The NKG plan for absolute gravity observations in the NKG/AG network

by
NKG Working Group for Geodynamics

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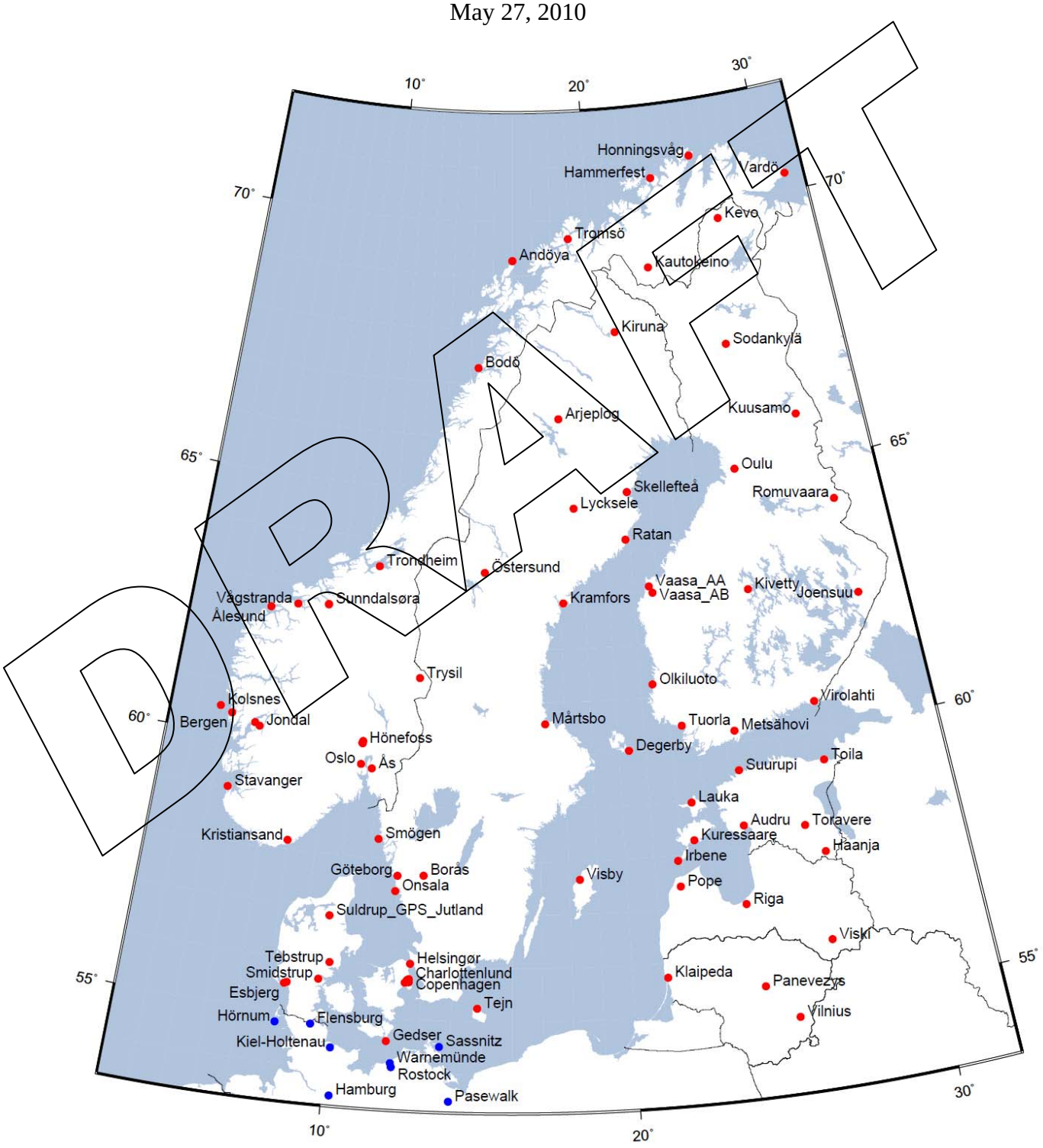

Figure 1. Existing stations in the NKG/AG network (red) and some adjacent German stations (blue).

Introduction

In the late 1990s there were some activities in the various Nordic countries in the field of absolute gravimetry. Uses for such measurements include primarily geodynamic studies in the Fennoscandian postglacial land uplift area, but may be useful in support of gravimetric survey as well, being one way to calibrate survey data to an absolute level.

With this in mind, the Presidium of Nordic Geodetic Commission (NKG) turned to the NKG Working Group for Geodynamics and requested a proposal for an *NKG Geodynamics plan for Absolute Gravimetry*. This plan was established in 2003, and according to that the increasing activities in the field of absolute gravimetry were coordinated. Since then the *NKG Absolute Gravity network* (NKG/AG) has been established, with many new absolute gravity stations (Figure 1). The NKG/AG constitutes a component of NGOS, the *Nordic Geodetic Observing System* (Poutanen et al., 2007). A number of different organisations have contributed with observations. Considering the development that has taken place since 2003, the NKG Working Group for Geodynamics has decided to make the following updated version of the original plan, now also including stations and activities in Greenland and Iceland (Figure 2).

So far the Inter-Nordic coordination through NKG and its working group for geodynamics has led to a concerted multi-decade effort to observe gravity change in conjunction with crustal dynamics and postglacial land uplift. Early efforts using relative (spring-) gravimeters along the land-uplift gravity lines (Figure 2) have attracted international attention (Ekman and Mäkinen, 1996; Ekman 1991; Mäkinen et al. 1986). In the last decade the focus has changed from relative to absolute gravimetry. Absolute gravity measurements are typically co-located with space geodetic observations and/or sea level observations. The NKG Working Group for Geodynamics has been coordinating these efforts. The group would provide a suitable forum for coordination in the future too, and most of its members have been involved in various ways in these measurements.

Being aware of the potential of the monitoring work, this group wants to point out the necessity to maintain an observing system with sufficient stability and observing plans with sufficient feasibility to last through a couple of decades. These observations will contribute in a substantially way to various efforts of combining different geodetic techniques as e.g. GGOS, NGOS, ECGN, DynaQlim etc.

This proposal contemplates the continuation of research work in gravimetry and concentration on absolute gravimetry as the prevailing method. We first take inventory of existing stations and observations so far in the NKG/AG network; then, we will formulate a possible common philosophy for future observations and maintenance of the network.

Figure 2. Existing stations in Greenland and Iceland.

Current status

During the last decade the NKG/AG network has been established. The existing stations are shown in Figure 1 and Figure 2. Appendix 1 is a more detailed description of the stations. A few of these stations coincide with points in the Fennoscandian land uplift gravity lines, see Figure 3.

A number of organisations have contributed with measurements and most of the stations have been occupied several times. The first measurements were carried out with JILAg instruments but since 2003 all measurements have been carried out with its successor FG5.

Appendix 1 contains information on occupations of the stations in the NKG/AG network so far.

Superconducting gravimeters installed at Metsähovi (1994-) and Onsala (2009-) (Ny Ålesund?) are considered important for future understanding of temporal variation in observed gravity change.

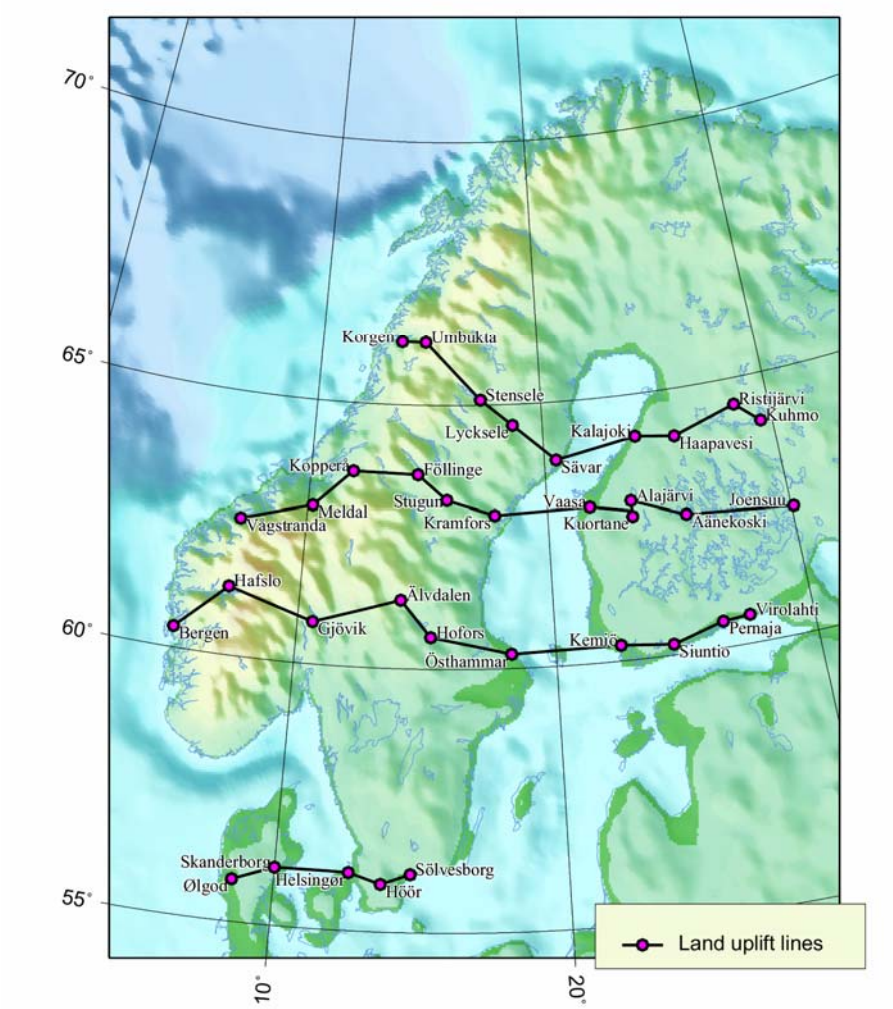

Figure 3. The Fennoscandian land uplift gravity lines.

Future plans

Denmark

National Space Institute of the Technical University of Denmark (DTU) plans to measure all permanent GPS gravity stations in Denmark with their A10 gravimeter. The rate of stations to be measured depends on the AG activities in Greenland, which is the main task (and the main purpose for buying an A10).

Besides the above stations there is also a plan, as part of a national obligation (and a contract with KMS), to remeasure our precision gravity network located in a number of churches around the country. This includes both the abs. gravity measurements and the abs measurements on eccenter points (or, if not possible, the repeated relative ties over short distances using our new CG5). Some stations will be measured in 2010 and the project will continue in the future. Special attention could be paid to the stations related to the 56N-gravity line.

A new absolute gravity point have established in Esbjerg Airport - for the aerogravity use.

Finland

Information added by FGI

Norway

Information added by UMB / Statens Kartverk

Sweden

Lantmäteriet (Swedish mapping, cadastre and registry authority) has the intention to continue FG5 absolute gravity measurements in a foreseeable future. Focus will be on the Swedish stations, the western part of the 63° gravity land uplift line and the Danish station Tejn at Bornholm. A rate of approximately ten stations per year seems realistic right now.

No major increase of the number of stations in Sweden is planned (maybe one or two).

Other contributing organisations

Bundesamt für Kartographie und Geodäsie (BKG) and Institute für Erdmessungen (IfE) have contributed with comprehensive and valuable observations in the NKG/AG network. The founding for these organisations to continue their work with absolute gravity observations in Fennoscandia has decreased, but there is an intention that the cooperation between the NKG working group for Geodynamics and BKG and IfE will continue.

Proposal for the future

The NKG/AG network is by now pretty well established (Figure 1) and focus of this proposal is on maintenance of the network, long term observation plans and data handling.

Coordination

It is proposed that the *NKG Working Group for Geodynamics continues the coordination* of the NKG/AG network and issues related to that.

Stations

Host organisations for stations in the NKG/AG network should hold *good documentation* on the stations, maintain them and keep them in good shape so that scientists from all Nordic countries, and others, can include them in their measurement programs.

For storage and distribution of metadata on the stations the *"Agrav"* database, implemented at BKG and BGI should be used.
http://agrav.bkg.bund.de/agrav-meta/
http://bgi.dtp.obs-mip.fr/agrav-meta/
Also, the document referred to in *Appendix 1* will be updated on a yearly basis

The number of stations in the network should be *limited*, which will make it more likely that limited resources will be directed effectively and the necessary instrumentation and sufficiently frequent re-occupation will actually take place.

Observations

It is of greatest importance that a *regular occupation* of the stations in the NKG/AG network is maintained, preferable every, or every second year and as a minimum every fifth year. Crucial to make this successful is good coordination within the Working Group for Geodynamics and of course long term goals and stable financing for the participating groups.

Teams doing measurements in the NKG/AG network should strive for *instrument comparisons* with other active teams every year, primarily by simultaneous measurements in laboratories and not by double measurements of field sites.

Data

It is important that groups participating in the project will make sufficient resources available also for the *processing and publication* of the measurements obtained within a reasonable time frame.

A framework should be agreed upon which allows the data collectors adequate time to analyse their data and publish scientific results themselves. After that, the data should be made available to project participants in order to jointly publish project results. Following this, the *data should be available for use* by the scientific community at large.

Requirements to reach the goal

Observing the change of gravity in the Nordic region involves a long time-scale. The scope of this proposal is therefore until further reconsideration. The number of locations that participate in the NKG/AG network is limited to a reasonably small size, trading off the necessary spatial resolution needed to sample the postglacial rebound signal and to obtain the necessary redundancy to study systematic influences e.g. from oceanic and hydrological loading effects.

The coordinated operation of absolute gravity measurements needs to be a steady state of activities. This is only possible with a stable availability of instruments and personnel. With increased levels of funding an expanded plan would primarily propose the same amount of stations to be reobserved more densely in time before additional stations would be considered.

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Appendix 1

Document containing information on all stations in the NKG/AG network; to be found at http://www.xxxxxxx