EGU21-14972
https://doi.org/10.5194/egusphere-egu21-14972
EGU General Assembly 2021

Exploring the use of gpr and satellite-based snow data for snowmelt runoff predictions

Ilaria Clemenzi[1], David Gustafsson[1], Jie Zhang[2], Björn Norell[3], Wolf Marchand[4], Rickard Pettersson[2], and Veijo Pohjola[2]
[1]SMHI, Sweden
[2]Uppsala University, Sweden
[3]Vattenregleringsföretagen, Sweden
[4]Sweco Norge AS, Norway

Snow in the mountains is the result of the interplay between meteorological conditions, e.g., precipitation, wind and solar radiation, and landscape features, e.g., vegetation and topography. For this reason, it is highly variable in time and space. It represents an important water storage for several sectors of the society including tourism, ecology and hydropower. The estimation of the amount of snow stored in winter and available in the form of snowmelt runoff can be strategic for their sustainability. In the hydropower sector, for example, the occurrence of higher snow and snowmelt runoff volumes at the end of the spring and in the early summer compared to the estimated one can substantially impact reservoir regulation with energy and economical losses. An accurate estimation of the snow volumes and their spatial and temporal distribution is thus essential for spring flood runoff prediction. Despite the increasing effort in the development of new acquisition techniques, the availability of extensive and representative snow and density measurements for snow water equivalent estimations is still limited. Hydrological models in combination with data assimilation of ground or remote sensing observations is a way to overcome these limitations. However, the impact of using different types of snow observations on snowmelt runoff predictions is, little understood. In this study we investigated the potential of assimilating in situ and remote sensing snow observations to improve snow water equivalent estimates and snowmelt runoff predictions. We modelled the seasonal snow water equivalent distribution in the Lake Överuman catchment, Northern Sweden, which is used for hydropower production. Simulations were performed using the semi-distributed hydrological model HYPE for the snow seasons 2017-2020. For this purpose, a snowfall distribution model based on wind-shelter factors was included to represent snow spatial distribution within model units. The units consist of 2.5x2.5 km^2 grid cells, which were further divided into hydrological response units based on elevation, vegetation and aspect. The impact on the estimation of the total catchment mean snow water equivalent and snowmelt runoff volume were evaluated using for data assimilation, gpr-based snow water equivalent data acquired along survey lines in the catchment in the early spring of the four years, snow water equivalent data obtained by a machine learning algorithm and satellite-based fractional snow cover data. Results show that the wind-shelter based snow distribution model was able to represent a similar spatial distribution as the gpr survey lines, when

assessed on the catchment level. Deviations in the model performance within and between specific gpr survey lines indicate issues with the spatial distribution of input precipitation, and/or need to include explicit representation of snow drift between model units. The explicit snow distribution model also improved runoff simulations, and the ability of the model to improve forecast through data assimilation.