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Relationship between tree transpiration, stem growth and carbon fluxes during soil drought of an old spruce forest.

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Knowledge about the site water balance is the key for sustainable management of forests, especially before the background of changes to more deciduous mixed forests. To determinate the water supply of forests, the interaction between trees and environments is quite necessary. At a long-term study site in the Tharandt forest (375 m a.s.l.; eastern Germany) dominated by old-growth Norway spruce (*Picea abies* (L.) Karst.), sap flow of several trees is continuously measured by thermal dissipation technique after Granier since 2001. Measurements are accompanied by standard meteorological and soil physical observations as well as by studies of eddy-covariance (since1996) and above-ground tree growth. The period since 2001 covers some meteorological extremes observed at the site during the last 45 years: the warmest year with annual mean air temperature (T_a) of 9,5 ˚C (2007), the year with maximum annual precipitation of 1098 mm (2002, Saxonian flood), and the driest year with 501 mm (2003). Seasonal stand transpiration (April-October) derived by up scaling from sensors to stand ranged between 68 mm (2003) and 189 mm (2006). Inner annual variations of growth, especially of dry periods, can also be identified by growth ring analyses at the cell-level from stem discs and monthly circumference measured by band dendrometers. Significant reduction in tree sap flow (e.g., 2003 and 2006) and thus in canopy conductance g_c during drought periods are connected with reduced shoot and needle growth in the following year. Further, we analysed δC13 isotopes from spruce nee-

dles of every age group since 2001. Relationships between water and carbon gain, i.e. water-use efficiency (WUE) is derived from radial tree growth and tree water use and canopy conductance determined from sap flow measurements. Results of these investigations are discussed with respect to (1) effects of soil drought, (2) inter and intra annual variation of carbon-water relationships and (3) differences between various determinations of WUE.