TRAFIKVERKET

Reference network in the air 2.0

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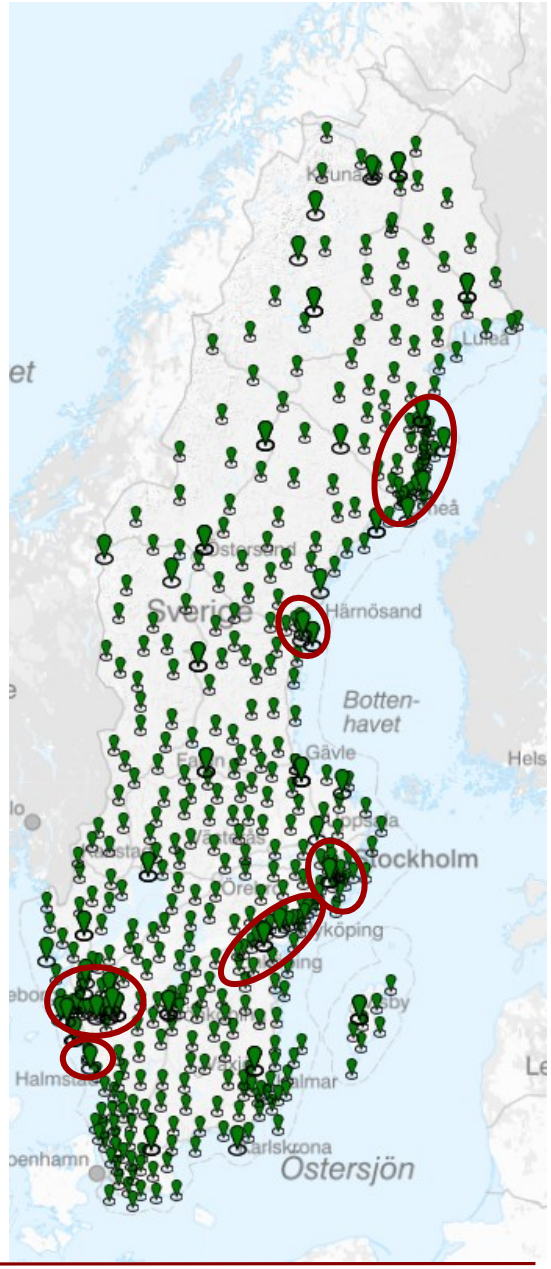
Project adapted network-RTK

- Cooperation between Trafikverket and Lantmäteriet for large infrastructure projects
- Densified SWEPOS network to 5-10 km
- Increased redundancy of the infrastructure (receivers, power supply, communication)
- Distribution of RTK-corrections with radio
- Local postprocessing service
- Increased monitoring of the services



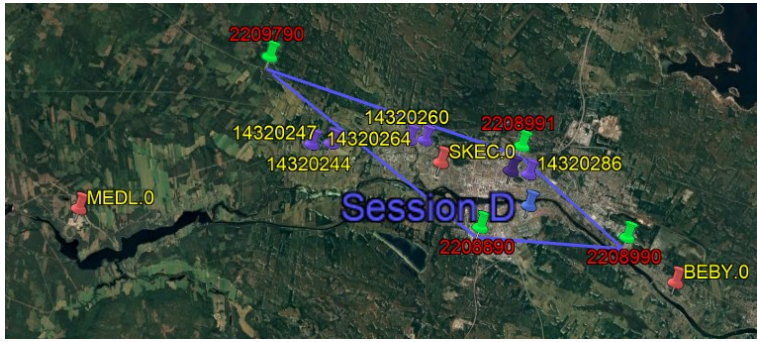
Reference network in the air 2.0

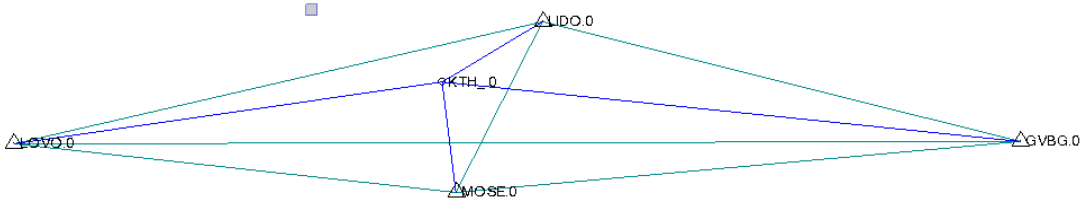
13 activities focusing on development of the project adapted network-RTK concept

1. New and developed satellite systems
2. Coordination between projects and a uniform way of working
3. Investigation of conditions for development of the post processing service for static measurements
4. Distribution of corrections for RTK measurements
5. Investigation of the influence of ionosphere disturbances at future maxima
6. Development of portals for communication and administration of the project adapted services within a project
7. Identification of jammers in project areas
8. Routines for monitoring of reference station positions
9. Investigation of optimal placement of antennas on construction machines and reference stations
10. New positioning methods
11. Positioning system for autonomous construction machines
12. Project adapted geoid models
13. Documentation and communication of results from the project

3. Investigation of conditions for development of the post processing service for static measurements

- Theoretical and practical comparison between different calculation strategies
  - Single baselines + network adjustment
  - Multistation adjustment
  - Virtual Reference Station (Postprocessing + Network-RTK)
- Theoretically similar if same data is used
- Practically some mm difference, due to settings, hidden satellites, etc.





Diff Multistation-Single baseline Skellefteå	N	E	Planar	Distance	Bearing (gon)
14320244	-0,001	0,000	0,001		
14320247	-0,002	-0,001	0,002	-0,001	0,000
14320260	0,003	-0,003	0,004		
14320264	-0,004	0,001	0,004	0,004	0,001
14320282	-0,003	-0,001	0,004		
14320286	-0,004	0,000	0,004	0,002	0,000

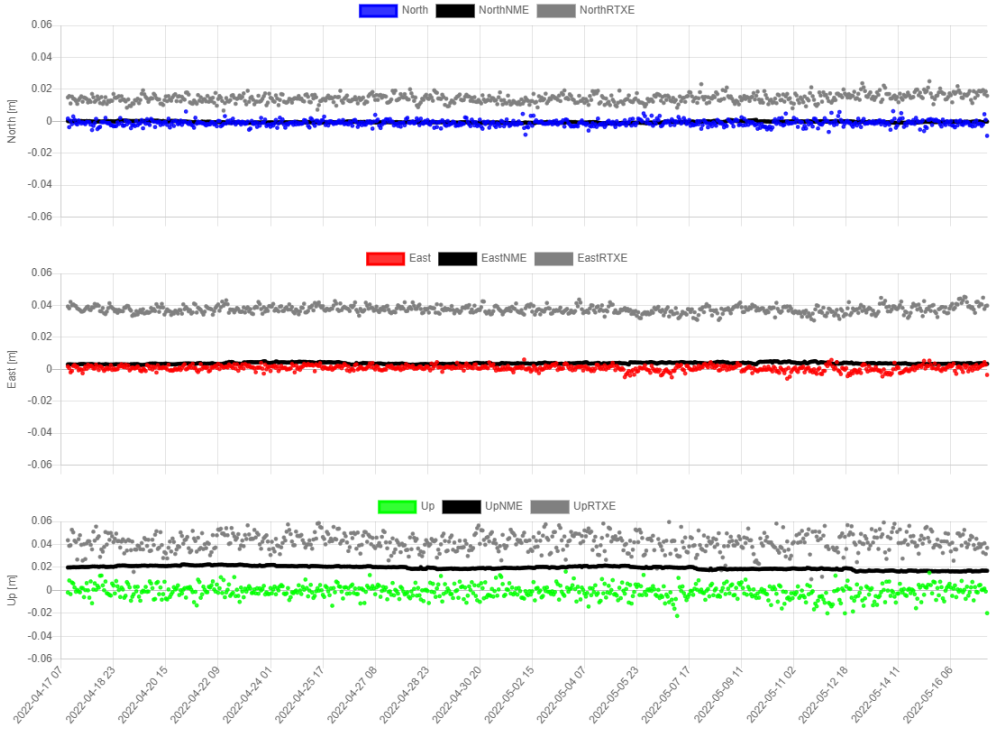
KTH 24 h	Diff N [m]	Diff E [m]	Diff H [m]
Multistation	0,000	0,001	0,000
Single basline	0,001	0,000	-0,004
VRS Postprocessing	0,000	0,000	0,001

8. Routines for monitoring of reference station positions

Black and grey show the results from the monitoring algorithms of the network RTK software.

Near Real-Time coordinates for monitoring of CORS

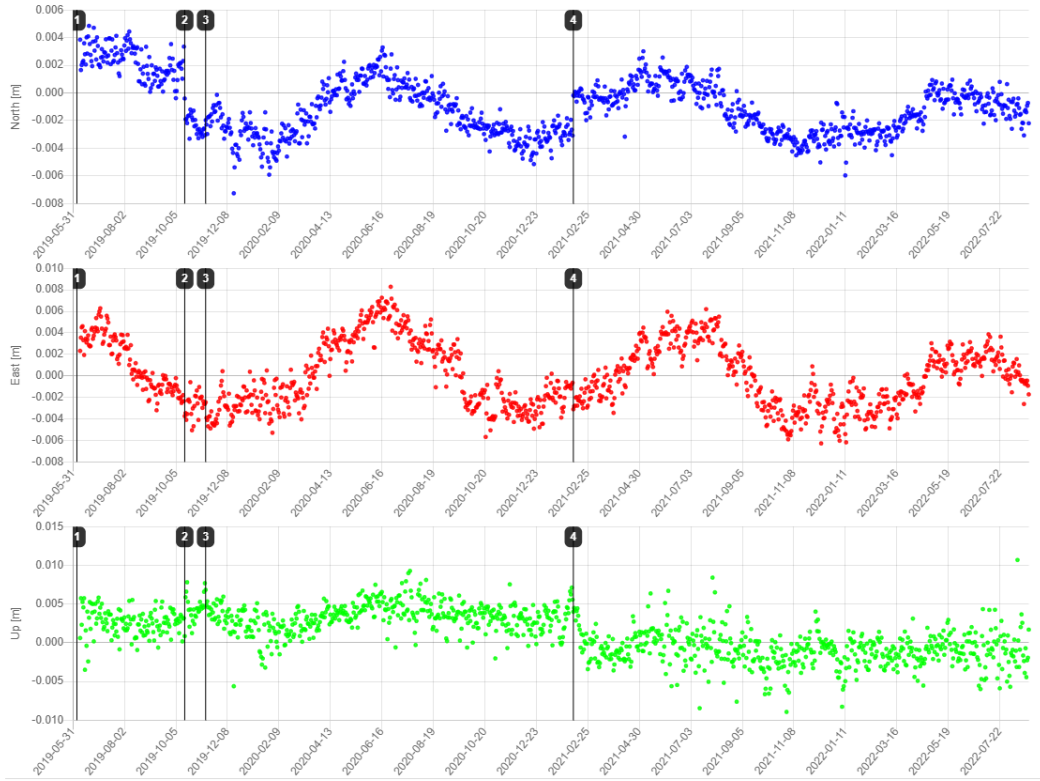
- Since late 2021, hourly coordinate sets is used for monitoring of the SWEPOS™ national CORS network
- GNSS data are processed by Bernese GNSS Software
- Displacement of the hourly coordinates wrt to the ”official” station coordinates is calculated → distributed to SWEPOS monitoring system
- An important supplement to the monitoring algorithms of the network RTK software and daily coordinate determination



8. Routines for monitoring of reference station positions

- Reviewed and updated coordinates of the SWEPOS network
- Statistic analyses of time series for detection of sudden movements, trends and annual variations
- Inclinometers to monitor movements during a day – possibly <1mm
- Daily coordinates for postprocessing
  - Coordinates not suitable – risk of introducing errors

Time series with daily solutions from station Teg from Norrbottniabanan project



10. New positioning methods

Evaluation of geometry of reference stations

- Distance to closest reference station affect the uncertainty
- Distribution of reference stations have no big impact of result due to correlated measurements to satellites
- Station offline affects uncertainty in nearby area