Technical Note

GFZ GravIS RL06 Level-3 Products

Ice-Mass Change

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Introduction:

This Technical Note describes the processing scheme and product details of the Ice-Mass Change Level-3 products that are visualized at the GFZ web portal GravIS (http://gravis.gfz-potsdam.de) and provided at GFZ's data archive ISDC.

Data Product Details:

Ice-mass change products are provided both as basin averages and as gridded products for (i) the Antarctic Ice Sheet (AIS), and (ii) the Greenland Ice Sheet (GIS); each individual file contains the complete available time series.

Filenames: **GRAVIS-3_yyyyddd-YYYYDDD_GFZOP_0600_rrr_tttt_iii_0001.xx**

where:

yyyyddd and YYYYDDD are the beginning and end epoch of the time series given as year and day of year (similar to the filenames of the Level-2/2B products)

rrr specifies the region (either AIS or GIS)

tttt specifies the type of product (either BAVE for basin average products or GRID for gridded products) iii specifies the institute (either AWI for Alfred-Wegener-Institut or TUD for Technische Universität Dresden)

xx is the file extension (either .nc, .tif or .asc)

Format: **ASCII** (basin average products), **NetCDF, GeoTiff** (gridded products)

Product link: **ftp://isdcftp.gfz-potsdam.de/grace/GravIS/GFZ/Level-3/ICE/AIS** (products for AIS)

ftp://isdcftp.gfz-potsdam.de/grace/GravIS/GFZ/Level-3/ICE/GIS (products for GIS)

Processing Details:

1) Basin average products

Produced by: Ingo Sasgen (ingo.sasgen@awi.de)

Basin-average ice mass variations for the AIS and GIS are obtained from unfiltered GFZ GravIS RL06 Level-2B coefficients (Dahle et al., 2019; http://gravis.gfz-potsdam.de/corrections). The definition of 25 major drainage basins for the AIS and 7 drainage basins for the GIS, as well as the inversion procedure based on a forward modelling approach follows Sasgen et al. (2013) and Sasgen et al. (2012), respectively. The inversion procedure uses predefined spatial patterns of surface-mass change of known magnitude to calculate their regional imprint in the gravity field. In a second step, the regional patterns are filtered identically to GRACE observations and least-squares adjusted (scaled) to fit the observations in the spatial domain. Using the forward model localizes the mass change more towards the coast, leading to a more realistic mass distribution with each basin compared to assuming uniform mass distribution. The inversion results are weakly dependent on the choice of the mass distribution (< 10 %), however, less prone to biases as the forward model and the GRACE data are subjected to the same post-processing procedure. For the time series presented here the following processing steps were applied:

(I) Spectral masking of region of interest
(II) Low-pass filtering using a Wiener optimal filter (Sasgen et al. 2006) constant in time
(III) Conversion from gravity field to surface-mass changes using elastic compressible surface-load Love numbers
(IV) Least-squares adjustment

The spectral mask is 1 until 200 km outside the grounding line of the ice sheet, following a smooth transition to 0 reached at 1000 km (AIS) or 600 km (GIS). The Wiener filter is approximately equivalent to a Gaussian filter of 4° spatial half-width.

2) Gridded products

Produced by: Andreas Groh (andreas.groh@tu-dresden.de)

Gridded ice mass variations for the AIS and GIS obtained from unfiltered GFZ GravIS RL06 Level-2B coefficients (Dahle et al., 2019; http://gravis.gfz-potsdam.de/corrections) are provided at polar-stereographic grids with a grid spacing of 50km x 50km. The applied algorithm has been successfully used to generate gravimetric mass balance products within the ESA Climate Change Initiative (CCI) projects for the AIS and the GIS. A more comprehensive description of the algorithm and the error assessment of the products is given in Nagler et al. (2017a, b).

We derive tailored sensitivity kernels (Groh & Horwath, 2016), i.e. averaging kernels to be used in the regional integration approach (Swenson & Wahr, 2002), for each grid cell covering the entire AIS/GIS. Each kernel realizes a trade-off between the following conflicting conditions, which are to minimize leakage effects (I+II) as well as GRACE error effects (III):

(I) Mass changes inside the cell will be correctly recovered
(II) Mass changes outside the cell will have no impact on the grid cell
(III) Propagated errors of the GRACE solutions have minimum influence on the mass change estimate of the cell

To solve for the spherical harmonic coefficients of each sensitivity kernel, a large number of condition equations, accounting for mass changes of the ice sheet as well as of the surrounding far-field regions, needs to be established. To control the propagation of the GRACE error effects, an error variance/covariance model for the GRACE monthly solutions is required. This model is expressed as an empirical variance/covariance matrix derived from the short-term month-to-month scatter of the monthly Level-2B products. The optimal weights for the conflicting conditions are chosen from a set of plausible combinations by assessing the noise level and leakage errors in the corresponding surface mass estimates. Leakage errors are derived from a range of synthetic data sets with a priori known true mass changes, mimicking mass variations in different compartments of the Earth system.

Citation:

The GFZ GravIS RL06 ice-mass change Level-3 products are published as data publication via GFZ Data Services and should be cited as follows:

Sasgen, I., Groh, A., Horwath, M. (2019): GFZ GravIS RL06 Ice-Mass Change Products. V. 1.0. GFZ Data Services. http://doi.org/10.5880/GFZ.GRAVIS_06_L3_ICE

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