Geophysical Research Abstracts
Vol. 19, EGU2017-13573, 2017
EGU General Assembly 2017

Tree-, stand- and site-specific controls on landscape-scale patterns of transpiration

Sibylle Hassler (1,2), Weiler Markus (3), and Blume Theresa (2)

(1) Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany (sibylle.hassler@kit.edu), (2) GFZ German Research Centre for Geosciences, Potsdam, Germany, (3) University of Freiburg, Freiburg, Germany

Transpiration is a key process in the hydrological cycle and a sound understanding and quantification of transpiration and its spatial variability is essential for management decisions as well as for improving the parameterisation of hydrological and soil-vegetation-atmosphere transfer models. For individual trees, transpiration is commonly estimated by measuring sap flow. Besides evaporative demand and water availability, tree-specific characteristics such as species, size or social status control sap flow amounts of individual trees. Within forest stands, properties such as species composition, basal area or stand density additionally affect sap flow, for example via competition mechanisms. Finally, sap flow patterns might also be influenced by landscape-scale characteristics such as geology, slope position or aspect because they affect water and energy availability; however, little is known about the dynamic interplay of these controls.

We studied the relative importance of various tree-, stand- and site-specific characteristics with multiple linear regression models to explain the variability of sap velocity measurements in 61 beech and oak trees, located at 24 sites spread over a 290 km^2-catchment in Luxembourg. For each of 132 consecutive days of the growing season of 2014 we modelled the daily sap velocities of these 61 trees and determined the importance of the different predictors. Results indicate that a combination of tree-, stand- and site-specific factors controls sap velocity patterns in the landscape, namely tree species, tree diameter, the stand density, geology and aspect. Compared to these predictors, spatial variability of atmospheric demand and soil moisture explains only a small fraction of the variability in the daily datasets. However, the temporal dynamics of the explanatory power of the tree-specific characteristics, especially species, are correlated to the temporal dynamics of potential evaporation. Thus, transpiration estimates at the landscape scale would benefit from not only considering hydro-meteorological drivers, but also including tree, stand and site characteristics in order to improve the spatial representation of transpiration for hydrological and soil-vegetation-atmosphere transfer models.