Critique of

Can We Detect Trends in Tropical Cyclones?

by

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This Perspective, published in the July 28th 2006 issue of *Science*, argues that recent upward trends in tropical cyclone activity are the spurious result of changes in the techniques by which tropical cyclones are detected. In particular, the Dvorak technique whereby tropical cyclone intensity is estimated from satellite imagery, has undergone several changes since its inception in the 1970s.

It is important first to note that Landsea et al. offer no quantitative support for their hypothesis that the changes in Dvorak-based measurements; instead, they cite a few cases where independent measurements show that the earlier Dvorak-based measurements underestimated the intensity of storms. Such anecdotes hardly constitute a comprehensive argument and the authors fail to account for the fact that the Dvorak technique, when it first appeared, had been calibrated against aircraft-based measurements. During the entire evolution of Dvorak-based intensity estimation, independent, aircraft-based estimates were available in the North Atlantic region and, until 1987, in the western North Pacific. Although very little information is available about the calibration of the Dvorak technique, it hardly seems credible that forecasters would have applied it to new satellite data without at least spot checking it against aircraft data where it was available. And even in places where aircraft data have never been routinely available, forecasters have been able to compare satellite-based estimates to estimates based on measurements or damage assessments when storms made landfall or passed over islands.

The Perspective also overlooks two important recent results. The first, reported by Emanuel (2005), shows that in the Atlantic, where aircraft measurements have been available since the late 1940s, the power dissipation index (*PDI*), a measure of the total amount of kinetic energy released by tropical cyclones, is exceptionally well correlated with the sea surface temperature of the tropical North Atlantic in late summer and early fall. As shown in Figure 1, below, 88% of the variance of *PDI* is "explained" by variations in the sea surface temperature. Since the sea surface temperature is measured independently of tropical cyclones, it is very unlikely that this correlation is an accident. Contrary to the assertions of Landsea et al., there are no "sudden" changes in the record.

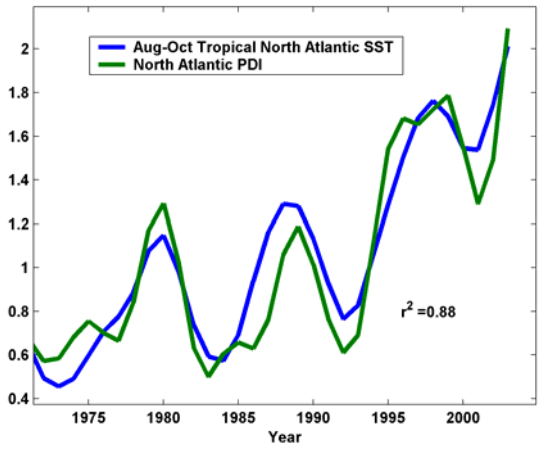

Figure 1: North Atlantic tropical cyclone power dissipation index (green) and scaled August-October sea surface temperature of the tropical North Atlantic (blue), using data from 1970 to 2006. Each curve has been smoothed with a filter that removes the high frequency (year-to-year) variability.

The second result overlooked by Landsea et al. is a paper by Sriver and Huber (2006), which uses re-analysis data to estimate tropical cyclone power dissipation. Very little, if any, of the criticized "best track" tropical cyclone data is used in the re-analysis technique, yet the results of this exercise, when normalized by the variance of the re-analyzed tropical cyclone intensities, are very close to those reported by Emanuel (2005) based on an adjusted best-track data set (Figure 2). Although both the best-track data and the re-analysis tropical cyclones can be criticized on different grounds, it would be a startling co-incidence if they yielded the same result by accident.

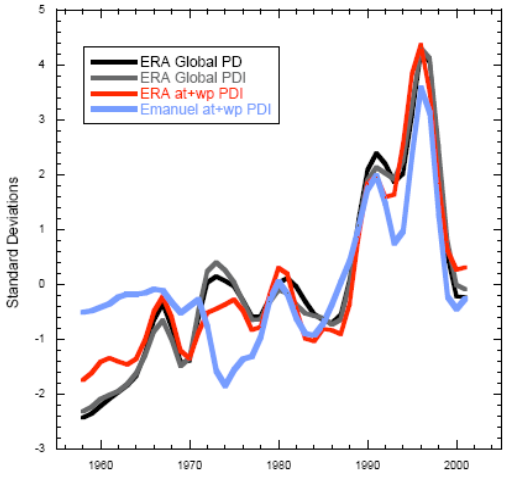

Figure 2: Power dissipation index from the ERA-40 re-analysis data set for global tropical cyclones (gray), and North Atlantic and western North Pacific tropical cyclones (red). The latter can be compared to the results of Emanuel (2005; blue). Each result is expressed in terms of standard deviations from the respective data sets. The black curve shows the re-analysis global power dissipation including the effect of varying storm diameters. From Sriver and Huber (2006).

Both of these results weigh heavily against the speculation by Landsea et al. that the upward trend in recent years is merely an artifact of the tropical cyclone best-track data. It is curious that the lead author (Landsea et al. 1996) has used the Atlantic best-track data to infer a downward trend in intense hurricanes, a result understandable from Figure 1 when one considers that Landsea's analysis ended in 1992. Even more curious is the Perspective's favorable mention of the work of Klotzbach (2006), who inferred a neutral trend in global tropical cyclone activity in the period 1986-2005, during which only about 10% of the storms were ever surveyed by aircraft. Apparently, Landsea et al. would have us believe that the tropical cyclone best track data set is, after all, useful for long-term trend analysis, as long as the inferred trends happen to be downward or neutral.

Finally, Landsea et al. refer to "large" bias corrections that were applied to the pre-1970 data. It is of some interest to note that, in the Atlantic, this bias correction was introduced by the first author himself (Landsea 1993), and that at its largest, the correction amounts to a 17% change in power dissipation, hardly a large correction. A re-examination of the pressure-wind relationships in the original data strongly supports the need for a bias correction of about the magnitude originally advocated by Landsea (1993).

While the entire community of tropical cyclone researchers recognizes the limitations of the tropical cyclone best track data and the need for a comprehensive re-analysis of these data, the field is not well served by arm-waiving speculations about what such an analysis might show. In particular, the high correlation between tropical cyclone power and sea surface temperature, and the consistency of the best-track data with re-analysis based estimates of tropical cyclone power, support the basic integrity of the tropical cyclone data and results like those of Emanuel (2005) and Webster et al. (2005) that are based on them.

References

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