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Process-based simulation of snow cover evolution in ski resorts using the AMUNDSEN model: results and validation

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Snow management, i.e., snowmaking and grooming, is an integral part of modern ski resort operation. While the current snow cover distribution on the slopes is often well known thanks to the usage of advanced monitoring techniques, estimates about its future evolution are usually lacking. Management-enabled numerical snowpack models driven by meteorological forecasts can help to fill this gap. In the frame of the H2020 project PROSNOW such software tools are developed to be run on an operational basis with the aim to optimize snow management as well as the use of water and energy resources. As part of PROSNOW, model simulations for the ski resorts Seefeld and Obergurgl (both Austria) as well as Colfosco and San Vigilio (both Italy) are performed with the physically based snow model AMUNDSEN. In its particular snow management module, both socioeconomic and physical factors are considered, the former concerning the decision when, where and how much snow should be produced, and the latter considering the snowmaking conditions, i.e., how much snow can be produced in the current ambient conditions (in terms of temperature and humidity) and the given ski resort infrastructure (number and efficiency of snow guns, water availability, etc.).

In our contribution we show the implementation of snowmaking and grooming practices in the AMUNDSEN model, its adaptation to individual ski resorts, and how different potential snow management strategies are accounted for. Model results obtained using historical meteorological observations and hindcast simulations are validated against observations from numerous data sources such as Sentinel-2 snow cover maps, distributed snow depth measurements from groomers, temperature and humidity measurements from snow guns as well as water consumption recordings.