

Trends in Global Tropical Cyclone Activity over the Past Twenty Years (1986-2005)

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Talking Points

- 1) “Best track” tropical cyclone data is evaluated worldwide from 1986-2005 to see if there are trends in tropical cyclone activity over this time period.
- 2) Globally, tropical sea surface temperatures have increased approximately 0.2°C – 0.4°C from 1986-2005.
- 3) If the increases in TC activity found by Emanuel [2005] over the past 30 years (based on data from 1975-2004) and Webster et al. [2005] over the past 35 years (based on data from 1970-2004) are robust, one would expect to see similar trends over the shorter time span evaluated in this paper (1986-2005), especially since SST increases have accelerated in the past twenty years.
- 4) There is considerable disagreement about the data quality before the middle 1980s. Best track datasets for the Western North Pacific, the North Indian Ocean and the Southern Hemisphere before 1985 should be “used with great caution” according to the authors of the best track dataset.
- 5) Two metrics were evaluated to determine trends over the past twenty years. The first metric is the Accumulated Cyclone Energy (ACE) index, which is the maximum sustained wind speed squared at six-hour intervals. ACE represents an approximation of the kinetic energy generated by a tropical cyclone. ACE correlates globally at 0.97 with Emanuel’s PDI index which is the wind speed cubed at six-hour intervals.
- 6) The second metric is the number of Category 4-5 hurricanes in each tropical cyclone basin.
- 7) With regards to ACE, there has been a large increase in ACE in the North Atlantic basin since 1986. There has been a large decrease in ACE in the Northeast Pacific basin since 1986. All other basins show small upward or downward trends. Globally, there has been a slight increasing trend from 1986-2005; however, if only the past sixteen years are evaluated (1990-2005), there has actually been a slight decreasing trend.

- 8) With regards to the number of Category 4-5 hurricanes, there has been a large increase in North Atlantic storms but also a large decrease in Northeast Pacific storms. When these two regions are summed together, there has been virtually no increase in Category 4-5 hurricanes (i.e., 47 Cat. 4-5 hurricanes from 1986-1995 and 48 Cat. 4-5 hurricanes from 1996-2005). For the globe, there has been an approximate 10% increase in Category 4-5 storms from 1986-1995 to 1996-2005; however, most of this increase occurred from the late 1980s to the early part of the 1990s in the Southern Hemisphere where some data quality issues may have still been present. There has been very little change in the number of Category 4-5 hurricanes since 1990, which is an agreement with Figure 4, panel A from Webster et al. [2005].
- 9) Finally, correlations between basin-wide sea surface temperatures (SSTs) and ACE values and Category 4-5 hurricanes are conducted for each basin. There is a positive correlation (significant at the 99% level) between SSTs and ACE values and Category 4-5 hurricanes for both the Atlantic and the Northeast Pacific basins. However, correlations between SSTs and ACE values and Category 4-5 hurricanes for all other basins (i.e., Northwest Pacific, North Indian, South Indian and South Pacific) are not significant.
- 10) These findings indicate that there has been very little trend in global tropical cyclone activity over the past twenty years, and therefore, that a large portion of the dramatic increasing trend found by Webster et al. [2005] and Emanuel [2005] is likely due to the diminished quality of the datasets before the middle 1980s. One would expect that if the results of Webster et al. and Emanuel were accurate reflections of what is going on in the climate system, than a similar trend would be found over the past twenty years, especially since SSTs have warmed considerably (about 0.2°C – 0.4°C) during this time period.
- 11) The weak correlations between SSTs and ACE values and Category 4-5 hurricanes for most of the global basins indicates that other factors such as the state of El Niño – Southern Oscillation, the strength of the vertical wind shear, and the amount of mid-level moisture, etc. play a critical role in determining the level of expected seasonal tropical cyclone activity.
- 12) The issue of climate change and tropical cyclone activity is likely to remain a central focus of research, and further study will likely increase our understanding of this important topic.