The Carbon-Land Modeling Intercomparison Project (C-LAMP) and the International Land Model Benchmarking (ILAMB) Project for the IPCC AR5

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The need to capture important climate feedbacks in general circulation models (GCMs) has resulted in new efforts to include atmospheric chemistry and land and ocean biogeochemistry into the next generation of production climate models, now referred to as Earth System Models (ESMs). While a number of terrestrial and ocean carbon models have been coupled to GCMs, recent work has shown that such models can yield a wide range of results [1], suggesting that a more rigorous set of offline and partially coupled experiments, along with detailed analyses of processes and comparisons with measurements, are warranted. The Carbon-Land Model Intercomparison Project (C-LAMP) provides a simulation protocol and model performance metrics based upon comparisons against best-available satellite- and ground-based measurements [3]. Originally developed by the Community Earth System Model (CESM) Biogeochemistry Working Group to test state-of-the-art biogeochemistry models within the CCSM3 framework [2], C-LAMP provides feedback to the modeling community regarding model improvements and to the measurements community by suggesting new observational campaigns. The model output metadata standards and diagnostics package developed for C-LAMP round out a prototype for an international biosphere-atmosphere model benchmarking activity, called ILAMB, that will enhance the planned model simulations for the IPCC Fifth Assessment Report (AR5).
C-LAMP Experiment 1 consists of a set of uncoupled simulations of terrestrial carbon models specifically designed to examine the ability of the models to reproduce surface carbon and energy fluxes at multiple sites and to exhibit the influence of climate variability, prescribed atmospheric carbon dioxide (CO_2), nitrogen (N) deposition, and land cover change on projections of terrestrial carbon fluxes during the 20^{th} century. Experiment 2 consists of partially coupled simulations of the terrestrial carbon model with an active atmosphere model exchanging energy and moisture fluxes. In all experiments, atmospheric CO_2 follows the prescribed historical trajectory from C^4MIP. In Experiment 2, the atmosphere model is forced with prescribed sea surface temperatures (SSTs) and corresponding sea ice concentrations from the Hadley Centre; prescribed CO_2 is radiatively active; and land, fossil fuel, and ocean CO_2 fluxes are advected by the model. Both sets of experiments were performed using two different biogeochemistry modules coupled to the Community Land Model (CLM3) in CCSM3: the CASA′ model of Fung, *et al.*, and the carbon-nitrogen (CN) model of Thornton.

Comparisons with Ameriflux site measurements, MODIS satellite observations, NOAA flask records, and other datasets have been performed. More information about C-LAMP, the experimental protocol, performance metrics, output standards, and model-data comparisons from the CLM3-CASA′ and CLM3-CN models are available at `http://www.climatemodeling.org/c-lamp`.

References

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