Spatiotemporal analysis of snow trends in Austria

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This study presents the spatiotemporal analysis of Austrian snow observations. A set of consistent and reliable long-term time series of snow depth on a daily scale from selected meteorological sites across Austria is used. The time series were collected by the Central Institute for Meteorology and Geodynamics (ZAMG) and the Hydrographical Central Bureau of Austria (HZB). The data cover a time period from the late nineteenth century until today.

In the first part of the study spatiotemporal characteristics of seasonal snow depth observations were investigated by the method of principal component analysis (PCA). Furthermore, the spatial patterns of variability have been used for a regionalisation, identifying regions with similar conditions during the base period 1961 to 2010. The results show a clear separation of four major regions including various sub-regions. However, the regionalisation was limited due to sparse data coverage.
The non-parametric Mann-Kendall statistical test had been used to assess the significance of trends in snow indices, e.g. snow depth, maximum snow depth, snow cover duration, at monthly and seasonal time scales. In order to remove the influence of the lag-1 serial correlation from the snow data, the trend-free pre-whitening approach was applied. In the monthly and seasonal time series during the period 1961-2010, negative trends in snow indices were significant at the 95% confidence level primarily at stations in the Western and Southern part of Austria. In addition, the correlation between snow observations and gridded HISTALP winter temperature and precipitation fields was investigated. The analysis has shown an increased temperature and decreased precipitation during the 1990s, yielding a pronounced reduction in snow depth and duration. As a matter of fact, the results indicate major shifts of the snow depth and snow cover duration around the 1970s and especially the 1990s, which are predominantly responsible for trends.