GravIS Portal: User-friendly Ice Mass Variations in Greenland and Antarctica from GRACE and GRACE-FO

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26 May 2022, 16:21–16:27 hrs, EGU22-6961, On-site presentation

GRACE/GRACE-FO processing steps

Level-1 products: instrument data (KBR, accelerometer etc.)

Determination of monthly gravity field solution

Level-2 products: gravity fields (spherical harmonics)

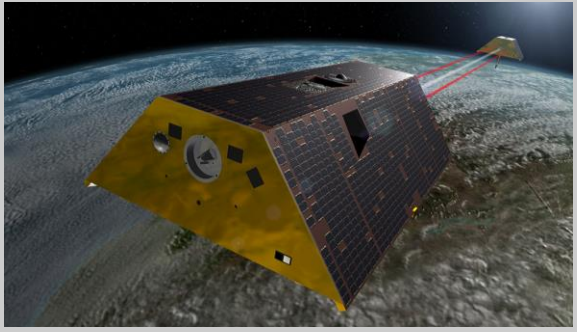
Determination of mass changes in Earth system compartments

COST-G

GFZ RL06

Corrections

Level-3 products: mass change products (basin-scale time series, grids)



Science Data System archives: ISDC, PODAAC

GravIS Gravity Information Service

- **Greenland and Antarctic Ice Mass Change (AWI + TUD)**
- Terrestrial Water Storage (GFZ)
- Ocean Bottom Pressure (GFZ)

Gravity field post-processing

Application of state-of-the-art corrections, necessary to obtain surface mass changes as accurate as possible

Input: Stokes coefficients (Level-2), GFZ RL06 and COST-G RL01 (combined solution)

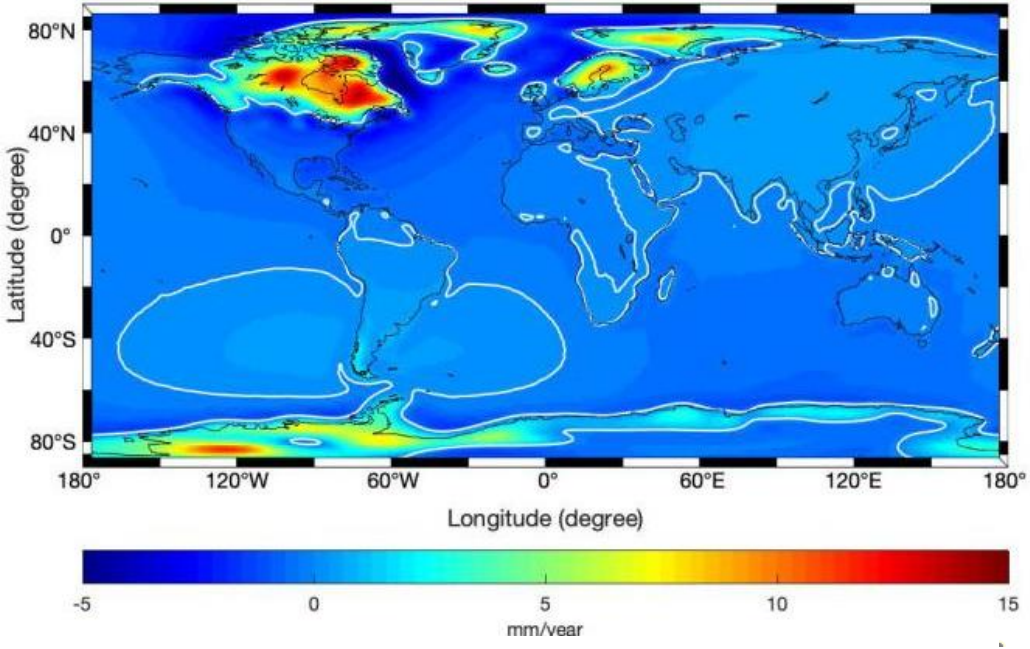
Processing:

1. Reduce mean (2002/04 - 2020/03)
2. Replace coefficients C_{20}, C_{30} (only after 2016/11), C_{21}/S_{21}(only for GFZ RL06) by estimates of a GRACE/GRACE-FO+SLR combination (*generated GFZ in-house*)
3. Subtract model of GIA ICE-6G_D (VM5a) (Peltier et al. 2018)
4. Insert coefficients of geocenter motion C_{10}, S_{11}, S_{11} (*generated GFZ in-house*)
5. Subtract aliasing signals of S2 ocean tide (161d period)

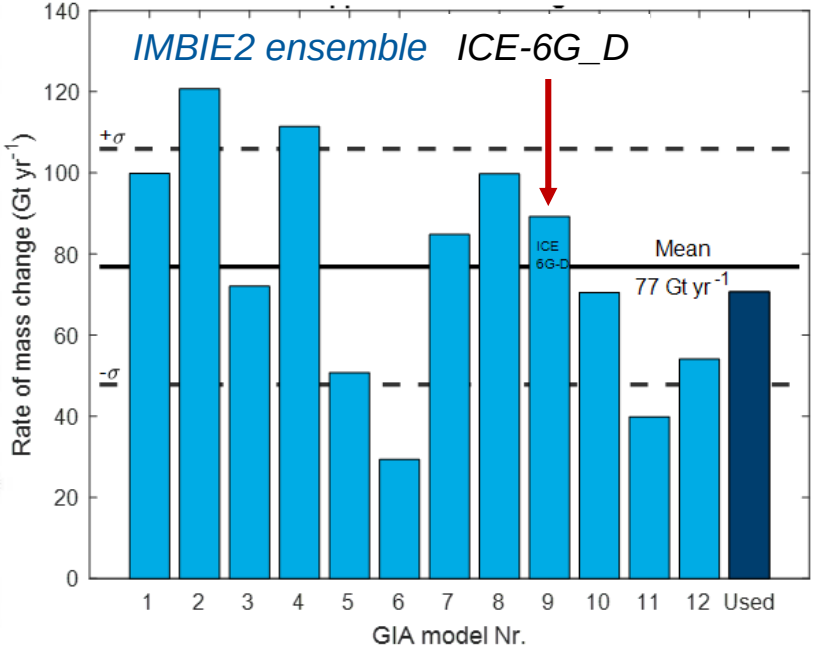
Output: Stokes coefficients (Level-2B)

GIA correction with ICE-6G_D

GIA-induced rate of surface displacement



GIA-induced apparent mass change in Antarctica



modified from IMBIE2, Shepherd et al. (2018)

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Gravity to ice-mass change inversion

Input: Stokes coefficients, with corrections applied (Level-2B)

Basin estimates

- Spectral masking of region of interest
- Low-pass filtering using a Wiener optimal filter (Sasgen et al. 2006) constant in time
- Conversion from gravity field to surface-mass changes using elastic compressible surface-load Love numbers
- Least-squares adjustment
- **Sasgen et al. (2012, 2013)**

Time series of storage variations in gigatons (Gt) for **7/25 major drainage basins** of the Greenland/Antarctic Ice Sheet, including **empirical uncertainty estimates**

Gridded data

- Tailored sensitivity kernels
- Mass changes inside the cell correctly recovered
- Mass changes outside the cell have no impact on the grid cell
- Propagated errors of the GRACE solutions with minimum influence on cell
- **Groh & Horwath (2016)**

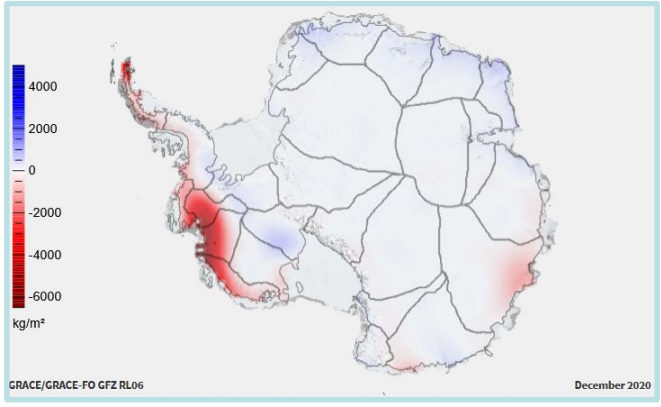
Time series of **gridded ice-mass change** per surface area (kg/m²) with a formal spatial resolution of **50 km x 50 km**

To keep in mind: The basin estimates are not derived from the gridded data

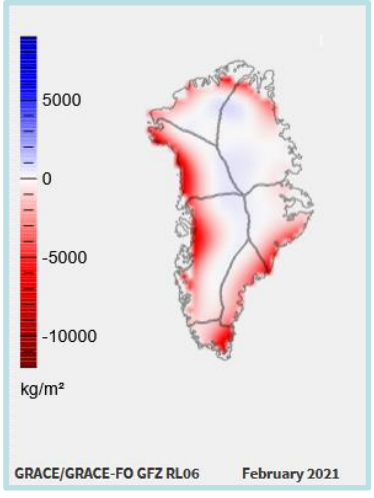
GravIS Level-3 ice-mass change products

Dedicated products for:

- Ice-mass changes in Antarctica (gridded)

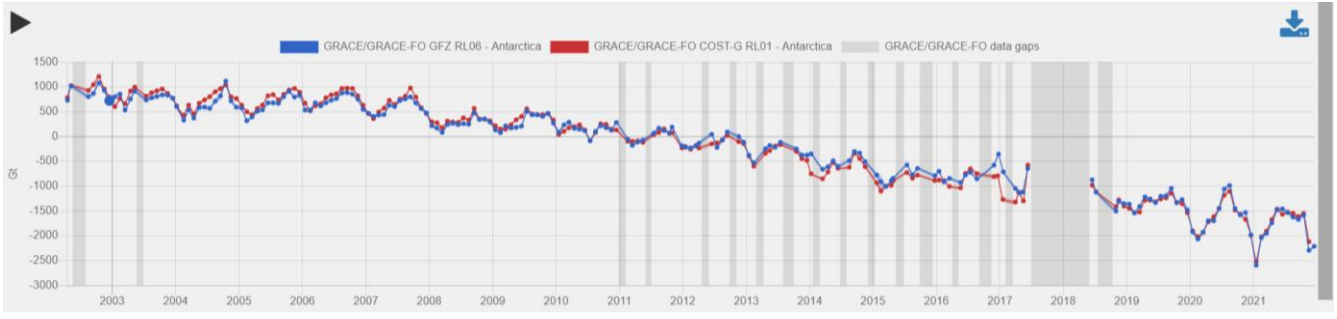


- Ice-mass changes in Greenland (gridded)



- Time series for entire Antarctic ice sheet (basin)

Download button for basin-scale time series (csv-files)



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GravIS website

Main page:

GFZ Helmholtz Centre Potsdam

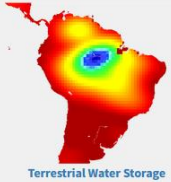
GravIS Gravity Information Service

Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences

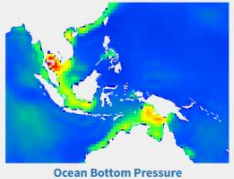
TERRESTRIAL WATER STORAGE | OCEAN BOTTOM PRESSURE | ANTARCTIC ICE-MASS CHANGE | GREENLAND ICE-MASS CHANGE | CORRECTIONS AND AUXILIARY PRODUCTS | RELATED LINKS

Welcome to GravIS, the Gravity Information Service of the German Research Centre for Geosciences (GFZ), in collaboration with the Alfred-Wegener-Institut (AWI) and Technische Universität Dresden. Data products derived from the gravimetric Earth observation satellite missions GRACE and GRACE-FO are widely used by scientists and other interested users to study mass variations in the Earth system. However, processing of GRACE/GRACE-FO data into user-friendly products for dedicated geophysical applications is nontrivial, neither when starting from original satellite observations nor from the level of gravity field products. In order to enable the usage of satellite gravimetry data for a broader community, user-friendly ('Level-3') products are generated by various institutions.

GravIS visualizes and describes Level-3 products based on the most recent GRACE and GRACE-FO data release from GFZ. In addition, Level-3 products based on the most recent release of combined models for GRACE and GRACE-FO from COST-G are offered as well. The products presented at GravIS are available for download at GFZ's Information System and Data Center (ISDC).



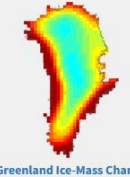
Terrestrial Water Storage



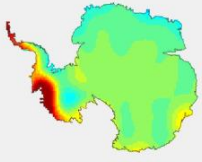
Ocean Bottom Pressure

The Gravity Recovery and Climate Experiment (GRACE; 2002 - 2017) and its Follow-On mission (GRACE-FO; launched in May 2018) typically provide monthly independent estimates of the Earth's global gravity field. Differences between consecutive months are caused by mass redistribution and mass transport in the Earth system, particularly in the geophysical fluid layers of the atmosphere, oceans, and continental hydrosphere.

GRACE/GRACE-FO data processing is structured into sensor data analysis (Level-0 to Level-1), global gravity field estimation (Level-1 to Level-2), and geophysical mass anomaly inversion (Level-2 to Level-3). Level-3 products at GravIS comprise gridded mass anomalies as well as basin average time series and are available for terrestrial water storage over non-glaciated regions, bottom pressure variations in the oceans, and ice-mass changes in both Antarctica and Greenland. In order to achieve the highest possible accuracy of the mass anomalies, several post-processing steps have been applied to the Level-2 spherical harmonic coefficients before inversion.



Greenland Ice-Mass Change



Antarctic Ice-Mass Change

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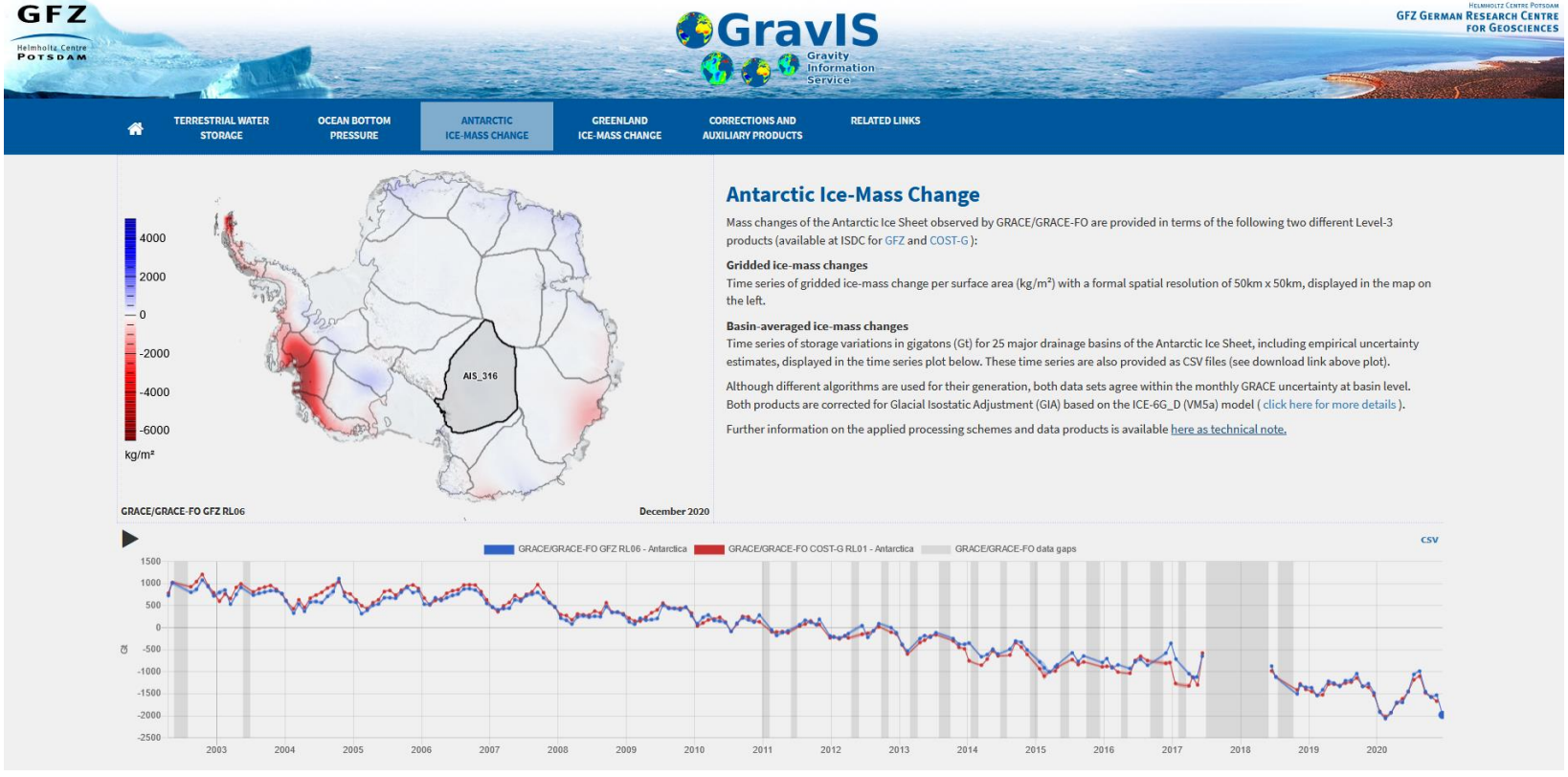
Antarctic ice-mass change:



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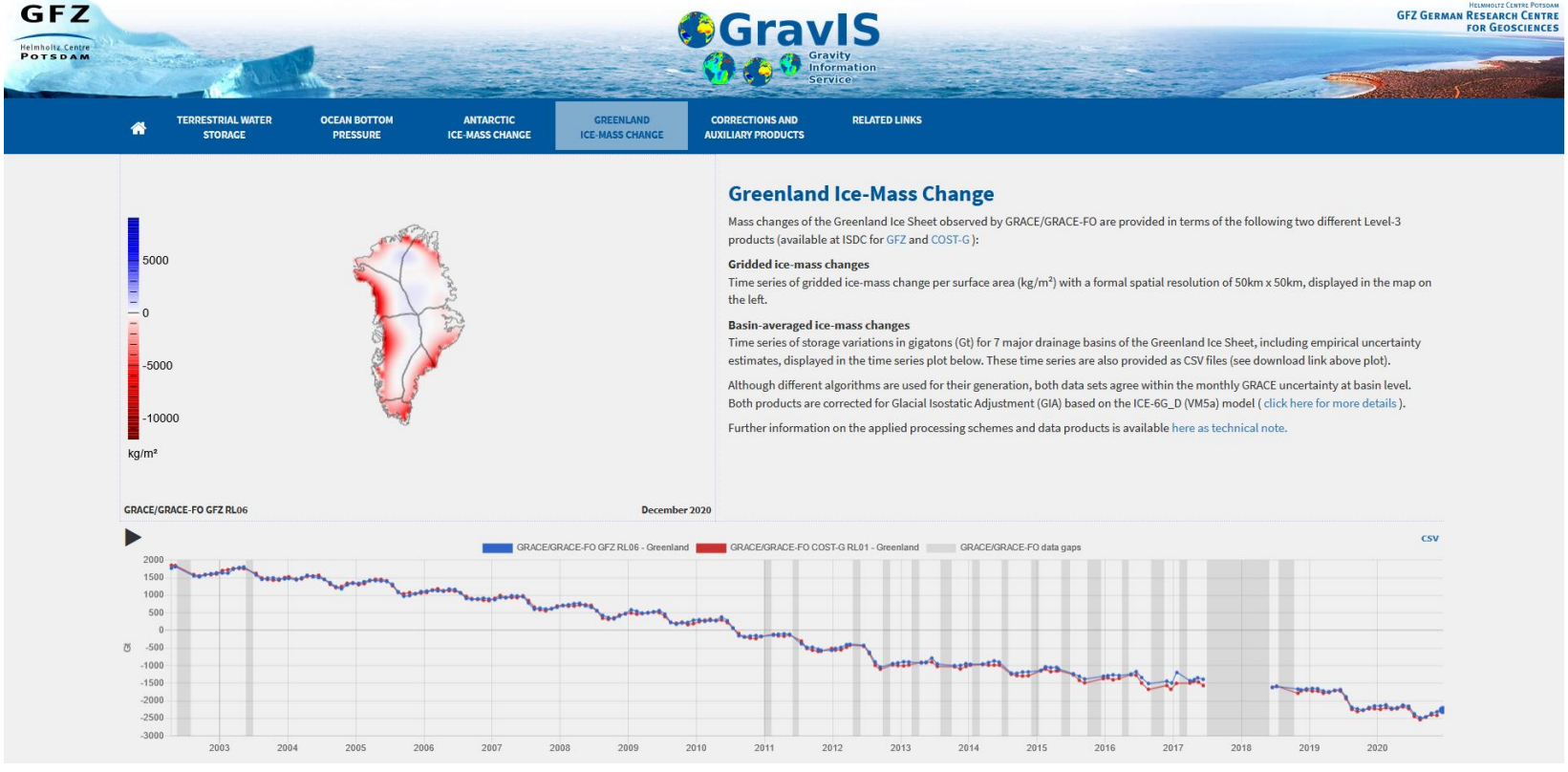
Greenland ice-mass change:



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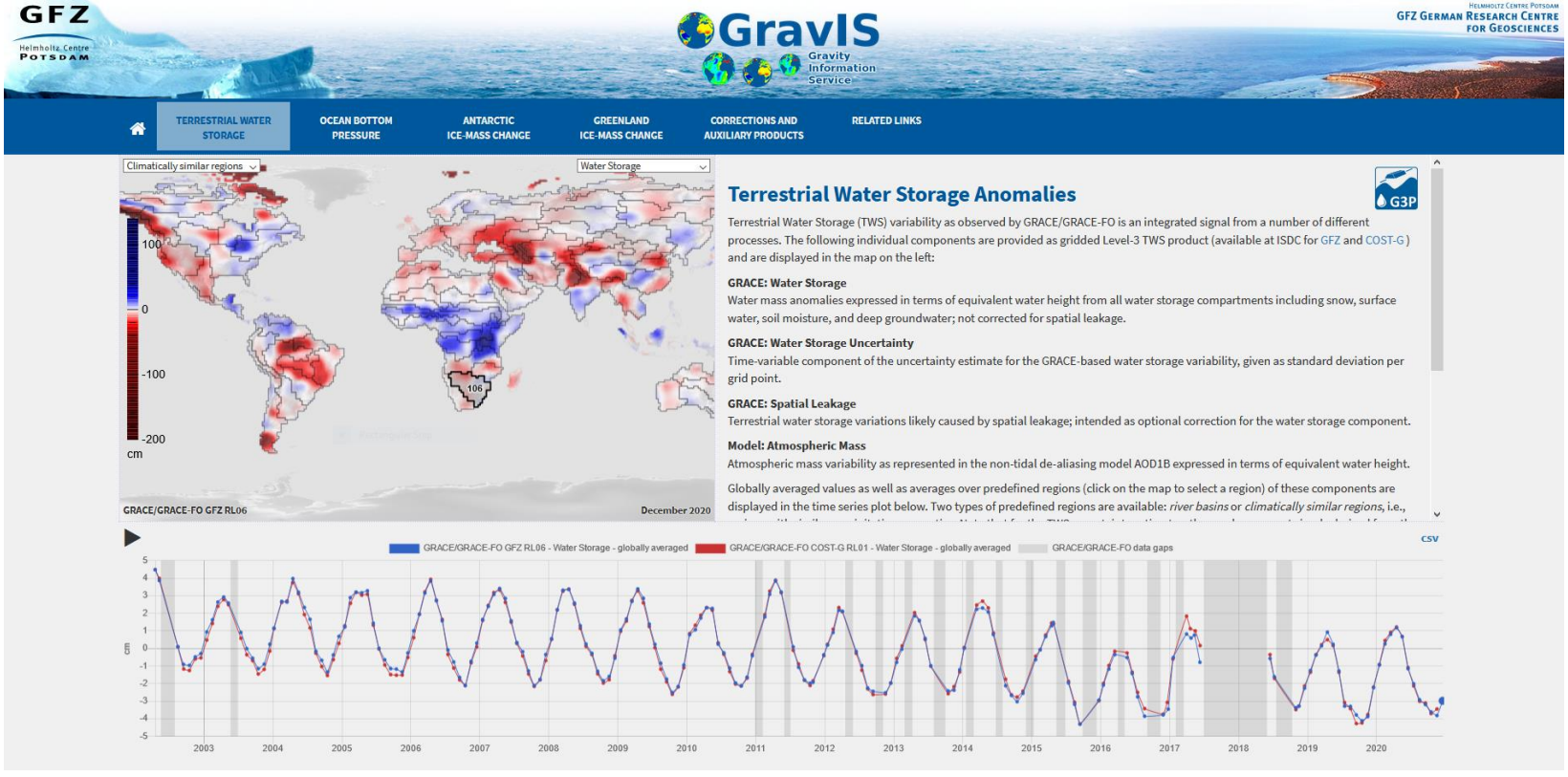
Terrestrial water storage:



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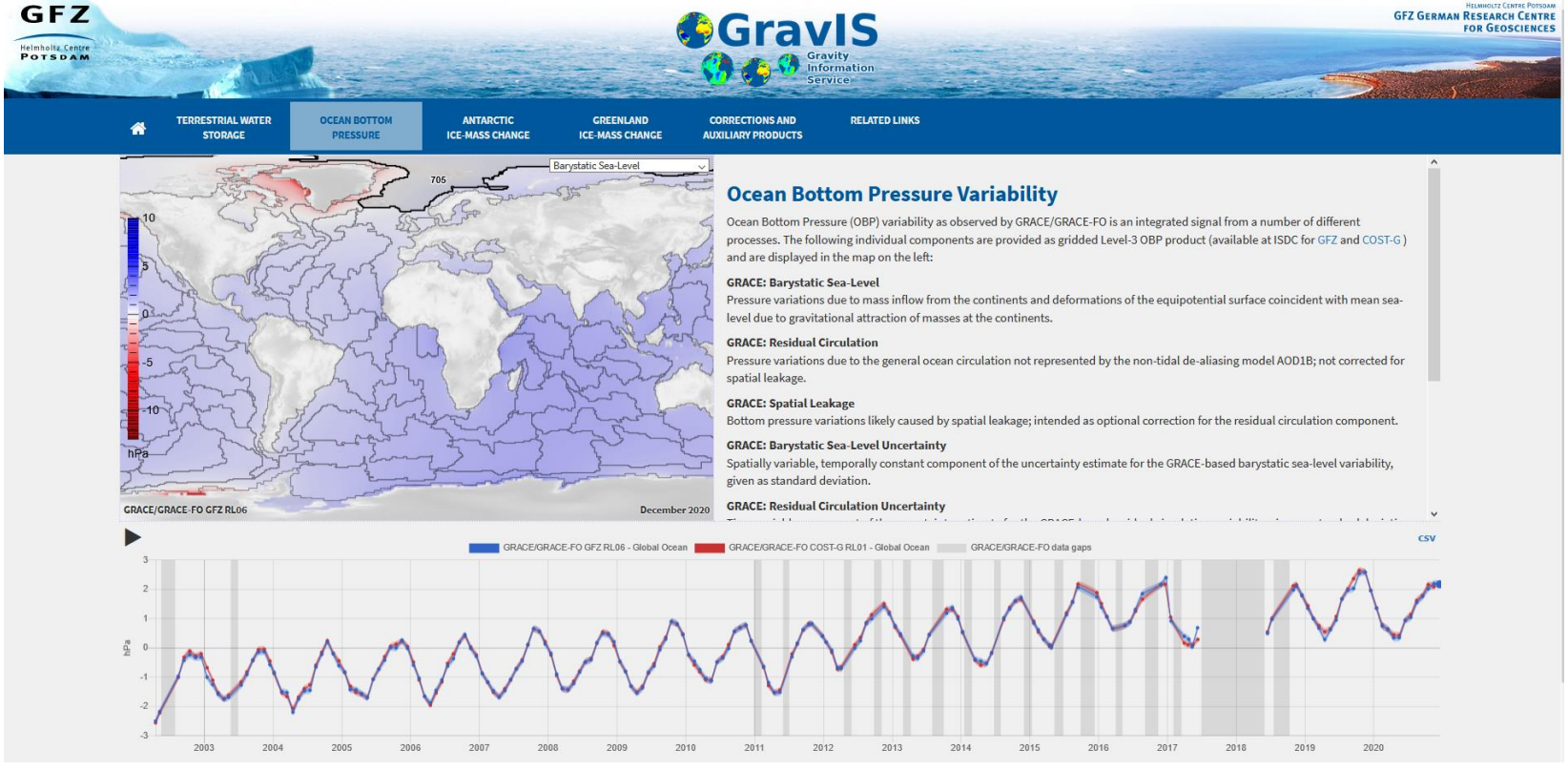
Ocean bottom pressure:



Data accessibility

- GravIS portal: http://gravis.gfz-potsdam.de/home

- All data are available for download and can be used free of charge
  - **No login or registration** is necessary
  - **Gridded** data (**NetCDF**, **GeoTIFF**) as well as **basin-scale** data (**ASCII**) can be directly downloaded via ftp: ftp://isdcftp.gfz-potsdam.de/grace/GravIS/
  - **Basin-scale** data can also be directly downloaded from the GravIS website as **csv-file**
  - Please do not forget to cite the data:
    - **GFZ RL06:** http://doi.org/10.5880/GFZ.GRAVIS_06_L3_ICE
    - **COST-G RL01:** http://doi.org/10.5880/COST-G.GRAVIS_01_L3_ICE

- Future plans:
  - Refined GIA models for Greenland and Antarctica, include GIA uncertainties
  - Update Level-3 products when improved Level-2 releases are available

References

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