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# Detecting ecosystem resilience to drought across 119 flux tower stations

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**Abstract:** More frequent and intense droughts are predicted with climate change and probably have large impacts on the water and carbon fluxes of ecosystems (IPCC, 2022). Ecosystem resilience to drought is an important metric to characterize the response of ecosystems to drought, which can fully evaluate the ability of the ecosystem to retain normal function (ecosystem resistance) and recover from drought (ecosystem recovery). Previous studies have been carried out for ecosystem resistance or recovery based on remote sensing products (Schwalm, 2017; Zhao, 2022), whose results are strongly influenced by the uncertainty of the products. Therefore, it is urgently required to comprehensively estimate and compare the resilience of water and carbon fluxes in different ecosystems to drought. More importantly, the unknown relationship between ecosystem resistance and ecosystem recovery prevents us from better understanding the divergence in the responses of different ecosystems to drought.

This study used evapotranspiration (ET) and gross primary productivity from 119 eddy flux provided by FLUXNET 2015, OzFlux, and AmeriFlux to comprehensively investigate both the resilience of water and carbon fluxes in nine ecosystems to drought, including Evergreen Needleleaf Forests (ENF), Evergreen Broadleaf Forests (EBF), Deciduous Broadleaf Forests (DBF), Mixed Forests (MF), Shrublands (SHR), Savannas (SAV), Grasslands (GRA), Wetlands (WET), Croplands (CRO). Our results represent that the GPP decreases more strongly than ET in most ecosystems during drought, especially CRO and WET. This indicates a decrease in water use efficiency (WUE) in most ecosystems during drought. It seems that ecosystems with more dramatic decreases in ET and GPP during the drought have stronger compensation effects during recovery duration with a faster recovery rate. Therefore, the recovery time of ET and GPP is similar at 5.7 months and 5.5 months respectively. However, this correlation between resistance and recovery, which is beneficial to the recovery of ecosystems from drought, may become invalid in severe drought events.

This study highlights the strong link between the process of absorbing the drought to retain the function and the process of drought recovery. More studies are required to further explore the response mechanisms behind this strong association.

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