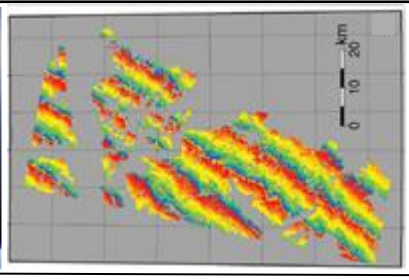
Master of Science Project

Department of Geoscience and Remote Sensing (GRS)

Discipline: Earth Observation

Is it possible to radically improve the spatial resolution of estimated mass changes of the Greenland ice sheet using InSAR data?



Research context

The Greenland Ice Sheet (GrIS) has been the largest single contributor to global sea level rise in recent decades. As such, ongoing ice mass changes in Greenland attract a close attention of climatologists. One of the most informative observational techniques to quantify those changes is satellite gravimetry. In contrast to most of other remote sensing techniques, satellite gravimetry is sensitive to mass changes not only at the surface, but also inside the GrIS. This allows this technique to detect, among other, an accumulation and release of meltwater within the GrIS. That process remains poorly known, in spite of its important role in the evolution of the GrIS. Unfortunately, the spatial resolution of satellite gravimetry is relatively poor (~300 km). Therefore, there are on-going attempts to complement satellite gravimetry data with additional information that may improve the spatial resolution. One of the most promising sources of such information is elastic rock deformations resulting from changing surface load. Such information can be delivered, among other, by Interferometric Synthetic Aperture Radar (InSAR) observations. A potential added value of this observation technique has been already demonstrated in the context of two largest outlet glaciers in Greenland: Jakobshavn (Liu et al, 2012) and Helheim (Erfani Jazi et al, 2022). It was shown that the spatial resolution of estimated mass loss trends can be substantially improved in this way. Nevertheless, the full potential of InSAR data in the context of GrIS monitoring remains unexplored. With this project, we intend to start filling in this knowledge gap.

References

- L. Liu et al (2012), Constraining ice mass loss from Jakobshavn Isbræ (Greenland) using InSAR-measured crustal uplift. Geophys J Int, 188 (3), pp. 994–1006.
- Z. Erfani Jazi Z. et al (2022). Inferring Mass Loss by Measuring Contemporaneous Deformation around the Helheim Glacier, Southeastern Greenland, Using Sentinel-1 InSAR. Remote Sensing, 14 (16), art. no. 3956.

Research questions

- What are the most promising locations in the Greenland coastal areas to demonstrate the potential added value of InSAR data for monitoring elastic rock deformations?
- How to minimize the impact of nuisance signals, such as frost heave and subsidence?
- What is the spatial resolution achievable with InSAR data in the context of a quantification of both seasonal variations in meltwater mass and long-term ice mass losses?
- What is the accuracy of the estimates, depending on the temporal scale and the spatial extension of observed elastic rock deformations?
- How do obtained estimates compare with other available information about mass changes in the study area(s)?

In the course of the project, the student will have an opportunity to gain/expand/apply his/her knowledge in:

- InSAR data processing
- Elastic loading theory
- Greenland Ice Sheet evolution
- Python programming

A sussessfully completed project may culminate in the preparation of a manuscript for a high ranked scientific journal.

Further information and project supervisors:

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