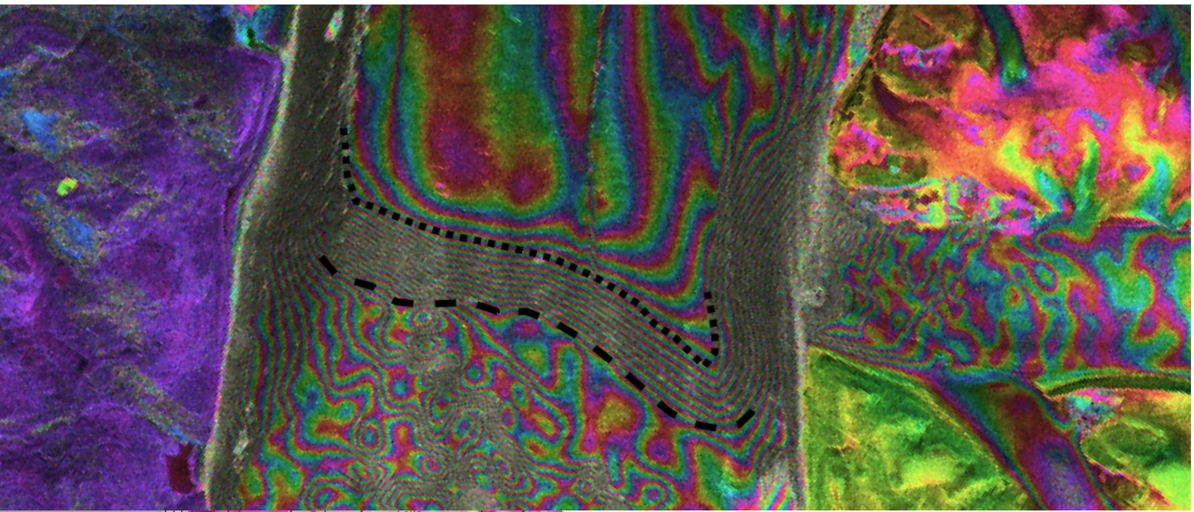
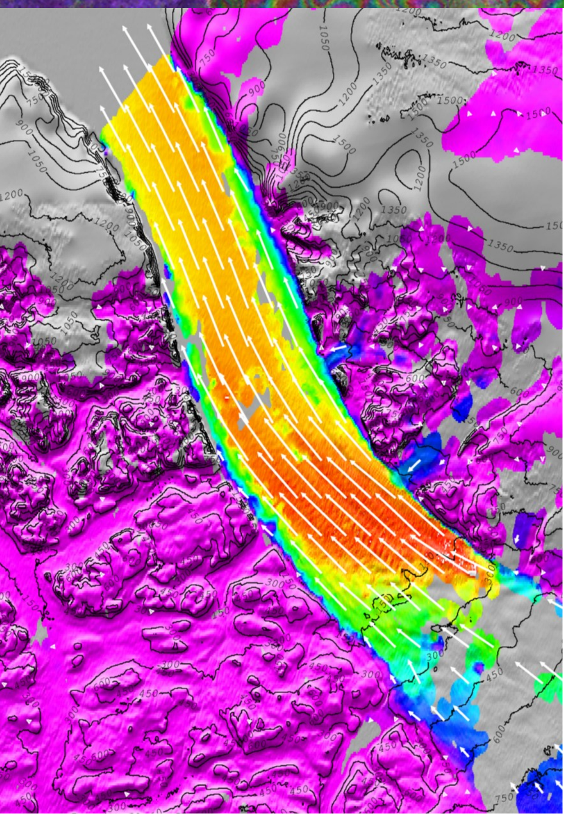
climate change initiative

→ ICE SHEETS NEWSLETTER

Issue n. 3 | September 2013



In this issue:



The Ice_Sheets_cci project releases prototype products

The **ESA Ice_Sheets_cci** has released prototype products for each of the four monitored parameters.

The prototype products demonstrate the format and expected quality of the project output, expected to be finalized in 2014.

For each parameter of the CCI Ice Sheets project, a prototype product is available for download from our products page:

http://products.esa-icesheets-cci.org/

For further instructions on how to download the prototype products turn to page 4.

CCI Antarctica? Fill out our user survey!

To assess the user requirements for satellite-based Antarctic ice sheet data products we have produced an on-line survey, which we invite you, as a possible future user of these data products, to complete.

The short questionnaire comprises 16 multiple choice questions and should take about 10 minutes to complete.

Your recommendations and feedback will influence the focus of a possible future CCI Antarctica Project.

For information on how to access the user survey please turn to page 2.

ABOVE: Detail from Grounding Line Location (GLL) product (see page 4). **LEFT:** Processing of IV data, (for product see page 3) **BOTTOM:** CCI Ice Sheets partner logos.

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Participate in the ESA Antarctic Climate Change Initiative user survey

To assess the user requirements for satellite-based Antarctic ice sheet data products we have produced a short on-line survey which we invite you to complete by September 16th.

In order to complement these existing activities ESA has launched a scoping study. The study will determine the user requirements for satellite data products that should be developed as part of an CCI Antarctica project. Examples of possible Antarctic satellite data products include ice velocity, surface elevation change, and grounding line location. We require information from the scientific community about which products would be most valuable.

We encourage you to fill in the on-line survey. Your input will help determine the user requirements for satellite-based Antarctic ice sheet data products. The questionnaire takes about ten minutes to complete; it contains sixteen multiple choice questions.

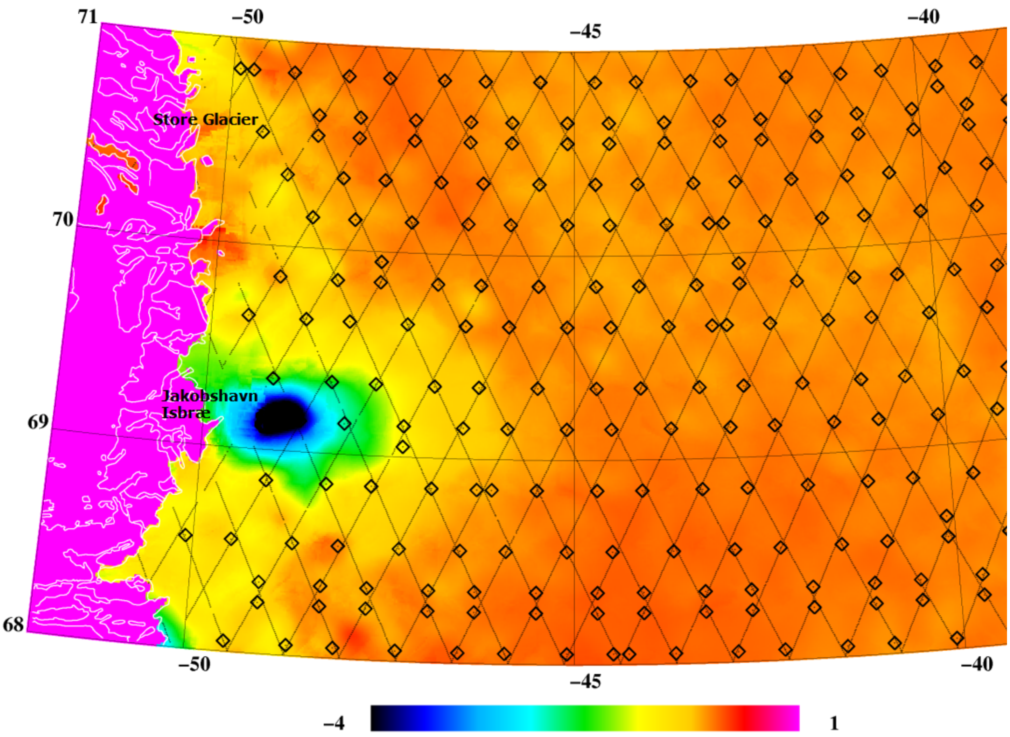
As a reader of the CCI Ice Sheet newsletter you are a possible future user of the CCI Antarctica data products and your input and prioritisations concerning parameters, coverage and product types will be of great use to us.

Please click go to the following URL to respond to the survey:

https://www.surveymonkey.com/s/AntarcticaCCI

The survey will remain open until 16.09.2013.

Your feedback will be used to help us prioritise which Antarctic CCI products should be produced, and help us maximize the scientific and societal outcome of the project.



LEFT: SEC sample product. Example of merged Envisat 2002-2012 SEC product for the Ilulissat/Uummannaq section of the Greenland Ice Sheet, from the coastal margin to the center of the ice sheet (slightly cropped on the right in this newsletter). The colour scale is m/year. The algorithm used is a combination of repeat-track data (lines of points) and cross-overs (diamonds).

Surface Elevation Change

Surface elevation changes of an ice sheet are directly linked to the atmospheric forcing and hence climate changes.

The SEC prototype processing system consists of two different algorithms, crossover and repeat-track, which are merged in order to benefit from the accuracy of the former and the spatial resolution of the latter.

Radar altimeter data from Envisat are used to form the dH/dt estimates. The observation period is 2002–2012. When the processor is ready, ERS-1 and ERS-2 data will be added along with CryoSat-2 and Sentinel-3 data when available. In total, this will expand the observation period from 1991 to the present.

For the cross-over results three-month time periods were used to form time series with a one month time step. For the repeat-track results a least squares approach is used to generate the dH/dt values

Using the geostatistical spatial interpolation technique kriging/collocation, the cross-over and repeat-track results are gridded together. The preliminary results, obtained for the Jakobshavn Isbræ drainage basin, reveals a surface lowering near the glacier outlet and near zero values at higher locations.

Ice Velocity

The IV parameter is used for calculating calving fluxes and detecting glacier changes.

The IV product will be based on a combination of several SAR techniques.

The IV sample product image shows the horizontal velocity magnitude and direction of the Petermann Glacier in North Greenland during the winter 1995/96 derived by applying feature tracking to ERS-2 35 day repeat data and assuming surface parallel flow. The associated error standard deviation is also provided with the downloadable prototype product (see page 4) but not shown in this newsletter.

The IV measured with space-borne SAR and optical sensors represents the mean velocity within a temporal span ranging from the

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satellite repeat-cycle (between 1 and 46 days for past and current sensors) to several months (when measurement sensitivity must be improved or when multiple velocity measurements are combined in order to increase the measurement accuracy). Areas as large as the whole Greenland Ice Sheet are covered by a mosaic of smaller velocity maps representing different time intervals. In the mapping geometry, IV is naturally measured on a uniform grid, which can be resampled to any map-projection given the orbital information and an external digital elevation model.

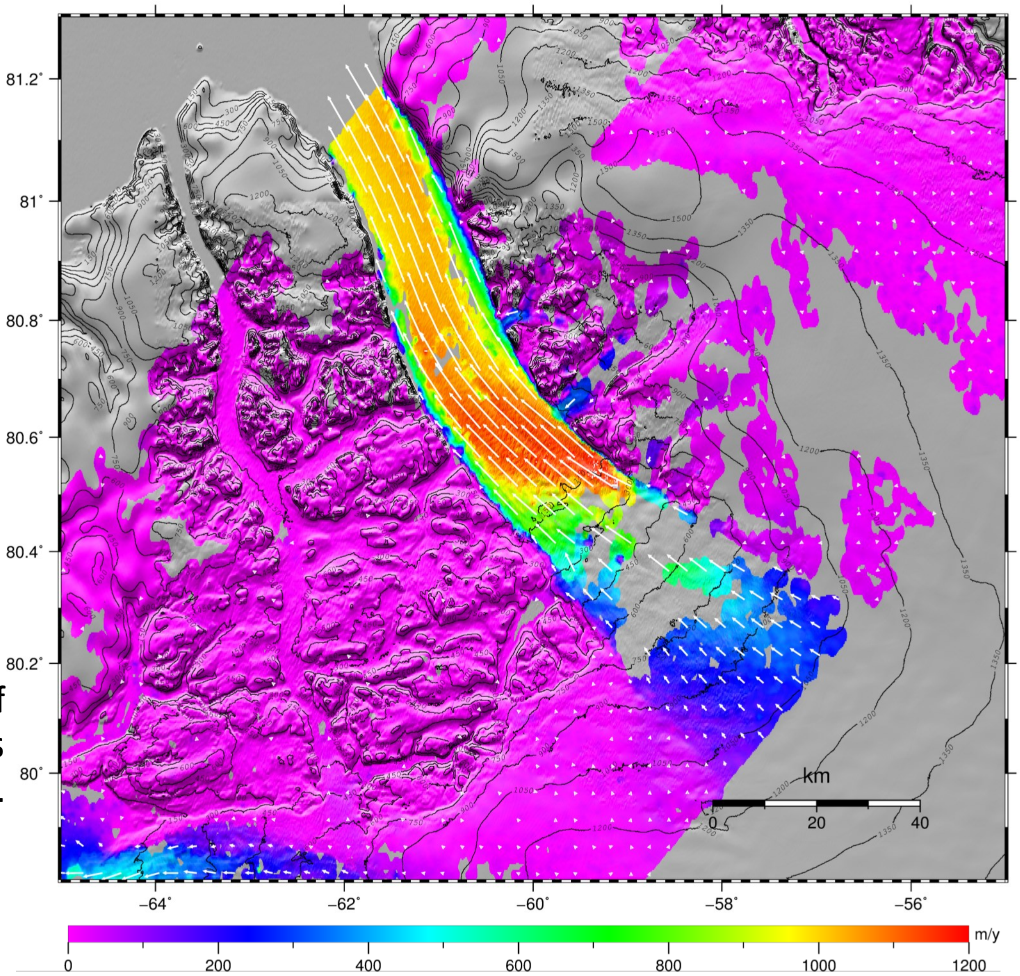
Calving Front Location

The Calving Front Location of outlet glaciers from ice sheets is a basic parameter.

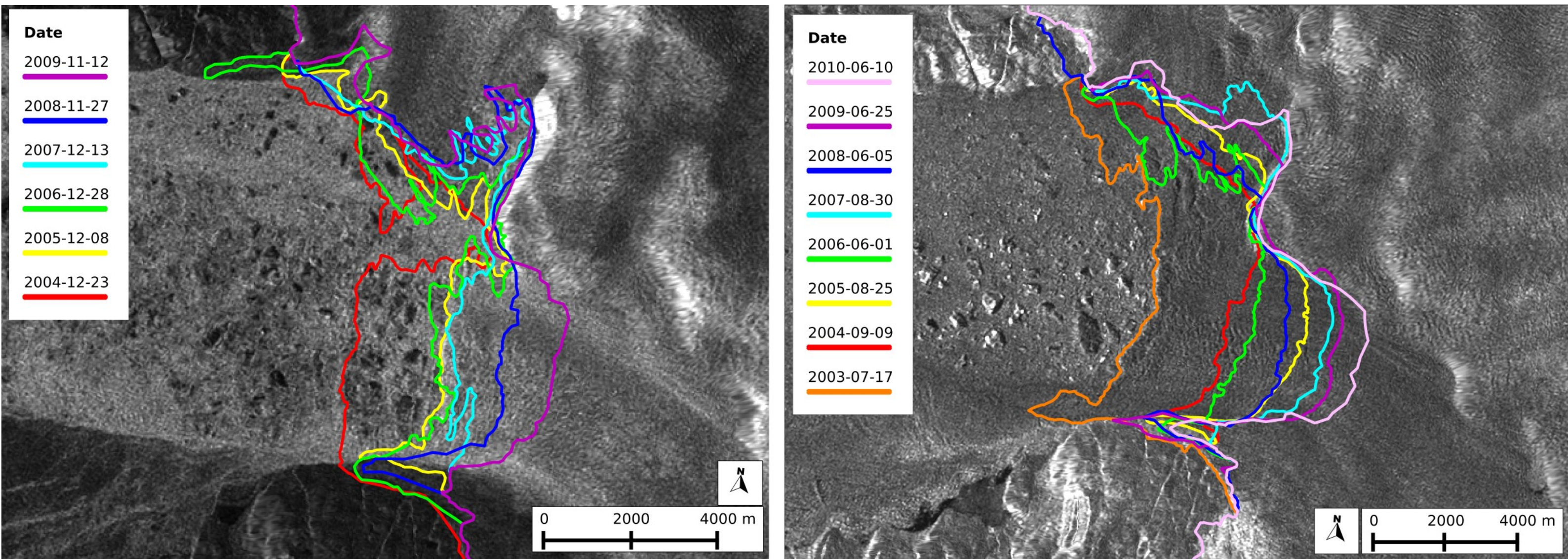
It is used in ice dynamic modelling for computing the mass depletion due to frontal retreat, and for mapping glacier area change.

These images show the terminus position of Jakobshavn Glacier between 2003 and 2010 in the summer and winter season. The calving front locations are obtained from a selection of ENVISAT ASAR images.

The positional accuracy is limited by the pixel size of the map (90 m). The trend in CFL is clearly visible and indicates a general retreat, except for a slight advance in summer 2006. In 2004 the two main trunks of the glacier got separated, a condition that remains until today. The figures also illustrates seasonal variations: in winter the terminus generally extends further downstream than in summer.



ABOVE: IV sample product. Peterman glacier horizontal velocity for the winter 1995/96. The velocity map was retrieved applying feature tracking to ERS-2 35 day repeat data. The associated error standard deviation is also provided with the product (but not shown in here). The gray areas are either not covered by the input SAR data, or no IV measurement could be obtained because of an excessive change of the ice surface features (crevasses etc.) occurring between the two data acquisitions, i.e. over 35 days. The ice free area with the bumpy height contours is naturally stationary (magenta). The flatter ice sheet surrounding the upstream end of the Peterman glacier is moving less than 100 m/year.



BOTTOM: CFL sample product. Time series of Calving Front Location of Jacobshavn Glacier, from ENVISAT ASAR Images. **LEFT:** Winter CFL, background image ENVISAT ASAR 8 December 2005. **RIGHT:** Summer CFL, background image ENVISAT ASAR 17 July 2003.

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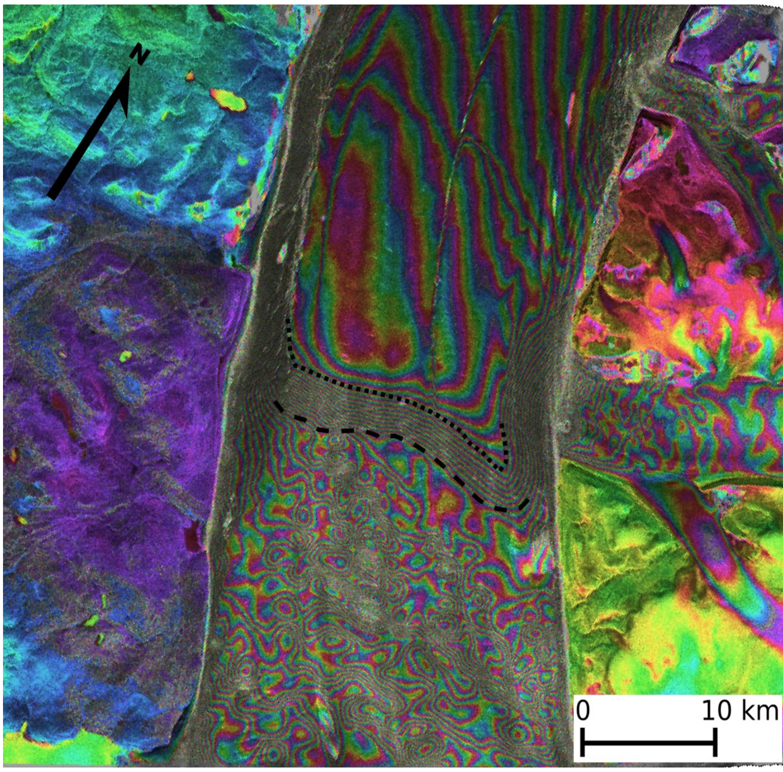
Grounding Line Location

The grounding line separates the floating part of a glacier from the grounded part.

Processes at the grounding lines of floating marine termini of glaciers and ice streams are important for understanding the response of the ice masses to changing boundary conditions and for establishing realistic scenarios for the response to climate change. The grounding line location product is derived from InSAR data by mapping the tidal flexure and is generated for a selection of the few glaciers in Greenland, which have a floating tongue. In general, the true location of the grounding line is unknown, and therefore validation is difficult for this product.

Remote sensing observations do not provide direct measurement on the transition from floating to grounding ice (the grounding line). The satellite data deliver observations on ice surface features (e.g. tidal deformation by InSAR, spatial changes in texture and shading in optical images) that are indirect indicators for estimating the position of the grounding line. Due to the plasticity of ice these indicators spread out over a zone upstream and downstream of the grounding line, i.e. the tidal flexure zone. This is also called the grounding zone.

Currently, manual or semi-automated techniques are applied to map GLL on case-by-case basis. The GLL is derived either from observations of surface deformation, applying differential interferometric SAR, by means of repeat altimetry measurements, or from texture and shape in visible satellite images.



ABOVE: GLL product. Interferogram of the terminus of Petermann Glacier, Greenland, derived from repeat pass SAR data of ERS-1 and ERS-2, 28/29 Oct 1995. One colour cycle (fringe) corresponds to a displacement of 1/2 wavelength (2.8 cm) in the direction of the radar beam. The two lines include the grounding zone (transition from grounded to floating ice). Dashed line: Hinge line (upper limit of the tidal deformation zone). Dotted line: Seaward limit of the tidal deformation zone.

Download the Prototype Products

The CCI Ice Sheet prototype product data will be on-line on September 9th. To download the data, please go to http://products.esa-icesheets-cci.org/ and follow these steps:

Fill in the simplified registration form by clicking on 'register', then enter the following information about yourself:

- Your name in the following form: Firstname.Lastname,
- your organisation, and
- your email address.

Choose your password and click 'Register'. Click 'log in' and provide (again) your name on the form Firstname.Lastname, and the password you previously picked. The SEC, IV, CFL and GLL prototype products may now be downloaded.

Outreach, Conferences, and Publications

Since the last issue of our newsletter, our team has given the following talks:

R. Forsberg, L. S. Sørensen, J. Levinsen, D. Evensberget, M. Kamstra, S. B. Andersen, J. Dall, A. Kusk, C. Hvidberg, K. Khvorostovsky, T. Nagler, K. Scharrer, A. Shepherd, F. Ticconi. "Ice_Sheets_cci: Essential Climate Variables for the Greenland Ice Sheet" ESA-Clic Earth Observation and Cryosphere Science, Frascati, November 2012. A revised version will be presented at the ESA Living Planet Symposium, Edinburgh, September 2013.

J. Levinsen, K. Khvorostovsky, F. Ticconi. "Validation and intercomparison of surface elevation changes derived from altimetry over the Jakobshavn Isbræ drainage basin, Greenland – Round Robin results from ESA's Ice_Sheets_cci" European Geosciences Union (EGU) meeting. Vienna, April 2013.

F. Ticconi, J. Levinsen, K. Khvorostovsky, R. Forsberg, A. Shepherd. "Preliminary Results of the Ice_Sheets_cci Round Robin Activity on the Estimation of Surface Elevation Changes" IGARSS. Melbourne, July 2013.

Newsletter published by Science [&] Technology AS for the **ESA Ice_Sheets_cci** project **www.esa-icesheets-cci.org.** Contributors: CCI Ice Sheets science team. Editor: D. Evensberget, evensberget@stcorp.no