Channelized Antarctic ice shelf melting from high-resolution remote sensing

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Why?

Ice shelf instability plays a key role in the uncertainty in sea level rise projections from Antarctica.

Basal melting is key parameter, but the quantitative understanding of this process is limited.

Basal melting is determined by fine scale processes (e.g. channelized basal melting) that until recently were difficult to quantify.

Opportunity

High-resolution, multi-source satellite products (e.g., REMA strips + Cryosat-2) offers the opportunity to quantify channelized melting for all ice shelves across Antarctica.

In this study

We present:

- a methodology to develop high-resolution indicators of basal melt from REMA strips over ice shelves
- a sensitivity analysis to assess the performance of the methodology if function of the co-registration method with:
    - Operation IceBridge (OIB)
    - Cryosat-2
    - REMA mosaic
- for a test case over Dotson ice shelf

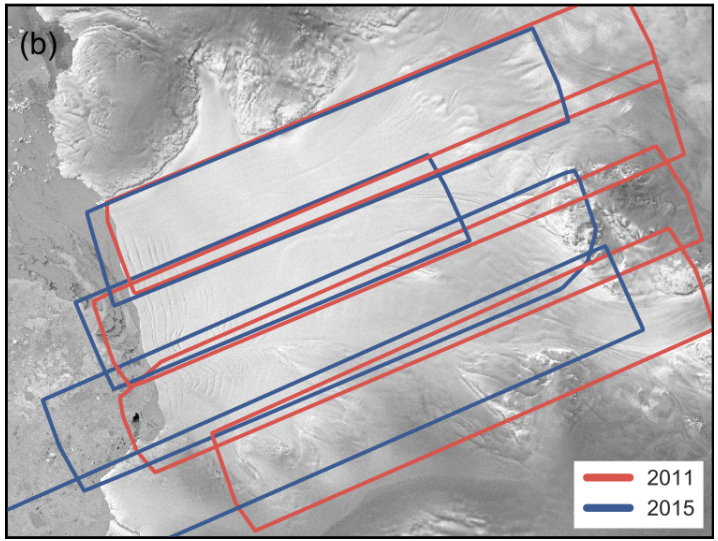
Methodology

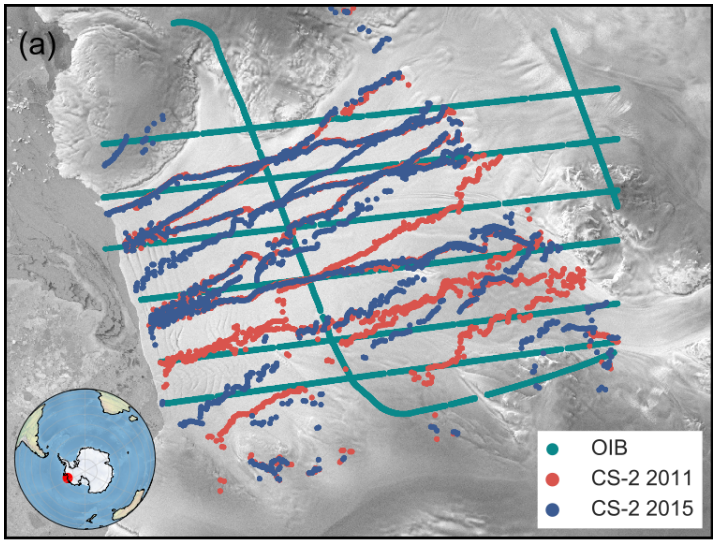
REMA strips uncorrected

OIB Elevation

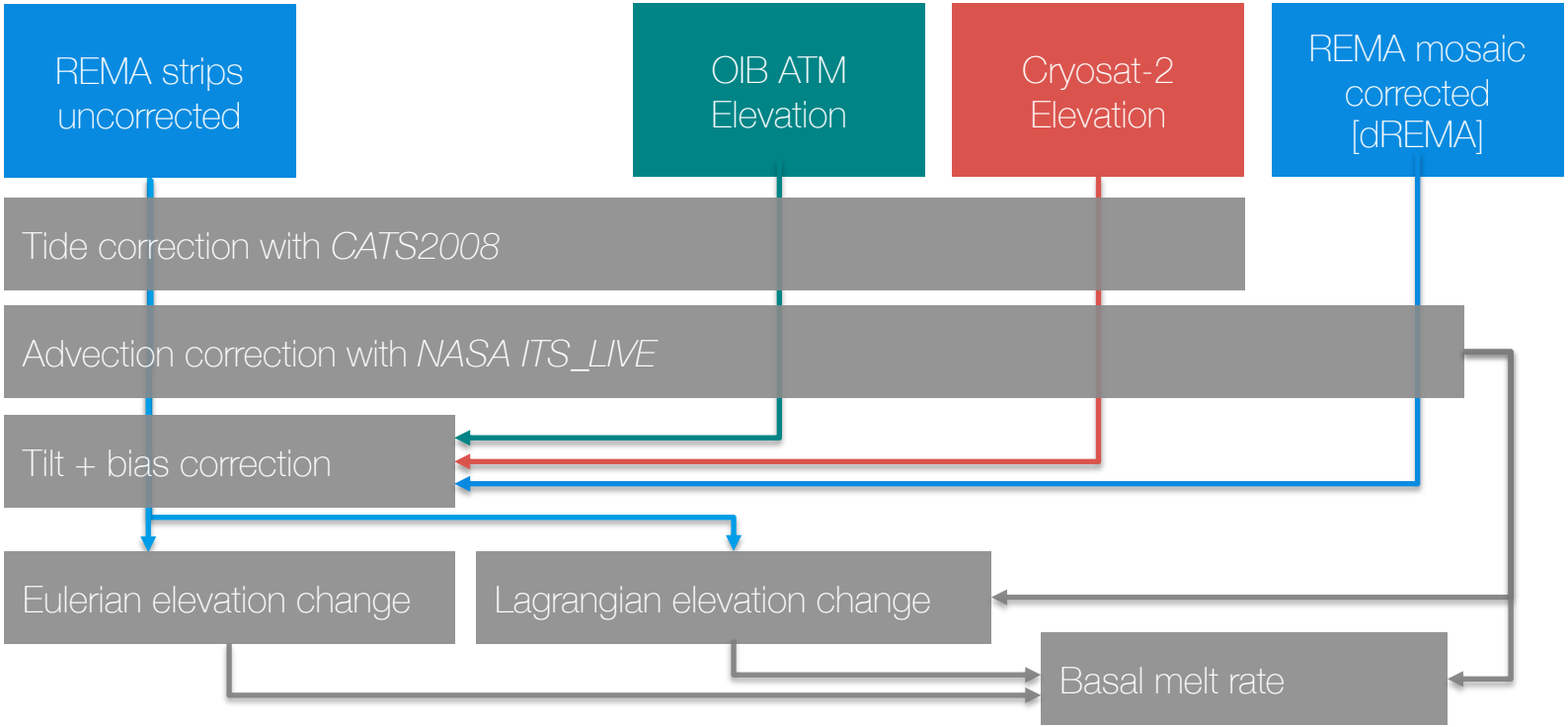
Cryosat

REMA mosaic corrected





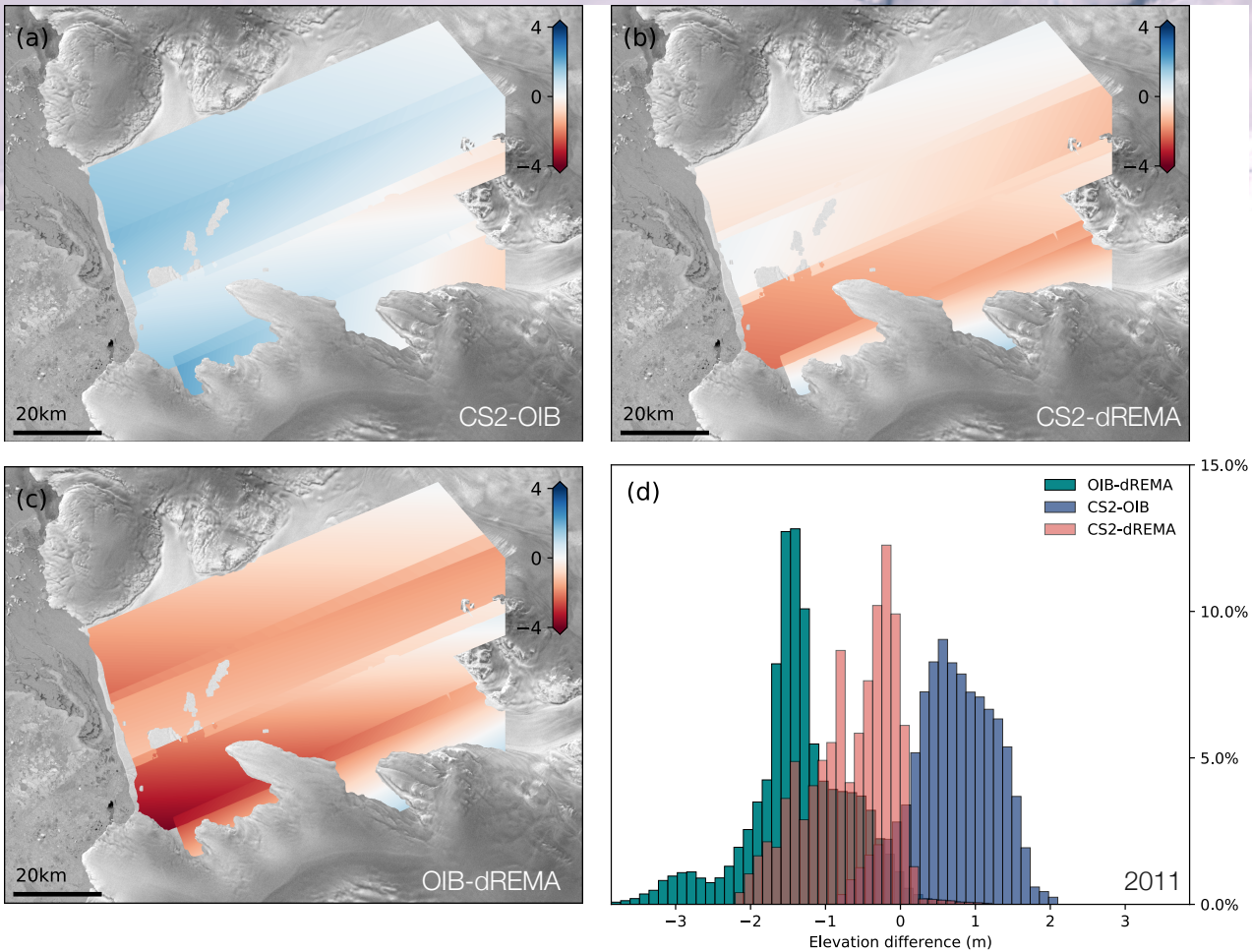
Methodology



Co-registration

Artefacts of imperfect tilt and bias offsets between individual strips are notable for each method.

Co-registration uncertainty often below 1m.



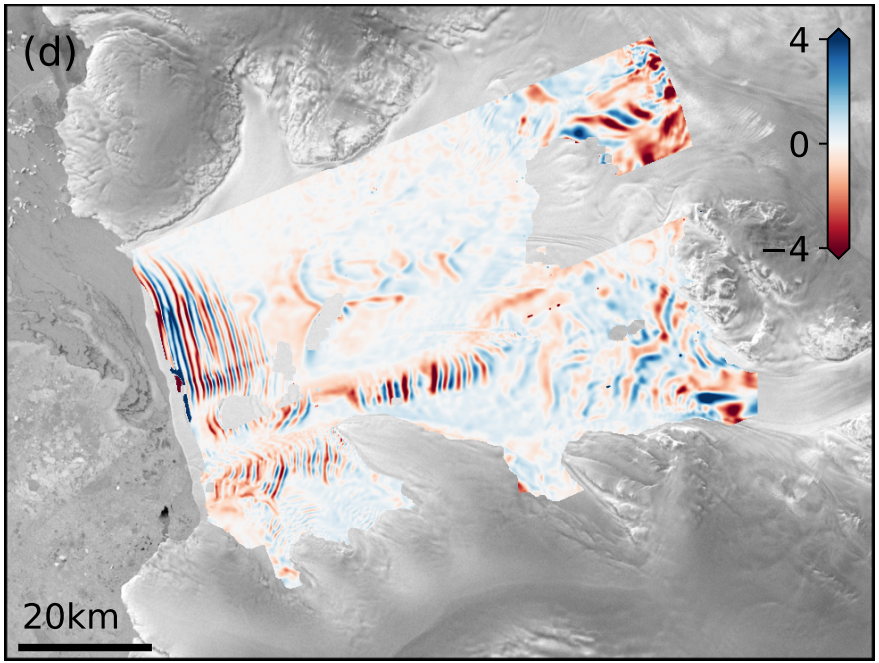
Eulerian framework

Eulerian elevation change shows:

Advection of topographic features

Mean ice shelf surface elevation change -2-15 cm / year depending on methodology.

Local features where elevation lowering of >2 m /year

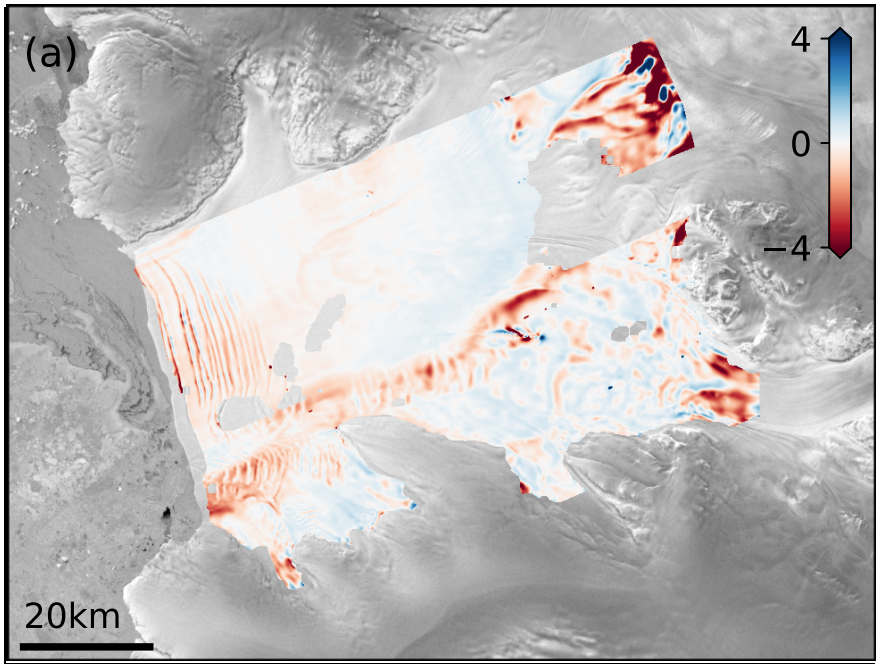


Lagrangian framework

Lagrangian elevation change shows:

Channelized melting with local thinning rates > 15 m /year

Consistent with Gourmelen *et. al.* (GRL, 2017), but with increased spatial resolution (< 10 m)



Conclusion

REMA shows the potential to derive high resolution basal melt products.

We are currently working on finetuning/upscaling the methodology to apply across all Antarctic ice shelves.

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