Analyzing trends and patterns in extreme precipitation in observations and models using statistical extreme value analysis

Christopher J. Paciorek (1), Michael Wehner (2), Prabhat (2)

May 15, 2013

(1) Department of Statistics, University of California, Berkeley, and (2) Lawrence Berkeley National Laboratory

Extreme weather events are a key aspect of climate but are difficult to study because of sparse data. Statistical extreme value analysis provides a rigorous methodology to analyze extremes, either through analysis of maxima within time blocks (Generalized Extreme Value [GEV] models) or exceedances over a high threshold (Peaks over Threshold [POT] models). However, current statistical methods for spatial extremes focus on joint models for multiple locations that are computationally infeasible for large numbers of locations.

We focus on a statistical approach that allows for embarrassingly parallel analysis of individual locations. The basic approach is to fit individual POT models at individual locations, allowing for simple trends in time. To borrow strength spatially and reduce uncertainty in light of limited data, we smooth in space using a local likelihood approach at each location. For uncertainty assessment, we use a bootstrap approach that preserves spatial structure. We compare extreme precipitation by season in station data and GCM output using these techniques. In addition we include ENSO as a potential predictor of extreme precipitation, assessing its role in explaining both observations and model output.