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How tree species-specific drought responses influence hydrology

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The future changes in soil moisture conditions are controlled by environmental conditions as well as by the ecosystems themselves. In a mature deciduous forest Leuzinger et al. (2005) found that tree species reduced their transpiration during drought in a species-specific manner. Using such species specific responses to drought, we investigated both the short- and the long-term consequences for ecosystems by applying the ecosystem model LPJ-GUESS (Smith et al. 2001, Sitch et al. 2003).

The competition between species influenced the outcome of the simulations. Direct competition lead to an inferior performance of water saving trees, whereby water spenders win the competition for the limited water resources in the local soil patch. However, when trees species did grow without competition (i.e. neighboring gridcells) carbon uptake was comparable, especially after longer drought periods. Water savers transpired about 15-20% less water in the beginning of a drought, which lead to a higher soil moisture and therefore a higher water availability later during the drought. These trees maintained therefore a positive carbon balance during prolonged droughts

These results stress that if species differ in their ability to take up water, the pattern of rain and drought as well as the degree of root space competition determine both the hydrology as well as the carbon uptake of the ecosystem.

References

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