Geophysical Research Abstracts
Vol. 20, EGU2018-15449, 2018
EGU General Assembly 2018

Revisiting the response of vegetation-atmosphere interplay to soil moisture droughts in Europe

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Soil moisture drought has comprehensive and complex implications on ecosystems. This is investigated in this study by analyzing and comparing the drought response of transpiration and gross primary productivity (GPP) in Europe. The mean evolution of these ecosystem fluxes during drought is determined by computing composites across the most severe soil moisture droughts. We find very similar mean evolutions with strongest reductions of the fluxes in the weeks after drought peak due to the persistent lack of soil water. Interestingly, the fluxes are enhanced in the weeks before drought peak thanks to a dominant surplus in incoming radiation. Further, we re-compute the drought evolution of transpiration and GPP for northern, central and southern Europe, respectively, and determine the overall drought response of the fluxes by integrating the evolution curves. We find a contrasting drought response across the sub-regions with slightly enhanced ecosystem fluxes in northern Europe and strong reductions in southern Europe. Relating these integrated drought responses across different severe droughts (time) and the sub-regions (space) we find the ecosystem drought response in Europe to be largely linearly related to drought length across time and space. This reflects a similar linear spatiotemporal drought response of vegetation greenness (NDVI). Moreover, highlighting economic impacts of this relationship, we find that the interplay of drought-integrated NDVI anomalies and applied irrigation can explain observed agricultural yield anomalies during drought years in Europe.