Proposal: Land Use Model Inter-comparison Project (LUMIP)

Overview:

Human land-use activities have resulted in large changes to the biogeochemical and biophysical properties of the Earth surface, with resulting implications for climate. In the future, land-use activities are likely to expand and/or intensify further to meet growing demands for food, fiber, and energy. CMIP5 achieved a qualitative scientific advance in studying the effects of land-use on climate, for the first time explicitly accounting for the effects of global gridded land-use changes (past-future) in coupled carbon-climate model projections. Enabling this advance, the first consistent gridded land-use dataset (past-future) was developed, linking historical land-use data, to future projections from Integrated Assessment Models, in a standard format required by climate models. Results indicate that the effects of land-use on climate, while uncertain, are sufficiently large and complex to warrant an expanded activity focused on land-use for CMIP6.

Primary Contacts:

George Hurtt (gchurtt@umd.edu), Dave Lawrence (dlawren@ucar.edu)

Additional Contacts:

Victor Brovkin, Louise Chini, Jae Edmonds, Kees Klein Goldewijk, Chris Jones, Nathalie Nobelet, Julia Pongratz, Elena Shevliakova, Peter Thornton, Detlef van Vuuren

Primary Science Questions:

The primary science questions of LUMIP are:

- What are the effects of land use and land-use change on climate (past-future)?
- What are the effects of climate change on land-use and land-use change?

In addressing these questions, LUMIP will also address a range of more detailed science questions to get at process level attribution, uncertainty, data requirements, and other related issues in more depth and sophistication for the community than possible to date. Of particular focus will be the separation and quantification of the effects on climate from fossil fuel emissions and land-use change, biogeochemical from biophysical effects, and land cover from land management effects.

Major Activities:

The goal of LUMIP is to address the major science questions related to land-use in the most organized and effective way possible. Three major sets of science activities are envisioned.

- Model metrics and diagnostics- A set of metrics will be developed to quantify model performance with respect to land use. A diagnostic protocol will also be developed to quantify related model sensitivities. Development of biogeophysical and biogeochemical land-use impacts benchmarking products will help constrain models and dovetails with expanding emphasis in CMIP on metrics. Diagnosis of model sensitivities will aid interpretation and will inform input data requirements.
- Data standardization- A key to an effective model intercomparison is data standardization. LUMIP will build off the lessons learned and protocols in CMIP5, and work with historical data, present data, IAMS, and CMs to produced an enhanced standardized land-use data for CMIP6 model experiments passing the maximum amount of common information between these relevant domains.
- Model experiments- Central to LUMIP will be the development of an efficient model experiment designed to isolate and quantify land-use effects. Integrated analysis of coupled and offline (forced with observed meteorology) simulations with identical land models will enable better understanding and assessment of forced response and climate feedbacks associated with land-use. Both scenarios and idealized experiments will be investigated.

Relationship to Other CMIP-MIPS:

Land use is a characterization of human activity that affects the land through land cover changes and/or management practices. LUMIP has a unique focus on quantifying and understanding the effect of these activities on climate. Two other MIPS have foci that are significantly related and that will both benefit from and inform LUMIP. C4MIP has a focus on carbon, which is impacted by land-use activities in part. AGMIP has a focus on agriculture yields, which both informs and is impacted by land-use change. LUMIP will work closely with these and other MIPS to maximum scientific benefit.

Participation:

Participation in LUMIP is voluntary and open. LUMIP will be coordinated by a small interdisciplinary working group composed of engaged representatives from the land-use history, land-use modeling, integrated assessment, and climate modeling communities. This working group will engage the broadest possible degree of input and involvement from members of the scientific community.