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Statistical downscaling of GRACE products to improve spatial resolution

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The satellite missions Gravity Recovery And Climate Experiment (GRACE) and GRACE Follow-On record the change in the gravity field, which is then related to water mass redistribution near the Earth's surface and disseminated as monthly fields of Total Water Storage Change (TWSC). GRACE products effectively carry signal information only above spatial scales of about 300 km, which limits their application in regional hydrological applications. At present, several GRACE products are available at 0.5° or 1° grid cells, but they are only an interpolated version of the coarse resolution GRACE products and do not offer additional physical information.

In this study we implement a statistical downscaling approach that assimilates high resolution TWSC fields from the WaterGAP hydrology model (WGHM), precipitation fields from 3 models, evapotranspiration and runoff from 2 models, with GRACE data to improve its resolution. The downscaled product exploits dominant common statistical modes between all the datasets to inform the estimates of TWSC. An improvement in the spatial resolution is obtained from using WGHM that incorporates the geometry of various water compartments and simulates spatio-temporal changes in TWSC due to climate forcing, land use land cover change, and human intervention. Therefore, the downscaled product at a 0.5° grid is able to capture physical attributes of water compartments at a spatial resolution better than the available GRACE products.