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Downscaling of climate change scenarios and key climate indices in the Swiss Alpine region

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Probabilistic climate change scenarios for Switzerland have been developed in the framework of the national Swiss CH2011 initiative. However, no information could be provided for the mountainous regions of the Alps. Here, we present an extension of the CH2011 scenarios for this higher altitudes and complex topography. Additionally, a methodology is introduced to provide such scenarios on a high-resolution grid and on a daily basis. Results are shown for some key climate indices, such as the number of summer days and tropical nights, growing season length, number of frost days, heating and cooling degree days, and the number of days with fresh snow. Particular focus is given to changes in the vertical distribution for the future periods 2020-2049, 2045-2074 and 2070-2099 relative to the reference period 1980-2009 for the A1B, A2 and RCP3PD scenario. The number of days with fresh snow is approximated using a combination of temperature and precipitation as proxies. Some findings for the latest scenario period are: (1) a doubling of the number of summer days by the end of the century under the business-as-usual scenario A2, (2) tropical nights appear above 1500 m asl, (3) the number of frost days may be reduced by more than 3 months at altitudes higher than 2500 m, (4) an overall reduction of heating degree days of about 30% by the end of the century, but on the other hand an increase in cooling degree days in warm seasons, and (5) the number of days with fresh snow tends to go towards zero at low altitudes. In winter, there is little change in snowfall above 2000 m asl (roughly -3 days) in all scenarios. The largest impact on snowfall is found along the Northern Alpine flank and the Jura (-10 days or roughly -50% in A1B for the winter season). It is also highlighted that the future projections for all indices strongly depend on the chosen scenario and on model uncertainty.