Technical Note

GFZ GravIS RL06 Level-3 Products

Terrestrial Water Storage Anomalies

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Introduction:

This Technical Note describes the processing scheme and product details of the Terrestrial Water Storage (TWS) Anomaly Level-3 product that is visualized at the GFZ web portal GravIS (http://gravis.gfz-potsdam.de) and provided at GFZ's data archive ISDC.

Data Product Details:

TWS anomaly products are provided as gridded products divided into yearly batches.

Filenames: **GRAVIS-3_YYYY-----------_GFZOP_0600_TWS_GRID_GFZ_0001.nc**

where YYYY is the corresponding year (note that files may contain partial years)

Format: **NetCDF**

Product link: **ftp://isdcftp.gfz-potsdam.de/grace/GravIS/GFZ/Level-3/TWS**

Processing Details:

TWS estimates obtained from GRACE and GRACE-FO are provided at 1° latitude-longitude grids as defined over all non-glaciated land regions. The files each contain three different variables (see variable names of the NetCDF files marked in **bold** below) providing

1) gravity-based TWS (**tws**);
2) gravity-based TWS uncertainties (**error_tws**); and
3) background model atmospheric mass (**model_atmosphere**).

Temporal changes in the Earth's gravity field over the continents are interpreted in terms of changes in the terrestrially stored water masses. We use GFZ GravIS RL06 Level-2B coefficients (Dahle et al., 2019; http://gravis.gfz-potsdam.de/corrections) filtered with VDK5 and VDK3 and estimate trend as well as annual and semi-annual harmonics for both series. In view of the lower noise level of the seasonal components, we subsequently combine the deterministic components from VDK5 with residual month-to-month and inter-annual variations from VDK3. As an additional correction which is not part of the Level-2B processing, co- and post-seismic deformations from megathrust earthquakes (magnitude > 8.8) are removed. Thus, the seismic events (i) Sumatra-Andaman 2004, (ii) Chile 2010, and (iii) Tohoku-Oki 2011 are taken into account. The empirical correction is based on a step function which is fitted to all available monthly solutions in a spherical cap with a radius of 1000 km centered at the epicenter and an exponential decay function which is fitted over two years following the main event (note that solutions from subsequent epochs are no longer statistically independent as soon as earthquake signals were empirically estimated and removed). Mass anomalies are unambiguously inverted from the Stokes coefficients by utilizing the thin layer approximation (Wahr et al., 1998). In contrast to the gridded TWS data set previously used by Zhang et al. (2016), we do not apply any re-scaling coefficients taken from numerical models.

The signal estimates are accompanied by associated uncertainties that take into account the varying noise level from month-to-month associated with (i) the amount of available sensor data in a certain month which might be limited due to, e.g., satellite maneuvers; (ii) the actual ground track pattern which might be sparse during periods of occasional short repeat orbits; and (iii) the condition of the satellites' on-board batteries which impacts the maintenance of thermal stability and thereby the noise level of the science instruments. Further details on the statistical modeling of uncertainties, the further propagation of gridded errors to realistic estimates for basin averages under consideration of its spatial correlations, and plausibility checks based on the evaluation of results from GRACE-FO end-to-end simulations will be reported elsewhere (Boergens et al., in preparation).

It should be noted that a certain fraction of the time-variable gravity signal picked up by a satellite gravimetry mission is caused by atmospheric mass variability. The non-tidal de-aliasing product AOD1B RL06 (Dobslaw et al., 2017) has been used to subtract the atmospheric contribution already during the processing of the Level-2 monthly gravity fields. In order to provide users with some flexibility to restore the atmospheric signals, the monthly mean estimate of the atmospheric background model is provided as well.

Citation:

The GFZ GravIS RL06 TWS Level-3 product is published as data publication via GFZ Data Services and should be cited as follows:

Zhang, L., Dobslaw, H., Dill, R., Boergens, E. (2019): GFZ GravIS RL06 Continental Water Storage Anomalies. V. 1.0. GFZ Data Services. http://doi.org/10.5880/GFZ.GRAVIS_06_L3_TWS

References:

Dahle, C., Murböck, M. (2019): Post-processed GRACE/GRACE-FO Geopotential GSM Coefficients GFZ RL06 (Level-2B Product). V. 1.0. GFZ Data Services. http://doi.org/10.5880/GFZ.GRAVIS_06_L2B

Dobslaw, H., Bergmann-Wolf, I., Dill, R., Poropat, L., Thomas, M., Dahle, C., Esselborn, S., König, R., Flechtner, F. (2017): A new high-resolution model of non-tidal atmosphere and ocean mass variability for de-aliasing of satellite gravity observations: AOD1B RL06. Geophysical Journal International, 211, 1, pp. 263-269. http://doi.org/10.1093/gji/ggx302

Wahr, J. M., Molenaar, M., & Bryan, F. (1998): Time variability of the Earth's gravity field: Hydrological and oceanic effects and their possible detection using GRACE. J. Geophys. Res., 103, 30205-30229. http://doi.org/10.1029/98JB02844

Zhang, L., Dobslaw, H., & Thomas, M. (2016): Globally gridded terrestrial water storage variations from GRACE satellite gravimetry for hydrometeorological applications. Geophysical Journal International, 206(1), 368–378. http://doi.org/10.1093/gji/ggw153