Geophysical Research Abstracts
Vol. 12, EGU2010-9314, 2010
EGU General Assembly 2010

A Comparison of Water Balance Components of a Spruce and a Beech Canopy Based on Parallel Micrometeorological and Plant Physiological Measurements

Uwe Spank (1), Christian Bernhofer (1), Falko Clausnitzer (1), Babara Köstner (1), Kai Schwärzel (2), and Karl-Heinz Feger (2)

(1) TU-Dresden, Hydrology and Meteorology, Meteorology, Germany (meteo@forst.tu-dresden.de, +49(0)351 463 31303),
(2) TU-Dresden, Forest Science, Soil Science and Site Ecology, Germany (boku@forst.tu-dresden.de, +49(0)351 463 31388)

We present the investigations of water balances of two neighbouring canopies, a spruce and a beech canopy. The water balances were analyzed on small scale of areas less than 0.5 km^2 during two growing seasons. The investigations are based on a combination of different meteorological (eddy-covariance measurements, EC) and plant physiological measurements (sap flow measurements, SF), as well as on the integration of measurements of soil moisture. The periods of investigation were very different concerning weather conditions. One of the seasons was hot and dry, the other season was cool and rainy. Thus, we are able to compare both canopies under different, however typical, prevailing weather.

The first part of our study was the partitioning of gross precipitation P into components: interception I, canopy drip P_c and stem flow P_s. The main focus was to arrive at net precipitation P_n to quantify the plant available water W_a. Here, also the partitioning of P_c into throughfall P_t and canopy drainage P_d was analysed. In the second part we investigated the evapotranspiration ET as well as its partitioning into transpiration T, interception and soil evaporation E_s. The third part addressed the combination of micrometeorological measuring methods and measurements of soil moisture Θ to close water balance and to estimate seepage R at canopy scale. In this context measuring errors have significant influences on the interpretation of results. However, they had been often ignored in former studies. Here, we try to give a robust approximation of measuring errors for the different methods.

The analyses of partitioning of P showed that P_n and I were almost identical in both canopies. That means water input was almost identical in both canopies and was around two-thirds of P. This statement is confirmed especially against the background of unavoidable measuring errors. However, the partitioning of P_n was completely different for both canopies. P_s was 20 - 25% of P and around one-third of P_n at the beech site. P_s is negligible in the spruce canopy. The statistical analyses of P_c showed a P_t of 12 % at the spruce site and 14 % at the beech site, which correspond to expectations, derived from measured sky view coefficients. In this context the important regulating role of P_t for silvicultural, ecological and hydrological issues becomes clear.

The analyses of ET, T and I as well as the integration of Θ to close of water balance were complex due to different scales of measurements. Which are different scales of EC measurements (used for ET) and SF measurements (used for T) as well as spatial heterogeneity of Θ. To overcome the scale problem in components of ET somewhat an inverse solution of Penman's approach was used to separate T and I in the EC data. Here we found: differences in T between both canopies are caused predominately by different W_a in both canopies. However, influences due to differences of plant physiological characteristics between beeches and spruces were found to be less important. The potential water supply depends on two parameters: characteristics of soils and range of rooting zone. Therefore, soil characteristics determine water balance significantly under all climate conditions. However, the range of the rooting zone and the specifics of roots are only significant in droughts and dry periods, when water supply is restricted. Differences in interception between both canopies were found to be negligible during the growing season.