

## Spatial Extreme Value Analysis for Large-Scale Severe Weather Indicators

Changes in extreme weather conditions under a changing climate are of great concern to society. While some weather processes of interest can have extremes over a large-scale region, such as temperature, most severe weather of interest happens on very fine scales that cannot be resolved by climate models. One proposed method for inferring about extreme weather under a future climate is to look at larger scale variables that are indicative of environments conducive to severe weather conditions. Concurrently high values of convective available potential energy (CAPE) and 0-6 km wind shear (Shear) have been proposed for this context.

The present study investigates extremes of these variables from an NCEP reanalysis, and climate model output from NARCCAP. The main challenge statistically is in accounting for the joint tail behavior of the processes over space; an active area in statistical extreme value analysis (EVA). Here we employ a conditional EVA approach to explore the structure of  $WmSh$  (the product of  $W_{max}$  and Shear, where  $W_{max}$  is a transformation of CAPE that has the same units as Shear, m/s) over space and time given days when a high measure of energy exists within the spatial field. This method correctly accounts for spatial correlation, and yields results for all values of the process, extreme or not, and provides a method for projecting probabilities of extremes of the process beyond the range of the data along with appropriate uncertainty information.

The analyses are performed separately for winter, spring, summer and fall, and three time periods are examined. Initial results from the reanalysis suggest that this method correctly identifies physically meaningful characteristics of  $WmSh$ . For example, larger values of  $WmSh$  are found in the winter over the Pacific ocean pointed at the western United States in a fashion consistent with atmospheric rivers, as well as larger values Gulf of Mexico and Atlantic Oceans consistent with hurricane activity in those areas. These values are found to be increasing generally over time, though over the Pacific ocean, there is a slight decrease over the last six years. Spring and summer are marked by very high values of  $WmSh$  over the central United States where heavy tornadic activity is prominent.