**Estimation of Regional CO2 Budgets and Biomass by Fusion of LandSat, MODIS, and Atmospheric Observations**

NASA Terrestrial Ecology / Carbon Cycle and Ecosystems

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We are conducting an analysis of the carbon fluxes and storage by synthesizing observations of weather, surface spectra, and high-resolution land-cover, and atmospheric CO2 with a suite of mechanistic models. The analysis will be performed globally, but many of the data products we propose to use are available only over the contiguous USA, so the quality of the estimation will be enhanced here and will contribute to NACP synthesis and integration. The synthesis of these data products will result in (1) global maps of time-varying sources and sinks of atmospheric CO2, wood biomass and soil carbon that are consistent with many kinds of observations; and (2) a self-consistent process- based model of these sources and sinks that can be extrapolated beyond this region of high data density. We have developed a robust data assimilation system (the Maximum Likelihood Ensemble Filter, MLEF) that can efficiently process very large volumes of data into a complex and nonlinear forward model. We have tested the system by assimilating weather and CO2 data into SiB-CASA, a global model of the interactions between ecosystems and the climate. The model has been updated to include carbon allocation, storage, and biogeochemical cycling through multiple ecosystem pools. Other recent improvements include explicit treatment of crops, high-resolution fossil fuel emissions estimates, and a prognostic phenology algorithm derived by assimilating 8 years of global MODIS data. The model simulates fluxes that result from both short-term (sub-diurnal physiology to seasonal phenology) and long-term (disturbance, succession, land management) processes, predicting carbon pools as well as hourly fluxes and high-frequency variations in atmospheric CO2.

The model will be initialized using climatology and historical land-use data, then run in forward mode for the satellite era using disturbance maps derived from LandSat-derived disturbance products obtained from the North American Forest Dynamics project. Finally, we will perform ensemble data assimilation during the period of rich continuous CO2 data from NACP (2007-2012), including GOSAT/Ibuki data when they become available. We will GEOS-5 weather analyses on a 0.5°x 0.67°grid, NAFD disturbance data, GFED fire products, VULCAN fossil fuel emissions, and daily air-sea gas exchanges derived from the WHOI ocean model to predict vegetation and soil carbon pools, fluxes, and atmospheric CO2 on an hourly basis. Carbon pools will then be optimized by running ensemble assimilations of data from flux towers, atmospheric CO2 measurements. The final simulations will be made available through the NACP Modeling and Synthesis Thematic Data Center.

Image

Full Proposal

Annual Report 2012

Publications

Students