Evidence that growing season length and tree growth are decoupled in an urban arboretum

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Anthropogenic climate change affects many natural systems at the global scale. The most frequently observed biological impact of climate change—shifts in the timing of recurring life history events (phenology)—is likely to have cascading/additional/knock-on effects. For trees, shifted phenology has extended the vegetative growing season, which is widely expected to increase tree growth, with important effects on forest carbon sequestration dynamics. Multiple recent studies, however, have failed to find this relationship and suggested shifts in drought or competition may prevent increased growth. Here, we use two datasets with limited impacts of drought and competition to test for a relationship between longer seasons and tree growth. These datasets come from a common garden experiment and a citizen science program, both located in an urban arboretum. With the common garden project, we monitored leaf phenology for three years across four species and four provenances (75 individuals), and we collected cross sections spanning seven years of growth data through tree rings. For the citizen science project, we leveraged nine years of phenology data across 11 species of mature trees (50 individuals), which we relate to their tree rings. Together, these data span 14 deciduous tree species of different age classes and over 10 years of growing season length data (111 to 157 days). We found contrasting evidence that trees grow more during longer seasons. Nine of our species did not change their growth; two grew less, and three grew more with longer seasons. In contrast to the expectation that fast-growing species would be most responsive to changing conditions, our results suggest that the most responsive species were slower-growing, more conservative species. Moreover, with the common garden study, we show little growth differences across the four sites, suggesting provenance effects may be weak for growth under current conditions. Together, these two complementary datasets indicate that longer growing seasons do not uniformly increase tree growth in an urban arboretum, and that factors other than drought and competition may underlie this observed decoupling. This could substantially affect future forest carbon sequestration dynamics in the context of a rapidly changing climate.