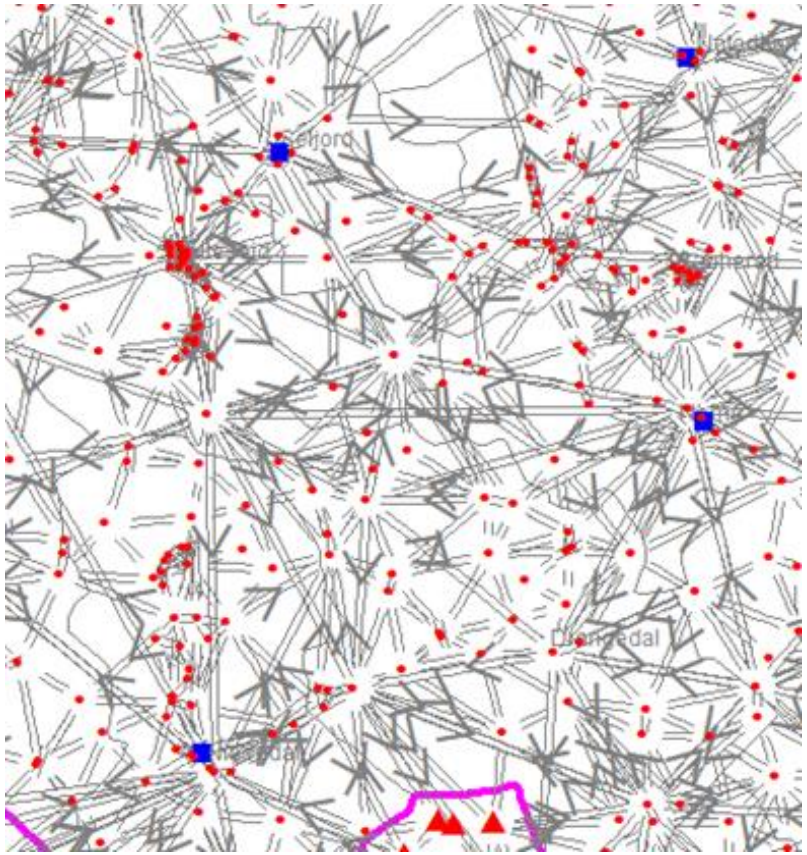
National report Norway 2022

Realization of IGS2014 in the active and passive network



All CORS realized in IGS2014 epoch 2020.0

In the GNSS network horizontal coordinates and ellipsoidal heights are calculated separately.

5-days-campaign measurements and short vectors to control points provide the connections between the active and passive network

In total 278 CORS and 16 000 GNSS points

Kartverket

Separation models

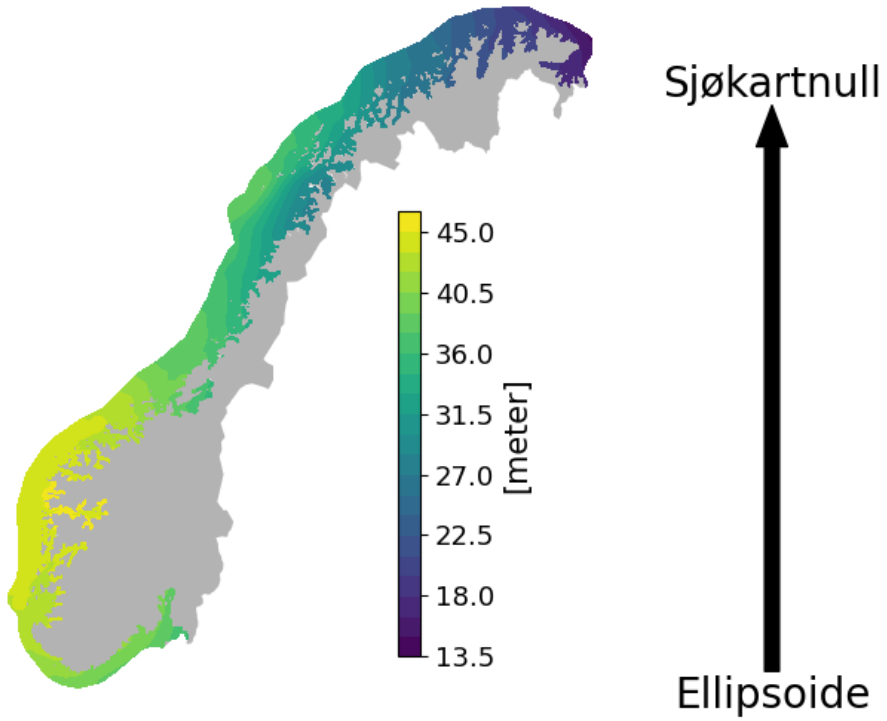
Released an update of the nationwide separation models:
Mean Sea Level above LAT
Mean Sea Level above Sea Chart Datum
Mean Sea Level above the geoid
Mean Sea Level above the ellipsoid
The geoid above Sea Chart Datum
Sea Chart Datum above the ellipsoid
Mean Sea Level above NN2000
NN200 above Sea Chart Datum

Mean High Water above NN2000

New

Kartverket

Chart Datum model



- Combination of other collocation models
- Step 1: calculate geoid model and mean dynamic topography – done simultaneously => the combination gives **Mean Sea Level relative ellipsoid**
  - Based on long and short term sea level measurements relative to NN2000 or the ellipsoid, levelling benchmarks, NKG2015 geoid, land uplift model
- Step 2: calculate **Chart Datum relative Mean Sea Level** in separate collocation
  - Based on harmonic analysis of sea level time series
- **Chart Datum relative ellipsoid** is the combination of these two

Expanding the Norwegian tide gauge network

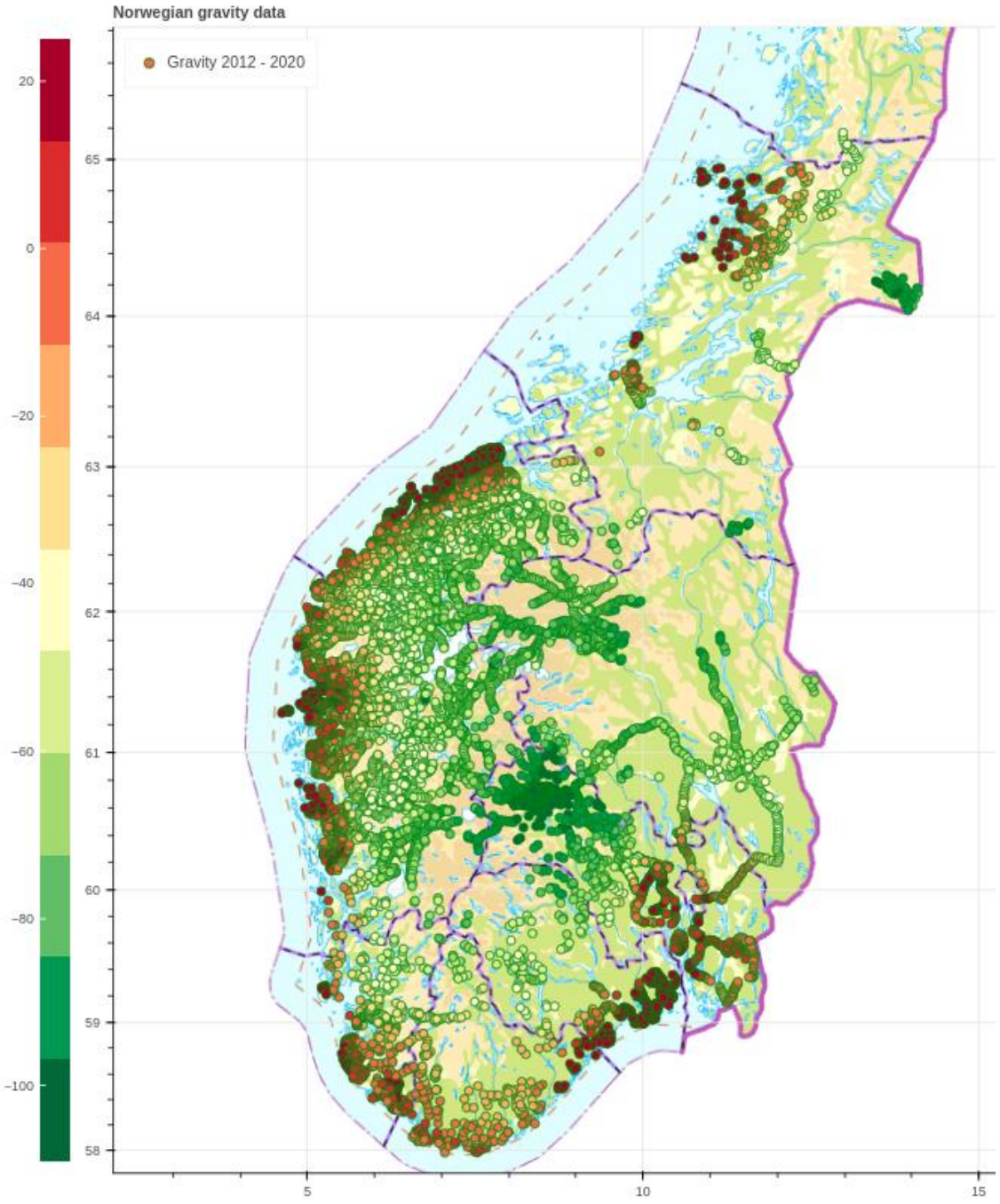
- Network consists of 24 permanent tide gauges and temporary campaigns when necessary
- Data is collected, quality controlled and distributed online
- Used for: navigation, water level forecast, vertical datums (MSL, chart datum, return levels for storm surge etc.), monitoring sea level change etc.
- Challenges identified:
  - Lack of geographical coverage
  - Knowledge of and collaboration with other entities doing similar measurements

8777 new land gravity measuremets added to NKG gravity database

2012: 77
2013: 364
2014: 576
2015: 1200
2016: 3723
2017: 1333
2018: 673
2019: 549
2020: 281

Sd: 2.5 mGal compared to existing database

2021: 434 not added yet



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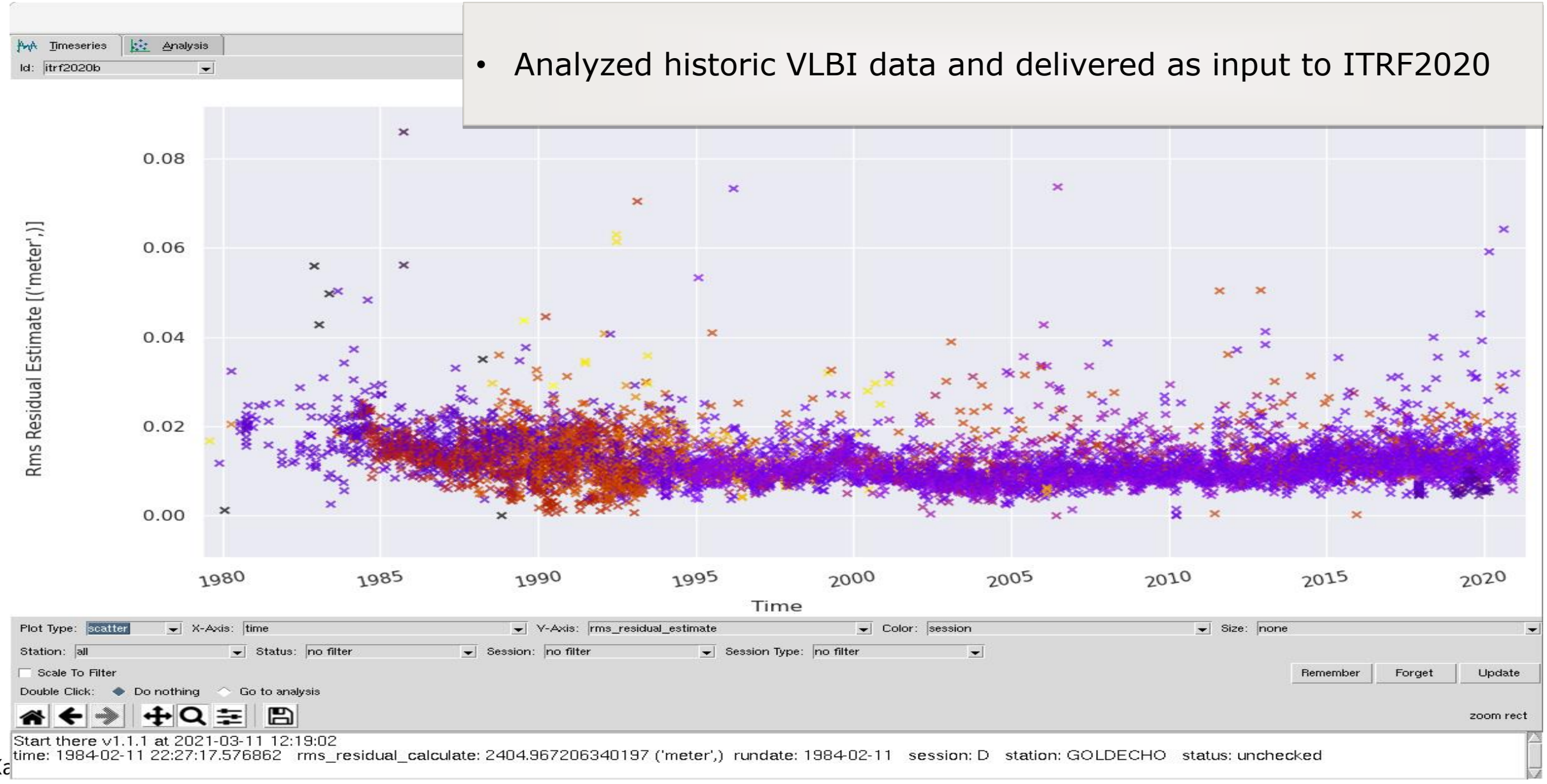
Ny-Ålesund geodetic observatory

VLBI – NYALE13S and NYALE13N

- The VLBI south telescope (right) has a VLBI legacy receiver installed, and are contributing to the IVS during regular sessions (R1, R4, T2, RD, Rv and intensives)
- The VLBI north telescope (left) has a VGOS receiver installed, and are currently doing test sessions.
- The old VLBI telescope in Ny-Ålesund (not in picture), will be dismantled end of 2022

VLBI - ITRF2020

- Analyzed historic VLBI data and delivered as input to ITRF2020



SLR

- 2022 - Installation of the first components with setup of the dome on the roof at Brandal and installation of the riser. Gimbal and telescope assembly installation.
- 2024 – laser system will be installed
- 2025 - SLR fully operational

- 2025 – The observatory – a fundamental station with all space geodetic techniques co-located

Proj

- NMA has decided to replace all transformation libraries and routines with proj, within the next years.

So far we have

- transformations between EUREF89 and ITRF2014/ITRF2000 based on NKG transformation
- the height reference frames NN1954 and NN2000
- transformations between EUREF89 and NGO1948 based on Triangle-based transformation
- Norway chart datum in Proj. Seamless transformation between land and ocean.
- New OpenAPI webservice based on Proj (https://ws.geonorge.no/transformering/v1/)

Yet to be done in Proj

- Support old reference frames, eg. ED50
- EUREF89 and ITRF2014 transformation for Svalbard
- Define Normal Null and vertical height transformation for Svalbard
- Local reference frames, eg. Oslo, Bergen, Trondheim

Goal

Make proj available on common platforms for most users.

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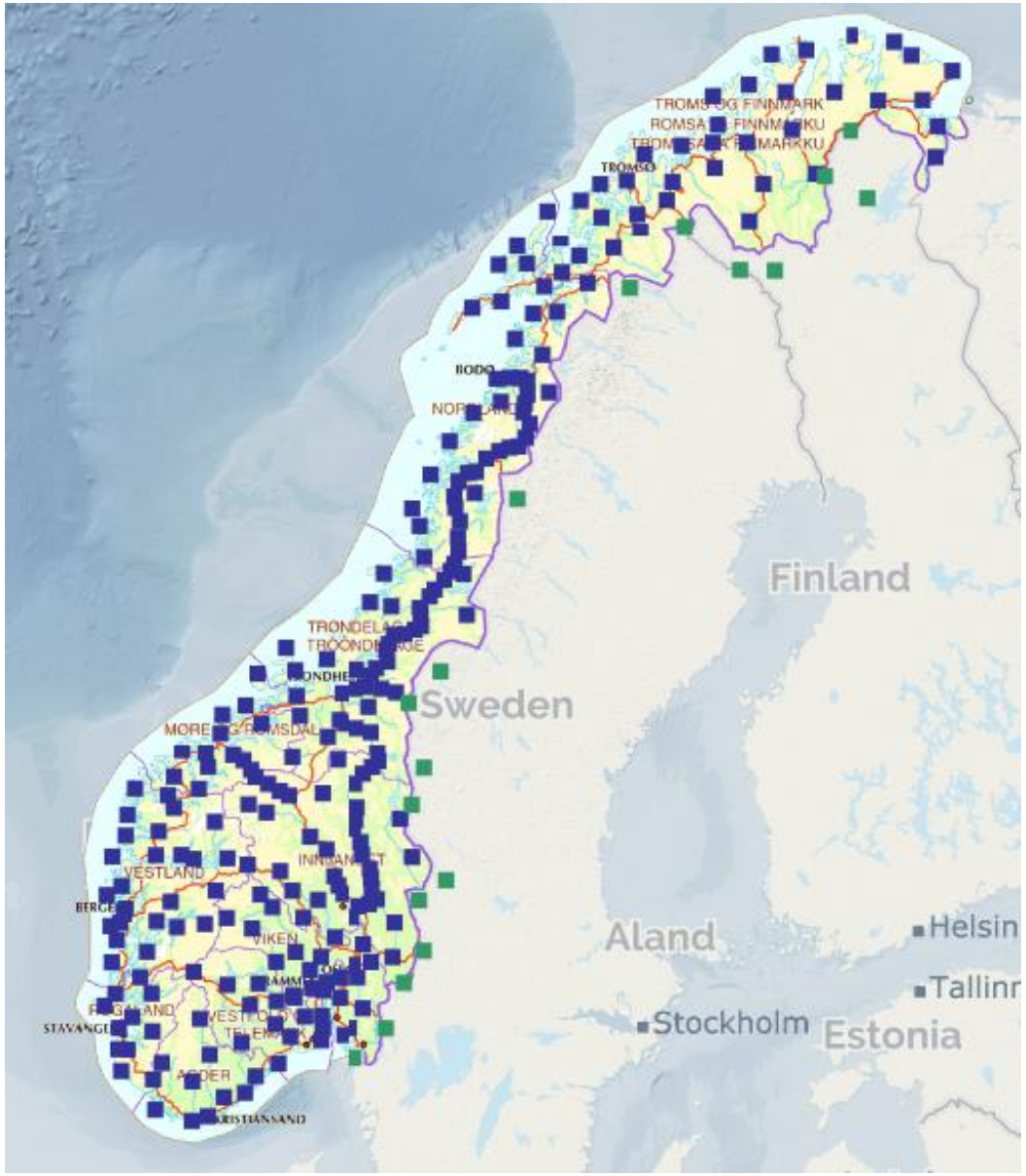
Positionservices

- We are constantly increasing the number of users on the real-time positioning services.
- The Norwegian mapping authority (NMA) have 4200 unique users.
- Private companies have more than 10 000 unique users, based on the GNSS-stations from NMA.
- The main part of the increased use is machine control, but we also see new users within new areas of use.



GNSS stations

294 stations pr 1.1.2022

up from

210 stations pr 1.1.2018

The main reason for the increased number of stations

- Densification along non-electrified railway lines
- The station network of the private company, Leica, has been transferred to The Norwegian mapping authority

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HyPos- National Hybrid Positioning Service for the Digital and Autonomous Societies of the Future

The Norwegian Mapping Authority wants to develop an accurate, scalable service for position determination in real time, with a larger coverage and higher redundancy than before.

(i) develop a new scalable method for broadcasting GNSS correction data;

(ii) use the telecommunications network's 5G as an independent source for position determination

(iii) develop a new hybrid positioning service using both GNSS Correction (i) and 5G broadcasting (ii)

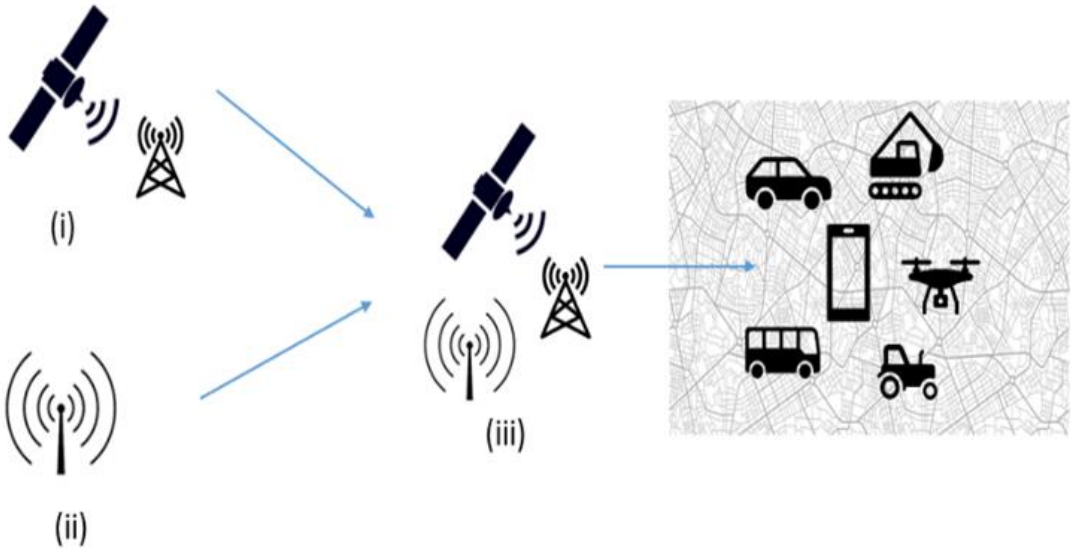


Figure 1. (i) GNSS with the Norwegian Mapping Authority's GNSS infrastructure, (ii) mobile network, (iii) hybrid positioning service.

Forskningsrådet Telia ERICSSON SINTEF Kartverket

Teapot - Technology for advanced positioning within the transport system

Main goals of the project:

- Identify the transport sector's need for positioning technology, especially with regard to Nordic conditions.
- Develop a procedure for how different technologies and methods for positioning can be combined using sensor fusion.
- Describe how cooperation between road authorities and actors within positioning can be organized and regulated without hampering Norwegian business and industry

Figure 1.The Norwegian Mapping Authority's Measuring Car with navigation system: GNSS, IMU, Odometer and LiDAR.

SINTEF

Statens vegvesen

NTNU

Kartverket

APPLIED AUTONOMY

Forskningsrådet

Aventi

Kartverket

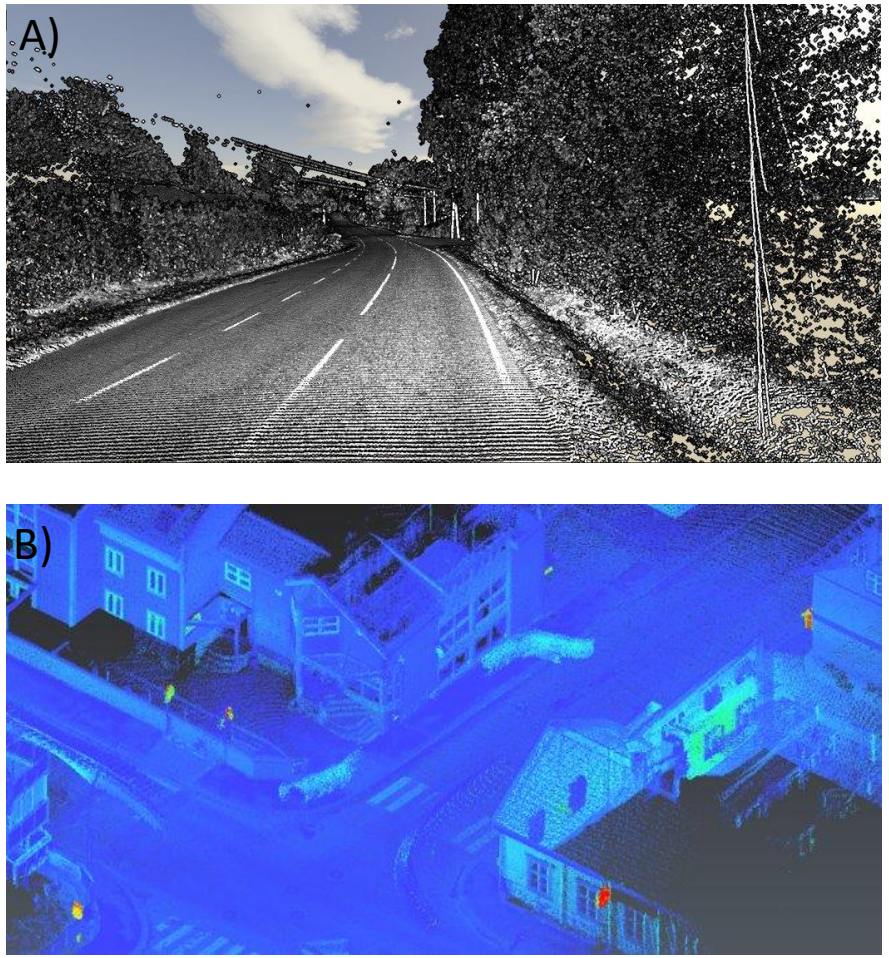
PISI- Point cloud in real-time for ITS

Work package 1

- Further develop the management solution for point cloud data
- Change the process for how point clouds are collected

Work package 2

- Development of proof of concept for real-time data streaming of point cloud data for ITS applications
- Use of point clouds from vehicles in real time
- The Norwegian Mapping Authority is preparing for future needs from users



A) Point clouds in Høydedata.no and B) "raw point cloud" collected.

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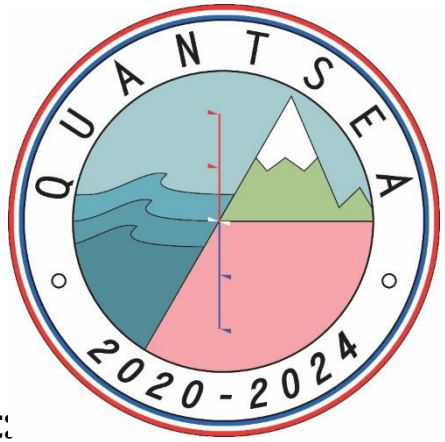
QUANTSEA



Project:
Quantifying Past and Future Sea Levels for Norway (QUANTSEA)

Rationale:
Use new glacioisostatic adjustment (GIA) modelling to improve century-scale relative sea-level (RSL) projections
… new postglacial RSL database will constitute an up-to-date calibration dataset for GIA modelling in Scandinavia
… additional implications for archeology, paleoclimatic/environmental variability, geodynamics, etc.

Team:
F. Chantel Nixon, NTNU-Geography
Max Holthuis, Ph.D. NTNU-Geography
Anders Romundset, NGU
John Inge Svendsen, UiB-Earth Science
Kristian Vasskog, UiB-Geography
Jan Mangerud, UiB-Earth Science
Stein Bondevik, HVL
Mark Furze, UNIS-Arctic Geology
Maurin Rosseau, M.Sc. UiB-Geography
Jonas Pedersen, M.Sc. UiB-Earth Science
Matthew Simpson, Kartverket
Halfdan Kierulf, Kartverket
Glenn Milne, University of Ottawa
Lev Tarasov, Memorial University

New Sea level report post IPCC AR6

FNs Klimapanel

Globalt kunnskapsgrunnlaget

Koordinerings ansvar

Miljø-direktoratet

Prosjektgruppen

Kartverket

Norwegian Meteorologica Institute

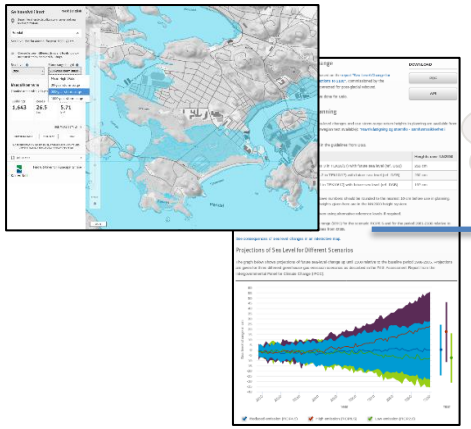
NORCE

NERSC

Kartverket

Nasjonalt kunnskapsgrunnlaget for klimatilpasning i kystsonen

Se havnivå



Veilederen

Havnivå og stormflo – samfunnssikkerhet i kommunal planlegging

dsb

Riksantikvaren

Business

NVE

Kystverket

DSB

Statens vegvesen

Kommunene

Forsikrings bransjen

Media

Forskning

Direktoratet for byggkvalitet

Folk flest

Avinor

The new geodetic observatory at Brandal, Ny-Ålesund. Stability and local tie.

The GNSS-station NABG accepted as IGS station.

Local tie report published at itrf.ign.fr

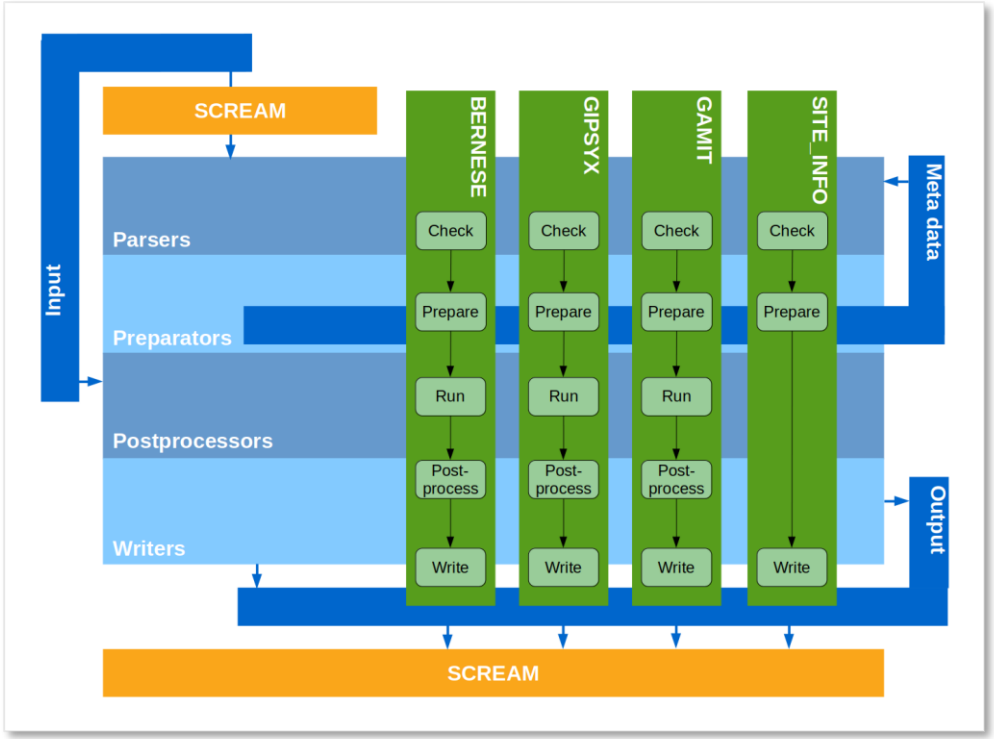
Stability has been an issue at Brandal. VLBI-telescopes and NABG have proven to be stable. DORIS seems to be OK, but further measurement necessary.

Local tie calculations in cooperation with IGN, France, using software Comp3D.

Project: Operationalization of GNSS high-presicion analysis

Goals:

- Common program which can start processing of Bernese, GipsyX and Gamit automatically by collecting necessary input files and meta data
- Automated generation of station input files by using station information from SINEX/SSC files and database information
- Automated result analyses (e.g. GNSS timeseries analysis)



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