

Climate change: What is at stake?

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Woodwell Climate Research Center



Woodwell
Climate
Research
Center



SunWize
Age of Power Autonomy

Founded as the Woods Hole Research Center in 1985, the organization was established to put the insights of climate science into the hands of decision makers.



**Woodwell
Climate
Research
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Putting science to work via partnerships

McKinsey & Company

WELLINGTON MANAGEMENT

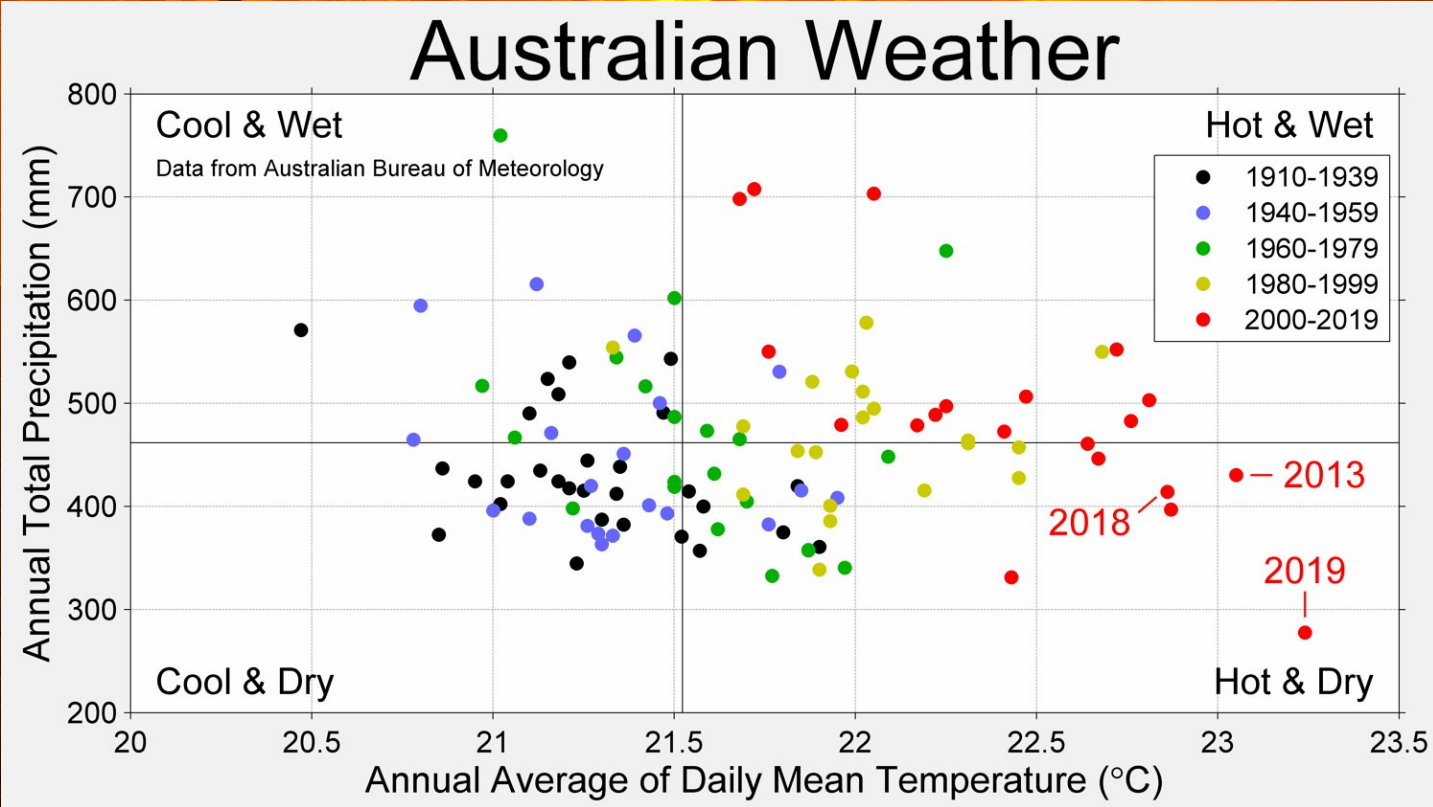


NISKANEN CENTER



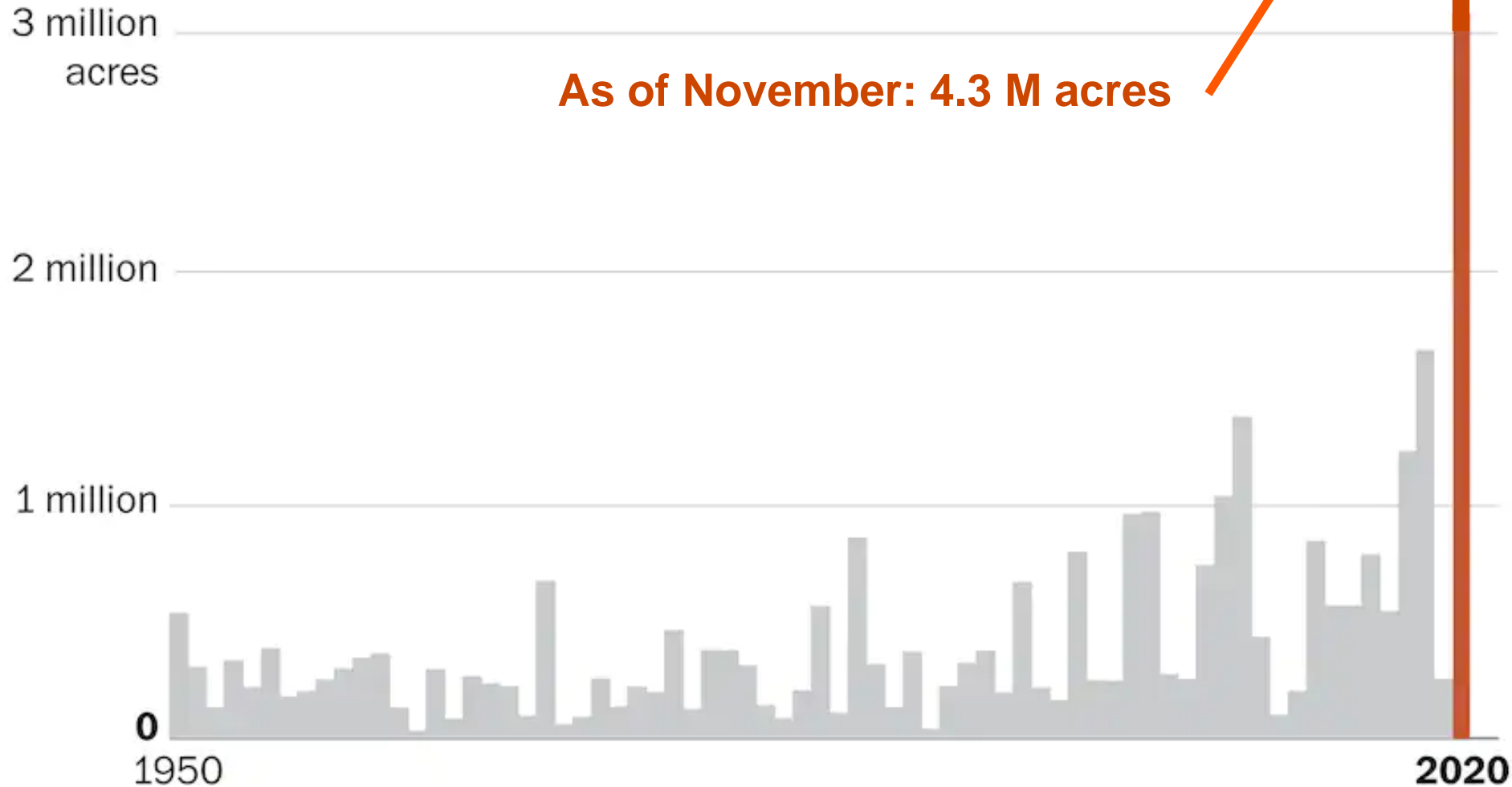
Impacts of climate change
are material *now*.

19 million Ha burned 2019 - 2020 fire season



Total acres burned by fires in California

This year has already broken the state's record, with more than 3.1 million acres burned.



As of November: 4.3 M acres

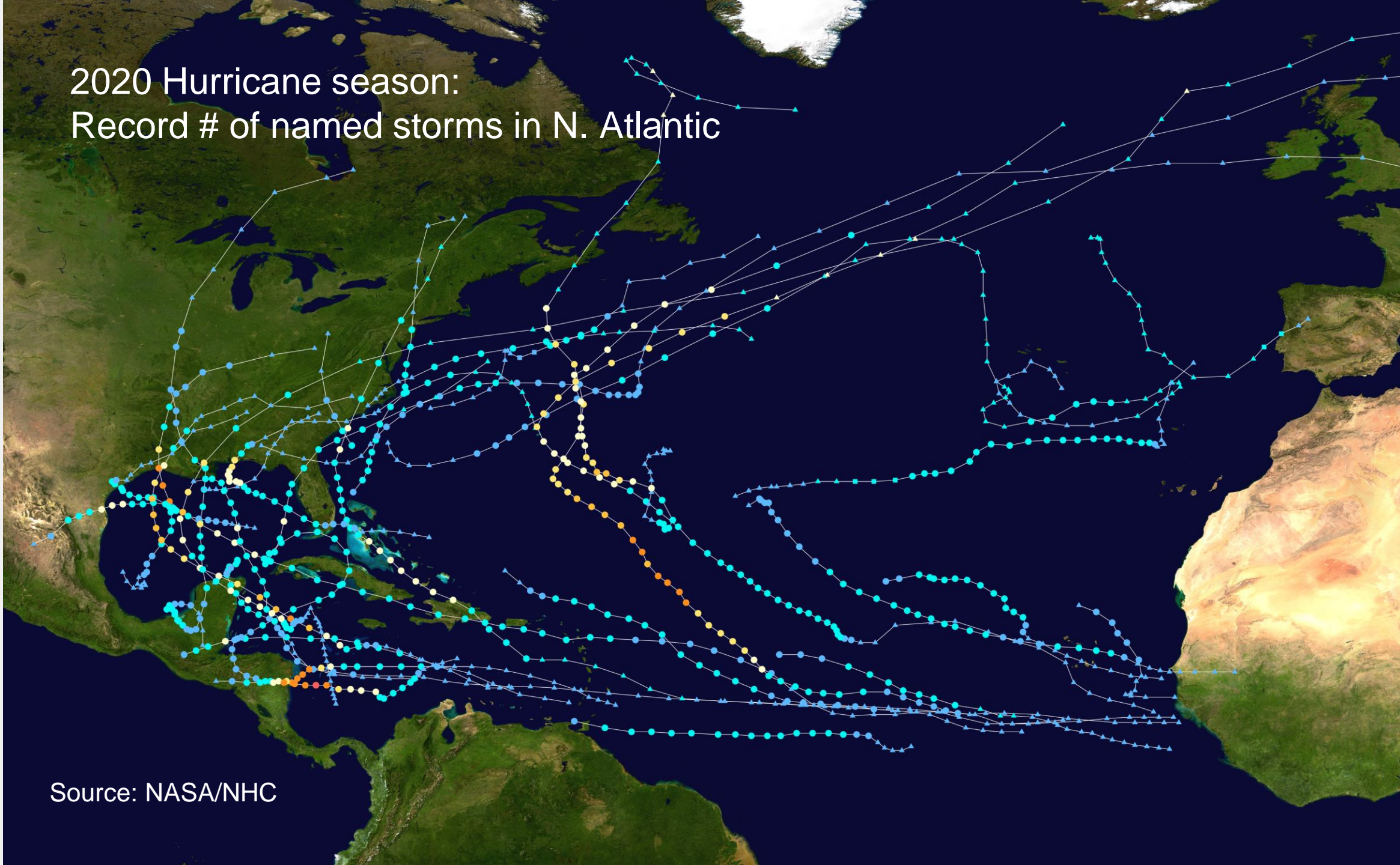
Source: Cal Fire via Washington Post
Updated by Phil

Data as of Sept. 10

Source: CalFire

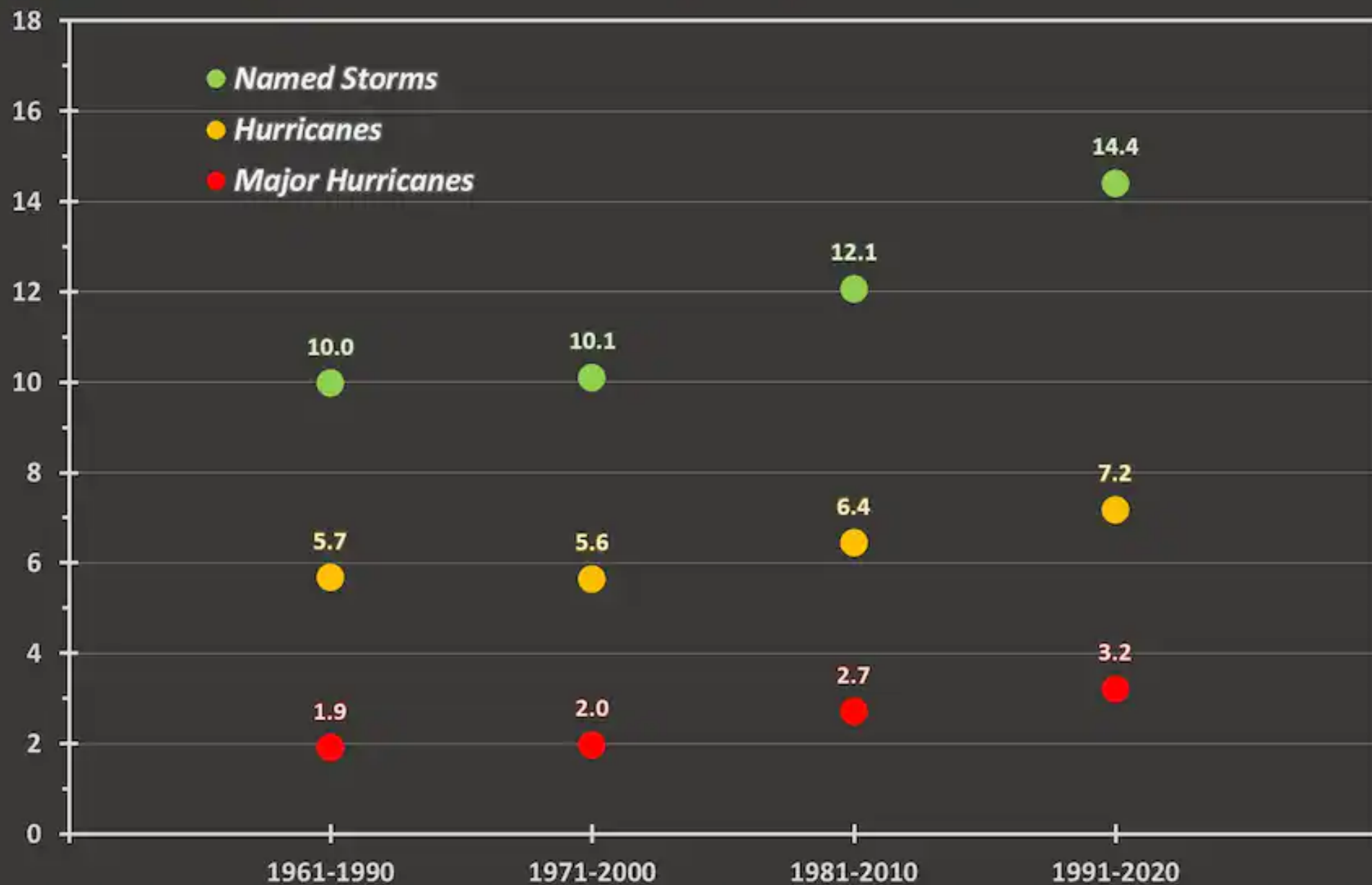
LAUREN TIERNEY/THE WASHINGTON POST

2020 Hurricane season:
Record # of named storms in N. Atlantic



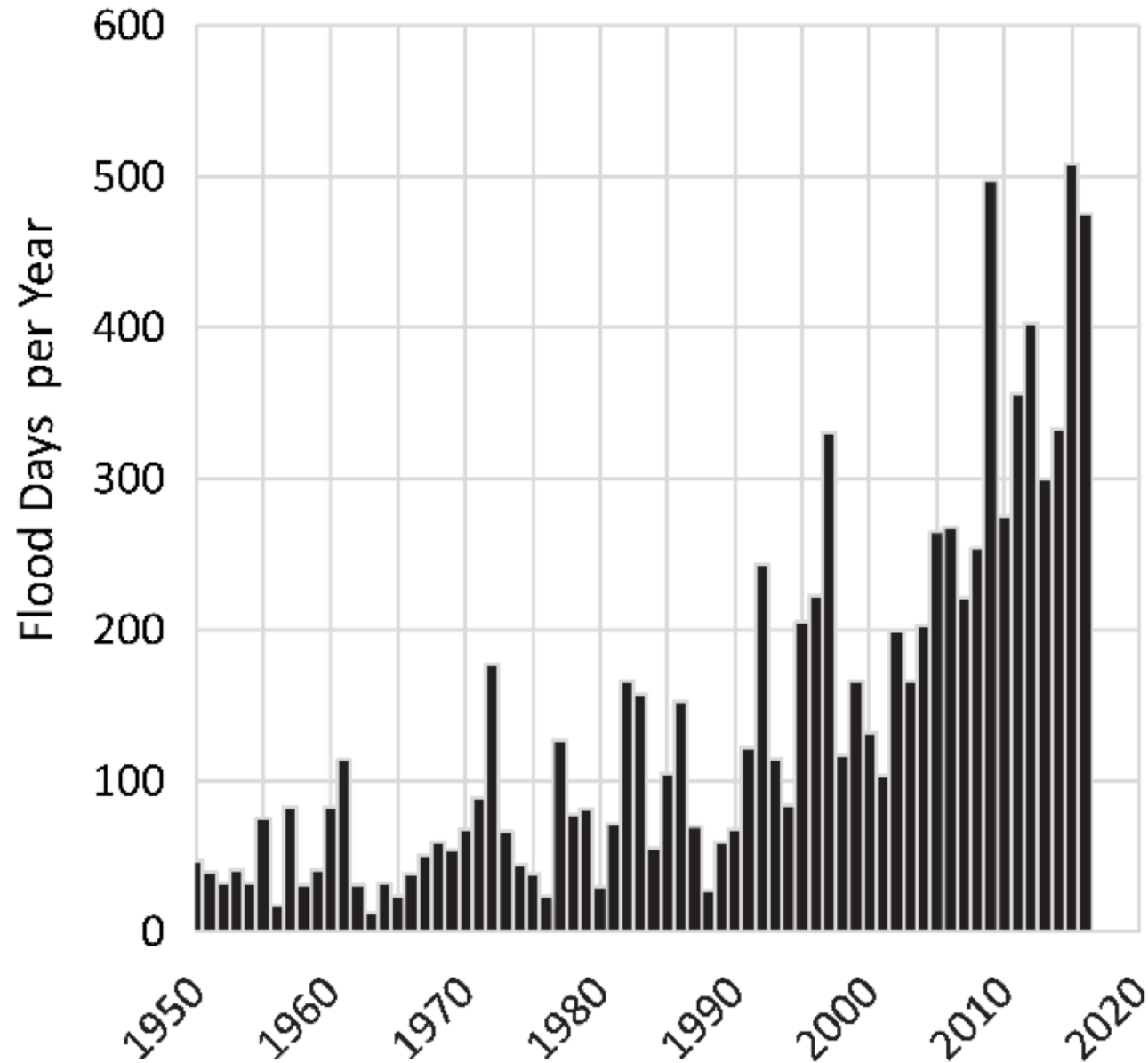
Source: NASA/NHC

Atlantic Basin 30-year "Climate Normals"



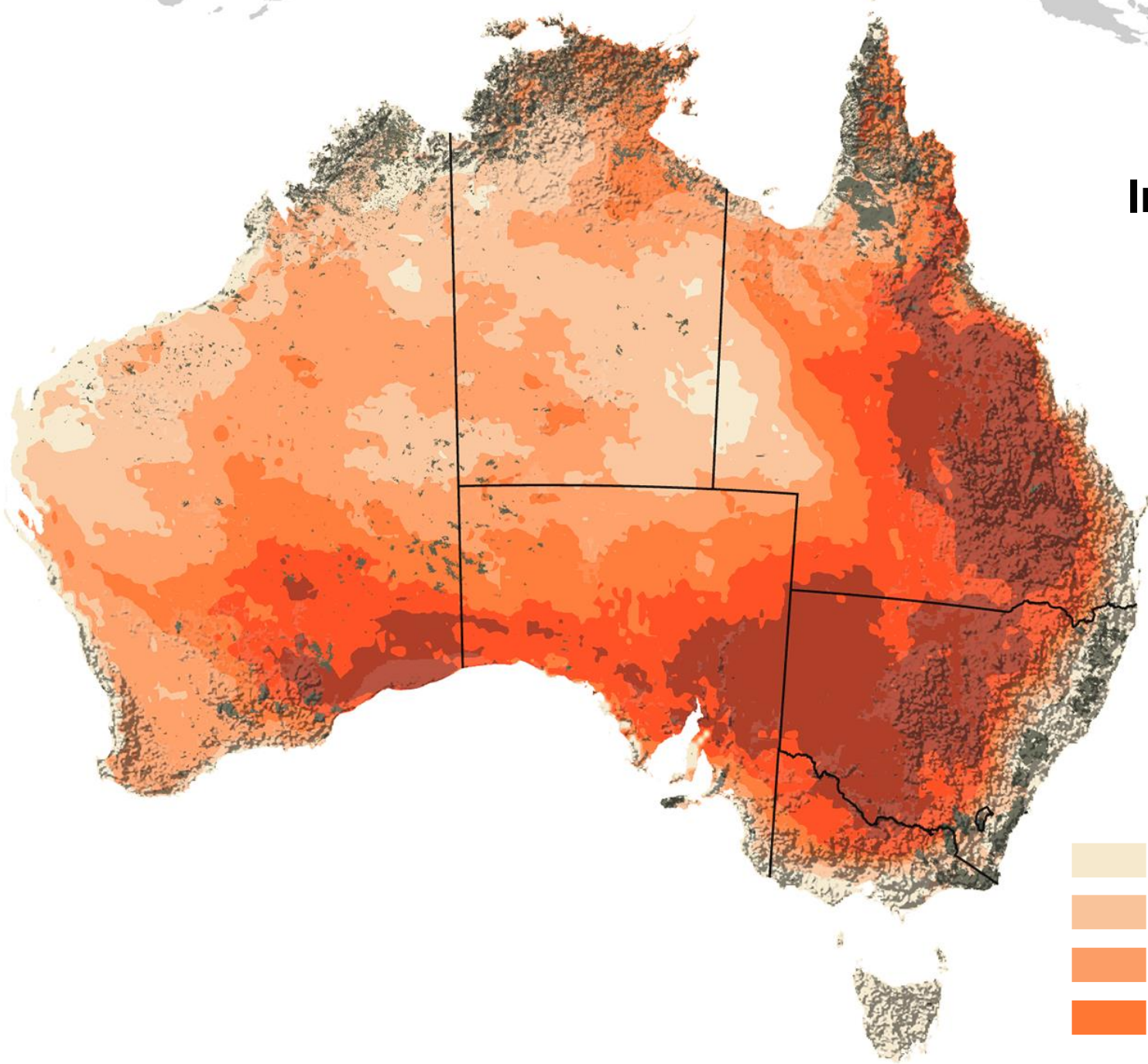
High tide flooding is increasing

Tally of Minor High Tide Flooding



How are risks likely
to evolve in coming decades?

Increase in # high-risk fire days (2021-2051) - (1971-2000)



- ≤ 1 Week
- ≤ 2 Weeks
- ≤ 3 Weeks
- ≤ 4 Weeks
- ≤ 5 Weeks
- ≤ 5 Weeks +

*Bushfires
(2019 -20)*

Out of Domain

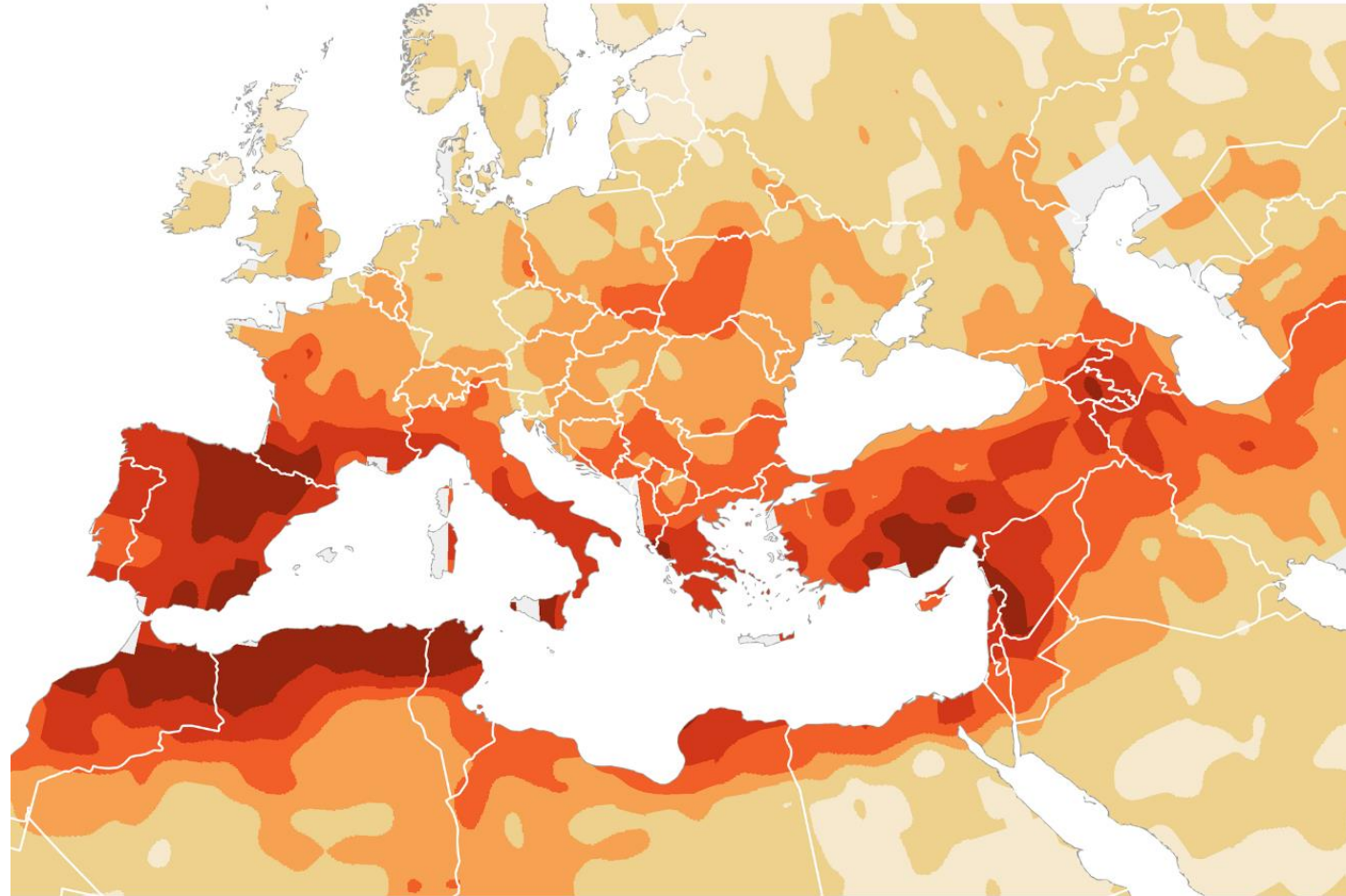
*Aboveground
Biomass*

Decadal Drought Frequency

(2030-2039) - (1951-1980)

Desertification

- The Sahara Desert will effectively cross the Mediterranean Sea.
- The heavily-populated coast of Africa will be squeezed between the desert and the rising seas.



Additional Months of Drought per Decade

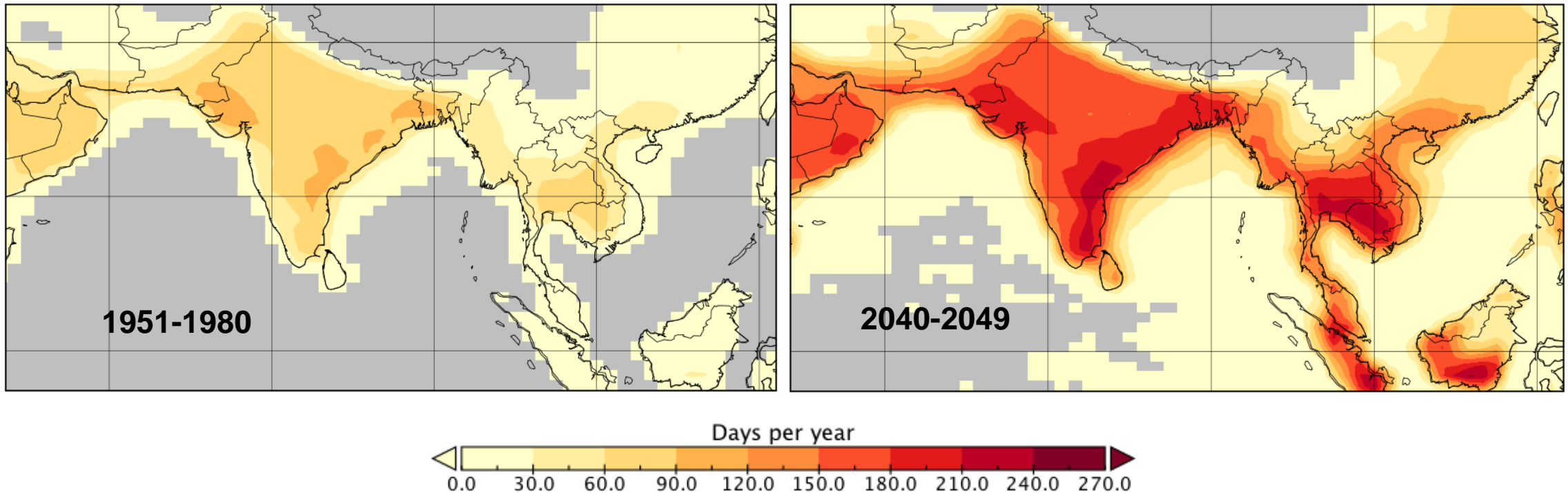
0 < 15 < 30 < 45 < 60 60+



Out of Domain

Dangerous heat + humidity will become more frequent

NWS Heat Index “danger zone” frequency

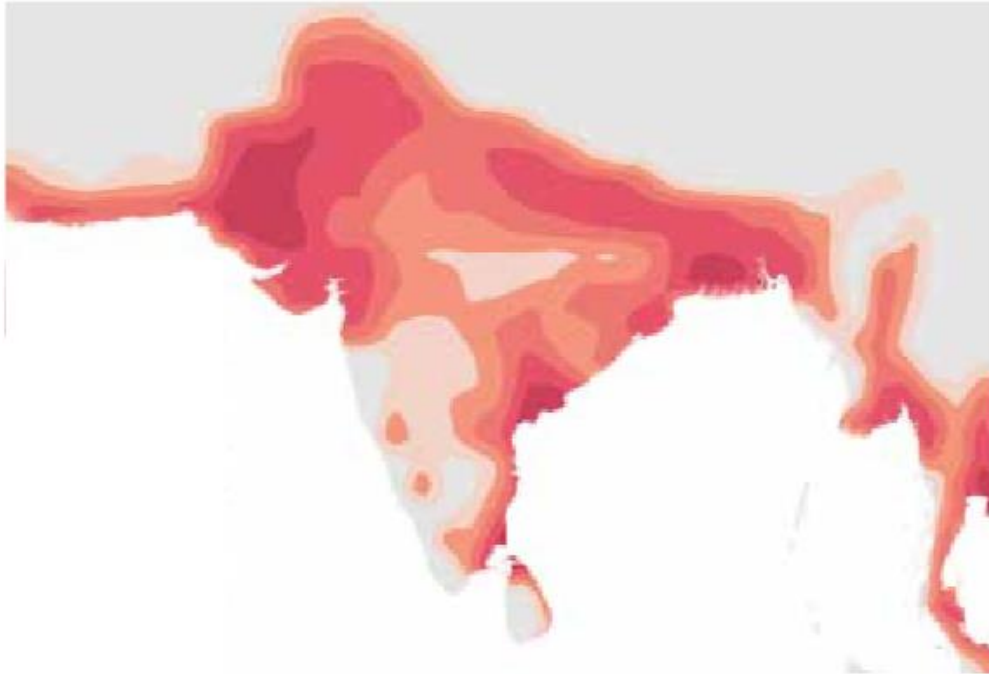


This region is:

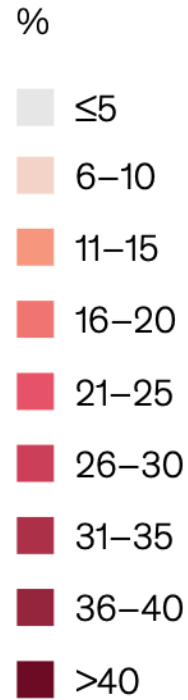
1. already very hot and humid
2. Populous -- these images contain over 3 billion people
3. expected to be a primary driver of global economic growth
4. heterogeneous in cultures and religions, making migration difficult

Extreme heat limits outdoor labor

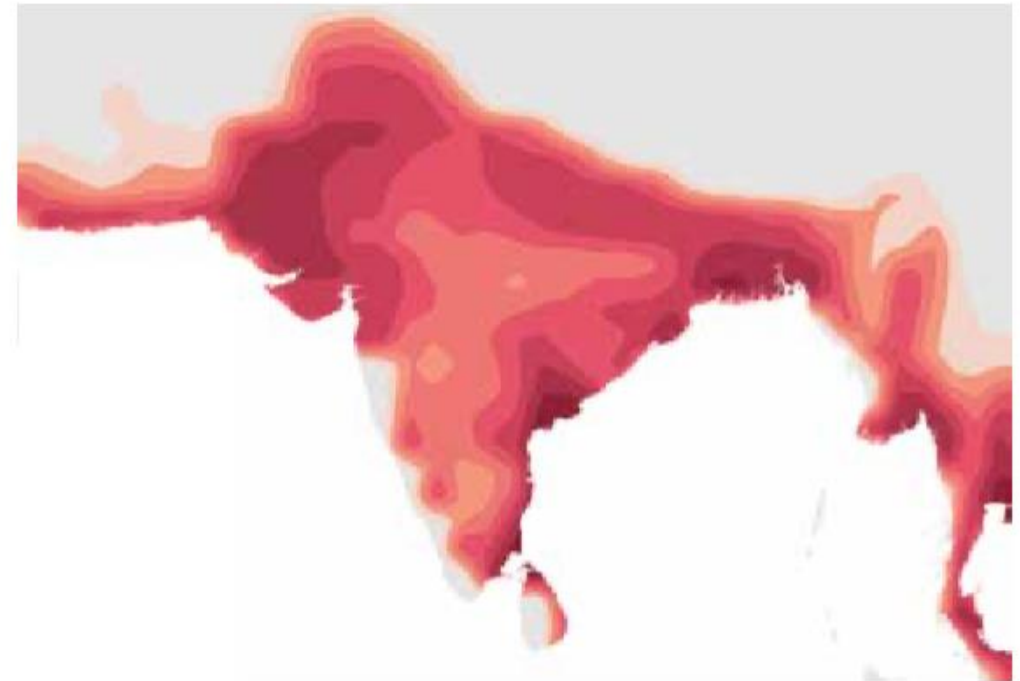
Today



Share of work
hours lost



2050



Climate change tends to increase likelihood of global low yields

With CO₂ fertilization

Crop	<i>1998 - 2017</i>	<i>2021 - 2040</i>	<i>2041 - 2060</i>	<i>2061 - 2080</i>	<i>2081 - 2100</i>
Maize	0.1	0.19	0.31	0.43	0.58
Wheat	0.03	0.02	0.04	0.06	0.11
Rice	0.03	0	0.05	0.17	0.47
Soybean	0.13	0.2	0.22	0.33	0.47

Without CO₂ fertilization

Crop	<i>1998 - 2017</i>	<i>2021 - 2040</i>	<i>2041 - 2060</i>	<i>2061 - 2080</i>	<i>2081 - 2100</i>
Maize	0.07	0.17	0.54	0.8	0.9
Wheat	0.02	0.09	0.42	0.88	0.97
Rice	0.02	0.08	0.5	0.83	0.99
Soybean	0.12	0.4	0.81	0.94	0.98

Probability of crop yield failure, defined as 10% decline from 1998-2017 yield, throughout the 21st century in all respective breadbaskets of maize, wheat, rice, and soybean.

Our work with McKinsey illustrates socioeconomic consequences of climate change



Permafrost holds 2x the carbon that's in the atmosphere



Letter | Published: 21 October 2019

Large loss of CO₂ in winter observed across the northern permafrost region

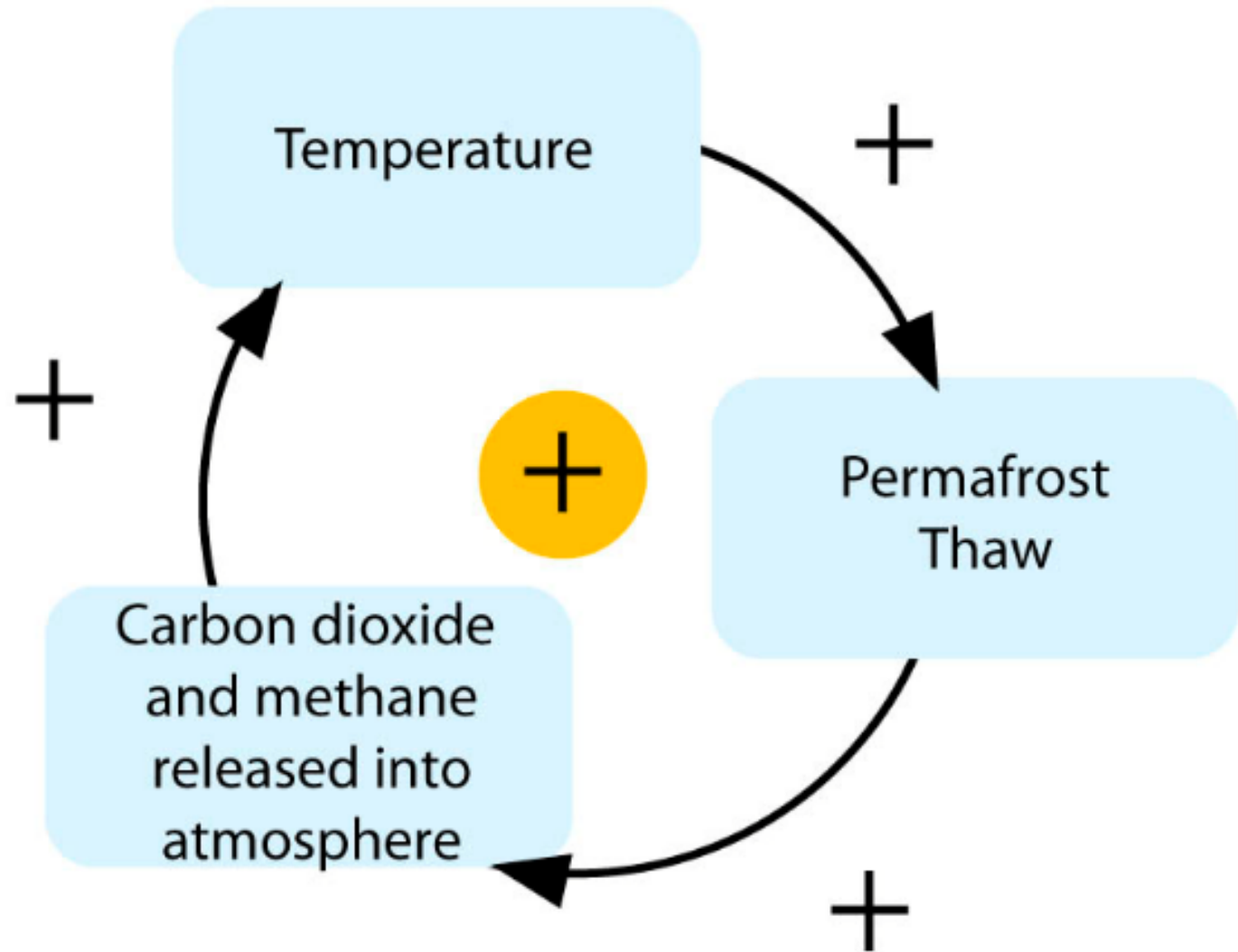
Susan M. Natali , Jennifer D. Watts, [...] Donatella Zona

Nature Climate Change **9**, 852–857(2019) | [Cite this article](#)

8411 Accesses | **25** Citations | **904** Altmetric | [Metrics](#)

Winter-season emissions of CO₂ from permafrost are equivalent to 16% of global human emissions

Emissions from
thawing
permafrost are
self-reinforcing



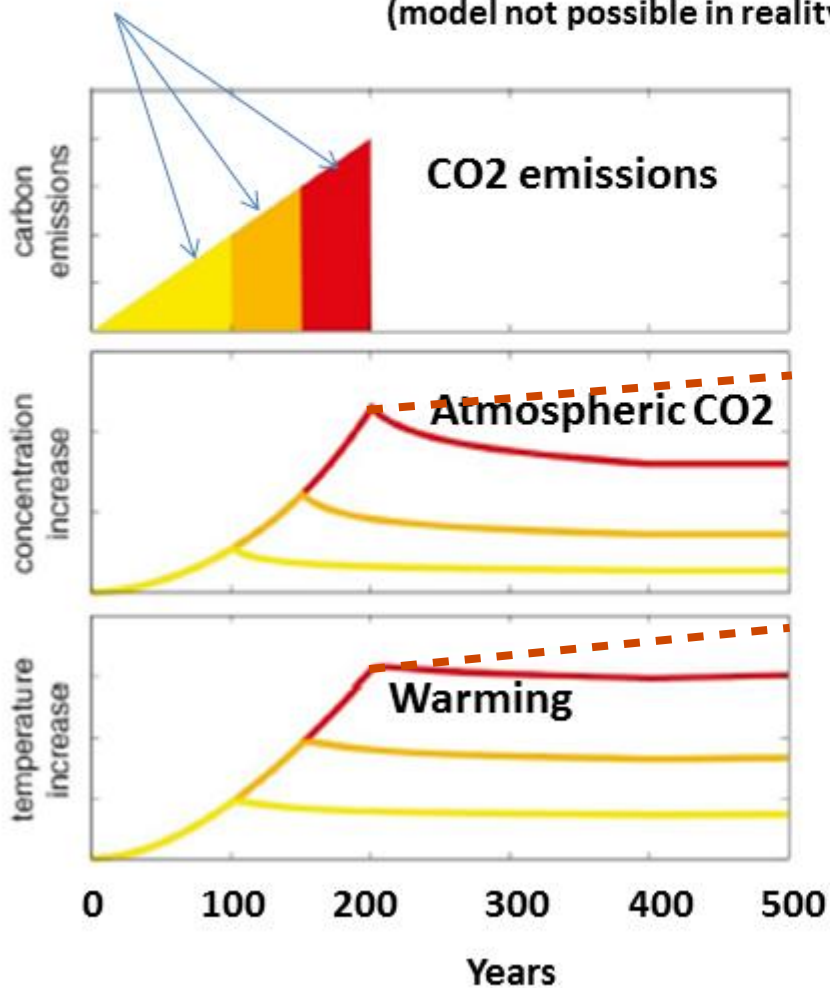
Warming will persist for centuries

Zero emissions

At various times

Instantaneous zero emissions

(model not possible in reality)



- Zero CO₂ emissions lead to near constant surface temperature. A large fraction of climate change persists for many centuries.
- Depending on the scenario, about 15-40% of the emitted carbon remains in the atmosphere for 1000 yrs.
- This represents a substantial multi-century climate change commitment created by past, present and future emissions of CO₂.

Summary: What is at stake from climate change?

- Impacts of climate change are material today.
- They will continue to worsen as warming continues.
- Cessation of human greenhouse gas emissions will not reduce risks—they only stop getting worse.
- Parts of the world will become difficult to inhabit.
- Large-scale societal disruption is possible.