

Technical Comments on the recently published paper in Science by Webster, Holland, Currie, and Change, titled “Changes in tropical cyclone number, duration, and intensity in a warming environment” (16 September 2005, Vol. 309, pp. 1844-1846, www.sciencemag.org)

by

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ABSTRACT

This recent *Science* paper by Webster, Holland, Currie and Chang indicates that the global number of Category 4-5 hurricanes have increased in the last 15 years (1990-2004) in comparison with the prior 15-year period of 1975-1989. Global mean surface temperature in the later period has been about 0.3°C higher than in the earlier period. The authors' imply that their observed rise in global Category 4-5 hurricanes are related to higher global temperatures which may have an anthropogenic greenhouse gas component. I do not agree that global Category 4-5 tropical cyclone activity has been rising, except in the Atlantic over the last 11 years. The recent Atlantic upsurge in Category 4-5 hurricanes is not found in the other global basins and is due to processes other than global surface temperature increase.

DISCUSSION

I cannot accept the accuracy of the measurements of global Category 4-5 hurricanes during 1975-1989 as indicated in the author's Table 1. This earlier 15 year global data set would not have been able to accurately delineate Category

4-5 hurricanes from Category 3 hurricanes or even at times from Category 1-2 hurricanes.

In the late 1970s I visited all the global tropical cyclone centers and observed their satellite capabilities and the training of their forecasters as part of a World Meteorological Organization (WMO) tropical cyclone survey trip that I was commissioned to make. The satellite tools and forecaster training in the tropical cyclone regions of the Indian Ocean and Southern Hemisphere during the 1975-1989 period was not adequate for the task of objectively distinguishing Category 4-5 hurricanes from other hurricane intensities. Table 1 of the Webster et al. paper indicates that there were 32 Indian Ocean and South Pacific Category 4-5 tropical cyclones in 1975-89 and 79 (247 percent more) during the 15-year period of 1990-2004. Such large increases are not reasonable given the fact that the frequencies of the weaker cyclones in these basins did not show much difference.

It would be instructive to observe the increase of major hurricanes (Category 3-4-5) during the last 20 years when satellite technology had improved. It would be easier to distinguish Category 3-4-5 hurricanes as compared to just Category 4-5 hurricanes alone. Also, the largest rise in global surface air temperature occurred during the last 10 years. The NOAA-NCEP reanalysis of global mean temperature differences between the last two 10-year periods show that the last 10 years (1995-2004) of global surface temperature have been about 0.4°C warmer than the earlier 10-year period of 1985-1994. If there was an influence of global warming on major hurricane activity, one would expect to see this increase represented by greater numbers of global major hurricanes during the last 10 years in comparison with the earlier 10-year period.

Table 1 shows the number of measured major hurricanes (Cat. 3-4-5) around the globe (excluding the Atlantic). Note that there has been no apparent difference

in reported major (Cat. 3-4-5) hurricanes between these two 10-year periods despite the globe being about 0.4°C warmer in the recent period.

By contrast, the Atlantic has seen a very large increase in major hurricanes between 1995-2004 in comparison to the previous 10-year period of 1985-1994. This large increase in Atlantic major hurricanes during the more recent period is a result of the multi-decadal increase in the Atlantic Ocean thermohaline circulation (THC) and is not due to global temperature increase. Changes in salinity are believed to be the driving mechanism. These multi-decadal changes have also been termed the Atlantic Multi-Decadal Oscillation (AMO).

There have been past hurricane periods in the Atlantic which have had just as many major hurricanes and Category 4-5 hurricanes as in recent years. A comparison of the last 15 years of hurricane activity with an earlier 15-year period from 1950-64 shows no significant difference in major hurricanes or Category 4-5 hurricanes even though the global surface temperatures were colder and there was a general global cooling during 1950-64 as compared with global warming during 1990-2004.

The most reliable comparison of Category 4-5 hurricanes that can likely be made is to compare the last ten years (1995-2004) with the prior ten years (1985-1994) for North Pacific storm areas monitored by the US and Japan. The two North Pacific basins do not indicate that the number of hurricanes of Category 4-5 intensity have increased in the last 10 years when global surface temperatures have risen. Measured Category 4-5 numbers in the North Pacific were 101 in the 1985-1994 period and 95 in the more recent 1995-2004 period – no significant difference.

SUMMARY

Global measurements do not support the contention of Webster, et al. that global numbers of Category 4-5 hurricanes have become more frequent in the last 15 years. There is no physical basis for assuming that global tropical cyclone intensity or frequency is necessarily related to global mean surface temperature changes of less than $\pm 0.5^{\circ}\text{C}$. As the ocean surface warms, so does the global upper air temperature rise to maintain conditionally unstable lapse-rates and global rainfall rates at their required values. Seasonal and monthly variations of SST within the individual storm basins show only very low correlations with monthly, seasonal, and yearly variations of hurricane activity. These correlations typically explain only about 10 percent of the hurricane variance. Other factors such as tropospheric vertical wind shear, surface pressure, low level vorticity, mid-level moisture, etc. play more dominant roles in explaining hurricane variability.

Although there has been a general global warming over the last 30 years and particularly over the last 10 years, the SST increases in the individual tropical cyclone basins have been smaller (about half) than for the globe as a whole and have not brought about any significant increases in global major hurricane activity except for the Atlantic which, as discussed, has multidecadal oscillations which are driven by changes in salinity. No credible observational evidence is available or likely will be available in the next few decades which will be able to directly associate global temperature change to changes in global Category 4-5 hurricane frequency and intensity.

For a longer and more detailed review of this paper please refer to my project's website at (tropical.atmos.colostate.edu).

	1985-1994 (10 Years)	1995-2004 (10 Years)
North & South Indian Ocean	45	50
South Pacific & Australia	44	41
NW Pacific	88	87
Northeast Pacific	41	40
GLOBE TOTAL (excluding Atlantic)	218	218

Table 1. Comparison of observed major (Cat. 3-4-5) tropical cyclones in all global basins (except the Atlantic) in the two most recent 10-year periods of 1985-94 and 1995-2004.