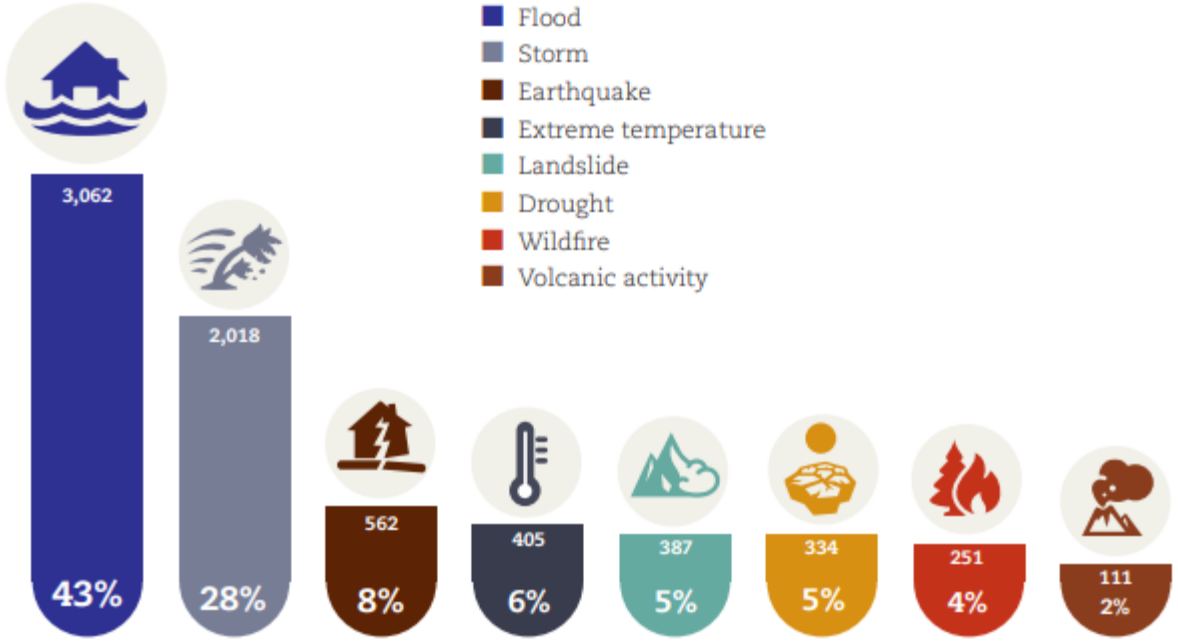
How Will Climate Change Impact Human Health?

Peter Sousounis, PhD

Overview of Weather-Related Health Impacts

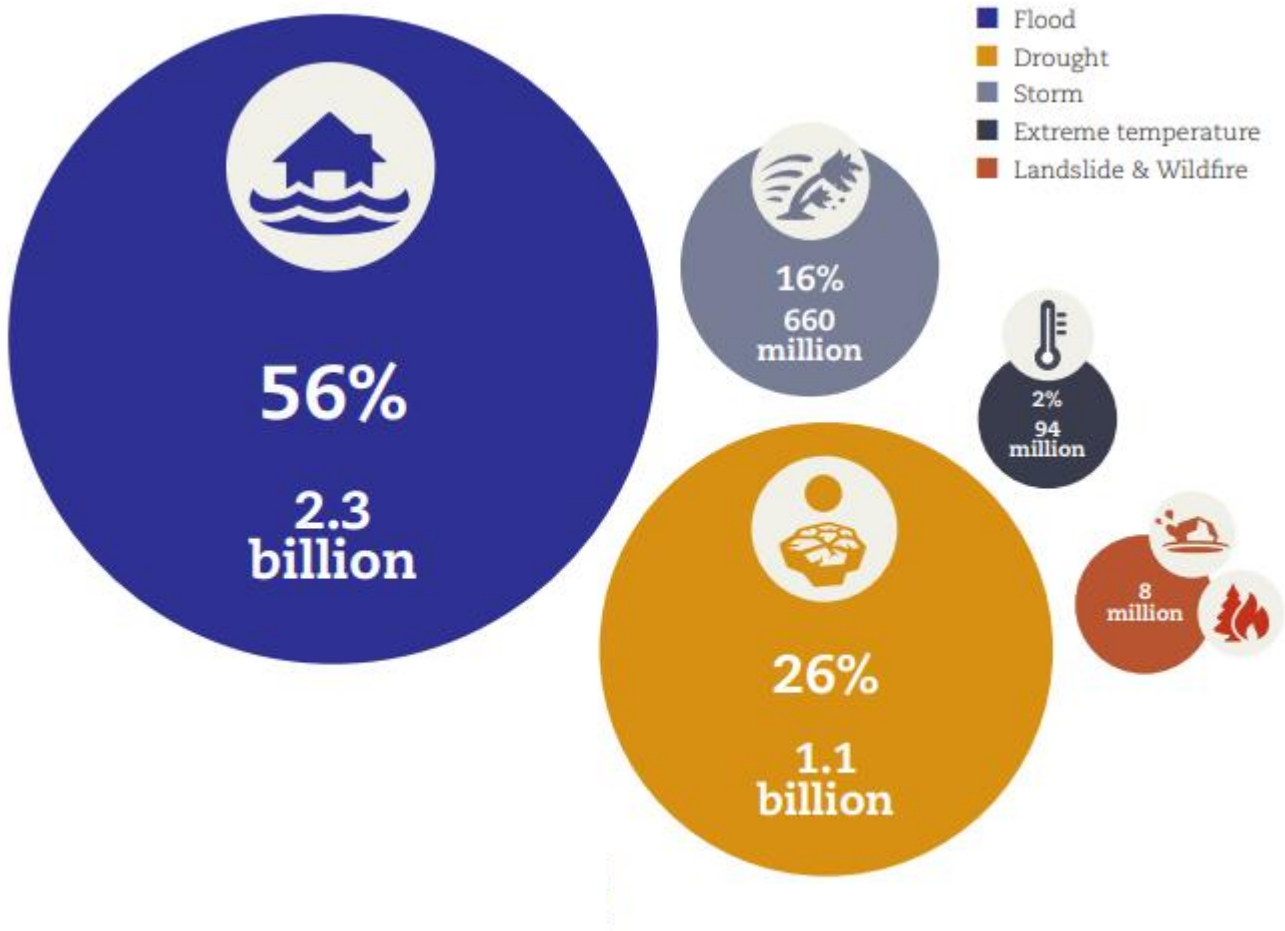
Percent occurrence of natural disaster by disaster type (1995-2015)



The Human Cost of Weather-Related Disasters 1995-2015 | 11

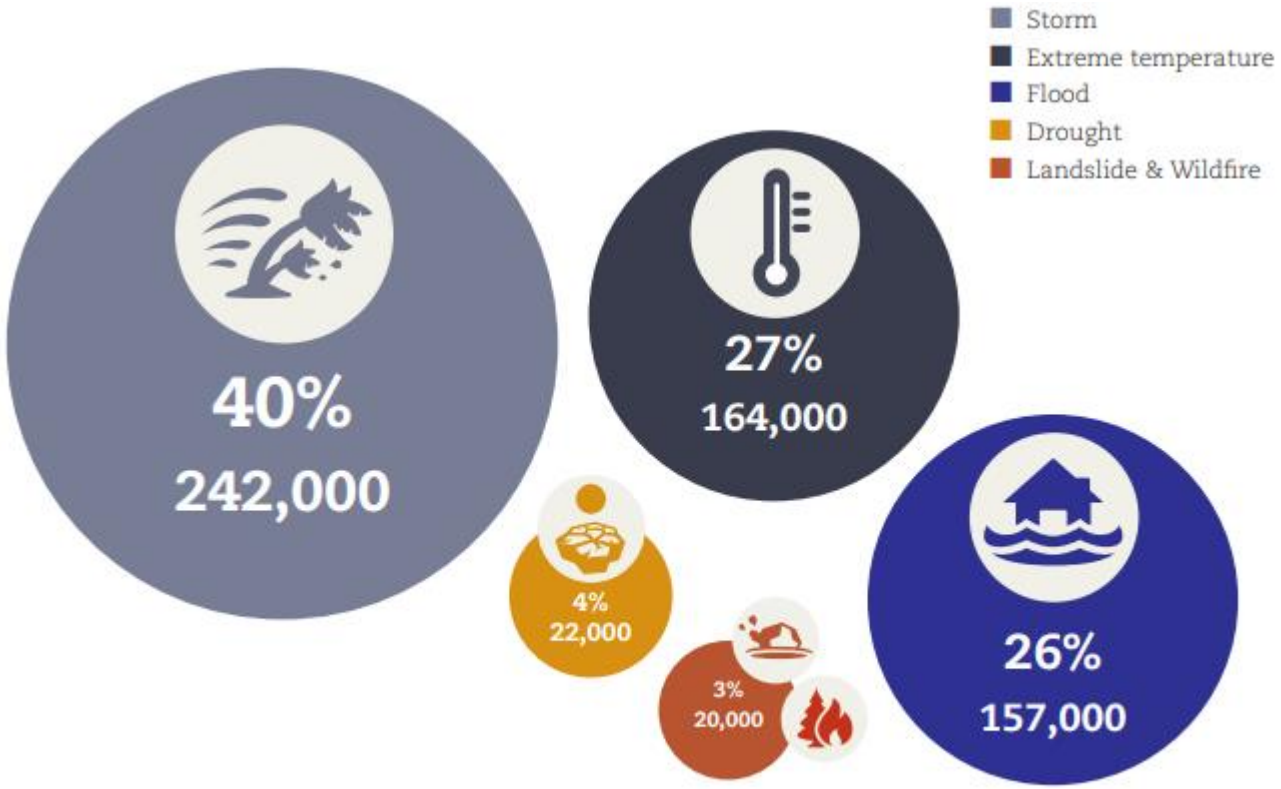
Overview of Weather-Related Health Impacts

Number of people affected by weather related disasters (1995-2015)



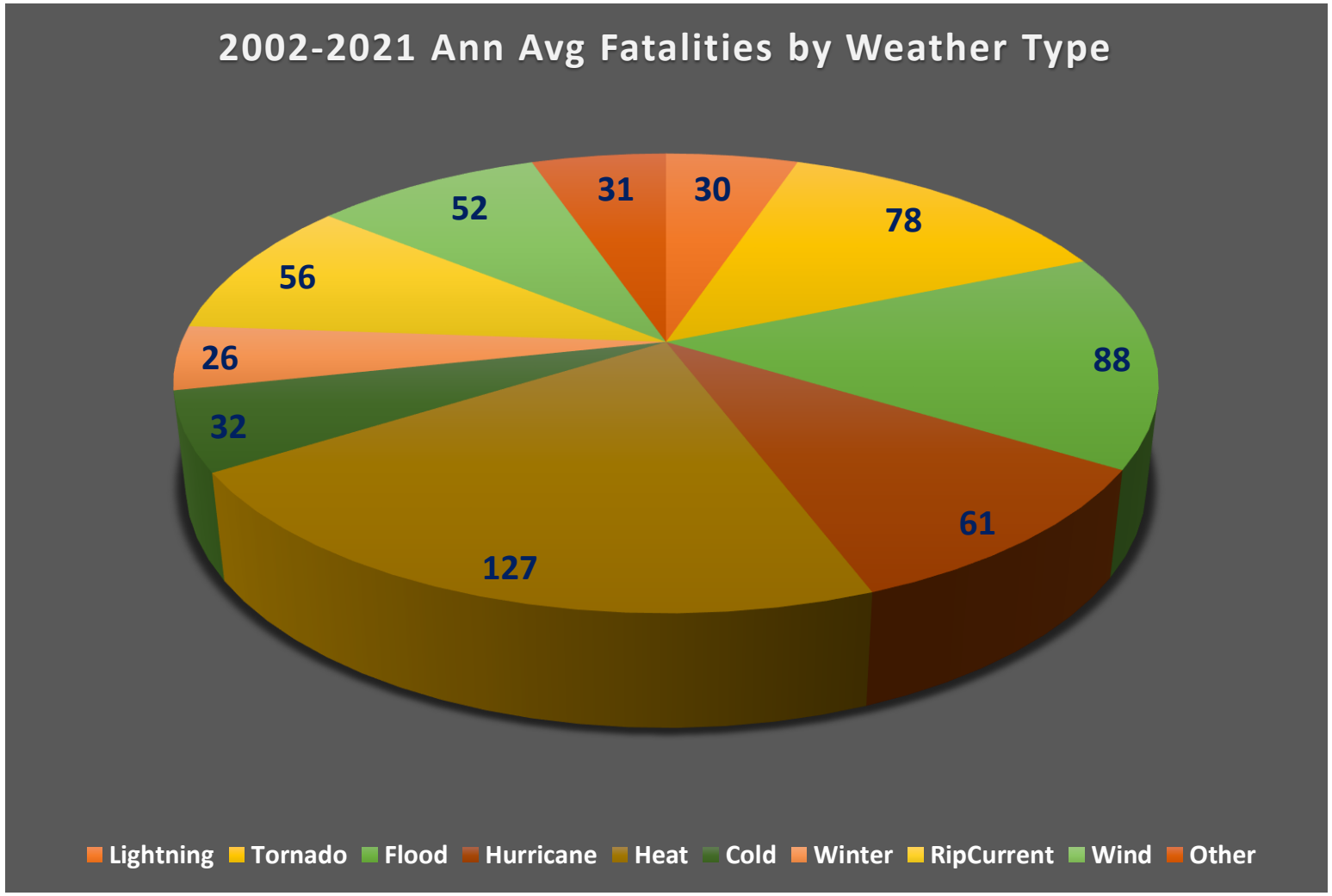
Overview of Weather-Related Health Impacts

Number of people killed by disaster type (1995-2015)



14 | The Human Cost of Weather-Related Disasters 1995-2015

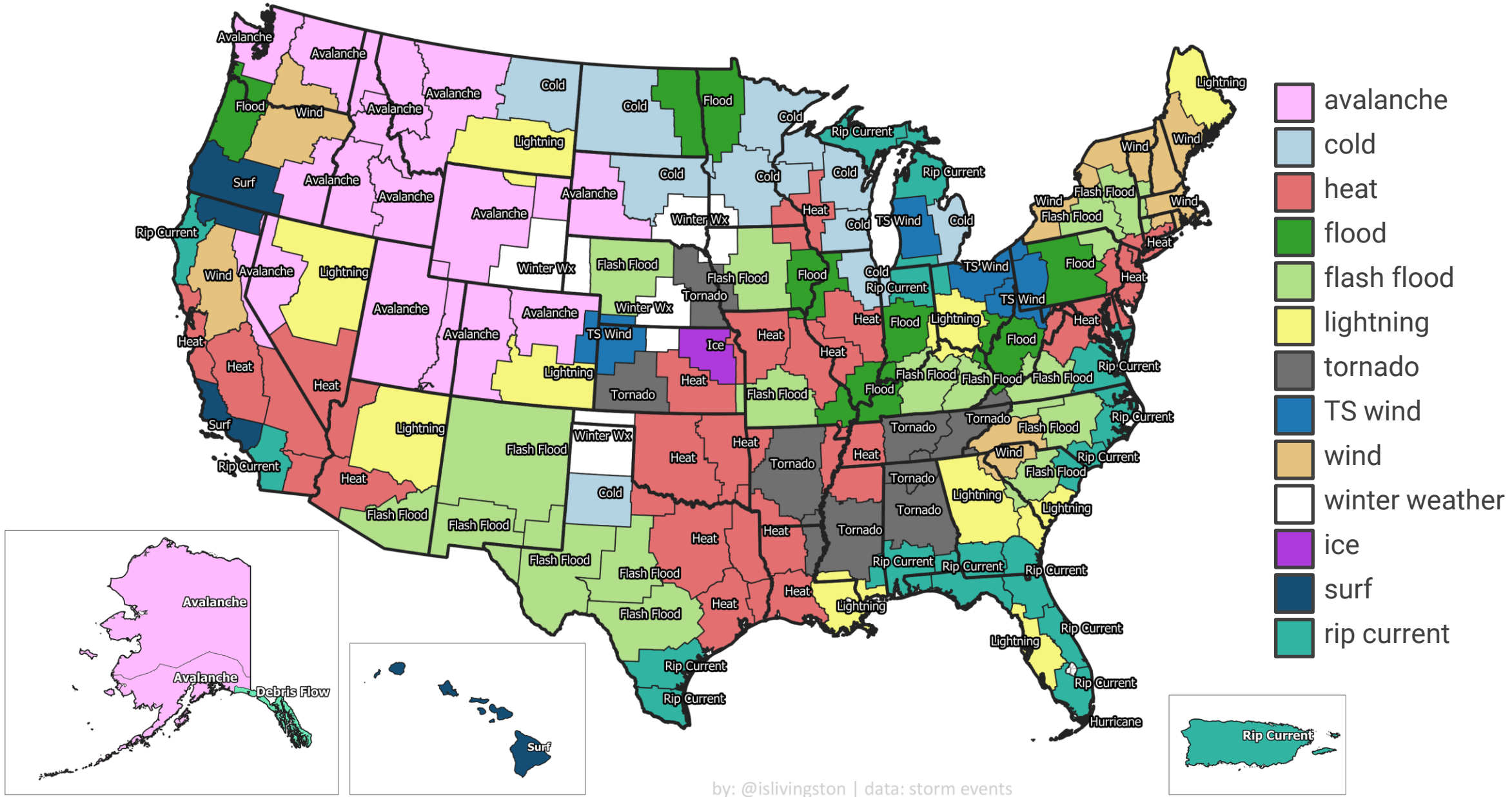
Stats Are Further Broken Down By Wx Type



Statistics compiled from information contained in Storm Data, a database comprising information from NWS forecast offices in the 50 states, Puerto Rico, Guam, and the Virgin Islands.

Most frequent cause of weather fatalities (1999-2018)

Ranked by number of reported incidents in NWS County Warning Areas. Not necessarily the cumulative deadliest.



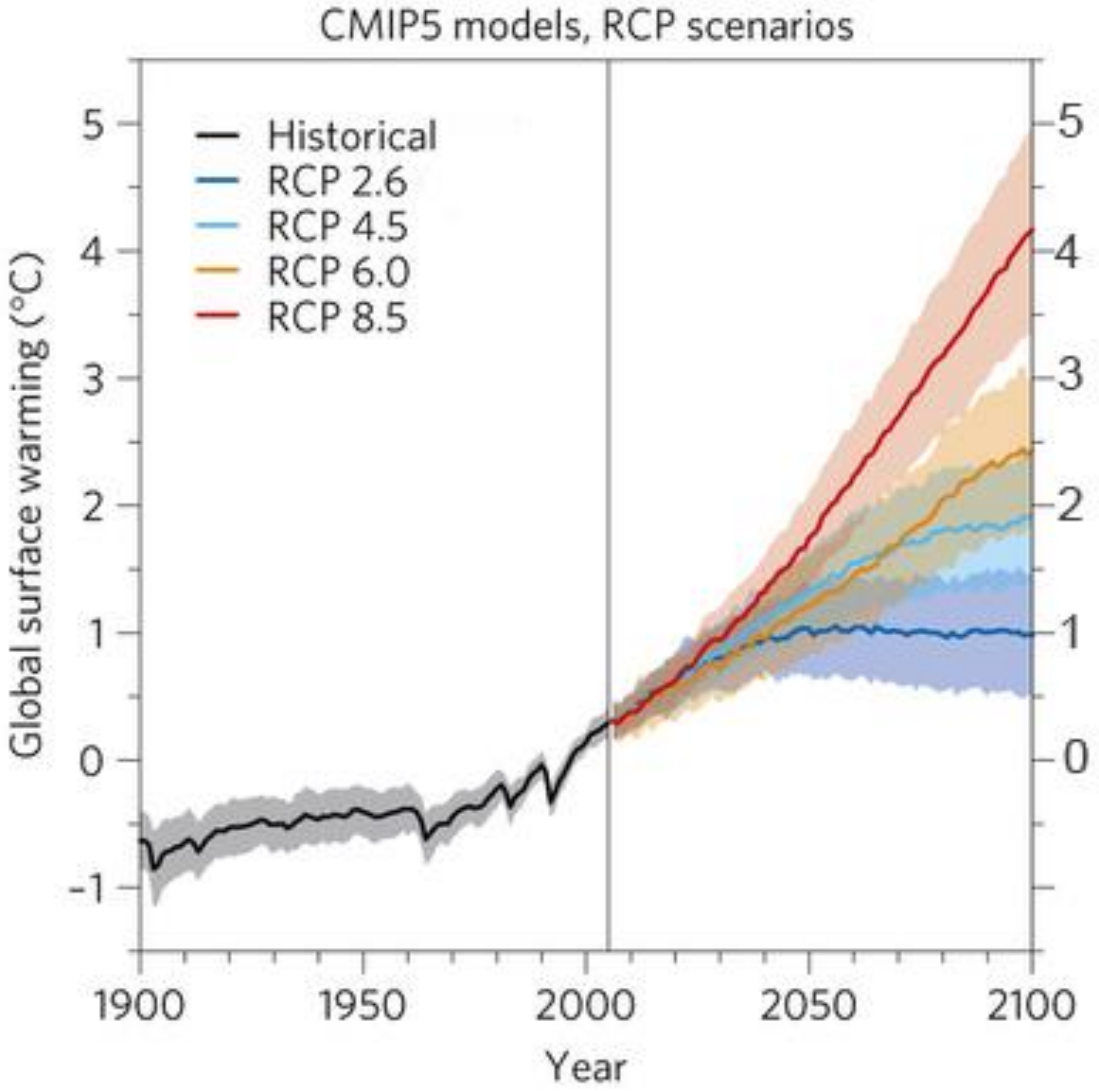
by: @islivingston | data: storm events

Agenda

- Temperature: The Obvious and Not So Obvious
- Impacts from Other Extreme Weather
- Indirect Climate Change Effects on Health
- Summarizing the Health Impacts

Temperature: The Obvious and the Not So Obvious

Climate Scenarios

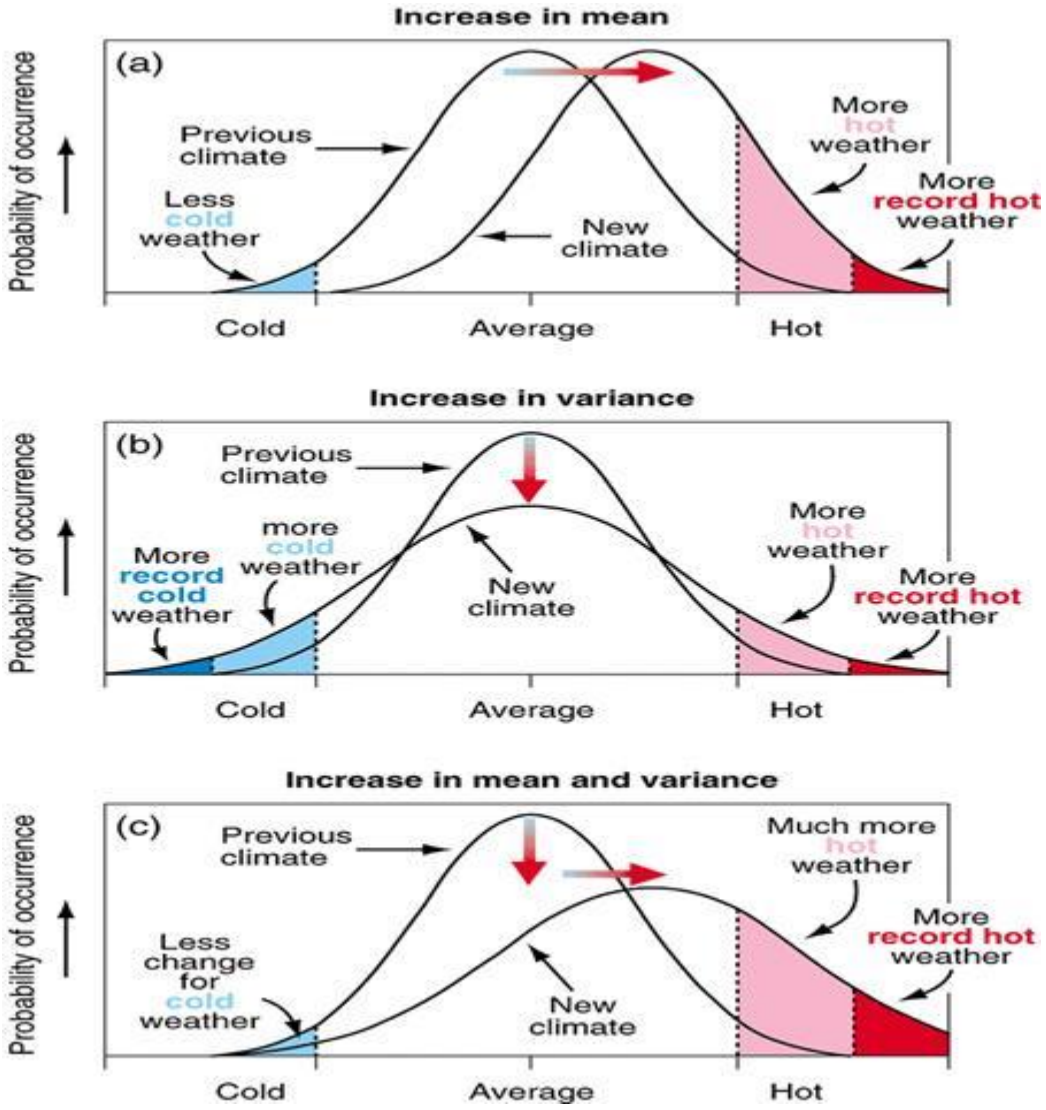


Earth's climate has already warmed 1.1 C from pre-industrial times (mid-1800's)

Further warming depends on how we curb our use fossil fuels and other activities that contribute to (other) greenhouse gasses

We are likely to reach/exceed 2 C by later this century

A Small Change in the Mean Can Be Very Significant

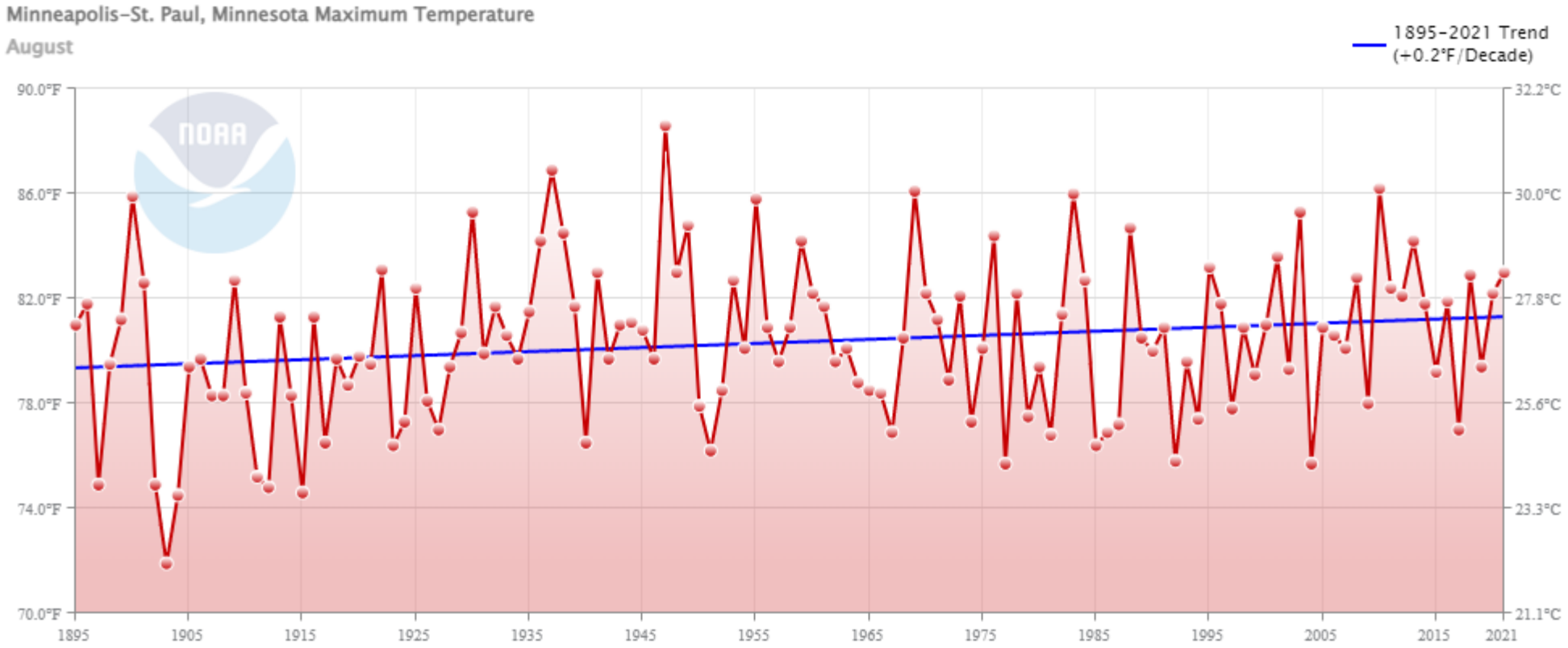


- Assuming a normal distribution of some weather variable (temperature)…
- A shift of 1σ in the mean will increase the likelihood of an extreme event by 7x
- An increase in the variance by 2x does the same
- Climate change can shift the mean and (skew) the variance

The Importance of Minimum Temperature

The most serious health impacts of a heat wave are often associated with high temperatures at night, which is usually the daily minimum. The human body needs to cool off at night, especially after a hot day. If the air stays too warm at night, the body faces extra strain as the heart pumps harder to try to regulate body temperature.

How Have Tmax and Tmin Changed in Places?



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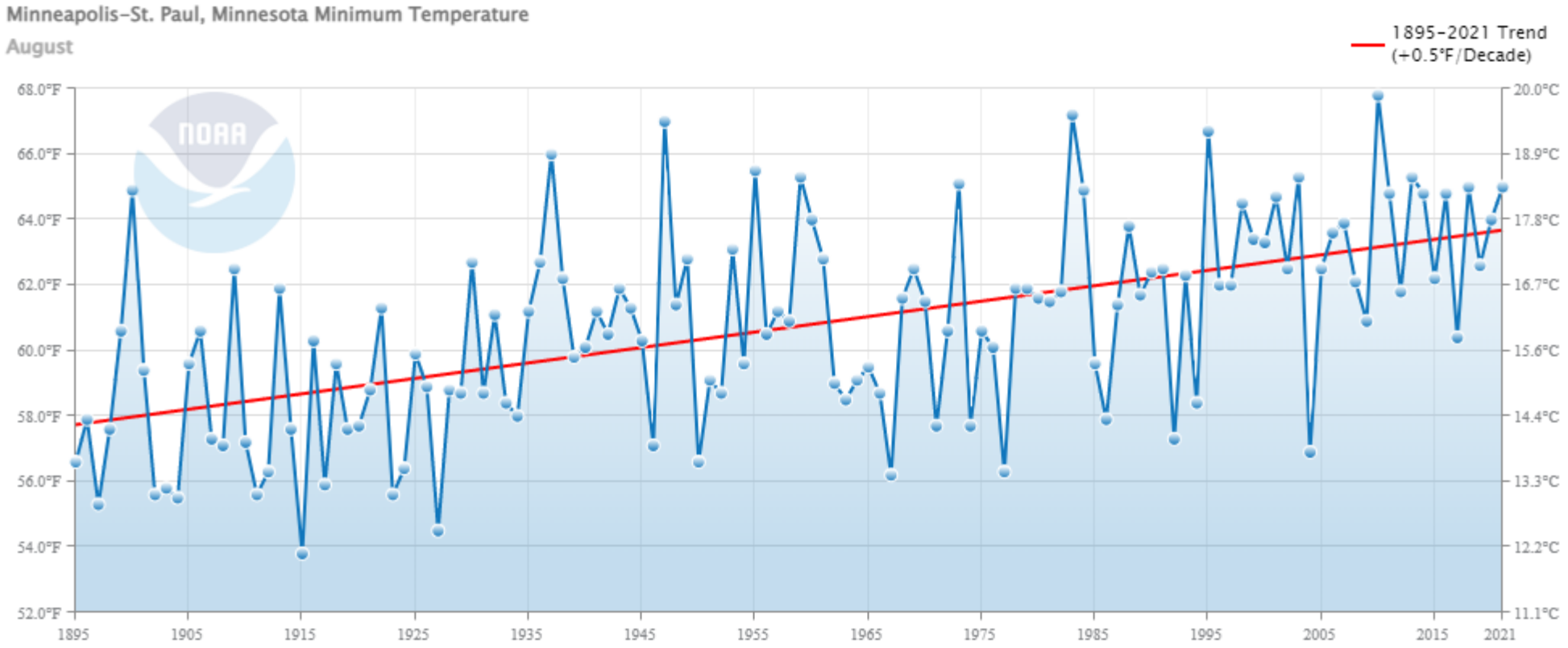
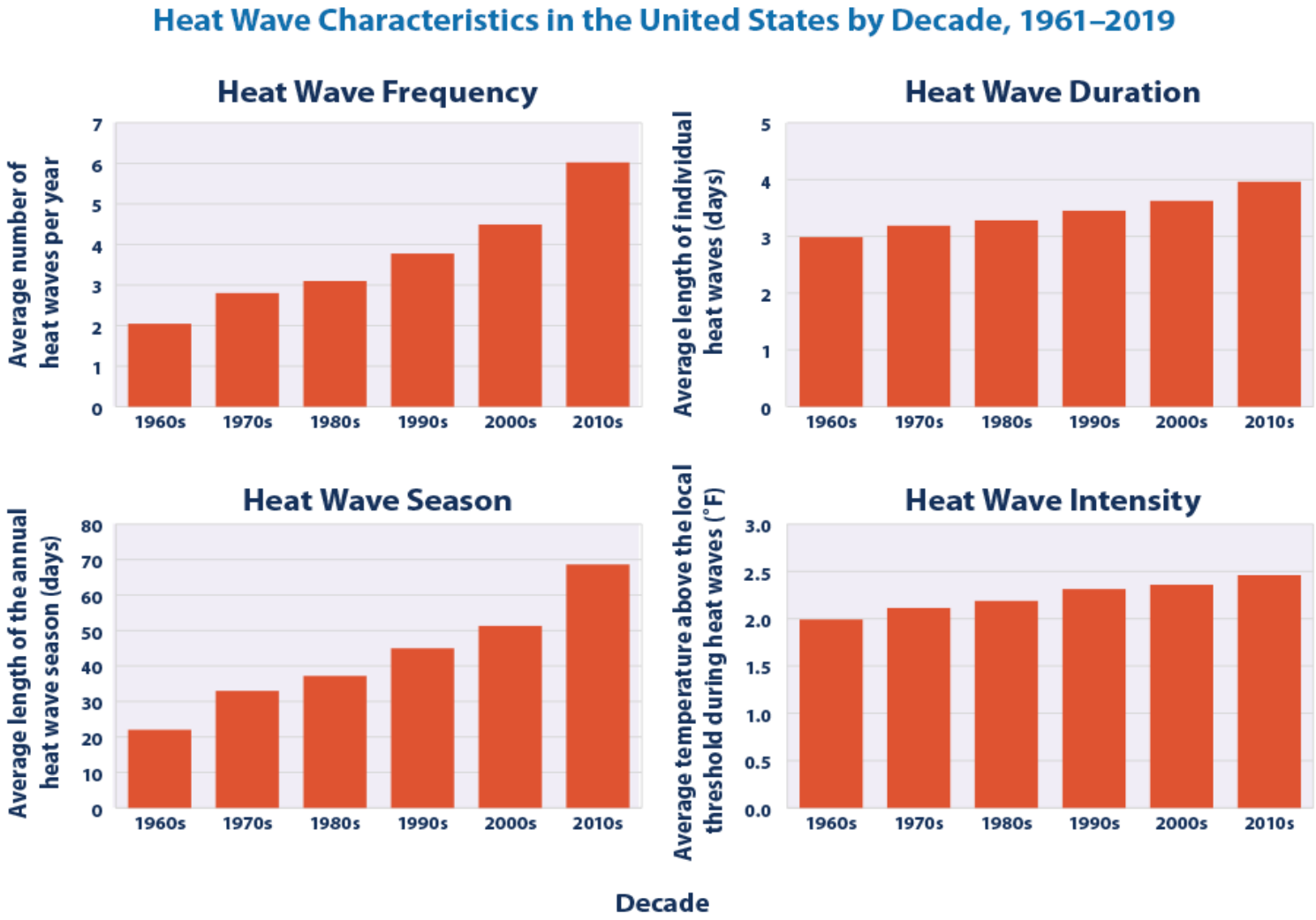


Heat Waves Have Been Increasing



Data source: NOAA (National Oceanic and Atmospheric Administration). 2021. Heat stress datasets and documentation. Accessed February 2021. www.ncdc.noaa.gov/societal-impacts/heat-stress/data.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

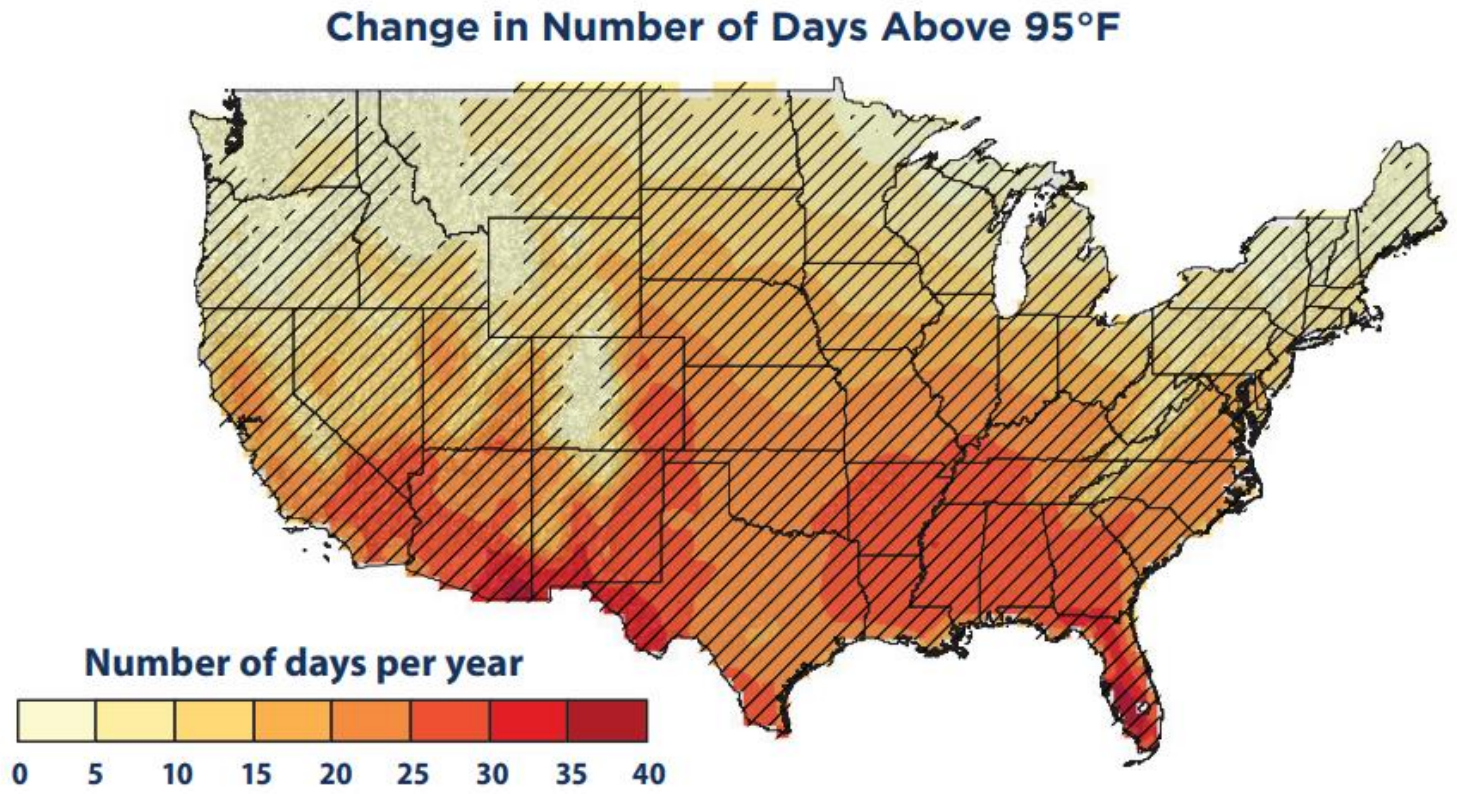
Extreme Heat Events Will Likely Increase

Extreme Heat Events Will...

These maps compare the differences in extreme heat between the recent past (1980–2000) and the mid-21st century (2041–2070) in a projected scenario with high greenhouse gas emissions. Hatched areas indicate confidence that the projected changes are significant and consistent among models. Source: USGCRP, 2016[8]

Become More Common

As climate change continues, there will be more hot days each year. For instance, someone in Tampa, Florida, may experience up to 40 more days a year where the temperature is over 95°F.



https://www.cdc.gov/climateandhealth/pubs/extreme-heat-guidebook.pdf

Extreme Heat Events Will Likely Increase

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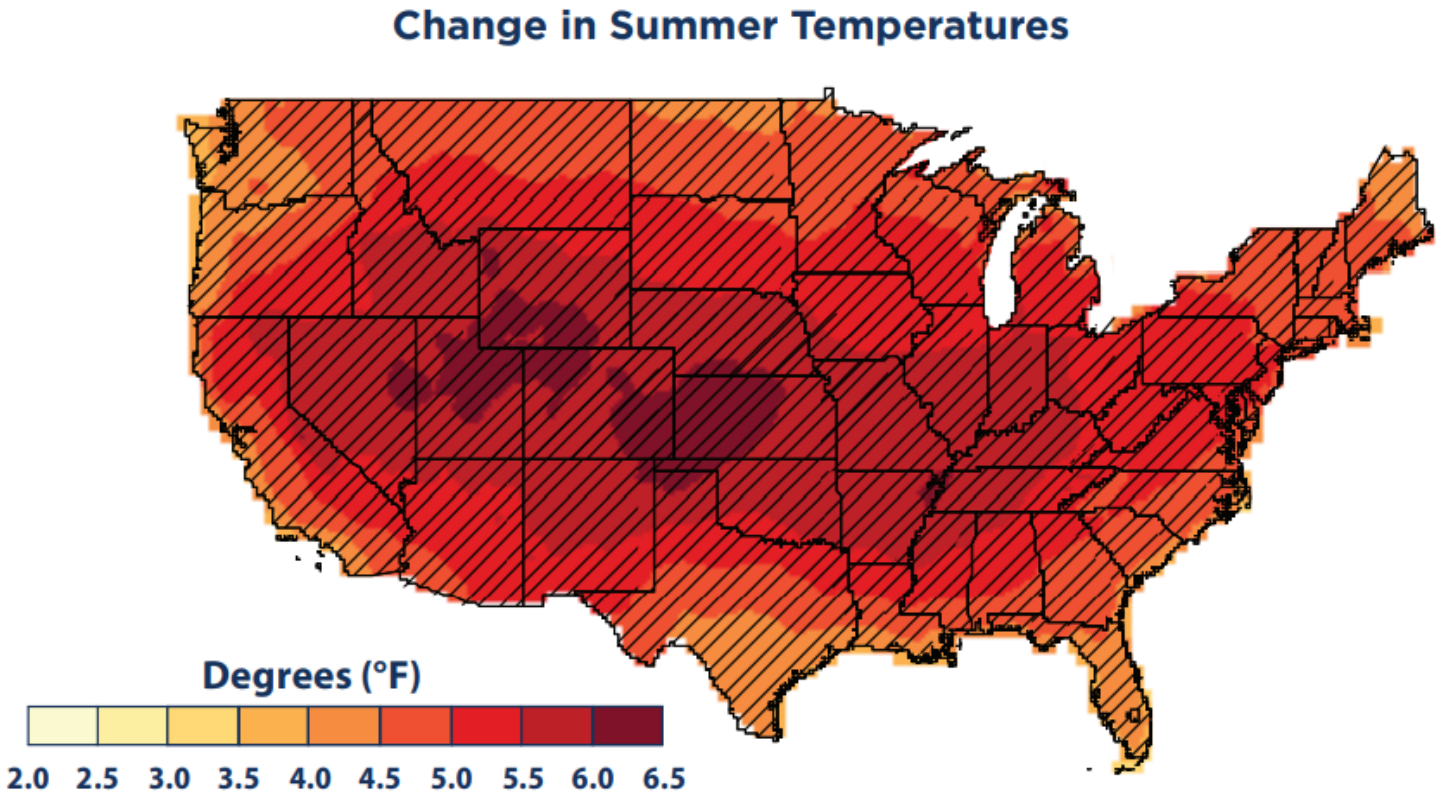
Become More Severe

Rising average summer temperatures will make the hottest days even hotter than they used to be, especially in the central United States. For example, someone in Wichita, Kansas, may experience summers that are 6°F hotter than in the recent past.



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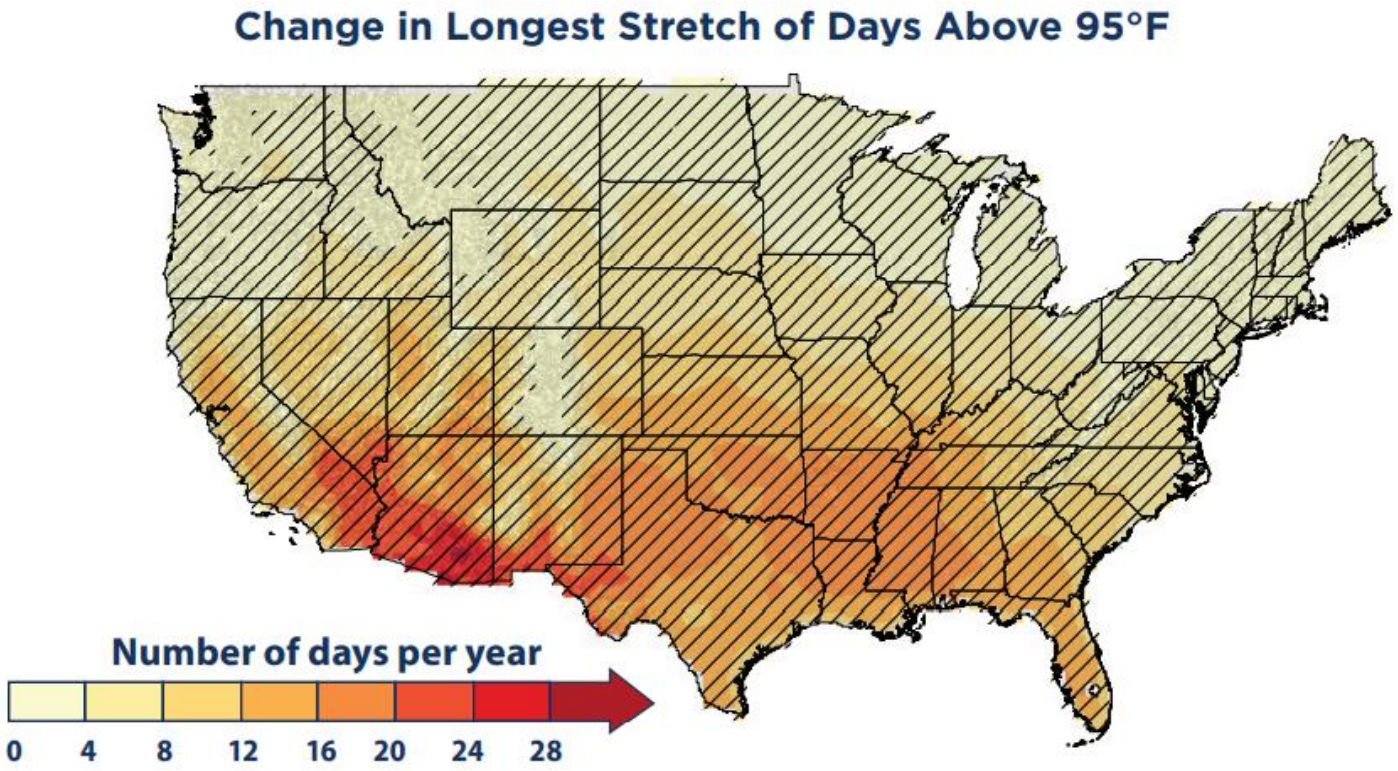
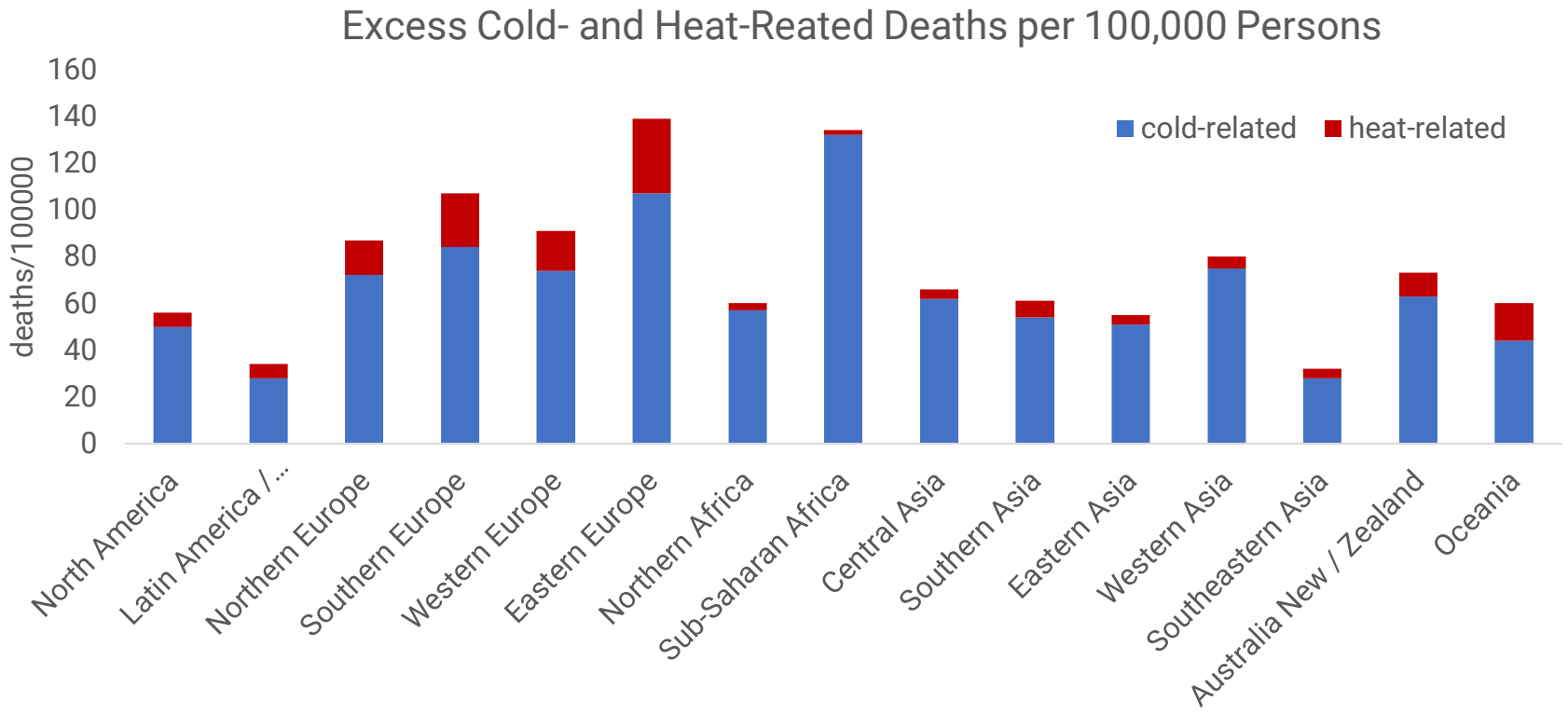
Last Longer

Consecutive days of extreme heat are projected to last even longer in the future. For example, someone in Tucson, Arizona, may experience a stretch of days with temperatures above 95°F that is 28 days longer than the longest stretch of such days in the recent past.



https://www.cdc.gov/climateandhealth/pubs/extreme-heat-guidebook.pdf

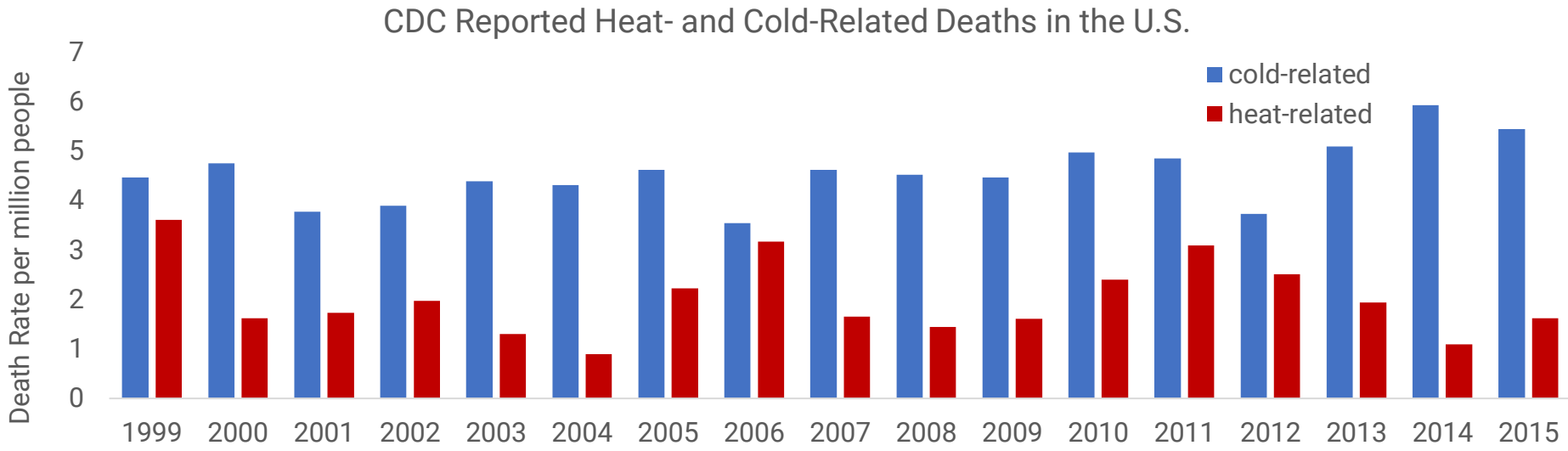
What About the Cold?



from Zhao et al., 2021: Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019: a three-stage modelling study, *The Lancet*, **5**, e415-425.

- 9.43% of all deaths worldwide associated with non-optimal temperatures
- Approximately 90% of non-optimal temperature deaths associated with cold
- Only polar/alpine regions had higher Heat-related death rate than Cold-related
- Heat-/Cold-related deaths increased/decreased by 0.2%/0.5% from 2000-03 to 2016-19

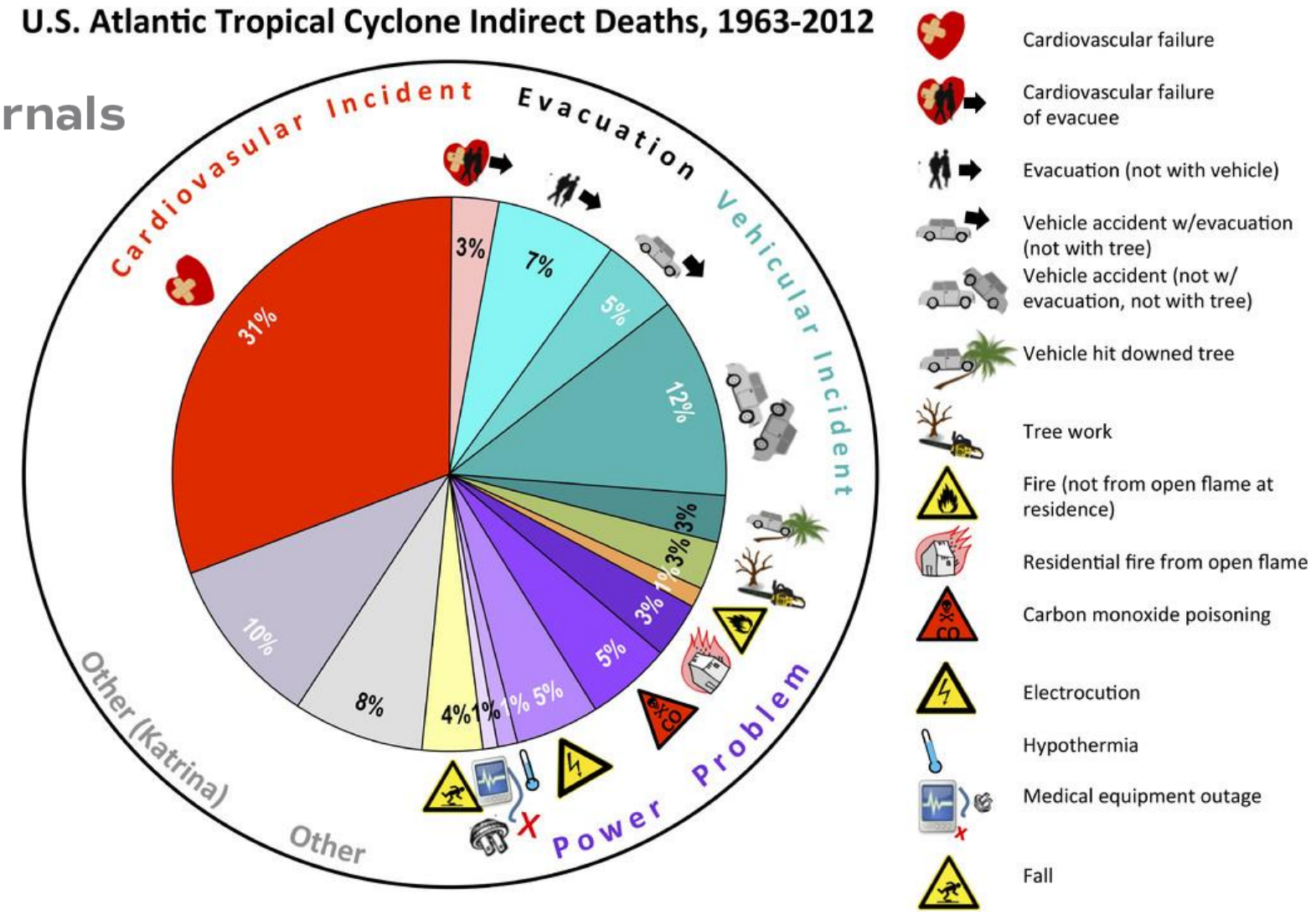
What About the Cold?



- In recent years, U.S. death rates in winter have been 8 to 12 percent higher than in non-winter months.
- Listing as “contributing factor” doubles the rate
- Death rate is higher in winter anyway – e.g., b/c of flu
- Much of the increase relates to seasonal changes in behavior and the human body, and increased exposure to respiratory diseases.
- Heart attacks

Indirect Deaths are Hard to Count

AMS American Meteorological Society | Journals



Rappaport and Blanchard, Fatalities in the United States Indirectly Associated with Atlantic Tropical Cyclones, *Bull. Amer. Meteor. Soc.*, 2016

Indirect Deaths are Hard to Count

N Engl J Med. 2018 Jul 12;379(2):162-170. doi: 10.1056/NEJMsa1803972. Epub 2018 May 29.

Mortality in Puerto Rico after Hurricane Maria

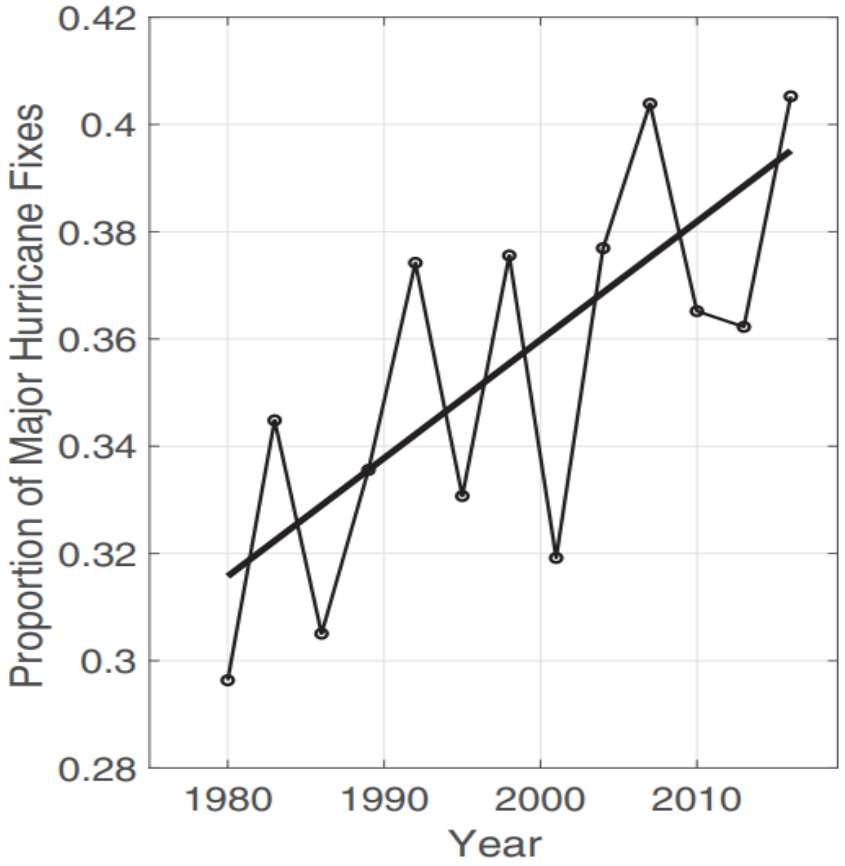
Nishant Kishore [1], Domingo Marqués [1], Ayesha Mahmud [1], Mathew V Kiang [1], Irmary Rodriguez [1], Arlan Fuller [1], Peggy Ebner [1], Cecilia Sorensen [1], Fabio Racy [1], Jay Lemery [1], Leslie Maas [1], Jennifer Leaning [1], Rafael A Irizarry [1], Satchit Balsari [1], Caroline O Buckee [1]

- Govt reported death toll from Hurricane Maria (2017) in Puerto Rico was 64
- Study found mortality rate of 14.3 deaths per 1000 persons from Sep 20 through Dec 31, 2017
- This rate yielded a total of 4645 excess deaths during this period equivalent to a 62% increase in the mortality rate as compared with the same period in 2016
- One third of deaths attributed to delayed or interrupted health care
- Likely an underestimate because of survivor bias

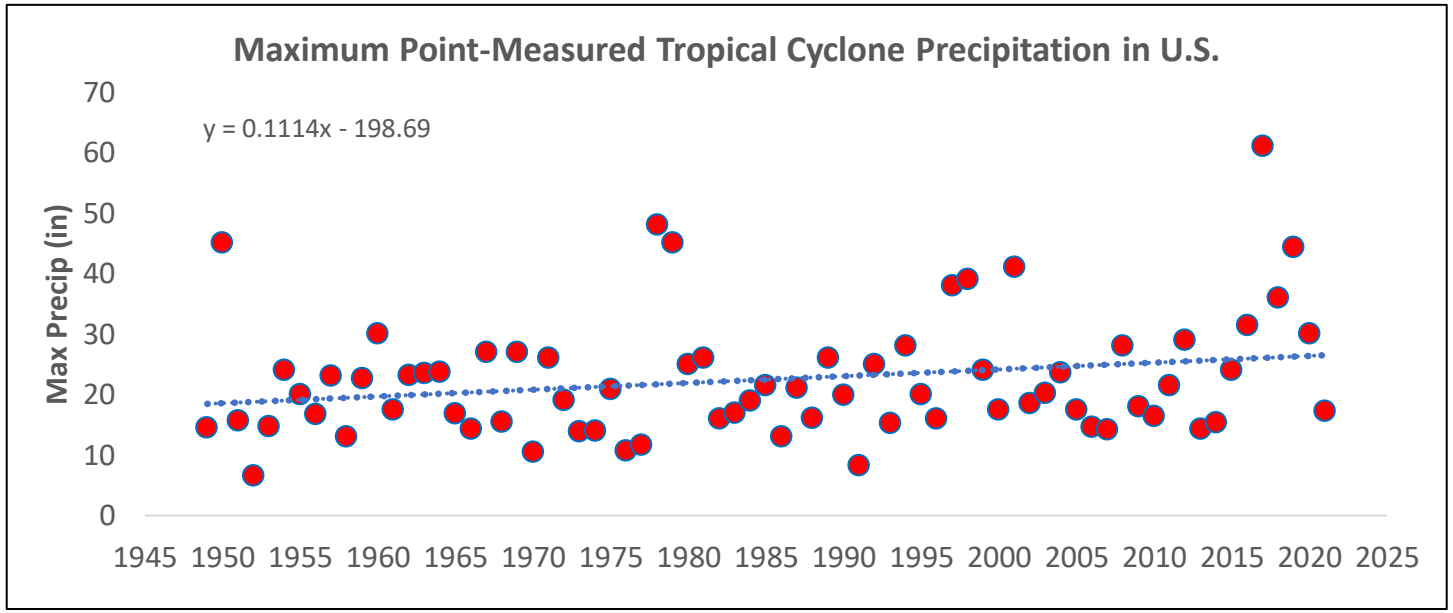
Impacts from Other Extreme Weather

Recent Historical Hurricane Activity

Proportion of cat 3-5 storms has steadily Increased in N. Atlantic

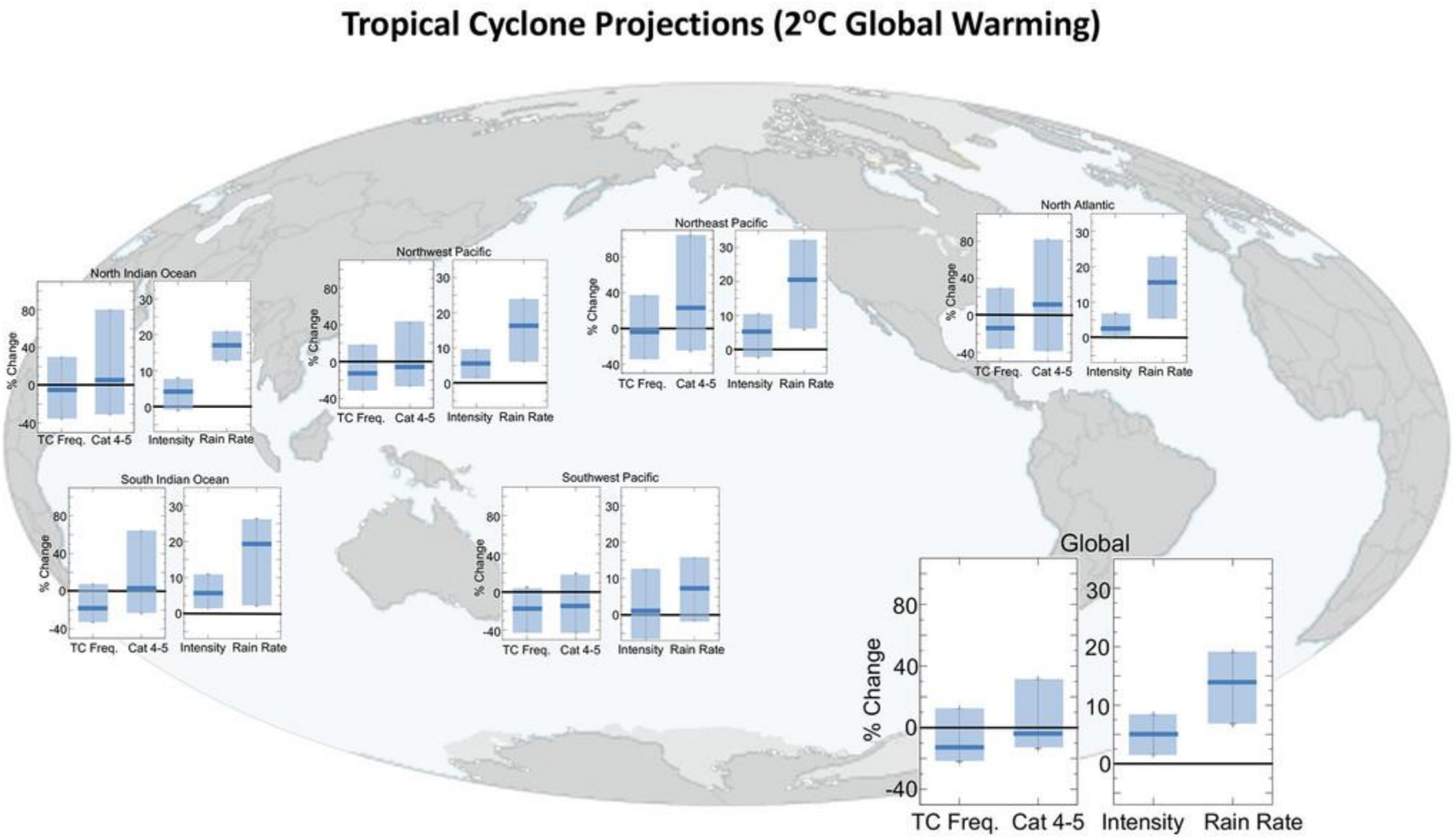


. From Kossin et al. (2020).



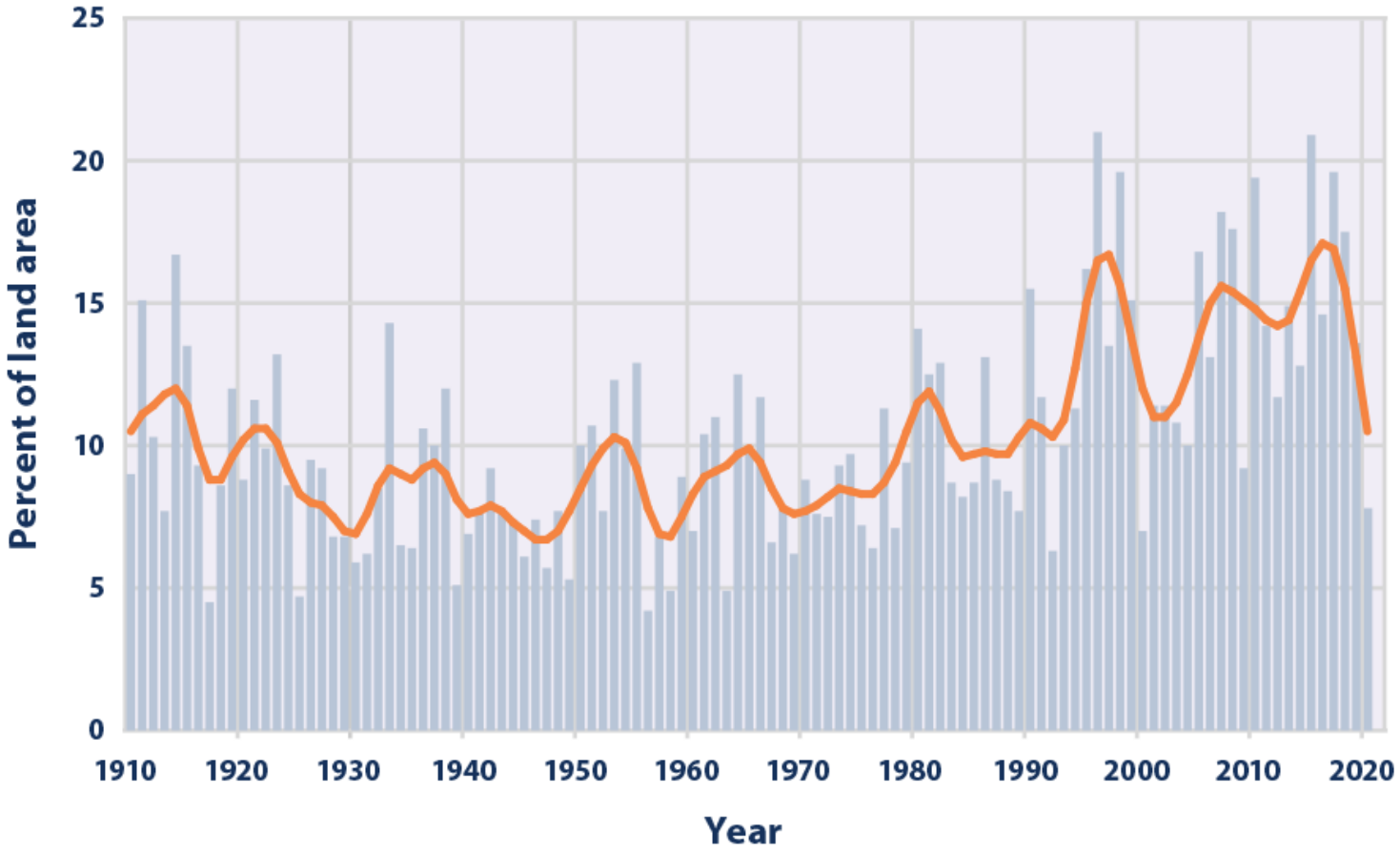
Heaviest Precipitation from Tropical Cyclones has steadily increased.

How Will Hurricane Activity Change?



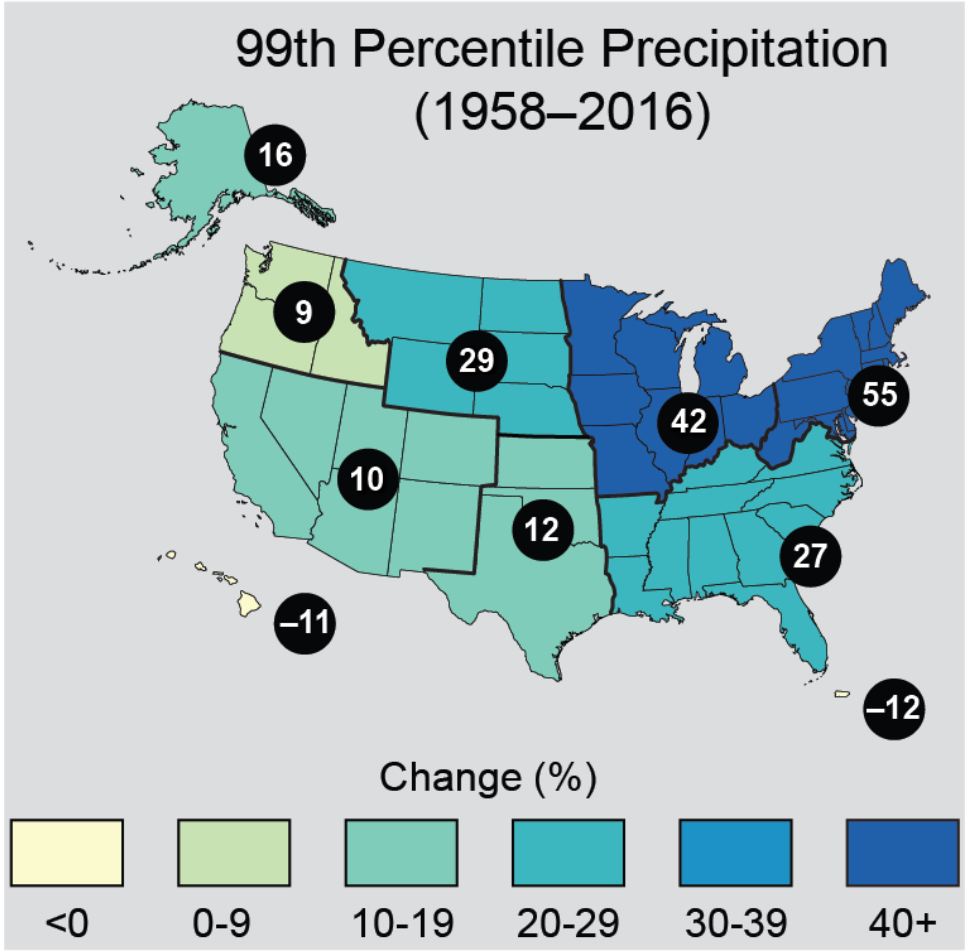
Heavy Precipitation Events Have Been Increasing

Extreme One-Day Precipitation Events in the Contiguous 48 States, 1910–2020



Data source: NOAA (National Oceanic and Atmospheric Administration). 2021. U.S. Climate Extremes Index. Accessed January 2021. www.ncdc.noaa.gov/extremes/cei.

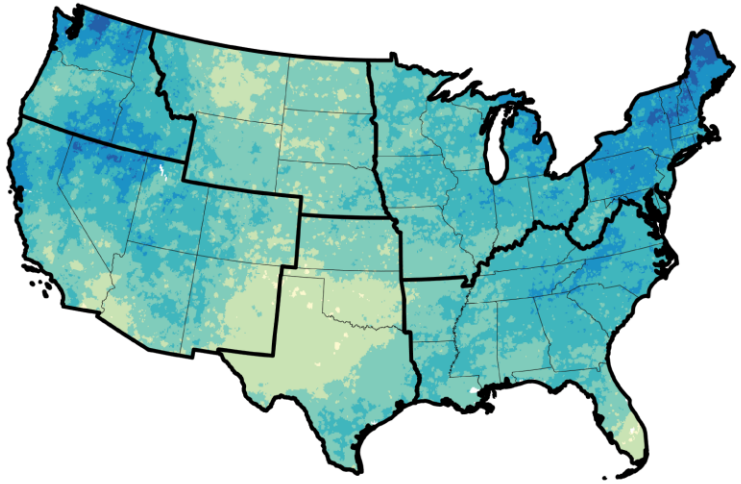
Observed Change in Heavy Precipitation



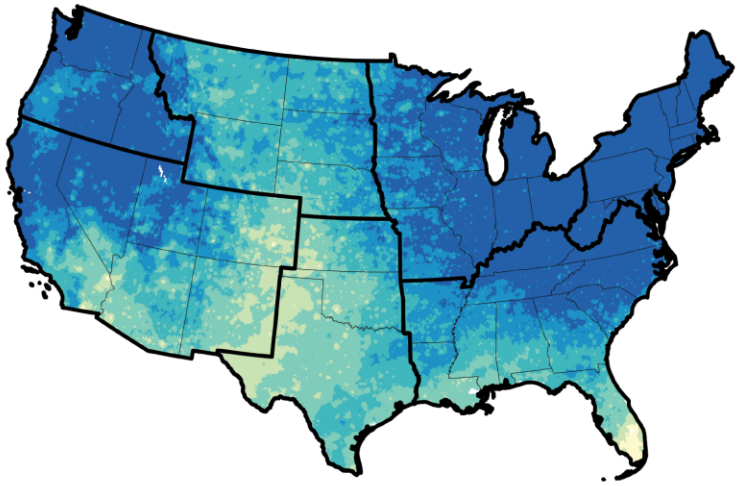
How Will Heavy Precipitation and Floods Change?

Projected Change in Total Annual Precipitation
Falling in the Heaviest 1% of Events by Late 21st Century

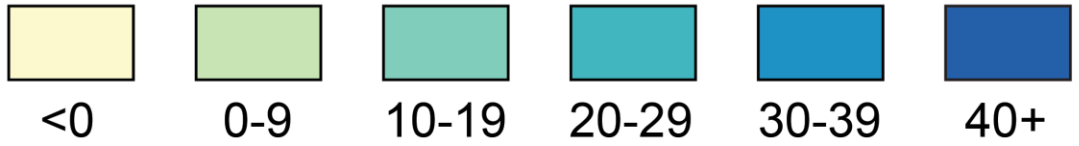
Lower Scenario (RCP4.5)



Higher Scenario (RCP8.5)

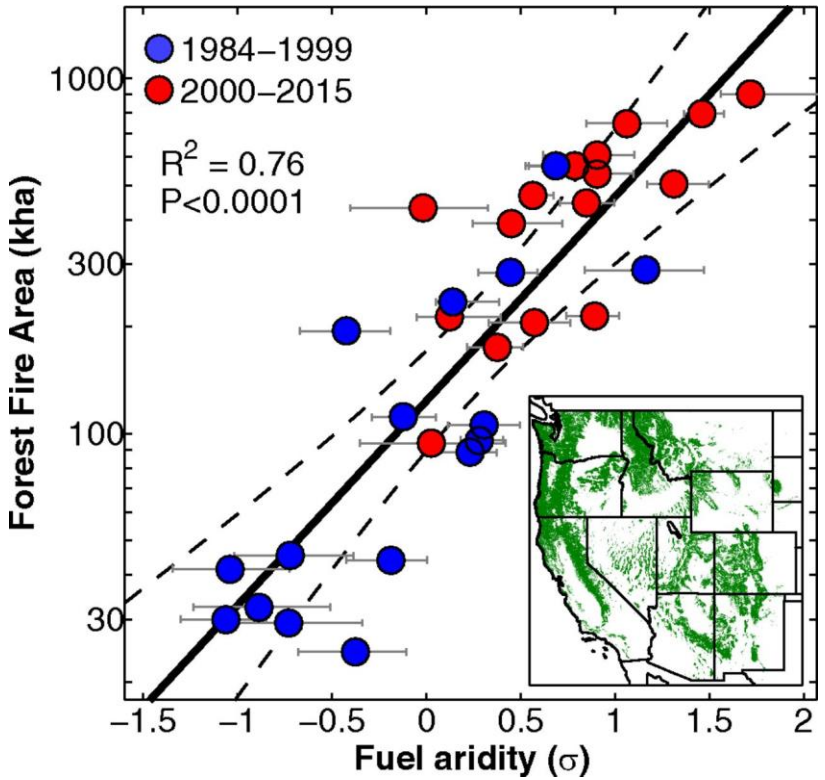


Change (%)



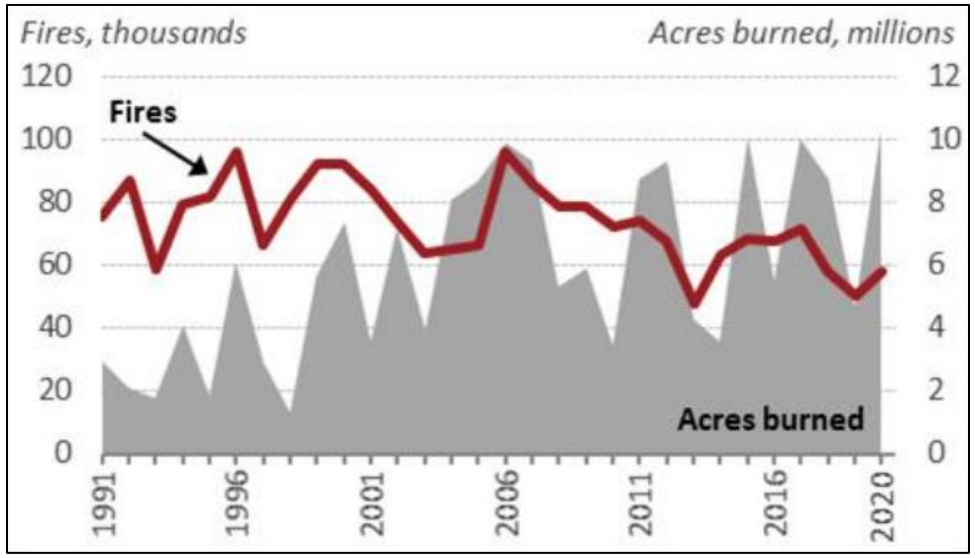
Western U.S. Drought Has Been Increasing and So Has Annual Area Burned from Wildfire

Annual western continental US forest fire area versus fuel aridity: 1984–2015.



John T. Abatzoglou, and A. Park Williams PNAS 2016;113:42:11770-11775

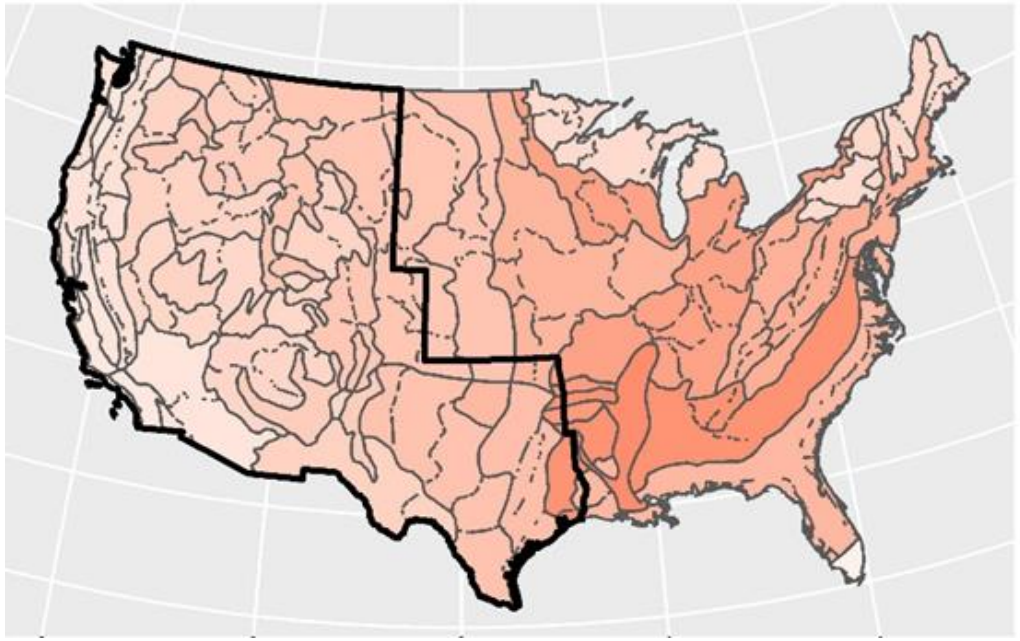
Number of Fires and Annual Area Burned



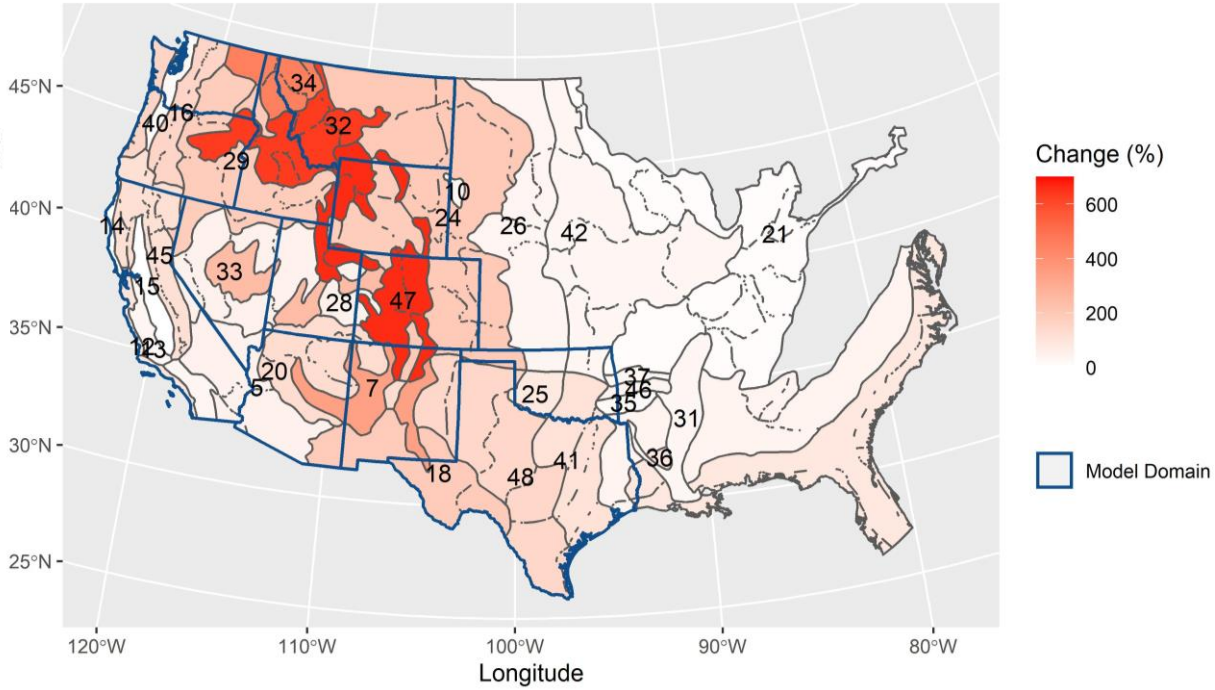
Source: National Interagency Fire Center (NIFC).

Verisk Projected Changes in Summer Dryness and Annual Wildfire Burned Area by 2050

Summer VPD Changes by 2050 from Mean GCM

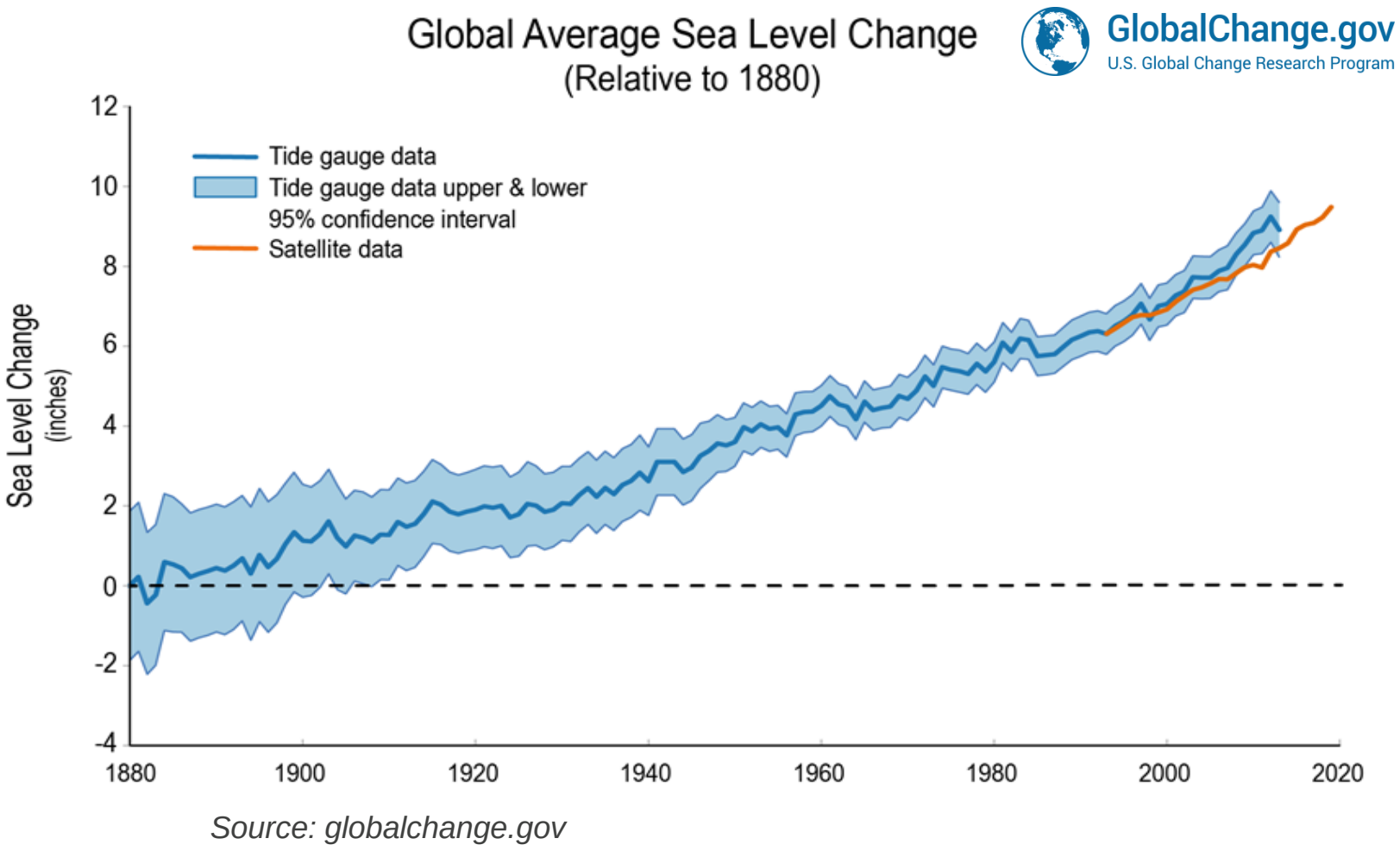


Annual Burned Area Changes by 2050 from Mean GCM



Sousounis et al. 2021, Potential Impacts of Climate Change on U.S. Wildfire Risk by Mid Century

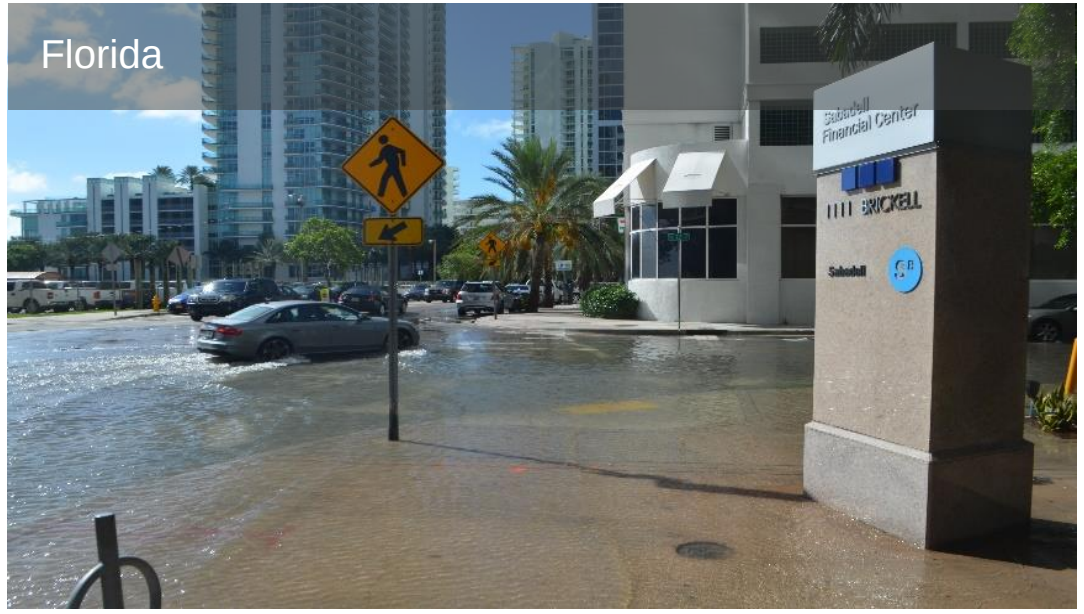
Global Sea Levels Have Been Rising for Over 100 Years



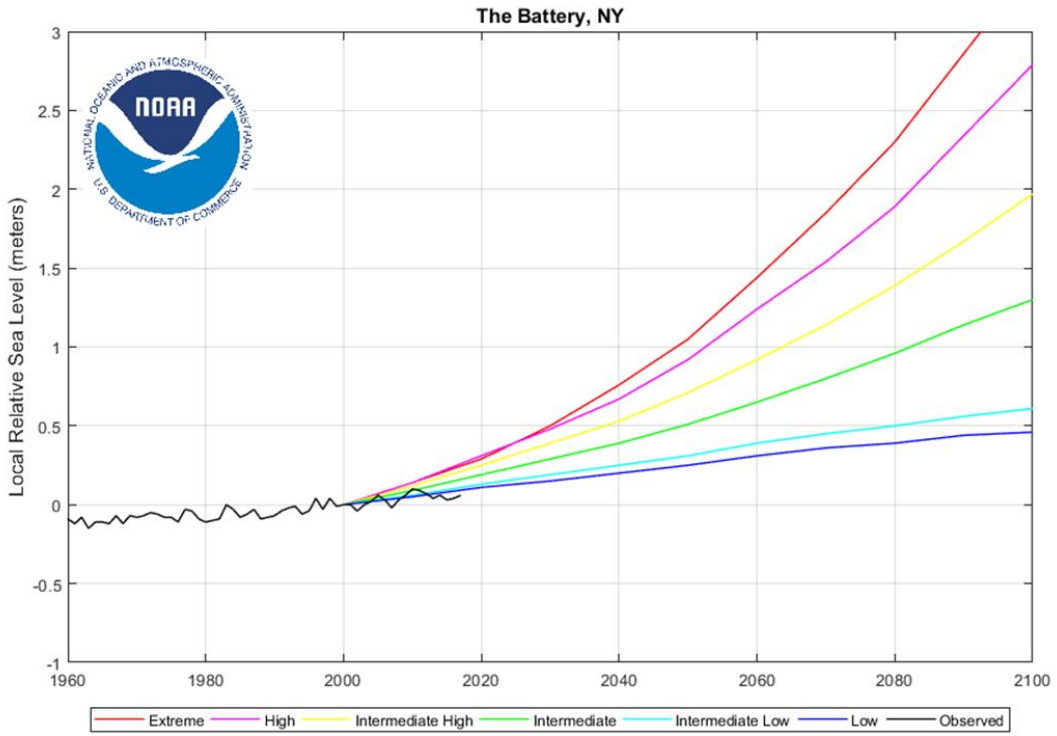
Source: globalchange.gov

- Sea level has risen 8–9 inches (21–24 cm) since 1880
- In 2019, global sea level was 3.4 inches (9 cm) above 1993 average
- This is an increase of 0.24 inches (6 mm) since 2018
- Rate of sea level rise is accelerating from 1.4 to 3.6 mm/year last 30 years

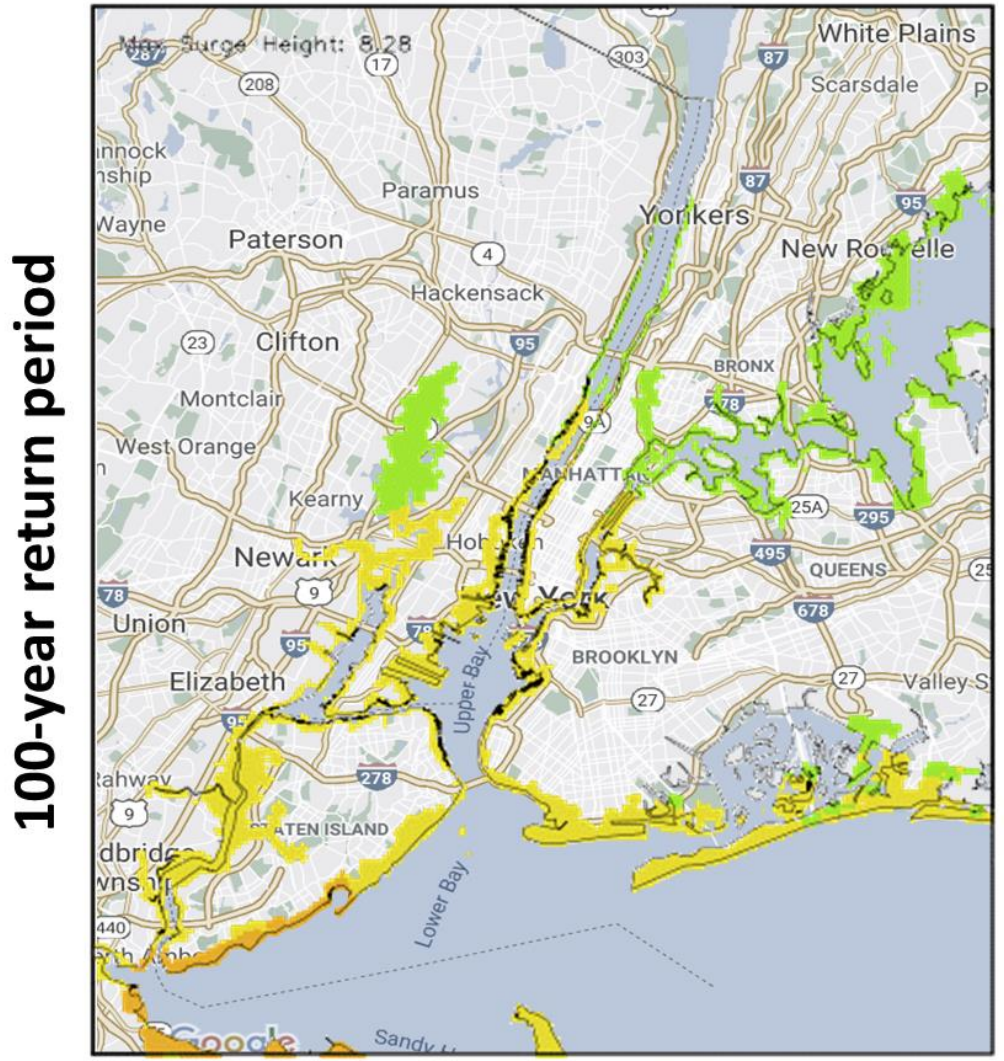
Flooding Now Occurs Frequently Without Storms



Storm Surge Will Be More Deadly from Increased Sea Levels and from Stronger Storms



Impact of SLR and storm frequency changes on RP Storm Surge Footprints in NYC Area



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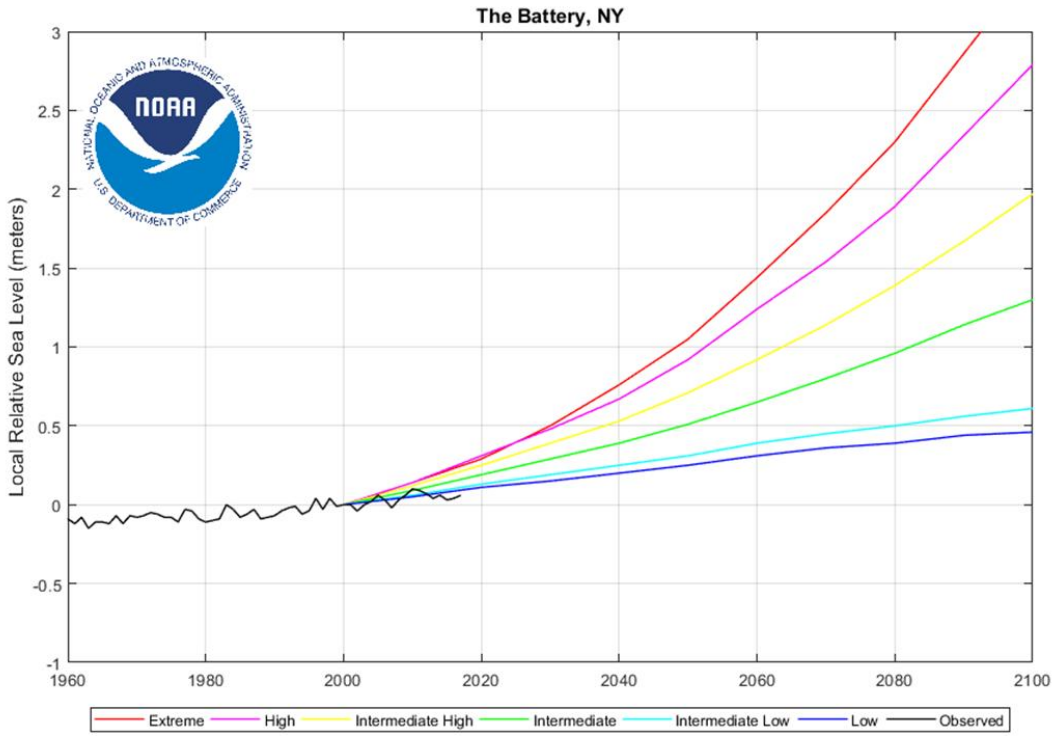

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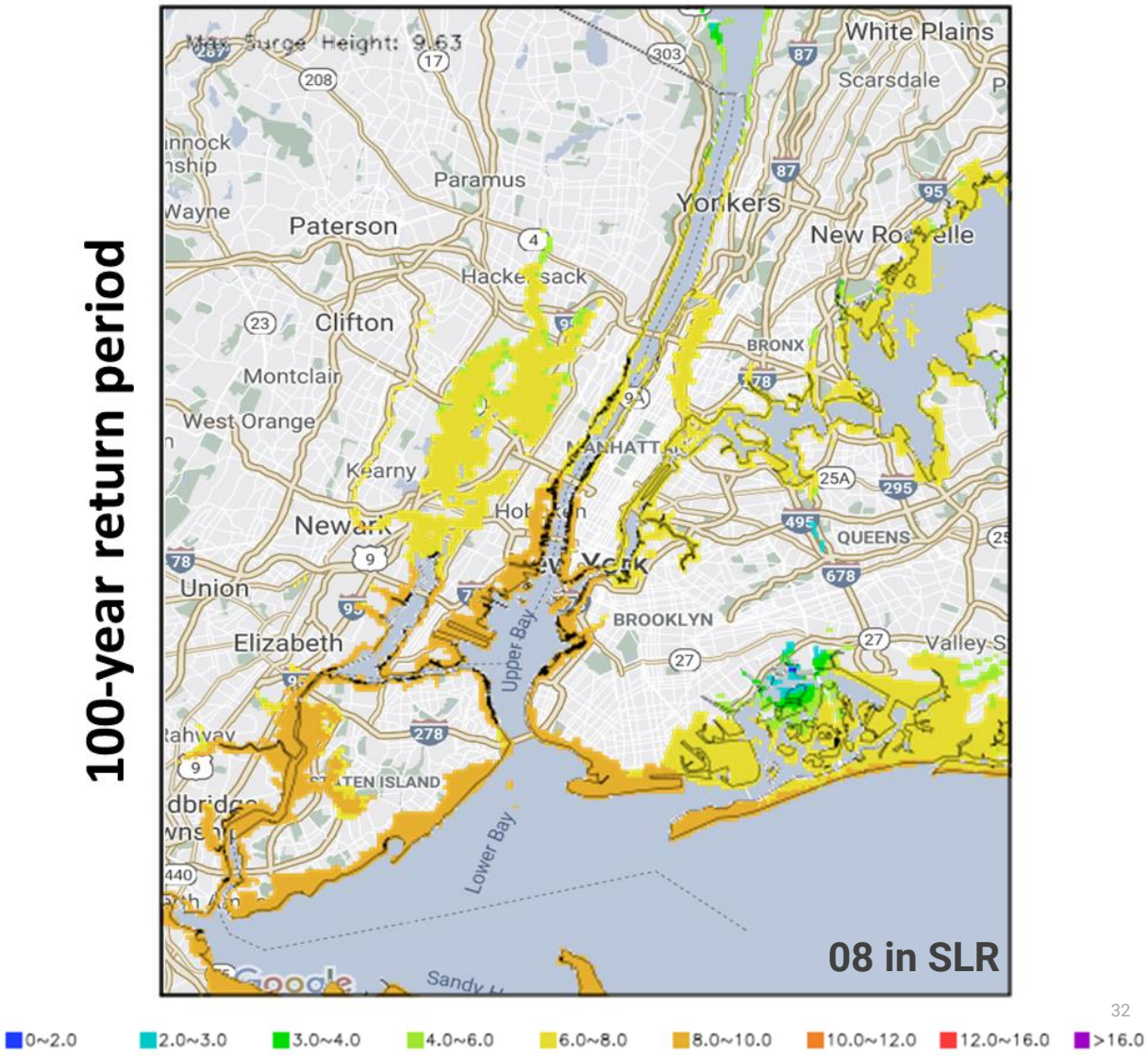

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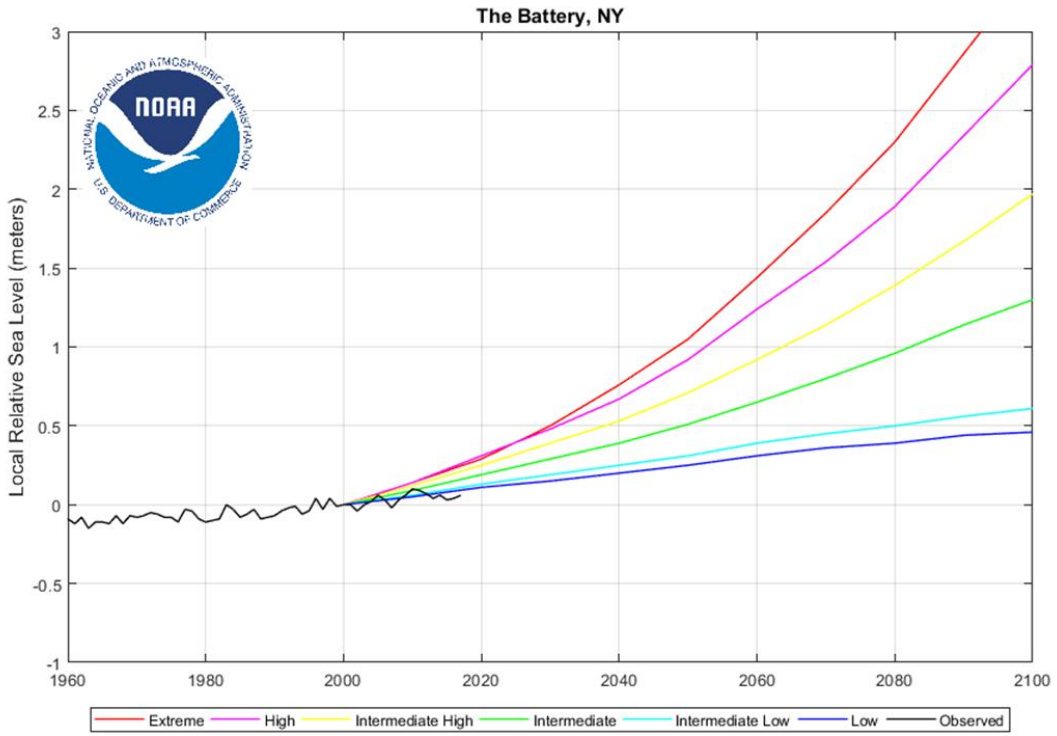
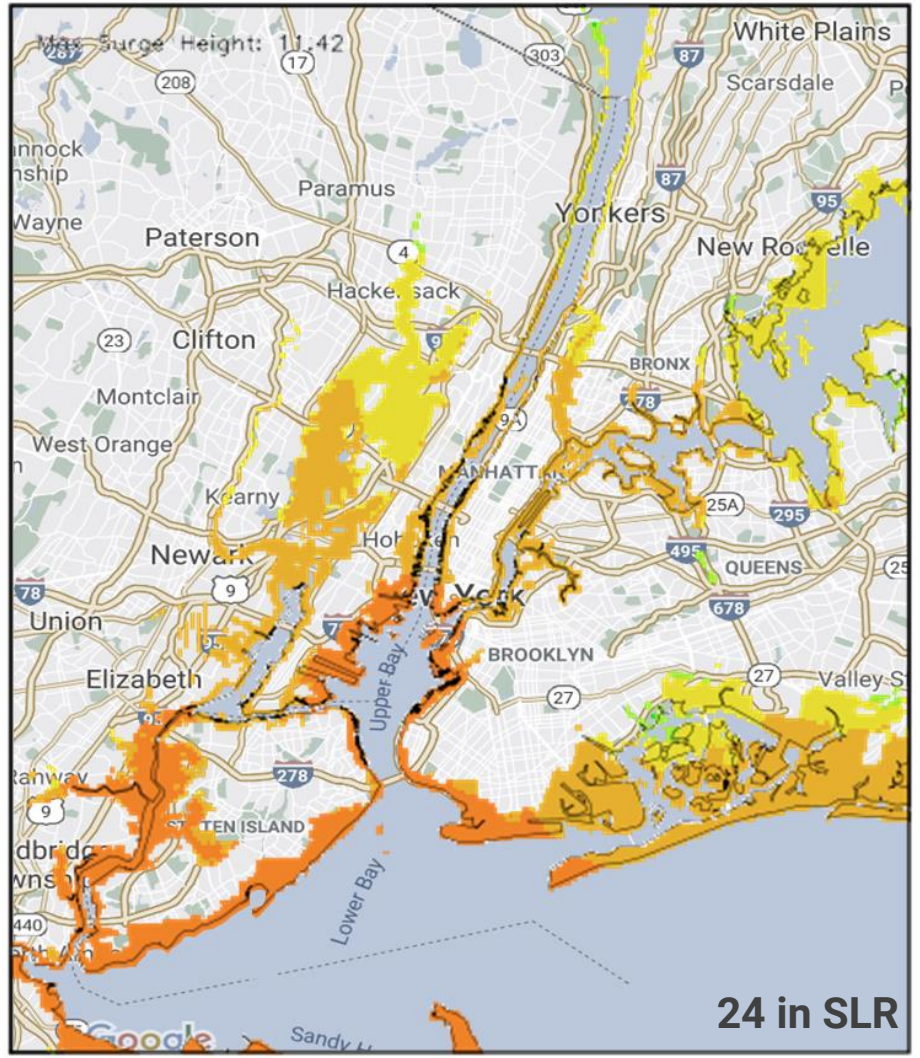


Impact of SLR and storm frequency changes on RP Storm Surge Footprints in NYC Area

100-year return period



Indirect Climate Change Effects on Health

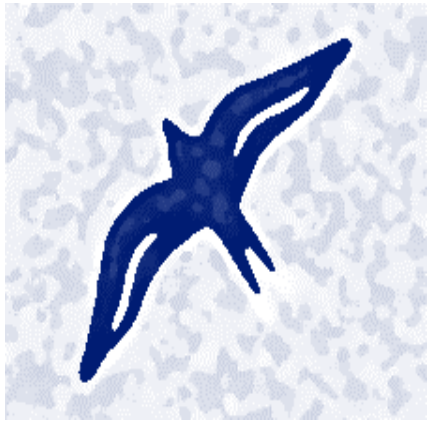
Diseases May Be More Prevalent

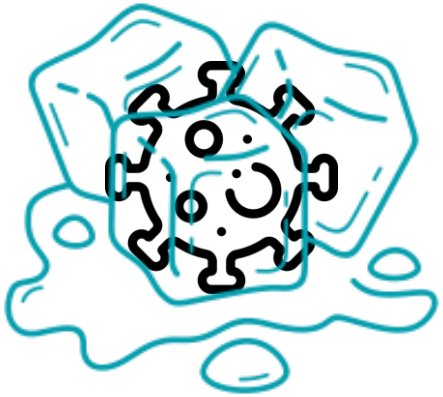
Vector-borne disease

- Almost all of world's human population could be exposed to disease-carrying mosquitos at some point in the next 50 years
- The diseases mosquitos will carry won't be just the vector-borne diseases we know about today such as malaria, West Nile virus, yellow fever, dengue fever, eastern equine encephalitis (EEE), and Zika

Animal migration

- Climate change will also influence bird (and other animal) migration patterns and potentially the locations where—and the climate patterns when—viruses get transmitted.





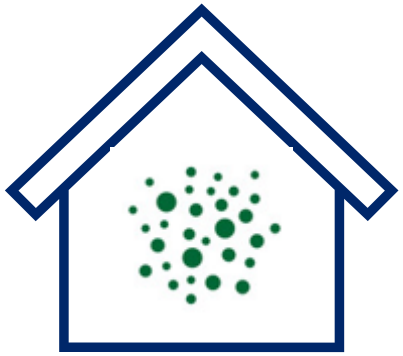
Melting permafrost

- Arctic amplification is causing the Arctic to warm two to three times as fast as the tropics.
- melting permafrost will also likely lead to the release of glacial microbes and viruses.
- Group studying glaciers in Tibet identified 28 of 33 viruses previously unknown.

Air, Water, and Food Quality May Be Compromised

Air stagnation

Food quality



Indoor mold

Water quality

Depression May Be More Common

Trauma from disaster

Post-traumatic stress disorder

Solastalgia

Summarizing the Many Health Impacts of Climate Change

Impacts Expected to Increase from Climate Change

	Heat Waves	Hurricanes	Floods	Severe Tstorms	Winter Weather	Wildfire
Auto Accident	X	X	X	X	X	
Projectiles		X	X	X	X	
Electrocution		X	X	X	X	
Drowning		X	X	X		
Power Failures	X	X	X	X	X	X
Respiratory Distress	X					X
Extreme Temps	X				X	

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Thank You

for more info: