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Evaluating the effects of model structure and meteorological input data on runoff modelling in an alpine headwater basin

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Modelling water resources in snow-dominated mountainous catchments is challenging due to both, short concentration times and a highly variable contribution of snow melt in space and time from complex terrain. A number of model setups exist ranging from physically based models to conceptional models which do not attempt to represent the natural processes in a physically meaningful way.

Within the flood forecasting system for the Tyrolean Inn River two serially linked hydrological models with differing process representation are used. Non- glacierized catchments are modelled by a semi-distributed, water balance model (HQsim) based on the HRU-approach. A fully-distributed energy and mass balance model (SES), purpose-built for snow- and icemelt, is used for highly glacierized headwater catchments.

Previous work revealed uncertainties and limitations within the models' structures regarding (i) the representation of snow processes in HQsim, (ii) the runoff routing of SES, and (iii) the spatial resolution of the meteorological input data in both models. To overcome these limitations, a "strengths driven" model coupling is applied. Instead of linking the models serially, a vertical one-way coupling of models has been implemented. The fully-distributed snow modelling of SES is combined with the semi-distributed HQsim structure, allowing to benefit from soil and runoff routing schemes in HQsim.

A monte-carlo based modelling experiment was set up to evaluate the resulting differences in the runoff prediction due to the improved model coupling and a refined spatial resolution of the meteorological forcing. The experiment design follows a gradient of spatial discretisation of hydrological processes and meteorological forcing data with a total of six different model setups for the alpine headwater basin of the Fagge River in the Tyrolean Alps. In general, all setups show a good performance for this particular basin. It is therefore planned to include other basins with differing hydrological characteristics.