NKG, Working Group: Positioning and Reference Frame
06th - 07th of May 2009, Lantmäteriet, Gävle, Sweden

**Participants**

Denmark: Per Knudsen, Bo Madsen, Mette Weber
Estonia: Priit Pihlak
Finland: Hannu Koivula
Norway: Torbjørn Nørbech, Oddvar Bråvold Tangen, Olav Vestøl
Sweden: Martin Lidberg, Lotti Jivall

**A (draft) agenda:**

1) Welcome - Practical info

2) Status

3) Week 40 campaign:

   - Status and strategy of the computations (Lotti Jivall)

4) Brief national reports (including report from the NKG LAC)

5) Other activities - WGs, NGOS, projects - (all)

6) AOB - ESA project on Arctic Testbed (Per Knudsen)

7) Next meeting

8) End of meeting

# 1. Welcome and opening

Lotti welcomed everybody to Gävle and Lantmäteriet, and Per opened the meeting. The agenda was approved and Martin and Lotti were appointed to share the task as secretary for the meeting.

# 2. Status (of the GPS campaign)

The status of the NKG 2008 GPS campaign was reviewed:

- Data has been uploaded and is available at the KMS server

- "quality check" (QC in the teqc program) has been done using 5° and 10° elevation mask for most sites, except for stations in Denmark

- Discussion on experience on whether the multipath value presented from "teqc" is correlated with good or bad stations. There is apparently no clear conclusion on the topic

- Some few Swedish stations has been re-submitted to the KMS server due to collision in the 4 character abbreviations used for station identifier (HOLM ->HOS0, HOBU -> HOB0)

- For some stations in Latvia and Lithuania, the antenna height values differ between the RINEX headers and the log-files. For one station in Sweden, HARA″ there is an uncertainty about the antenna type. It is an Ashtech Dorne Margolin choke-ring antenna (similar to AOAD/M_T) but which one of two possible types is not known.

## 3. Week 40 campaign: - Status and strategy of the computations

Lotti has prepared files for processing of the NKG Backbone using the Bernese software. Files with information on absolute and relative antenna models, receivers, satellites, coordinates, velocities, ocean tide loading, station information, orbits, clocks and ionosphere have been uploaded to the KMS ftp-server.  To use the individually calibrated values used by EPN (and included in the file prepared by Lotti) each user need to register at EPN to formally get access to the values.

Lotti has sent an email (2009-03-30) with information on this as well as a proposal for which solutions to produce:

- Solution based on absolute receiver and satellite antenna models, computed in IGS 05, using elevation cut-off at 3°, 10° and 25°.

- Solution based on relative receiver and satellite antenna models, computed in ITRF 2005, using elevation cut-off at 10° and 25°.

The idea with the "relative" solution is to have a solution comparable with the solution from the NKG 2003 campaign. The orbits, clocks and EOPs are however the same, IGS orbits based on abolute antenna models.

***Status of the computation of the backbone network***

Lotti presents her computation of the 70 station backbone (BB) network, as well as comparisons to computation done by Oddvar. Agreement is in general good, but occasionally there are differences in the order of 5 mm. It is discussed whether this is small or not. After a while it is concluded that using the same data and the same software (and aiming for the same analysis strategy and models) the differences are somewhat larger than what can easily be explained.

Regarding processing strategy, Lotti have computed using elevation mask of 3 (in practice 5 for many stations), 10 and 25 degrees. FES2004 is used for ocean tide loading (OTL).

Torbjørn has computed with GIPSY PPP and using relative antenna models so far.

Abbas has used absolute antenna models; So far type calibration, but individual models should be possible to use.

*About antenna calibration models, OTL values*

We would like to use the best available (absolute type) antenna calibration models available. Thus, for EPN stations the models used within EPN should be used, including individual calibrations. For other IGS sites, values from IGS will be used. For other stations, the "best available values" are preferred – i.e. individually calibrated values (of antenna +radome) if available. If not available, type calibration values need to be used.

The antenna type JNSCR_C146_22-1 (Javad DM Choke Ring) used in Sweden has been absolute calibrated at Geo++ (4 antennas) but no official type values was available at the time of the meeting. Lotti has used a plain average of these models for the preliminary processing of the Swedish part of the campaign, but has after the meeting requested Geo++ for a rigorously computed mean using the full covariance information from the four antenna calibrations. Absolute type values for this antenna are now (June 2009) available from Geo++ PCV data base and at the KMS-ftp-server.

Each country should provide model values for antenna (+ radome) used in that country. This should be uploaded to the KMS server by May 20.

Also OTL models (FES2004) should be uploaded by the "station owner organisation", or group that has agreed to compute the site, to the KMS server before May 20.


*Check for consistency in processing using Bernese*

Lotti will upload her setup-files (PCF- , OPT and other files for Bernese - same as used in the EPN analysis) to the KMS-server, so it is possible to compute the BB-network using Lotti's setup. Oddvar will also upload his setup.

In a first step Oddvar's and Lotti's setups will be compared to figure out the reason for the different results and after that, Oddvar's and possible also Lotti's setup will be adjusted to a common one.

Each group that will compute using Bernese should "install" these setup files and compute the BB network in order to compare the results between analysis groups. Comparison will primarily be done using day 273. Tests should be done using the full 70-sites backbone-network computed without division into clusters. Oddvar is main responsible for the comparison.


*Various decisions*

Discussion on cluster size for Bernese processing; Lotti will probably compute using some 40 sites per cluster, and Oddvar maybe up to some 70 sites.

Regarding division of the complete campaign;

- Bernese (all compute the BB network)
    - o Lotti: Sweden and Finland

- o Oddvar: Norway
- o Mette: Denmark, Færø Islands, Greenland*
- o Priit: Estonia, Latvia, Lithuania
- GAMIT/GLOBK: all sites
- GIPSY:
  - o Abbas: BB, Denmark, Iceland, Greenland, Færø Islands, Svalbard + few sites in Sweden and Norway
  - o Torbjørn: BB, Norway (or all sites) ???

* Remark July 3rd 2009: We need to find another processing center for Denmark, Færø Islands and Greenland.

The setup for computation using Bernese should be ready by the end of June.

For the backbone also GIPSY and GAMIT should be ready done by end of June.

Priit contact Janis Kaminski and Eimuntas Parseliunas on discrepancies between RINEX-header and log-files for Lavtian and Lithuanian stations and reports back to the group.

The full NKG2008 campaign, computed in ITRF2005 (IGS05), should be completed by the end of September.  This means that each analysis center should deliver their solution (including the full network or as in the Bernese case a sub-network) to this date. Two main solutions should be calculated, one solution with absolute antenna models and one with relative. Each main solution shall be computed with different elevation cut-off (3, 10, 25 degrees).

The GPS-processing may be performed in IGS05, and by the end the solution may be adjusted to ITRF2005.

The solutions from the different analysis centres will be compared during the first part of October.

Re-computation of NKG2003 GPS-campaign is discussed, but it is decided to focus on the NKG2008 for the moment and postpone the decision on re-computation of NKG2003.

Torbjörn will be responsible for the transformation part. But we will all contribute to the work. Input from Torbjörn to the next meeting.

## 4. Brief national reports (including report from the NKG LAC)

**Denmark**

A professor in Navigation has been employed at the Danish National Space Institute, DTU. His name is Per Høeg and he worked at DMI and Aalborg before.

KMS will add one or two new permanent stations. By end of 2010 KMS will have 10 stations in Denmark.  To prepare for the future, antennas will be replaced, probably next year, to LEIAR25 (3D Choke-ring antennas capable of tracking L5 and Galileo).

KMS has decided to re-measure the complete network of 100 stations in the national reference network realizing ETRS 89 in Denamark. There are 5 defining "EUREF-stations" stations in Denmark densified with another 95 stations with some 40-50 km spacing between stations.

KMS has responsibility for the reference frame for the 26 stations of the GPS-net RTK service.

Greenland:

The GNET Cooperation with Ohio State and Univ. Luxemburg goes on. There will be some 50+ stations in Greenland by the end of the year. Besides that, there will be 9 national permanent sites on Greenland.

The GNET sites use 4*70W solar panels + 1-2 wind turbines + 800kg batteries and iridium for communication.

Three tide gauges is running co-located with national GNSS sites. Also AG is planned at some sites.


**Estonia**

Estonian Land Board has 9 permanent stations today with plans to have in total 17 stations, which hopefully will be completed in 2011. The reason for extending the network is aerial photography, where the 9 current stations not are sufficient.

There are RTK services from private companies. In total 45 permanent stations in Estonia.

12 stations in first order network was measured last summer.


**Finland**

A Transformation service (INSPIRE connected) has been developed.

Comparisons have been performed between Mekometer and GPS.

FinnRef need to be updated with new antennas and monuments. Discussions and thinking on how to do this.

There are now two persons working continuously in Mestähovi with the SLR laser, which is planned to be ready next year.  Local tie measurements between VLBI and GNSS have been performed at Metsähovi.

**Norway**

A new internal Structure in Geodesidivisionen was implemented January 1st 2009.

Statens Kartverk is aiming for a goal to have a positioning service giving 1 cm uncertainty (1 sigma) in 3 dimensions. It seems that the reference frame needs to be improved to be able to serve this need.

More focus on permanent reference stations for reference frame in the future, where time series are crucial.

**Sweden**

Lantmäteriet has last year started a program to re-measure about 50 SWEREF-points each year (2x24 hours directly connected to SWEPOS). Preparations have been made for station calibration (in-situ-calibration) of the original 21 SWEPOS-stations.  New monuments are planned to be built beside the existing SWEPOS-pillars, were new antennas (LEIAR25) will be placed. Jan Johansson has started re-processing of BIFROST with Gipsy.

EPN

NKG LAC contributes with daily and weekly solutions of 50 stations in northern Europe on routine basis and plan to join the  re-processing project with two solutions, one Bernese (approximately the same network as in the routine analysis) and one with Gamit (approximately half the network).

# 5. Other activities – WGs, NGOS, projects

From the presidium meeting in Copenhagen may 2008, we have the task to present advice on procedures for changing antenna at permanent GPS stations:

> **"Agreed action:** The Positioning and Reference Frames WG and the Nordic Positioning Service Project will come up with procedures for changing the GPS antenna (and other equipment) on the permanent GPS stations."

This topic is postponed to the next meeting. Note however the importance of this issue where Denmark has plans to re-place all (?) antennas at the permanent sites, and Sweden and Finland is also planning to modernise their permanent networks!

# 6. AOB – ESA project on Arctic test bed (Per Knudsen)

The European GNSS Evolution program studies and develops technologies associated with Europe's contributions to the field of Global Navigation Satellite Systems (GNSS), i.e. EGNOS and Galileo. The program is headed by ESA and its function is to ensure the ongoing evolution of these systems in terms of technology and performance so they can adequately meet future demands in the short, medium and long terms.

In the group of "accompaniment activities" is four "test beds" included where "the Arctic test bed", addressing usage of GNSS in the High North, is one. NKG has been in contact with ESA about possible contribution.

There will be a Workshop in Tromsö, 24-26 June, which is planned tightly together between ESA and Norwegian Space center. Gunter Hein will run the workshop and there are 16 persons invited. Items that will be discussed during the workshop are the stations, communication, evolution of EGNOS (version 4 or 5…) e.t.c. The realization of the test bed will be decided after the summer.

## 7. Next meeting

Next meeting will be held at FGI in Finland, Wednesday-Thursday lunch-to-lunch October 21-22, 2009.

## 8. End of meeting



*Lotti, Hannu, Olav, Torbjørn, Oddvar, Per, Martin, Mette, Bo and Priit at Lantmäteriet's antenna calibration field.*