

Downscaling Grace Gravity Models Using Spectral Combination Techniques for Terrestrial Water Storage and Groundwater Storage Estimation

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Abstract : The Gravity Recovery and Climate Experiment (GRACE) is a satellite mission with twin satellites for the precise determination of spatial and temporal variations in the Earth's gravity field. The products of this mission are monthly global gravity models containing the spherical harmonic coefficients and their errors. These GRACE models can be used for estimating terrestrial water storage (TWS) variations across the globe at large scales, thereby offering an opportunity for surface and groundwater storage (GWS) assessments. Yet, the ability of GRACE to monitor changes at smaller scales is too limited for local water management authorities. This is largely due to the low spatial and temporal resolutions of its models (~200,000 km² and one month, respectively). High-resolution GRACE data products would substantially enrich the information that is needed by local-scale decision-makers while offering the data for the regions that lack adequate in situ monitoring networks, including northern parts of Canada. Such products could eventually be obtained through downscaling. In this study, we extended the spectral combination theory to simultaneously downscale spatiotemporally the 30 spatial coarse resolution of GRACE to 0.250 degrees resolution and monthly coarse resolution to daily resolution. This method combines the monthly gravity field solution of GRACE and daily hydrological model products in the form of both low and high-frequency signals to produce high spatiotemporal resolution TWSA and GWSA products. The main contribution and originality of this study are to comprehensively and simultaneously consider GRACE and hydrological variables and their uncertainties to form the estimator in the spectral domain. Therefore, it is predicted that we reach downscale products with an acceptable accuracy.

Keywords : GRACE satellite, groundwater storage, spectral combination, terrestrial water storage

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