



Drought Effects on Ecosystem Carbon and Energy Fluxes in Beech Forests in Central Europe

A. Knohl (1,2), W. Kutsch (1), M. Mund (1), O. Kolle (1), C. Rebmann (1), P. Anthoni (1), N. Buchmann (3), E.-D. Schulze (1)

(1) Max Planck Institute for Biogeochemistry, Jena, Germany, (2) University of California, Dept. of Environmental Science, Policy and Management, Berkeley, USA, (3) Institute of Plant Science, ETH Zürich, Zürich, Switzerland (aknohl@bgc-jena.mpg.de / Fax: ++1 510 643 5098 / Phone: ++1 510 642 2421)

Extreme climate events are expected to increase in intensity and frequency. It remains unclear how such events will impact terrestrial ecosystems in their physiological functions and their capability to sequester carbon from the atmosphere. Here we use the severe drought in Europe from 2003 as a natural experiment to study the impact of drought on carbon, water and energy fluxes between forest ecosystems and atmosphere. In the years before, during and after the drought, continuous flux measurements based on the eddy covariance method were performed at two beech sites in Thuringia/Germany (Hainich and Leinefelde site) that are typically not exposed to severe droughts. The warm and sunny weather during the beginning of summer 2003 with sufficient water availability led first to an increase in carbon uptake compared to previous years. In late summer however, when soil water reservoirs were depleted, maximum carbon uptake rates declined sharply from $40 \mu\text{mol m}^{-2} \text{s}^{-1}$ to less than $15 \mu\text{mol m}^{-2} \text{s}^{-1}$ resulting in decline of 30% in carbon uptake during July, August and September compared to previous years. Furthermore, water and energy fluxes were also strongly affected. The ratio of sensible to latent heat fluxes (Bowen-Ratio) switched from values close to one during the non-stressed conditions to values between three and four during the drought indicating major changes in plants physiology. In the year after the drought, carbon uptake rates were also reduced compared the years prior the drought, although climatic conditions were similar, suggesting a carry-over of drought effects to the following year.