GLDAS & CEOP

CEOP/GLDAS integration to evaluate land surface model performance

The Coordinated Enhanced Observing Period (CEOP) is an international effort intended “to understand and model the influence of continental hydroclimate processes on the predictability of global atmospheric circulation and changes in water resources, with a particular focus on the heat source and sink regions that drive and modify the climate system and anomalies” (Koike 2004). This is an ambitious goal, and it requires the effective integration of field observations, satellite data, and modeling systems. GLDAS is a valuable tool for CEOP because it assimilates the information from a number of models and observation systems to provide optimal estimates of land surface states and fluxes. These products are used to support regional climate analysis, model initialization, and globally-consistent intercomparisons between CEOP field sites, and are available at GES DISC. At the same time, the detailed field data collected during CEOP can be used to evaluate the land surface models (LSMs) included in GLDAS and to inform future model development.

Sample Application

One of the strengths of CEOP/GLDAS integration is the ability to evaluate the performance and sensitivity of land surface models at diverse sites around the globe. Kato et al. (2007) applied GLDAS to assess LSM performance at four CEOP sites. Simulations with Noah LSM, Mosaic LSM, and Common Land Model were compared with CEOP observations for a temperate grassland (Lindenberg, Germany), a semi-arid cropland (Tongyu, China), a temperate cropland (Bondville, Illinois), and a wet temperate forest (Tumbarumba, Australia) (Figure 1). Each LSM was then used in a set of numerical experiments, designed to assess model sensitivity to various sources of simulation uncertainty, including input data on elevation, soils, land cover, precipitation, and radiation (Table 1). Results indicated that the simulation of evapotranspiration was most sensitive to precipitation, land cover, and radiation (in that order), sensible heat flux was most sensitive to radiation, precipitation and land cover, and soil moisture was most sensitive to precipitation, soil, and land cover. In general, radiation was a more important source of sensitivity in energy-limited regimes while precipitation was of primary importance in water-limited regimes. Nonetheless, the selection of LSM was generally the most important factor governing output, indicating the need for continued model development.
Figure 1: Monthly accumulated evapotranspiration (mm/month) from October 2002 to September 2003. Lines represent the CEOP reference site observations (blue) and control run output from the three LSMs: Noah (orange), CLM (pink), and Mosaic (turquoise). [From Kato et al. (2007)]
Table 1: Sensitivity by model, represented by the normalized RMS of the difference between output from the experimental simulation and the control, for evapotranspiration, sensible heat flux, and top layer soil moisture. Differences were normalized by dividing by the seasonal mean of the control, thus the numbers are unitless. The type of sensitivity is indicated by the column heading. Results were averaged over the entire period, 1 October 2002 to 30 September 2003. Results for the precipitation and radiation experiments were also averaged over the two alternative forcings tested for each. Table cells are colorized to guide the reader's eyes, with the highest sensitivity for a given row (site and season) shown in red, followed by orange, yellow, green, and blue in order of decreasing sensitivity. [From Kato et al. (2007)]
References
