

Publication

Past and future snowmelt trends in the Swiss Alps: the role of temperature and snowpack

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The start of the growing season for alpine plants is primarily determined by the date of snowmelt. We analysed time series of snow depth at 23 manually operated and 15 automatic (IMIS) stations between 1055 and 2555 m asl in the Swiss Central Alps. Between 1958 and 2019, snowmelt dates occurred 2.8 ± 1.3 days earlier in the year per decade, with a strong shift towards earlier snowmelt dates during the late 1980s and early 1990s, but non-significant trends thereafter. Snowmelt dates at high-elevation automatic stations strongly correlated with snowmelt dates at lower-elevation manual stations. At all elevations, snowmelt dates strongly depended on spring air temperatures. More specifically, 44% of the variance in snowmelt dates was explained by the first day when a three-week running mean of daily air temperatures passed a 5 °C threshold. The mean winter snow depth accounted for 30% of the variance. We adopted the effects of air temperature and snowpack height to Swiss climate change scenarios to explore likely snowmelt trends throughout the twenty-first century. Under a high-emission scenario (RCP8.5), we simulated snowmelt dates to advance by 6 days per decade by the end of the century. By then, snowmelt dates could occur one month earlier than during the reference periods (1990-2019 and 2000-2019). Such early snowmelt may extend the alpine growing season by one third of its current duration while exposing alpine plants to shorter daylengths and adding a higher risk of freezing damage.

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