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Long-term water uptake dynamics in the spruce tree SPA system - measurement and numerical modeling

Michal Dohnal (1), Tomas Vogel (1), Miroslav Tesar (2), and Jana Votrubova (1)

(1) Czech Technical University in Prague, Prague, Czech Republic (vogel@fsv.cvut.cz), (2) Institute of Hydrodynamics AS CR, Prague, Czech Republic

Soil water dynamics in the plant root zone is a key compartment of the soil-plant-atmosphere (SPA) system. The soil-root interface is a hydrologic boundary, through which important part of the evapotranspiration crosses to the atmosphere. In the present study, the results of long-term monitoring of plant water uptake dynamics in spruce trees are presented. Soil water responses to atmospheric forcing (rain and transpiration) are analyzed by means of numerical modeling based on Richards' equation. Simulated responses are compared with tensiometric and soil water content data. Experimental station Liz, located in a forested mountain area (Sumava Mts., Czech Republic), is instrumented for monitoring of the relevant meteorological and hydrological variables. Soil water dynamics in the soil profile is measured by automated tensiometers and soil moisture sensors. Long-term sap flow observations by heat field deformation method on six full-grown spruce tree specimens provide valuable information about transpiration demand of spruce forest. Sap flow patterns and their spatial and temporal variability is analyzed and compared to observed meteorological data. Special attention is paid to the issue of night-transpiration and to hydraulic redistribution phenomena related to the soil moisture compensation effects between roots.
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