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MM5-derived fields of wind speed and direction for distributed simulations of snow transport processes in the Berchtesgaden National Park (Germany)

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Wind-induced snow transport processes like saltation and suspension lead to a significant variability of the snow cover in space and time due to erosion and deposition. Knowledge about this variability is important for determining the temporal dynamics of the snowmelt runoff. Furthermore, in rugged terrain pronounced interception losses of snow through transport or snow on canopy stands can have important effects on the water balance. It is a goal of contemporary hydrological sciences to include the related processes and the variability generated by them into the modelling of the seasonal dynamics of a snow cover. Therefore, the knowledge of the local windfield is an essential prerequisite. In high-alpine rugged relief such wind fields can not be provided by a simple interpolation of station recordings of wind speed and direction. However, wind fields can be derived from high-resolution numerical simulations with an atmospheric model. In this work we use a modified version of the PSU/NCAR Mesoscale Model MM5 with a multiple nesting approach to derive wind fields for a 24 x 19 km^2 area at a target resolution of 200 m, accounting for topography and related dynamic effects. The results consist of wind speeds and directions for each raster element and specific atmospheric situations. For the intended snow modelling a library of these wind fields was composed on a LINUX cluster computer by (1) statistical analysis of historical ECMWF reanalysis data for the Alpine region and (2) computation of the corresponding wind fields, resulting in a library of 226 data files. The criteria for the extraction of the wind field for the current snowmodel time step are mean wind speeds and directions in the 700 hPa level derived from DWD (German Weather Service)

Local Model forecasts with a temporal resolution of one hour. These data are then compared with the corresponding mean wind speeds and directions from the appropriate MM5 nesting area indicating which one of the library files represents the best fit. Verification is conducted by comparison of historical station measurements with corresponding downscaled simulation results. For this downscaling a semi-empirical approach is utilized which accounts for topographic effects. The presented scheme shows that available mesoscale atmospheric models can be effectively used to provide valuable wind fields even in areas of a larger scale for a variety of applications such as the modelling of snow transport processes.