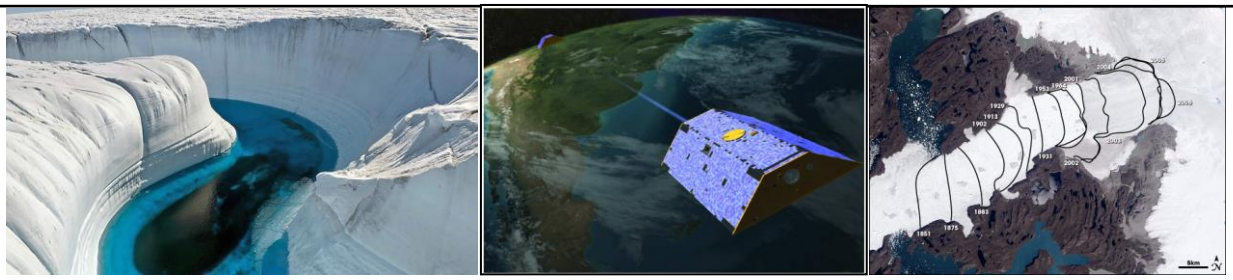
Master of Science Project

Department of Geoscience and Remote Sensing (GRS)

Discipline: Earth Observation

Separation of mechanisms of ice mass losses in Greenland with a constrained spatio-temporal inversion of GRACE data



Research context

The Greenland Ice Sheet (GrIS) contains enough ice to raise the global sea level by about 7 meters and has been a major contributor to global sea level rise in recent decades. As such, ongoing ice mas losses in Greenland attract a close attention of climatologists. The best observational technique to quantify those mass losses at a regional scale is satellite gravimetry. Since year 2002, GRACE and GRACE Follow-On (GFO) satellite gravimetry missions deliver information about GrIS mass variations with a monthly temporal sampling almost continuously. Importantly, GRACE/GFO data only contain information about total mass changes. On the other hand, it is essential to quantify individual contributions to the total mass balance of the GrIS. In particular, comprehensive monitoring and understanding of individual processes responsible for ice mass losses in Greenland is crucial. This is needed, for instance, for an accurate projection of the GrIS behaviour onto the decades to come.

Research objective

Two primary contributors to ice mass losses in Greenland are meltwater runoff and ice discharge. These processes are characterized by a substantially different behaviour in the time domain. This triggers an idea to separate these processes by developing a novel technique for a properly constrained spatio-temporal inversion of GRACE data. Unique features of this technique will be: (i) simultaneous inversion of an entire time-series of GRACE data (instead of processing monthly datasets individually) and (ii) direct inversion of GRACE data into parameters of the processes of interest (instead of estimating total mass changes). An expected by-product of the new technique is a higher accuracy of the resulting estimates, as compared to the techniques used currently, due to the usage of constraints reflecting the properties of the processes of interest.

Methodology

It is envisioned that the project will comprise the following major steps:

1. Analysis of available data on precipitation in Greenland
2. Preparation of GRACE data for the intended separation of mass losses mechanisms in Greelnad (including the sudtraction the pecipitation signal)
3. Analysis, further development, and testing of the Python code for GRACE data inversion, which was prepared at our research group earlier.
4. Application of the developed Python code to the properly prepared GRACE data; preliminary analysis of the obtained results and fine-tuning of the inversion procedure
5. Interpretation of the final results and comparison of them with already existing knowledge of ice mass losses in Greenland.

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

- GRACE satellite gravimetry
- Ice sheet modelling
- Inverse theory
- Python programming.

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

Further information and project supervisor:

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