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Humid, warm and treed ecosystems show longer time-lag of vegetation response to climate

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Climate-induced temperature rise and shifting precipitation patterns across diverse global ecosystems impact vegetation growth. Due to the diverse nature of terrestrial ecosystems and their climates, interactions between climate and vegetation vary spatially and temporally. Most studies focus on simultaneous interactions, overlooking the legacy effects of climate on vegetation physiology and growth. In this research, we use satellite-observed Solar-Induced Fluorescence (SIF) and Enhanced Vegetation Index (EVI) as the indicators of vegetation photosynthesis and greenness to assess the time-lag effect in vegetation response to climate from May 2018 to Dec 2021. Specifically, we examine the relationship between SIF, EVI, and concurrent or antecedent climate variables containing precipitation, soil moisture, and temperature. Additionally, we compare different time-lags of these climate variables under distinct environmental conditions to understand how climatic conditions influence them. Our findings reveal that arid and cold climates exhibit more concurrent climate-vegetation interactions than other ecosystems. In contrast, humid ecosystems with high mean annual temperature and precipitation show a substantial time-lag response of vegetation to climate, for up to six months. Given the significance of time-lag effects in global climate-vegetation interactions, acknowledging these effects is paramount for improving our understanding of vegetation dynamics in a changing climate.