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OSPA participant

Rapid iceberg calving following removal of tightly packed pro-glacial mélange at Jakobshavn Isbræ, Greenland

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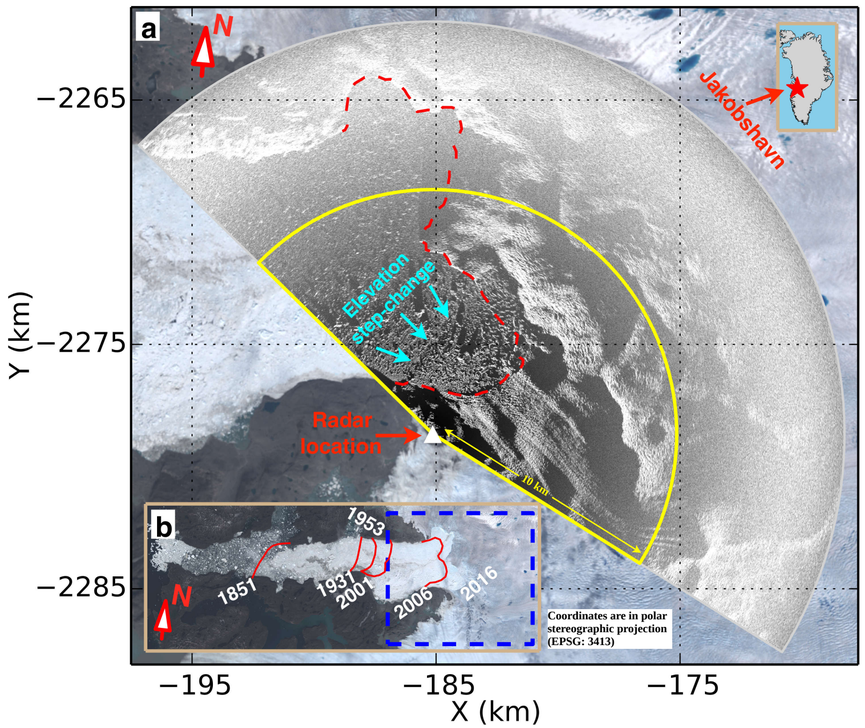
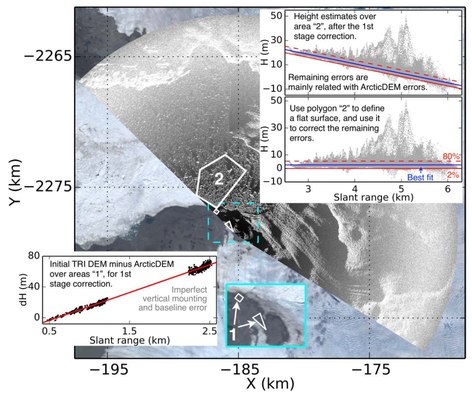
Abstract:

- A new radar-based approach was developed to estimate time-varying elevations near the terminus of Jakobshavn Isbræ.
- No major calving events occurred at Jakobshavn Isbræ over a one-month period from late May to late June 2016.
- An unusually thick mélange wedge that increases in thickness towards the glacier front was observed.
- The extent and thickness of the mélange wedge gradually decreased and large-scale calving began after significant reduction of buttressing force.



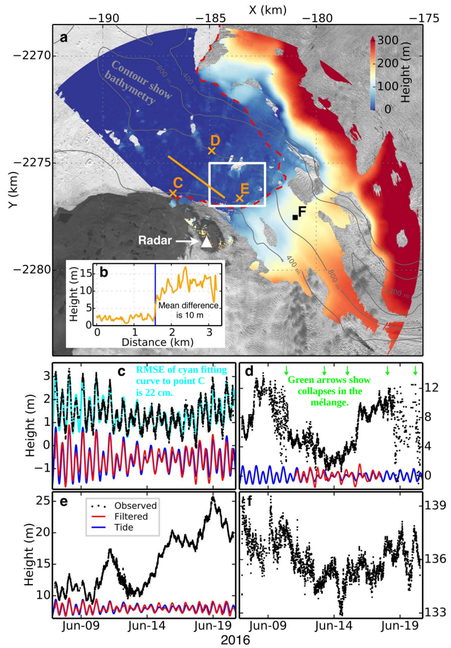
TRI set-up at Jakobshavn Isbræ:

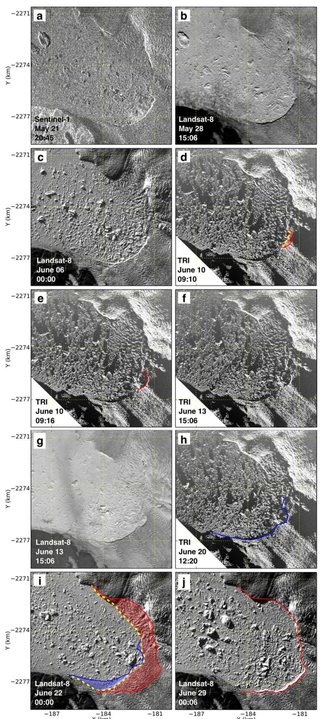
1) The terrestrial radar interferometer (TRI) used is a real-aperture radar operating at Ku-band (1.74 cm wavelength), and is sensitive to line-of-sight (LOS) displacement of ~1 mm.
2) The antennas are rigidly attached to a rack structure, which sits on a motor that rotates around a fixed vertical axis. The instrument was protected by a radome to eliminate disturbance from wind and rain.
3) Scanned arc: 170°; Repeat time: 2 min; Maximum distance: ~17 km; Campaign period: 7 June to 20 June in 2016.
4) The resolution of range measurement is ~1 m, the azimuth resolution varies linearly with distance. All results were resampled into 10 m × 10 m pixel spacing maps.
5) To minimize water vapor effects, data within 10 km of the radar were used.



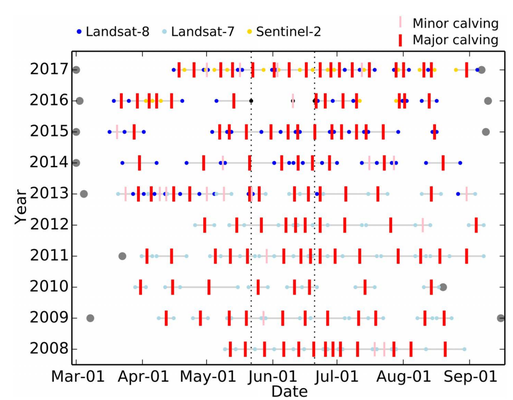
TRI-derived elevations:

1) ArcticDEM (Polar Geospatial Center at U. Minnesota) was used to correct errors due to imperfect vertical mounting of radar and baseline error.
2) Tide-induced elevation changes of the the mélange are well represented by TRI-derived elevation time series.
3) A 10 m elevation step-change in the mélange was observed.
4) The mélange was unusually thick, hundreds of m thick.





Ice loss due to iceberg calving over 40 days bracketing the TRI campaign.

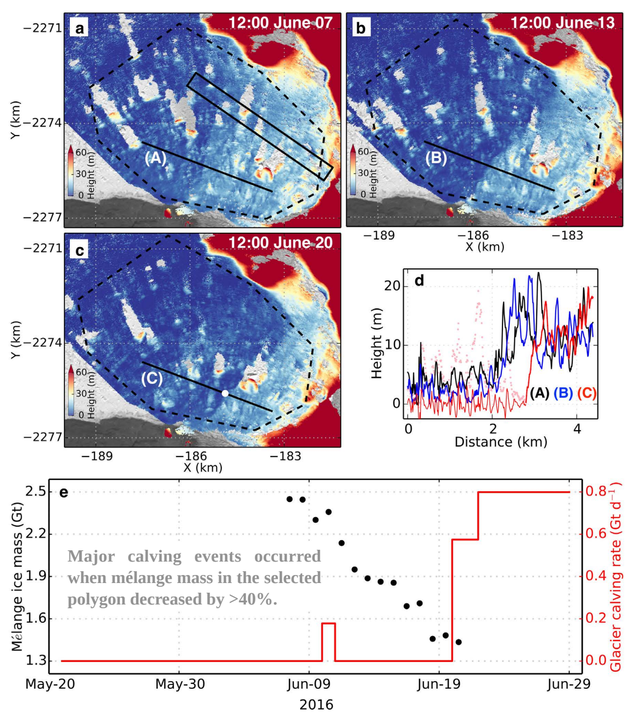


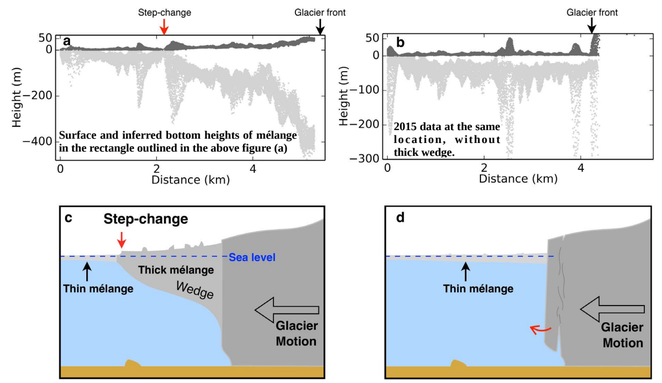
Calving events inferred from TRI and satellite images

A period of glacier quiescence:

1) In a month between 21 May 2016 and 20 June 2016, no major calving events (defined as block size >0.25 km² and causing significant mélange motion) occurred. This is unusually long compared to other years at the same time of year.
2) A sequence of calving-like events (collapses of tightly-packed mélange) moved the elevation step-change towards the glacier.
3) Major calving events occurred when large amount of mélange advected away by calving-like collapses.

For elevation change and calving-like collapse movies, please watch on Surui's tablet.





Our conclusion: Thick pro-glacial mélange suppresses iceberg calving.

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