



A1B scenario simulations of future natural snow conditions in Tyrol and Styria (Austrian Alps)

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We use four different realizations of the IPCC A1B emission scenario based climate simulations provided by the ENSEMBLES project for the study regions Tyrol and Styria. They represent average as well as above average cold/warm and wet/dry conditions in the winter half year (November to April). The scenario and control run simulations were downscaled and error corrected to station locations with a quantile based empirical-statistical method on a daily time basis. To provide 3-hourly meteorological snow model input data, diurnal variations have been extracted from uncorrected RCM simulations to disaggregate the downscaled and bias corrected daily data. The resulting time series of meteorological parameters are spatially interpolated on the basis of existing parameter-elevation relations, and by means of a kriging technique.

The control simulations (1971–2000) and scenario simulations (2021–2050) are applied as meteorological forcing for two snow models: The process based snow model AMUNDSEN includes physical descriptions of all snow relevant surface processes, is therefore transferable in space and time, and provides results at high spatial resolution (50 m). Due to its computational demands its application is limited to the two test regions Kitzbuehel (Tyrol) and Schladming (Styria). To establish a regional snow simulation, the conceptual model SNOWREG is used. The temperature-index-approach requires only few input variables, is efficient in terms of computational costs and allows a large-scale application for the provinces of Tyrol and Styria at a spatial resolution of 250 m. SNOWREG is trained by means of assimilating natural snow cover patterns provided by remotely sensed snow coverage and station recordings.

Indicators for skiing conditions are used to quantify and compare changes in future natural snow conditions. The moderate increase in average area mean winter temperature (up to 2,6 °C in Tyrol and 2.3 °C in Styria) and changes in area mean winter precipitation (between -7 and +7 % in Tyrol and between -7 and +8 % in Styria) result in a decrease of the natural snow cover, the latter significantly increasing with altitude. There, the difference of natural snow coverage is 3 to 6 weeks between the historical and the scenario period, depending on the climate realization used as snow model input. Comparison of the AMUNDSEN and SNOWREG results in the two test regions shows the advantage of the high spatial resolution simulations using AMUNDSEN, and the robustness of the regional scale snow model SNOWREG.