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Impact on runoff simulation by assimilation of remote sensing snow data in a multi-basin hydrological model for Sweden

David Gustafsson (1), Lena Strömbäck (1), Berit Arheimer (1), Thomas Nagler (2), Sari Metsämäki (3), Kari Luojus (4), Rune Solberg (5), and Eirik Malnes (6)

(1) Swedish Meteorological and Hydrological Institute, Norrköping, Sweden (david.gustafsson@smhi.se), (2) ENVEO IT GmbH, Innsbruck, Austria, (3) Finnish Environment Institute SYKE, Helsinki, Finland, (4) Finnish Meteorological Institute, Helsinki, Finland, (5) Norwegian Computing Center, Oslo, Norway, (6) NORUT, Tromsø, Norway

The main objective of this study was to assess the impact on stream-flow simulations when assimilating remote sensing snow data from the EU FP7 Cryoland project in a hydrological model. The analysis was made using the S-HYPE model, which is a Swedish application of the hydrological model HYPE (HYdrological Prediction for the Environment). The remote sensing data was used both for evaluation of the simulated snow cover without data assimilation, and for state-updating using the Ensemble Kalman filter method.
In general, there was a better agreement between model simulation and remote sensing data with respect to fractional snow cover (FSC) than for snow water equivalent (SWE). In most of Sweden, the correlation and bias was close to 1 and 0, respectively. The main difference was found in the standard deviation, especially in the most steep mountain areas in western Sweden. For SWE, there was also good agreement between model and remote sensing data in central and northern Sweden, but there were considerable biases and low correlation in the south, along the east coast towards the Baltic Sea, and in the mountain region in the north-western part of the country.
The data assimilation experiments illustrated both the potential of remote sensing snow data for improving hydrological model simulations and the problems related to the systematic errors discussed above; stream-flow simulations were improved in some areas and deteriorated in others. The largest improvement was achieved in the upper part of the Tornionjoki river basin, which is a high-mountain area above the tree-line in northern Sweden, whereas the largest reduction in the stream-flow simulation performance was experienced in forest areas along the central eastern coast of Sweden. Additionally, it can be noted that assimilation of one snow product also affected the correspondence between the model simulations and the other snow products. There was more interaction between the snow products than between the snow products and the stream-flow data.