Geophysical Research Abstracts
Vol. 20, EGU2018-16621, 2018
EGU General Assembly 2018

No signs of hydraulic failure or carbon shortage in mature temperate forest trees during a severe summer drought

Lars Dietrich (1), Sylvain Delzon (2), Guenter Hoch (1), and Ansgar Kahmen (1)

(1) University of Basel, Department of Environmental Sciences | Botany, Basel, Switzerland (lars.dietrich@unibas.ch), (2) BIOGECO, INRA, University of Bordeaux, 33615 Pessac, France

1. Climate change-induced increases in the frequency and intensity of summer droughts and heat waves are predicted to increase the mortality of forests world-wide. The main climate-related drivers that have been suggested to be responsible for tree mortality are hydraulic failure and carbon starvation.
2. Here, we tested the vulnerability of six temperate tree species to drought-induced mortality during the 2014 – 2016 growing seasons including the exceptional 2015 Central European summer drought. Specifically, we assessed stem increment growth, sap flow, water potentials and non-structural carbohydrate concentrations in leaves and branches to determine how mature temperate trees responded to this exceptional climate event and if the trees were approaching their lethal physiological limits with respect to hydraulic failure and carbon starvation.
3. We found that the trees' pre-dawn water potential strongly decreased during the 2015 summer drought, much more than during the other study years. Also, most species reduced their sap-flow by up to 80% during the 2015 summer drought and increment growth ceased with the onset of the drought. Midday water potentials also strongly decreased and saturated at a species-specific low-point with decreasing soil water availability. Despite the strong responses in the trees' growth and water relations, the trees were found to exhibit large hydraulic safety margins. In addition, we detected no distinct decrease in non-structural carbohydrates in leaves, bark and stems during the drought event suggesting that the trees were far from carbon starvation. Therefore, we conclude that although the six species responded sharply in their water relations to the 2015 summer drought they maintained large hydraulic and 'carbon' safety margins.
4. Synthesis: This study shows that mature trees of six common Central European forest tree species strongly reacted to a severe summer drought by reducing their water consumption and stopping growth. At the same time, however, the trees were far away from potentially lethal thresholds concerning the functioning of their hydraulic system and carbon household, respectively, emphasizing that trees take effective measures to survive a drought. Our results suggest that Central European forests might be less vulnerable to severe summer droughts as has previously been assumed.