**Collaborative Studies of Anthropogenic Climate Change**

**Using a Multi - Scale Modeling Framework**

NSF

2011 - 2013

The primary goal of the proposed research is to conduct and analyze simulations of anthropogenic climate change based on a version of the Community Earth System Model (CESM) in which the atmosphere and land-surface models are based on “super-parameterization.” We will develop and test a community version of this new model configuration to be called SP-CESM. The effects of moist convection, stratiform cloudiness, radiative transfer, boundary-layer processes, and the land surface will be computed by embedding a cloud-resolving model (CRM) in each grid column of the host general circulation model (GCM). The CRM explicitly accounts for indirect aerosol effects by using the CESM’s global aerosol distribution and composition as input to a drop-activation parameterization. The land-surface model, which runs on the CRM’s grid, predicts exchanges of latent and sensible heat and CO2 with the global atmosphere, including those due to changes in fine-scale vegetation and land use. We will perform at least one simulation of the pre-industrial climate, at least one of the twentieth century climate, and at least one of the twenty-first century climate based on emissions scenarios developed for use in the Fifth Assessment of the Intergovernmental Panel on Climate Change (AR5). The results will be shared with the scientific community, including scientists involved in AR5.

The analysis will focus on improving our understanding and prediction of critical processes and modes of decadal variability in the earth system. These processes include the interaction of the land surface hydrology and the atmosphere, and atmospheric cloud processes, including the indirect effect of anthropogenic aerosols on clouds and especially precipitation. These processes impact extreme hydrological cycle events (droughts, floods, extreme precipitation). We will evaluate the SP-CESM against observations. We will use the model to better understand the feedbacks and changes to interannual and decadal modes of variability with an eye towards increasing our predictative capacity.

Broader Impacts

The broader impacts of this activity are focused around improving predication for society, providng better tools that others can use, and training the next generation of scientists. The core activity of this project is to develop improved models of climate to help society better understand possible future impacts of anthropogenic emissions of greenhouse gases and particulates. This improved understanding will be critical for decadal predication. Confidence and evaluation of models comes from process-based studies that can constrain model solutions to observations. The model we will develop is to be released as open source code for other researchers to use and improve in the future. Finally, we will be employing graduate students and post-docs to train the next generation of scientists.

Image

Full Proposal

Annual Report 2012

Publications

Students