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Runoff modelling and the contribution of snow and glacier melt to the discharge for highly glacierized catchments in Norway

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In highly glacierized catchments snow and ice melt are the most important contributors to the magnitude and variations in streamflow. In Norway, 98 % of the electricity is generated by hydropower of which 15 % is based on discharge from glacierized basins. Thus, the assessment of water availability is crucial for hydropower applications. Changes in discharge are connected to both, changes in temperature and precipitation and can be amplified or balanced by the presence of a glacier in the catchment. Therefore, variations in annual glacier mass balances alter the streamflow regime. With ongoing climate change, it is expected to see major changes in timing and magnitude of future water availability.

Daily discharge rates are available for the catchments of Nigardsbreen (64 km^2, since 1962) and for Storbreen (8 km^2, since 2010). These measurements are compared with simulated discharge rates calculated from a melt model for both, the glacierized and non-glacierized parts of the catchment. The model uses runs gridded temperature and precipitation from seNorge (http://senorge.no) as input and runs on a daily time step from 1957 to present. It accounts for evaporation, retention of surface water, refreezing processes and transformation of snow to firn and ice. The simulated discharge data can be split up into their water sources rain, ice and firnmelt, snowmelt on and outside the glacier. For validation of the melt model, both measured seasonal and annual mass-balance measurements of the glacier are used. In addition, daily melt rates were compared with measurements from sonic rangers located in the ablation zones of Storbreen (1580 m a.s.l.) and Nigardsbreen (600 and 1000 m a.s.l.).

First results from different catchments in Norway show that the on average 20 % increase in discharge in the 2000s compared to the 1990s is mainly caused by increased icemelt and to a lesser extend by increased precipitation. The increase in discharge is accompanied by increased interannual variations.