



A New Common Nordic Reference Frame

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Background

The Nordic countries have implemented national realizations of ETRS89 during the 90s accommodating the needs of the NMCAs and international standards. So far – so good.!

Technologies develop – new applications of GNSS:

- cm accuracy RTK services
- Construction work Geo-Rail
- Subsidence of structures
- Earth system monitoring (sea level) GGOS
- -> New requirements





Background

- Presently, a Nordic Positioning Service is under development by the Nordic collaboration NKG,
- Different epochs and different ITRFs for the individual national realizations caused differences up to a few cm.
- Hence, we have a situation, where a common Nordic reference frame would be useful.
- A common reference frame could also act as a link between the different national realizations and between those realizations and ITRF.





Background

NKG requested for the Nordic area the development of

- a unified ETRS 89 reference frame on the cm level,
- transformations from such a reference frame to the national realizations of ETRS 89, as well as the
- transformation from ITRF to the unified ETRS 89 reference frame.

The NKG working group for Positioning and Reference frames was given the task to develop such a common Nordic reference frame and the transformation formulas.







Tasks

- To establish the new common Nordic reference frame the following tasks were considered:
- 1. Campaign specifications, epoch, link modern geodetic monitoring stations (EPN) and original defining points
- 2. Data processing, more softwares, to establish the common Nordic reference frame
- 3. Define transformations to National ETRS89 realizations, and, furthermore, to
- Estimate a velocity field to secure future applications, i.e. the long term stability, of the common Nordic reference frame.





Campaign specifications

- 133 stations (old defining bench [™] marks and EPN stations), +Baltic +Iceland +GR
- 7 days, Week 40 in 2003, GPS week 1238,
- Coordinator:
 - F.B. Madsen, DK/DNSC







Data processing

Softwares:

- N: NMA GIPSY
- S: OSO GAMIT/GLOBK
- S: LMV Bernese ver 5.0
- DK: KMS Bernese ver 4.2
- Use recommended settings for each programme
- ITRF 2000, epoch of the campaign (2003.75)

Coordinator:

Lotti Jivall, S/LMV

(see dedicated presentation)





Harmonizing the solutions (Jivall, S/LMV)







The combined solution (Jivall, S/LMV)

The combined solution realize the common Nordic reference frame in ITRF2000_2003.75 fulfilling the requirements.

Estimated accuracy:

Internal: RMS of all differences (E, N, Up)

• 0.9, 1.2 and 2.5 mm after harmonization A few large residuals after harmonization

External: Systematic, common mode errors, seasonal effects

• ~5, ~5 and ~10 mm (RMS)





Transformations

The National ETRS89 realizations have already been adopted and introduced to the users. They will not be replaced.!

We will not promote a new ETRS89 realization, but recommend that the new Nordic frame will be in ITRF2000_2003.75.!

Define transformations directly from the ITRF200_2003.75 Nordic frame to each National ETRS89 realization (7parameter, low degree polynomials)

On-going task (/ discussion). Coordinator: T. Nørbech, N/NMA





Transformations

The Nat'l ETRS 89 frames are made at different epochs and ITRFs

- there are differences between the realizations up to a few cm.

On-going task (/ discussion). Coordinator: T. Nørbech, N/NMA







Velocity field

Estimate a velocity field to secure future applications, i.e. the long term stability of the common Nordic reference frame.

Future task - soon!

Contribution by BIFROST, Milne, and M. Lidberg. See presentation by M Lidberg







Velocity field

Horizontal velocities from **BIFROST**, Milne et al, and

M. Lidberg.







Velocity field

Vertical velocities from Ekman Lidberg Milne et al Winter







Conclusions - discussion

To accommodate a future Nordic RTK service

- A common Nordic reference frame with up-dated accuracy in ITRF2000_2003.75 has been established.
- Transformations to National ETRS89 frames will be made.
- A velocity field in 3D (consistent with ITRF2000) will be developed to secure the long term stability.

The frame may accommodate needs of a variety of new GNSS applications.

Covering Greenland and Norway we have an arctic frame valuable for the IPY.

We do not recommend a new ETRS89 frame to avoid multiple ETRS89 realizations – nor numerous technical frames..(???)