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Responses of European forest fluxes to the 2022 heatwave and drought recorded by ICOS Eddy-covariance stations

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In 2022, Europe experienced a widespread severe summer edaphic drought and heat event, as well as abnormally hot autumn temperatures. By contrasting year 2022 with previous ones and using high-frequency Eddy-covariance and meteorological monitoring from 16 ecosystem ICOS forest stations across Europe, we(i) characterized the impact on carbon uptake and evapotranspiration rates, and (ii) disentangled the effects of soil water deficit from effects of atmospheric dryness on the forest fluxes.

Reduction of observed CO₂ uptake and evapotranspiration varied across Europe relative to drought intensity. Scandinavian forests were minimally affected in 2022, unlike the 2018 drought. On the contrary, several sites in southern Europe became a carbon source during the 2022 drought. Specifically, in southern France, some sites experienced a reduction of GPP of up to 70% relative to 2015-2021. Using artificial neural networks to analyze the responses of forests' CO₂ uptake to soil water content and atmospheric dryness, showed the very high vapor pressure deficit experienced in 2022 was the major driver of the ecosystem responses in southern France this particular year.