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When ‘Dry’ Isn’t Dry: How drought definitions shape our understanding of forest responses to drought

Mana Gharun
University of Münster, Landscape Ecology, Geosciences, Münster, Germany (mana.gharun@uni-muenster.de)

Drought is a major driver of change in forest ecosystems, yet its quantification remains highly inconsistent across ecological studies. Consequently, the same period or location may be classified as under the effect of drought in one study and as near-normal in another, undermining comparability, synthesis, and inference. A systematic reanalysis of 161 drought events reported in forest ecosystem studies was conducted, to assess how drought definitions and quantification practices affect the accuracy of reported drought conditions.

Drought definitions were categorized into general descriptors (e.g., “dry,” “dry season,” or “different from normal”) and specific, quantifiable metrics (e.g., reduced precipitation, low soil moisture, standardized drought indices). We then examined how these definitions varied across forest types, drought “spheres” (atmospheric, soil, and hydrological), study approaches, and global regions. A clear pattern emerged showing that drought definitions are strongly biased toward atmospheric metrics, with soil and hydrological droughts being underrepresented, largely due to differences in data availability.

Across both experimental and observational studies, drought quantification proved to be a critical determinant of classification accuracy. General, non-quantified terms such as “dry” or “dry season” were frequently used but contradicted when benchmarked against the Standardized Precipitation–Evapotranspiration Index (SPEI). This highlights the importance of explicitly defined thresholds in ecohydrological research. Clearly stated and standardized thresholds would substantially improve global comparability, reduce subjective bias, and strengthen links among observational, experimental, and modeling studies of drought impacts on forests. Such improvements are essential for robust synthesis of drought attribution, development of mechanistic physiological understanding, and effective forest management under climate change.