climate change initiative

→ ANTARCTIC ICE SHEET NEWSLETTER

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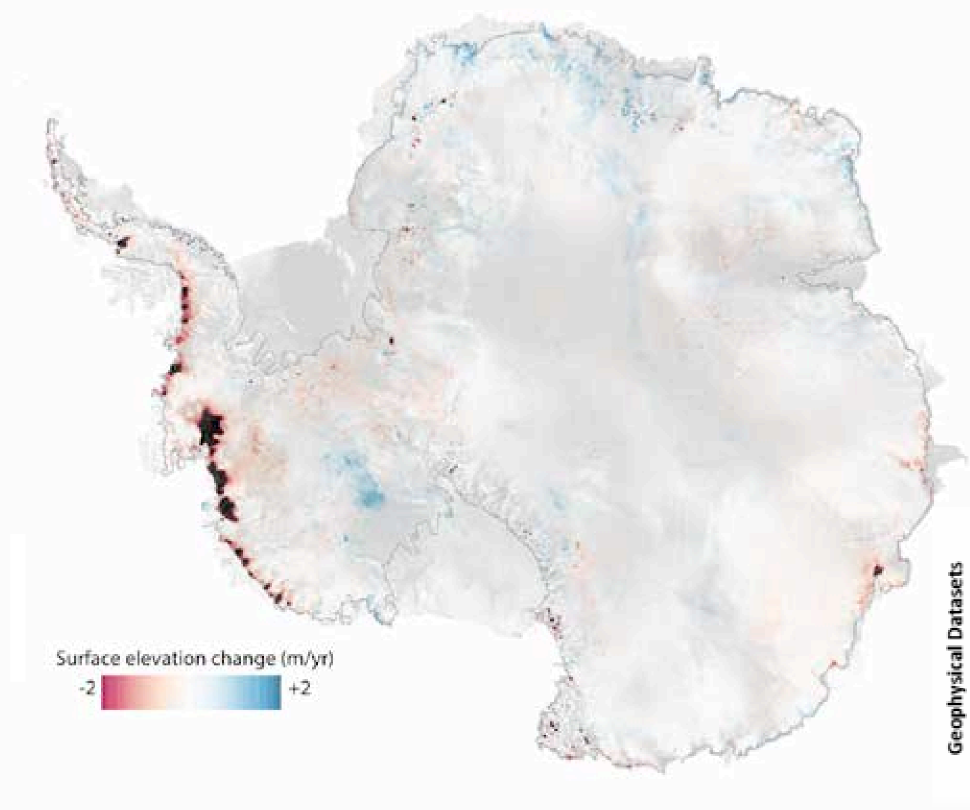

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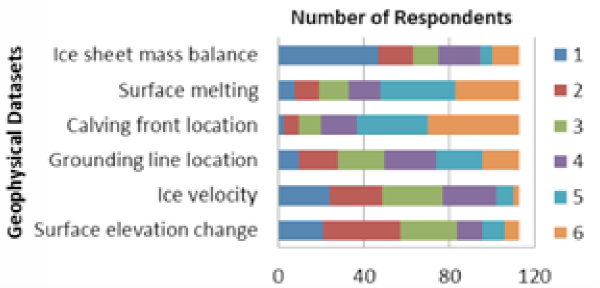


ABOVE LEFT: Surface elevation change of Antarctica measured by Cryosat-2 between 2010 and 2014 (McMillan et al., 2014)

ABOVE RIGHT: Relative importance of Antarctic Ice Sheet geophysical dataset records as identified during the CCI user consultations. Priority: 1 - highest, 6 - lowest.

Antarctic Ice Sheet cci

The Antarctic Ice Sheet CCI project will use satellite observations to produce the reliable climate data records that are required by the scientific user community.

These data records will improve our understanding of how the Antarctic Ice Sheet is changing today, and will provide data for climate models at finer spatial and temporal resolution than has been possible, underpinning improved estimates of future change.

In 2014 we conducted a community-wide survey to establish which Antarctic geophysical datasets are most useful for the scientific community; asking what the spatial and temporal resolution of the satellite data sets should be, and which sectors of the Antarctica to prioritise. The survey was a great success with over 113 responses, of which over half had more than 10 years of experience.

Although the respondents primarily had an Earth Observation background, 34 were climate modellers and 6 were 'decision makers with interest in Cryosphere and its changes,' indicating that our data products will help to inform policy decisions.

Antarctic Ice Sheet mass balance, velocity, surface elevation change and grounding line location were identified to be the most important data products (see figure above), and so we will produce long term records of these four parameters over the next three years.

antarctic ice sheet cci

Gravimetric Mass Balance (GMB)

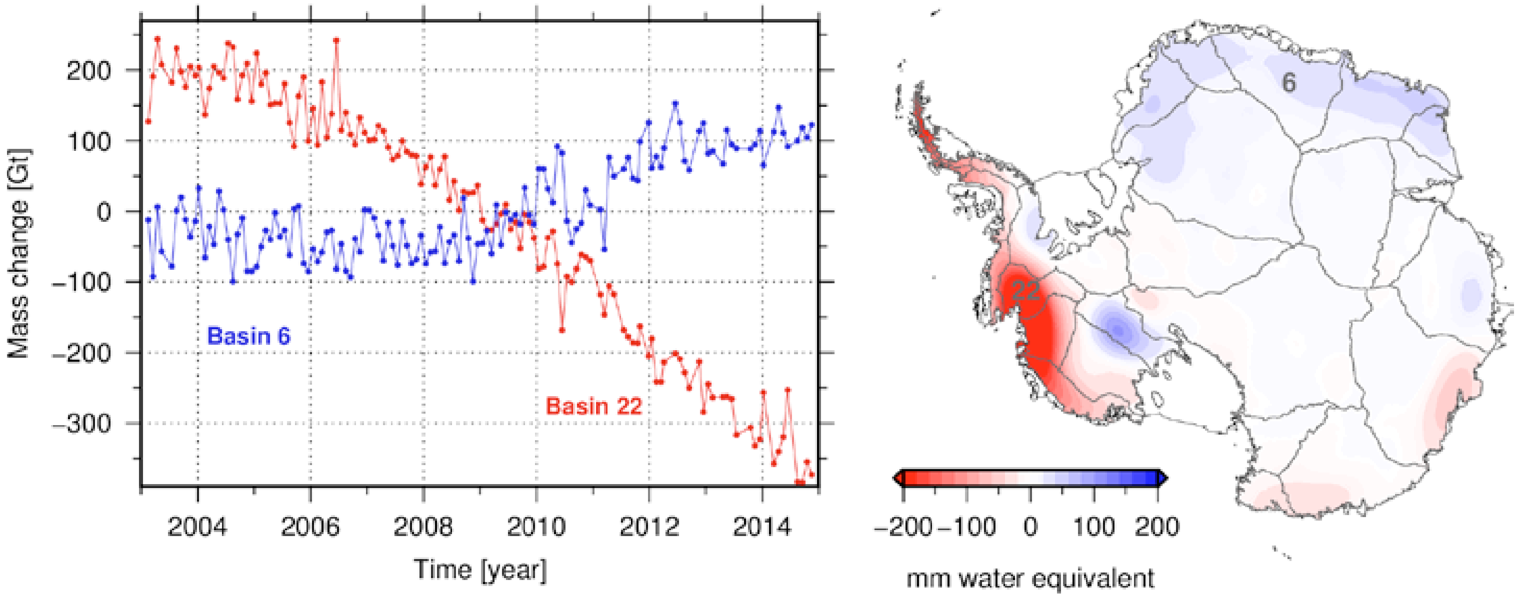
The Gravimetric Mass Balance products are based on measurements acquired by the Gravity Recovery and Climate Experiment (GRACE) satellite mission.

GRACE gravity observations have the advantage of their direct sensitivity to change in the total ice sheet mass, including fluctuations in snow and ice (rather than geometry changes) on an approximately monthly time resolution, though with intrinsic limits in spatial resolution.

GRACE has been operating since 2002, and the GRACE-Follow-On mission scheduled for launch in 2017 will ensure continuity with enhanced accuracy and resolution.

Two products will be developed and produced; time-series of monthly mass changes for individual drainage basins, and gridded maps of mass changes over the entire ice sheet.

The second product will illuminate the spatial patterns of mass changes at a formal resolution of 50-100 km, although the actual physical resolution of GRACE is rather on the 200 km level.



ABOVE: Illustration of the Gravimetry Mass Balance data products (processing by TUDr/TUM).

Left side above: Time series of ice sheet mass change within two ice drainage sectors of Antarctica.

Right side above: Map of rate of ice sheet mass change between 2003 and 2014.

Join the Round-Robin today!

Gravimetric Mass Balance (GMB) Round-Robin experiment

The CCI Antarctic Ice Sheet project will perform an open round robin experiment to compare and evaluate algorithms for the generation of Gravimetric Mass Balance (GMB) products.

Since the experiment is carried out in close collaboration with the CCI Greenland Ice Sheet project it deals with both the Antarctic Ice Sheet and the Greenland Ice Sheet. Beside GRACE data, synthetic datasets of global mass changes form the basis for the algorithm evaluation. We are looking forward to receive your contribution by 18 September 2015. All contributions will be analysed anonymously.

We envisage a publication of the results with co-authorship of all participants.

For additional information and registration please visit the project website:

www.esa-icesheets-antarctica-cci.org

Or go directly to Round Robin website: http://roundrobin.esa-icesheets-cci.org/nb/login/

antarctic ice sheet cci

Surface Elevation Change (SEC)

Satellite altimetry is a key method used for assessing the sea level contribution from the polar ice sheets by measuring their volume change. The technique is unique in spatially resolving the detailed pattern of mass imbalance, with monthly temporal sampling, and has been applied to both the Greenland and Antarctic ice sheets.

Thanks to a succession of ESA satellite missions starting with ERS-1 in 1992 and continuing with CryoSat-2, satellite altimetry provides the longest unbroken record of ice sheet mass balance from all geodetic techniques. Altimeter measurements of elevation change are extremely precise, because they require only modest adjustments to account for sensor drift, changes in the satellite attitude, atmospheric attenuation, and movements of Earth's surface. The Antarctic_Ice_Sheet_cci project will produce a continuous monthly time series of surface elevation change measured using over 25 years of radar altimetry satellites including ERS-1/2, ENVISAT, CryoSat-2 and in the future, Sentinel-3. (See front page for SEC figure).

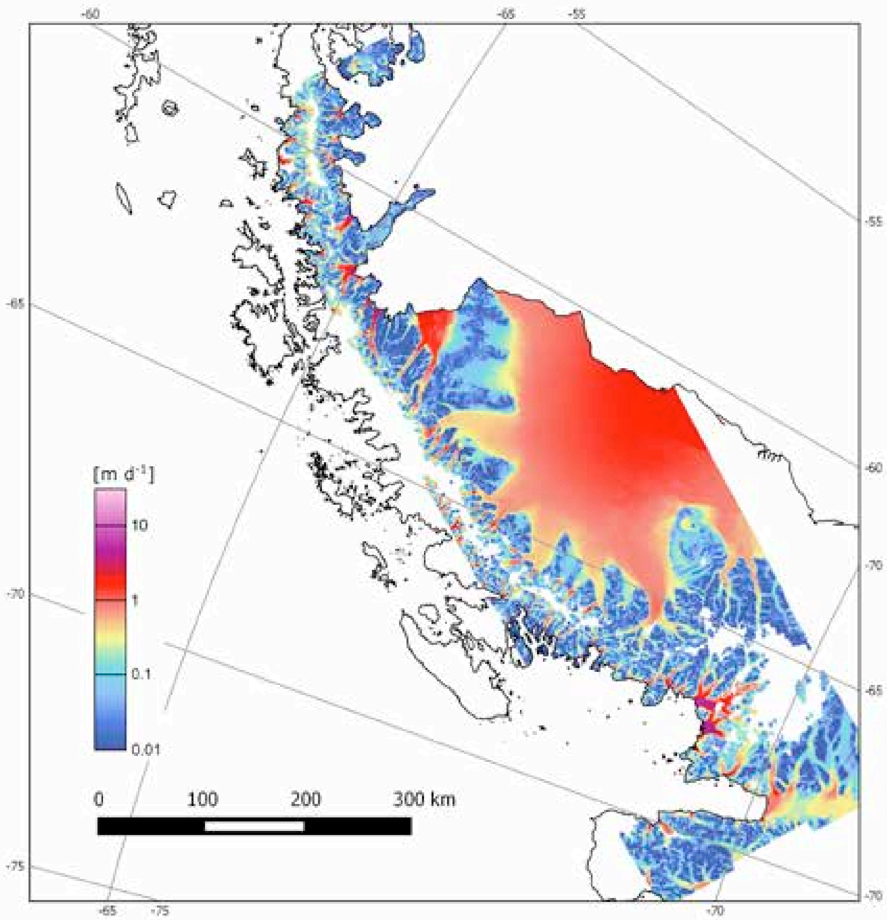
Ice Velocity

There is ample evidence indicating large and rapid changes of the Antarctic Ice Sheet in recent decades, including the break-up of several large ice shelves followed by glacier acceleration and grounding line retreat, resulting in increased ice discharge and contributing to sea level rise.

Mapping changes in glacier velocity provides key information for investigating the dynamic response of glaciers and ice sheets to changing environmental conditions.

Remote sensing techniques that utilise SAR and optical satellite data are the only practical methods of obtaining accurate surface velocities across Antarctica's remote glaciers on a regular basis. Several techniques have been developed over the years, including feature tracking and SAR interferometry. With the launch of the European Sentinel-1 SAR satellite in April 2014, glaciologists now have a dedicated tool to remotely measure ice flow.

Archived and new data from Sentinel-1 and other sensors, including ALOS PALSAR and the ERS and TerraSAR-X mission will be used to map changes in ice flow velocity in key regions of Antarctica. Combined, these data sets will allow for a unique assessment of ice-velocity changes over recent decades.



RIGHT: Ice velocity map for Antarctic Peninsula from Sentinel-1 data acquired in June 2015 (processing by ENVEO).

antarctic ice sheet cci

Grounding Line Location (GLL)

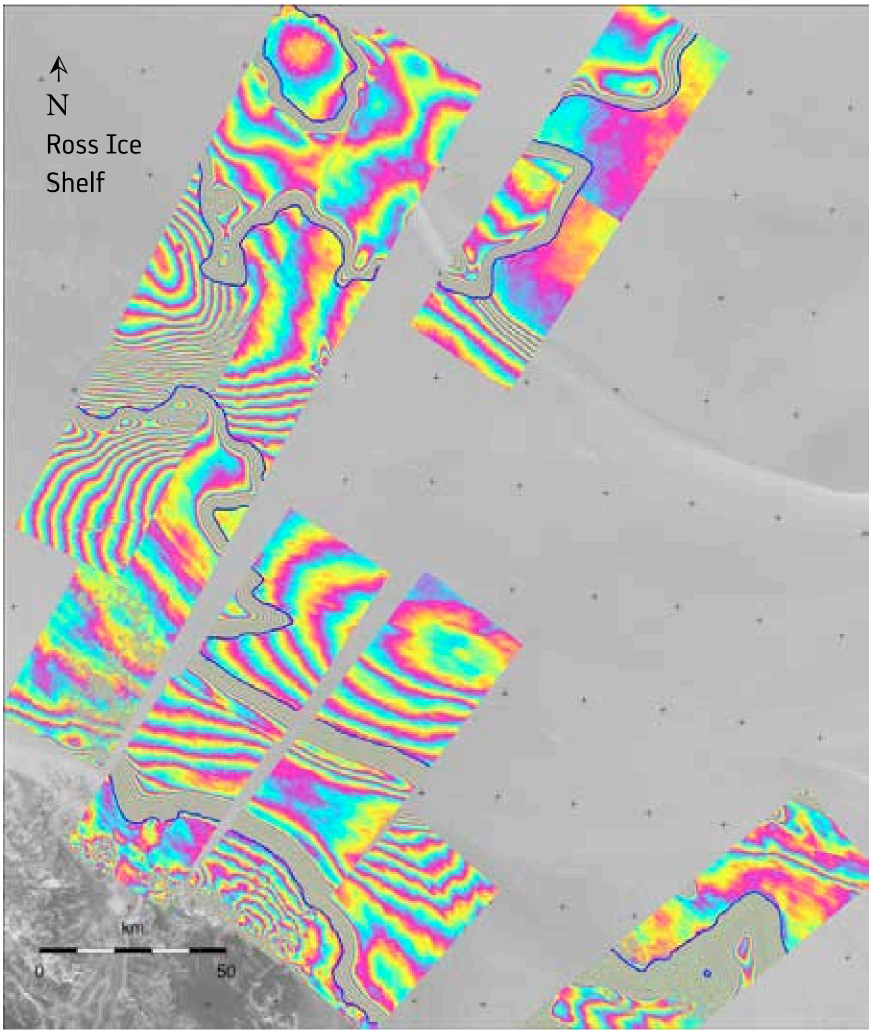
The location of the transition where the ice resting on bedrock detaches and becomes a floating ice shelf is a critical parameter needed for calculations of the ice sheet mass discharge, as well as for modelling ice ocean interactions, ice sheet dynamics, subglacial melt and oceanic tides.

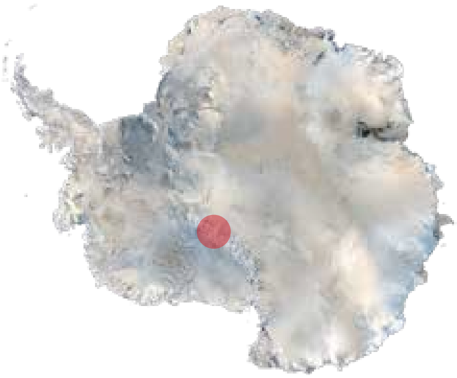
Due to its importance, the grounding line position is one of the key parameters that will be produced within the project.

The retrieval of the grounding line position is based on the influence of the ocean tides on the floating part of the ice which rests in hydrostatic equilibrium. Because this tidal rise is absent on the grounded part of the glacier, a ramp of deformation occurs in the transition area.

Differential InSAR (DInSAR) is the most accurate technique for locating ice sheet tidal deformation. At least two pairs of coherent repeat pass SAR images are required to remove the common effects of ice flow and terrain, isolating the vertical deformation due to tides. The main limiting factor of this technique are the effects of snow accumulation, drift, or melting, which can change the surface scattering properties between the satellite passes and lead to loss of phase coherence in the interferometric data.

Recognising the landward limit deformation can be difficult, as can joining the pixelated grounding locations into a continuous line. The GLL will be derived at key Antarctic ice streams and glaciers identified by the science community.





ABOVE: Grounding Line Location (blue line) at the Ross Ice Shelf derived from repeat pass TerraSAR-X data acquired in 2012 (processing by DLR). Ice deformation at the grounding zone is apparent as a dense fringe belt separating the floating and grounded ice. The grounding line product will consist of a polygon representing the inland limit of tidal flexure.

LEFT: Image of Antarctica showing the Ross Ice Shelf location.

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