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Optimization of a prognostic biosphere model for terrestrial biomass and atmospheric CO_2 variability

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Abstract. This study investigates the capacity of a prognostic biosphere model to simulate global variability in atmospheric CO_2 concentrations and vegetation carbon dynamics under current environmental conditions. Global data sets of atmospheric CO_2 concentrations, above-ground biomass (AGB), and net primary productivity (NPP) in terrestrial vegetation were assimilated into the biosphere model using an inverse modeling method combined with an atmospheric transport model. In this process, the optimal physiological parameters of the biosphere model were estimated by minimizing the misfit between observed and modeled values, and parameters were generated to characterize various biome types. Results obtained using the model with the optimized parameters correspond to the observed seasonal variations in CO_2 concentration and their annual amplitudes in both the Northern and Southern Hemispheres. In simulating the mean annual AGB and NPP, the model shows improvements in estimating the mean magnitudes and probability distributions for each biome, as compared with results obtained using prior simulation parameters. However, the model is less efficient in its simulation of AGB for forest type biomes. This misfit suggests that more accurate values of input parameters, specifically, grid mean AGB values and seasonal variabilities in physiological parameters, are required to improve the performance of the simulation model.

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