Geophysical Research Abstracts
Vol. 17, EGU2015-1778-1, 2015
EGU General Assembly 2015

Uncertainty analysis of a coupled ecosystem response model simulating greenhouse gas fluxes from a temperate grassland

Ralf Liebermann (1), Philipp Kraft (1), Tobias Houska (1), Lutz Breuer (1), Christoph Müller (2), David Kraus (3), Edwin Haas (3), and Steffen Klatt (3)

(1) University of Giessen, Institute for Landscape Ecology and Resources Management, Research Centre for BioSystems, Land Use and Nutrition (IFZ), Giessen, Germany, Ralf.Liebermann@umwelt.uni-giessen.de, (2) University of Giessen, Institute for Plant Ecology, Research Centre for BioSystems, Land Use and Nutrition (IFZ), Giessen, Germany, (3) Institute of Meteorology and Climate Research – Atmospheric Environmental Research, Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany

Among anthropogenic greenhouse gas emissions, CO_2 is the dominant driver of global climate change. Next to its direct impact on the radiation budget, it also affects the climate system by triggering feedback mechanisms in terrestrial ecosystems. Such mechanisms – like stimulated photosynthesis, increased root exudations and reduced stomatal transpiration – influence both the input and the turnover of carbon and nitrogen compounds in the soil. The stabilization and decomposition of these compounds determines how increasing CO_2 concentrations change the terrestrial trace gas emissions, especially CO_2, N2O and CH4. To assess the potential reaction of terrestrial greenhouse gas emissions to rising tropospheric CO_2 concentration, we make use of a comprehensive ecosystem model integrating known processes and fluxes of the carbon-nitrogen cycle in soil, vegetation and water.

We apply a state-of-the-art ecosystem model with measurements from a long term field experiment of CO_2 enrichment. The model – a grassland realization of LandscapeDNDC – simulates soil chemistry coupled with plant physiology, microclimate and hydrology. The data - comprising biomass, greenhouse gas emissions, management practices and soil properties - has been attained from a FACE (Free Air Carbon dioxide Enrichment) experiment running since 1997 on a temperate grassland in Giessen, Germany. Management and soil data, together with weather records, are used to drive the model, while cut biomass as well as CO_2 and N2O emissions are used for calibration and validation. Starting with control data from installations without CO_2 enhancement, we begin with a GLUE (General Likelihood Uncertainty Estimation) assessment using Latin Hypercube to reduce the range of the model parameters. This is followed by a detailed sensitivity analysis, the application of DREAM-ZS for model calibration, and an estimation of the effect of input uncertainty on the simulation results. Since first results indicate problems with the correct representation of the seasonal cycle of soil moisture and N2O emissions, our model is soon to be augmented with a more elaborate sub model for hydrology. Subsequent steps include the comparison of simulations and measurements under 20% elevated atmospheric CO_2 concentrations, and the integration of a Farquhar-type sub model for photosynthesis.