Preliminary compilation of Antarctica gravity and gravity gradient data

Rene Forsberg
DTU-Space, Denmark, rf@space.dtu.dk
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New data have become available since the latest compilation of Antarctic gravity data ("AntGG", M. Scheinert et al., GRL 2016, https://doi.org/10.1002/2015GL067439). A new preliminary compilation of Antarctic gravity data has therefore been carried out for the *ESA 4D-Antarctica* project, using the same grid as the AntGG compilation (10 x 10 km Polar Stereographic grid). The new compilation is based on:

1. The AntGG grid, with associated error estimates
2. New Antarctic gravity data from DTU Space (IceGrav 2009-13), and PolarGap 2015-16, filling major voids in the AntGG coverage
3. A compilation of available older data south of ca. 82°S, quality checked and bias-adjusted where needed, based on the ESA DTU-BAS-NPI 2015-16 PolarGap aerogravity survey (to augment the limited data coverage possible due to logistics limitations in operating at Amundsen-Scott South Pole Station)
4. Offshore satellite altimetry gravity data (DTU15, south of 60°S)
5. Updated NASA IceBridge data to 2018
6. Reprocessed AWI data around Dome-C and Recovery Lakes region, East Antarctica
7. ROSETTA Ross Ice Shelf airborne gravity data, edited for outliers
8. The latest GOCE data ("direct" model to degree 240, release 6)
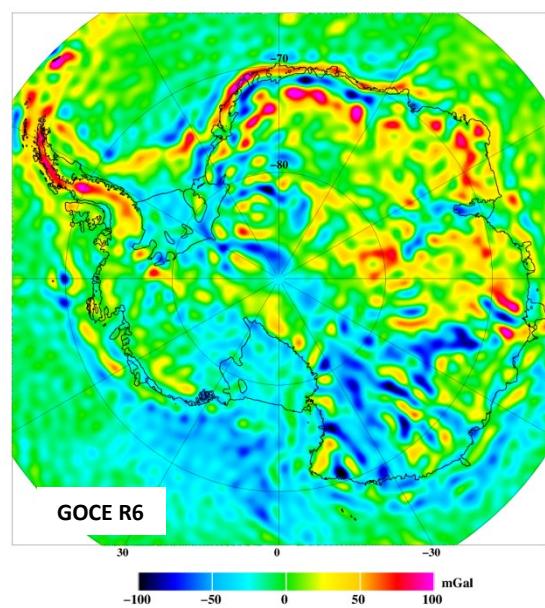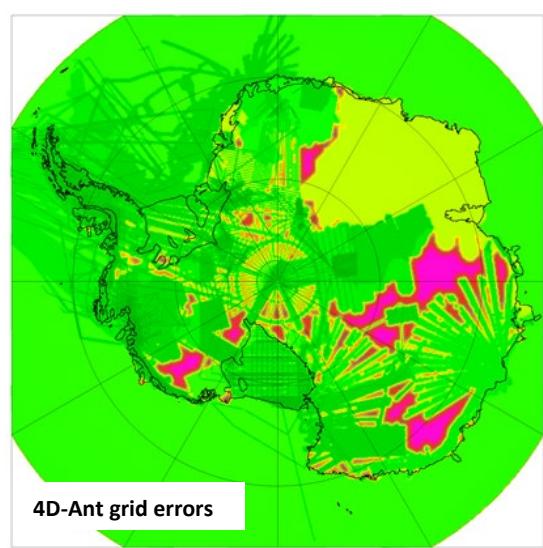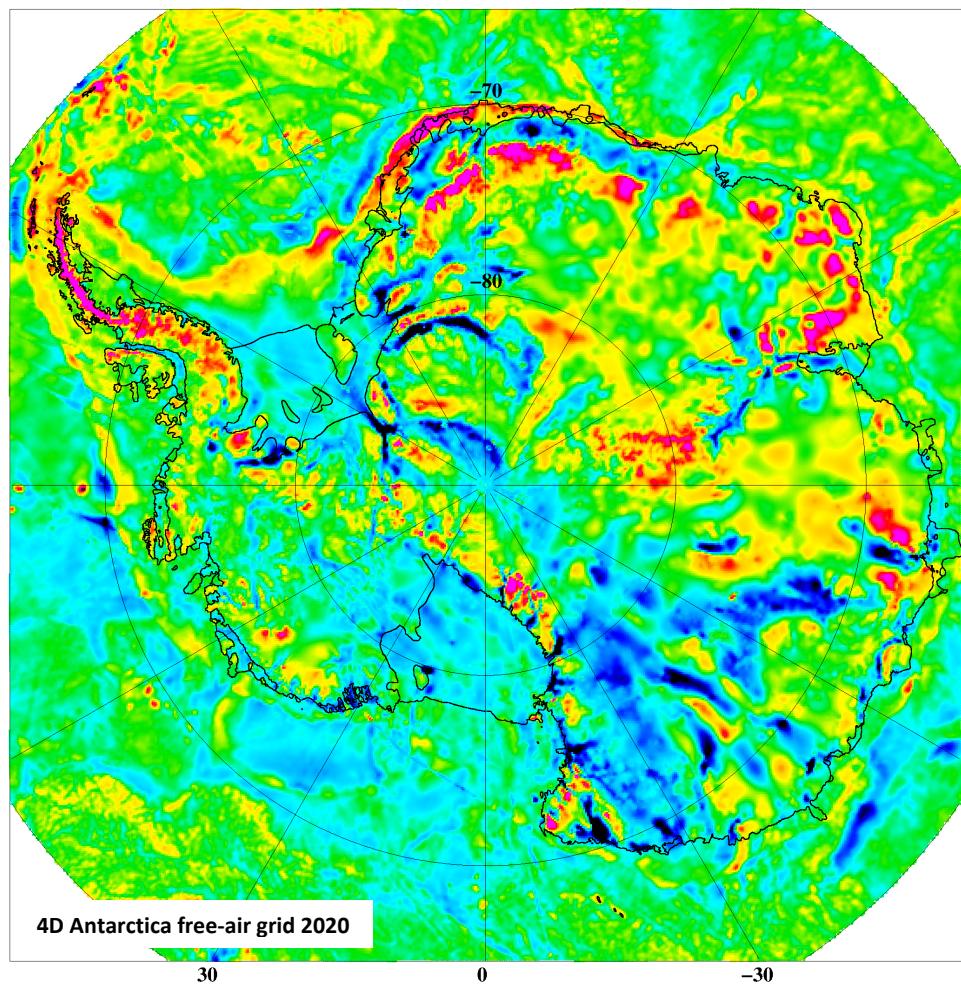
All data sets have been gridded using least-squares collocation taking into account the estimated data uncertainty. The gridding has been done in a remove-restore fashion, gridding the difference to GOCE, and restoring the GOCE reference field for the final grid. All data has been converted to geodetic free-air anomalies ahead of the gridding, using the GOCE geoid to convert between gravity disturbances ("free-air anomalies computed by ellipsoidal heights") and the geodetic free-air anomalies (also used in AntGG). The flight elevation of the different aerogravity data sets has *not* been used in this preliminary compilation (due to lack of flight height information for some data sets); this will give errors, especially for regions with high-altitude IceBridge flights.
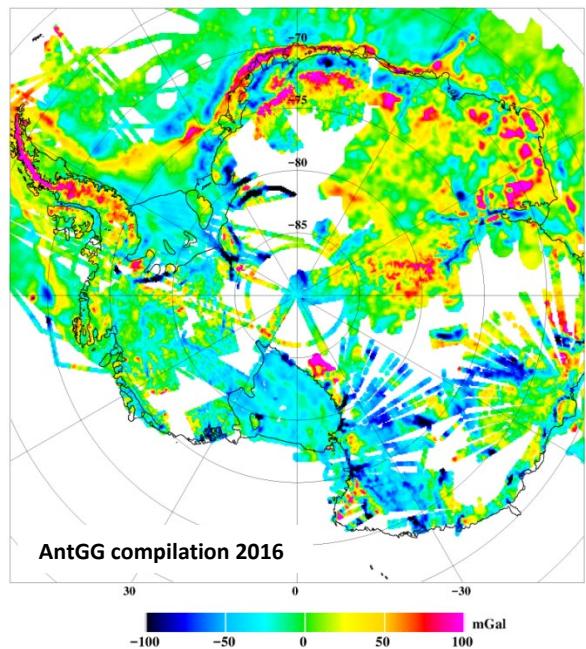
The data are available as a simple ASCII file *ant4D_fa.dat* (id, lat, lon, free-air anomaly, error, gravity disturbancer, Bouguer anomaly), or as geotiff. The Bouguer anomalies have been computed using ice thickness and inferred water depth below ice shelves and Lake Vostok from Bedmap2, and are restricted to the land and ice shelf areas. Data are for the region south of 60°S; underlying polar stereographic grids in GRAVSOFT or SURFER formats are also available. These grids cover -3330 to 3330 km in N and E, 667 x 667 grid points, and refer to the SCAR projection with true scale 71°S.

Vertical gravity gradients (Vzz, Eotvos units) have been computed by Fourier methods (GRAVSOFT *geofour*), and are given together with GOCE gradients at the geoid in separate file *ant4d_tzz.dat*

Figures in the following show the compiled free-air grid, error estimates, and selected data sources.
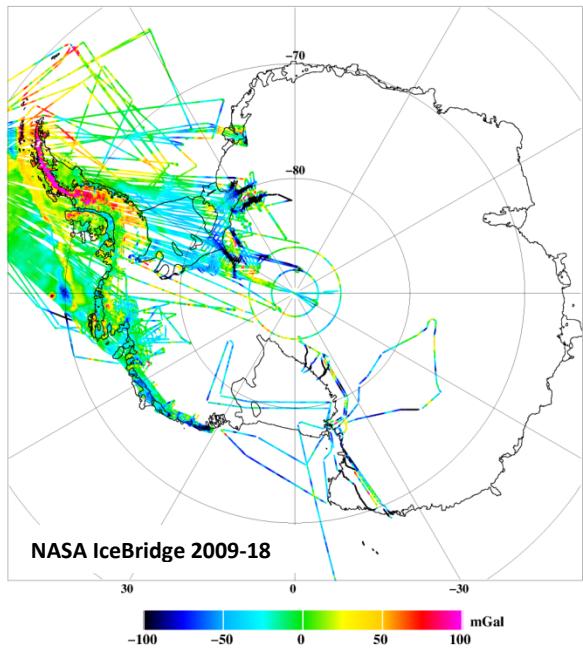
4D Antarctica free-air grid 2020

mGal

−100   −50   0   50   100

4D-Ant grid errors

0   5   10   15   20   mGal

GOCE R6

30   0   −30
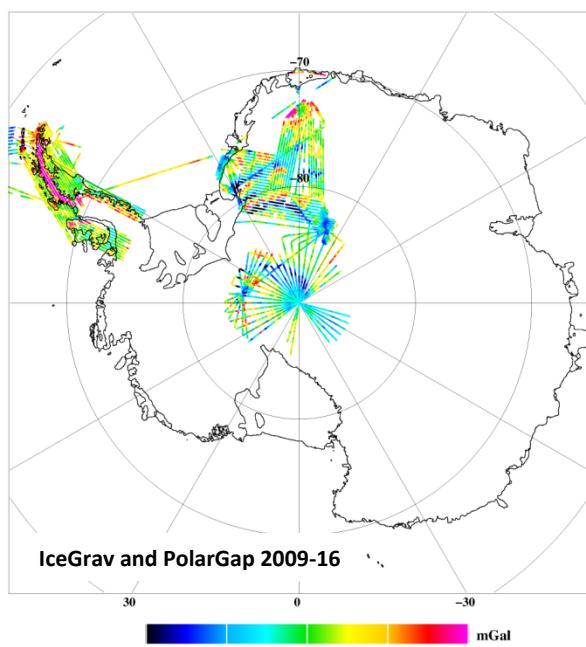
−100   −50   0   50   100   mGal

AntGG compilation 2016
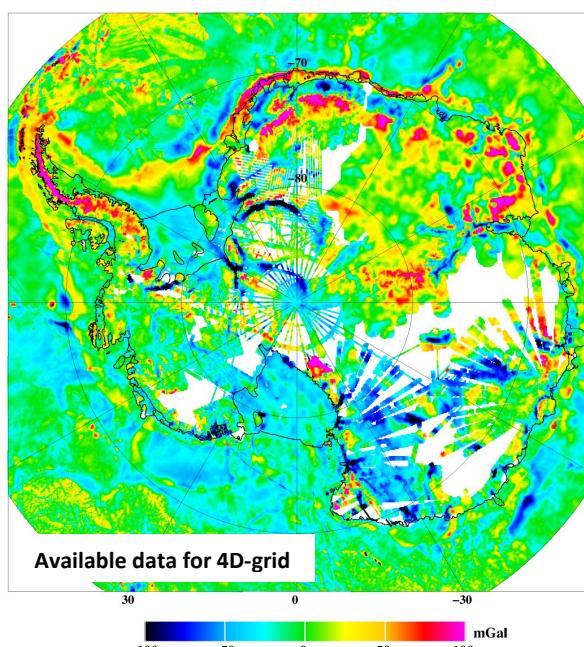
NASA IceBridge 2009-18
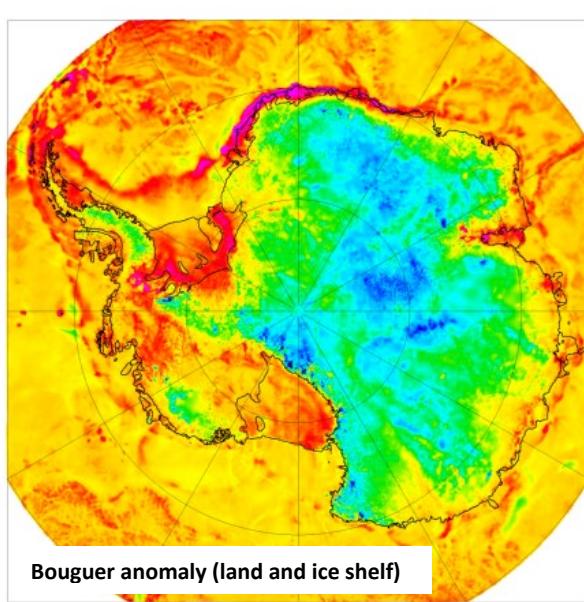
IceGrav and PolarGap 2009-16
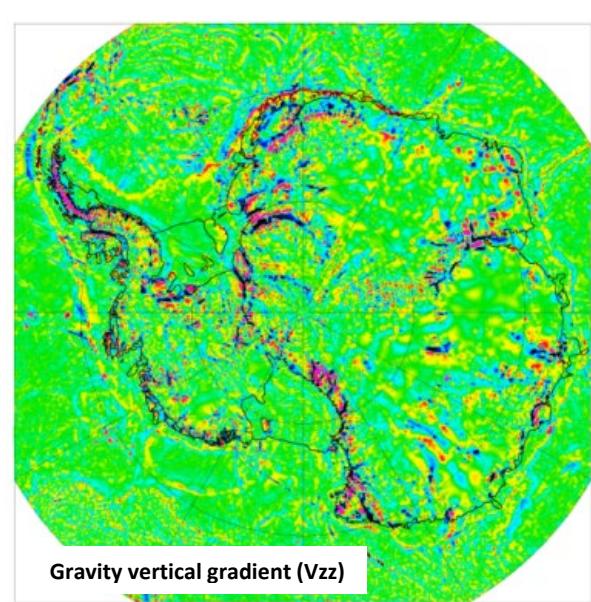
Available data for 4D-grid

Bouguer anomaly (land and ice shelf)

Gravity vertical gradient (Vzz)