



Experiences from using earth-observed snow covered area in national flood forecasting in Norway

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Snowmelt is a significant contributor to spring floods in Norway. Updated information of the snow conditions is therefore of major importance to the national flood forecasting. At the Norwegian Water Resources and Energy Directorate (NVE) daily flood predictions are carried out based on runoff simulations using the HBV-model. Satellite imagery are used to observe the snow covered area (SCA), but has not been used directly in the model simulations. In this study we have calibrated and updated the HBV-model with earth-observed SCA in order to test whether the spring flood prediction could be improved. Two versions of the model were tested, 1) the traditional HBV-model with log-normal snow distribution and 2) a HBV-model with a new snow distribution model which takes into account that the spatial distribution of snow changes during the season. The models were run for ten catchments in Norway, representing different hydrological regimes and geographical locations. Four years were used for calibration and six independent years were used for validation and updating. The results showed that the HBV-models calibrated against SCA in addition to discharge simulated discharge nearly as well as models calibrated against discharge only, and that the simulated SCA was markedly improved. Updating of the model based on satellite-observed SCA showed ambiguous result. In half of the cases the spring flood prediction was improved whereas the remaining cases were worsened by the update. Many of the successful updates occurred in years where weather conditions deviated from normal. In such cases, satellite observations of the snow can provide valuable information of the snow situation. The SCA from radar was tested, but not included in the models due to considerable deviations from the optical SCA. The model with new snow distribution function predicts SCA slightly better than the traditional HBV-model with log-normal snow distribution when neither of the models are calibrated against SCA. Similar to the traditional model, the results of model update by SCA

diverge. For some years improvements in predicted runoff can be observed, but the opposite is equally possible. The new method has a feature for automatically updating SWE from satellite images, but both the new and the traditional model are completely dependent on correct and consistent estimates of SCA from satellite images.