Improving and Evaluating Dynamic Models of Natural and Managed Ecosystems over the Central and Southern U.S. Using AmeriFlux and MODIS Data

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(1) This project will improve a terrestrial biosphere model (IBIS) and perform validation using AmeriFlux data, soil carbon data in prairie relics, and MODIS observations. IBIS will be improved by (1) adding representation of a dynamic organic soil/residue layer, (2) modifying the natural vegetation phenology scheme, (3) refining plant physiological response to water stress and modifying root water uptake, and (4) refining algorithms that numerically simulate values of fPAR and NDVI.

(2) The improved model will be evaluated using AmeriFlux data and soil carbon storage in approximately 60 remnant prairies from Texas northward to Wisconsin. Continental-scale evaluation of simulated carbon-water-energy fluxes and plant phenology will be conducted using high spatial (250 m – 1 km) and temporal resolution (~8 day) MODIS products (e.g., NDVI, LAI, GPP, fPAR, and ET).

(3) Relevant science questions: (1) Does the addition of a soil organic soil/residue layer, and improvements to plant phenology lead to improved accuracy? (2) Can IBIS be used to predict the effects of elevated CO_2 concentrations on ecosystem processes, vegetation structure, and water & carbon fluxes? (3) Given the known simplified representation of vegetation structure and functioning in similar ecosystem models, with what level of accuracy can we simulate variability in phenology, leaf area index, evapotranspiration, and GPP? (4) Can regional parameterizations of farmer planting date and generalization of crop hybrids and carbon allocation be used to simulate farmer decision-making, yields, and regional LAI & ET?

(4) The project will be addressed in three stages: (1) A model improvement phase based on previous evaluation work and subsequent re-evaluation at the original AmeriFlux sites; (2) An extended model evaluation phase at the AmeriFlux site level using additional sites that cover a wider range of managed and natural vegetation types and climate regimes; (3) Model evaluation across continental scales using satellite (MODIS) observations of vegetation structure and function and USDA crop yield data.

(5) This proposal targets a main thrust of the DOE's Research Program (*Development and testing of ecosystem models needed for integrated assessments*). We are assessing the level of accuracy that we can expect to achieve with models that represent coupled carbon-water-energy fluxes between the biosphere and atmosphere, and their response to environmental changes associated with energy production. We will attach a level of confidence and error that is likely to result from attempting to simulate complex, integrated biophysical and biogeochemical systems within the soil-plant-atmosphere system.