EGU22-10218
https://doi.org/10.5194/egusphere-egu22-10218
EGU General Assembly 2022

Measuring and modeling water fluxes across soil-plant-atmosphere continuum in a temperate forest environment

Tomas Vogel[1], Veronika Skalova[1], Michal Dohnal[1], Jana Votrubova[1], and Miroslav Tesar[2]
[1]Department of Hydraulics and Hydrology, Faculty of Civil Engineering, Czech Technical University in Prague, Czech Republic
[2]Institute of Hydrodynamics, Czech Academy of Sciences, Prague, Czech Republic

This study is focused on fluxes of water and energy associated with the plant transpiration in a temperate montane forest of Central Europe. The research is based on the long-term monitoring of basic hydrological and meteorological variables at two adjacent forest sites, covered with Norway spruce and European beech. The analysis of the observed variables is combined with the numerical modeling of soil-plant hydraulics.

Among the monitored variables, sap flow in tree xylem is measured continuously by thermal dissipation probes. Soil water pressure and soil water content are monitored by tensiometers and FDR sensors at several depths. Catchment discharge observations, reflecting the subsurface responses to major rainfall events, are used together with the soil water content data to provide the relevant information on the catchment water balance, which constrains the long-term cumulative transpiration amount.

A one-dimensional soil water flow model, involving vertically distributed macroscopic root water uptake and whole-plant hydraulic capacitance algorithm to account for the transient xylem water storage, is used to simulate the temporal variations of water fluxes in the soil-plant-atmosphere system.

The observed sap flow rates are compared with the simulated transpiration fluxes. A particular attention is paid to the different behavior of spruce and beech trees during periods with extreme transpiration demand (summer midday conditions). The results of the comparisons confirm the expected isohydric response of spruce in contrast to a more anisohydric behavior of beech trees.

The comparison of the modeling results with the in-situ observations reveals a complex interplay of soil and plant hydraulic properties determining the specific responses of spruce and beech forest stands to the same weather conditions.

The research is supported by the Czech Science Foundation Project No. 20-00788S.