Seasonal-to-decadal geodetic mass balance of Hofsjökull, 2003–2020, based on time-series analysis of DEMs

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Cryosphere 2022, 25 Aug 2022.
Safnarhús auditorium, Reykjavík, Iceland

LANDMÆLINGAR ÍSLANDS
VEÐURSTOFA ÍSLANDS 1920-2020
UNIVERSITAS ISLANDIAE SIGILLUM
UNIVERSITY OF ICELAND INSTITUTE OF EARTH SCIENCES
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LEGOS
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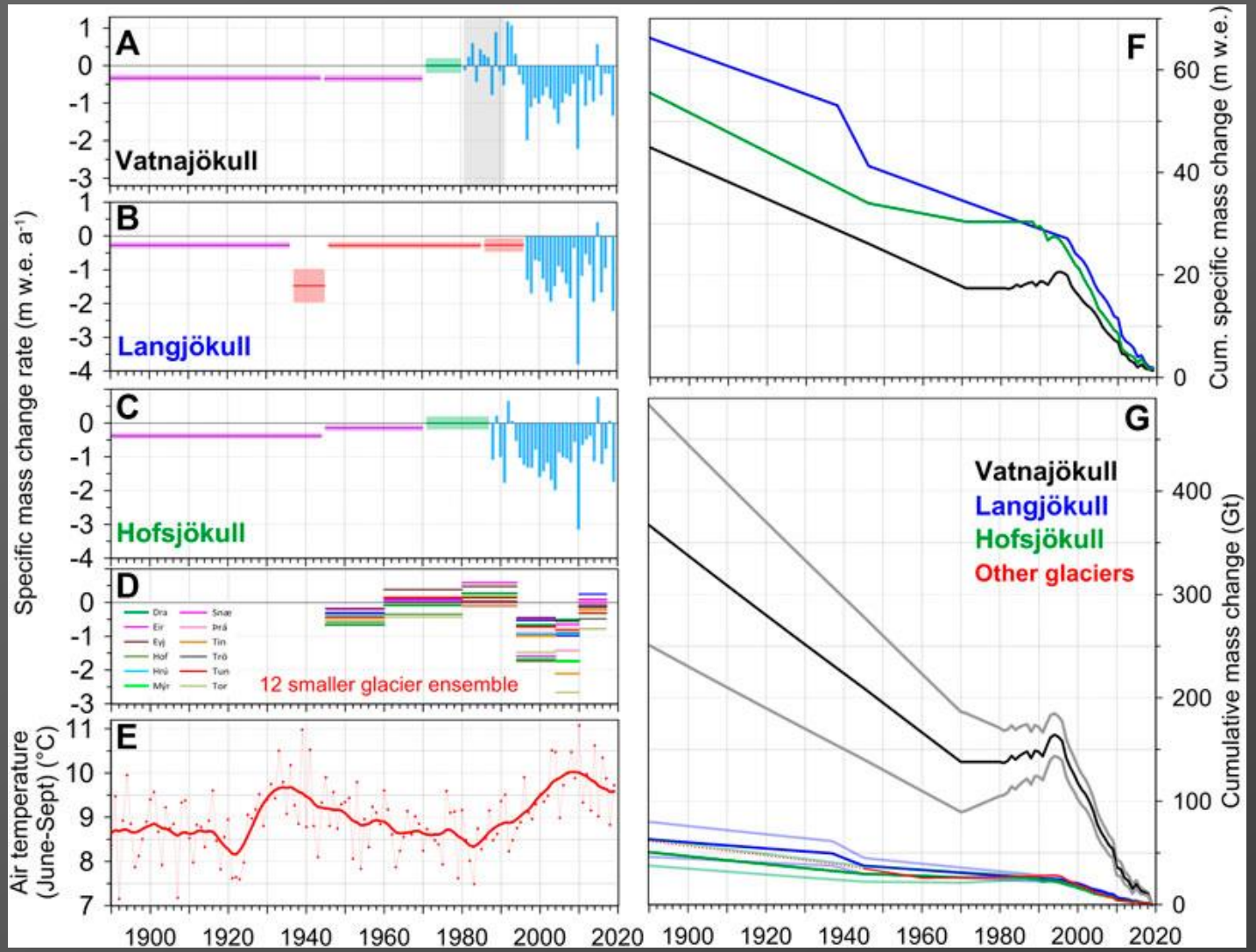
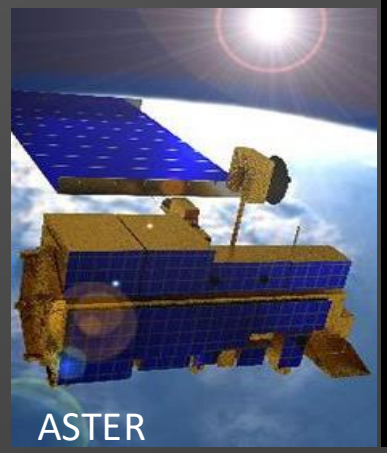
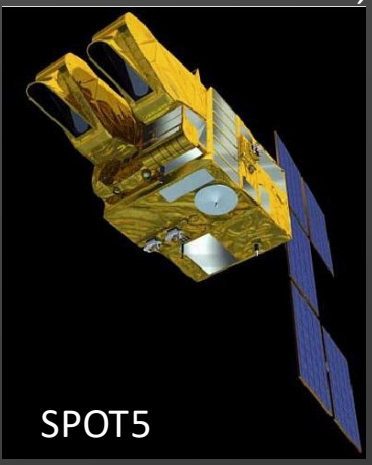
Glacier mass balance in Iceland: geodetic observations



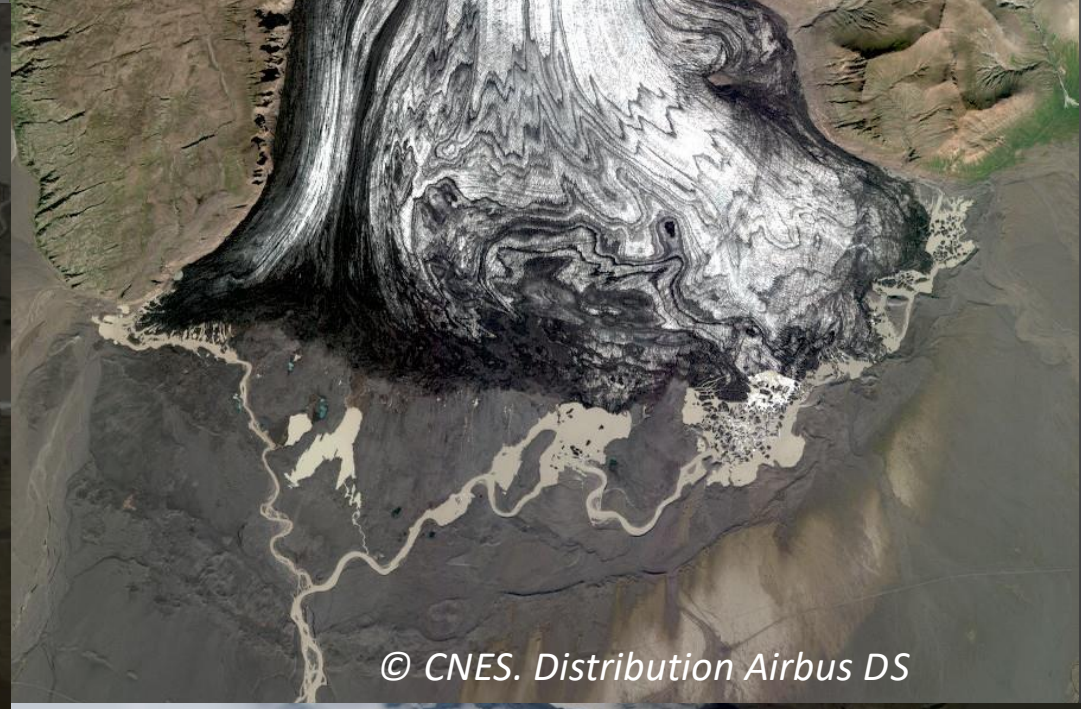
Aðalgeirsdóttir et al., 2020

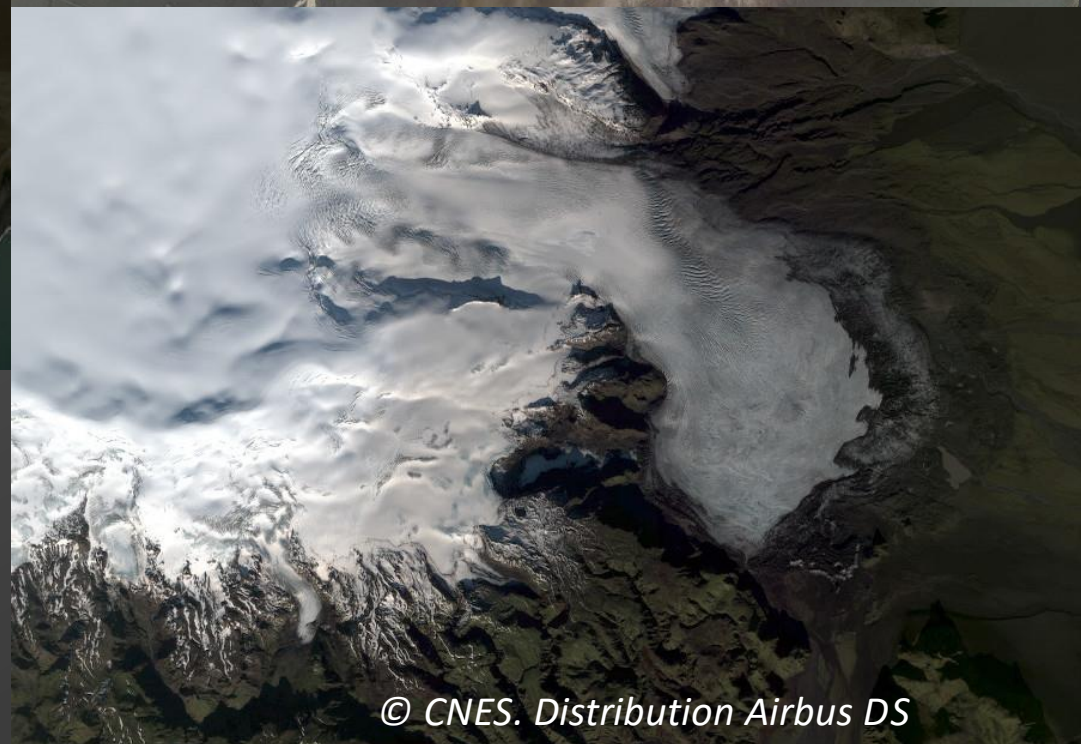
Jóhannesson et al., 2013





Porter et al., 2018



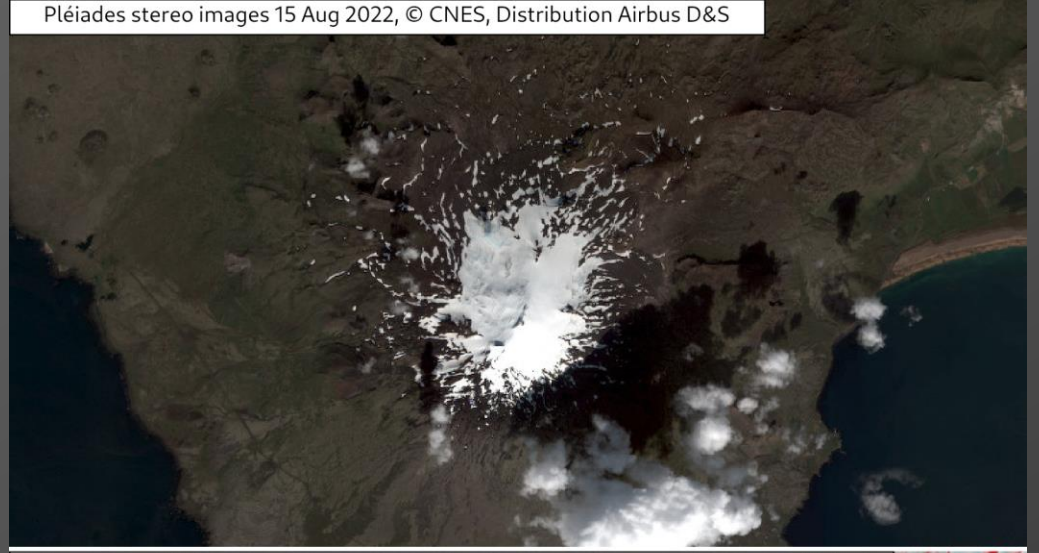


Glacier mapping from Pléiades stereo images:	2020: ~2,000 km^2
	2021: ~15,000 km^2
	2022: ~4,000 km^2

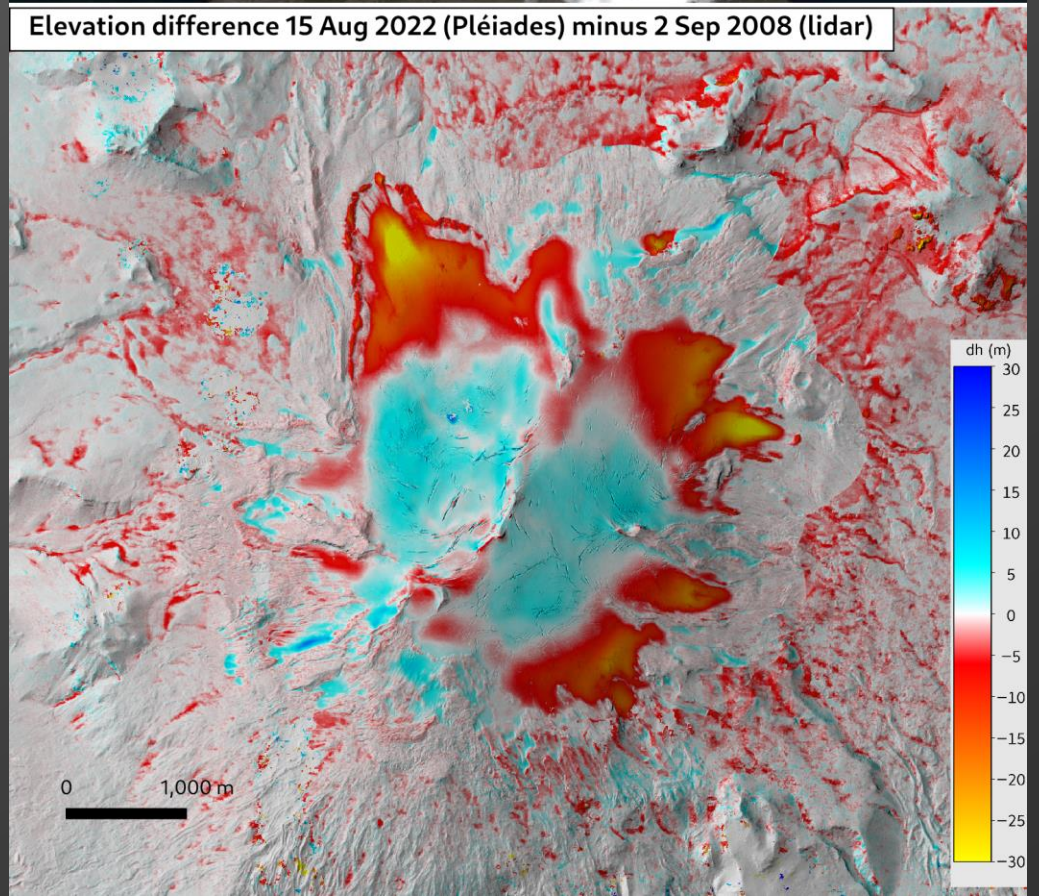
Hofsjökull elevation difference
Oct 2020 minus Oct 2013
Data: lidar (2013) & Pléiades (2020)

-50 -40 -30 -20 -10 0 10 20 30 40 50 m

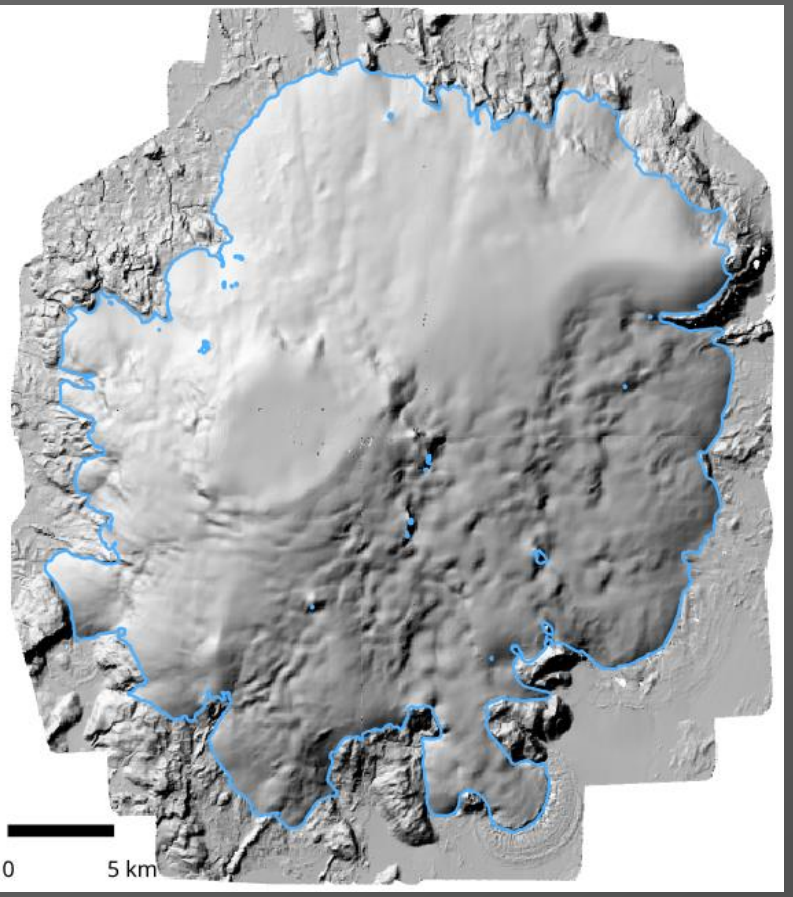
Pléiades stereo images 15 Aug 2022, © CNES, Distribution Airbus D&S



Elevation difference 15 Aug 2022 (Pléiades) minus 2 Sep 2008 (lidar)

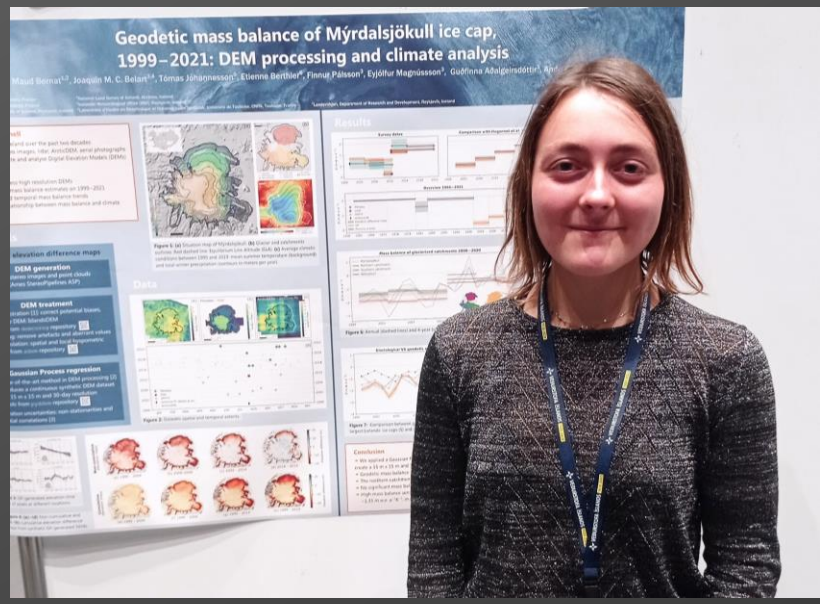


Case-studies: Hofsjökull (810 km^2) & Mýrdalsjökull (520 km^2)

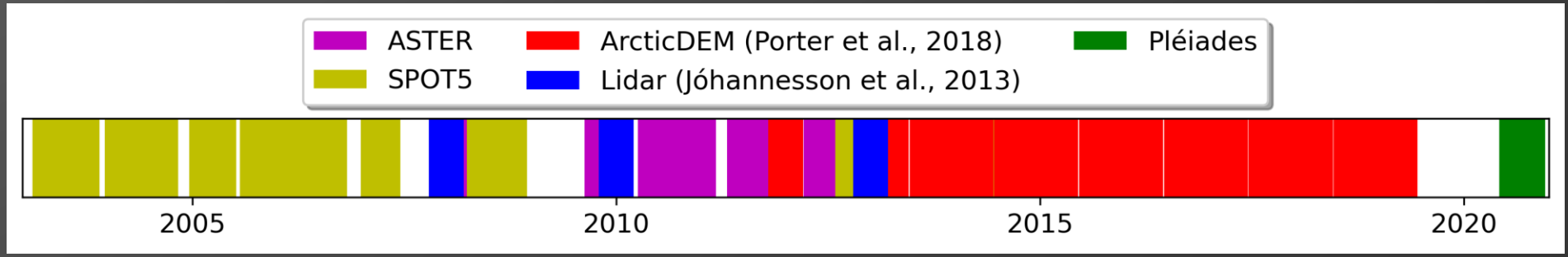


Glaciological mass balance since 1987

Three lidar surveys (2008, 2010, 2013): Calibration and re-positioning of mass balance points

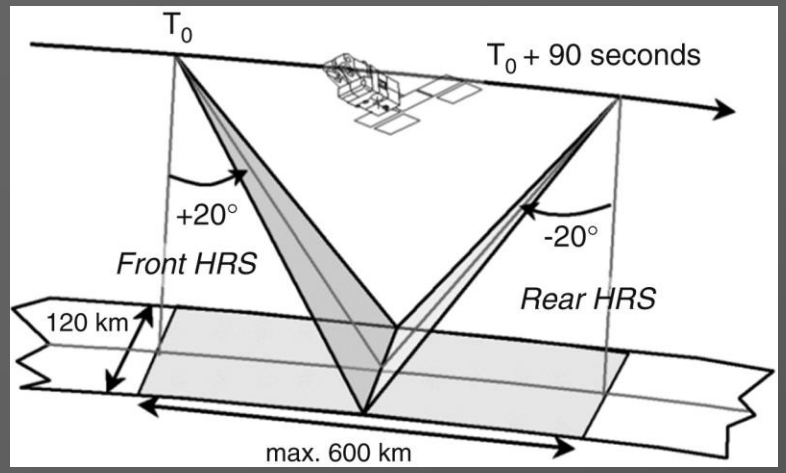


Maud Bernat, poster session 1



SPOT5 processing

All SPOT1-5 raw imagery is now fully open at: https://regards.cnes.fr/user/swh



Korona et al., ISPRS, 2009

SPOT5 processing

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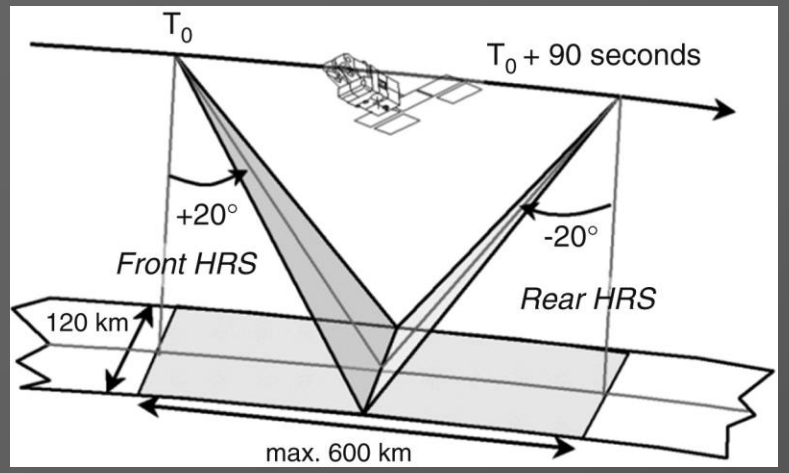

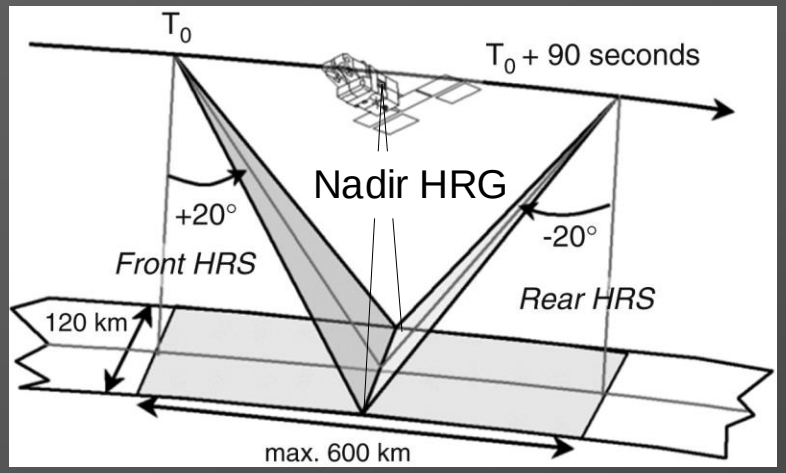

Korona et al., ISPRS, 2009

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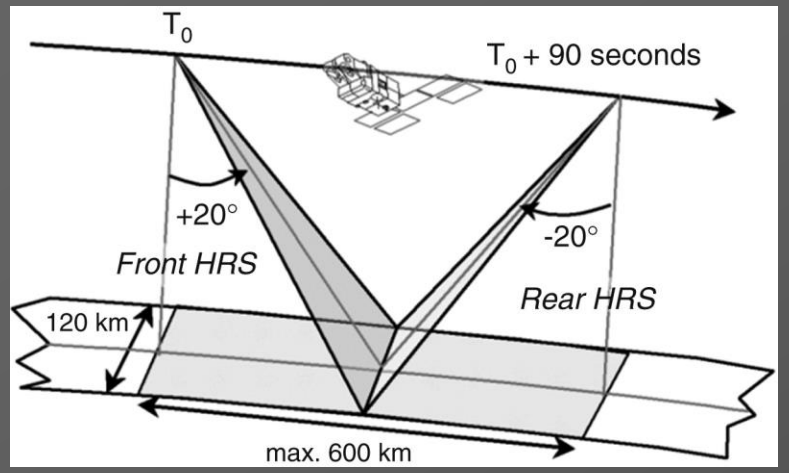

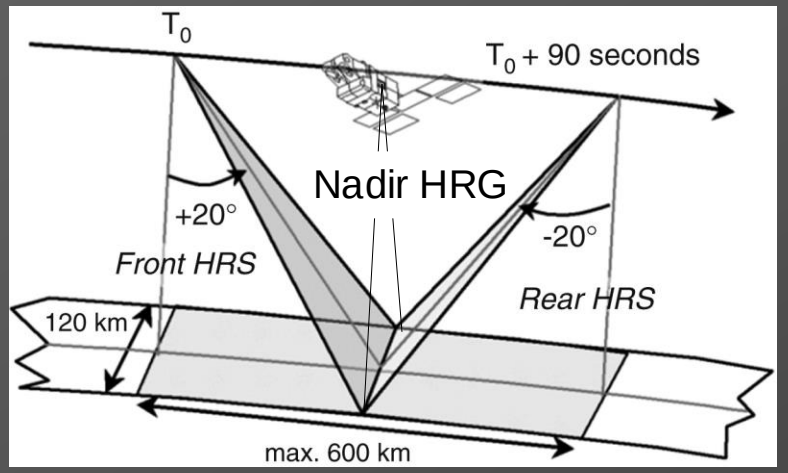

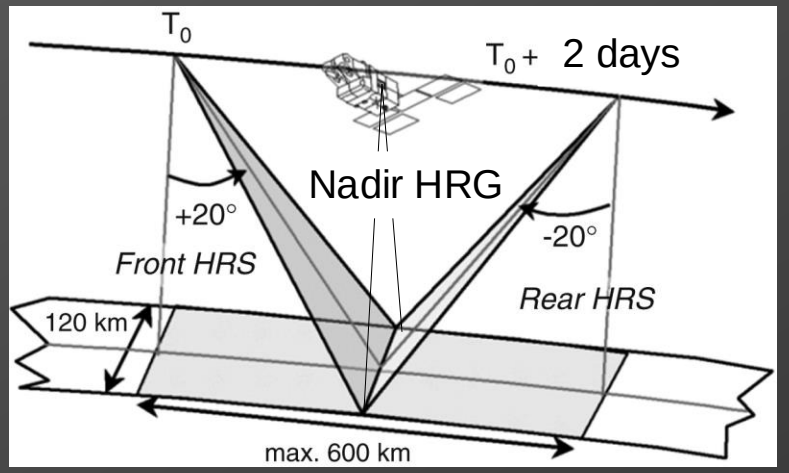

Korona et al., ISPRS, 2009

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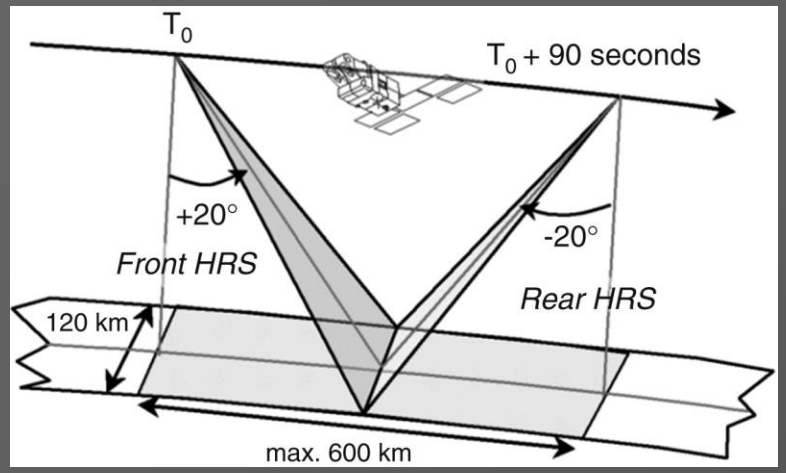
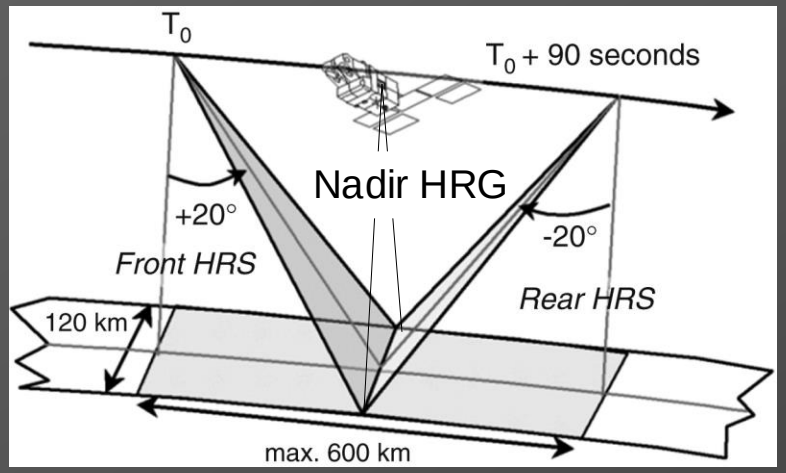
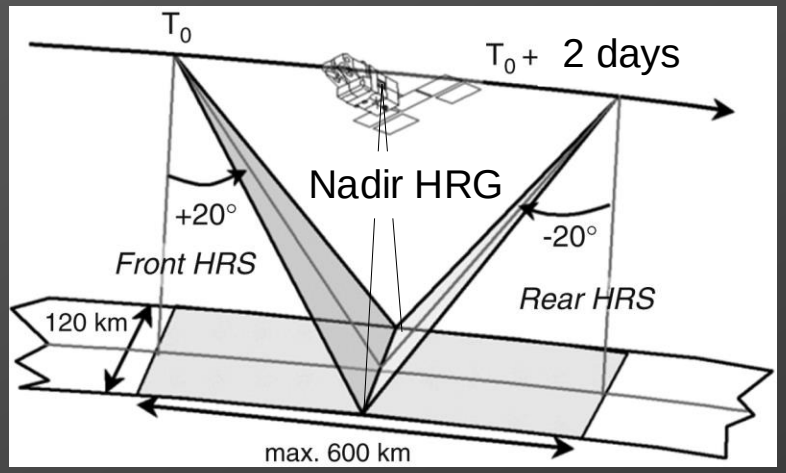


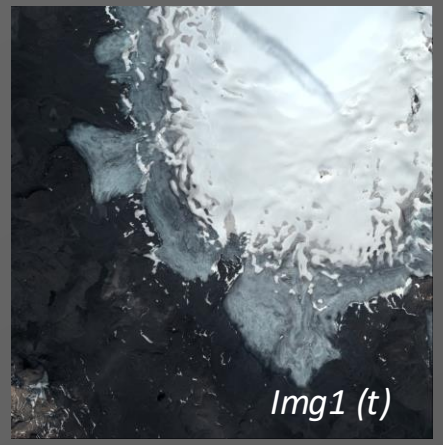


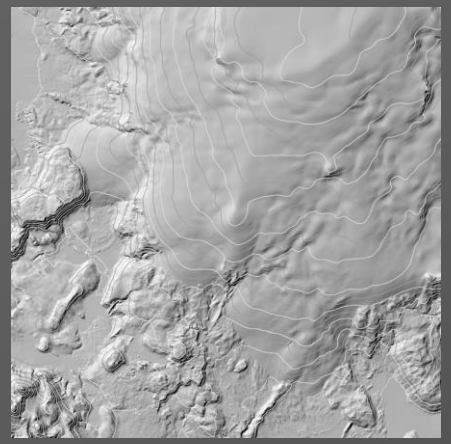


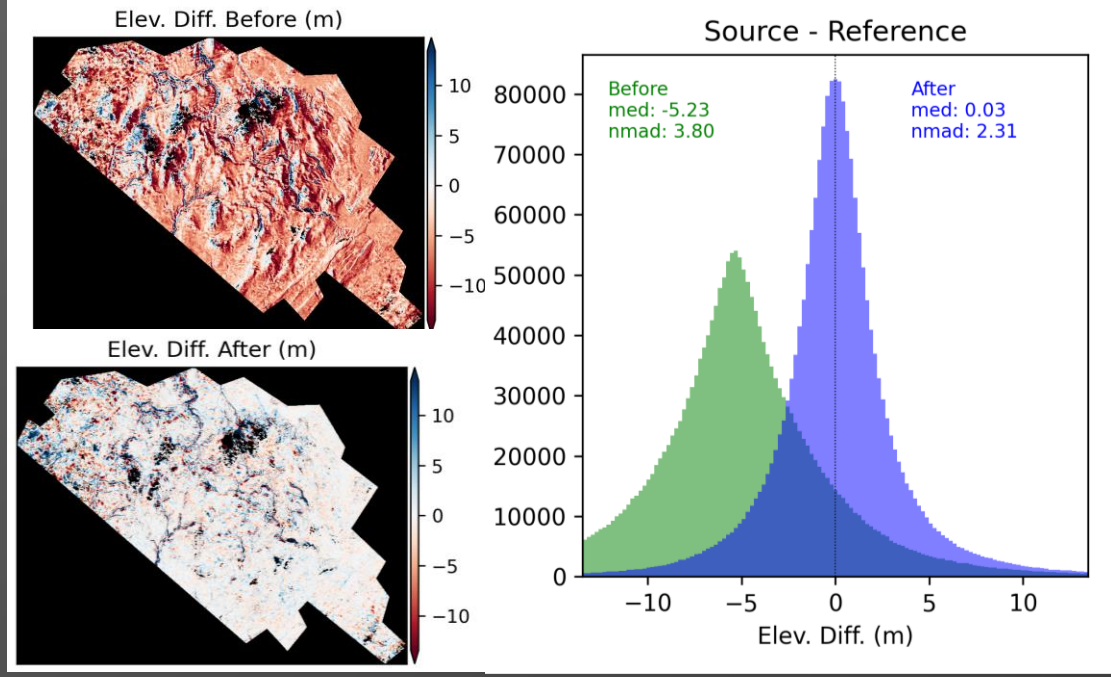
Korona et al., ISPRS, 2009

Hofsjökull:
-197 single images (258 tentative couples)
-160 DEMs (segments)
-36 DEMs (single day + 2-day mosaics)

DEM processing: Ames StereoPipeline





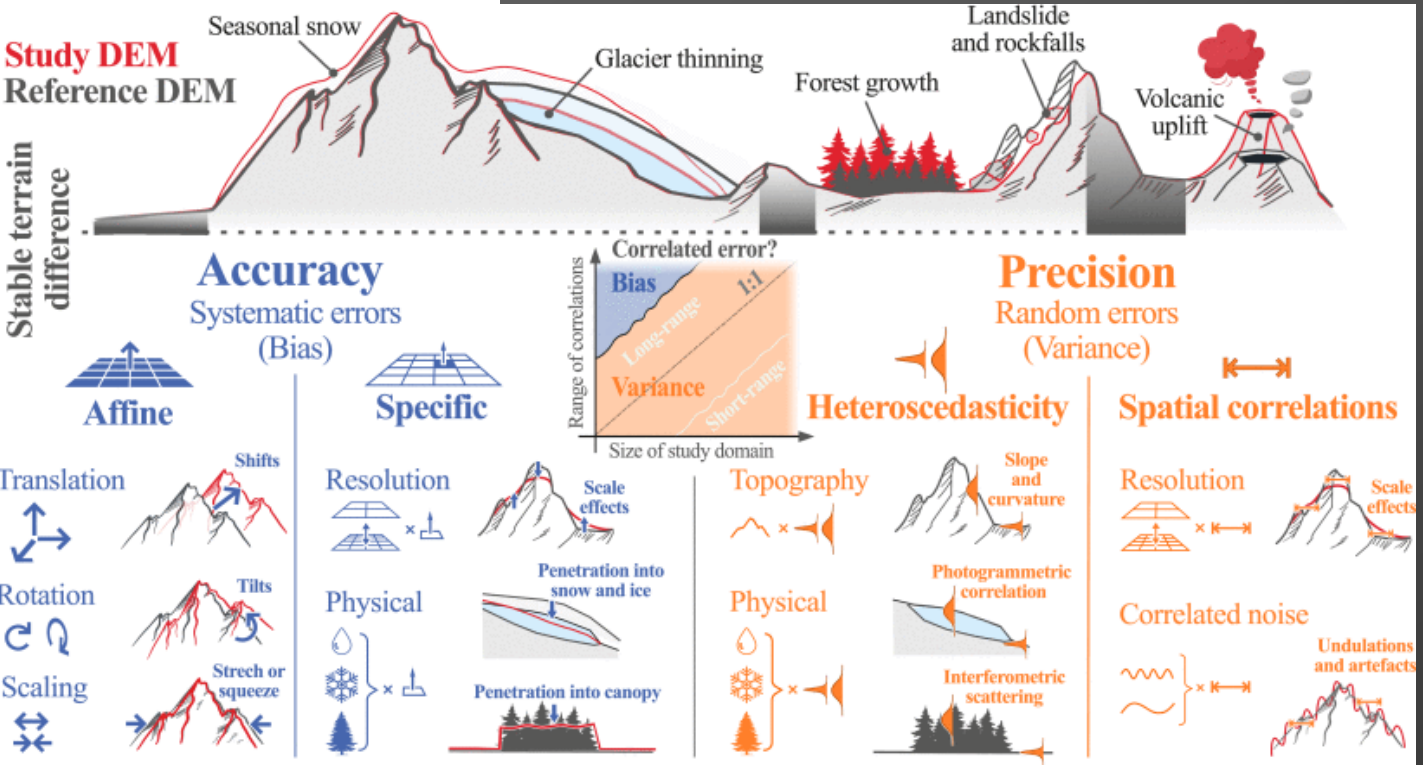


DEM co-registration

https://github.com/dshean/demcoreg

(Shean et al., 2016)

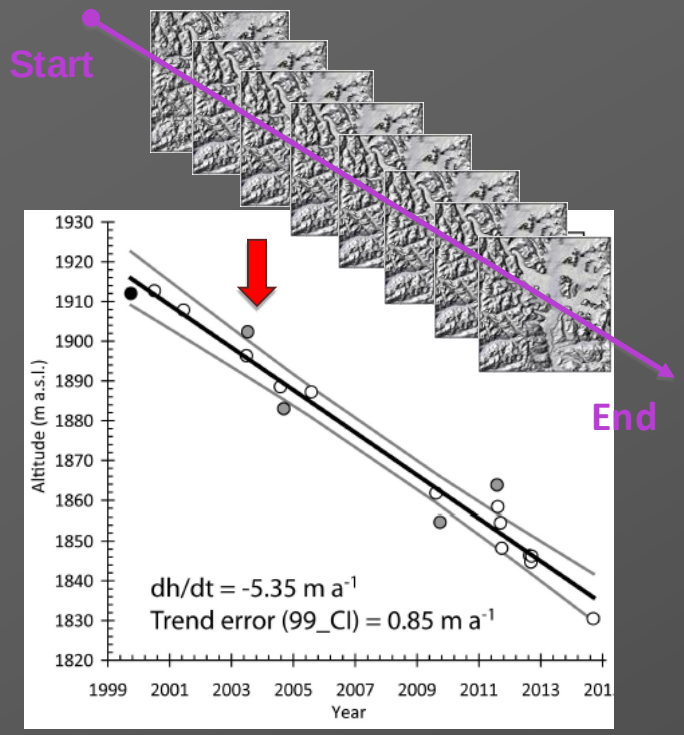
New Paper Alert



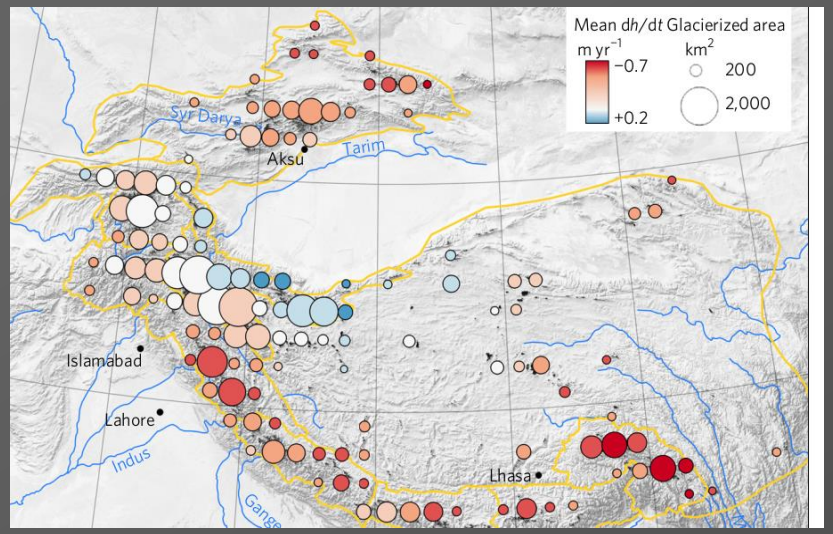
Filtering, gap filling, uncertainties: Hugonnet et al., 2022

https://github.com/GlacioHack/xdem

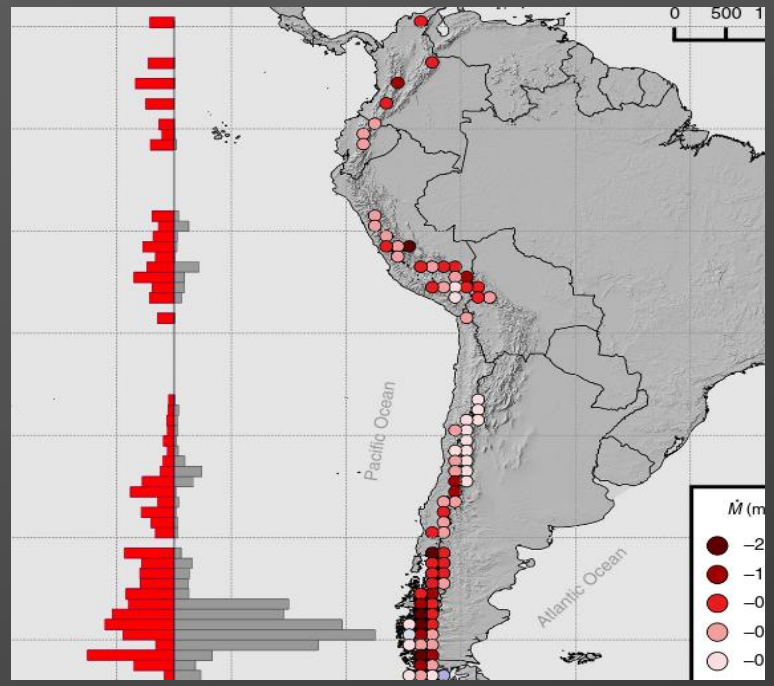
ASTER DEM stacks



Berthier et al., Frontiers, 2016

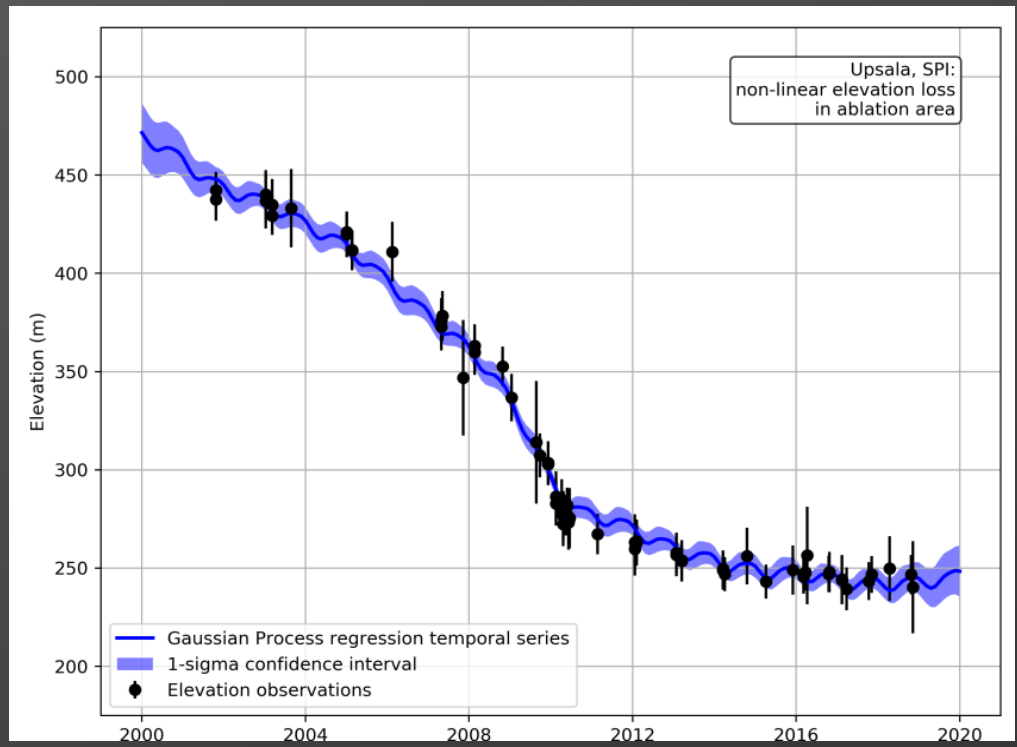


Brun et al., 2017



Dussaillant et al., 2019

Gaussian processes

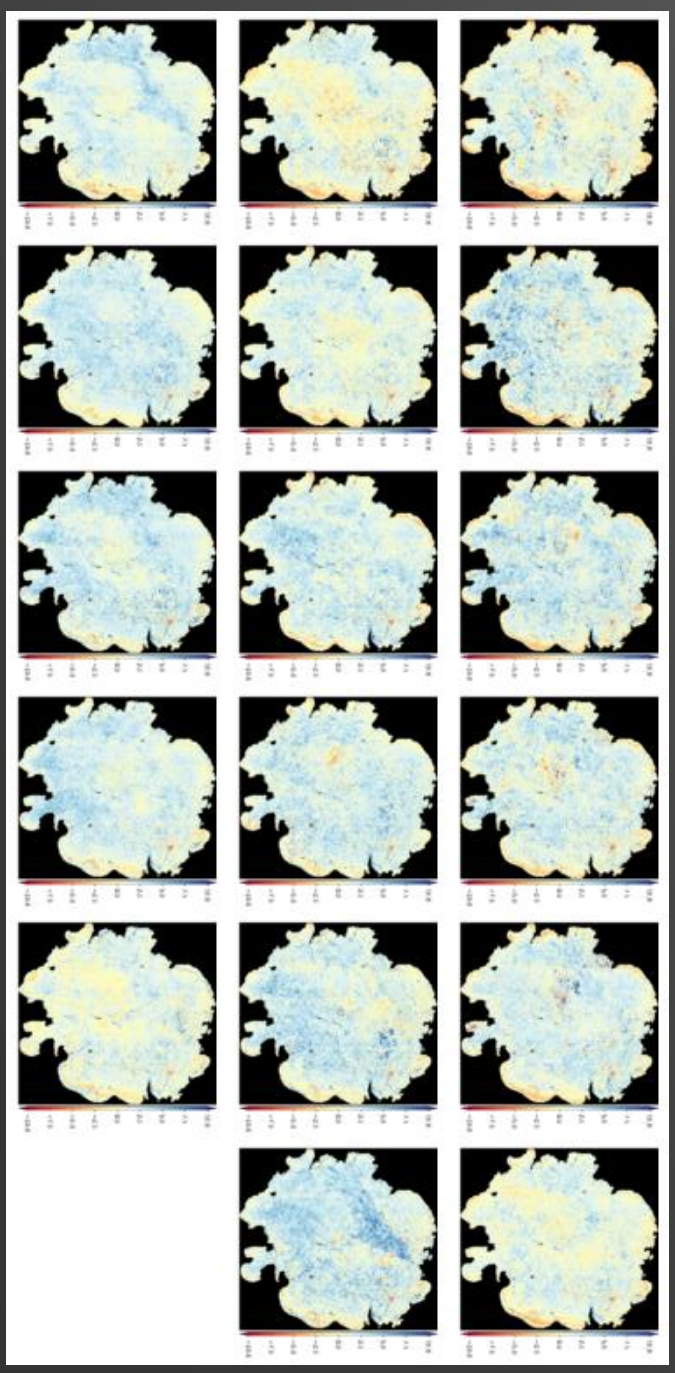


Hugonnet et al., 2021.

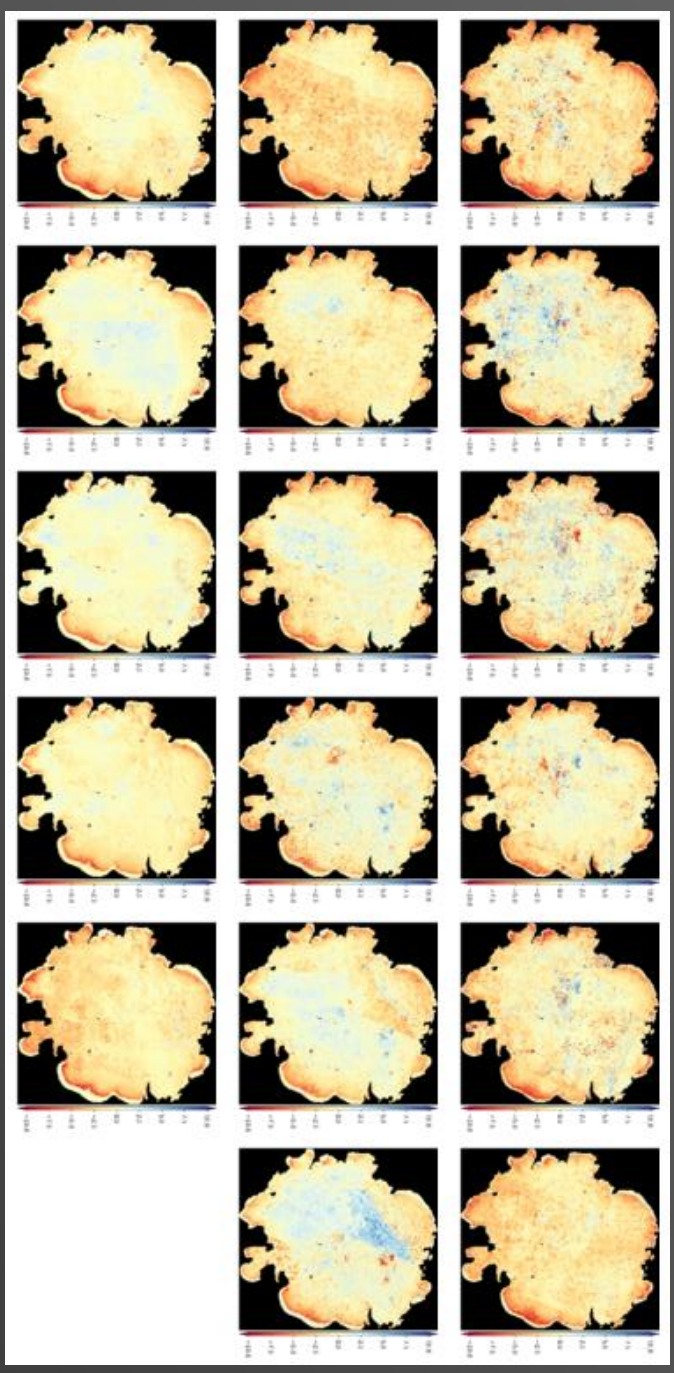
https://github.com/iamdonovan/

https://github.com/rhugonnet/

1 Oct – 1 Jun

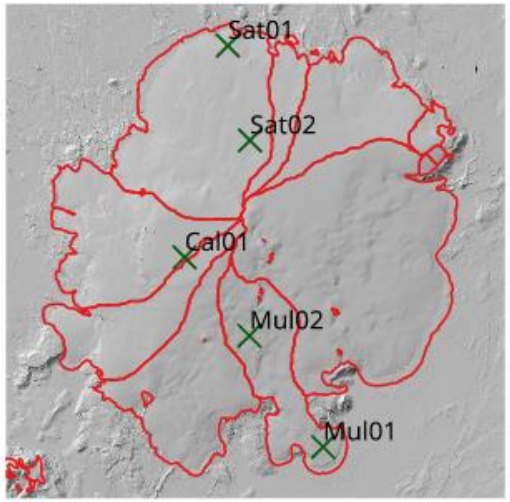


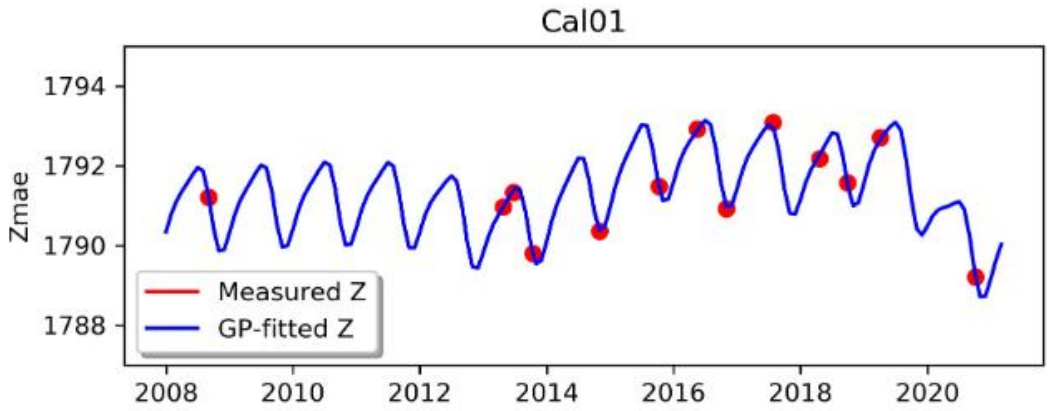
1 Oct – 1 Oct

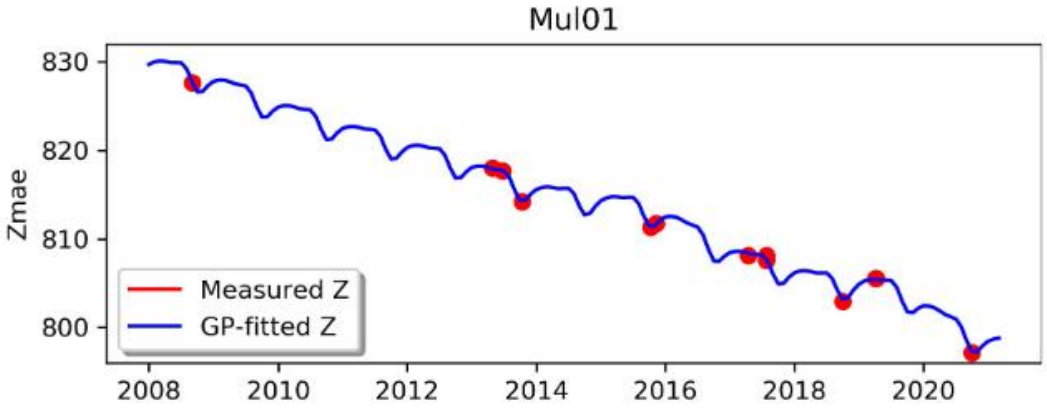


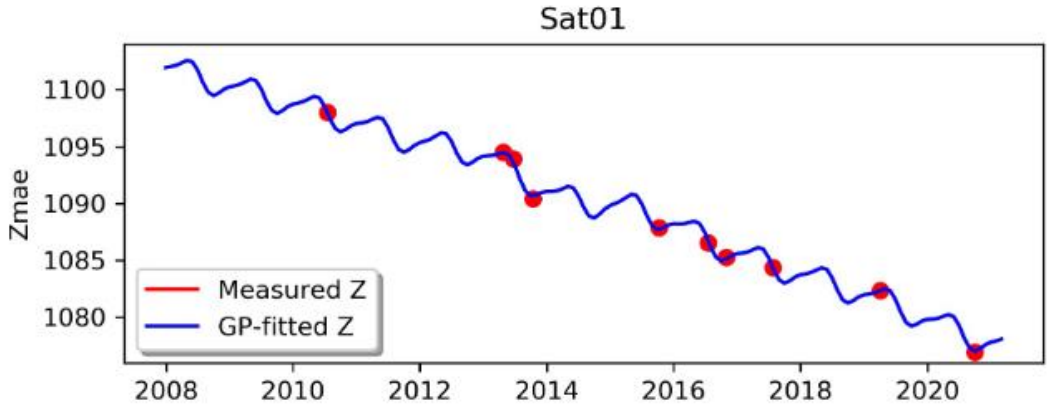
Ablation area:

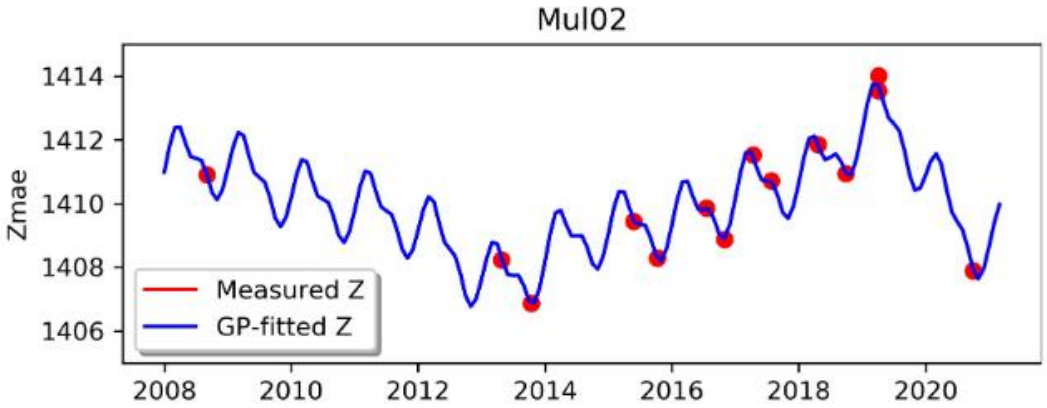
Acc. area:

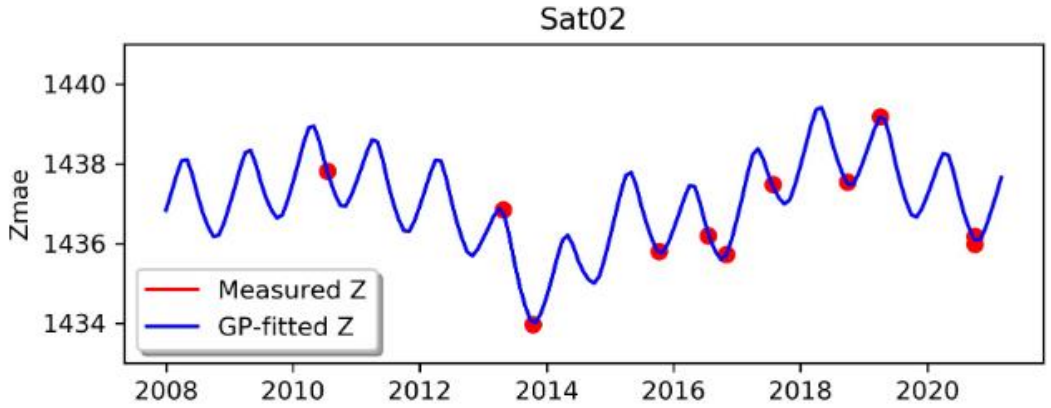




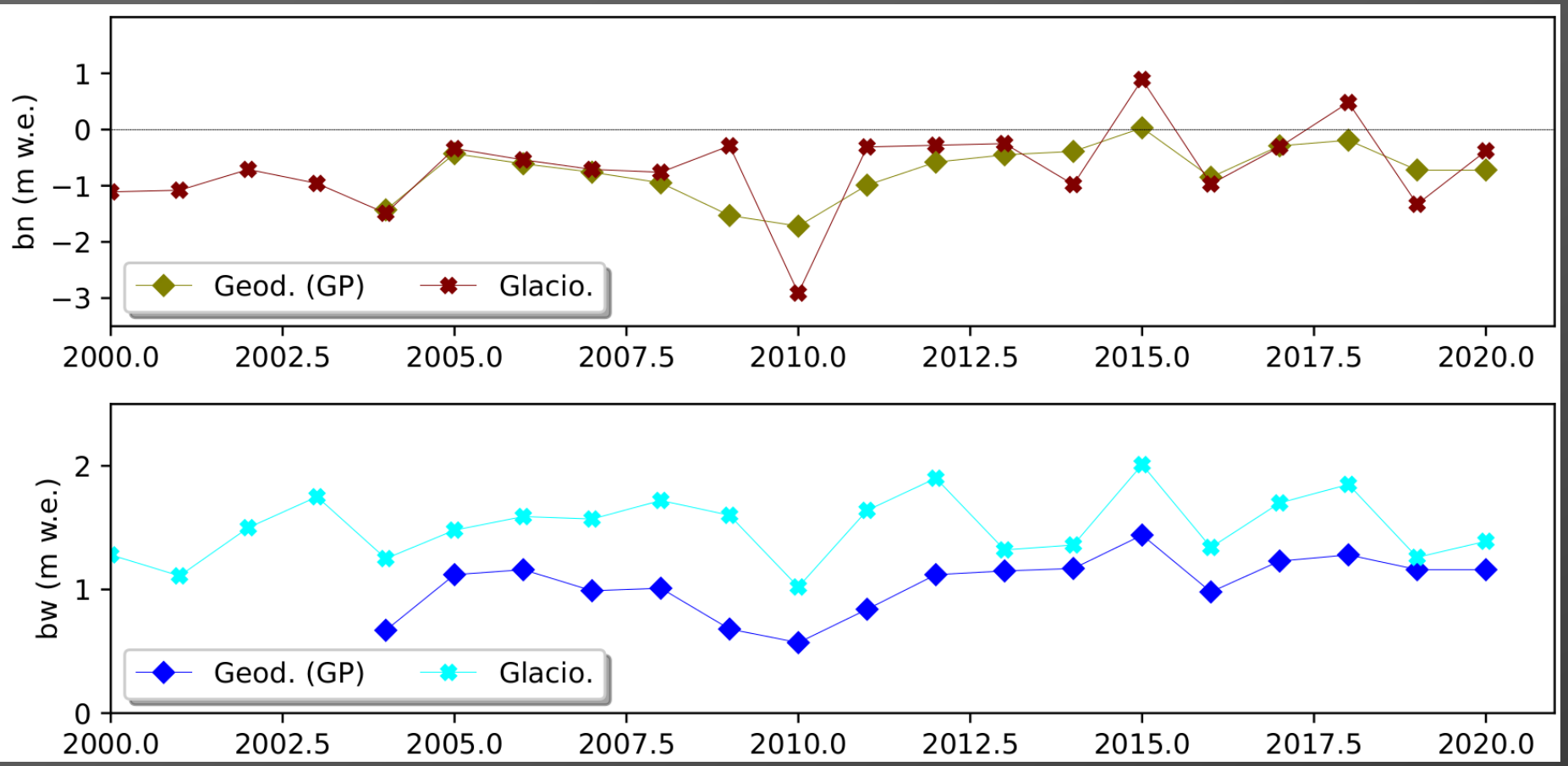








Geodetic vs glaciological mass balance



ΔV to m w.e.:
ρ = 850 ± 60 kg m^{-3} *(Huss, TC, 2013)*

ΔV to m w.e.:
In situ measurements
(ρ ≈ 500 kg m^{-3})

Perspectives and challenges

- Multitemporal, open DEMs available. Particularly abundant in Iceland. High-performance, “off the shelf” methods to process them

- Remaining (Non Remote Sensing) challenges:
- Density assumptions/observations. Snow & firn densification

- Challenges in satellite stereo in years coming:
  - ASTER and Pléiades end of support soon. No open replacement planned.

January 29, 2021

Upcoming Terra Constellation Exit

https://asterweb.jpl.nasa.gov/