A Few Onging Climate-related Statistics Projects at Penn State

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Researchers

Meteorology (Meteo), Geosciences (Geosc), Statistics (Stats), Earth and Environmental Systems Institute (EESI)

- ▶ Faculty/research scientists: Chris Forest (Meteo), Murali Haran (Stats), Klaus Keller (Geosc), David Pollard (EESI), Patrick Applegate (EESI), Rob Nicholas (EESI)

- ▶ Graduate students: Saksham Chandra (Stats), Rob Ceres (Geosc), Kelsey Ruckert (Geosc), Yawen Guan (Stats), Ying Cui (Geosc), Alex Libardoni (Meteo)

- ▶ Undergraduate students (Stats): Evan Bittner, Kira White

Current NSF-funded projects: (1) Sustainable Climate Risk Management (SCRiM), NSF network: 5 year cuts across

Project Support/Organization

- Sustainable Climate Risk Management (SCRiM), 5 year NSF research network at 22 universities, 8 institutions, 7 countries
    - Threshold responses
    - Geoengineering impacts, adaptation
    - Downscaling for local impacts
    - Dynamics of learning
    - Robust decision making
    - (Ethical, epistemic issues.)
    - Truly interdisciplinary: climate sciences, statistics, economics, risk analysis, ethics/philosophy, operations research, sensitivity analysis, etc.
- NSF-CDSE Statistical Methods for Ice Sheet Projections

Some Projects

- Quantifying uncertainties about important climate properties, e.g. climate sensitivity

- Decision-making when accounting for learning, uncertainties

- Risk estimates about climate system threshold responses to climate forcings: coupled natural and human systems can react with nonlinear/persistent threshold responses

Extremes

- Modeling extreme weather events while accounting for spatial dependence (Ben Shaby)
- Is the risk of storm surges changing? Flood events (SCRiM project: Rob Ceres, Klaus Keller, Chris Forest, Murali Haran)

Large Spatial Data; Combining Data

- Computation for large spatial datasets (Ben Shaby)

- Large non-Gaussian spatial data sets (Yawen Guan, Saksham Chandra, Murali Haran): interpolation, computer model emulation-calibration

- Separating spatial signals in climate model output and observational datasets

- Combining disparate sources of data on ice sheets in the Antarctic with physical constraints to approximate thinning rates.
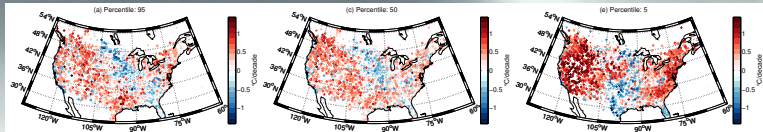
Emulation-Calibration

- ► Emulation for complex computer models with high-dimensional spatial data, non-Gaussian
- ► Projections for ocean circulation system (the AMOC) and ice sheets
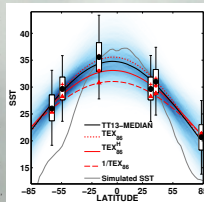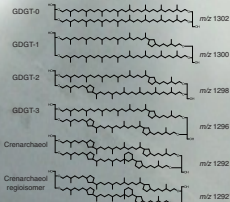
Paleoclimate

Tingley, Haran and others (2012, 2014)

Statistical climatology:
A data-based exploration of past, current and future climate.

Trends in the (50th, 50th, 95th) percentiles of daily summer temperatures, 1979–2012, from weather stations.

Left: Climate sensitive biomarkers.
Right: predictions of the latitudinal gradient of sea surface temperatures during the early Eocene, $\sim$50 million years ago.