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Modelling the soil-plant-atmosphere water transfer of mixed temperate broad-leaved forest stands

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The water balance of an old-growth broad-leaved forest in central Germany has been simulated using 1D soil-plant-atmosphere continuum (SPAC) transfer models. The observation site was divided into subplots with different fractions of beech (Fagus sylvatica) and other broad-leaved tree species (Tilia spp., Acer spp., Carpinus betulus, and Quercus robur). The impact of the forest structure and the tree species composition on hydrological functions such as soil water depletion and water retention was analysed by comparing the water balances of these subplots with similar climatic conditions and similar soil properties.
Simulated hydrological and physiological processes of the SPAC included models of evapotranspiration (Penman-Monteith), interception (revised Gash), soil water flows (Richards equation for porous media), and water stress (Feddes). The simulations couple hydrological and physiological processes and are in accordance with precedent hydrological measurements at the same forest. A model scenario points out the influence of tree species specific functional traits on the water balance. Especially the reaction of the trees to dry soil conditions is in focus, because beech reaches its drought limit in summer and has to compete with more drought-tolerant tree species such as ash for the available soil water.
The limits of 1D SPAC models are discussed and further efforts on modelling spatial inhomogeneity of forest structure and species composition are presented.