Geophysical Research Abstracts
Vol. 16, EGU2014-1286, 2014
EGU General Assembly 2014

Influence of physiological phenology on the seasonal pattern of ecosystem respiration in deciduous forests

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In this contribution we present a study on the role of physiological phenology (defined as seasonal changes in physiological properties) as an additional driver of the ecosystem respiration (RECO) in deciduous forests. With a model–data integration approach we analyzed the RECO data from 19 deciduous sites belonging to the FLUXNET La Thuile database. We analyzed the performance of two semi–empirical models, one with (TPdGPP) and the other without (TPLinGPP) the explicit dependency of RECO on the rate at which gross primary productivity (GPP) changes in spring, the latter used as proxy of physiological phenology.
We identified a clear effect of physiological phenology on RECO that needs to be included as a driver of RECO in addition to the GPP, temperature and precipitation.
The semi–empirical model developed led to a decrease in root mean square error (RMSE) of about 8% and an increase in the modeling efficiency (EF) of about 6% of modeled RECO. The reduction of the model–observation bias occurred mainly in spring and in summer, while less reduction was observed at the annual time–scale.
For few sites the use of the explicit description of physiological phenology did not reduce the bias in modeled RECO consistently. This might be partly related to the spatial heterogeneity of the canopy at these sites.
The results obtained point toward the need of improving the current approach used for modeling the RECO in deciduous forests by including the phenological cycle of the canopy.