Linking carbon uptake in terrestrial ecosystems with other climate forcing factors

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The goal of our proposal is to reduce the uncertainties associated with changing climate and land cover type on climate forcings, including albedo, latent and sensible heat, and surface roughness. We request 2-year postdoctoral support to carry out NCEAS-associated activities that combine five land surface modelers with ecologists and micrometeorologists who use eddy flux and other experimental approaches. We hope to improve the representation of biophysics and climate feedbacks in land-surface models.

Our research questions are:

1. How will future climatic variability and climate change influence terrestrial ecosystem structure and functioning, particularly through differences in energy balance?
2. In what locations will changing land-cover types (e.g., transitions of pastures, grasslands, or agricultural lands to deciduous or evergreen forests) lead to net climate cooling or warming?
3. How do we use field and remotely sensed data to test land-surface parameterizations in climate models and their representations of the energy balance?

The research is a data synthesis and data-model comparison carried out at Duke and UC Irvine and involving 10 other groups.

We propose to use the outputs of each land-surface model to build response surfaces (e.g., normalized evaporation vs. rainfall or energy; GPP vs ecosystem respiration, etc.) along latitudinal, climate, and land-cover gradients in the models, comparing the modeled response surfaces with actual field and remote-sensing observations. The latter include MODIS data and the La Thuile eddy flux dataset with over 900 site years of gap-filled data from 200 sites.

The project will allow us to understand differences in climate models and to build a framework for a formal inter-model comparison of full radiative forcing for projected climate and land-cover change. Our proposed products are:

1. A comparison of albedo between Ameriflux towers, MODIS, and model estimates for the continental U.S., including seasonal and latitudinal analyses.
2. An analysis of the sensitivities of different land cover types within climate models to climate change, particularly projected changes in temperature and precipitation.
3. An analysis of temperature and precipitation changes associated with land-use change: a climate model evaluation using remote sensing and eddy covariance observations
4. An analysis of carbon vs. biophysical tradeoffs associated with forest and land cover change across the continental U.S.
5. A paper that compares Fluxnet data from sites having a given land cover type with climate model data from model gridpoints within the same region having the same land cover type.
6. A related Fluxnet comparison of data from sites having contrasting land cover types versus climate model data from gridpoints where land cover is altered in simulations.