Understanding the effect of warming temperatures on spring phenology of trees in the Alps using data from a citizen science program

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Abstract

Mountain regions are particularly exposed to climate change and temperature. In the Alps increased twice faster than in the northern hemisphere during the 20th century. As an immediate response, spring phenological phases of plant species such as budburst and flowering, have tended to occur earlier.
In 2004, the CREA (Centre de Recherches sur les Ecosystèmes d'Altitude, Chamonix, France) initiated the citizen science program Phenoclim, which aims at assessing the long-term effects of climate changes on plant phenology over the entire French Alps. Sixty sites with phenological observations were equipped with temperature stations across a large elevational gradient.

Here we used phenological records for five tree species (birch, ash, hazel, spruce and larch) combined with measurements or projections of temperature. We first tested the effects of geographic and topo-climatic factors on the timing of spring phenological phases. We then tested the hypothesis that a lack of chilling temperature during winter delayed dormancy release and subsequently spring phenological phases. Our data are currently being used to calibrate process-based phenological models to test to which extent soil temperature and photoperiod affect the timing of spring phenological phases.
We found that growing degree-days was the best predictor of the timing of spring phenological phases, with a significant contribution of chilling. Our results also suggest that spring phenological phases were consistently delayed at low elevation by a lack of chilling in fall during warm years for the three deciduous species.

Keywords: Spring phenology, elevation gradients, crowdsourcing, empirical and process based modeling

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