Geophysical Research Abstracts
Vol. 13, EGU2011-6959, 2011
EGU General Assembly 2011

Water use efficiency of Norway spruce stand

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Water use efficiency (WUE), as an important vegetation parameter, has been commonly estimated on leaf or plant level as a ratio between CO2 assimilation or biomass production and transpiration in different time steps (ITE instantaneous water use efficiency as ratio of actual values, WUE as ratio of monthly or seasonally summed values; e.g. Mor[U+FFFD]t al. 2001). Recently at the ecosystem level direct estimation of WUE as ratio between net ecosystem production (NEP) or gross primary productivity (GPP) of ecosystem and its evapotranspiration (ET) measured by eddy-covariance technique can be estimated in short (usually per half of hour) as well as in long time steps (Kuglitsch et al. 2008). Unfortunately, there are still too many problems with accurate measurements of the both carbon dioxide and water vapor fluxes (Baldocchi 2003, Kuglitsch et al. 2008). Thus, ecophysiological measurements including ecosystem respiration (R; consist of leaf, woody tissue and soil respiration) and transpiration (T; evaluated on individual tree level by some of heat movement detection method and then scaled-up to the stand level) are necessary for the eddy-covariance data correction. Long-term continuous measurement of carbon and water vapor fluxes by eddy-covariance (for methodology see Aubinet 2000), R by an automatic system (Pavelka et al. 2007), campaign measurement of T and monitoring of microclimate parameters allow us to: i) compare WUEs obtained by different approaches, ii) do sensitivity analysis of WUE on meteorological conditions, and iii) model missing data in young mountain Norway spruce monoculture. Additionally, sap flux rate used for T evaluation by heat pulse method per trees with different canopy strata occupation (CSO) and volume changes of stems monitored by a set of automatic dendrometers enable us to: i) identify radial stem growth increment and stem volume variation due to water content changes with regard to the variation in stem circadian cycle (SCC), ii) identify proportion of trees grouped per different CSO on total stand T under variable microclimatological conditions, and iii) evaluate T and WUE of spruce stands with different densities.

Acknowledgement
The authors are grateful for the financial support by grants no. SP/2d1/70/08 and SP/2d1/93/07 of the Ministry of Environment of the Czech Republic and Governmental Research Intention no. AV0Z60870520.

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