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# Climate Extremes Workshop
# May 16-17, 2018

## SPEAKER TITLES/ABSTRACTS

**Ansu Chatterjee**
University of Minnesota

"Networks and Extremes: Review and Further Studies"

We present a review of the activities carried out by various members of the "Extremes and Networks" working sub-group. In particular, we discuss our initial findings on different connectivity metrics on networks and their applicability on data on extremes, and case studies on networks of precipitation extremes for southern USA and for India. A considerable part of this work is ongoing, and some challenges and features of this research will be discussed.

**Whitney Huang**
SAMSI

"Network Analysis of Gulf Coast Extreme Precipitation"

We explore the extremal dependence of annual maximum precipitation in Gulf coast using pairwise chi measure. We adopt the idea of climate network (Tsonis et. al, 2006) to construct an extremal network. A spatial block bootstrap is apply to obtain an assessment of estimation uncertainty of the resulting extremal network.

**Brook Russell**
Clemson University

"Employing a Multivariate Spatial Hierarchical Model to Characterize Extremes with Application to US Gulf Coast Precipitation"

Over a seven day period in August 2017 Hurricane Harvey brought extreme levels of rainfall to the Houston area, resulting in catastrophic flooding that caused loss of human life and damage to personal property and public infrastructure. In the wake of this event, there is growing interest in understanding the degree to which this event was unusual and estimating the probability of experiencing a similar event in other locations. Additionally, we investigate the degree to which the sea surface temperature in the Gulf of Mexico is associated with extreme precipitation in the US Gulf Coast. This talk addresses these issues through the development of an extreme value model.

We assume that the annual maximum precipitation values at Gulf Coast locations approximately follow the Generalized Extreme Value (GEV) distribution. Because the observed precipitation record in this region is relatively short, we borrow strength across spatial locations to improve GEV

parameter estimates. We model the GEV parameters at US Gulf Coast locations using a multivariate spatial hierarchical model based on coregionalization; for inference, a two-stage approach is utilized. Spatial interpolation is used to estimate GEV parameters at unobserved locations, allowing us to characterize precipitation extremes throughout the region. Nearby locations may experience extreme precipitation from the same event, resulting in dependence between annual maxima that previous spatial models of this sort have ignored. Our model incorporates dependence of this type and uses the nonparametric bootstrap to estimate its effect.

**Ben Shaby**
Pennsylvania State University

"Max-Infinitely Divisible Models for Spatial Extremes Using Random Effects"

Distinguishing between the subtly different dependence characteristics implied by current families of stochastic process models for spatial extremes is difficult or impossible based on exploratory analysis of data that is by definition scarce. Furthermore, different choices of extremal dependence classes have large consequences in the analysis they produce. I will present stochastic models for extreme events in space that are 1) flexible enough to transition across different classes of extremal dependence, and 2) permit inference through likelihood functions that can be computed for large datasets. These modeling goals will be accomplished by representing stochastic dependence relationships conditionally, which will induce desirable tail dependence properties and allow efficient inference through Markov chain Monte Carlo. I will present models for spatial extremes in the class of max-infinitely divisible processes, a generalization of the limiting max-stable class of processes which has received a great deal of attention. This work extends an old family of max-stable models based on a conditional hierarchical representation to the more flexible max-id class, thus accommodating a wider variety of extremal dependence characteristics while retaining the structure that makes it computationally attractive.

**Surya Tokdar**
Duke University

"Semiparametric Density Estimation for Heavy Tailed Data"

I will introduce a transformation based model for probability densities that seamlessly conjoins a nonparametric function representing the bulk of the distribution with a parametric representation of the tails. This semiparametric model offers an exact characterization of the tail index. I will talk about methods for Bayesian inference from this model and present asymptotic frequentist guarantees of the resulting estimates. I will present illustrative examples of applications to forecasting extreme outcomes from limited data assumed to come from a heavy tailed distribution. I will discuss challenges and possible avenues of extending the model to multivariate density estimation.