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# Global hydro-meteorological anomalies associated with vegetation productivity extremes

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Vegetation productivity is generally governed by water and energy availability. In arid regions, it is usually water-controlled (i.e. soil moisture), whereas in humid regions it is mainly influenced by energy variables (i.e. incoming radiation). Shifts within or even between these regimes might result from hydro-meteorological extremes. For example, during droughts vegetation might become water-limited even in typically energy-controlled regions. In this context, the aim of our analysis is to detect the difference between the controls of average and extreme vegetation productivity.

For this purpose, we use global satellite-based Sun-Induced Chlorophyll Fluorescence (SIF) data as a proxy for vegetation productivity alongside several hydro-meteorological variables. We select the three largest positive and negative monthly SIF anomalies from 2007 – 2015 and determine the hydro-meteorological variable with the largest corresponding standardized anomaly, which is considered to represent the main driver of the respective vegetation extreme.

We aggregate the results across grid cells of similar climate conditions. By contrasting main controls and their importance on vegetation productivity during extreme and general conditions, we find that water control in arid regions and energy control in humid regions are overall consistent in both conditions, while the importance of deep root-zone soil moisture is significantly increased in arid regions. Then, we identify regions where transitions between water and energy-control occur and further assess to which extent such regime transitions amplify vegetation productivity anomalies and/or impact their recovery.

This study contributes to a better understanding of vegetation productivity extremes, which may change with changing future patterns of temperature and precipitation, with subsequent feedbacks on the climate system and implications on food security.