Satellite based datasets for the sea level contribution estimates of the Antarctic Ice Sheet

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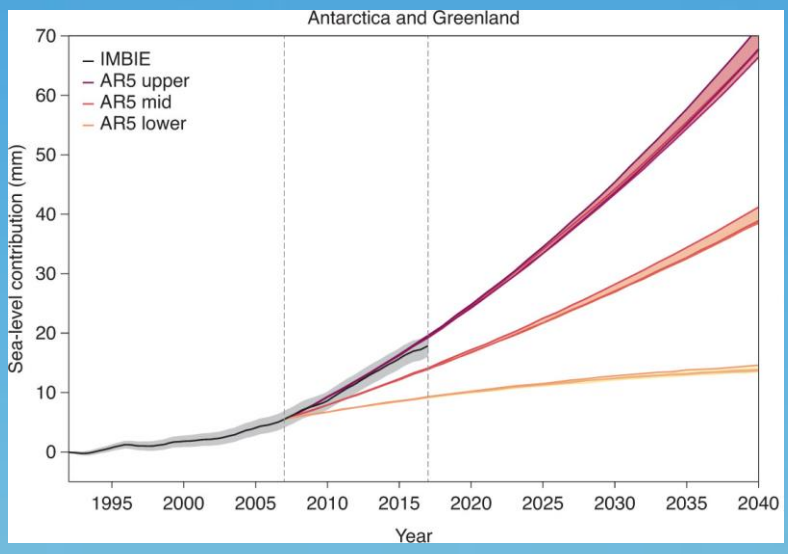
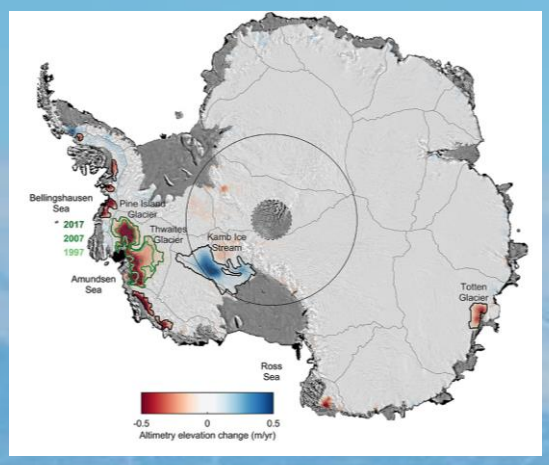
The Antarctic Ice Sheet cci project produces measurements of the ice sheet mass change based on satellite altimetry, satellite gravimetry and the mass budget method, and provides scientific leadership for the ESA-NASA Ice Sheet Mass Balance Inter-comparison Exercise (IMBIE). With the aid of regional climate models, the satellite records allow separation of the ice sheet mass balance into its main components - surface mass balance (SMB) and glacier dynamic ice loss. This, in turn, allows detailed comparison to climate projections.

According to our latest assessment [1], ice sheet losses are tracking the worst case climate warming scenario of the IPCC Fifth Assessment Report (AR5). During the overlap period 2007 to 2017, the total ice sheet losses from Antarctica and Greenland increased the global sea level by 12.3 +/- 2.3 mm, and this value is closest to the AR5 upper range (13.7 to 14.1 mm for all emissions pathways). We present the datasets used by IMBIE team for their second assessment of ice losses from Antarctica.

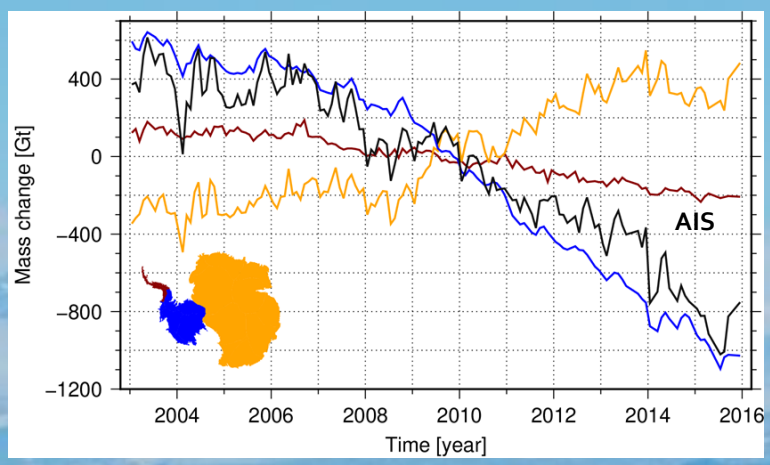


Surface Elevation Change (SEC) 1992 - 2017



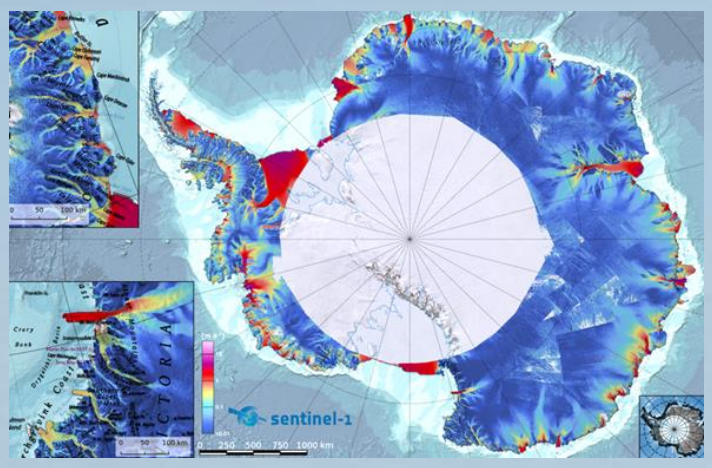
- ERS-1, -2, ENVISAT, CryoSat-2 radar altimeter
- 24% of West Antarctica is in a state of dynamical imbalance
- Contributions to global sea level: East −1.1 ± 0.4 and West +5.7 ± 0.8 mm [2]
- SEC data portal: cpom.ucl.ac.uk/csopr

Gravimetric Mass Balance (GMB) 2003 - 2015



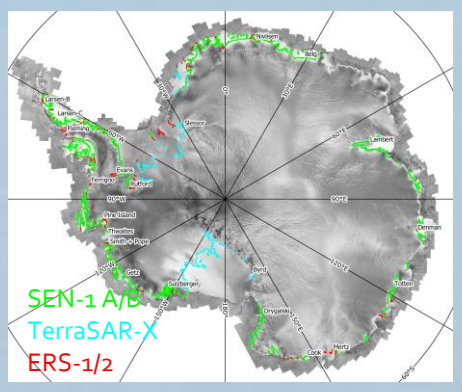
- Gravity Recovery and Climate Experiment (GRACE) [3]
- Mass changes: West -140.4±19.8 Gt/yr; East 65.9±32.6 Gt/yr; AP -30.9±7.4 Gt/yr
- Total contribution to global sea level rise: 0.29 ±0.10 mm/yr
- GMB data portal: data1.geo.tu-dresden.de/ais_gmb

Ice velocity (IV) for mass budget approach



- ERS-1, -2, ALOS PALSAR, TerraSAR-X, Sentinel-1 SAR
- dense archive of detailed IV maps [4]
- flow velocity & ice thickness at the grounding line → solid ice discharge
- IV & GLL data portal: cryoportal.enveo.at

Grounding Line Location (GLL)



- ERS-1/-2, TSX, Sentinel-1 A/B SAR
- time series of GLL since 1992 of key glaciers
- grounding line retreat due to ice thinning is an indicator of dynamical imbalance of the ice sheet

References

[1] Slater T., Hogg A., Mottram R. Ice-sheet losses track high-end sea-level rise projections. Nature Climate Change (2020)

[2] Shepherd, A., Ivins, E., Rignot, E. et al. Mass balance of the Antarctic Ice Sheet from 1992 to 2017. Nature 558, 219–222 (2018). https://doi.org/10.1038/s41586-018-0179-y

[3] Groh, A., and Horwath, M. (2016). The method of tailored sensitivity kernels for GRACE mass change estimates. Geophysical Research Abstracts, 18, EGU2016-12065.

[4] Nagler, T., Rott, H., Hetzenecker, M., Wuite, J. and Potin, P. (2015). The Sentinel-1 Mission: New Opportunities for Ice Sheet Observations. Remote Sens., 7, 9371-9389.

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