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## Quantifying the responses of ecosystem production and respiration to drought time scale, intensity, timing and lagged response: A FLUXNET synthesis

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Drought is not only a multiscale (e.g., temporal, spatial) but also a multidimensional (e.g., onset, offset, duration, frequency, magnitude, intensity) phenomenon, and ecosystem production and respiration may respond to each drought dimension differently. Although multiple reports exist in literature on the drought impact on ecosystem productivity, it remains unclear how each component of drought impacts ecosystem gross primary production (GPP), ecosystem respiration ( $R_{ECO}$ ), and net ecosystem exchange (NEE) and how the different drought dimensions interacted with each other on their impacts. In this study, we conducted a comprehensive drought impact assessment on forest GPP, NEE, and  $R_{ECO}$  including all the drought dimensions using FLUXNET observations and multiple time-scales of Standardized Precipitation-Evapotranspiration Index (SPEI). Our results indicated that while most earlier drought studies focused on simultaneous and post-drought conditions, the cumulative drought impacts and drought timing are more significantly impacting forest carbon uptake than simultaneous drought severity. Temporal standardization based meteorological drought indices could be used to accurately reflect plant water stress if antecedent and cumulative drought conditions are considered.