Improving the Representations of Human-Earth Interactions

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PROJECT DESCRIPTION

The goal of this project is to strengthen the coupling between climate and Earth System Models (ESMs) and Integrated Assessment Models (IAMs). The research will address five central issues: 1) What is the influence of past, present and future land-use and land-use change on the evolution of the terrestrial carbon cycle, and what are its influences on the evolution of climate forcing in the future? 2) What is the potential for replacing fossil fuels with biofuels, and what are the implications of this substitution for climate forcings, and therefore the evolution of the climate system? 3) How does human decision-making on water use and water resources affect regional impacts of climate, given the changes in the hydrological cycle that will accompany a changing physical climate system? 4) What are the most important feedbacks of changes in the climate system on the evolution of carbon sources and sinks in the biosphere, and on human decision-making about energy futures? How do these feedbacks affect the evolution of the climate system over the coming decades to a century? 5) To what extent do human decisions about energy futures, and adaptation to changes in climate affect possible emissions pathways, and therefore the evolution of climate forcings and the physical climate system?

Four international IAM teams are each providing one Representative Concentration Pathway (RCP) (defined in terms of its radiative forcing in 2100). The PNNL MiniCAM team is the only US IAM team involved in this process. Its RCP (4.5 W/m^2) will be used by all climate modeling teams to drive both long-term climate ensembles and decadal climate forecast ensembles. Members of the ORNL and LBNL teams are instrumental in the development of the leading U.S. research ESM, the Community Climate System Model (CCSM), that will be used to simulate the scenarios and RCPs for the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

SIGNIFICANCE

IAMs are the primary tool for describing the human-Earth system—the source of greenhouse gases, and short-lived species emissions and the system experiencing impacts of anthropogenic climate change. ESMs are the primary scientific tools for examining the climate and biogeophysical impacts of changes to the radiative properties of the Earth's atmosphere. This project will integrate the economic and human dimension modeling of IAMs within fully coupled ESMs. By doing so, the team will improve climate predictions and enhance scientific understanding of climate impacts and adaptation opportunities. The research team will improve scientific understanding of the human-earth system dynamics, such as the interactions and feedback leading to the timing, scale and geographic distribution of emissions trajectories and other human influences, corresponding climate effects and the subsequent impacts of a changing climate on human and natural systems.