

A Marked Reduction in the Growth Rate of Sugar Maple Following the Accumulation of Climatic Stress Events in Southern Quebec, Canada

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Understanding the influence of climatic variation on forest dynamics is of great ecological and economical interest and is essential to prescribe interventions that will facilitate ecosystem adaptation to climate change. However, the retrospective identification of climatic events responsible for the inter-annual variation of tree growth is challenging, notably because both their duration and their subsequent effect can be highly variable in time. In this study, we aimed to (1) quantify empirically the effect of severe climatic events on the short- and long-term growth dynamics of dominant sugar maple (*Acer saccharum*) trees; (2) compare the effects of different types of climatic events (i.e., drought, winter thaw-freeze, and late frost); and (3) compare the effects of climatic stress events to those of traditional monthly-level climate metrics.

While the analysis from monthly-level metrics first suggested a weak and nonstationary relationship between climatic conditions and tree growth, the analysis from daily-level metrics showed that severe climatic events, and more particularly winter thaw-freeze events, were strongly related to the growth and vigour of sugar maple trees. Our results suggest that the synergic influence of cumulative climatic stress events, which was exacerbated by insect outbreaks during the late 1970s and the early 1980s, induced an important shift in the growth dynamics of sugar maple and its response to variation in climatic conditions.

These results highlight the potential negative impact of global climate change on our capacity to predict stand productivity accurately, especially if climate-sensitive growth models are based on projections of future monthly metrics. Because climatic events are expected to increase both in frequency and severity over the next decades, a general decrease in growth rate and vigour of sugar maple is anticipated in its native range.

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