Mass change in Antarctica

Results from new GRACE/GRACE-FO releases

ID: EGU23-12155ECS
Session G3.1 – Geodesy for Climate Research

Barbara Jenny, Nicolaj Hansen, Tim Jensen, and René Forsberg
DTU Space, Geodesy and Earth Observation
Contact: barbj@space.dtu.dk

Introduction

We are looking at ice mass changes in Antarctica from different GRACE-FO solutions and compare them to the results from ICESat-2. We are only looking at the grounded ice sheet and only at the time period from June 2018 to November 2022.

CSR RL6.0 vs RL6.1

The newest Level-2 GRACE-FO CSR release 6.1 was published in November 2022. For this product, the new ACT1B product was used for the GFO-2 processing [1,2]. Looking at the ice mass change of the Antarctic Ice Sheet for the time period of June 2018 to November 2022, we can see changes in the solution for the months 06/2020 and 07/2020 as well as 01/2021 (see Fig. 1).

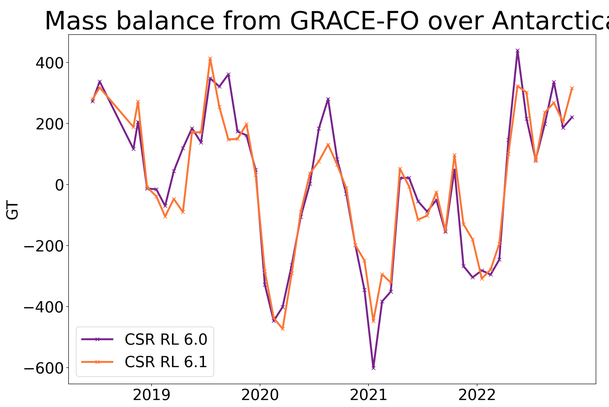


Figure 1: Mass changes with respect to mean of the time series for CSR RL 6.0 and CSR RL 6.1.

Comparison to other solutions

To better understand the changes, we compare the two CSR time series with the GFZ RL 6.1 [3], JPL RL 6.1 [4], the ITSG-Grace2018 [5,6] and the combination product COST-G [7]. The GFZ RL 6.1 and the JPL RL 6.1 series use the same accelerometer product as CSR RL 6.1. ITSG-Grace2018 does co-estimate accelerometer parameters. The COST-G time series is a weighted combination of seven time series including ITSG-Grace2018 and CSR RL 6.0, GFZ RL 6.0 and JPL RL 6.0.

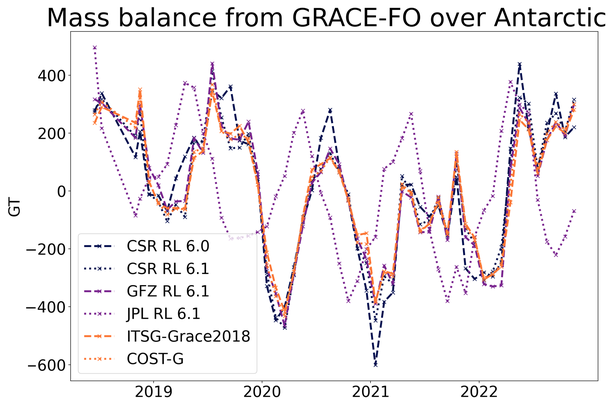


Figure 2: Mass changes with respect to mean of the time series for CSR RL 6.0 and CSR RL 6.1.

The CSR RL 6.1, GFZ RL 6.1, ITSG-Grace2018 and COST-G show very similar results and all considered time series show a mass gain in 03/2022 to 05/2022.

Figure 5: Mean (a) and standard deviation (b) of the trends of the five time series CSR RL 6.1, GFZ RL 6.1, JPL RL 6.1, ITSG-Grace2018 and COST-G.

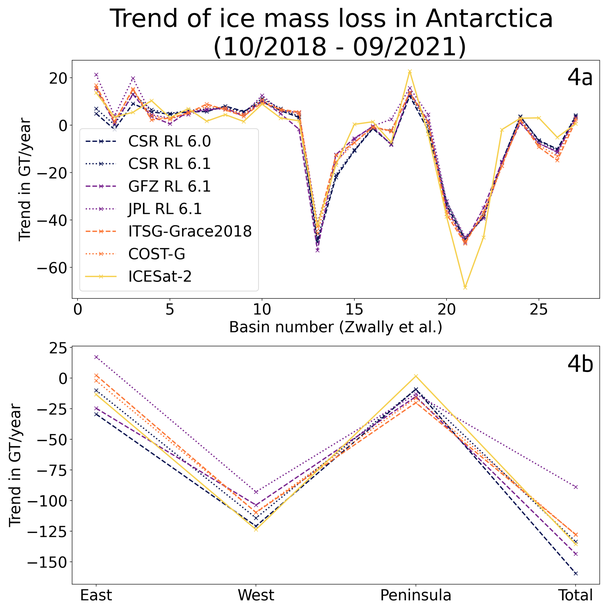
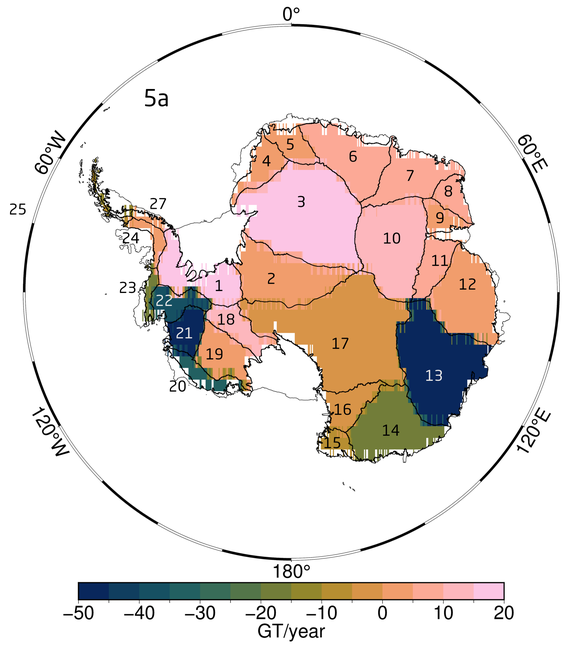
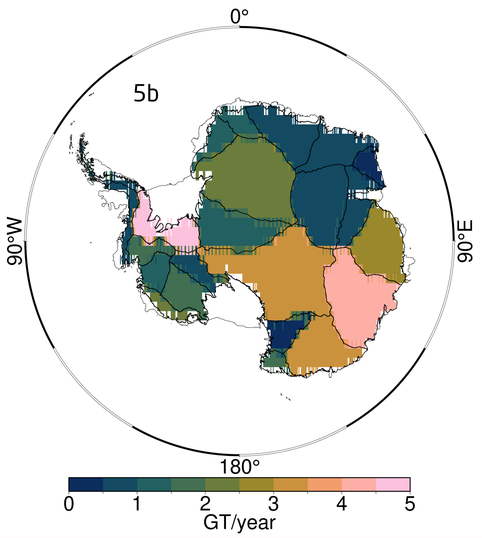


Figure 4: Trend of ice mass loss for the different drainage basins (Zwally et al.) for the time period of 10/2018 to 09/2021.





Comparison to ICESat-2

To compare with the results of ICESat-2 [8], we estimated a trend for the same time period for all six GRACE-FO time series. For most basins on East-Antarctica (No. 2-17), the seven solutions are in good agreement. For basins 21, 22, and 23 the GRACE-FO solutions do not show the same result as the ICESat-2 solutions but when looking at the whole Antarctica, these differences even out (see fig. 4b). If we include the whole time series of the GRACE-FO data, we get a slightly positive trend in East Antarctica

Conclusion

The new GRACE-FO release CSR RL 6.1 show a similar trend in ice mass change in Antarctica as its predecessor but some of the monthly solutions are closer to the independent ITSG-Grace2018 solutions. The measured trends for the bigger regions are similar to the trends measured with ICESat-2 but differ in some of the smaller basins on West Antarctica.

References

Barbara Jenny, Nicolaj Hansen, Tim Jensen, and René Forsberg
DTU Space, Geodesy and Earth Observation
Contact: barbj@space.dtu.dk

References

1. GRACE-FO. GRACEFO_L2_CSR_MONTHLY_0060. Ver. 6.0. PO.DAAC, CA, USA. accessed 2023-04-04 at 10.5067/GFL20-MC060

2. GRACE-FO. GRACEFO_L2_CSR_MONTHLY_0061. Ver. 6.1. PO.DAAC, CA, USA. accessed 2023-04-04 at 10.5067/GFL20-MC061

3. GRACE-FO. GRACEFO_L2_GFZ_MONTHLY_0061. Ver. 6.1. PO.DAAC, CA, USA. accessed 2023-04-04 at 10.5067/GFL20-MG061

4. GRACE-FO. GRACEFO_L2_JPL_MONTHLY_0061. Ver. 6.1. PO.DAAC, CA, USA. accessed 2023-04-04 at 10.5067/GFL20-MJ061

5. Kvas, A., Behzadpour, S., Ellmer, M., Klinger, B., Strasser, S., Zehentner, N., & Mayer-Gürr, T. (2019).ITSG-Grace2018: Overview and evaluation of a new GRACE-only gravity field time series. *Journal of Geophysical Research: Solid Earth*, 124. https://doi.org/10.1029/2019JB017415

6. Mayer-Gürr, Torsten; Behzadpur, Saniya; Ellmer, Matthias; Kvas, Andreas; Klinger, Beate; Strasser, Sebastian; Zehentner, Norbert (2018): ITSG-Grace2018 - Monthly, Daily and Static Gravity Field Solutions from GRACE. GFZ Data Services. http://doi.org/10.5880/ICGEM.2018.003

7. Meyer, Ulrich; Lasser, Martin; Jaeggi, Adrian; Dahle, Christoph; Flechtner, Frank; Kvas, Andreas; Behzadpour, Saniya; Mayer-Gürr, Torsten; Lemoine, Jean-Michel; Koch, Igor; Flury, Jakob; Bourgogne, Stéphane (2020): International Combination Service for Time-variable Gravity Fields (COST-G) Monthly GRACE-FO Series. V. 01. GFZ Data Services. https://doi.org/10.5880/ICGEM.COST-G.002

8. Hansen, N., Sørensen, L. S., Spada, G., Melini, D., Forsberg, R., Mottram, R., and Simonsen, S. B.: ICESat-2 Ice Sheet Mass balance: Going below the surface, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-12349, https://doi.org/10.5194/egusphere-egu23-12349, 2023.

9. Zwally, H. Jay, Mario B. Giovinetto, Matthew A. Beckley, and Jack L. Saba, 2012, Antarctic and Greenland Drainage Systems, GSFC Cryospheric Sciences Laboratory, at http://icesat4.gsfc.nasa.gov/cryo_data/ant_grn_drainage_systems.php