Poster Abstract

A New Project -- An Earth Systems Modeling Framework for Understanding Biogeochemical Cycling in the Context of Climate Variability

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Abstract

One of the grand challenges of the 21st Century is to understand biogeochemical cycles in the biosphere, and in particular, to understand how to manage nitrogen (N) in the environment to maximize agricultural productivity while minimizing negative environmental effects. Developing a clear understanding of climate and human-induced changes in environmental N cycling in tightly coupled atmospheric, terrestrial, and aquatic systems, including how these changes feed back into the climate system, is critical to addressing this challenge.

Our project's *overarching goal* is to improve understanding of the interactions among C, N, and H_2O at the regional scale in the context of global change to inform decision makers' strategies regarding natural and agricultural resource management.

Our *approach* is to create a regional modeling framework by integrating a network of state-of-the-art process-based models that are currently in existence and that are undergoing continuous development.

Our *rationale* is that by choosing among the most sophisticated models for each earth system component, and either linking these models (or fully integrating them where possible) into a biosphere relevant earth system model (Bio-EaSM), the integrated modeling framework can be continually improved as each contributory component develops. The framework plan includes: WRF for meteorology, CMAQ for atmospheric chemistry and transport, VIC for hydrology, CropSyst for agricultural dynamics, RHESSys for natural ecosystem dynamics, NEWS for aquatic nutrient transport and CREM for economic interactions. The end product will be a state-of-science regional earth system modeling framework that explicitly addresses N and C flows in the context of inter-annual and decadal climate variability. Relevance and utility to

decision-makers will be enhanced through integrated stakeholder input throughout model development.

In the Pacific Northwest region (PNW) of the U.S. the interactions among N, carbon (C), climate and human activities are complex. The PNW has extensive and diverse agricultural lands surrounded by pristine natural ecosystems, interspersed with heavily populated urban areas. The topography of the PNW is diverse; the terrain is drained by extensive river systems, including the vast Columbia River. Storm patterns are closely tied to the jet stream position and sensitive to long-term circulation patterns including the El Niño Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO). The complexity of the PNW makes it a challenging domain for development and testing of our Bio-EaSM. This modeling framework will be developed to support improved understanding of the interactions and feedbacks between N and C cycling in coupled atmospheric, terrestrial, and aquatic systems as they are affected by the climate system at inter-annual to decadal time-scales over the PNW region. To support application of such gains in understanding to environmental management decisions, the project involves private and public stakeholders, beginning early in the process, to identify informational needs matched to stakeholder requirements for making sound decisions for resource management.

This BioEaSM project was proposed under the NSF solicitation 10-554, *Decadal and Regional Climate Prediction using Earth System Models (EaSM),* and will be developed over a five year period beginning in Spring of 2011, with support totaling ~$3M provided via the USDA.