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Seasonal hydro-ecological feedbacks during the 2018 drought in Europe

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The drought affecting central Europe, UK and Scandinavia in 2018 was one of the strongest in the past decade, and comparable in severity to the 2003, 2010 and 2015 droughts. From the atmospheric perspective, the summer drought and heatwave in 2018 differed from the previous events as it was preceded by unprecedented high temperatures and lower than average rainfall from early in April that persisted until late summer.

Unlike the other events, this drought affected regions that seldom experience strong drought (e.g. Scandinavia and UK). In some of the regions experiencing the strongest summer drought anomalies, e.g. Germany and UK, preceding spring rainfall deficits were within the normal variability but the warming from April onwards was particularly extreme. In these regions, ecosystem activity is limited by spring temperature, and therefore the extreme warming in spring likely stimulated photosynthesis early in the growing-season.

Increased productivity trends in spring due to earlier onset of the growing season in the Northern Hemisphere have been associated with stronger water deficits and reduced productivity in summer (Buermann et al., 2018). However, analyzing the heatwave in 2010, Flach et al. (2018) pointed to a north-south asymmetry in ecosystems response to spring and summer heatwaves, with northern forests showing increased GPP even during the heatwave and drought, possibly because of differentiated responses by different vegetation types to warming and drying.

Here we analyze a series of land-surface model simulations using high-resolution climate forcing for the European region. We evaluate the impacts of the 2018 drought on the carbon and hydrologic processes in ecosystems, during spring and summer and compare them to observation-based estimates of CO_2 and water fluxes over the region. Finally, we quantify the contribution of the spring extreme warming and the resulting hydro-ecological feedbacks to the intensity of the summer drought.

Buermann, Wolfgang, et al.: Widespread seasonal compensation effects of spring warming on northern plant productivity. *Nature* 562.7725 (2018): 110.

Flach, M., Sippel, S., Gans, F., Bastos, A., Brenning, A., Reichstein, M., and Mahecha, M. D.: Contrasting biosphere responses to hydrometeorological extremes: revisiting the 2010 western Russian heatwave. *Biogeosciences*, 15, 6067-6085, https://doi.org/10.5194/bg-15-6067-2018, 2018.