

NORDISKA KOMMISSIONEN FÖR GEODESI

Nordic Geodetic Commission, Working Group of Reference Frames
Chairman
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NKG Working Group of Reference Frames

Minutes of the working group meeting Tallinn/online on 30–31 Mar 2023

Place: Tallinn + online (marked with *)

Participants:

EST: Karin Kollo, Jaanus Metsar, Andres Rüdja, Tarmo Kall*

DEN: Kristian Evers*, Mette Weber*, Casper Jepsen*, Thomas Knudsen, Henrik Olsen*

FIN: Pasi Häkli, Sonja Lahtinen (secretary)

ISS: Dalia Prizginiene

LAT: Aigars Keiselis, Ksenija Kosenko*, Janis Kaminskis*, Inese Varna*

LIT: Jokubas Ogintas, Eimuntas Parseliunas*

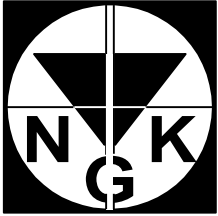
NOR: Michael Dähnn, Hans Sverre Smalo, Sveinung Himle*, Oddvar Tangen*, Karoline Arnfinnsdatter Skaar*

SWE: Tina Kempe, Lotti Jivall, Tobias Nilsson, Per-Anders Olsson, Martin Lidberg*, Christina Lilje*, Holger Steffen*

The slides of the presentations will be available at the SDFI's FTP server.

Session 1: Scientific presentations

- **Anders Rüdja, Final results of GeoRefAct:** Harmonisation of the Estonian and Latvian geodetic systems have been done under GeoRefAct project. The coordinate and height differences have been measured and transition models created in the border area and in the city of Valka/Valga.
- **Michael Dähnn, Operationalization of GNSS high-precision analysis:** NMA has been developing tools to facilitate the GNSS processing using different software, e.g. creating input and configuration files, running programs, handling failures and analysing results. It utilises the earlier developed Midgard Python geodesy library. The main tools are Operax for running the GNSS processing and Analyx to analyse the results. There is a need for a common time series format, Martin suggested to check what has been developed in the EPOS-GNSS consortium.



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- **Christina Lilje, About antennas on Swepos fundamental stations:** The change of the antennas of the Swepos has been going on. The antennas are from 1990's, and they did not anymore meet all the requirements. Some antenna/radome changes have been made/planned also at the newer mast stations. They are equipped with LEIAR25.R3 and LEIT radomes, which are more affected by snow accumulation and lichen growing than the by LM developed OSOD/OSOS radomes. Additionally, LM has developed a heating plate that can be mounted under the choking antenna to prevent snow accumulation on the radome. It has worked perfectly at Kiruna. Some more tests will be done with different antennas.

Session 2: National reports

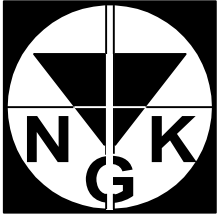
Some main points listed here; for all project and details, see the slides.

Denmark

- CORS stations: GREJ00DNK replaced the old SMID/SMI2 stations.
- SAR transponders/corner reflectors installed at most of the CORS stations
- New strategy for the geodetic infrastructure; available on web.
- New vertical reference systems at sea: primary user is the hydrographical office producing sea charts.
- Work for automating work with Bernese going on (AutoBernese)

Estonia

- ESTPOS: TOR200EST decommissioned in 2022, TOR300SEST established; will be applied into EPN.
- ELB monitors coordinates of GNSS stations in ESTPOS and several commercial networks. There is no official status for the work at the moment, but it is under consideration.
- Assessment of national 2nd order geodetic network has continued using GNSS measurements
- Activities at Vääna metrological baseline has continued. ELB's total station (TS60) was calibrated in Nummela in August 2022.
- Geodetic point database has been further developed: new web interface and various transformation calculators available now
- Revision of geodetic legislation going on



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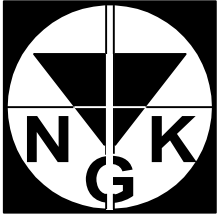
- Finnref network is the backbone for the national coordinate, height and gravity reference systems. Precise levellings and terrestrial measurements of the GNSS stations are going on and will be finished by about 2025. Twenty stations have been measured at least once using absolute gravimeter. Furthermore, SAR reflectors will be installed at sites.
- FINPOS is the positioning service that provides open DGNSS service, RINEX data, raw data stream and positioning services for own operational needs. It utilises FinnRef stations and about 50 second class roof top stations.
- FGI moved to Otaniemi, Espoo in 2022. The rod comparator has been rebuilt to new premises and it is now operational again.
- Official opening of the renewed Metsähovi Geodetic Research Station was held in August. There is now a new main building. The work to finalised SLR and VLBI systems is in progress.
- NLS has new general director Pasi Patrikainen.

Iceland

- GNSS data from all CORS stations (157 in total) has been processed using Bernese from 1999 to 2022. The time series will be analysed next.
- NLSI has participated in the [EPOS-ISLAND project](#). The idea is to collect and provide all Icelandic data, and later include the information to EPOS Europe.
- GNSMART is used to provide positioning services: software version will be changed to newer version.

Latvia

- Benchmark inspection continued in river Daugava area in 2022 and will be continued in 2023.
- A [new geodetic registry](#) is available.
- LatPos network is providing operational positioning service. A record number of connections was achieved last year.
- Observation and calculations of geomagnetic parameters continued in 2022.
- Three gravimeters were calibrated in Estonian calibration line. There are plans to establish an own calibration line as well.
- EPSG code for LKS-2020 was assigned.



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Lithuania

- LITPOS: four new stations established between 2021 and 2022. The Trimble PIVOT software was updated.
- Started work with the Bernese 5.4.

Norway

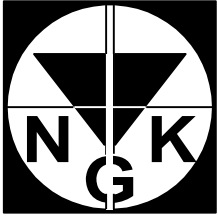
- A new chart datum model has been created
- New tide gauges have been installed. The Norwegian tide gauge net will expand with at least 10 new permanent tide gauges
- Svalbard: the two VLBI antennas are operational, and the NMA analysis centre processes the data routinely. A new SLR is under construction. The main GNSS station for the future will be NABG.
- NMA will replace all old transformation libraries and routines with Proj within next years.
- Positioning service has increasing number of users and about 300 stations currently.
- Many other projects; see slides.

Sweden

- Swepos: the work routines have been improved to better serve the customers. eServices have also been developed to simplify subscription handling for users.
- Near real-time (hourly) coordinates are processed for monitoring of Swepos stations using Bernese. The results are compared to the official station coordinates.
- Development of a new post-processing service is going on; more options will be available
- A cumulative solution for Swepos stations has been computed. It fits well to NKG_LU model.
- A new [LM report](#) has been published on the analysis of 20 years of GPS data from Sweref consolidation points.
- Metadata/sitelogs of the Swedish EPN-densification stations have been added to M3G

Session 3: NKG WGRF 2022-2026

- Pasi presented the main outcome of the NKG General Assembly 2022 related to our WG. All the documents are available at [NKG webpage](#).
- The NKG Science Week will be in Iceland, week 11/2024, and the NKG Summer School will be postponed to 2025.



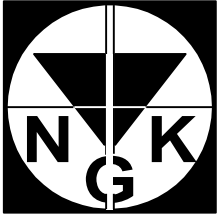
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- Pasi asked each country to update its primary contact persons in our WG.
- **Sharing codes and scripts:** Kristian gave an introduction to Git, which enables version managing of code. Git works both on linux/win and it is an easy tool to get the latest code. Pasi proposed to continue planning in smaller group: how to work with Git and what could be the content. Each country is encouraged to join if interested. Hans-Sverre promised to help us to get started.
- **Sharing GNSS metadata:** Michael presented different formats in which the metadata is nowadays stored. There are no restrictions on M3G side to upload site logs of national stations. It would support the GeodesyML as well.

Session 4: NKG transformations

- **Status of NKG transformation project:** NKG_RF17 velocities have been finished, but the uncertainties and the publication are still under progress. NKG2020 transformation has been documented and the manuscript has been submitted to the Special Issue of the JGS.
- **NKG2020 transformation uncertainties:** Pasi has estimated the uncertainties for the NKG2020 transformation. The constant part of the uncertainty is 1.7, 1.8, 3.6 mm in NEU. The transformation works in ITRF2020 with the same accuracy. The time dependent component was estimated to be 0.1, 0.1, 0.3 mm/yr.
- **On ISO Geodetic Registry:** Martin demonstrated the [ISO geodetic registry](#). Current version of the registry is not fully prepared for dynamic frames, but the work is under progress. There are different ways to include the NKG transformations. The NKG2020 transformation publication will work as the needed documentation.
- **Registrations to EPSG:** Pasi presented the status in Finland. Currently EUREF-FIN datum does not have an EPSG code, and getting one would cause issues with the existing EPSG entries. Discussions on alternatives and consequences is ongoing with IOGP. Pasi asked to inform him if there are any updates regarding to the EPSG registrations in other countries.
- **Discussion and plans:** Next, more detailed local/national documentation (e.g. instructions for use, recommendations, etc) of the NKG2020 transformation can be done if needed. An example of local documentation can be found by [Lantmäteriet](#). The reference implementation for registering the NKG2020 transformation to EPSG needs to be submitted, but it was decided to wait and see, how it goes with the ISO registration by Sweden. Pasi, Kristian and Martin will form a group and decide in which way forward. Representatives from other countries can join the work if interested. Other project related tasks, including NKG202XLU/NKG_RF2Xvel model and updated NKG transformation, will follow after BIFROST/NKG Repro2.

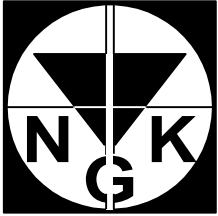


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Session 5: Project NKG GNSS AC

- **Alignment in global frame:** Tobias presented results of a test to combine EPN-NKG solution with CODE's global solution. The results showed that we could include more datum points in this way. Further tests can be run when we get started producing operational solutions in IGS20. Sonja commented that it is good to test, how the CODE combined solutions work in the cumulative stacking and if it is possible to reduce the number of stations in CODE solution before or after the combination.
- **Repro1_C2237:** Sonja presented preliminary cumulative solution up to end of IGS14 solutions. The stations velocities are mostly close to the C2111 solution, though differences exist at individual station especially in case of short time series. The uncertainties of the constraint twin stations need still revision. The residuals plots and Tsview formatted time series are available at FTP server. Everyone can check their time series and suggest changes in discontinuities and/or constraints. The deadline for the feedback is end of April.
- **LAC status:** All LACs have now got started with the Bernese 5.4. SK and LM has occasionally detected issues with the ambiguity resolution mainly in case of short baselines. The issue has been reported to AIUB and they have promised to troubleshoot it. SK intends to increase the number of stations from 66 to 113 to achieve better compatibility with the BIFROST solution. LM considers using a new GPS/GLO/GAL calibration for a Javad antenna (JNSCR_C246-22-1), because there is no GAL calibration for the antenna in IGS20.atx.
- **Guidelines:** Sonja presented the processing parameters and related methods in IGS20 operational solution. Sonja will prepare an updated document with guidelines and send it after the meeting.
- **Combination:** The NKL/ADDNEQ2 combined daily solution will be the main solution starting from GW2238. Lotti will update the combination routines to Bernese 5.4. Sonja will in future help in checking the SNX files.
- **Benchmark test:** Lotti will share example PCFs and the benchmark test setup. Every LAC has first to run the benchmark test to verify the Bernese installation.
- **Software/tools:** We try to share/develop some tools to reduce the manual operations in the processing and avoid mistakes in the AC solutions. The following three items were notified.
 - Building the STA file for EPN stations: LM and FGI have routines to create the STA file considering the EPN-excluded information. LM and FGI will discuss on how to share them.
 - Removing outliers from the weekly solution: LM has a script to print the ADDNEQ notified outliers into STA format. This can be shared and possible developed further.
 - Checking the SNX files before submitting: The SNXcheck script will be modified to work with IGS20.atx and EUREF54_20.STA file. Furthermore, a



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check of antenna (mis)orientation and number of included EPN stations will be added. Sonja and Tina will handle these and deliver the tool (probably via GitHub).

- **Repro2:** All LACs will contribute to the NKG Repro2. The processing setup will follow mostly the operational processing, but e.g. the choice of the troposphere model is not clear yet. The Repro2 will be discussed more in detail in a separate online meeting or by email. Holger presented the plans in the BIFROST project. It was agreed to process an additional 7-degree GPS-only solution that will be compatible with other BIFROST solutions (GipsyX, Gamit).
- **Schedule:**
 - Benchmark test input: mid-April
 - Benchmark test finished: end of May
 - Operational running: end of June; expecting that the processing related issues allows it

Session 6: Business matters

- Official information will be shared using only the mailing list in the future
- NKG awards: WG supported the other WG's idea of the long-term contributor award and young scientist award
- The next meeting will be during the NKG Science Week 2024 in Iceland