Multiscale Snow/Icemelt Discharge Simulations into Alpine Reservoirs: adding Glacier Dynamics to a Hydrological Model

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Glacier and snow runoff in high alpine regions is an essential process in hydrological research for its high relevance on lower altitude areas and hydro-power generation. MUSICALS II (Multiscale Snow/Icemelt Discharge Simulations into Alpine Reservoirs) seeks to identify and quantify water availability and runoff in alpine headwater catchments. The focus is on future changes due to glacier retreat, altering the multi-day and seasonal runoff available for hydropower operations. Our aim is to investigate and improve runoff forecasts by coupling the semi-distributed hydrological model HQSim with a simple glacier evolution model. The glacier model MMBM (Marzeion Mass Balance Model) with its statistical nature allows for fast modelling of the dynamical properties of glaciers.

We present the design of the coupled hydrological application for different hydro power headwater catchments in Tyrol. The capabilities of the glacier model to simulate the selected glaciers is shown. Simulated discharge with the original and the coupled model are compared to downstream gauge measurements. Using the multi-objective optimization algorithm AMALGAM (A Multi-ALgorithm, Genetically Adaptive Multiobjective model), we optimize the glacier module parameters fully automatically.

The results show the improvements in runoff modelling for past periods, when altering of glaciated catchment parts is considered. This indicates consideration of this process is mandatory for simulating future developments.