Signals, noise, and gaps: connecting climate research with the insurance industry

Judith Curry
Georgia Institute of Technology
Climate Applications Network

The catastrophic 2004 and 2005 North Atlantic hurricane seasons, along with scientific publications on a link between hurricane intensity and global warming, focused attention on the nonstationarity of the 50 to 100 year climate records that have been used to project future high impact weather events by catastrophe modelers. Once the nonstationarity of the time series is accepted, the challenge then becomes to incorporate trends and multi-decadal variability into catastrophe models in the face of scientific uncertainty and opinions of individual scientists that vary widely. Results from successive scientific papers are often contradictory, and it is difficult to identify the underlying signal of scientific progress. Assessments made by groups such as the IPCC, the NAS/NRC, and the CCSP are of particular importance in "reducing the noise" from individual scientists discussing their personal papers or those of competitors. The most recent assessment that discusses extreme weather events (including hurricanes) is the President's Climate Change Science Program (CCSP) Synthesis and Assessment Report (SAP) 3.2 Weather and Climate Extremes in a Changing Climate (http://www.climatescience.gov/Library/sap/sap3-3/sap3-3-draft3.pdf). The importance of assessments is this: they represent a careful analysis of the data and literature over a period of months to years by a group of scientists selected by impartial government agencies to represent a diversity of perspectives. Assessments are not intended to be "consensus" reports, but rather a summary of our best current understanding of the issues at that time, including uncertainties. The insurance industry and catastrophe modelers should be accounting for trends and their uncertainties as identified in these assessments, as reflecting the current best understanding by the scientific community.

With regards to the high impact weather events of greatest concern to the insurance industry – hurricanes – the data remain imperfect and climate models cannot be run in coupled mode at sufficiently high resolution. However, our understanding continues to increase, and the following signals are emerging, although the magnitude of these signals remains uncertain:

1) The main signal in increasing hurricane intensity is the percentage of category 4 and 5 hurricanes, with the period since 2002 being particularly high globally (exceeding 40%). Of particular note, the last 2 years have seen 3 category 4-5 hurricanes in the North Indian Ocean, out of a total of 6 for the past 30 years. Modeling studies cannot resolve the most intense hurricanes; the only modeling study to date that can resolve the most intense hurricanes is the downscaling study of Kerry Emanuel, who finds a significant increase in the percentage of category 4 and 5 hurricanes globally since 1980, but smaller than the observations indicate.
2) While the global number of hurricanes has not been increasing, there is evidence of an increase in the number of North Atlantic hurricanes since 1900 that is significantly larger than can be explained by any credible scenario of undercounting. Climate model projections of future numbers of North Atlantic hurricanes range from an increase of 30% to a decrease of 27%; hence these projections are currently too uncertain to be of any use, and our physical understanding of the climatic controls on hurricane frequency is weak.
3) Links of hurricane activity with sea surface temperature are more complex than originally envisioned, whereby an increase in SST is insufficient to explain an increase in intensity or number. Changing patterns of sea surface temperature and their influence on atmospheric dynamics plays an important role. Statistical models relating hurricane activity to SST need to be revised in the context of this improved understanding.

While some clarity is emerging in terms of global hurricane intensity and the number of Atlantic basin hurricanes, this is not of direct interest to the insurance industry, which is interested in U.S. landfalls. However, until we understand the mechanisms behind global intensity increase and the increase in the total number of Atlantic hurricanes, we won't have a credible basis for interpreting U.S. landfalls. A critical issue is to understand why the number of U.S. landfalls does not show a trend given the trends in total Atlantic basin hurricanes. This issue can only be understood through a careful interpretation of the natural modes of climate variability that influence hurricane activity: the Atlantic Multidecadal Oscillation (AMO), the Pacific Decadal Oscillation (PDO), the North Atlantic Oscillation (NAO) and El Nino Southern Oscillation (ENSO). Unfortunately, the length of the available data record is insufficient to sort out all of these influences on landfalls in an unambiguous way. By focusing on the AMO and PDO (decadal scale oscillations), the recent elevated period of hurricane activity, associated with the warm phases of the AMO and the PDO (the majority of the years since 1995), has seen an increase in the number of U.S. landfalls of 41% percent relative to the previous comparable period (1926-1945).

Scientists and forecast centers are focused the weather time scale (1-10 days) and the century time scale (coupled climate model simulations), with some activity on the seasonal time scale (1-6 months) that is beginning to include coupled atmosphere-ocean models. By contrast, the time scales of greatest interest to the insurance industry is 1 to 5 years; there is an emerging interest in subseasonal (weeks to months) time scales by the reinsurance industry and increasing realization of the need for a decadal scale context of ~ 20 years. All three of these time scales of greatest interest to the insurance sector lie within gaps of current operational/research activity by the weather/climate community, and very possibly within fundamental predictability gaps. There is likely untapped predictability on the subseasonal and decadal time scales, but the 1-5 year time scale may be fundamentally unpredictable, other than in the context of slowly varying decadal modes.

Focusing operational and research activity of the weather/climate community on issues of relevance to the insurance industry requires one or more of the following:

1) Scientific partners of the insurance industry convincing the emerging NOAA Climate Services to focus on time scales and data/model products of interest to the insurance industry by identifying a broad range of societal benefits (outside the financial sector) from data/model products on these time scales.
2) Insurance industry providing funding for scientists and/or operational centers to explore the desired regimes of predictability and to provide the desired data/model products.
3) Expanding the collaborations between the insurance industry and academic/govt researchers, to target research on topics of specific interest to the insurance industry.

In the absence of such proactive steps by the insurance industry, scientists will either follow their personal scientific curiosity and/or follow the research dollars, with occasional results of incidental relevance to the insurance sector. A critical mass of climate/weather researchers are interested in interacting with the insurance sector, but gaps in understanding and funding currently hamper more targeted collaboration.