



# Nordiska kommissionen för Geodesi Nordic Geodetic Commission

Working Group for Geodynamics

## Minutes of the 39th meeting of the Working Group for Geodynamics within the Nordic Geodetic Commission

The meeting was hosted by Kartverket, Oslo, March 12-13, 2015. The meeting was organized together with the meeting for the Working Group for Geoid and Height Systems.

### 1. Introduction

The Chair of the NKG Working Group for Geodynamics (WGG), Matthew Simpson, welcomed all participants to the meeting at Blindern, University of Oslo, Norway.

The Chair began by thanking everyone for their efforts during the NKG General Assembly in Gothenburg. Matthew recognized that project administration within NKG should be toned down this four-year period. The Chair noted that, in comparison to the other WGs, the WGG has focused on scientific discussion rather than project work. He believes it is beneficial to invite speakers from outside of NKG to present their work at the WG meetings. He also mentioned the key words and resolutions 5 and 6 from the NKG General Assembly, which are relevant for our working group.

The agenda was approved with two changes. Hannu Ruotsalainen could unfortunately not attend and give his presentation. Miriam Bilker-Koivula presented the document “CCM – IAG Strategy for Metrology in Absolute Gravimetry”.

Dagny I. Lysaker, Kartverket, was appointed as secretary.

### 2. Minutes from the last WGG meeting

The participants of the meeting were invited to comment on the minutes from the last meeting in Gävle 2014. There was no comments to the minutes.

### 3. Scientific Program

There were four interesting scientific presentations:

1. Marie Keiding INVITED: “A comparison of strain rates and seismicity for Fennoscandia”
2. Halfdan P. Kierulf: “A new BIFROST solution”
3. Martin Lidberg: “Models of crustal deformations – from the European perspective”
4. Tõnis Oja: “Testing land uplift models in Estonia”

## 4. National/Institute reports

Sweden – Andreas Engfeldt, Lantmäteriet

Norway – Matthew Simpson, Kartverket

Estonia – Tõnis Oja, Estonian Land Board

Finland – Miriam Bilker-Koivula, FGI/NLS

Denmark – Emil Nielsen, DTU

Iceland – Gudmundur Valsson, Landmælingar Islands

## 5. Project activities

### 5.1 GIA modelling and empirical land uplift models

Holger Steffen presented: “Towards NKG201XGIA- a GIA Model for Fennoscandia – Status March 2015”

Holger outlined the progress made with the GIA modelling work. A major new step in this work is the availability of an ensemble of glaciological models developed by Lev Tarasov and coworkers. As of November 2014, Lev has made available 35 new ice histories to be tested. These ice histories are determined by way of Bayesian calibration. The calibration provides a posterior distribution for model parameters (and thereby modeled glacial histories) given the observational data sets that takes data uncertainty into account. The observational data sets used to constrain the model ensemble are past ice extent, paleo sea level histories and geodetic observations.

There is general agreement that the approach employed by Lev Tarasov appears promising and offers a sound method for quantifying GIA model *uncertainty* estimates. Something that has been lacking up until this point.

In the second round of GIA model testing to be performed by Holger and others, the following was noted:

1. We have 35 ice histories for Fennoscandia. In other parts of the world we will make use of the ICE-6Gc model (Peltier et al., 2015). The ICE-6Gc model will need to be adjusted to fit the global sea-level equivalent time series.
2. Earth model.
  - Will be close to VM5a, with perhaps a few more layers. Maxwell rheology.
  - Other models parameters as used in COST benchmark activity (Spada et al., 2010)
3. Observations.
  - New BIFROST 2015/2016 release.
  - Global RSL data and Fennoscandian RSL data.
  - GRACE, tide gauges and geological information.

Holger plans to speak to Lev Tarasov between 20<sup>th</sup>–24<sup>th</sup> April 2015. He will update the activity members thereafter and also investigate the following issues: The Chair thinks that it is important to (1) get more details from Lev about the methodology he applies as it is clear some GIA modelling must be part of his model setup and (2) get a timeline from Lev for when he plans to submit his work for publication.

Some members wanted to know more about how the input of the GPS solution to the Bayesian calibration used by Lev Tarasov would affect the ice histories produced.

In summary, there has been good progress with the GIA modelling work and the activity will continue into the next period starting with a second round of testing (see above).

The discussion moves to the empirical uplift model 'NKG2014LU\_test'. It is agreed that the empirical approach is probably best for correcting geodetic observations for vertical land motion. However, if you are interested in understanding the physical processes driving vertical land motion, then clearly modelling must play a role. It is stressed that GIA is only one process contributing to vertical land motion in Fennoscandia.

A timeline for the new empirical land uplift model 'NKG2015LU\_test' is outlined:

1. The new BIFROST solution(s) *must* be included in this model. It is anticipated that this work will be completed by *IUGG in June 2015*.
2. The underlying GIA model will be provided by Holger – it is thought that this can be achieved by *IUGG in June 2015*. (Horizontal velocities will also be made available from this GIA model solution).
3. Latvia, Lithuania and Estonia will provide tide gauge data by *end of 2015*.
4. Lithuania will provide levelling data by *end of 2015*.

Olav Vestøl and Jonas Ågren are responsible for the computation of the empirical land uplift model. The empirical land uplift model will be required within 1-2 years, so it is prudent to be finished with this work by *end of 2015*.

Some other points made in the discussion:

1. When using the GPS data in GIA modelling they should be first corrected for reference frame issues due to current geodynamic processes (e.g. present-day ice melt)
2. There remain residuals between the GIA model and observations. Holger indicated that preliminary work by Lev Tarasov indicates that residuals in the Lofoten area of Norway can not be explained by GIA alone.

## **5.2 Absolute gravity measurements in Fennoscandia**

The Chair gave an introduction to the project and described some of the background work. The 'agreement on exchange of data from absolute gravity observations and conditions for use' was briefly outlined. The Chair also detailed what was agreed upon at the last WGG meeting in Gävle 2014; that each observing group would work on publications based on their own instruments and have that work done within one year (approximately by March 2015). The joint AG publication will be a focus of the WGG over this NKG working period.

Following that, there were three presentations on the progress made by each observing group:

1. Sweden - Per-Anders Olsson. Per-Anders has analyzed data from FG5-223 and aims to publish the results in the proceedings of IUGG. He was encouraged to take all measurements at the Swedish stations into account.
2. Finland - Mirjam Bilker-Koivula. Mirjam has made significant progress with the data analysis and is close to having something ready for submission to a journal. She aims to submit her work for publication after IUGG in June.

3. Norway - Vegard Ophaug. Vegard has conducted a preliminary analysis of the Norwegian data and has no concrete plans for publishing yet.

It is apparent that the different observing groups are at different stages of work. Finland is close to submitting work for publication whereas the other groups are still working on the data analysis.

After some discussion, it is decided that a joint AG publication is still wanted in addition to the national publications being worked on by each observing group. It is a good idea to bring all the data from across Fennoscandia together and there will be new results to present once all the data are analyzed together. It is suggested the data could be compared to GRACE and/or modelling work in a follow-up paper.

It is decided that a kick-off meeting to the joint AG work be organized in ***Finland in September 2015***. One member from each observing group will attend (Vegard, Mirjam and Per-Anders). Per-Anders Olsson will be responsible for coordinating the meeting. The group will discuss how to proceed with the joint AG publication, including the many issues surrounding the data analysis and scientific aim of the work. The group will decide among themselves a ***timeline*** for publication and how the work will be divided (including who will be ***first author***).

Following this, there was a discussion on how to correct g-values in the new Nordic gravity systems. There are several different possible approaches here:

1. Using g-dot from the absolute gravity observations.
2. Using a GIA model.
3. Using an empirical land uplift model like NKG2005LU and the ratio g-dot/h\_dot.
4. Using observed GNSS h-dot and the ratio g-dot/h-dot.

The group recommends that the same model/method be used within NKG. It is decided that for RG 2000, which will be realized in Sweden later this year, using NKG2005LU is probably the best alternative. Finland is also about to finalize their new gravity system, but it was not known what strategy they plan to use. Mirjam will check on this. There was no final conclusion on which approach will be recommended or which is more preferable, this will have to be discussed further.

## **6. Business matters**

1. The NKG webpages are in the process of being migrated from FGI to DTU. We will start using them as soon as they are operative.
2. No need for strict coordination of AG field campaigns this year. The instrument owners contact each other for comparisons if needed.
3. Andreas Engfeldt informed the meeting that the absolute gravity data up to 2013 is in the AG data archive. Data from 2014 should be submitted within the year.
4. Estonia would like more absolute gravimeter measurements. Finland has offered to try and measure in Estonia when going to Latvia for other measurements.

There was a general discussion about the amount of work within the working group. The Chair is of the opinion that enough work within the WG with our ongoing projects and activities but welcomes any suggestions for new initiatives. No new activities were suggested.

## **7. Closing of the meeting**

The next meeting for the WGG will be in Estonia week 11 2016 together with the WG for Geoid and Height Systems.