EGU21-2579
https://doi.org/10.5194/egusphere-egu21-2579
EGU General Assembly 2021

Modeling of plant water uptake in two distinct forest stands using whole-plant capacitance approach

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Soil-plant-atmosphere interactions are studied to improve the estimation of actual transpiration – the key part of the catchment water balance. The one-dimensional soil water flow model S1D, involving vertically distributed macroscopic root water uptake and whole-plant hydraulic capacitance, was used. The model is based on the numerical solution of Richards' equation coupled with a transient transpiration stream algorithm.

The study focuses on the catchment Liz located in the Bohemian Forest, Czech Republic. The catchment is covered with Norway spruce (Picea abies) and European beech (Fagus sylvatica). In 2020, sap flow measurements by thermal dissipation probes were conducted at both forest environments. Soil water pressure head, soil water content, and soil temperature data, as well as complete meteorological data from the nearby meteorological station, were also available for the whole period of interest.

The registered sap flow and simulated transpiration fluxes are compared with a particular attention to the different behavior of isohydric (spruce) and anisohydric (beech) trees. The model reasonably well reproduces the plant responses caused by both the high midday potential transpiration demand and the occasional soil drought.

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