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Forecasting the weather
- ensemble techniques
in probabilistic weather prediction

Temperature dependence and seasonal trends of the snowfall/precipitation-day ratio

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A general decreasing trend in snow cover has been clearly demonstrated in the Northern Hemisphere. The decrease in snow cover is statistically significant in many locations at least since the early 1980s or late 1970s. However, particularly in the European Alps, the high interannual variability in precipitation amounts and the impact of the NAO index have created uncertainty. The exact impact of changing temperatures is difficult to measure because of the potentially large variation in total precipitation through time. In addition, the impact of increasing temperatures varies, depending on region and altitude.

In order to isolate the impact of changing temperatures on snowfall from the impact of changes in the frequency and intensity of total precipitation, we analyzed the proportion of snowfall days compared to precipitation days for up to 100 years at 76 meteorological stations, spanning elevations from 200 to 2700 m asl in Switzerland. This simple measure does not require high-quality snow water equivalent data or estimates of the phase change based on temperature. This day-based snow/precipitation ratio is complementary to other methods that compare the snow water equivalent to total precipitation volume.

Our results show clear decreasing trends in snowfall days relative to precipitation days. Snowfall days relative to precipitation days decreased both in winter (December to February) and in spring (March and April), with even stronger decreases during spring, probably because baseline temperatures were warmer, and temperature increases were greater, during that season. The decrease in snowfall days was also stronger at lower elevations, i.e. at locations with temperatures closer to the melting point. We observed a baseline seasonal temperature threshold of -2.7°C $\pm$ 0.8°C in winter and -3.8°C $\pm$ 0.6°C in spring, above which the decrease in snowfall days grew rapidly. Above these thresholds, the decrease in snowfall days relative to precipitation days ratios could be as high as 80% over the 30 years from 1979 to 2008.