OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY
FACT SHEET

Geographic Information Science and Technology

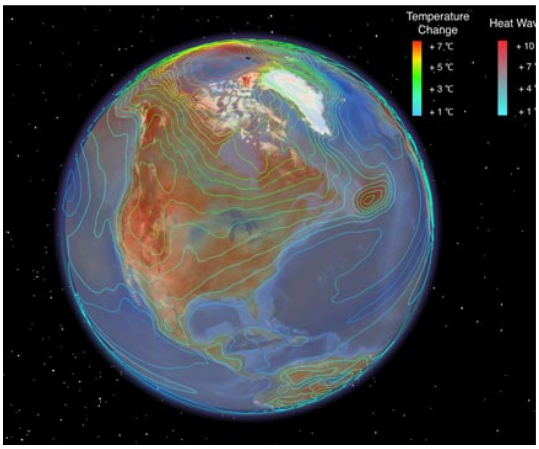
Climate Extremes and Uncertainty

Science Challenge

Climate extremes may be defined inclusively as severe hydrological or weather events, as well as significant regional shifts in climate or hydrometeorology, caused or exacerbated by climate change or natural climate variability, and potentially leading to extreme stresses on natural, engineered and human systems. One of the most significant knowledge-gap relevant for policymakers and stakeholders remains our inability to produce credible and precise estimates of climate extremes and their impacts, at regional and decadal scales.

Primary Benefits

- **Climate Prediction and Modeling:** Quantify predictive skills of multiple earth system models and downscaling strategies, with a focus on regional or decadal scale change in temperature, precipitation, wind and other variables as well as extreme events like heat waves, cold spells, floods, droughts, tropical cyclones, landslides and sea level rise. The evaluation process could consider models and/or downscaling methods which embed different physics and parameter schemes and have different process resolutions, with the aim of informing climate modelers.
- **Climate Change Adaptation:** Develop comprehensive characterizations of uncertainties and where possible, translate to risk assessments and data-guided uncertainty reduction, with the goal of informing local to regional scale resource or infrastructure managers for preparedness efforts.
- **Climate Change Mitigation:** Produce what-if scenarios with uncertainties to inform national leaders and international policy negotiations regarding the effect of emissions commitments on food and water resources, hazards and humanitarian aid or population and migration.



Our 2009 PNAS paper developed bias-corrected projections and quantified uncertainty in temperature and heat waves

Interdisciplinary Computational and Mathematical Solutions

Comprehensive solutions need to blend interdisciplinary computational and mathematical sciences ranging from extreme value theory and Bayesian models in statistics to nonlinear dynamics in physics and mathematics, along with machine learning and data mining in computer science, as well as econometrics and operations research. In addition to characterization of extremes and predictive modeling of mean and extreme change, multi-scale uncertainty across model ensembles and data-guide uncertainty reduction are critical focus areas. Risk assessments and attribution studies demonstrate the value-add.

Further Details: http://www.ornl.gov/knowledgediscovery/ClimateExtremes

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