Highlights from the BioEarth project

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For more information, visit bioearth.wsu.edu/

How will our actions today affect our earth's systems into the future? Humans and the earth's natural resources have been interacting for millennia and will continue to do so into the future. The overarching goals of the BioEarth project at Washington State University are to improve our understanding of the dynamics between coupled carbon, nitrogen, and water (C:N:H_2O) and human actions at the regional and decadal scales under global climate change in order to (1) better understand the impact that resource management has on earth system dynamics and (2) inform resource managers about the consequences their decisions have for the earth system. To accomplish these goals, we are developing a modular integrated modeling framework that will allow researchers to investigate how changes in climate, policy, water infrastructure, and agricultural management practices (in cropping, forest, and rangeland systems) will affect the overall earth system in the Pacific Northwest (PNW) region (Figure 1).

IMPACT

While not intended specifically to be a decision support tool, the BioEarth framework provides a context for evaluating various management scenarios by highlighting environmental and economic trade-offs and feedback to inform a variety of decision makers with different priorities, concerns, and constraints. Because of its large scope, the project lends itself well to partnering with existing or new initiatives focused on agricultural and environmental sustainability.

One key output involves the ability to incorporate cropping system management (e.g., crop selection, planting date, and irrigation technology and management) into an earth system model that allows us to investigate the interplay among climate change and variability, hydrology, water resources management, cropping system management, and crop growth and phenology (for more than 40 crop types) at a regional scale. Results for the 2030s indicate that the net effect of climate change on crop yield is highly dependent on the crop type, whether or not it is irrigated, and the degree to which water rights are curtailed during drought years, although not always in anticipated ways. Our team is investigating a variety of strategies producers across the PNW may use for adapting to climate change and its associated impacts.

Photo by Nita Robinson.

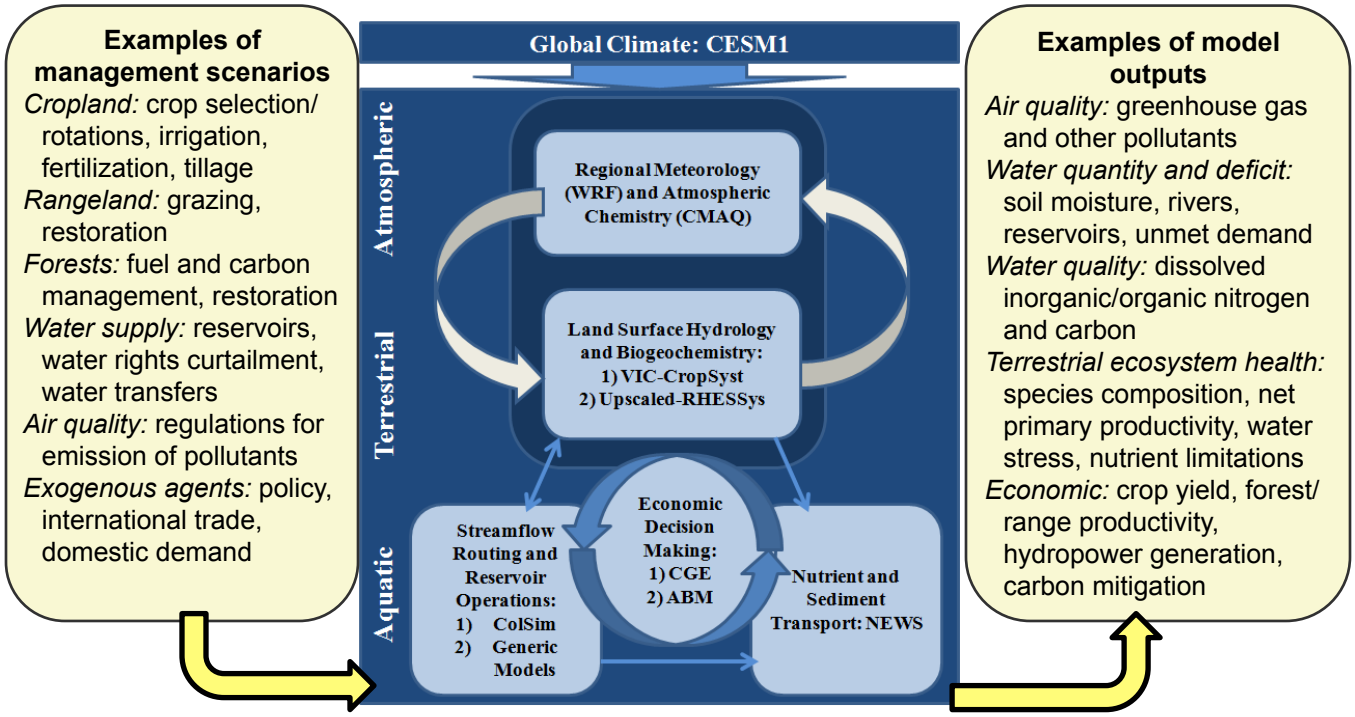

Figure 1. *Linkages between the atmospheric, terrestrial, aquatic, and economic components that make up the BioEarth model, as well as examples of management scenarios and model outputs that can be explored with this framework.*

Because of agriculture's role as a source of reactive nitrogen, faculty and students are also actively investigating the sources, transport, fate, and impacts of nitrogen between the atmosphere and biosphere in the PNW. For example, we have used the National Atmospheric Deposition Program (NADP) to demonstrate that 46% to 53% of variation in wet nitrogen deposition in the Rocky Mountains, the Gulf Coast, and near the Great Lakes can be explained by El Niño Southern Oscillation (ENSO) activity. We are also refining, upscaling, and applying the RHESSys ecohydrologic model over managed forests and rangelands. Although RHESSys is intended for fine-resolution catchment studies, we are developing a decision tree to determine (for each biome and research question) when upscaling the model is defensible to reduce computational requirements. This decision tree will enable improved C:N:H_2O modeling with respect to natural and agricultural resource management activities within the context of coupled earth system dynamics.

The BioEarth project's approach to stakeholder engagement involves a series of six issue-based workshops to learn from regional natural resource managers; five of these workshops have been completed. Different stakeholder groups have diverse levels of experience with environmental models and climate science, and their information needs vary widely. Demonstrating tangible sample model outputs helps stakeholders understand the scope and scale of model outputs that are possible. There is widespread demand for online tools that enable users to synthesize the results from research efforts across the region and that provide a forum for stakeholders to ask questions of researchers. The BioEarth and REACCH teams are linked in that they are both grappling with the question of how to sustain agriculture in the PNW while minimizing the effects on the environment. Project cross-fertilization is occurring through sharing of models and data, as well through findings from our stakeholder engagement efforts.

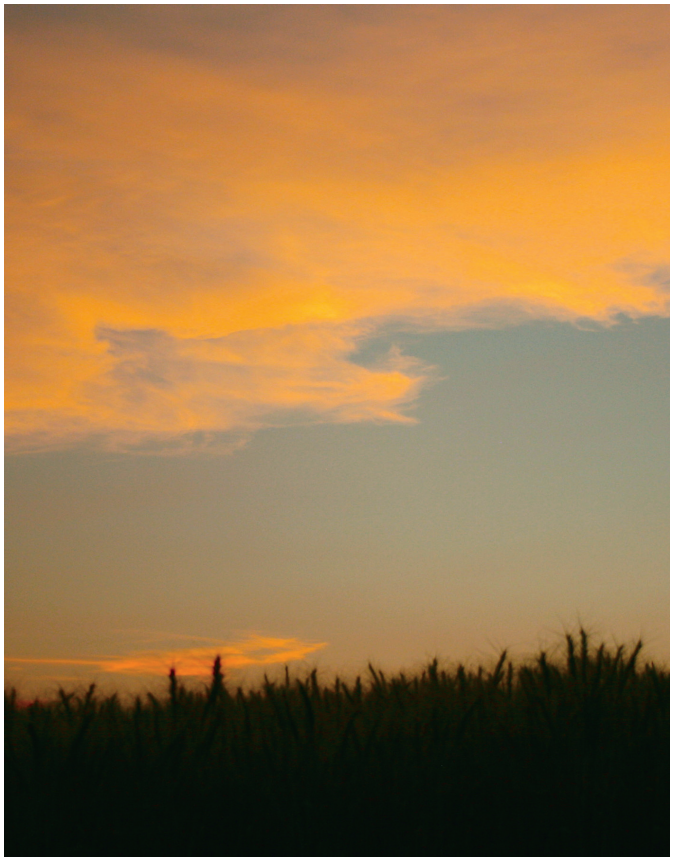

Photo by Brad Stokes.