Geophysical Research Abstracts
Vol. 17, EGU2015-6582, 2015
EGU General Assembly 2015

Evaluating the influence of plant-specific physiological parameterizations on the partitioning of land surface energy fluxes

Mauro Sulis (1), Matthias Langensiepen (2), Prabhakar Shrestha (1), Anke Schickling (3), Clemens Simmer (1,5), Stefan Kollet (4,5)

(1) Meteorological Institute, Bonn University, Germany (msulis@uni-bonn.de), (2) Institute of Crop Science and Resource Conservation (INRES), Bonn University, Germany, (3) Institute for Bio- and Geosciences, Plant Sciences (IBG-2), Research Centre Juelich, Germany, (4) Institute for Bio- and Geosciences, Agrosphere (IBG-3), Research Centre Juelich, Germany, (5) Centre for High-Performance Scientific Computing in Terrestrial Systems (HPSC TerrSys), Geoverbund ABC/J, Germany

Vegetation has a significant influence on the partitioning of radiative forcing, the spatial and temporal variability of soil water and soil temperature. Therefore plant physiological properties play a key role in mediating and amplifying interactions and feedback mechanisms in the soil-vegetation-atmosphere continuum. Because of the direct impact on latent heat fluxes, these properties may also influence weather generating processes, such as the evolution of the atmospheric boundary layer (ABL). In land surface models, plant physiological properties are usually obtained from literature synthesis by unifying several plant/crop species in predefined vegetation classes. In this work, crop-specific physiological characteristics, retrieved from detailed field measurements, are included in the bio-physical parameterization of the Community Land Model (CLM), which is a component of the Terrestrial Systems Modeling Platform (TerrSysMP). The measured set of parameters for two typical European mid-latitudinal crops (sugar beet and winter wheat) is validated using eddy covariance measurements (sensible heat and latent heat) over multiple years from three measurement sites located in the North Rhine-Westphalia region, Germany. We found clear improvements of CLM simulations, when using the crop-specific physiological characteristics of the plants instead of the generic crop type when compared to the measurements. In particular, the increase of latent heat fluxes in conjunction with decreased sensible heat fluxes as simulated by the two new crop-specific parameter sets leads to an improved quantification of the diurnal energy partitioning. These findings are cross-validated using estimates of gross primary production extracted from net ecosystem exchange measurements. This independent analysis reveals that the better agreement between observed and simulated latent heat using the plant-specific physiological properties largely stems from an improved simulation of the photosynthesis process owing to a better estimation of the Rubisco enzyme kinematics. Finally, to evaluate the effects of the crop-specific parameterizations on the ABL dynamics, we perform a series of semi-idealized land-atmosphere coupled simulations by hypothesizing three cropland configurations. These numerical experiments reveal different heat and moisture budgets of the ABL that clearly impact the evolution of the boundary layer when using the crop-specific physiological properties.