NKG structure 2022-2026

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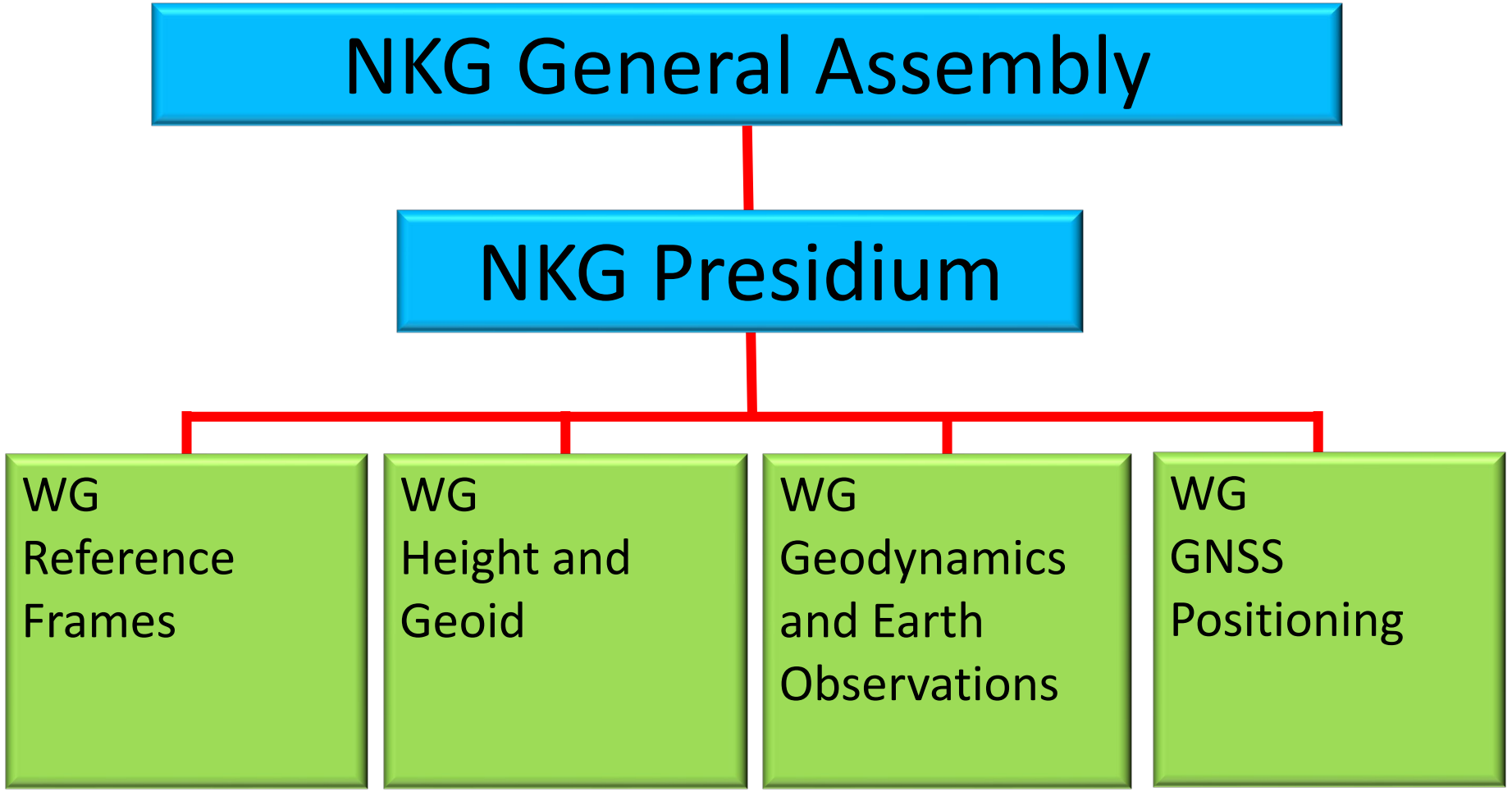

Focus area:

”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 1(2)

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.

WG Reference Frames 2(2)

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 1(2)

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.

WG Height and Geoid 2(2)

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 1(2)

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.

WG Geodynamics and Earth Observations 2(2)

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.
5. 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

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Holger Steffen, WGGEO

Casper Jepsen, WGGNSS