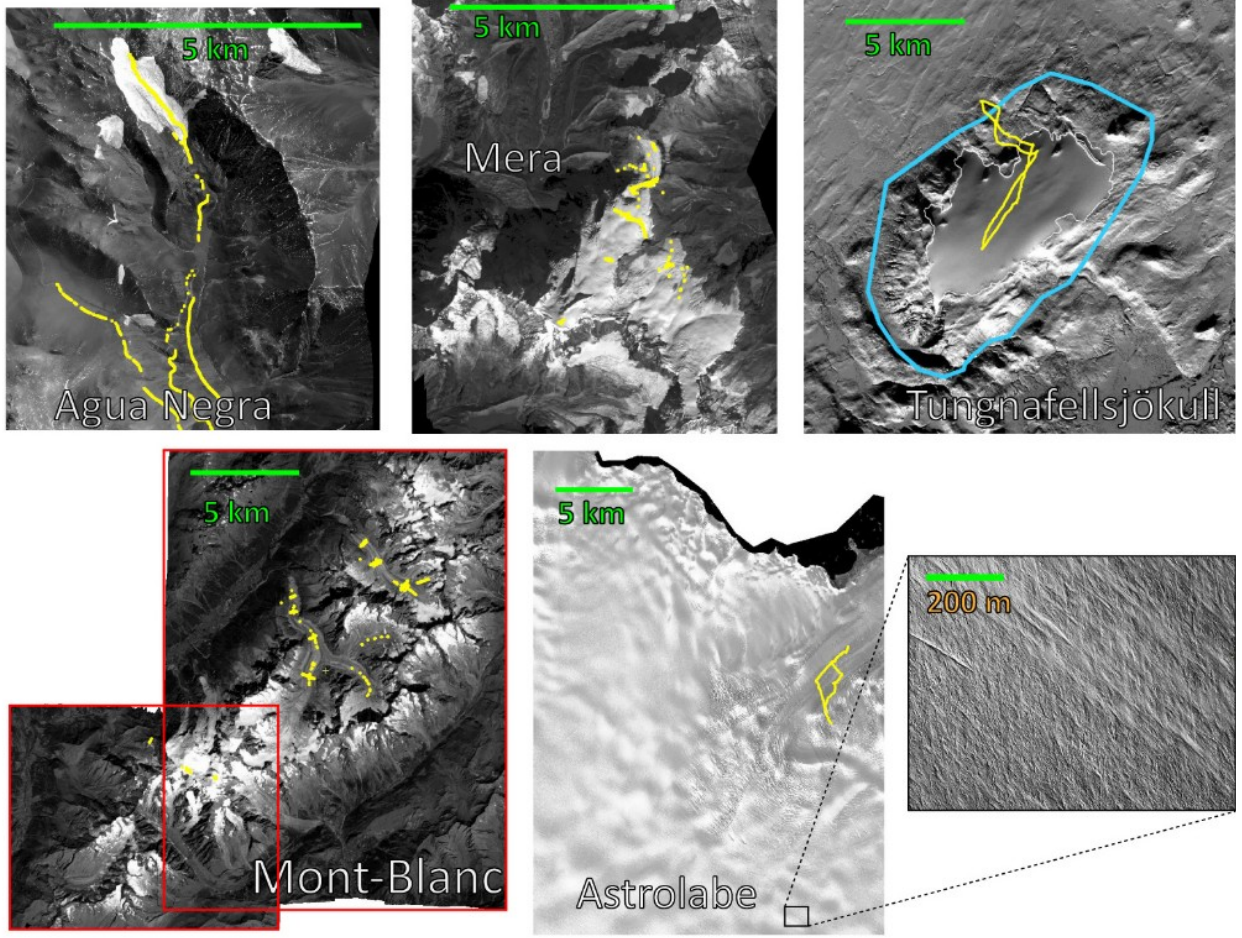
Natural Science
Institute of Iceland

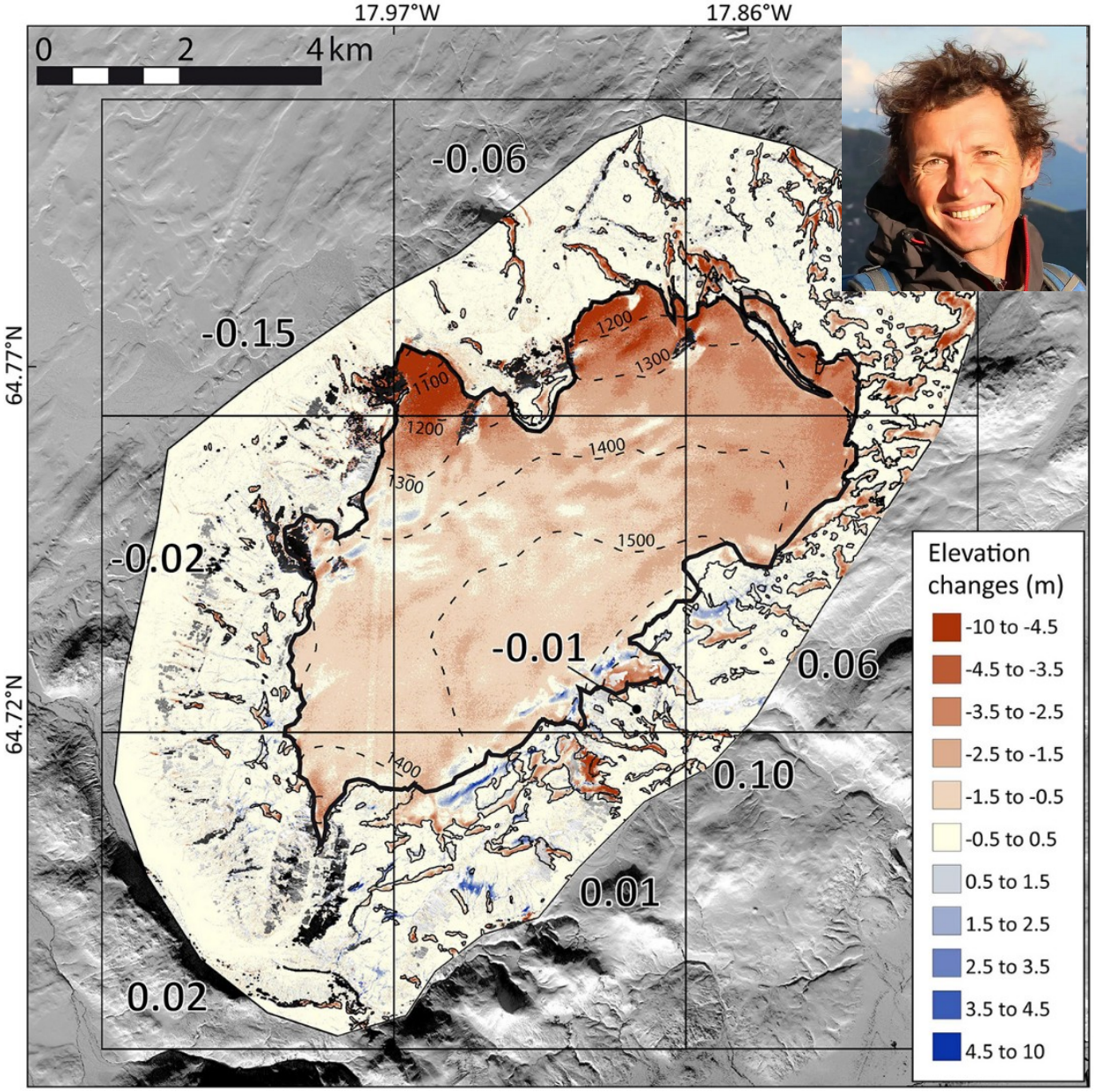
Mapping and monitoring of Iceland with Pléiades since 2013: applications in geosciences

Joaquín M.C. Belart, Etienne Berthier, Eyjólfur Magnússon, Tómas Jóhannesson, Virginie Pinel, Magnús T. Guðmundusson

Skeiðarárjökull, 2021 © CNES. Distribution Airbus DS

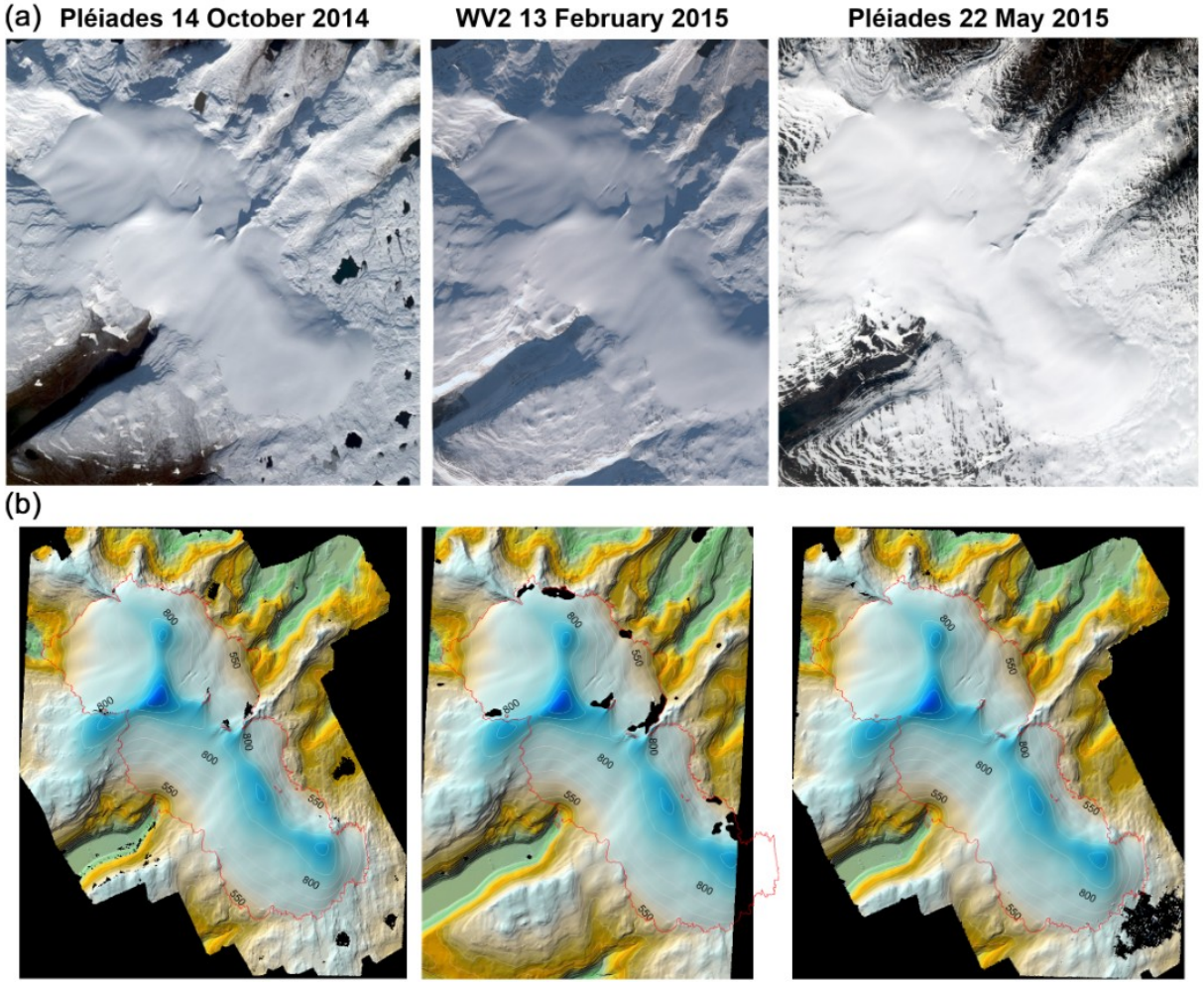
First years (2013): Annual glacier elevation changes

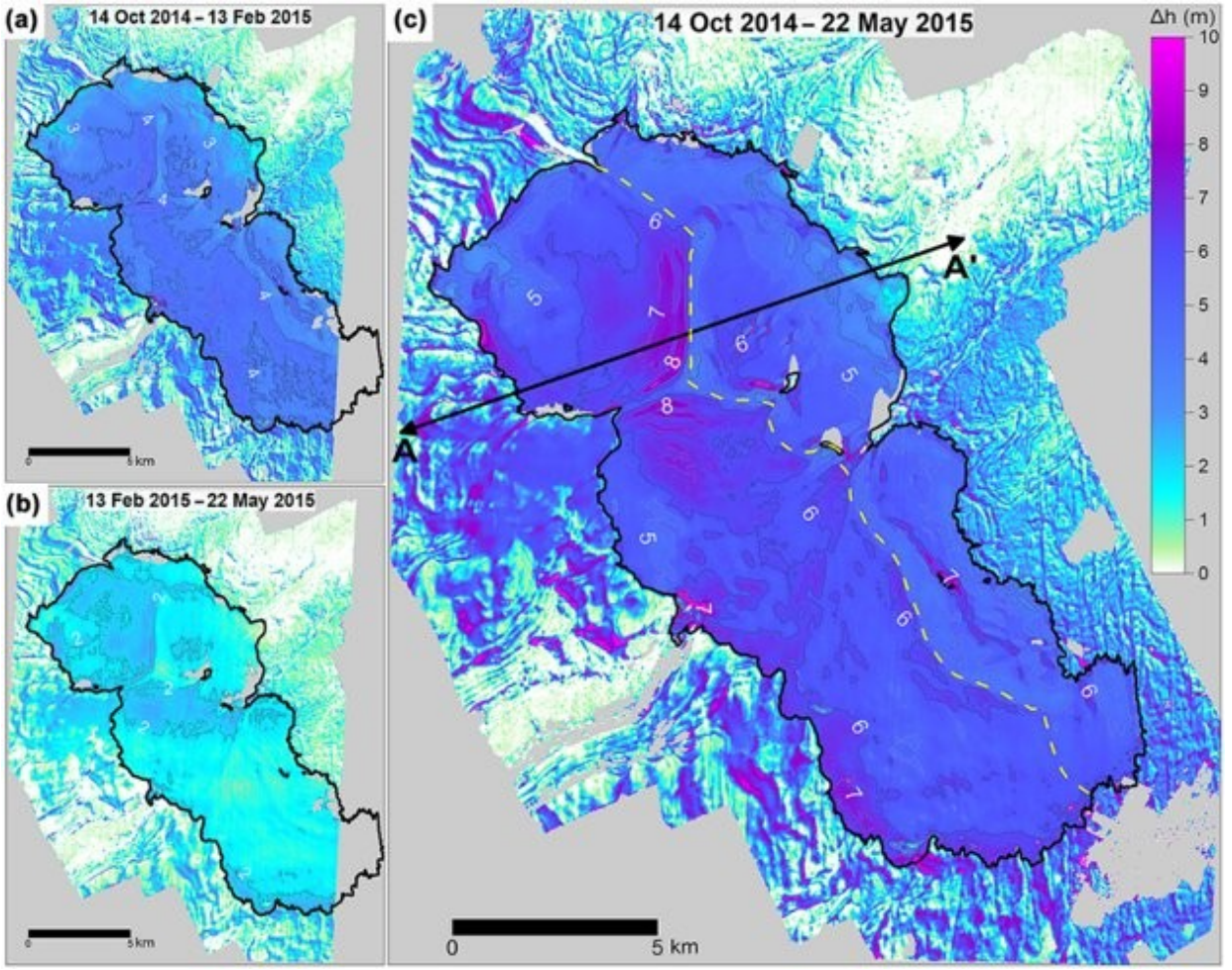




Berthier et al., 2014, The Cryosphere

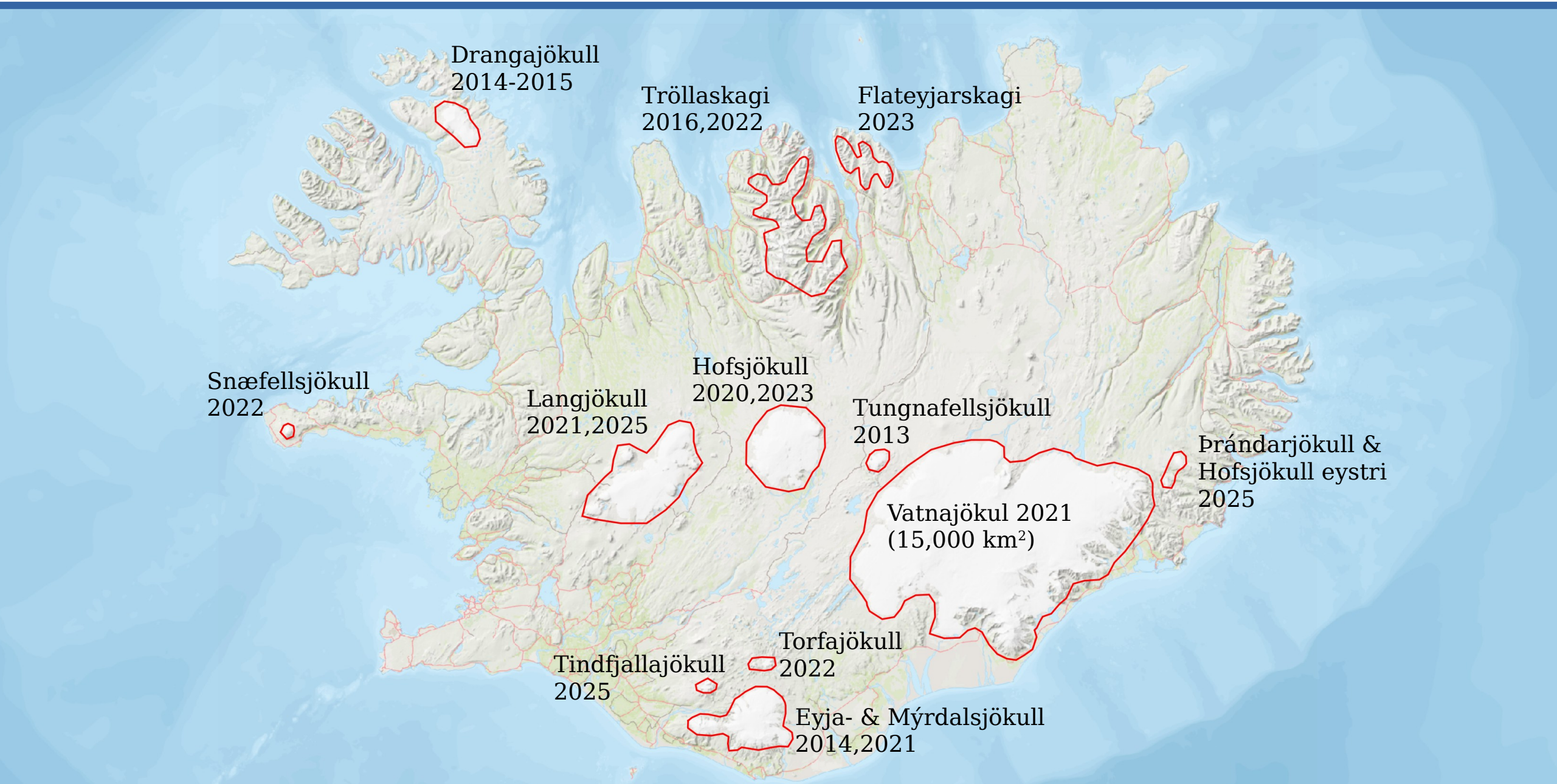
First years (2014-2015): Seasonal elevation changes





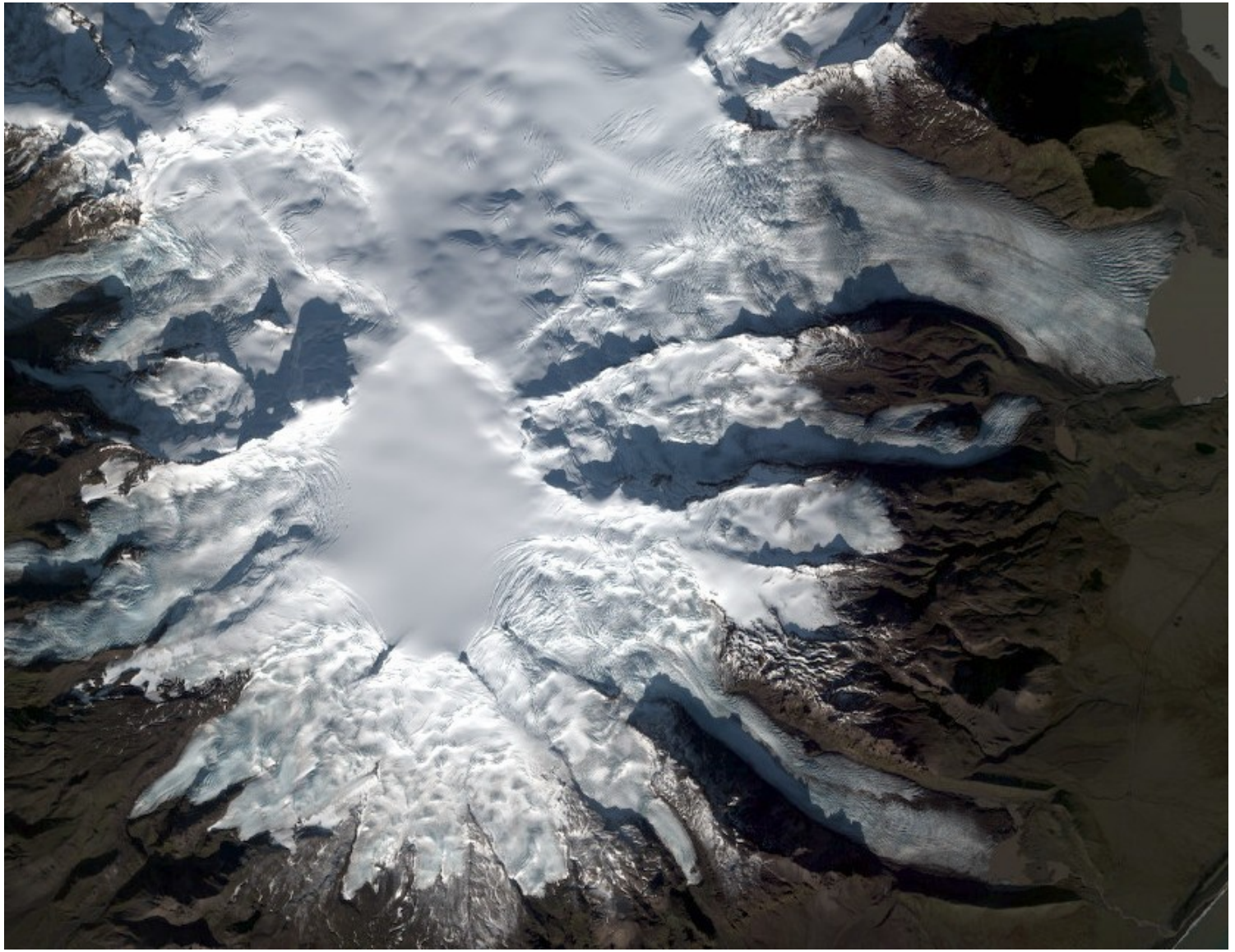
Belart et al., 2017, The Cryosphere

Overview of Pléiades surveys on glaciers



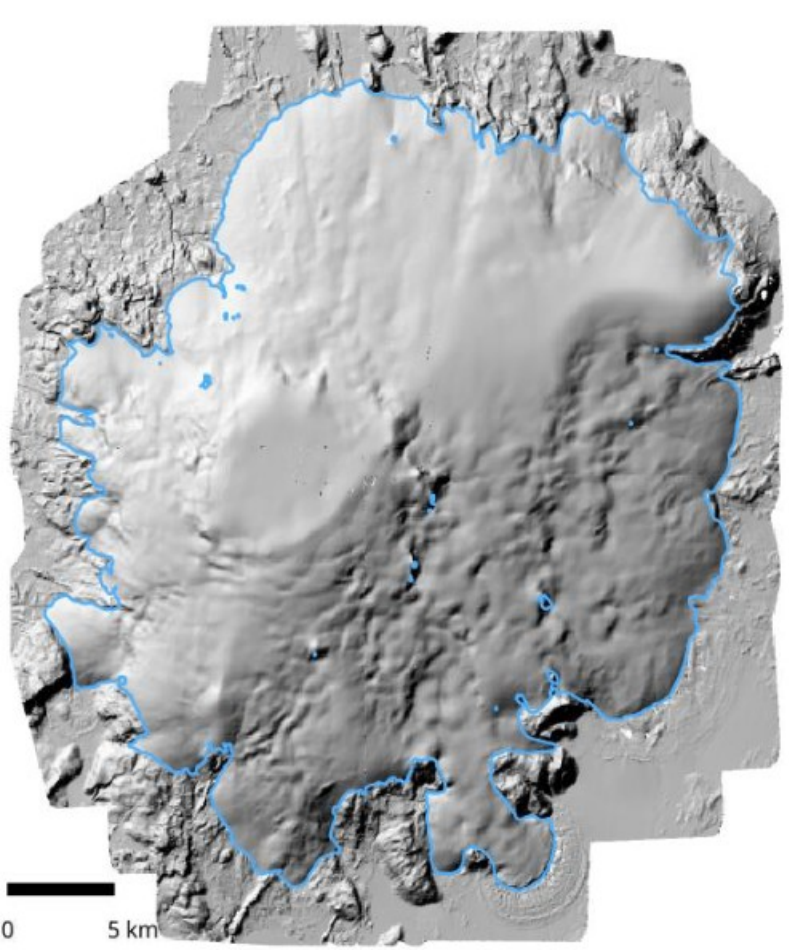
Pléiades surveys as reference for other measurements

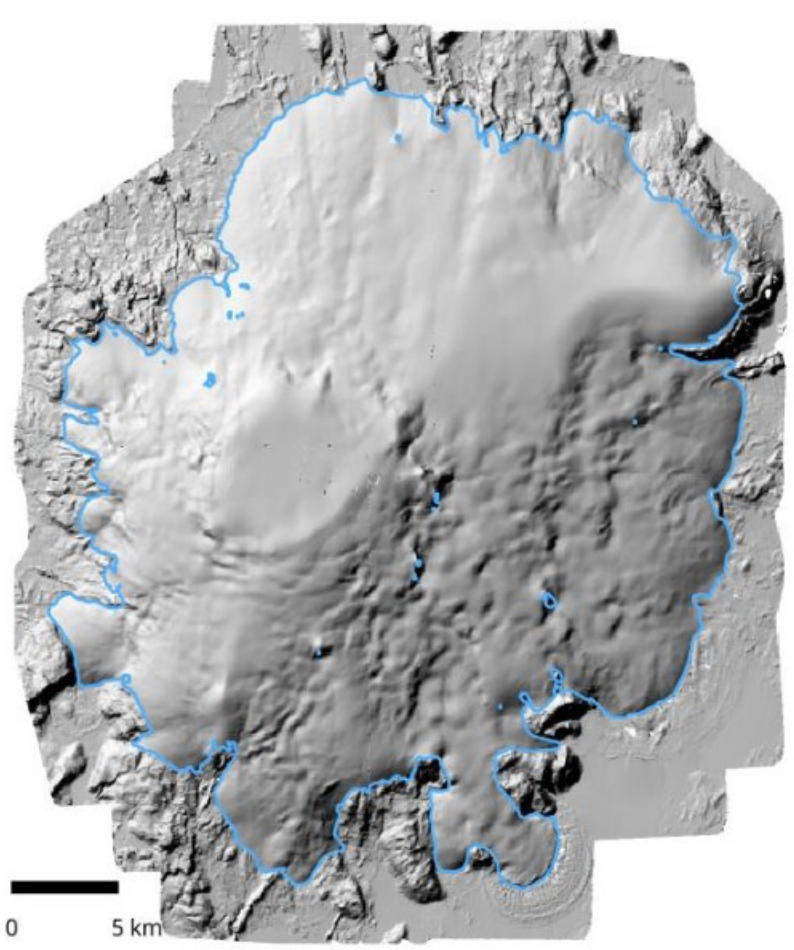
DEMs of glaciers every 3-5 years:
calibration of **field measurements**

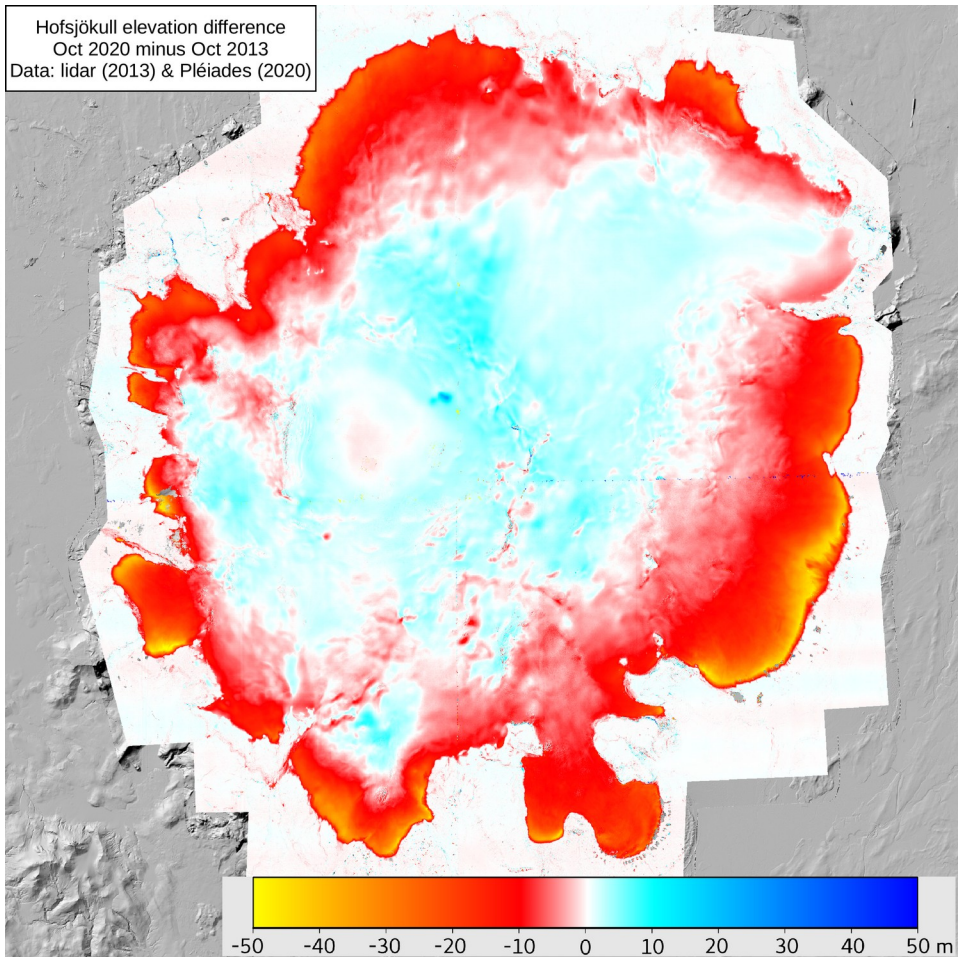


Öræfajökull ice cap, 2021 © CNES. Distribution Airbus DS

Example of large (>1000 km^2) survey





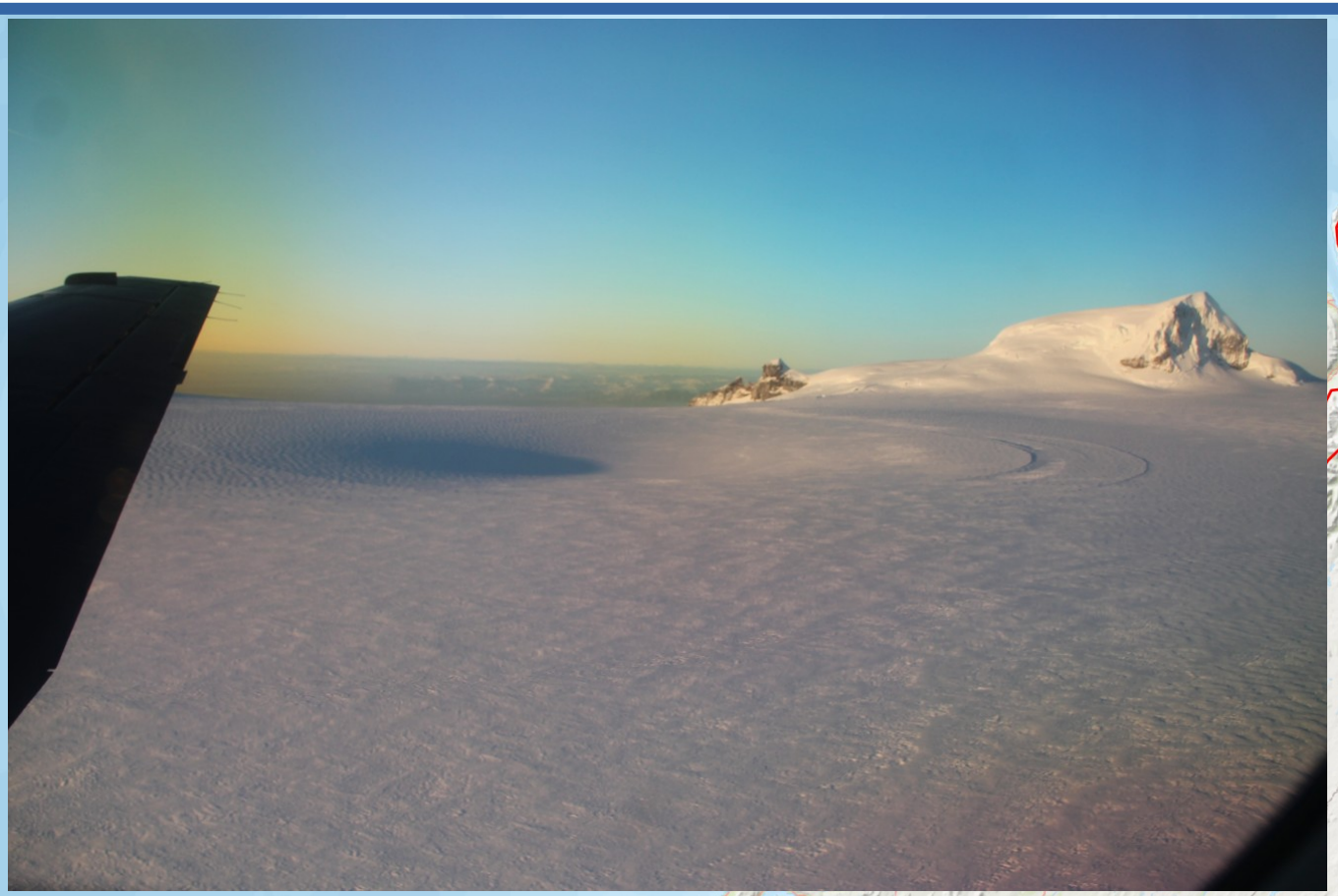


Two publications in progress using Pléiades data for calibration/validation

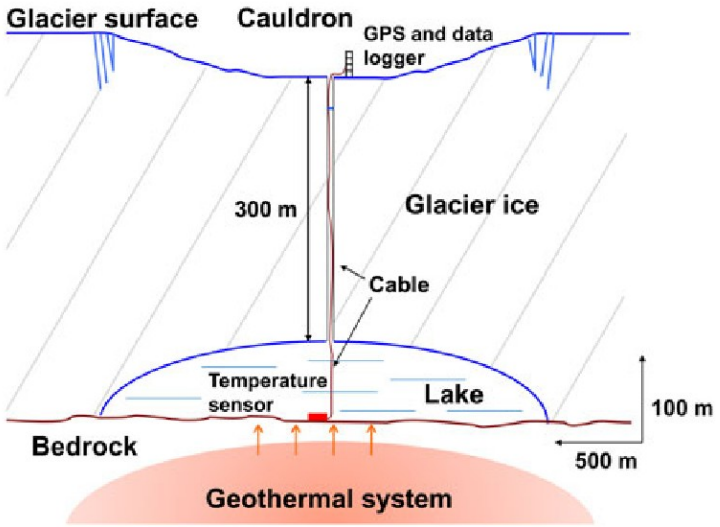
*Mass balance of Hofsjökull ice cap, Iceland, estimated from repeat **ICESat-2** satellite altimetry observations, Koo et al. (in prep)*

*Seasonal to decadal geodetic mass balance of Hofsjökull from **SPOT5 and ArcticDEM**, Piermattei et al. (in prep)*

Monitoring of geothermal areas

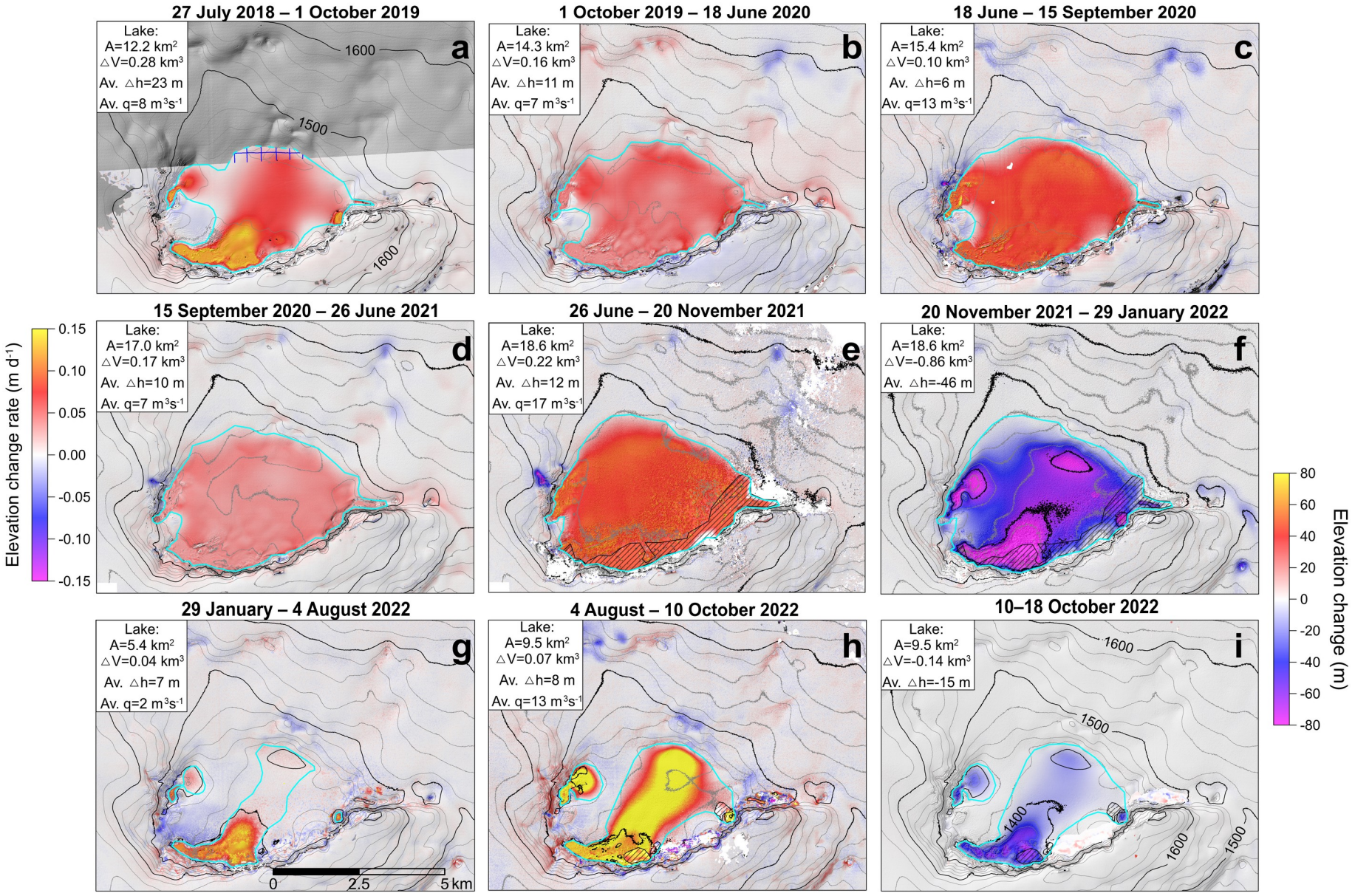


Monitoring of geothermal areas



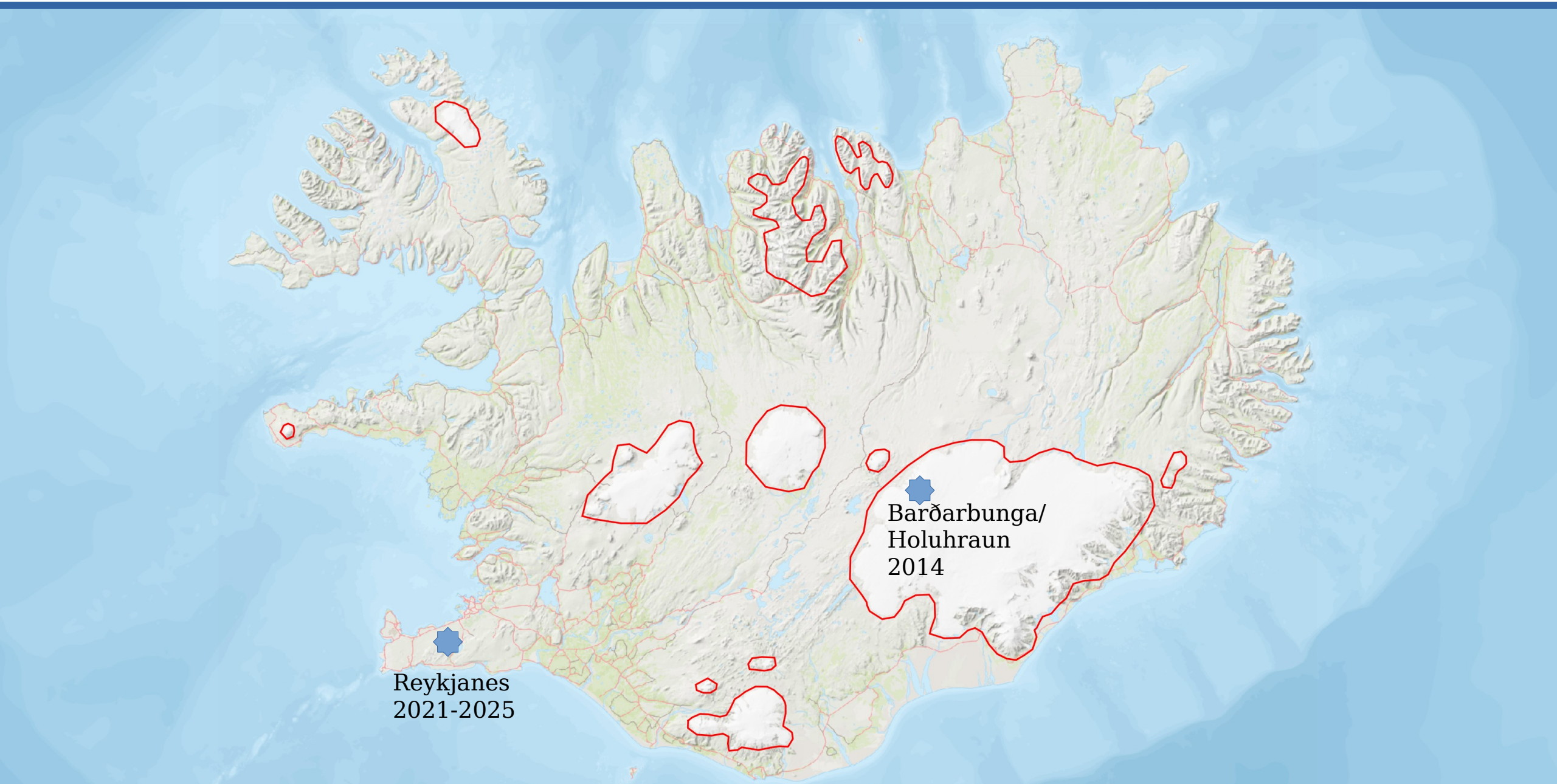
Einarsson et al., JoG (2017)

Flooding in Múlakvísl in 2011 from a geothermal area

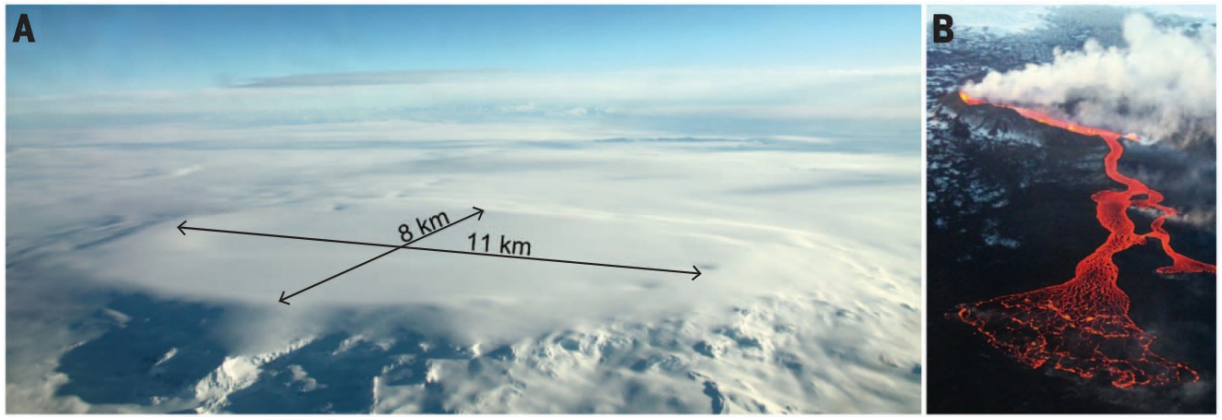


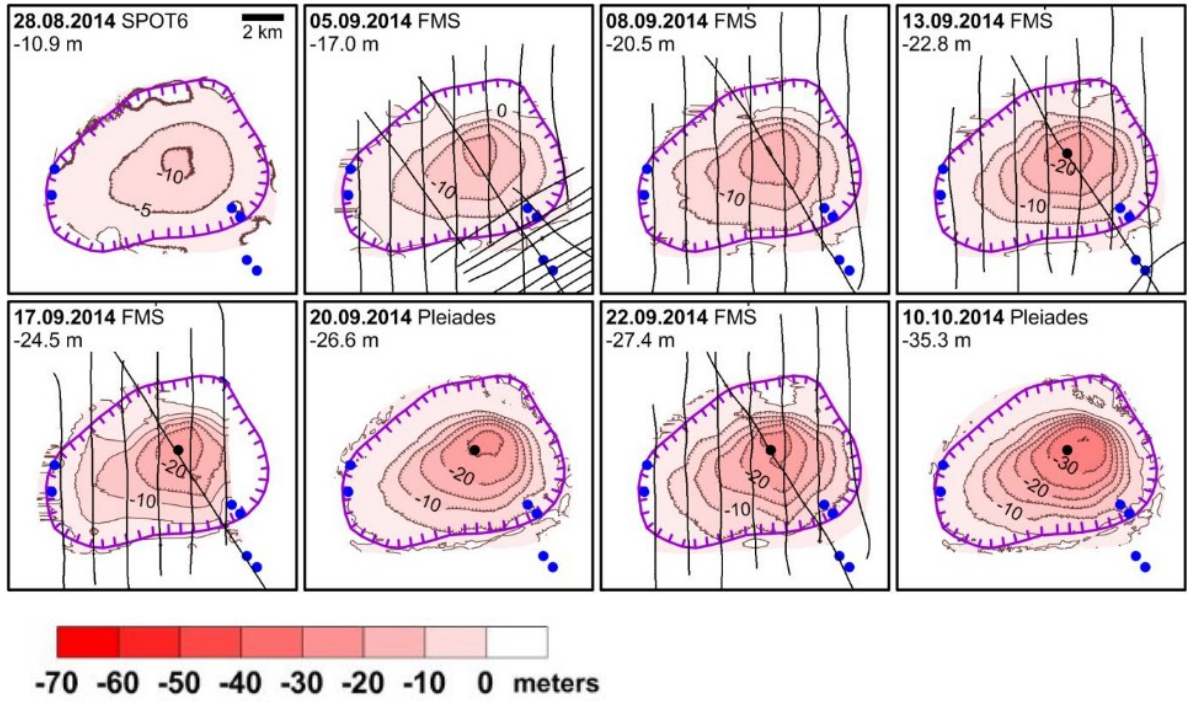
Magnússon et al., Nat. Env (in review)

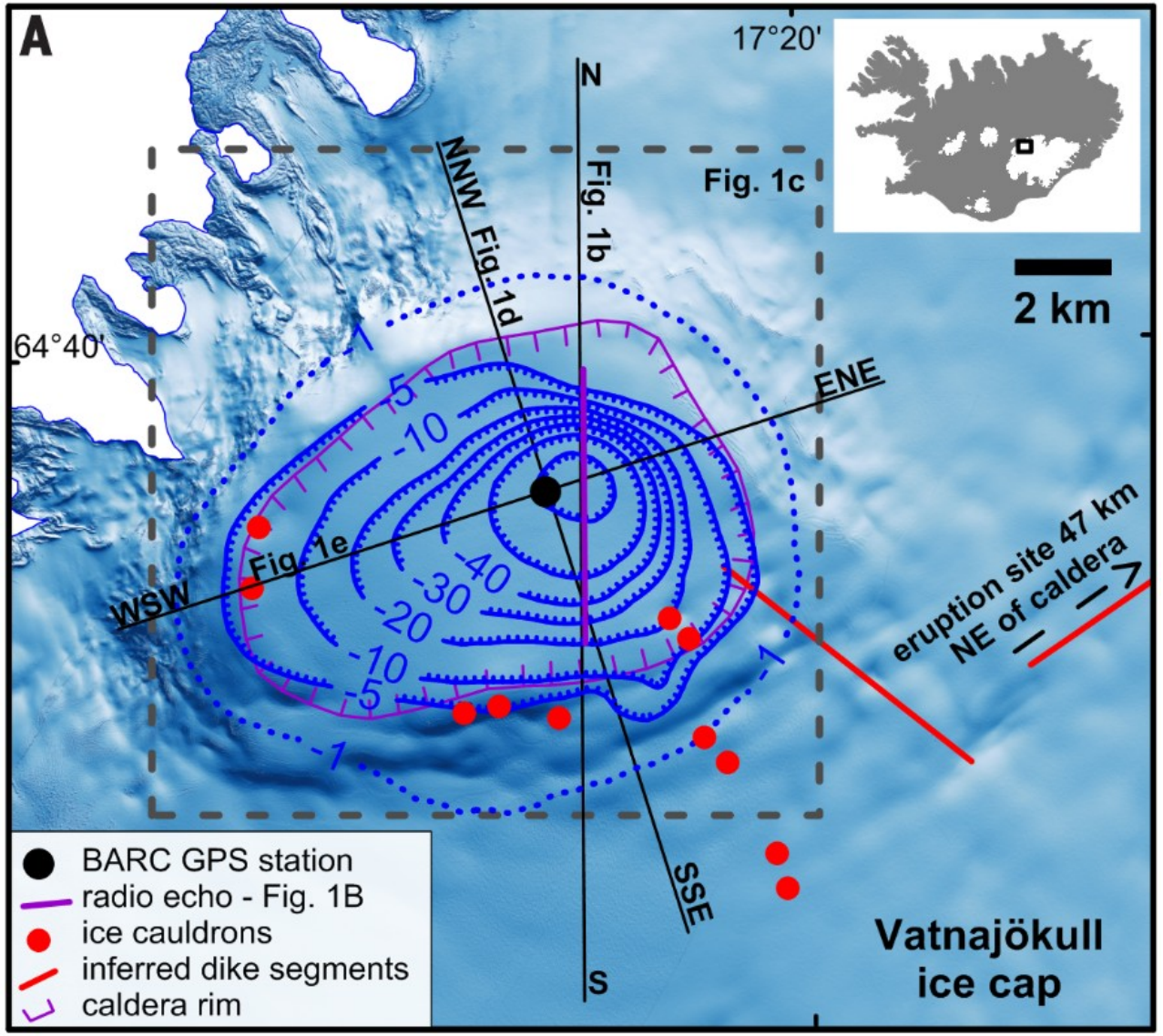
Volcanic eruptions measured by Pléiades



Volcano monitoring: 2014 Bárðarbunga/Holuhraun

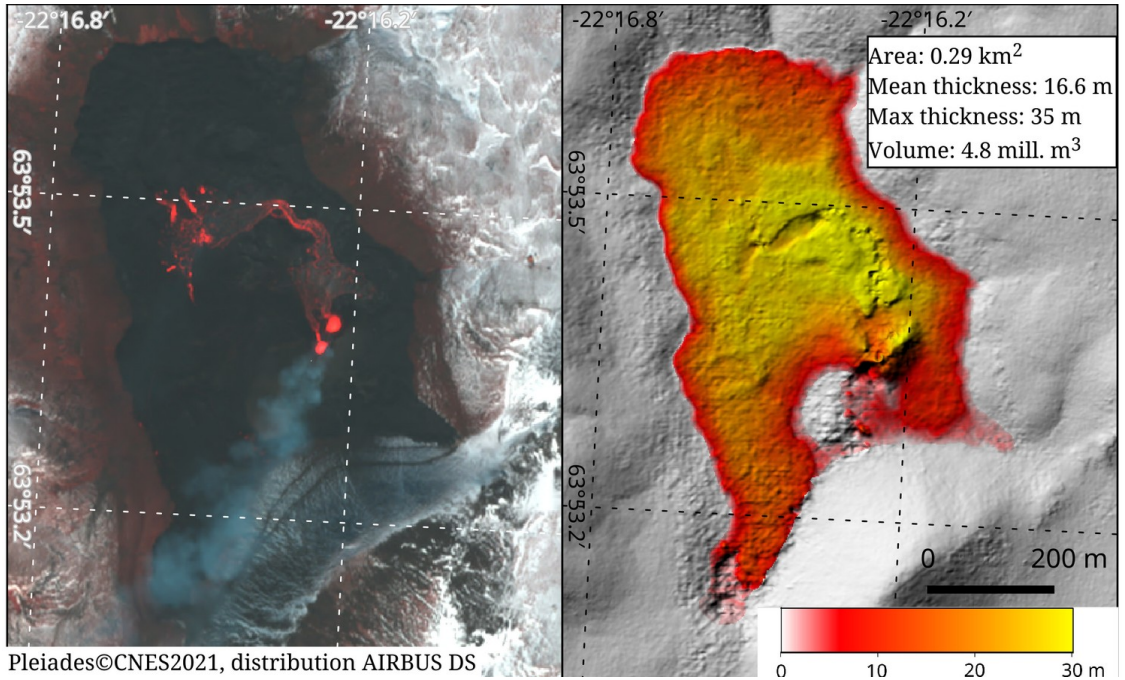




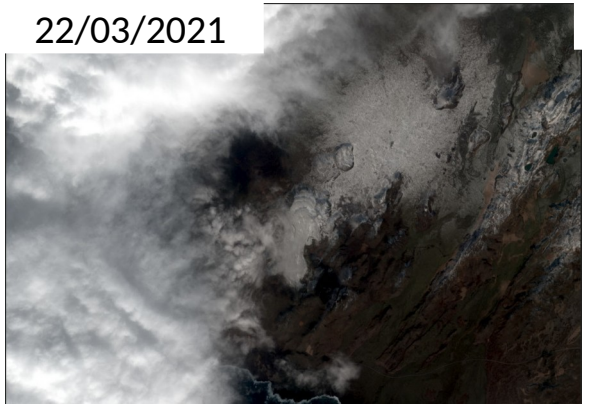


Guðmundsson et al., Science, 2016

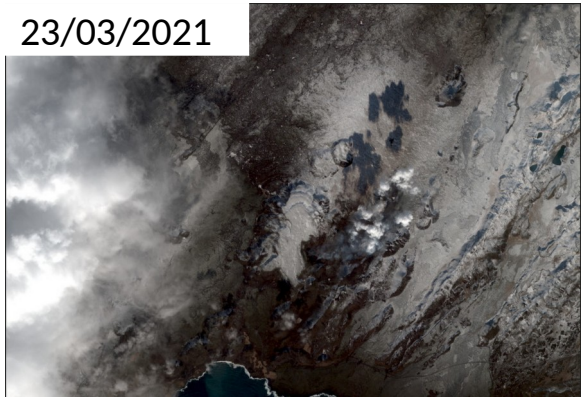
Volcano monitoring: 2021-2025 Reykjanes (CIEST2)



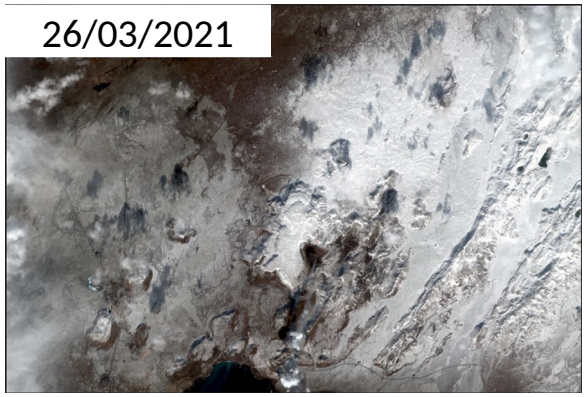
22/03/2021



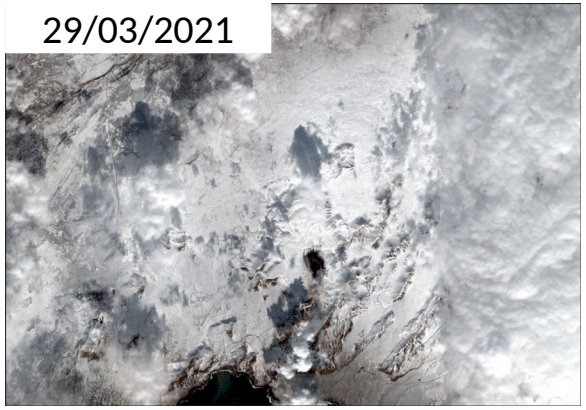
23/03/2021



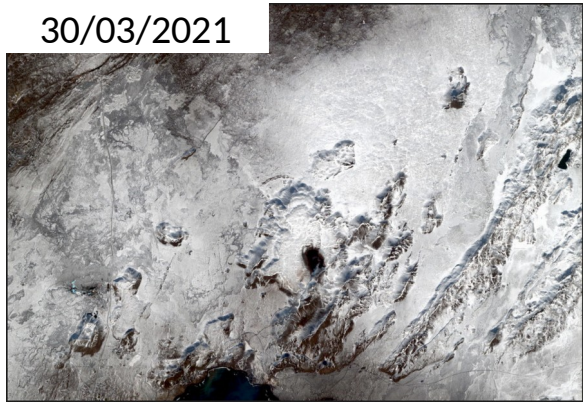
26/03/2021



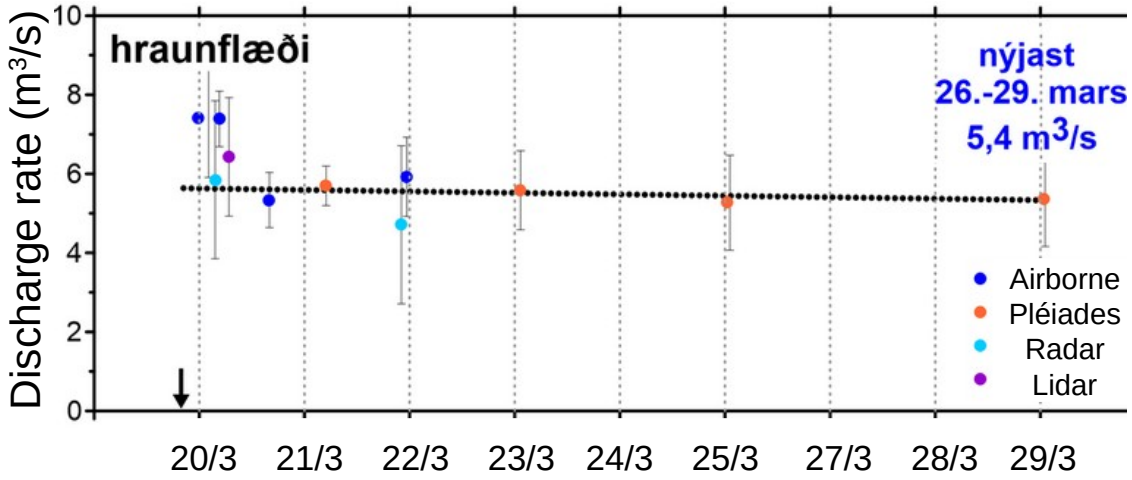
29/03/2021



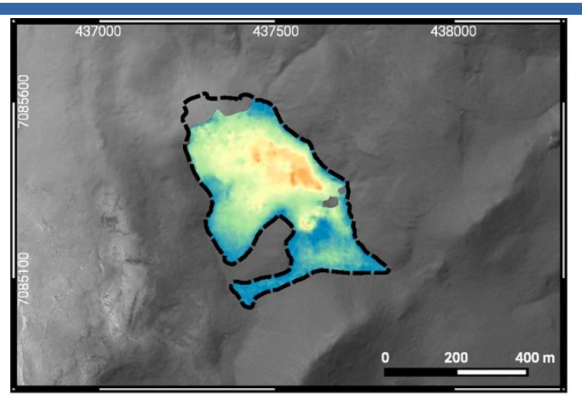
30/03/2021



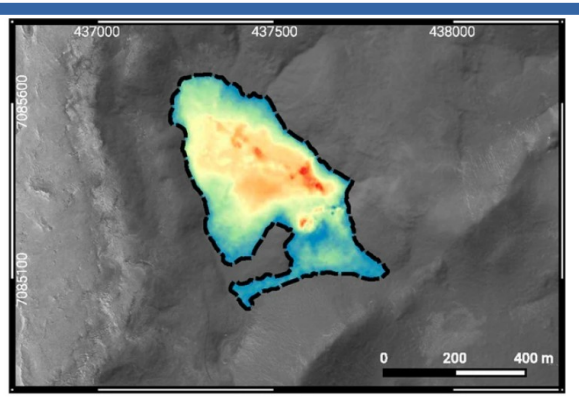
Volcano monitoring: 2021-2025 Reykjanes



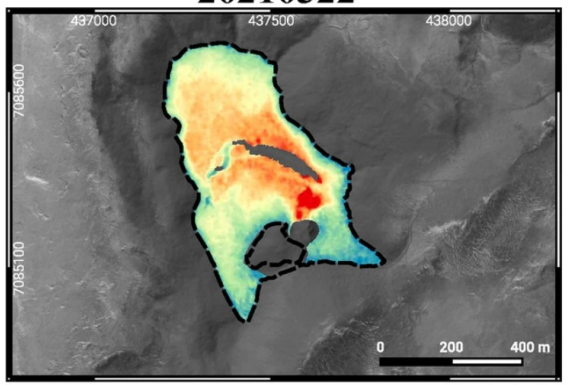
Gouhier et al., 2022, Journal of Applied Volcanology



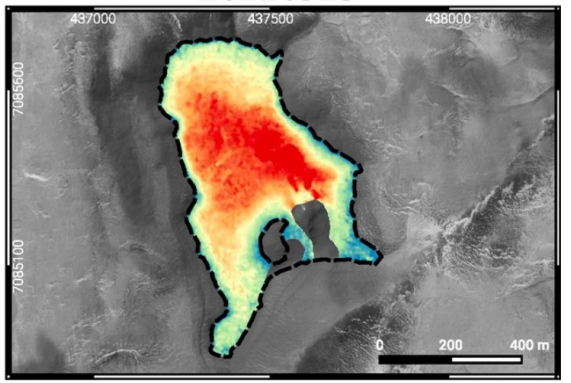
20210322



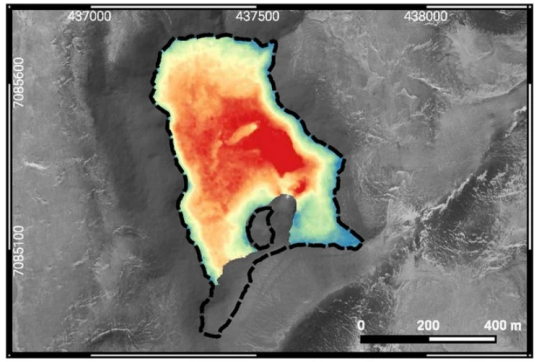
20210323



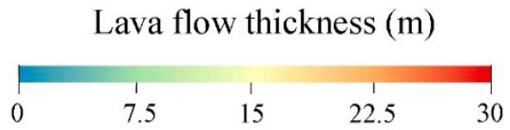
20210326



20210329



20210330

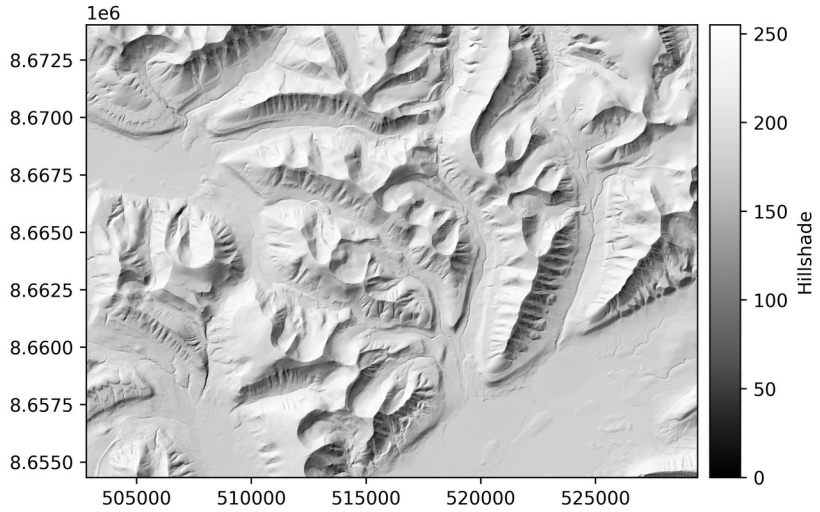


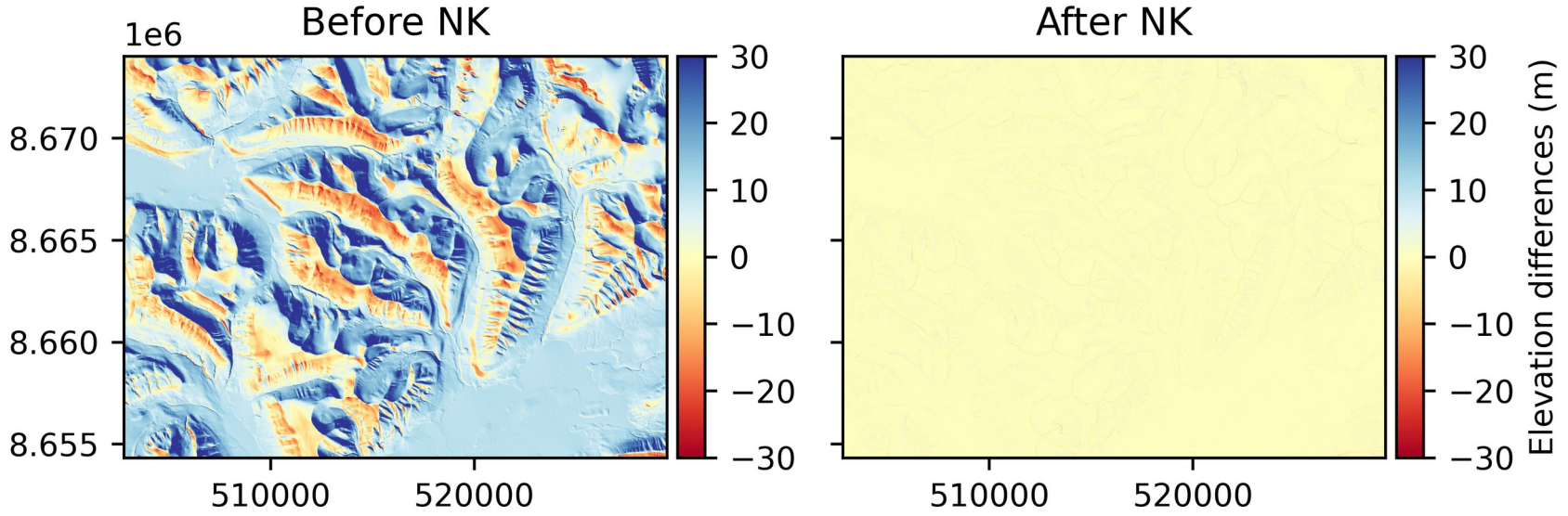
General workflow

Ames StereoPipeline + Semi-Global Matching/More Global Matching

DEM co-registration. Reference: lidar & national Icelandic DEM (dem.gis.is)

Processing time: ~8h to 10h for a large (~800 km^2) scene (i.e. overnight processing)

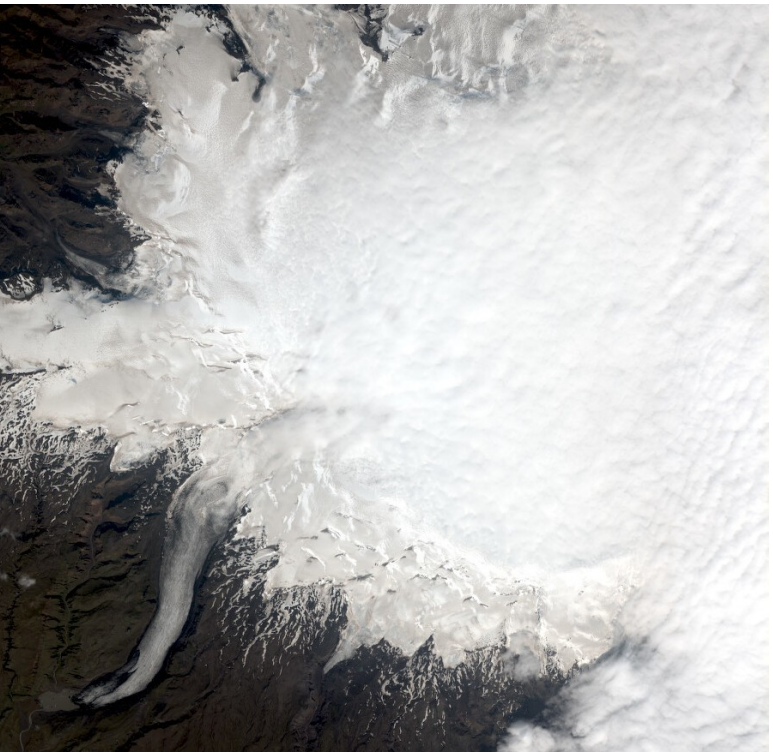




https://github.com/NeoGeographyToolkit/StereoPipeline
https://github.com/dshean/demcoreg
https://github.com/GlacioHack/xdem

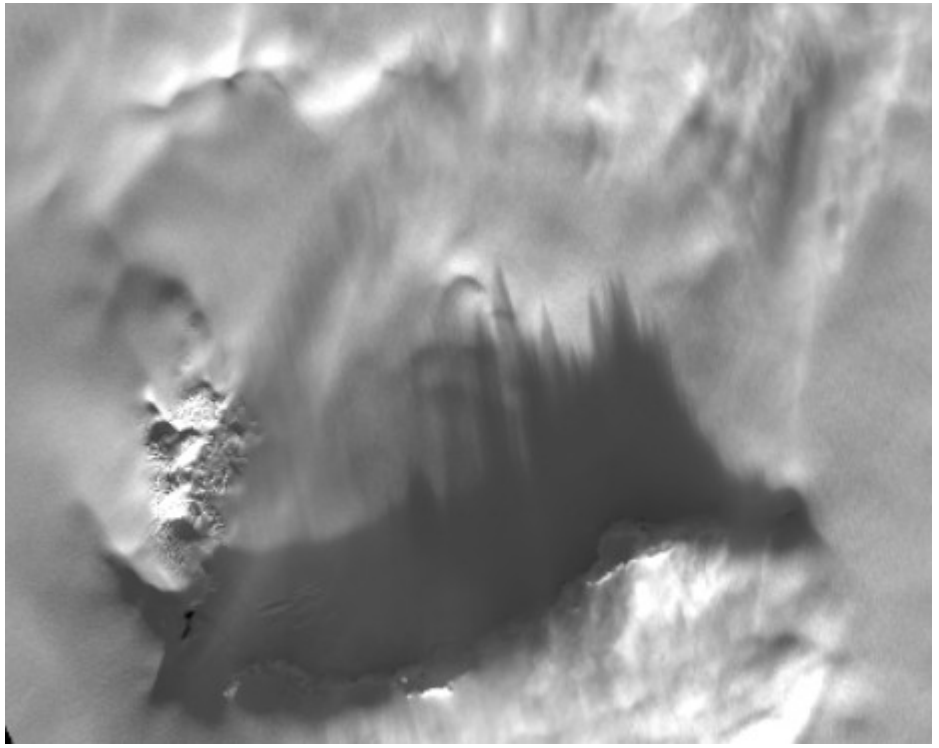
Challenges through years

Clouds



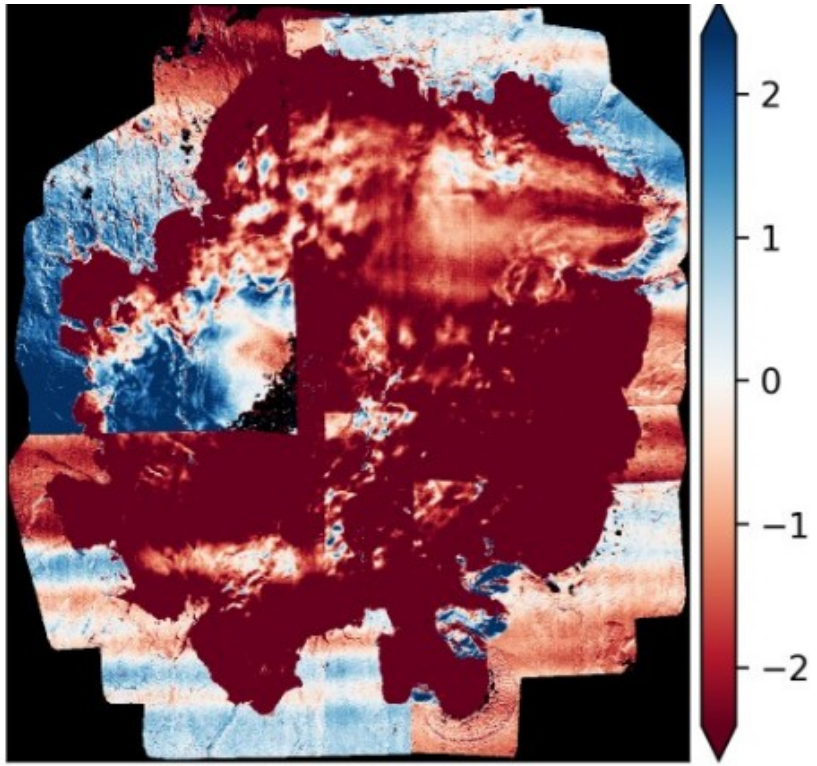
Clouds on top of Mýrdalsjökull

Polar night



Large shadows on Grímsvötn on the 20th Nov 2021

Jittering



Strong jittering (up to 2 m) as combination of multiple Pléiades acquisitions in 2020 and 2023

Data access

Main access through:

Dinamis (dinamis.data-terra.org)

CEOS-Volcano Supersite (ceos.org)

CIEST² (https://www.poleterresolide.fr/ciest-2-nouvelle-generation-2/)

Price of stereo in 2024:

Pléiades:	3.6 €/km²
Aerial photos:	10-20 €/km²
Pneo & other commercial satellites:	20-30 €/km²

Present & Perspectives

Pléiades data used by local & international researchers in >20 peer reviewed publications in Icelandic glaciers, volcanoes and landslides

Jittering is becoming a real challenge, but new tools are becoming available to correct it

Pléiades World Heritage → (out)cropped areas of interest will become available and re-processed

Mýrdalsjökull cropped to the AOI (left) and full scene (right)

Merci !
Takk fyrir!

E-Vatnajökull, 2021 © CNES. Distribution Airbus DS