THE 2024 HURRICANE SEASON

Paul Homewood

The Global Warming Policy Foundation
Briefing 74

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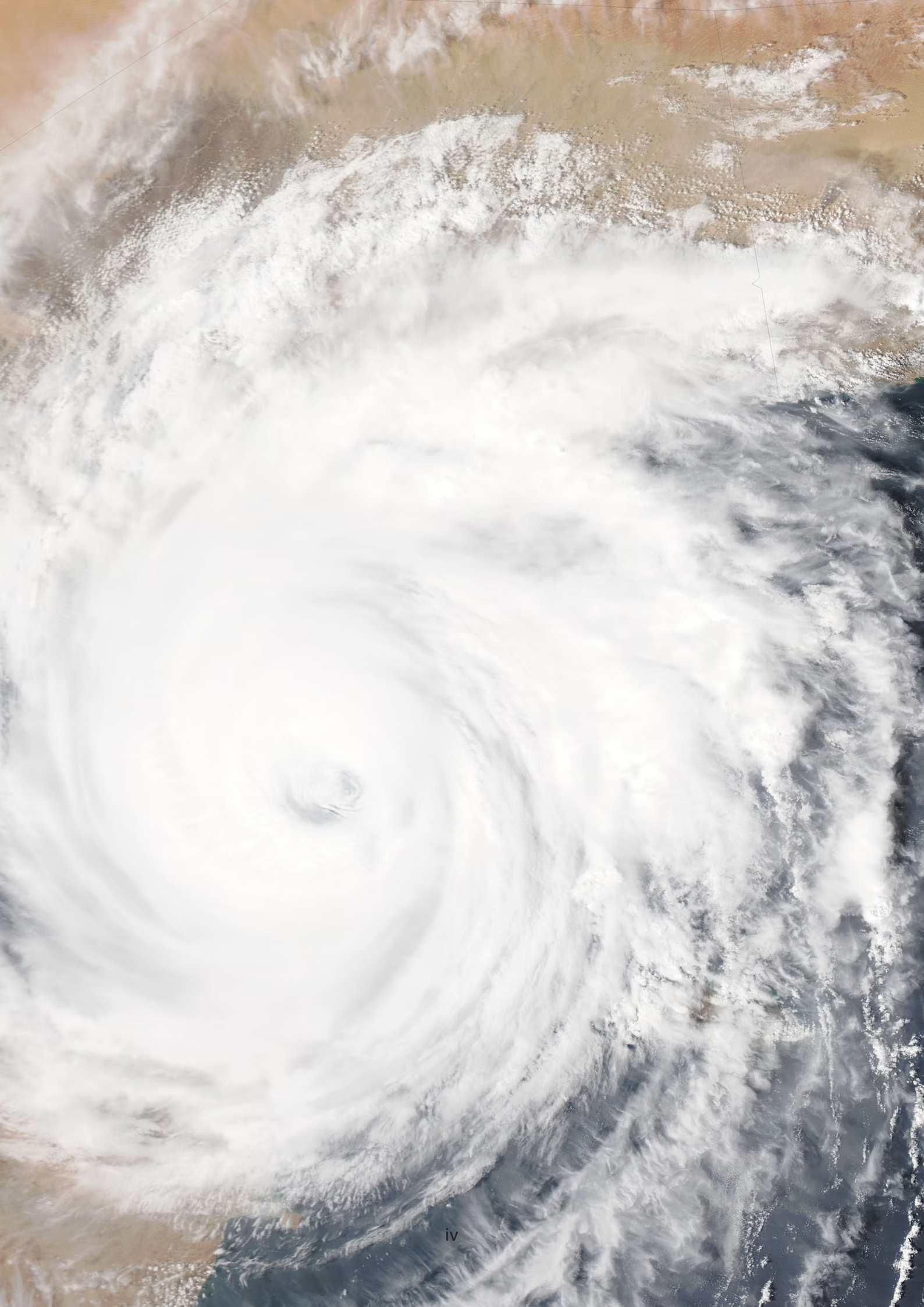
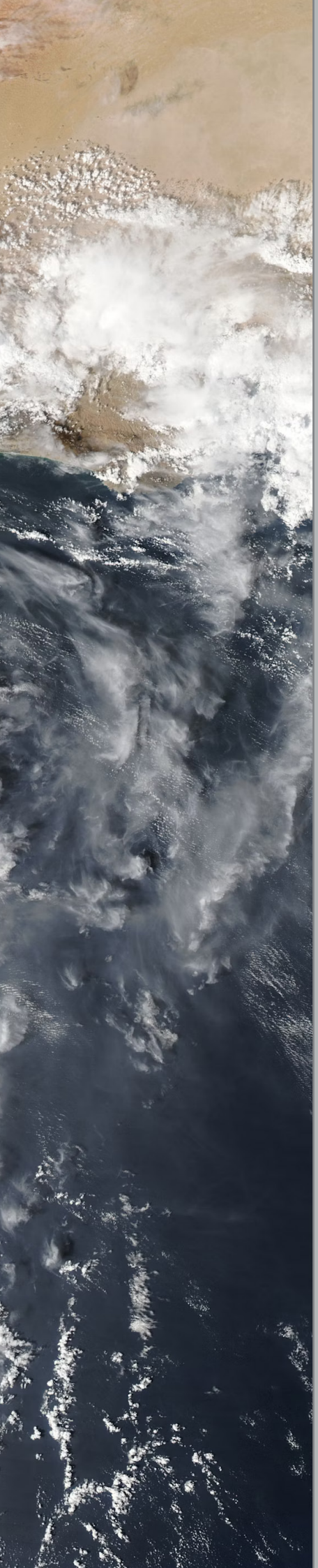
Contents

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 the GWPF.





Executive summary

Are hurricanes getting worse? It is widely believed that hurricanes are now more frequent, powerful, or both, than they used to be. And the cause, we are told, is climate change. This belief is fuelled by widespread claims from the media and some politicians, particularly when a bad storm occurs. The media also encourages this belief via 24/7 video coverage.

The belief is also reinforced because the damage caused by hurricanes is much greater nowadays, thanks to increasing population 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 observation practices over the years, rather than an actual increase.
- 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 storms 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 is also no global trend in overall hurricane frequency 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 linked to 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 official bodies such as the US National Oceanic and Atmospheric Administration (NOAA) and the Intergovernmental Panel on Climate Change (IPCC).

Introduction

Tropical cyclones are intense circular storms that originate over warm tropical oceans. Commonly known as hurricanes, they are also named '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*.

Hurricanes have been known about and reported for many centuries, but systematic recording really only started in the mid-19th century.

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 1 looks at how observational practices have changed over time, and the effect they have had on reported data. Sections 2 and 3 present the data for US landfalling and Atlantic hurricanes respectively. Section 4 presents global trends. Finally, Section 5 reviews the latest IPCC findings in Assessment Report 6 (AR6).

1. Changes in observational methodology

Since the 19th century, the way we observe, monitor and measure hurricanes has changed out of all recognition, as Hagen and Landsea have summarised:[1]

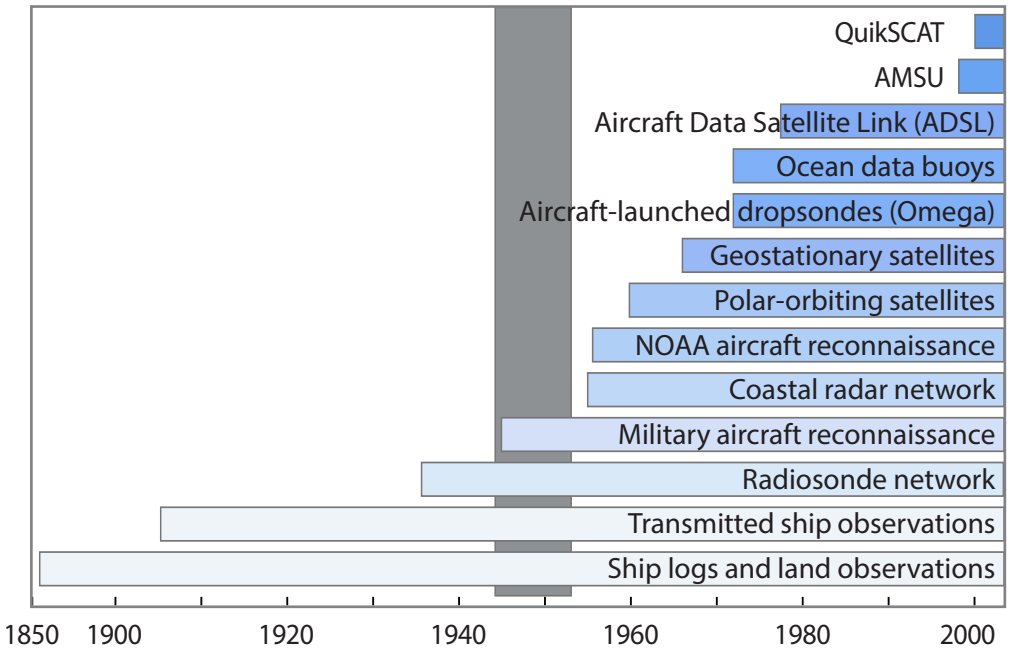


Figure 1: Changes in observational technologies for hurricanes.

Adapted from Hagen and Landsea.

The Atlantic hurricane database (or HURDAT) is maintained by 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.

Starting in 1944, systematic aircraft reconnaissance commenced for monitoring both tropical cyclones and disturbances that had the potential to develop into tropical storms and hurricanes. This did provide much improved monitoring, but about half of the Atlantic basin remained uncovered. Beginning in 1966, daily satellite imagery became available at the National Hurricane Center, and thus statistics from this time forward are the most complete.[2]

For hurricanes striking the US Atlantic and Gulf coasts, one can find relatively reliable counts going further back in time, because enough people have lived along those coastlines since 1900.[3]

In the Pacific and Indian Oceans, early coverage was even less reliable. Full satellite coverage may not have been available until around 1980.[4] This lack of coverage has a particular impact on the reporting of short-lived storms, according to Vecchi and Knutson:[5]

When allowance is made for these storms that were 'missed' in earlier decades, Vecchi and Knutson concluded that:

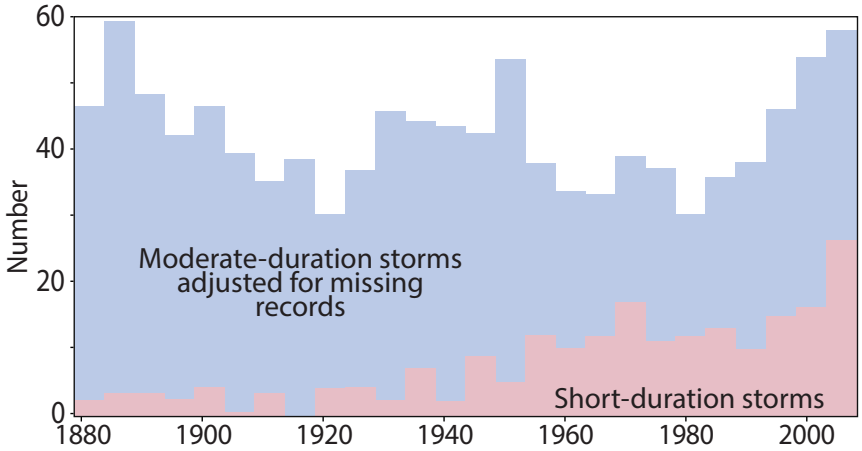


Figure 2: The effect of missing storms.
Source: Vecchi and Knutson.

> …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.

It is not only the number of storms that tended to be underestimated. Hagen and Landsea demonstrated that the strength of the most intense – Category 5 – hurricanes were also underestimated 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 that occurred between 1992 and 2007, and found that only two – Andrew and Mitch – would have been categorised as such using 1940s' technology.

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.

2. 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 going back to 1851. However, although many parts of the coastline were populated that far back, 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 between 1862 and 1864. This is unlikely to be a reliable count.

Considerable re-analysis work has been carried out over the years by the HRD, using a variety of 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 all hurricanes since 1851 that have made landfall as hurricanes on the US mainland, and all major hurricanes (defined as Category 3 and over on the Saffir-Simpson scale). Neither dataset shows any evidence of increasing frequency. The busiest decades for major hurricanes were the 1940s and 1890s, whilst the most recent decade (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 system, which 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.

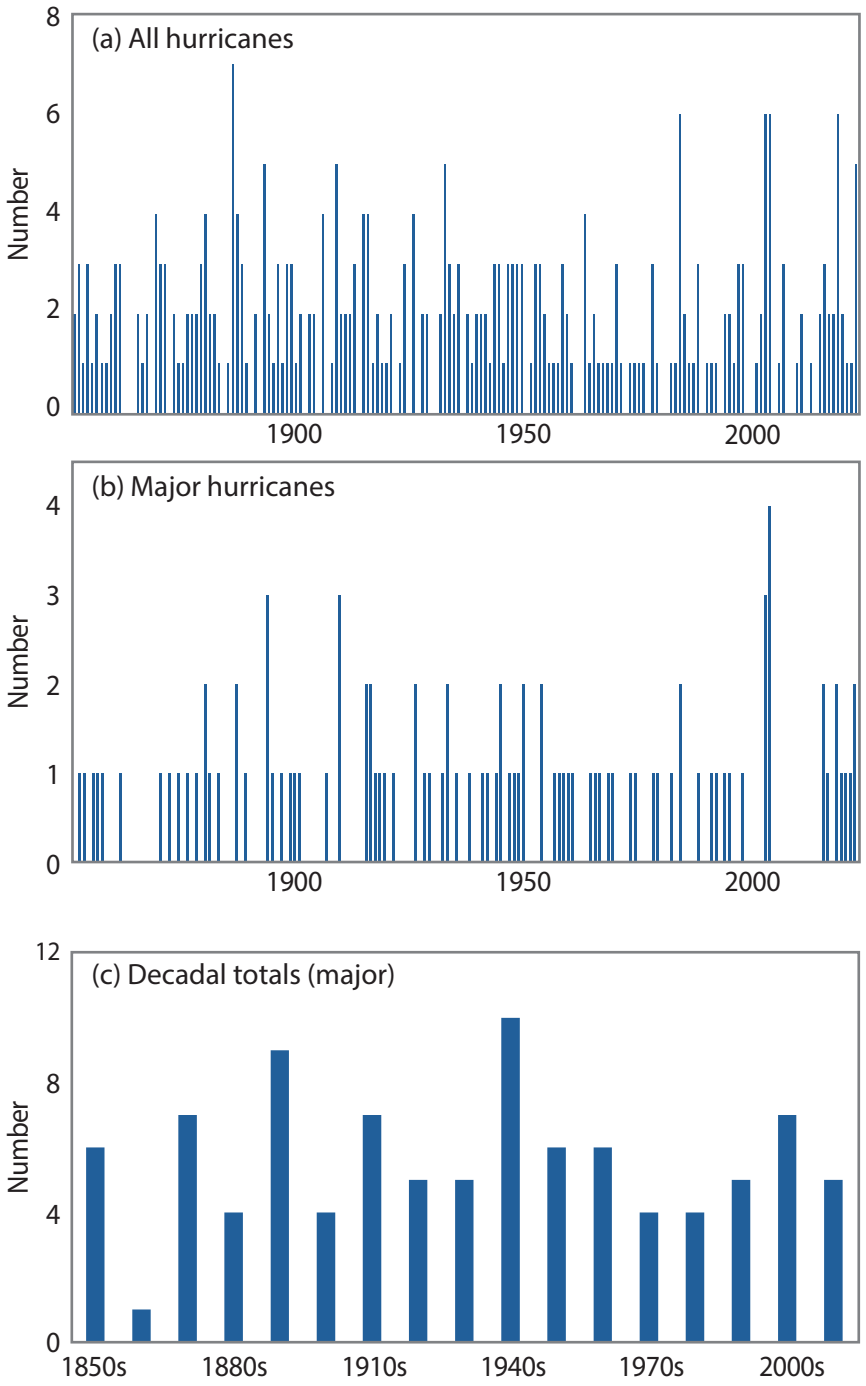


Figure 3: US landfalling hurricanes.

(a) All hurricanes
(b) Major hurricanes (Cat 3+)
(c) Decadal totals (major).

Source: US Hurricane Research Division.[11]

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

The GWPF's *The 2022 Hurricane Season*[6] showed that some

of the stronger historical hurricanes with similar estimated wind speeds to recent ones had much lower central pressure – see Table 1.

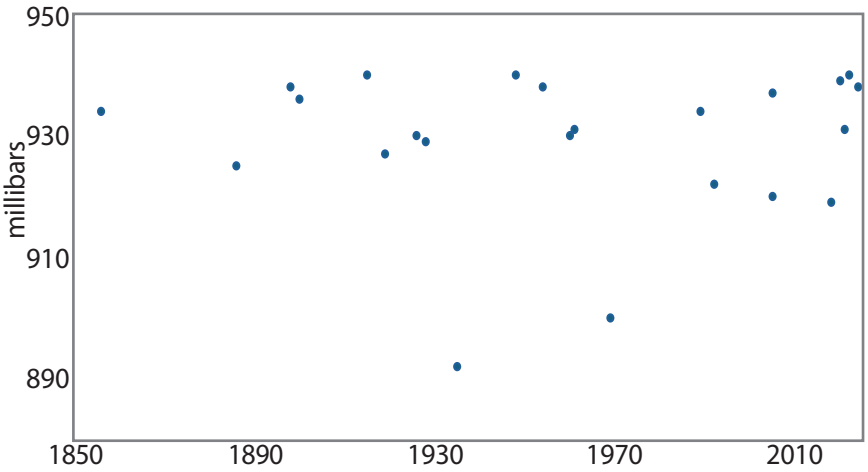
Table 1: Pressure and windspeed in selected US hurricanes.

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

There was the same discrepancy in 2024 with Hurricane Helene, which hit Florida last September, with reported winds of 140 mph and a minimum pressure of 938 mb. This is not consistent with another Hurricane Helene in 1958, which had the same minimum pressure but much lower wind speeds of 126 mph. Moreover, two hurricanes with lower pressures of 937 mb – Rita (2005) and Harvey (2017) – also had lower wind speeds than Helene (2024), at 115 mph and 132 mph respectively.

Figure 4: Most intense US landfalling hurricanes by pressure.

Source: US Hurricane Research Division.[10]



Evidence continues to mount that wind speeds in the pre-satellite era were underestimated in comparison with hurricanes today. For that reason, it is worth looking at the time distribution of the most intense hurricanes (as measured by central pressure), as in Figure 4.

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, the data clearly shows no evidence that they are becoming more intense, or that extremely intense ones are becoming more common.

3. Atlantic hurricanes

There were eleven Atlantic hurricanes in 2024, including five major ones. Both figures are above the 30-year average (Figure 5).

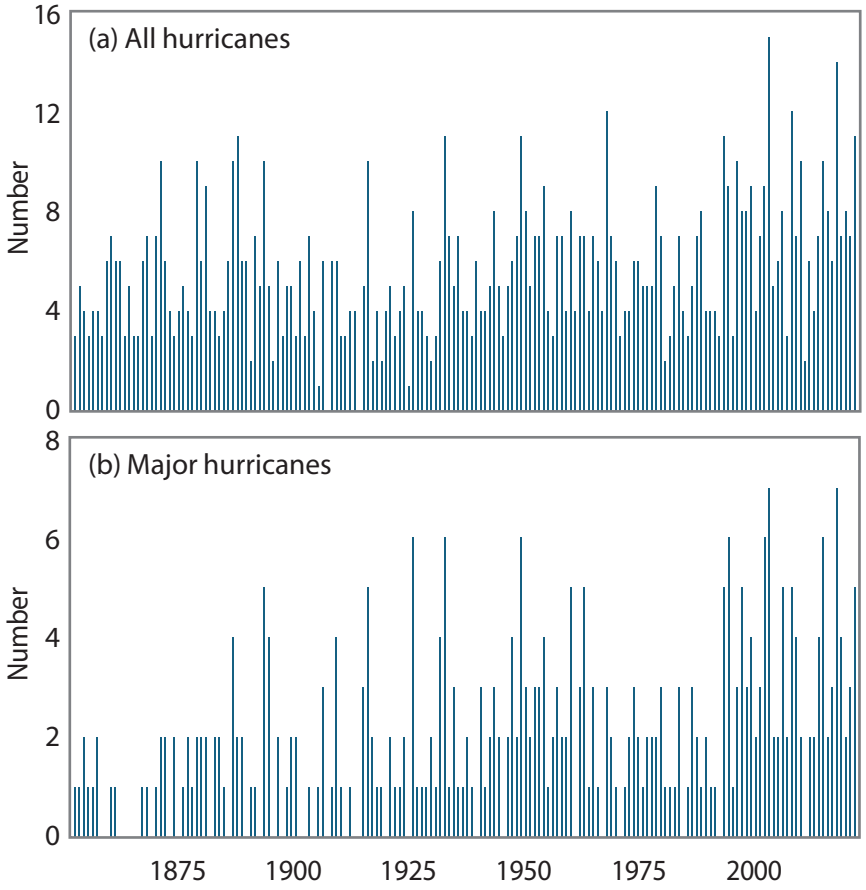


Figure 5: Number of Atlantic hurricanes.

(a) All hurricanes and (b) Major hurricanes. Source: US Hurricane Research Division.[12]

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.[5]

NOAA concur with Vecchi *et al.*'s conclusions, stating:

> 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.

This discrepancy of missing hurricanes can be seen in Figure 6.

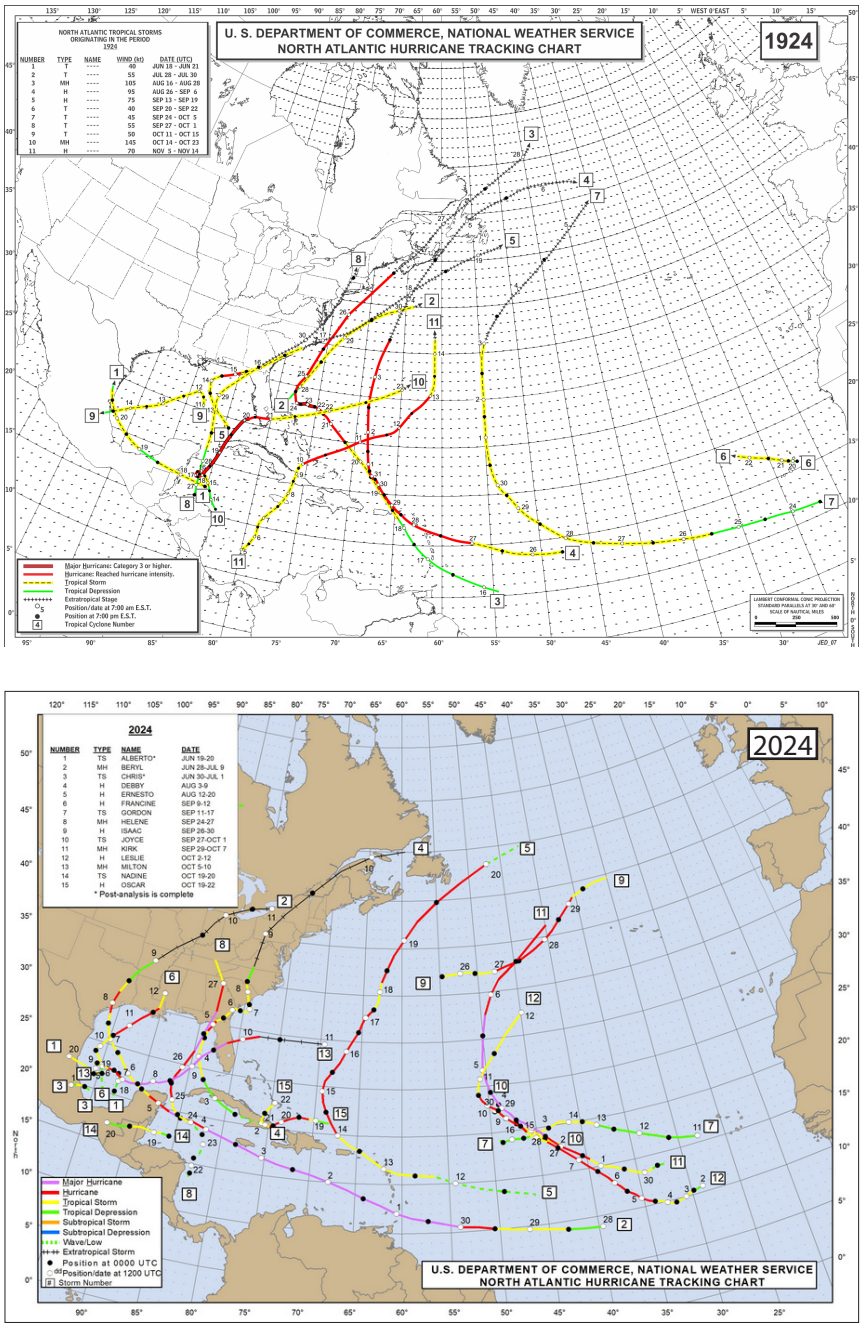
Only five hurricanes were officially recorded in 1924, all close to land. Although there were eleven hurricanes in 2024, five were out in the mid-Atlantic, where they would have been unlikely to be spotted, or at least properly measured, prior to the satellite era. These were: Ernesto, Isaac, Kirk, Joyce and Leslie.

The deep minimum in Atlantic hurricane activity in the 1960s–1980s (Figure 5) is associated with the cold phase of the Atlantic

Multidecadal Oscillation (AMO). The AMO is a naturally occurring oscillating cycle of sea-surface temperatures in the North Atlantic Ocean, which has a period of 60–80 years.

Figure 6: Atlantic hurricane tracks

Source: US Hurricane Research Division.[13]



According to NOAA, the number of tropical storms that mature into major 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 the 1900s and 1920s, also coincided with reduced hurricane activity.

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 volcanic forcing.[8]

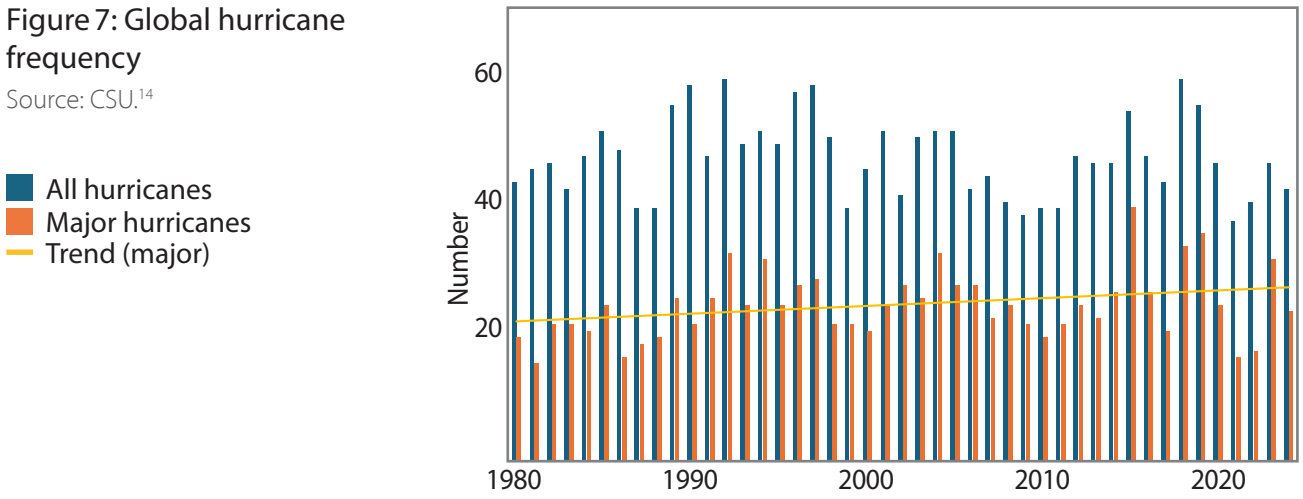
4. Global trends

As noted in Section 2, comprehensive observation of hurricanes worldwide probably did not start until around 1980.

In 2024, globally, there were 42 hurricanes, of which 23 were major, both numbers below the averages since 1980, of 47 and 24 respectively. 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.

Figure 7: Global hurricane frequency

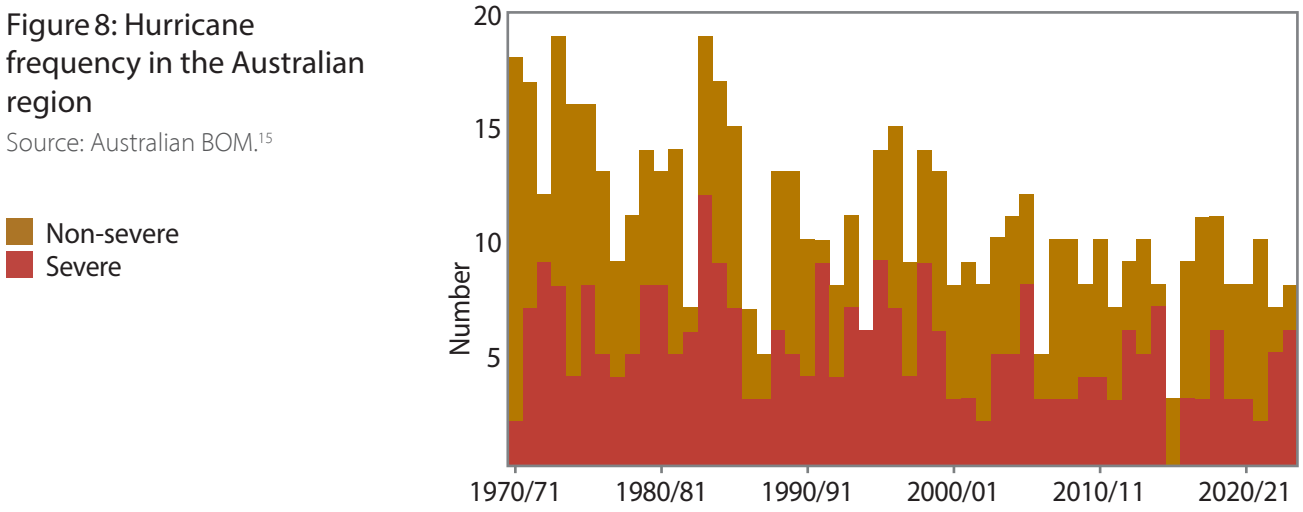
Source: CSU.[14]



The Australian Bureau of Meteorology (BOM) maintains records of hurricanes back to 1971. There is a clearly declining trend in both overall numbers and severe storms (equivalent to Category 3 or above – see Figure 8).

Figure 8: Hurricane frequency in the Australian region

Source: Australian BOM.[15]



Landfalling hurricanes in the north Atlantic and western north Pacific, which account for 67% of global hurricanes, have been analysed by Pielke and Maue. Landfalling hurricanes are an

important statistic because they are not subject to observational changes that affect mid-ocean storms. No significant trend can be seen in either major or minor category.

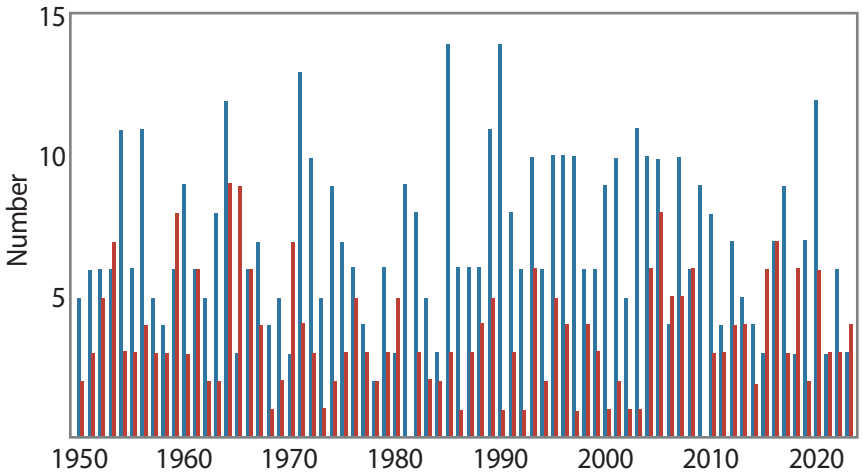


Figure 9: North Atlantic and western north Pacific hurricane landfalls, from 1950 to 2023.

Source: Pielke and Maue.[16]

5. What do the IPCC say?

The IPCC's Sixth Assessment Report (AR6) states:[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.

The authors noted that the global proportion of major hurricanes had increased over the previous four decades. However, as already shown, this is likely to be a product of the AMO, rather than part of a longer-term trend.

AR6 made two further claims. The first was that the latitude at which hurricanes reach their peak intensity had shifted northwards. The second was that climate change had increased heavy precipitation associated with tropical cyclones. However, this claim was derived from speculative weather-attribution models, which are controversial.

It also acknowledged that anthropogenic influence on recent active tropical cyclone seasons was 'principally associated' with changes in aerosol forcing, rather than with the effect of greenhouse gases.[10]

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/comparison_table.html.
3. NOAA – https://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html.
4. Judith Curry – https://www.thegwpf.org/gwpf-tv-climate-hysteria-vs-hurricane-resilience/.
5. GFDL– https://www.gfdl.noaa.gov/historical-atlantic-hurricane-and-tropical-storm-records/.
6. GWPF – The 2022 Hurricane Season https://www.thegwpf.org/content/uploads/2023/02/Homewood-Hurricanes-2022-IP.pdf.
7. NOAA – https://www.aoml.noaa.gov/phod/faq/amo_faq.php.
8. NOAA – https://www.gfdl.noaa.gov/global-warming-and-hurricanes/.
9. IPCC AR6 Chapter 11, pp. 1585 – https://www.ipcc.ch/assessment-report/ar6/.
10. IPCC AR6 Chapter 11, pp. 1590 – https://www.ipcc.ch/assessment-report/ar6/.
11. US Hurricane Research Division – https://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html.
12. US Hurricane Research Division – https://www.aoml.noaa.gov/hrd/hurdat/comparison_table.html.
13. US Hurricane Research Division – https://www.aoml.noaa.gov/hrd/hurdat/DataByYearandStorm.html.
14. CSU – https://tropical.atmos.colostate.edu/Realtime/index.php?arch&loc=global.
15. Australian BOM – http://www.bom.gov.au/cyclone/tropical-cyclone-knowledge-centre/history/climatology/.
16. Pielke and Maue – https://rogerpielkejr.substack.com/p/global-tropical-cyclones.

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72	V. Ismet Ugursal	The Ethics of Decarbonisation for the Poor
73	Paul Homewood	The UK's Weather in 2023
74	Paul Homewood	The 2024 Hurricane Season

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