Nonstationary Hurricane Risk in the United States

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The 107 year (1900-2006) historical record[1] of US hurricane impacts (Figure 1) fails to show upward trends of either damage (normalized for economic factors) or US landfall frequency. This pattern arises despite the apparent increase[2] in Atlantic-basin-wide tropical cyclone activity (Figure 2). In terms of multidecadal cycles,[3] the HURDAT climatology delimits more-active periods in the very early 20th Century, in the middle of the 20th Century, and since 1995. It also includes less-active periods in the late teens and twenties and 1970-1994. Thus, the documented record does represent a range of extremes within the present climate.

There is growing evidence that the century-scale apparent increase in Atlantic hurricane numbers or intensities is either a) largely confined to the Eastern Atlantic far from US shores or b) the result of lacunae in the early historical record.[4] These arguments appear to explain why the apparent basin-wide increases in numbers and intensity do not appear in the US landfall statistics.

It is reasonable for catastrophe modelers to try to represent multidecadal cycles or trends in risk. Doing so in a scientifically sound manner, however, poses significant challenges because hurricane track and patterns of intensification, as well as numbers, almost certainly change with climate regime. For example, simply increasing the number of hurricanes without changing storm histories as represented by the model is likely to introduce biases or inaccuracies. The Commission is open-minded to representation of the models, and it is incumbent upon the modeler to incorporate the best science. This statement is true even though many salient scientific questions are by no means settled.

In the course of the debate about short-tem risk, it is crucial to remember that years, or pairs of years, with multiple damaging US landfalls have occurred often in the historical record. During the 1893 season, for example, the US experienced 6 hurricane landfalls (Figure 3). Other similar examples from the past include 1916, 1933, 1954-1955, and 1985. Thus, even in a more active regime, years like 2004 and 2005 will not be the norm. Most years will be like 2006 or 2007, or for that matter like 1995-2003. The challenge facing the modelers is to find ways to represent real short-term risk that are supported by rigorous, up-to-date science.

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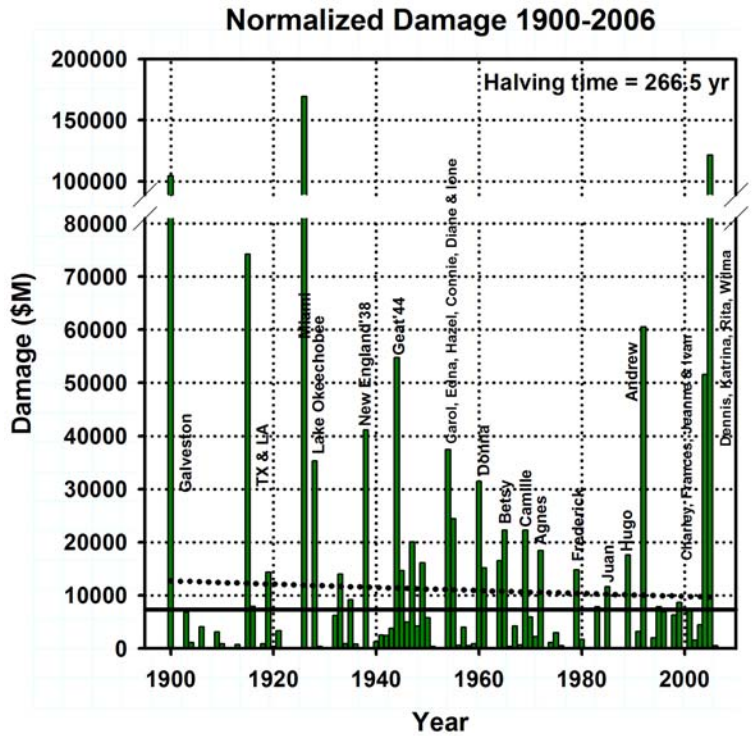

Figure 1a. Time history of US hurricane damage normalized for inflation, population, and index of wealth. The solid curve is the 107 year mean, and the dotted curve is a fitted exponential trend, equivalent to a halving time of 267 years. The trend is not significantly different from zero.

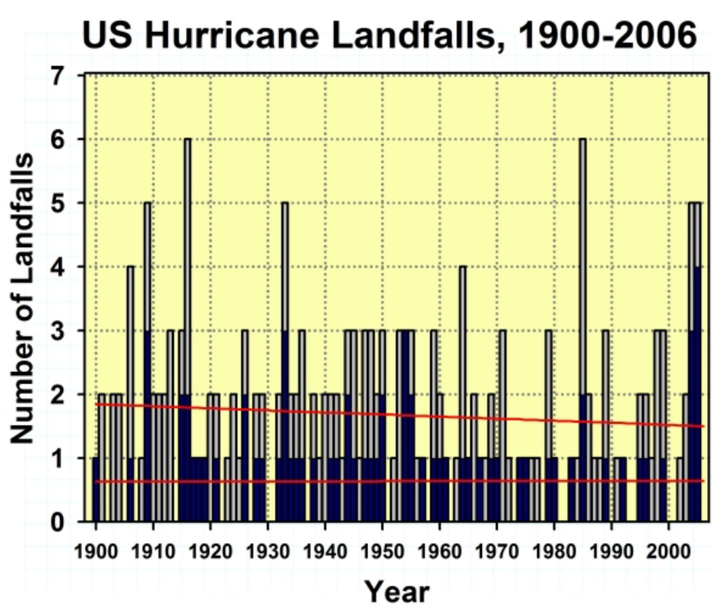

Figure 1b. US Hurricane landfalls 1900-2006. Dark blue bars represent the number of landfalls by major hurricanes with winds > 115 mph. Major hurricanes account for 80-85% of US hurricane damage.

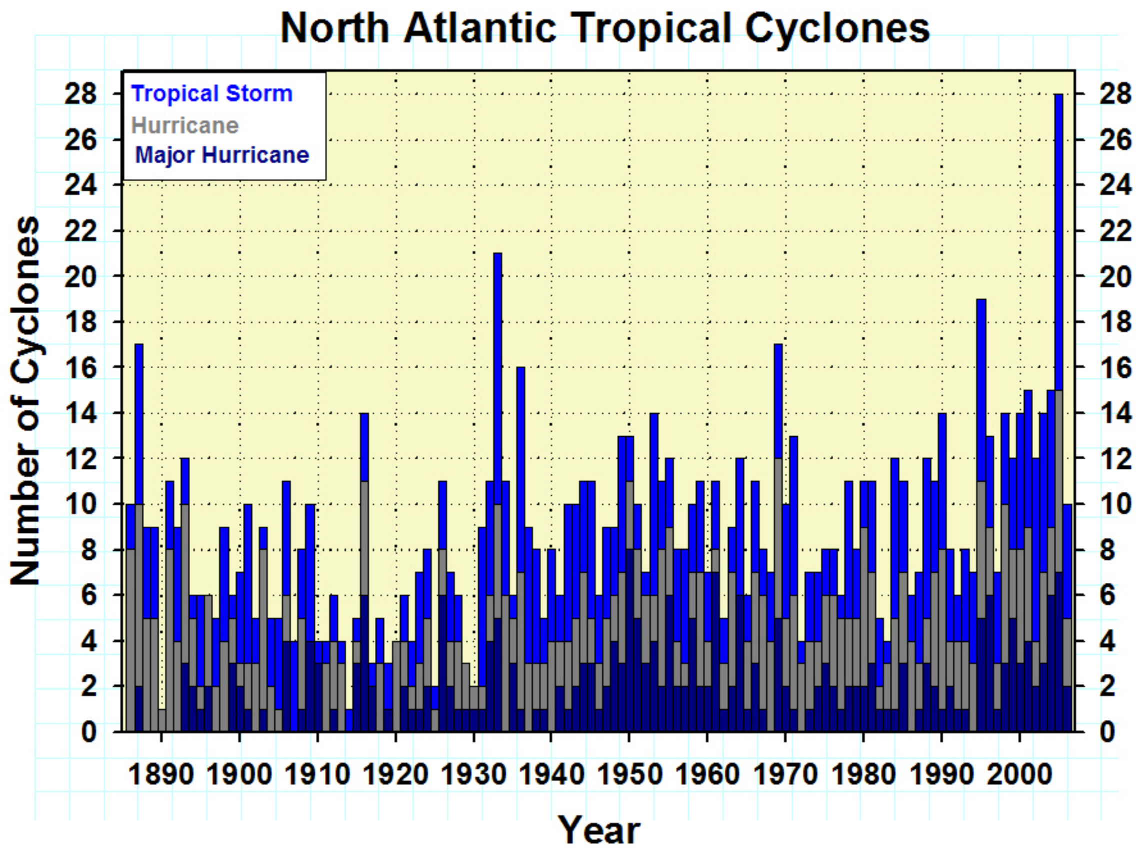

Figure 2. Total number of Atlantic, Caribbean and Gulf of Mexico hurricanes and tropical storms 1886-2006. Dark blue bars represent the number of major hurricanes; gray bars represent nonmajor hurricanes; and light blue bars represent tropical storms. The data indicate a significant upward trend, an undetermined portion of which is due to storms missed in the early art of the record. It also exhibits quasi-cyclic minima in the early 20th century and from 1970-1994. In the three periods, the early years, from 1926-1969, and since 1995, levels of activity are significantly above the long-term trend; 1995-2006 clearly represent the most active years in the record.

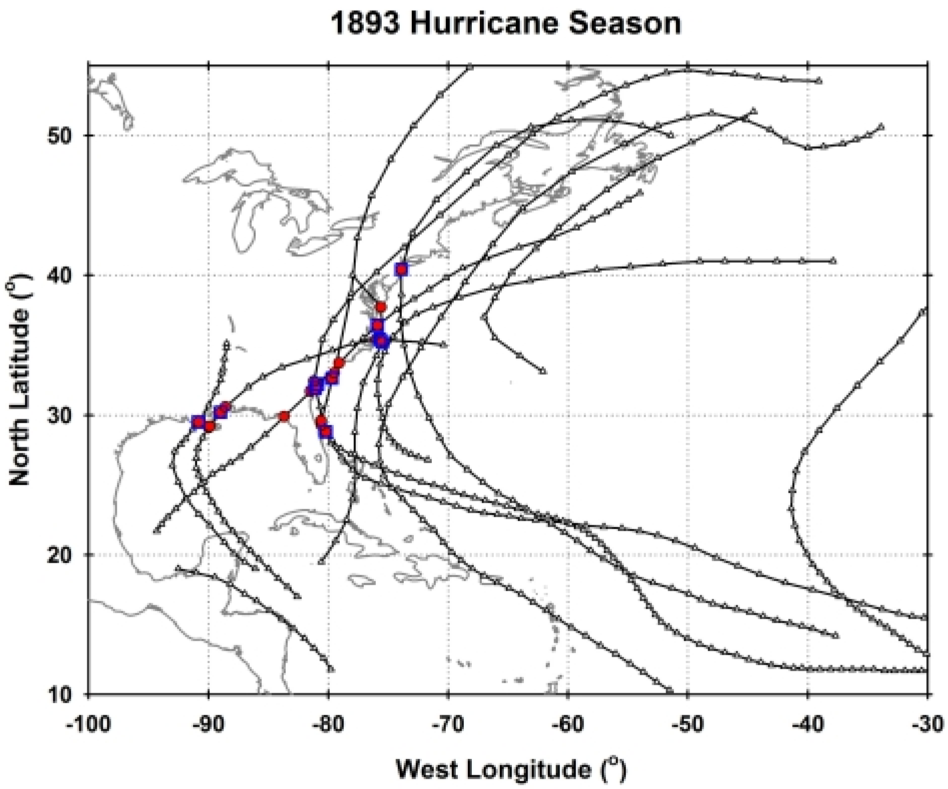

Figure 3. Tropical cyclone tracks for the 1893 hurricane season drawn from the HURDAT archive. The US experienced six hurricane landfalls in 1893. Open triangles represent cyclone positions at 6-h intervals. Blue squares are the positions where the storm became most intense. Red circles are landfall points.