Climate Extremes: Attributions and Future Projections

Richard L. Smith*
University of North Carolina, Chapel Hill, USA – rls@email.unc.edu

Michael Wehner
Lawrence Berkeley National Laboratory, Berkeley, USA – mfwehner@lbl.gov

Many studies have been published arguing that a variety of extreme climatic events have become either more probable or more extreme as a result of human-induced climate change. The "Fraction of Attributable Risk" (FAR) is one widely used measure to quantify this. However, calculating the FAR relies on comparing climate model runs under both anthropogenic and non-anthropogenic conditions, and this may induce a bias if the climate model runs are not closely aligned with observational data. By combining extreme value theory to estimate the probabilities of extreme events, with a hierarchical models analysis to account for differences among climate models and observational data, we propose estimates of the FAR and of future extreme event probabilities that take account of inter-model and model-observation differences. The method is applied to extreme events associated with the European heatwave of 2003, the Russian heatwave of 2010, and the Texas/Oklahoma heatwave of 2011. We also outline some possible extensions of the methodology.

Keywords: Extreme Value Theory; Climate Change Detection and Attribution; Bayesian Hierarchical Models.