Geophysical Research Abstracts
Vol. 21, EGU2019-4360, 2019
EGU General Assembly 2019

A physically based approach of the canopy heat storage and towards assessing the climatic impact of leaf thermoregulation

Marvin Heidkamp (1,2), Andreas Chlond (1), Felix Ament (1,3)

(1) Max Planck Institute for Meteorology, Hamburg, Germany, (2) International Max Planck Research School on Earth System Modeling, Hamburg, Germany, (3) Meteorological Institute, CEN, University of Hamburg, Hamburg, Germany

We investigate the exchange fluxes of energy and water between the land and the overlaying air mass using the new JSBACH scheme, in which the unphysical treatment of the heat storage in the energy balance equation is replaced by a physically based estimation of the canopy heat storage. The new scheme leads to several improvements, particularly for sites with shallow vegetation, but still oversimplifies the description of near surface heat fluxes in forests. In these regions, the thermodynamic structure, in particular the leaf temperature, plays an important role as it affects not only the evaporative gradient but also directly the plant metabolic activities and as a consequence the leaf carbon gain. In the past, laboratory and field experiments have shown that leaf temperature can deviate from its ambient temperature due to water or heat losses. Moreover, recent studies have found significant deviations between leaf and ambient temperature in regions ranging from tropical to boreal biomes among various tree species. However, current Earth system models neglect the difference between leaf and ambient air temperature and the effect of thermoregulation on climate feedbacks and the global carbon uptake has not been investigated in a climate model. To address this issue a new Canopy layer Energy BAlance scheme (CEBA) is introduced into JSBACH, which allows a differentiation of the temperatures and humidities of the ambient canopy air space, the ground surface and the leaf itself. This enables a more realistic representation of the canopy layer in Earth system models and of the different turbulent exchange fluxes. The performance of the new scheme is evaluated by means of an offline single site experiment against observed energy and mass fluxes at different forest FLUXNET sites.