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Direct and lagged climate change effects intensified the widespread 2022 European drought

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In 2022, Europe faced an extensive summer drought that resulted in severe socio-economic consequences. Combining observations and climate model outputs with hydrological and land-surface simulations, we show that central and southern Europe experienced the highest observed total water storage deficit since the observations started in 2002, likely marking the highest and most widespread soil moisture deficit since 1960. While precipitation deficits primarily drove the soil moisture drought, global warming contributed to over 30% of the drought intensity and its spatial extent via enhancing evaporation. We reveal that about 15-40% of the climate change contribution was mediated by the warming that started drying the soil before the hydrological year of 2022, indicating the importance of considering lagged climate change effects to avoid underestimating risks. Qualitatively similar effects were observed in river discharges. These findings highlight that global warming impacts on droughts are widespread, long-lasting, and already underway, and that drought risk may escalate in the future.