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Reducing the uncertainty in terrestrial carbon cycle modeling

Maria Malene Kvalevåg and Gunnar Myhre
Center for International Climate and Environmental Research – Oslo (CICERO), Norway

With continued global warming, the land reservoirs will continue to take up a fraction of anthropogenic CO2 emissions. However, global climate models differ in their representation of uptake of CO2 in the biosphere. Our study focuses on constraining the uncertainty in terrestrial carbon cycle modeling by comparing climate model results to observed atmospheric CO2 concentrations. The goal is to improve the representations of the seasonal cycle of terrestrial carbon uptake in the model.

We use the NCAR Community Earth System Model (CESM) climate components CLM4CN and CAM4 to run a prognostic version of the coupled land-atmosphere model where the atmospheric CO2 concentration in CAM4 is interactively calculated. Atmospheric CO2 concentrations from the model are compared to observations provided by flux towers in the AMERIFLUX network through the FLUXNET database and from the WDCGG for year 2000. We compare model results from sensitivity studies using different Q10 parameterizations, which is an important function in calculating maintenance respiration.

The carbon uptake in the biosphere is also under anthropogenic influence through emission of nitrogen and ozone from air pollution. Whereas nitrogen limitations in the soil reduce land ecosystem response to increasing CO2 concentrations, nitrogen from anthropogenic emissions increases the nitrogen availability and hence stimulates plant growth. These two effects as well as the damaging impact on plants due to tropospheric ozone fertilization have been included in this study.