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The driver for spring phenology: Temperature reconstructions and impact assessment on Swiss phenological spring observations back to 1659

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Recent climate change has left an imprint on terrestrial ecosystems. From local to continental scale, this fingerprint of a changing climate can be detected in plant phenological phases such as earlier budburst or flowering dates since the 1960s. The shift mirrors warming trends of late winter and spring temperatures. For the assessment of longer-term climate-phenology interactions, the period of analysis has to be extended into the past. Here we use multivariate statistical reconstructions and associated uncertainties of European late-winter and early spring temperatures (Luterbacher et al. Science 2004; Xoplaki et al. GRL, 2005) back to 1659 to describe temperature changes. Temperature as the main driver of spring phenology explains 20 to 40 percent of phenological variability depending of the choice of species selcted. The warmest February-April were measured in 1990, 2000 and 1961 with more than 5°C higher temperatures compared to the long-term mean. Reconstructions indicate that only 1822 was as warm as the late 20th century springs. In consequence, climate-phenology interactions and spring season variability are analysed for the periods 1951-2004 and 1766-1802. Present-day network and high quality historical phenological observations from the Swiss Plateau region are considered to distinguish differences in the industrial and pre-industrial period (Pfister 1999; Rutishauser 2003). According to the warming trends of the last decades phenological events have shifted towards earlier appearance dates (high correlation between temperature and phenology which is not due to the common trend). We discuss stationarity issues concerning temperature impacts on phenological spring events for past and present by comparing the temperature reconstructions with independent historical phenological observations.