

National Report: Denmark

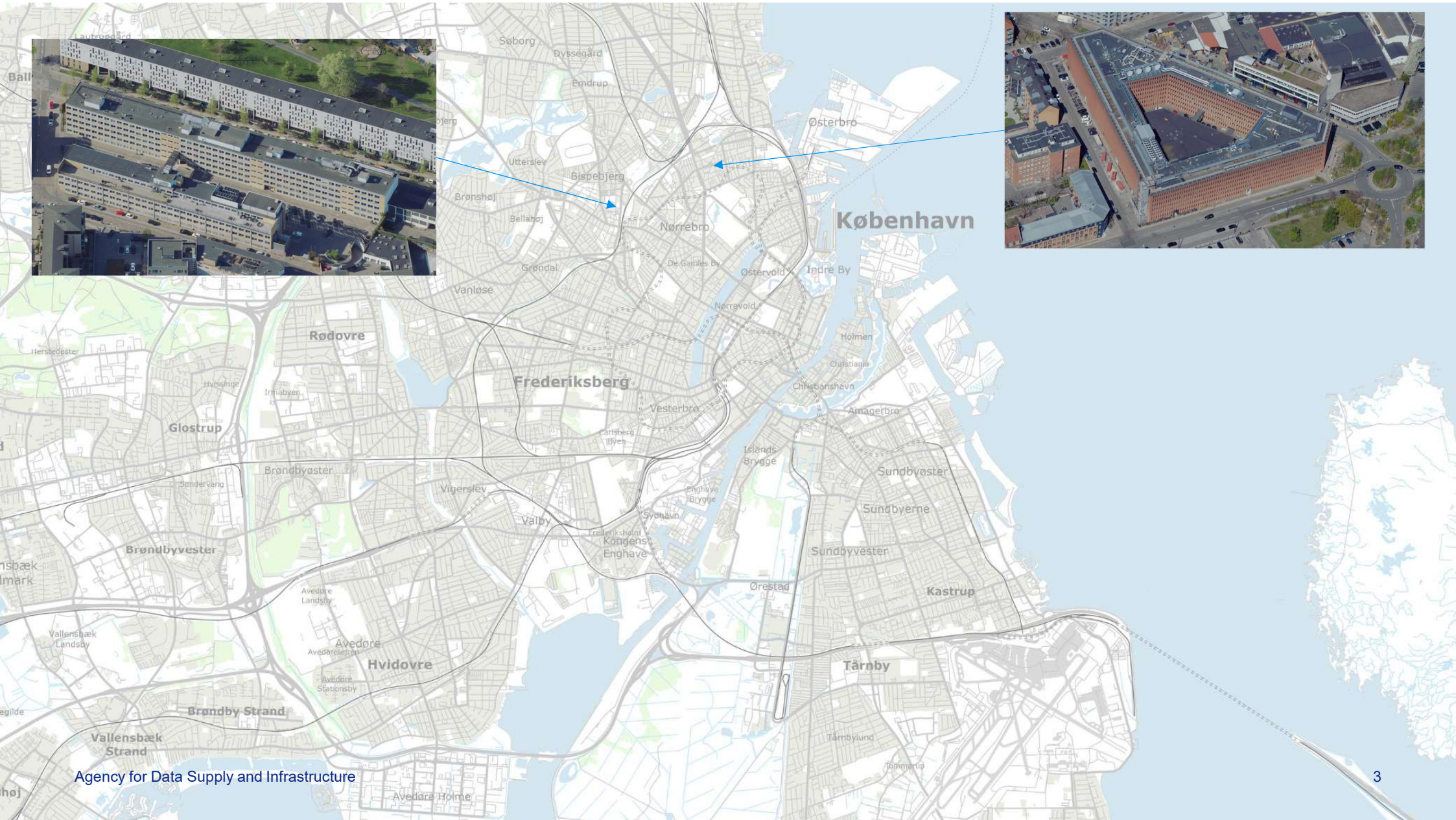
Working Groups Reference Frames & GNSS Positioning

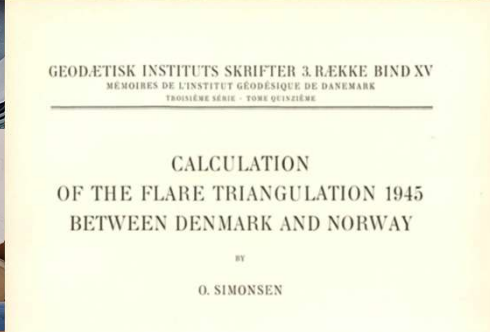
NKG Science Week, March 2024, Reykjavik



Agency for Data Supply
and Infrastructure

We've moved!





Introduction. Calculations Based on an Adjustment of the New Danish Triangulation Net, this Net being Forced to fit the Triangulation Chain around the Baltic. The Coordinates thus Determined Represent Coordinates in the *New Danish System*.

This international measuring work was carried out in 1945 by collaboration between the INTELLIGENCE DIVISION, OFFICE OF THE CHIEF ENGINEER, UNITED STATES ARMY, THE ROYAL AIR FORCE (R.A.F.) and another British corps, ROYAL SIGNALS, as well as the Norwegian Geographical Survey, NORGES GEOMATISKE OPMÅLING, and the DANISH GEODETIC INSTITUTE. The calculations have been performed by the latter institution.

A preliminary report on the flare triangulation in 1945 was read before the Meeting of the International Geodetic Association in Oslo 1948. (Bull. géod. No. 11, 1949).

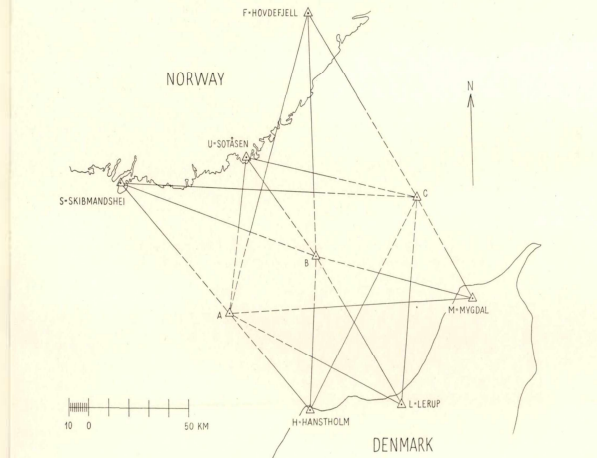


Fig. 1. Denmark-Norway Connexion. On the letter U at Sotåsen (see p. 12).





SKG1 replaces KMS3



Danish
Meteorological
Institute

Understaffed in 2023

- Several vacant positions, maternity leave and other employee absence has left limited time for
 - The NKG Analysis Center
 - Migration to Bernese 5.4
 - GNSS-surveying of 5D-benchmarks
 - Modernisation of GNSS data infrastructure
 - ...
- For the first time in 2 years we have no vacancies



RINEX processing and distribution

- Data is processed from ~200 stations
 - 30 DNK, 60 GRL, 4 FRO and 115 private
- Recently added remaining 42 GNET stations
- Most data distributed freely through the national data platform Dataforsyningen

SITE	42	43	44	45	46	47	48	49	50	51
AAS200GRL	97	96	97	97	97	97	97	97	97	97
ASKY00GRL	98	95	98	98	98	97	98	98	98	98
BLAS00GRL	99	96	99	99	99	98	99	99	99	99
DANE00GRL	96	93	96	96	96	95	96	96	96	96
DGG00GRL	92	89	92	92	92	91	92	92	92	92
DKSG00GRL	95	92	95	95	95	93	95	95	95	95
GBAD00GRL	99	96	99	99	99	98	99	99	99	99
GROK00GRL	97	94	97	97	97	96	97	97	97	97
HEL200GRL	93	92	93	93	93	93	93	93	93	93
HJCR00GRL	97	94	97	97	97	96	97	97	97	97
HMBG00GRL	92	89	92	92	92	91	92	92	92	92
HRDG00GRL	97	94	97	97	97	96	97	97	97	97
ILUL00GRL	95	94	94	94	94	95	95	95	95	95
ISOR00GRL	97	95	96	96	96	97	96	97	96	97
JGBL00GRL	99	96	99	99	99	97	99	99	99	99
JWLF00GRL	95	92	95	95	94	93	95	95	95	95
KAGA00GRL	96	93	96	96	96	95	95	96	96	95
KAGZ00GRL	97	94	97	97	97	95	97	97	97	97
KAP100GRL	89	88	89	89	90	90	90	89	90	89
KBUG00GRL	92	89	92	92	92	92	92	92	92	92
KELY00GRL	92	89	92	92	92	91	92	92	92	92
KLQ300GRL	98	97	98	98	98	98	98	98	98	98
KLSD00GRL	98	97	98	98	98	98	98	98	98	98
KLYZ00GRL	98	95	98	98	98	97	97	98	97	98
KMJF00GRL	96	93	96	96	95	96	96	96	96	96
KMOR00GRL	97	94	97	97	97	95	97	97	97	97
KSNB00GRL	94	91	94	93	94	93	94	94	94	93
KSUT00GRL	95	94	95	95	96	95	95	95	95	95
KUAQ00GRL	95	92	95	95	95	95	95	95	95	95
KULL00GRL	96	94	95	95	96	95	96	96	96	96
KULD00GRL	91	91	91	91	92	91	92	92	92	91
LEBI00GRL	99	96	99	99	99	97	99	99	99	99
LEFM00GRL	97	94	97	97	97	96	97	97	97	97
LYNS00GRL	97	94	97	97	97	97	97	97	97	97
MARG00GRL	98	95	98	98	98	97	98	98	98	98
MIK200GRL	96	93	96	96	96	95	96	96	96	96
MSVG00GRL	95	92	95	95	95	94	95	95	95	95
NNVN00GRL	98	97	98	98	98	97	98	98	98	98
NORD00GRL	99	98	99	99	100	99	100	100	100	99
NRSK00GRL	98	95	98	98	98	97	98	98	98	98
NUUK00GRL	98	96	97	97	98	97	98	98	98	98
PAMI00GRL	98	96	97	97	98	98	98	98	98	98
PLFK00GRL	86	85	86	85	86	85	85	86	85	85
QAAR00GRL	93	92	92	92	93	92	93	93	93	93
QAQ100GRL	92	92	92	92	93	92	93	93	92	92
QAQ200GRL	94	94	93	93	94	94	94	94	94	94
RINK00GRL	95	92	95	95	95	94	95	95	95	95
SCBY00GRL	99	96	99	99	99	97	99	99	99	99
SCCR00GRL	93	92	92	92	93	92	93	92	91	92
SEN000GRL	98	95	98	98	98	98	98	98	98	98
SIS100GRL	94	93	94	94	95	94	95	95	95	95
SRMP00GRL	99	96	99	99	99	97	99	99	99	99
THU200GRL	96	95	96	96	97	96	97	97	97	96
THU400GRL	97	95	96	96	97	96	97	97	97	97
TIDM00GRL	96	94	96	96	96	96	97	97	97	97
TINI00GRL	98	95	98	98	98	97	98	98	98	98
UPVK00GRL	97	96	97	97	98	97	97	98	97	97
UTMG00GRL	96	95	96	96	96	95	96	96	96	96
VFDG00GRL	93	90	93	93	93	92	93	93	93	93
WTHG00GRL	99	96	99	99	99	98	99	99	99	99
YMER00GRL	99	96	99	99	99	98	99	99	99	99

GNSS real time data

- Next generation real time caster based on BKG software
- Streaming NTRIP v. 2s (s for secure)
- Data available for Danish stations at ntrip.dataforsyningen.dk
- Official release of the new caster awaits the big companies to fully adapt NTRIP v. 2s
- Client software with no such issues are BKG's BNC software and SNIP



Regulation of private GNSS positioning services providers

- New guidelines proposed – planned to take effect July 2024
 - First revision since introduction in 2008
 - Three accuracy classes
 - A: 1.0 cm, 2.0 cm
 - B: 2.0 cm, 4.0 cm
 - C: 2.5 cm, 5.0 cm
 - Coverage map
 - New control procedures using independent monitoring stations
- New provider accepted: RTKConnect
 - Single station RTK

Geodetic standardisation

- ISO-19111 "Referencing by coordinates" is up for review in 2024
- This offers the opportunity to refine the standard so it is better suited for high accuracy geodetic work
- SDFI has investigated ways to improve the standard and lobbied for a thorough revision in the coming years
- Hopefully paving the way for a EPSG-registration of the NKG Transformations

Geodesy ruminations

TL;DR

- You just need a brief, self contained introduction to Rust Geodesy?

Jump directly to [Rumination 009](#): Teach yourself Geodesy in less than 900 seconds (of arc)

All ruminations

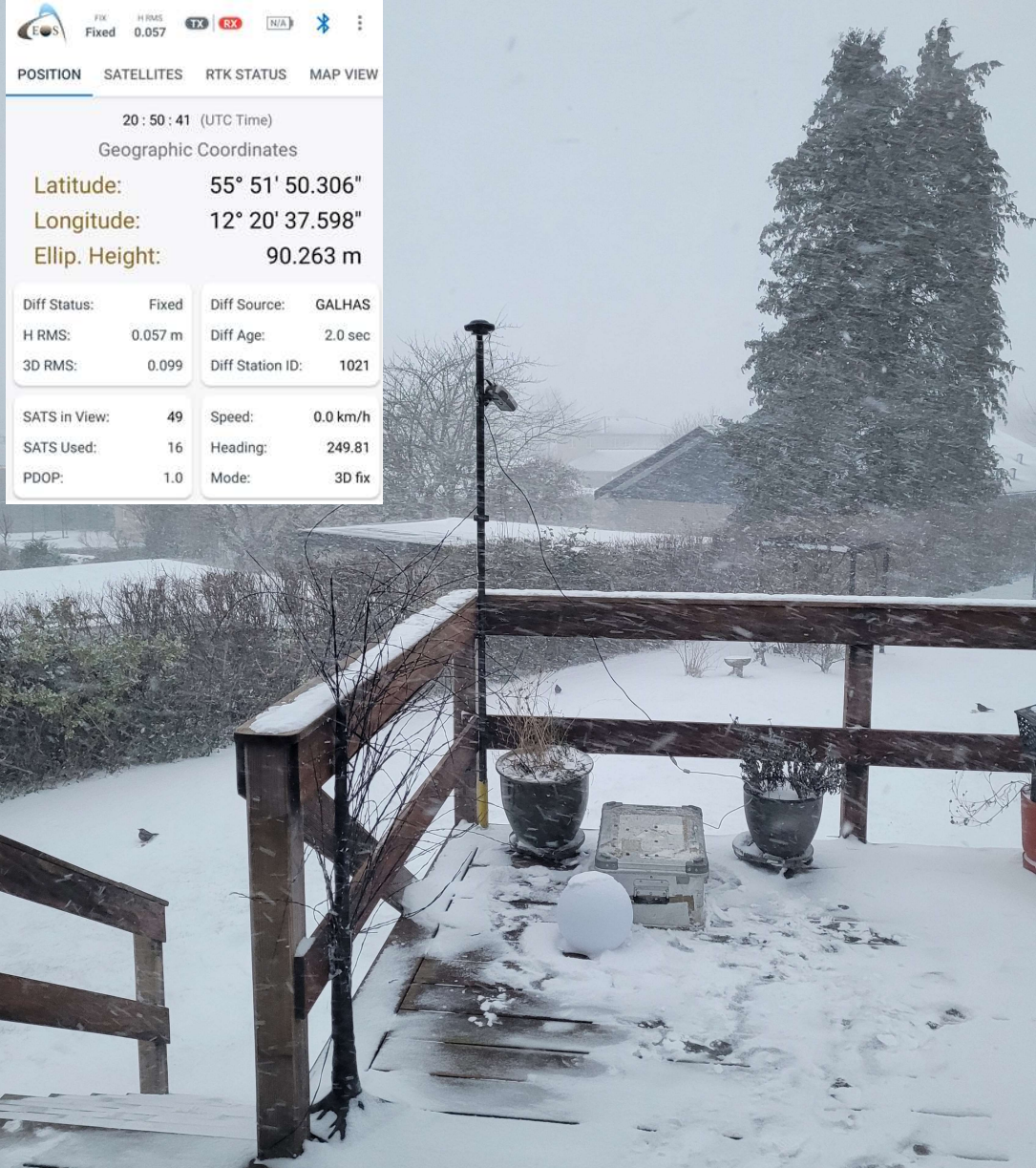
If you have plenty of time, feel free to work your way through, and ruminate over, all the ruminations:

- [Rumination 000](#): Overall architecture and philosophy
- [Rumination 001](#): A few words about an often-seen pipeline
- [Rumination 002](#): The missing manual
- [Rumination 003](#): kp - the RG Coordinate Processing program
- [Rumination 004](#): Why Rust Geodesy - some background
- [Rumination 005](#): Divided by a common language
- [Rumination 006](#): Still confused, but at a higher level
- [Rumination 007](#): Operator parameter introspection
- [Rumination 008](#): Geodesy from a PROJ perspective
- [Rumination 009](#): Teach yourself Geodesy in less than 900 seconds (of arc)

GNSS Jamming

- Several large scale jamming events during 2023
- Increased political focus → Several SDFI departments seeking more knowledge
- Representing SDFI at the Norwegian Jamming test was both the Geodetic Office and the Frequency Authority





The screenshot shows a GNSS receiver interface with the following data:

POSITION		SATELLITES		RTK STATUS		MAP VIEW	
20:50:41 (UTC Time)							
Geographic Coordinates							
Latitude:	55° 51' 50.306"						
Longitude:	12° 20' 37.598"						
Ellip. Height:	90.263 m						
Diff Status:	Fixed	Diff Source:	GALHAS				
H RMS:	0.057 m	Diff Age:	2.0 sec				
3D RMS:	0.099	Diff Station ID:	1021				
SATS in View:	49	Speed:	0.0 km/h				
SATS Used:	16	Heading:	249.81				
PDOP:	1.0	Mode:	3D fix				

Galileo Services

- High Accuracy Service
 - HAS receiver acquired
 - Initial results show a quite long initialization time of about an hour and re-initialization around 20 minutes
 - A rough transformation to ETRS89 gives a horizontal accuracy of about 20 cm
- OS-NMA
 - Successful demonstration of jamming detection



GNET

- New station west of Nuuk
 - Kitsissut/Telegraføen - KSUT
- GNSS-IR receiver installed next to tide gauge in Nuuk
- Starlink tests
 - Very reliable, great data transfer (100%)
 - Not useable at remote sites, at this point
 - Big and active antenna (has been fixed to point south)
 - High power consumption (compared to Iridium)



Thank you