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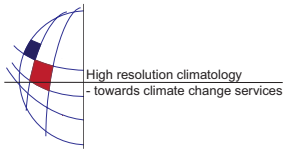

Local and large-scale influences on Swiss temperature trends 1959-2008

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Temperature is a key variable for monitoring global climate change. Here we perform a trend analysis of Swiss temperatures from 1959-2008, using a new 2x2 km gridded data set based on carefully homogenized ground observations from MeteoSwiss. The aim of this study is twofold: first, to discuss the spatial and altitudinal temperature trend characteristics in detail and second, to quantify the contribution of global, large-scale and local-scale effects to these trends.

The seasonal trends are all positive and mostly significant with an annual average warming rate of 0.35°C/decade (∼1.6 times the global warming rate), ranging from 0.17 in autumn to 0.48°C/decade in summer. Altitude-dependent trends are found in autumn and early winter where the trends are stronger at low altitudes (<800 m asl), and in spring where slightly stronger trends are found at altitudes close to the snow line. The corresponding seasonal trends from the ENSEMBLES project regional climate models are weaker (∼0.2°C/decade for all seasons) and show somewhat different patterns of altitude dependence.

A large fraction of the trends can be explained by fluctuations in atmospheric circulation patterns, but with substantial differences from season to season. In winter, the magnitude and vertical distribution of the trends are reproduced accurately using large-scale and regional circulation dynamics effects only, while ∼30-45% of the trends remain unexplained in spring and summer. In autumn, the mean trend is roughly reproduced but the altitudinal differences remain unexplained. This suggests that local effects are important to explain part of recent temperature trends in spring, summer and autumn. Snow-albedo feedback effects could be responsible for the 5-10% higher spring trends at altitudes close to the snow line. In autumn, the observed decrease in fog frequency might be a key process in explaining the stronger temperature trends at low altitudes.