

An Ode to Bias

Putting the Climate Cat Amongst the Pigeons

John Wardman & Tom Philp

9th November 2023

Bayes



Climate Change: The Case

- Today we'll open a debate about Climate Change with two questions in mind:
 - 1) Is it real?
 - 2) Is it having impacts on extreme weather?
- Tom will be arguing the side for Yes
- John will be arguing the opposite, for No
- We will be playing up to media-defined stereotypes on both sides of the political divide.
- Our personal beliefs may not come to the fore, but are inconsequential today – the spectrum of opinion is our focus.



Climate Change: Real or Not?

The Case For Personal Background

- I'm playing the climate-advocate/protestor role.
- The media tells people my hobbies include gluing myself to the pavement.
- My favourite colour is orange.

The Case Against Personal Background

- I'm playing the severe sceptic role.
- The media tells people I hate wind turbines.
- I eat a substantial amount of cattle
- Dares to zig while the rest zag: the view that the 'science is settled' on human-induced CC is very much open to debate!



Climate Change: Is it Real?



Headlines abound – is this even a debate?

You're not imagining it, the wildfires really were a lot of climate change.

Greece wildfires: climate crisis will 'manifest itself everywhere with greater disasters', says

World is entering 'era of global boiling', warns as July is the hottest month

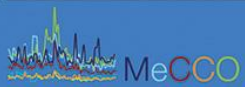
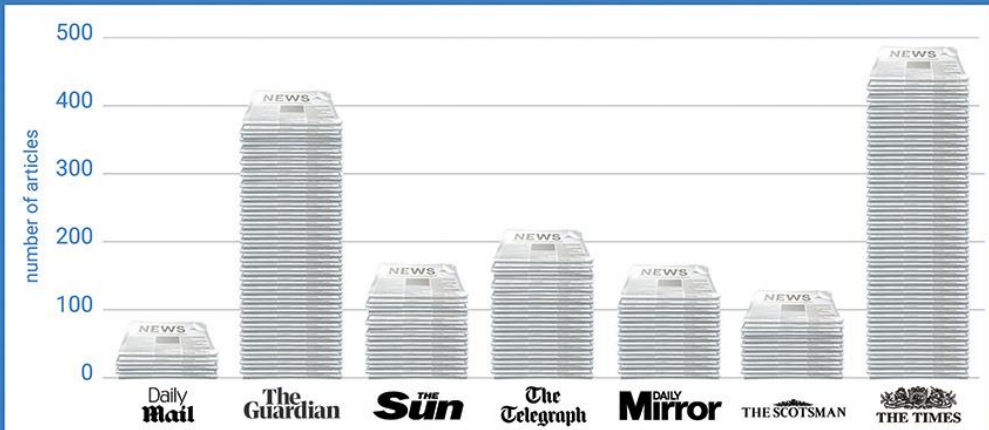


Simon Kofe, Tuvalu's foreign minister, addresses COP26 in November 2021. Tuvalu is one of many small island states looking to developed nations for funding to deal with the impact of climate change © REUTERS



It's all media hype!

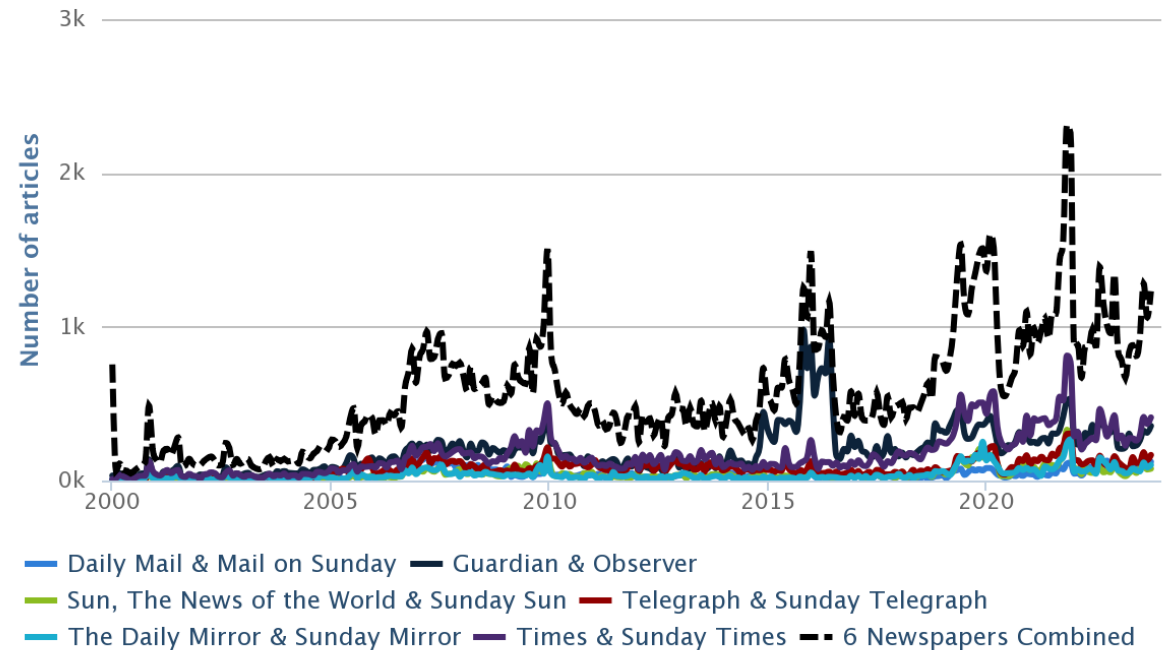
UK print news stories on climate change or global warming in Jan. 2020



CENTER & FOR
SCIENCE & TECHNOLOGY
POLICY RESEARCH



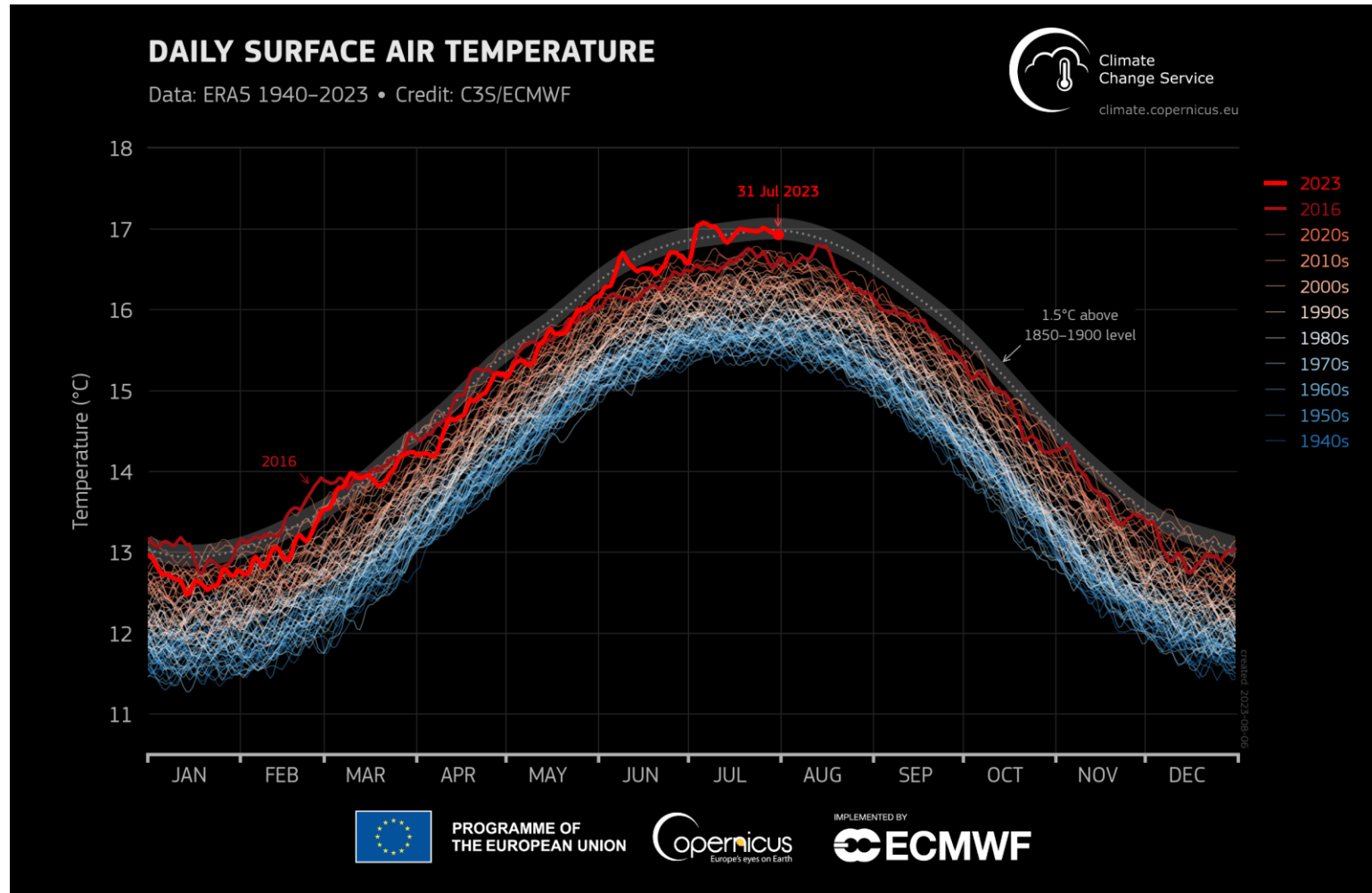
2000–2023 United Kingdom Newspaper Coverage of Climate Change or Global Warming



Media and Climate Change Observatory, University of Colorado Boulder, <http://mecco.colorado.edu>

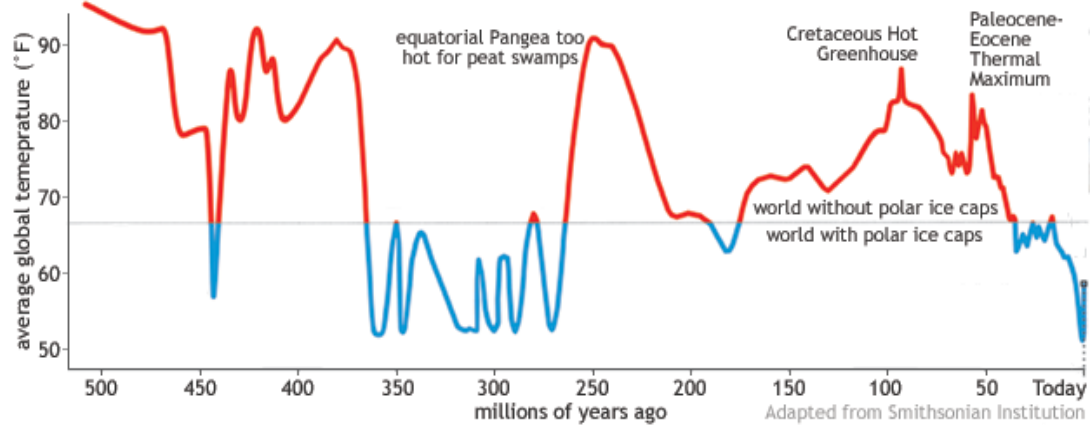


The Hard Evidence

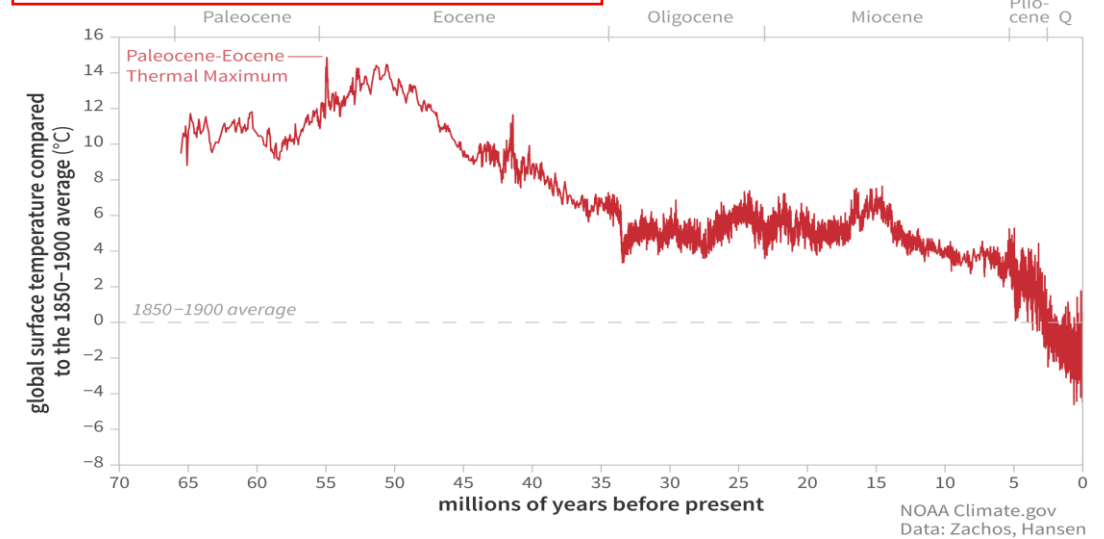


It's been far warmer in the past, what's the big deal?

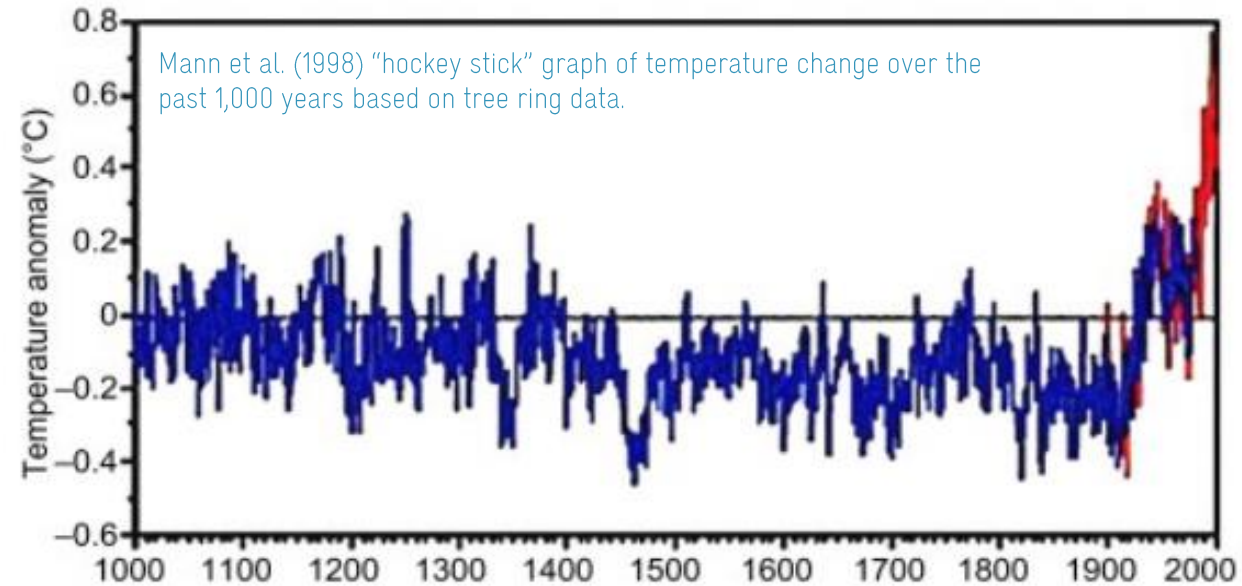
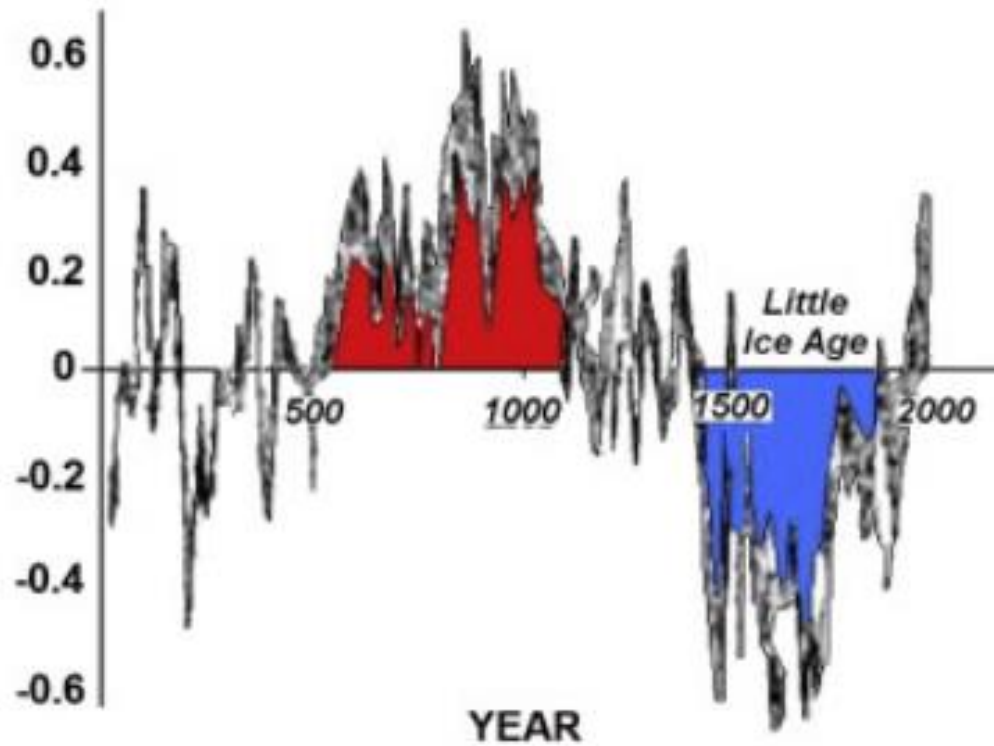
Estimated global temperature over the last 500 million years



Global temperatures over the last 65 million years



The hockey stick trick



Lack of scientific consensus that change is real/happening

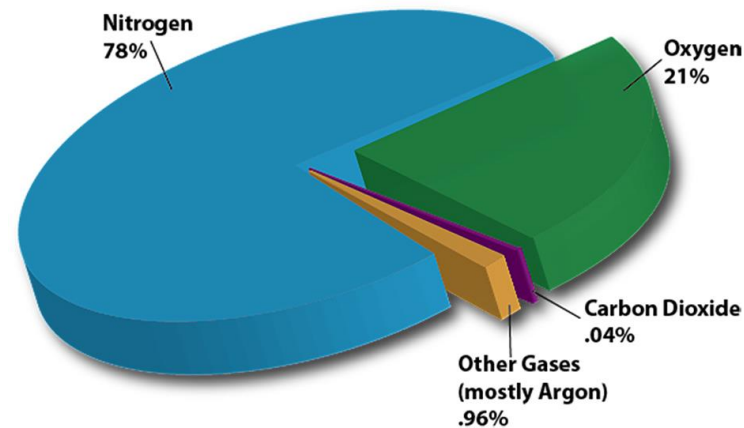
Freeman Dyson: "Current models are way too simplistic to capture what's really going on in the real world."

Ivar Giaever: "Climate change orthodoxy has become a new religion for scientists. The data aren't nearly as compelling as they should be to get this kind of conformity."

Will Happer: "The influence of CO₂ is vastly overstated and the benefits of a modest reduction in it will be negligible."

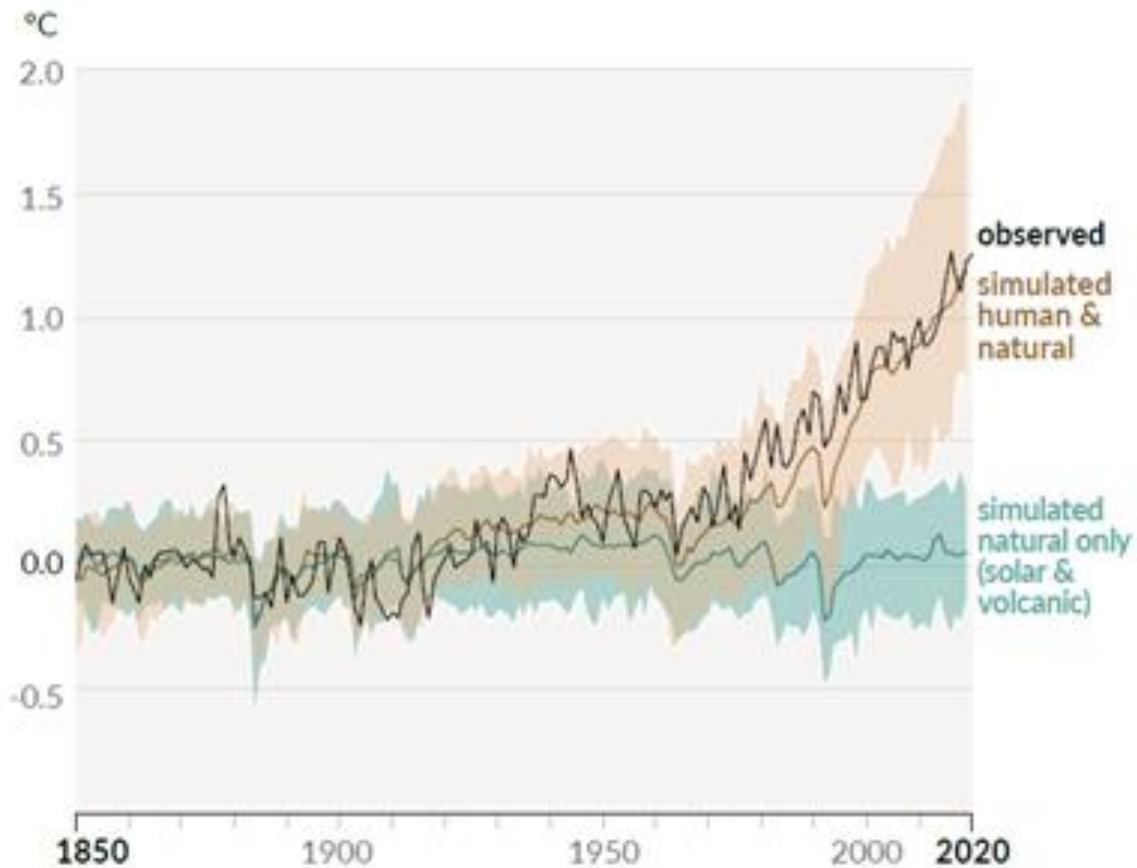
Ian Plimer: "Climate has always been driven by the Sun, the Earth's orbit and plate tectonics and the oceans, atmosphere and life respond."

Composition of the Atmosphere



Natural variability can't explain it

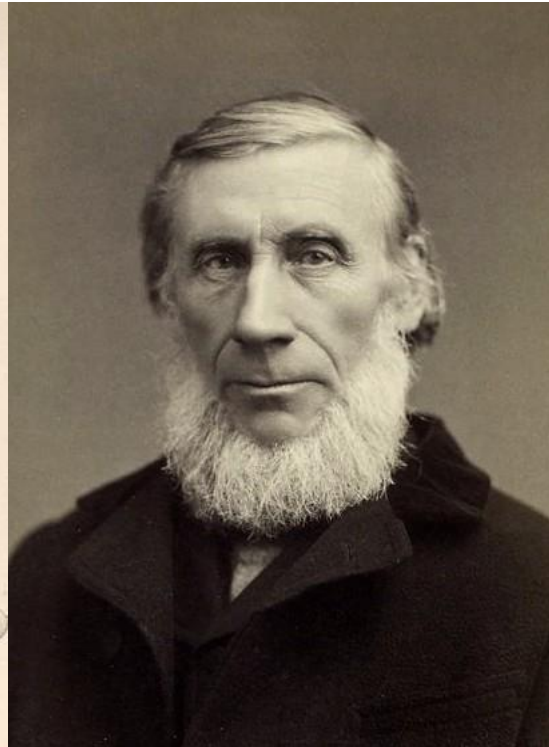
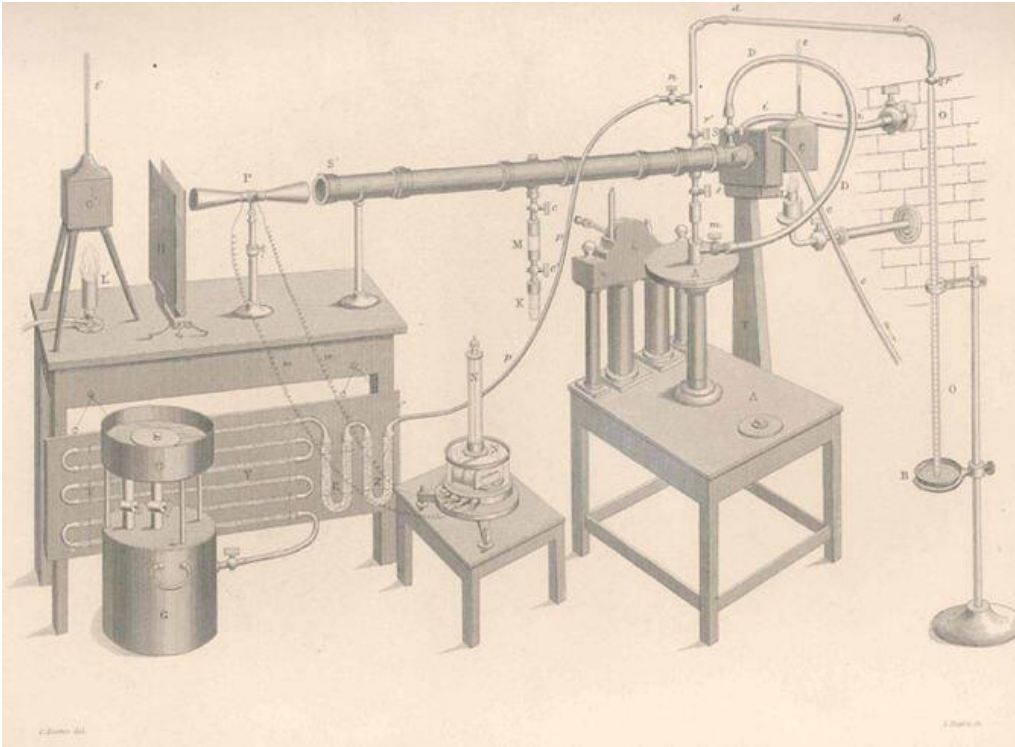
b) Change in global surface temperature (annual average) as **observed** and simulated using **human & natural** and only **natural** factors (both 1850-2020)



- You want to know why we know it's not just natural?



John Tyndall (1820-1893)



- John Tyndall 1820-1893, Physicist @ Royal Institution
- Proved that different gases had different absorptive properties of heat
- You can still see it – the very same one – mere minutes from here!



Svante Arrhenius (1859 – 1927)



The Selma Morning Times.

SELMA, ALA., WEDNESDAY, OCTOBER 15, 1902

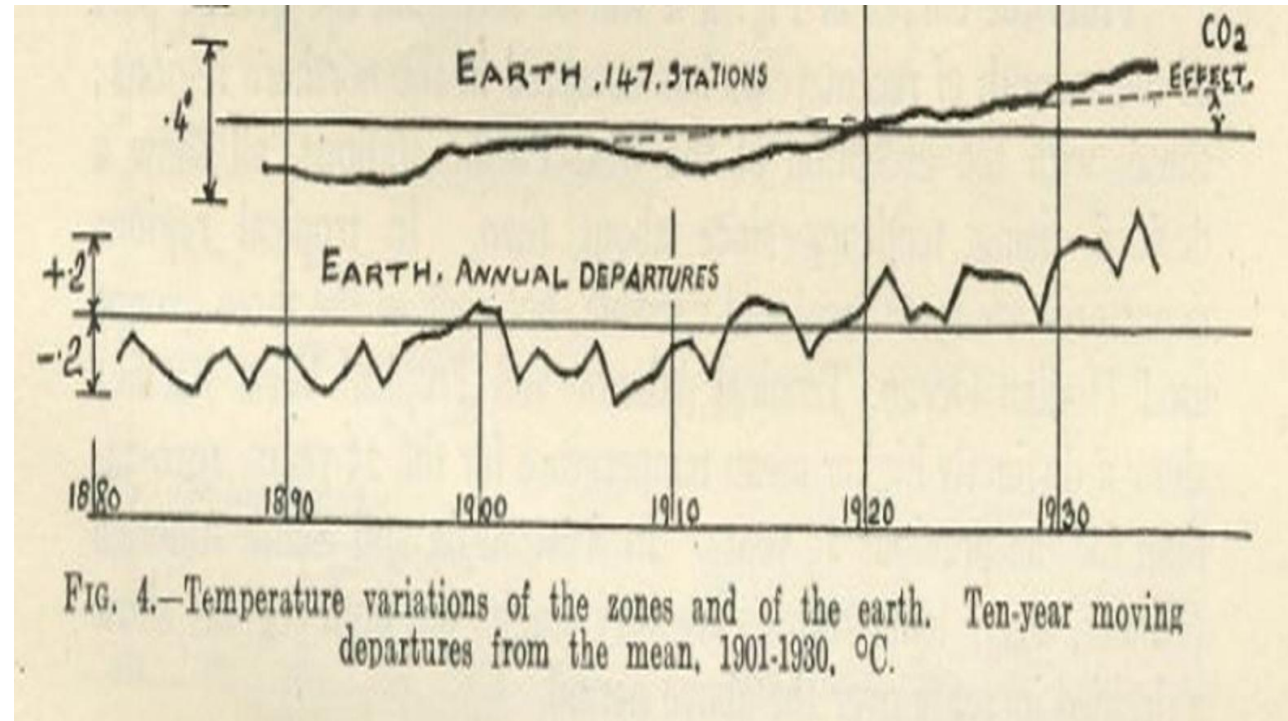
Hint to Coal Consumers.

A Swedish professor, Svend Arrhenius, has evolved a new theory of the extinction of the human race. He holds that the combustion of coal by civilized man is gradually warming the atmosphere so that in the course of a few cycles of 10,000 years the earth will be baked in a temperature close to the boiling point. He bases his theory on the accumulation of carbonic acid in the atmosphere, which acts as a glass in concentrating and refracting the heat of the sun.

- 1902 – in an ALABAMA newspaper, no less!
- The greenhouse effect – ever heard of it? One of the best analogies ever



Guy Callendar (1898 – 1964)



- 1938 – first to show that earth's atmosphere had warmed 0.3degC in conjunction with a rise in atmospheric CO₂ over 50 years.
- Evaluated that climate sensitivity was ~2degC – still within IPCC ranges!

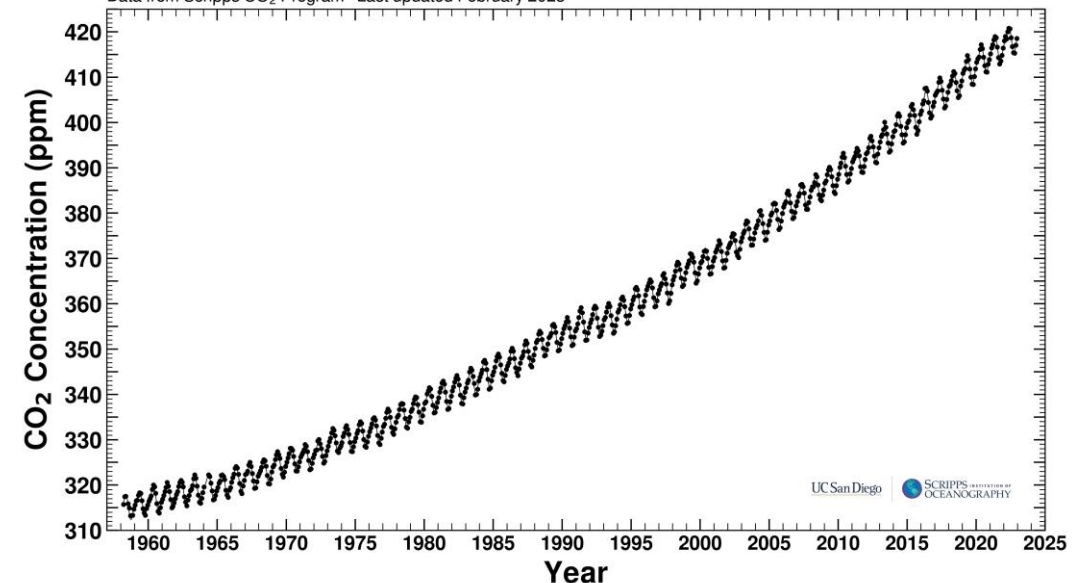


Charles Keeling (1928-2005)

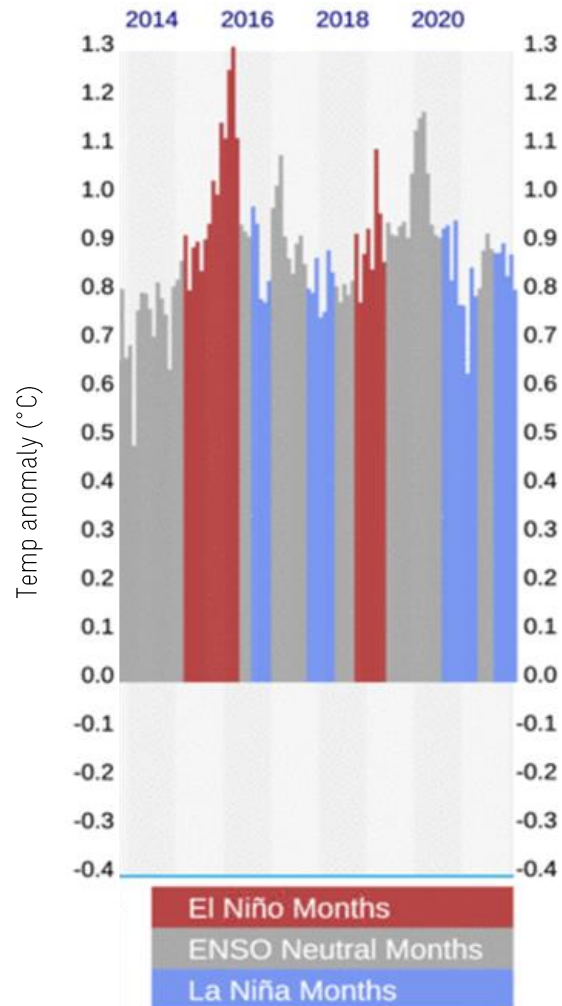
- Charles Keeling, 1961, was able to show the seasonal CO₂ variations at Mauna Loa, and the underlying trend.
- Put it all together John! This is over 150 years of stable science! It's still the same!



Mauna Loa Observatory, Hawaii
Monthly Average Carbon Dioxide Concentration
Data from Scripps CO₂ Program Last updated February 2023



Look at impact of CC on hazards... IPCC have low confidence...

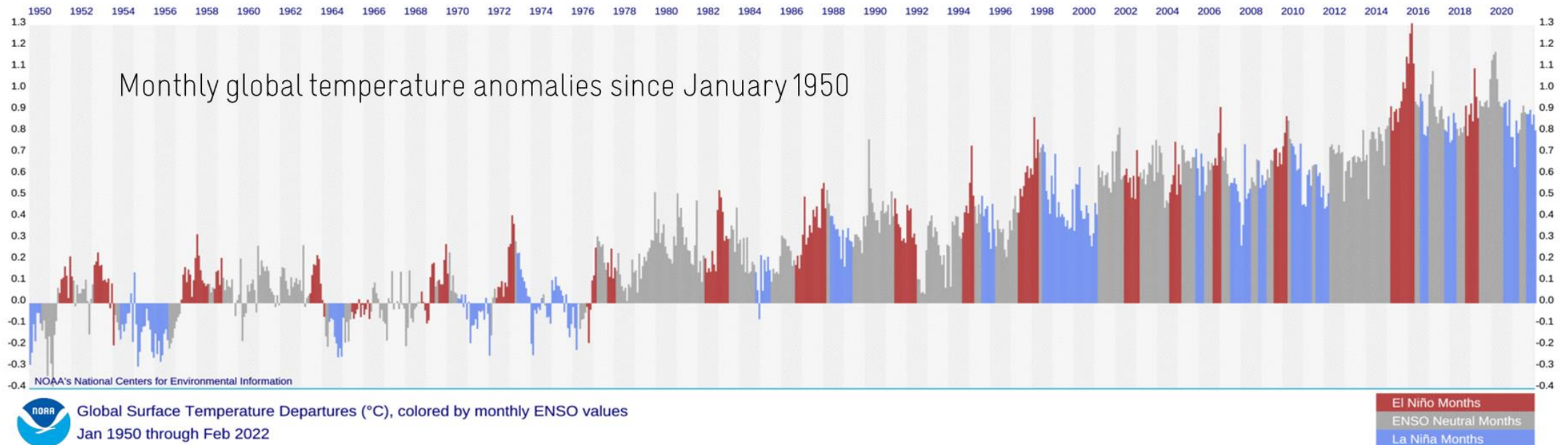


IPCC AR6 summary on CC detection:

Hazard	Change in frequency and/or intensity?
Tropical Cyclone	Low confidence
Extra Tropical Cyclone	Low confidence
Flood	Low confidence
Severe Convective Storm	Low confidence
Wildfire	Medium confidence*



Hang on – I know that plot – is it this one?



It's too simplistic to reduce everything to two-word confidence statements

- You have to drill into each peril & each region to understand things properly.
- Frankly I only think scientists do it because people like you demand it.
- So why don't we do that, rather than bicker about these abstract/high level concepts
- And let me be gracious this time – you can kick us off. Why don't you give us your enlightened opinion on what is happening with hurricane?



Hurricane (Tropical Cyclone)



Big ones nothing to do with *change*



Galveston 1900



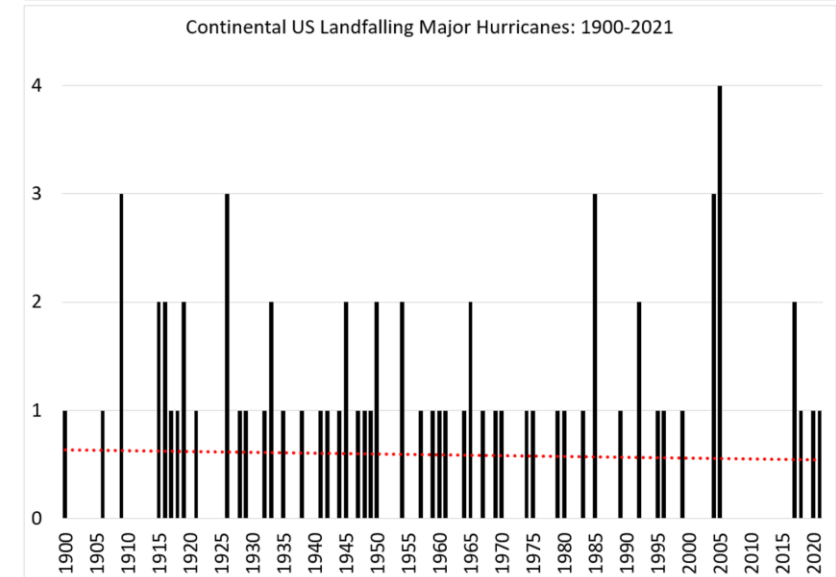
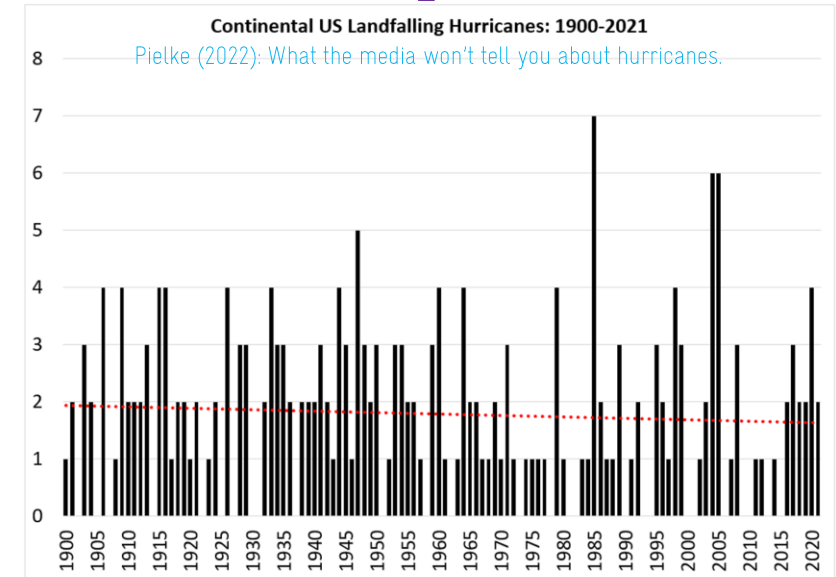
Miami 1926



Camille 1969



We're just witnessing natural variability



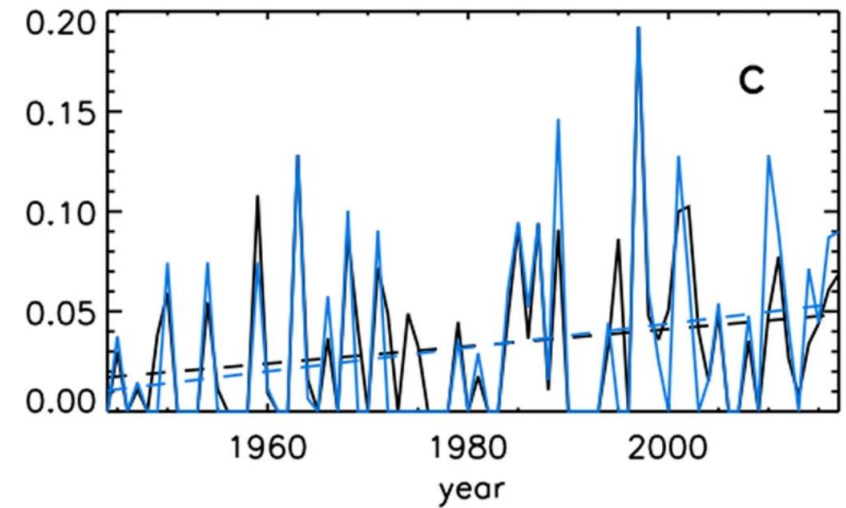
I'm not saying we haven't had hurricanes

- I'm saying the likelihood is increasing, not that it's easy to detect – these are rare events!
- But what about specifics of recent events?
 - Slowdown?
 - Rainfall?
 - Rapid Intensification?

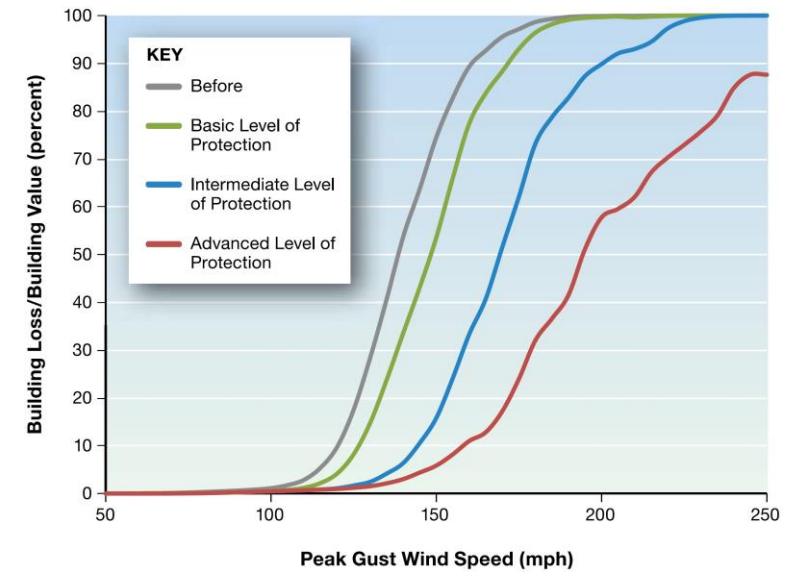
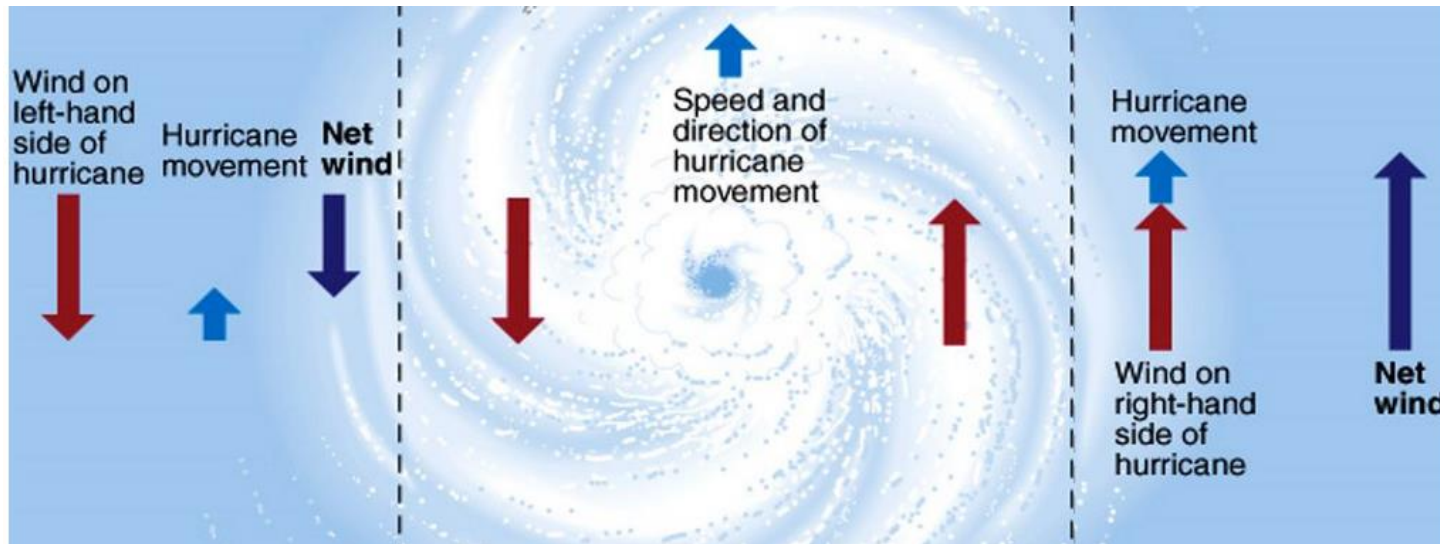


TC Slowdown and Harvey, 2017

- Hall & Kossin 2019 – number of stalling hurricane trends (>48hrs) near the US coastline
- Know what it probably leads to? This:

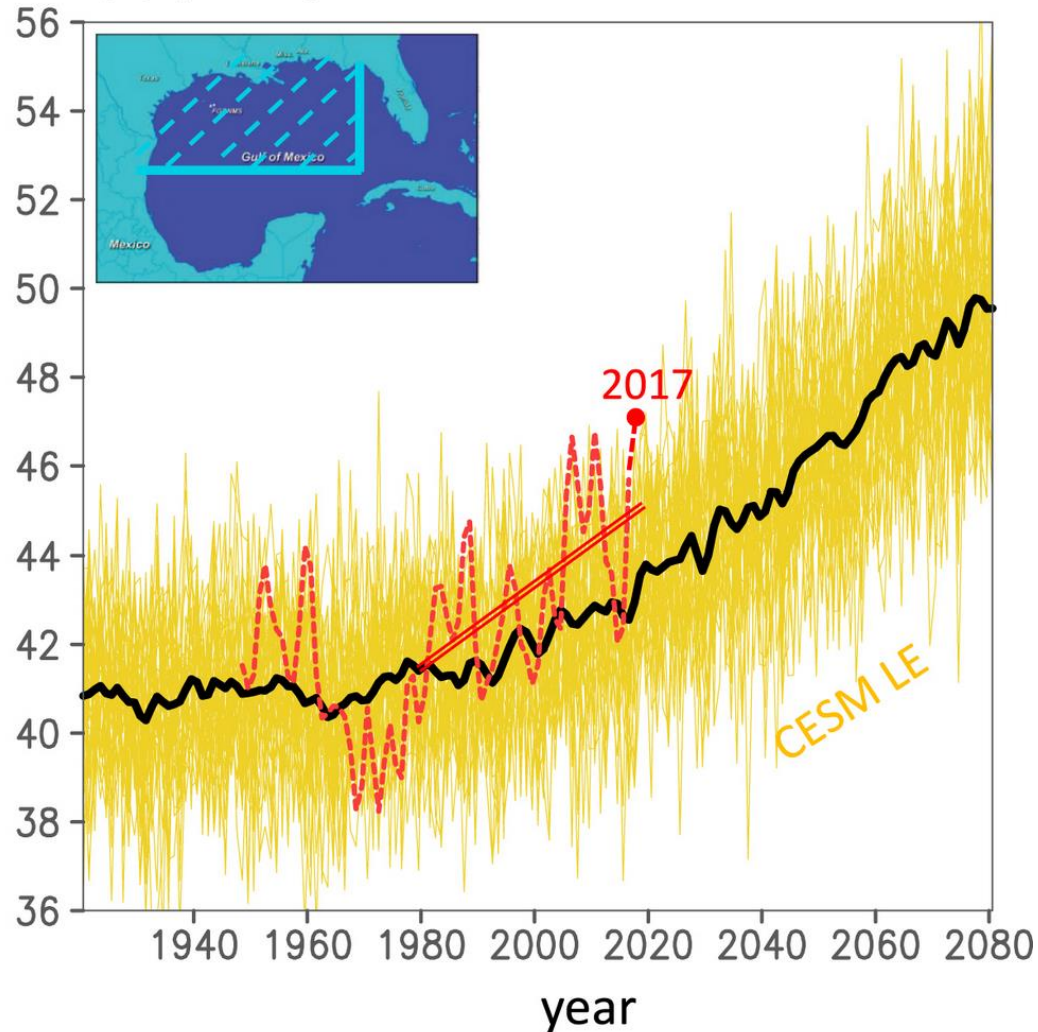


Slowdown could be looked at the other way – what about a reduction in top end windspeed?



TC Rainfall and Harvey

(c) precipitable water



- Well hang on, if you're not going to hear the slowdown argument, what about rainfall changes in the background climate?
- (Wang et al., 2018)

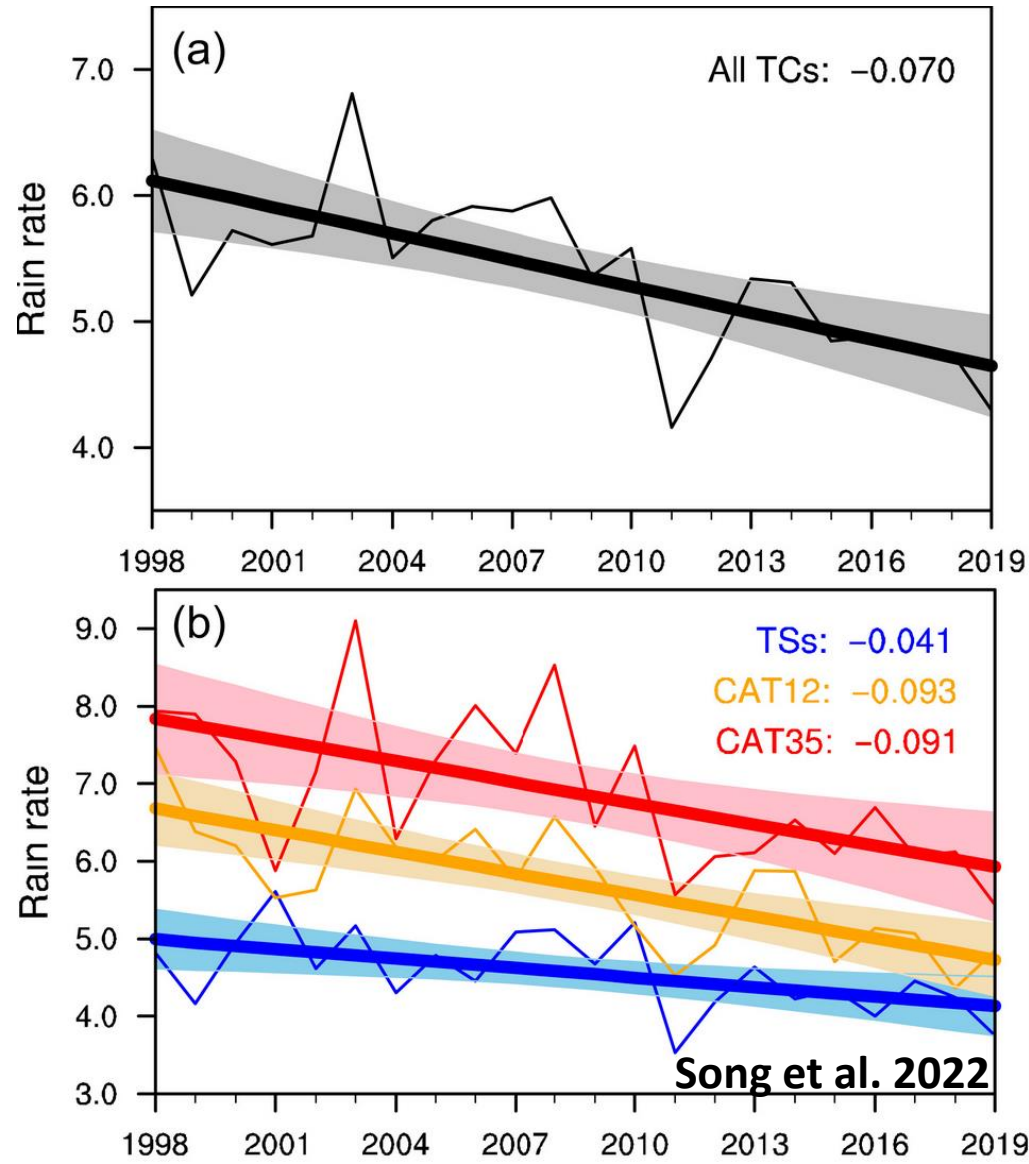
CLIMATE CHANGE

Global Warming Tied to Hurricane Harvey

Harvey's record rainfall was three times more likely than a storm from the early 1900s



Inner Core Rain Rate TCs



Rapid Intensification & Otis



- Only have to look a few weeks back to see climate change impacts!
- Otis went from cat 1 to cat 5 in less than 12hours!

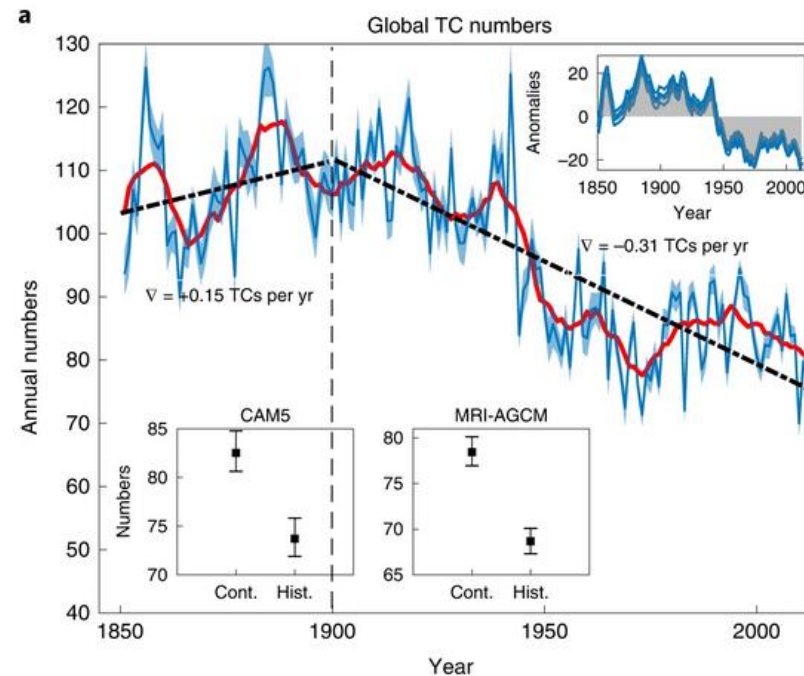


But all evidence points to less TC hazard...

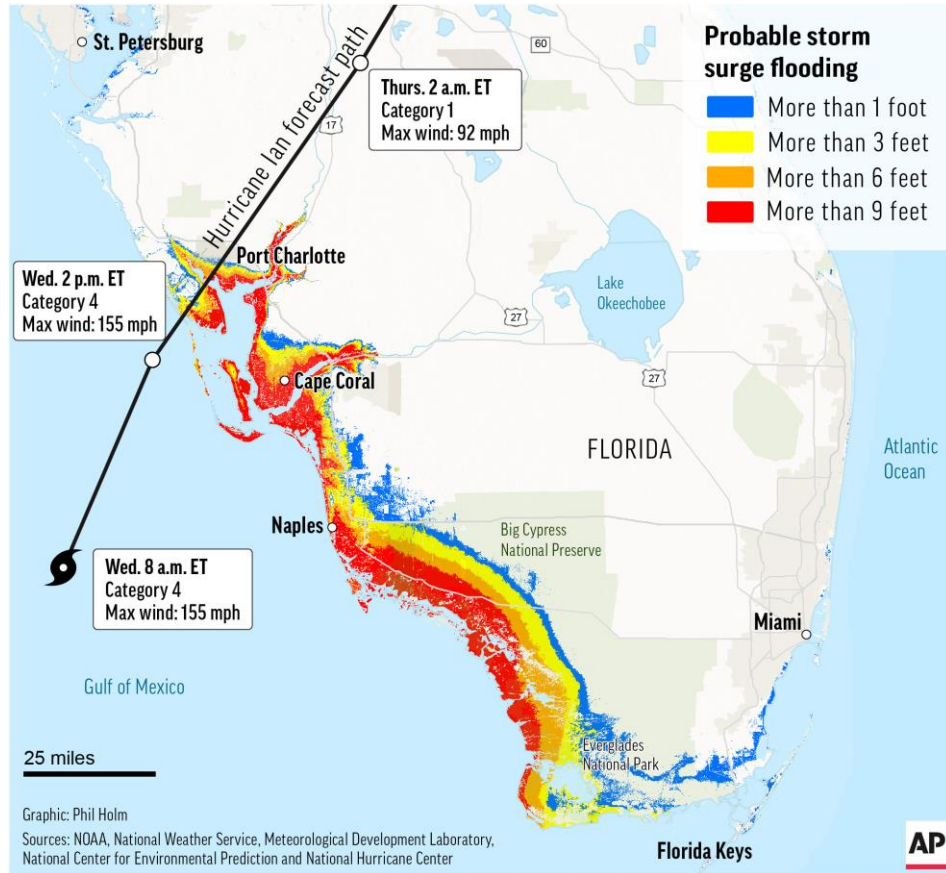
Declining tropical cyclone frequency under global warming

[Savin S. Chand](#) , [Kevin J. E. Walsh](#), [Suzana J. Camargo](#), [James P. Kossin](#), [Kevin J. Tory](#), [Michael F. Wehner](#), [Johnny C. L. Chan](#), [Philip J. Klotzbach](#), [Andrew J. Dowdy](#), [Samuel S. Bell](#), [Hamish A. Ramsay](#) & [Hiroyuki Murakami](#)

Nature Climate Change **12**, 655–661 (2022) | [Cite this article](#)

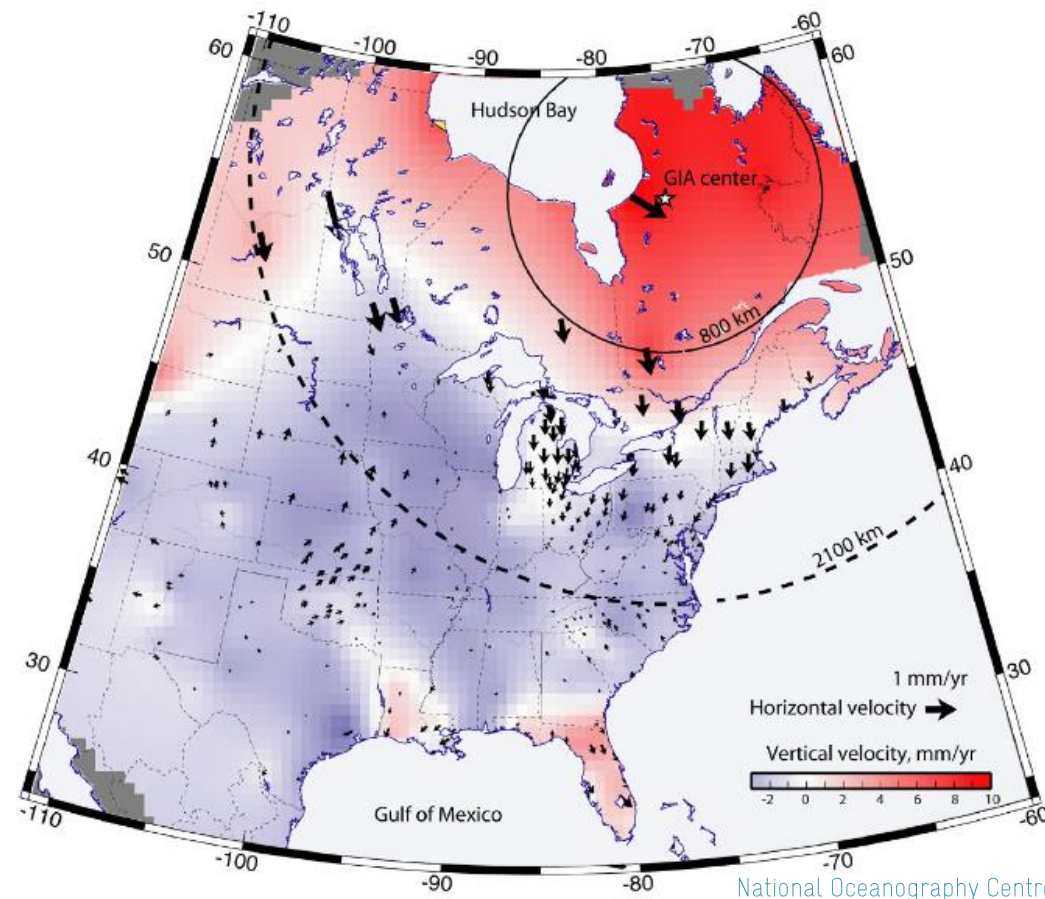


Ian + Surge



Sea level rise should be called SL *change*

Uplift Rate from GPS



National Oceanography Centre, 2017



Flood



Europe/Germany Floods 2021

European officials say ‘climate change has arrived’ as deadly floods engulf entire towns



By [Angela Dewan](#), Nadine Schmidt and Ulrike Dehmel, CNN

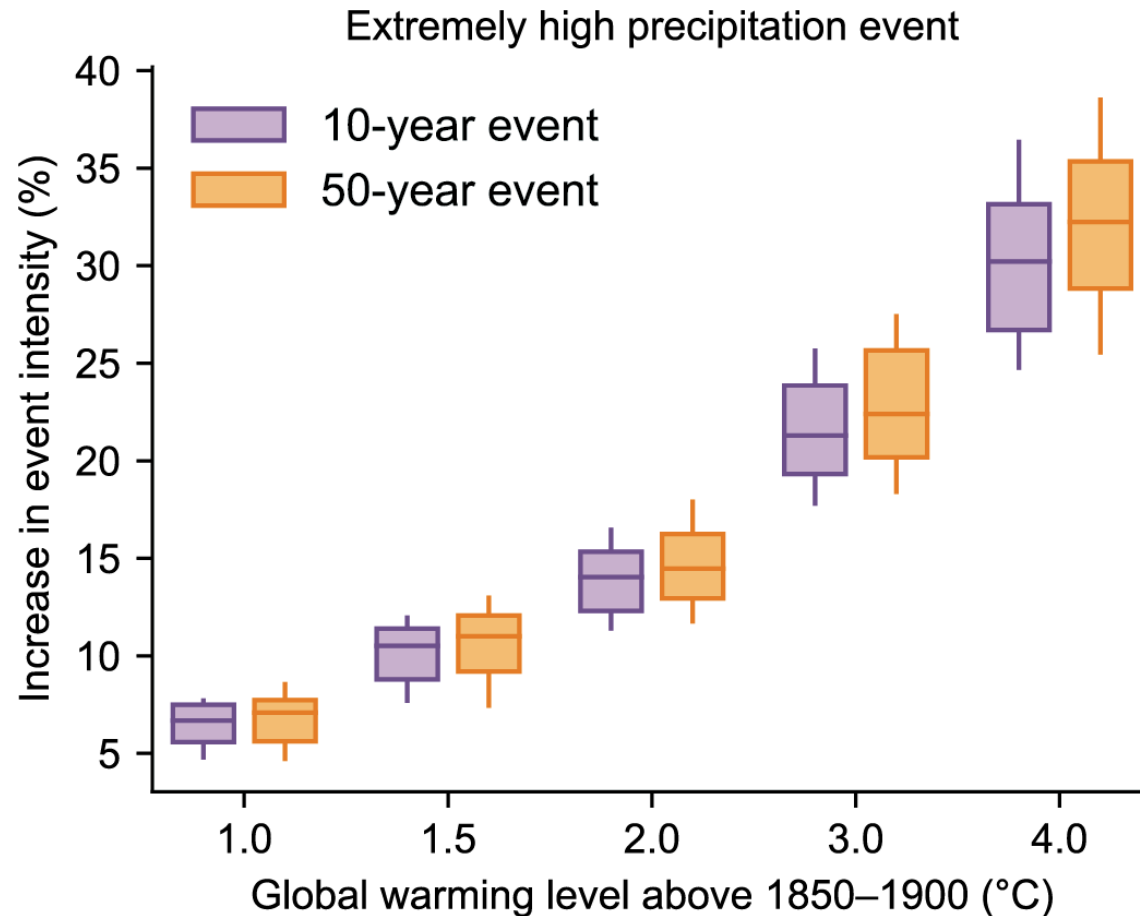
Updated 2:14 PM EDT, Fri July 16, 2021



Try arguing with me here then.
Did you see this devastation?
Just one of so many recent
flood disasters, as I've
described already.



Linked so clearly to precipitation change



- From IPCC AR6
- Explained by simple physics!
- Also – it occurs on the drought side of the distribution too – in general, longer between rainfall events in a warmer climate



Flood disasters aren't natural

- Human activity has significantly altered natural drainage processes, often leading to greater flood risk...
 - **Urbanisation**: constructing buildings and surrounding roads and paths creates impermeable surfaces which increase surface run-off (pluvial flooding). Drains also increase the flow of water into surrounding rivers, increasing the (fluvial) flood risk.
 - **Changing land use within river catchments**: natural landscapes modified for agricultural, industrial and urban purposes. When vegetation is removed, infiltration and interception reduce and surface run-off increases.
 - **River mismanagement**: channelisation (displaces downstream sections), damming (blocks sediment transport, increases erosion), embankments (can fail when floods exceed designed capacity)...
- So, really, humans are to blame for any change we see in flood disasters...



Again, stop listening to the media

- IPCC AR6

- Confidence about peak flow trends (fluvial flood) over past decades on the global scale is *low*
- *“Here is low confidence in the human influence on the changes in high river flows on the global scale. In general, there is low confidence in attributing changes in the probability or magnitude of flood events to human influence because of a limited number of studies, differences in the results of these studies and large modelling uncertainties.”*

- Media hype around flood disasters when the ‘evidence’ shows that many places are seeing less floods (but you wouldn’t know it by watching the news)

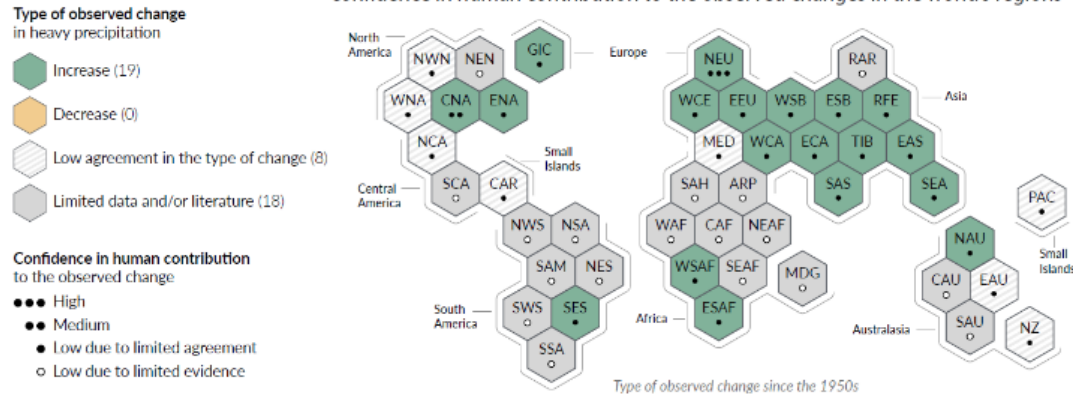
- [NPR](#): “How climate change drives inland floods”
- [The Washington Post](#): “both drought and flooding are closely tied to human-driven warming”
- [New York Times](#): “When it comes to river floods, climate change is likely exacerbating the frequency and intensity of the extreme flood events”



Let's get real about flood obs and projections

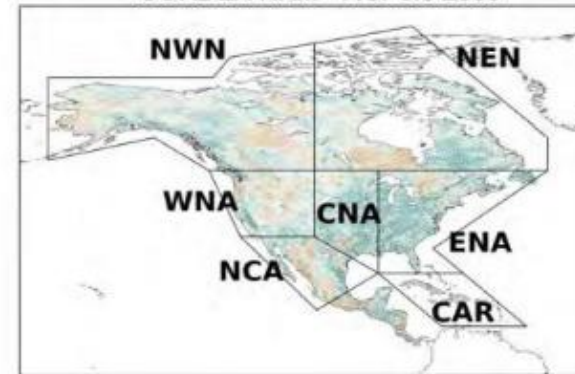
Global Observations

b) Synthesis of assessment of observed change in **heavy precipitation** and confidence in human contribution to the observed changes in the world's regions



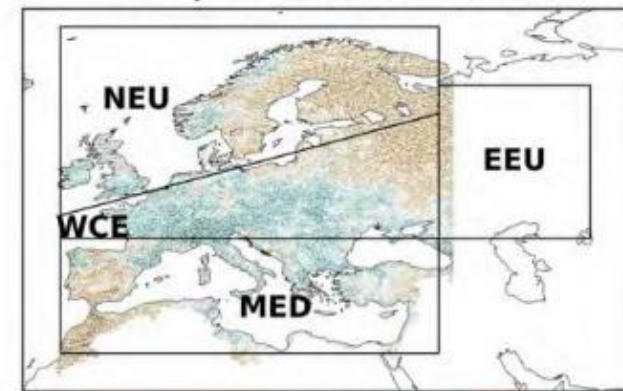
Regional Projections

1-in-100 yr river discharge per unit catchment area
CORDEX NAM - RCP8.5 2050



-0.2 -0.1 -0.05 -0.02 -0.01 0 0.01 0.02 0.05 0.1 0.2
 $m^3 s^{-1} km^{-2}$

1-in-100 yr river discharge per unit catchment area by 2050, CORDEX RCP8.5



-0.2 -0.1 -0.05 -0.02 -0.01 0 0.01 0.02 0.05 0.1 0.2
 $m^3 s^{-1} km^{-2}$

Wildfire



Scientific Paper Titles

Article

Warming weakens the night-time barrier to global fire

U.S. fires became larger, more frequent, and more widespread in the

https://doi.org/10.1038/s41586-020-2000-0
2020 Research article

Received

20

VIRGINIA

Increase in
activity
of spring
fires in
the
US

Anthony

Warmer and Drier Fire Seasons Contribute to Increases in Area Burned at High Severity in Western US

Climate change is increasing the likelihood of extreme autumn wildfire conditions across California

S. A.

Michael Goss^{10,1} , Daniel L Swain^{2,3,4} , John T Abatzoglou^{5,6} , Ali Sarhadi¹ ,

Crysta

Global increase in wildfire risk due to climate-driven declines in fuel moisture

Todd M. Ellis , David M. J. S. Bowman, Piyush Jain, Mike D. Flannigan, Grant J. Williamson



The Impact

Figure 25.4 Climate Change Has Increased Wildfire ✕

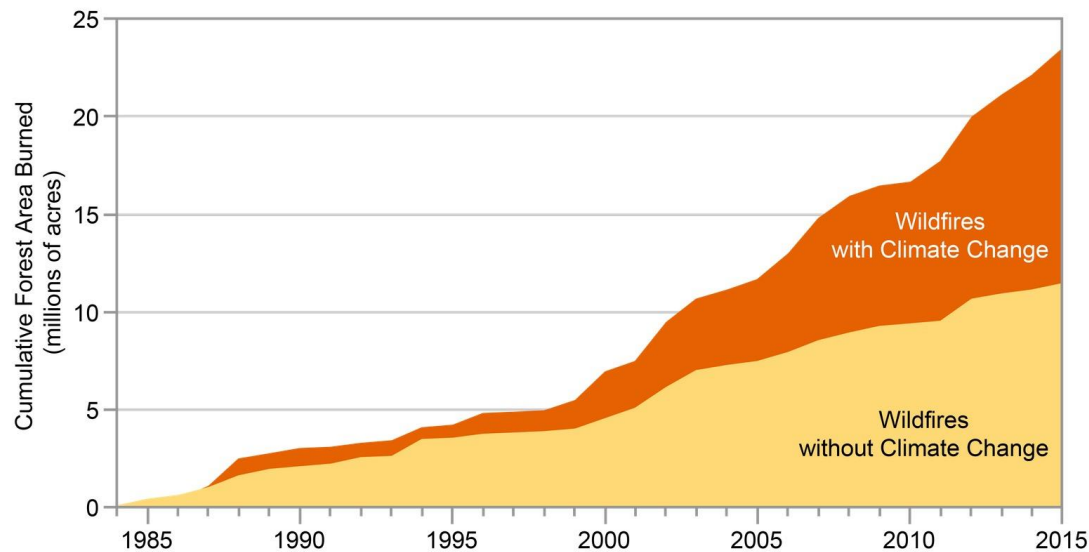
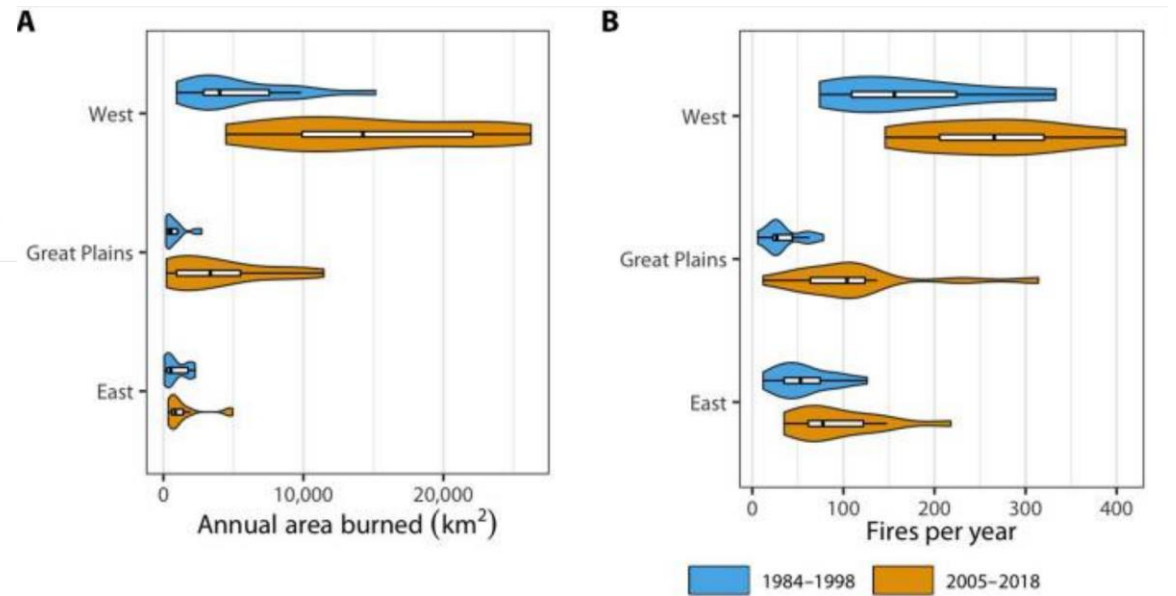


Figure 25.4: The cumulative forest area burned by wildfires has greatly increased between 1984 and 2015, with analyses estimating that the area burned by wildfire across the western United States over that period was twice what would have burned had climate change not occurred. Source: adapted from Abatzoglou and Williams 2016.⁷

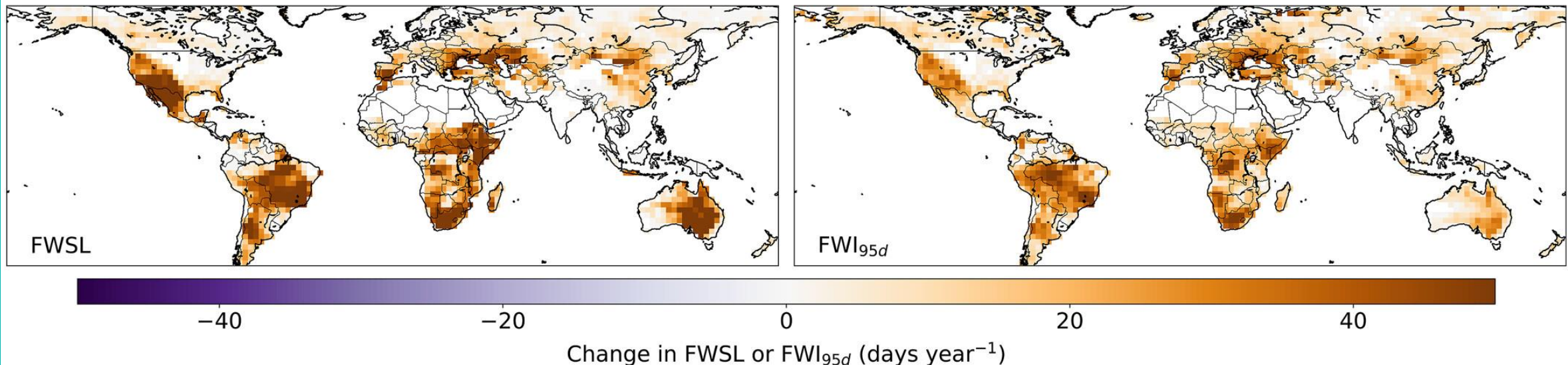


- Frequency of large fires (≥ 1000 acres) has **increased**
- average fire size has **increased**
- average burn duration has **increased**
- number of fire weather days have **increased**
- fire season length has **increased**
- night fires are burning **hotter**



Global Fire Weather

- Jolly et al. (2015): showed that fire weather season length (FWSL) lengthened across 25% of the Earth's vegetated surface during 1979–2013, leading to a 19% increase in global mean FWSL
 - increasing trends in FWSL in the range of 5%–7% per decade

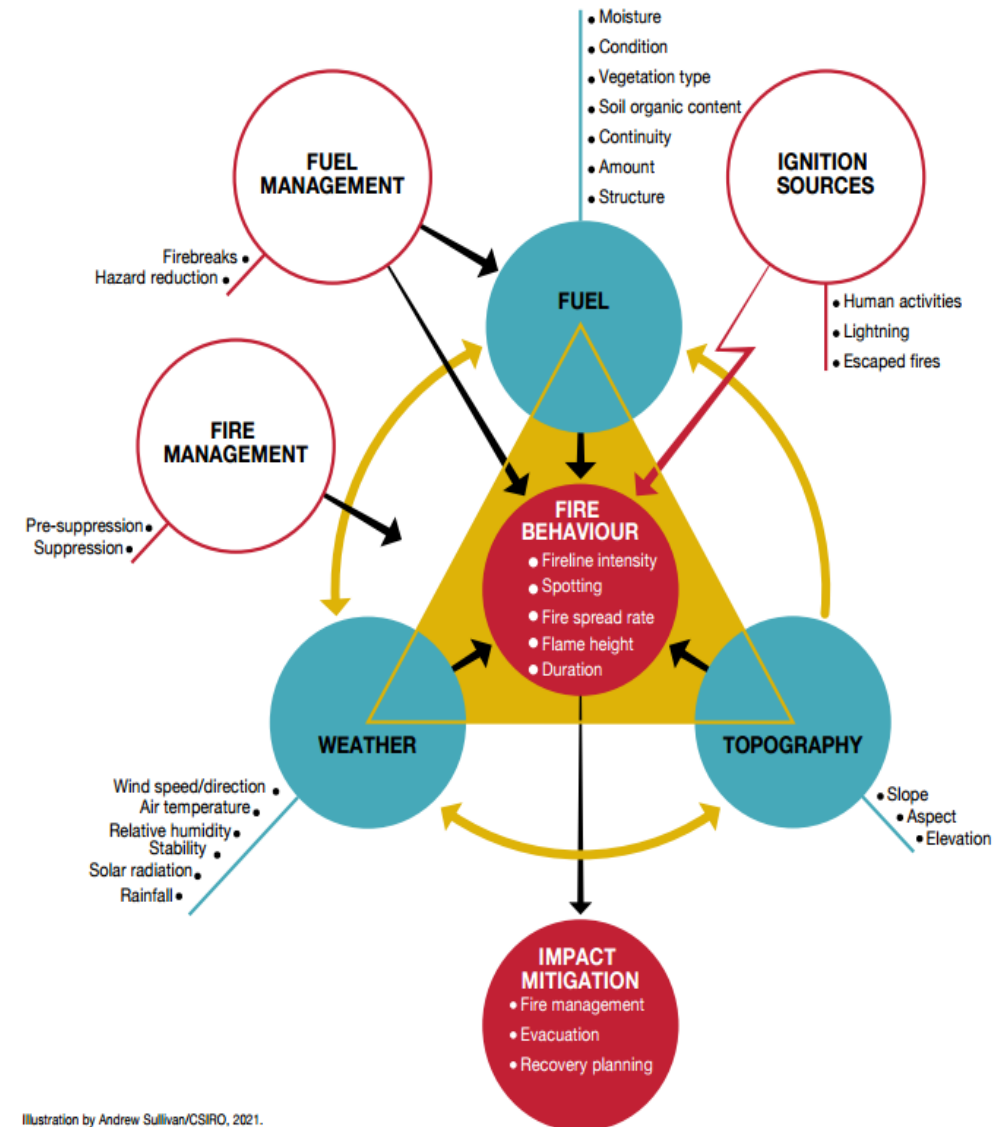


It's not so simple...

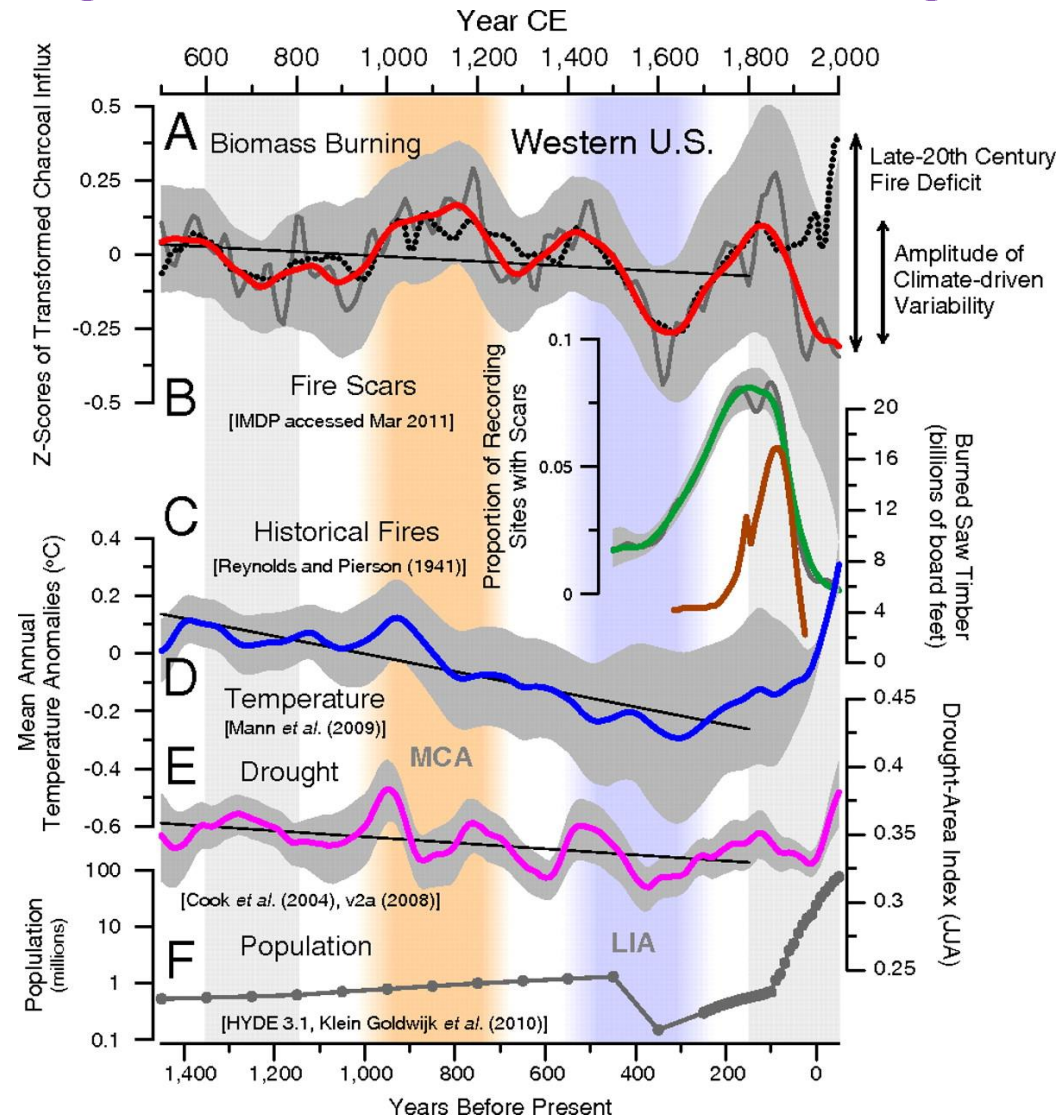
- IPCC AR6

- There is **medium confidence** that weather conditions that promote wildfires (fire weather) have become more probable in southern Europe, northern Eurasia, the US, and Australia over the last century.
 - No definitive change in overall global frequency/intensity due to short length of high-quality data records

Factors and conditions influencing wildfire occurrence



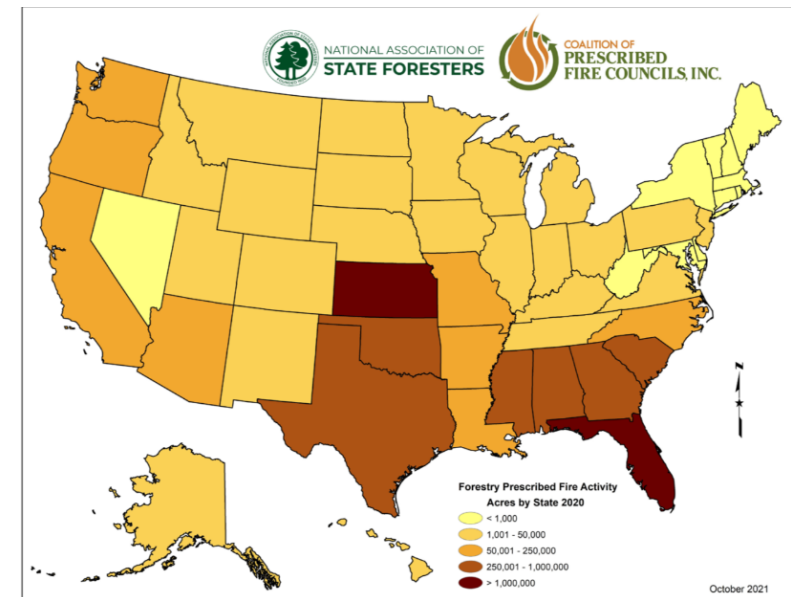
Current burning but a mere smidgen



Humans will prevail

- As with other perils, humans will overcome the wildfire problem through adaptation
 - Better building practices
 - Community efforts e.g. FireWise (US) and FireSmart (Canada)
 - Harsher penalties for negligent ignitions
 - Prescribed burning...

More prescribed fire in the western US could solve all their problems!



Losses

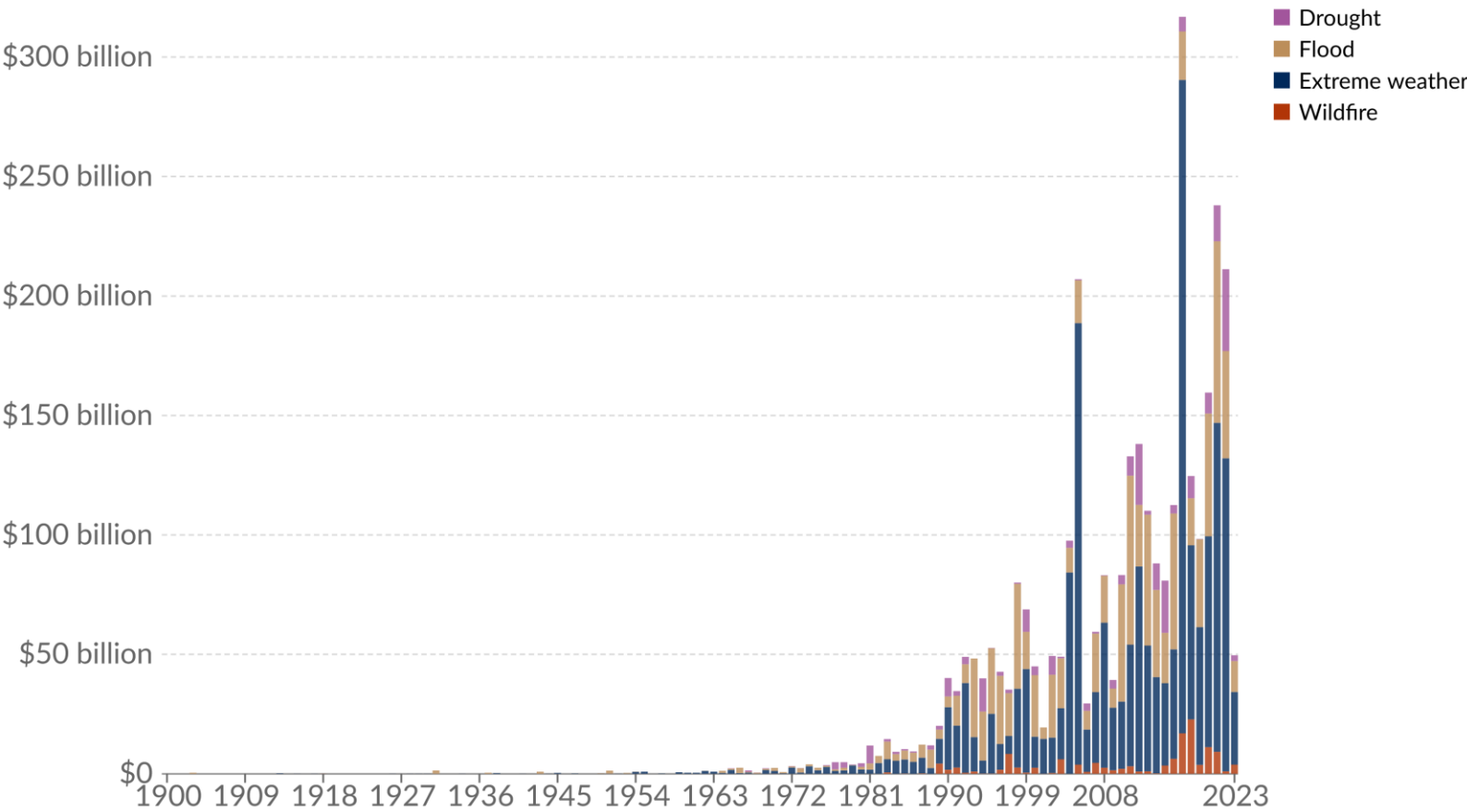


Massive increase in losses through time

Economic damage by natural disaster type, 1900 to 2023



Global economic damage from natural disasters, differentiated by disaster category and measured in US\$ per year.



Data source: EM-DAT, CRED / UCLouvain (2023)

Note: Data includes disasters recorded up to September 2023.

OurWorldInData.org/natural-disasters | CC BY



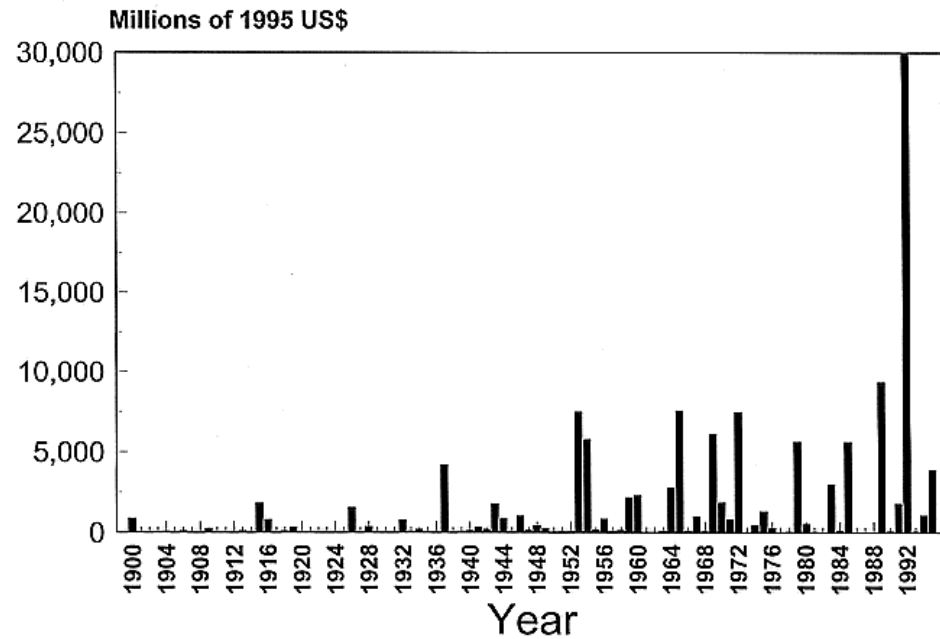
Trends disappear when normalizing

- In addition to observed changes in climate, society has also undergone dramatic change in the last century
- Society changes must faster than even the most aggressive projections of climate change
- Estimates of risk that are not using the most up-to-date and accurate information on exposure and vulnerability will result in flawed risk estimates

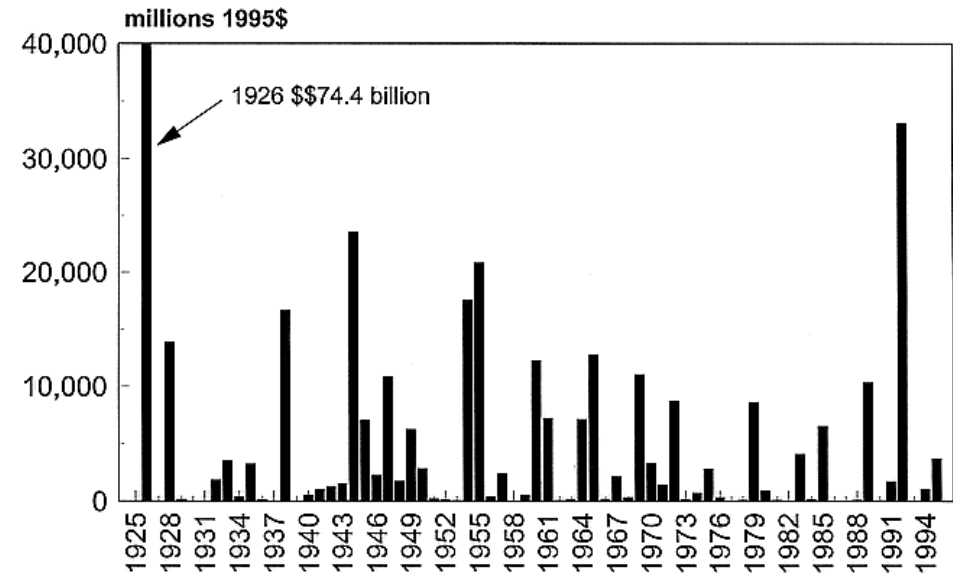


Normalizing USA Hurricane Losses

Annual Hurricane Damage 1900-1995



Annual Hurricane Damage: 1925-1995
Normalized to 1995 values



Pielke & Landsea, 1998

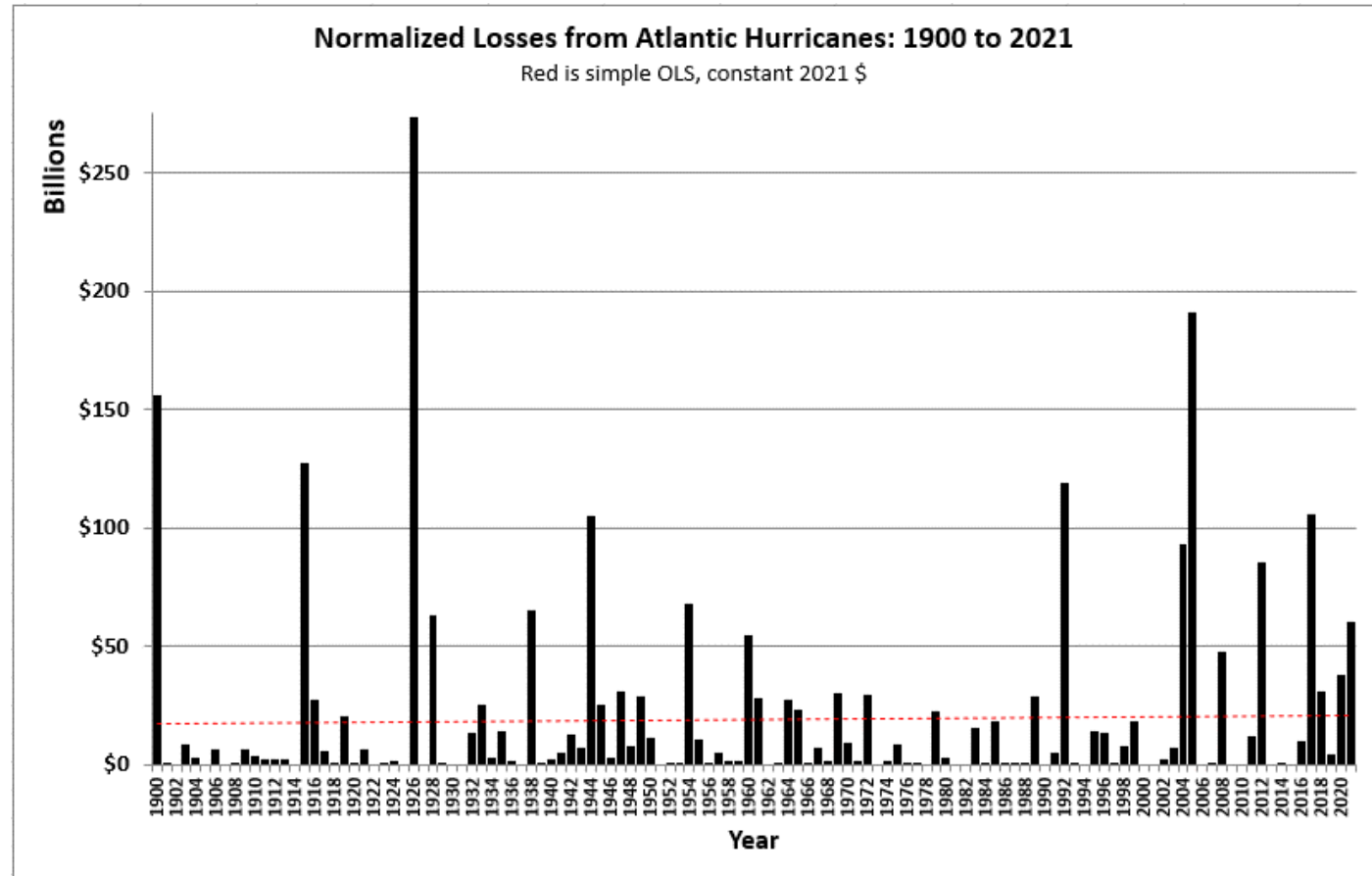


How much damage would past hurricanes cause in 2022?

Rank	Year	Hurricane	Category	States	2022 Damage (billions \$)
1	1926	Great Miami	4	AL, MS, FL	\$261.6
2	1900	Galveston	4	TX	\$153.7
3	2005	Katrina	3	FL, LA, MS, AL	\$129.7
4	1915	Galveston	4	TX, LA	\$121.8
5	1992	Andrew	5	FL, LA	\$117.6
6	2012	Sandy	1	NY	\$81.5
7	1944	Cuba-Florida	3	FL	\$81.5
8	2017	Harvey	4	TX	\$69.0
9	1938	Great New England	3	LA, NY	\$64.1
10	2021	Ida	4	LA, MS	\$62.1
11	1928	Lake Okeechobee	4	FL, GA, SC	\$60.3
12	1960	Donna	4	FL, NC, VA, NY, CT, RI, MA	\$53.7
13	2008	Ike	2	TX, LA	\$39.0
14	1954	Hazel	4	SC, NC	\$36.8
15	2005	Wilma	3	FL	\$35.4
16	2017	Irma	4	FL	\$34.4
17	2004	Charley	4	FL, SC	\$29.8
18	1969	Camille	5	LA, MS	\$29.3
19	1972	Agnes	1	FL, MD, NY, PA, VA	\$28.8
20	2004	Ivan	3	AL, FL	\$28.7
21	1989	Hugo	4	SC, NC	\$27.8
22	1961	Carla	4	TX	\$27.8
23	1949	Florida	4	FL, GA	\$26.8
24	1947	Fort Lauderdale	4	FL, LA, MS	\$26.6
25	1954	Carol	3	NC, NY, CT, RI, MA	\$26.1

Pielke & Landsea: \$74.4 billion in 1995

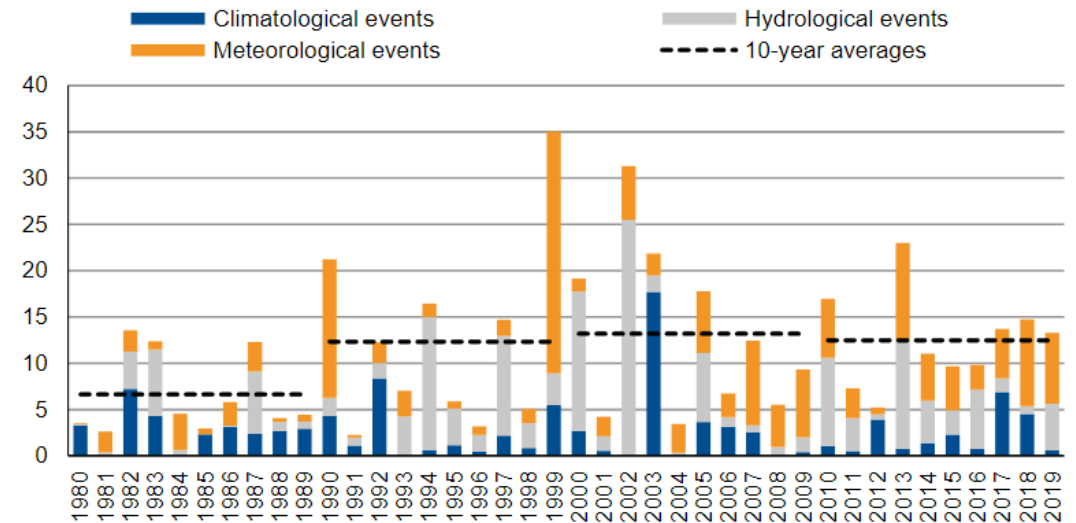
1900-2021 Hurricane Losses (in 2021 USD)



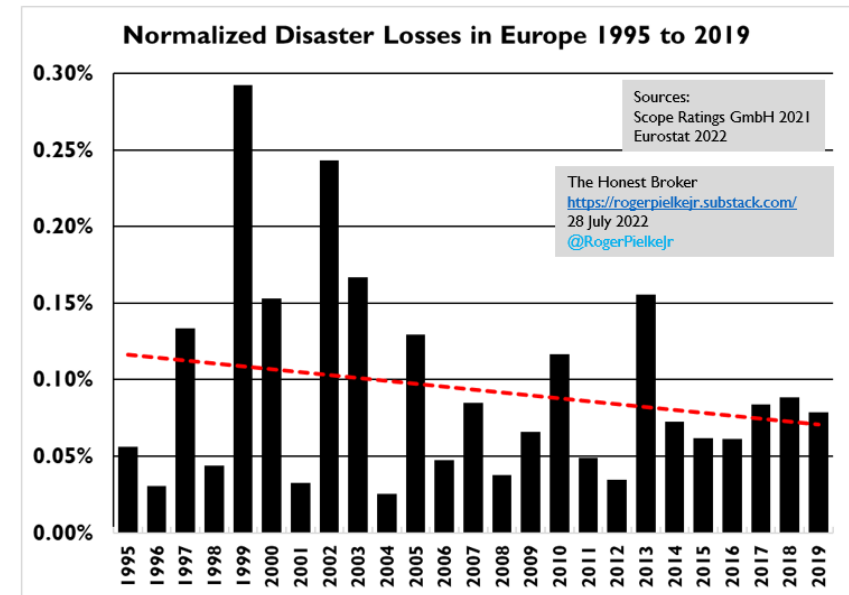
What about Europe?

- From 1990 there is no overall trend up or down.
- Over the 25-year period from 1995 to 2019, Europe's disaster losses as a proportion of GDP decreased significantly, by almost half.

Figure 1. Economic damage caused by extreme climatic events in EEA countries
EUR bn



Source: EEA, Scope Ratings GmbH



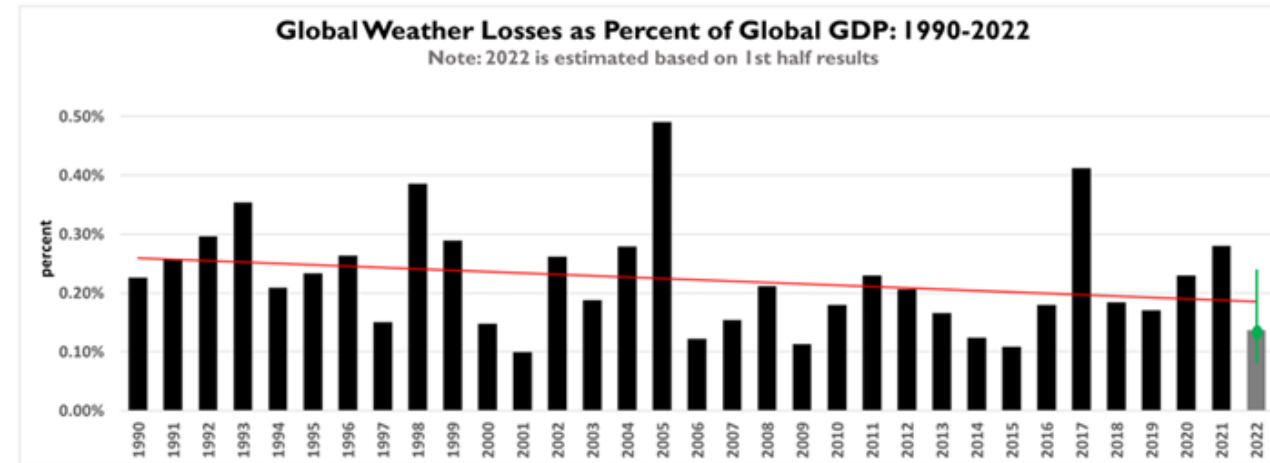
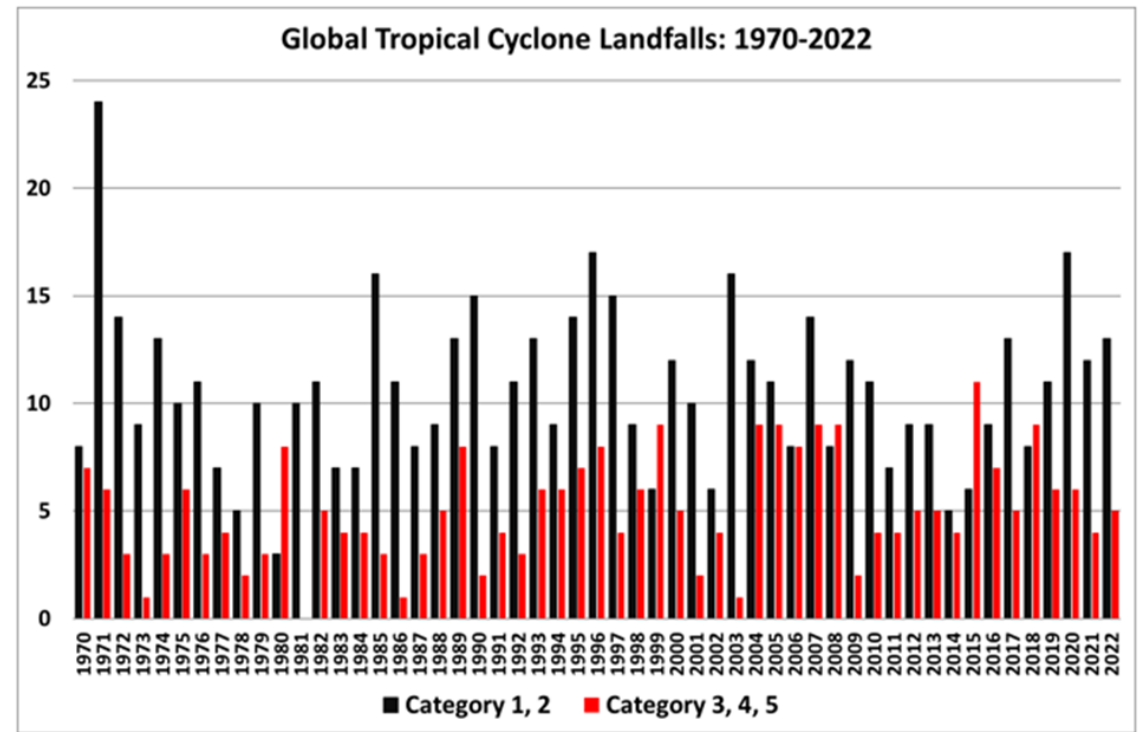
Sources:
Scope Ratings GmbH 2021
Eurostat 2022

The Honest Broker
<https://rogerpielkejr.substack.com/>
28 July 2022
@RogerPielkejr



Global?

- No upward trend in global tropical cyclone landfalls...
- Most studies to date show that climate- and weather-related losses have remained largely constant after normalization.



Sources:
Munich Re, World Bank, Aon



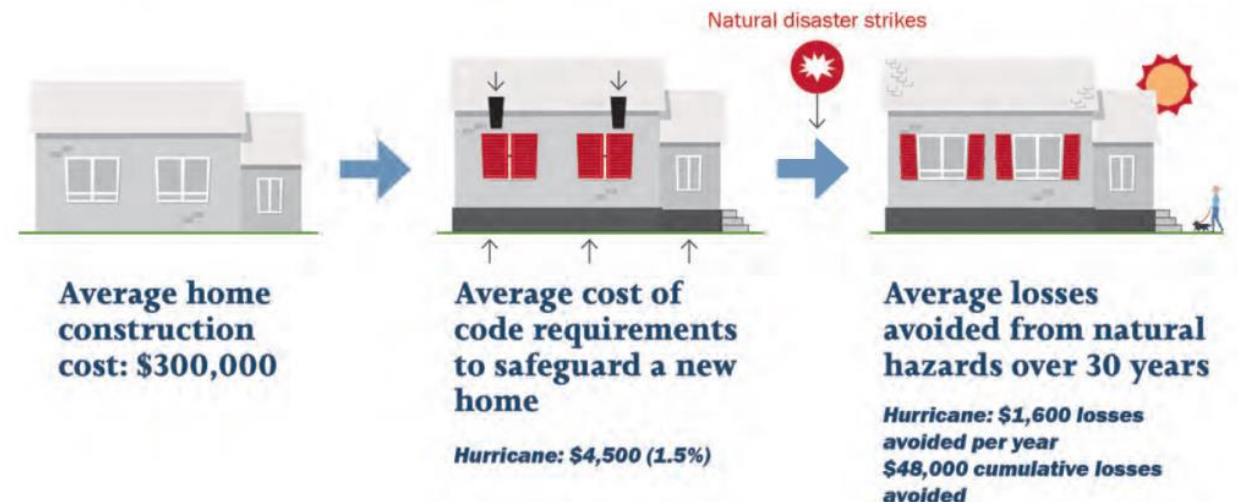
Missing key info from these normalizations

- You aren't taking all key aspects of risk into account, John!

$$\text{Risk} = f(\text{Hazard}, \text{Exposure}, \text{Vulnerability})$$

- Newer building stock is generally less vulnerable...
- If you're not seeing a trend in these data without vulnerability accounted for, that may mask a climate trend!

Building Codes Generate Big Benefits at a Low Cost



FEMA 2020: Every \$1 spent on mitigation in new building code construction saves \$11 in disaster repair and recovery costs



Final Thoughts: Middle Ground?



Final Thoughts

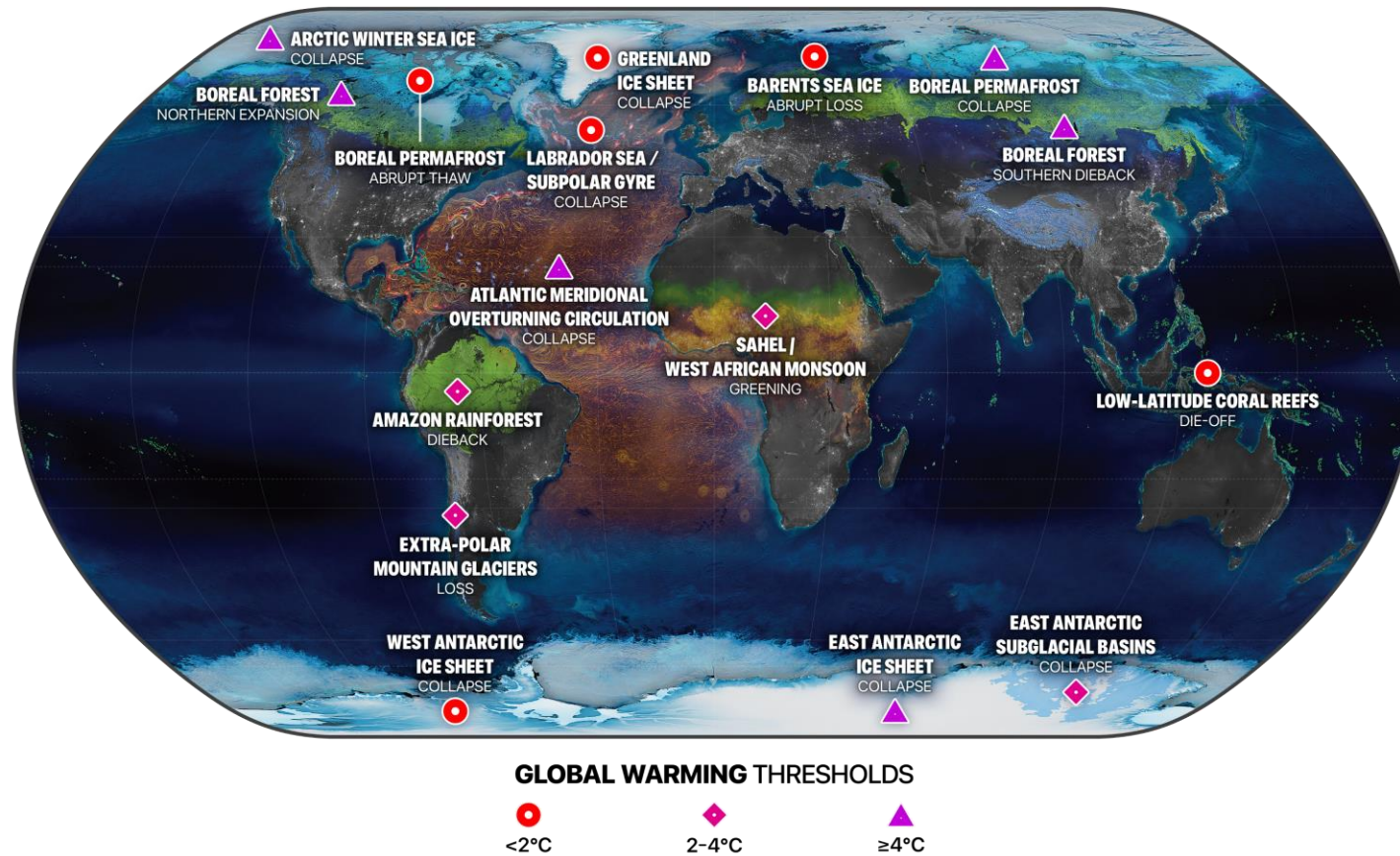
- Anthropogenic climate change is indisputable, it's been well-known for >50years, and was from science that evolved between 1860-1960.
- Climate change and extreme weather events debates are messy! Any narrative can be spun almost any way you like. Arguments on **both** sides of the divide are often politicized.
- There are no short-term/quick narrative wins on extreme events – **risk managers need to think through a lot of angles very carefully** – be aware of who is speaking to you!
- Short term extreme events, and the nuanced/unending debates around them, are potentially distracting...



The Ghost of Climate Yet to Come...

- Armstrong-Mckay et al. (2022) suggest tipping points likely to occur from 1.5°C
 - We are currently at ~1.3 °C

CLIMATE TIPPING ELEMENTS



Thank You

