Report from the WG of Reference Frames, Positioning and Navigation

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Chairman of Working Group of Reference Frames, Positioning and Navigation

+all participants of the WG

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NKG General Assembly 2014, Göteborg, Sweden, September 1-4, 2014.

Working Group of Reference Frames, Positioning and Navigation (WGRFPN)

- National representatives 2010-2014:
  - DK: Mette Weber
  - FI: Pasi Häkli (Chairman), Hannu Koivula
  - IS: Þórarinn Sigurðsson, Guðmundur Valsson
  - NO: (Matthew Simpson -2011), Michael Dähnn (2011-)
  - SE: Lotti Jivall, Peter Wiklund
  - But many more participating to the WG work including Baltic states (mailing list ~30 people)
- Meetings:
  - 2011/03/15-16: Masala, Finland
  - 2012/03/27-28: Hønefoss, Norway
  - 2013/03/14: Reykjavik, Iceland (+project meeting 2013/03/13)
  - 2014/05/26-27: Copenhagen, Denmark

NKG General Assembly 2010: input to the WG

Working Group for Reference Frames, Positioning and navigation

Keywords:

Reference frames,
EPN,
ETRS 89, ITRF,
Transformations to National realisations of ETRS89
Positioning service

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Discussed topics

1) Transformations ITRF←→ETRS89 with velocity models
2) NKG GNSS Analysis Centre (NKG GNSS AC)
3) Geodetic infrastructure (in Sweden)
4) Modernization of permanent GNSS stations
5) GNSS antenna calibrations
6) Nordic Positioning Service
7) use of GNSS for ionosphere and troposphere modelling
8) Navigation related projects
9) other projects

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1. Transformations ITRS-ETRS89 (with velocity models)

- current procedure/model:
  1. ITRFyy(t_c) → ITRFyy-PMM + NKG_RF03vel → ITRFyy(t_{NKG})
     - yy=2000/2005
     - t_{NKG}=2003.75 for NKG2003/ITRF2000 and t_{NKG}=2008.75 for NKG2008/ITRF2005
  2. ITRFyy(t_{NKG}) → intraplate correction ($t_{NKG} \rightarrow t_r$) with NKG_RF03vel
     - t_r=epoch of national ETRS89 realization
  3. 7-parameter Bursa-Wolf to national ETRS89 realizations
     - 2 different parameters at the moment (ITRF2000/2005)

1. Transformations ITRS-ETRS89 (with velocity models)

- future:
  - new ITRF solutions
  - new models

  → optimum procedure?

  → how to avoid unnecessary jumps/offsets while transforming from ITRFyy to national ETRS89 realization?

1. Transformations ITRS-ETRS89 (with velocity models)

- Minutes from the first WG meeting in 2011:

  ”The transformation project was not fully finalized during the last WG period. On the other hand new ITRF’s are coming (how to handle these) and new velocity models would be useful (current model is aligned to ITRF2000 and is based on GNSS data up to 2004). Thus, the meeting concluded that the work should be finalized and models further developed.“

Decisions in the WG/Proposals

1) Transformations ITRF←→ETRS89 with velocity models
   → **PROJECT PROPOSAL**

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2. NKG GNSS Analysis Centre (NKG GNSS AC)

NKG General Assembly 2010:

Res no 8: NKG GNSS analysis centre

The Nordic Geodetic Commission

recognizing the large number of permanent stations for GNSS in the Nordic area,

noting the wide range of potential products beneficial for society that can be derived from these stations

noting the demand for near real time supervision of these stations

noting the interest for products from these stations in the international scientific community, e.g. EUREF, IAG dense velocity field, the COST action ES0701 ”Improved constraints on models of glacial isostatic adjustment”, and E-GVAP

recommends the presidium to facilitate the establishment of a distributed NKG GNSS analysis centre.

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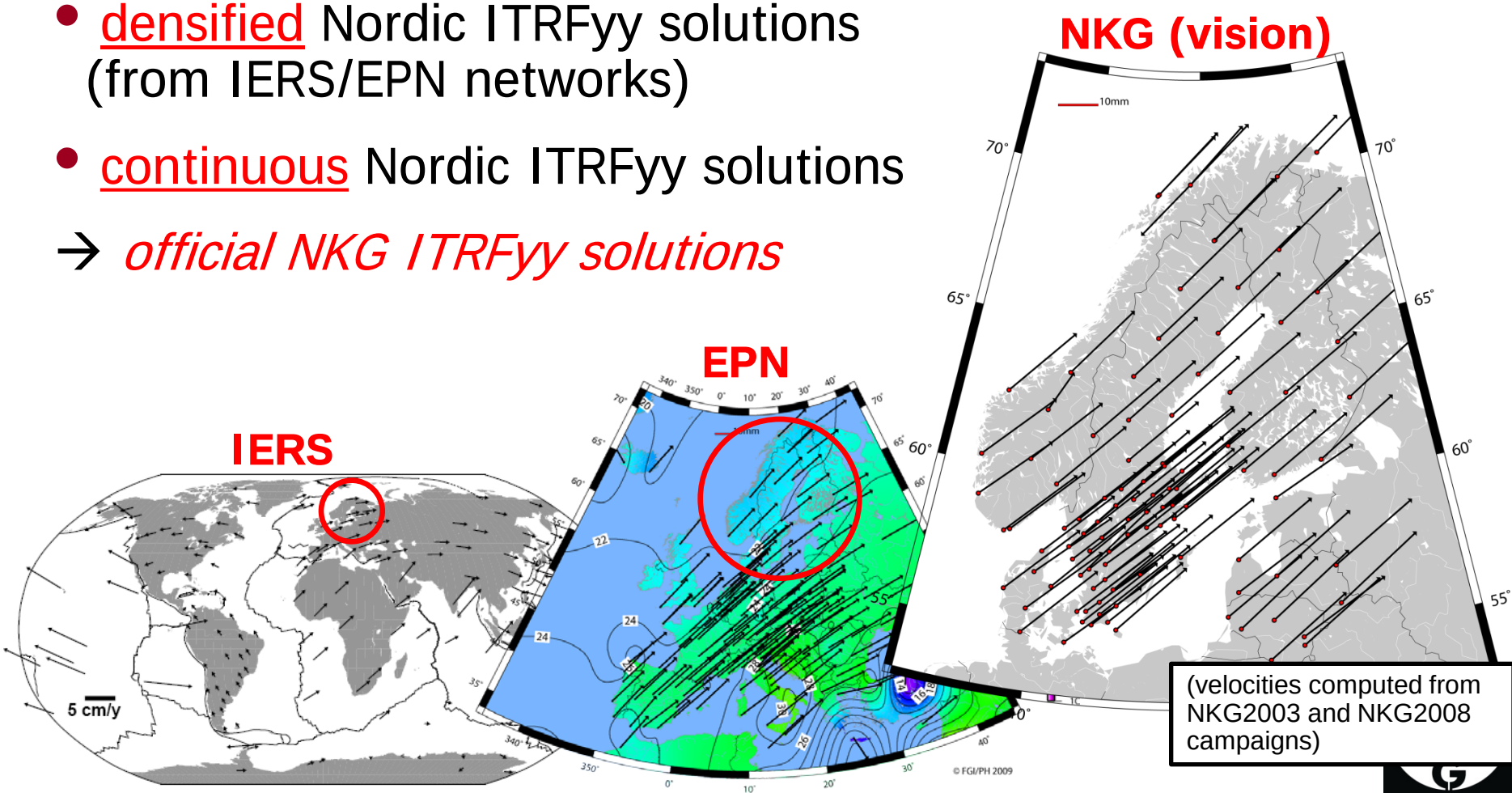
2. NKG GNSS Analysis Centre (NKG AC) - Motivation

- Need for a **consistent densified** field of station velocities in global ITRFyy frames in order to maintain national ETRS89 realizations and for GIA modelling
- **Continously** combined solutions could be used for the determination of coordinates in the national ETRS89 based reference frame
- Continous observations give more accurate results than campaigns → the NKG GNSS AC will replace the NKG campaigns
- Most of the Nordic/Baltic countries process/plan to process their national permanent stations anyway
- Using the same processing software → possible to distribute and combine solutions to a consistent solution

2. NKG GNSS Analysis Centre (NKG AC) - Characteristics of the product

- common Nordic ITRFyy solutions
- densified Nordic ITRFyy solutions (from IERS/EPN networks)
- continuous Nordic ITRFyy solutions

→ *official NKG ITRFyy solutions*



2. NKG GNSS Analysis Centre (NKG AC) - Products

- NKG densification of EPN: densified + continuous ITRF time series (instead of campaigns...)
- GNSS velocity field for producing deformation/intraplate model(s)
- accurate transformations from ITRFyy (w/ velocity models) to national ETRS89 realizations (~maintenance of national ETRS89 realizations...)
- maybe other products like ionosphere, troposphere,... etc models
- Products should be available for the public at NKG web or similar place – visibility for NKG (outreach)

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2. NKG GNSS Analysis Centre (NKG AC)

- Minutes from the first WG meeting in 2011:

  “NKG GNSS Analysis Center could produce as an end product NKG GNSS time series for maintaining reference systems and for geodynamical studies. The NKG GNSS Analysis Center is a wide and work-demanding topic, but if all countries are anyway processing their time series, it would not be impossible to combine them to an official NKG ITRF solution.”

Decisions in the WG/Proposals

1) Transformations ITRF←→ETRS89 with velocity models
   → **PROJECT PROPOSAL**
2) NKG GNSS Analysis Centre (NKG GNSS AC)
   → **PROJECT PROPOSAL**

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3. Geodetic infrastructure: Active or passive definition of the RF

National ETRS89 realizations:

- Passive control point networks
  - Each country has a lot of campaign-based points measured during many years
- Active control points = permanent GNSS stations
  - Continuous observations, homogeneous and accurate results
  - Requires a correction model for reduction to the reference epoch

- From the reference frame definition point-of-view, basically a question of on which coordinates to trust: from passive or active networks

- Sweden has changed to active definition for SWEREF99

3. Geodetic infrastructure: Arguments for the active definition (case Sweden)

+ No maintenance of the passive network
+ Efficient GNSS measurements
+ No risk of problems with lower quality densification in comparison to the future accuracy of GNSS
+ The stations control each other continuously
- Jump when velocity model is changed or other uncorrected changes are introduced in the active system
- In some areas discrepancies between SWEPOS and RIX95
- Geodynamic motions with a resolution <100 km

3. Geodetic infrastructure

- Minutes from the first WG meeting in 2011:

  WG discussed about publication Report on future geodetic infrastructure in Sweden. “The work was considered important for all other countries dealing with the same issues. At the moment other countries use passive networks. Future goals within this WG are to exchange information and knowledge and give support for each other. Later it may be useful to arrange e.g. workshop for more intensive co-operation.“

Decisions in the WG/Proposals

1) Transformations ITRF←→ETRS89 with velocity models
   → **PROJECT PROPOSAL**
2) NKG GNSS Analysis Centre (NKG GNSS AC)
   → **PROJECT PROPOSAL**
3) Geodetic infrastructure (in Sweden)
   → **to be discussed within the WG (no need for project)**

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4. Modernization of the permanent GNSS stations

- Many Nordic countries facing the same problem - need for upgrading the ”old” permanent GPS stations
- Harmonization/co-operation (each country does not need to re-invent the wheel again)
  - Monumentation
    - concrete, steel mast,…
  - Dual sites – local tie
    - how? GNSS only, auxiliary measurements,…
  - Antenna calibration
  - Site-dependent effects – multipath, etc
  - …

4. Modernization of the permanent GNSS stations

- Minutes from the first WG meeting in 2011:

  “Many countries are modernizing their GNSS stations and densifying their existing networks (as mentioned during national reports). Related issues to be considered are monumentation of the stations, dual sites, local ties, site dependent effects etc. Sweden has already decided how to build new monuments, but other countries do not have exact plans yet. This topic was considered to belong better to the scope of the WG of Geodetic Infrastructures.”

Decisions in the WG/Proposals

1) Transformations ITRF←→ETRS89 with velocity models
   → **PROJECT PROPOSAL**
2) NKG GNSS Analysis Centre (NKG GNSS AC)
   → **PROJECT PROPOSAL**
3) Geodetic infrastructure (in Sweden)
   → **to be discussed within the WG (no need for project)**
4) Modernization of permanent GNSS stations
   → **belongs to WG of Geodetic Infrastructure**

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Other possible projects

- Minutes from the first WG meeting in 2011:

  “Following project ideas where shortly introduced and considered less important at the moment, but to be potential projects later.

  - GNSS antenna calibrations: individual vs. type calibrations
  - Ionosphere and troposphere modelling in Nordic area
  - Nordic Positioning Service
  - Navigation related projects

  As a conclusion from the discussions, the WG decided to propose NKG GNSS Analysis Center and ITRS-ETRS89 transformations as (the first) projects for coming years. Preliminary project proposals/plans were prepared. Geodetic Infrastructures was considered an important topic to be discussed in the WG meetings.”

Decisions in the WG/Proposals

1) Transformations ITRF←→ETRS89 with velocity models
   → **PROJECT PROPOSAL**
2) NKG GNSS Analysis Centre (NKG GNSS AC)
   → **PROJECT PROPOSAL**
3) Geodetic infrastructure (in Sweden)
   → **to be discussed within the WG (no need for project)**
4) Modernization of permanent GNSS stations
   → **belongs to WG of Geodetic Infrastructure**
5) GNSS antenna calibrations
   → **No project; side-/sub-project of #4**
6) Nordic Positioning Service
   → **No project at the moment**
7) use of GNSS for ionosphere and troposphere modelling
   → **No project; possibly later a product of #2**
8) Navigation related projects
   → **None at the moment**
9) other projects
   → **None**

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Status of the projects:

- NKG GNSS AC: Presentation on Thursday morning
  - Lotti Jivall, Tina Kempe, Christina Lilje, Sonja Nyberg, Pasi Häkli, Karin Kollo, Priit Pihlak, Mette Weber, Ksenija Kosenko, Þórarinn Sigurðsson, Guðmundur Valsson, Dalia Prizginiene, Eimuntas Paršeliūnas, Oddvar Tangen: *Report from the project "NKG GNSS analysis centre"*
- Transformations ITRS-ETRS89: Poster
  - Pasi Häkli, Lotti Jivall, Martin Lidberg, Torbjørn Nørbech, Oddvar Tangen, Karsten Engsager, Mette Weber, Priit Pihlak, Ivars Aleksejenko and Eimuntas Paršeliūnas: *The NKG2008 GPS Campaign - final results including transformation parameters*

Big thanks to all participants for the WG work…

…and thanks for your attention!

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