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SNOWGRID – A distributed operational snow cover model for the eastern Alps

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The spatial and temporal evolution of snowpack properties play an important role for a wide range of applications, especially in mountainous regions. There is a great demand for high-resolution snowpack data regarding road maintenance, water resource management or avalanche forecasting, for example. Since the combination of topographic effects and climatic conditions mainly determines the local and regional snowpack variability, reliable estimates of the snow cover are essential for snow analyses and forecasts.

The Zentralanstalt für Meteorologie und Geodynamik (ZAMG) and the Hydrographical Central Bureau of Austria are operating together lots of daily manual and automatic ground-based snow observing stations across Austria. The regional avalanche warning services have many automatic snow depth measurement stations too, particularly in higher elevated alpine regions. In order to meet the demand of detailed spatial snow cover information, the ZAMG runs a very high resolution, physically based snow cover model on a model domain (roughly 400 x 700 km) which is currently focused on the eastern Alps. The spatial and temporal resolution are 100 m and 15 minutes, respectively. The model uses gridded meteorological data from INCA (Integrated NowCasting and Analysis system; Haiden et al. 2011) to produce hourly analysis of various snow quantities. Since ground-based stations deliver meteorological information at irregularly spaced locations, SNOWGRID makes an important contribution to monitoring snow cover. In addition, SNOWGRID uses the forecast output of NWP models to predict, for instance, the accumulated fresh snow and the temporal evolution of the total snow depth for 72h in advance.

SNOWGRID can also be used to estimate the maximum potential of net snow drift amounts during historical extreme storm events. The operational implementation of this snow drift model is currently in process. Snow extent from SNOWGRID together with satellite data is also operationally used to initialize the numerical weather prediction model AROME (Seity et al. 2010) with 2.5 km spatial resolution at ZAMG using a real snow distribution instead of climatological estimates (as it is traditionally done).

Furthermore a climate version of SNOWGRID was used to derive daily grids of snow depth and snow water equivalent at a spatial resolution of 1x1 km. This analysis data for Austria goes back to the year 1961 and was produced by using gridded datasets of air temperature and precipitation at same temporal and spatial resolution that take into account the high variability of these variables in complex terrain (Hiebl and Frei, 2016).