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Assessment the Applicability of the Satellite-In-Situ Composite Soil Moisture Data Assimilation Using Ensemble Kalman Filter

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The objective of this study is to evaluate the applicability of satellite based soil moisture data to improve the performance of Land Surface Model (LSM). For this purpose, various types of satellite-based soil moisture data were assimilated into the model and the performance of the LSM to predict the observed flow time series corresponding to each type of soil moisture data was analyzed and compared.
First, the LSM was developed for the Soyang river basin located in Korean Peninsula using the Variable Infiltration Capacity (VIC) model. Then, the model was calibrated for the four years (2007-2010) and validated for the next four years (2011-2014) based on the observed daily flow data. The model showed high accuracy in predicting the observed flow time series for both calibration and validation periods as indicated by the following statistical metric: For the calibration period, the model had Nash-Sutcliffe Coefficient (NS) of 0.9031; For the validation period, the model had the NS of 0.8964. Lastly, To further improve the performance of the developed LSM, the following three types of satellite-based soil moisture data was assimilated into the VIC model using the method of Ensemble Kalman Filter: (1) AMSR2 sensor satellite based soil moisture data (AMSR2); (2) satellite-in-situ composite soil moisture data produced using the Conditional Merging technique (CM); (3) spatially distributed in-situ soil moisture data using Kriging method (In-Situ-Kriging).
Compared to the case where no soil moisture data was assimilated, the assimilation of AMSR2 and CM data both reduced the error between the observed and the predicted flow throughout the modeling period. However, the degree of the error reduction was greater for the case of the CM data. Conversely, the assimilation of In-Situ-Kriging data degraded the performance of the model, especially during the high-flow period.