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Climate change scenarios and key climate indices in the Swiss Alpine region

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For climate adaption and to support climate mitigation policy it is of outermost importance to demonstrate the consequences of climate change on a local level and in user oriented quantities. Here, a framework is presented to apply the Swiss national climate change scenarios CH2011 to climate indices with direct relevance to applications, such as tourism, transportation, agriculture and health. This framework provides results on a high spatial and temporal resolution and can also be applied in mountainous regions such as the Alps. Results are shown for some key 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. Therefore, it is crucial that climate services carefully communicate the role of uncertainties in climate predictions.