Science Topic 09-28-23

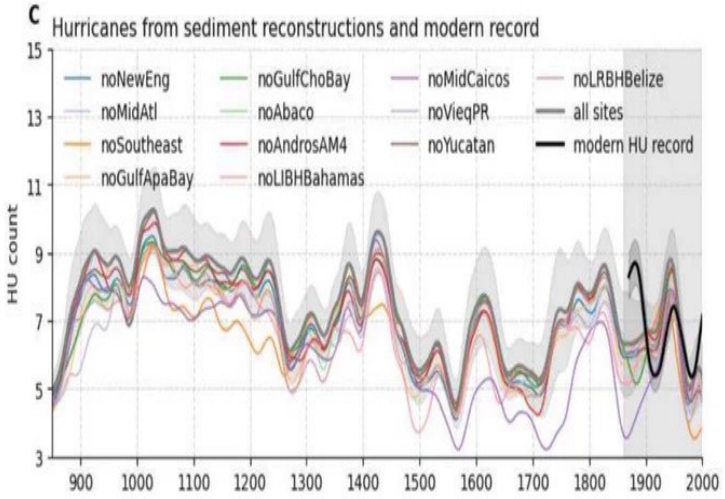
CliSciPol

Climate Science and Policy for Nonscientists

One picture is worth a thousand words.

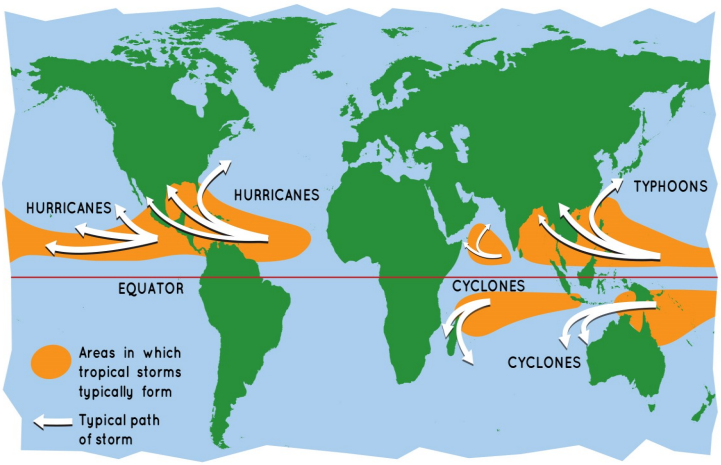
HURRICANES

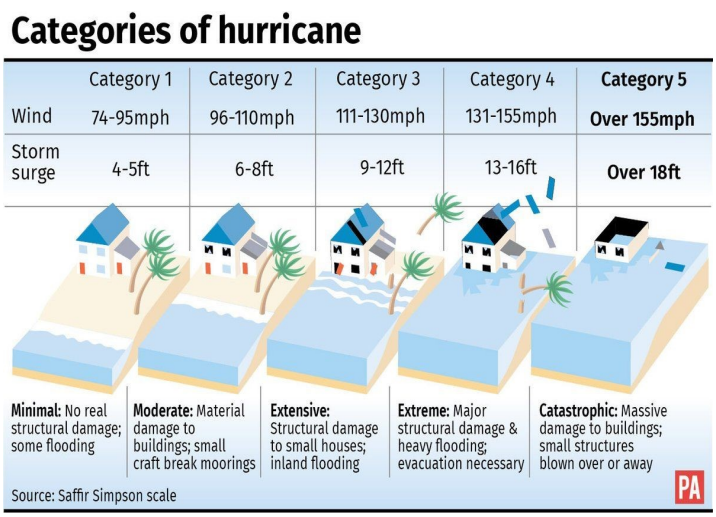
Hurricanes have been always with us and will remain so. Reconstructions as to frequency going back to the Middle Ages show frequency declining but with significant variability. Some reconstructions show hurricane frequency during the Middle Ages as much as twice recent frequencies. Hurricane frequency shows no correlation with atmospheric CO2 levels, which have been rising since around 1800 and at a significant rate since the 1950s.



Hurricanes cause about 60% of the world's total annual losses from all forms of disasters. The image shows some of the damage from the Great Miami Hurricane of 1926. Miami still has no sea walls. If that hurricane hit Miami today, it has been estimated that it would cause $266 billion in damages, which would set a new record for the greatest damage ever caused by a single hurricane.

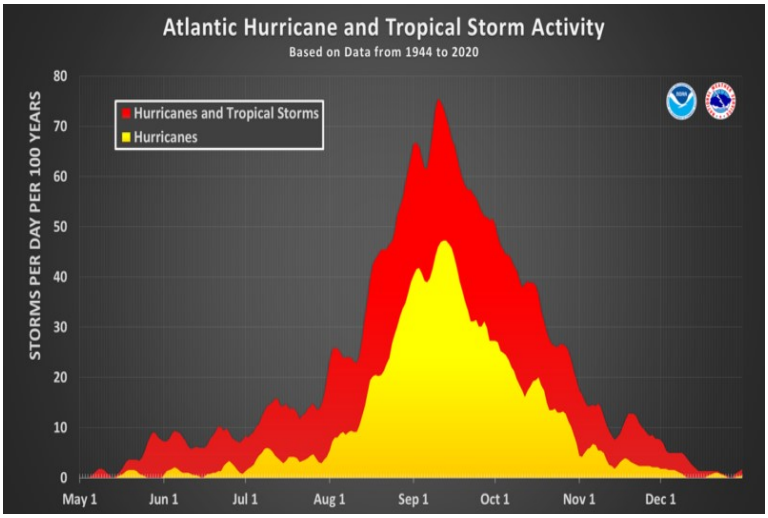
The scientific name for these events is Tropical Cyclone. But they have different names in different parts of the world. They form over the tropical oceans, typically oceans with a surface temperature of at least 80 F, and move Westward due to the rotation of the earth. If a storm reaches a wind speed of 39 mph, meteorologists give it a name.

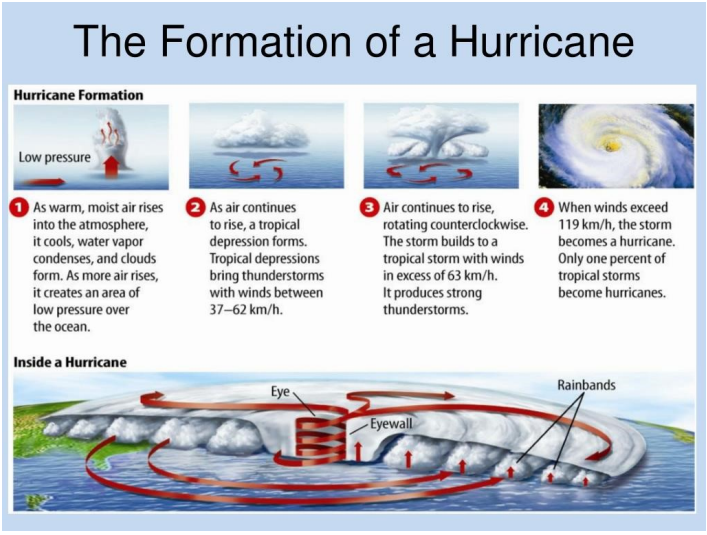




If the winds in a storm reache 74 mph, then it is classified as a hurricane. There are 5 standard categories of strength that are used. If the hurricane is Cat.3 or higher, it is considered a "major" hurricane.

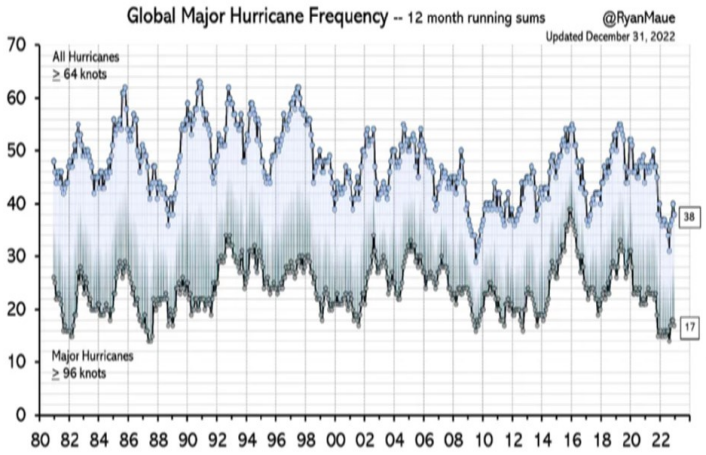
In the North Atlantic the hurricane season runs June-November with September being by far the month with greatest activity. This coincides with the warmest surface sea temperatures in the tropical Atlantic. But warm sea water is not enough alone to cause hurricanes. The yellow is the number of hurricanes. The red is the number of tropical storms





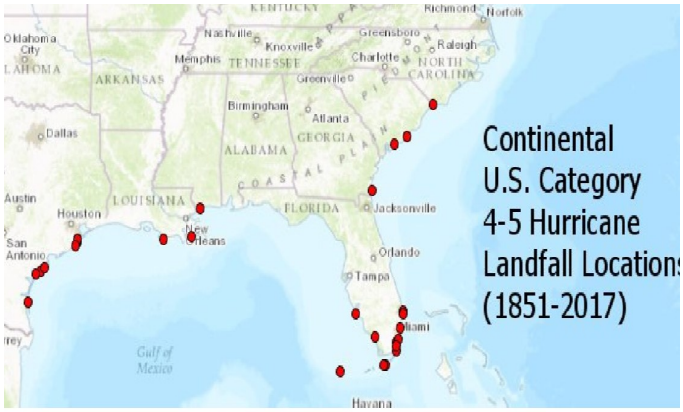
Hurricanes have a very complex structure. Barometric pressure and wind shear are significant factors in storm formation, but the exact process is not understood, and hence scientists can not predict storm formation. As noted in the image, only about 1% of storms rise to hurricane strength. Some storms last only 2 days or less.

During its lifetime a particular storm can vary greatly in its strength. The image shows the path of Katrina and its category ratings at various points along the path. When Katrina hit New Orleans, it was a Cat.3 storm. There was so much loss of life and damage, because the levees and sea walls, designed to protect against a Cat. 3 storm, failed. About half of New Orleans is 6 feet or more below sea level.



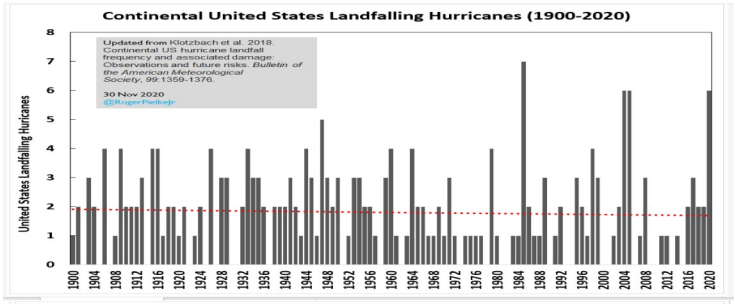
Running 12 month sums of global hurricane and major hurricane counts.

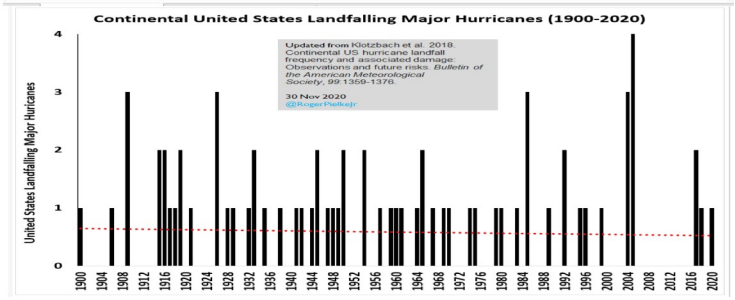
The frequency of US landfalling and major landfalling hurricanes is declining slightly. On average about 2 hurricanes hit the US each year and one major hurricane every other year. From 2005 until 2017 no major hurricane hit the US - an unprecedented period without such a hit. But hurricanes vary hugely - since 1945 there have been anywhere from 0 to 7 major hurricanes per year in the North Atlantic.



The IPCC can find no trend with respect to hurricane frequency or intensity or US landfalls. But the IPCC finds that the "global proportion of major (Cat.3+) hurricanes' occurrence has increased over the last four decades. (AR6 WGI p.9). This finding has been attacked as relying primarily on a single 2019 paper that has since been corrected by the authors.

There is good quality data on hurricane frequency and intensity since 1980 when it first started being collected by satellite. The top line shows the frequency of total hurricanes per year; the bottom line shows the number of major (Cat.3+) hurricanes. Both numbers have been decreasing irregularly since 1980. In 2022 there were 38 hurricanes and 17 major hurricanes.





Florida, Texas, and Louisiana are the states that have been hit most frequently by the strongest hurricanes (Cat.4+).

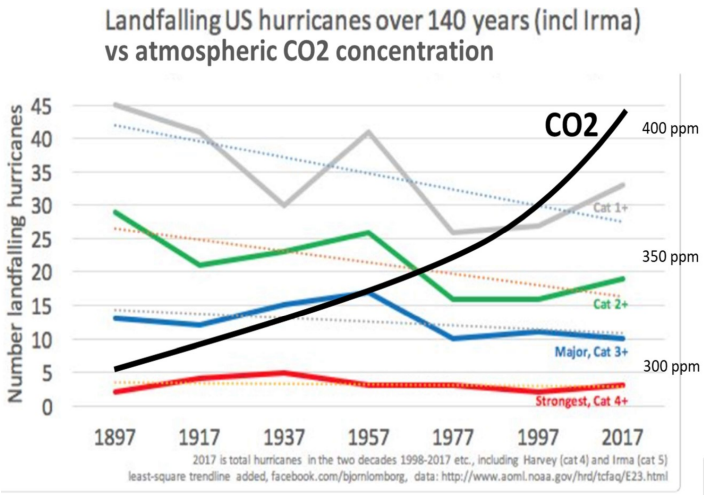
IPCC FINDINGS WITH RESPECT TO HURRICANES AR6 WGI, THE PHYSICAL SCIENCE BASIS (2021)

There is low confidence in long-term trends in the frequency of all-category tropical cyclones. (p.5)

The total global number of tropical cyclones is expected to decrease or remain unchanged. (p.70)

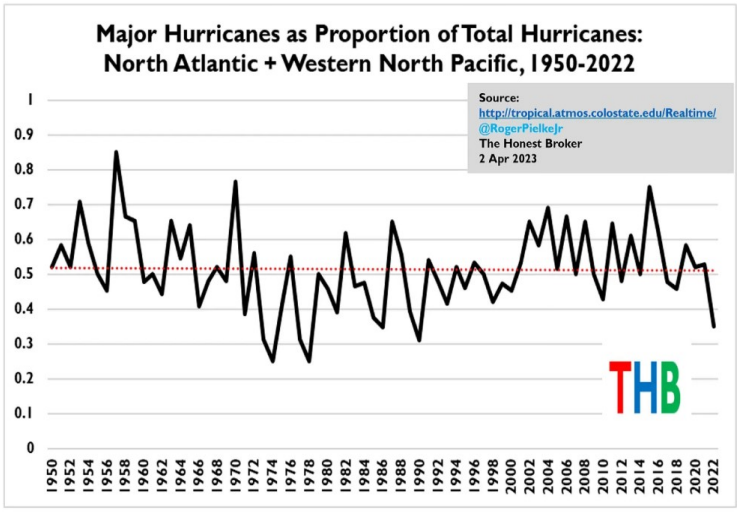
There is low confidence in past-century trends in the intensity of the strongest extratropical cyclones over the Northern Hemisphere. (p.71)

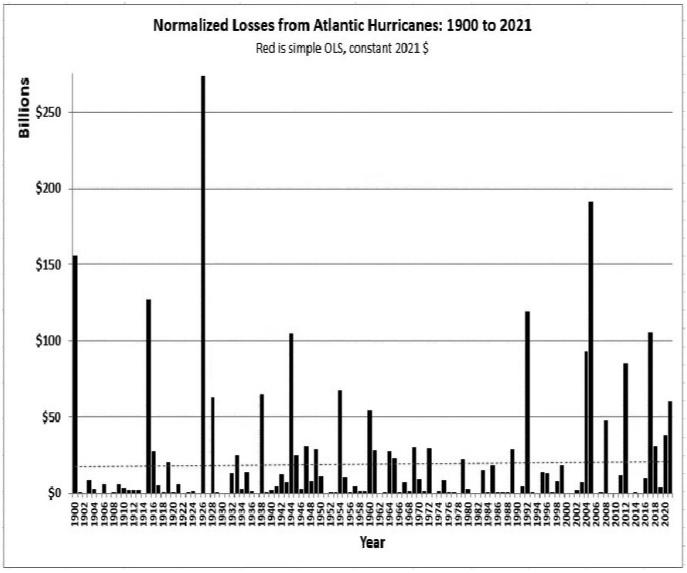
Hurricanes directly impacting the US since 1900 show no trend in the frequency of US landfall events. (p.1585)



Also this graph shows a rapid decrease in Cat. 1+ and Cat.2+ storms, a lesser decrease in Cat.3+ storms, and basically no change in Cat.4+ storms. With Cat.1 and Cat.2 storms decreasing in number faster than the Cat.3+ storms, this means that the *proportion* of Cat.3+ storm is increasing even though the number of Cat.3+ storms is actually decreasing. Thus even if this IPCC finding is correct, the trend is towards less strong hurricanes.

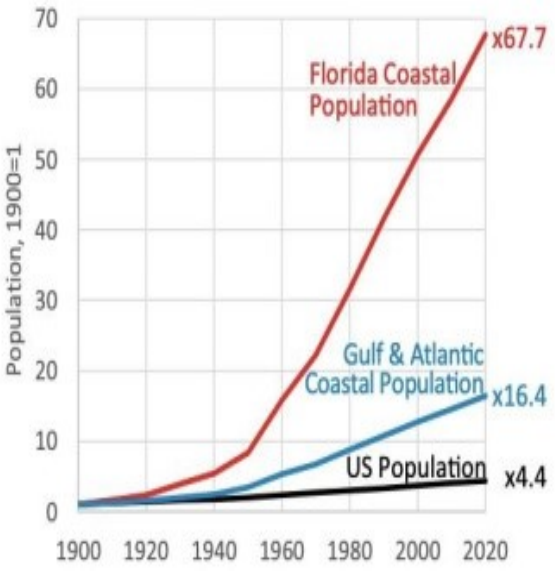
The IPCC has also "cherry-picked" its data by using 1980 (4 decades ago) as the point from which to start its trend line. If, instead, the trend line is started at 1950, as shown in this graph, there is no trend at all in the proportion of major hurricanes.





Normalized hurricane damage per year shows no trend, as one would expect if hurricane frequency and intensity were staying roughly the same, as the data shows. There is, however, great variability from year to year. Years that stand out with particularly high damages are 1900 (Galveston), 1926 (Miami), and 2005 (Katrina).

The media frequently comments upon the number of billion dollar storms," but economists are virtually unanimous that storm damages have to be normalized. The graph shows the explosion of the Florida coastal population from 1900 to 2020. More people mean more houses per square mile, so, when a storm hits, more damage. The normalization process takes into account the growing population, the growing number of structures, and the growing size and value of the various structures.



Deadliest Atlantic hurricanes

Rank	Hurricane	Season	Fatalities
1	"Great Hurricane"	1780	22,000–27,501
2	Mitch	1998	11,374+
3	Fifi	1974	8,210–10,000
4	"Galveston"	1900	8,000–12,000
5	Flora	1963	7,193
6	"Pointe-à-Pitre"	1776	6,000+
7	"Okeechobee"	1928	4,112+
8	"Newfoundland"	1775	4,000–4,163
9	"Monterrey"	1909	4,000
10	"Dominican Republic"	1930	2,000–8,000

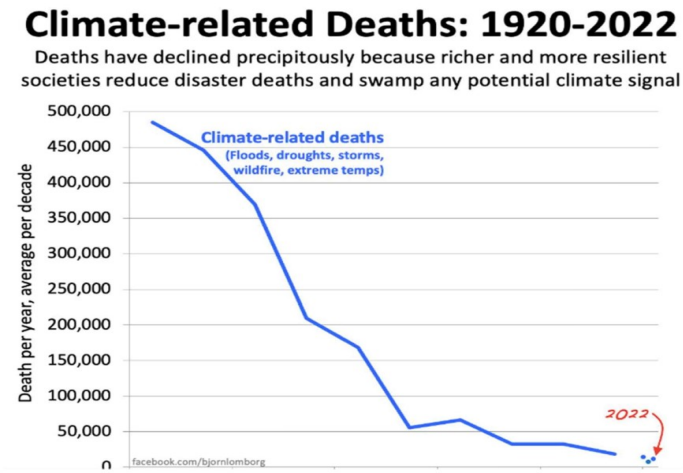
Here is a list of the 10 deadliest Atlantic hurricanes in history. Only two of them hit the US, Galveston in 1900 and Okeechobee in 1928. Katrina killed about 1,400 in 2005. The Great Miami Hurricane of 1926 killed only about 500, because the population of Miami was so small at the time.

The Galveston hurricane in 1900 delivered a 15 foot storm surge that totally destroyed the city.

In 1901 the Texas legislature appropriated the funds to build a 17 foot sea wall to protect Galveston.

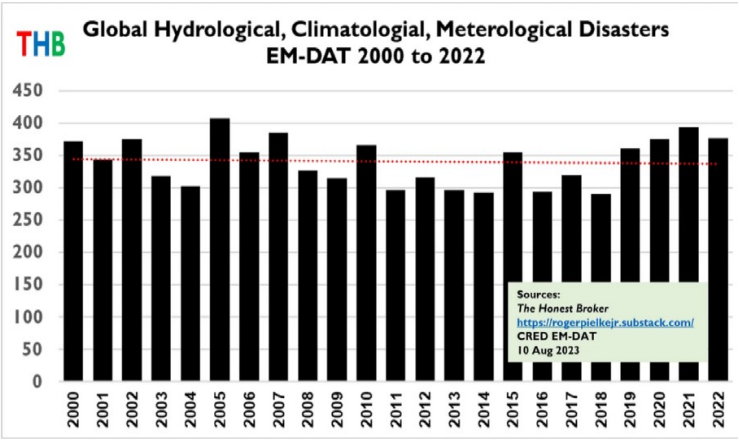
After Katrina killed about 1,400 people in New Orleans in 2005, Congress funded a massive program to build and repair the levees, breakwalls, etc., protecting New Orleans. So, when Ida hit in 2021 (about the same strength as Katrina), only 6 were killed. By contrast, Miami with an average elevation of only about 6 feet above sea level remains unprotected to this day.

Much of Miami is built right up to the water's edge. On average, it's 6 feet above sea level.



Extraordinary progress has been made reducing the numbers of people killed worldwide by extreme events.

The number of hydrological, climatological, and meteorological disasters over the last 20 years has remained roughly unchanged.



Source: EM-DAT downloaded 10 Aug 2023

BANGLADESH – DEATHS FROM INDIVIDUAL CYCLONES

CYCLONE NAME	YEAR	MAX. WIND	KILLED
Bhola	1970	185 km/hr	500,000 estim.
Unnamed	1991	235 km/hr	138,000
Sidr	2007	215 km/hr	3,400
Amphan	2020	240 km/hr	26

Bangladesh has made extraordinary progress in adapting to hurricanes (called cyclones in the Bay of Bengal) to reduce the death toll. Bangladesh and India have mastered the art of "vertical evacuation," as opposed to "horizontal evacuation" as practiced in the US.

Evacuation shelters are on stilts and double as schools or community centers. The Bangladesh goal is to have such a shelter within a one kilometer walk of every person at risk of storm surge. The shelters have space for cattle and other livestock as well.

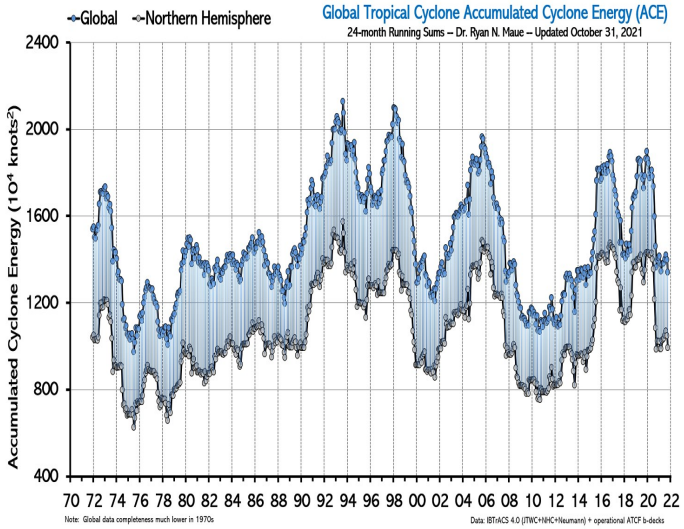
Most cyclone shelters in Bangladesh are also used as schools or community centres. This one in Chila village doubles up as a school (Credit: Catherine Davison)

By Catherine Davison 19th July 2022

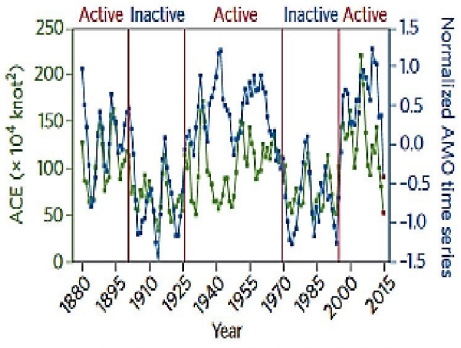
Bangladesh has a world-leading system to protect people from disasters, including through an army of female volunteers to better support women. What can other countries learn from it?

Bangladesh has organized an army of volunteers to spread the word "the last kilometer" of the need to evacuate to those who have not otherwise received warning.

Scientists have created a metric called Accumulated Cyclone Energy ("ACE"), which takes into account both the frequency of storms and their total energy throughout their lives. The ACE data shows cyclical motion without any discernable trend. Throughout the period 1960-present atmospheric CO2 levels have been steadily and significantly rising, so there is obviously no correlation between CO2 levels and hurricane frequency, intensity, or ACE.



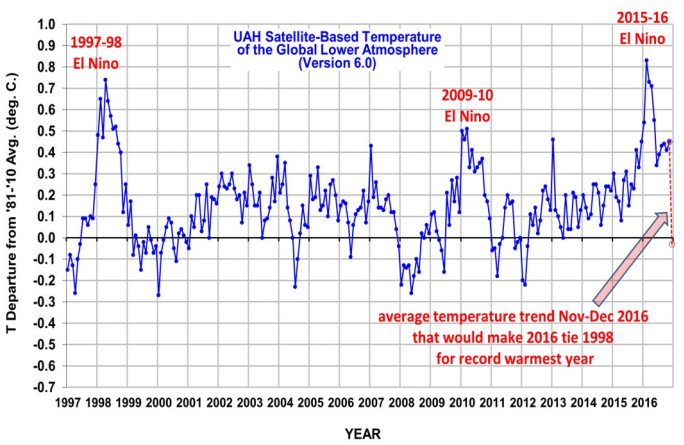
Tropical cyclone Atlantic multidecadal variability

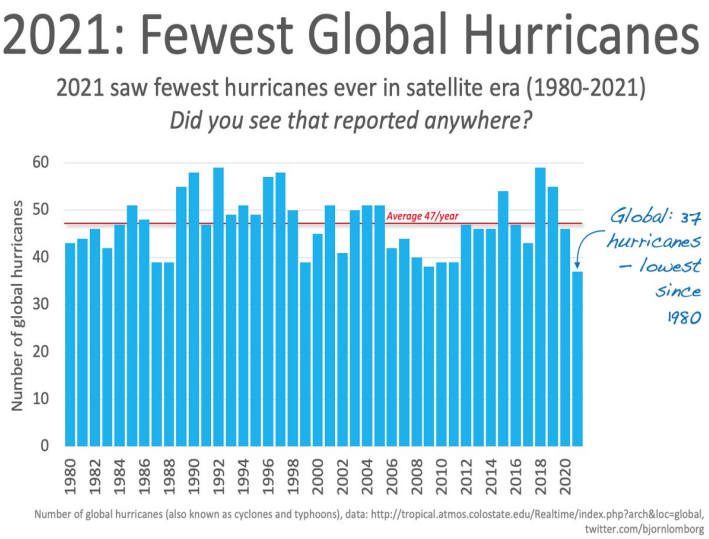


Three-year-averaged accumulated cyclone energy (ACE) in the Atlantic basin (green line) and three-year-averaged standardized normalized Atlantic multidecadal oscillation (AMO) (blue line) from 1880–2014 with predicted value for 2015 (red squares). The 2015 AMO value is the January–June-averaged value. The year listed is the third year being averaged (for example, 1880 is the 1878–1880 average). Correlation between the two time series is 0.61. *Source:* Klotzbach *et al.*, 2015.

Scientists have increasingly tied short term hurricane variability to two ocean currents. One is the Atlantic Multidecal Oscillation ("AMO"). The attached graph shows a significant correlation between shifts in the AMO and hurricane ACE. The correlation is particularly good during what are called the AMO "inactive" periods. In the next few years the AMO will be switching into its warm phase, which would mean hurricanes switching into an inactive period. Scientists are waiting to see if reduced hurricane activity follows.

The other ocean current is the El Nino Southern Oscillation ("ENSO"). The ENSO hot phase (El Nino) is strong enough to affect the atmospheric temperatures of the entire world for a year. It is generally recognized that the hot phase suppresses Atlantic hurricane activity, and the cold phase (La Nina) results in twice the number of US hurricane landfalls and in much greater hurricane damage. In 2023 an El Nino is arriving.





Scientists are unable to predict accurately hurricane activity even a few months in advance. Every May the US government (NOAA) issues a prediction for the following hurricane season (June-November). In May 2022 the prediction was 65% chance of above-normal activity, 25% normal, and 10% below normal. But, as shown in the graph at the top of page 3 above, there were only 38 hurricanes in 2022, just one above the 37 in 2021 (shown here) which was the fewest since 1980.

In May 2023 NOAA predicted for the 2023 hurricane season 40% chance of above-normal activity, 30% chance of normal, and 30% chance of below-normal. This prediction is so vague that it is the equivalent to admitting that NOAA does not know what is coming. By contrast the Colorado state hurricane team predicted an "unusually busy season," demonstrating significant difference between hurricane experts in their predictions.

CONCLUSION

Hurricanes will always be with us. Since there is no long-term trend, they are a weather problem, not a climate change problem. Science gives us little reason to believe that anything humans can do over the next century (such as reducing CO2 emissions) will reduce hurricane frequency or intensity below current levels. There is no choice but to adapt, as Bangladesh has done.

Work Cited

Intergovernmental Panel on Climate Change, Assessment Report 6,

Working Group I, The Physical Science Basis (2021) (AR6 WGI)