

Climate Change Workshop

Florida Commission on Hurricane Loss Projection Methodology

September 15-16, 2022

The Florida Commission on Hurricane Loss Projection Methodology (Commission) Climate Change Workshop was held on September 15-16, 2022, in Tallahassee, Florida. The primary purposes of the workshop were to educate the Commissioners on climate change and to determine what associated methodologies ought to be considered for improving the accuracy for projecting insured Florida losses and probable maximum loss levels resulting from hurricanes and floods. The Workshop consisted of eleven scientific presentations each followed by some clarifying questions and audience dialogue. Highlights from each of the presentations will be offered first in this summary. The individual presentations are available on the Commission website at <https://www.sbafla.com/methodology/Meetings/CurrentYear.aspx>. Subsequently, key findings from the workshop representing consensus opinions are presented along with some areas requiring further research.

In the opening presentation, Dr. Hugh Willoughby discussed trends and distributions of U.S. hurricane damage since 1900 and emphasized Dr. Kerry Emanuel's work on Maximum Potential Intensity (MPI) as fundamental to the understanding of tropical cyclones. He also discussed approaches to assessing the losses over time while accounting for many complicating factors. S&P Global Senior Scientist and former Professional Team meteorologist Dr. Tim Hall next presented recent research on the increasing intensity of hurricanes over time, northeastward track propagation particularly in the Gulf of Mexico, and his own research on the slowing and even stalling of tropical cyclones leading to increased accumulated rainfall. Dr. William Sweet presented multiple graphical summaries of historical and projected sea levels for tidal and storm surge flooding. Sea level rise was shown to vary regionally, and consequences would be severe from sea level rise by 2050 without additional risk reduction strategies for coastal communities. Dr. Sweet is a NOAA Oceanographer who leads multiple national efforts in tracking and predicting changes in sea level rise and coastal flood risks.

The next presentations in the workshop were given by current Professional Team members. Actuary Stu Mathewson (FCAS, MAAA) reviewed the development of an Actuaries Climate Index and an Actuaries Climate Risk Index, for which the underlying work has been jointly sponsored by four leading actuarial societies. The indices provide high level metrics on a regional basis (within North America) to educate and to document climate change. Research on the indices is ongoing to further educate the general public on climate change. Statistician Dr. Mark Johnson discussed standards currently in the *Hurricane Standards Report of Activities as of November 1, 2021*, that explicitly (Standard M-1, Disclosure 5) or implicitly (Standard S-1) address climate change. Following his presentation, Professional Team Coastal Engineer Chris Jones noted that sea level rise, changes in precipitation patterns, and changes in storm characteristics (i.e., severity and frequency) are addressed in the *Flood Standards Report of Activities as of November 1, 2021* (Standard MF-1, Disclosures 3, 4, and 5 and Audit item 5). These standards will be re-assessed following the next round of model reviews.

The remaining presentations were given by representatives from six of the seven modeling organizations whose models are currently accepted by the Commission. These presentations illustrate a diversity of approaches to incorporating climate change into future versions of their models. All six presentations demonstrated modeler appreciation of recent scientific literature on climate change, the challenges in converting recent research findings into existing commercial products, and efforts at exploring how their models can provide forecasts of insured losses under various climate change scenarios (as given in the Intergovernmental Panel on Climate Change (IPCC) reports). Future extensions recognize the computational complexity inherent in moving

from existing parametric models towards more physics-based models. Modeling organizations are monitoring and conducting research for further enhancement of their capability to estimate insured loss costs (average annual losses and probable maximum loss levels).

Several aspects of climate change were addressed in multiple presentations and there was universal agreement in the direction of certain effects. There was also a commonality as to the scientific canon underlying the understanding of hurricanes and coastal and inland flooding. Areas needing further research were also identified. Some key findings from the Workshop follow:

1. Climate change is indisputable—it has occurred; it continues to occur; and will continue to occur with some acceleration of effects depending on future forces. Specifically, global temperatures and sea surface temperatures are rising. Global sea level rise is ongoing. Sea level rise varies regionally, driven not only by global thermal expansion of seawater, but also effects, such as regional changes in ocean currents and local land subsidence.
2. The intensity of hurricanes is increasing, driving an increase in the proportion of hurricanes that reach category 4 or 5 in the North Atlantic.
3. Climate change adds significant new challenges to the already complex modeling of hurricane and flooding events. At present, computational limitations preclude direct numerical simulations by climate models of the tens of thousands of hurricanes needed for risk assessment, as are currently done with the Commission accepted models. Moreover, many global climate models exhibit biases in their hurricane climatologies. Nonetheless, using a wide range of approaches that blend statistical, numerical climate-modeling and theoretical analyses, several different researchers and organizations have reached similar conclusions: increasing intensity of hurricanes, increasing frequency and magnitude of hurricane-driven coastal flooding, and an eastward shift in hurricane hazard in the Gulf of Mexico. Although the quantitative results varied considerably by modeling approaches, the relative changes were in qualitative agreement.
4. With the increase in sea surface temperatures and global temperatures, the atmosphere can have increasing moisture content resulting in greater precipitation associated with extreme events.
5. Natural modes of interannual variability (e.g., Atlantic Multi-decadal Oscillation (AMO) and the El Niño Southern Oscillation (ENSO)) complicate the analysis of historical data and further challenge forecasts. There is no consensus on the evolution in frequency of hurricane formation in the North Atlantic driven by climate change, in part due to the role of ENSO. It is well known that an El Niño state is associated with greater wind shear in the Caribbean and Gulf of Mexico, which inhibits hurricane formation and intensification. Some recent research suggests that climate models are biased towards projecting increasingly El-Niño-like climates, which may impact their ability to forecast North Atlantic hurricane activity.
6. References for a selection of relevant research publications are provided below.

*Prepared by the Global Climate Workshop Organizing Group
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