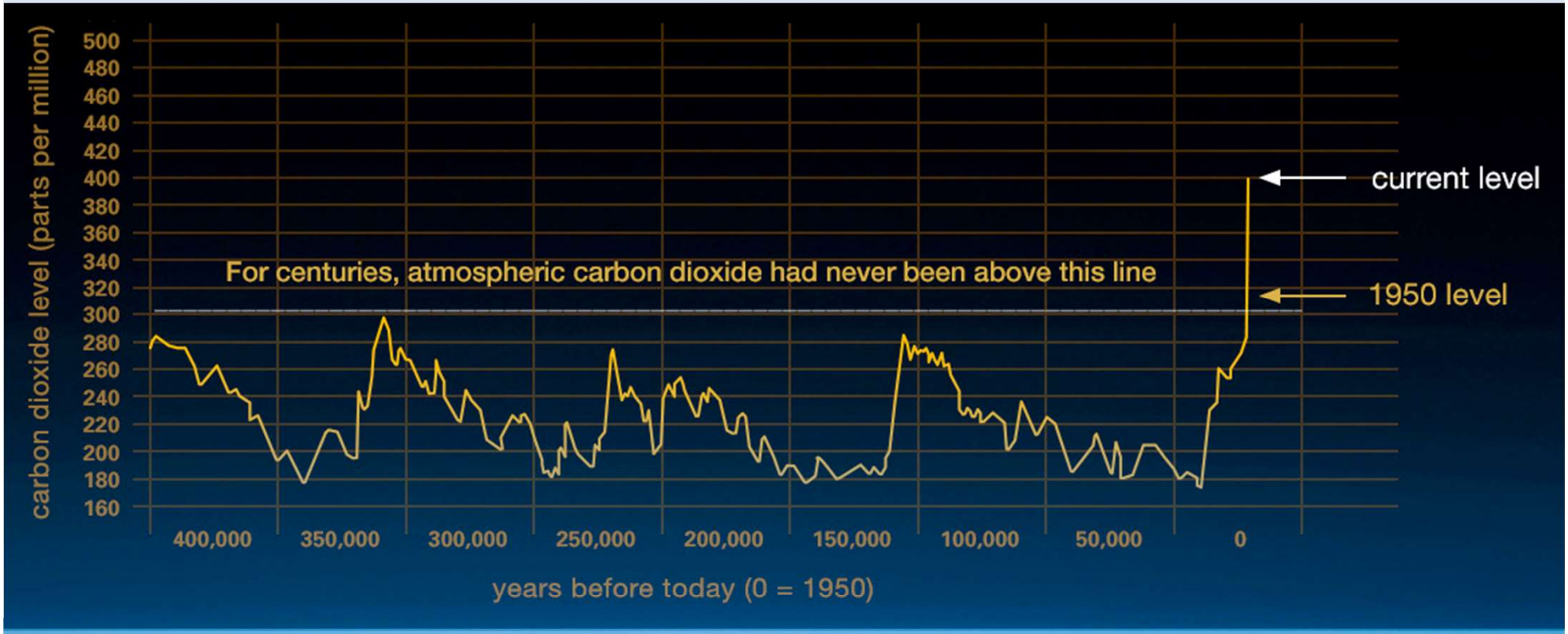


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

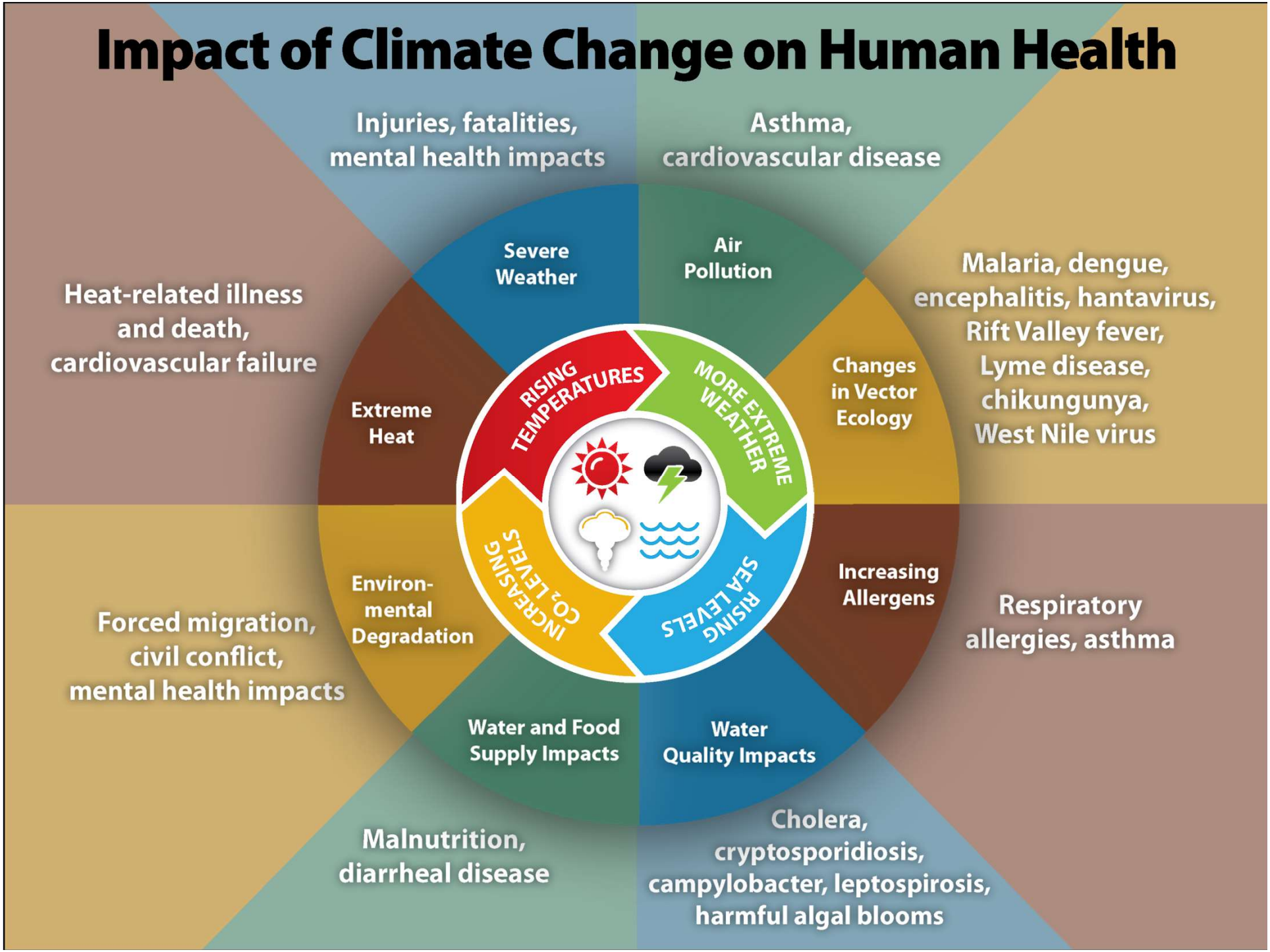
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

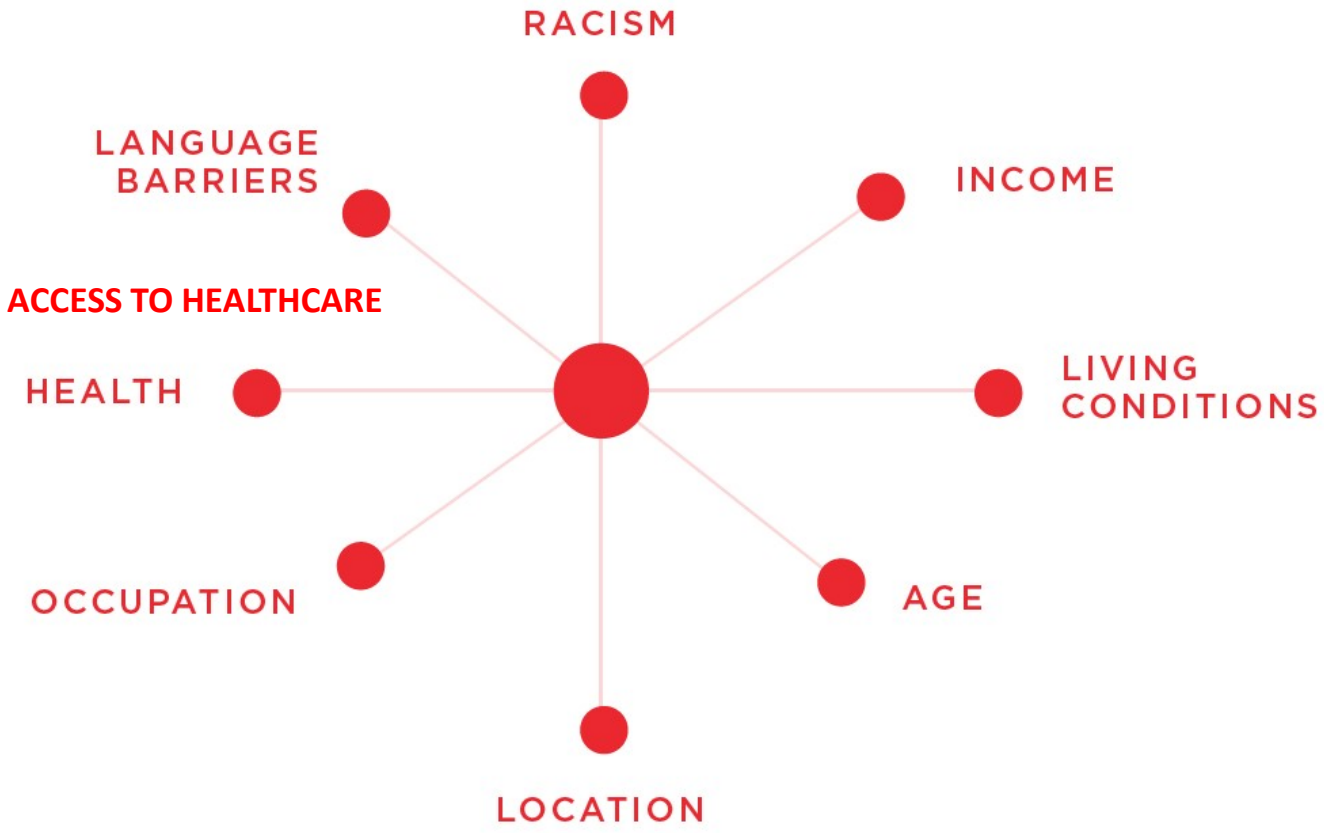
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

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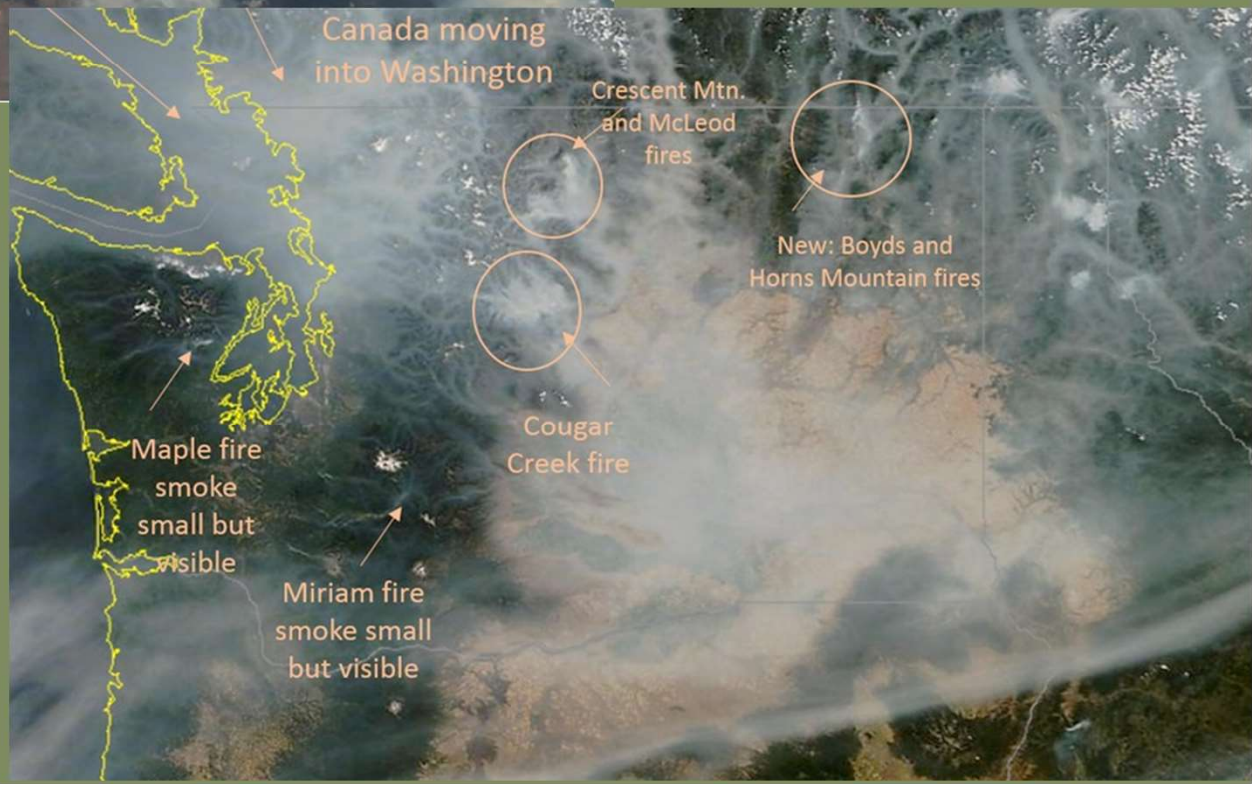
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

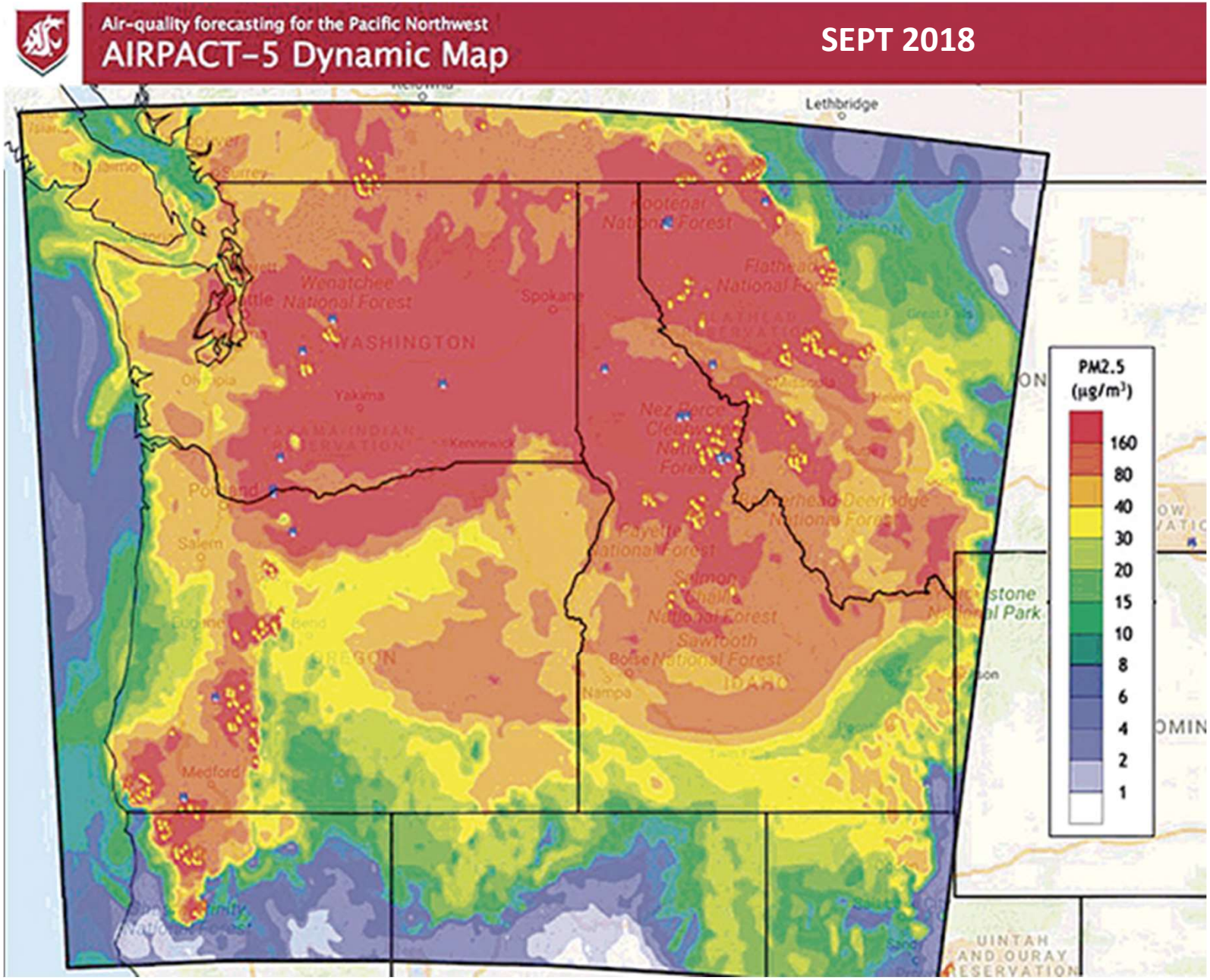
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

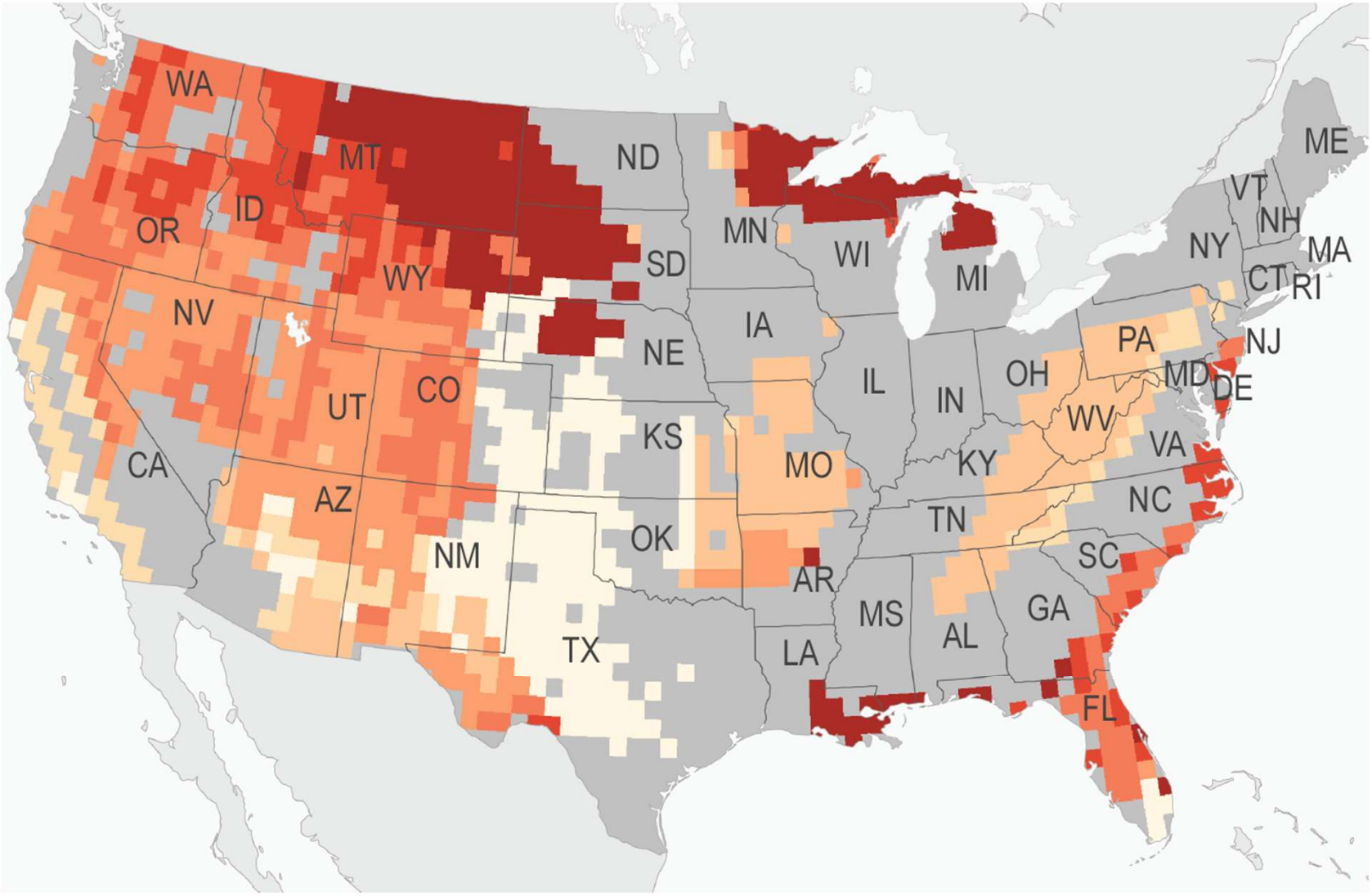
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

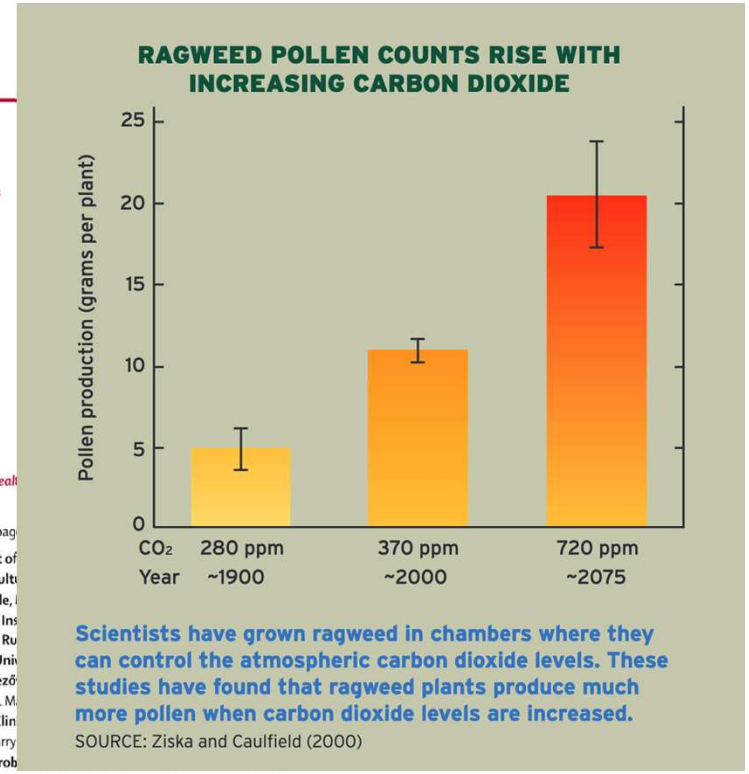
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

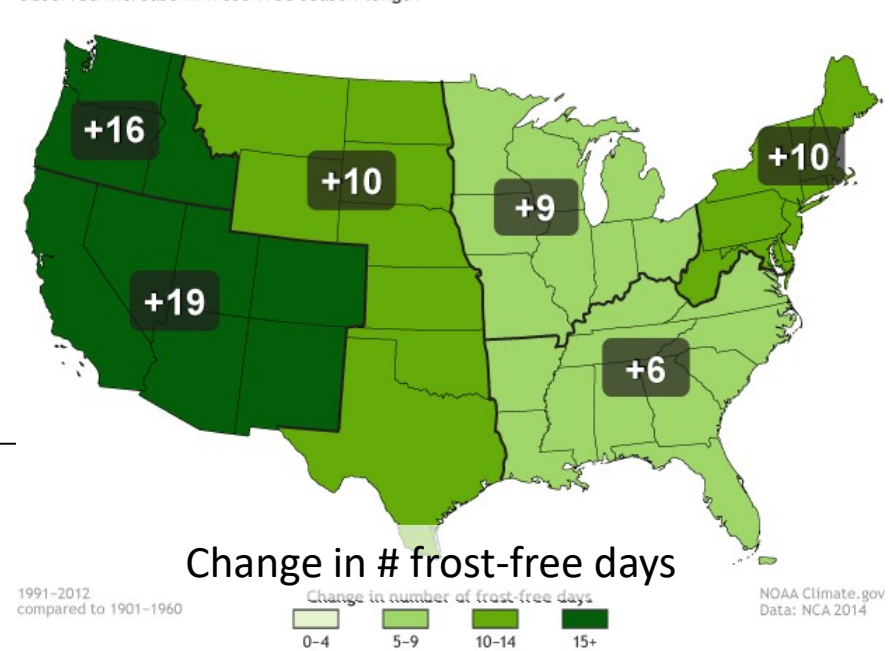
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

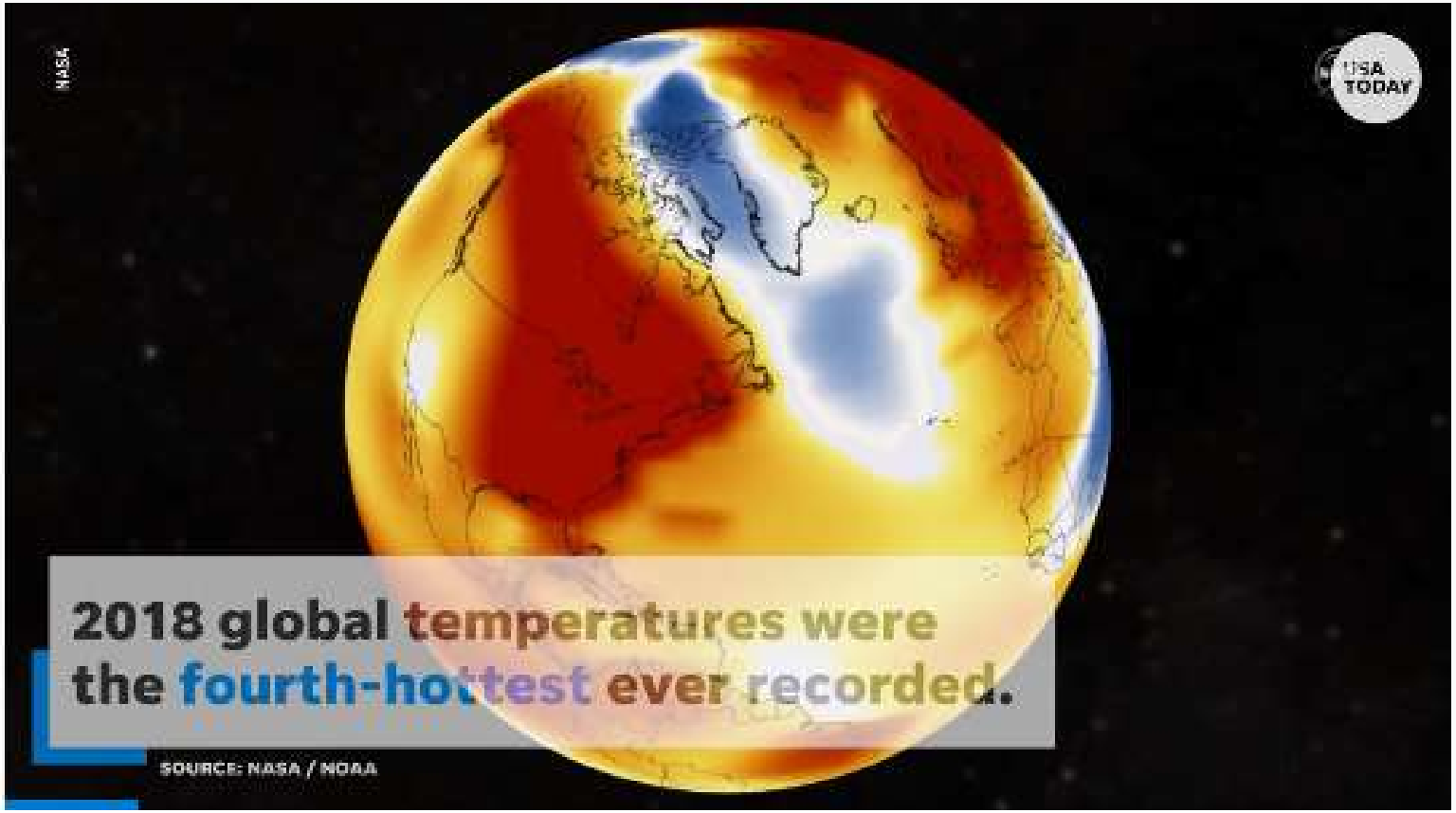
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



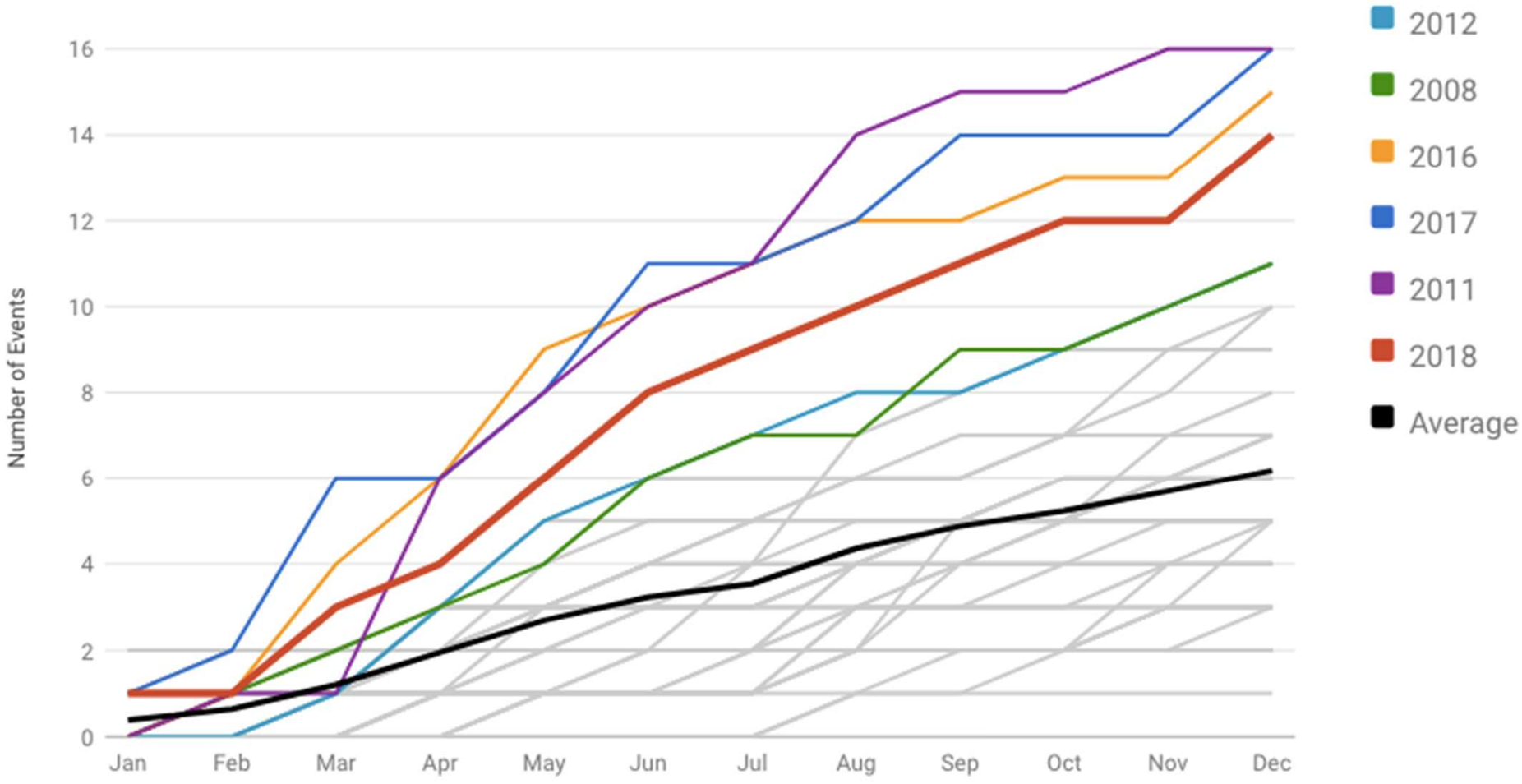
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



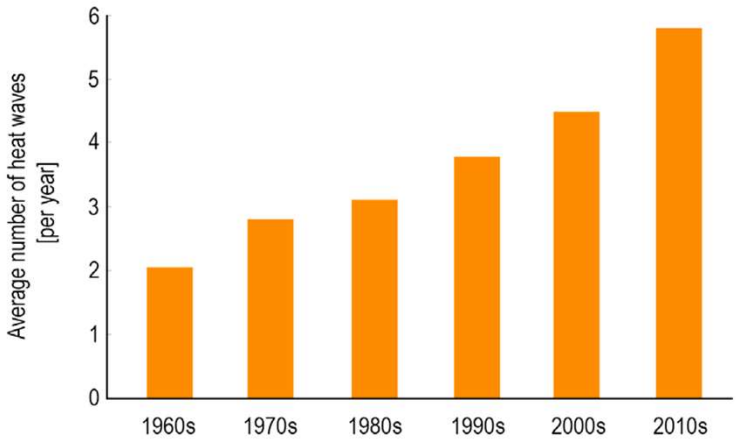
NOAA: National Centers for Environmental Information

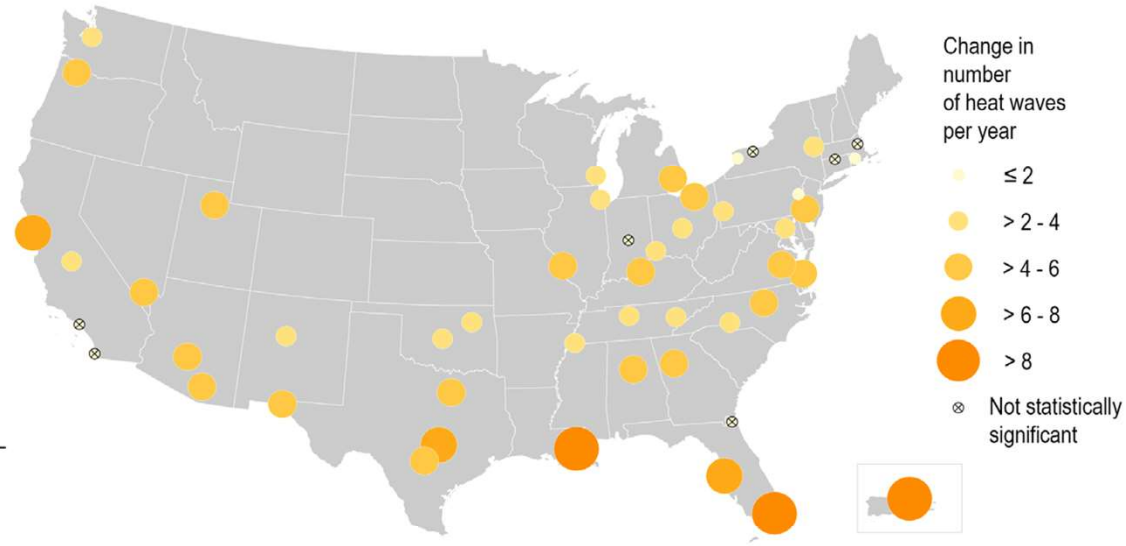
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

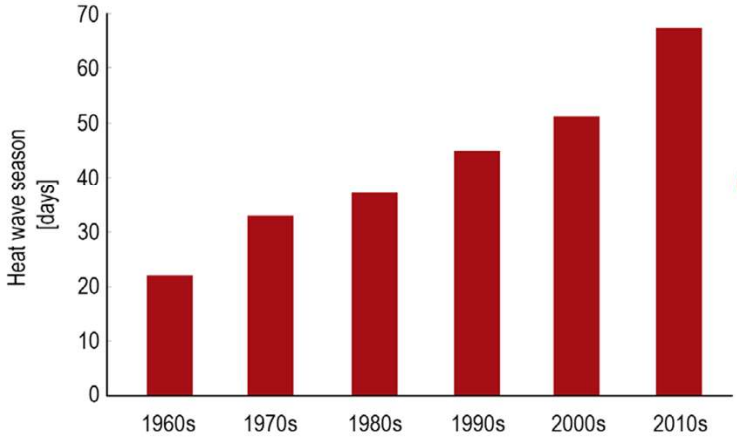
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

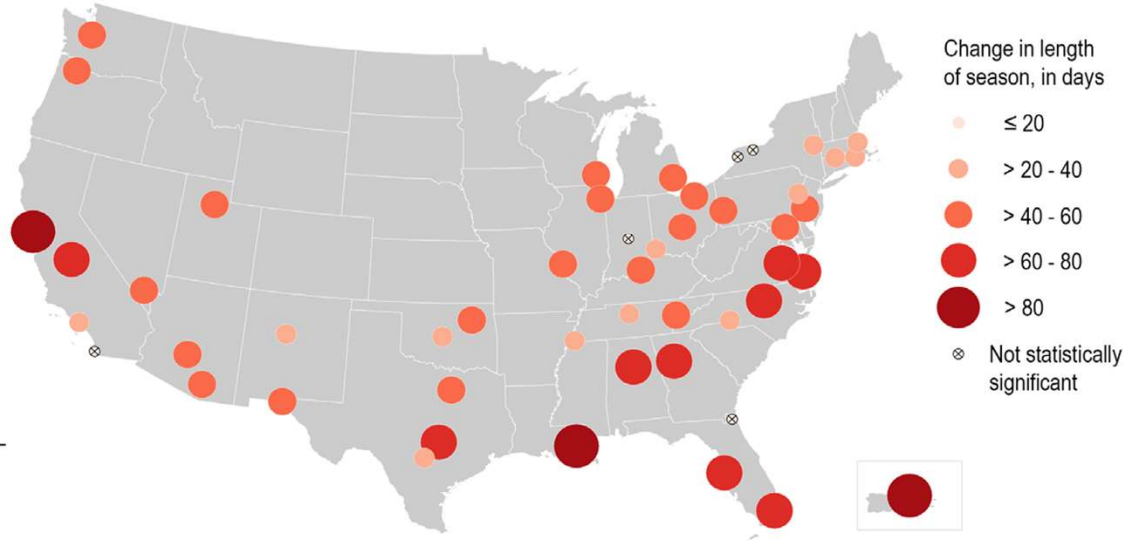
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

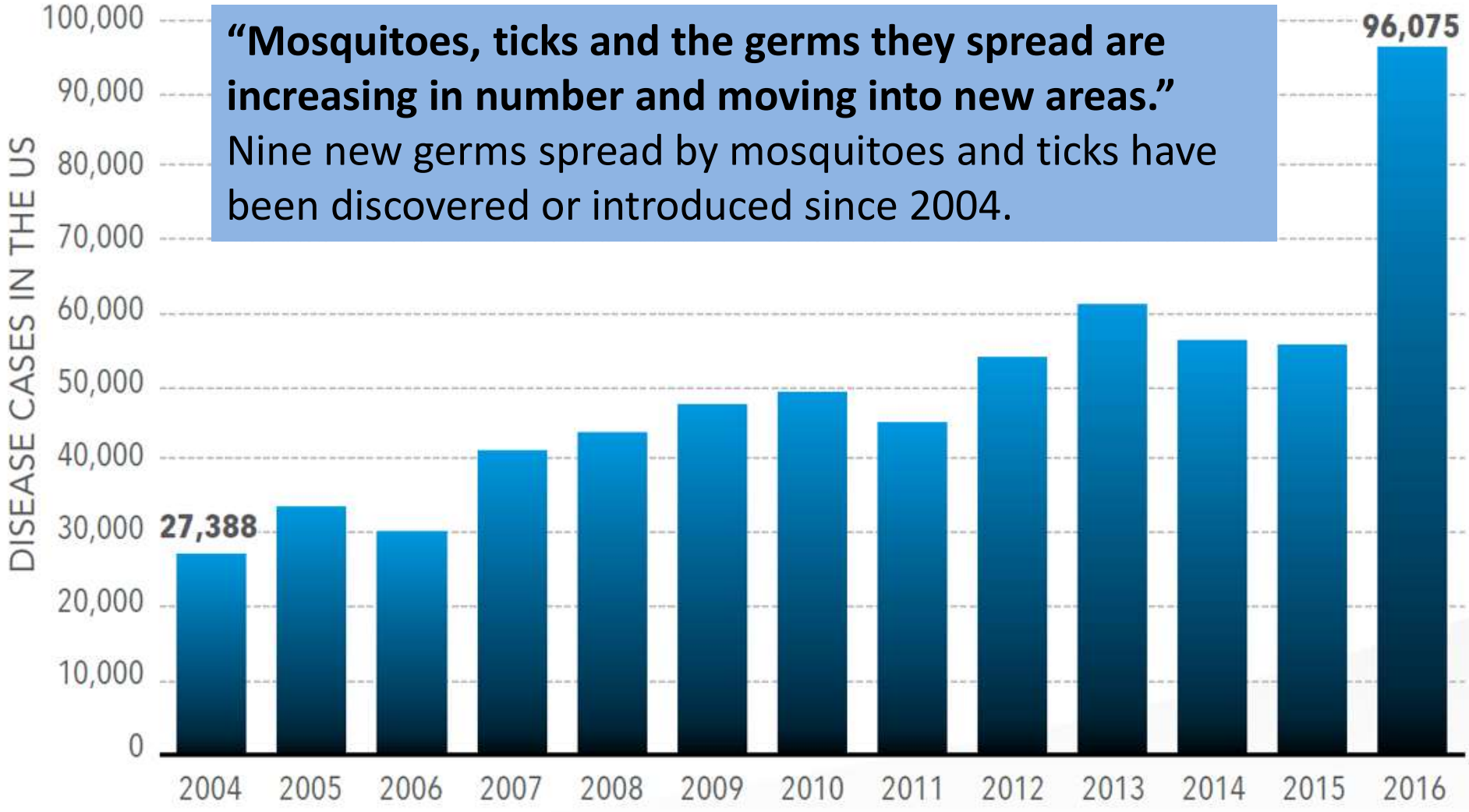
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

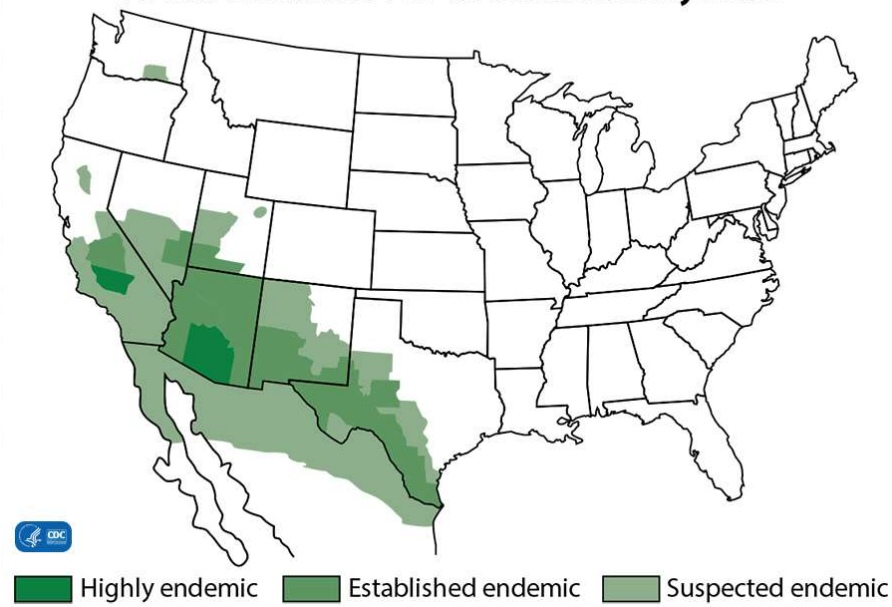
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

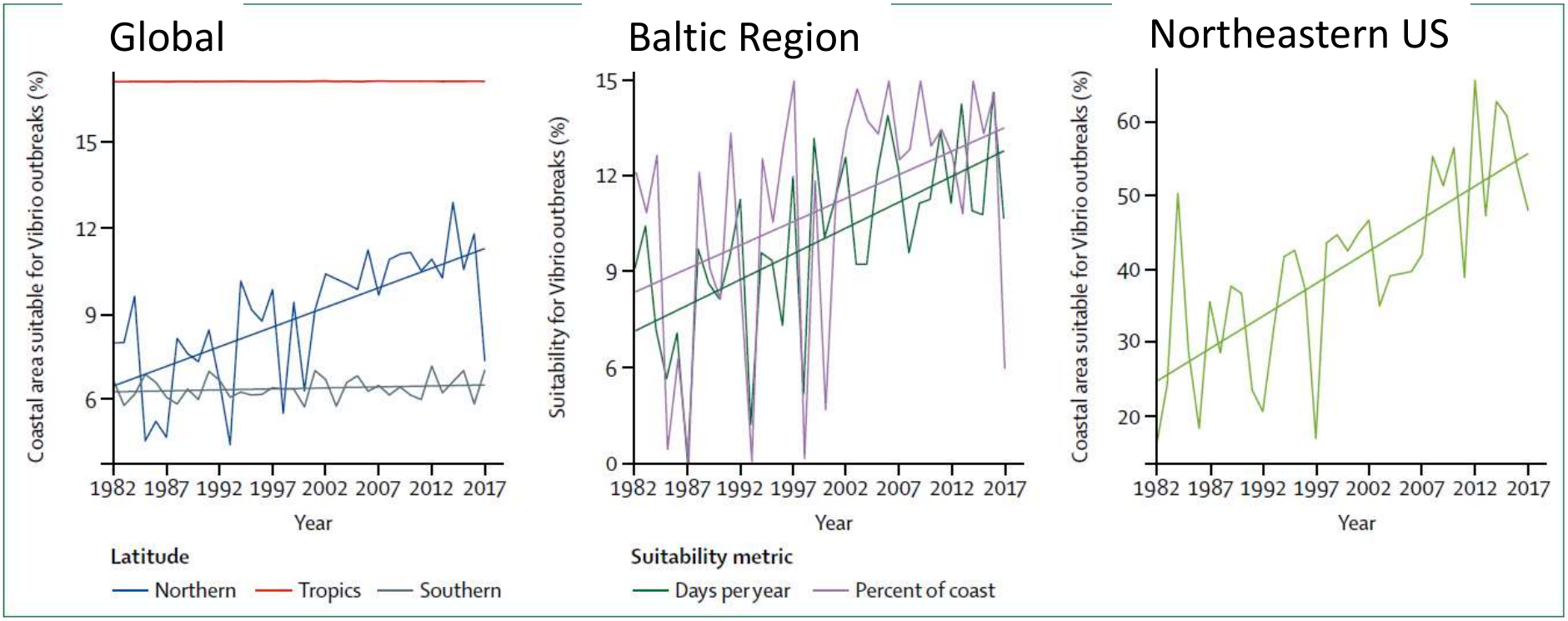
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

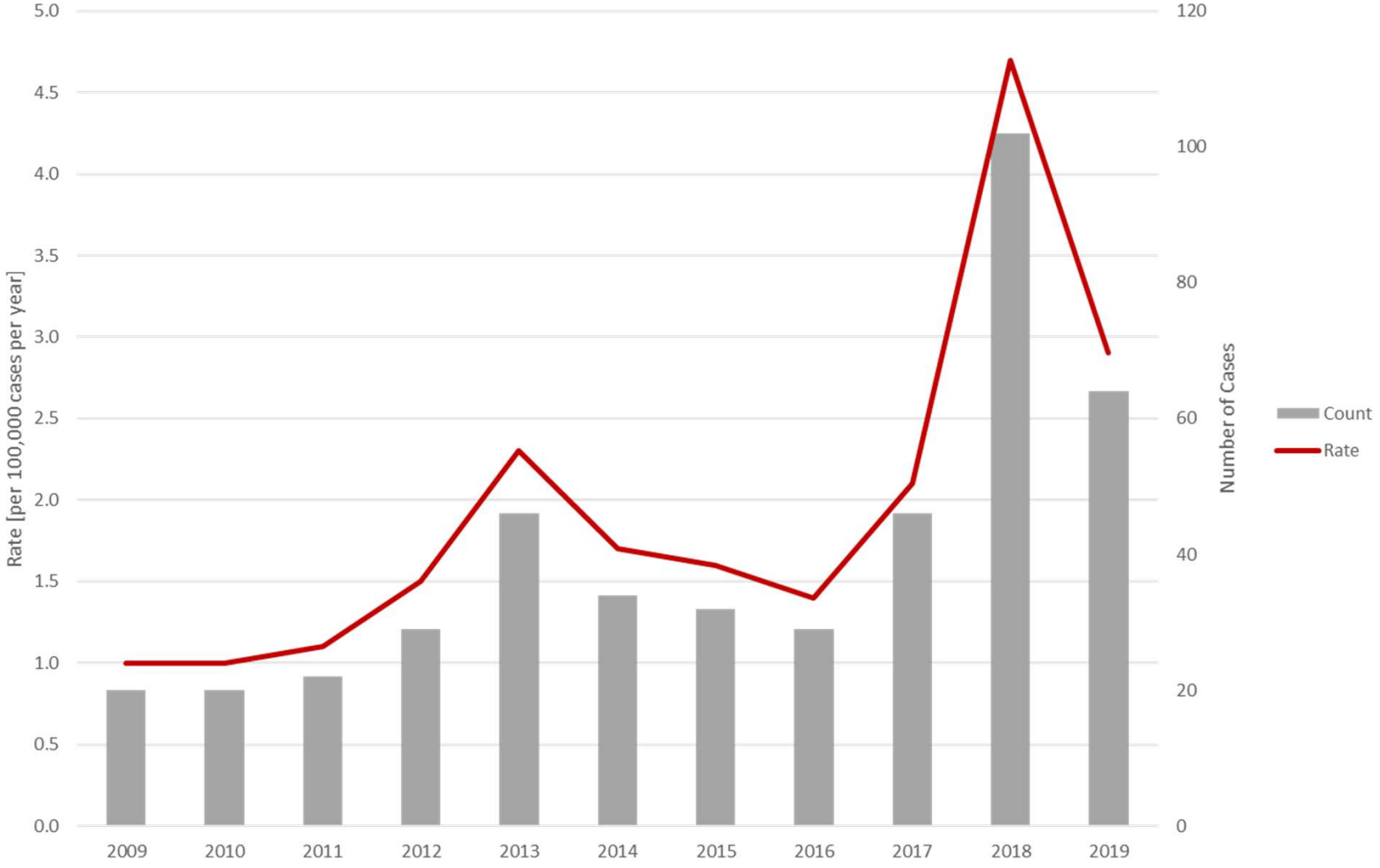
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

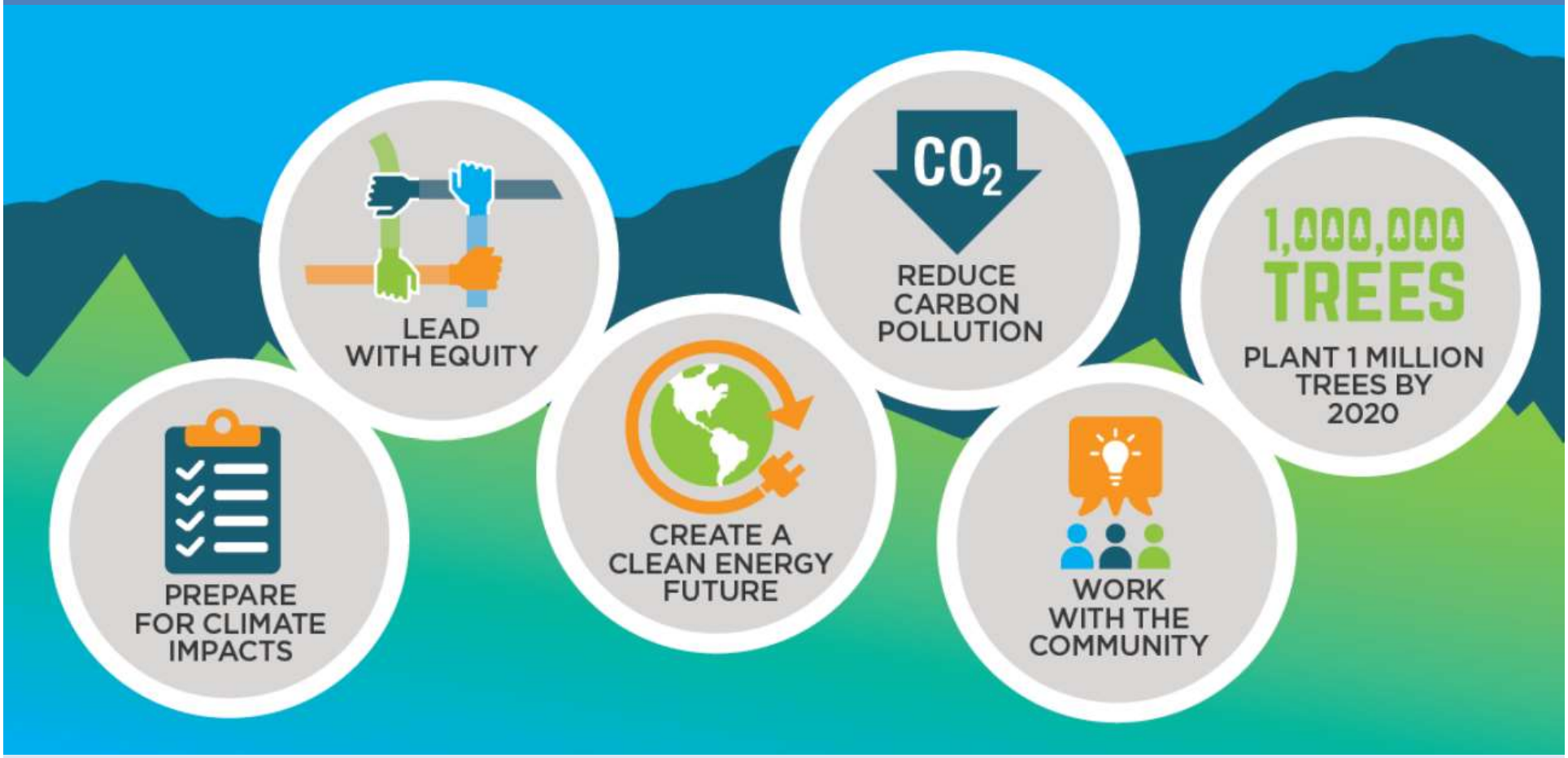
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

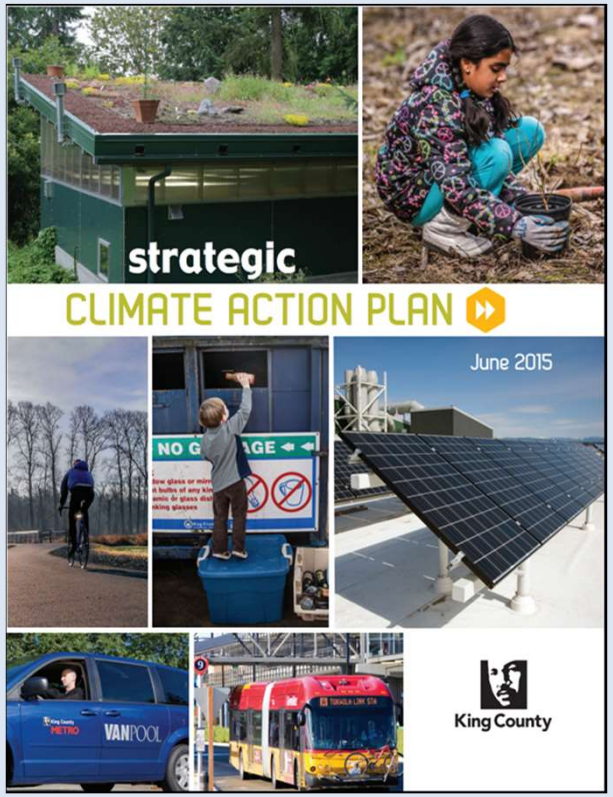


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

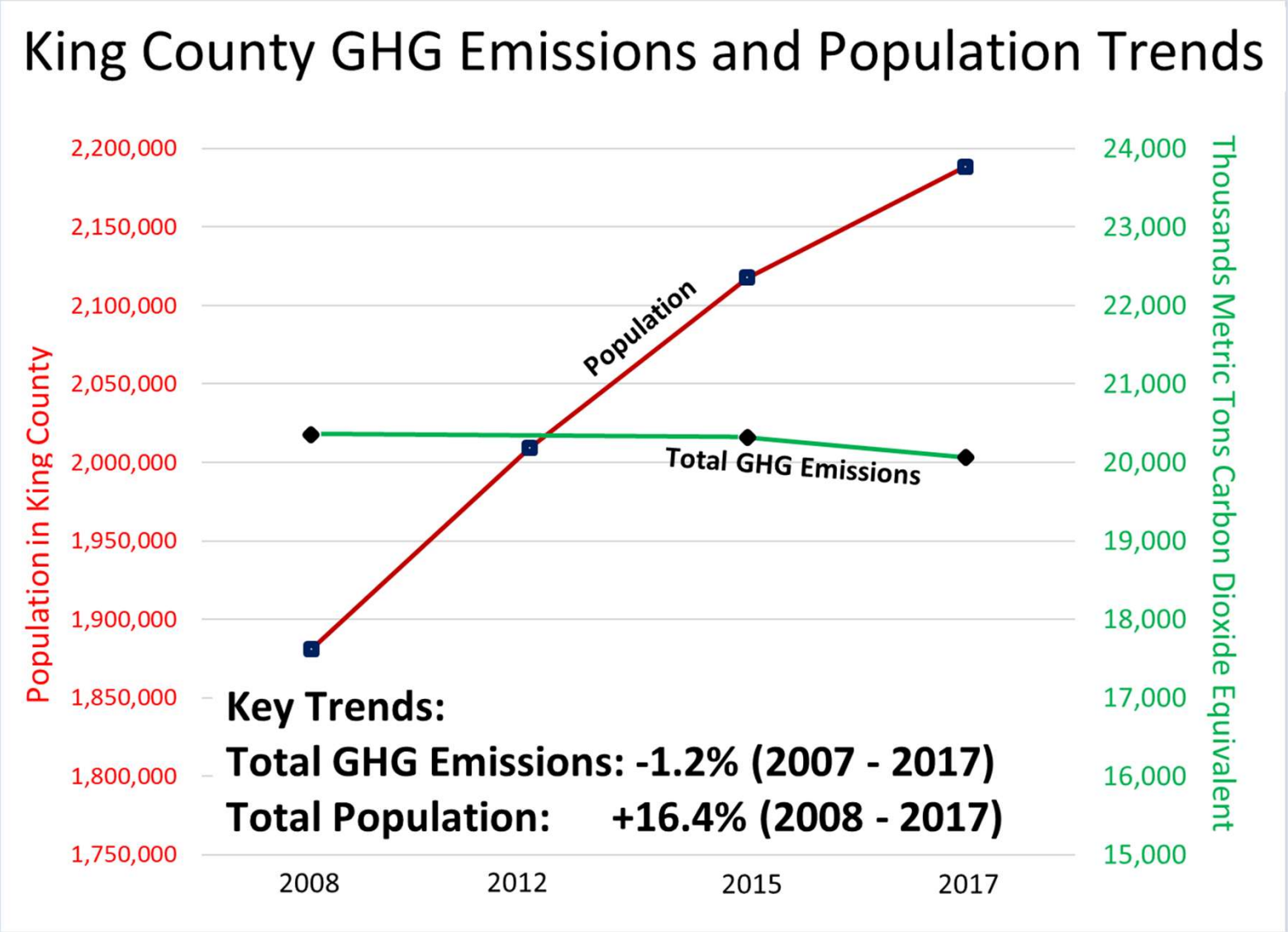
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



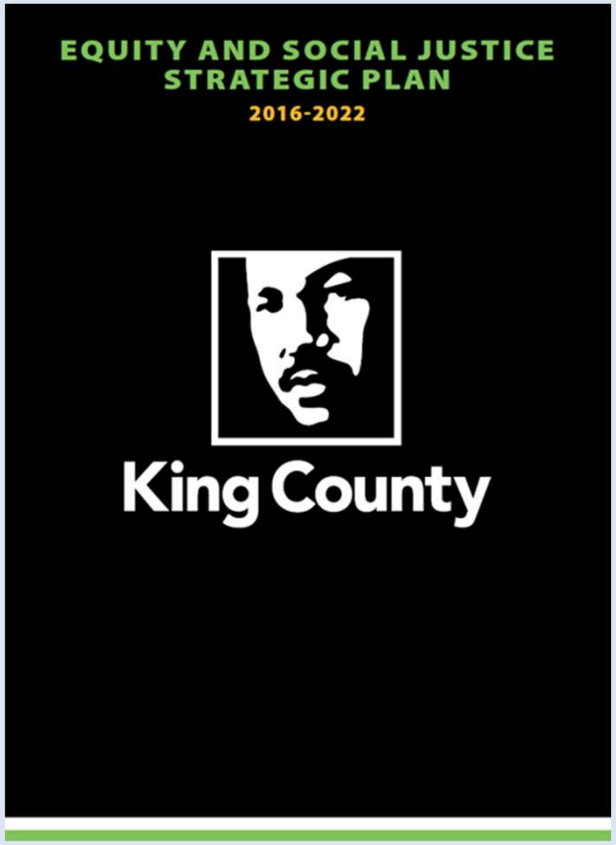
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

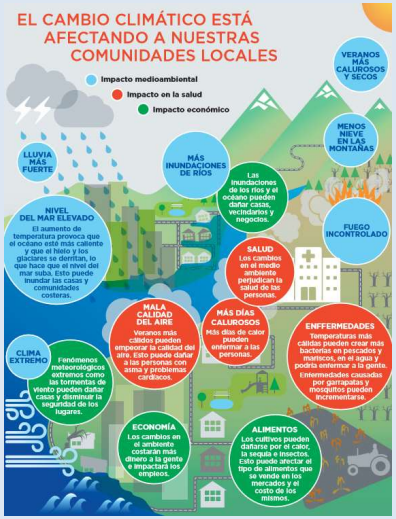
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

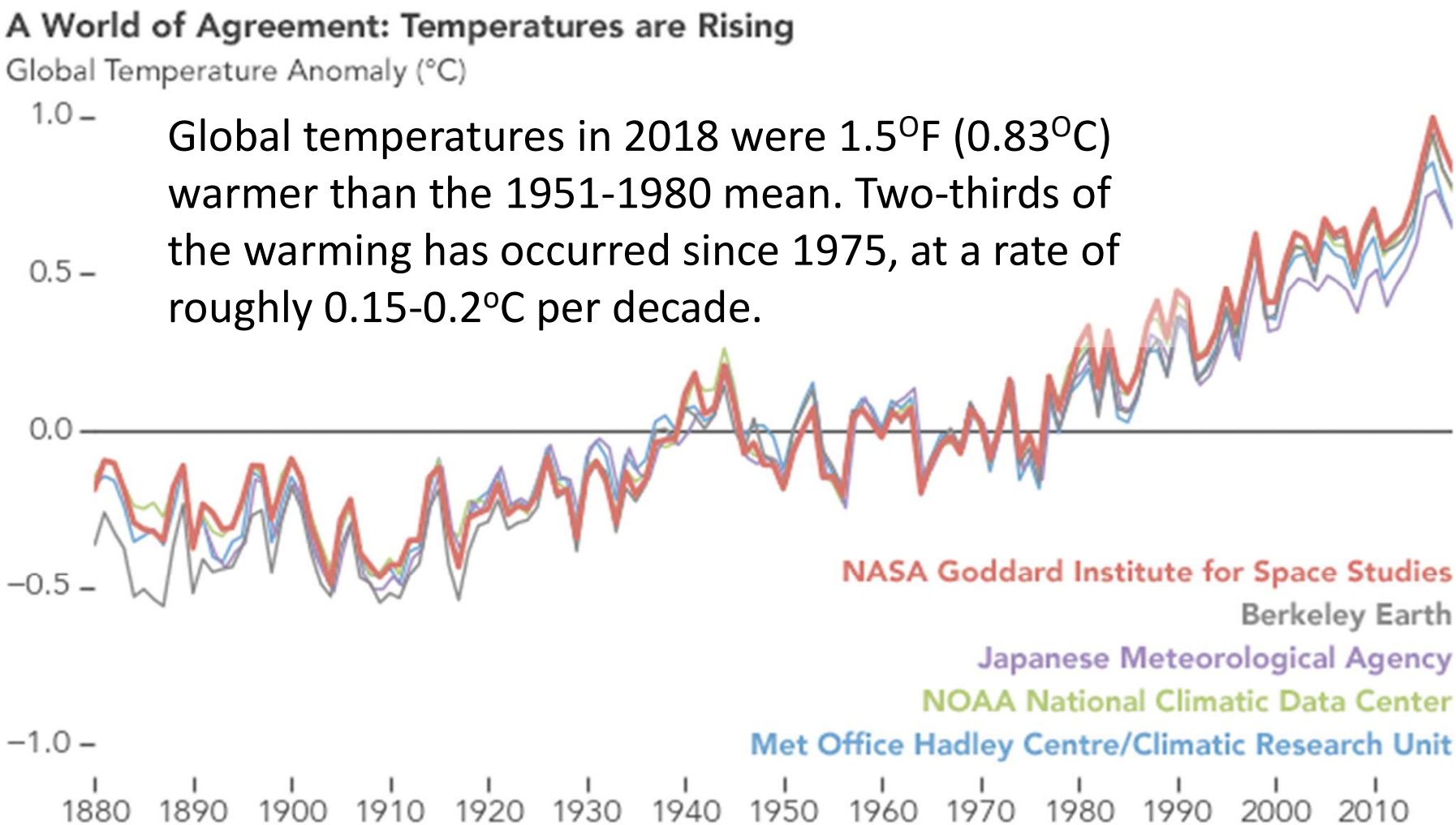
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

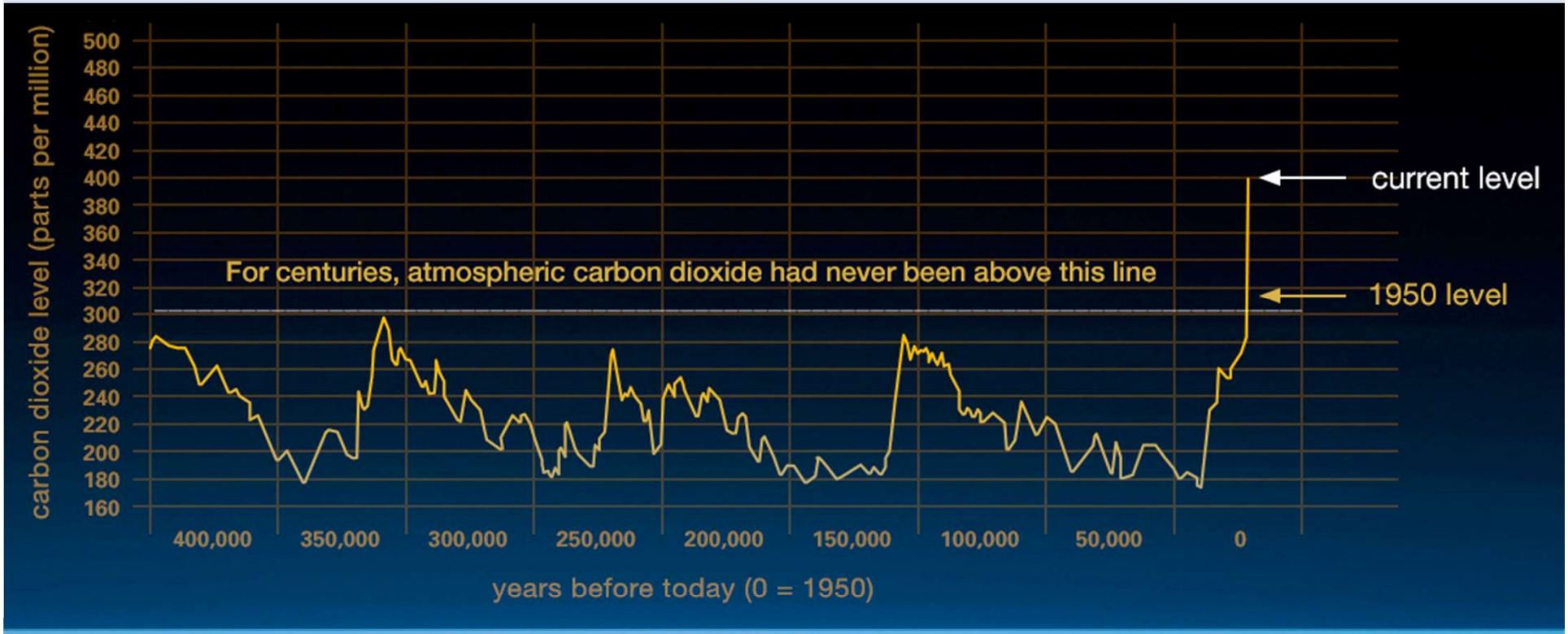


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

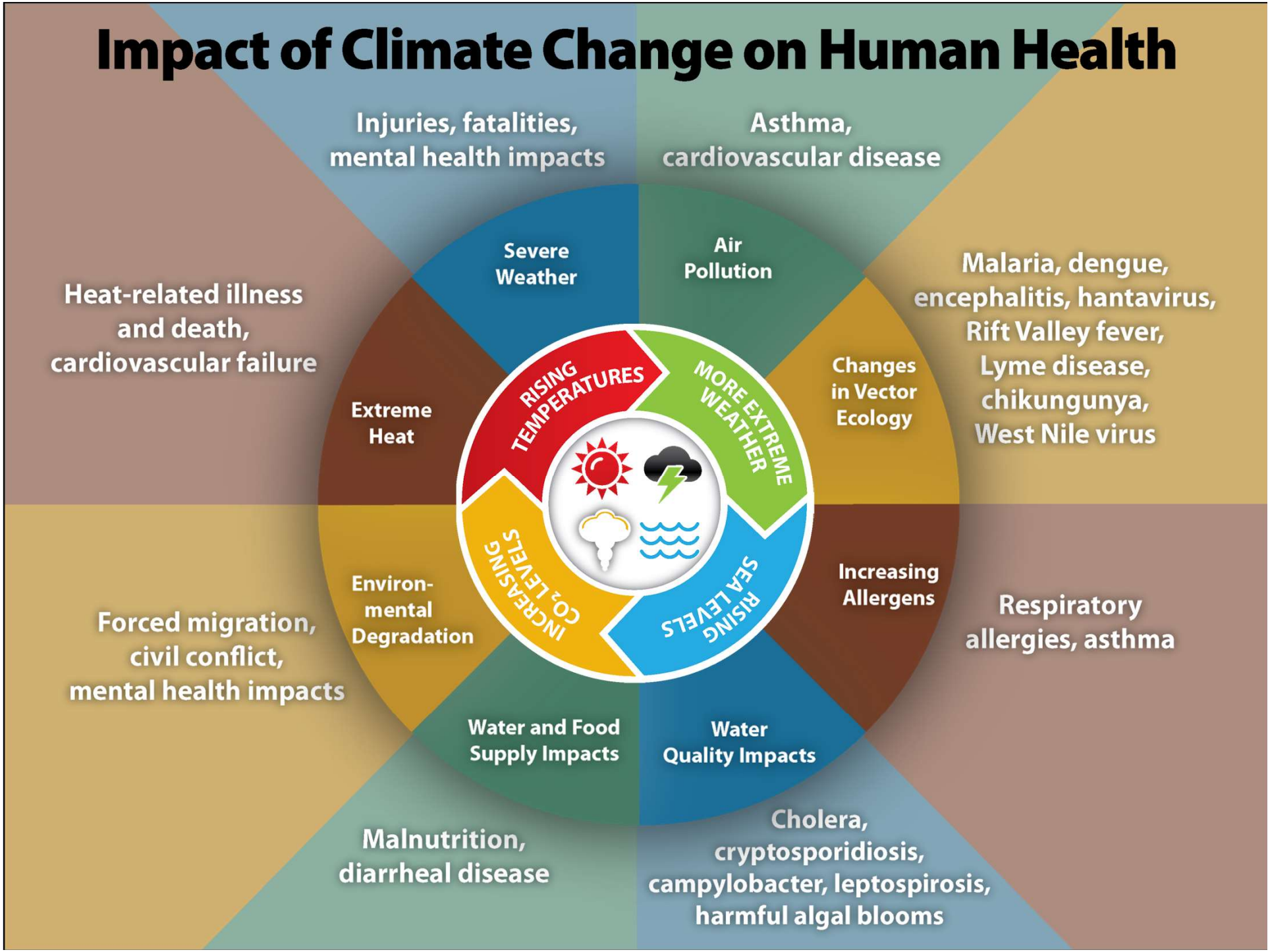
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

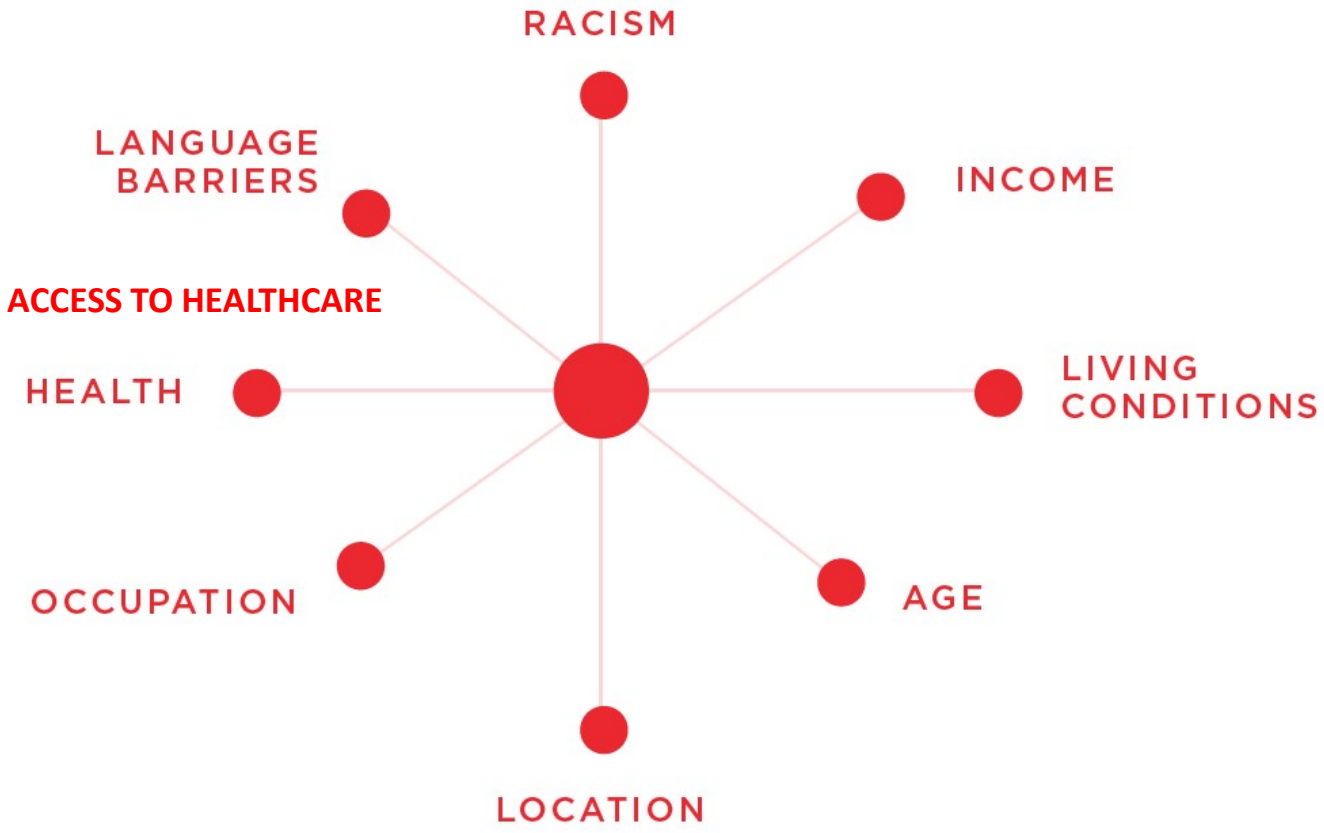
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

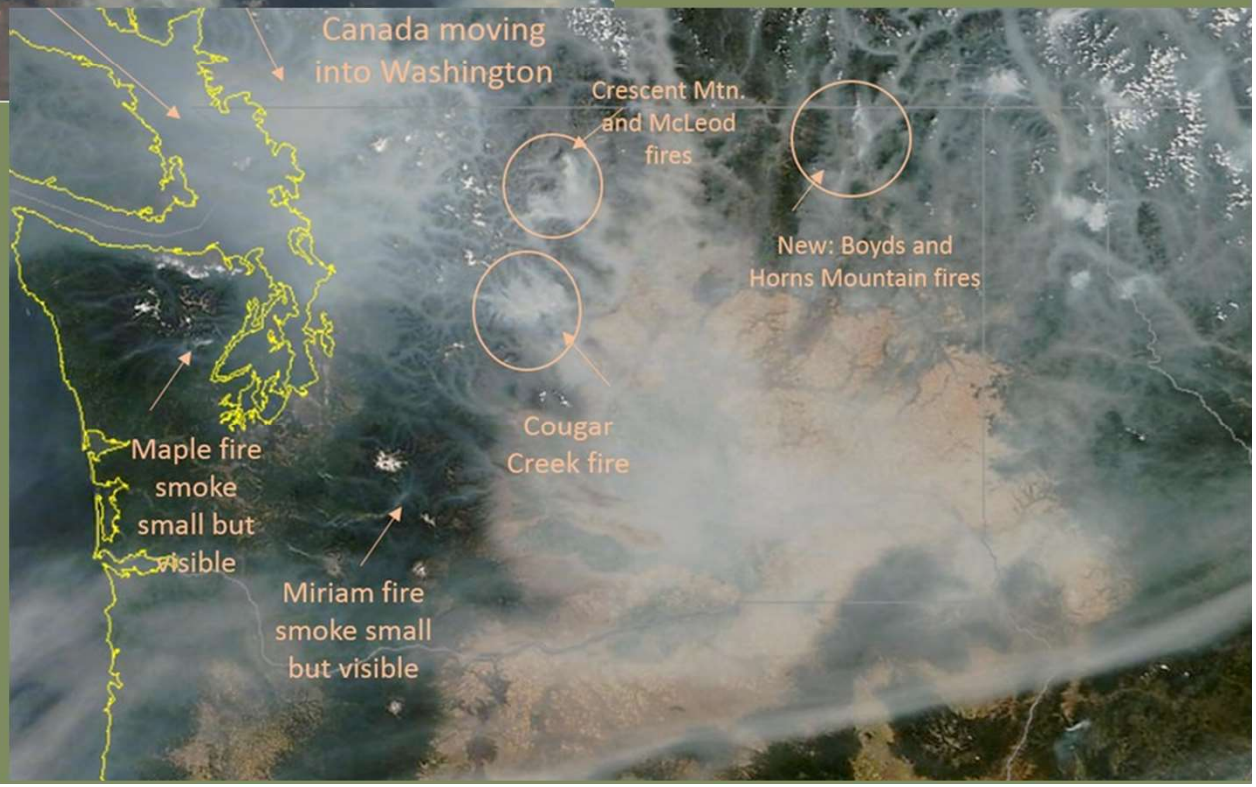
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

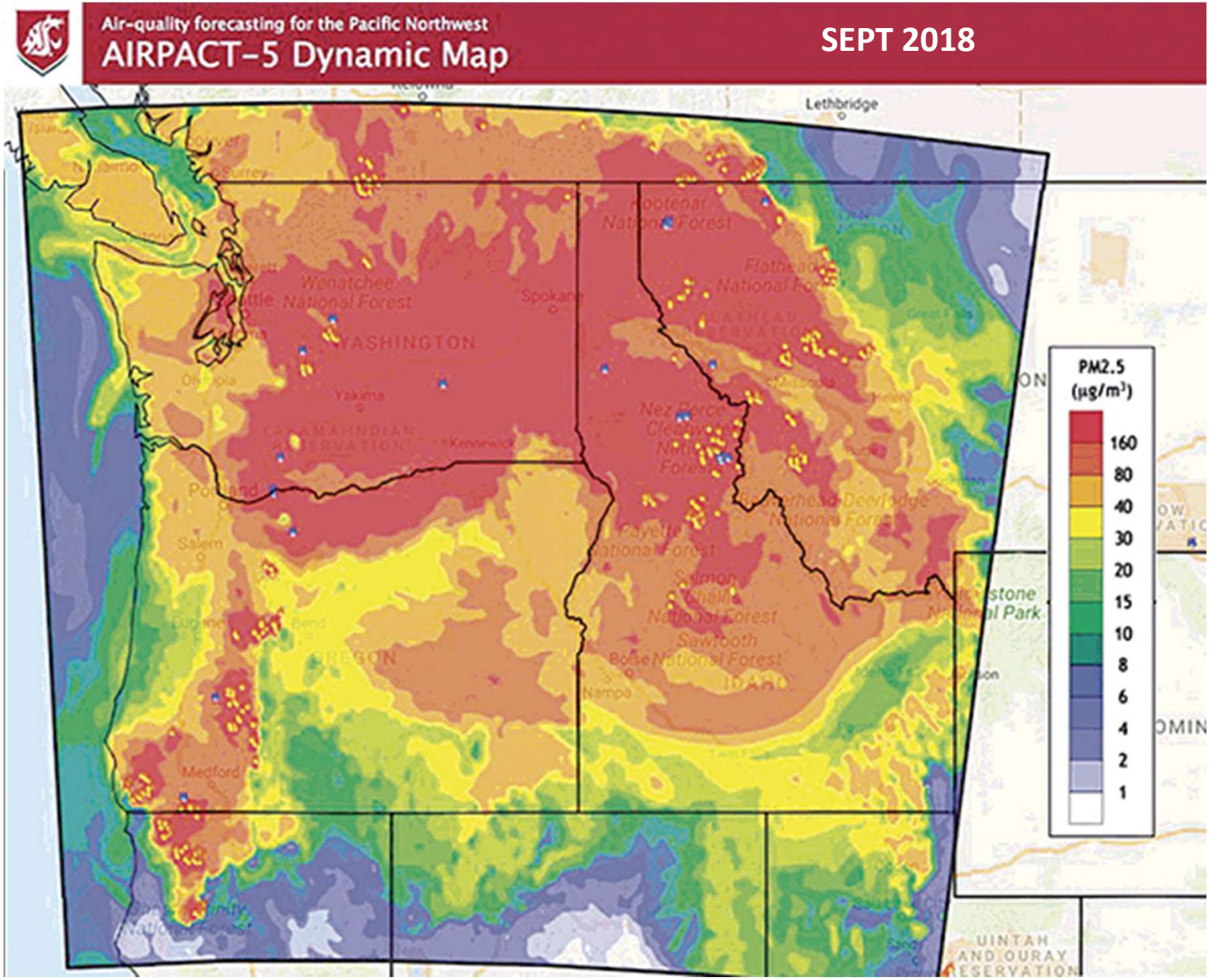
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

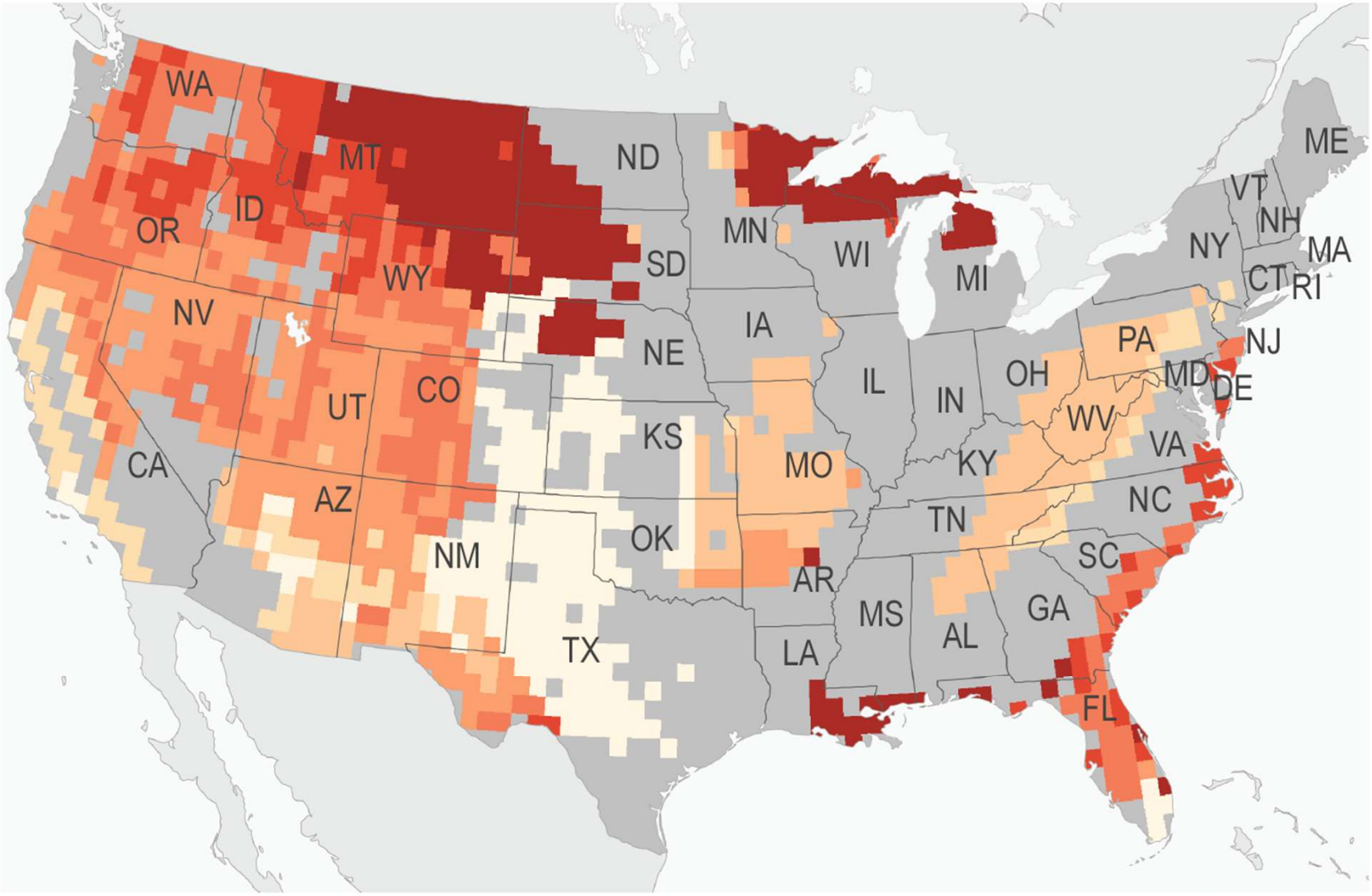
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

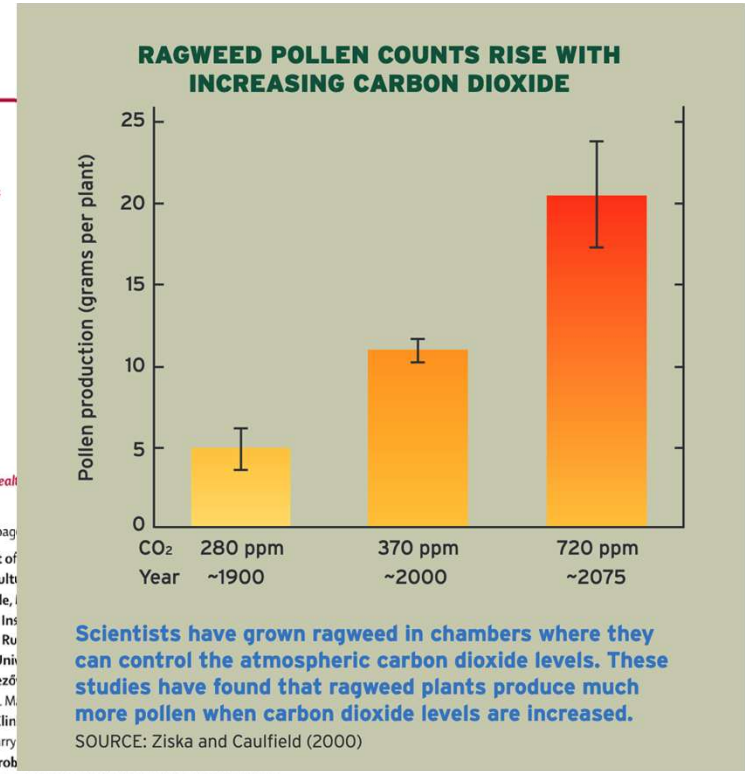
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

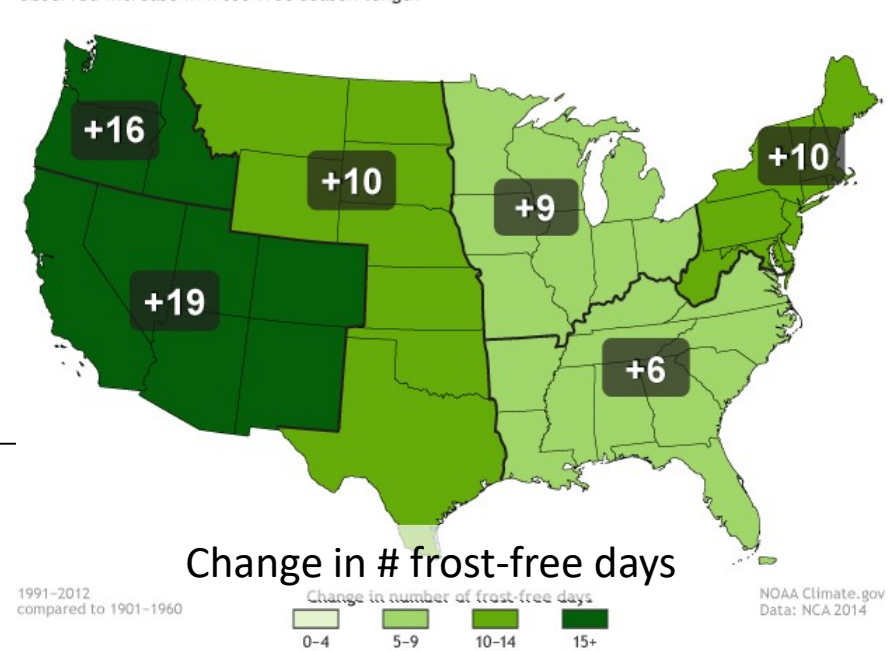
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

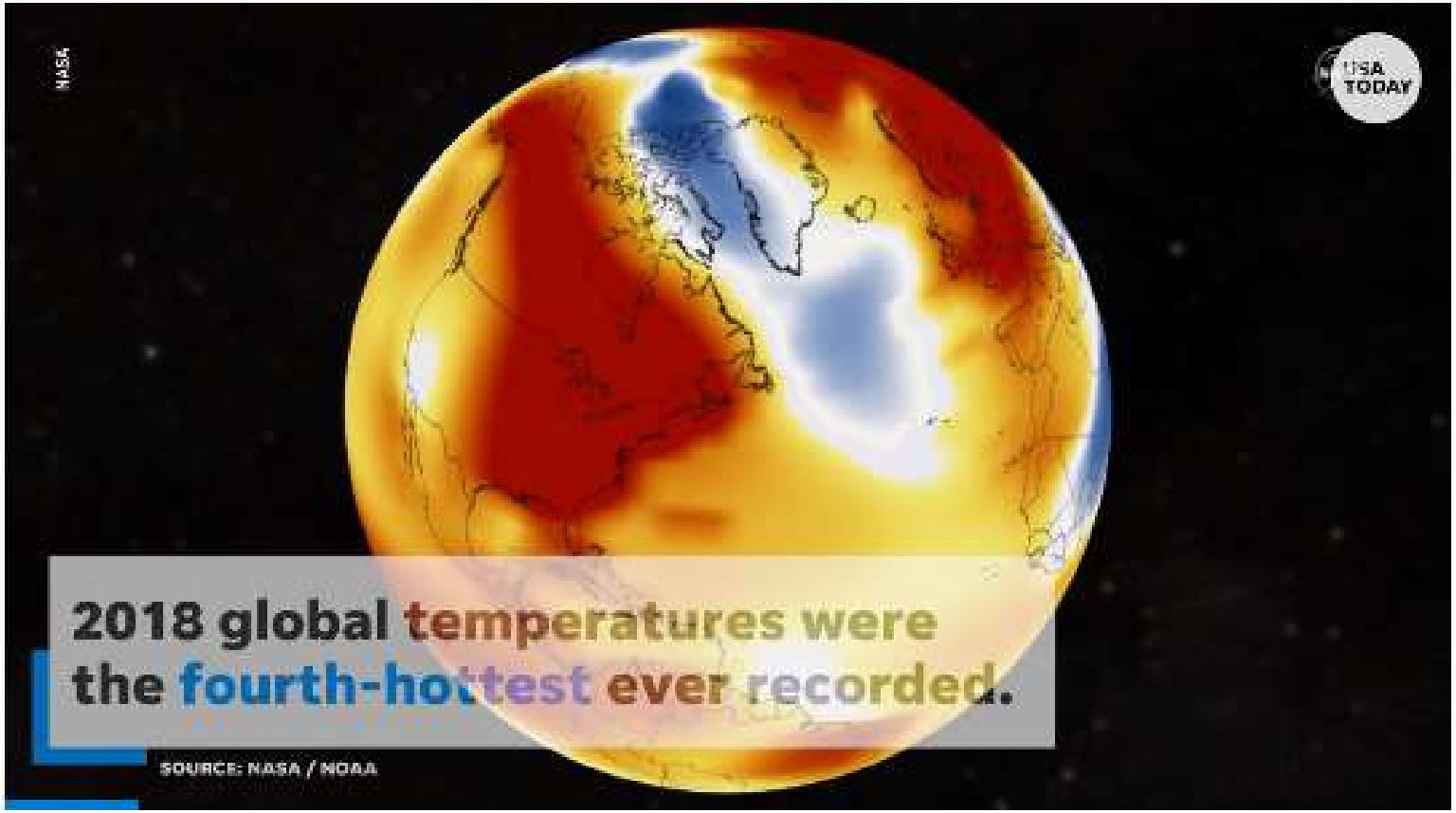
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



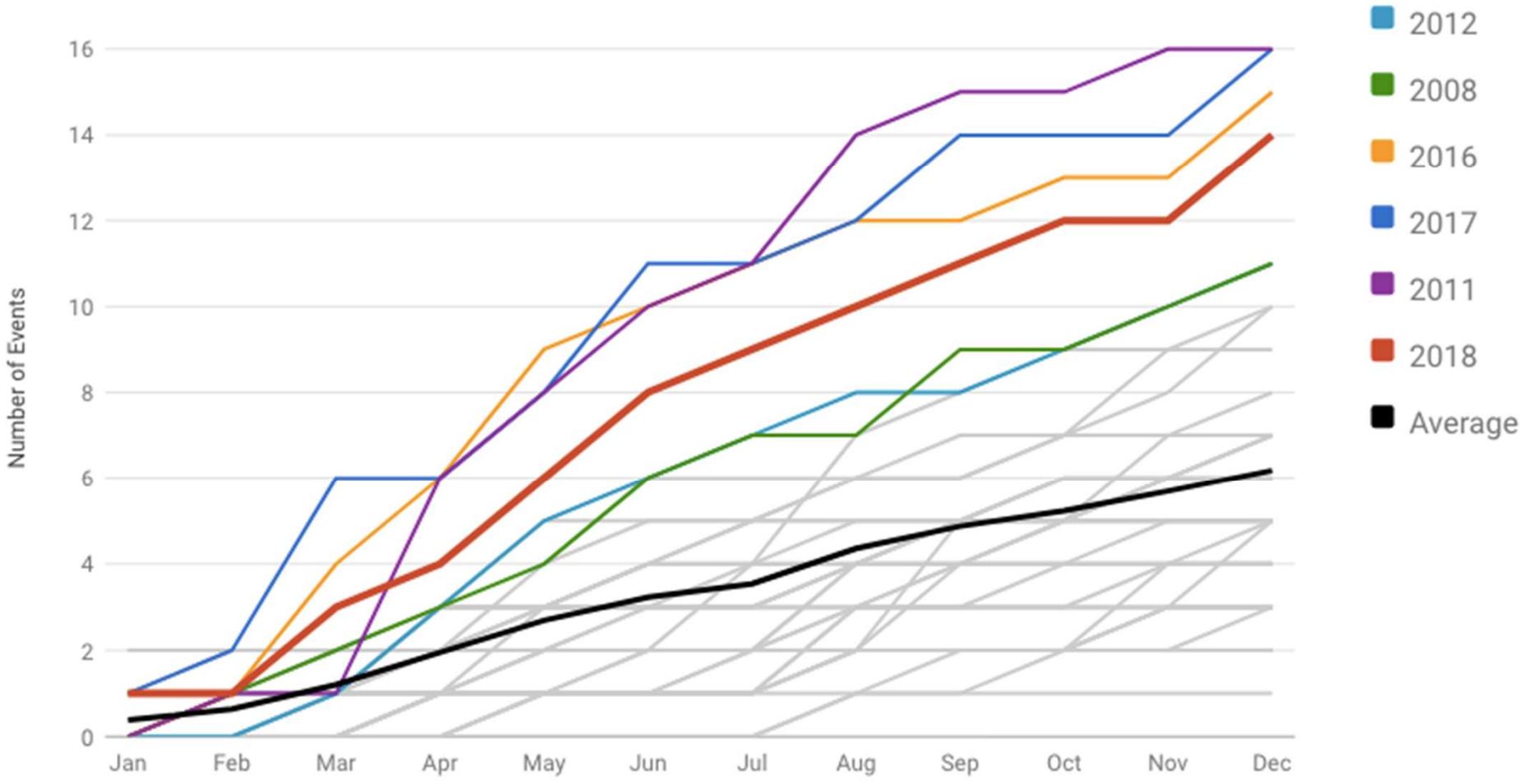
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



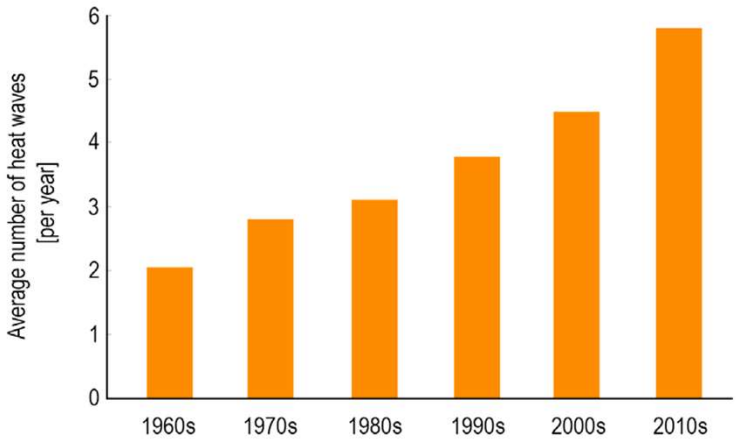
NOAA: National Centers for Environmental Information

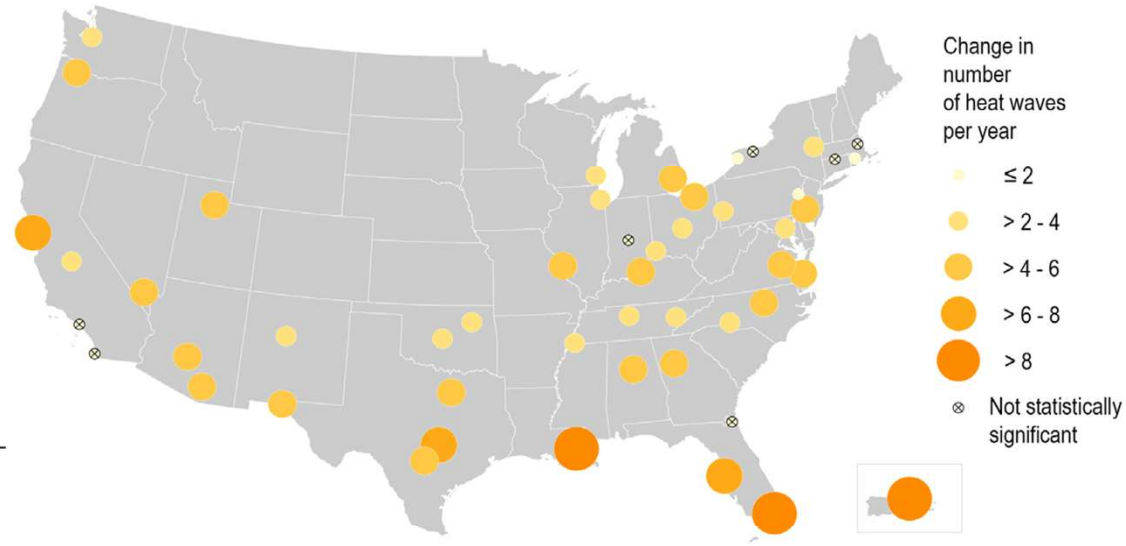
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

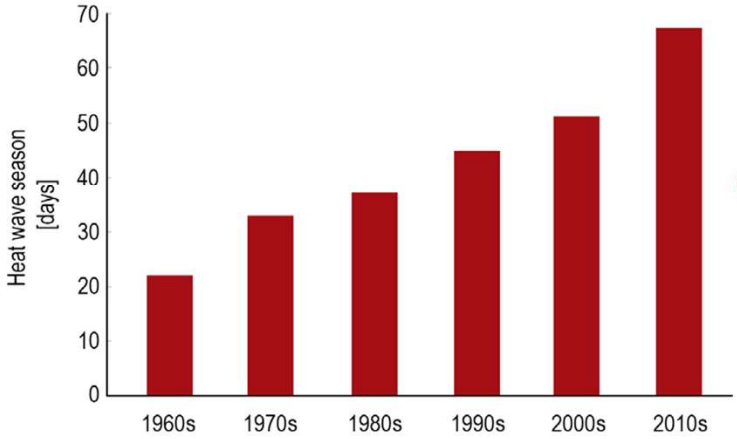
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

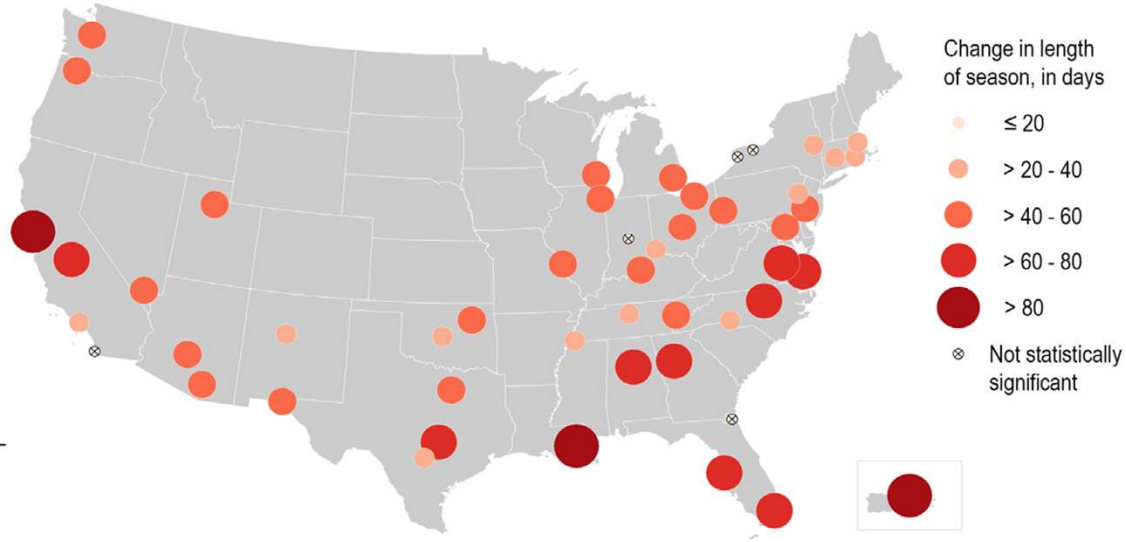
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

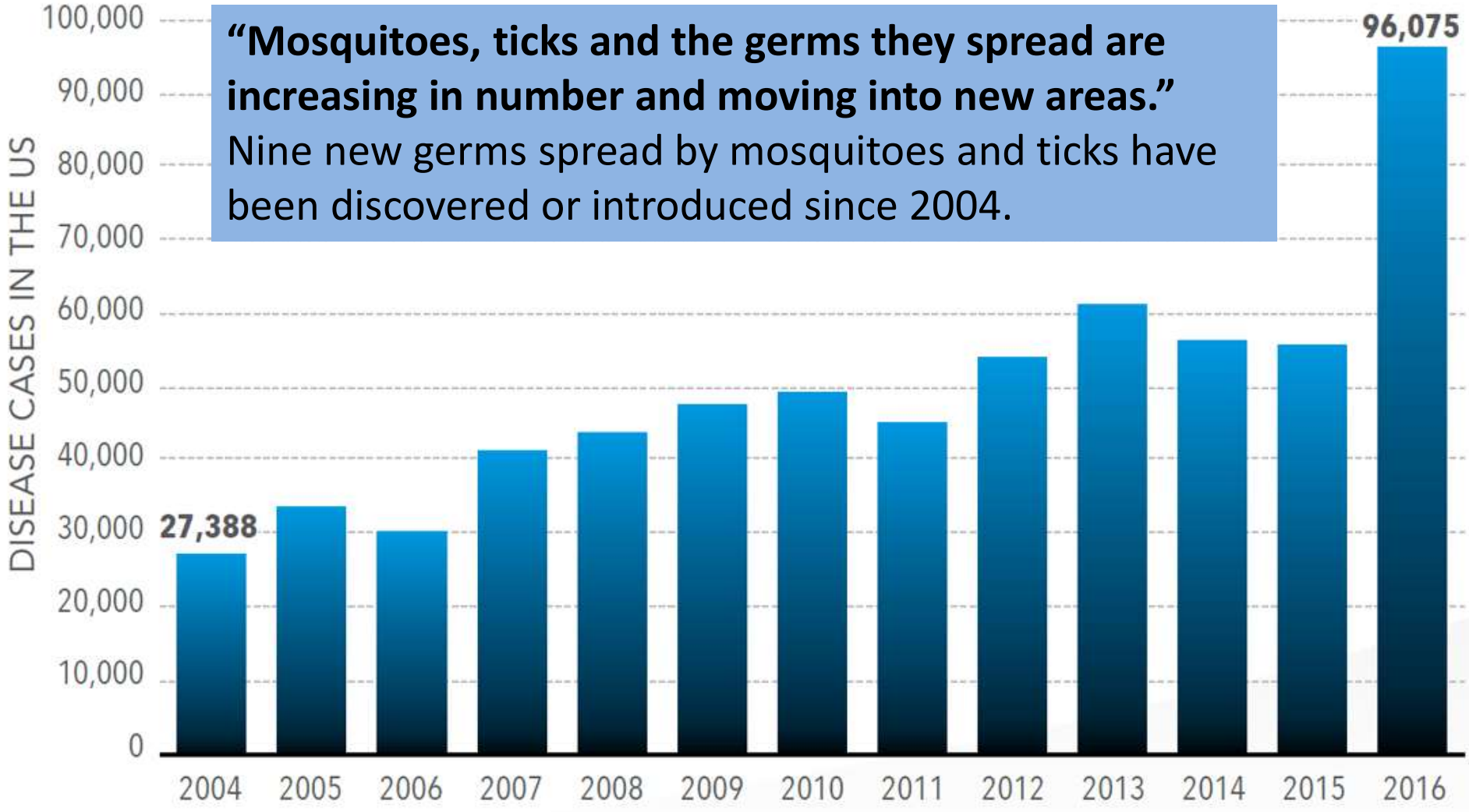
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

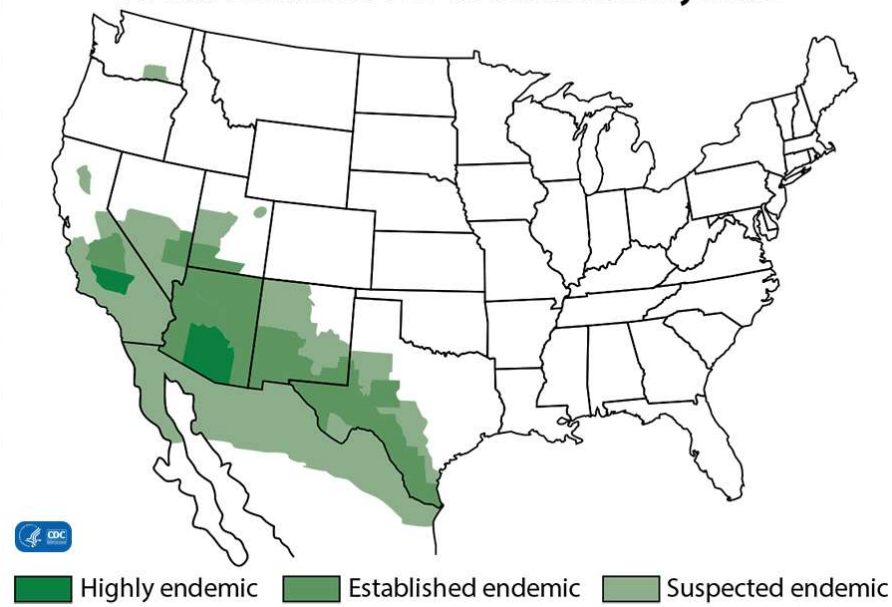
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

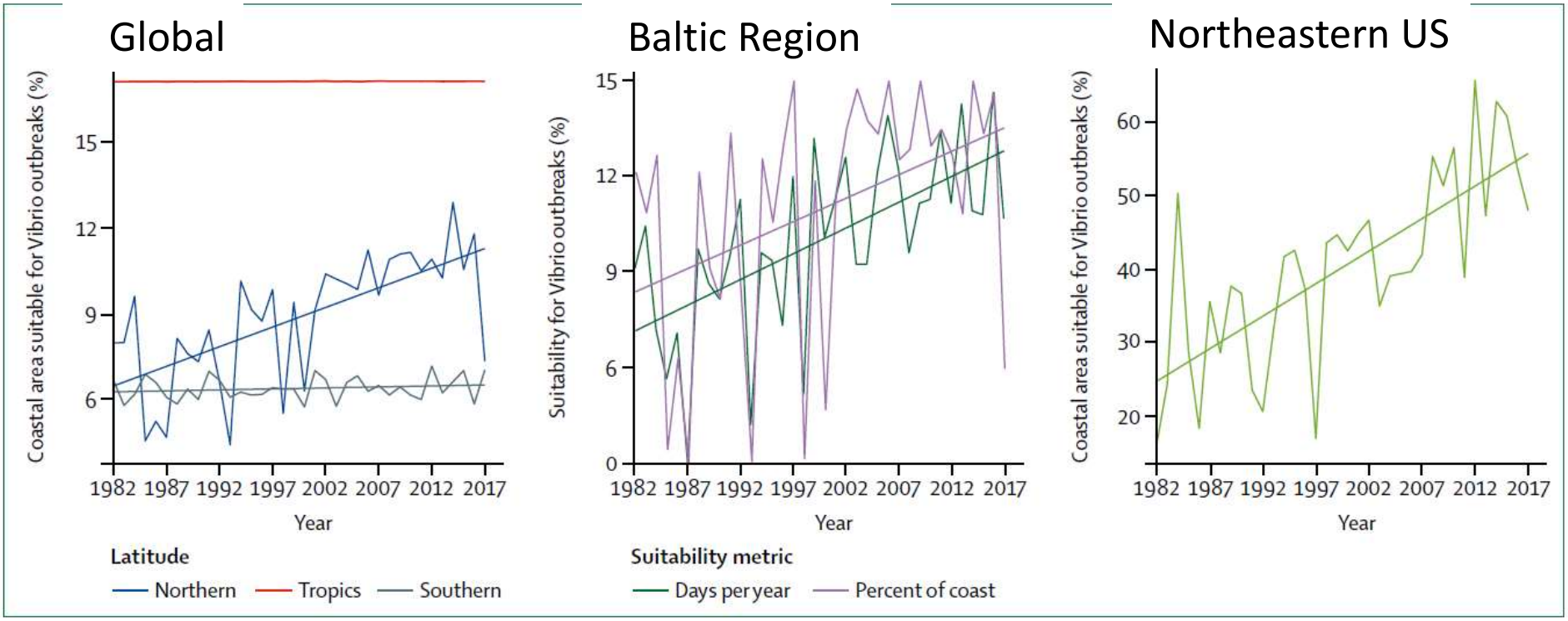
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

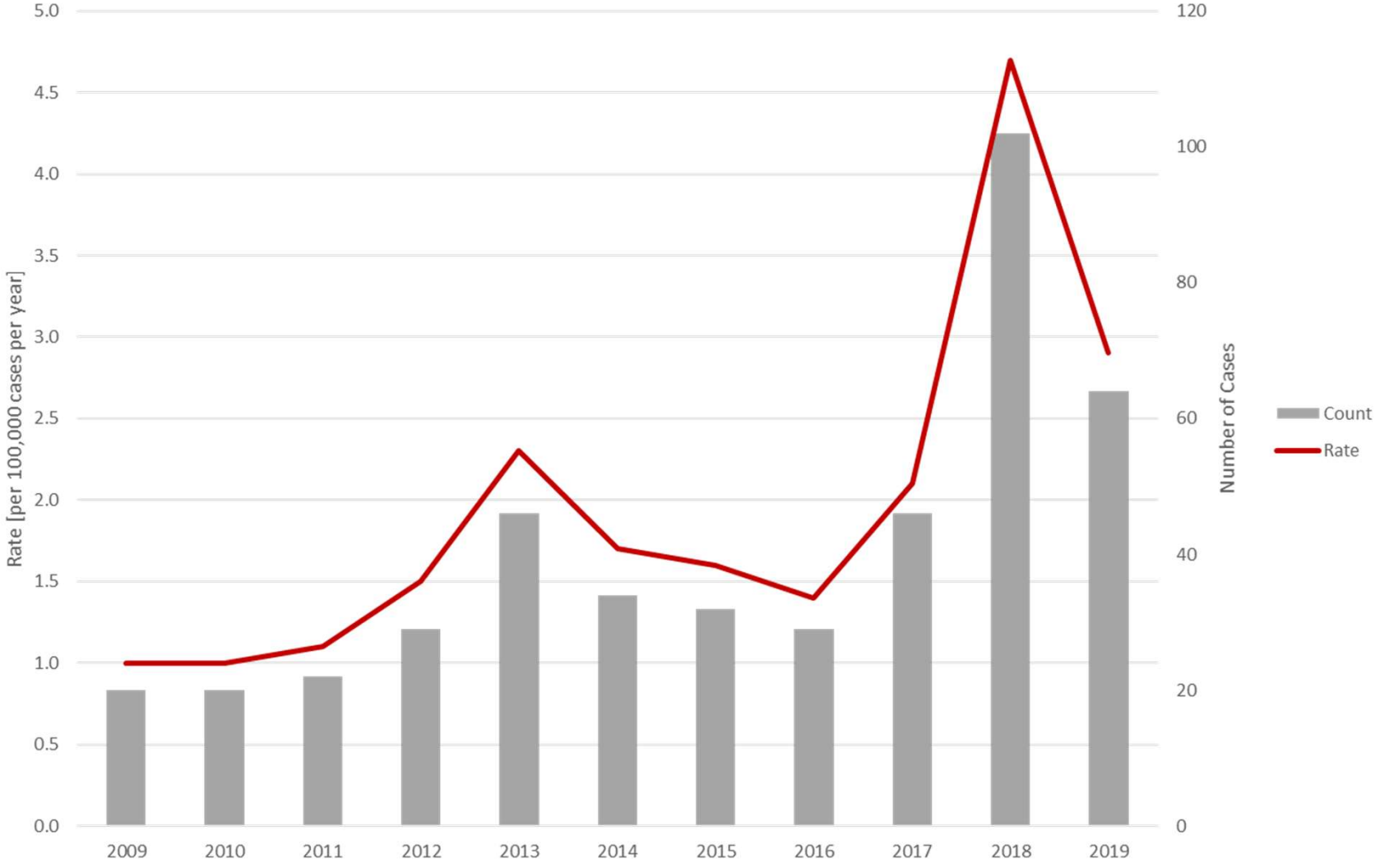
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

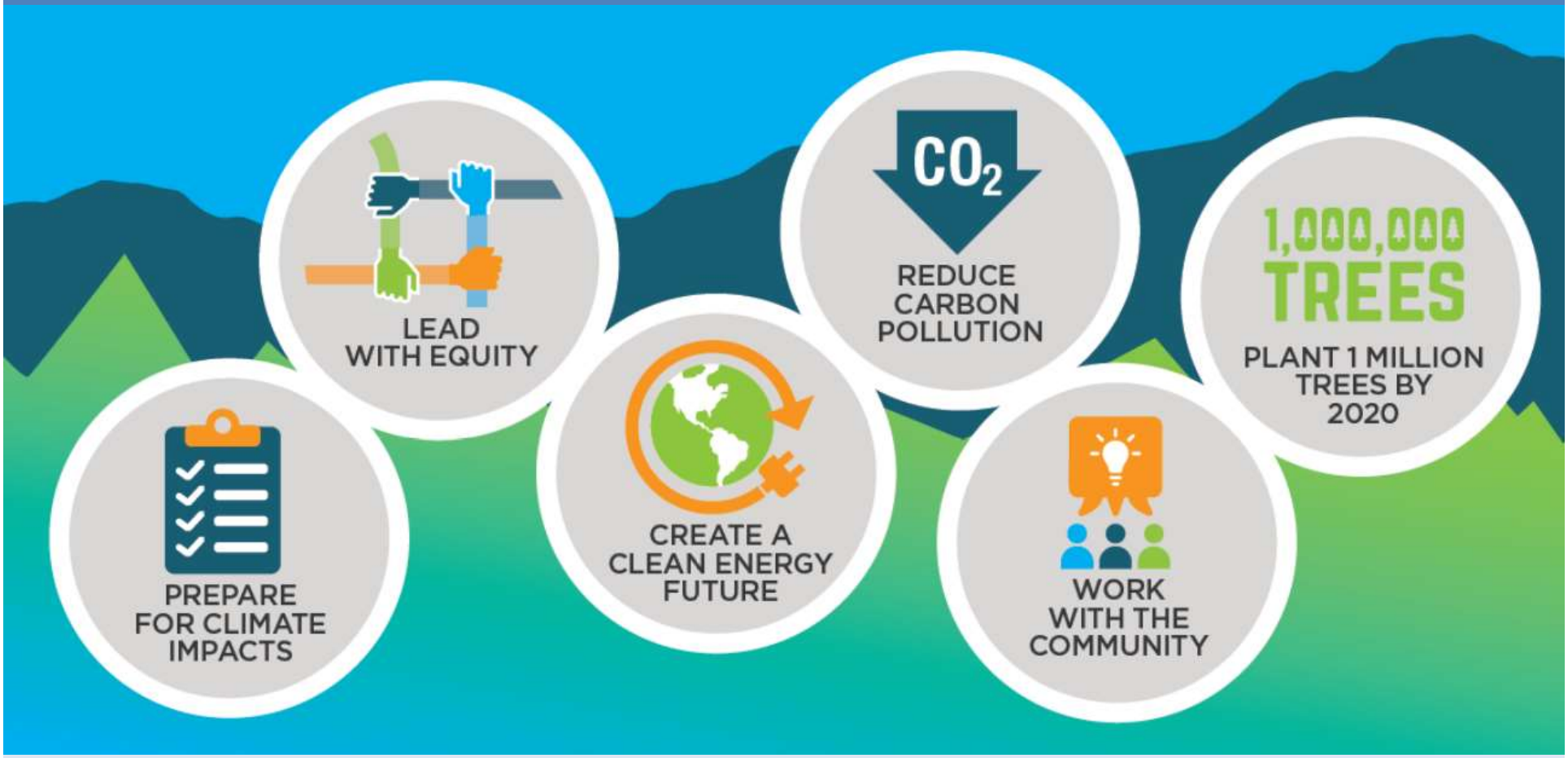
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

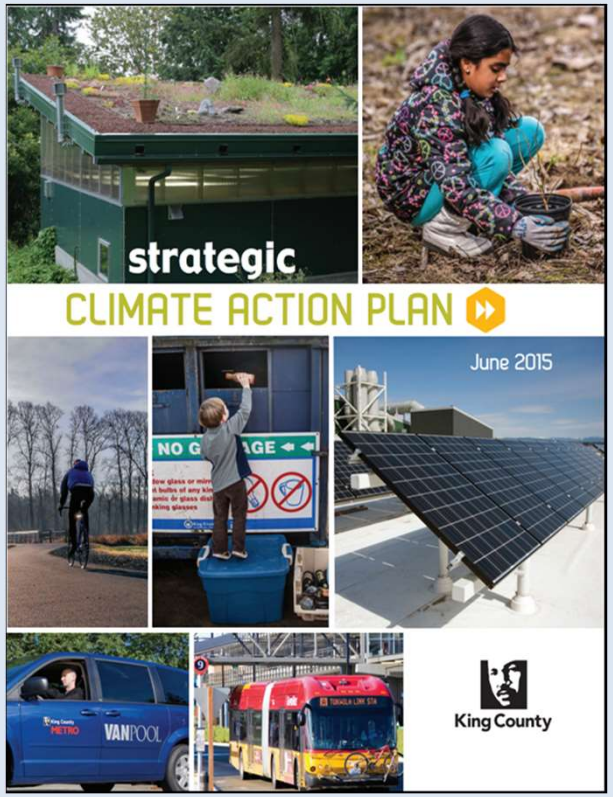


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

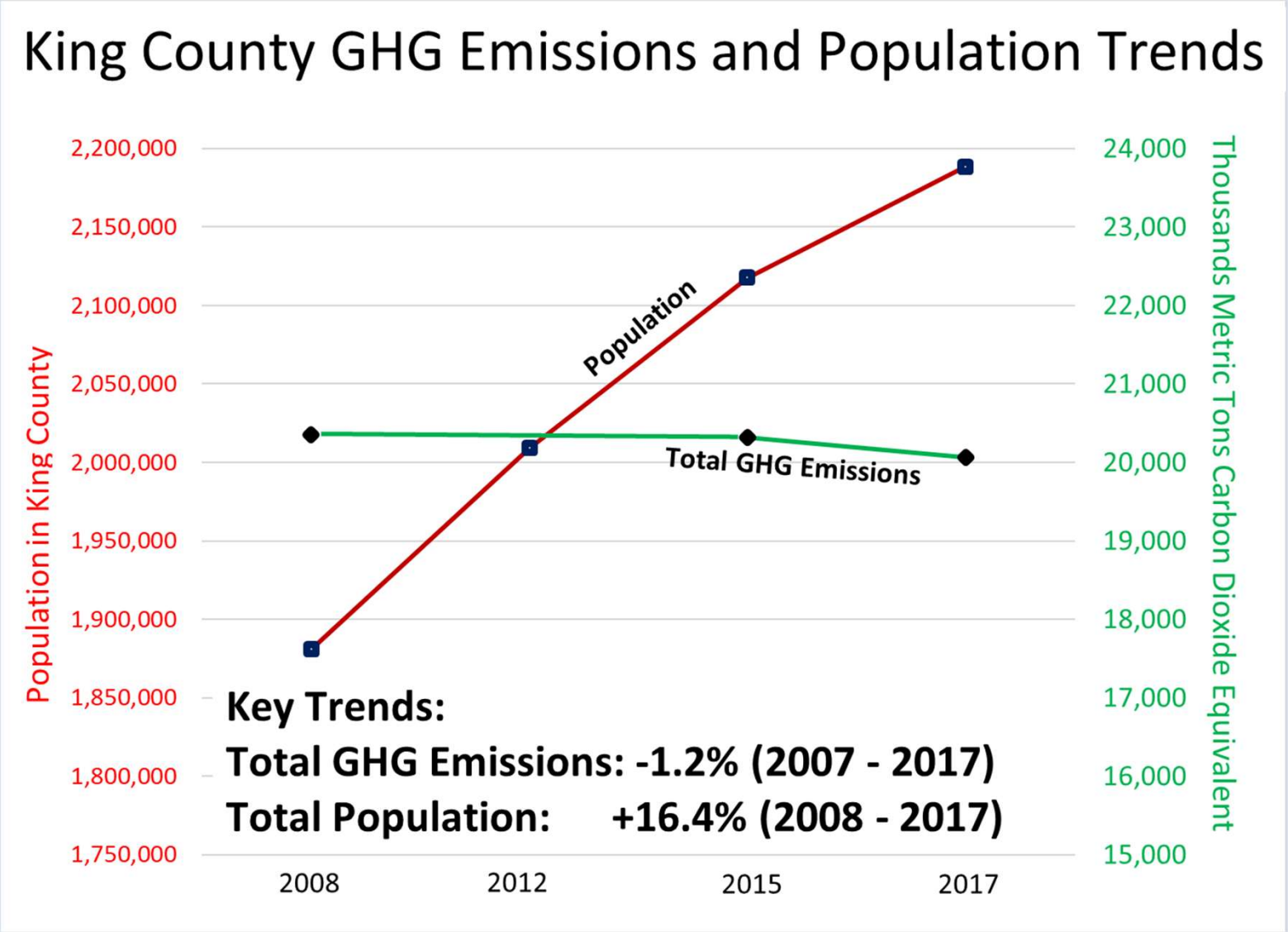
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



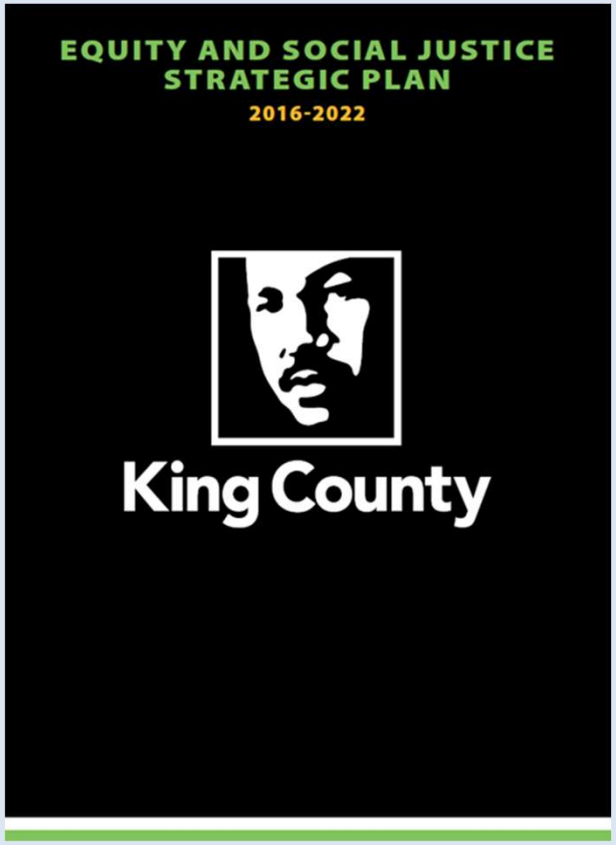
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

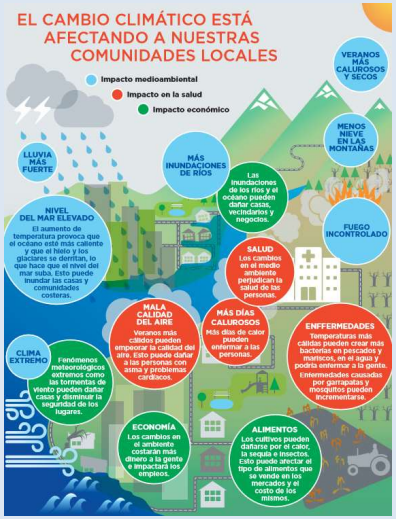
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

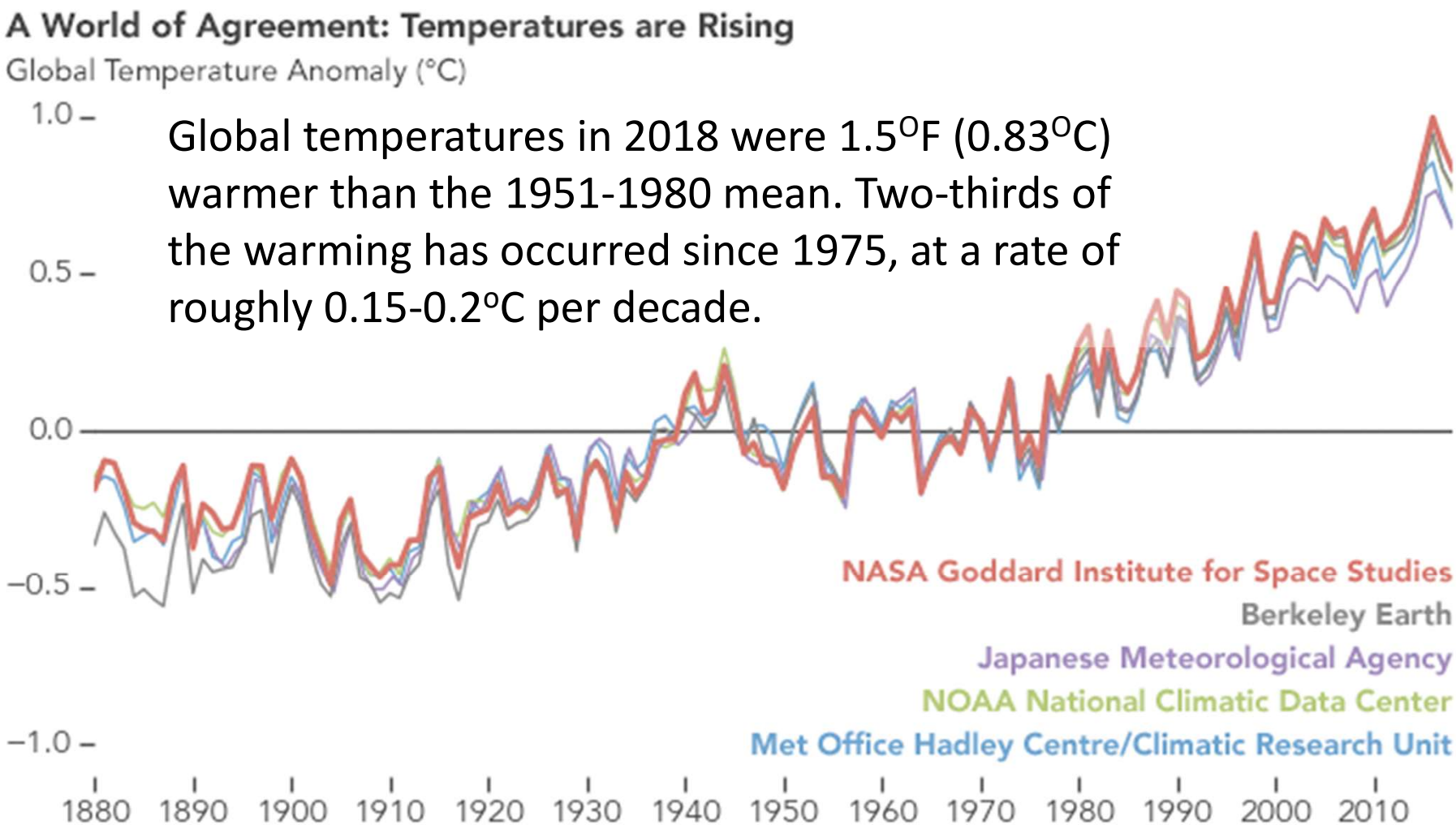
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

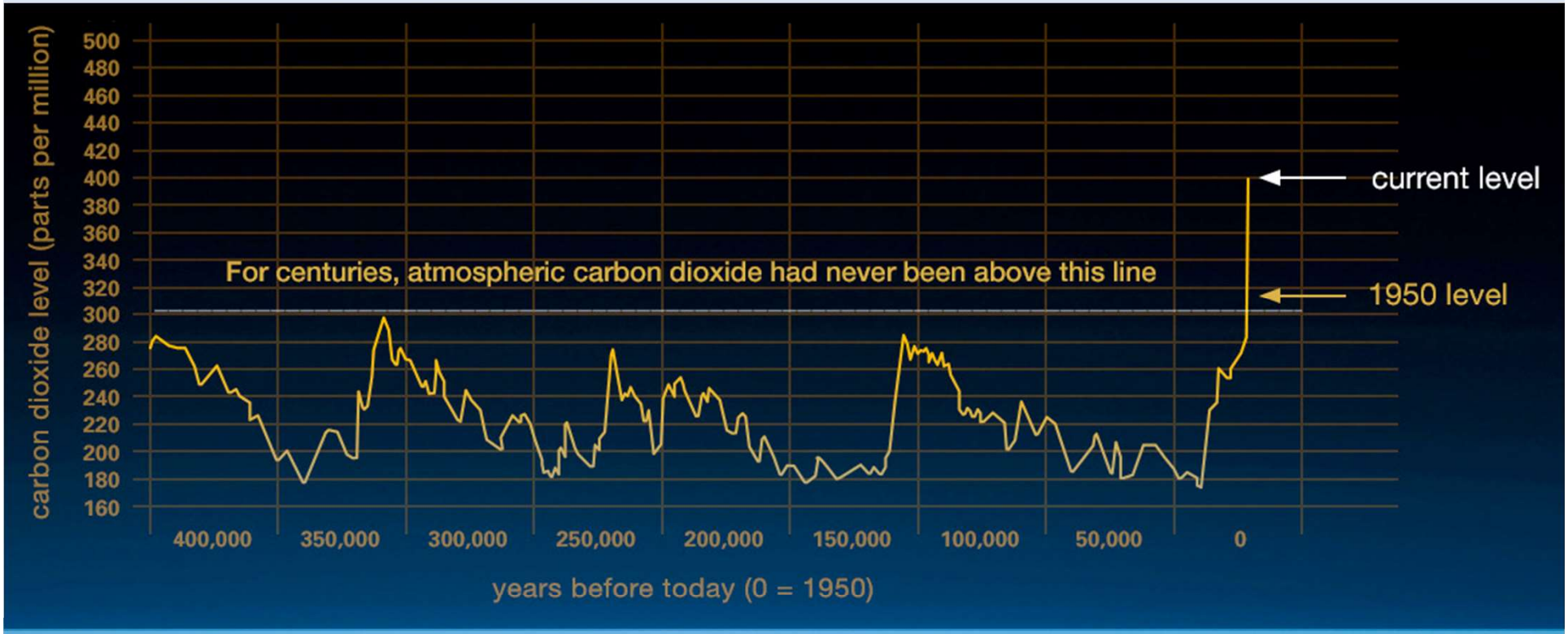


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

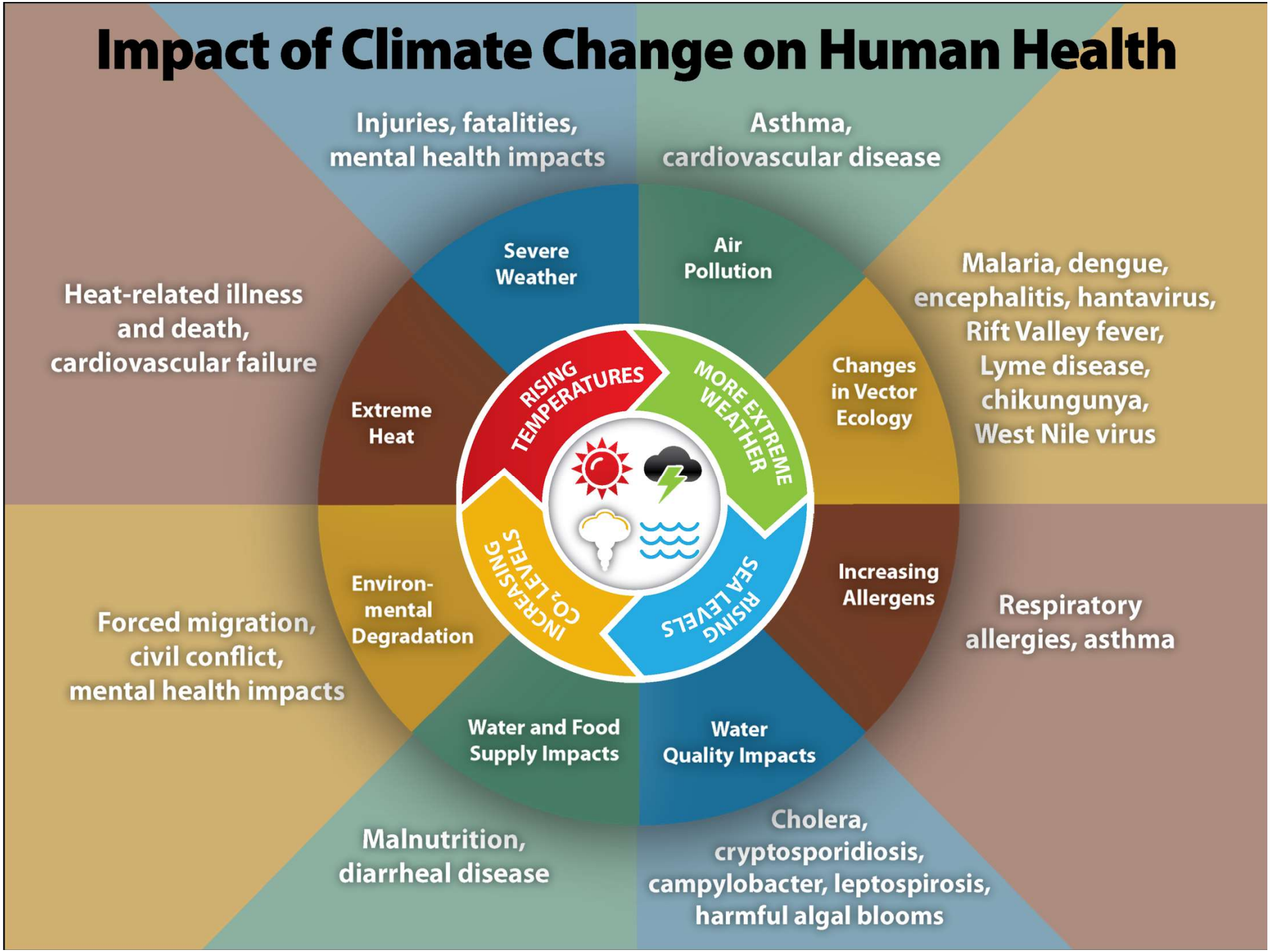
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

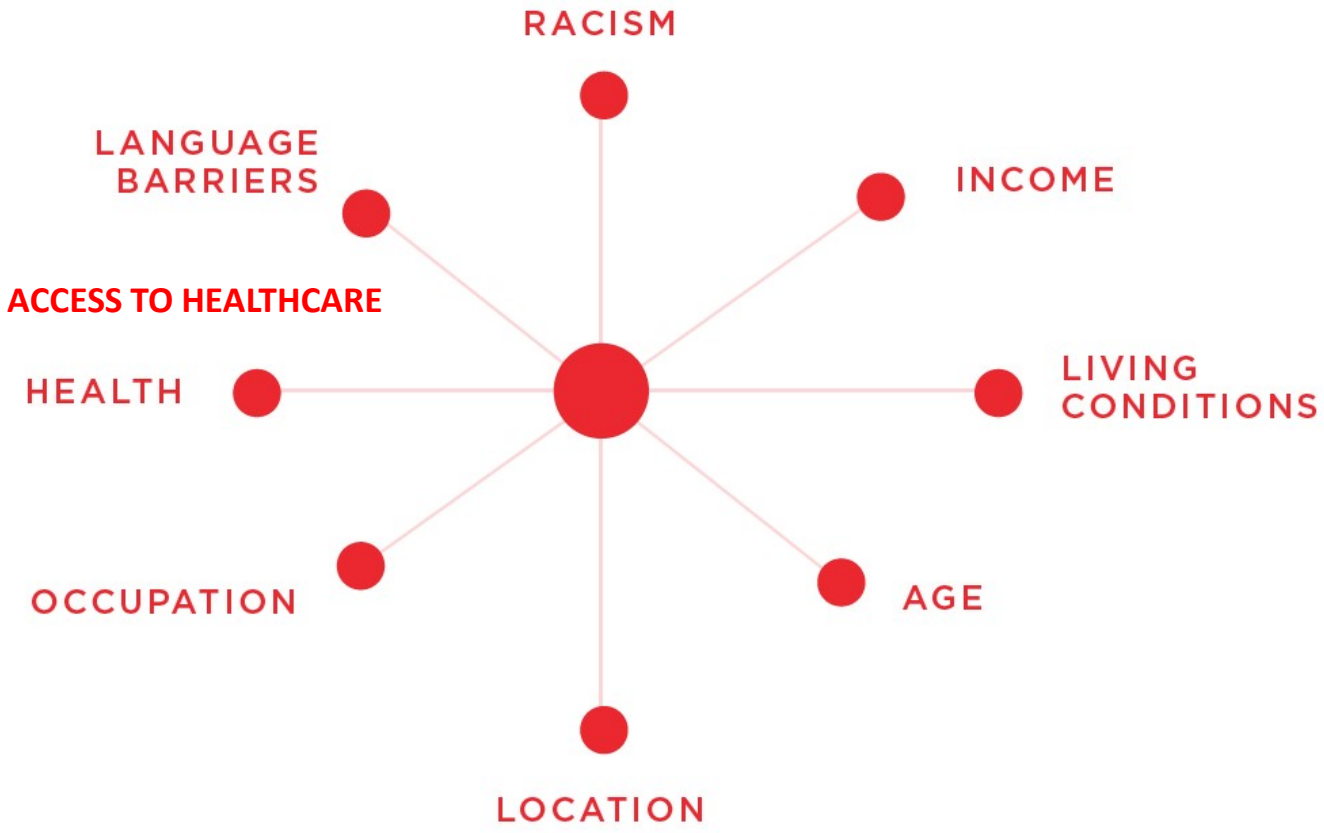
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

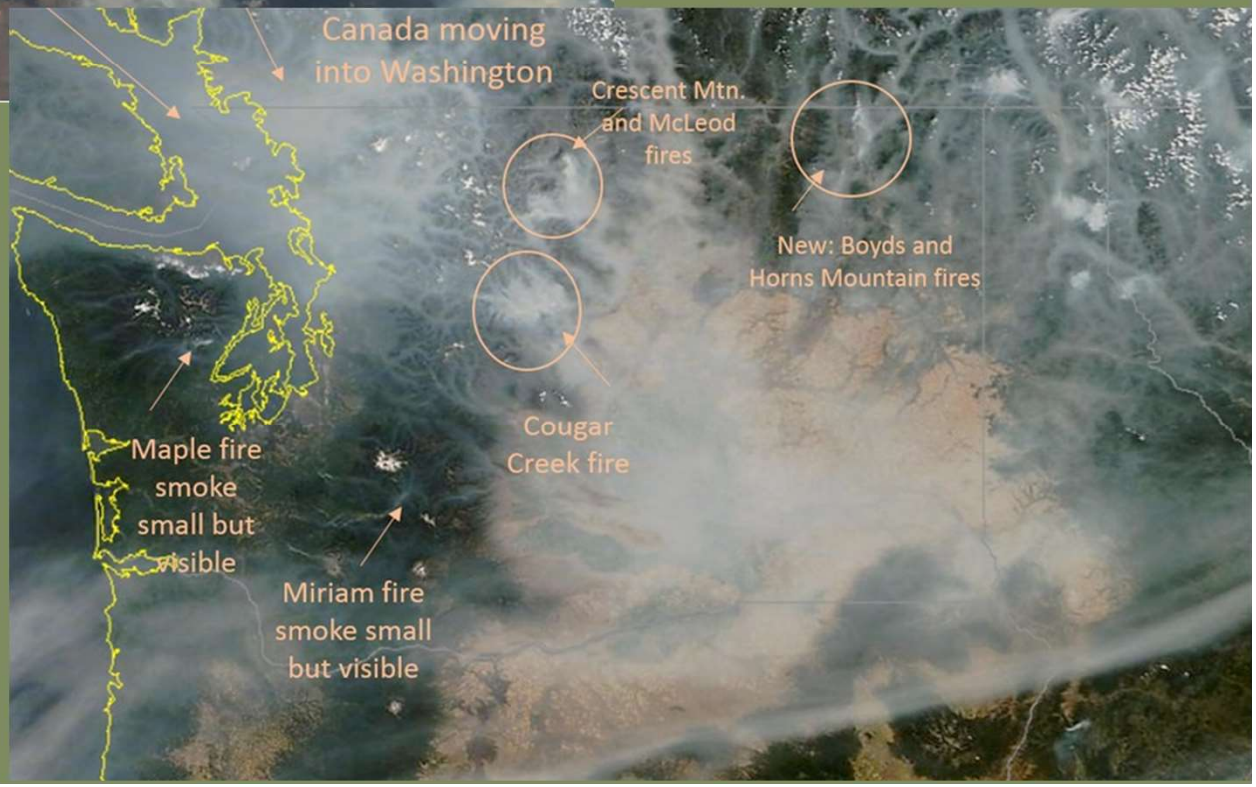
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

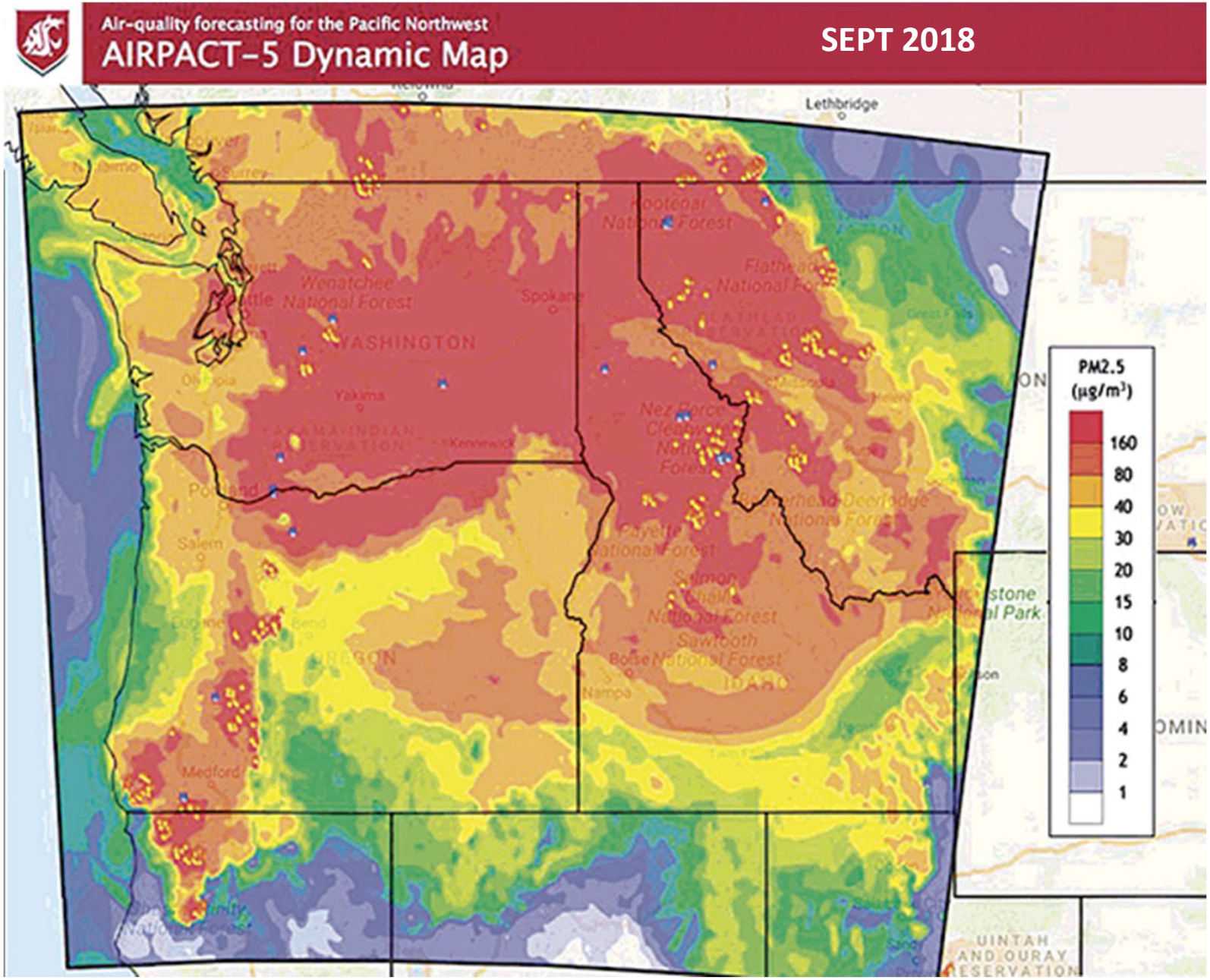
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

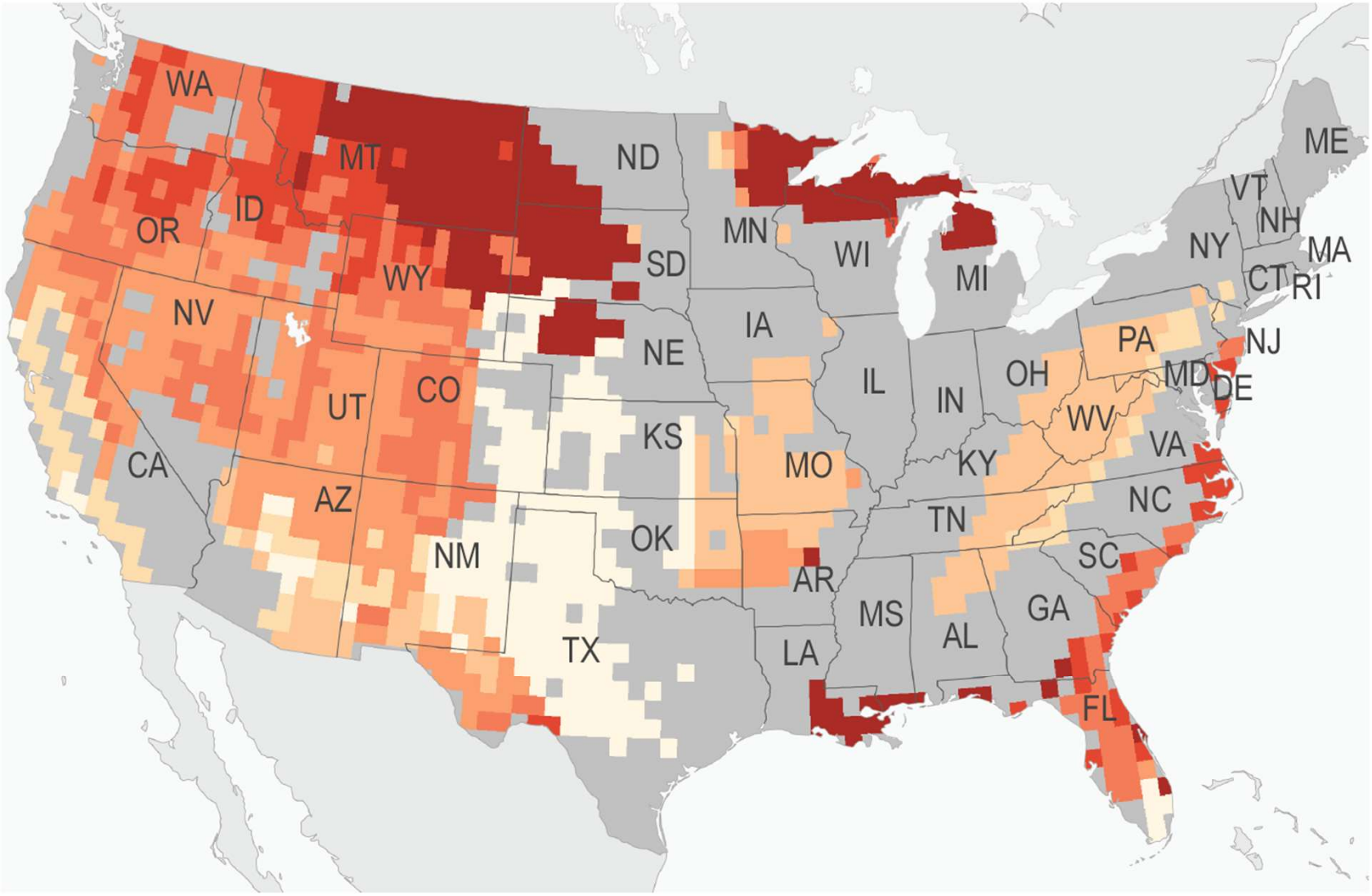
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

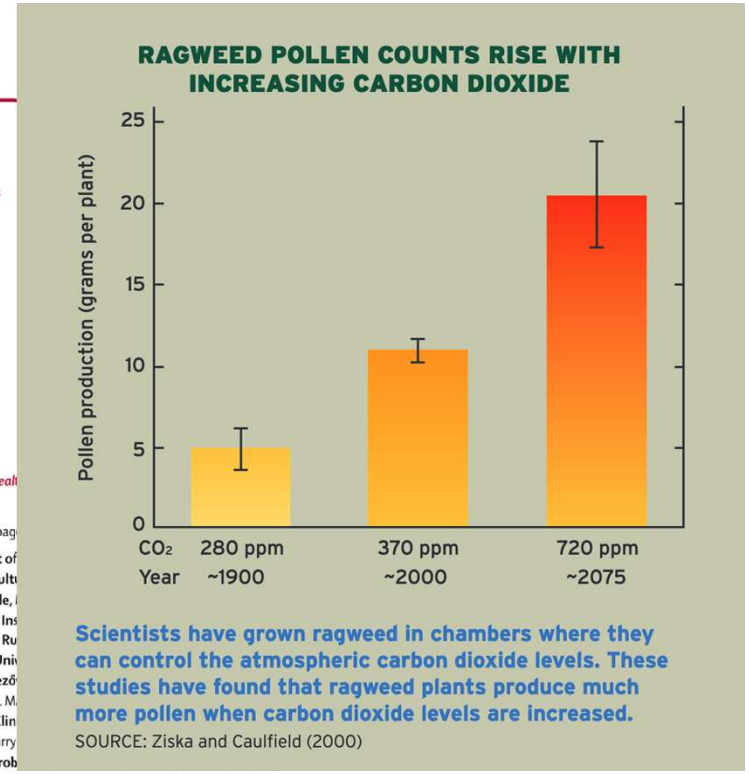
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

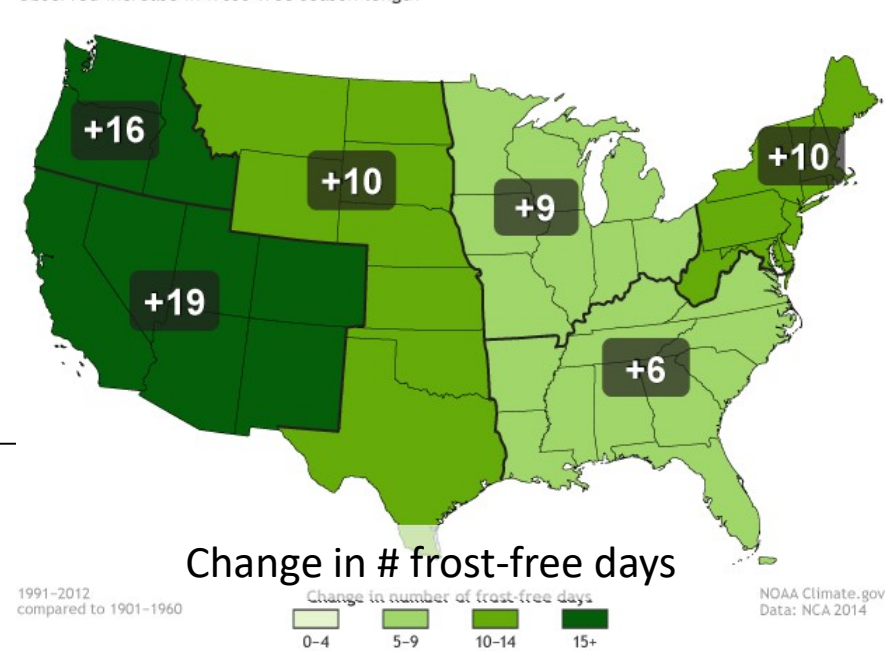
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

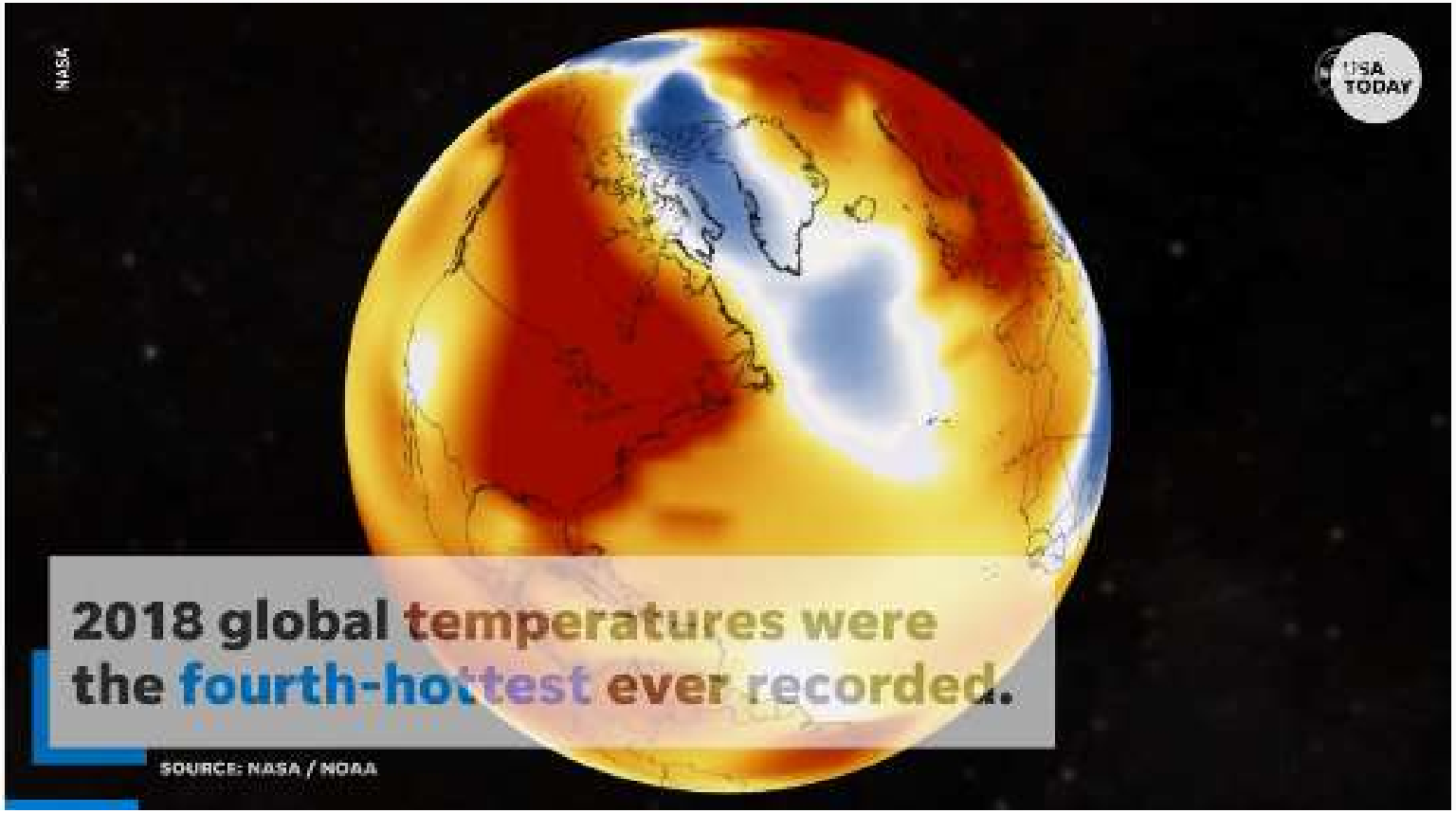
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



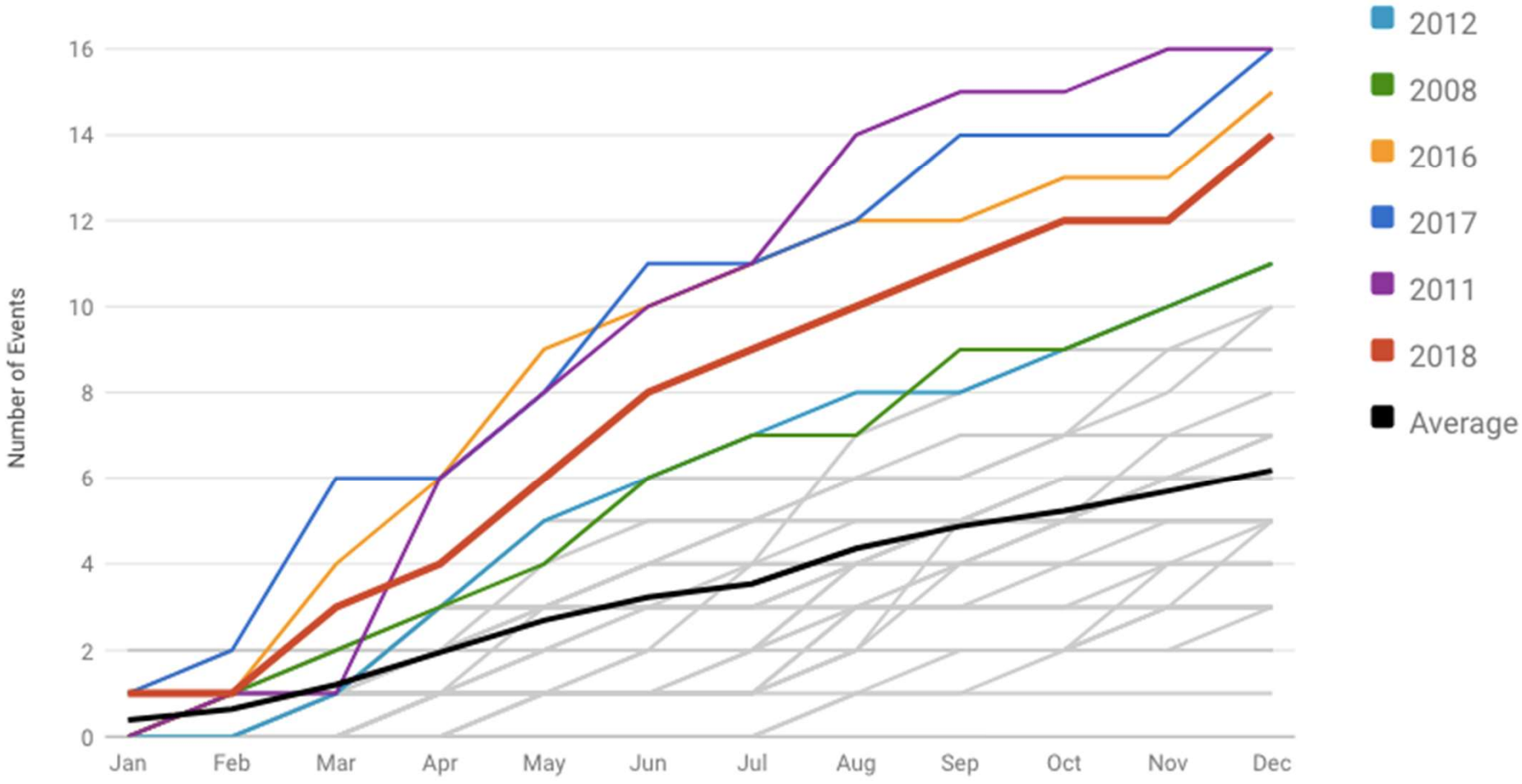
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



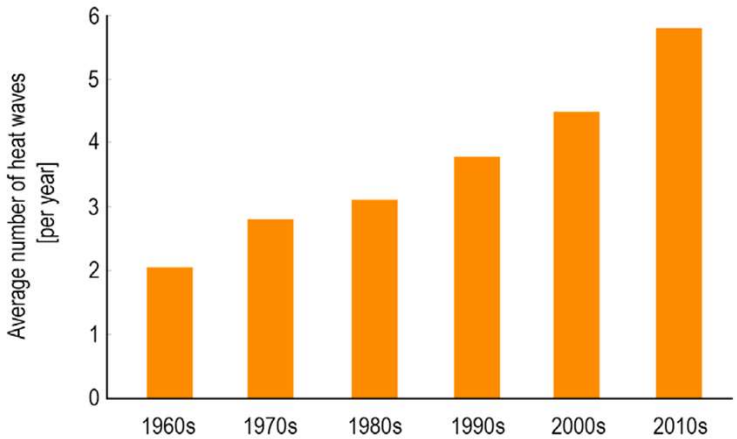
NOAA: National Centers for Environmental Information

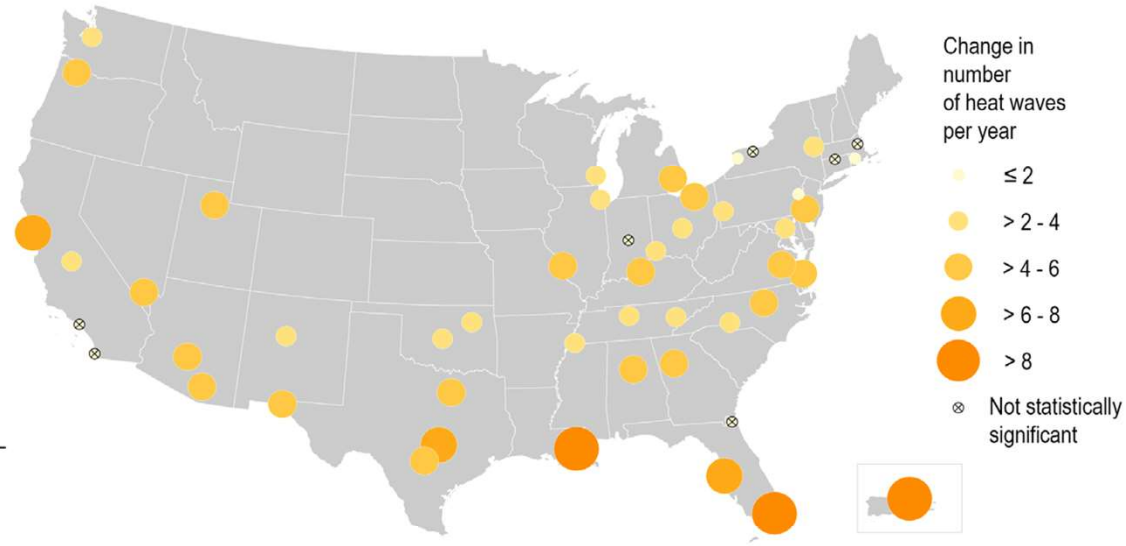
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

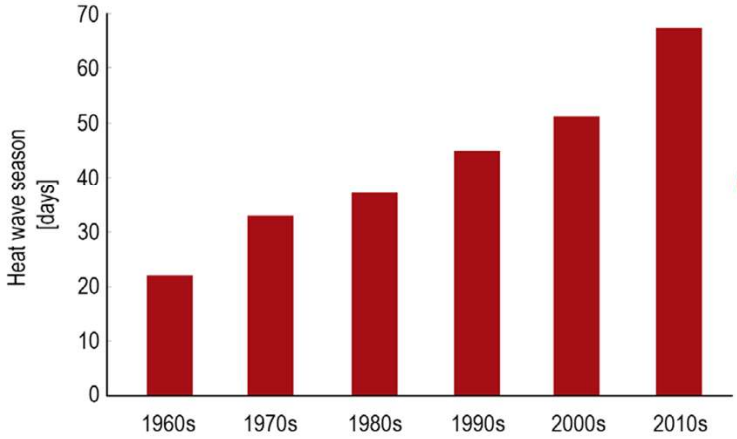
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

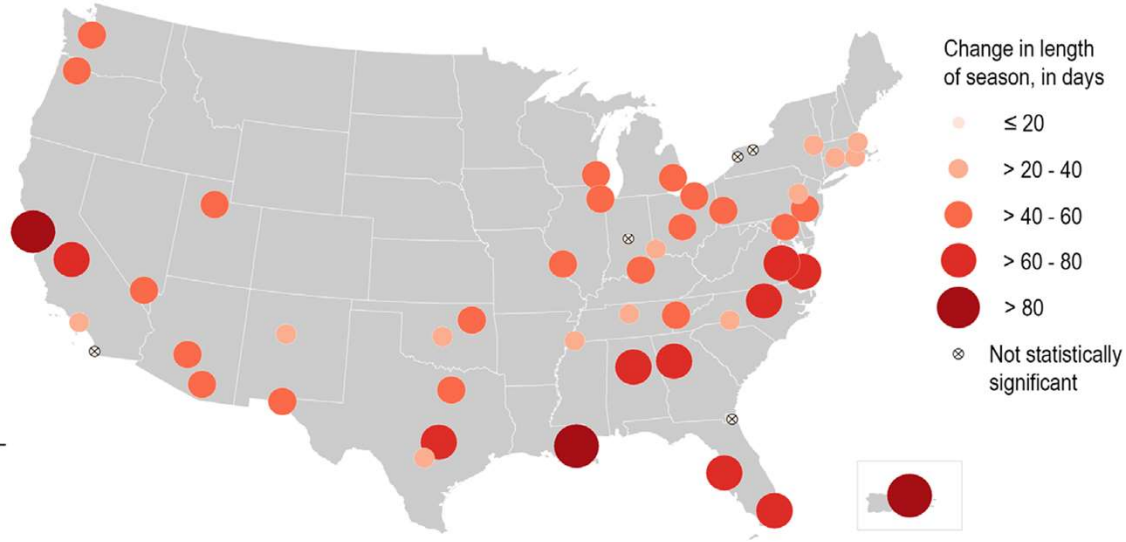
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

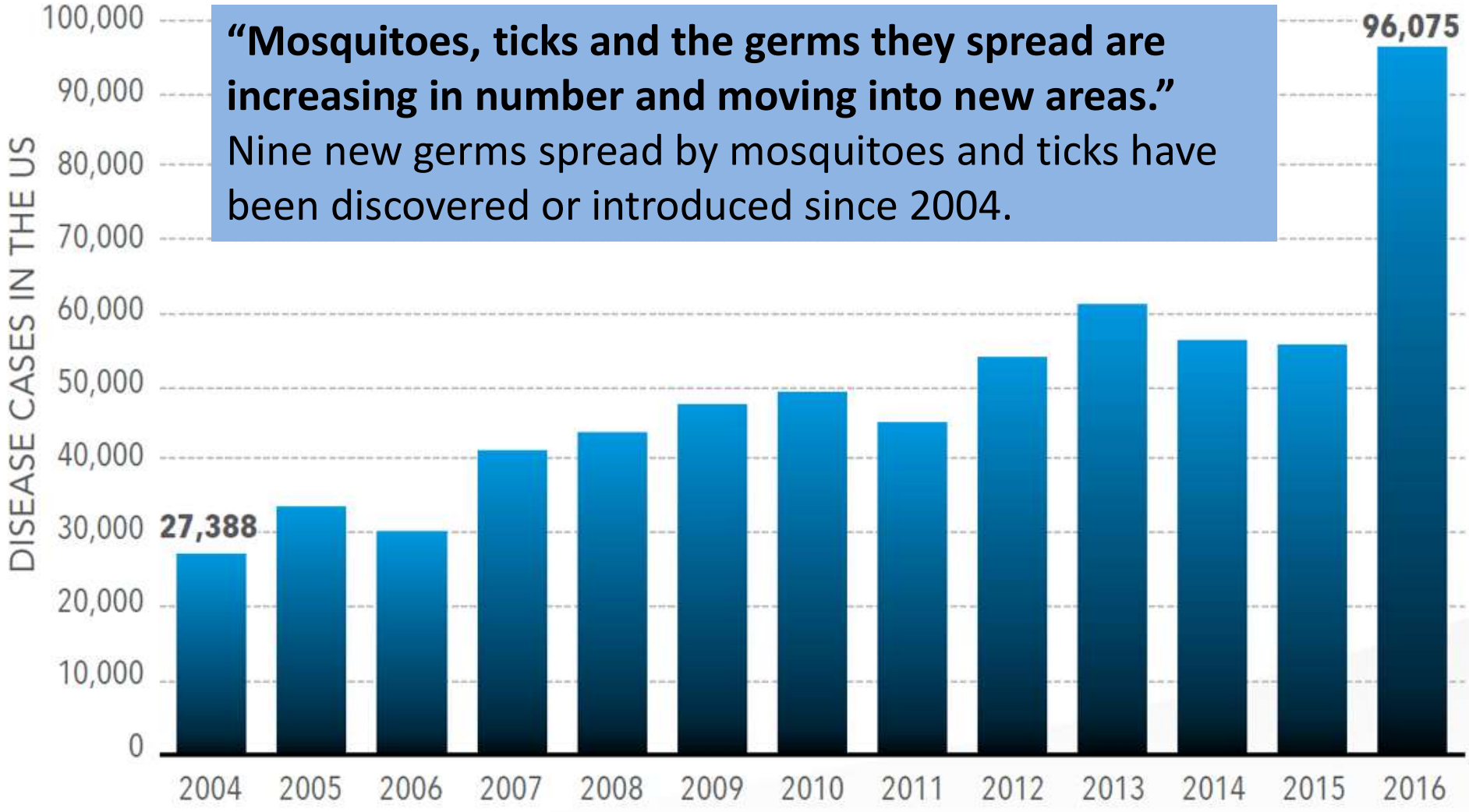
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

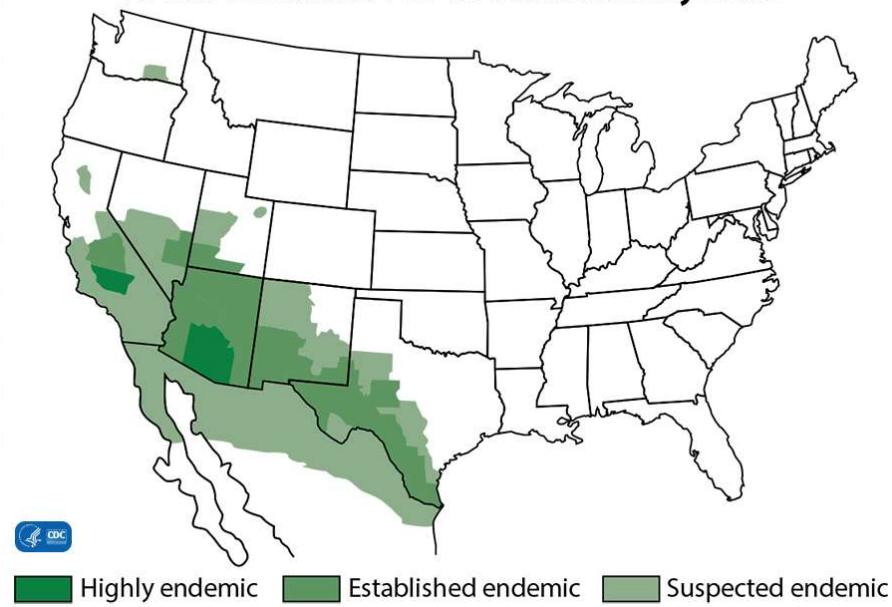
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

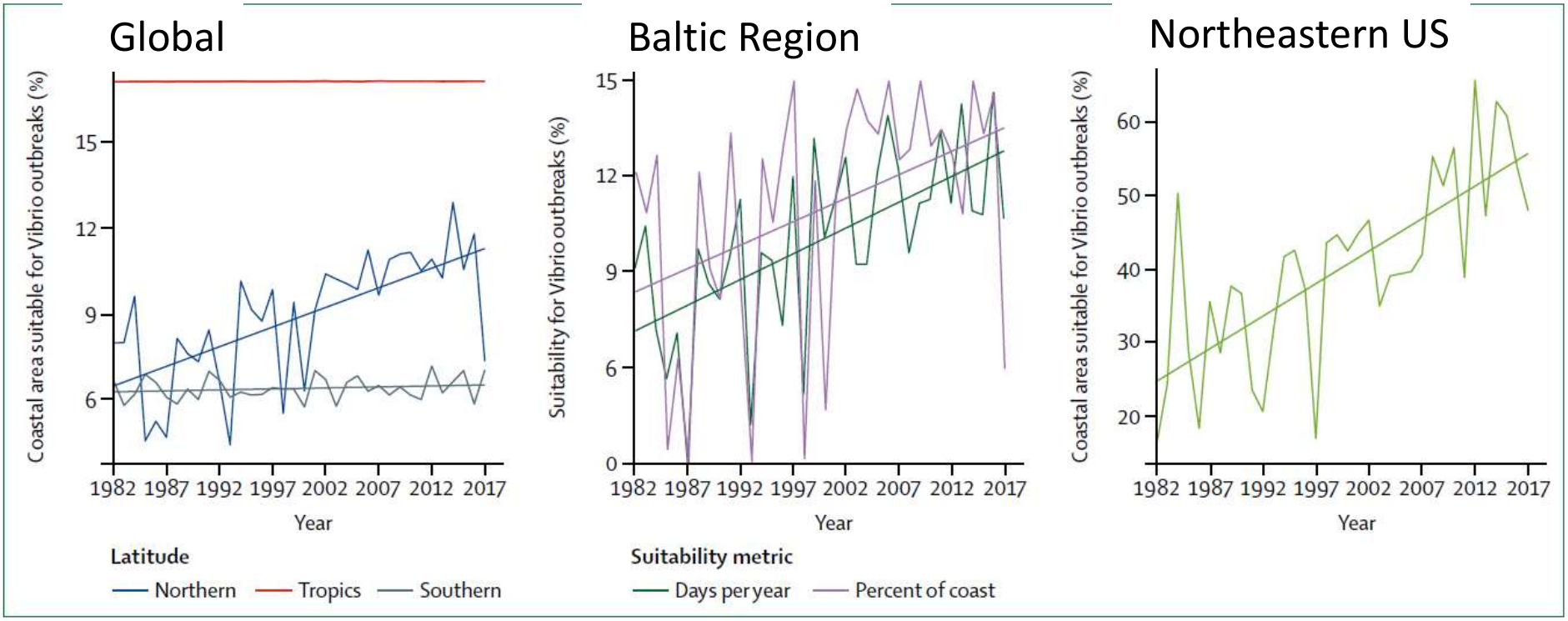
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

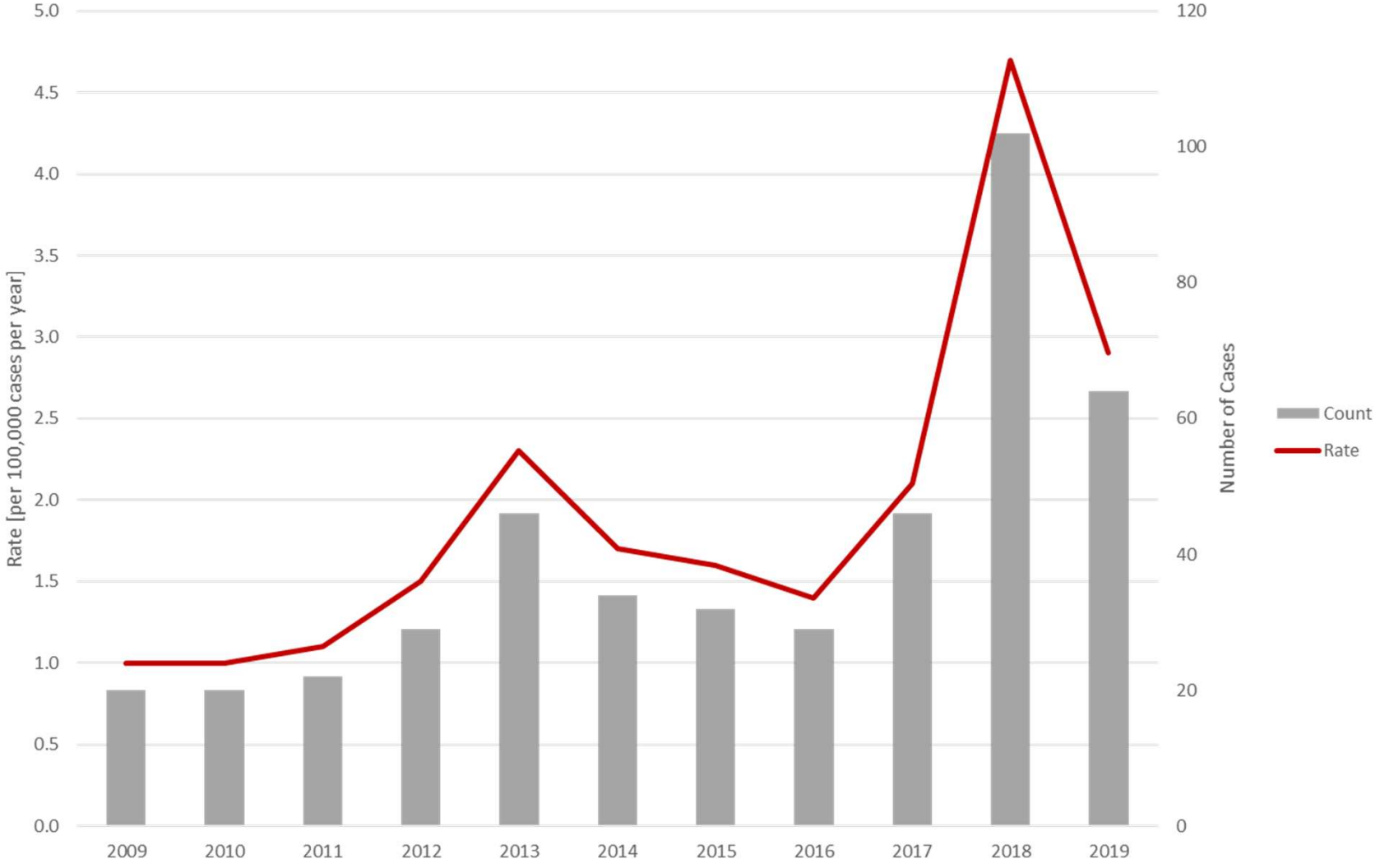
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

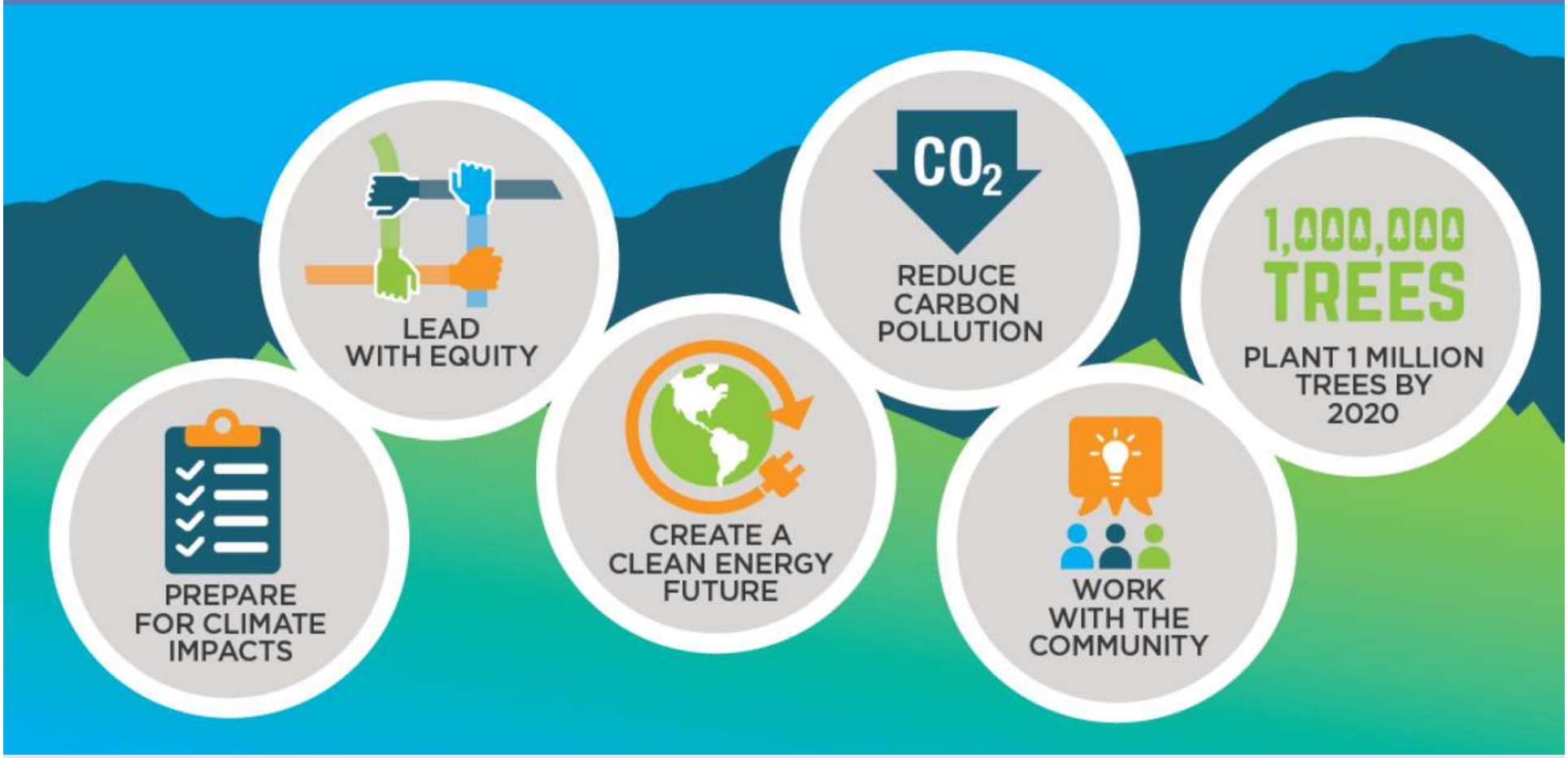
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

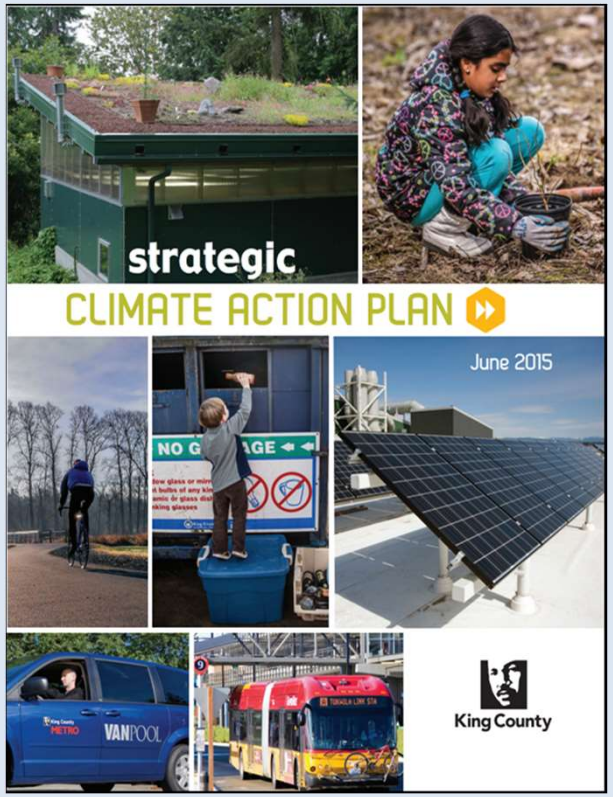


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

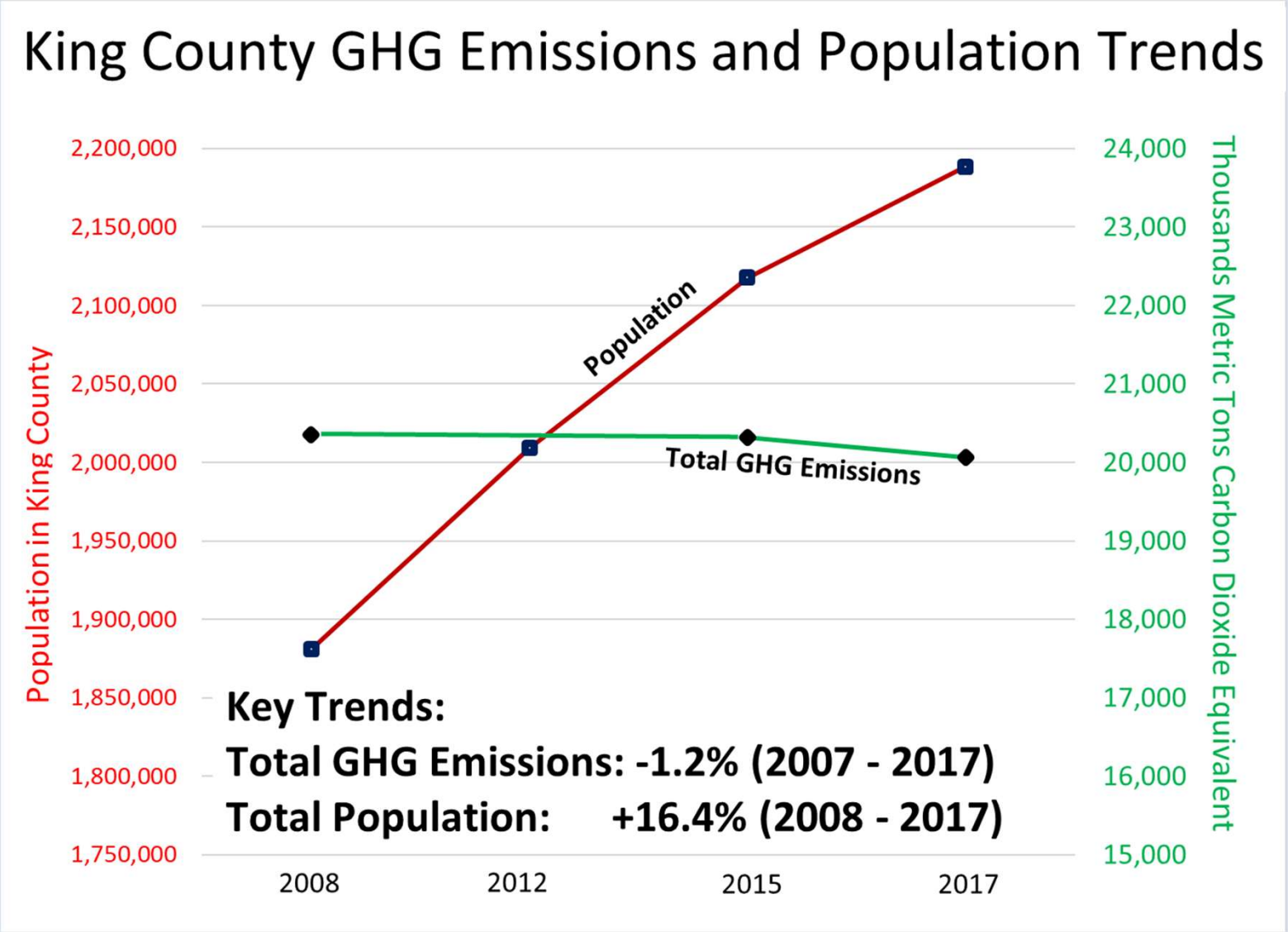
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



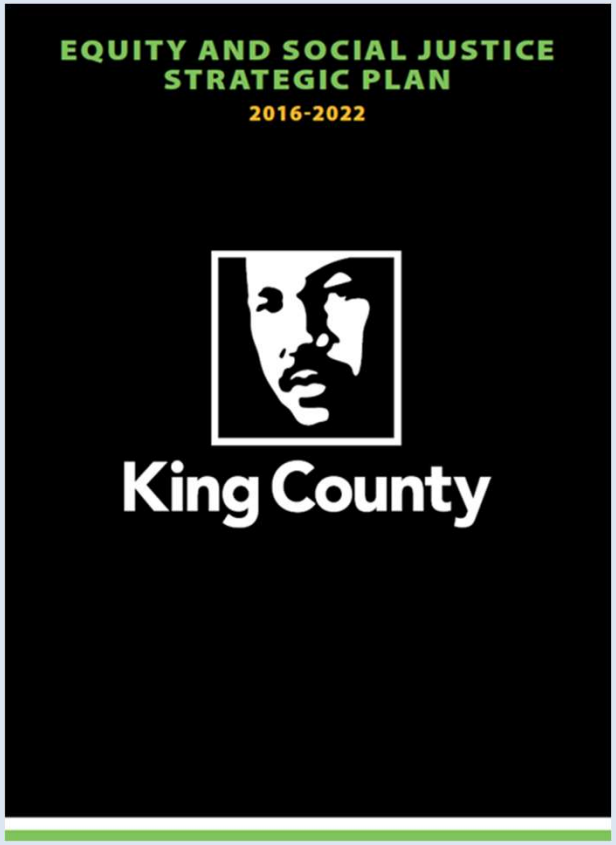
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

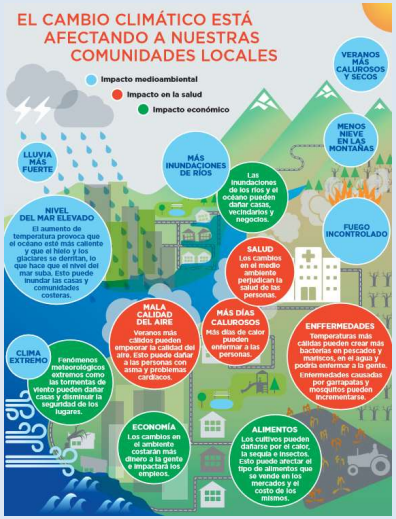
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

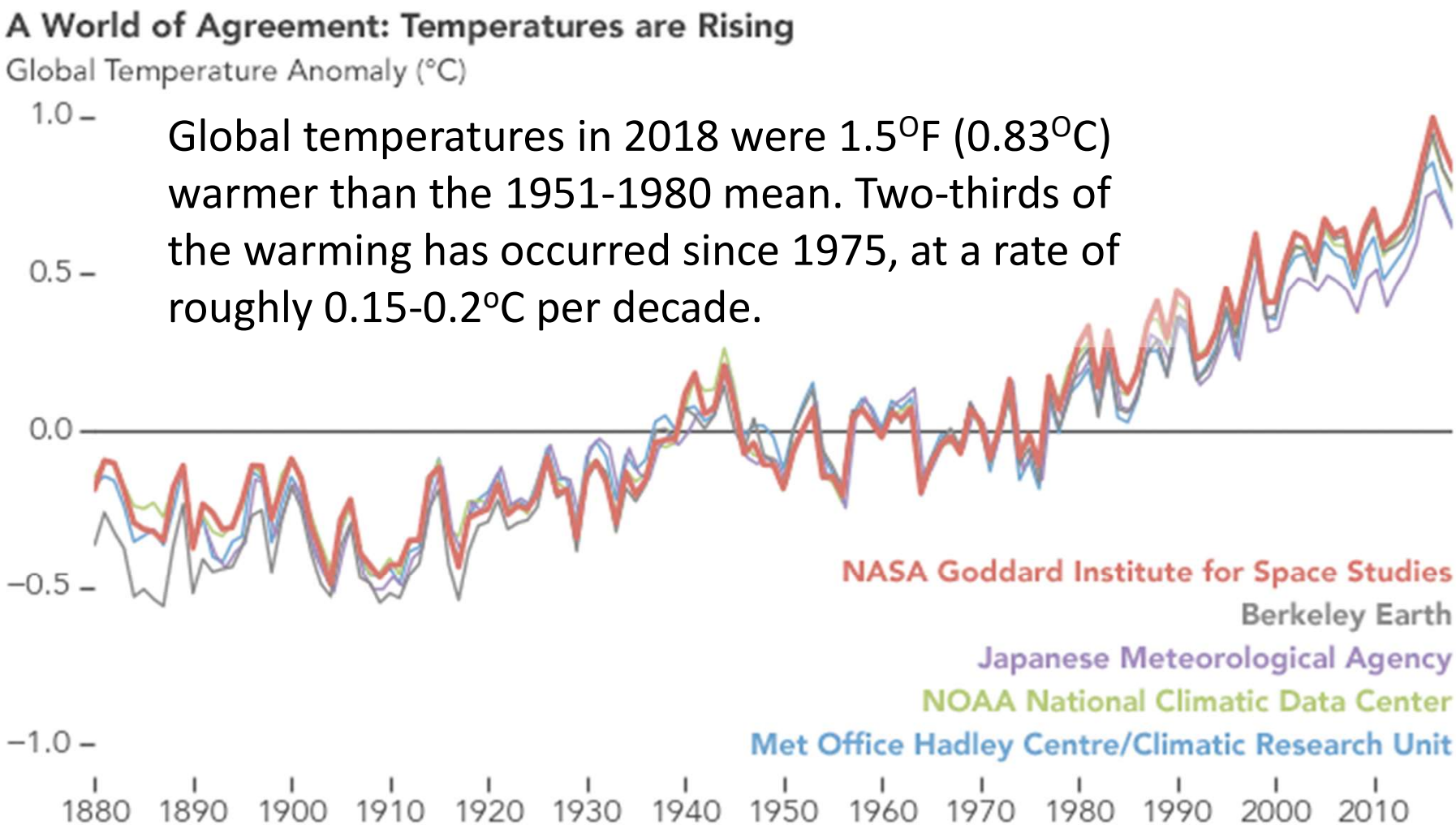
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

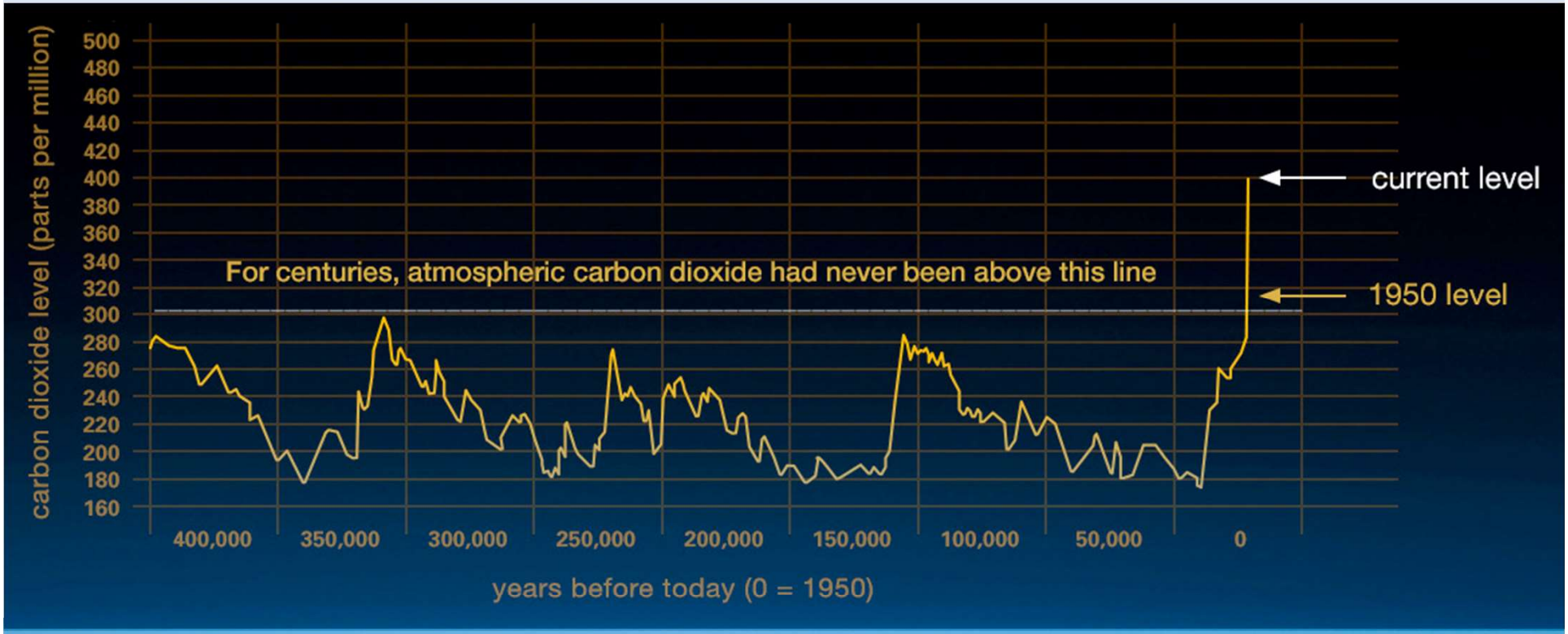


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

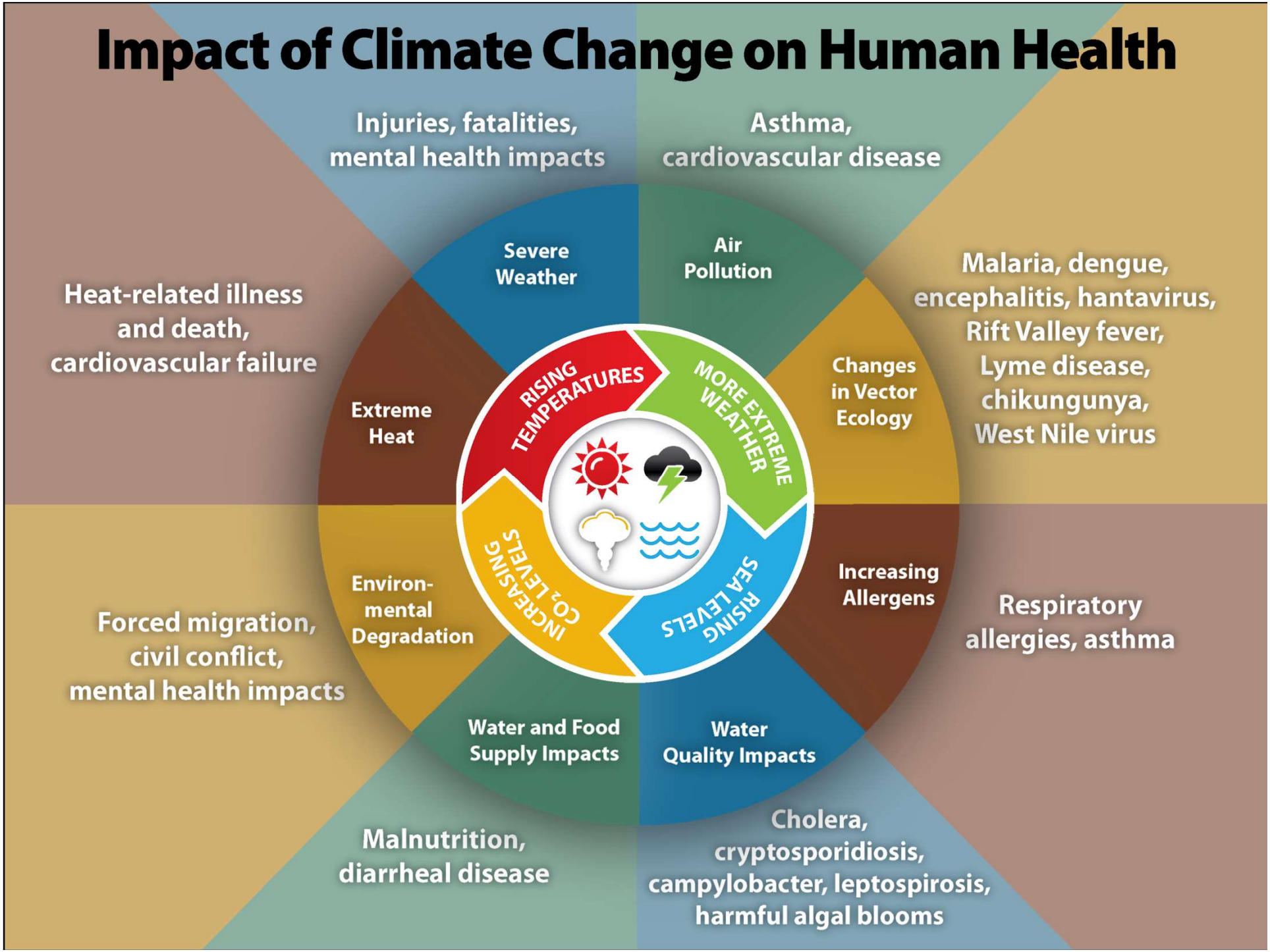
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

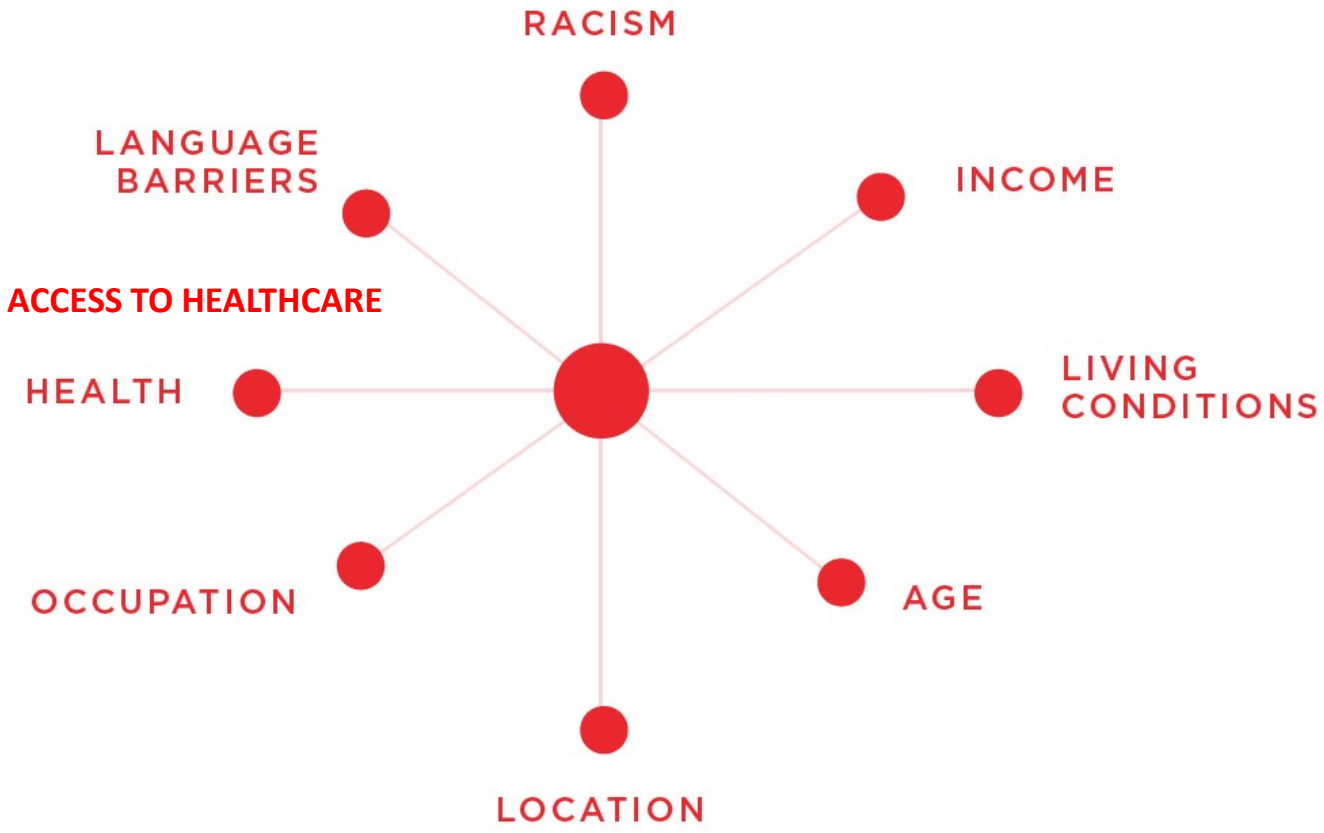
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Traffic Lab Project Homeless Crime Local Politics Education Eastside Watchdog News Obituaries FYI Guy Westneat Beason

Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

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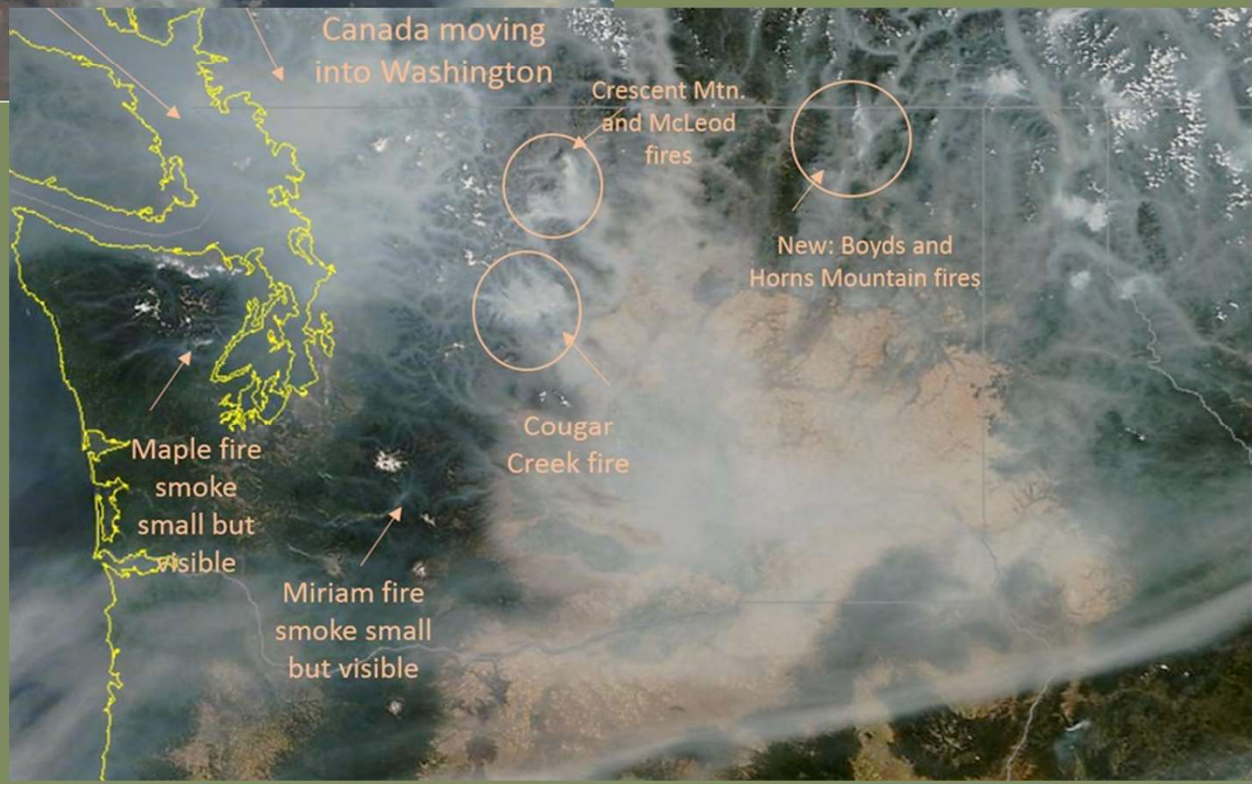
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

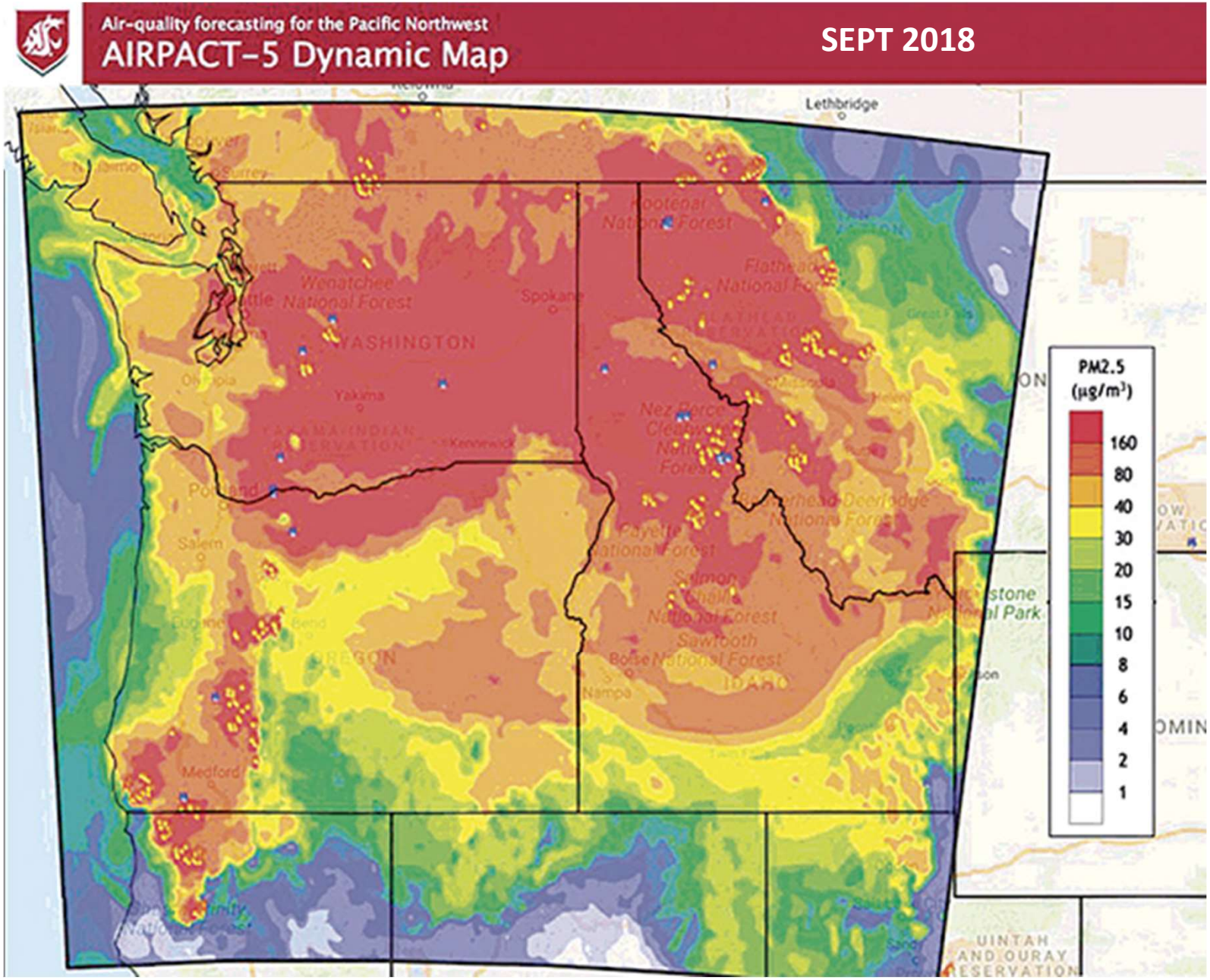
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

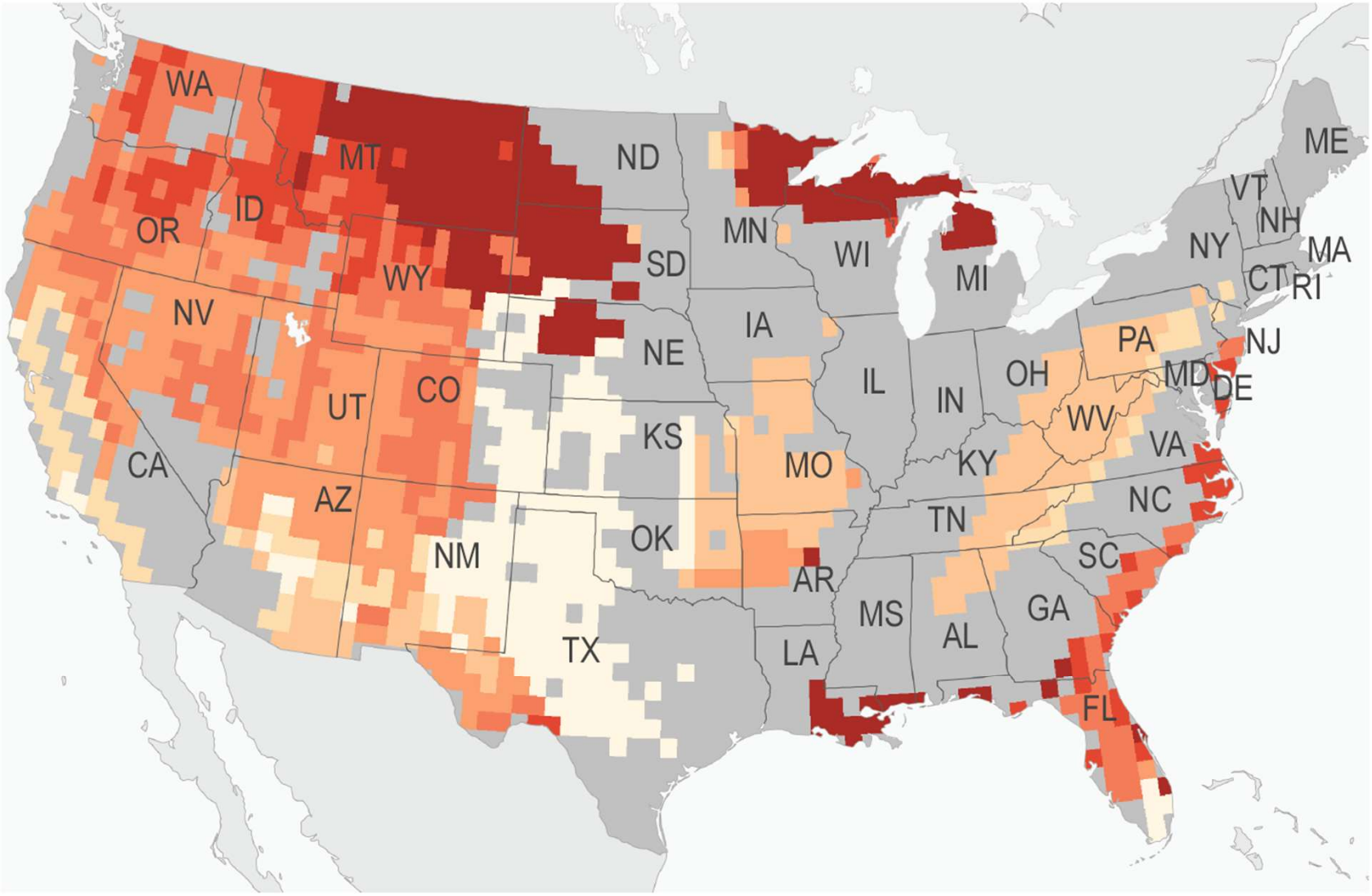
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

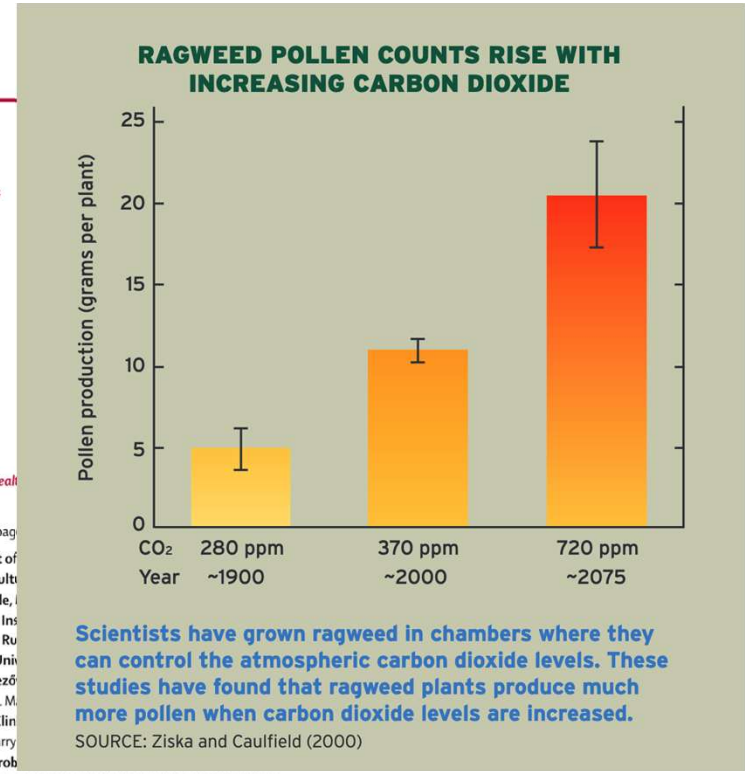
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

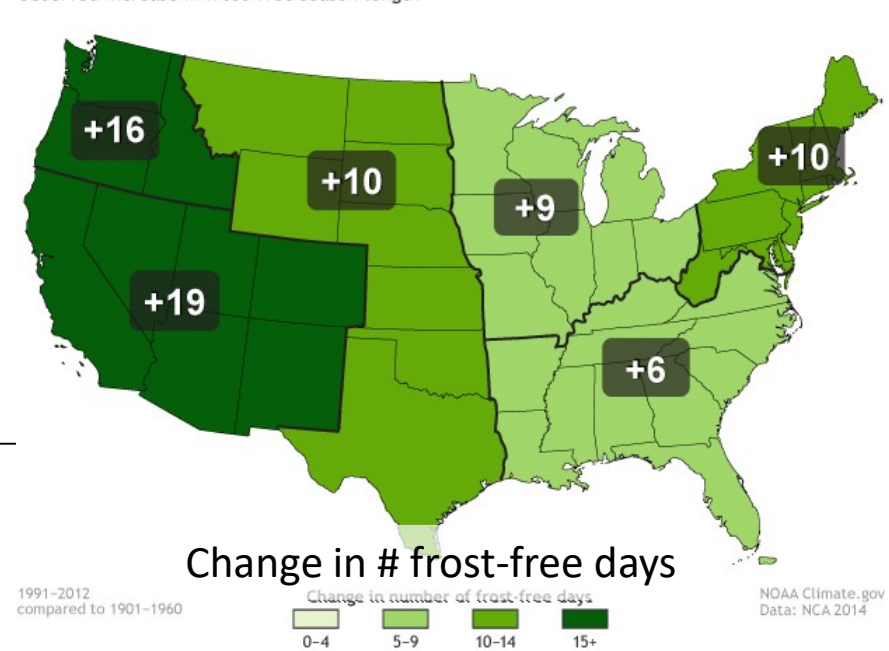
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

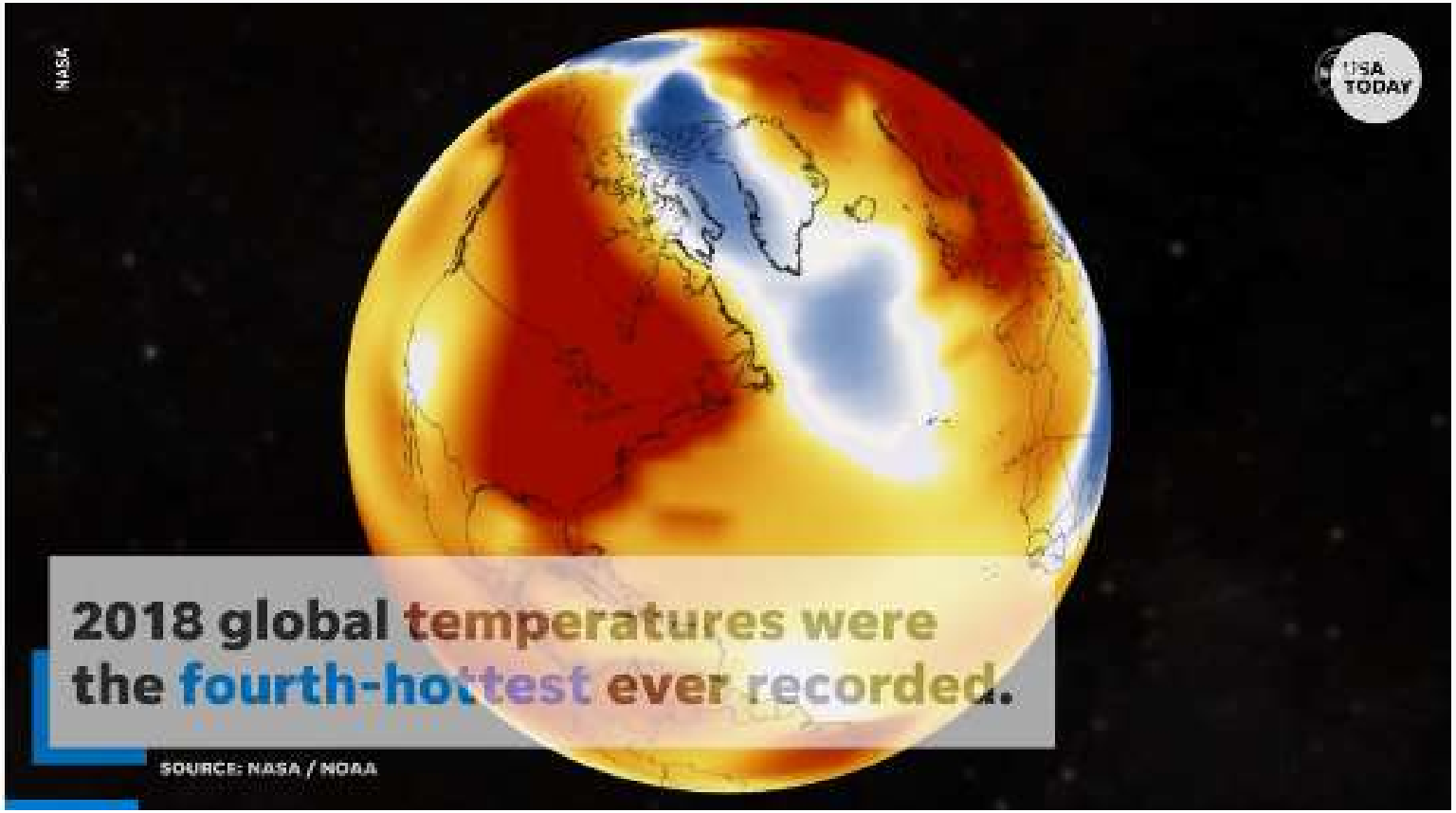
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



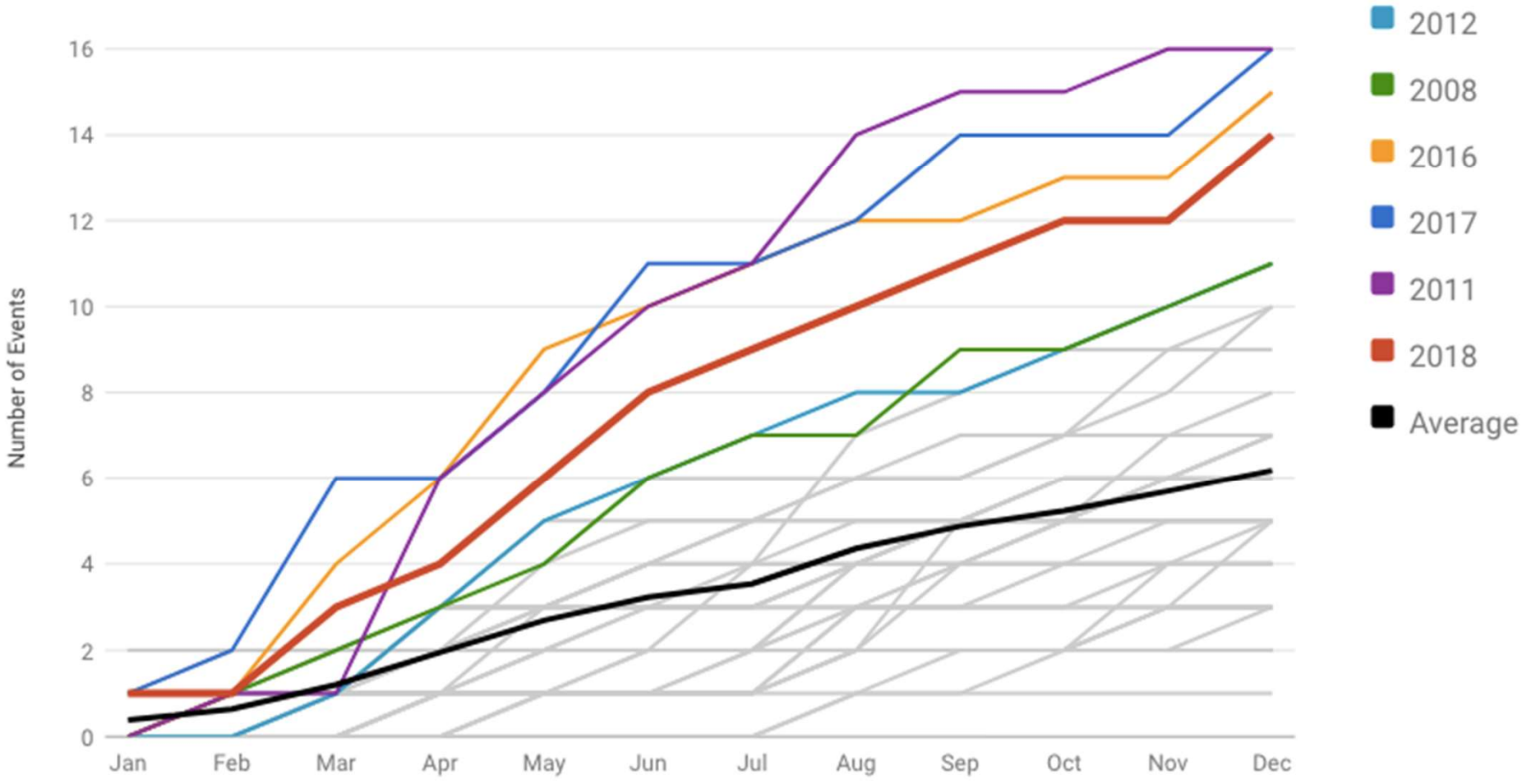
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



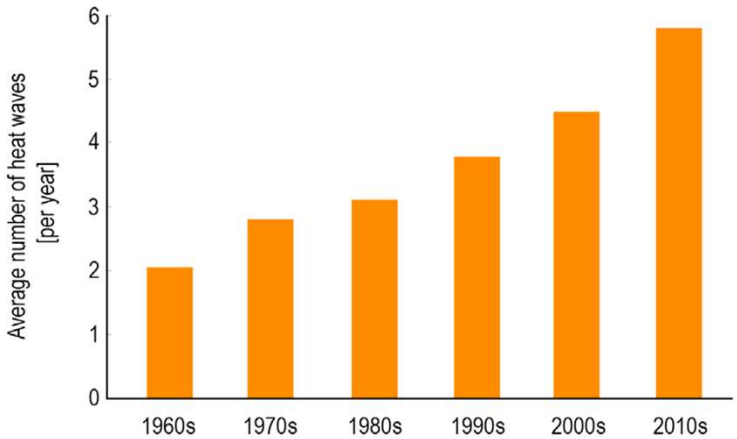
NOAA: National Centers for Environmental Information

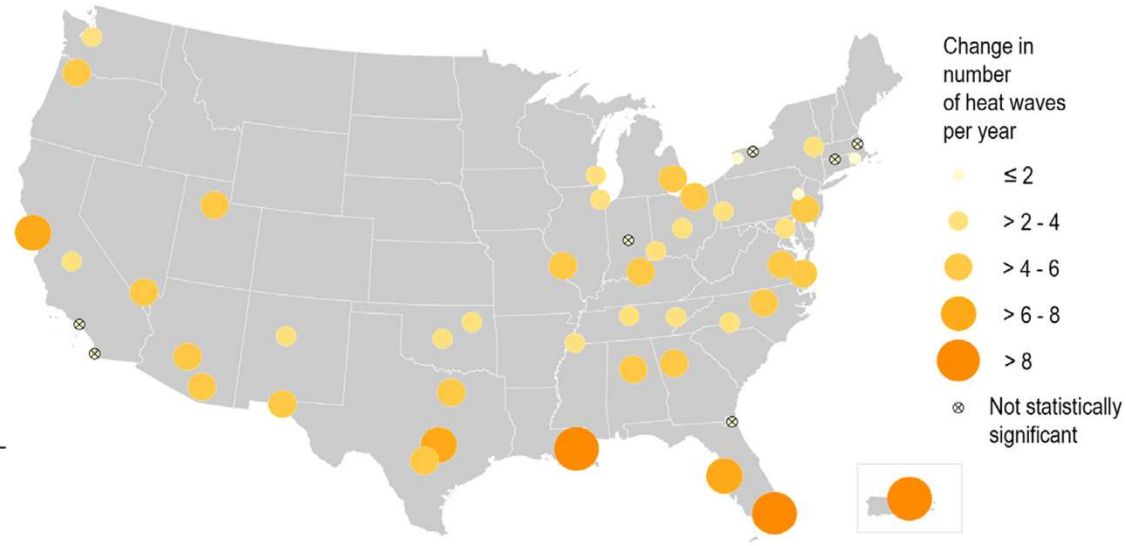
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

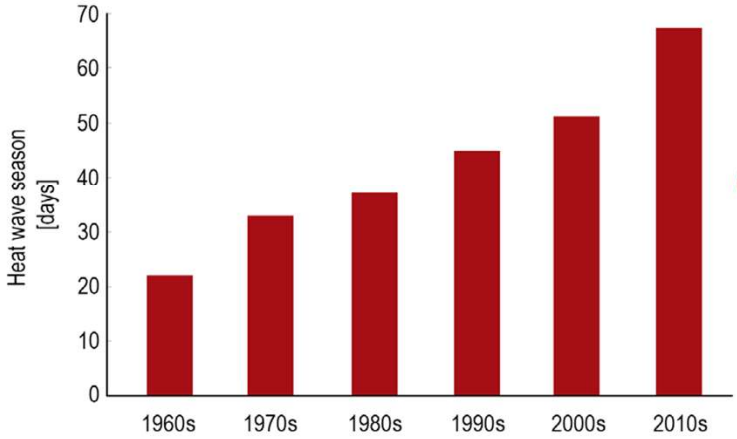
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

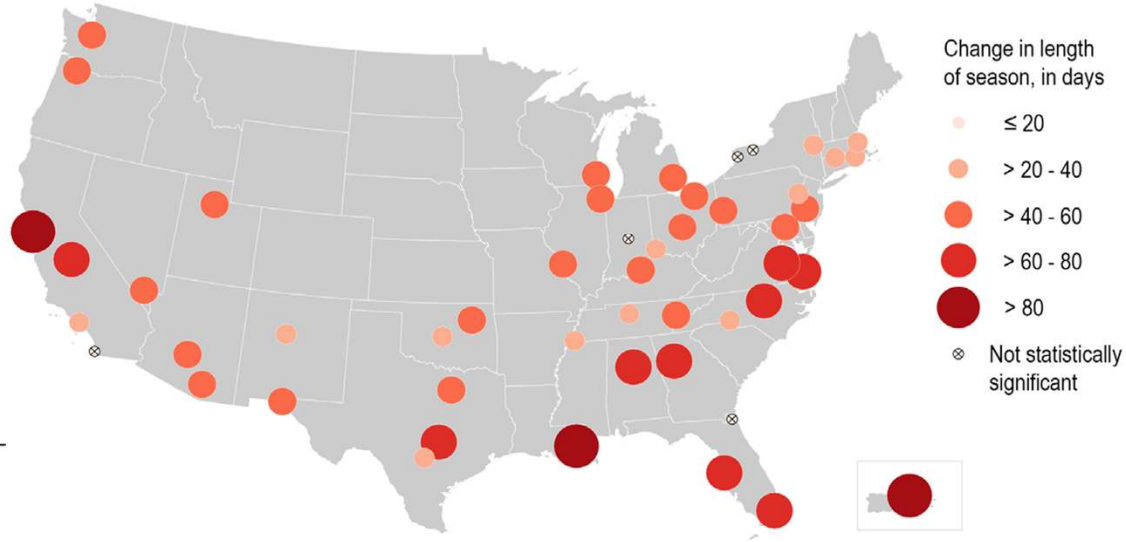
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

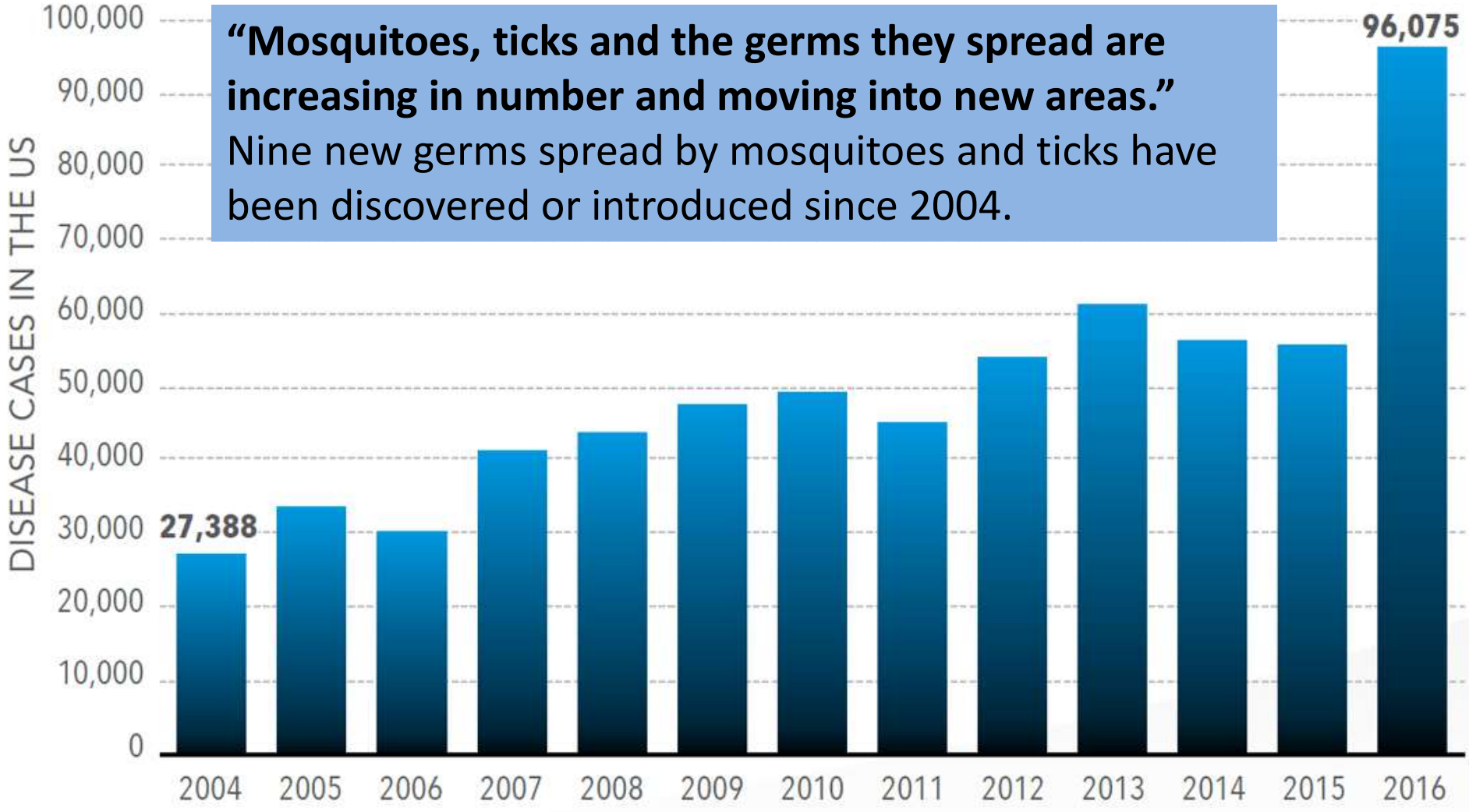
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

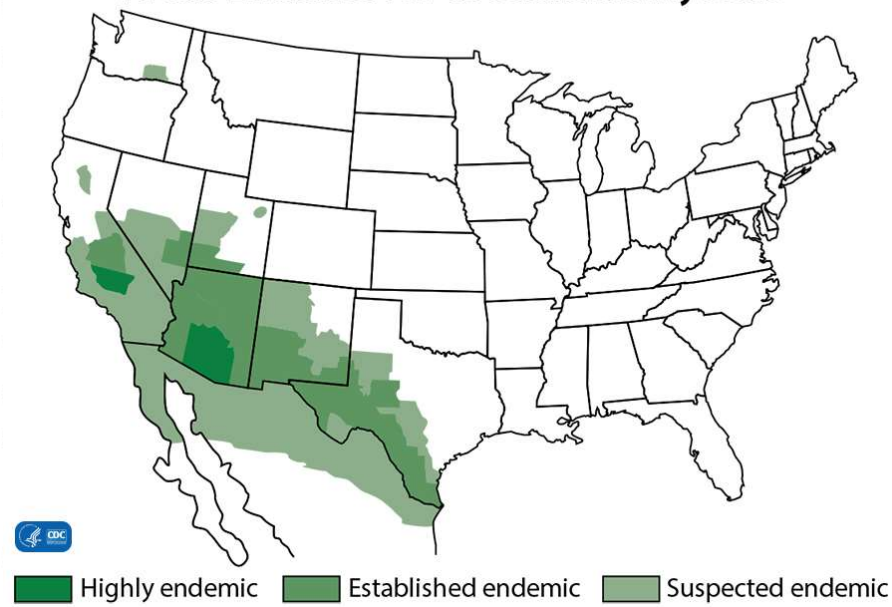
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

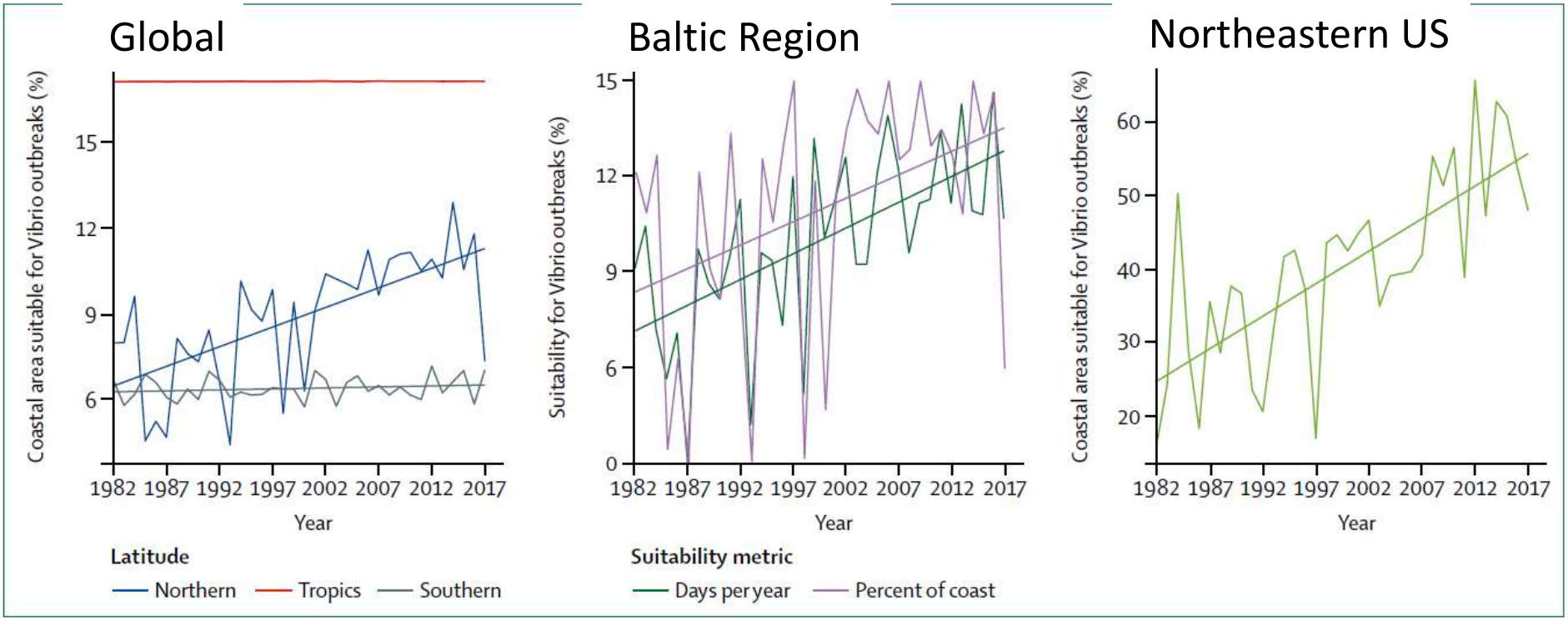
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

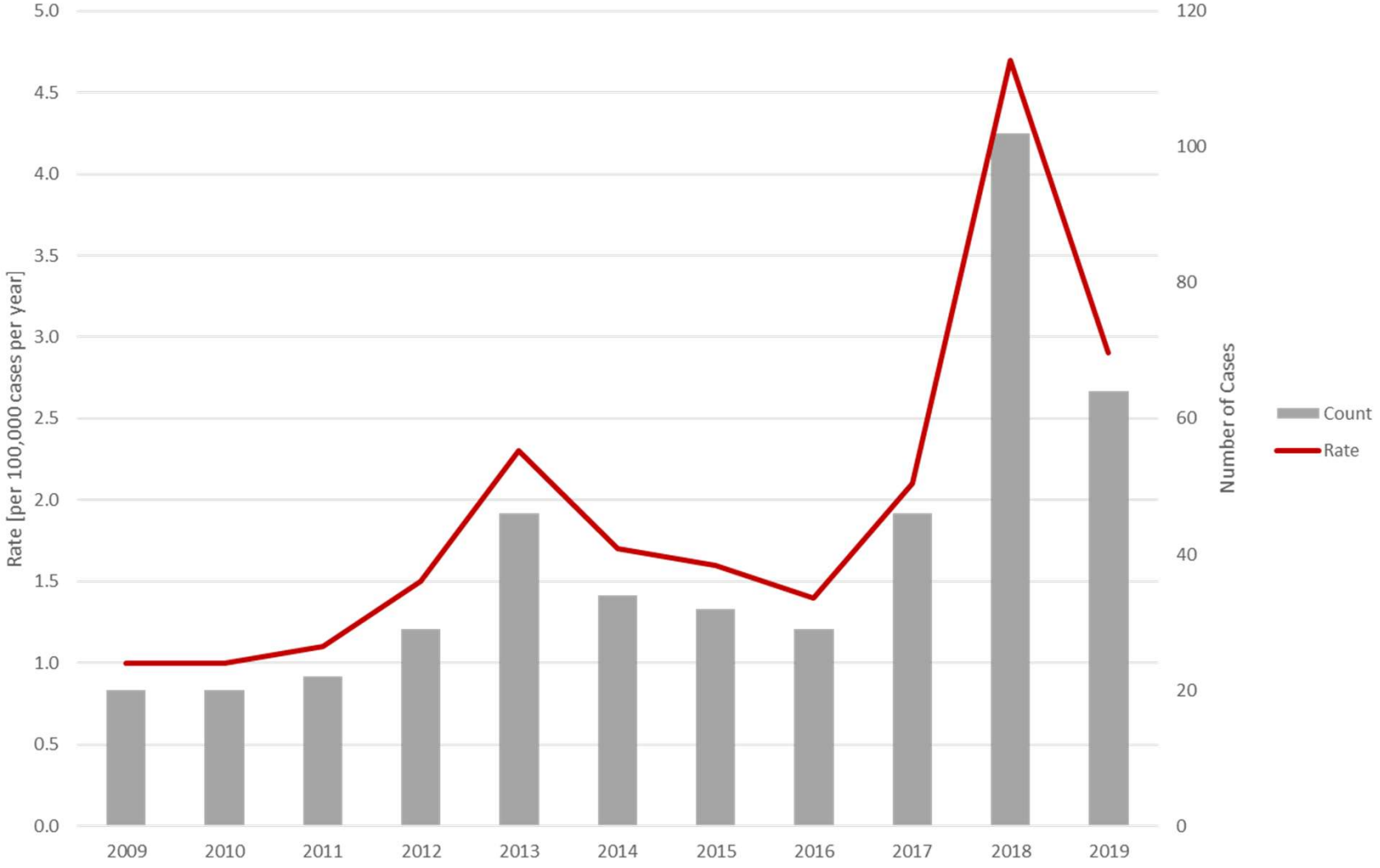
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

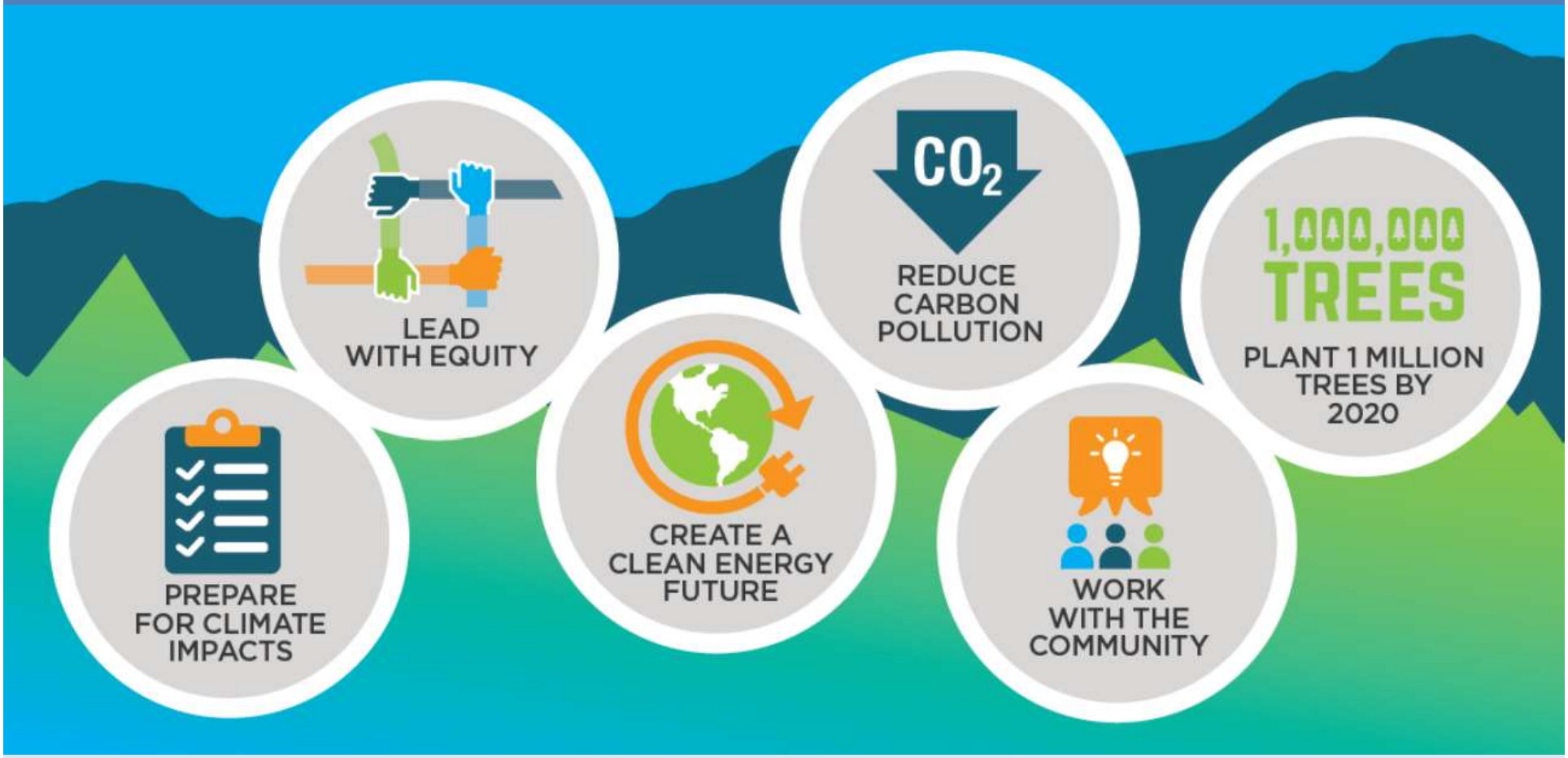
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

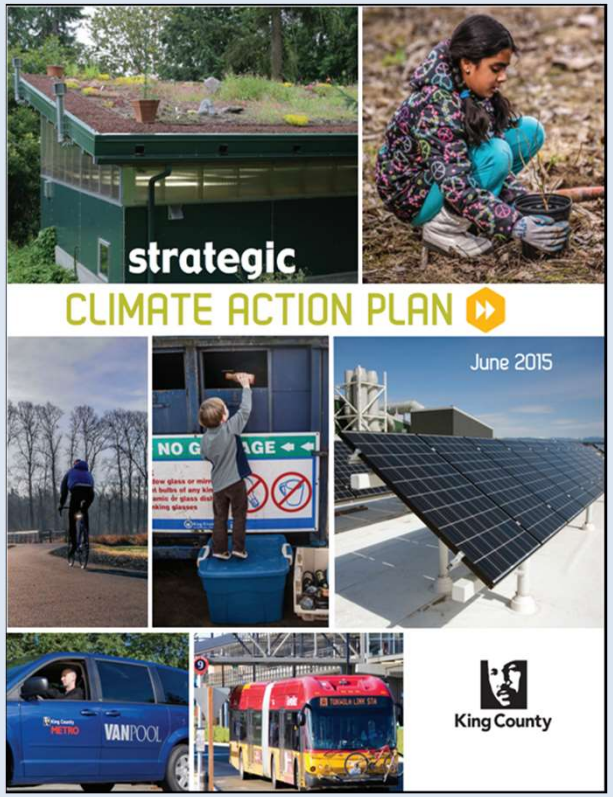


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

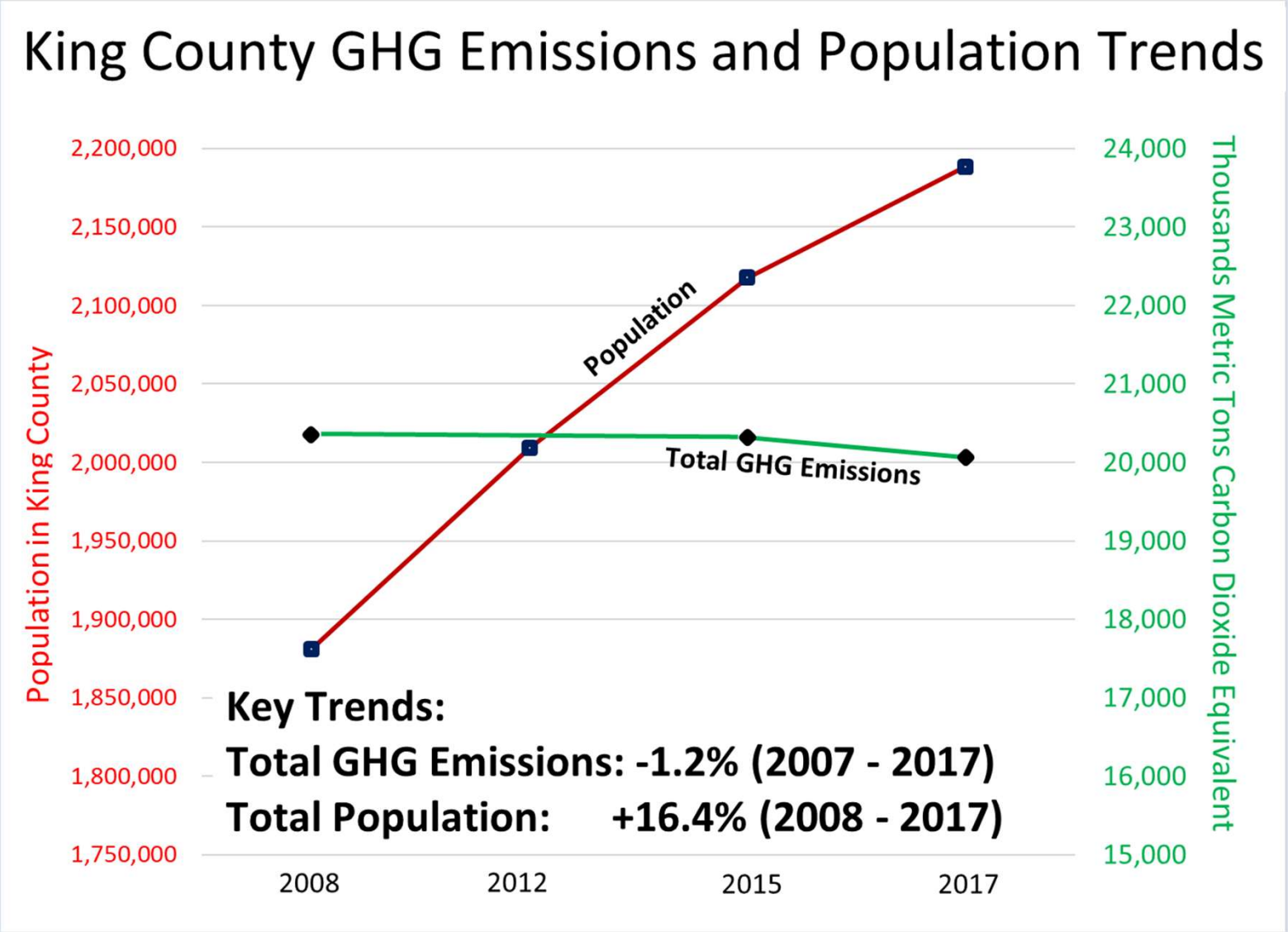
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



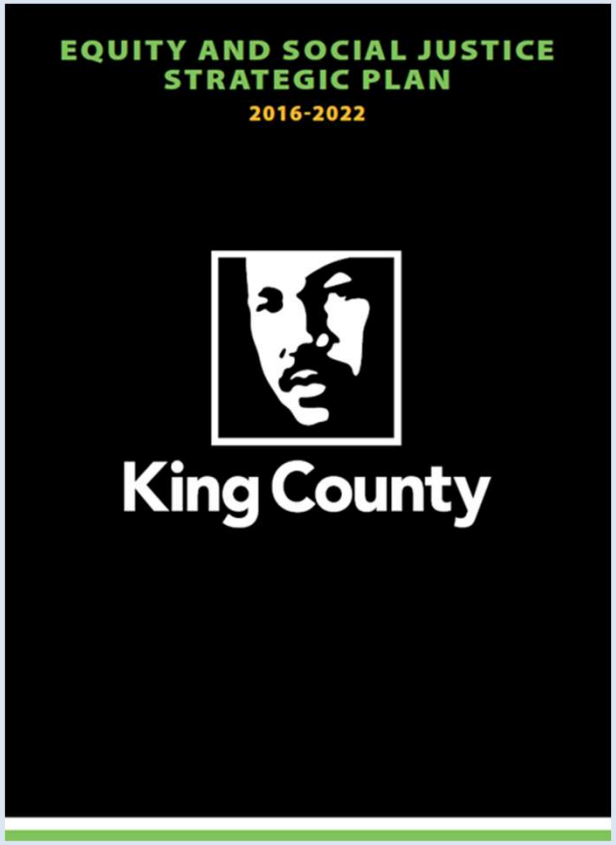
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

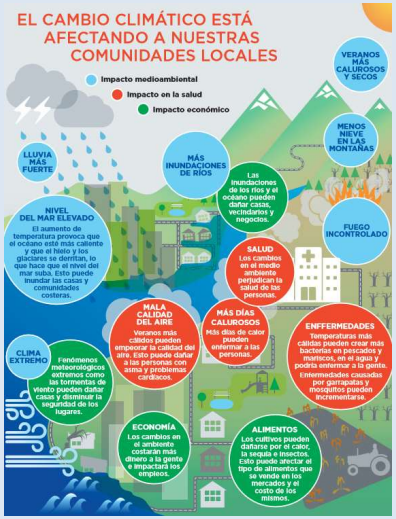
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

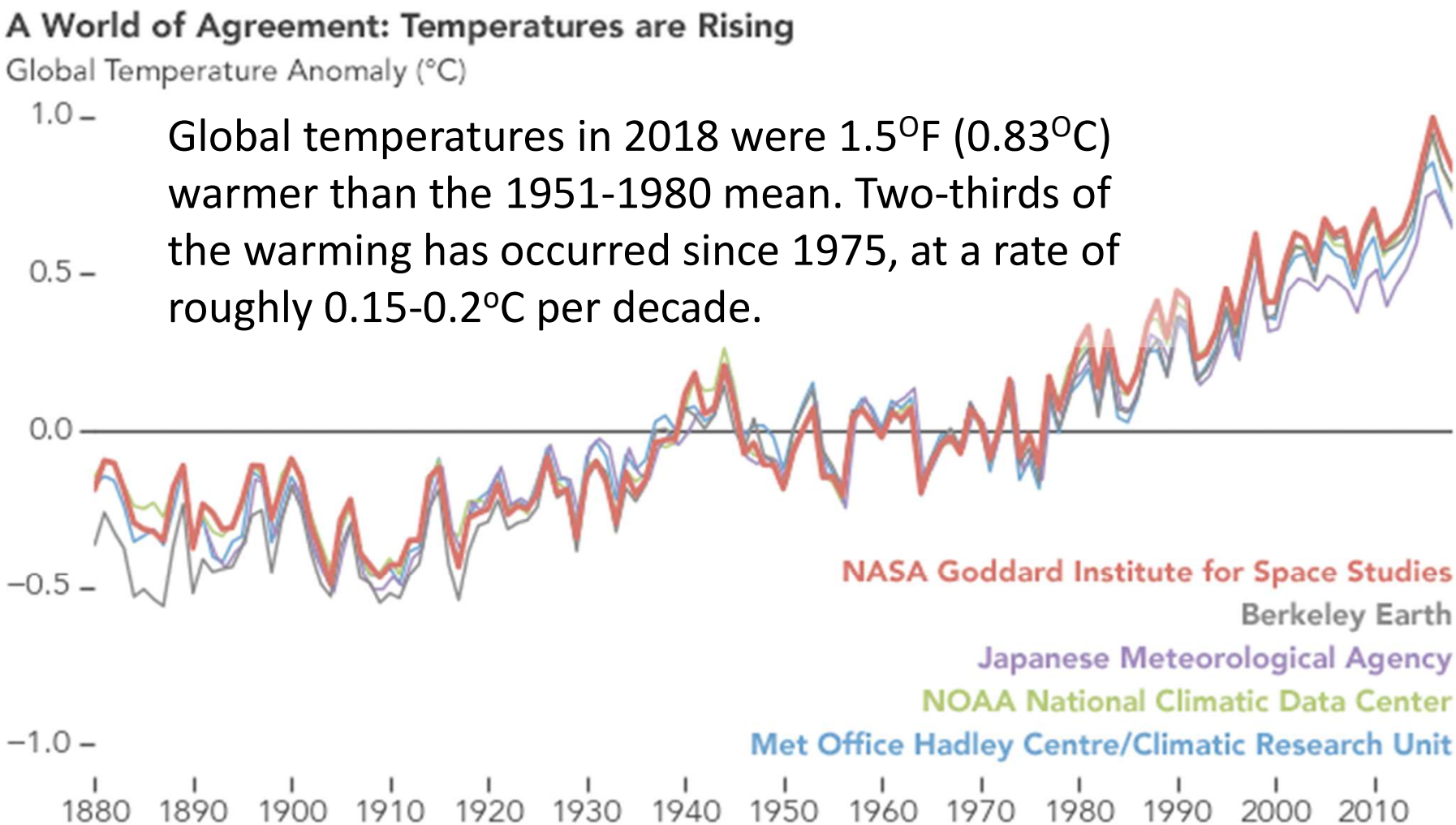
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

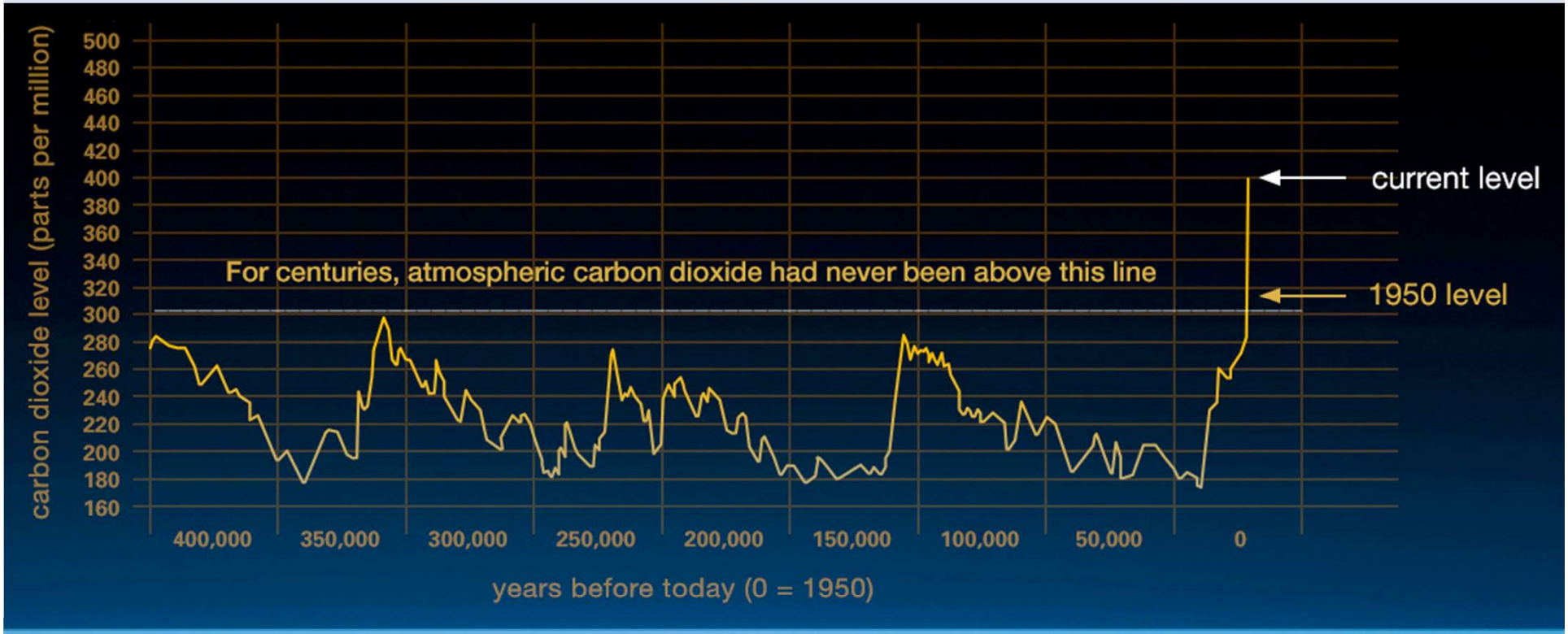


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

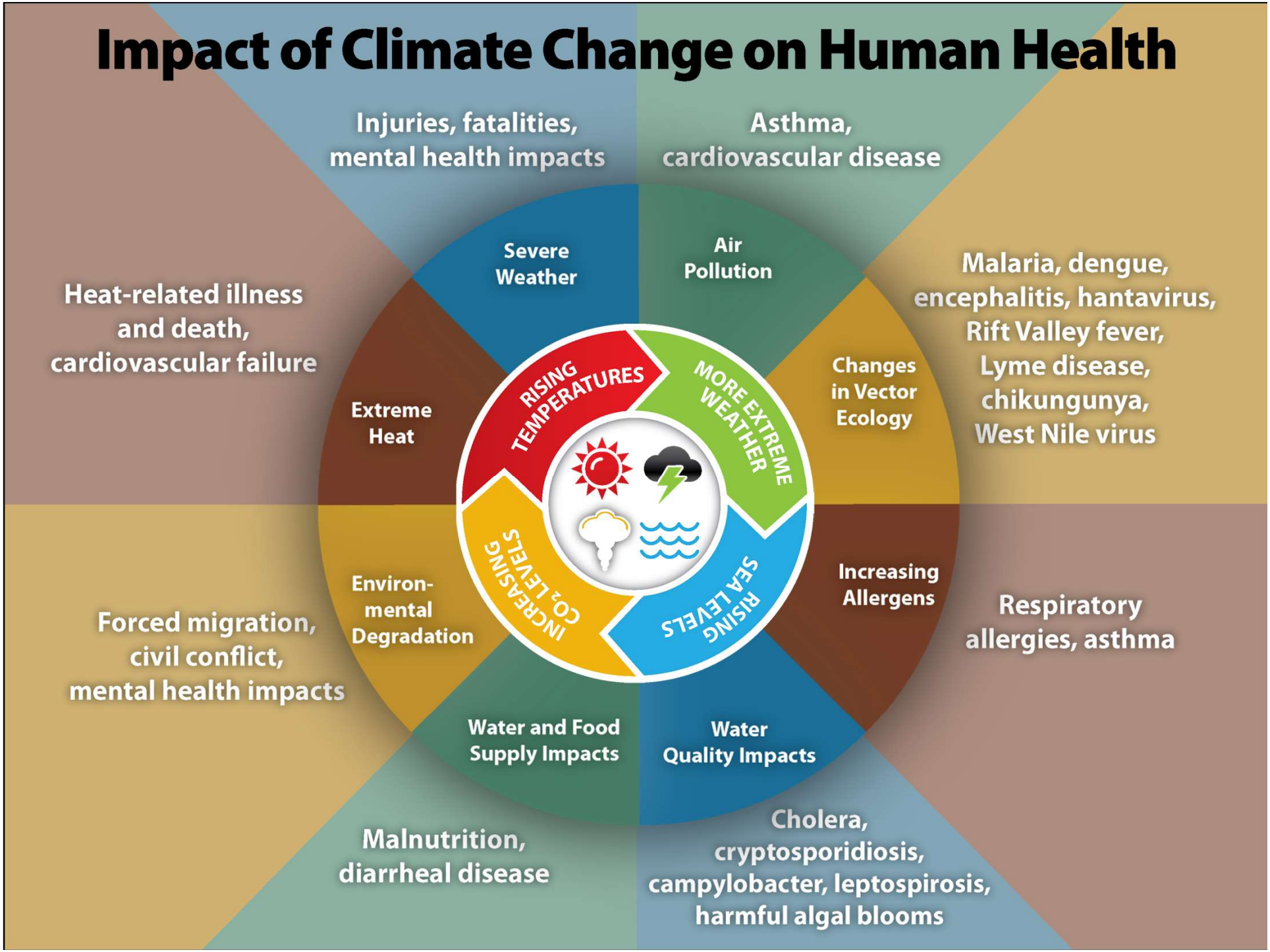
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

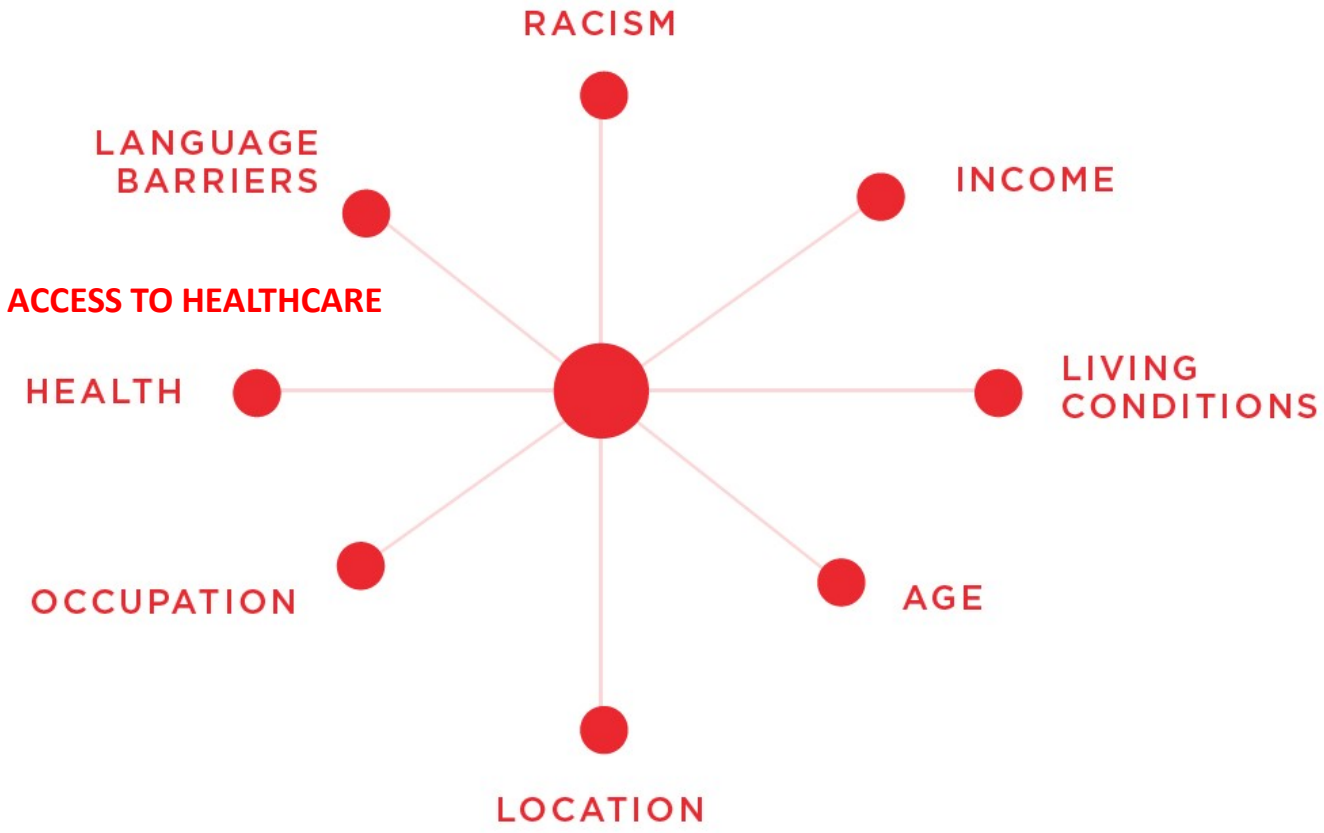
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

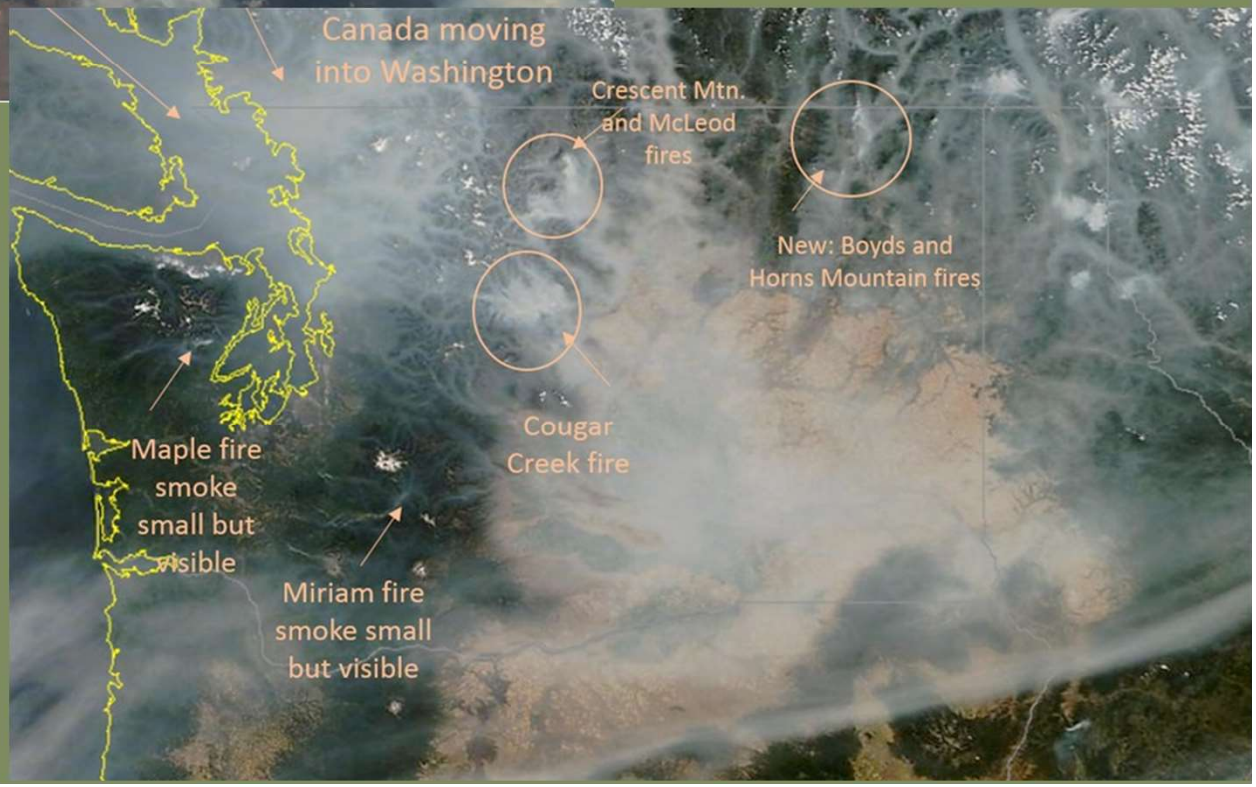
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

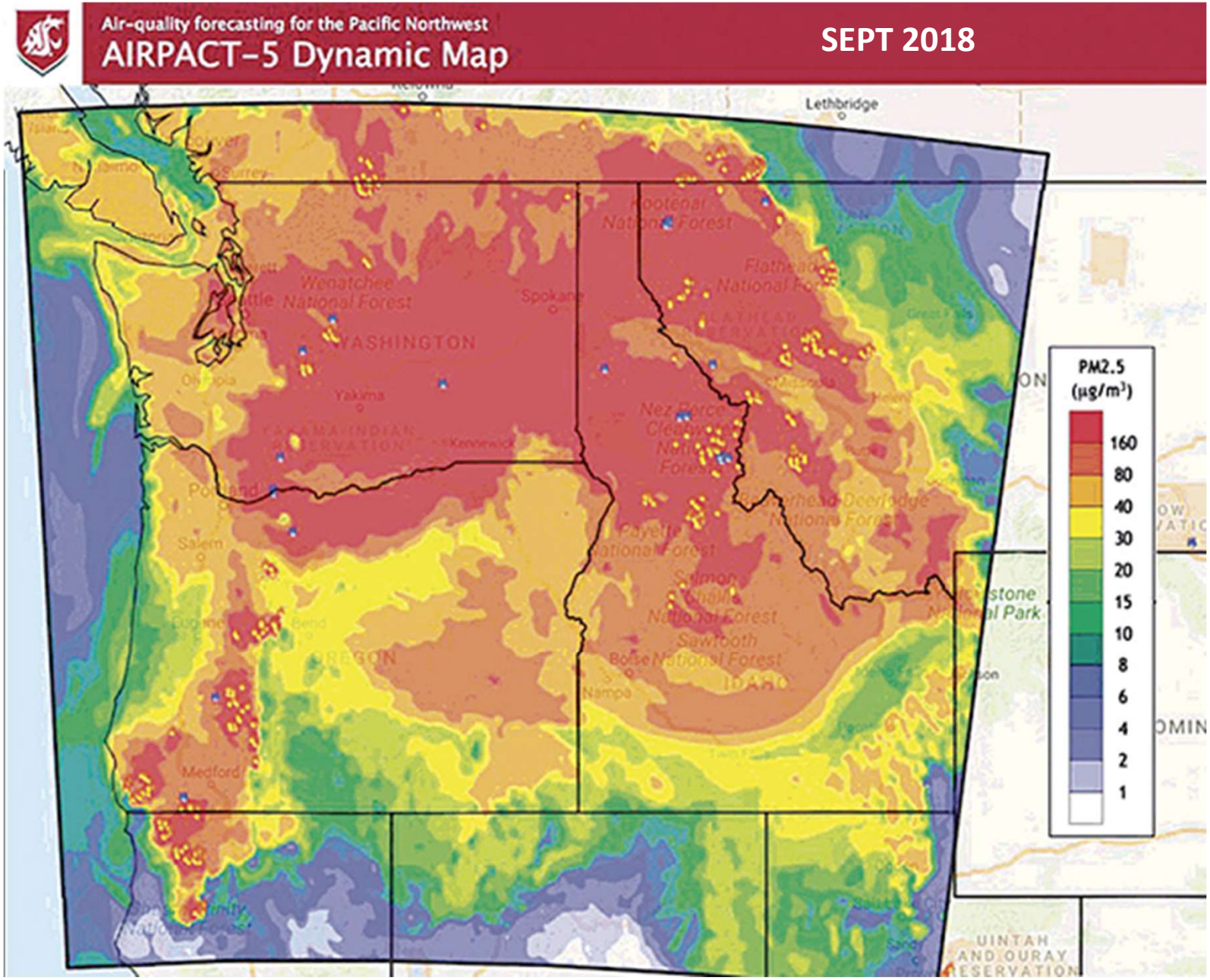
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

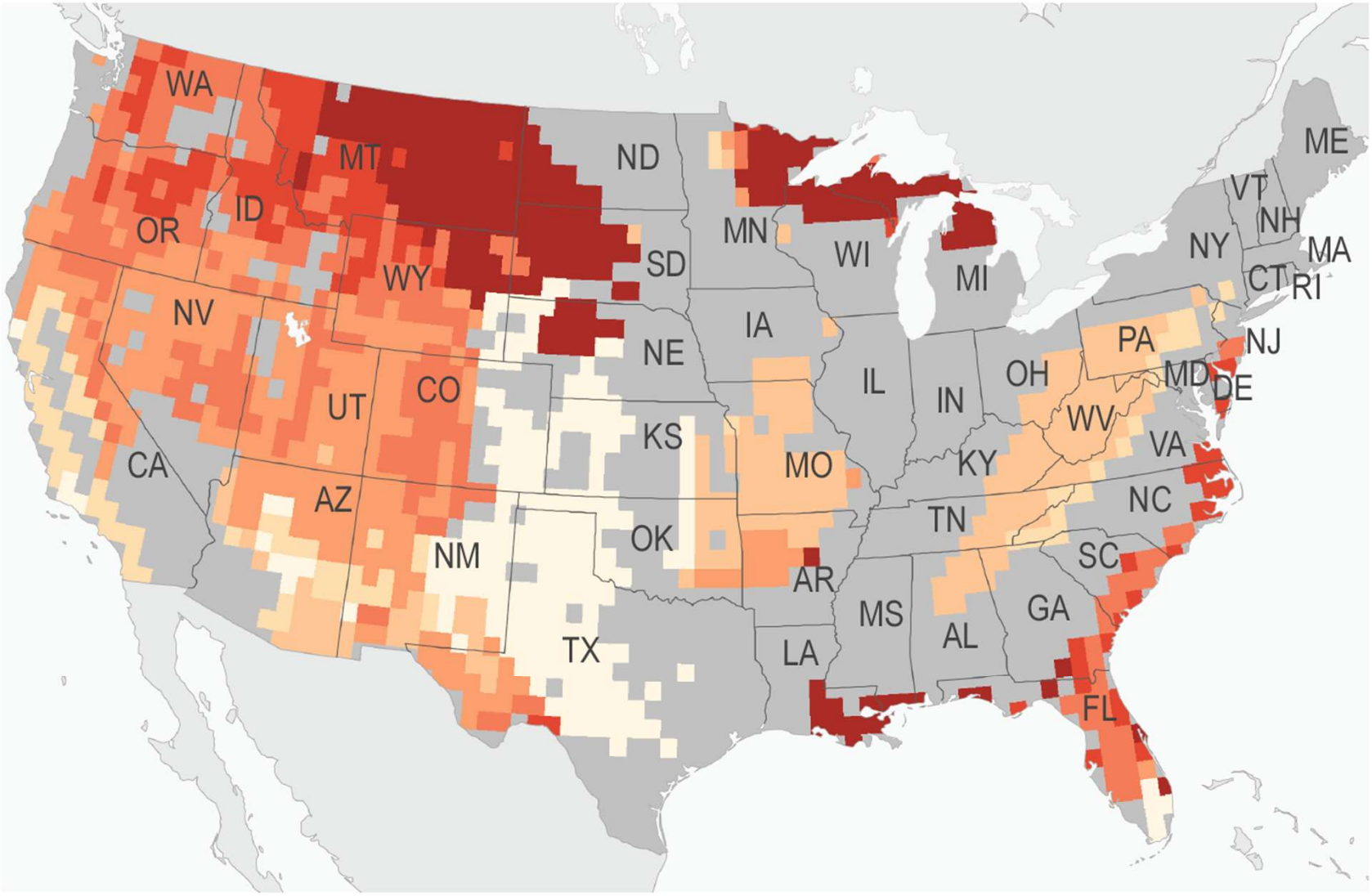
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

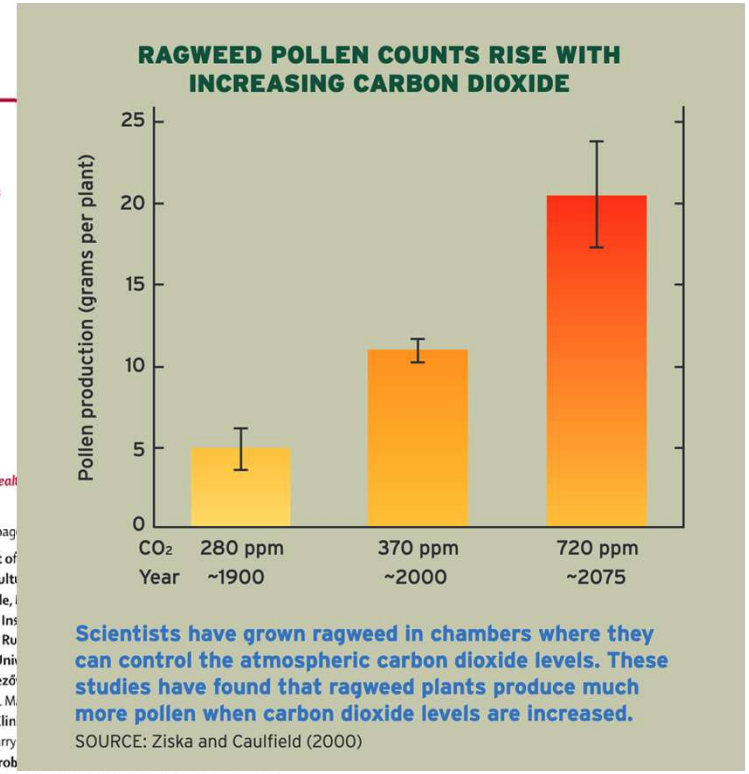
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

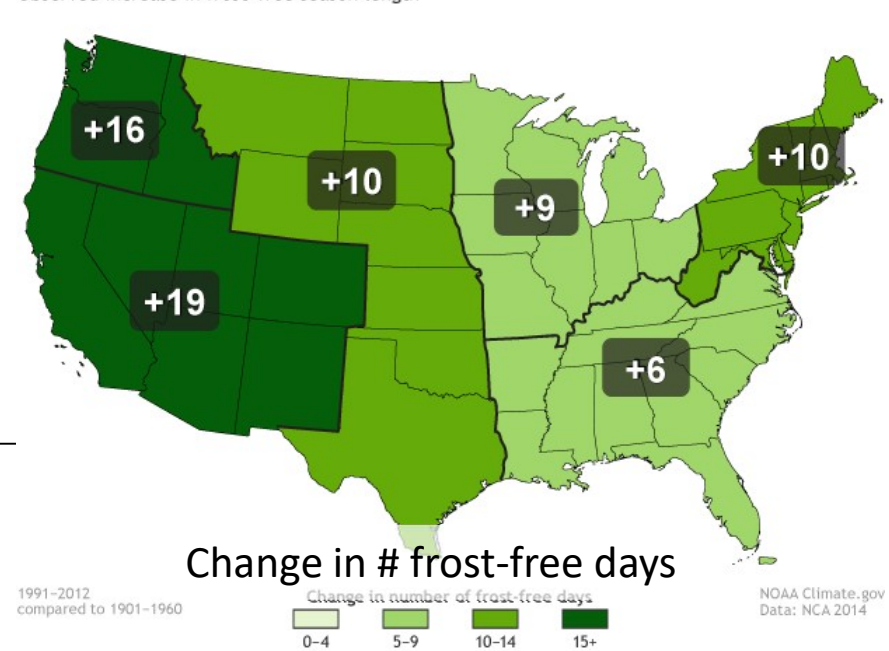
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

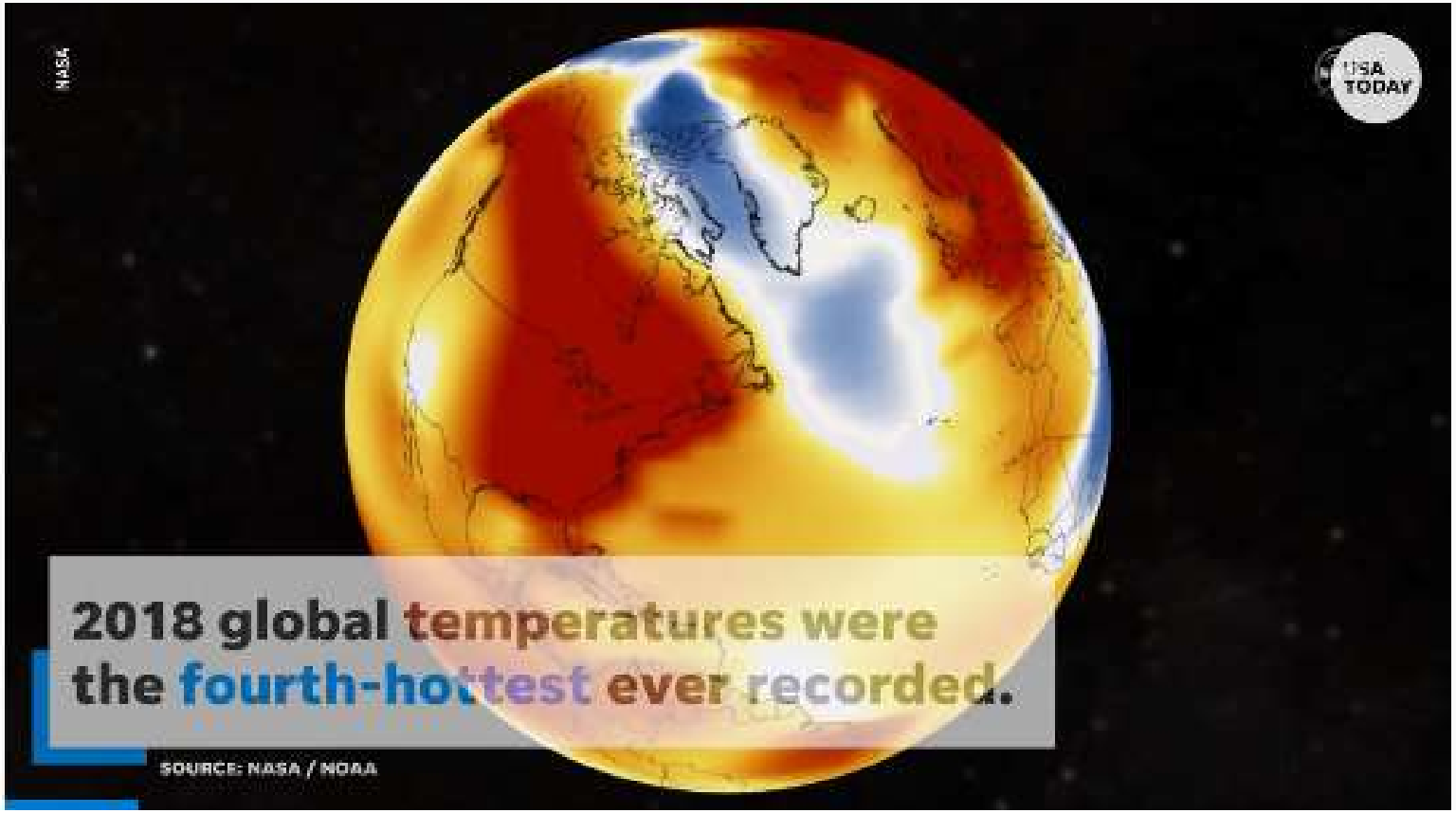
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



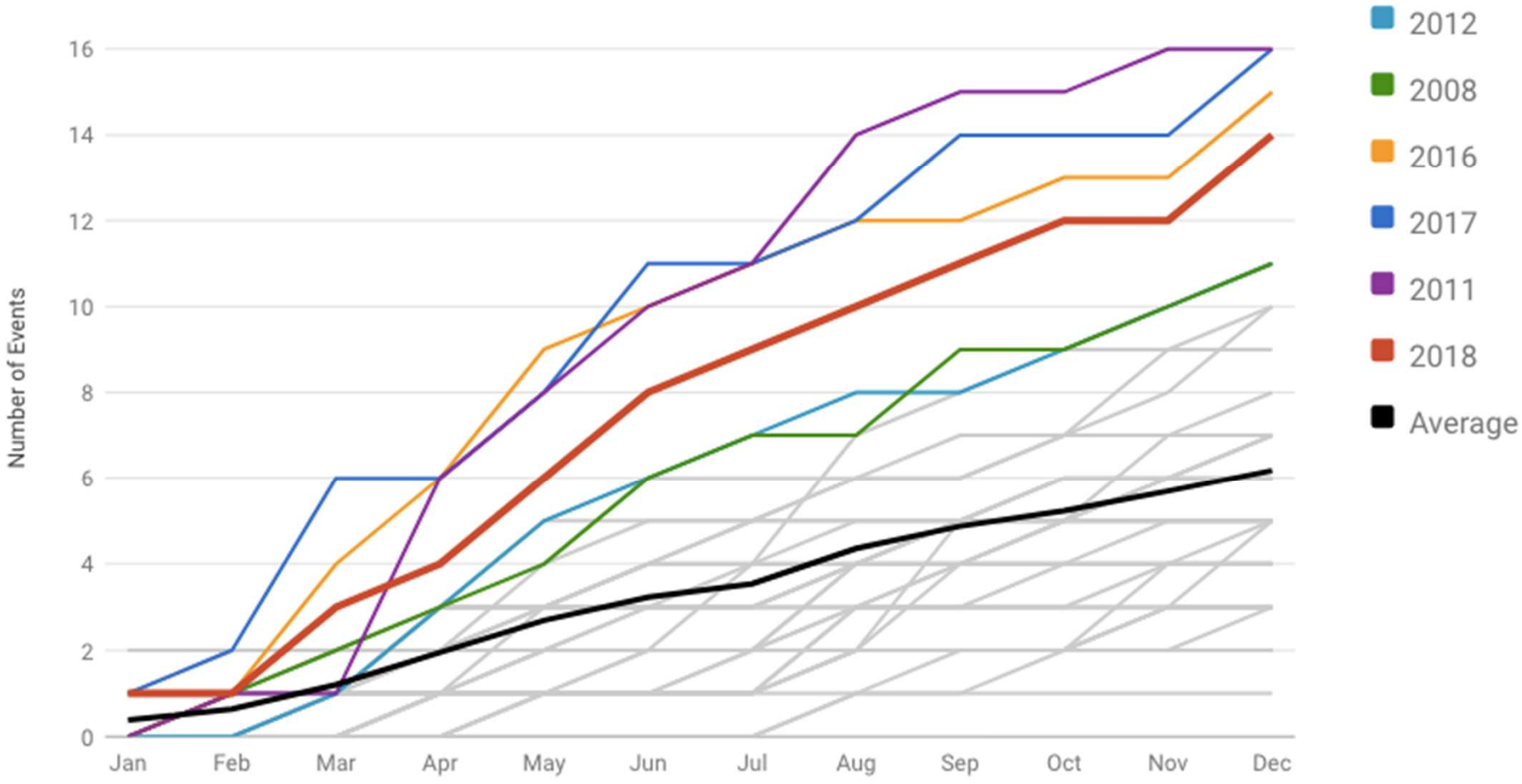
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



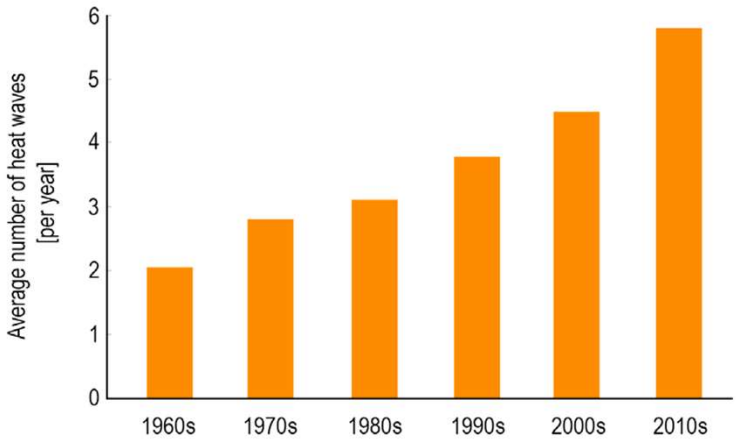
NOAA: National Centers for Environmental Information

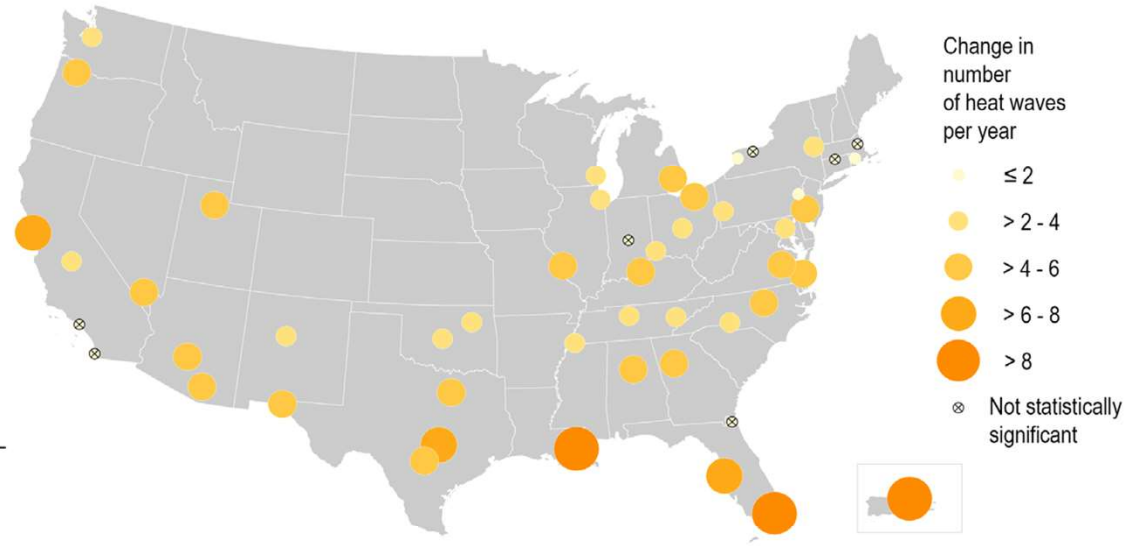
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

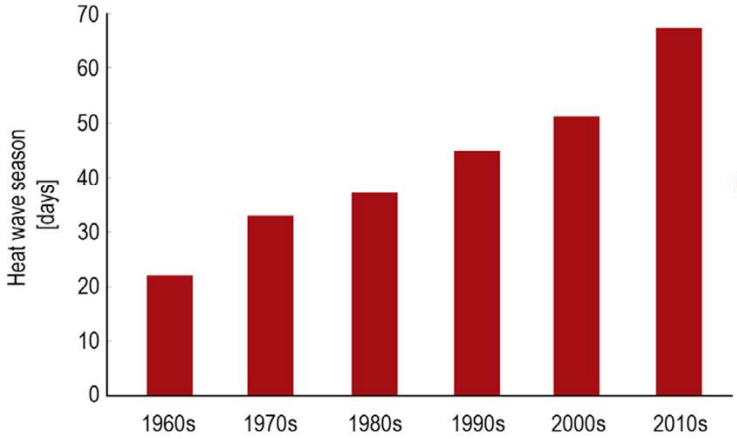
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

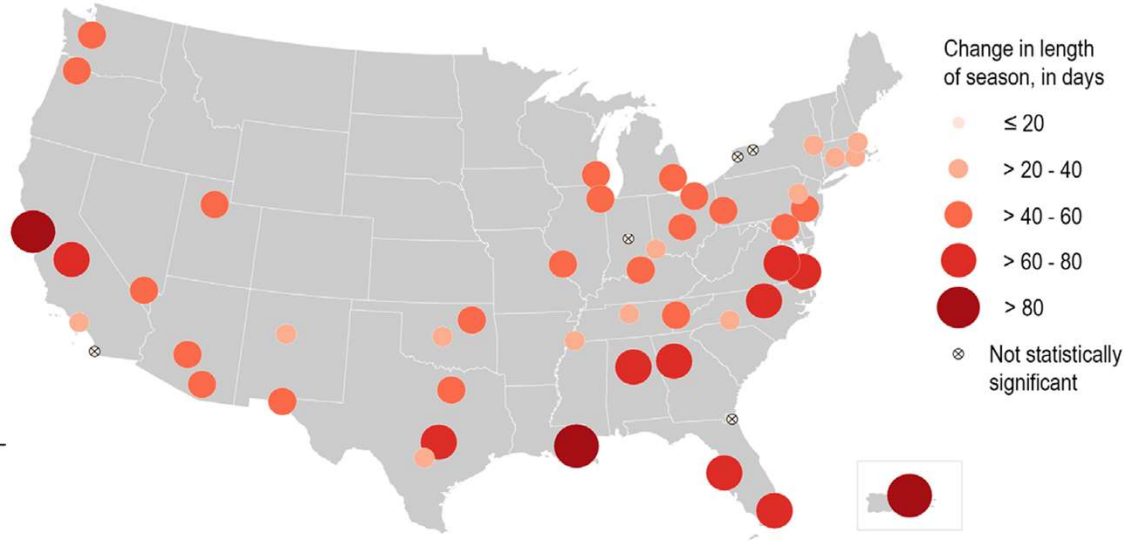
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

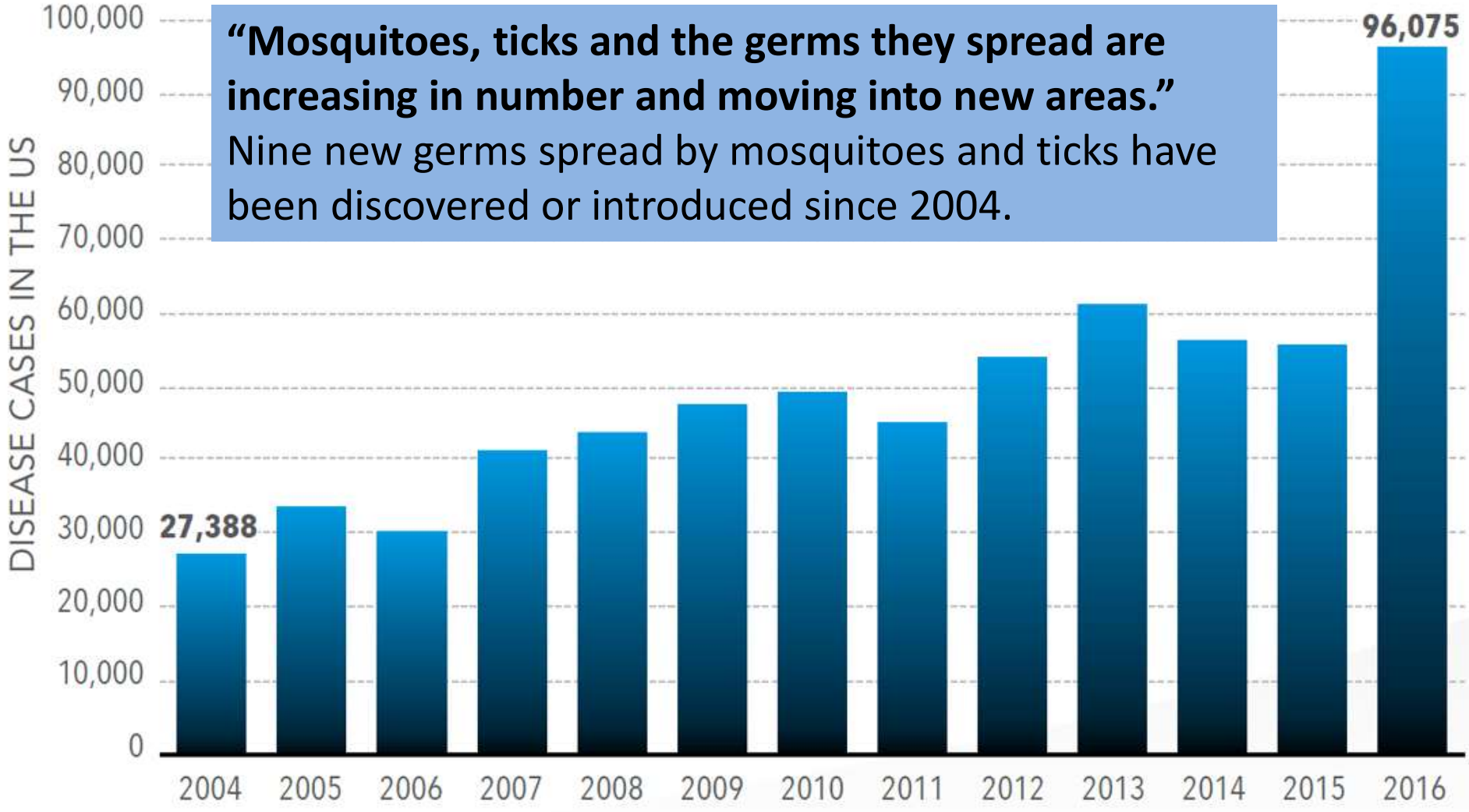
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

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"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

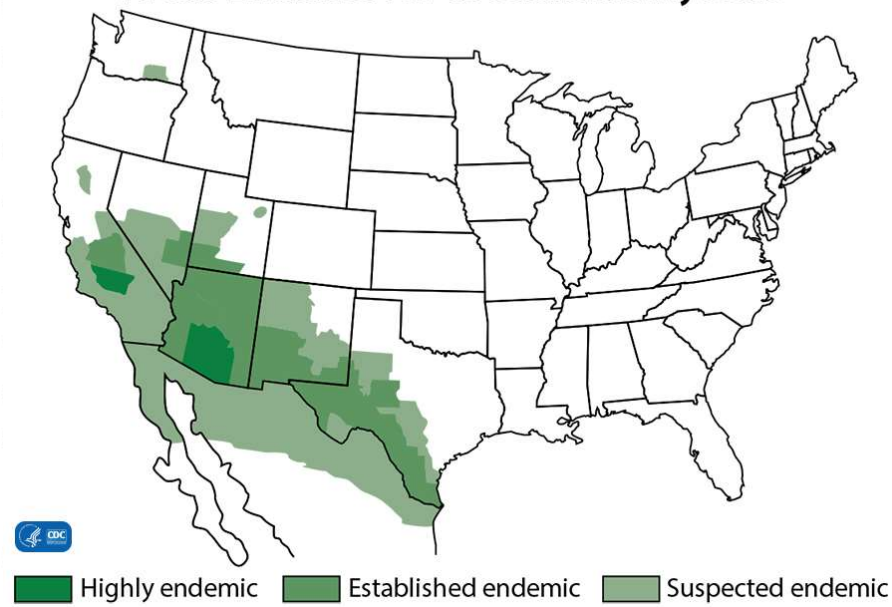
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

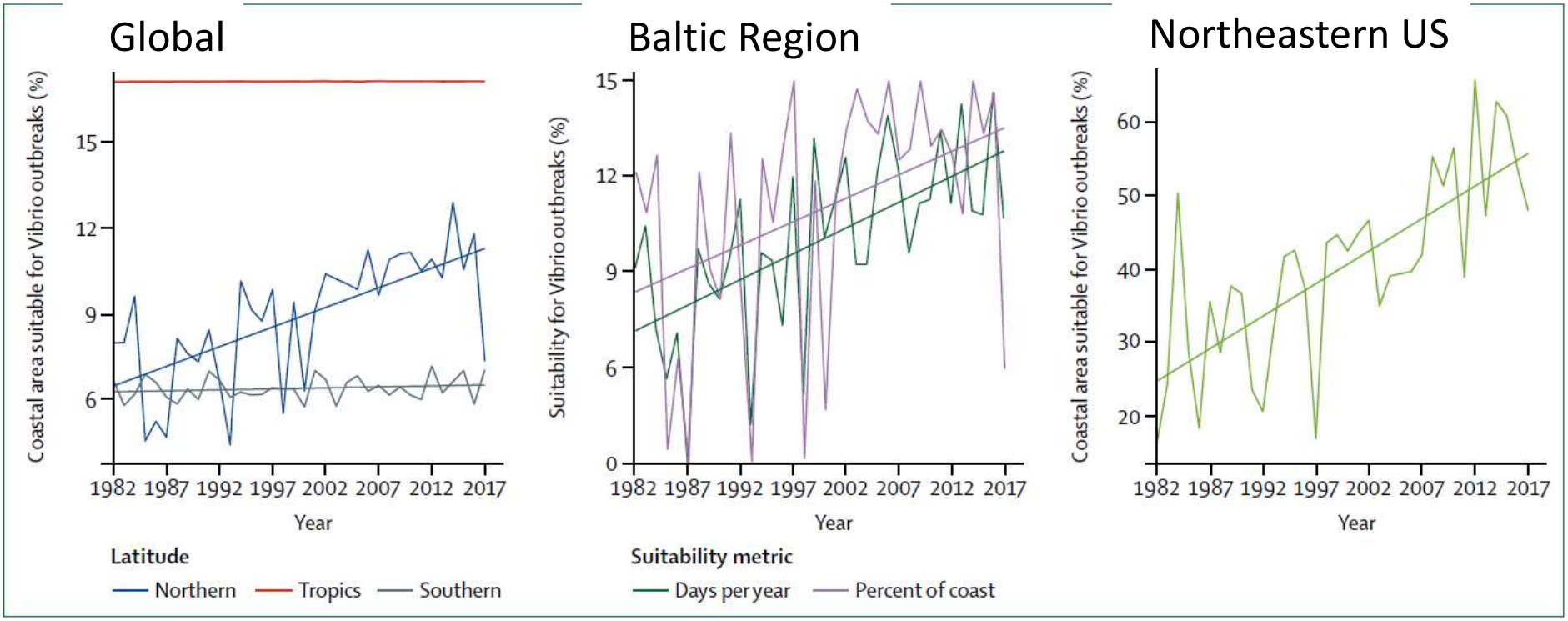
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

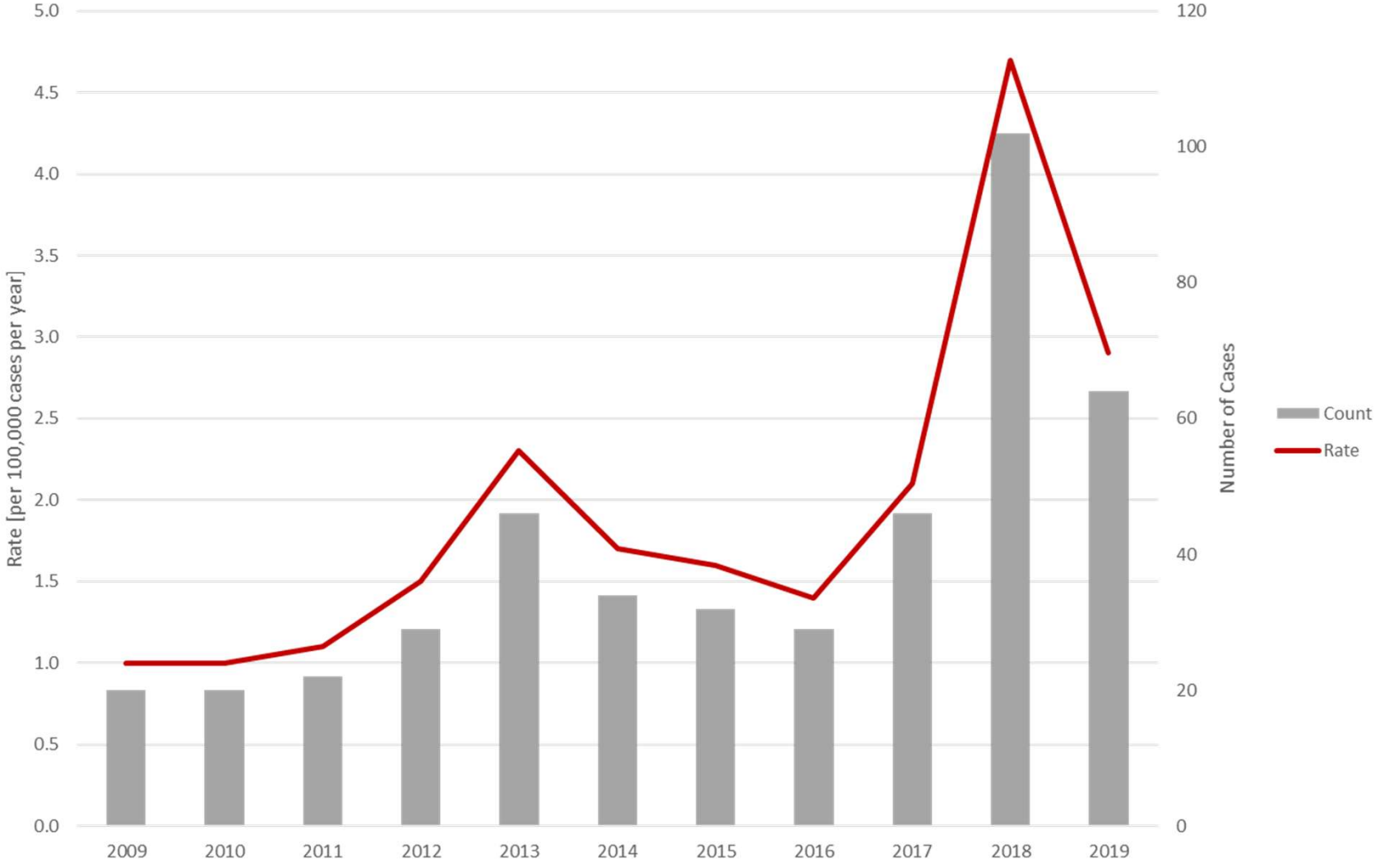
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

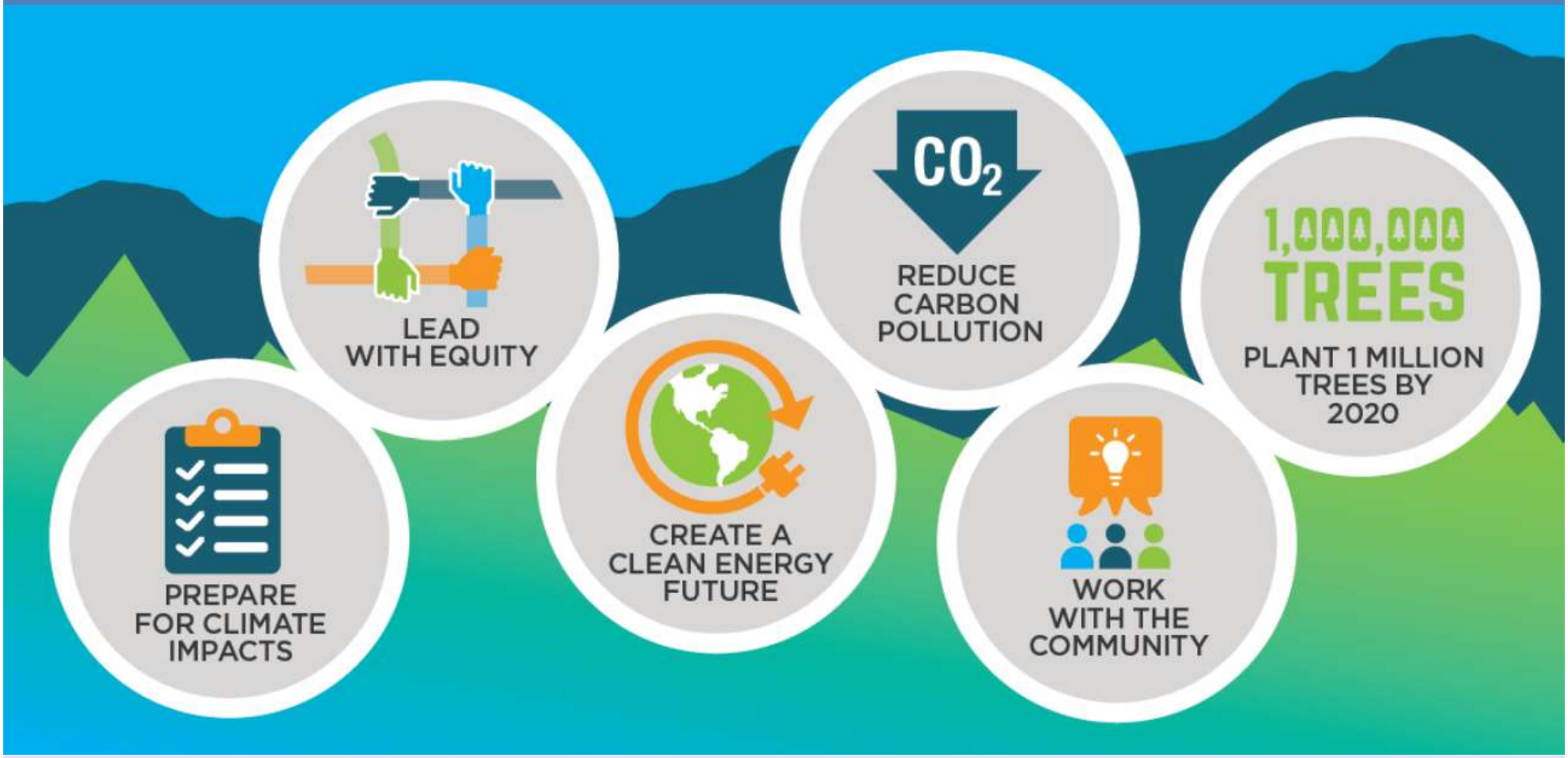
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

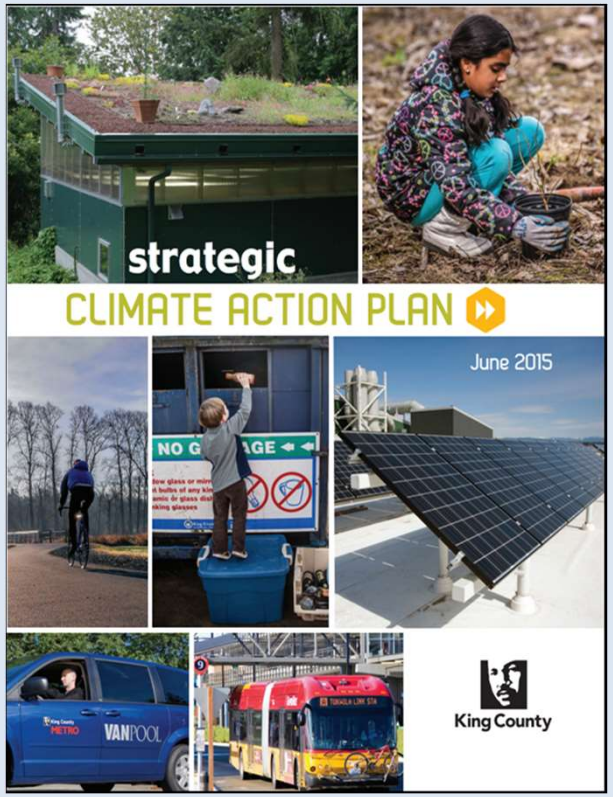


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

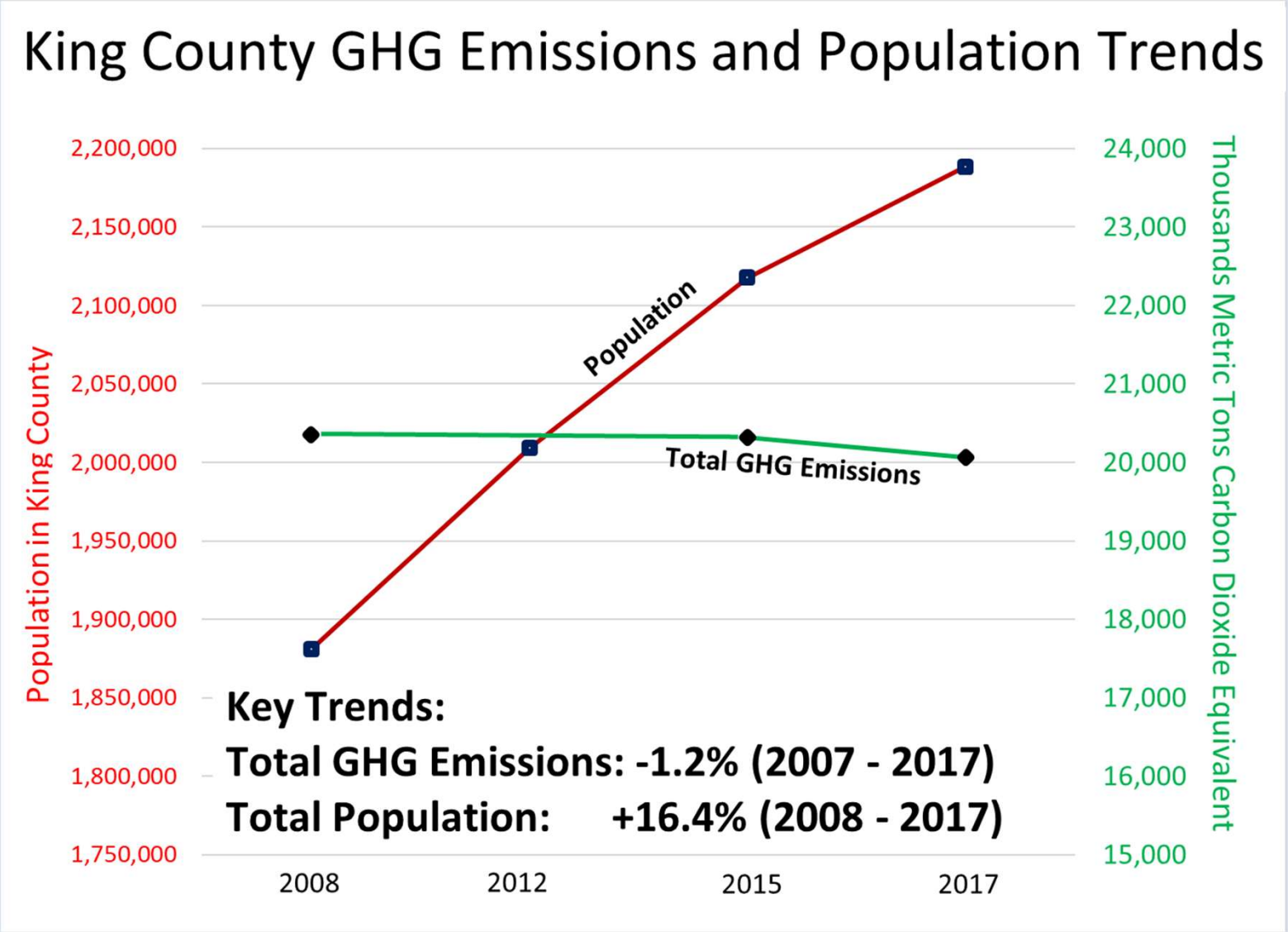
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



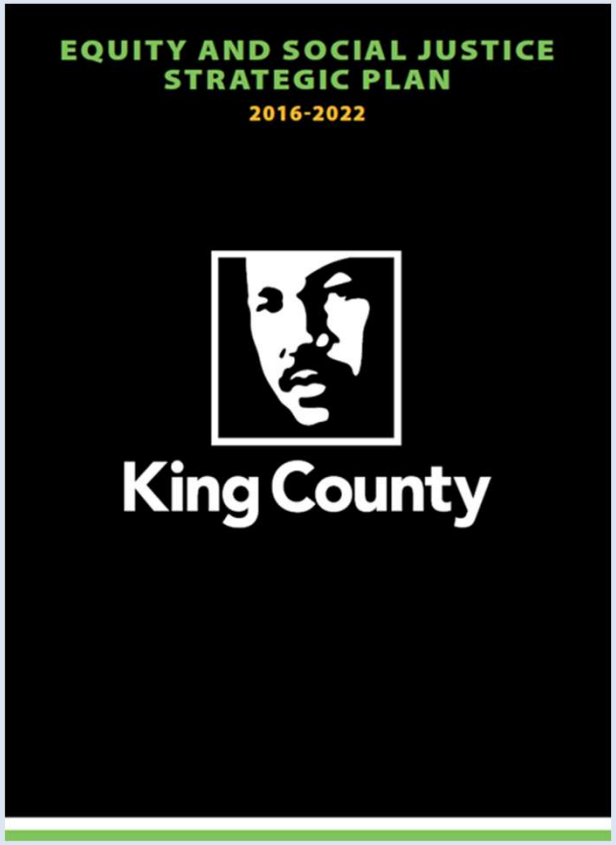
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

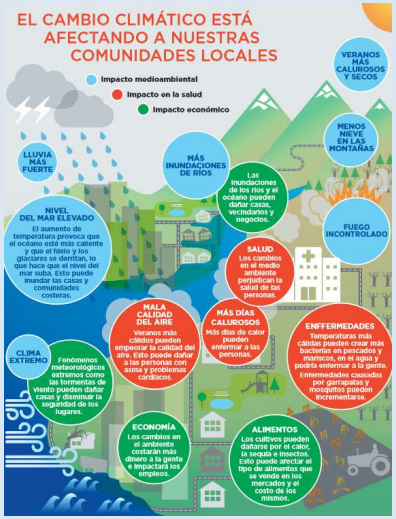
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

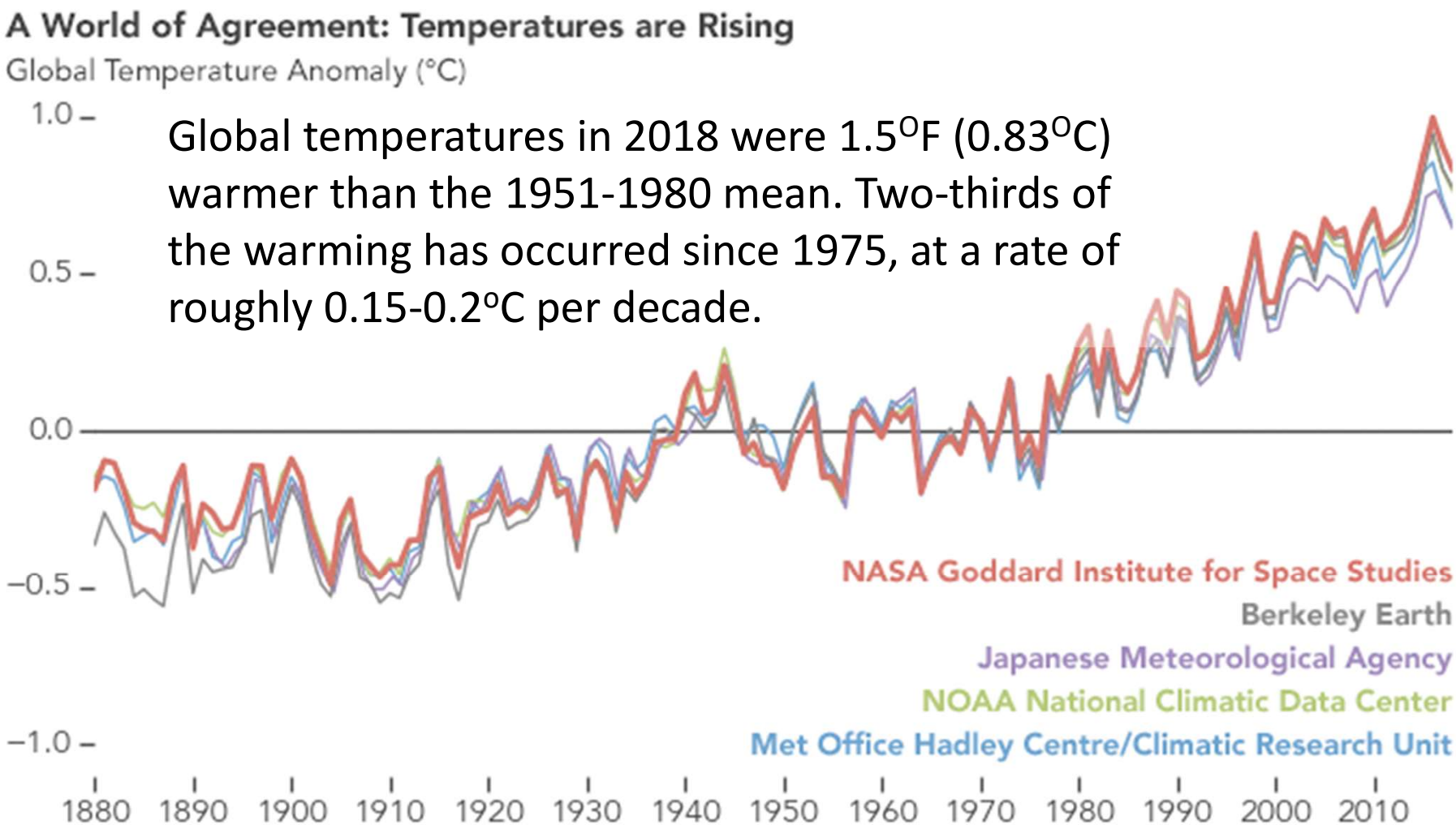
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

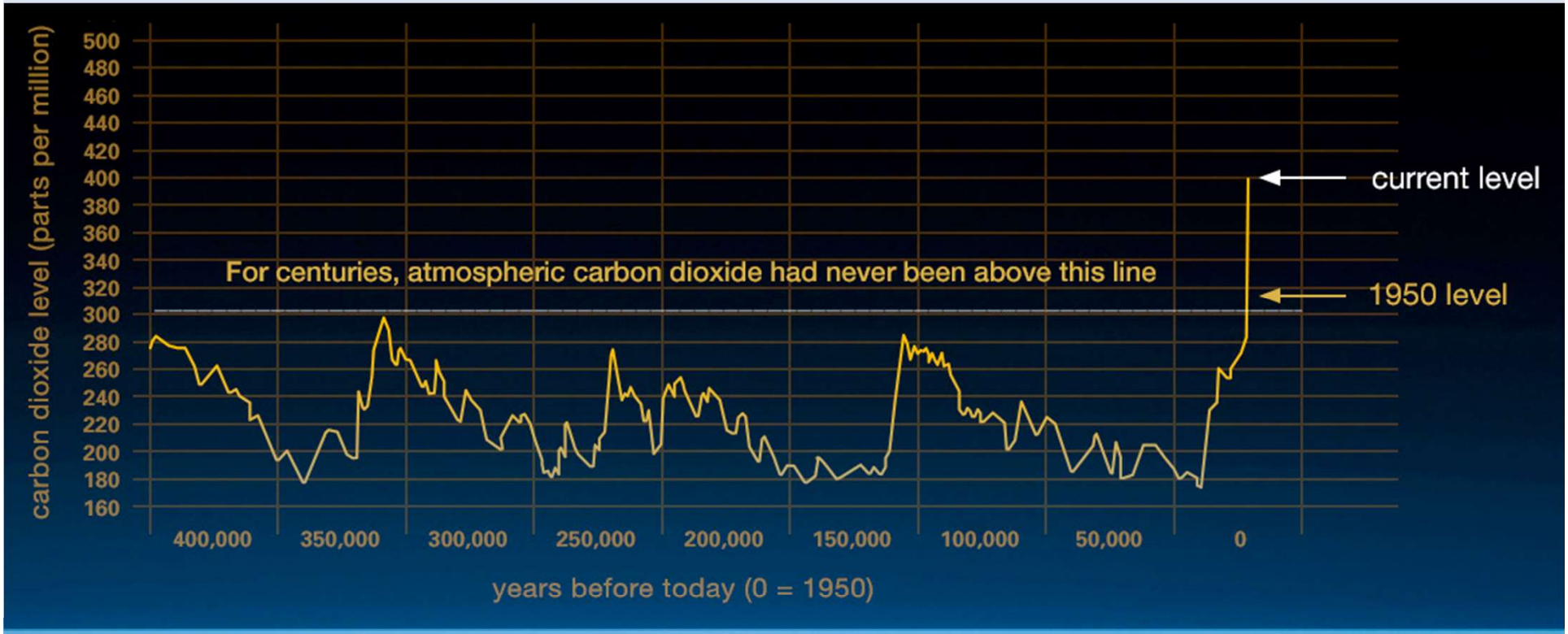


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

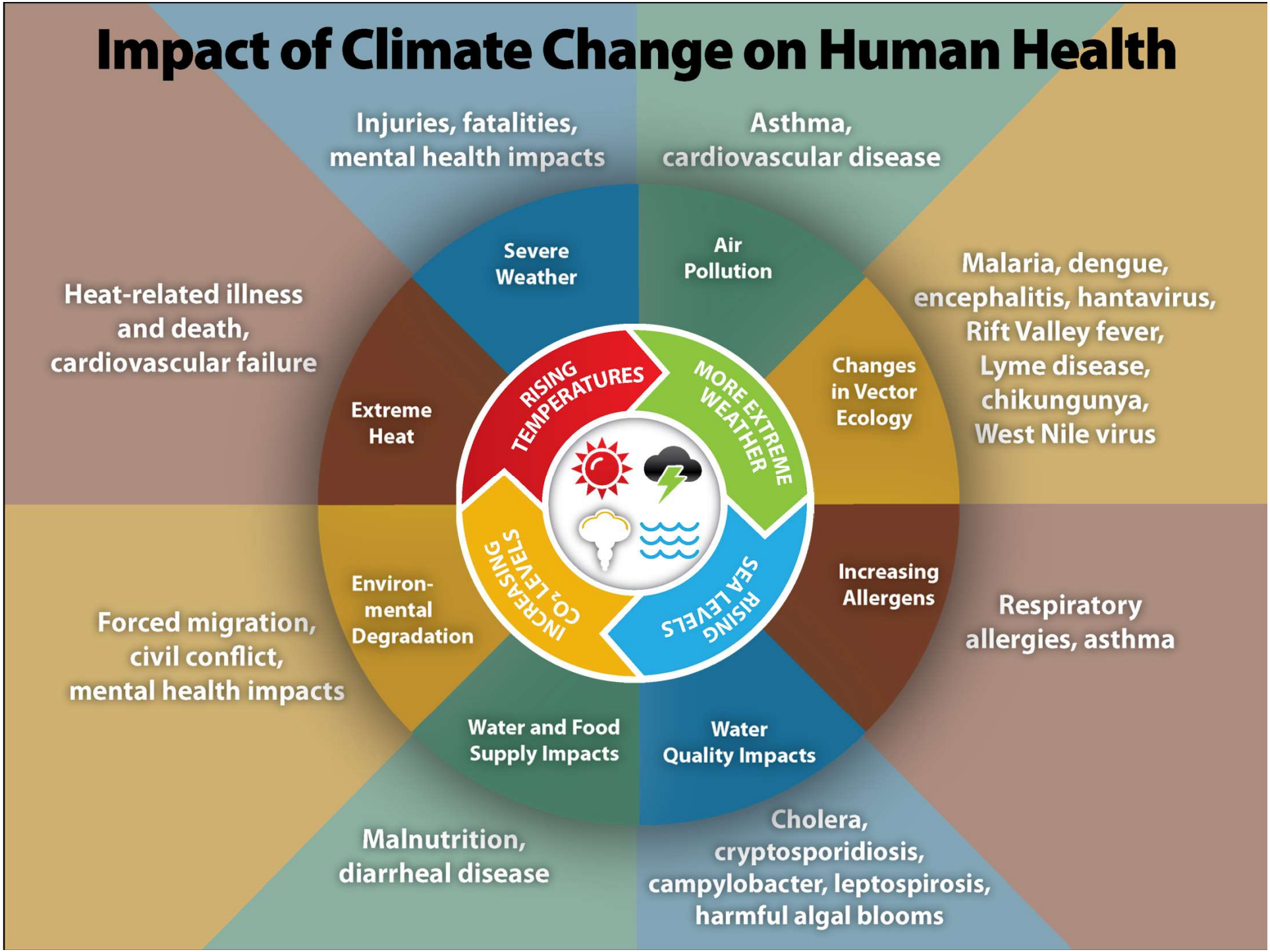
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

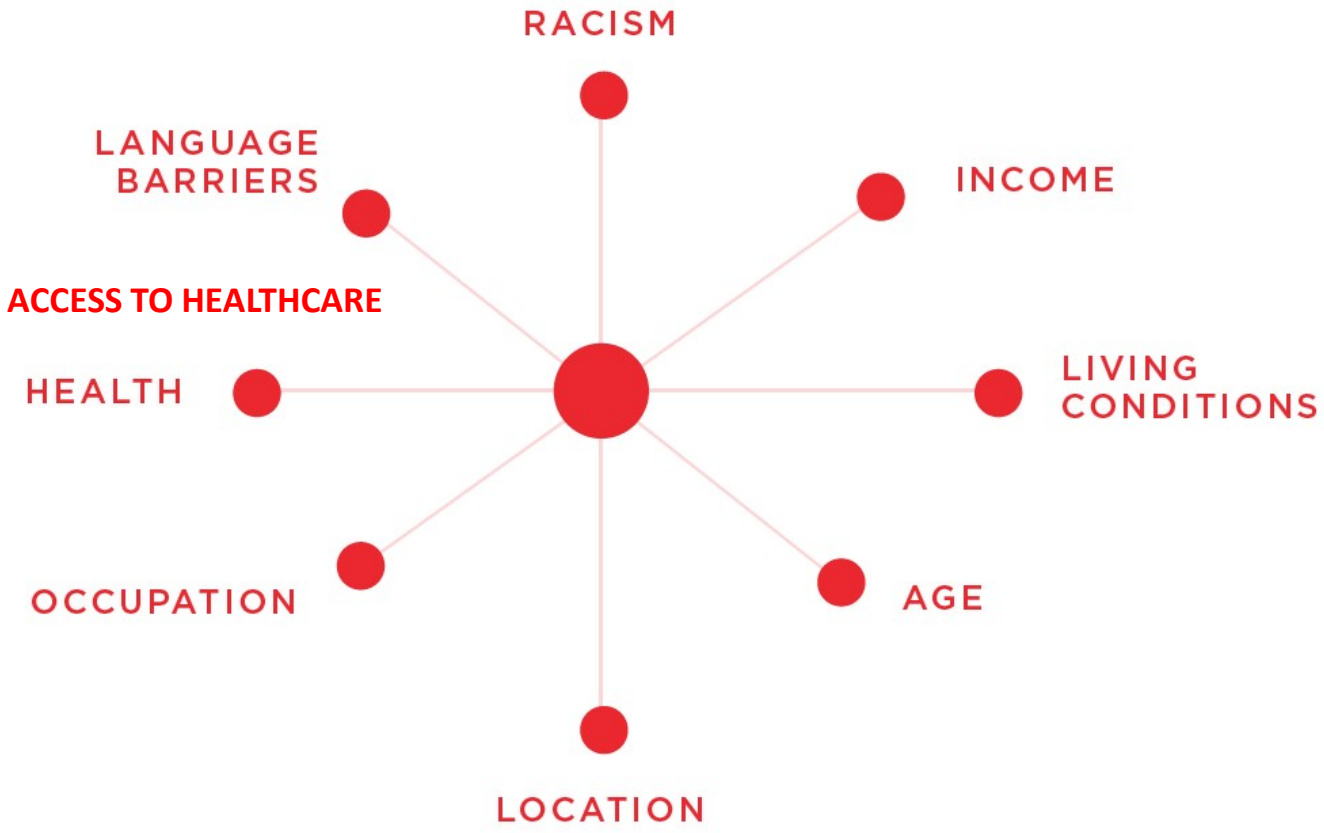
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

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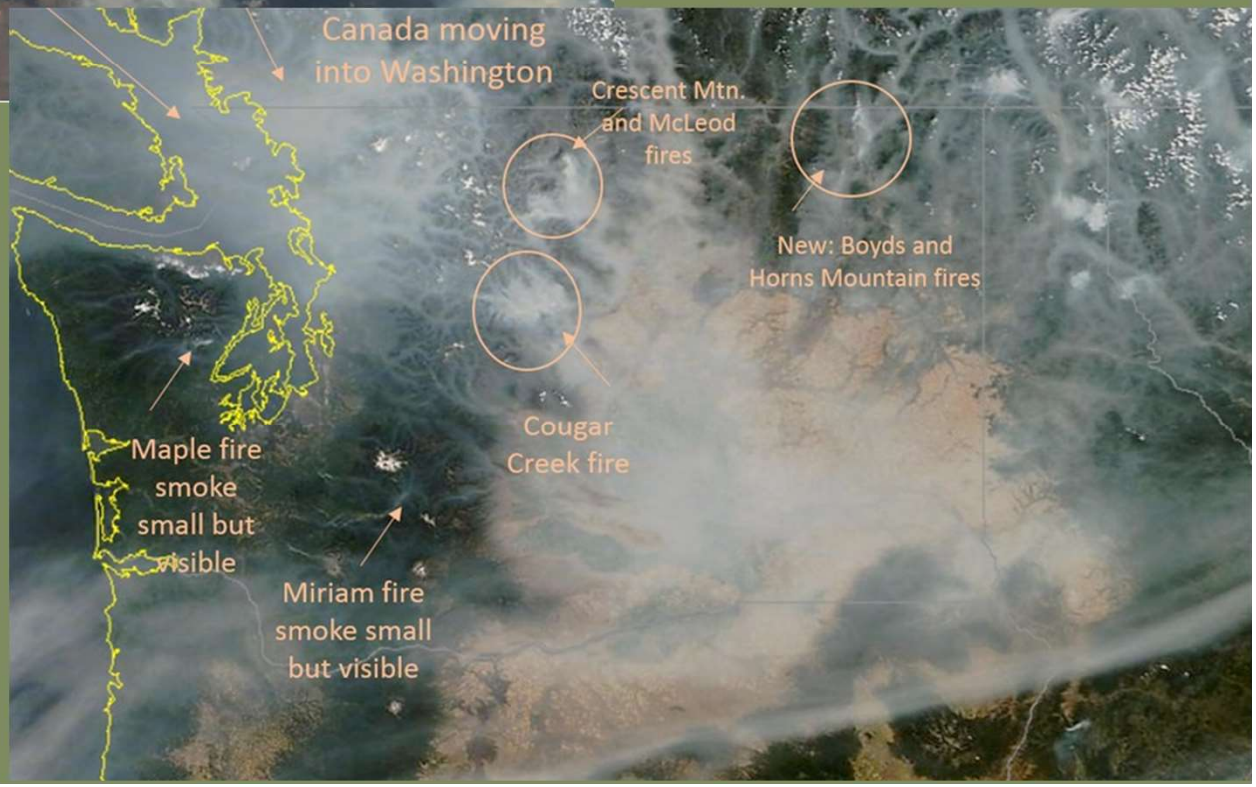
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

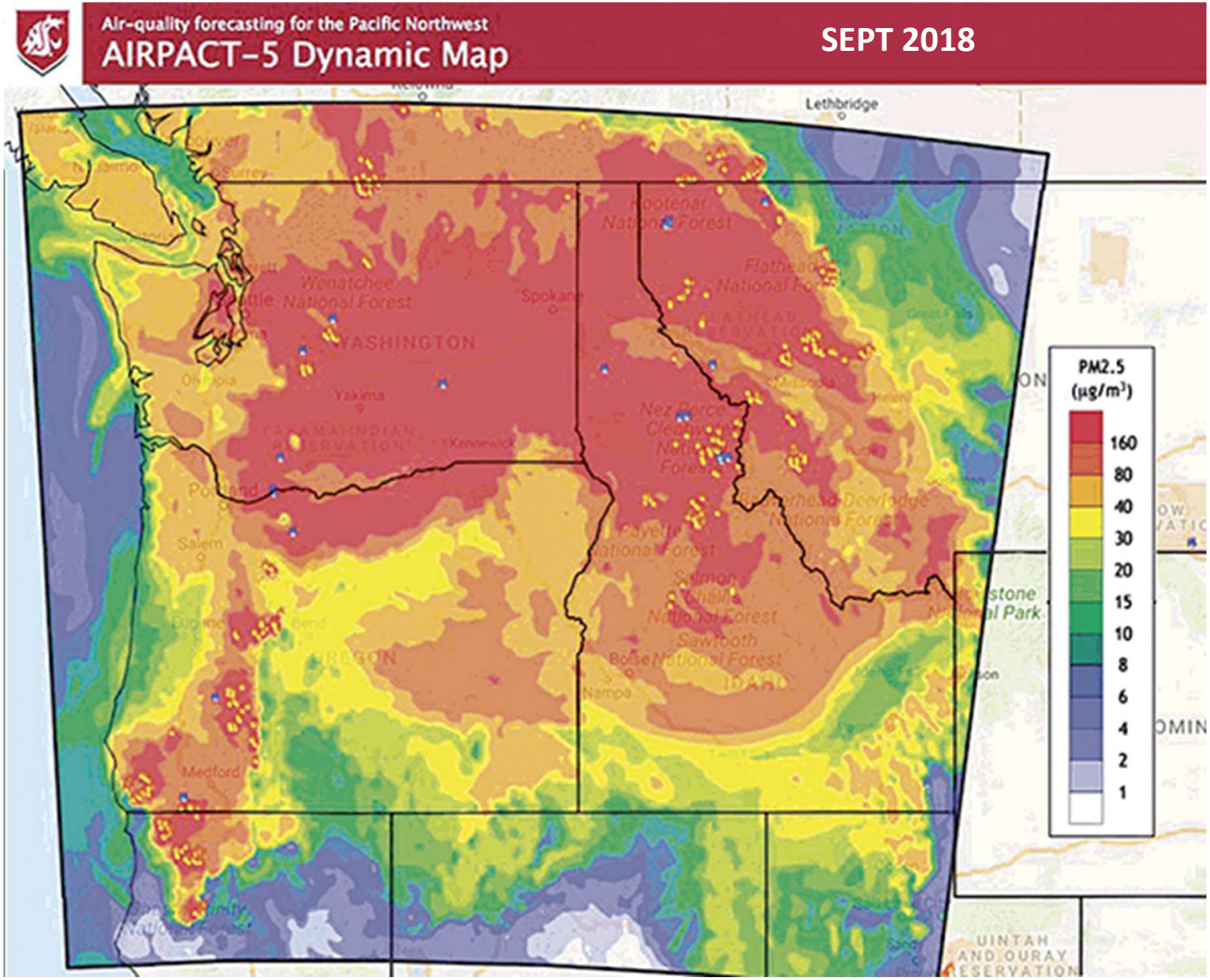
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

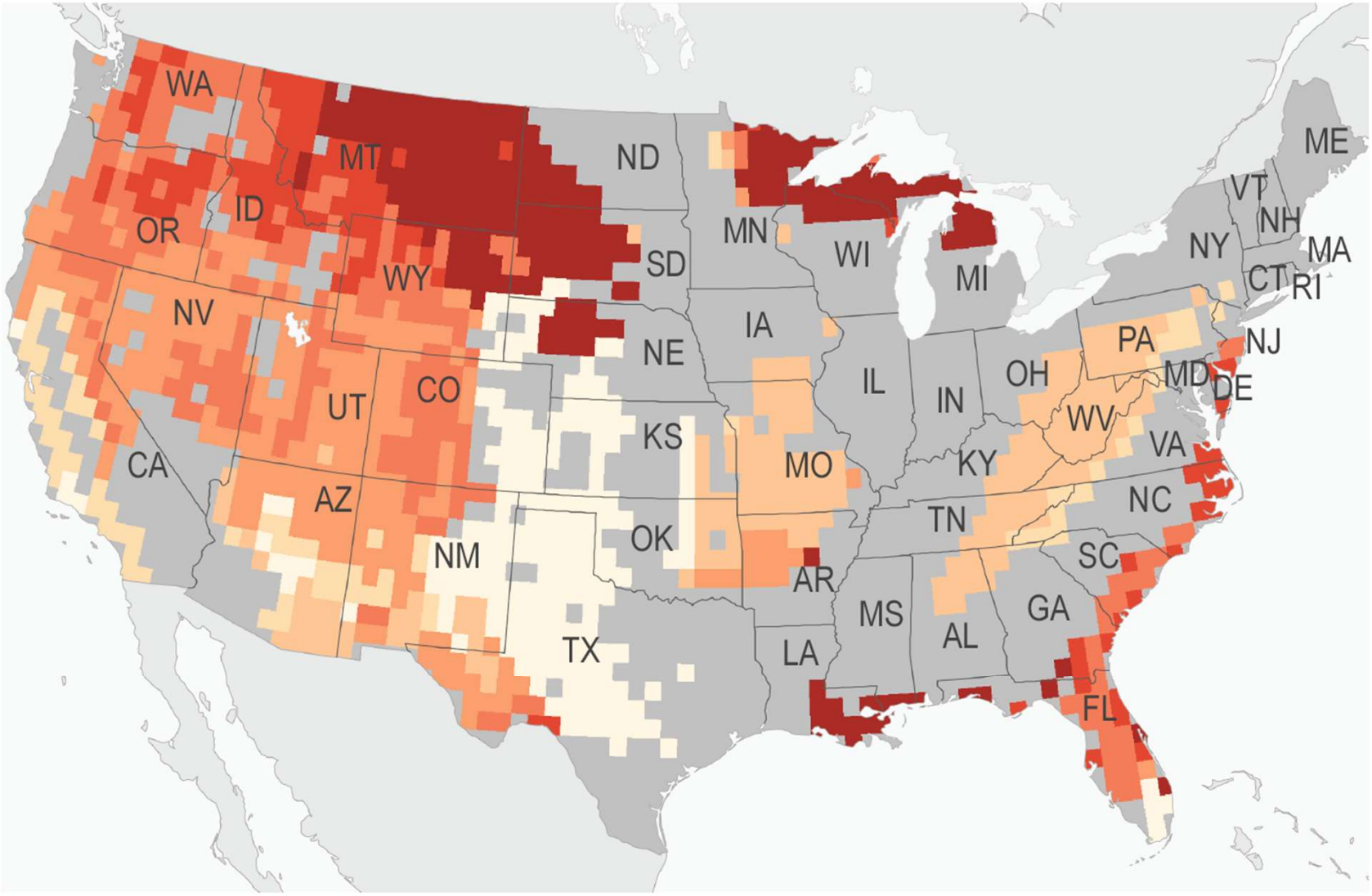
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

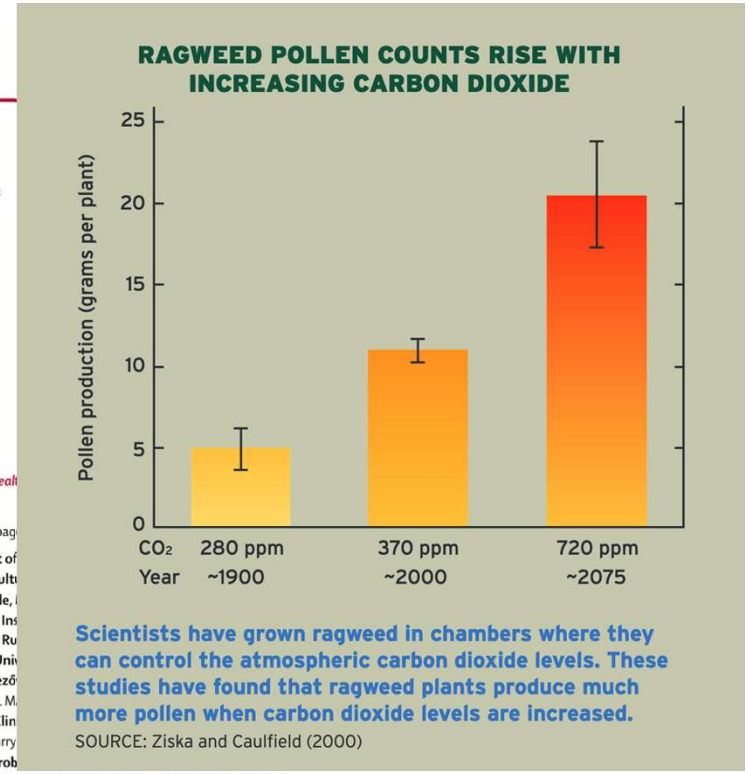
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

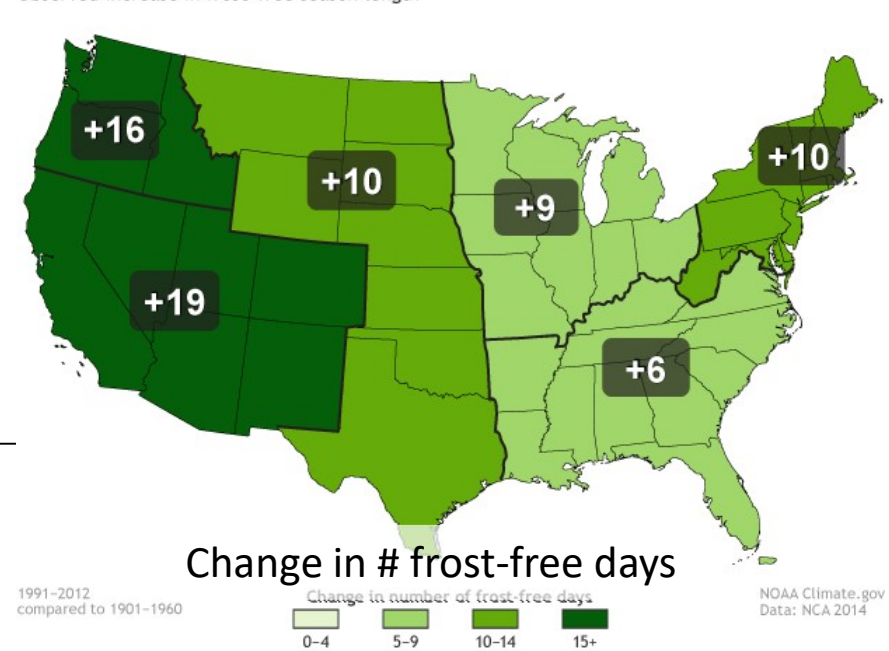
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

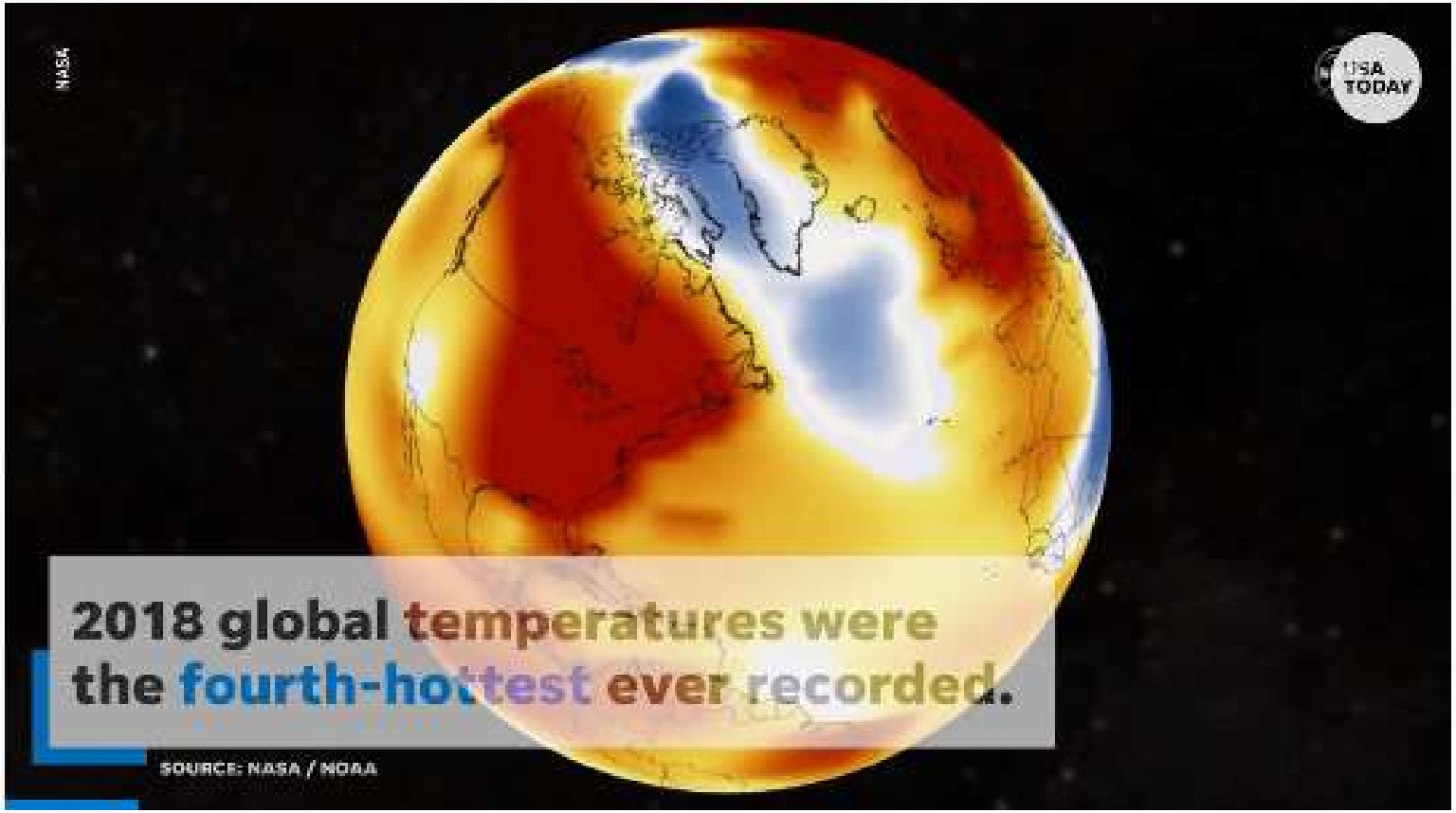
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



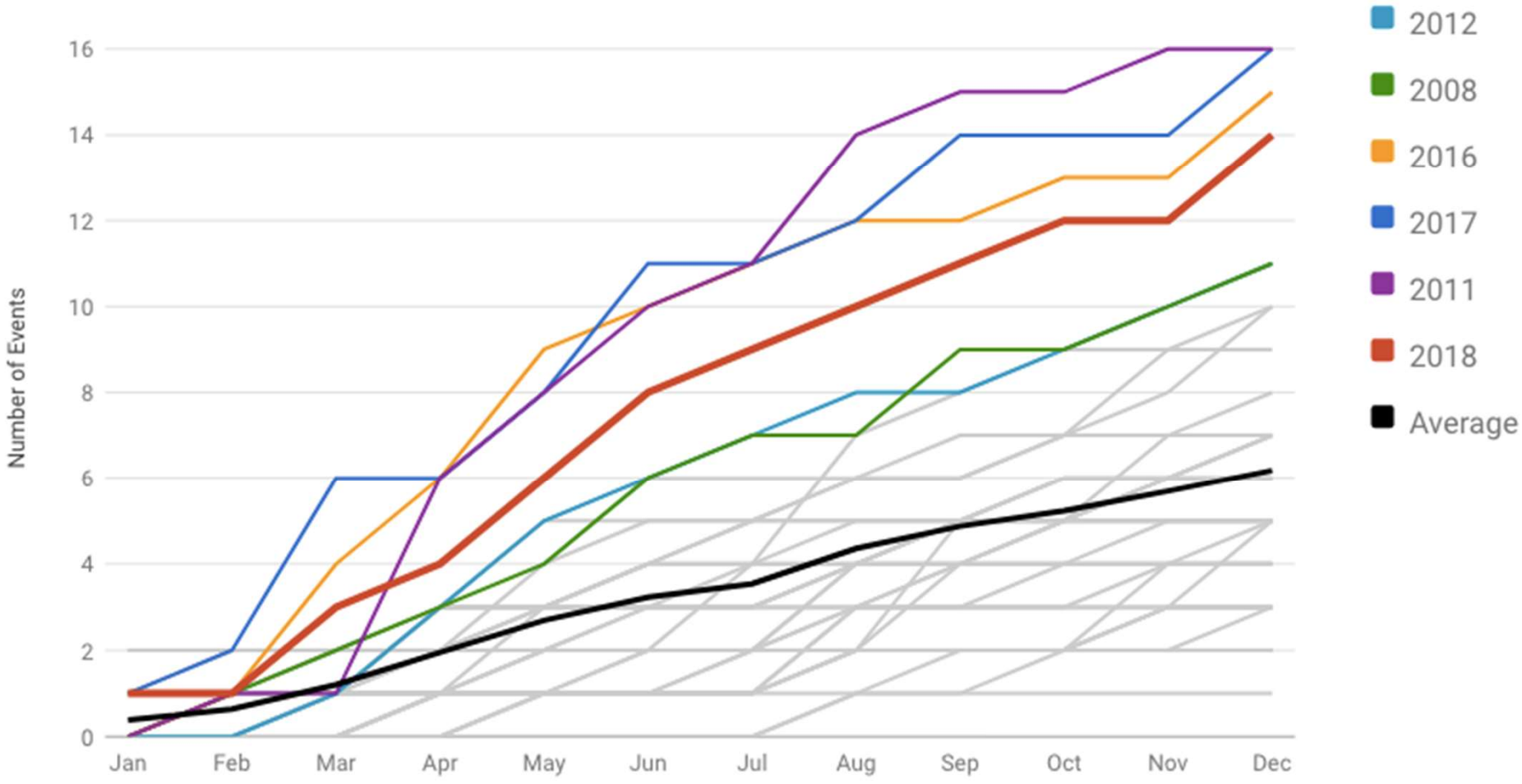
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



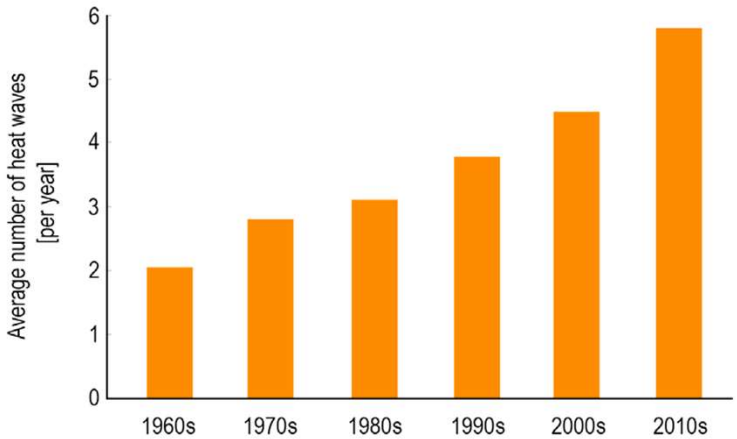
NOAA: National Centers for Environmental Information

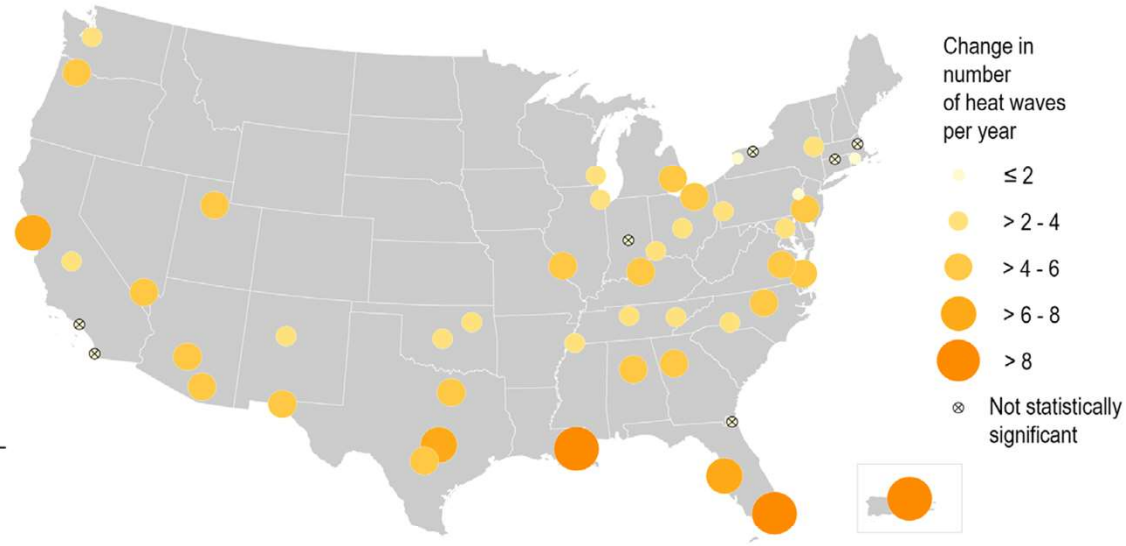
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

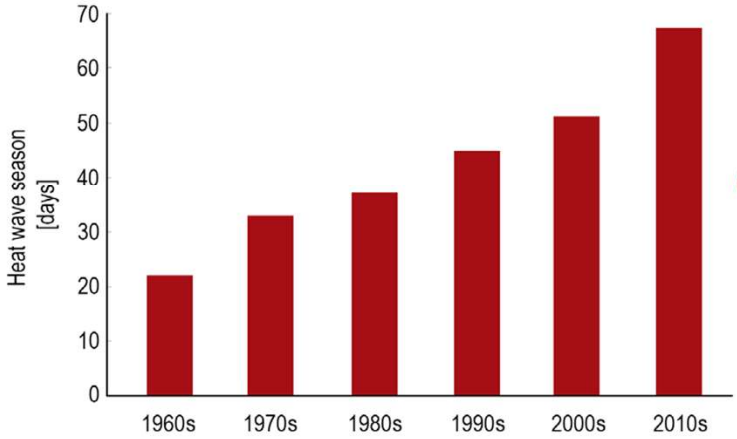
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

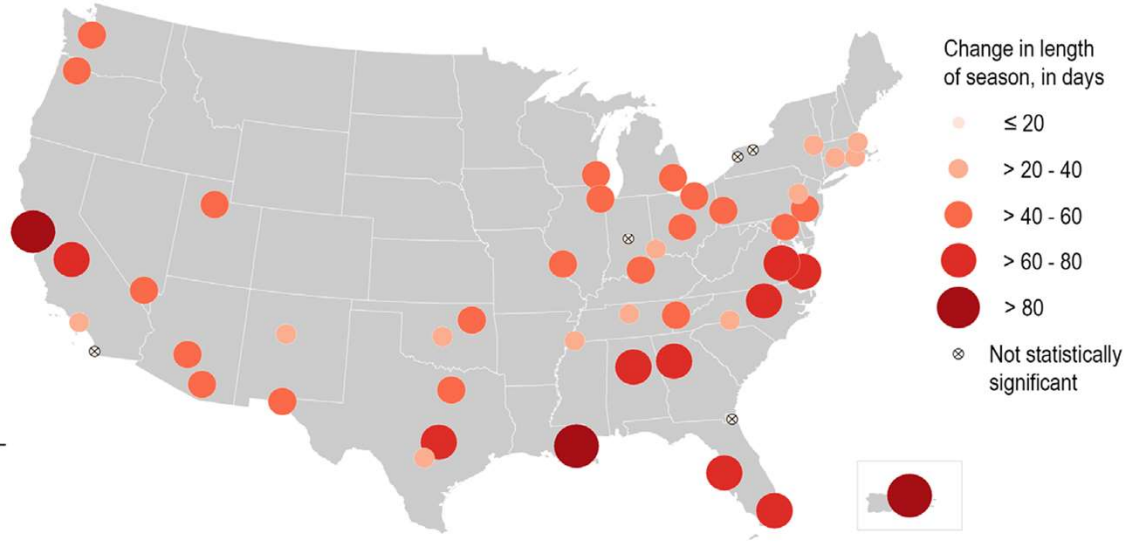
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

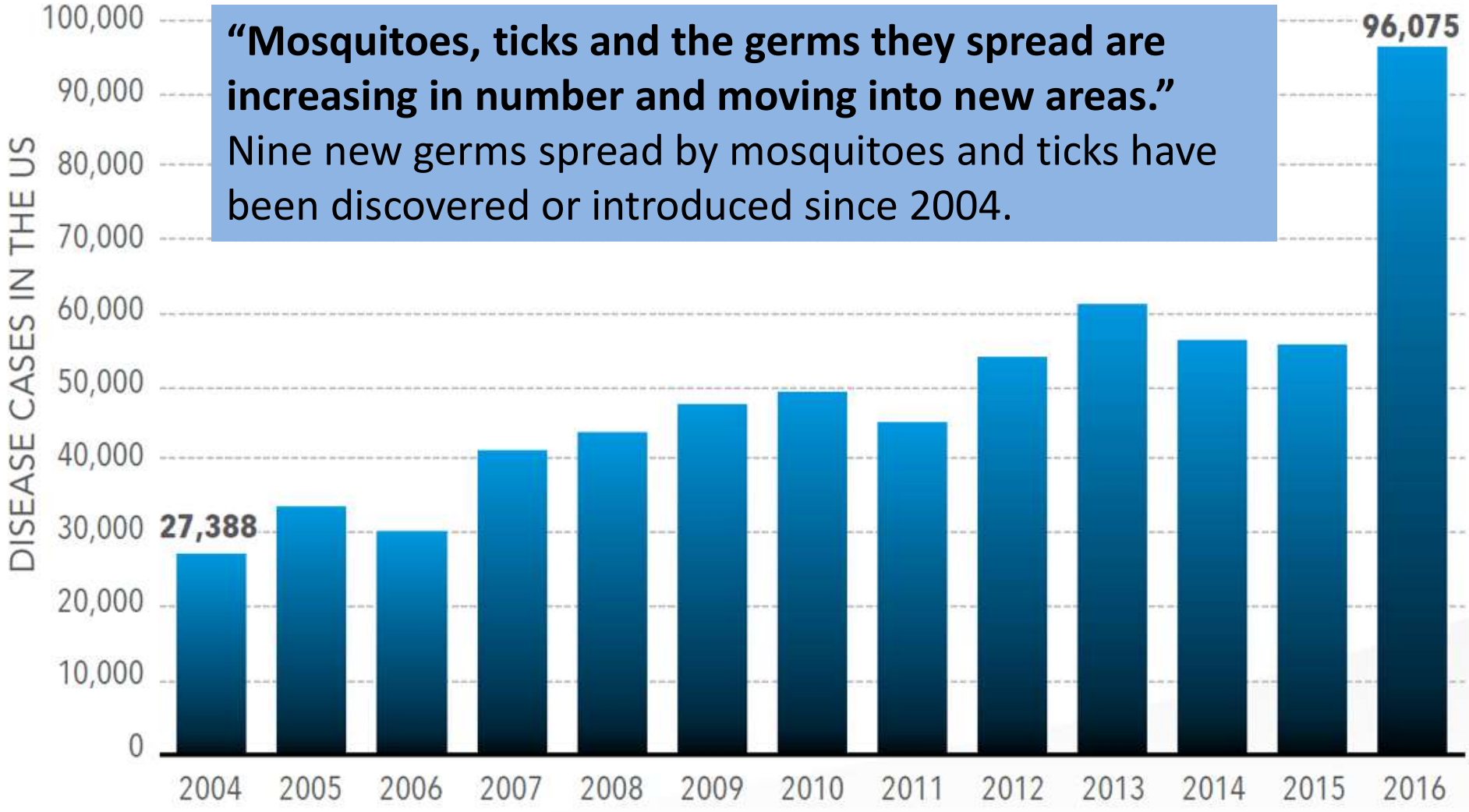
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

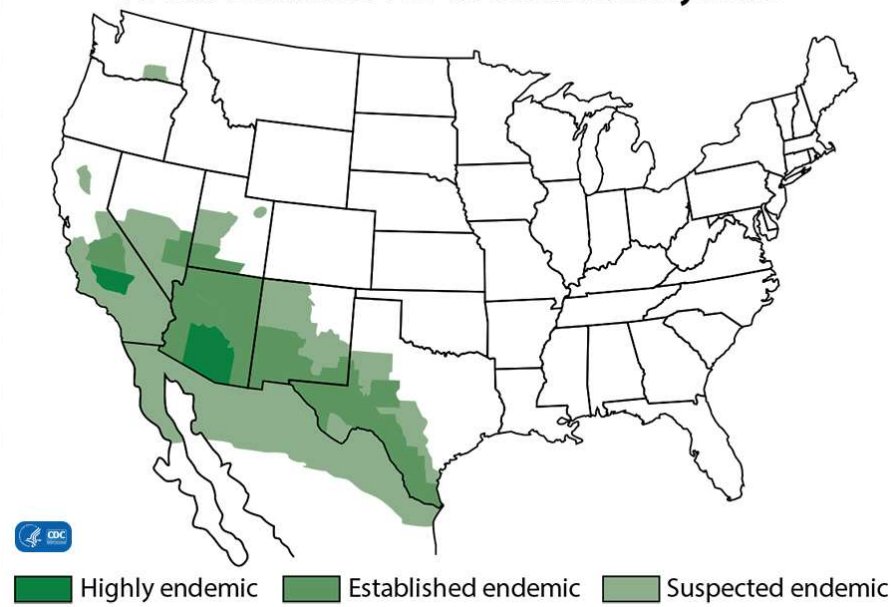
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

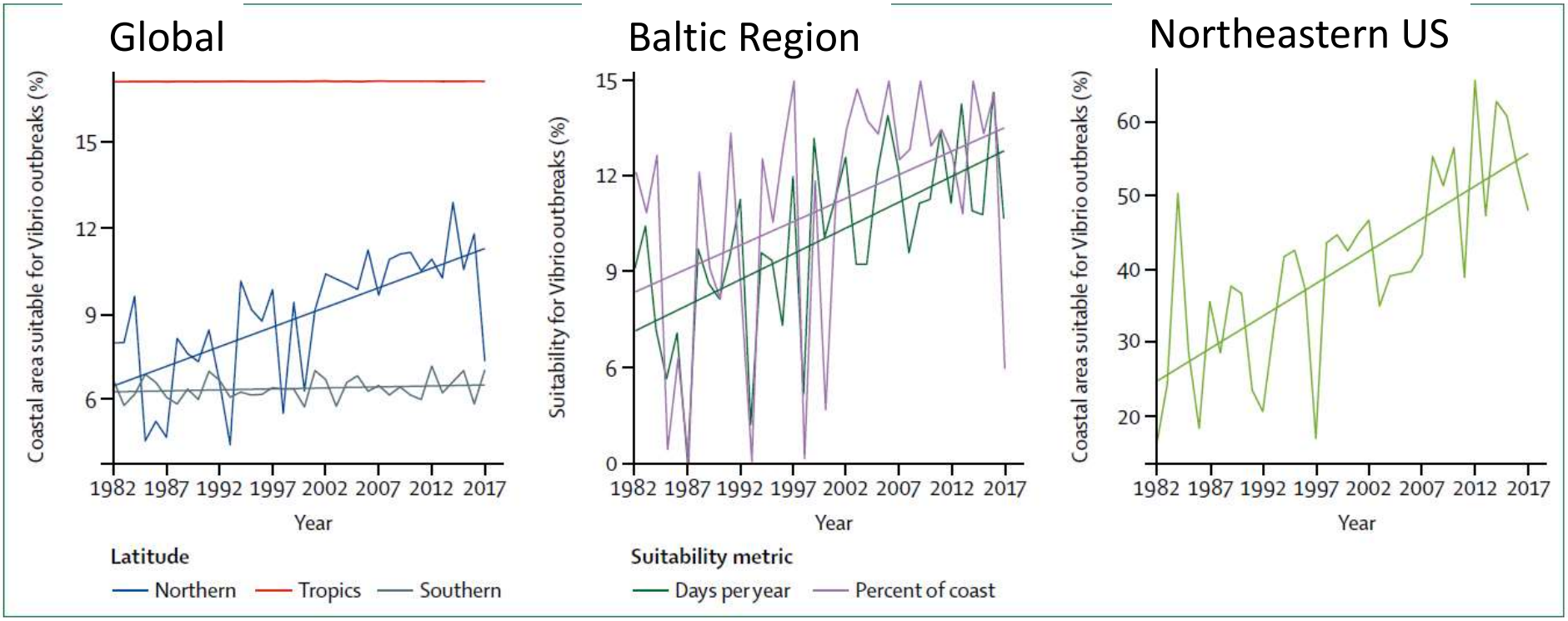
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

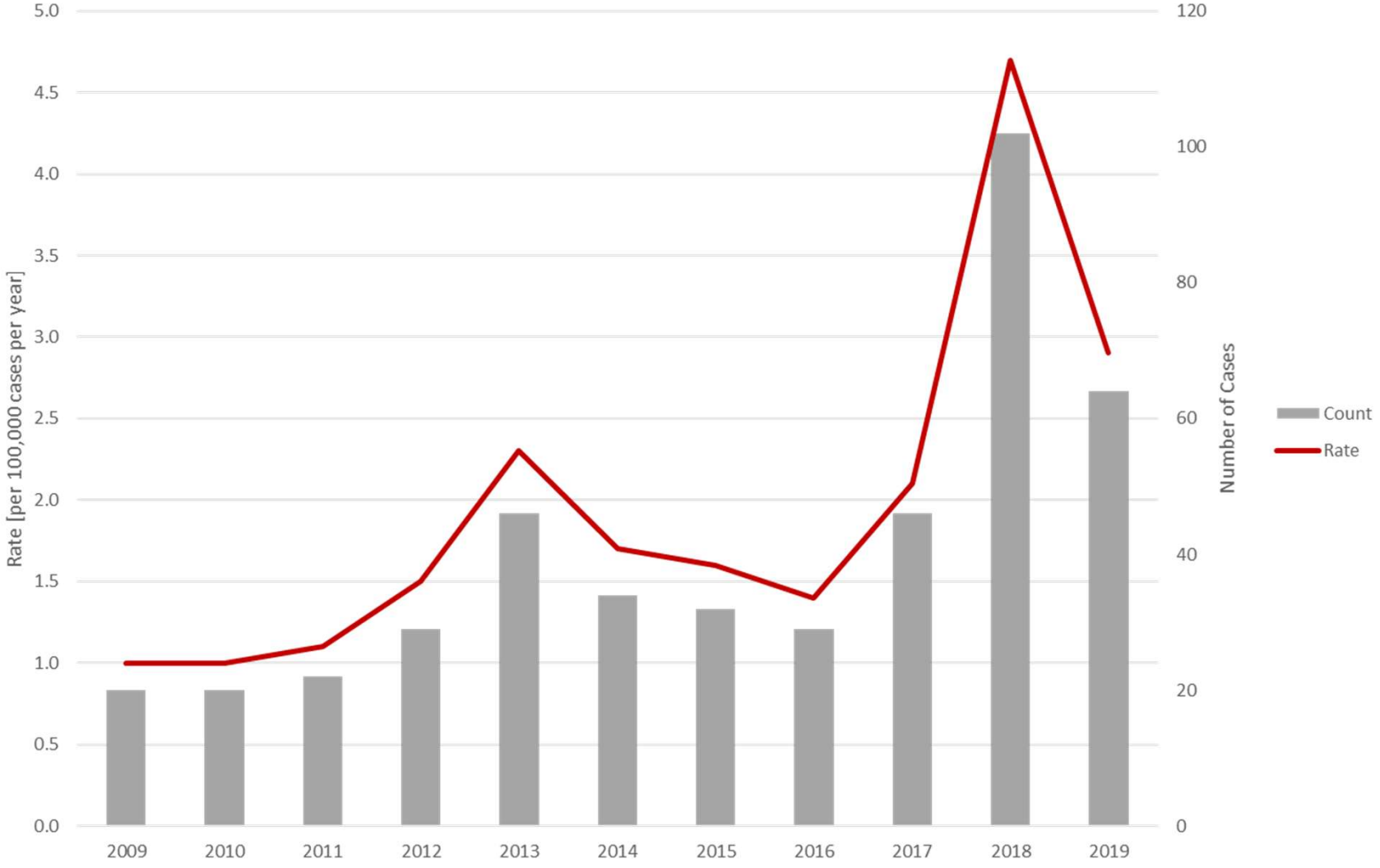
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

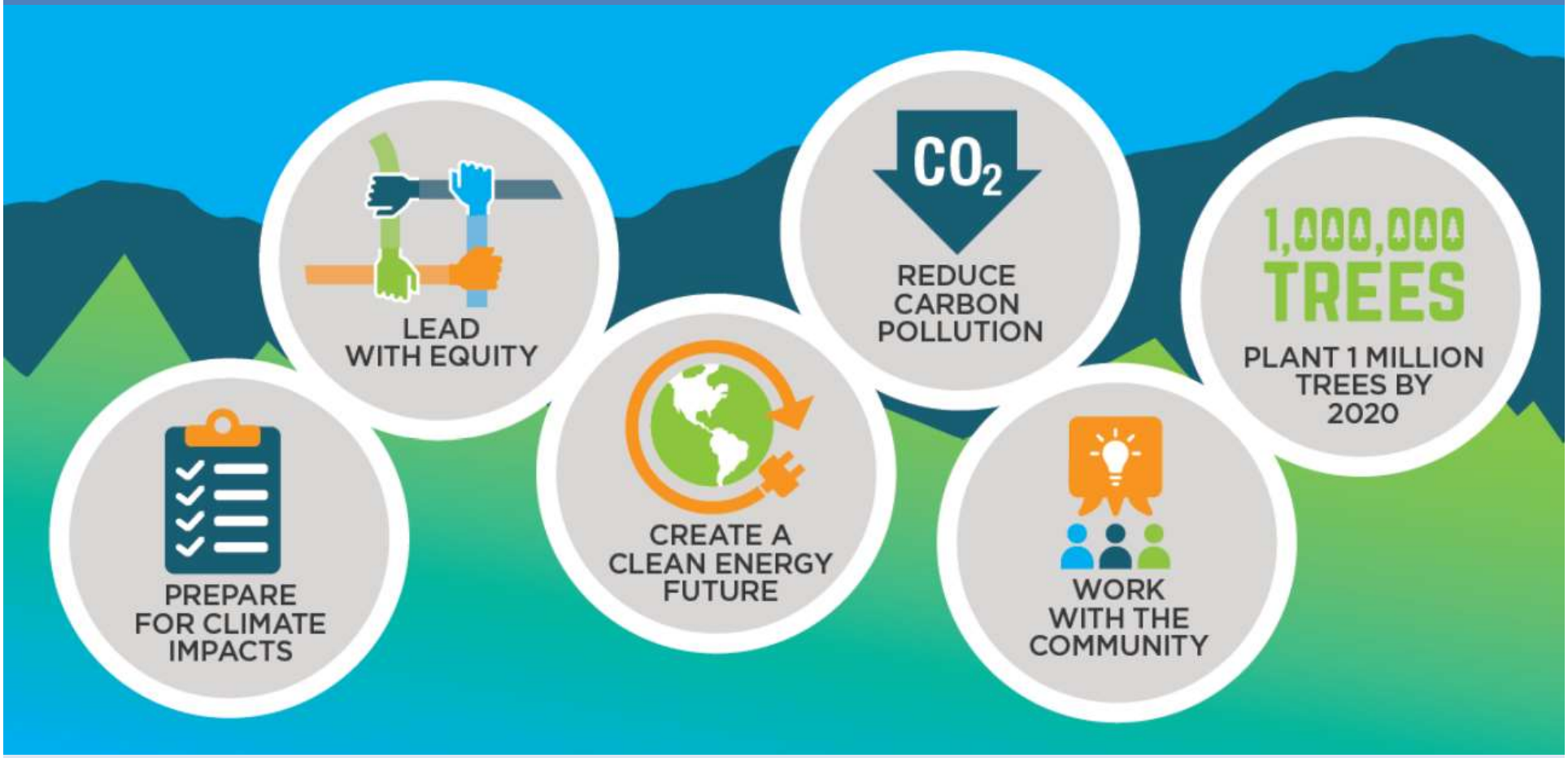
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

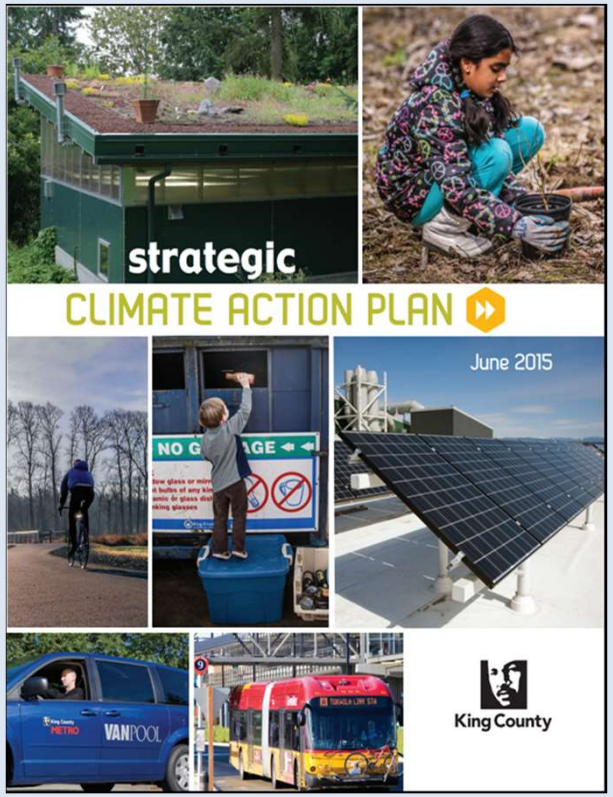


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

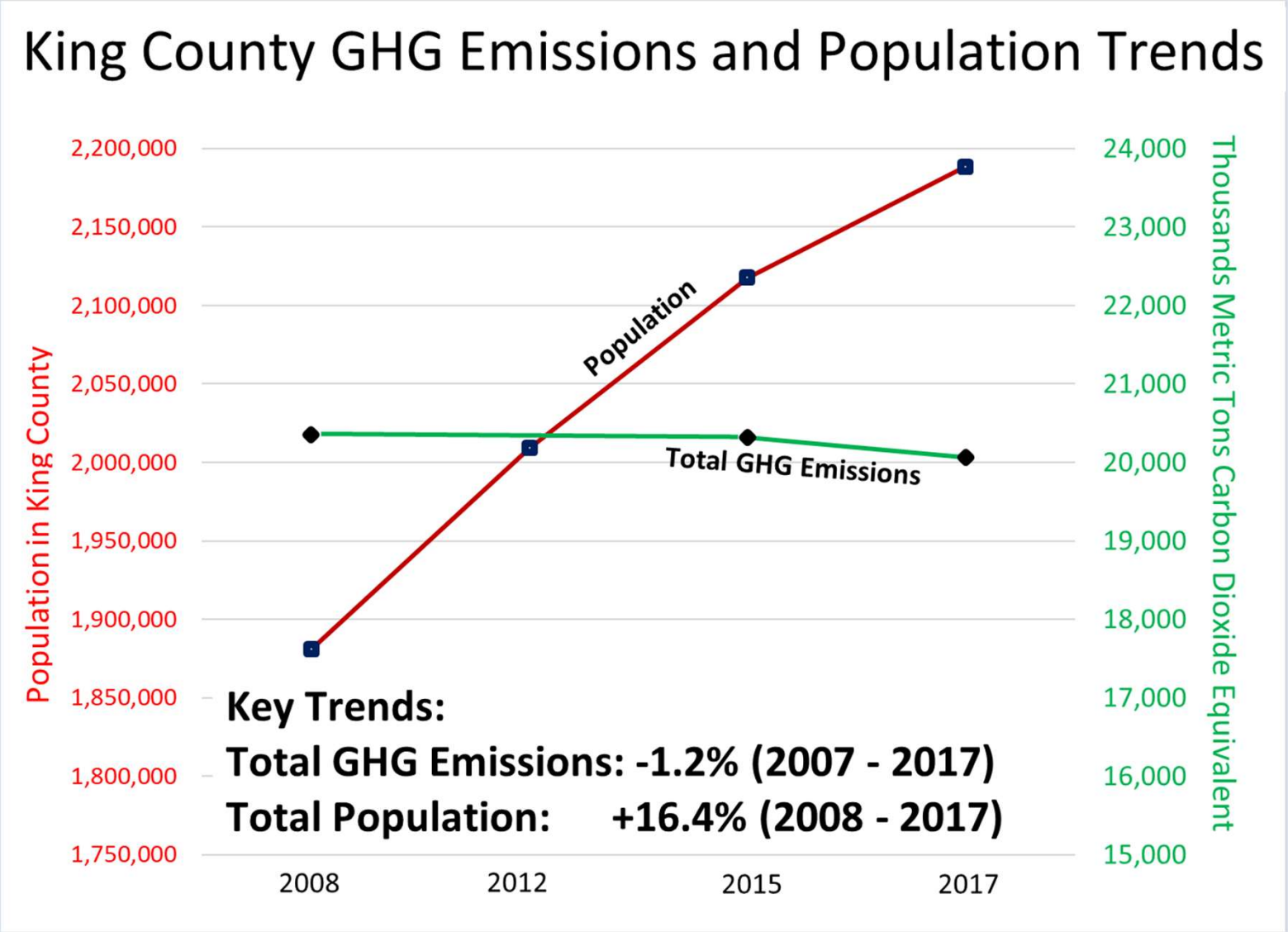
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



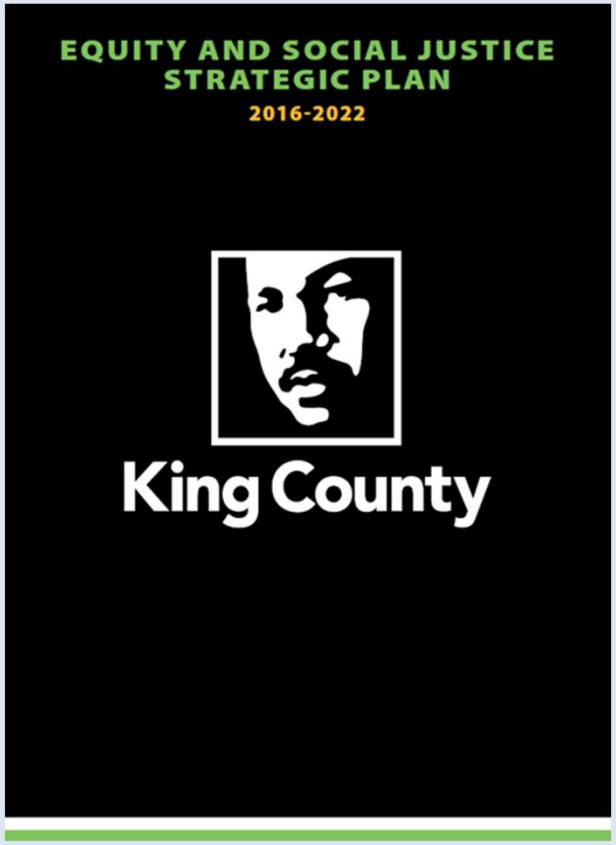
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

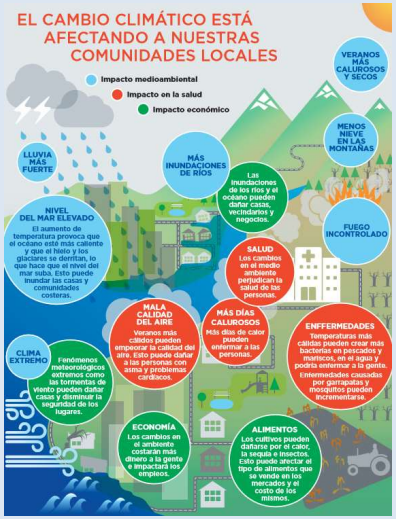
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

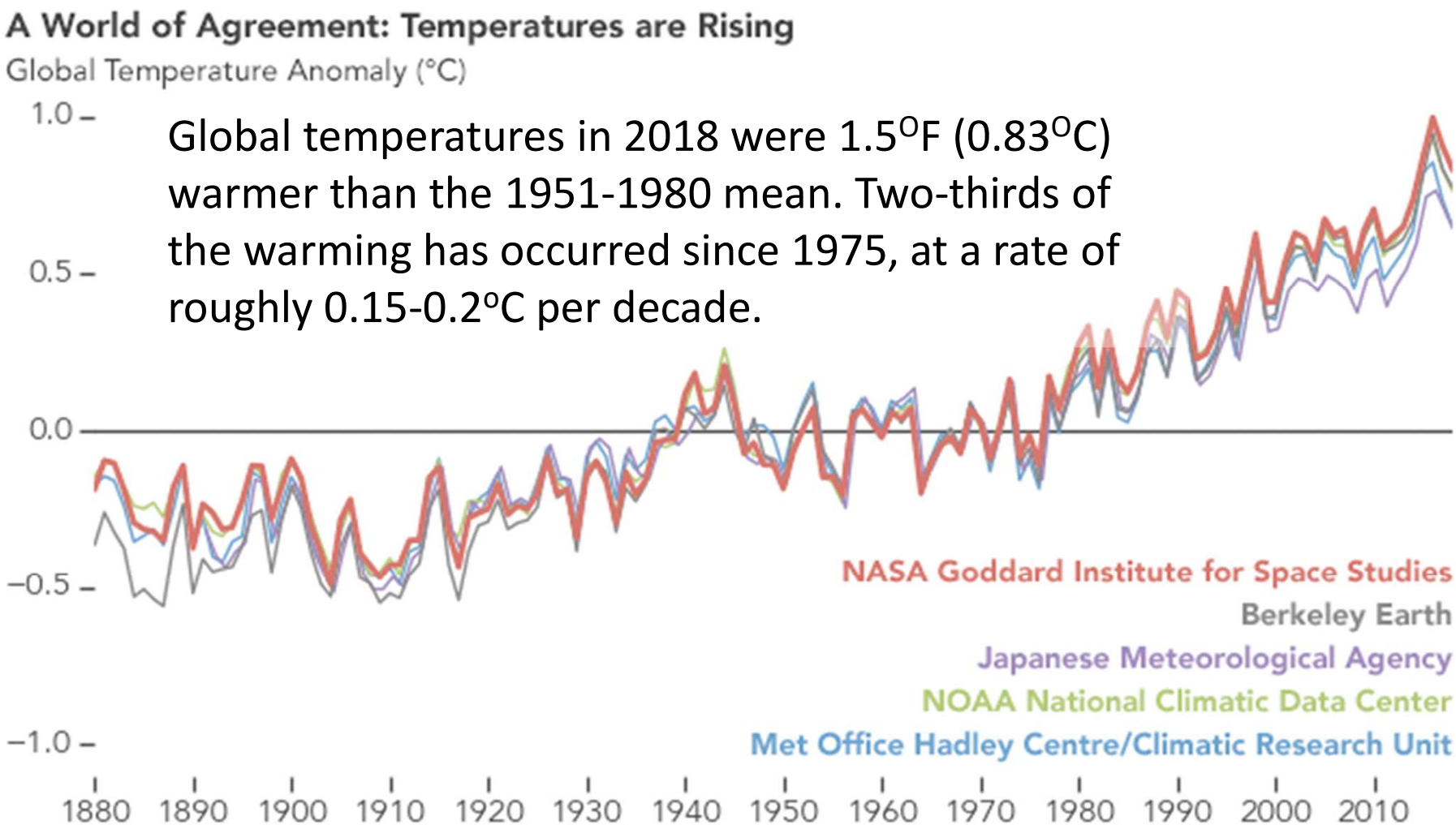
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

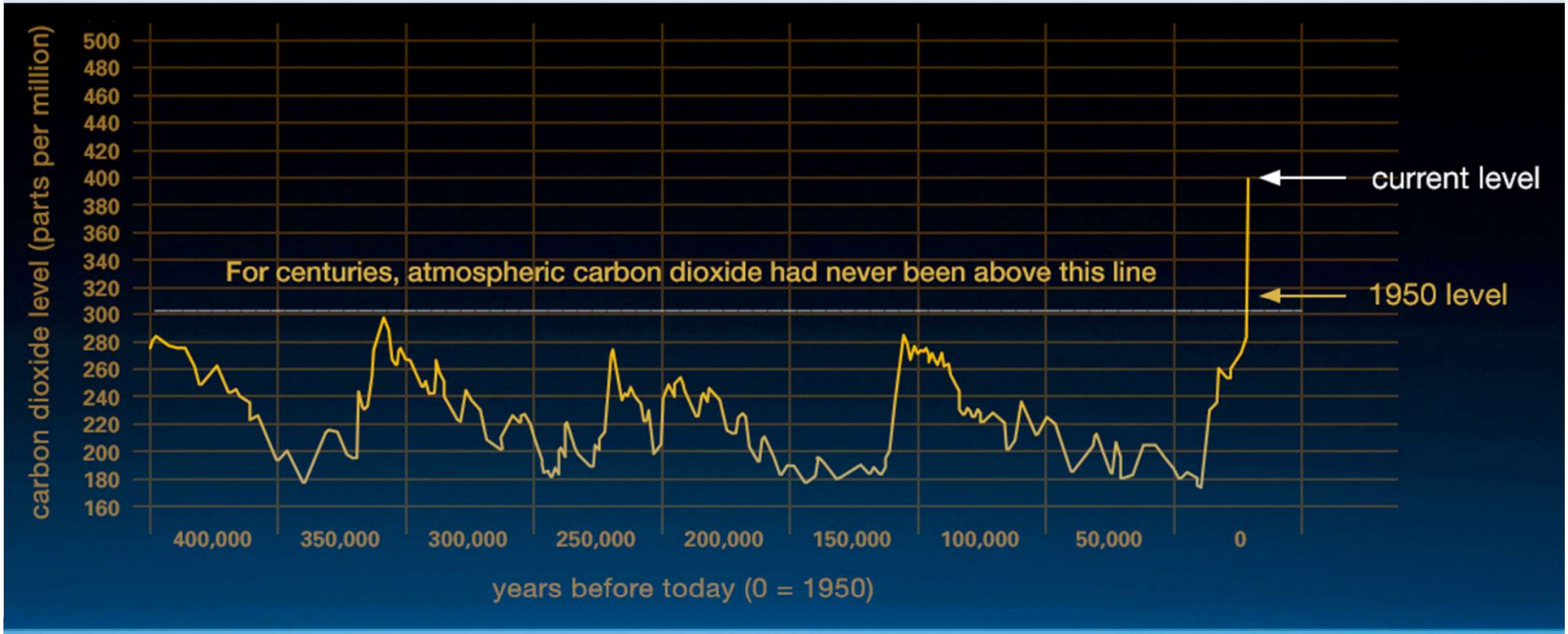


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

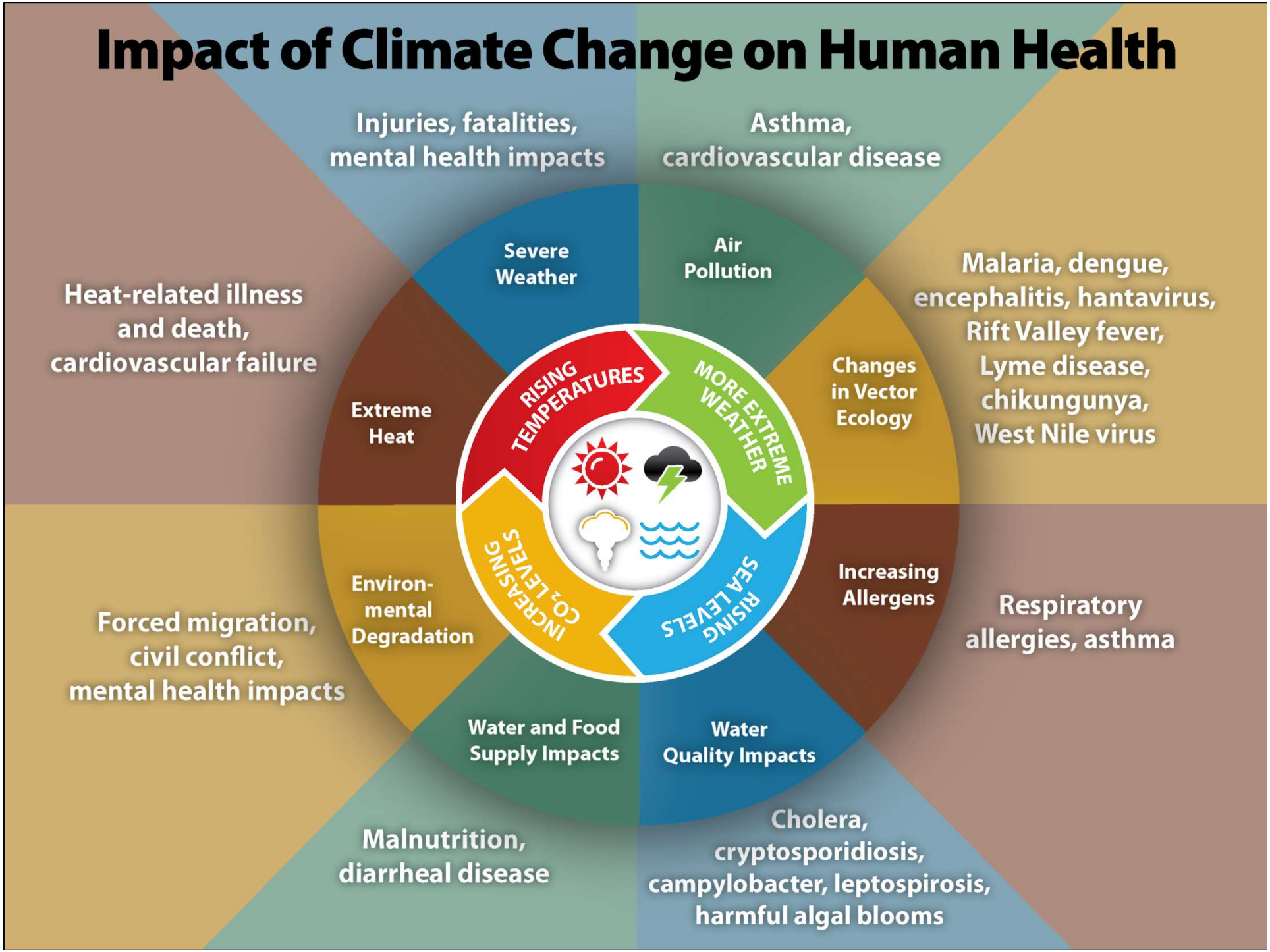
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

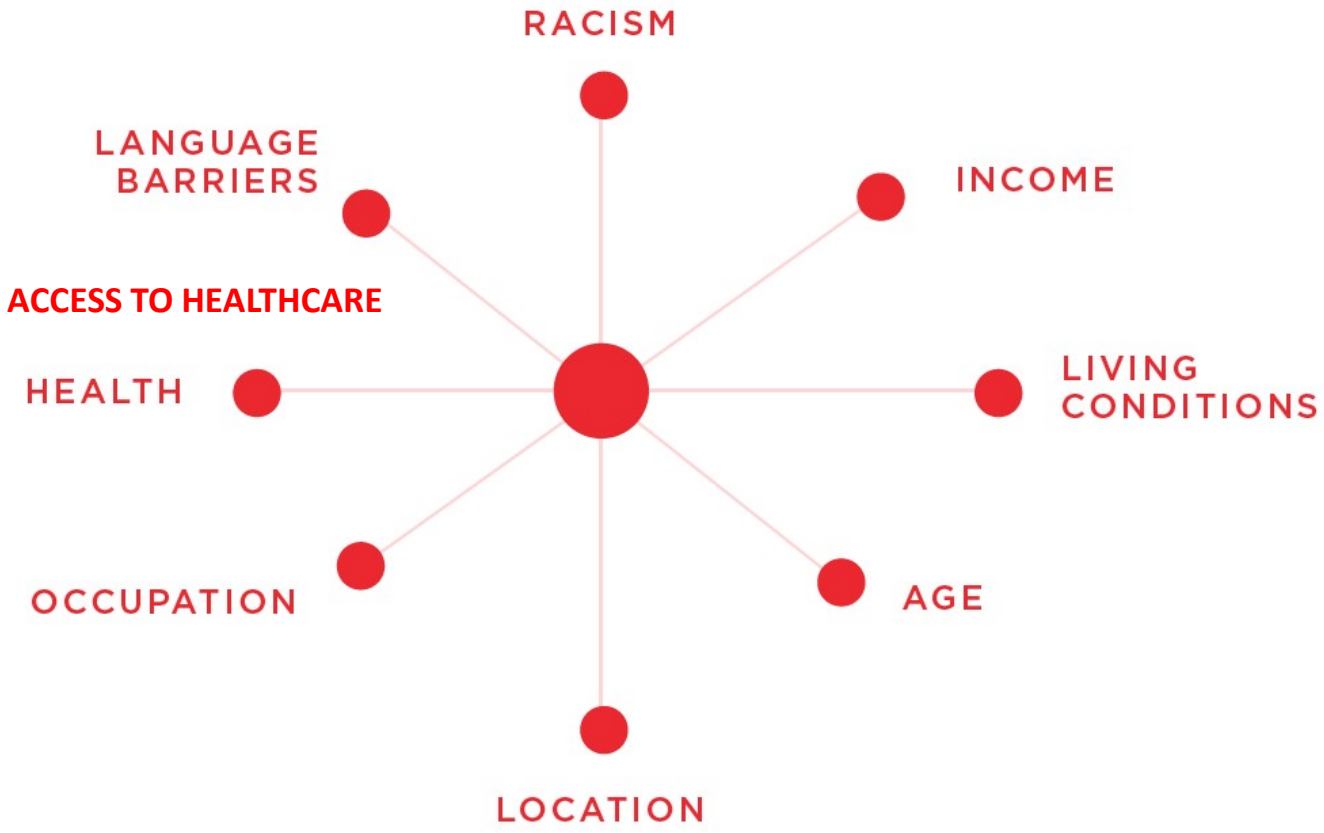
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

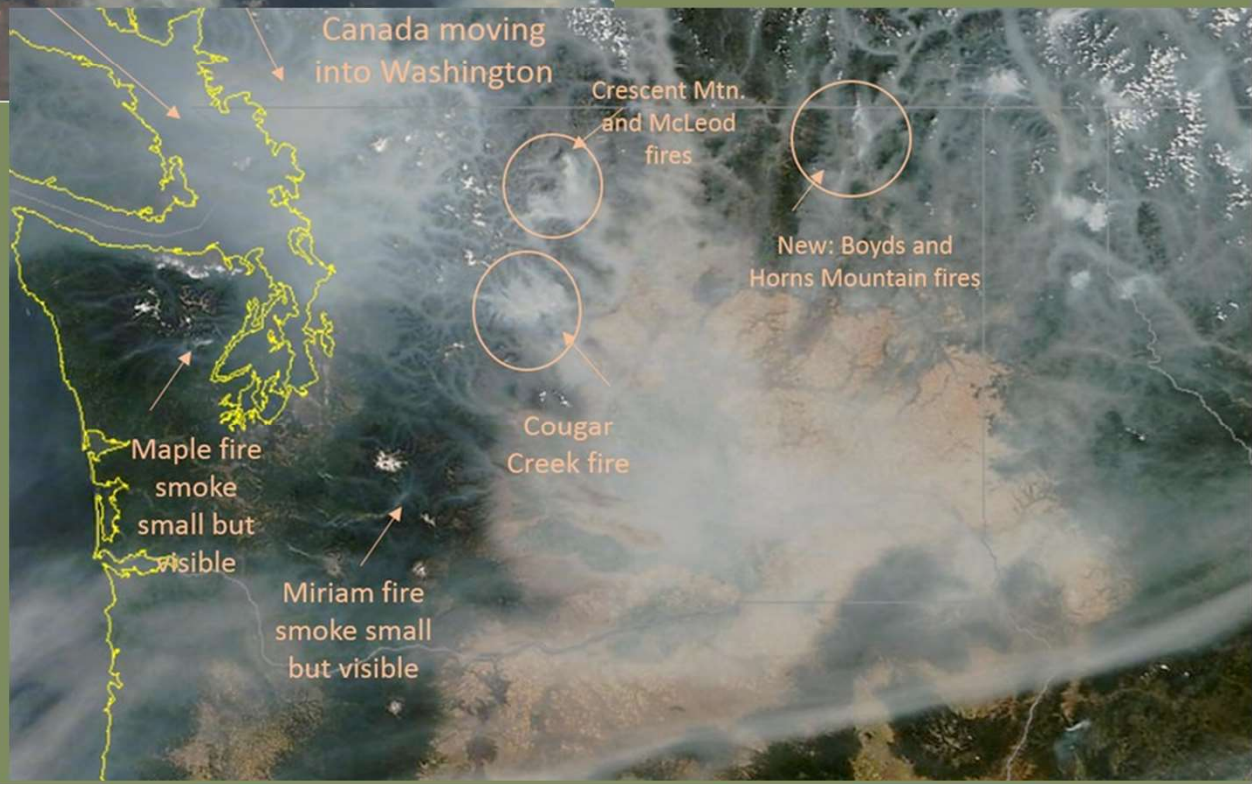
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

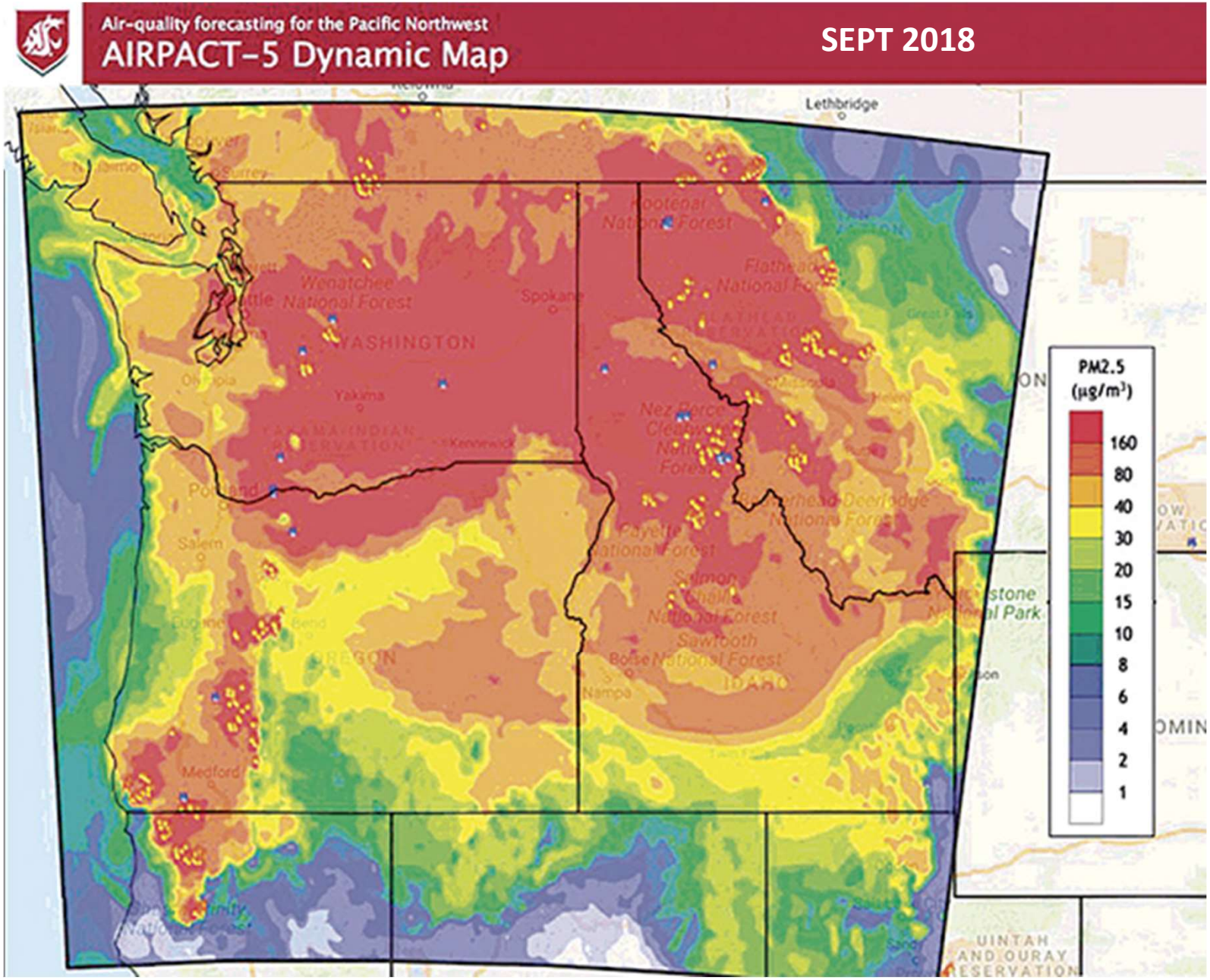
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

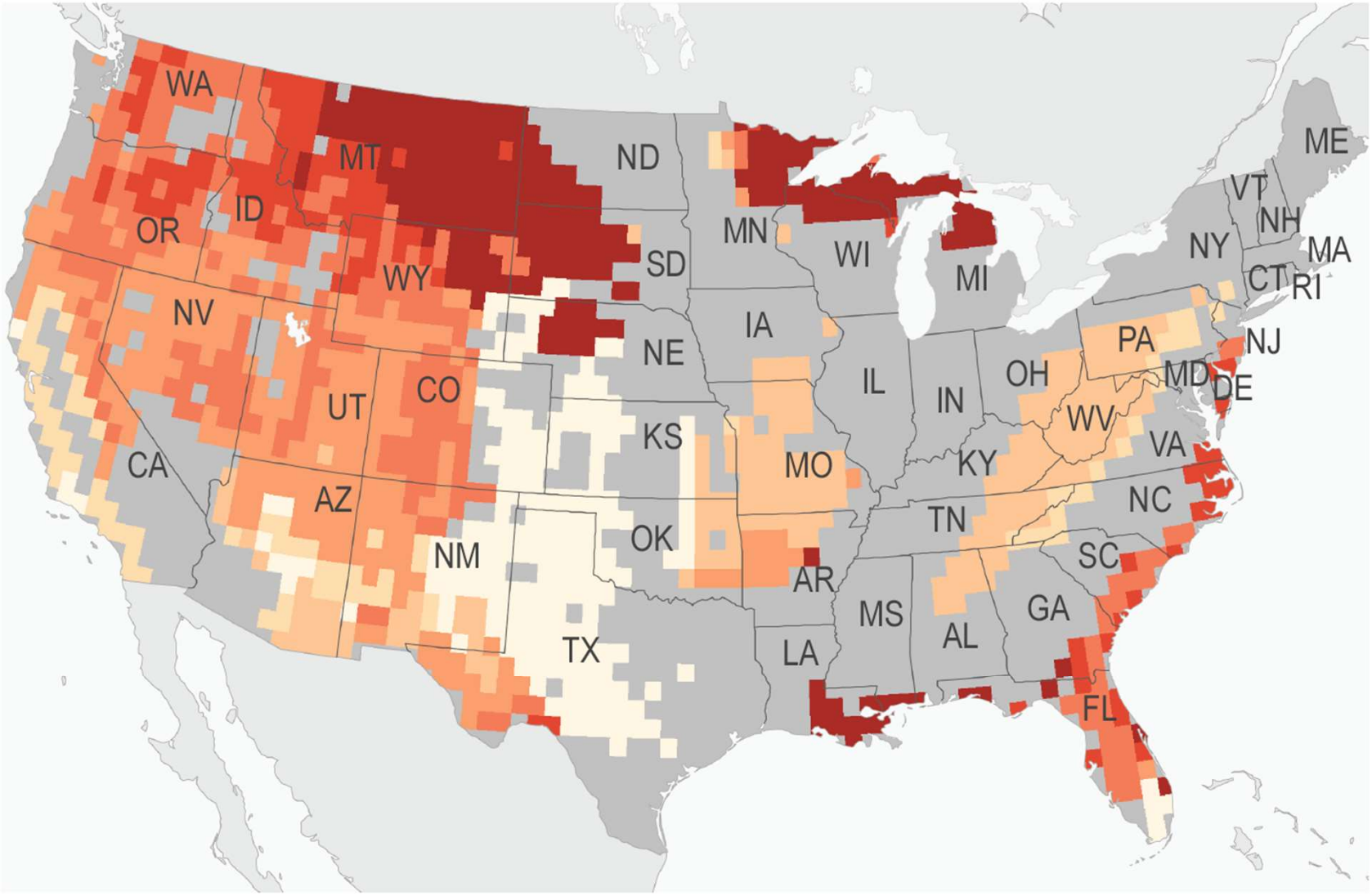
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

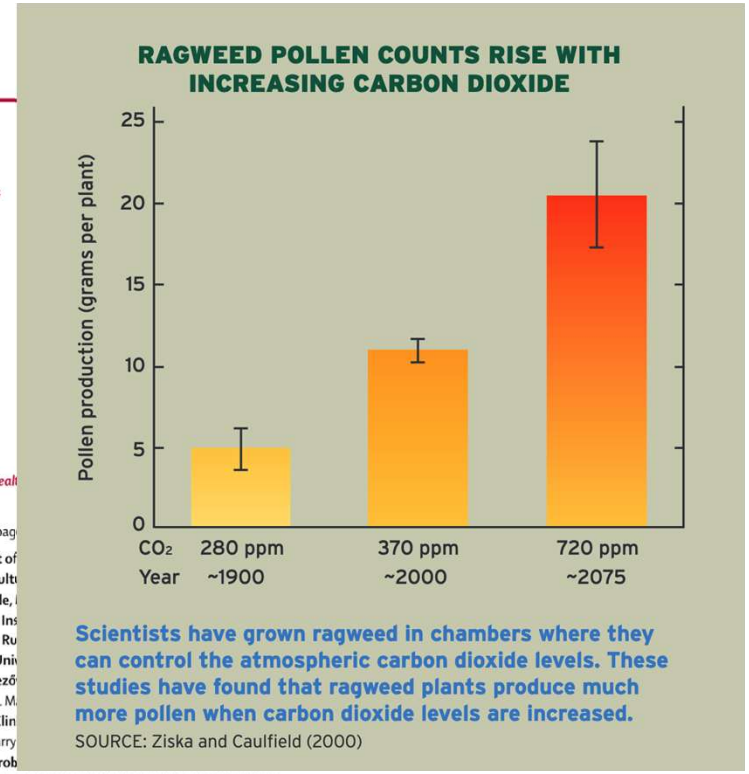
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

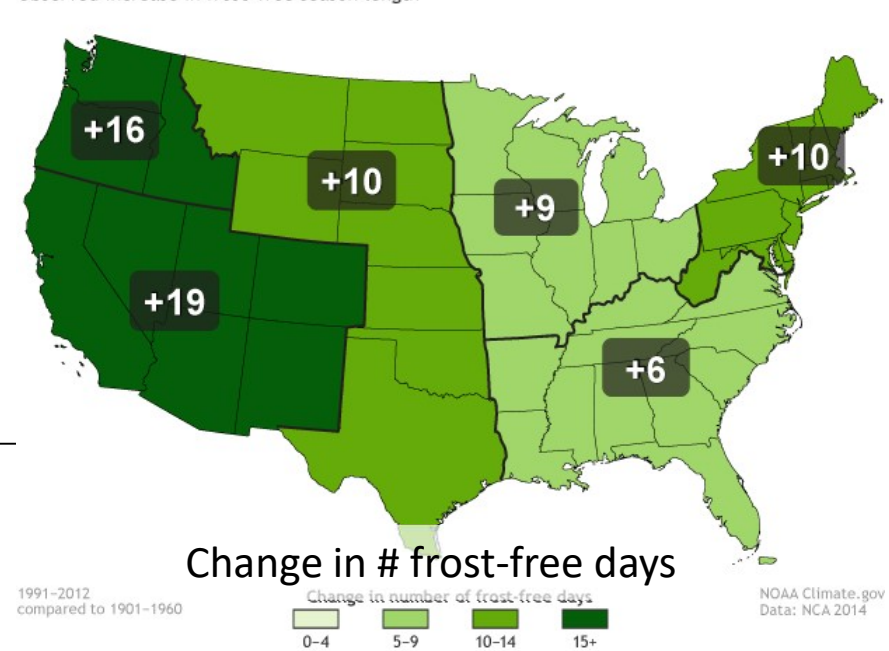
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

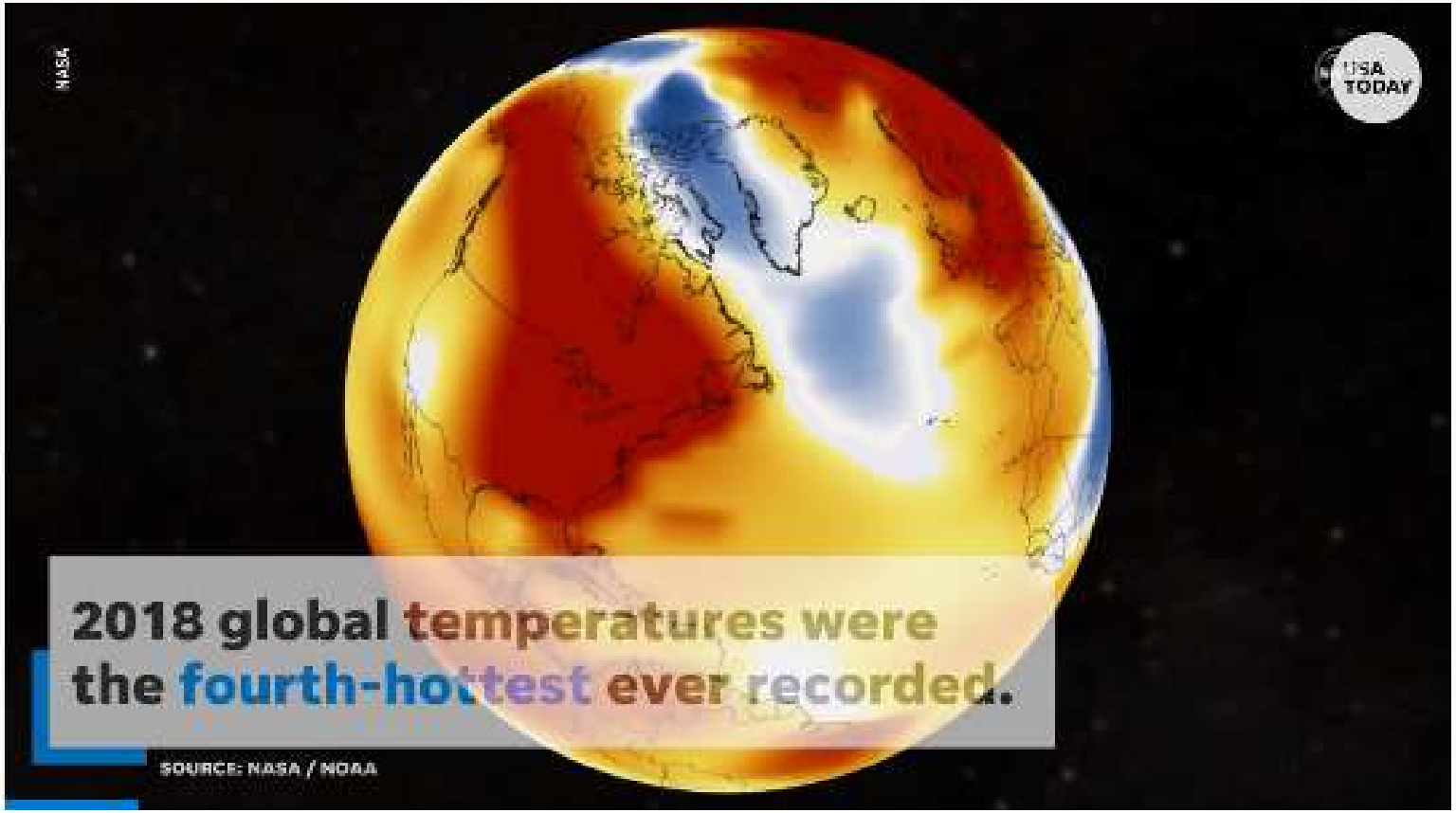
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



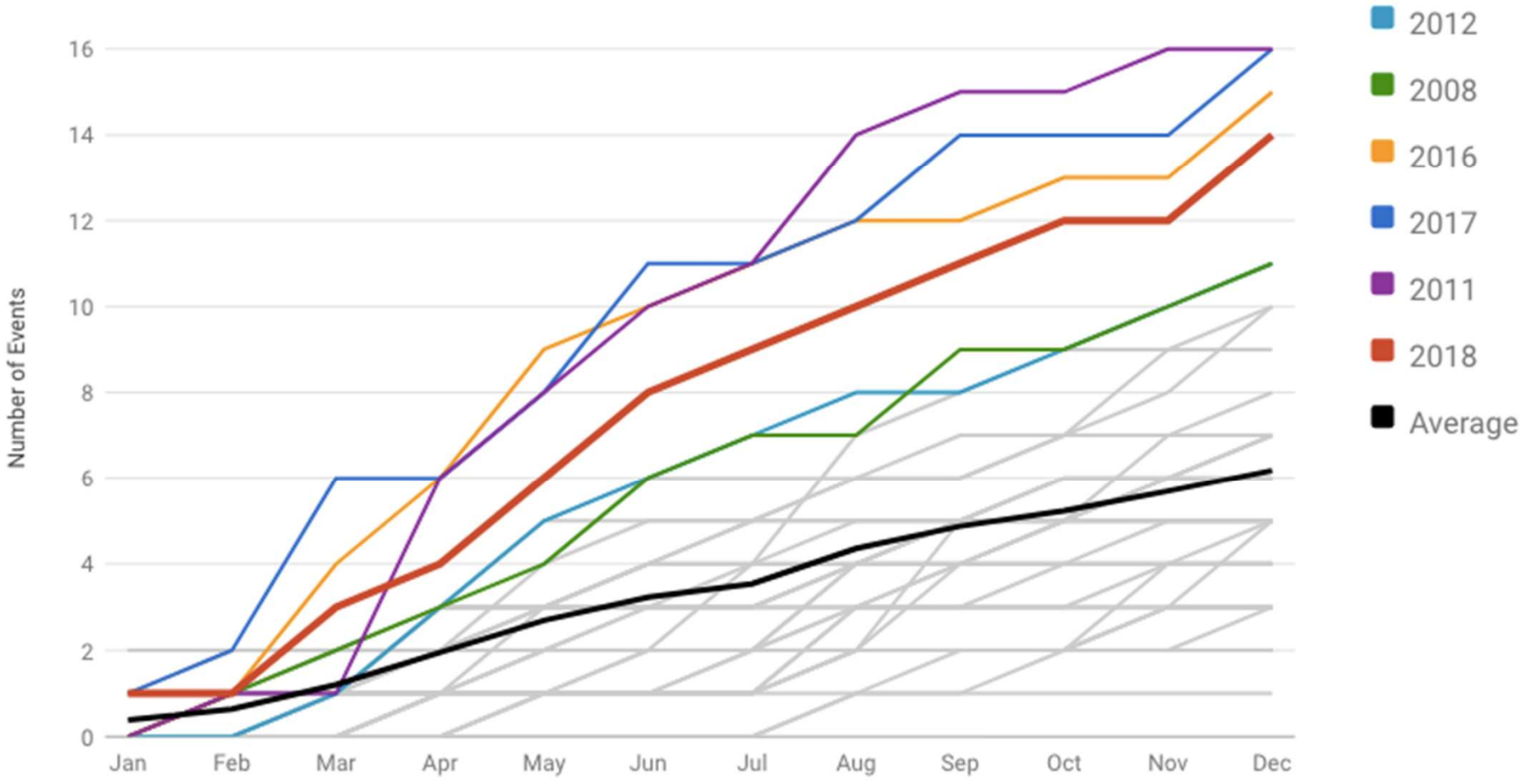
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



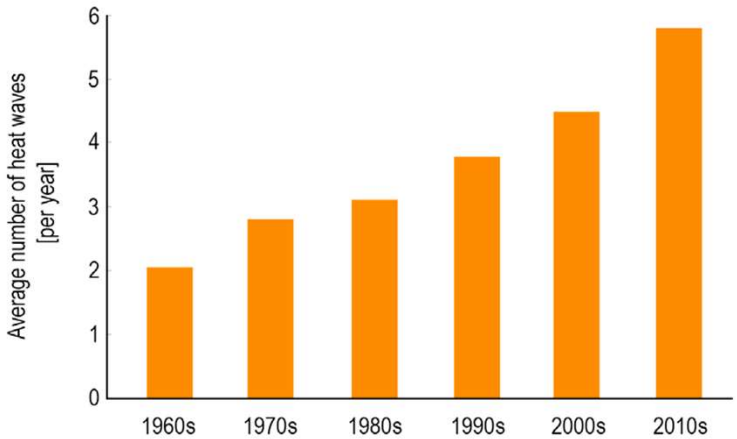
NOAA: National Centers for Environmental Information

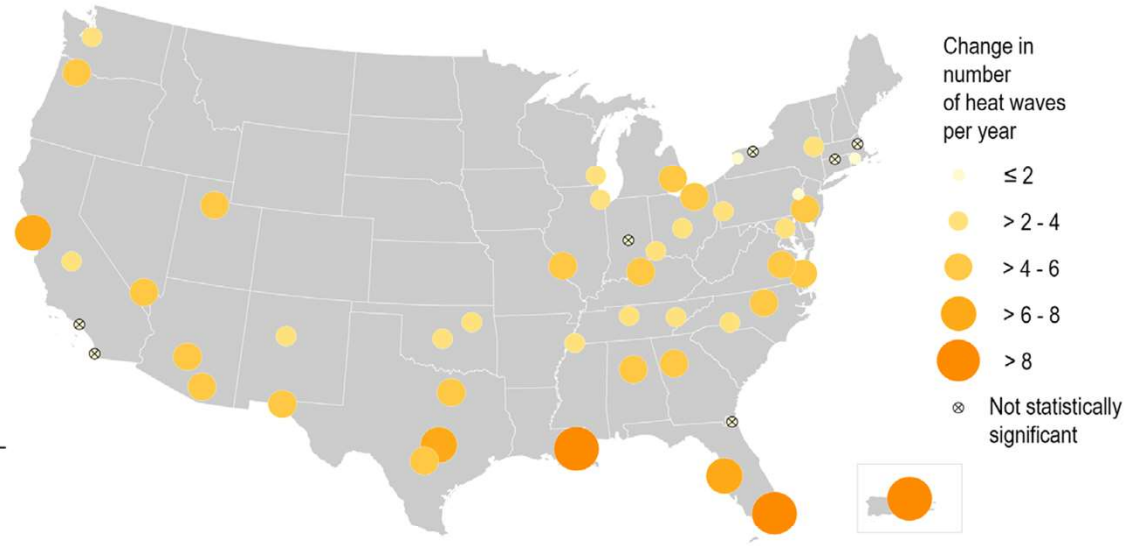
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

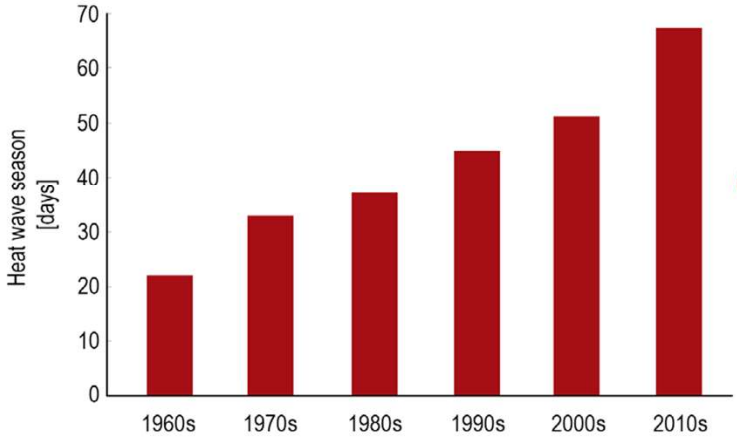
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

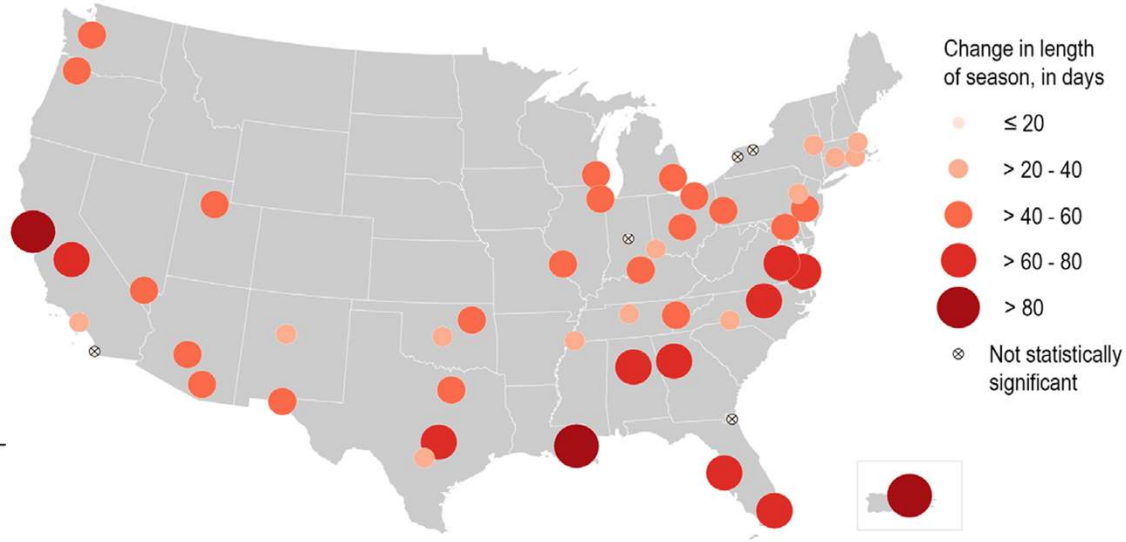
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

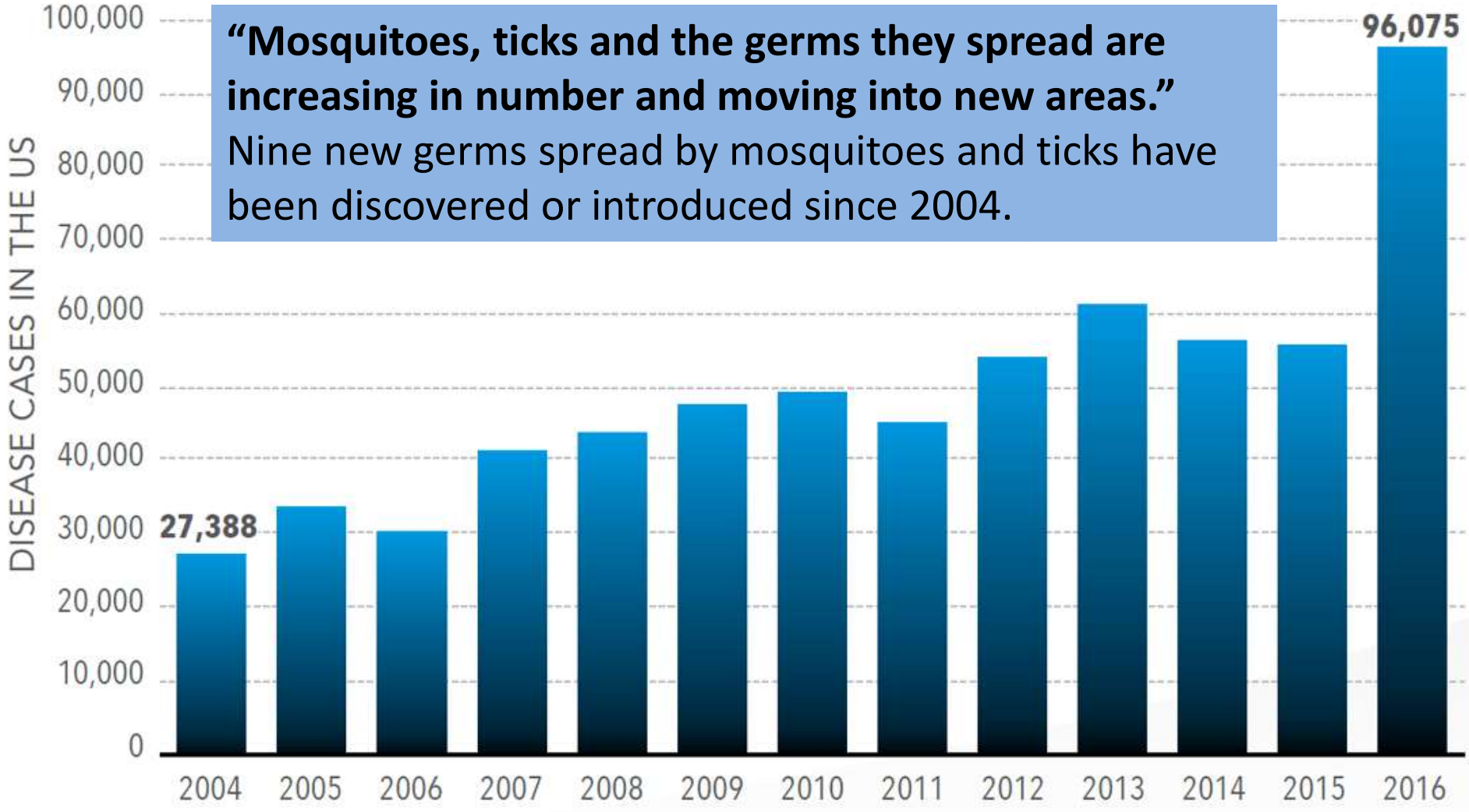
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

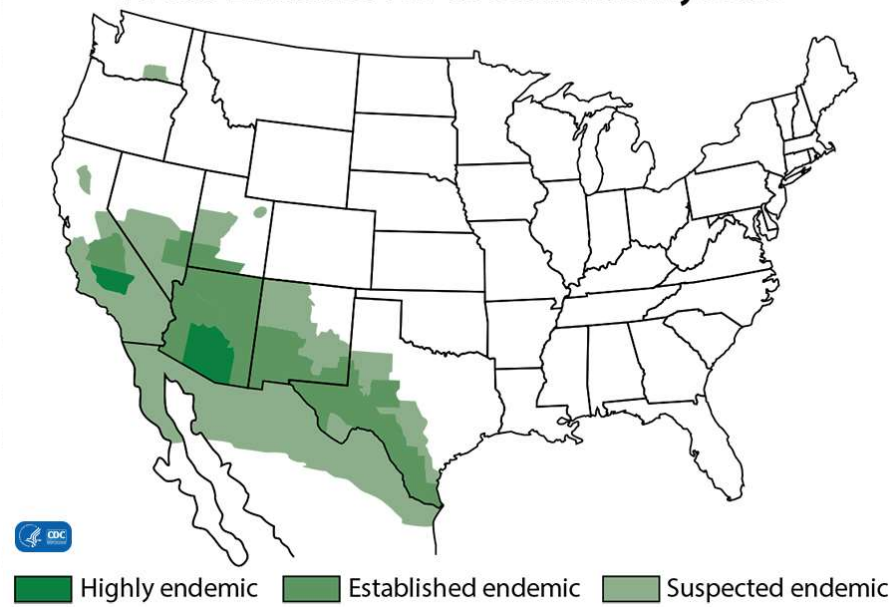
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

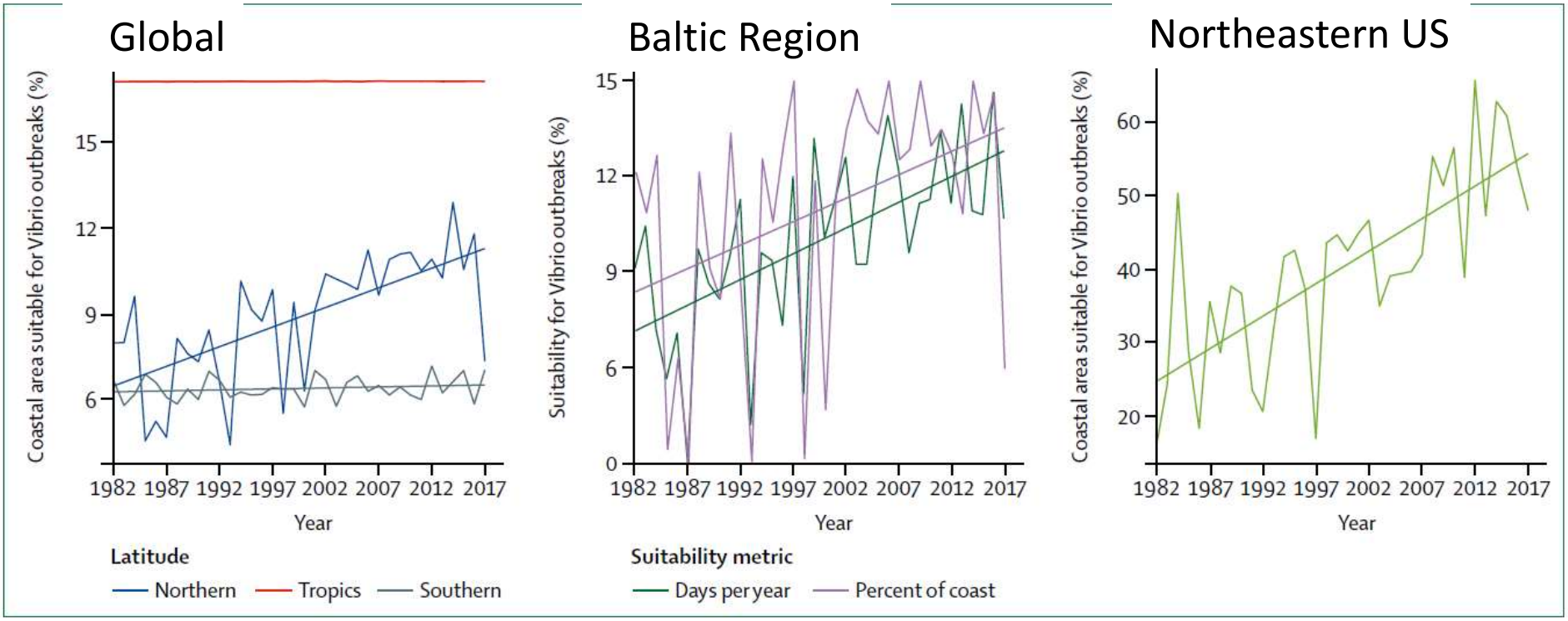
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

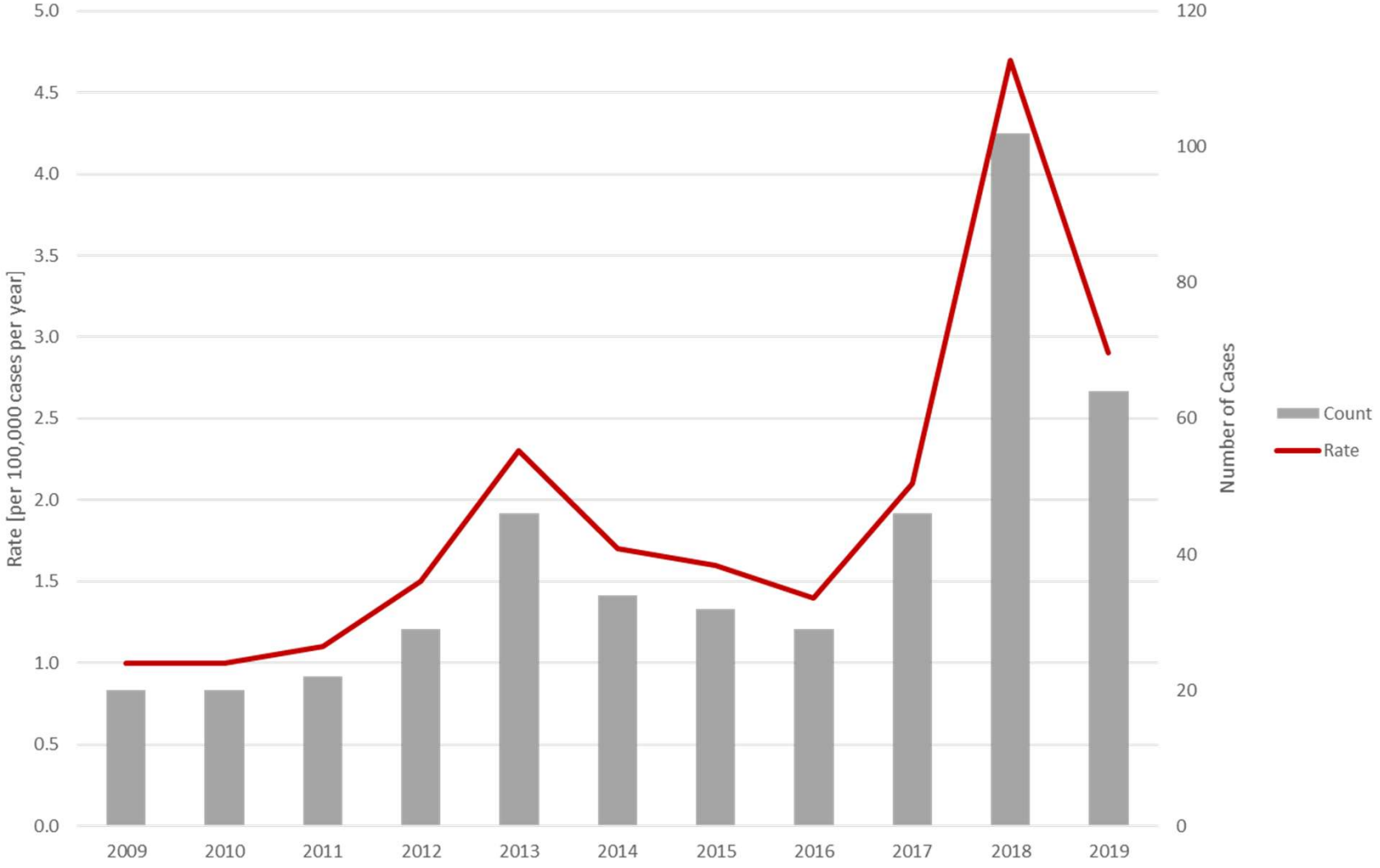
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

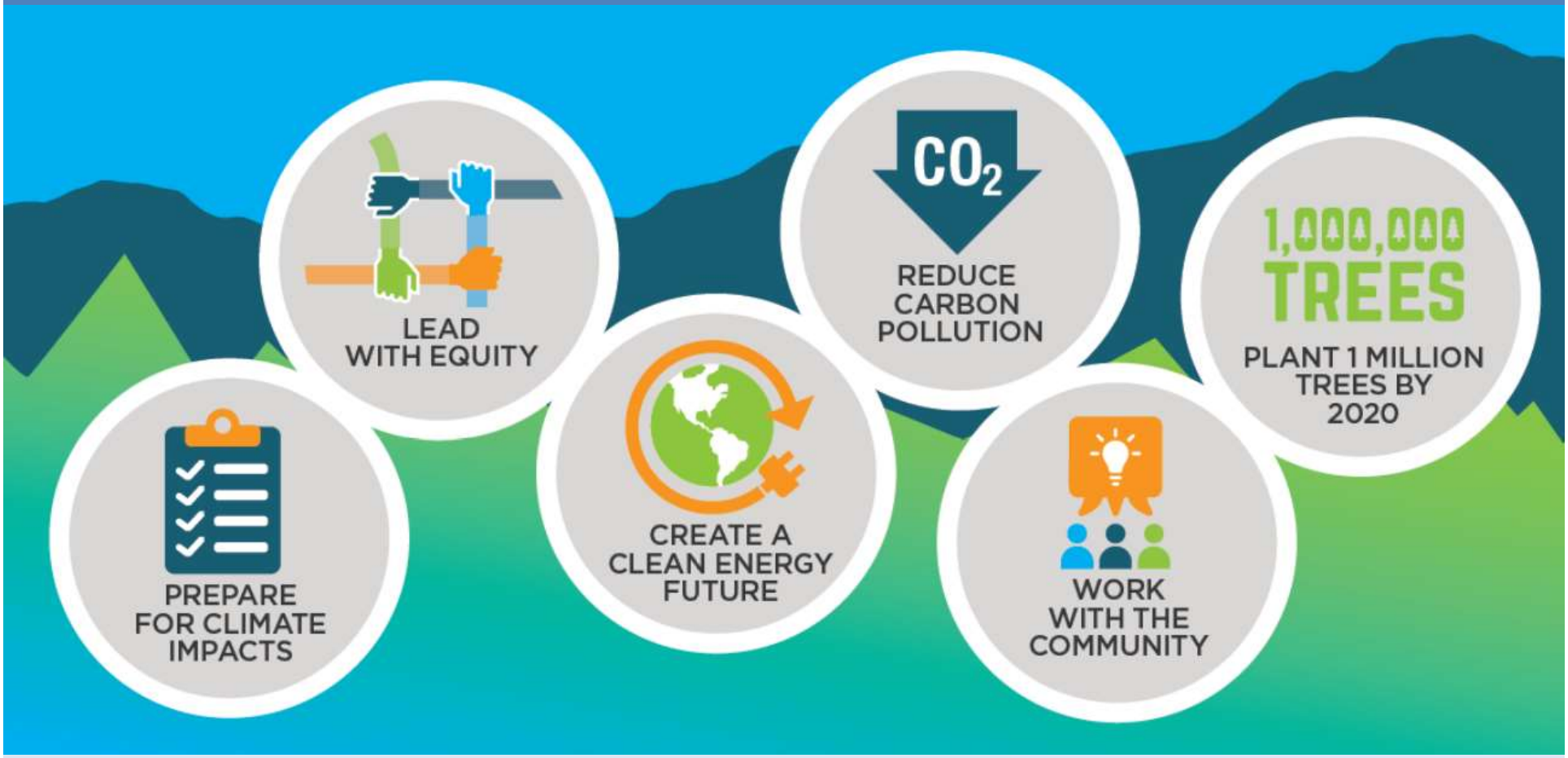
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

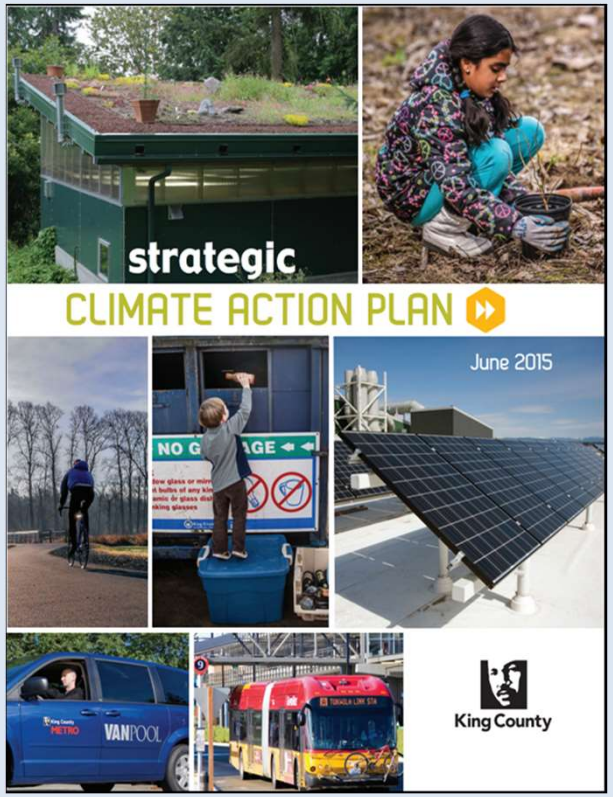


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

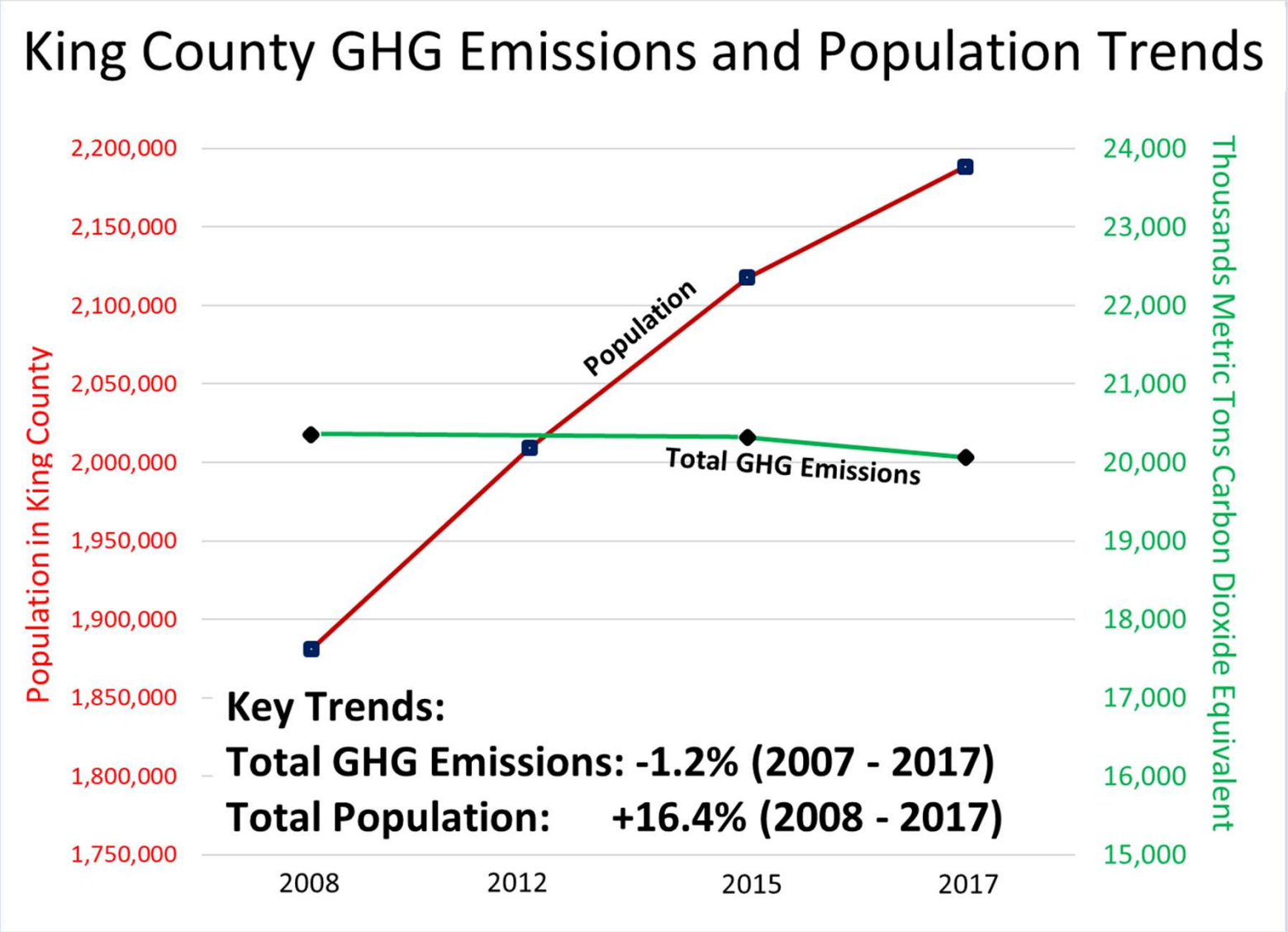
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



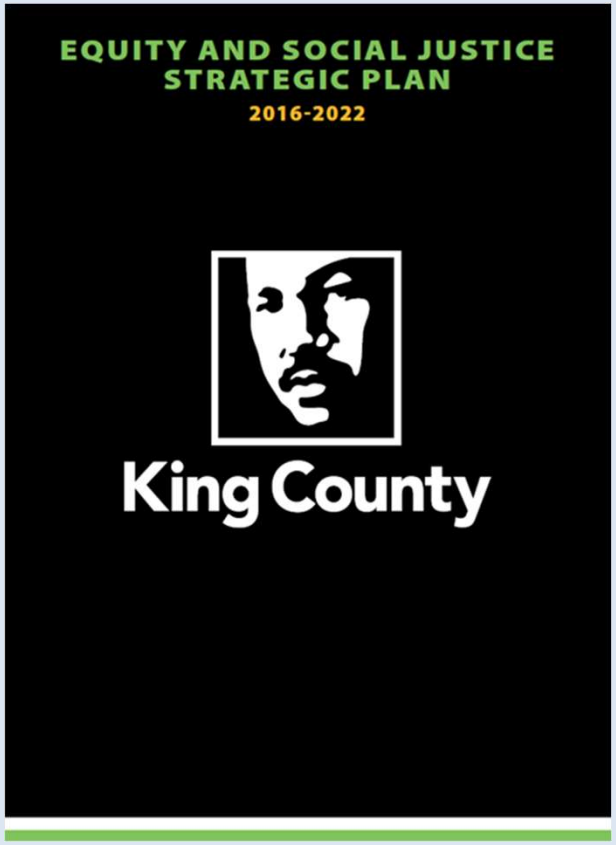
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

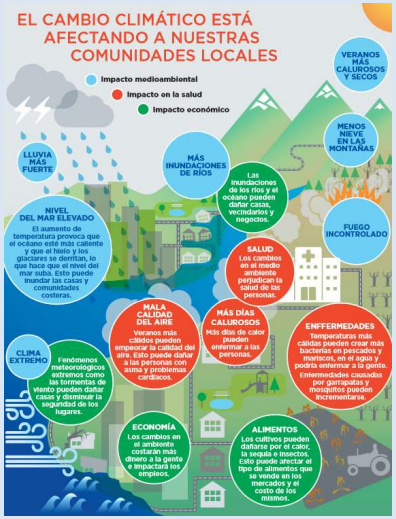
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

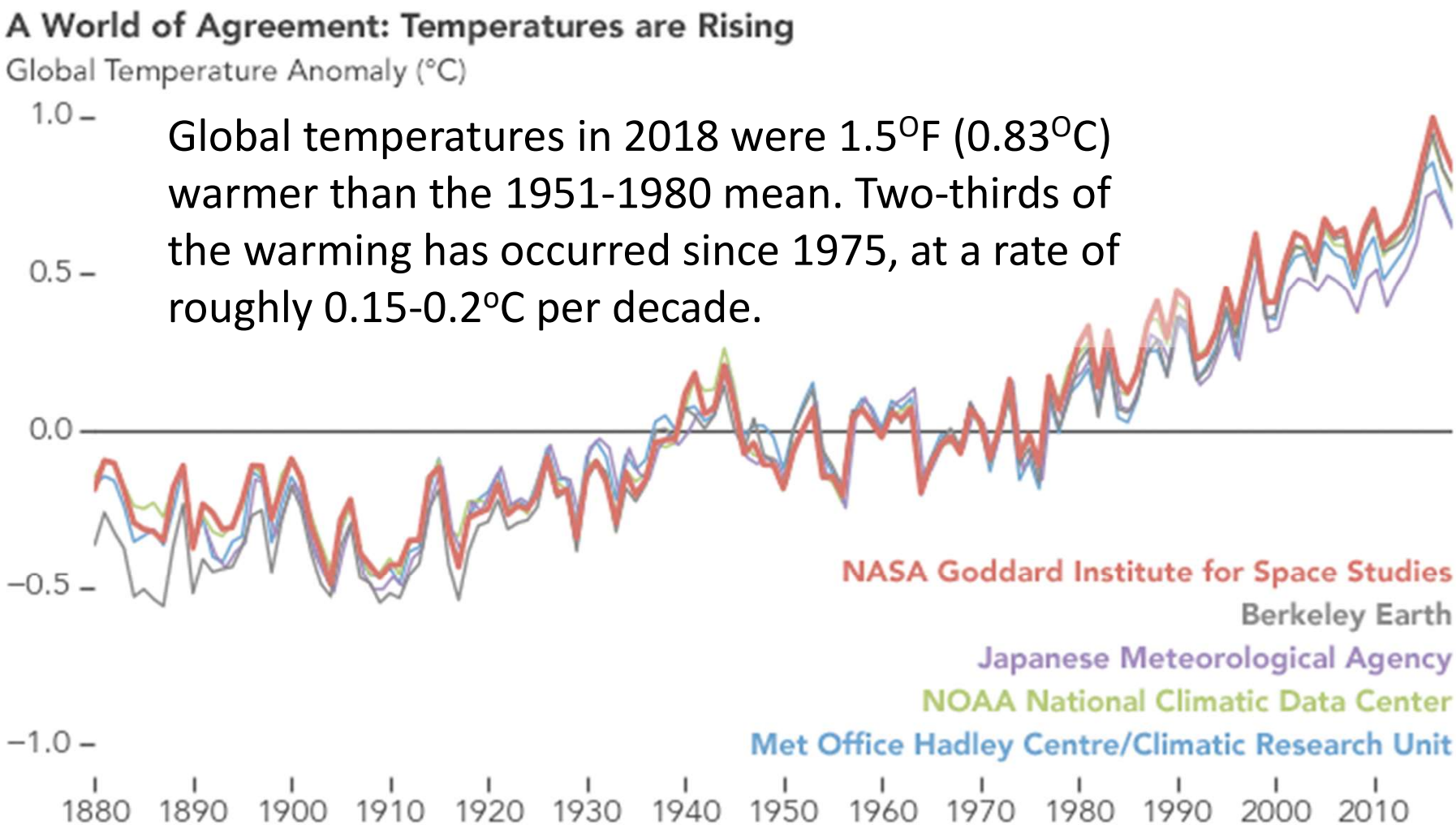
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

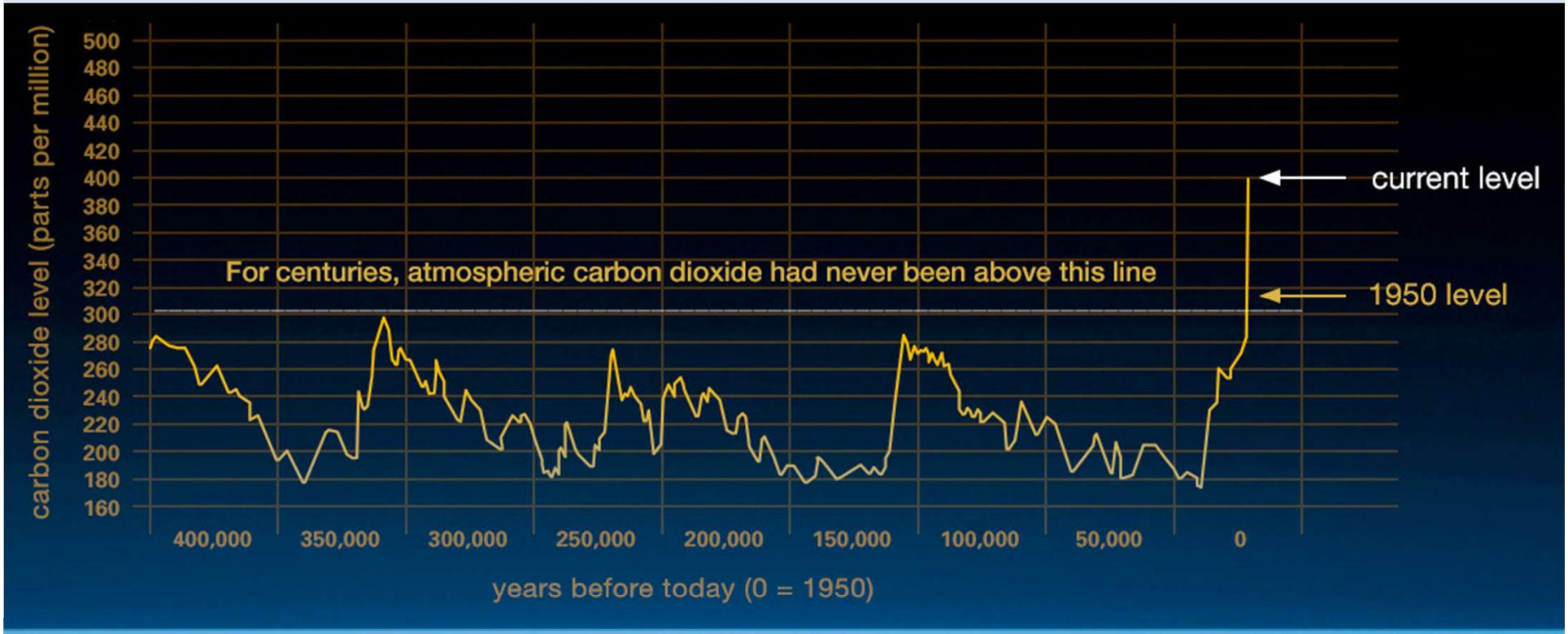


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

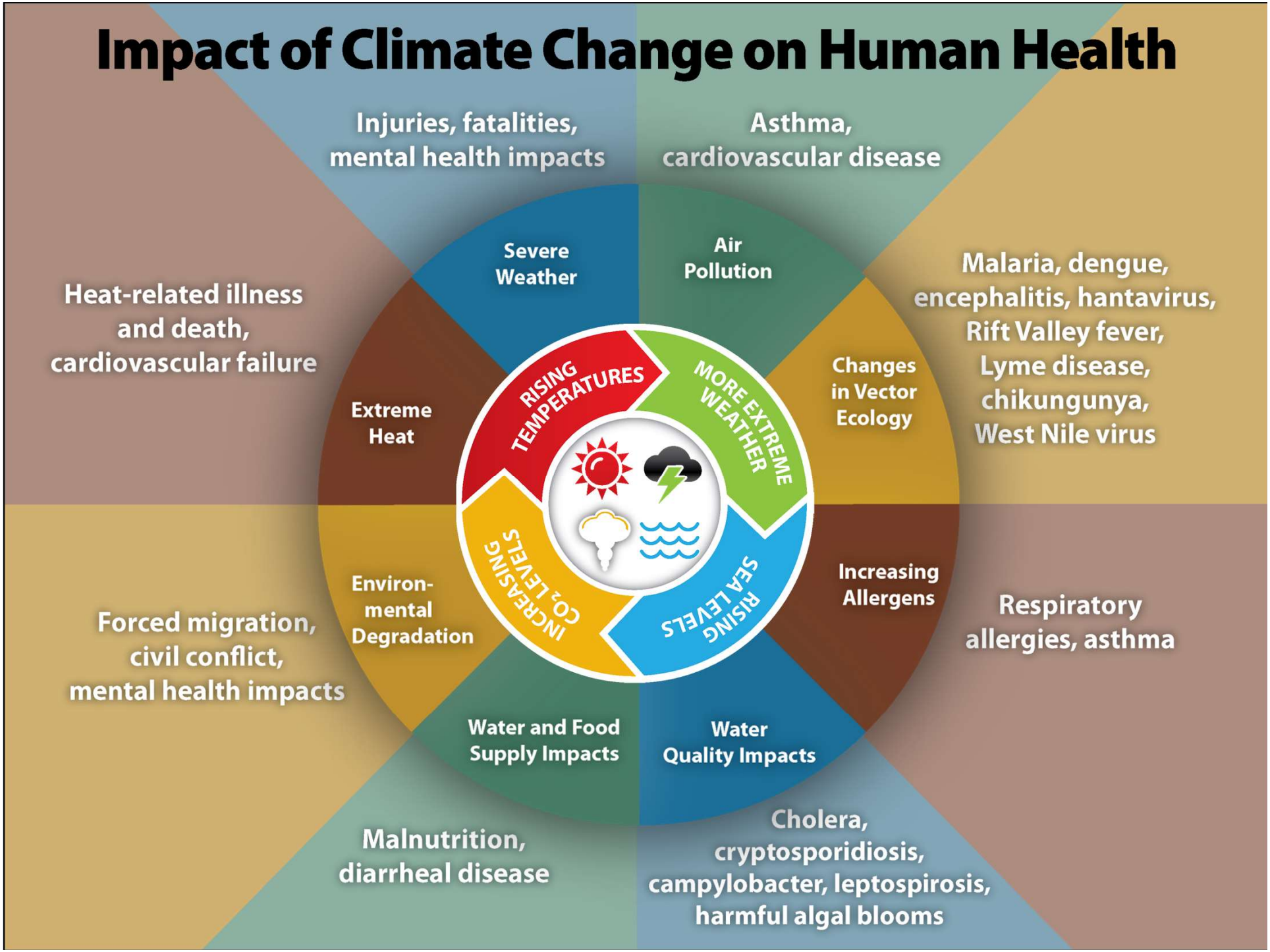
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

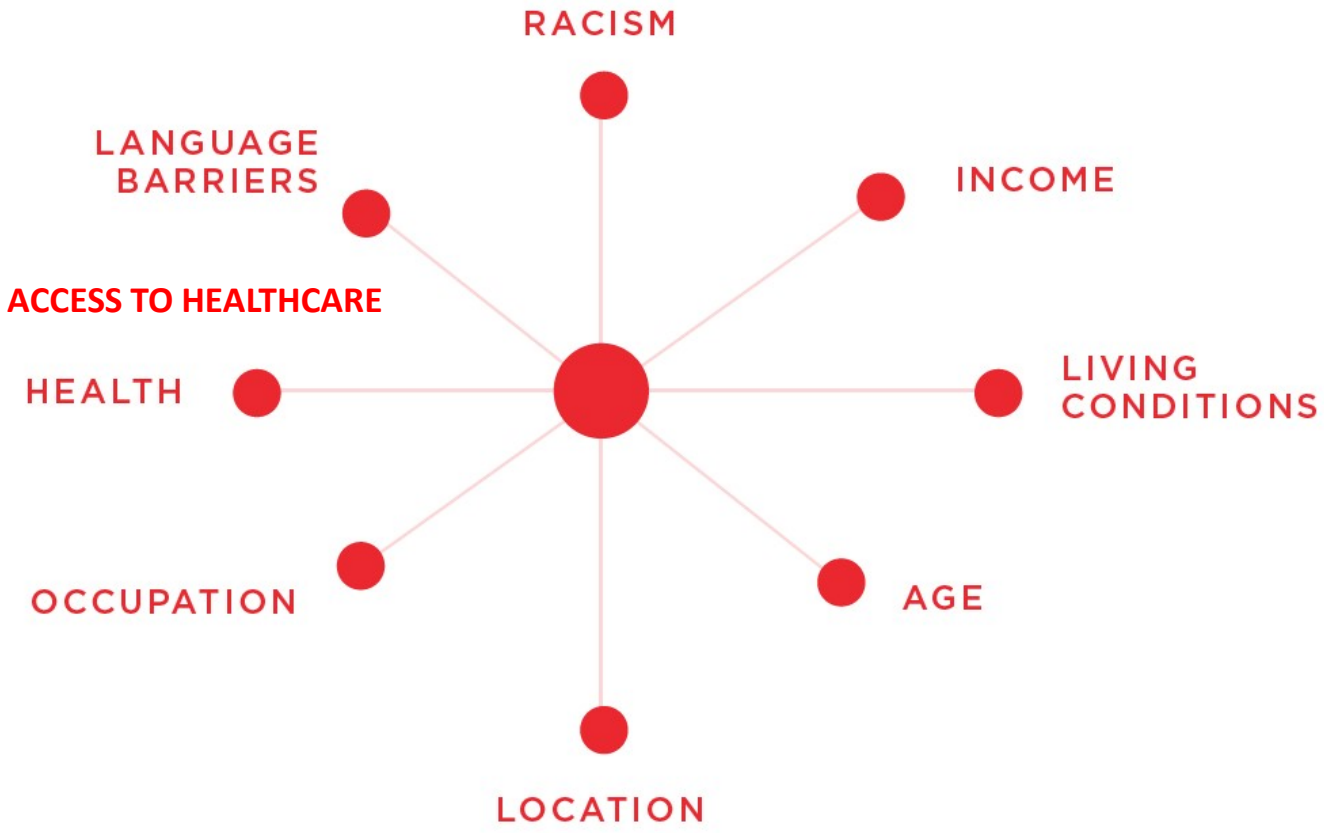
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

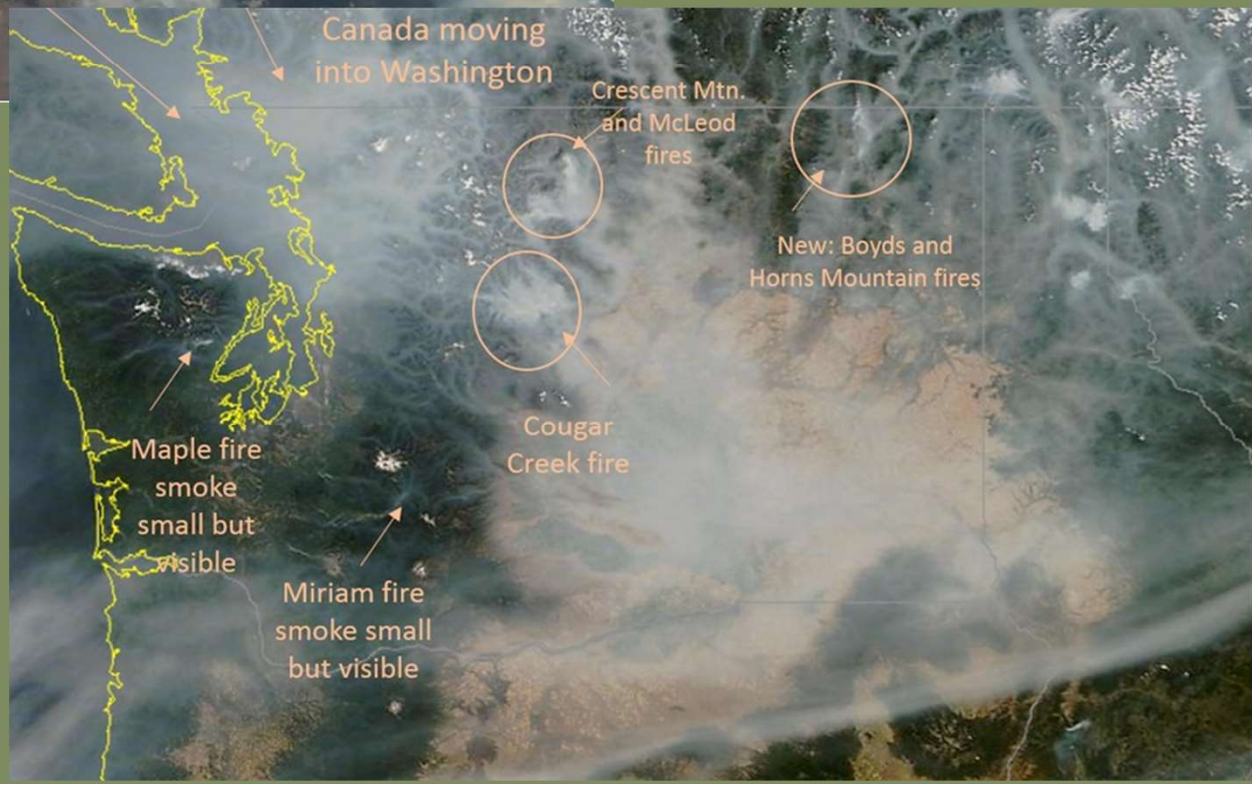
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

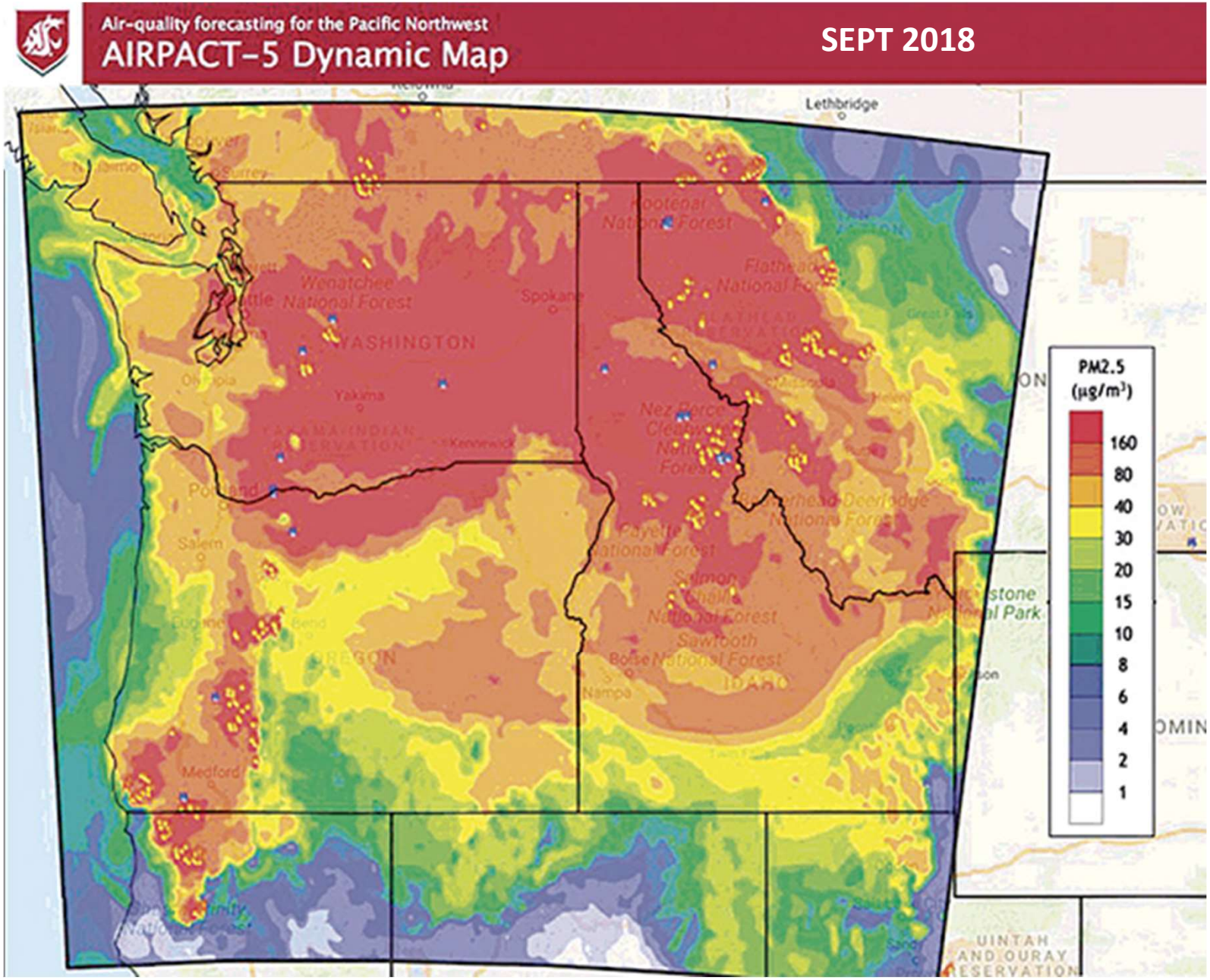
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

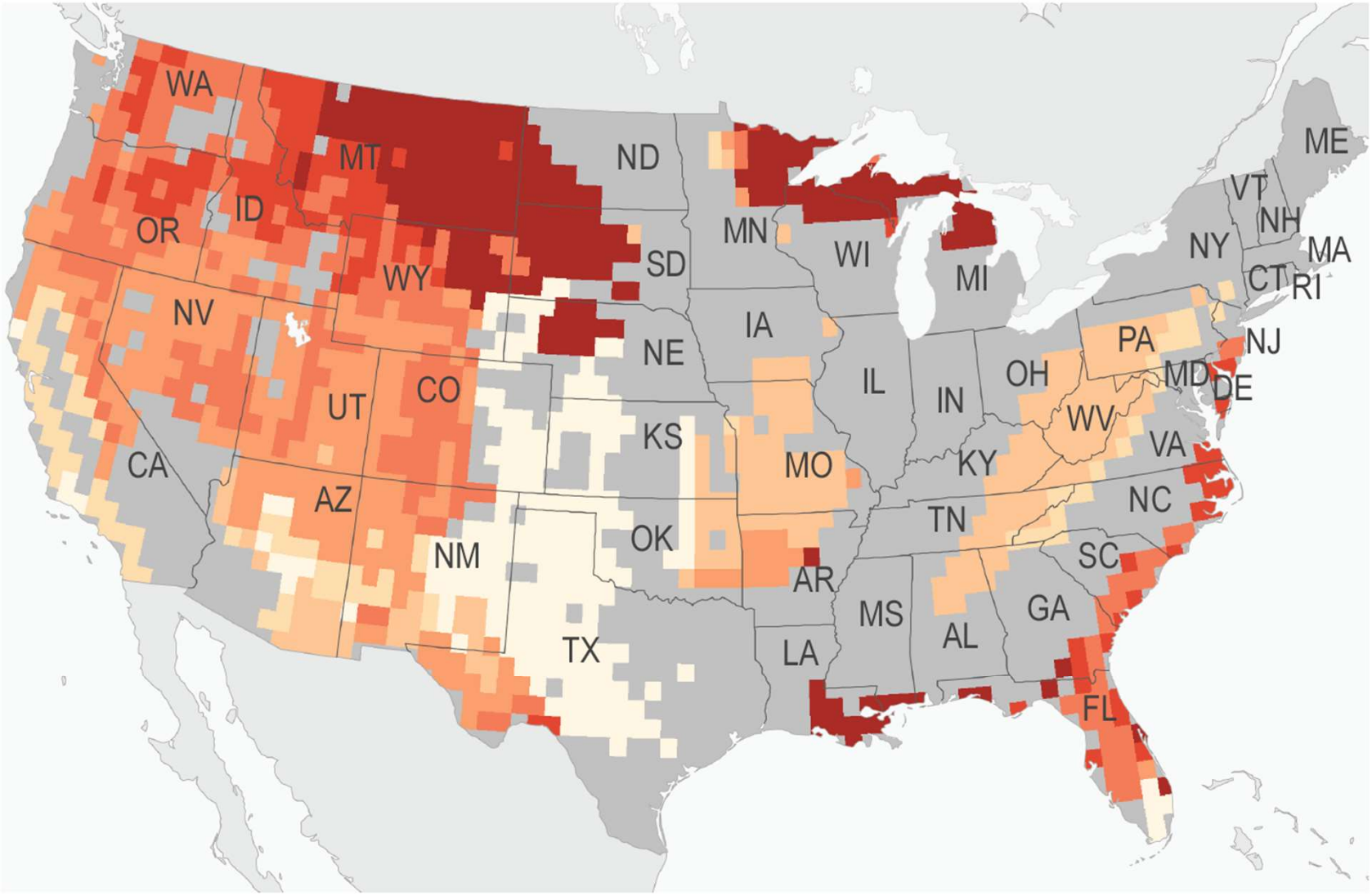
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

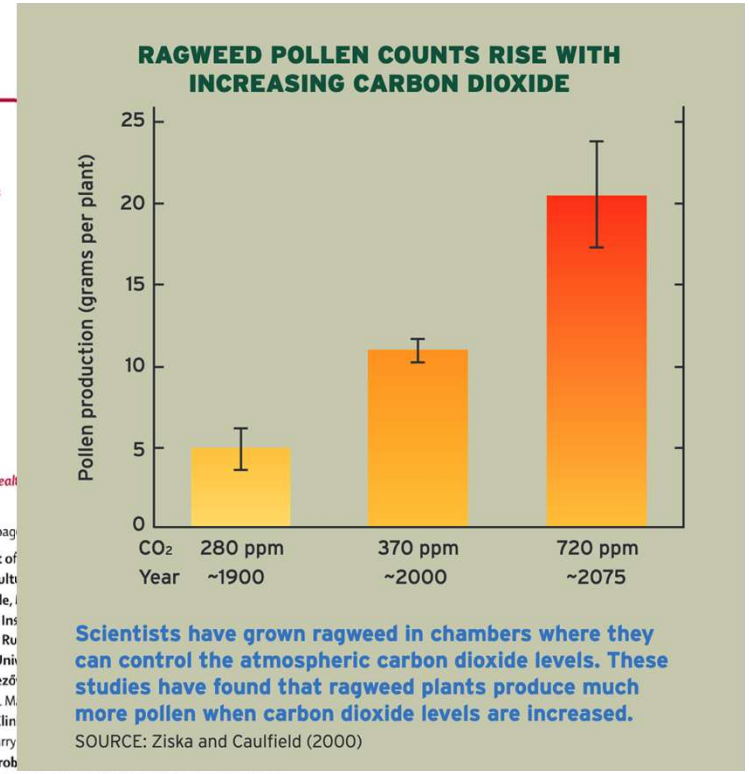
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

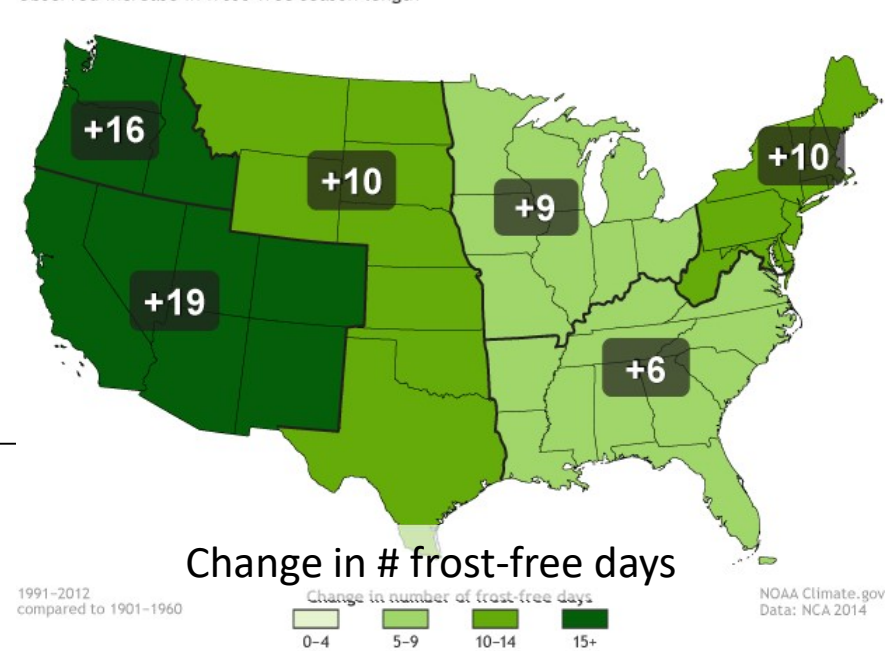
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

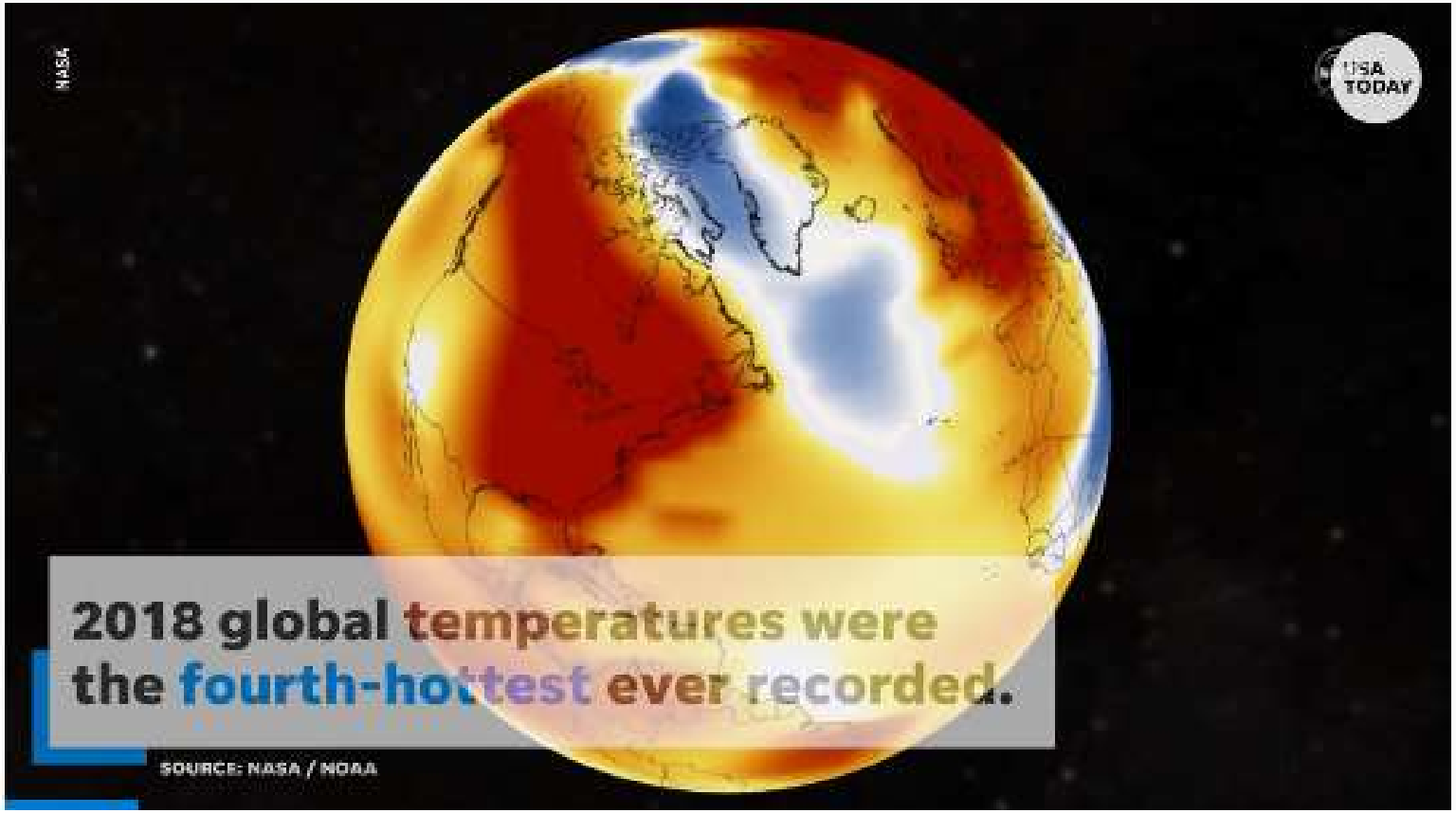
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



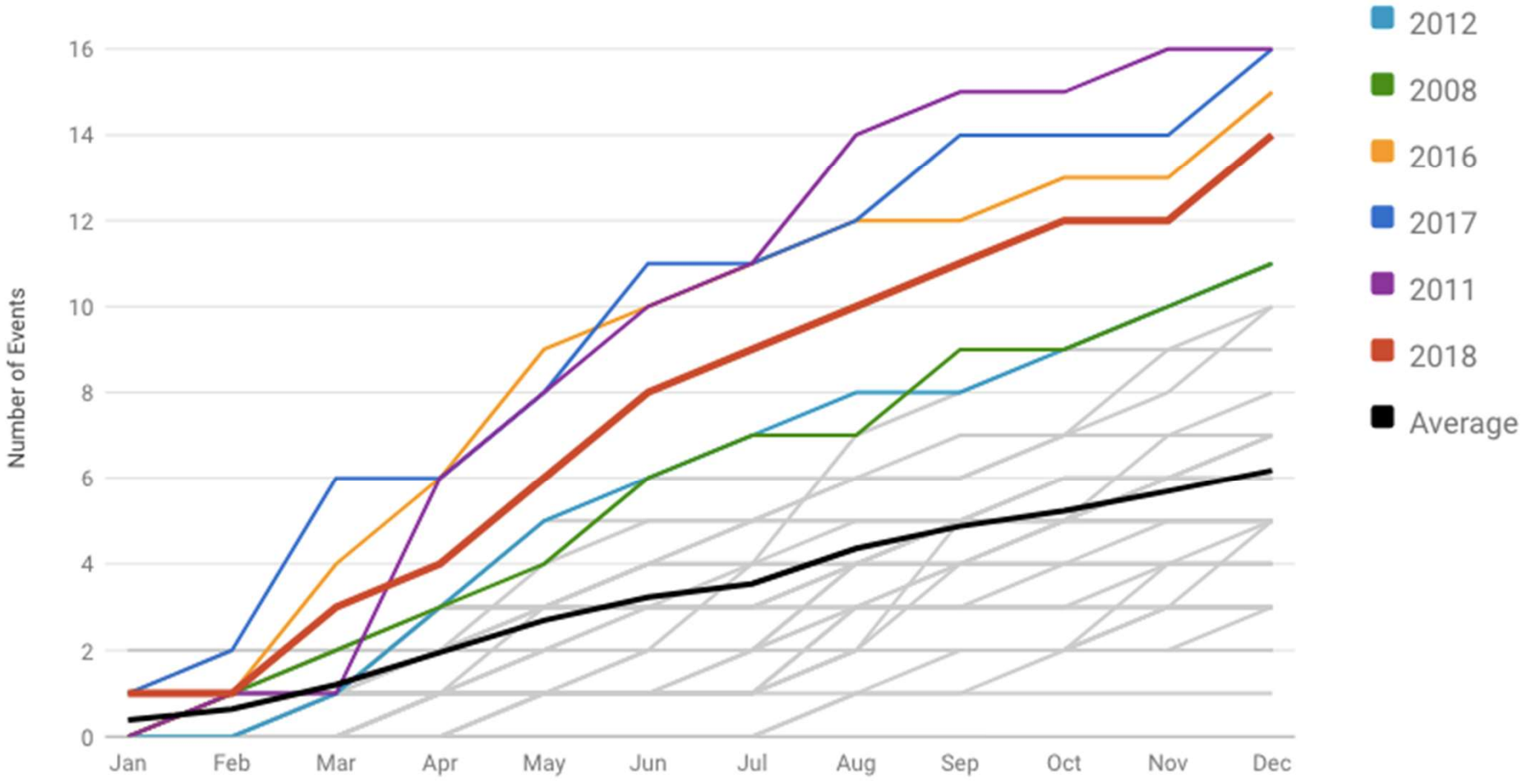
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



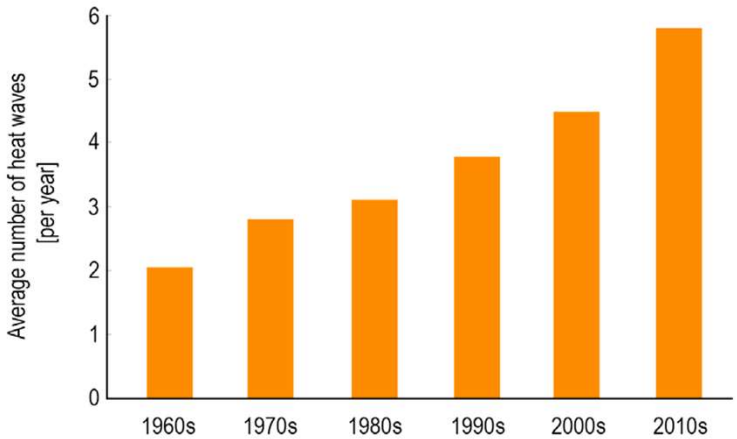
NOAA: National Centers for Environmental Information

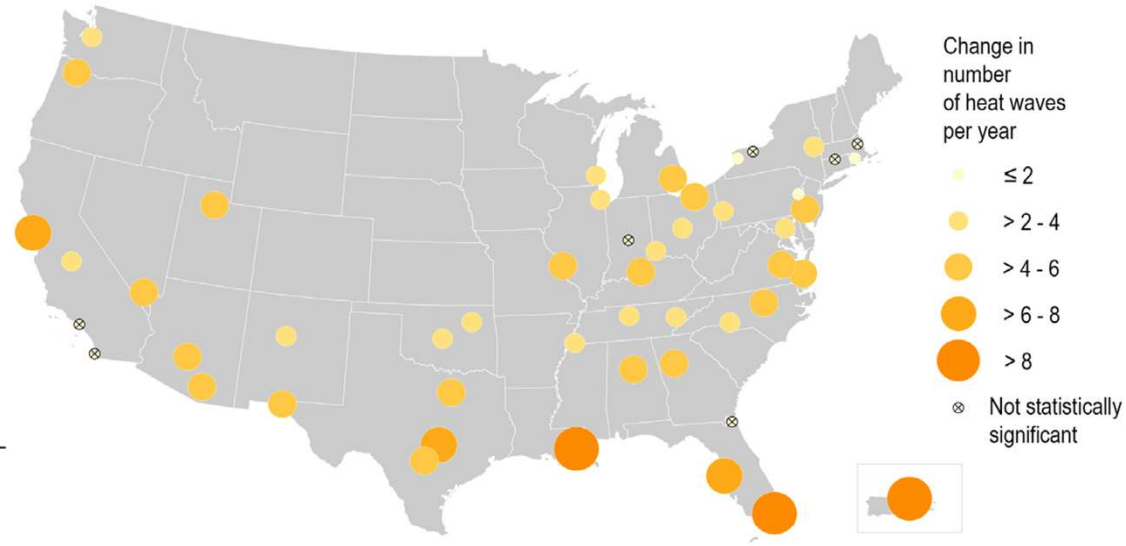
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

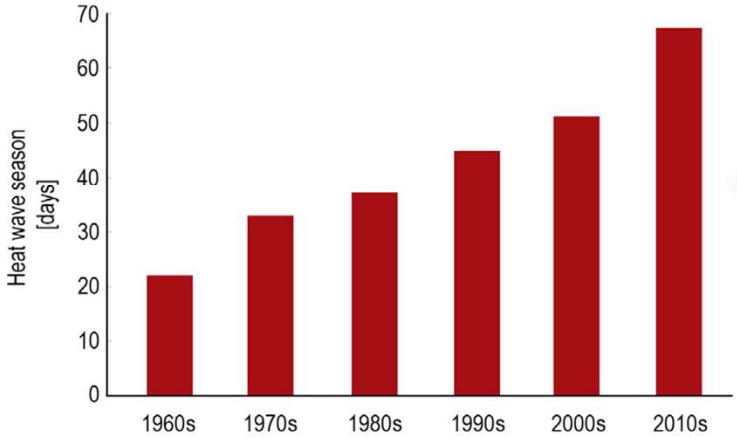
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

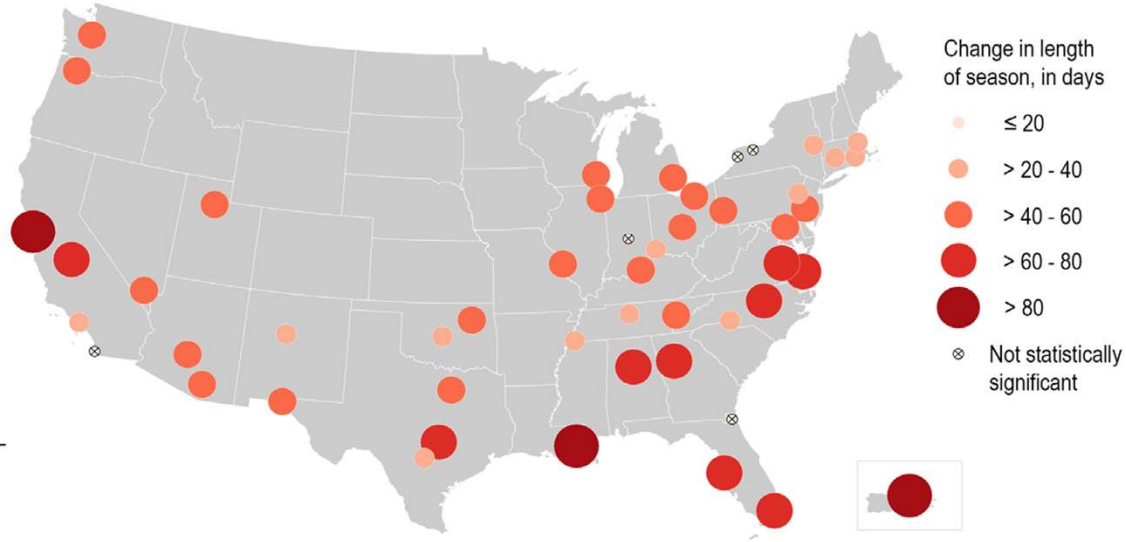
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

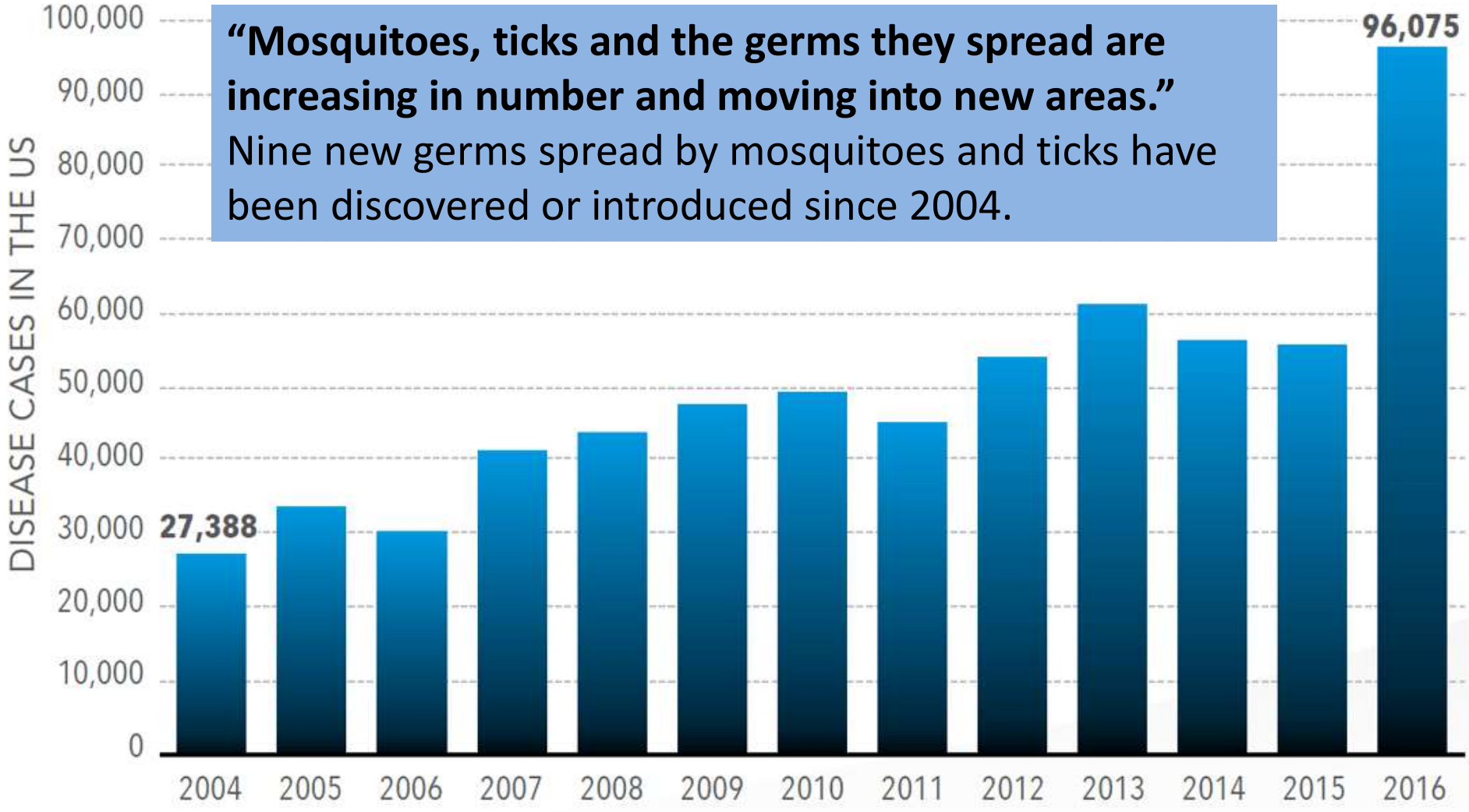
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

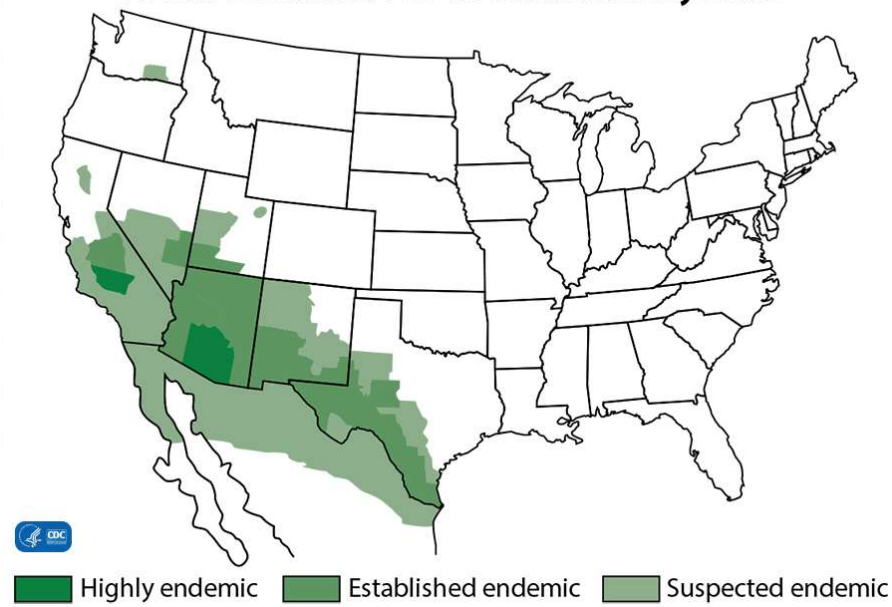
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

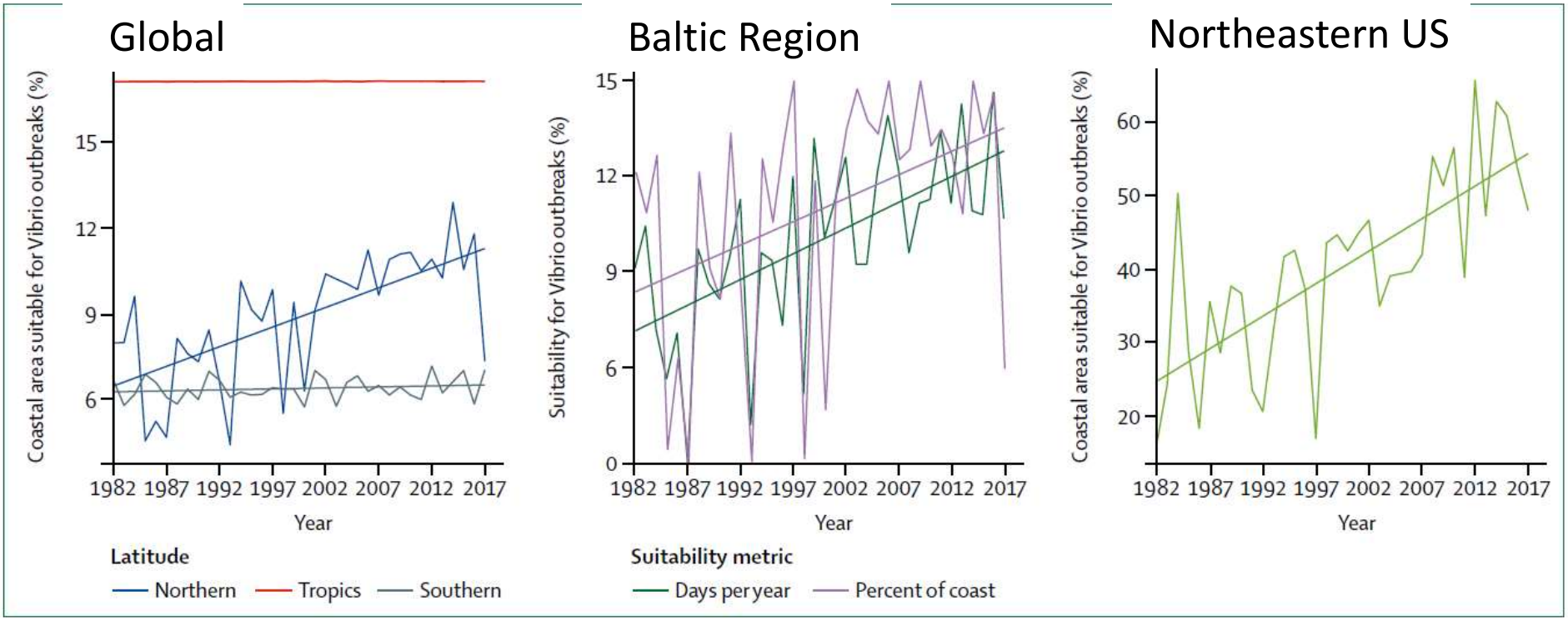
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

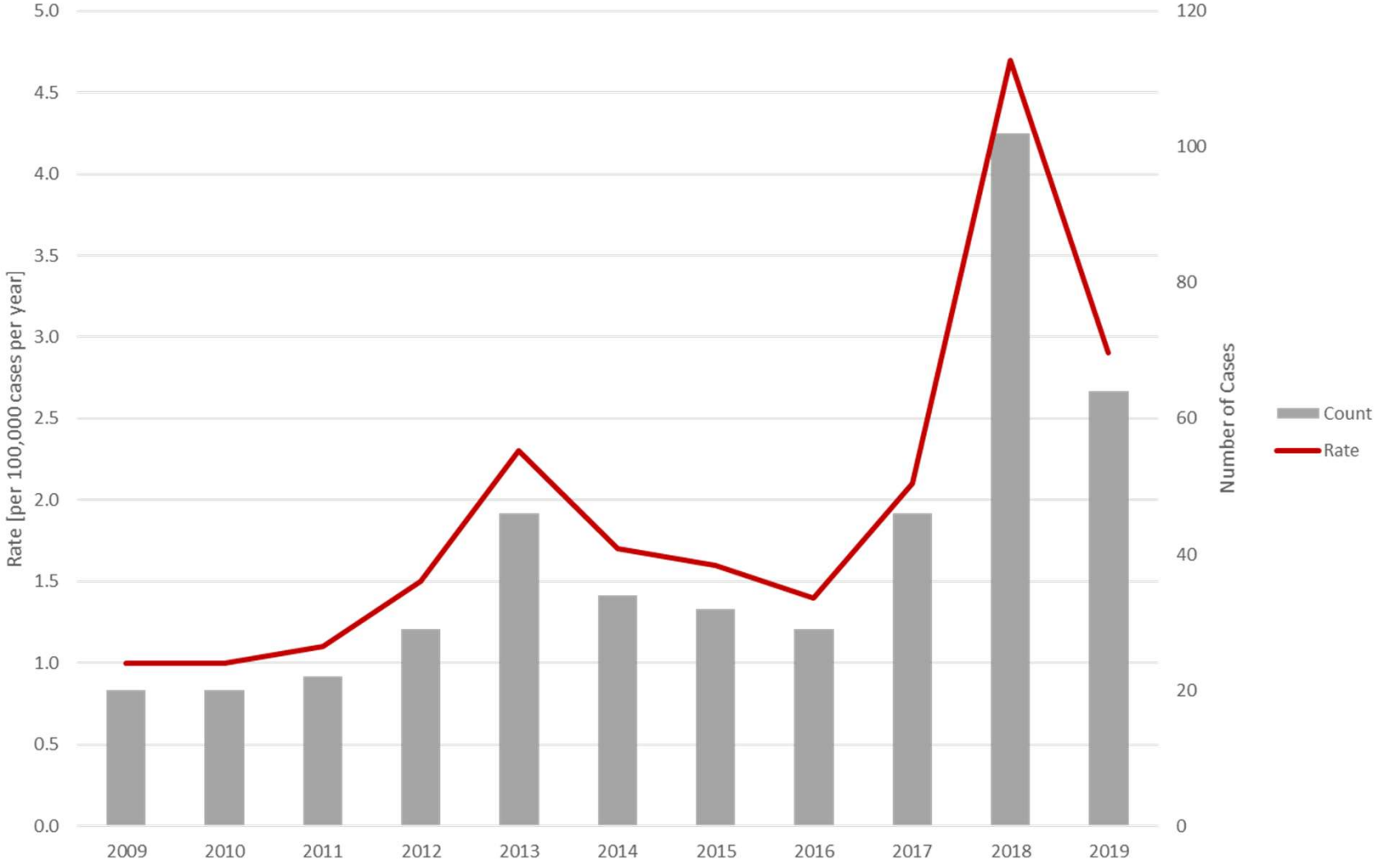
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

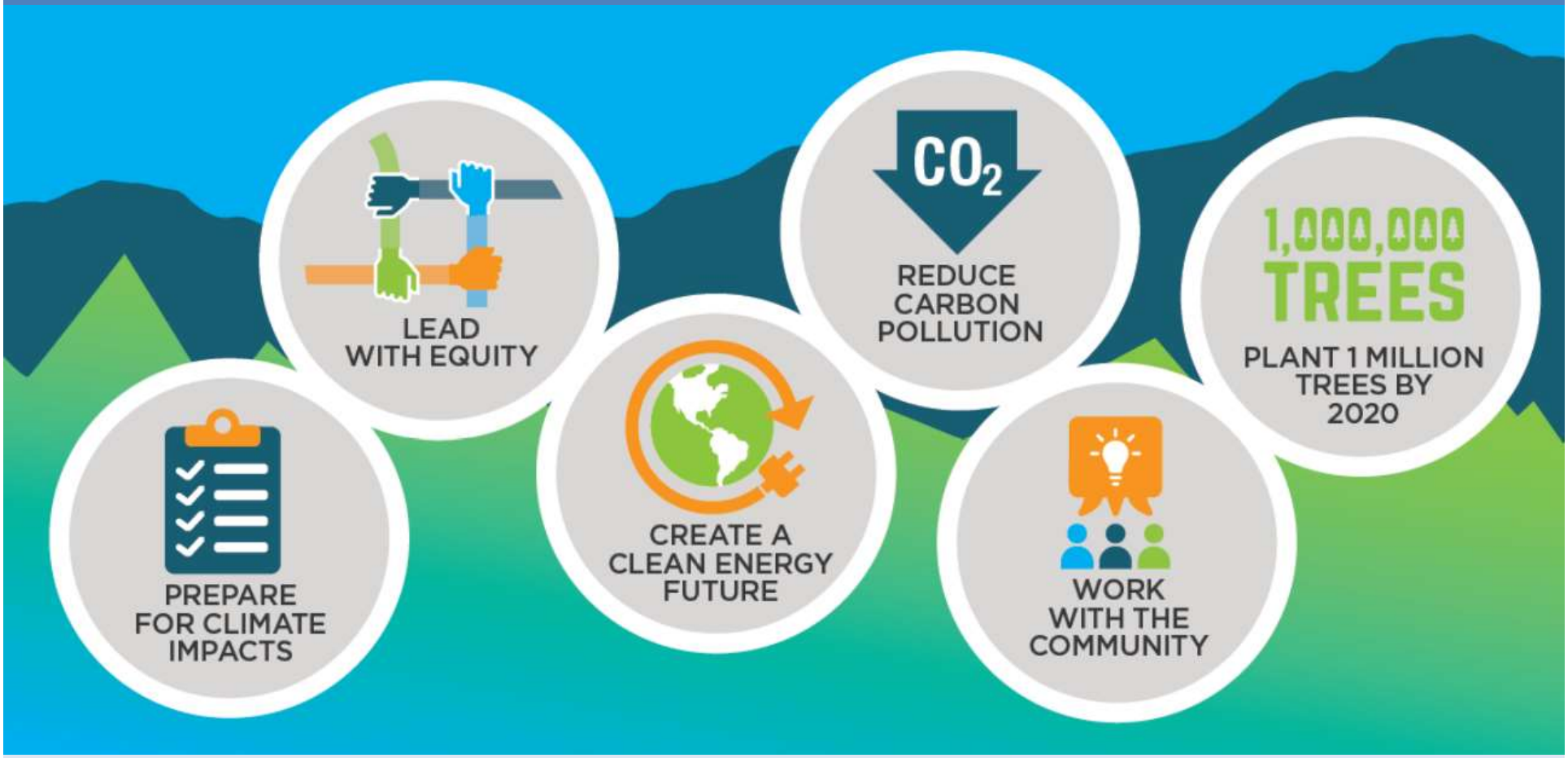
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

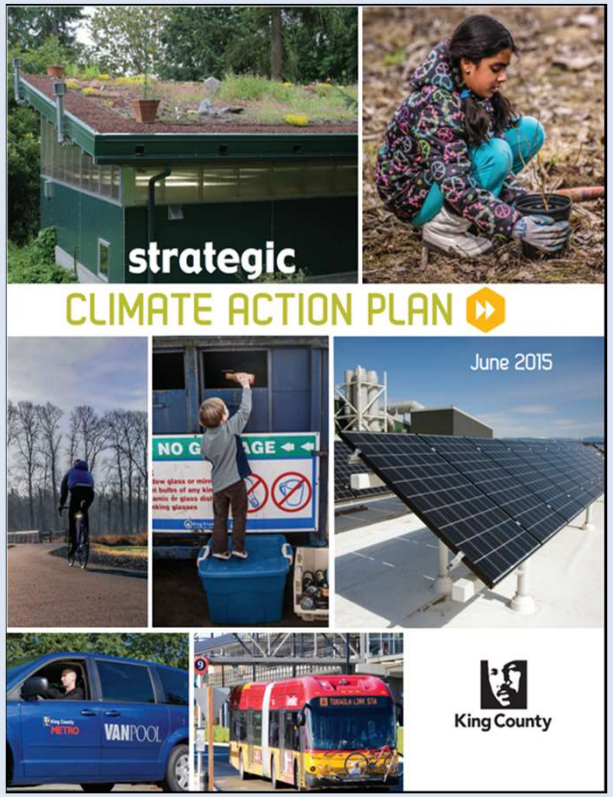


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

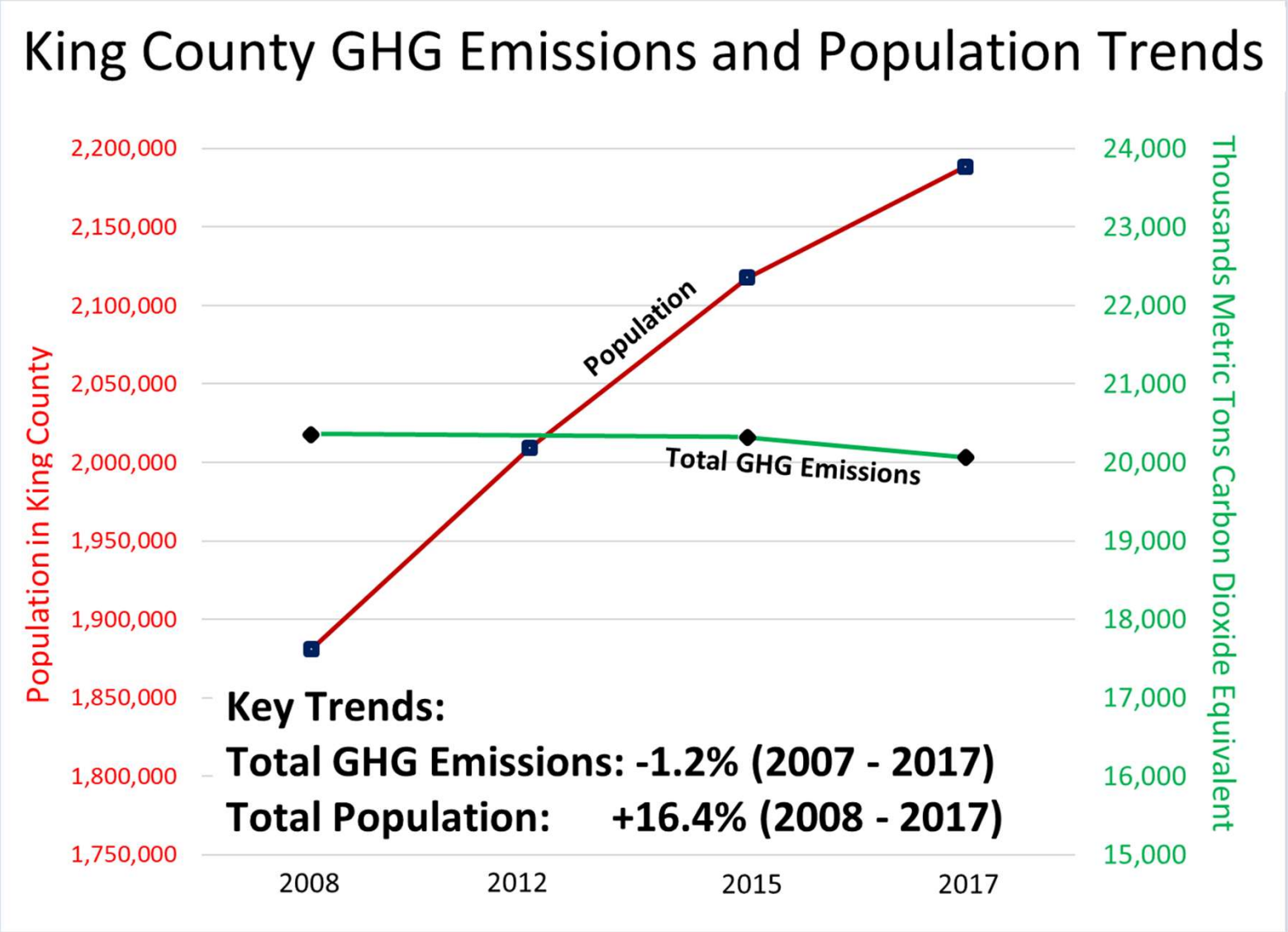
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



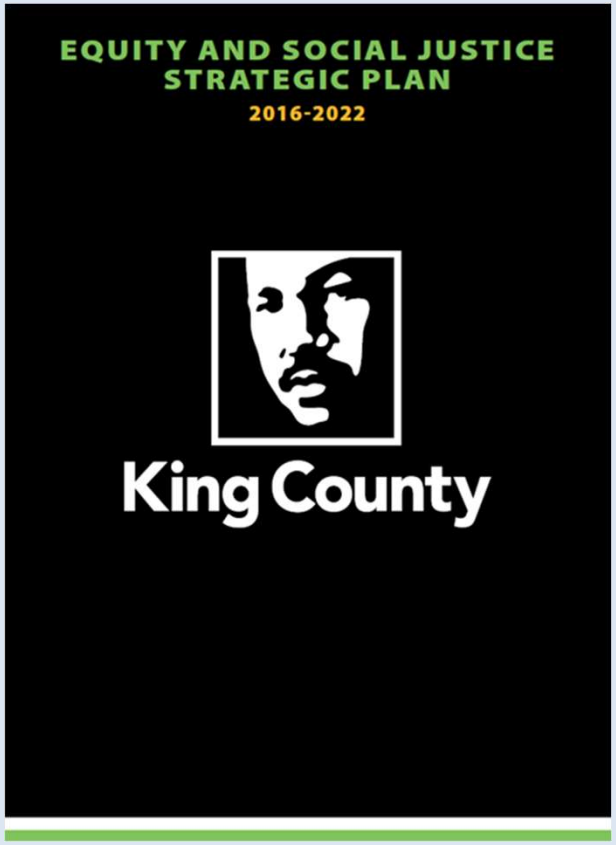
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

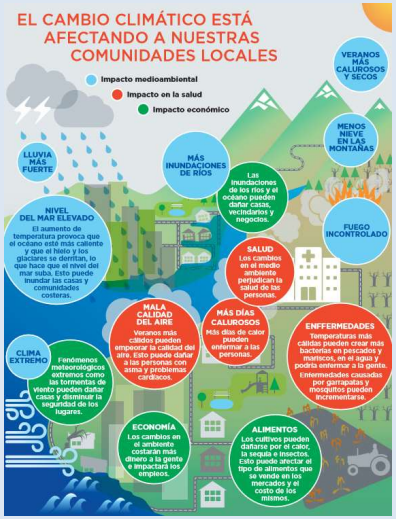
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?

Health Impacts of Climate Change

King County Board of Health

November 21st 2019

Health Impacts of Climate Change

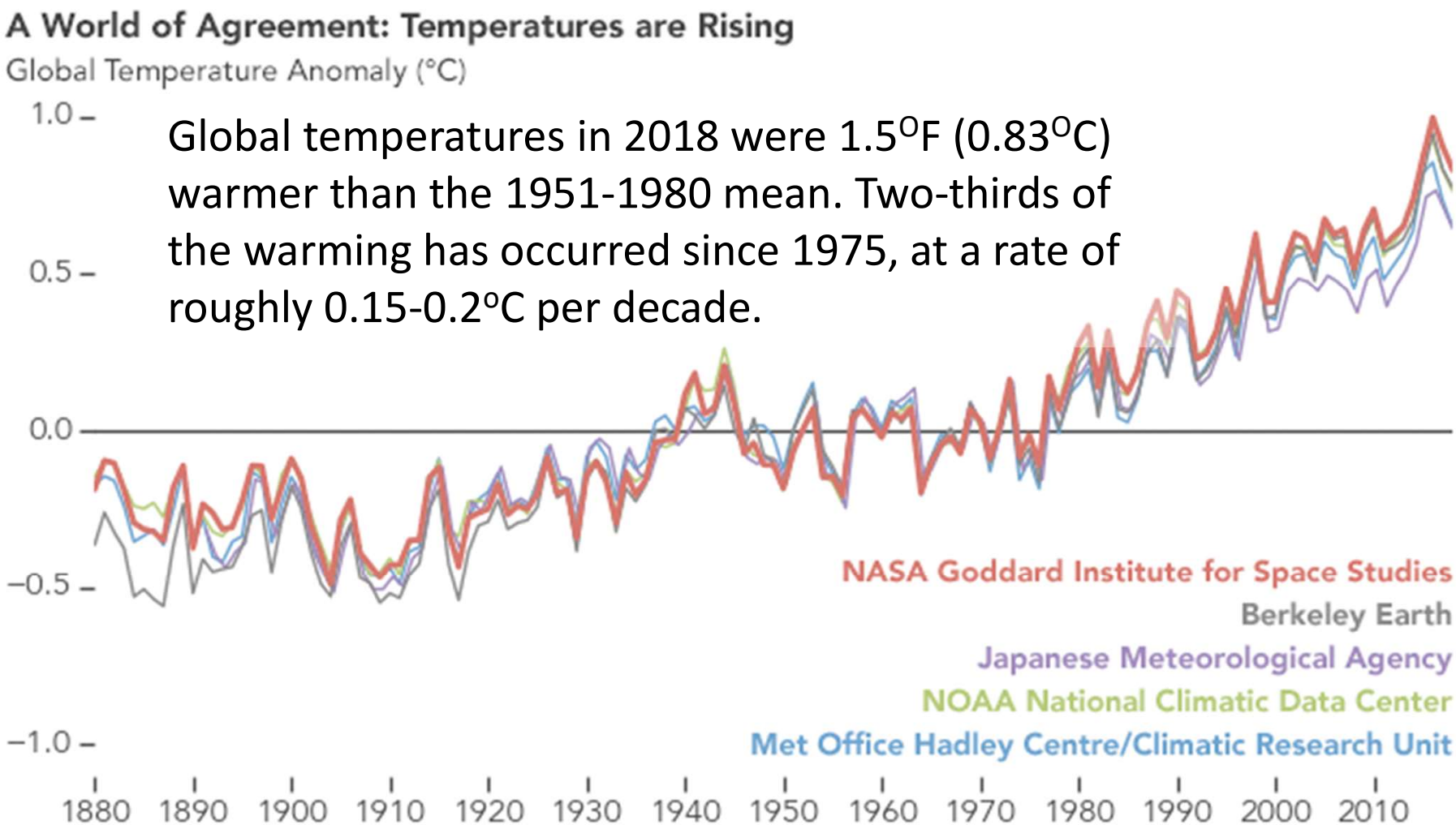
and what you can do about it

August 2017

Jeff Duchin, MD
Health Officer, Public Health - Seattle & King County
Professor in Medicine, Division of Allergy & Infectious Diseases,
Adjunct Professor, School of Public Health, University of Washington

Bottom Line – Climate Change & Health

- **The health and well-being of Americans today are adversely affected by climate change, and the health and economic consequences projected to worsen.**
- **Climate change affects human health through many pathways**: exposures to **heat waves, floods, droughts, and other extreme events; vector-, food- and waterborne infectious diseases; changes in the quality and safety of air, food, water; stresses to mental health & well-being**.
- **We need to cut global greenhouse gas emissions in half by 2030 and entirely by 2040 to avoid more catastrophic effects of climate change**.
- **Reductions in greenhouse gas emissions have *major health co-benefits* that offset the cost of GHG reduction policies**.

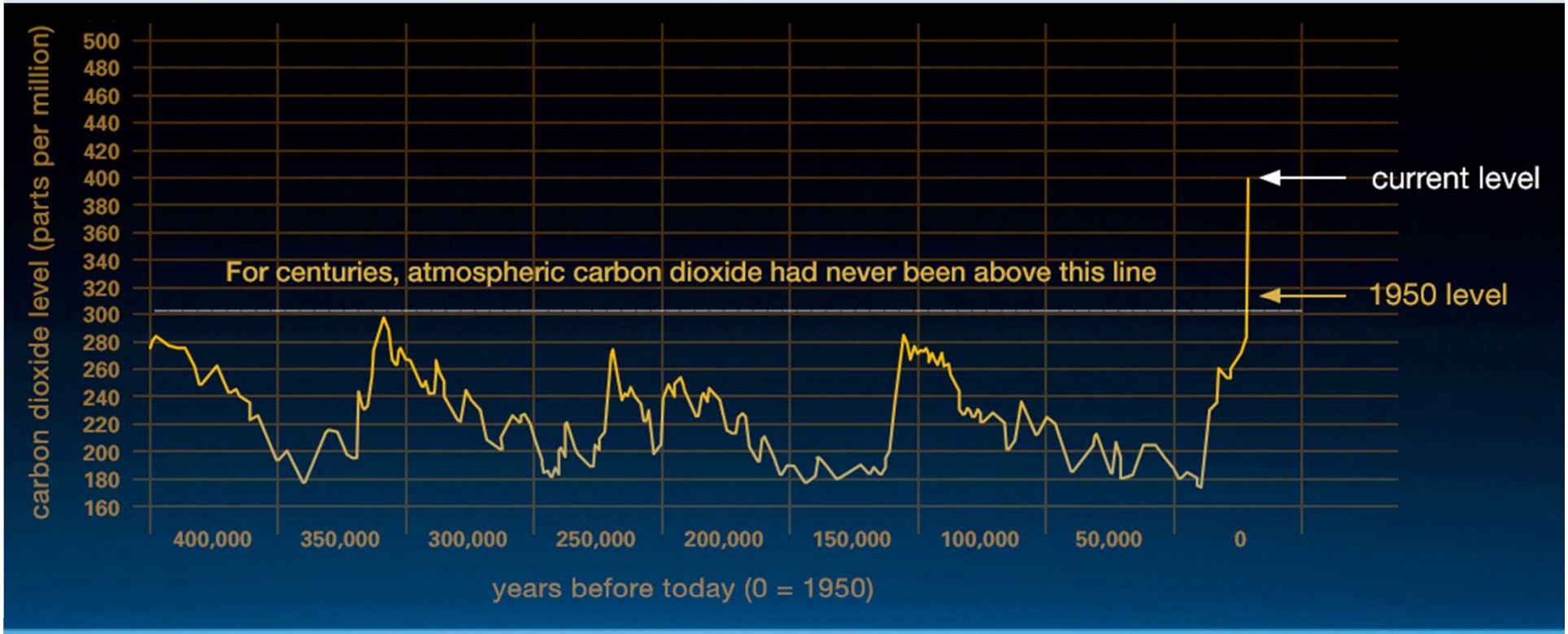


Global temperatures in 2018 were 1.5^{O}F (0.83^{O}C) warmer than the 1951-1980 mean. Two-thirds of the warming has occurred since 1975, at a rate of roughly 0.15-0.2^{o}C per decade.

The past five years are, collectively, the warmest years in the modern record.

NASA's Goddard Institute for Space Studies

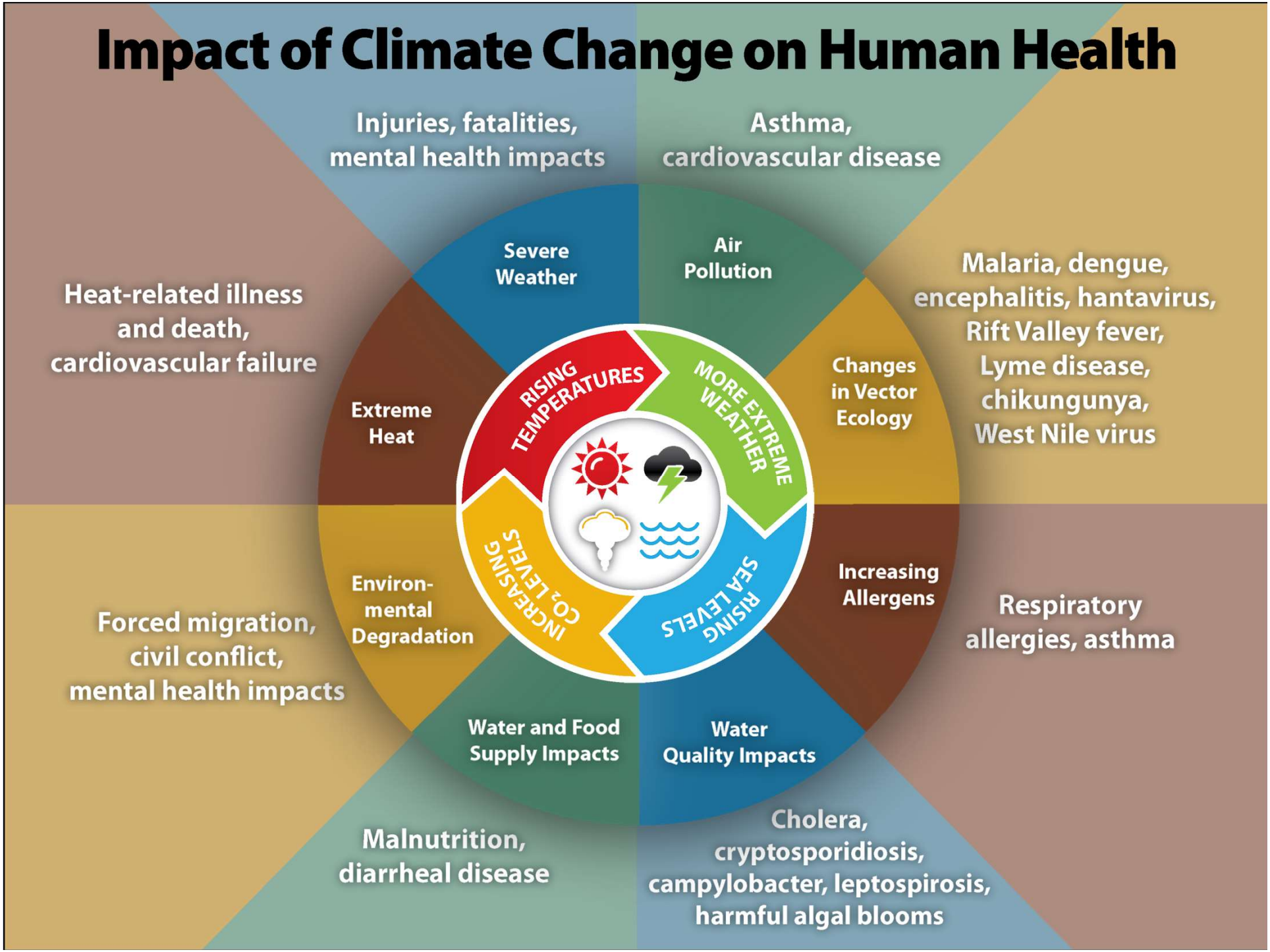
The Culprit: Atmospheric CO2 Over Time



Global average atmospheric CO2 in 2018 was 407.4 PPM (+/- 0.1 ppm).
CO2 levels today are higher than at any point in at least the past 800,000 years.

GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

Impact of Climate Change on Human Health



SCIENTIFIC AMERICAN
CLIMATE

Children Are Particularly Vulnerable to Climate Change's Health Impacts

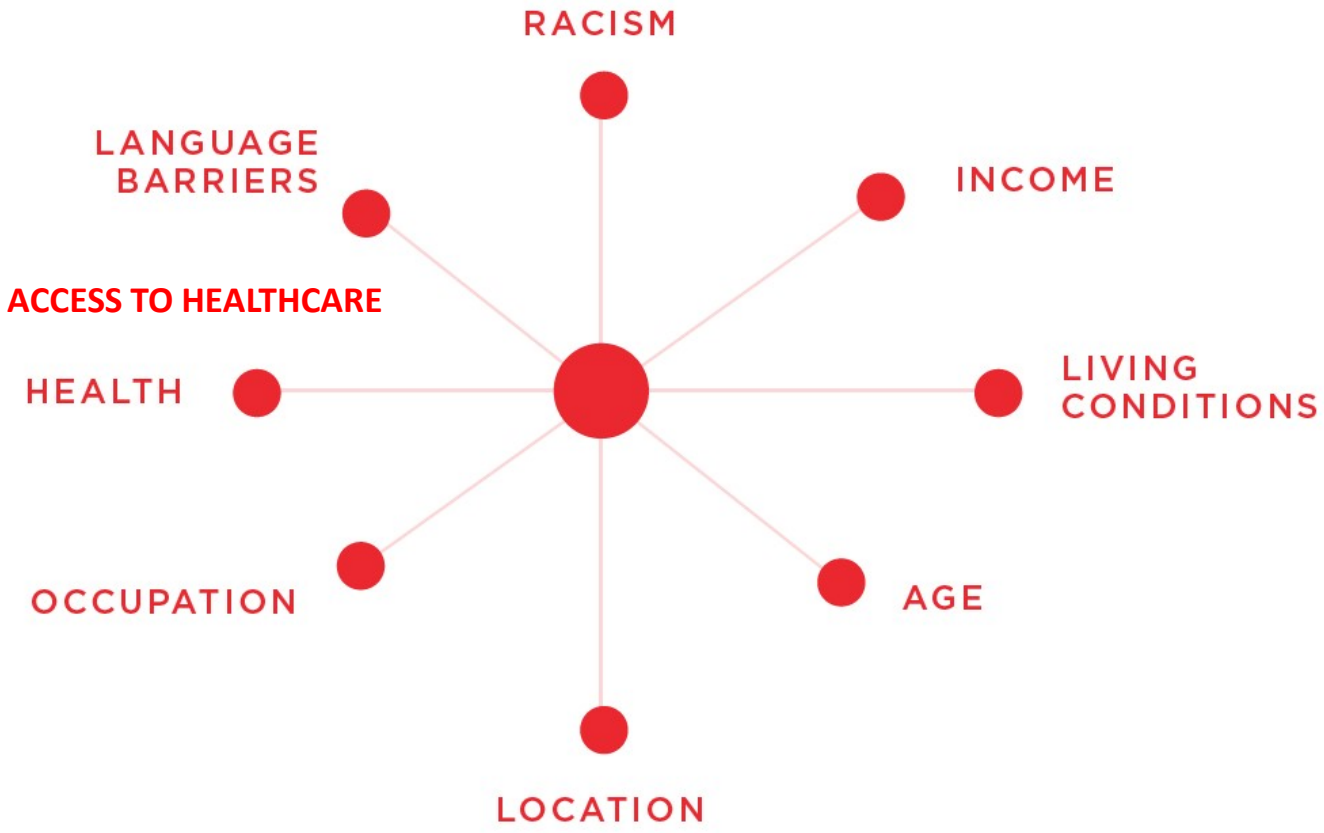
Global warming is already affecting public health, and efforts to address the problem are inadequate, a new report says

By Maya Earls, E&E News on November 14, 2019

- Children born today will face a lifetime of climate change-related health problems, one of the world's oldest and most prestigious medical journals warns in a report released yesterday.
- **The health impacts flagged by the report start at the prenatal level with a heightened risk of low birth weight and neonatal death and continue through childhood and adolescence with potential lung problems, asthma attacks and insect-borne diseases.**
- Older adults would see increasing vulnerability from extreme heat.

The health risks and impacts of climate change are not equally or fairly distributed across people or communities.

Factors that Influence Climate Vulnerability



URBAN SUSTAINABILITY DIRECTORS NETWORK

Increased Vulnerability

- Children
- Older adults
- Low income communities
- Urban communities
- Communities of color; disenfranchised communities
- Exacerbation of existing disparities

Air Pollution and Climate Change

- Air pollution and climate change are closely related
- The main sources of CO_2 emissions (extraction and burning of fossil fuels) are key drivers of climate change and major sources of air pollutants.
- Many air pollutants that are harmful to human health and ecosystems also contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.
- Outdoor air pollution can cause heart attacks, asthma, strokes, cancer, and premature death.
- An estimated 1,100 people die each year in Washington State due to outdoor air pollution (*Puget Sound Clean Air Agency*)

London

The Seattle Times

Health | Local News | Puget Sound | Weather

Seattle's dirty air among world's worst, but relief is in sight

Originally published August 15, 2018 at 7:10 am | *Updated August 15, 2018 at 6:02 pm*

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Traffic Lab Project Homeless Crime Local Politics Education Eastside Watchdog News Obituaries FYI Guy Westneat Beason

Local News | Weather

Puget Sound air-quality warning: Beware of smoke from British Columbia fires

Originally published August 13, 2018 at 5:49 pm | *Updated August 14, 2018 at 5:38 pm*

1 of 6 *Haze obscures the Seattle skyline as seen from Bellevue earlier this month. While the smoke may not be as bad this weekend, the Puget Sound Clean Air Agency advises everyone to limit time spent outdoors. (Ellen M. Banner / The Seattle Times)*

Smoke from fires in British Columbia will impact air quality in the King, Kitsap, Pierce and Snohomish county areas. A southern wind should push the wildfire smoke out by the end of the week.

Wildfire at the Wildland-Urban Interface

Twisp, Washington, August, 2015

(Ted S. Warren / Associated Press)

Weekend lightning, wind spread wildfires across Washington state

Originally published August 12, 2018 at 4:54 pm | *Updated August 14, 2018 at 5:49 am*

Almost 9,000 firefighters and support personnel are trying to put out fires burning across more than 250,000 acres of land in Washington and Oregon.

Grass Valley Fire, west of Grand Coulee Dam, August 12, 2018 (Almira Fire Dept)

AMERICAN LUNG ASSOCIATION®

1-800-LUNGUSA

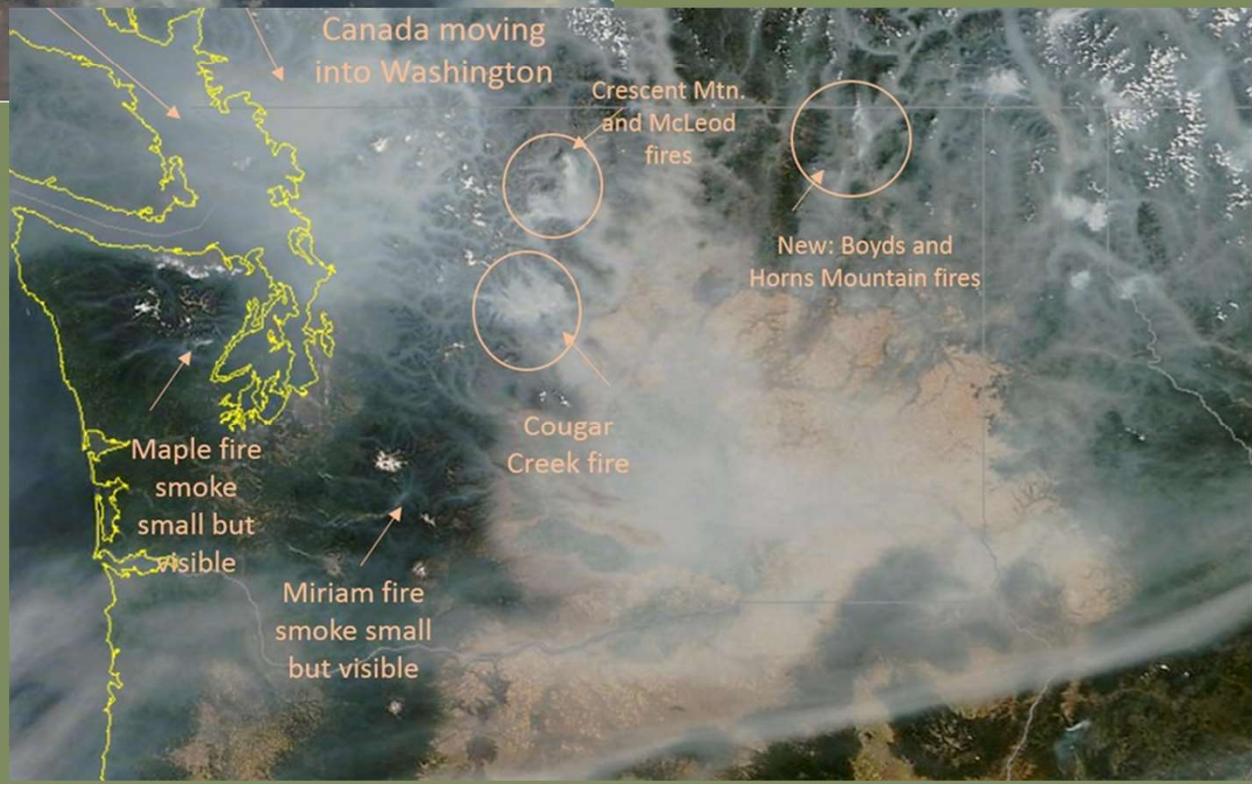
Submit a Question

Seattle-Tacoma Area is One of the Ten Most Polluted Areas in the Nation, According to 2019 'State of the Air' Report

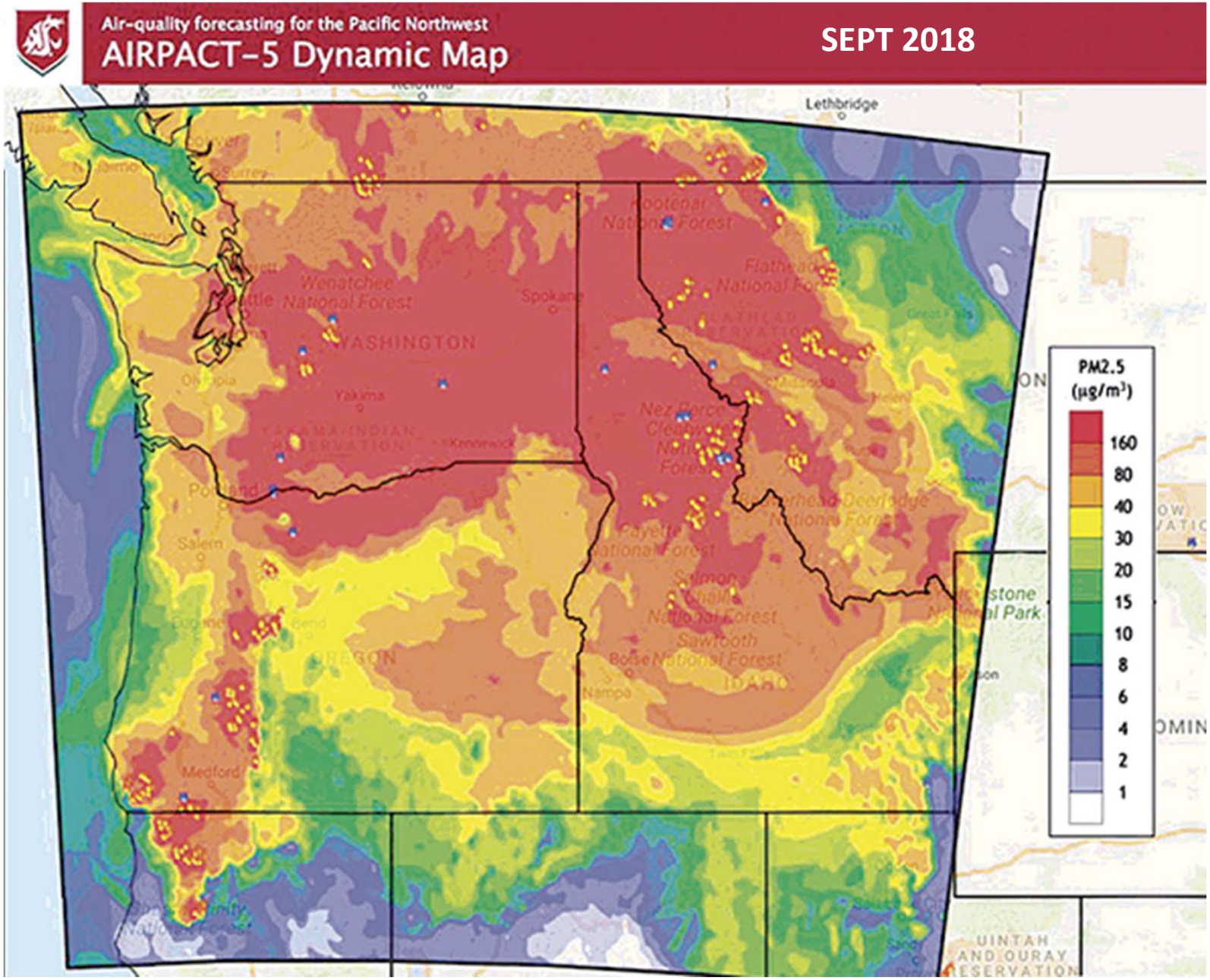
Wildfires significantly impact air quality in the region

- The American Lung Association "State of the Air" 2019 report found that the **Seattle-Tacoma region's air quality worsened from 15th most polluted in the country last year to ninth this year for short-term particle pollution.**
- In addition to short-term particle pollution, **Seattle-Tacoma jumped from 72nd last year to 35th most polluted area in the nation for ozone pollution**. **King County dropped from a "C" to an "F" grade…**
- **"People in the Puget Sound area should know that we're breathing unhealthy air, driven by wildfires as a result of climate change, placing our health and even lives at risk**," said Allison Hickey, National Executive VP for the American Lung Association Western Region.

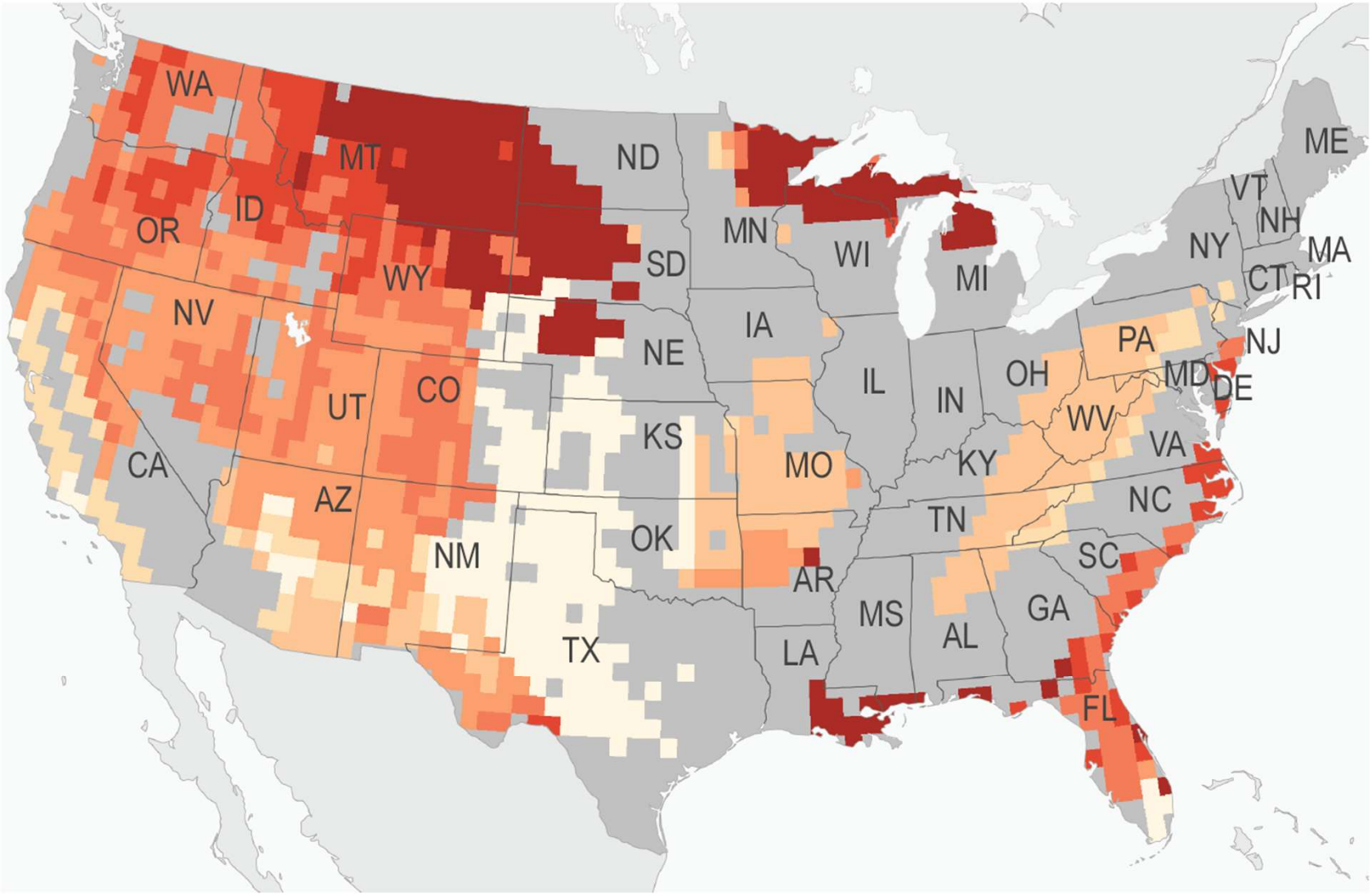
Widespread Smoke From Multiple Fires, California, 2018



Widespread Smoke From Multiple Fires, Pacific Northwest, 2018


Air-quality forecasting for the Pacific Northwest
AIRPACT-5 Dynamic Map
SEPT 2018
Lethbridge
Wenatchee
National Forest
Spokane
WASHINGTON
Yakima
Kennewick
Portland
Salem
OREGON
Medford
Nampa
Sawtooth
Boise National Forest
Flathead
National Forest
Nez Perce
Clearwater
National Forest
Bitterroot-Deerlodge
National Forest
Salmon
Challis
National Forest
Lolo
National Forest
Kootenai
National Forest
UINTAH
AND OURAY
RESERVATION
PM2.5
(μg/m³)
160
80
40
30
20
15
10
8
6
4
2
1

Projected Increase in Risk of Very Large Fires by Mid-Century



Increase in Weeks with Risk of Very Large Fires (%)

0 50 100 200 300 400 500 600

NOAA, RCP 8.5

Lancet Planetary Health, March 2019

Temperature-related changes in airborne allergenic pollen abundance and seasonality across the northern hemisphere: a retrospective data analysis

Lewis H Ziska, László Makra, Susan K Harry, Nicolas Bruffaerts, Marijke Hendrickx, Frances Coates, Annika Saarto, Michel Thibaudon, Gilles Oliver, Athanasios Damialis, Athanasios Charalampopoulos, Despoina Vokou, Starri Heiðmarsson, Ellý Guðjohnsen, Maira Bonini, Jae-Won Oh, Krista Sullivan, Linda Ford, G Daniel Brooks, Dorota Myszkowska, Elena Severova, Regula Gehrig, Germán Darío Ramón, Paul J Beggs, Kim Knowlton, Allison R Crimmins

Summary

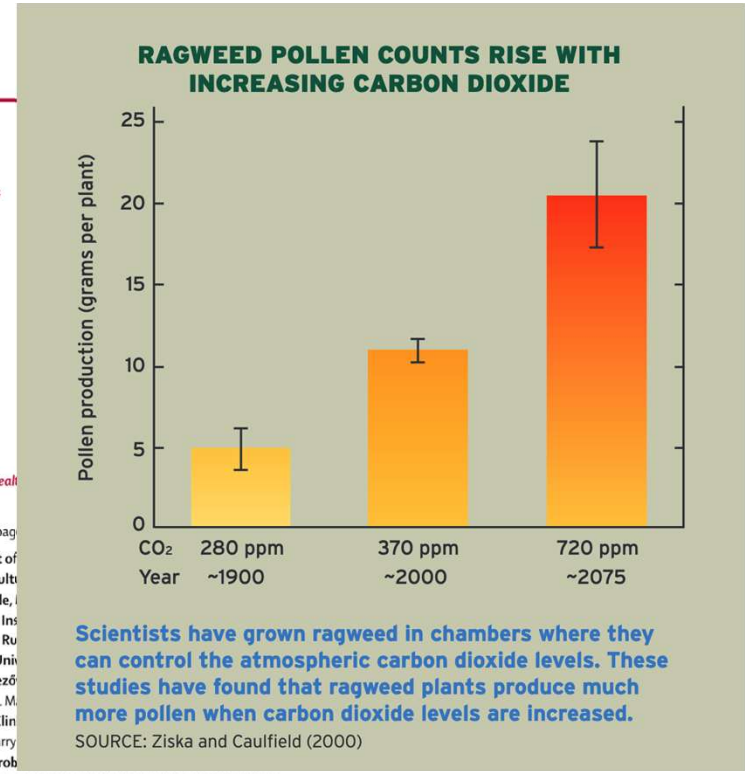
Background Ongoing climate change might, through rising temperatures, alter allergenic pollen biology across the

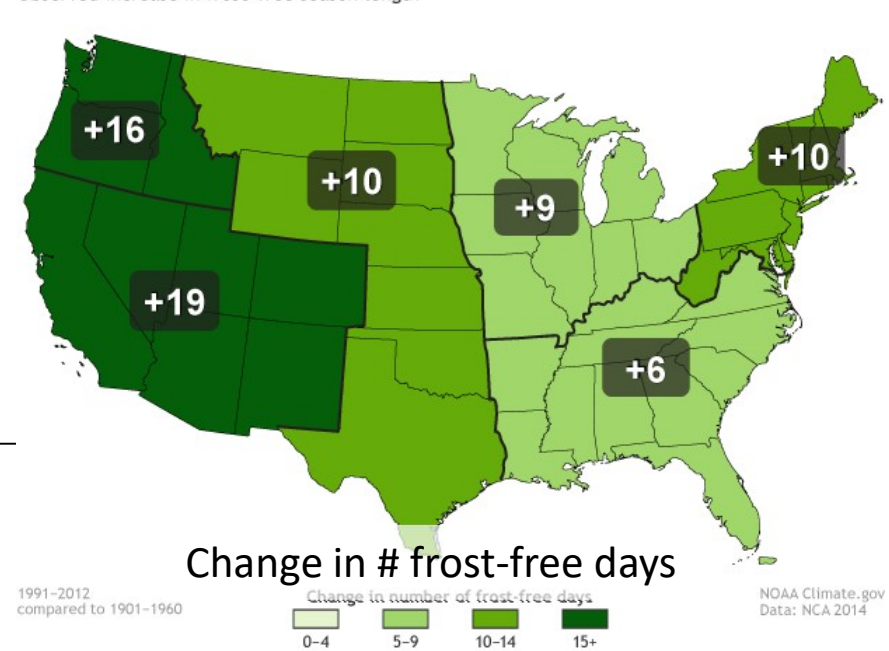
Lancet Planet Heal
3: e124–31

See Comment pag

US Department of
Beltsville Agricult
Center, Beltsville,
(L H Ziska PhD); Ins
Economics and Ru
Development Uni
Szeged, Hódmező
Hungary (Prof L M
Tanana Valley Clin
AK, USA (S K Harry
Mycology & Aerob

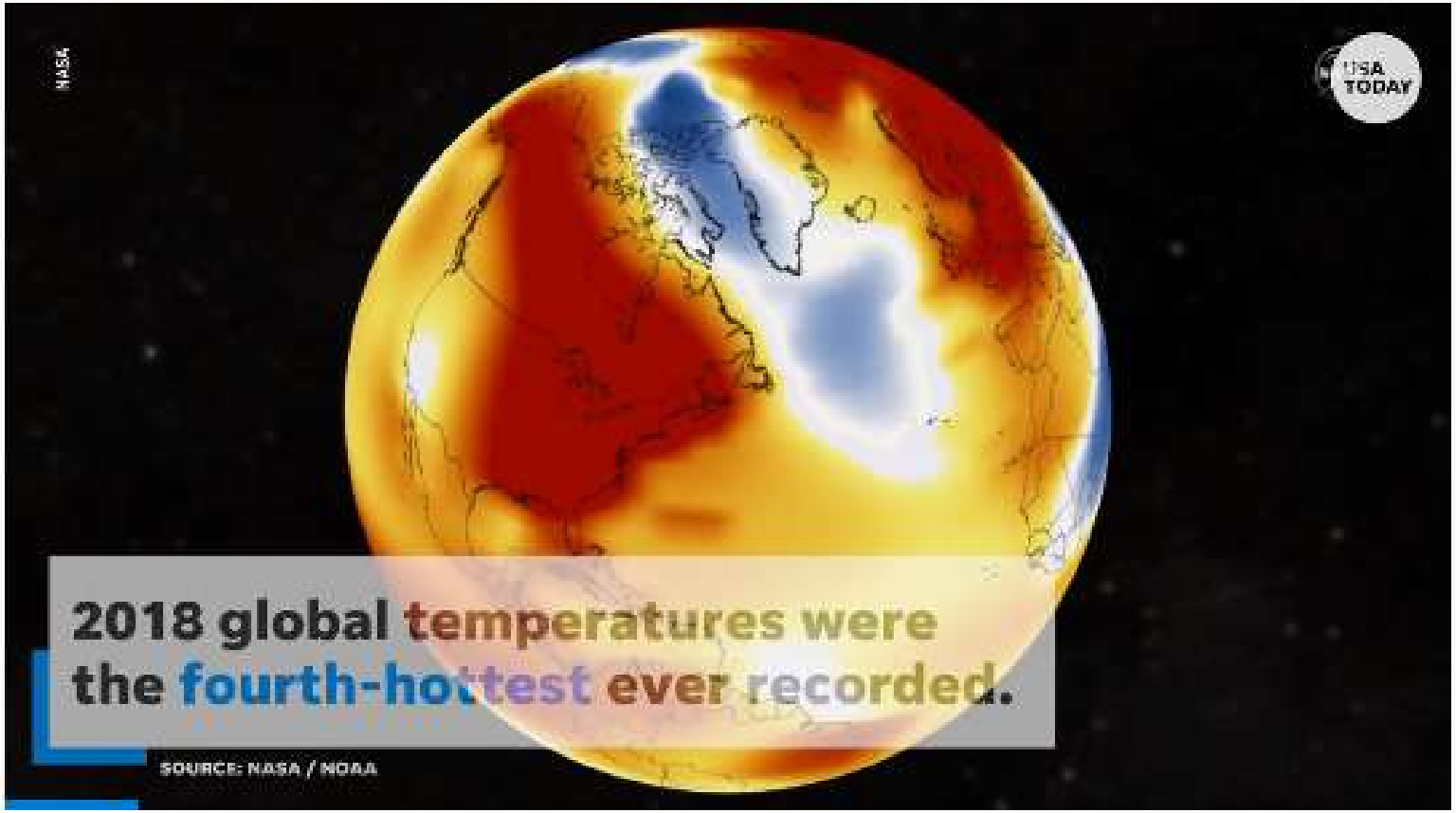
‘Overall, the long-term data indicate significant **increases in both pollen loads and pollen season duration** over time across the pollen collection locations...Our analysis also illustrates a **clear positive correlation between recent global warming and an increase in the seasonal duration and amount of pollen for multiple allergenic plant species**.’





Fueled by climate change, extreme weather disasters hit 62 million people in 2018, U.N. says

Doyle Rice, USA TODAY Published 6:43 a.m. ET March 29, 2019



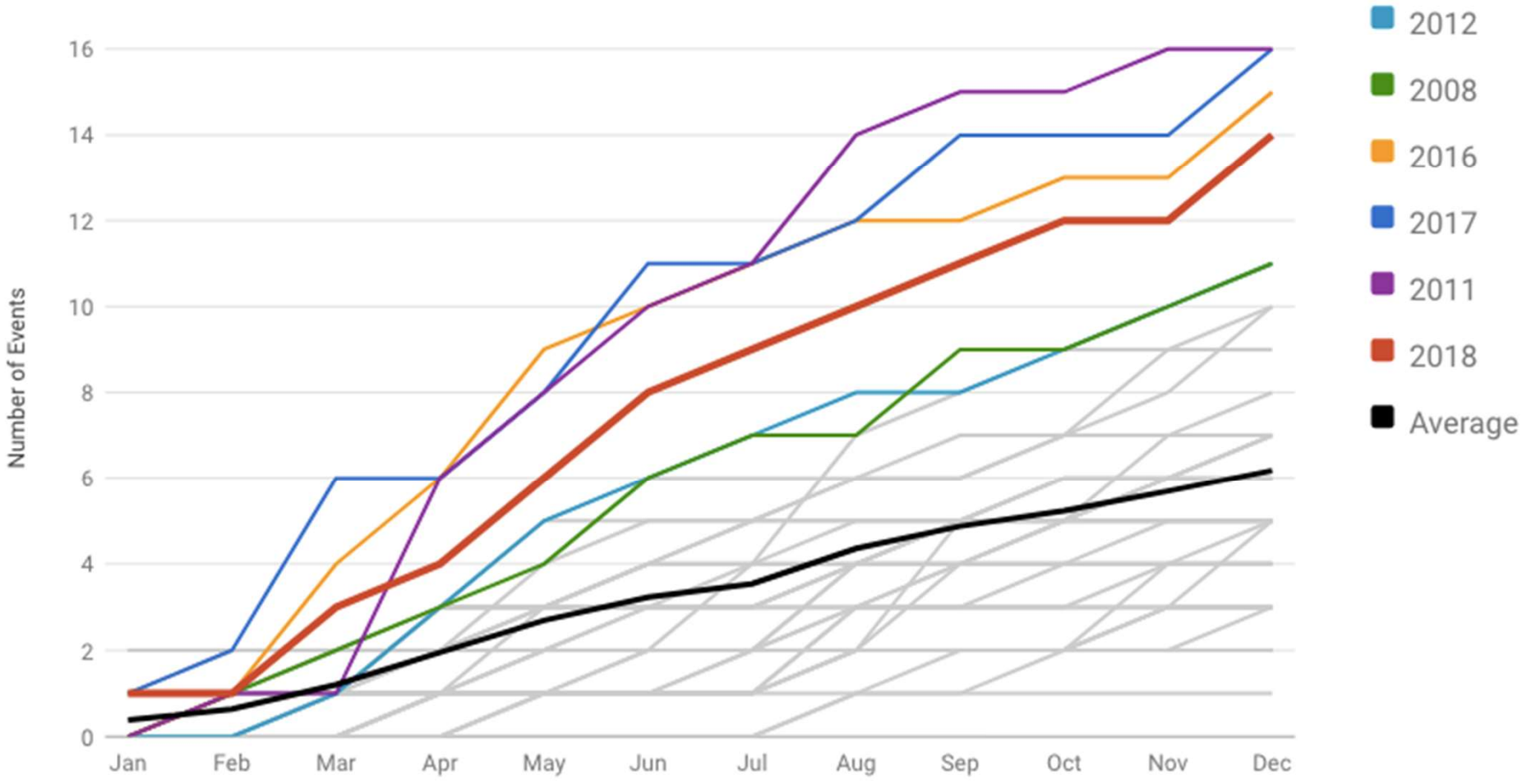
The past five years have been the warmest since records began in the late 1800s (NASA, NOAA).

Extreme Weather Events

- Impacts of floods, droughts, wildfires, hurricanes
  - **Death**
  - **Physical injury**
  - **Disease**
  - **Mental health impacts**
  - **Population displacement**
  - **Impacts on health systems, population health, livelihoods**
    - Destroy/damage healthcare infrastructure and critical medical equipment/supplies, interrupt provision of medical care
    - Disrupt/damage other critical infrastructure
      - water and sanitation facilities
      - transportation (roads, bridges, transit)
      - power/electricity/communication

1980-2018 Year-to-Date United States Billion-Dollar Disaster Event Frequency

Event statistics are added according to the date on which they ended (CPI adjusted)



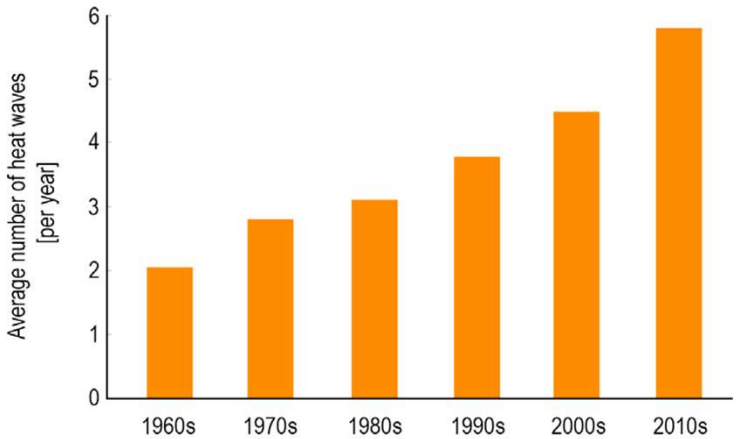
NOAA: National Centers for Environmental Information

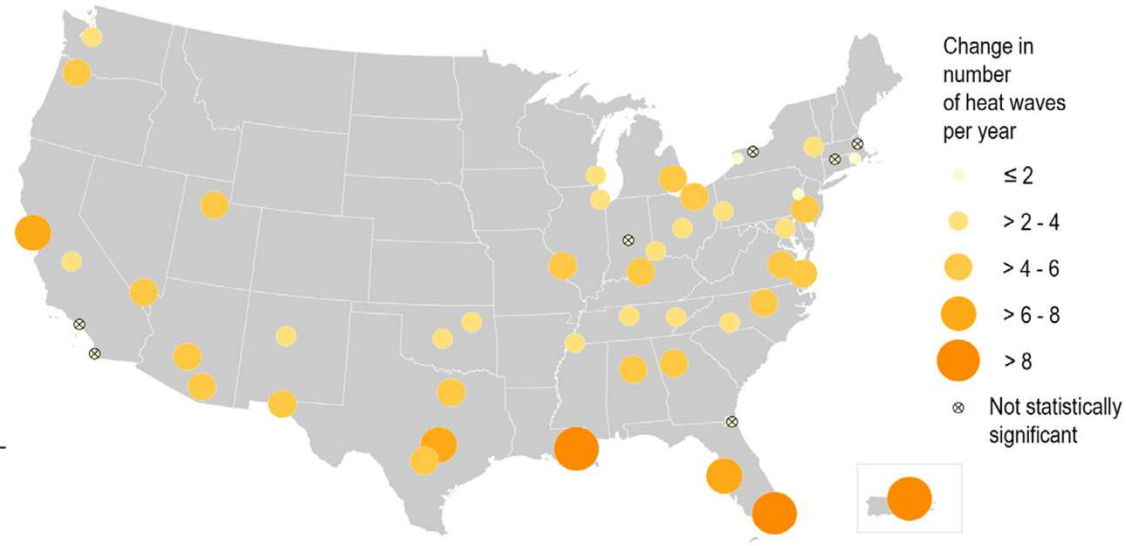
Extreme Heat

- **The leading cause of weather-related deaths** in the U.S.
- **Average summer temperature in 2016 was 2.2ºF greater than 1986-2005 average, resulting in 12.3 million more Americans exposed to extreme heat that year.**
- Exposure to extreme heat can lead to **heat exhaustion**, life threatening **heat stroke**, and **exacerbate chronic lung, heart, and kidney diseases**.
- Emerging evidence suggests that hotter temperatures can cause **pregnancy complications**, **worsen mental health conditions**, and **increase suicides**, amongst other risks.

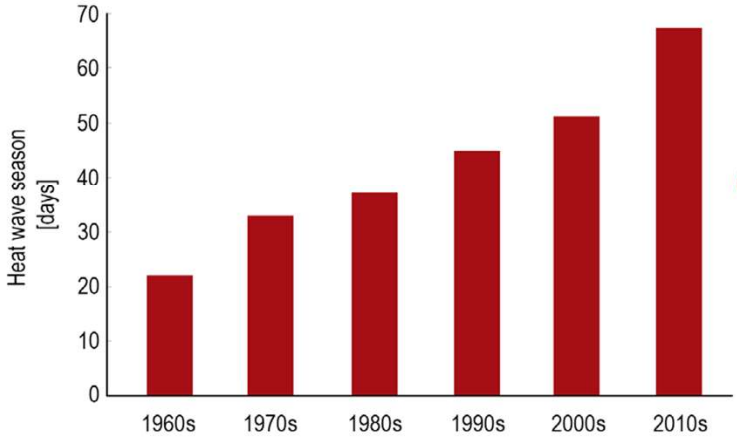
Heat Wave Characteristics in 50 Large U.S. Cities, 1961-2017

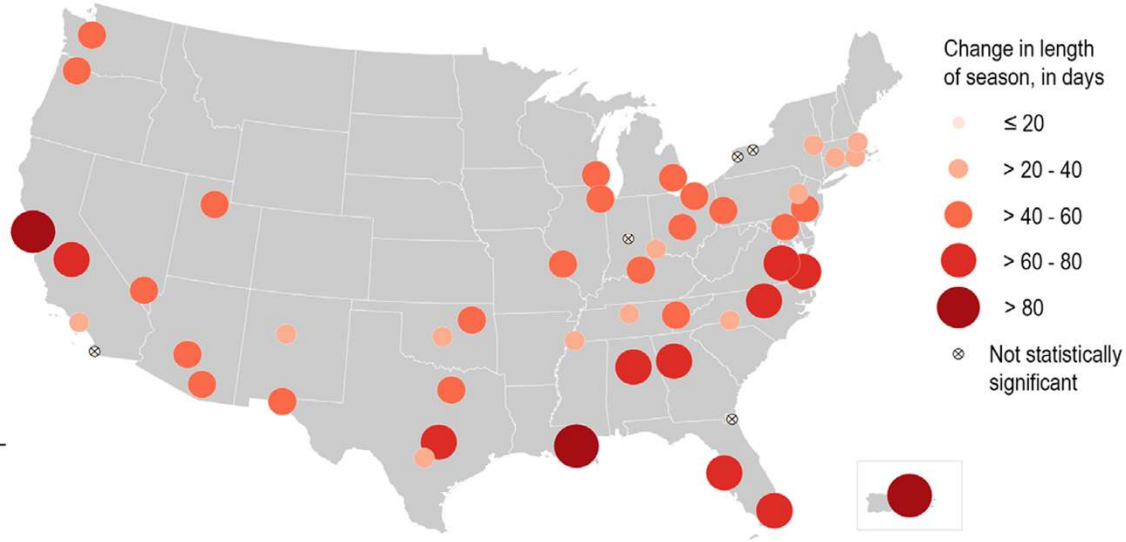
Heat Wave Frequency





Heat Wave Season Length





US Global Change Research Program, GlobalChange.Gov

DE GRUYTER Rev Environ Health 2015; 30(1): 51–64

Tania Busch Isaksen*, Michael G. Yost, Elizabeth K. Hom, You Ren, Hilary Lyons and Richard A. Fenske

Increased hospital admissions associated with extreme-heat exposure in King County, Washington, 1990–2010

Abstract: Increased morbidity and mortality have been associated with extreme heat events, particularly in tem-

risk for nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmo-

*"…heat, expressed as humidex, is associated with **increased hospital admissions**. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant risk for **nephritis and nephrotic syndromes, acute renal failure, natural heat exposure, chronic obstructive pulmonary disease, and asthma hospitalizations**"*

admissions per degree increase in humidex above 37.4°C. Admissions stratified by cause and age produced statistically significant results with both relative risk and time series analyses for nephritis and nephrotic syndromes, acute renal failure, and natural heat exposure hospitalizations. This study demonstrates that heat, expressed as humidex, is associated with increased hospital admissions. When stratified by age and cause of admission, the non-elderly age groups (<85 years) experience significant

that higher temperatures, or other indices of the physiologic effect of heat and humidity, are associated with increased mortality (2–8). Research focused on hospitalization and emergency room visits also found an increased risk associated with increasing temperatures (9–13). Studies conducted in the US have shown an increased risk of hospitalization for diverse conditions like heat stroke or heat exhaustion (12), acute renal failure (14), diabetes (15), respiratory (16), and cardiovascular diseases (17, 18).

Intensity and duration of heat events modify the heat's effect on mortality (4, 8) and morbidity (14). Socio-demo-

Rev Environ Health 2015; 30(1): 51–64

Int J Biometeorol
DOI 10.1007/s00484-015-1007-9

ORIGINAL PAPER

Increased mortality associated with extreme-heat exposure in King County, Washington, 1980–2010

Tania Busch Isaksen[1] · Richard A. Fenske[1] · Elizabeth K. Hom[1,2] · You Ren[3] · Hilary Lyons[3] · Michael G. Yost[1]

*These results demonstrate that heat, expressed as humidex, is associated with **increased mortality on heat days**, and that risk increases with heat's intensity*

mortality, particularly in temperate climates. Few epidemiologic studies have considered the Pacific Northwest region in their analyses. This study quantified the historical (May to September, 1980–2010) heat-mortality relationship in the most populous Pacific Northwest County, King County, Washington. A relative risk (RR) analysis was used to explore the relationship between heat and all-cause mortality on 99th percentile heat days, while a time series analysis, using a piece-wise linear model fit, was used to estimate the effect of heat intensity on mortality, adjusted for temporal trends. For all ages, all causes, we found a 10 % (1.10 (95 % confidence interval (CI), 1.06, 1.14)) increase in the risk of death on a heat day versus non-heat day. When considering the intensity effect of heat on all-cause mortality, we found a 1.69 % (95 % CI, 0.69, 2.70) increase in the risk of death per unit of humidex above 36.0 °C. Mortality stratified by cause and age produced statistically significant results using both types of analyses for: all-cause, non-traumatic, circulatory, cardiovascular, cerebrovascular, and diabetes causes of death. All-cause mortality was statistically significantly modified by the type of synoptic weather type. These results demonstrate that heat, expressed as humidex, is associated with increased mortality on heat days, and that risk increases with heat's intensity. to modify mortality risks, statistically significant increases in diabetes-related mortality for the 45–64 age group suggests that underlying health status may contribute to these risks.

Keywords Climate change · Extreme heat · Mortality · Washington State

Introduction

Extreme-heat events have contributed to thousands of deaths in the USA, Canada, and Europe since the early 1980s (Anderson and Bell 2009, 2011; Jackson et al. 2010; Baccini et al. 2008; Basu et al. 2008; Naughton 2002; Whitman et al. 1997). V-, U-, or J-shaped relationships have been identified where there is a minimum mortality temperature (also called "threshold" or "turning point) beyond which mortality increases significantly with increasing heat (Baccini et al. 2008; Kim et al. 2006; Curriero et al. 2002). Studies have also suggested that the heat-mortality relationship may not be the same in all locations (Baccini et al. 2008; Curriero et al. 2002). Curriero et al. 2002 research demonstrated a stronger association in mortality risk for northern cities in the USA, at lower

The New York Times

25 States Are at Risk of Serious Flooding This Spring, U.S. Forecast Says

Hamburg, Iowa, March, 2019

Nearly two-thirds of the lower 48 states will have an elevated risk of some flooding and 25 states could experience “major or moderate flooding,” according to the NOAA.

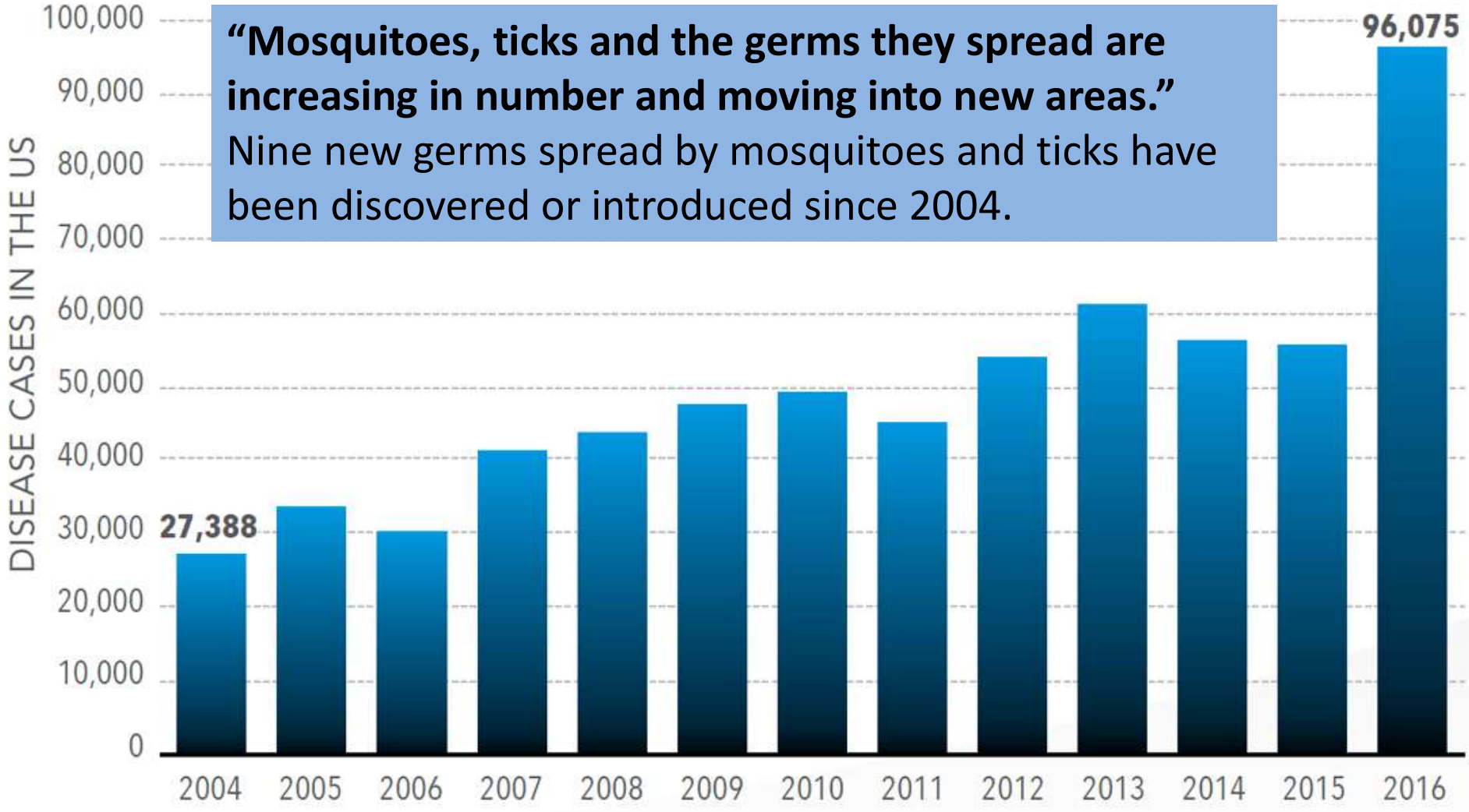
Craig, Missouri, March, 2019

Health Risks of Flooding Stratified by Time After Event

Immediate
Drowning
Trauma
Hypothermia
Electrocution
Carbon monoxide poisoning
Early (<10 d after event)
Cutaneous infection; Tetanus
Aspiration pneumonitis/pneumonia
Viral respiratory infections
Gastroenteritis
Late (>10 d after event)
Leptospirosis
Mosquito-borne illnesses
Cutaneous infection from atypical organisms (fungi, mycobacteria)
Hepatitis A or E virus infection; Vaccine preventable diseases
Mental health disorders, including posttraumatic stress disorder and depression
Management of chronic disease

Paterson. CID; 2018.

Disease cases from infected mosquitoes, ticks, and fleas have tripled in 13 years.



"Mosquitoes, ticks and the germs they spread are increasing in number and moving into new areas."
Nine new germs spread by mosquitoes and ticks have been discovered or introduced since 2004.

CDC

HOUSTON CHRONICLE

HOME LOCAL WEATHER POLITICS GRAY MATTERS US & WORLD TEXAS SPORTS NATION SPORTS BUSINESS OPINION A & E

Typhus, once thought eradicated, continues to spike in Texas

Todd Ackerman | July 24, 2018 | Updated: July 25, 2018 5:41 p.m.

The Texas health department reports 519 cases of typhus in 2017, more than triple the number in 2010. The uptick represents the 4th consecutive year the number has increased.

Outbreak Observatory | Johns Hopkins Bloomberg School of Public Health | Center for Health Security centerforhealthsecurity.org

HOME ABOUT #OUTBREAKTHURSDAY OBSERVAT

PUBLICATIONS CONTACT US SEA

"According to LAC DPH, '"in recent years the average number of reported cases has doubled to nearly 60 cases per year." The county has experienced 63 cases of typhus so far in 2018."

A deadly fungal infection that spreads through dust is on the rise in the southwestern US, and scientists warn the north may be next

Gabby Landsverk Sep 25, 2019, 6:00 AM

Clinical Infectious Diseases

Coccidioidomycosis Acquired in Washington State

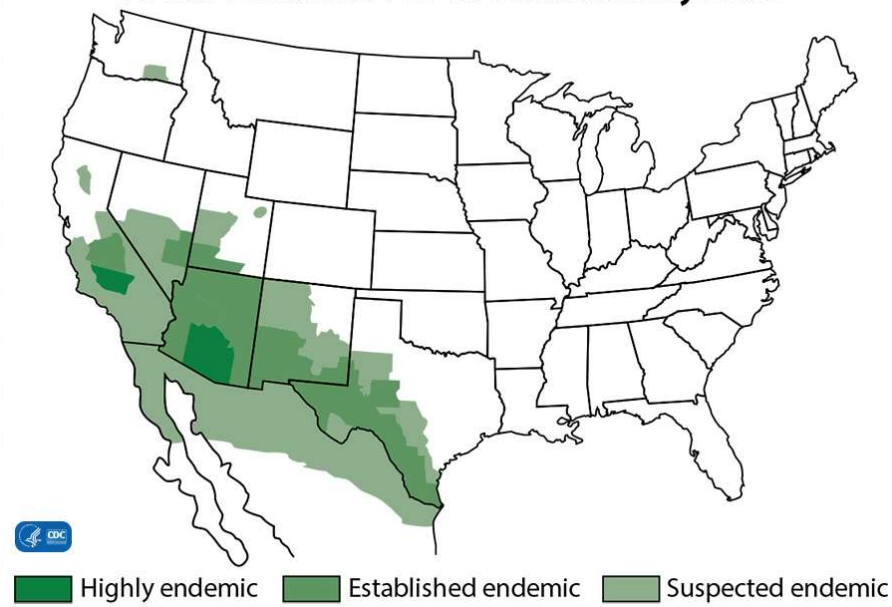
Nicola Marsden-Haug,[1] Marcia Goldoft,[1] Cindy Ralston,[2] Ajit P. Limaye,[4] Jimmy Chua,[3] Heather Hill,[2] Larry Jecha,[2] George R. Thompson III,[5] and Tom Chiller[6]

[1]Office of Communicable Disease Epidemiology, Washington State Department of Health, Shoreline, [2]Communicable Disease Program, Benton-Franklin Health District, and [3]Infectious Diseases Department, Kennewick General Hospital, Kennewick, and [4]Division of Allergy and Infectious Diseases, University of Washington, Seattle, Washington; [5]Coccidioidomycosis Serology Laboratory, University of California, Davis; and [6]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

Clinical, laboratory, and epidemiologic evidence suggest that 3 individuals with acute coccidioidomycosis were exposed in Washington State, significantly beyond previously identified endemic areas. Given the patients' lack of recent travel, coccidioidomycosis was not suspected, leading to delays in diagnosis and appropriate therapy. Clinicians should be aware of this possibility and consider the diagnosis.

Keywords. *Coccidioides*; coccidioidomycosis; endemic fungi; Washington

Areas Endemic for Coccidioidomycosis



Case 1

A 12-year-old boy developed chest pain on 1 June 2010. Outpatient chest radiography (CXR) 2 days later was clear. Three days later, CXR to evaluate worsening chest pain, fever, and difficulty breathing revealed right lower lobe parenchymal infiltrate and pleural effusion. The patient was admitted, prescribed vancomycin and ceftriaxone for pneumonia and azithromycin for erythema multiforme, then discharged 6 days later on oral amoxicillin/clavulanate.

Clinical Infectious Diseases 2013;56(6):847–50

Annals of Internal Medicine

OBSERVATION: CASE REPORT

Vibrio vulnificus Infections From a Previously Nonendemic Area

Background: Vibrio vulnificus is a gram-negative pathogen that lives in brackish, high-salinity waters with surface temperatures above 13 °C. *V vulnificus* wound infections occur through breaks in the skin, and intestinal infections occur after consumption of seafood. Either route can lead to bloodstream infections (1). Mortality from wound and bloodstream infections is high, particularly in patients with immunosuppression and those with cirrhosis or other iron-overload states

Patient 3 was a 46-year-old man with type 2 diabetes, morbid obesity, and left leg lymphedema who presented with progressive left leg erythema, pain, swelling, and blistering lesions 2 days after minor trauma to his leg while crabbing in the Delaware Bay. His left foot was edematous, erythematous, and diffusely tender, and his calf was fluctuant with bullae. He underwent emergent debridement for necrotizing fasciitis, and his large residual wounds required skin and tissue grafting. Operative cultures grew *V vulnificus*.

Patient 4 was a 60-year-old man with Parkinson disease who developed progressively severe right leg swelling and pain that required a fasciotomy. He developed shock, respiratory failure, and disseminated intravascular coagulation. All 4 distal limbs became necrotic and mummified and later re-

Climate change *has resulted in significant increases in sea surface temperatures in many regions of the US over the past 3 decades.*

These changes have resulted in longer summer seasons and are associated with ***alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including Vibrio species.***

cultures grew *V vulnificus*.

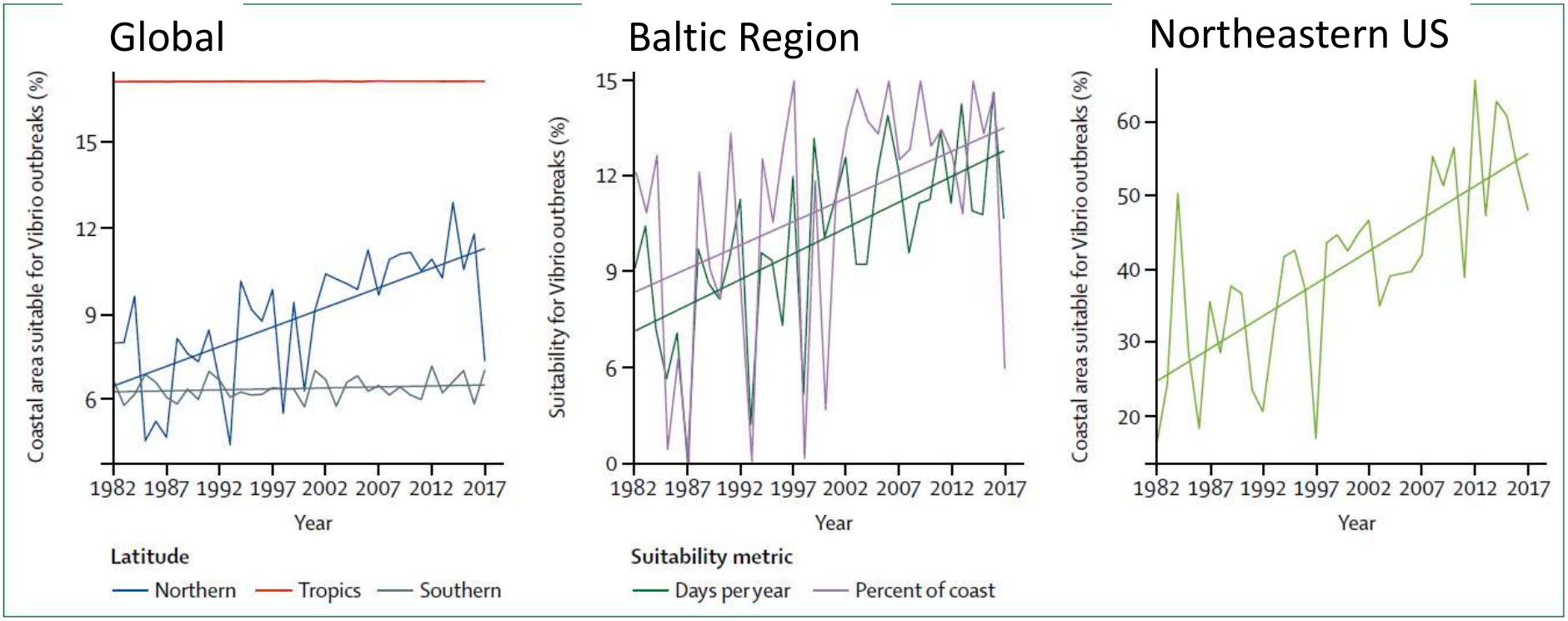
Patient 2 was a 64-year-old man with untreated hepatitis C who presented with rapidly worsening erythema, pain, and swelling of his right hand 2 days after cleaning and eating crabs caught in the Delaware Bay. His hand was severely swollen and erythematous with bullous lesions, and he underwent emergent fasciotomies for right arm compartment syndrome. During the third debridement, he developed unstable ventricular tachycardia and subsequently died. His admission blood cultures grew *V vulnificus*.

and treatment regimens are summarized in the **Table**.

Discussion: Climate change has resulted in significant increases in sea surface temperatures in many regions of the United States over the past 3 decades (3). These changes have resulted in longer summer seasons and are associated with alterations in the quantity, distribution, and seasonal windows of bacteria in marine ecosystems, including *Vibrio* species (3–5). Although reports of *V vulnificus* infections after exposure in the Chesapeake Bay are not uncommon, reports of infections from exposure in the cooler Delaware Bay are rare.

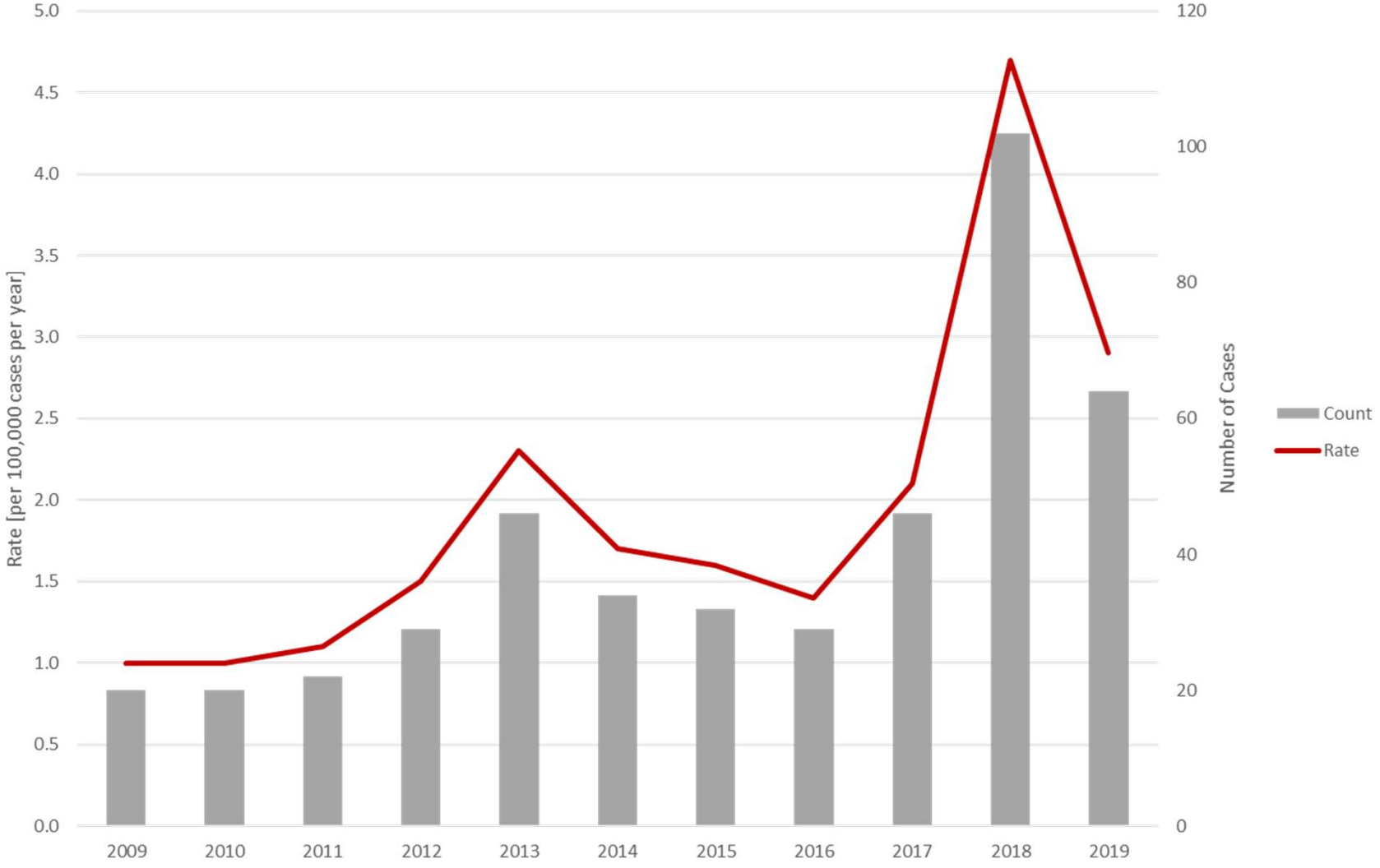
Ann Intern Med. 1 OCT 2019

Change in suitability for pathogenic Vibrio outbreaks as a result of changing sea surface temperatures



The 2018 report of The Lancet Countdown on health and climate change

Vibrio Infections in King County, WA



Climate Change and the US Healthcare Sector

- **Accounts for nearly 1/10th of U.S. GHG emissions** and would rank 7th in GHG emissions internationally if it were its own country.
- **Ranked 2nd in energy use after the food industry**; spends about $9 billion annually on energy costs.
- **Hospitals in the US produce a massive amount of waste** (>2.3 million tons per year).
- **The health care system (particularly hospitals) must adopt policies to reduce GHG emissions** and prepare for the inevitable effects of climate change.
- By increasing energy efficiency and using renewable energy sources, the EPA estimates that **30% of the health care sector's energy use could be reduced without compromising care quali**ty.

ACP Position Paper: Climate and Health; 2016.
Solomon. N Engl J Med 2019; 380:209-211

World Health Organization

Between 2030 and 2050, **climate change is expected to cause approximately 250,000 additional deaths per year**, from malnutrition, malaria, diarrhea and heat stress.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health.

Ten threats to global health in 2019

Forty years ago, scientists from 50 nations met at the First World Climate Conference in Geneva and agreed that alarming trends for climate change made it urgently necessary to act.

Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as scores of other global assemblies and scientists' explicit warnings of insufficient progress (Ripple et al. 2017).

Yet greenhouse gas (GHG) emissions are still rapidly rising.

OXFORD ACADEMIC

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BioScience

American Institute of Biological Sciences

Viewpoint

World Scientists' Warning of a Climate Emergency

05 November 2019

WILLIAM J. RIPPLE, CHRISTOPHER WOLF, THOMAS M. NEWSOME, PHOEBE BARNARD, WILLIAM R. MOOMAW, AND 11,258 SCIENTIST SIGNATORIES FROM 153 COUNTRIES (LIST IN SUPPLEMENTAL FILE S1)

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like

as actual climatic impacts (figure 2). We use only relevant data sets that are clear, understandable, systematically

forest loss in Brazil's Amazon has now started to increase again (figure 1g). Consumption of solar and wind energy

Scientists have a moral obligation to clearly warn humanity of any catastrophic threat and to "tell it like it is." On the basis of this obligation…we declare, with more than 11,000 scientist signatories from around the world, clearly and unequivocally that planet Earth is facing a climate emergency.

and agreed that alarming trends for climate change made it urgently necessary to act. Since then, similar alarms have been made through the 1992 Rio Summit, the 1997 Kyoto Protocol, and the 2015 Paris Agreement, as well as

global scale, because there are many climate efforts that involve individual regions and countries. Our vital signs are designed to be useful to the public, policymakers, the business community, and those working

A much higher carbon fee price is needed (IPCC 2018, section 2.5.2.1). Annual fossil fuel subsidies to energy companies have been fluctuating, and because of a recent spike, they were greater than US$400 billion in 2018

Downloaded from https://academic.oup.com/bioscience/advance-article-

BLUEPRINT

FOR ADDRESSING CLIMATE CHANGE AND HEALTH

Public Health
Seattle & King County

GUIDANCE FOR

INTEGRATING HEALTH AND EQUITY INTO CLIMATE CHANGE PLANNING

Climate change is a significant threat to public health. The primary drivers of our changing climate are greenhouse gas emissions from industry, transportation, agriculture and electricity generation. These emissions are causing rising temperatures, sea level rise, ocean acidification and precipitation changes, increasing the potential for more extreme weather events, wildfires, worsening air and water quality, flooding, and agricultural changes. Health effects from these and other climactic changes include respiratory and cardiovascular disease, injuries and premature deaths related to heat events and other extreme weather, more widespread allergy symptoms, changes in the prevalence and geographic distribution of foodborne and waterborne illnesses and vector borne diseases, and threats to food security and mental health.

Health-related Climate Change Impacts

Climate change poses greater risks to communities already impacted by inequities. This includes communities of color, those who speak a language other than English, low-income households, immigrants, and refugees. These populations often reside in areas with higher health risks, such as near heavy industrial pollution, in flood plains, or in heat islands (i.e. urban areas that are significantly warmer than surrounding rural areas due to human activities and infrastructure). Other groups at higher risk of harm from climate change impacts include outdoor workers, children, older adults, pregnant women, those with chronic health conditions, and those experiencing homelessness.

Centering equity in our climate change work is critical to producing better health outcomes and strengthening community resilience to climate change. We also need to prioritize low-carbon strategies that benefit public health, such as active transportation, multi-use development, and green building.

Public Health
Seattle & King County

CLIMATE RESILIENCE BUILDS COMMUNITY RESILIENCE

RESILIENT COMMUNITIES...

ensure an appropriate response to stressful events

and create and sustain conditions necessary for optimal health and well-being for all residents.

ONE OF THE MOST CRUCIAL COMMUNITY RESILIENCE STRATEGIES IS

to promote equity and improve the health outcomes for those who are disproportionately impacted by climate change.

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

1 - Build climate and health knowledge and messaging

2 - Increase capacity for assessment, surveillance and research to inform public health action and emergency response

3 - Engage with community partnerships and capacity building

4 - Integrate climate and health into policy and planning

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

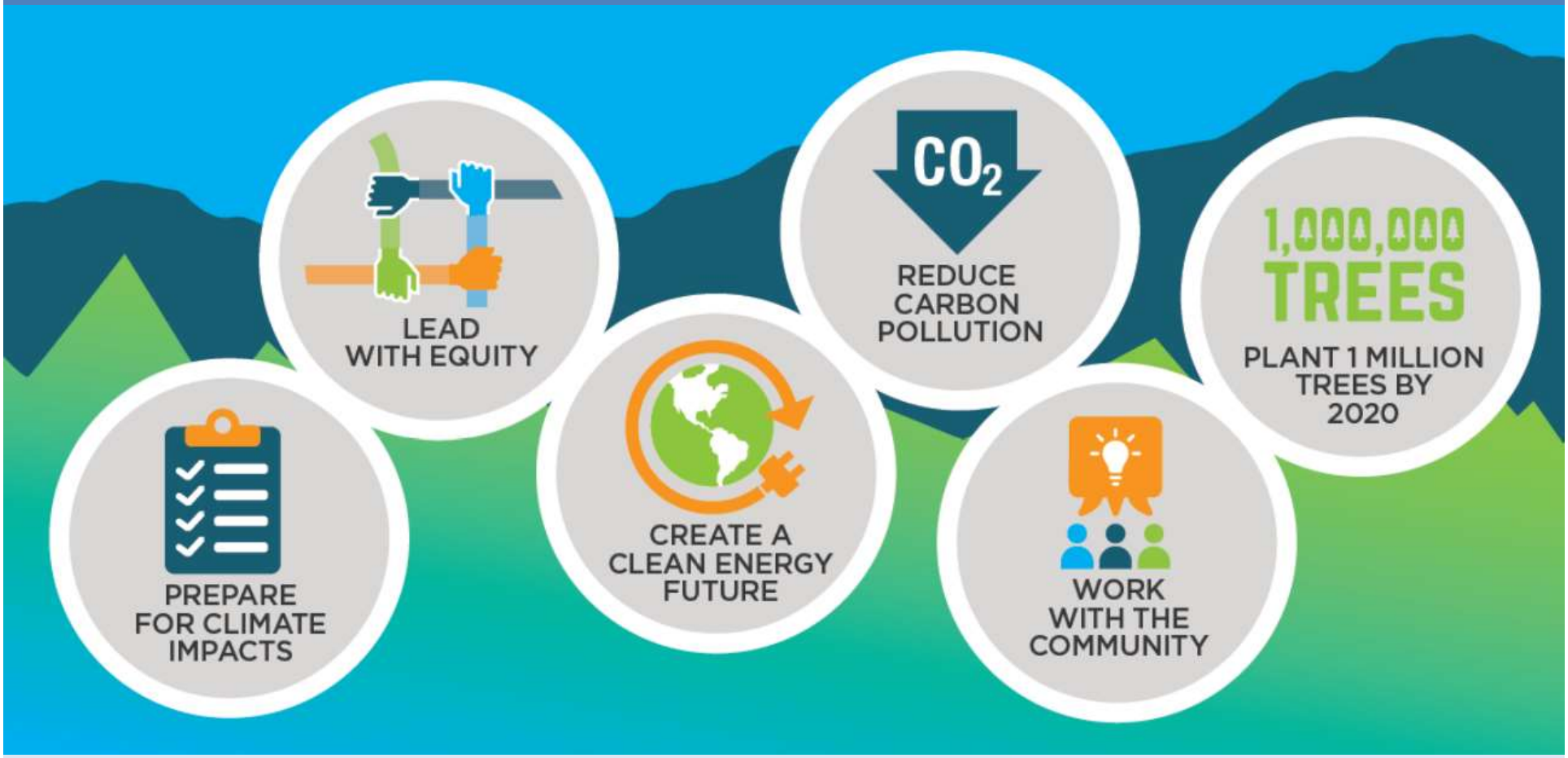
- Build climate & health literacy and integrate climate & health actions into Public Health & King County programs
- Disseminate and exchange climate & health information with communities and partners
- Develop data indicators and surveillance systems to monitor climate-related health impacts and inform timely public health actions
- Engage with communities on climate & health planning - assess vulnerabilities and needs to develop ways to support and help strengthen community assets and capacities
- Build capacity to effectively anticipate, prepare for and respond to emerging climate-related health emergencies

Prioritized Public Health actions per the *Blueprint for Addressing Climate Change and Health*

- Collaborate with partners on research opportunities for climate, health and equity
- Pursue funding to support community-led education, coalition building and community-based actions
- Implement coordinated, community resilience-related strategies in our community capacity-building initiatives
- Integrate climate and health considerations into transportation & land use planning efforts
- Provide health and equity information for climate change planning efforts and climate-related policy & legislative decision-making

Questions?

2020 King County Strategic Climate Action Plan Update

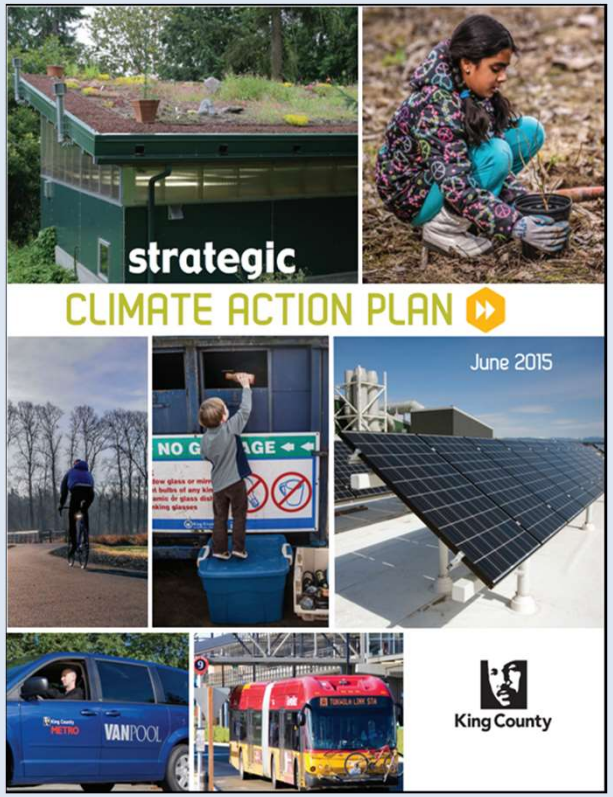


King County

CLIMATE ACTION

Clean Future. Strong Communities.

King County Strategic Climate Action Plan



2015 SCAP

SECTION 1: Reducing Emissions

- Transportation & Land Use
- Buildings & Facilities Energy
- Green Building
- Consumption & Materials Management
- Forests and Agriculture

SECTION 2: Preparing for Impacts

ork at two scales:

Community

Government Operations

King County-Cities Climate Collaboration

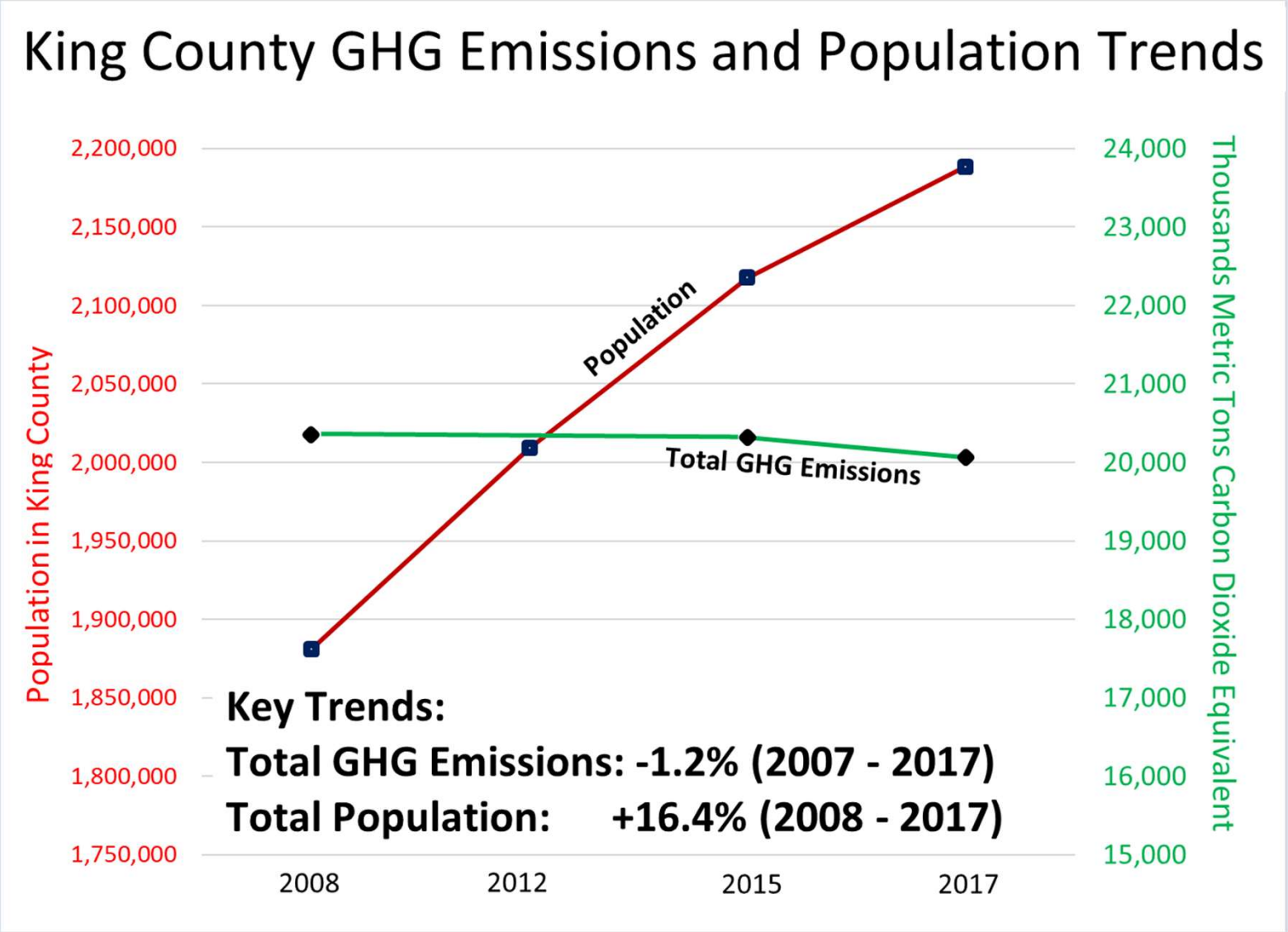
Results: Reducing Greenhouse Gas Emissions

- Achieving Energy Efficiency and Green Building Goals
- Green Direct and State Legislation
- Battery Buses
- Focusing Growth
- One Million Trees
- Land Conservation Initiative

Results: Climate Preparedness

- Evaluated how heavier rain events affect flooding and stormwater in King County
- Developed our first Climate Change and Public Health blueprint for action
- Launched the Puget Sound Climate Preparedness Collaborative
- Now strengthening land use codes to address sea level rise

Countywide Emissions Trends



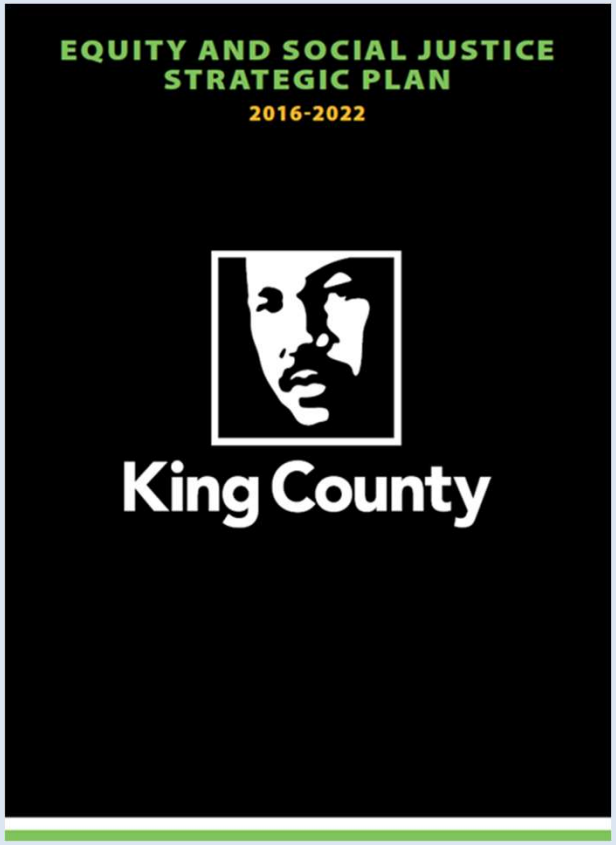
How do we create healthy, resilient communities as our population grows?

REGIONAL TRAILS IN KING COUNTY

King County
PARKS
Your Big Backyard

How will we make plan stronger?

- ✓ Update technical analysis: Where do we have the most impact and influence?
- ✓ Update shared action commitments with cities; create tools to support city action
- ✓ Integrate and prioritize equity throughout the process, plan, implementation and outcomes



2020 King County Strategic Climate Action Plan Update

2020 SCAP

Emissions Reduction

- Transportation
- Energy
- Green Building
- Waste reduction/recycling
- Forests and Agriculture

Sustainable & Resilient Communities (NEW!)

- Intersectional Issues: health, employment, housing, food
- Community driven goals & priorities
- Climate Equity Frontline Communities Task Force

Preparing for Climate Impacts

Flooding
Sea Level Rise
Salmon
Capital Projects
Wildfire
Stormwater
Public Health
Many Others…

2020 King County Strategic Climate Action Plan Update

Stakeholder Engagement & Topic Based Convenings

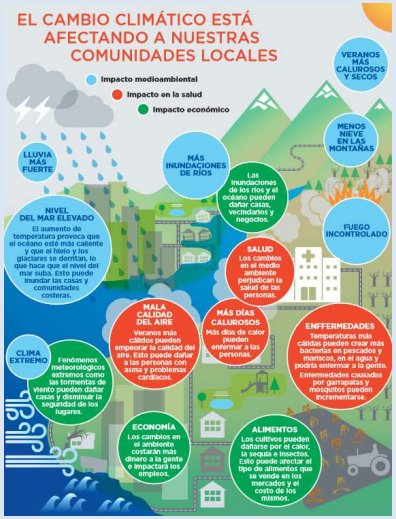
Community Presentations & Workshops

Working with Partners, Stakeholders and Communities

Climate & Equity Community Task Force

Collaborative Workshops

Communicating Climate Change



PUGET SOUND Climate Preparedness Collaborative

KING COUNTY-Cities CLIMATE COLLABORATION

2020 SCAP: Sustainable & Resilient Communities

Climate & Equity Community Task Force

- Group of community leaders who represent frontline communities that are disproportionately impacted by climate change
- Shaping policy anchored in community needs and knowledge, supported by long-term community partnerships
- Prioritizing strategies that make connections between issues, have co-benefits, and recognize intersectionality and historical inequities
- 26 people from 17 affiliated organizations/communities have participated in CECT meetings

Climate & Health Panel

Climate & Equity Community Task Force Members

- Nancy Huizar & Vera Hoang,

  Got Green
- Nourah Yonous,

  African Women's Business Alliance
- Niesha Fort-Brooks,

  Healthy King County Coalition – Built Environment Workgroup; Open Space Equity Cabinet; Metro Mobility Cabinet
- Sameth Mell,

  CIRCC; Cambodian American Community Council

Questions?