Improving the Resolution of GRACE Data for Spatio-Temporal Groundwater Storage Assessment

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摘要 Groundwater has a significant contribution to water storage and is considered to be one of the sources for agricultural irrigation; industrial; and domestic water use. The Gravity Recovery and Climate Experiment (GRACE) satellite provides a unique opportunity to evaluate terrestrial water storage (TWS) and groundwater storage (GWS) at a large spatial scale. However; the coarse resolution of GRACE limits its ability to investigate the water storage change at a small scale. It is; therefore; needed to improve the resolution of GRACE data at a spatial scale applicable for regional-level studies. In this study; a machine-learning-based downscaling random forest model (RFM) and artificial neural network (ANN) model were developed to downscale GRACE data (TWS and GWS) from 1° to a higher resolution (0.25°). The spatial maps of downscaled TWS and GWS were generated over the Indus basin irrigation system (IBIS). Variations in TWS of GRACE in combination with geospatial variables; including digital elevation model (DEM), slope; aspect; and hydrological variables; including soil moisture; evapotranspiration; rainfall; surface runoff; canopy water; and temperature; were used. The geospatial and hydrological variables could potentially contribute to; or correlate with; GRACE TWS. The RFM outperformed the ANN model and results show Pearson correlation coefficient (R) (0.97), root mean square error (RMSE) (11.83 mm), mean absolute error (MAE) (7.71 mm), and Nash–Sutcliffe efficiency (NSE) (0.94) while comparing with the training dataset from 2003 to 2016. These results indicate the suitability of RFM to downscale GRACE data at a regional scale. The downscaled GWS data were analyzed; and we observed that the region has lost GWS of about ?9.54 ± 1.27 km3?at the rate of ?0.68 ± 0.09 km3/year from 2003 to 2016. The validation results showed that R between downscaled GWS and observational wells GWS are 0.67 and 0.77 at seasonal and annual scales with a

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has the potential to downscale GRACE data at a spatial scale suitable to predict GWS at regional scales

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