EFFECT OF RESPIRATION AND CANOPY PARAMETERIZATIONS ON MODELED CARBON FLUX

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ABSTRACT
Simulations of the global carbon cycle are strongly dependent upon model representations of the exchange of carbon, energy, moisture and momentum between the atmosphere and terrestrial biosphere. The carbon flux produced by these biophysical models is subsequently dependent on the method used to produce respiration and photosynthesis within the model on both spatial and temporal scales. We use an updated version of the Simple Biosphere Model (SiB3) to simulate global carbon flux between atmosphere and land surface, and compare model results to flux tower and flask network observations. SiB3 assumes no annual net source or sink of carbon in each gridcell, but the spatial pattern and seasonality of carbon flux and atmospheric concentration can be strongly influenced by parameterization of heterotrophic and autotrophic respiration and the representation of vegetation phenology.

INTRODUCTION
SiB3 is a biophysical land-atmosphere model that utilizes carbon flux (in the form of stomatal resistance) to help constrain modeled fluxes of energy and moisture. The model runs in 'historical' mode, in that forward runs are not undertaken-the model diagnoses biophysical processes from antecedent cases where vegetation can be specified with satellite observations. A limited number of vegetation or biome types are available, and vegetation phenology and heterogeneity is obtained by using Normalized-Difference Vegetation Index to obtain many canopy parameters. SiB [*Sellers et al* 1986, 1996a] has been run in offline mode to calculate fluxes of energy, mass and momentum and carbon between the atmosphere and land surface [*Zhang et al* 1996, *Baker et al* 2003]. Simulated net ecosystem exchange of carbon (NEE) is a result of interaction between photosynthetic and respiratory fluxes, and is dependent on model parameterizations of each. For the current study, we look at NEE on broad spatial and temporal scales and compare model results to observations and published studies.

RESPIRATION
Annual NEE in SiB is assumed to be zero [*Denning et al*, 1996], but respiration partitioning effects seasonal and spatial patterns. Modeled heterotrophic respiration is a function of soil temperature and moisture. Maintenance (autotrophic) respiration is a function of biomass, represented in the model by fraction of absorbed photosynthetically active radiation, or fPAR. By adjusting the partitioning of the total respiratory flux between heterotrophic and autotrophic components, we can alter the seasonal cycle of NEE.

NDVI
SiB utilizes NDVI to obtain vegetation phenological fields such as fPAR, leaf area index (LAI) and roughness length [*Sellers et al*, 1996b], which in turn play a large role in determining photosynthetic flux of carbon. Once-monthly NDVI (as is often used in SiB) is generally the maximum value recorded for the month, so as to prevent cloud contamination. However, when these monthly values are interpolated to daily values within SiB, the result is an artificial trend towards early leaf-out in the model. We investigate an alternative method in interpolating NDVI to obtain a more realistic simulation of springtime canopy fluxes.

SUMMARY
A single observation value (eddy covariance NEE) is the result of multiple processes within the canopy (photosynthesis, respiration, turbulent transport). Biophysically realistic interpretations of these processes within a modeling framework ensure tightly constrained and self-consistent results, and more realistic interpretations of the biophysical processes involved. For the present study, we noted that the SiB3 annual cycle of carbon flux was inconsistent with both observations and published results from inversion studies, and identified two areas of possible improvement-the respiration calculation and interpolation of satellite-derived NDVI. By themselves, neither adjustment removes the inconsistency, but taken together much more realistic simulation of global carbon flux is achieved.

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