Report on IAG/SCAR-SERCE Workshop on Glacial Isostatic Adjustment and Elastic Deformation

Reykjavik, 5-7th September 2017

Around 80 scientists, from a diverse range of backgrounds, gathered in the highly relevant location of Reykjavik to present and discuss the latest research on modelling and measuring the mass balance of the Earth's glaciers and ice caps and associated solid Earth deformation. The 3-day meeting was divided into keynote talks, presentations of new research findings from scientists at all career stages, a lively poster session, and dedicated discussion time. The meeting ended with a half-day excursion that involved crossing a plate boundary twice – it's safe to say we were more excited than your average tourists!

The meeting was divided into four themes: (i) Observations of present-day changes in glaciers, ice caps and ice sheets and the associated Earth deformation, (ii) Measurement and Models of Elastic Rebound, (iii) Glacial isostatic adjustment on a heterogeneous Earth, and (iv) Reconciling models and observations of GIA. Looking back at the schedule of similar workshops held in Ilulissat (2013) and Fairbanks (2015), it is exciting to track the growth of research in the field of '3D' glacial isostatic adjustment (GIA) modelling, which considers lateral variations in Earth structure, as well as continued innovation in the approaches used to combined observations and modelling to understand ice mass change. A full list of talks and posters can be found on the meeting website: http://www.polar.dtu.dk/workshop-on-glacial-isostatic-adjustment-and-elastic-deformation-2017

At the close of the meeting, participants were invited to compile a list of the 'top 10 questions' that are currently at the forefront of the GIA research agenda. These are listed at the end of this summary, and we look forward to hearing about progress in these areas over the coming years!

If you feel that the research you presented at this meeting contributes to the aims of the SERCE program (https://www.scar.org/science/serce/home/), or if SERCE activities have facilitated the development of your research ideas, then please consider including an appropriate acknowledgement in your research outputs, such as "This research is a contribution to the SCAR SERCE program". If you do include such text, then please notify SERCE joint chief officers Pippa Whitehouse (pippa.whitehouse@durham.ac.uk) or Matt King (Matt.King@utas.au).

This friendly and productive workshop was organised by Abbas Khan and Maria Tammelin Gleerup at DTU Space, and benefitted from travel support provided by ESA and SCAR/SERCE.

Top 10 questions

Two overarching themes were felt to be crucial for advances in the field to take place:

a) Development of a culture of sharing of codes and numerical outputs, as well as geological and geodetic data
b) Continued collaboration across disciplines, allowing modellers to understand the nuances of field data, and observational scientists to understand the strengths and weaknesses of models

More specific issues that were discussed included:

1. What are the feedbacks between solid Earth deformation and ice dynamics, especially in regions with low viscosity upper mantle?

2. What is the rheological nature of the lithosphere/asthenosphere at timescales from hours to decades and what is the rheological nature of the mantle from years to millennia? Can processes across these time scales be explained by a single rheological model?
3. How should geodetic time series be interpreted in the presence of time-varying mass changes and varying rheologies? In particular, what approach should be taken in low viscosity regions where quite recent (decades to centuries), but poorly quantified, mass changes may have excited a viscous response?
4. To what degree do inferences of ice history and earth rheology depend on the type and distribution of the constraining data, such as relative sea-level constraints and GPS data? To what degree is it possible to determine ice history independent to Earth rheology?
5. When do lateral variations in rheology need to be considered and what are the consequences of using a simplified 1D rheology? Issues to be considered include computational efficiency and the sensitivity of GIA to lateral variations in rheology
6. What are the uncertainties associated with determining the 3D viscosity distribution of the mantle, e.g. from seismic velocities, and how should we determine realistic uncertainties on 3D GIA models?
7. How should we compare models and observations in the presence of poorly quantified reference frame errors and uncertainties (including the effects of loosely-constrained lower mantle viscosity)?
8. What is the ongoing deformation of the ocean floor and the land beneath ice sheets (in regions with no outcrops)? How can deformation in these areas be observed?
9. How does dynamic topography affect our understanding of relative sea-level curves?
10. What can the horizontal surface velocity field tell us about GIA processes?