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A physically based snowpack and icemelt model for the distributed simulation of the water balance in a high Alpine catchment

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The Goldbergkees catchment, situated in the Austrian central Alps, has already been the object of numerous glaciological monitoring and research campaigns. Therefore a high quality set of meteorological and hydrological data can be provided for modelling purposes. With 55% of the area covered by a glacier snow- and ice processes play a predominant role for the hydrology of this catchment with a total area of 2.7 kmˆ2. The modelling of accumulation and melting processes at the Goldbergkees catchment using temperature index based approaches has been investigated in earlier studies. Alpine3D is a predominantly physically based distributed snowpack model using a conceptual runoff generation module. The model has been developed at the Swiss Federal Institute of Snow and Avalanche Research. Its clear focus on snow and snow-cover processes qualifies Alpine3D for working out a hydrological simulation of the Goldbergkees catchment. We present the results of modelling a three year period, including the extreme summer of 2003. Runoff simulations were validated comparing discharge observations at the catchment outlet during the three summer periods. Simulated snow depth distributions, as a direct output of Alpine3D, were verified using monthly snow stake readings at six different locations in the basin and maps of distributed snow depths from measurements performed twice a year. In the special season of 2005 five campaigns for snow depth measurements were carried out. Statistical evaluation underlined that the observed runoff was reproducend by the model

in a very good quality. Also modelled snow depths correspond to a high degree with the measurements; significant deviations from observations occur mainly in connection with snow deposition by avalanches or wind drift at the particular stack. After validating our model results, Alpine3D offers further information on hydrological and meteorological processes within the catchment, like radiation balance or mass balance of the glacier. As a result, a precise description of the glacier volume change during the calculated period and its related physical processes can be established. This study is closely related to a second work, which investigates the redistribution of snow due to wind drift in the same area. The possibility to compare physically based snowmelt calculations with different conceptual approaches opens a wide field for further research.