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Warm Spring Reduced Impact of Summer Drought on Carbon Cycling

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Drought severely impacts biosphere-atmosphere carbon and water fluxes of terrestrial ecosystems by reducing productivity, carbon uptake and water transport to the atmosphere. The 2012 US drought was among the most intense and widespread drought events in the U.S. since the 'Dust Bowl' period in the 1930s, and had devastating effects on agricultural production. In addition, 2012 was among the warmest years on record. Using eddy covariance measurements of carbon, water and energy exchange from AmeriFlux sites along with remote sensing products, we show that this summer drought substantially reduced ecosystem productivity, net carbon uptake and water transport to the atmosphere. However, the warm spring with higher ecosystem productivity reduced the impact of the summer drought on annual carbon uptake. Shifts in vegetation activity during spring also triggered feedbacks that contributed to the summer heatwave. Although the drought was exceptional, 2012 was an example of what is expected in terms of future climate change – i.e. warmer temperatures all year and an increased frequency and duration of drought in summer. Understanding the response of ecosystem carbon and water cycling to drought will help to mitigate these changes, and our study provides important new insights for that.