

Rapid Thinning And Retreat Of Marine Terminating Outlet Glaciers In Northeast Greenland

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Introduction



During the last few decades, the Greenland ice sheet has experienced strong environmental changes. The most harsh and rapid of these have occurred particularly in the west and southeast of Greenland and have been well reported. The northeast of Greenland is yet to experience this transformation, which provides an excellent opportunity to observe the development of the ice sheet. Therefore, the present study aims at observing the evolution of outlet glaciers of this area with SAR data from the past and present. Consequences of regional climate warming are surface melting, speed-up of outlet glaciers and a retreat of the calving front location (CFL). We investigate these with TanDEM-X (TDM) and TerraSAR-X (TSX) satellite data.

■ Zachariae Isstrøm and Nioghalvfjersfjorden (79 deg Glacier) ■ Dagaard-Jensen

TanDEM-X DEM Differencing

- Multiple DEMs from bistatic TDM acquisitions are processed with the Integrated TDM Processor (ITP)
- DEM time series is adjusted to the absolute elevation of the operational TDM global DEM over ice free terrain
- Alternatively, DEMs are registered to previously corrected, coincident TDM acquisitions
- The DEMs are subtracted from each other to visualise surface elevation changes (SEC)
- Correction for SAR signal penetration in ice and snow must be considered

Dagaard-Jensen

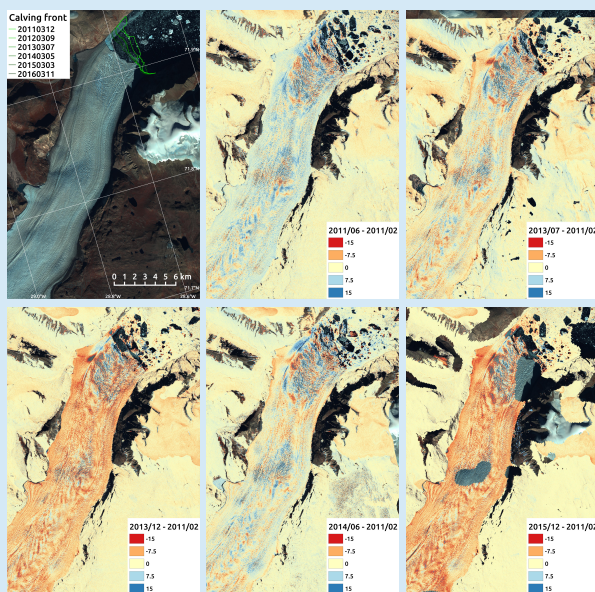


Figure 1: Surface elevation changes on Dagaard-Jensen show no pronounced thinning over time and are attributed mainly to seasonal effects. The front of Dagaard-Jensen is displayed on a Sentinel-2 Color Infrared image (2016-09-05) and has retreated approx. 700m since 2011.

References

- Khan, S. A. *et al.* Sustained mass loss of the northeast Greenland ice sheet triggered by regional warming. *Nature Climate Change* **4**, 292-299 (2014).
- Joughin, I. *MEaSUREs Greenland Ice Sheet Mosaics from SAR Data* 2015.

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Zachariae Isstrøm and 79 deg Glacier

Zachariae Isstrøm (ZI) and Nioghalvfjersfjorden (NI) are two main outlet glaciers of the Northeast Greenland Ice Stream (NEGIS), which is of particular interest, because it drains approx. 16% of the whole ice sheet [1].

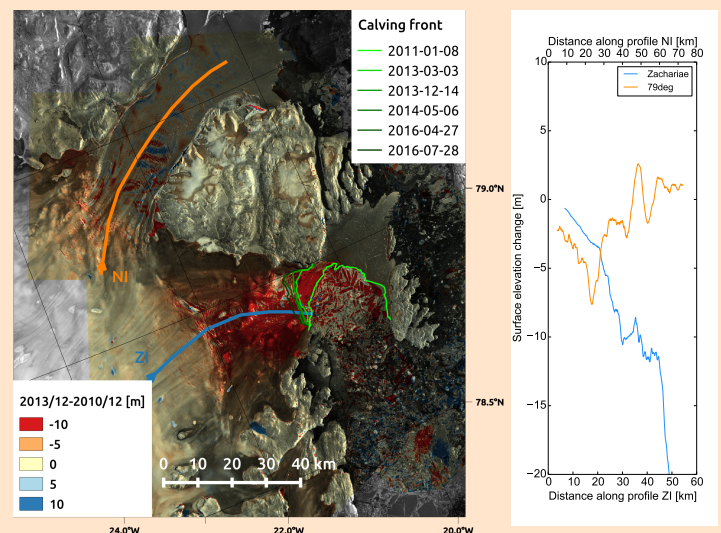


Figure 2: The difference of mosaicked TDM (2013/14) and TDM (2010/11) elevations for Zachariae Isstrøm (east flowing) and Nioghalvfjersfjorden (north flowing). TDM elevations have been vertically co-registered to the operational TDM global DEM over ice free terrain. In the background a RADARSAT-1 SAR amplitude mosaic from 2012-2013 [2]. Since 2011, the front of ZI retreated approx. 4.4 km.

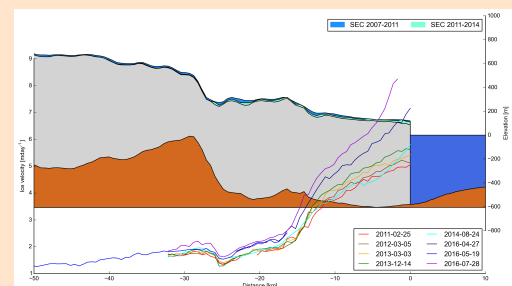


Figure 3: A cross section of Zachariae Isstrøm along profile ZI shows the deflation of the frontal part of the glacier. A second DEM differencing has been performed with elevations from the Greenland Ice Mapping Project (GIMP) dated to 2007. Additionally, the ice velocities derived from TSX acquisitions have been plotted for the profile ZI.

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