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Bias-correction of SNODAS snow water equivalent estimates for North America: case study of a Canadian basin

Zahra Zahmatkesh, James Leach, Paulin Coulibaly, and Dominic Tapsoba
McMaster University, Civil Engineering, Hamilton, Canada (zahmatkz@mcmaster.ca)

Snow water equivalent (SWE) is a critical hydrologic variable for improving the streamflow simulation and flood forecasting, particularly for Northern Hemisphere regions where snowpack is a major component of the hydrological cycle. In-situ measurement and collection of snow data while capturing the spatial variability of snow, specifically at remote areas and high altitudes, is difficult. Therefore, there have been significant modeling efforts to provide assimilated snow products using satellite derived data sets. As part of these efforts, the National Weather Service's SNOw Data Assimilation (SNODAS) modelling and data assimilation system provides daily, gridded estimates of SWE, at a 1-km2 resolution for conterminous USA and Southern Canada. To investigate the accuracy of the simulations of SNODAS for Canadian regions, in this paper, SNODAS SWE estimates are compared with the ground-measured snow data for the large La Grande River Basin located in Quebec Province. Comparison of SNODAS SWE estimates with the observations, from January 2010 to May 2016, indicates high deviation between the SNODAS simulations and in-situ measurements of SWE. Following the comparison of estimated and observed SWE, a bias-correction method is used to adjust SWE estimates to the ground based measurements. The employed bias-correction method is based on matching the cumulative distribution function of the SNODAS estimates to the observed snow data. Several evaluation metrics are then used to measure the performance of the adjustment approach by comparing SNODAS estimates with the in-situ measurements of SWE corresponding to the nearest stations, before and after the bias-correction. To investigate the precision of the adjusted SWE data, they are used in hydrologic modeling for the simulation of streamflow. Results indicate that the employed method for bias-correction of SWE estimates can significantly improve the snow simulations provided by SNODAS. Based on the results, the overall performance of streamflow simulation when adjusted SNODAS SWE is used in the set of the input data, is as good as when the observed SWE is utilized in hydrologic modeling. Although uncertainty of the SNODAS estimates of SWE could be high, specifically for regions with few number of local ground based stations, the bias-corrected SWE is still of great value for hydrologic modeling where snow melt is an important component of the water cycle.