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Influence of post-drought climate sensitivity deviations on secondary growth in European beech (Fagus sylvatica L.)

Christopher Leifsson[1], Allan Buras[1], Anja Rammig[1], and Christian Zang[1,2]
[1]Technical University of Munich, Freising, Germany
[2]University of Applied Sciences Weihenstephan-Triesdorf, Freising, Germany

Extreme drought events will have an increasing influence on forest ecosystems and services in the course of climate change. It is thus pivotal to understand their direct impacts and subsequent recovery patterns. Drought impacts are often reported as changes in net primary productivity (NPP) related to impact severity. However, because NPP integrates over all physiological processes, variability in NPP alone cannot explain internal mechanisms.

Due to temporally variable growing conditions, climate-growth relationships are naturally non-stationary on longer time scale. On shorter time scales, extreme drought events are considerable perturbations that likewise alter the climate sensitivity of growth, corresponding to physiological impacts caused by drought. Therefore, post-drought changes in the climate sensitivity of growth serves as a potential avenue of studying physiological impacts. Decoupled climate-growth relationships would be expected in the case of damage on the hydraulic system or reallocation of carbon to rebuild foliage. Conversely, tightened coupling would be expected in the case of stricter growing conditions as per the law of the minimum or carbon reallocation towards increased xylogenesis.

Because experimental ecophysiological studies are labour and cost intensive, they are typically limited in space and time. Meanwhile, climate-growth relationships derived from tree-ring widths (as an approximation for variability in NPP) and high-resolution climate products are easily accessible on regional to global scales. By finding common post-drought responses in climate sensitivity of tree-growth for trees grouped by abiotic and biotic factors it is possible to analyse physiological impacts on large scales, thus effectively enhancing our understanding of the underlying mechanisms that result in quantified impacts on NPP.

Here, we aim to find intraspecific differences in post-drought climate-growth relations for the ecologically and economically important European tree species European beech (*Fagus sylvatica* L.). Using a European-wide dataset of tree-ring widths, the European Beech Tree-Ring Network (EBTRN), we compute post-drought changes in climate-growth relationships – climate sensitivity deviations – in addition to direct and lagging impacts on absolute tree-ring derived growth. Preliminary analyses indicate a complex connection between growth recovery rates and diverging post-drought climate sensitivity deviations, in turn shaped by growing condition factors.