THE 2023 HURRICANE SEASON

Paul Homewood

The Global Warming Policy Foundation
Briefing 69

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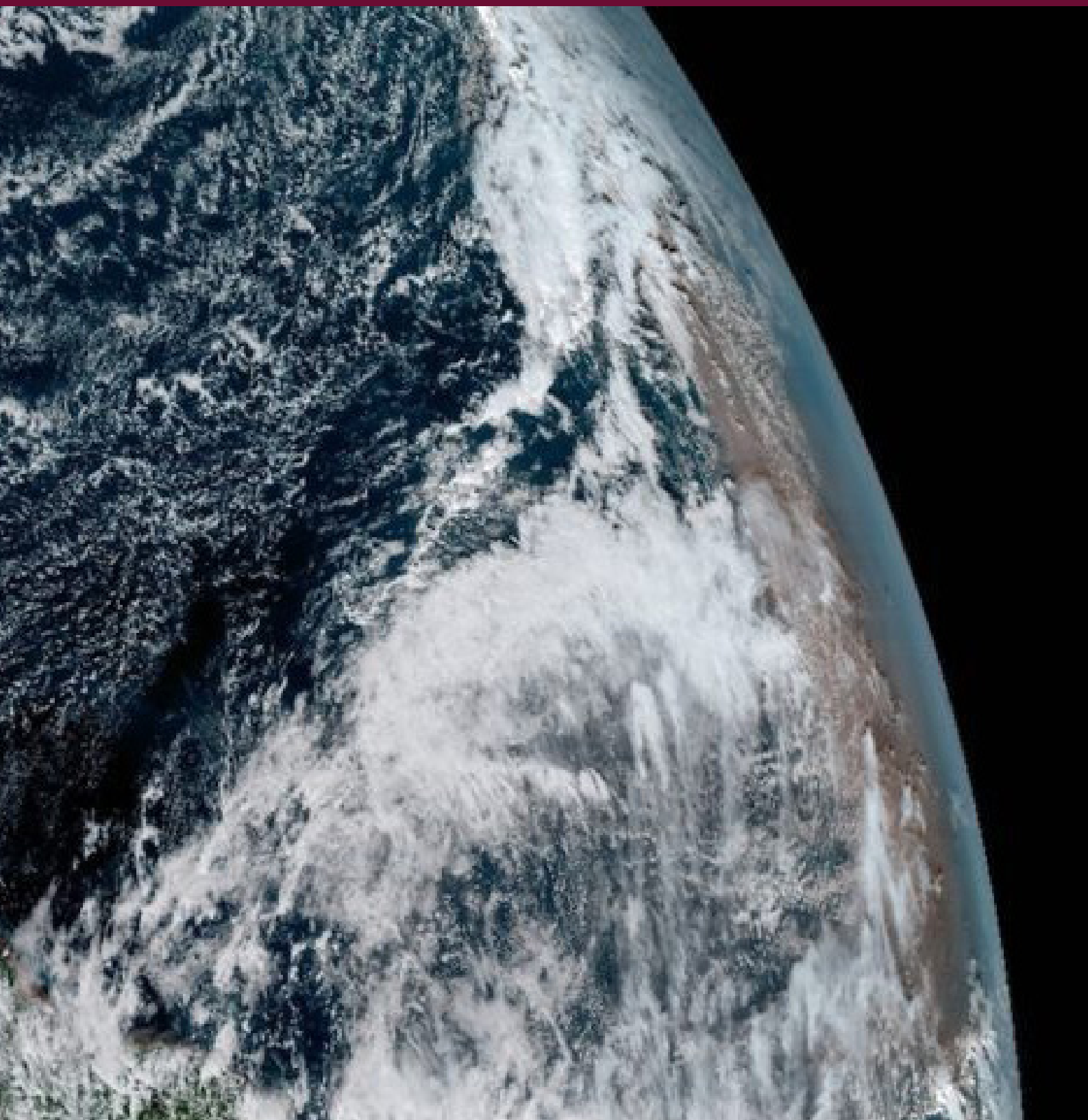

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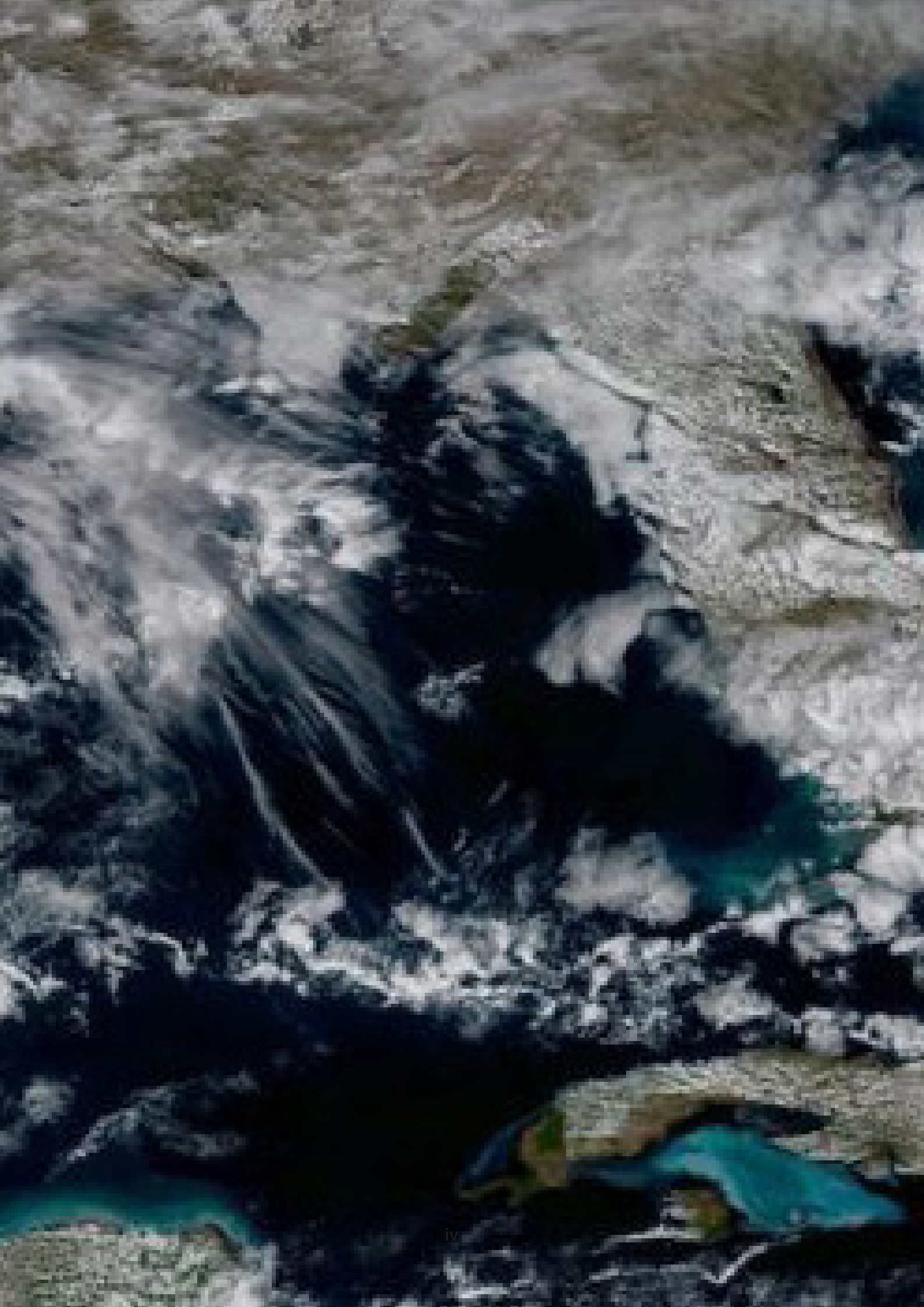
About the author

Paul Homewood had a career as an accountant in industry. He has been writing on climate and energy issues since 2011 and has written several papers for GWPF.



Executive summary

Are hurricanes getting worse? It is widely believed that they are now more frequent and/or more powerful than they used to be. And the cause, we are told, is climate change. This belief is fuelled by widespread claims by the media and some politicians, particularly when a bad storm occurs. The belief is also reinforced because the monetary damage hurricanes cause is greater nowadays, thanks to increasing populations in vulnerable coastal areas and greater wealth.

But is this belief correct, or is it a misconception? This study has carefully analysed official data and assessments by hurricane scientists and agencies, and finds:

- The apparent increase in the number of hurricanes since the 19th century has been due to changes in observational practices.
- Data show no long-term trends in US landfalling hurricanes since the mid-19th century, when systematic records began, either in terms of frequency or intensity.
- Similarly, after allowing for the fact that many hurricanes were not spotted prior to the satellite era, there are no such trends in Atlantic hurricanes either.
- Trends in landfalling Atlantic/Western Pacific hurricanes have been stable or decreasing since 1950.
- There are also no trends in global hurricane activity in the data collected since reliable records began in the 1970s.
- There is growing evidence that wind speeds of the most powerful hurricanes may now be overestimated in comparison to pre-satellite era ones, because of changing methods of measurement.
- The increase in Atlantic hurricanes in the last fifty years is not part of a long-term trend, but is simply a recovery from a deep minimum in hurricane activity in the 1970s, associated with the Atlantic Multidecadal Oscillation.

These findings are in line with those of hurricane scientists generally, as well as those of official bodies.

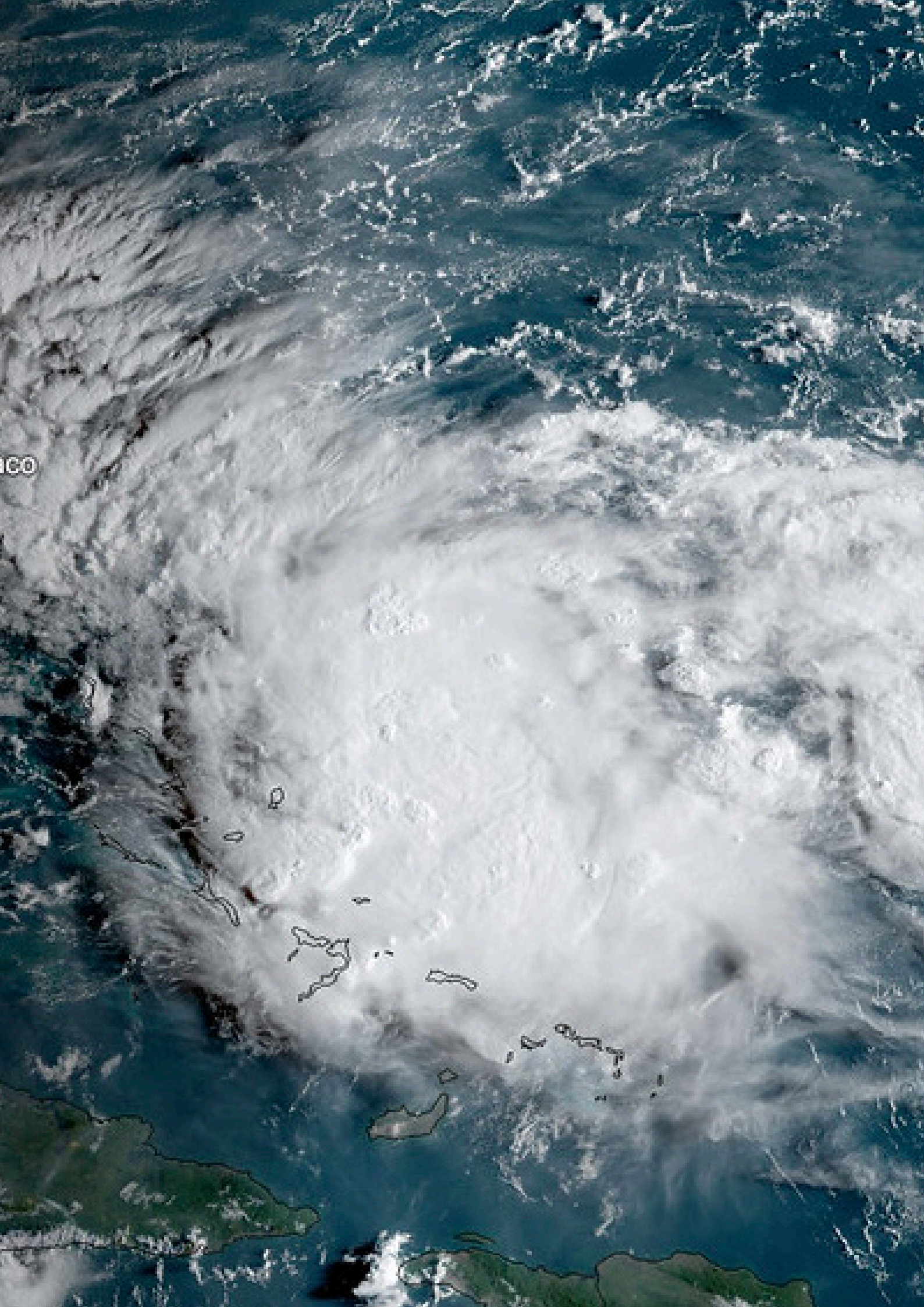
1. Introduction

Tropical cyclones are intense circular storms, which originate over warm tropical oceans. Commonly known as 'hurricanes', they are called 'typhoons' in the western Pacific, and 'cyclones' in the Bay of Bengal and northern Indian Ocean. For the purposes of this paper they will all be referred to as hurricanes.

Categorisation of hurricanes by wind speeds also varies in different parts of the world. Here we will refer to the Saffir-Simpson scale, which is always used for Atlantic hurricanes. The scale is based on 1-minute sustained wind speeds, ranging from Category 1, with winds of at least 74 mph, up to Category 5, where winds reach 157 mph.

The purpose of this paper is to examine trends in hurricane frequency and intensity, using official data, as well as summarising the latest science.

Section 2 looks at how observational practices have changed over time, and the effect those changes have had on reported data. Sections 3 and 4 present the data for US landfalling and Atlantic hurricanes respectively. Section 5 presents global trends. Finally, Section 6 reviews the latest findings from the Intergovernmental Panel on Climate Change.



2. Changes in observational methodology

Since the 19th century, the way we observe, monitor and measure hurricanes has changed out of all recognition (Figure 1).[1]

The Atlantic Hurricane Database (or HURDAT) is maintained by the US National Oceanic and Atmospheric Administration (NOAA), and extends back to 1851. However, because tropical storms and hurricanes spend much of their lifetime over the open ocean – some never making landfall – many systems were 'missed' during the late-19th and early-20th centuries. In 1944, systematic aircraft monitoring began, for both tropical cyclones and disturbances that had the potential to develop into tropical storms and hurricanes. This provided much improved monitoring, but still about half of the Atlantic basin was not covered. Then, beginning in 1966, daily satellite imagery became available at the National Hurricane Center, and thus statistics from this time forward are most complete.[1]

For hurricanes striking the US Atlantic and Gulf coasts, there are relatively reliable counts of systems further back in time, because enough people have lived along those coastlines since 1900.[2]

In the Pacific and Indian Oceans, early coverage was even less comprehensive. Full satellite coverage may not have been available until around 1980.[3] This lack of coverage has a particular impact on the reporting of short-lived storms, according to Vecchi and Knutson.[4] When allowance is made for these storms that were 'missed' in earlier decades, the authors concluded that:

> 'after adjusting for such an estimated number of missing storms, there is a small nominally positive upward trend in tropical storm occurrence from 1878-2006. But statistical tests reveal that this trend is so small, relative to the variability in the series, that it is not significantly distinguishable from zero (Figure 2). Thus the historical tropical storm count record does not provide compelling evidence for a greenhouse warming induced long-term increase'.

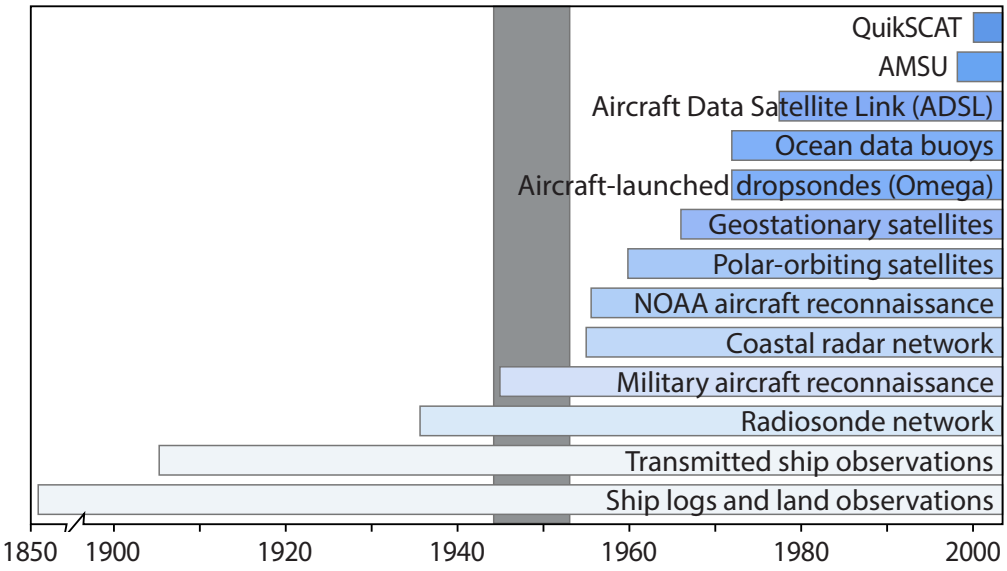
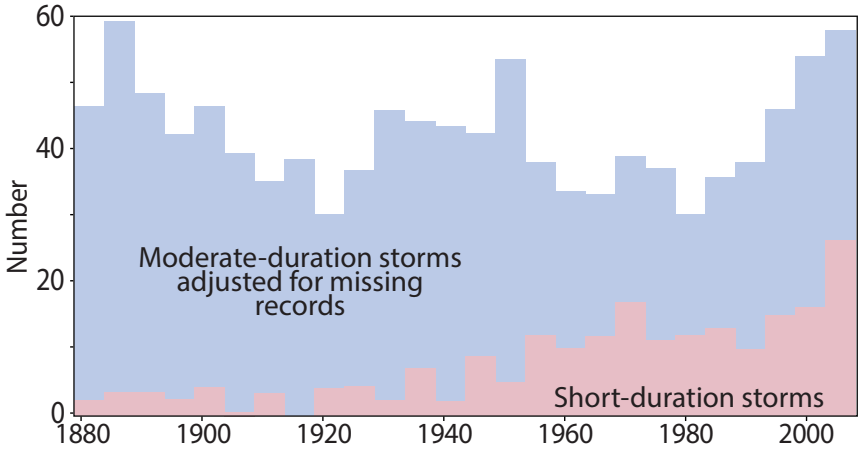


Figure 1: Changes in observational technologies for hurricanes.

Adapted from Hagen and Landsea.

Figure 2: The effect of missing storms.

Source: Vecchi and Knutson.



It is not only the number of storms which tended to be underestimated. Hagen and Landsea demonstrated that the strength of the most intense, Category 5 hurricanes was also understated prior to the satellite era:

> Observations of the peak intensity in strong hurricanes were much less common during the late 1940s/early 1950s when compared with recent years because the ability to measure the central pressure and peak winds in major hurricanes was very limited during the late 1940s/early 1950s. A Category 5 designation would be possible if a hurricane made landfall as a Category 5 at or very near a weather station, or if a ship passed through the center while at Category 5 intensity. Aircraft reconnaissance was generally only capable of recording Category 4 conditions at most because of the inability to penetrate intense hurricanes.

They re-analysed ten Category 5 hurricanes, occurring between 1992 and 2007, and found that only two would have been categorised as Category 5 using 1940s' technology. Both of these – Andrew and Mitch – made landfall as Category 5. They concluded that there are likely to have been several Category 4 and 5 hurricanes misclassified as being weaker prior to the satellite era.[1]

It is clear from all of the above that both the frequency and intensity of hurricanes were underestimated prior to the satellite era, making analysis of long-term trends challenging.

3. US landfalling hurricanes

As already noted, the longest record with reliable counts of hurricanes is for the US Atlantic and Gulf coasts. The US Hurricane Research Division (HRD), which is part of NOAA, has compiled lists of US landfalling hurricanes back to 1851. However, although many parts of the coastline were populated as far back as 1851, others, such as Texas and Florida, were still sparsely populated until around 1900. Therefore the list may be incomplete up to 1900. There is also the issue of the Civil War years, with no hurricanes listed at all in 1862 to 1864. This is unlikely to be a reliable count.

Considerable re-analysis work has been carried out over the

years by the HRD, using widespread records to reassess the original measurements of wind speeds and central pressure. In the past, it was rare for such measurements to be taken at the exact centre or strongest part of the storm. By re-analysing available data, the scientists have been able to piece together the wider picture, and thus estimate the missing parts.

Figure 3 shows (a) all hurricanes since 1851 that have made landfall as hurricanes on the US mainland, and (b) all major hurricanes (defined as Category 3 and over on the Saffir-Simpson scale). Neither dataset shows any evidence of increasing frequency. The final panel (c) shows that the busiest decades for major hurricanes were the 1940s and 1890s, whilst the most recent decade of 2011 to 2020 recorded five, which is just below average.

Prior to the satellite era, hurricane wind speeds were usually estimates based on the central pressure of the hurricane, which

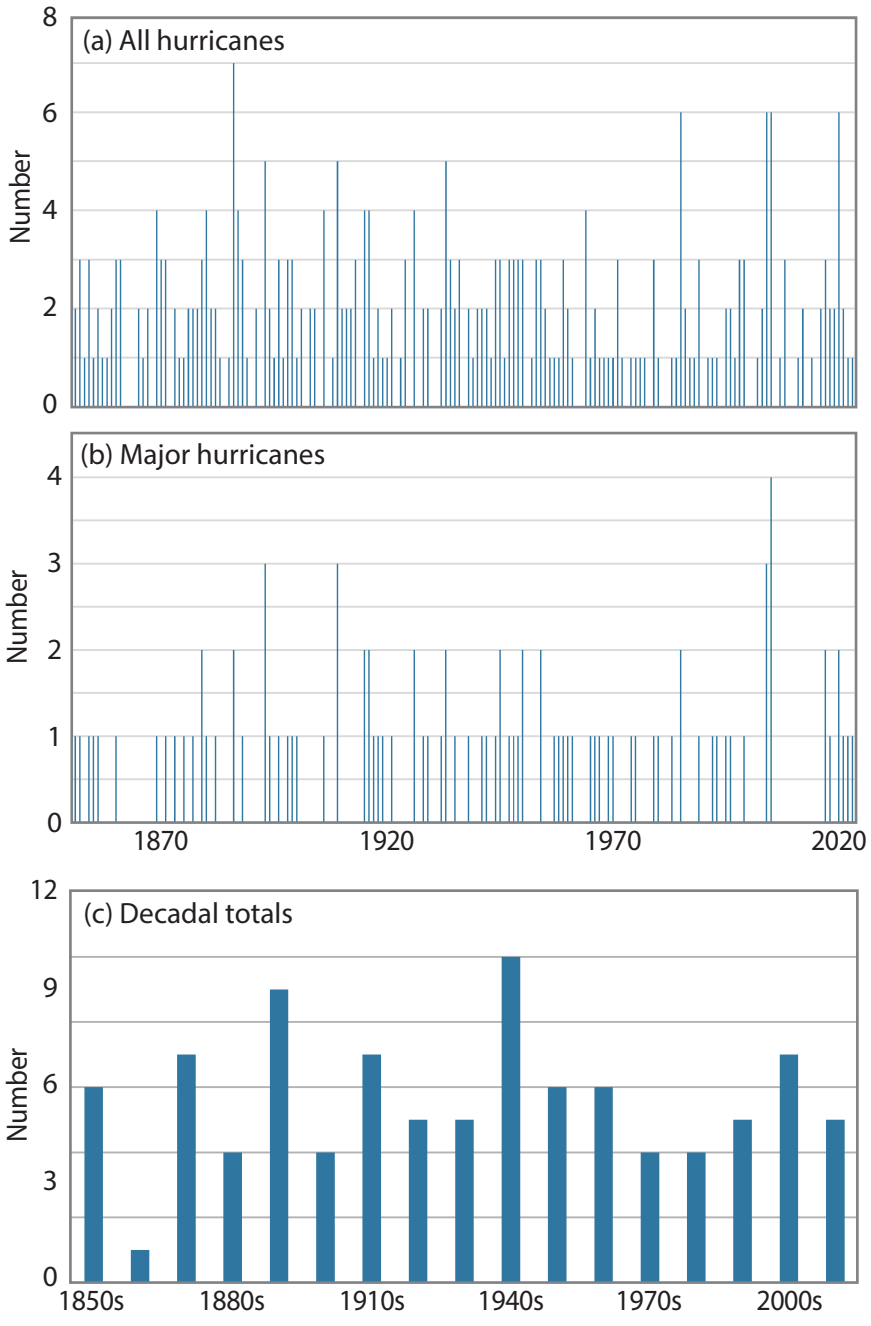


Figure 3: US landfalling hurricanes.

(a) All hurricanes, (b) Major hurricanes (>Cat3) (c) Decadal totals. Source: US Hurricane Research Division.[10]

could be more readily measured. It would have been extremely rare for an anemometer to be located at the exact point where wind speeds were at their highest, and such instruments were unable to withstand the strongest winds.

However, in recent years, wind speeds have been calculated using satellite and aircraft data. This has created an anomaly, whereby estimates of wind speeds for hurricanes now tend to be higher than past ones with similar central pressure.

The GWPF report *The 2022 Hurricane Season*[5] highlighted the fact that some of the stronger historical hurricanes with similar estimated wind speeds to recent ones had much lower central pressure (see Table 1).

Table 1: Pressure and windspeed in selected US hurricanes.

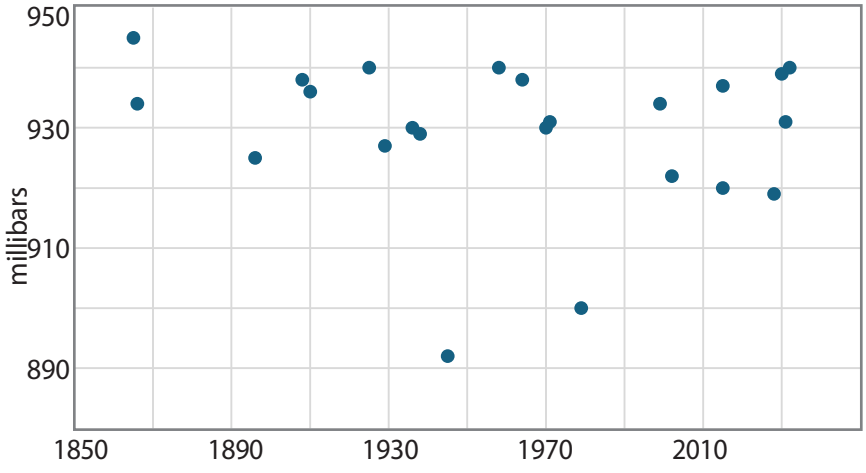
Hurricane	Year	Central pressure (mb)	Estimated wind speed (mph)
Ian	2022	940	150
Galveston	1915	940	132
Hazel	1954	940	132
Indianola	1886	925	150
Great Miami	1926	929	144
Laura	2020	939	150

The same discrepancy has arisen with Hurricane Idalia, the Category 4 storm which hit Florida in August 2023. The official record states that Idalia had central pressure of 949 mb, and sustained winds of 125 mph. However, the Great Miami Hurricane of 1926 was also estimated to have had winds of 125 mph, yet the central pressure was measured at 930 mb. Similarly, another catastrophic Florida hurricane, Okechobee in 1928, also had winds of 125 mph and an even lower central pressure of 929 mb.

Evidence is steadily mounting that wind speeds in the pre-satellite era were underestimated in comparison with hurricanes today. It is therefore useful to look at the time distribution of the most intense hurricanes (Figure 4).

Figure 4: Most intense US landfalling hurricanes by pressure.

Source: US Hurricane Research Division.[10]



The two most intense were the Labor Day hurricane in 1935, and Camille in 1969. These are also the two strongest hurricanes measured by wind speeds. As with the frequency of hurricanes, the data clearly shows no evidence that hurricanes are becoming more intense, or that extremely intense ones are becoming more common.

4. Atlantic hurricanes

There were seven Atlantic hurricanes in 2023, including three major ones. Both figures are slightly below the 30-year average.

As already noted, many hurricanes in the Atlantic were missed prior to the satellite era. Vecchi et al. have shown that when these missing hurricanes are accounted for, increases in basin-wide hurricane and major-hurricane activity since the 1970s are not part of a century-scale increase, but a recovery from a deep minimum in the 1960s–1980s.[4]

NOAA concur with Vecchi's conclusions, stating:[6]

> There is no strong evidence of century-scale increasing trends in U.S. landfalling hurricanes or major hurricanes. Similarly for Atlantic basin-wide hurricanes (after adjusting for observing capabilities), there is not strong evidence for an increase since the late 1800s in hurricanes, major hurricanes, or the proportion of hurricanes that reach major hurricane intensity.

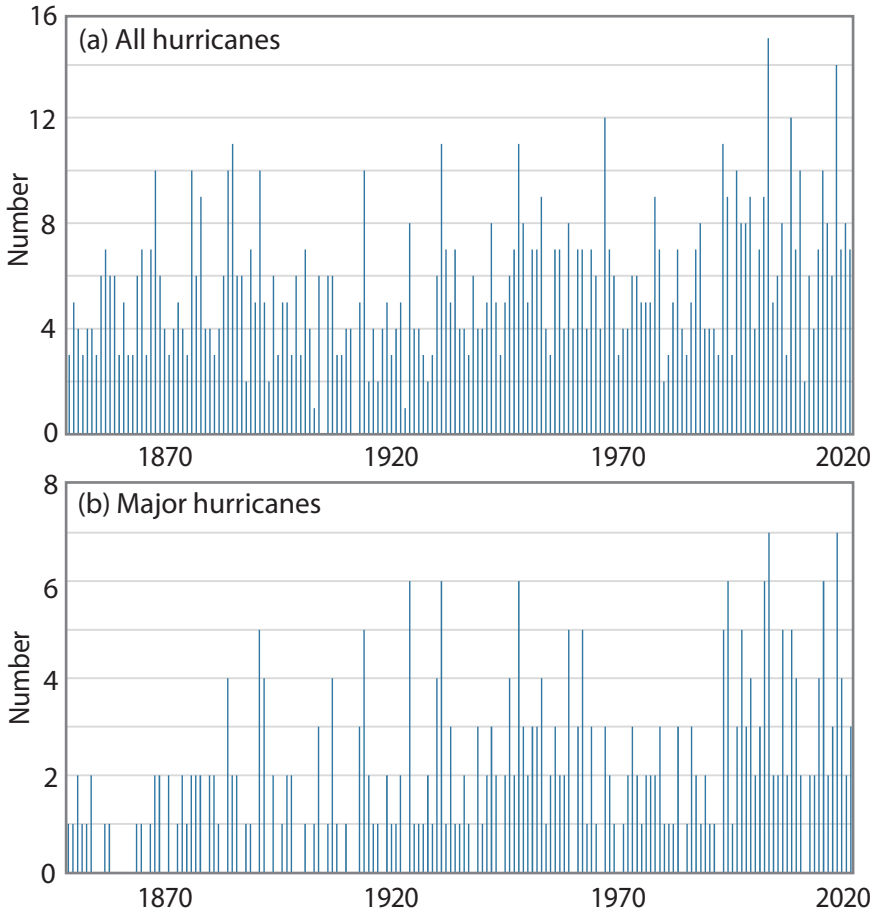


Figure 5: Number of Atlantic hurricanes.

(a) All hurricanes and (b) Major hurricanes. Source: US Hurricane Research Division.[11]

This discrepancy is represented in Figure 6. In 1922 there were five tropical storms, including three hurricanes recorded in the Atlantic, compared to fourteen and eight in 2022. But as the tracking charts for the two years show, all of the ones in 1922 passed close to land. By contrast, in 2023 most stayed well away from shore.

The deep minimum in Atlantic hurricane activity from the 1960s to the 1980s (Figure 5) is associated with the cold phase of the Atlantic Multidecadal Oscillation (AMO). According to NOAA, the number of tropical storms that mature into severe hurricanes is much greater during the warm phase of the AMO than during cool phases – at least twice as many.[7] The previous cold phase of the AMO between 1900s and 1920s also coincided with reduced hurricane activity.

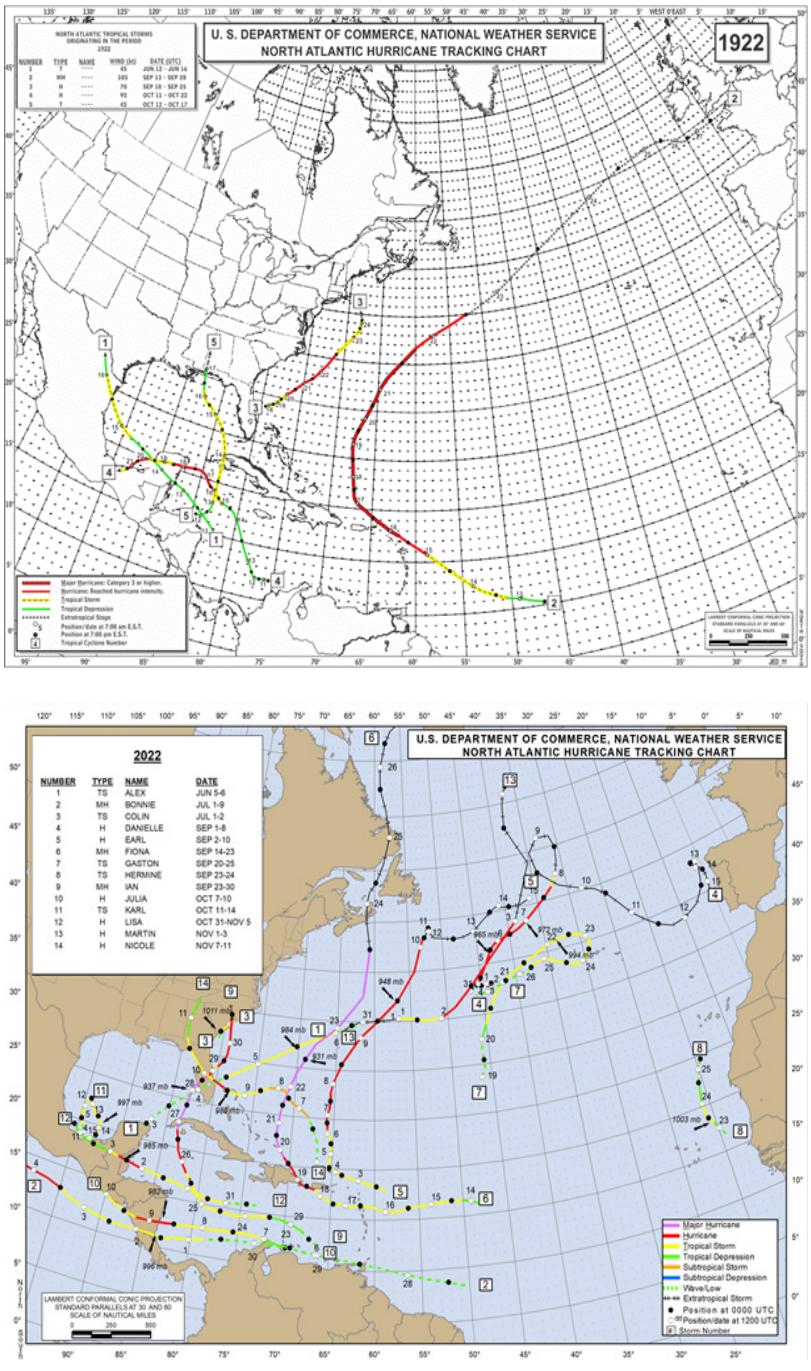


Figure 6: Atlantic hurricane tracks

Source: US Hurricane Research Division.[12]

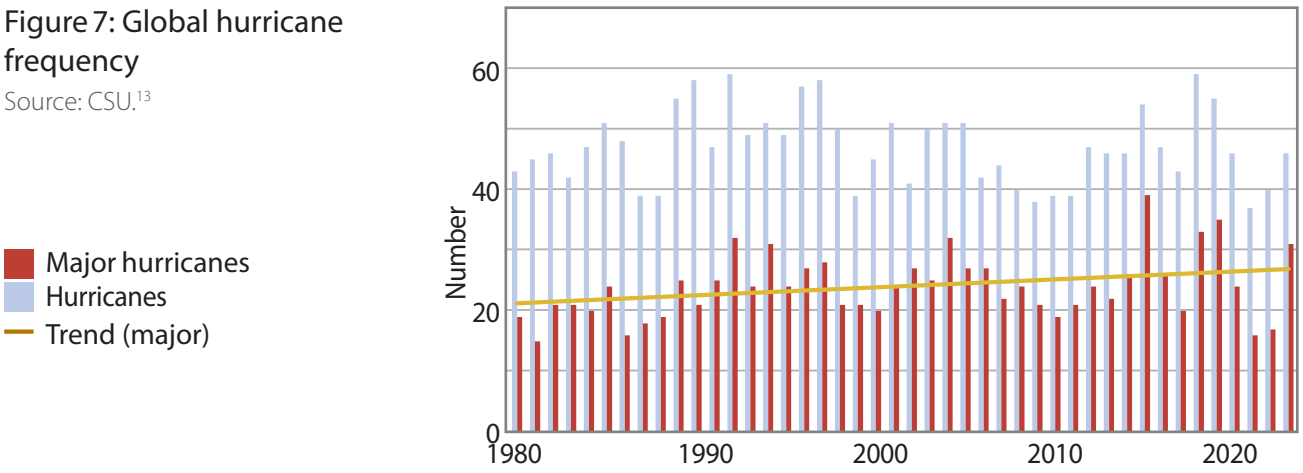
It has also been suggested that the increase in tropical storm frequency in the Atlantic basin since the 1970s has been at least partly driven by decreases in aerosols from human activity, and by volcanic forcing.[8]

5. Global trends

As noted above, comprehensive observation of hurricanes worldwide probably did not start until around 1980. Globally there were 46 hurricanes in 2023, compared to an annual average of 47 since 1980 (Figure 7). Major hurricanes were above average at 31, but were below average over the previous three years.

Figure 7: Global hurricane frequency

Source: CSU.[13]

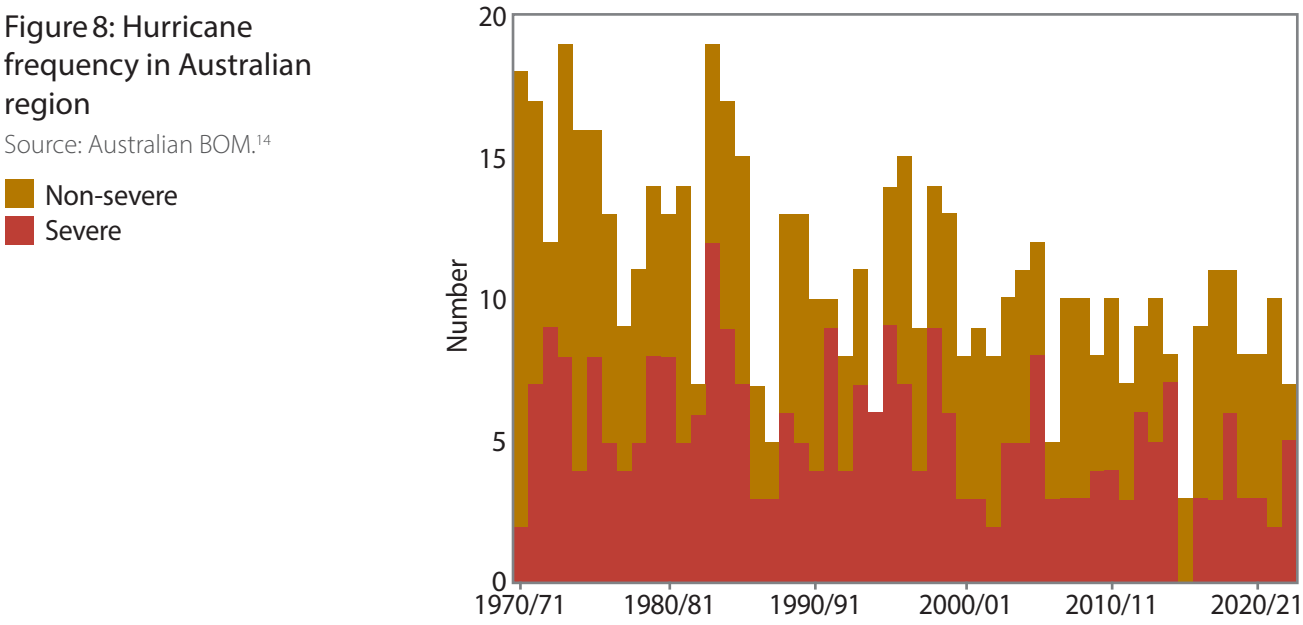


The number of major hurricanes increased during the 1990s, mainly because of the ending of the cold phase of the AMO. Since then, the trend has been flat.

The Australian Bureau of Meteorology maintain records of hurricanes back to 1971. There is a clearly declining trend in both overall numbers and severe storms, equivalent to Category 3 (Figure 8).

Figure 8: Hurricane frequency in Australian region

Source: Australian BOM.[14]



Landfalling hurricanes in the North Atlantic and Western North Pacific, which account for 67% of global hurricanes, have been analysed by Pielke and Maue.[8] Landfalling hurricanes are an important statistic, because they are not subject to the observational changes that affect mid-ocean storms.

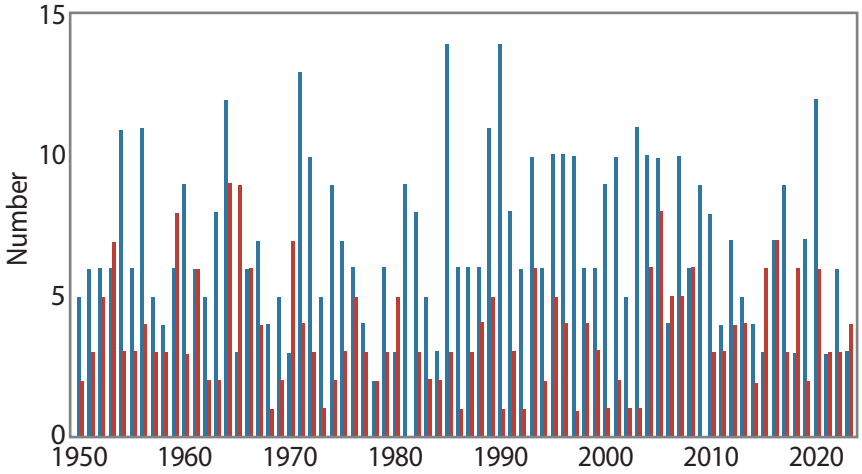


Figure 9: North Atlantic and north-west Pacific hurricane landfalls 1950 to 2023.
Source: Pielke and Maue.

There has been no discernable trend in minor hurricanes, and a decline in major hurricanes in these regions.

During 2023, the 3-year sum of global major hurricanes hit a record low (Figure 10):

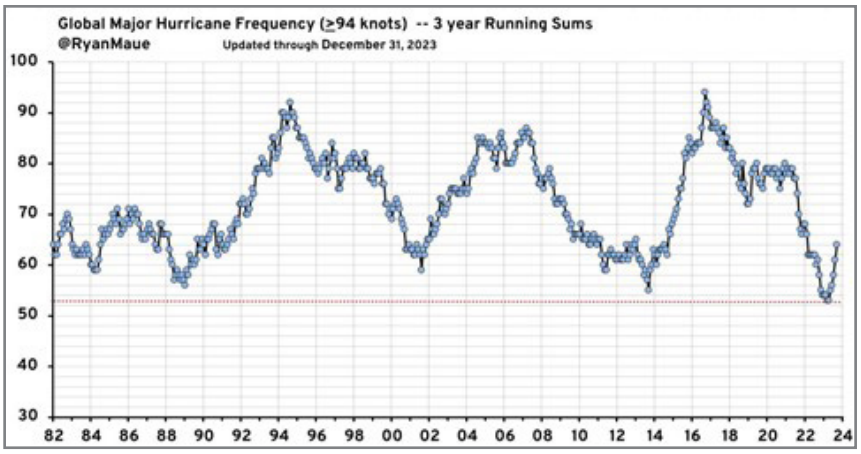


Figure 10: Global major hurricane frequency-3-year running average.
Source: Ryan Maue.

6. What do the IPCC say?

In 2021, in its Sixth Assessment Report, the IPCC stated:[9]

> 'There is low confidence in most reported long-term (multi-decadal to centennial) trends in Tropical Cyclone frequency- or intensity-based metrics due to changes in the technology used to collect the best-track data.'

They did, however, note that the global proportion of major hurricanes had increased over the last four decades. However, as already shown, this is a product of the AMO, and not part of any long-term trend.

The Sixth Assessment made two other claims. First, that the latitude where hurricanes reach their peak intensity had shifted northwards. Second, that climate change had increased heavy precipitation associated with tropical cyclones. However, this claim was derived from highly controversial weather attribution models; the IPCC were unable to find any evidence to support their claim.

Notes.

1. Hagen and Landsea – 'On the classification of extreme Atlantic hurricanes utilizing mid-twentieth-century monitoring capabilities' http://journals.ametsoc.org/doi/full/10.1175/JCLI-D-11-00420.1.
2. NOAA – https://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html.
3. Judith Curry – https://www.thegwpf.org/gwpf-tv-climate-hysteria-vs-hurricane-resilience/.
4. GFDL – https://www.gfdl.noaa.gov/historical-atlantic-hurricane-and-tropical-storm-records/.
5. P Homewood. *The 2022 Hurricane Season.* GWPF https://www.thegwpf.org/publications/hurricane-activity-not-getting-worse-new-paper-shows/.
6. NOAA – https://www.gfdl.noaa.gov/global-warming-and-hurricanes/.
7. NOAA – https://www.aoml.noaa.gov/phod/faq/amo_faq.php.
8. Pielke and Maue – https://rogerpielkejr.substack.com/p/global-tropical-cyclones.
9. IPCC AR6 Chapter 11, p. 1585 https://www.ipcc.ch/assessment-report/ar6/.
10. US Hurricane Research Division – https://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html.
11. US Hurricane Research Division – https://www.aoml.noaa.gov/hrd/hurdat/comparison_table.html.
12. US Hurricane Research Division – https://www.aoml.noaa.gov/hrd/hurdat/DataByYearandStorm.html.
13. CSU – https://tropical.atmos.colostate.edu/Realtime/index.php?arch&loc=global.
14. Australian BOM – http://www.bom.gov.au/cyclone/tropical-cyclone-knowledge-centre/history/climatology/.

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