UNDERSTANDING THE DRIVERS OF VARIABILITY IN SEVERE CONVECTION

Bringing Together the Scientific and Insurance Communities

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What is our current understanding of the drivers of year-to-year variations in severe thunderstorms over the United States, and how might a warming climate impact the risks associated with tornadoes and hail? These fundamental questions, along with assessing their importance to both the public sector and the insurance industry, were the focus of the Second Severe Convection and Climate Workshop on 9–10 March 2016 (http://extremeweather.columbia.edu/events/severeconvection2016/), organized by the Initiative on Extreme Weather and Climate at Columbia University. The workshop brought together over 110 researchers from China, Europe, and North America, reflecting a diverse spectrum of interests and experience, from graduate students to senior scientists and tenured faculty.

SEVCON16: 2016 SEVERE CONVECTION AND CLIMATE WORKSHOP

WHAT: Over 110 registered participants from the academic, operational meteorology, and insurance sectors met to discuss the latest research in severe convective storms and how they are influenced by the climate system.
WHEN: 9–10 March 2016
WHERE: New York, New York

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The understanding of severe thunderstorm variability is still in its infancy (Tippett et al. 2015). Engagement of stakeholders is critical to ensuring the questions relevant to the community are being asked. This meeting included representatives from both the climate and severe storms communities, hailing from the academic sector, operational meteorologists, emergency managers, reinsurers, insurers, and catastrophe modelers. This in turn allowed a broad perspective on the importance of modulations to severe thunderstorm occurrence as a response to subseasonal signals, such as the

Madden–Julian oscillation (e.g., Barrett and Gensini 2013) and the global wind oscillation (GWO; Gensini and Marinaro 2016); seasonal climate signals, such as El Niño–Southern Oscillation (ENSO; e.g., Allen et al. 2015); and the impacts of a warming climate (e.g., Diffenbaugh et al. 2013). Spatial, magnitude, and frequency modulations can have a considerable influence on the potential for insured losses (e.g., Sander et al. 2013), and thus ensuring the latest state of knowledge is communicated between the various sectors has important implications for the insurance industry and assessing public risk. Furthermore, bringing this wide-ranging group together provided the impetus to discuss the operating procedure and understanding of insurers, reinsurers, and catastrophe modelers, and to showcase the most recent research in the academic community.

A key question going into and during the workshop was the degree to which information on prediction or even understanding of severe thunderstorm activity on subseasonal to seasonal scales and its response to a warming climate could be applied in the insurance industry. While workshop participants were unable to draw a conclusive answer to this question, discussions suggested that such work is of interest to the insurance sector, provided it can be determined with sufficient lead time to influence business decisions or risk mitigation. Despite this challenge, it was agreed that information on the drivers of variability was presented to effect changes to the catastrophe models and to potentially better inform insurance decisions in the years to come.

The workshop opened with a session on observed severe thunderstorm events and climatology, highlighting new approaches for determining hail risk in Europe, including deriving hail swaths from favorable environmental conditions and satellite-detected overshooting-top data. Other topics included the increase in the number of tornadoes occurring during tornado outbreaks; a multinational, multilingual reanalysis of historical tornadoes in Europe; and exploration of the precursors to derecho occurrence in the United States. The next session focused on the primary drivers of seasonal to subseasonal variability, including an interesting result that is highly indicative of tornadoes being thermophobic, or at the very least subject to a goldilocks-type problem of the temperature being just right in the spring and summer for tornadoes to occur. An interesting point of contention arose between the below-average spring (March–May) seasonal outlook for hail and tornado occurrence across the United States based on ENSO contrasting subseasonal indications using the GWO for an active March. This raised the issue of how to handle contrasting forecasts of subseasonal variability despite contributions from seasonal signals.

The afternoon took on a different complexion, with a gentle introduction to (re)insurance that touched on the problems faced by insurers in dealing with the relatively long intervals between major severe thunderstorm-driven loss events. This situation can lead to insufficient reinsurance to protect against catastrophic losses by local companies, which can lead to the collapse of these companies and policyholders being left out in the cold. Challenges also include a poor understanding of the climatological risk and ensuring that appropriate reinsurance and capital are in place to handle multiple catastrophic or even cumulative loss years (e.g., the 2011 tornado season). Presentations on the various catastrophe models followed, including an introduction as to how they are derived and different approaches to estimating loss risk based on exposure. The panel that followed touched on one of the more interesting workshop discussions: what is the co-occurrence of severe thunderstorm loss events, or how do these events correlate to landfalling Atlantic hurricanes, for example. Other lively discussions explored the limitations and differences between existing models, and whether climate variability should be introduced. The evening poster session showcased an impressive array of graduate, undergraduate, and exploratory research discussing everything from the sensitivity of high-resolution storm simulations to aerosols to assessing the recent downward trend in hail occurrence over China and high-resolution dynamical downscaling of severe thunderstorm environments, as well as different approaches to determine climatological risk and to assess the impacts of soil moisture and the Gulf of Mexico on severe thunderstorm activity to the impact of various climate signals on seasonal forecasts for severe weather.

The second day of the workshop focused on understanding the implications of climate change and storm dynamics, and less thought of precipitation and lightning risks. A notable feature in the first session included a fascinating numerical simulation experiment that explored the sensitivity of recent severe thunderstorm events to the influence of a warmed climate, revealing that increasing convective inhibition would generally result in fewer storms, but that when storms did form, the contributions from instability would lead to greater vertical velocity. This was accompanied by the latest research on the response of convective available potential energy (CAPE) to global warming,

changes to severe thunderstorms over Europe under a warming climate, and continual decreasing trends in hail occurrence in China. The conversation shifted to higher resolution, to what we know about tornadic formation, approaches to observing lightning and the new development of long-term records of satellite-derived observations of severe storms, and the potential for these datasets to be applied to climate problems. The final session of the workshop featured presentations on the long-range predictability of precipitation extremes using the Climate Forecast System, version 2, and was rounded out by evidence of seasonal predictability of lighting activity over Venezuela.

Critical themes derived from the proceedings include the need for greater scrutiny of the observed datasets to identify superior climatologies of severe thunderstorms; the search for further predictors of severe thunderstorm variability, particularly when ENSO is not the driving influence; and the need to consider the potential for the clustering of risk from severe thunderstorm events and exposure.

The first workshop on Severe Convection and Climate (http://wiki.iri.columbia.edu/index.php?n=Climate.TornadoWorkshop) was a small event in March 2013, which was the first effort to bring together both the climate and severe storms communities. This workshop contributed to the beginning of the discussion about the influence of climate variability on severe thunderstorm events and seasonal prediction (http://iri.columbia.edu/news/wheres-my-seasonal-tornado-forecast/). The growth of this field in the intervening three years speaks to the importance of bringing together cross-disciplinary groups at the early stages of development for new research directions. The growth has meant that the second workshop doubled in size compared to the first, and that it now includes a strong representation from the insurance industry and a growing number of student and early-career researchers. Presentations and posters from the meeting have been made available at the workshop's website for interested parties that were unable to attend (http://extremeweather.columbia.edu/events/severeconvection2016/). With productive interactions between those from the insurance and academic sectors, it is hoped that this workshop will continue to foster future collaboration between these groups, along with growth in the research community to help mitigate risk and to better understand the differences between and challenges of years with high and low severe thunderstorm occurrence. To revisit a final point from the 2013 meeting, "Where is my seasonal tornado forecast?," our question following the 2016 workshop has now changed to "What is our seasonal tornado forecast, how can we improve on it, and how can this information be used?"

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