



## **Plant safety margin against frost damages has declined in Switzerland over the last four decades**

Yann Vitasse (1,2,3), Léonard Schneider (1,2,3), Geoffrey Klein (1), Christian Rixen (3), Martine Rebetez (1,2)

(1) University of Neuchâtel, Institute of Geography, Neuchâtel, Switzerland (yann.vitasse@unine.ch), (2) WSL Swiss Federal Institute for Forest, Snow and Landscape Research, Neuchâtel, Switzerland, (3) WSL Institute for Snow and Avalanche Research SLF, Group Mountain Ecosystems, Davos, Switzerland

Winters and early springs have become warmer over the last decades which has in turn promoted earlier plant development in temperate regions. While temperatures will on average continue to increase in the coming decades due to the rise of greenhouse gases concentration in the atmosphere, there is no consensus about how the occurrence of late spring frosts will change. If the frequency and the severity of late spring frosts remain unchanged in the future or advance less than vegetation onset, vulnerable plant organs (young leaves, flowers or dehardened buds) may be more exposed to frost damage. Here we analyzed long-term series of temperature data during the period 1975–2016 at 50 locations in Switzerland. We used different thresholds of growing degree days (GDD) as a proxy for spring phenology of fruit trees based on long-term series of phenological observations. Finally, we tested whether the time lag between the date when the GDD is reached and the latest occurrence of frost has changed over the study period. Overall we found that the safety margin against potential frost damage to plants has slightly decreased during the study period, irrespective of elevation (from 203 to 2283 m). Our results suggest that the cost for preventing frost damages on fruit trees could increase in the coming decades and the introduction of new varieties of fruit trees adapted to warmer climate should be carefully considered as they generally exhibit earlier spring phenology.