Geophysical Research Abstracts
Vol. 12, EGU2010-12532, 2010
EGU General Assembly 2010

How tree species-specific drought responses influence the carbon-water interaction in temperate forests

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Climate-change-induced differences in soil moisture conditions will influence the carbon uptake of tree species and hence the carbon budget of ecosystems. Experimental data showed that in a mature deciduous forest tree transpiration during a prolonged drought was reduced in a species-specific manner (Leuzinger et al. 2005). We implemented such a differential drought responses using the ecosystem model LPJ-GUESS. We simulated forest ecosystems in central Europe, using mixed forests and single species stands. The model showed that one result of the species specific drought response are differences in tree species diversity in the long run. At the intra-annual scale, we showed that a reduction in ecosystem evapotranspiration at an early stage during the drought period resulted in lower water stress later on in the drought. A consequence was that drought sensitive tree species could maintain a positive carbon balance during longer drought periods. As drought periods are likely to become more frequent and/or longer in many parts of the world, projections of ecosystem responses will be sensitive to the processes investigated here, and therefore ecosystem models should be upgraded to take them into account.

Leuzinger et al. (2005) Tree physiology 25: 641-650.