

National Report, Denmark (SDFE)

NKG WG Reference Frames

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Continuously operating GNSS Stations (Class A)



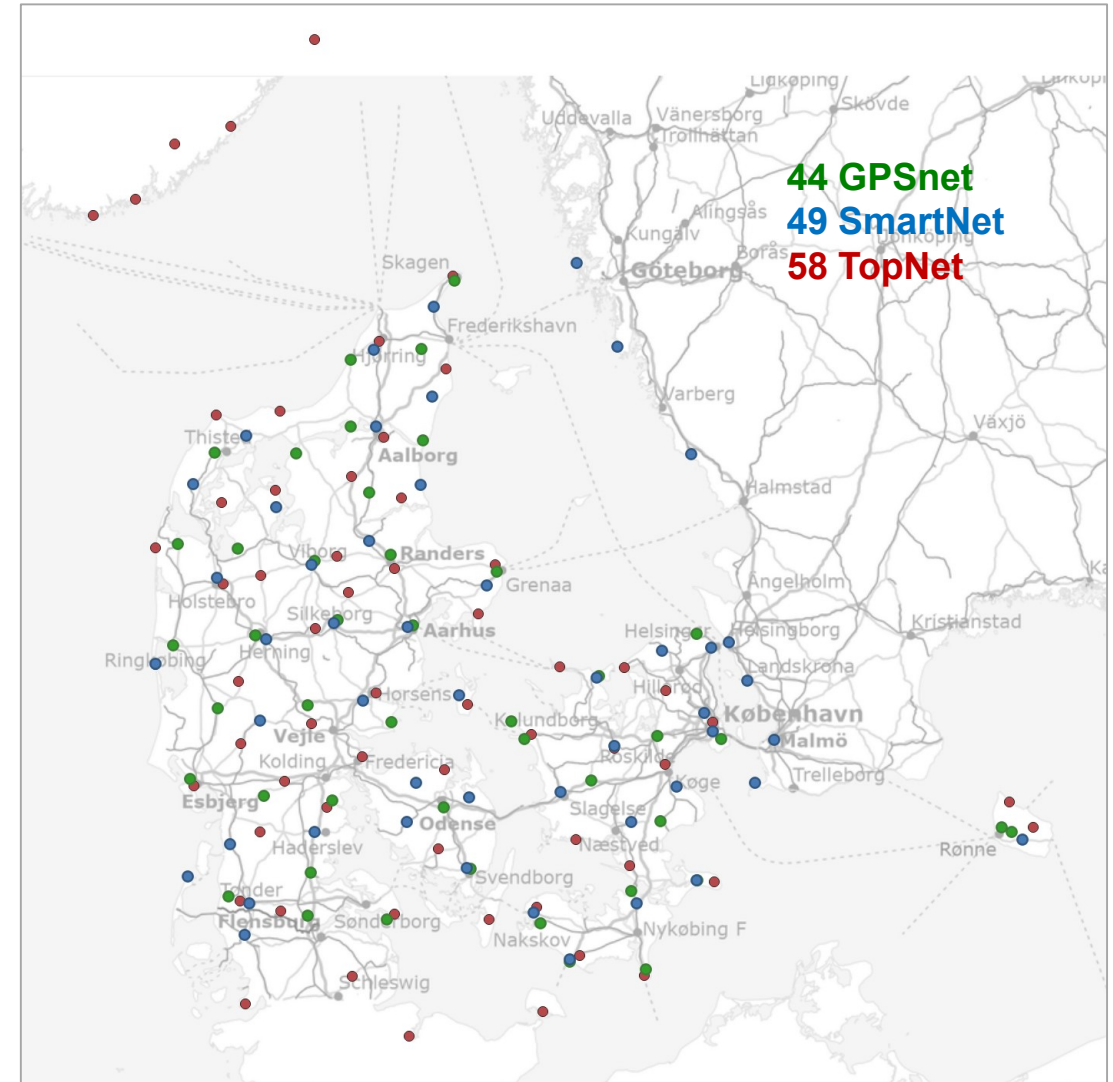
FYNO: New station 2021

At the moment no further expansion of the GNSS network is planned.



Commercial RTK services

- 4 (5) nation-wide RTK services in DK
- 2 approved according to “Norm for RTK services” by SDFE: HxGN SmartNet and GPSnet.dk.
- New for approval: TopNetLive
Approval according to “Norm”: The service must fulfill “certain requirements” to be used for cadastral surveying
- SDFE: Yearly processing of ETRS89 coordinates for the reference stations (one week data)
- + potentially 1-2 more services for approval



Towards an active height reference

- Based on commercial RTK services and a geoid model -> reduce the need for levelling
- Revision of “Norm for RTK services” to fit the increasing requirements for height accuracy
- Future role of Galileo Services...?

RTK/fast static test in 2020

Test of vertical accuracy using commercial RTK services on 150 benchmarks across Denmark.

Results: RTK: Average height difference 7 mm, Std.Dev. 19 mm

Fast static: Average height difference 5 mm, Std.Dev. 16 mm

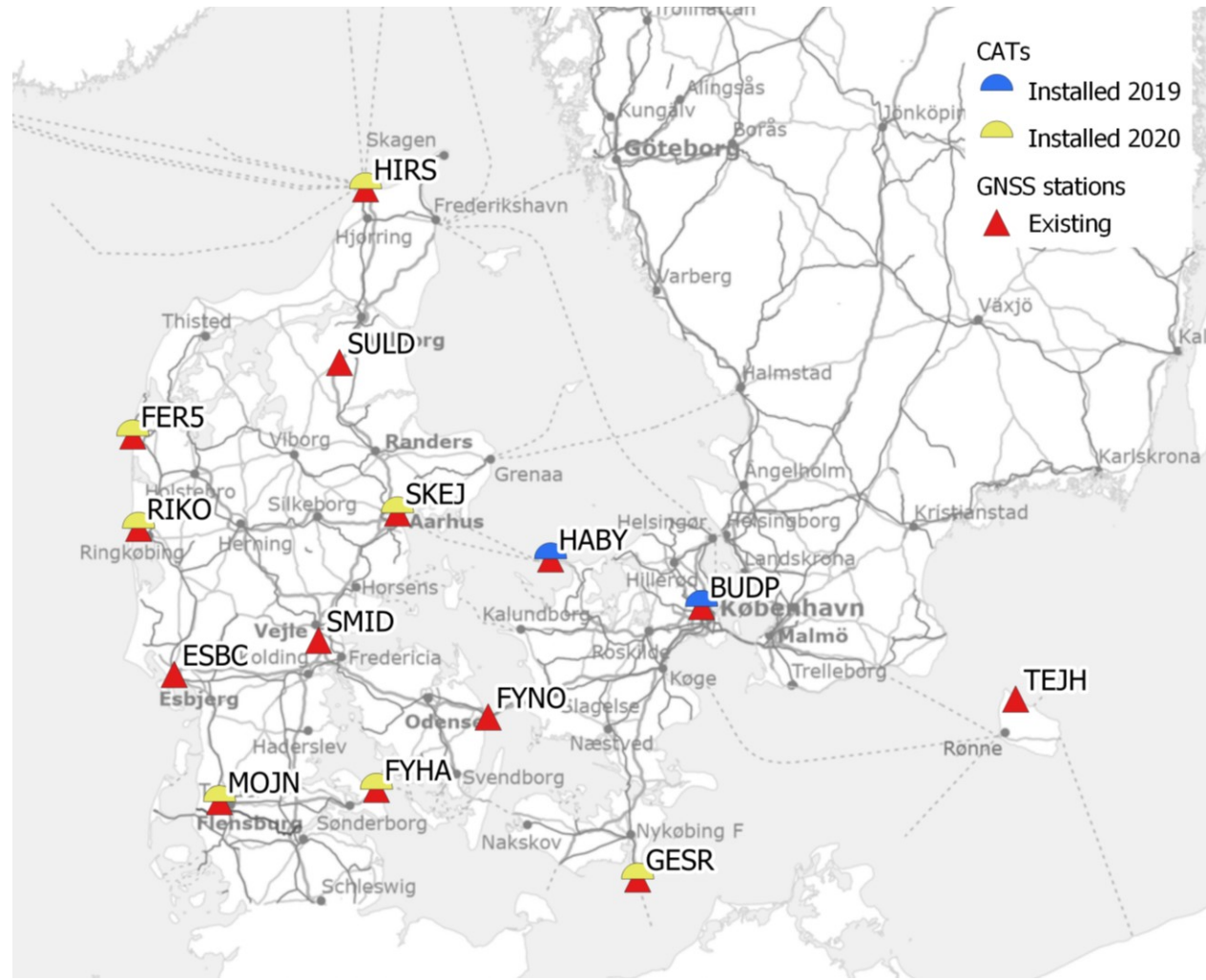
Conclusion: Improvement of vertical accuracy is needed

5 mm geoid model

QC of GNSS/levelling points is ongoing, e.g. by cross-validation techniques

Version 1.0 to be completed ultimo 2021

Installation of InSAR CATs



InSAR CATs from MetaSensing installed onto GNSS-stations.

In general the CATs have performed poorly so far (weak or no return signal after a few months, insufficient sealing etc.).

In 2021 focus will be on installing CRs co-located with GNSS-stations (for long term check of CAT phase stability etc.).

However we still believe in the overall concept of installing InSAR CATs onto GNSS-stations.

Test bed for CATs at HABY



Is it possible to correlate displacements determined by levelling with displacements calculated from the return signal of CATs?

FIRE – new geodetic data management system

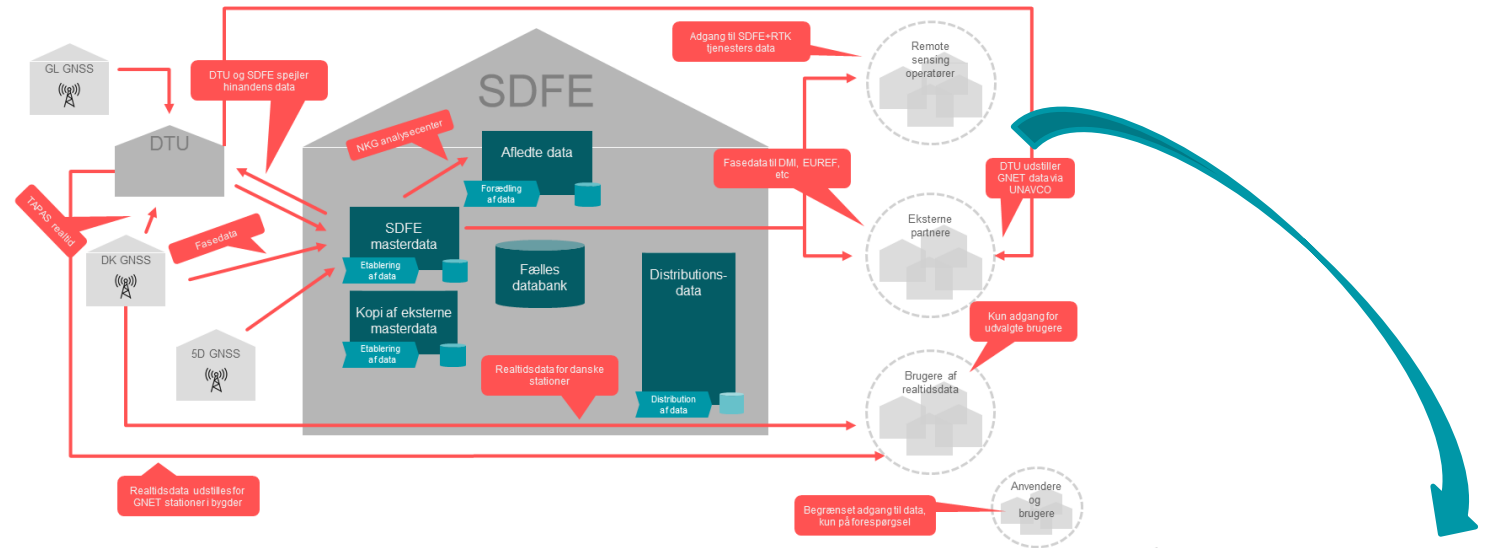
- Migrated 2 133 527 coordinate tuples, 2 848 160 observations, 4 562 432 descriptors, related to 796 552 geodetic benchmarks.
- Replaced approx. 500 000 lines of legacy C code with approx. 6 000 lines of crisp fresh baked Python...
- A command line interface integrating **GNU Gama** (adjustment), **Excel** (inspection/interaction wrt. numeric output), and **QGIS** (network visualization).
- Internally operational, but no public data access yet – awaits final roadblocks at the corporate data distribution level.
- Concludes a decade-long striving to modernize our geodetic IT system, also including our work towards making PROJ the "go to" software for geodetic transformations.

PROJ

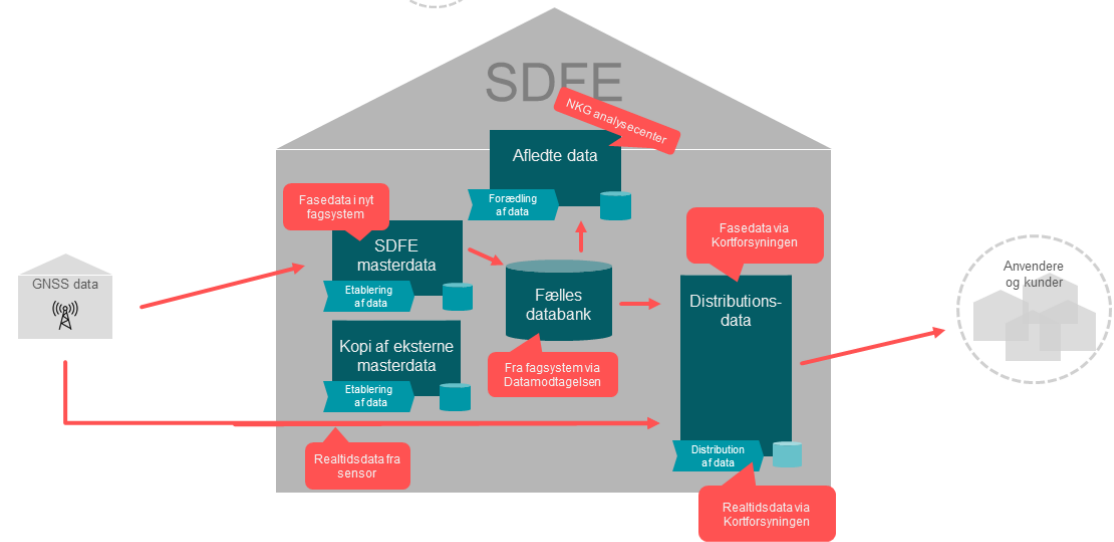
- 7 new releases since the last meeting, with 8.0.0 being the latest
- NKG2020 transformations implemented per version 7.2.1
- TIN-based transformations now possible thanks to FGI
- Multi-component time-based deformation model transformations added thanks to Land Information New Zealand

Harmonizing the GNSS IT infrastructure in SDFE

- Decrease complexity of GNSS data flow
- Make GNSS data publicly available, not just for selected partners



- Decided to use NtripCaster Pro from BKG for realtime data distribution
- Considering to distribute RINEX data using EPOS GNSS software (GLASS)



Standards – long term work (2019-2027)

- **ISO 19111 (coordinates) and 19162 (systems) are incompatible with the geodetic realities**
- They will come up for revision around 2024... be prepared!
 - Describe the problem(s),
 - Build understanding and alliances (Thomas Knudsen, thokn@sdfе.dk)
 - Conduct experiments
 - Draft potential solutions
- Controversial: Touching the geometric foundation of the ISO 191XX series
- Necessary for relevance in the sub-decimeter-accuracy society

Geodetic infrastructure Greenland

- In 2021: Remeasure 4 fundamental reference points defining the national reference frame GR96:
 - Connect GR96 to GNET stations
 - Develop transformation parameters between ITRFYY and GR96; parameters for intra-plate deformations
- In 2020: New GNSS station KLY2 – the old IGS station KELY (from JPL) was dismantled in 2017
- Yearly maintenance of GNET stations by DTU Space

