NORDISKA KOMMISSIONEN FÖR GEODESI

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Minutes

19th Nordic Geodetic Commission (NKG) General Assembly

Time: 6th to 8th September 2022

Place: Crowne Plaza Copenhagen Towers, Copenhagen, Denmark

Item 1. Opening of the General Assembly

The NKG President, Markku Poutanen welcomed everyone and opened the meeting.

Welcome from DTU Space director Henning Skriver (DTU Space) and Head of department Thorbjørn Nielsen (SDFI)

Item 2. Work in Sessions

- Session 1: Planet ocean and geodesy
- Session 6: Geodetic infrastructure
- Poster session
- Session 2. Geodynamics and Earth Observation
- Session 3: Future Height Systems and Geoid
- Session 6: Geodetic infrastructure
- Session 5: Reference frames
- National reports

More detail program and presentation at https://www.nordicgeodeticcommission.com/general-assemblygeneral/copenhagen-denmark-2022/

Item 4. Adaption of new bylaws

NKG President Markku Poutanen introduced the proposed new bylaws and main changes. All participants on the General Assembly (GA) have prior to the GA been given possibility to get familiar with the new bylaws and add suggestions. The bylaws were adopted unanimously by the participants of the GA.

Item 5. New presidium and election of new president

After a short break new presidium members and president Martin Lidberg were introduced to the GA.

Item 6. NKG Resolutions

The outgoing and new NKG president introduced five resolutions to the GA. The resolutions were adopted unanimously by the GA participants.

Item 7. Structure of NKG

The outgoing and new NKG presidents introduced the NKG structure for the next period to the GA covering focus area, Working groups' visions, goals and milestones. The NKG structure was adopted unanimously by the GA participants.

Item 8. Closing

New NKG President Martin Lidberg thanked everybody for a fruitful NKG GA and closed the meeting.

Appendix 1. New bylaws

Appendix 2. NKG Resolutions

Appendix 3. Structure of NKG

Appendix 4. Presidium

BYLAWS OF THE NORDIC GEODETIC COMMISSION

Endorsed by the 19th General Assembly in Copenhagen 2022-09-08

§1 Preamble

The Nordic Geodetic Commission (*NKG*, later on also *The Commission*) was established in 1953. It is an association of geodesists and experts active in the field of geodesy and related disciplines, and is a cooperation between Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway, and Sweden, hereafter called the NKG region. Anyone who is either by education or by function connected to geodetic activities and based in the NKG region can join the Commission as a member. The vision of the NKG is to advance geodetic cooperation, education, and research. NKG aspires to gender equality and sustainability in its activities.

§2 Mission

The mission of the NKG is to

- Co-operate on the scientific basis for development and maintenance of the coordinate, height, and gravity reference systems, transformation and deformation models, and other geodesy-related research, and support their practical implementation in the NKG region,
- Participate in the creation and implementation of high-quality geodetic products and services, and conduct joint projects and research to achieve those goals,
- Maintain archives of geodetic data used for creating NKG products,
- Serve as a cooperation hub for the geodetic community in the NKG region, and provide a link between NKG and the wider scientific community,
- Promote work and achievements made within the scope of NKG, and disseminate information on geodesy and education in general,
- Support Open Data Policy and principles of FAIR (findability, accessibility, interoperability, and reusability) with its data and products, and
- Follow international progress, trends and innovations in geodesy, discuss their implications in the NKG region, and if appropriate, support or initiate their implementation in the NKG region.

§3 Structure

Components of the Commission are the General Assembly, Presidium, Working Groups and Projects. The General Assembly and Presidium can establish other temporary entities for specific tasks.

§4 Membership

Individuals mentioned in §1 can join the Commission as members. Members are divided into eight National Groups and a member can belong to only one National Group. The National Groups are free to organize themselves and keep information of their members at their own discretion.

Members of the Commission are eligible to be nominated and can nominate other members to organs of the Commission. Members have a right to vote in the General Assembly (§6-9).

The NKG can have guests from outside the NKG region. They can participate in the activities of the Working Groups and Projects, and can participate in meetings, but they have no right to vote in the General Assembly.

§5 Meetings

The Commission shall have its General Assembly every four years. The General Assembly is the Commission's highest decision-making body (§8).

The NKG Summer School can be organised in the middle of the period between two General Assemblies.

Working Groups shall have their meetings at least once per year, with additional events organized according to their needs.

§6 Presidium

The Presidium is the permanent body of the Commission, and it handles the Commission's running topics and tasks. The Presidium consists of two representatives from each National Group (§4) and the chairs of the Working Groups (§9). The President of the Commission (§7) will be the chairperson of the Presidium. The election of the President is defined in §7.

Each National Group nominates two representatives to the Presidium based on their own rules and practices. These representatives should, whenever possible, represent both the National Mapping and Cadastral Agencies (NMCAs) and

scientific community (universities etc.) at the national level. The number of terms a person can serve in the Presidium is not limited.

The nomination of the Presidium members shall be announced at the latest two weeks before the General Assembly (see §7 and §8 for details). Replacement of a member of the Presidium during the term is done by the respective National Group considering the guidelines outlined above.

The Presidium shall have a meeting at least once a year. The Presidium can invite guests to their meetings. Remote meetings and electronic voting are possible when needed.

In decisions taken by voting, each National Group has one vote. A quorum is reached when at least half of the members are present. In case of a tie, the President shall cast the decisive vote, except when the President is elected. In that case, the tie is solved by lot (§7).

Members of the Presidium will serve as the official point of contact in their country.

Tasks of the Presidium are to:

- Handle the governance of the Commission between the General Assemblies,
- Accept new NKG Projects and other temporary entities and nominate their chairpersons,
- Collect and prepare the proposals for Working Groups and nominations for chairpersons for the General Assembly,
- Follow the progress of the Working Groups, Projects and other NKG entities,
- Monitor enforcement of tasks and resolutions accepted by the General Assembly,
- Nominate a Resolution Committee to prepare the NKG resolutions which will be presented for adoption at the General Assembly,
- Exchange information within the Presidium on activities at the national level, and inform national authorities and the geodetic community on the work of NKG.

§7 President and Secretary

The President of the Commission is nominated among the two representatives from each National Group (§6) and elected by the Presidium. The candidates for the position shall be announced at the same time as the members of the Presidium.

The election shall take place in the meeting of the new Presidium members during the General Assembly (§8). In the case of two or more candidates receiving not more than 50% of votes, the two candidates who received the most votes move on to the second round. In case of a tie after the second round, the winner is settled by a lot.

The length of the term of the President is four years and cannot be renewed. If the President resigns or for any other reason is not able to continue, the Secretary shall call the meeting of the Presidium to elect a new President.

The Secretary of the Presidium is elected by the Presidium in its first meeting. The Secretary can be elected outside of the Presidium members. The number of terms of the Secretary is not restricted.

Tasks of the President are:

- To chair and coordinate the work and meetings of the Presidium,
- To represent the Commission in official contexts,
- To sign on behalf of the Commission and Presidium after the mandate of the Presidium, and
- To chair the official sessions of the General Assembly.

Tasks of the Secretary are:

- To prepare the Presidium meeting together with the President, compile the Agenda, agree on details with the host of the meeting, and send out the invitation to the Presidium members,
- To keep and write the Minutes of the Presidium meeting including decisions and Action Items, and distribute them on time to all Presidium members and the NKG website,
- To keep minutes of the Plenary session of the General Assembly, and together with the Organizing Committee, collect and distribute results of the elections, resolutions and other decisions of the Plenary,
- To collect the memberships lists of the National Groups, and
- To perform other tasks agreed by the Presidium.

§8 General Assembly

The host of the next General Assembly is agreed by the Presidium, at least a year before the meeting, and announced on the NKG website. The meeting is prepared and conducted by an organizing committee, appointed by the National Group of the country in which the Assembly is intended to be held.

The scientific program for the Assembly is decided by the Organizing Committee after consultation with the Presidium and is announced in due time before the Assembly for participants to submit abstracts and prepare participation.

The Agenda of the Assembly shall be published at least two weeks before the meeting, together with the information for the Plenary Session. This information shall include names of the new Presidium members nominated by the National Groups (§6), Candidates for the next President (§7), proposed Working Groups and Working Group Chairs (§9), information on the Resolution Committee (§9), and other topics which may require a decision by the General Assembly.

Decisions of the Commission are endorsed in the Plenary Session. Details of the decision and voting procedure are defined by the guidelines prepared by the Presidium. Each member participating in the voting has one vote and it is not possible to vote on behalf of another person. Unless otherwise stated, decisions are made with a simple majority. To keep the balance between National Groups of different sizes, any National Group cannot have more than 20% of the total votes given. In case of a tie, the President has the casting vote. In case of exceptional circumstances where the Plenary with a voting session cannot be arranged, electronic voting can be made. In that case, the Secretary will send the instructions to the NKG Members, based on the membership list.

Tasks of the Plenary of the General Assembly are:

- Endorsement of the proposed composition of the next Presidium,
- Adoption of the NKG resolutions,
- Adoption and dissolution of the Working Groups (§9),
- Adoption of the Chairpersons of the Working Groups (§9),
- Adoption of the changes in the bylaws (§13), and
- Adoption of the dissolution of the Commission (§14).

The closing session at the end of the General Assembly is chaired by the new President as the first duty of the new Presidium. The Secretary together with the Organizing Committee shall prepare the minutes of decisions and resolutions of the General Assembly, which are communicated to members.

§9 Working Groups, Projects and other entities

A **Working Group** is meant to be a long-term entity continuing for more than one four-year period. New Working Groups can be established, and existing Working Groups can be renewed or discontinued by the General Assembly. The initiative to establish, renew, or discontinue can be made either by the Working Group, a National Group, or the Presidium. Any proposal with motivation, aims and objectives shall be presented to the Presidium latest at the Presidium meeting preceding the General Assembly. The Presidium shall present the proposal to the General Assembly for decision (§8).

The Working Group shall meet at least once a year, send a copy of its meeting minutes to the Presidium, report to the Presidium and give a summary report to the General Assembly. The Working Group Chair is a member of the Presidium.

A **Project** is meant to be a short-term entity for a specific task with a maximum lifetime of one four-year period. The Project is established and discontinued, and the Project leader is nominated by the Presidium by the same initiatives as the Working Group. The Project shall report its activities and results to the Presidium.

A **Service** is a long-term joint entity of two or more NKG countries to perform a specific task to produce and maintain a product of the NKG. Status of the Service is given by the Presidium.

The **Resolution Committee** is a temporary entity established by the Presidium before the General Assembly to prepare the resolutions.

§10 Fees

The Commission does not charge membership fees. Costs associated with organizing meetings can be covered by participation fees.

§11 Publications and website

The Commission's documents are preserved by the Presidium. A copy of the bylaws, meeting decisions and other important documents shall be included in each country's archive. The websites of the Commission are freely available on the internet. Final results of the Working groups, minutes of meetings, and decisions of the Assembly are published on the NKG website. Whenever possible products of the NKG should be made available (or linked) via the NKG website.

§12 Awards

NKG can grant awards for meritorious or excellent contributions to geodesy or the mission of the NKG.

§13 Change of the bylaws

Decisions on amendments or additions to these bylaws are taken by a simple majority at a General Assembly. This is exceptional voting where each National

Group has one vote. In case of a tie, the President of the NKG will give the decisive vote.

Proposals to change the bylaws, made by one or more National Groups, or the Presidium itself, shall be submitted to the Presidium by January 31 of the year of the General Assembly. The Presidium or a subgroup of the Presidium will prepare and formulate any changes to the bylaws and propose them at the General Assembly.

§14 Dissolution of the Commission

A decision on the dissolution of the Commission shall be taken at a General Assembly. Proposals for dissolution of the Commission shall be subject to the same procedure as the change of the bylaws, except that the decision in the General Assembly shall be made by 2/3 majority. A Quorum is achieved when at least six National Groups are present in the meeting.

Appendix 2. NKG Resolutions

Resolution no 1. Reference frames

The Nordic Geodetic Commission (NKG)

recognising the increasing need for joint analysis of global and national geospatial data sets from various data sources, and the importance of accurate/associated reference frame information,

recognising the work of NKG on joint coordinate and velocity solutions and subsequent velocity models, transformations, and their implementation into PROJ to facilitate public use,

noting a general lack of standardization of reference frame and transformation information,

recommends to continue developing transformations and associated products and

encourages its member countries to address standardization of reference frames and transformations.

Resolution no 2. Gravity, geoid and IHRF

The Nordic Geodetic Commission (NKG)

recognising new space and terrestrial gravity data are available,

recognising the importance of improved global potential field models and the need for high precision geoid models,

noting that new marine gravity data are available, especially from the FAMOS project,

noting the importance of improved potential values for the reliable transformation between IHRF and regional/national vertical reference frames,

recommends to continue maintaining the NKG gravity database,

encourages developing a revised NKG geoid model and

also encourages to provide uncertainties for the NKG geoid model.

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encourages developing a revised NKG geoid model and

also encourages to provide uncertainties for the NKG geoid model.

Resolution no 3. InSAR

The Nordic Geodetic Commission (NKG)

recognising the significant potential societal and geodetic benefits from ground motion products derived from InSAR, including the European Ground Motion Service,

noting the potential benefits of integrating SAR/InSAR into geodetic infrastructures,

recommends NMAs, research institutes and universities to continue exploring SAR/InSAR and possible synergies related to integrating InSAR and geodetic infrastructures.

Resolution no 4. GNSS positioning

The Nordic Geodetic Commission (NKG)

recognising the rapid development of advanced real-time positioning applications like autonomous platforms, and the interest for such applications in society,

recognising the vulnerability of real-time positioning applications for GNSS interference (e.g. jamming and spoofing),

noting the modernisation of existing GNSS (GPS and GLONASS), and finalising of new GNSS (e.g. Galileo and BeiDou) as well as the interest for new positioning techniques like precise point positioning (PPP),

noting the existing mature technology for real-time positioning available in the NKG region (Network-RTK) and the associated infrastructures and

also **noting** the importance of outreach activities to secure the geodetic reference frame to be included in real-time data streams from both positioning service and source of geospatial information, acknowledging the on-going standardisation initiatives (e.g. 3GPP and RTCM) regarding real-time positioning services,

encourages to *prepare* for the future, including *strategies* for how to benefit from the existing infrastructures and know-how, and to perform appropriate *research* and *development* of the geodetic infrastructure, in order to achieve efficient use of existing investments and know-how in this wider development.

Resolution no 5. NKG awards

The Nordic Geodetic Commission (NKG)

recognising that NKG has been one of the most successful scientific organizations when looking at results and benefits for the society during the last seven decades,

recognising that scientific excellence in front-line research and/or dedication to the NKG mission and its goals by its members have been the most important prerequisites for this,

recognising outstanding meritorious work for NKG and excellent contributions to geodesy by fellow colleagues,

noting that the revised NKG bylaws allow NKG to grant awards,

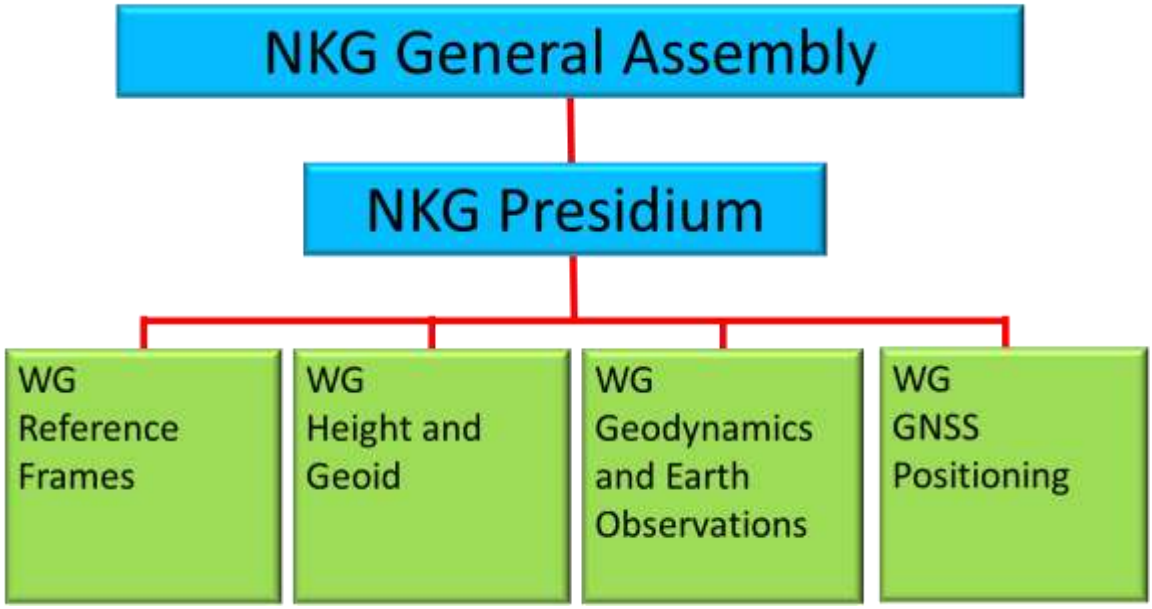
requests the NKG Presidium to prepare guidelines for one or more NKG awards by December 2023 enabling the first award(s) to be granted at the NKG summer school in 2024.

Resolution no 6. Thanks!

The Nordic Geodetic Commission and its members

present at the 19th General Assembly of the Commission in Copenhagen, Denmark express their sincere thanks to the Danish Agency for Data Supply and Infrastructure (SDFI) and the Danish National Space Institute (DTU Space), to the scientific committee and to the local organizing committee for the fantastic arrangement and fruitful atmosphere during the meeting and at the social events.

Appendix 3. Structure of NKG



Focus area:
″Bringing Reliable Positioning to Society″

An increased demand for more precise GNSS based positioning is foreseen during the period. Identified applications are e.g. autonomy and intelligent transport. The area includes, but may not be limited to:

- GNSS mass market for precise (cm – dm) real time applications
- Cyber security (on GNSS and its services)
- Integrity (on GNSS, from services, and in applications)
- Dynamic reference frames
- Identifiers for Geodetic Reference Frames (EPSG, ISO register…)

WG Reference Frames

Vision and goals:

A common, harmonized, densified, continuous and up-to-date ITRFyy coordinate and velocity solutions are in a key role for maintaining/monitoring of the national reference frames (ETRS89) in the Nordic and Baltic countries. The GNSS solutions together with associated velocity/deformation models and transformations form the basis for high-quality national reference frames in the long term. The GNSS velocities are essential data especially for Glacial Isostatic Adjustment (GIA) and deformation modelling and up-to-date coordinates for accurate transformations from global to national reference frames. We produce and constantly improve the GNSS solutions, deformation models and transformations for the maintenance of national reference frames.

1. **NKG GNSS Analysis Centre (NKG GNSS AC):** We produce operational daily GNSS solutions for the Nordic and Baltic countries through local analysis centres (LAC) and combine the LAC subnets to NKG daily solutions. Subsequently these solutions are stacked and analyzed to obtain multiyear solution (coordinates, velocities and their uncertainties). We produce regular cumulative solutions (and necessary reprocessings) to keep solutions up-to-date.
2. **NKG transformations:** We create and maintain accurate links between global and national reference frames. Together with the transformation parameters we develop and/or incorporate existing crustal motion models to account for the deformations caused e.g. by the GIA. Furthermore, we make NKG transformation available to users, e.g. through PROJ transformation software.

Keywords: reference frames, EPN, ETRS89, ITRF, coordinate transformations, densified GNSS velocity field, time series analysis, local ties, GNSS stations, geodetic registries

Milestones2022-2026:

- NKG GNSS analysis centre
    - Operational processing and combined NKG solutions continuously, switching to ITRF2020/IGS20
    - Continue development of cumulative NKG solutions towards regularly updated solutions
    - New NKG GNSS reprocessing(NKG Repro2), coordinated with IGS/EPN and BIFROST
    - Improving codebase needed for the LAC operations, e.g. Github
- NKG transformations
    - Continuing registrations to EPSG (and ISO registry) to facilitate the use of existing transformations
    - Updated NKG deformation model (2D+1D), coordination with WGGEO and WGHG (e.g. NKG Repro2/BIFROST, GIA, NKG202XLU)
    - Updated NKG transformations and implementations (after new NKG deformation model)
    - Developing/securing codebase needed for the transformations, e.g. Github

Chairperson proposal: Pasi Häkli, FGI, Finland

WG Height and Geoid

Vision and goals:

- We have methods for effective use of our Nordic/Baltic realizations of EVRS in parallel to IHRS and its first realizations through IHRF, both on land and for maritime applications.
- We are continuously well aware of the progress on "the Global Height System" and are involved in its development. Thereby we are well prepared for its first use and for possible adoption in the future.
- We study and develop theory and methods to maintain, upgrade or create a modern height system in the Nordic area that is up-to-date w.r.t. the land uplift.
- We investigate different alternatives for a future unified Nordic height system/frame, taking European and International developments into account (EVRS/EVRF and IHRS/IHRF, respectively).
- We collect and keep our gravity data up to date, and we share data within the NKG for geoid purposes.
- We develop and improve our geoid models, especially the NKG geoid model. The long term objective is a common Nordic geoid model with relative uncertainty better than approx. 5 mm (1 sigma, for the gravimetric geoid model), which makes it possible to determine accurate heights by GNSS and to realize high quality vertical reference systems in the future.
- We study and develop new techniques for height determination and practical use of height systems, with and without traditional levelling, but without loosing the accuracy of levelling.

Keywords: Height systems, gravity, levelling, height determination, chart datums, EVRS, BSCD2000, IHRS/IHRF, 5-mm geoid, geoid uncertainty, relative gravimetry, gravity database, GNSS/levelling database, methodology for geoid determination, chronometric levelling, optical lattice clocks, satellite altimetry, tide gauges, empirical land uplift modelling, InSAR

Milestones 2022-2026:

- NKG202XGEOID: new geoid estimated based on updated gravity data from both NKG and FAMOS database
- Coordination on InSAR corner reflector in the NKG area
- Develop a common Nordic realization of IHRF (International Height Reference Frame) and derive relations to the existing national height systems and BSCD2000 (realizations of EVRS with land uplift epoch 2000.0)
- Maintain and update the NKG gravity and GNSS/levelling databases.
- Research on how the present geoid can be improved assuming already collected data.

Chairperson proposal: Ove Christian Dahl Omang, Kartverket, Norway

WG Geodynamics and Earth Observations

Vision and goals:

Improved understanding of the Earth and climate system is key to the interpretation and use of geodetic observations. Being of utmost importance in detecting environmental changes, geodetic observations are, in turn, often undesirably affected by them. The GIA process and ongoing climate related changes such as glacial melting (especially in Greenland, Iceland, Svalbard, Norwegian glaciers) and hydrological changes are of particular importance for the countries within NKG, thus represent the core of our working group. We further investigate and study other geodynamic processes (e.g., plate tectonics, regional and local subsidence, erosion, sedimentary loading) important for our activities. In addition, we follow the progress of international programs such as the European Plate Observing System (EPOS).

1. We **develop and improve** GIA models as well as empirical **models of geophysical processes**. Our models are tested against the most up-to-date palaeo and geodetic data of international standard. We provide model uncertainties and further investigate GIA models with lateral changes in Earth's subsurface structure.
2. We cooperate on the **collection and analysis of absolute gravity data**. These data are used and made available for new studies of GIA and other geophysical processes. We constantly refine our analyses of the absolute gravity data by, for example, investigating and applying corrections for hydrological changes. We encourage periodic Nordic comparisons of absolute gravimeters.
3. We serve as Nordic and Baltic platform for **collaboration of geodesists and geophysicists within the InSAR community.** We investigate and validate the potential applications of InSAR data relevant for our WG, assist in the coordination of InSAR reflector installation in the NKG area and help connecting InSAR to GNSS.
4. We **investigate** and/or provide data for studies on and projections of **climate-related changes, sea level and different types of loading**.
5. We cooperate on the **analysis and preservation of data from existing relative gravity lines** and make them publicly available.
6. We **make NKG products**, i.e. data, models and codes, **available to users and the scientific community** at regular intervals. We encourage continued collaboration with universities and other institutions and participation in funding proposals.

Keywords: Glacial isostatic adjustment, Plate tectonics, Environmental effects, Climatic Changes, Ice melt, Sea-level changes, Gravity measurements, InSAR, Modelling, Education

Milestones 2022-2026

1. NKG2022GIA: Deliverables are modelled output of land motion, gravity, sea level, and stress field changes over time, i.e., from the past glacial, to today, and in the near future (max. 1000 years), together with their uncertainty estimates.
2. BIFROST2022: New 3D velocities for a largely extended time series (+7 years) and GNSS station network (500+) that includes the forebulge area will be calculated with three different software. In cooperation with WGHG and WGRF (NKG GNSS AC).
3. NKG202XLU: Based on BIFROST2022, NKG2022GIA and an extended levelling dataset a new land uplift model will be generated in a one-step approach. In cooperation with WGHG.
4. Report on findings of investigations on

a. how the national geodetic infrastructures can add value to an InSAR-based deformation monitoring, such as the European Ground Motion Service (EGMS), and

b. applications of InSAR data for maintaining and developing the national geodetic infrastructures.

In cooperation with WGHG.

1. Relative gravity lines: Joint NKG publications on data and results from the relative gravity lines.

Chairperson proposal: Holger Steffen, Lantmäteriet, Sweden

WG GNSS Positioning

Vision and goals

…To be worked out by the WG, with inspiration from the NKG focus area and resolutions...

…and the adopted "White Paper on Future Positioning Services"…

Keywords: GNSS etc.

…To be worked out by the WG, with inspiration from the NKG focus area and resolutions...

Milestones 2022-2026

…To be worked out by the WG, with inspiration from the NKG focus area and resolutions...

Chairperson proposal: Casper Jepsen, SDFI, Denmark

The NKG Presidium 2022-2026

Denmark
Michael Schulz Rasmussen
Thorbjørn Nielsen

Estonia
Artu Ellmann,
Aive Liibusk

Finland
Hannu Koivula
Maaria Nordman

Iceland
Þórarinn Sigurðsson
Guðmundur Valsson

Latvia
Ivars Liepiņš (Secretary)
Jānis Kaminskis

Lithuania
Simonas Valotka
Eimuntas Paršeliūnas

Norway
Ola Øvstedal
Per Christian Bratheim

Sweden
Jan Johansson
Martin Lidberg (President)

WG Chairs
Pasi Häkli, WGRF
Ove Omang, WGHG
Holger Steffen, WGGEO
Casper Jepsen, WGGNSS