climate change initiative

GREENLAND ICE SHEET NEWSLETTER

Issue n. 8 | November 2017

Greenland_Ice_Sheet_cci – New Data Products are released

The Greenland_Ice_Sheet_cci project (2015-2018) is now closing in on final activities in April 2018.

The Greenland_Ice_Sheet_cci project processes and provides Essential Climate Variables (ECV's) for the Greenland Ice Sheet, as part of the ESA CCI program.

This newsletter summarizes updated and new data sets, provided to users on the updated project data website; **http://products.esa-icesheets-cci.org/**

The ECV parameters provide consistent, long term data sets for climate modeling and sea level changes. The data series go back to the first ERS measurements in 1991, or whenever data is available for particular ECV's.

The following ECV parameters are computed and updated at regular intervals:

- Surface Elevation Change (SEC),
- Ice Velocity (IV),
- Grounding Line Location (GLL),
- Calving Front Location (CFL),
- Gravimetric Mass Balance (GMB).

GMB is the new ECV in Phase 2.

See download guide on last page.

In this issue:

Surface Elevation Change (SEC) - New Data Product - Altika

As weather conditions are directly leaving imprints in the accumulated snow on the Greenland ice sheet, the snow column properties

are continually evolving. The Ku-band radar altimeter onboard Cryosat-2 penetrates the upper snow, and is highly susceptible for the presence of ice lenses (Nilsson et al. 2015, Simonsen & Sørensen 2017). We have in the Greenland CCI added a new experimental product of surface elevation change based on data from the AltiKa-instrument onboard the France (CNES)/Indian (ISRO) SARAL satellite (Verron et al. 2015). The AltiKa altimeter utilizes Ka-band radar signals, which have less penetration in the upper snow. However, the surface slope and roughness has an imprint in the derived signal and the new product is only available for the flatter central parts of the Greenland ice sheet. Se figure for the 2013-2016 AltiKa elevation change product.

References:

Nilsson, J. et al., 2015. Greenland 2012 melt event effects on CryoSat-2 radar altimetry. Geophysical Research Letters, 42(10), pp.3919–3926.

Simonsen, S.B. & Sørensen, L.S., 2017. Implications of changing scattering properties on Greenland ice sheet volume change from Cryosat-2 altimetry. Remote Sensing of Environment, 190, pp.207–216.

Verron, J. et al., 2015. The SARAL / AltiKa Altimetry Satellite Mission The SARAL / AltiKa Altimetry Satellite Mission. Marine Geodesy, 38, pp.2–21.

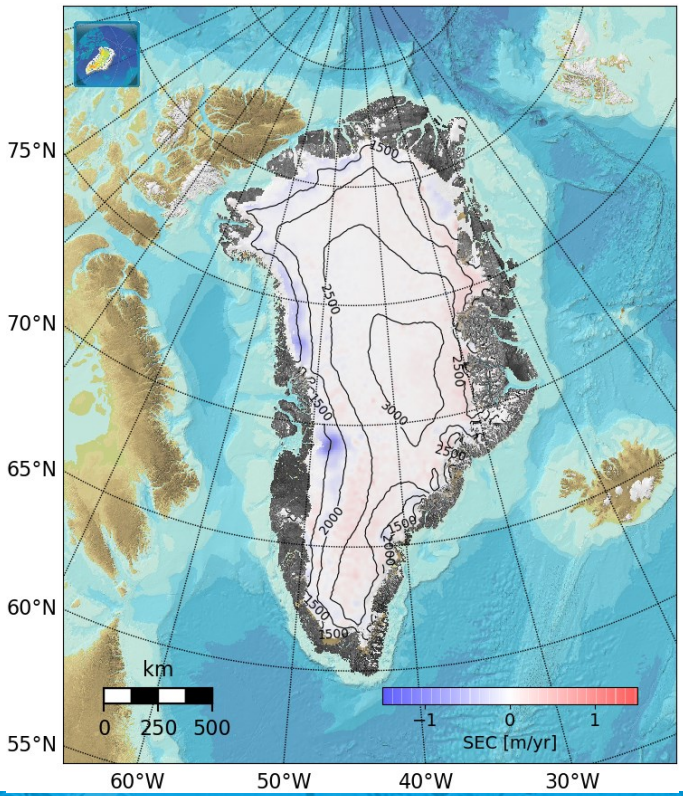

FIGURE: Surface elevation change (SEC) seen from the AltiKa instrument.

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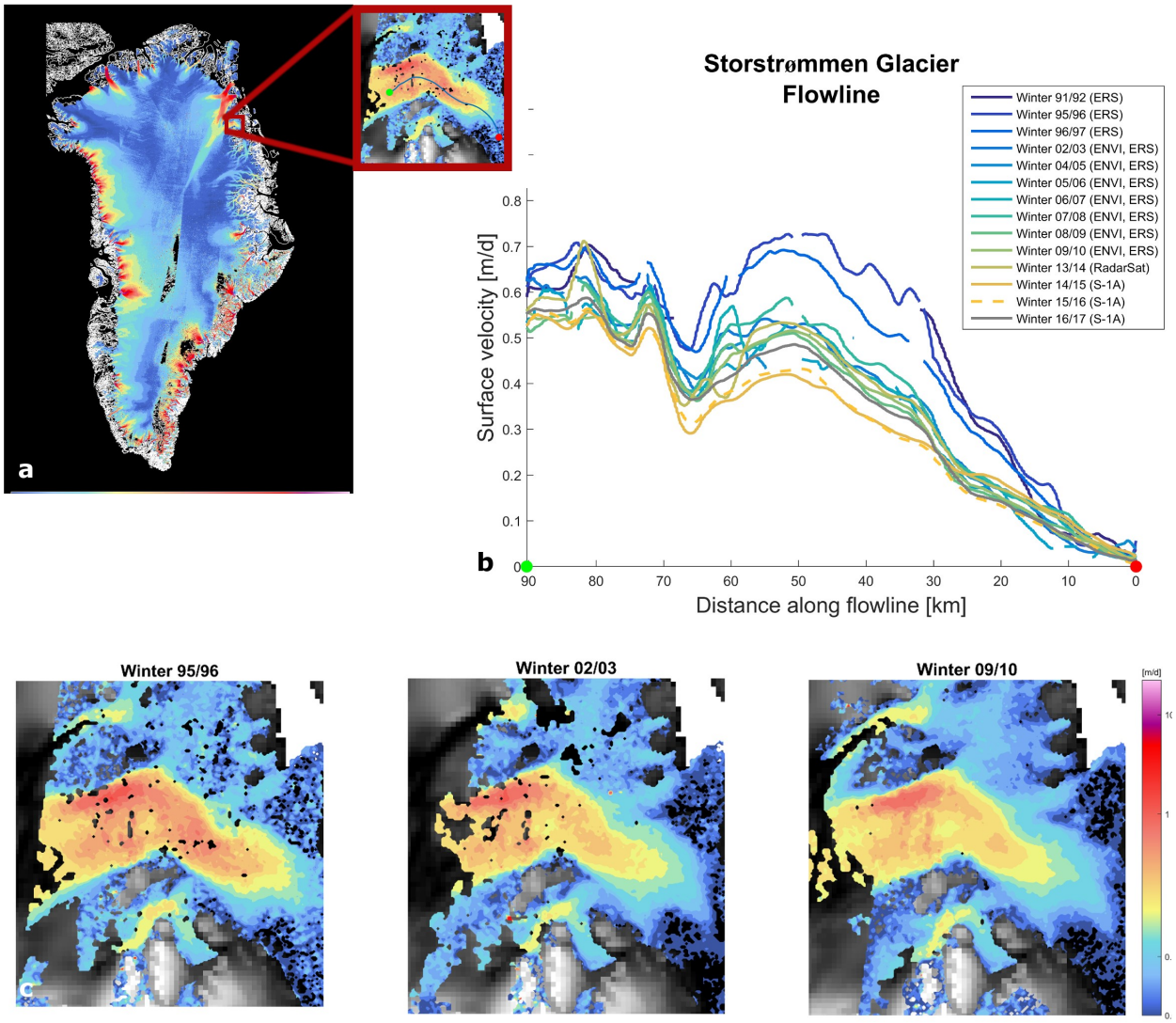
Ice Velocity (IV) - SAR - New Data Product - ERS-1/2 and Envisat

Storstrømmen Glacier has now been added to the long time series of ice-velocity.

Previously, only a few maps covering Storstrømmen were included. The time series span the period from October 6th 1991 to March 20th 2010 and consists of 69 maps derived from ERS-1/2 and Envisat SAR data. Examples of Storstrømmen Glacier ice-velocity are displayed in figure below, both in plane view as well as along a flowline using all available CCI Greenland ice-velocity data derived from SAR spanning the period 1991 to 2017. The glacier surged in the 1980's and the figures show that the glacier has slowed down over the period spanned by the CCI Greenland data.



F IGURE: Overview of Storstrømmen Glacier including the position of the flowline used in b. b: Winter velocites along the flowline shown in a. The green and red dots mark the start and end of the flowline, respectively. c: Examples of winter velocities using the time series data.

Four of the time series going back in time using SAR data from past ESA missions have been updated: Since the start of 2000, most of the gyros on board ERS-2 were not working. This caused large variations in the antenna pointing, leading in some cases to an aliasing phenomenon (Doppler ambiguities) causing large (~5km) shifts of the focused radar images in the satellite flight direction. By geocoding the individual focused images and comparing to an external radar intensity map, the absolute Doppler ambiguity of each image could be determined, and a refocusing using the correct Doppler ambiguity carried out. Using this approach, 250 image pairs were revisited. For each pair, it was manually determined which image was shifted or whether the offset tracking failed due to low data quality. In the end, 70 images were refocused and 25 new maps have been added to the following time series: Hagen Glacier, Zachariae Isstrøm and 79-fjord Glacier, Petermann Glacier and Helheim Glacier.

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Ice Velocity (IV) - SAR - Updated Data Products – Sentinel-1

The enhanced imaging capabilities of Sentinel-1A and 1B and the systematic acquisition planning of the polar regions by ESA form the basis for the development and implementation of an operational system for monitoring ice dynamics and discharge of Greenland, Antarctica and other polar ice caps. Within the framework of the ESA CCI an automatic system for generation of IV maps from repeat pass Sentinel-1 TOPS mode data is implemented by ENVEO applying advanced iterative offset tracking.

The Greenland winter acquisition campaigns, consisting of 4 to 6 repeat track observations acquired within a few weeks, provide nearly gapless and seamless ice sheet wide IV maps on a yearly basis. Besides the ice sheet wide campaigns, the Sentinel-1 acquisition plan allows for nearly continuous monitoring of the Greenland and Antarctic ice sheet margins. With repeat acquisitions now reduced to 6 days, this provides an unprecedented insight in short-term variations of ice flow even in regions with high accumulation rates and velocities.

The IV timeseries are important for ice sheet modelling and accurate mass balance assessments and provide an important benchmark for gauging future changes in ice dynamics. Continuous monitoring of ice streams, exploiting both satellites and new approaches for efficient processing and data analysis, is ongoing to detect changes of ice flow as indicators of climate change.

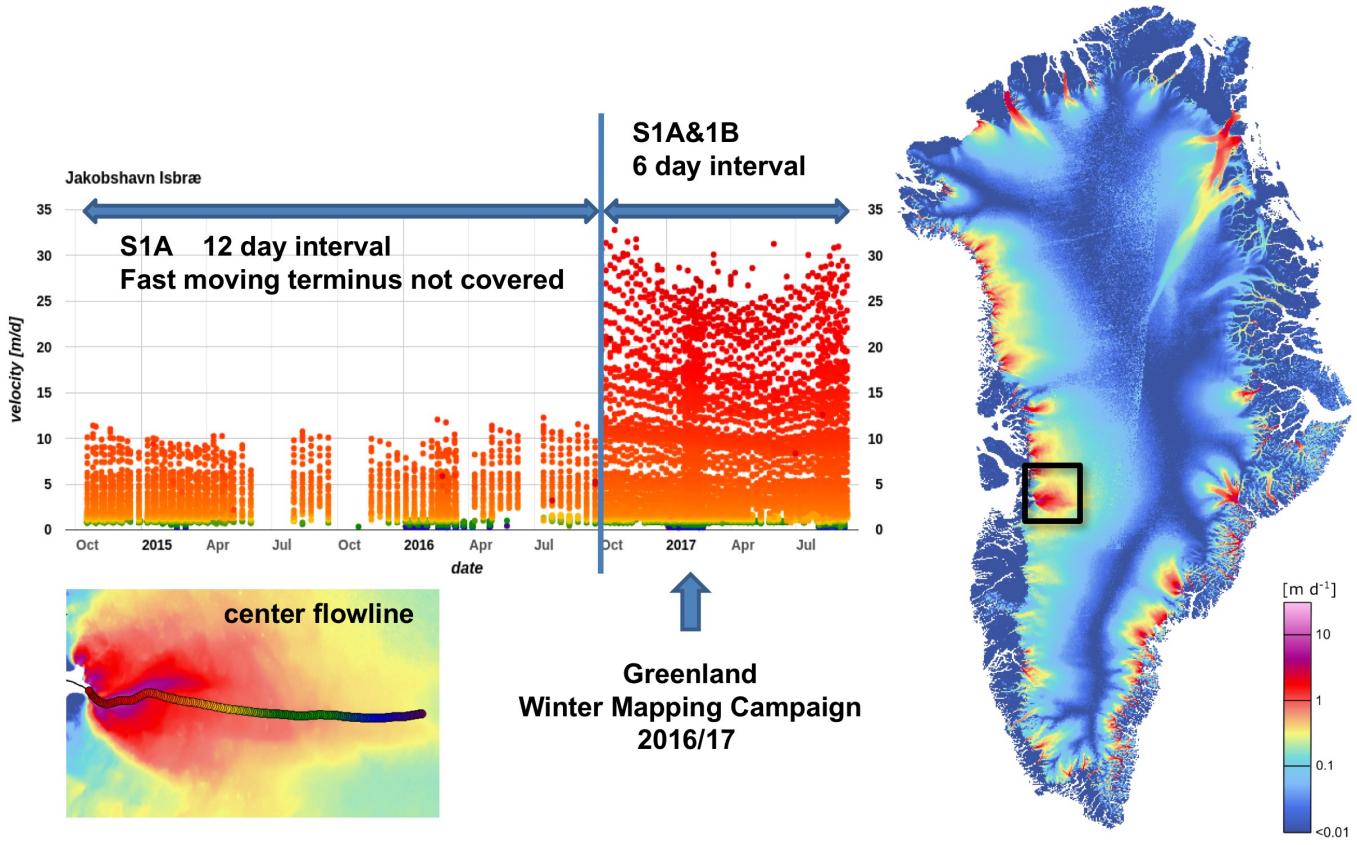

FIGURE: Greenland 2016/2017 ice sheet velocity and temporal evolution of ice velocity at points along the center flowline of Jakobshavn Isbrae (see inset) derived from Sentinel-1 SAR data. The figure illustrates the increased sampling and improved coverage for fast flowing glaciers enabled using the twin constellation.

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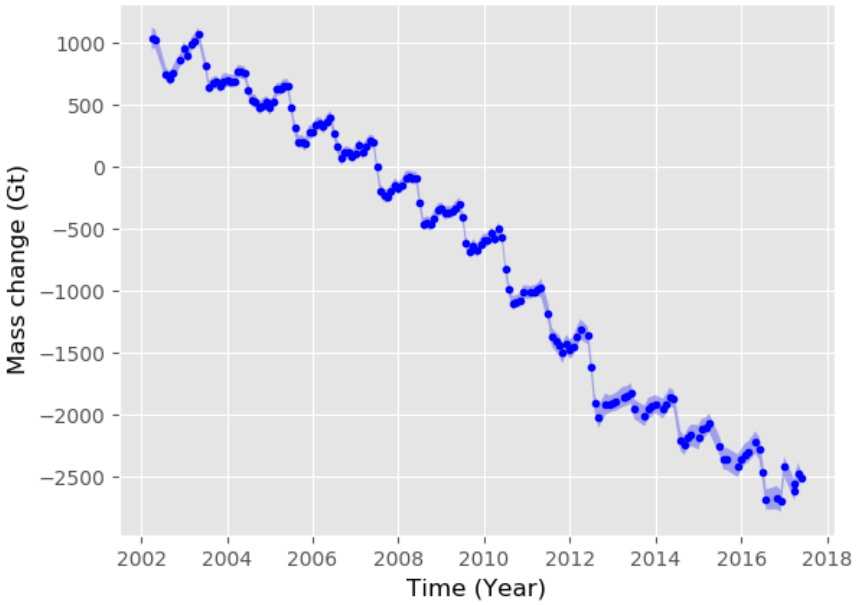
Gravimetric Mass Balance (GMB) – Updated data product – GRACE coming to an end

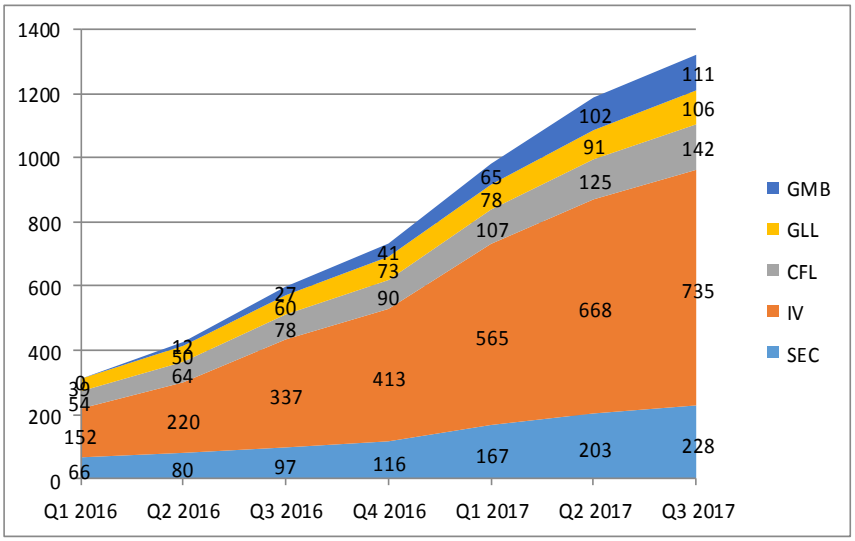
The GRACE time series from DTU have also been updated, patching in latest CSR solutions as extensions until June 2017, the last epoch of the GRACE mission.

This ends most likely the GRACE GMB data, as the mission is now over, and both GRACE-1 and GRACE-2 will de-orbit the coming months.



F IGURE: The DTU Space CCI GRACE monthly time series for the entire Greenland

Data Product Traffic – Accumulated Downloads from project data product web



The trend on data product usage is very encouraging.

On the CCI Data Portal we have passed 230 users for a total of 2230 accesses to our data products.

On the project data product website we have passed 500 unique users and accumulated more than 1320 downloads.

FIGURE: The figure shows accumulated downloads per ECV on our project data product website per Q3 2017.

Download Data Products

Instructions on how to download data products

Enter the Greenland_Ice_Sheet_cci project website; http://esa-icesheets-greenland-cci.org/ and click your way to the product portal; http://products.esa-icesheets-cci.org/.

For inquiries or if you experience problems with our websites, please contact Science [&] Technology AS, Andreas Thorvaldsen, thorvaldsen@stcorp.no.

Products from all of ESAs CCI projects are collected and made openly available on the CCI Open Data Portal; **http://cci.esa.int/data**

IV products by ENVEO are also available for download directly from the ENVEO CryoPortal; **http://cryoportal.enveo.at/**

GMB products by TU Dresden are also available for download directly from **https://data1.geo.tu-dresden.de/gis_gmb/**

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