

On Estimates of Historical North Atlantic Tropical Cyclone Activity

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In press at *J. Climate*.

3 January 2008

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In this study, we develop an estimate of the expected number of Atlantic tropical cyclones (TCs) that were missed by the observing system in the pre-satellite era (between 1878 and 1965). We also estimate the significance of trends in both number and duration since 1878 and relate these results to estimated changes in sea surface temperature (SST) over the 'main development region' (MDR). The sensitivity of the estimate of missed TCs to underlying assumptions is examined. According to our base case adjustment, the annual number of TCs has exhibited multi-decadal variability that has strongly co-varied with multi-decadal variations in MDR SST, as has been noted previously. However, the linear trend in TC counts (1878-2006) is notably smaller than the linear trend in MDR SST, when both time series are normalized to have the same variance in their 5-year running mean series. Using the base case adjustment for missed TCs leads to an 1878-2006 trend in number of TCs that is very weakly positive, though not statistically significant, with $p \sim 0.2$. The estimated trend for 1900-2006 is highly significant ($+ \sim 4.4$ storms/century) according to our tests. The 1900-2006 trend is strongly influenced by a minimum in 1910-1930, perhaps artificially enhancing significance, whereas the 1878-2006 trend depends critically on high values in the late 1800s, where uncertainties are larger than during the 1900s. The trend in average TC duration (1878-2006) is negative and highly significant. Thus the evidence for a significant increase in Atlantic storm activity over the most recent 125 years is mixed, even though MDR SST has significantly warmed. The decreasing duration result is unexpected and merits additional exploration; duration statistics are more uncertain than those of storm counts. As TC formation, development and track depend on a number of environmental factors, of which regional SST is only one, much work remains to clarify the relationship between anthropogenic climate warming, the large scale tropical environment and Atlantic TC activity.