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Project Abstract

Interactive Drivers of Land-Use/Land-Cover Change in Agricultural Areas: Climate and Land-Manager Choices

Coming decades: land manager choices in response to conservation policy and climate change. Our environmental economics team has developed a tightly integrated modeling system that predicts changes in agricultural land use from changing policy variables, economic drivers, and physical characteristics of the land. These models are being used, in part, to assess the consequences of possible changes in U.S. farm policy as enumerated in discussions related to the 2007 farm bill. Our climate science team currently plays a central role in the North American Regional Climate Change Assessment Program which is developing climate change scenarios at the regional scale by use of regional climate models for use in impacts assessments. We propose to study how the combined drivers of climate change and conservation policies affect land managers land use and cover decisions and, importantly, we tie those decisions directly to changes in environmental outcomes. Specifically, we will focus on how the use of conservation tillage, land retirement, and fertilizer may change as climate changes and in response to a variety of possible conservation policies. Our environmental measures include both in-stream water quality measures and field-level measures of carbon sequestration, soil and wind erosion, and nutrient loading. Changes in these environmental measures trigger public policy changes which produce feedbacks to the ecosystems being managed (cropping choices, etc) and hence feedbacks to the climate system through biophysical factors such as plant type, evapotranspiration, and albedo. To assess the magnitude of these drivers, watershed models that fully capture the complex interactions between land use, conservation practices, land characteristics, and hydrology will be completely coupled with economic models that can predict the costs of adopting land use changes under various policy regimes. Finally, all of these interactions depend upon the climate conditions in the region and therefore are likely to be altered under different global climate scenarios and by regional feedbacks to the climate system. Indeed, preliminary analysis by our group suggests that climate change may have substantial consequences on major hydrological systems of the region. And another study by our group revealed a regional warming hole that has developed and likely will continue, in part due to feedbacks from soil-atmosphere interactions mediated by agricultural crops. Thus, a key element that must be incorporated in a fully coupled system is a global climate model, complete with feedbacks to land cover, agroecosystem responses, economic consequences and human behavior. This project will to address major questions raised in the US Climate Change Science Program (CCSP) Strategic Plan (CCSP, 2005), namely: CCSP Q1 What are the primary drivers of land-use and land-cover change? CCSP Q2 What will land-use and land-cover patterns and characteristics be 5 to 50 years into the future? CCSP Q3 How do climate variability and change affect land use and land cover, and what are the potential feedbacks of changes in land use and land cover to climate? CCSP Q4 What are the environmental, social, economic, and human health consequences of current and potential land-use and land-cover change over the next 5 to 50 years?