Geophysical Research Abstracts
Vol. 17, EGU2015-844, 2015
EGU General Assembly 2015

Species specific temporal patterns of throughfall and stemflow in deciduous and coniferous forests with implications for unsaturated zone and groundwater recharge processes

Janek Dreibrodt (1), Luisa Hopp (2), Sonja Germer (3), Markus Morgner (1), Andreas Güntner (1), and Theresa Blume (1)

(1) Section 5.4 Hydrology, Helmholtz Centre Potsdam - GFZ, Germany (dreibrod@gfz-potsdam.de), (2) Department of Hydrology, University of Bayreuth, Germany, (3) Department Bioengineering, Leibniz Institute for Agricultural Engineering ATB Potsdam-Bornim, Germany

The extent of rainfall redistribution by forest canopies and resulting spatial patterns vary for different tree species and can play an important role for soil moisture distribution and subsequently for groundwater recharge. A thorough understanding of these relationships will improve our ability to predict future impacts of climate and forest structural changes on the water balance of forest stands. Therefore we quantified the fractions of throughfall and stemflow per gross rainfall for different forest types and for different meteorological conditions and rainfall characteristics.

Throughfall was continuously measured at 7 sites with different dominant tree species and ages: young and old beech, young oak, and young and old pine. Within 2000m^2-plots situated in the Müritz-Nationalpark (north-eastern Germany), trough-based throughfall monitoring systems with a total collecting area of 6.6m^2 per site, and soil moisture, leaf wetness and sapflow sensors were installed. Stemflow was measured for 5-10 trees per site with a temporal resolution of 1min.

Canopy structure is likely to have a major influence on the throughfall distribution. Therefore, the forest structure was characterized by a detailed mapping of tree species, stem positions and stem diameters. Seasonal variations of leaf coverage were monitored by ground-based leaf-area index (LAI) measurements. Evaporation from the canopy is the sum of evaporation during rainfall events and of precipitation stored in the canopy that is evaporated after rainfall ceased. We estimated the storage capacity of the canopy based on the cumulative precipitation between the onset of rainfall and the onset of throughfall. The influence of rainfall intensity and leaf wetness before the onset of rainfall events on canopy storage was also assessed.

The data set was used to parameterize and run the soil hydrological model HYDRUS-2D at various spatial scales to assess the effect of stemflow and throughfall patterns on the dynamics and distribution of soil moisture and groundwater recharge.

First results highlight the importance of concentrated water input by stemflow, subsequent high infiltration rates around beech stems and the resulting local soil saturation for rapid groundwater recharge. For the other tree species stemflow plays a minor role and rainfall redistribution patterns are more determined by canopy gaps or ground vegetation.

This study is a contribution to the Virtual Institute of Integrated Climate and Landscape Evolution Analysis -ICLEA- of the Helmholtz Association, grant number VH-VI-415 and is supported by TERENO infrastructure of the Helmholtz Association.