SWEPOS

GNSS applications in Sweden and on-going developments of the national CORS network SWEPOS™

54th meeting of CGSIC

Tampa, Florida, USA, September 8th–9th 2014

Dan Norin

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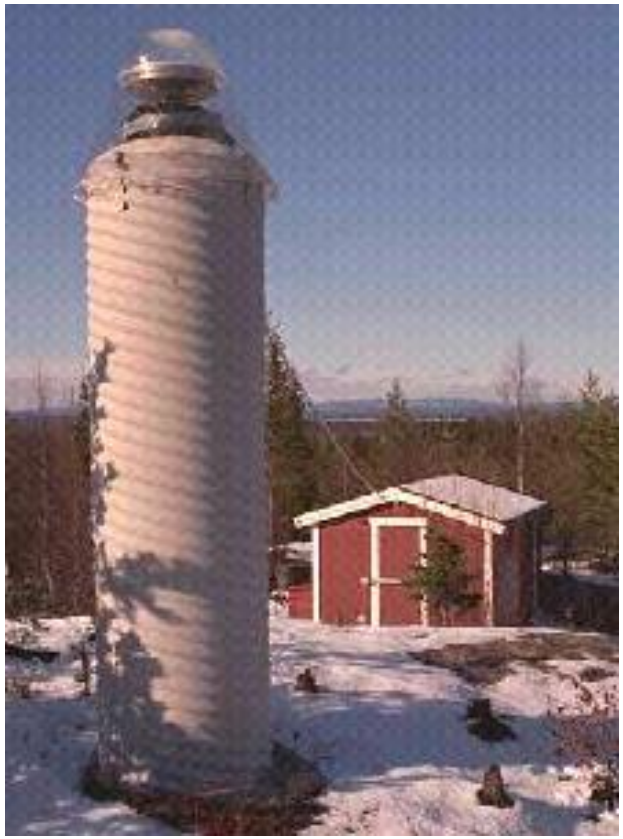

- The Swedish mapping, cadastral and land registration authority
  - Approximately 2 000 employees at around 100 offices located throughout Sweden
- Geodetic Research Department
  - Approximately 40 persons
  - SWEPOS™ and national geodetic reference frames

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Early GPS measurement in Sweden

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CORS at Onsala Space Observatory (Chalmers Technical University)

- One of eight original CIGNET (Cooperative International GPS Network) stations in 1986, later IGS station
- TI4100 receiver, about USD 100 K, could track four satellites

ONSALA RYMDOBSERVATORIUM
CHALMERS TEKNISKA HÖGSKOLA

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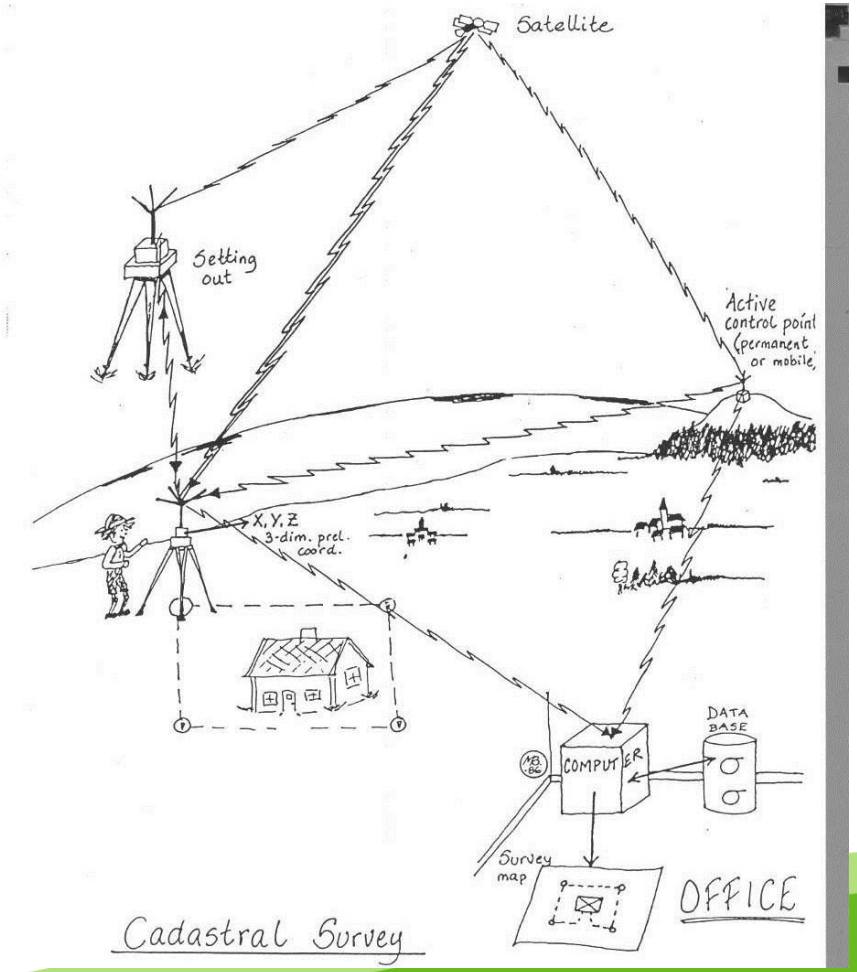
Vision for cadastral surveying from 1986



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Post-glacial land uplift

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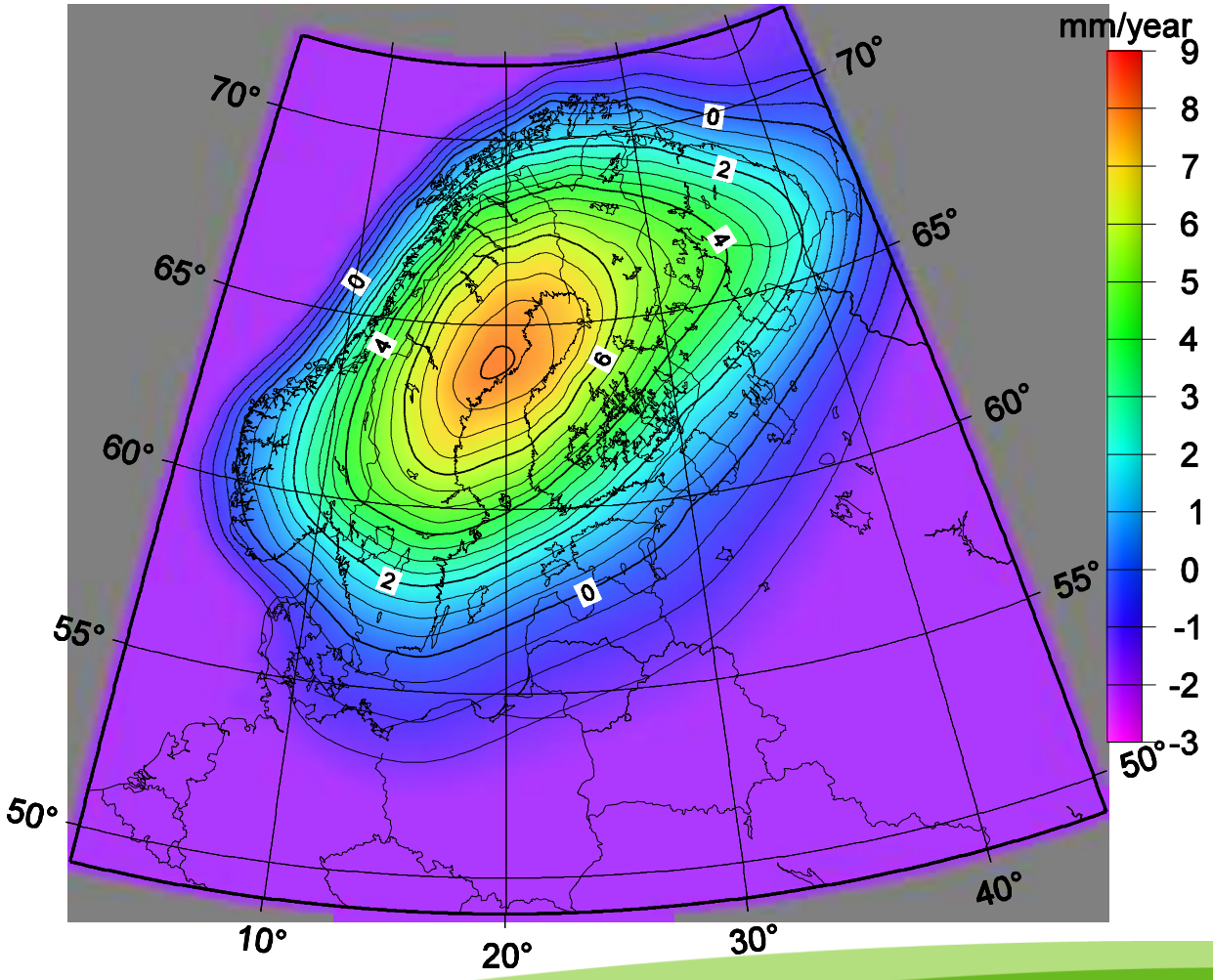
Nordic land uplift model



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BIFROST (Baseline Inferences for Fenno-scandian Rebound, Sea-level, and Tectonics)

- Purpose to use GPS to measure crustal deformation in Fennoscandia for geodynamic, sea-level, and tectonic studies
- Onsala Space Observatory in cooperation with NASA, Harvard-Smithsonian Center for Astrophysics, University of Toronto, Finnish Geodetic Institute and Lantmäteriet
- Measurements started in August 1993

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SWEPOS started in 1993

- Established by Lantmäteriet in cooperation with Onsala Space Observatory and further developed (also in cooperation with SP Technical Research Institute of Sweden, governmental organisations and municipalities)

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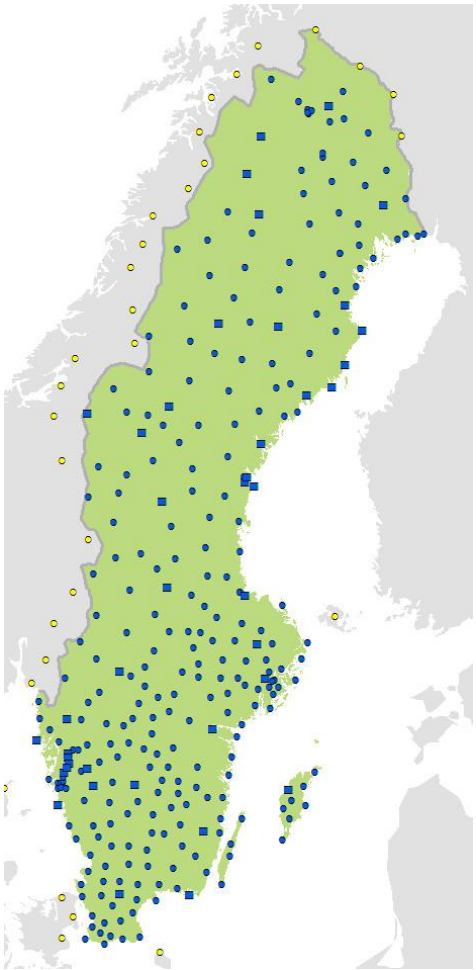
SWEPOS today



- 307 reference stations
- 5 IGS stations and 3 MGEX stations
- All antennas of DM choke ring design

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SWEPOS – Purposes

- GNSS raw data for post-processing
- DGNSS and RTK corrections
- High-precision control points, a tool for connection to the national reference system SWEREF 99
- Scientific studies of crustal motion and meteorological applications
- Monitor the integrity of the GNSS systems

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SWEPOS – Infrastructure

- Data lines: 0.5 mbit ADSL with a 24/7 service. Redundant wireless communication to about half of the stations
- GNSS receivers
  - Trimble Net R9
  - Leica 1200 GNSS
  - Javad Delta
  - Javad Sigma
- Trimble Pivot Platform TPP for network RTK
- FTP for RINEX access
- Tape archive containing all SWEPOS data from the beginning

SWEPOS – control centre

- Opening hours
  - Weekdays 06:30 to 20:30
  - Weekends/night: on call duty
- Surveillance of CORS /GNSS-stations, data communication, electricity and backup power, temperature.
- Customer support
- Problem solving
- Quality control of data

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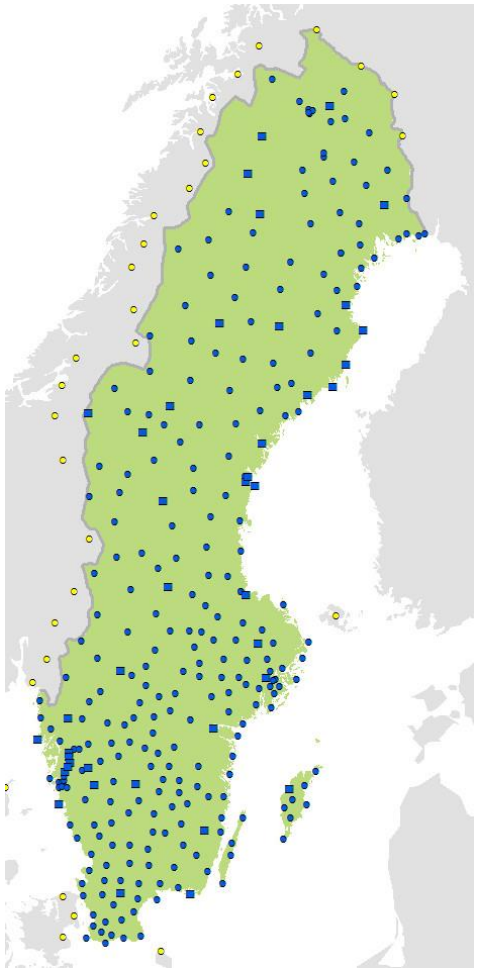
SWEPOS – services



- Post processing data (RINEX-data)
  - Virtual RINEX-data
- SWEPOS Automatic processing service
- Real time services
  - Network DGNSS service
  - Network RTK service
- SWEPOS-website
  - Coordinate transformation
  - Satellite prediction
  - Monitor stations
  - Ionospheric monitor

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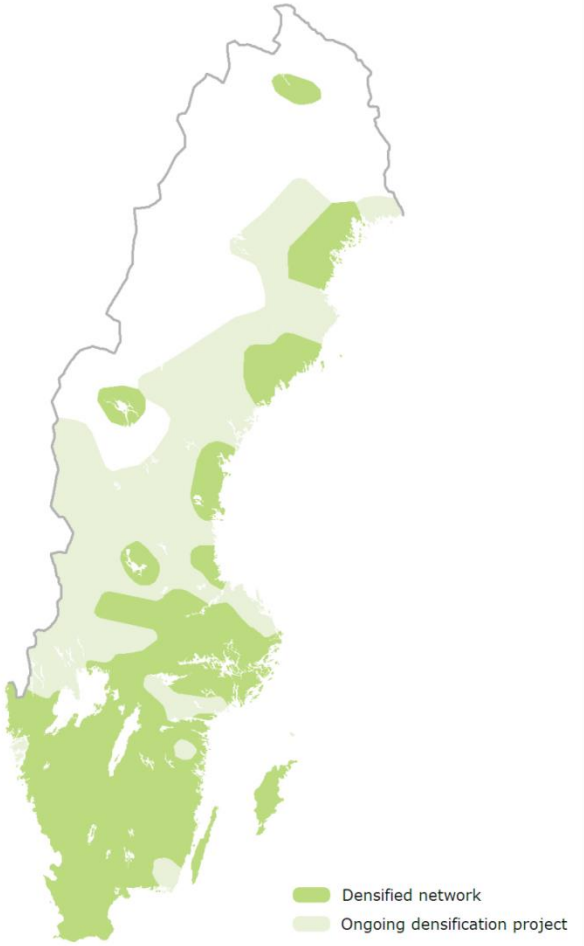
Densification of SWEPOS since 2011



- Lower uncertainty, especially in the vertical position
- Improved redundancy
- Improved modelling of the ionosphere and troposphere
- Further improvements with new satellite signals and systems

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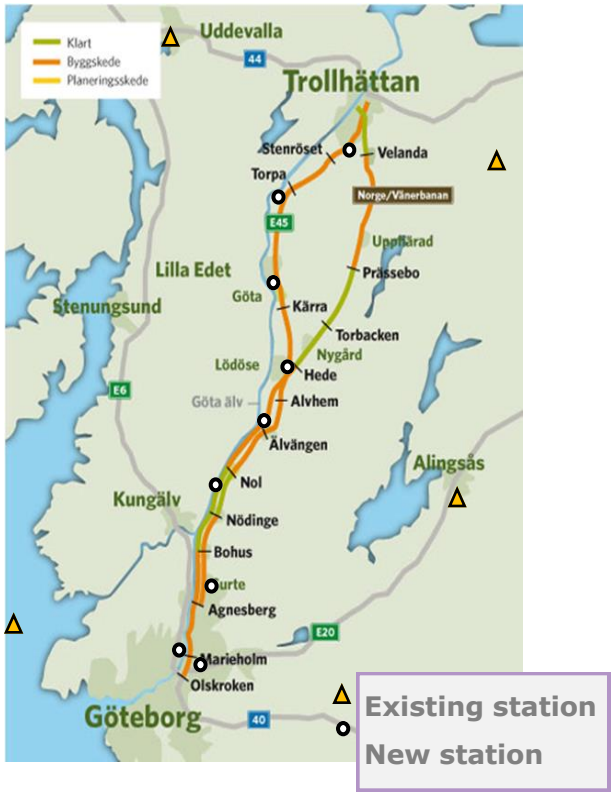
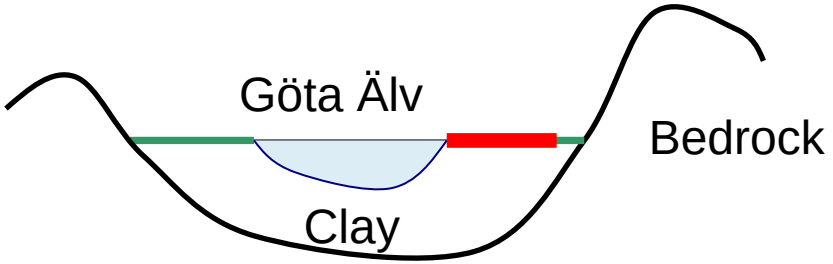
Example of adapted SWEPOS for large-scale infrastructure projects (2003-2013)



- 75 km new railway and highway with many bridges and a new tunnel
- 9 new SWEPOS stations (≤ 12 km) and 9 fixed VRS locations with distribution through radio link
- 4 monitoring stations
- Only limited passive control points



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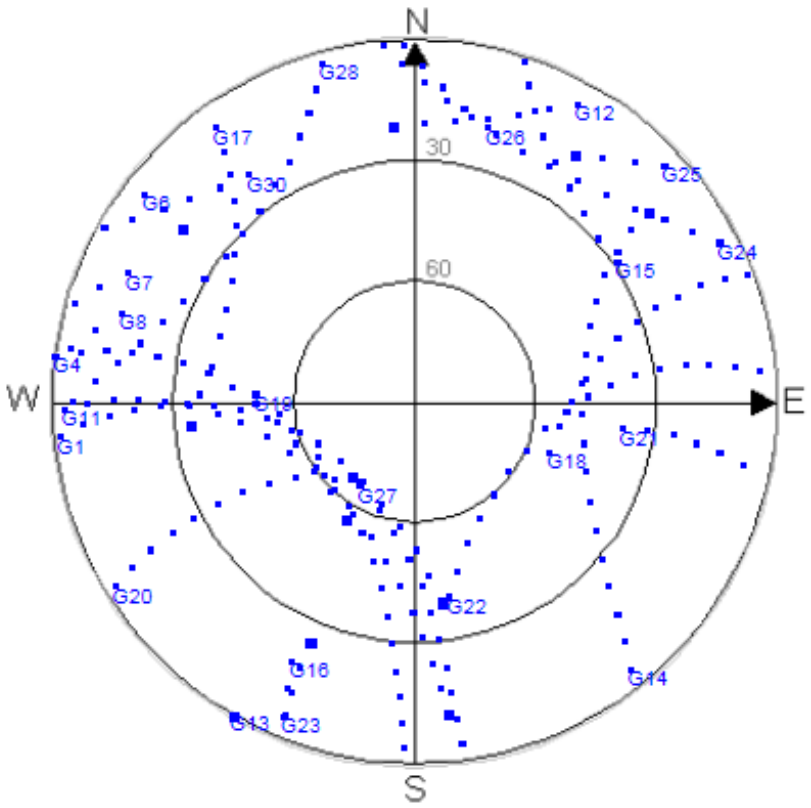
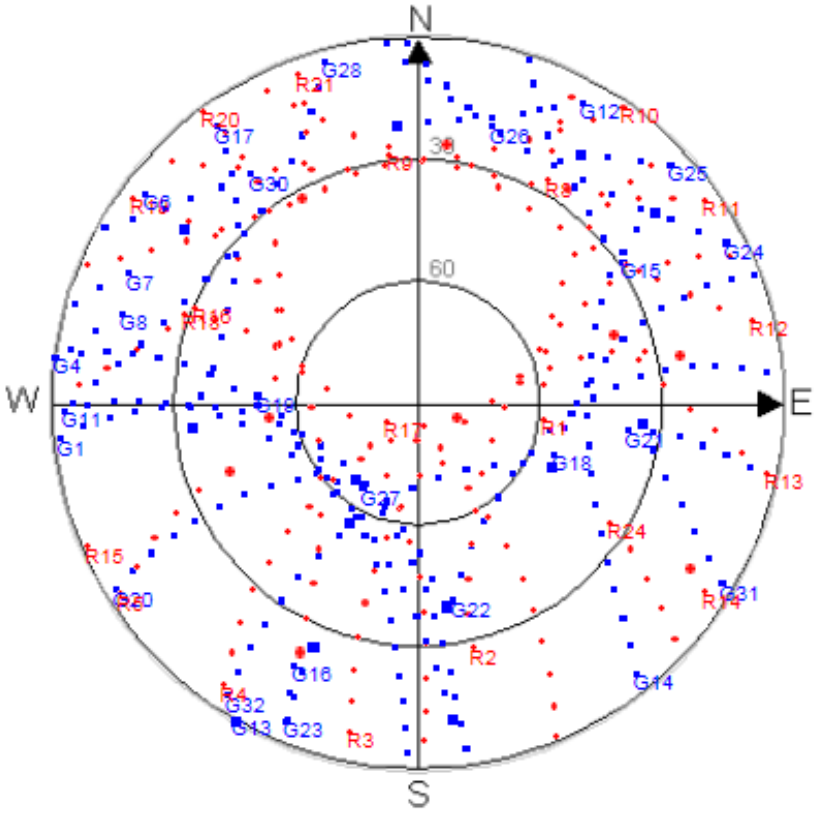
Sky plot for Kiruna (68°N)

GPS = G



GPS = G GLONASS = R



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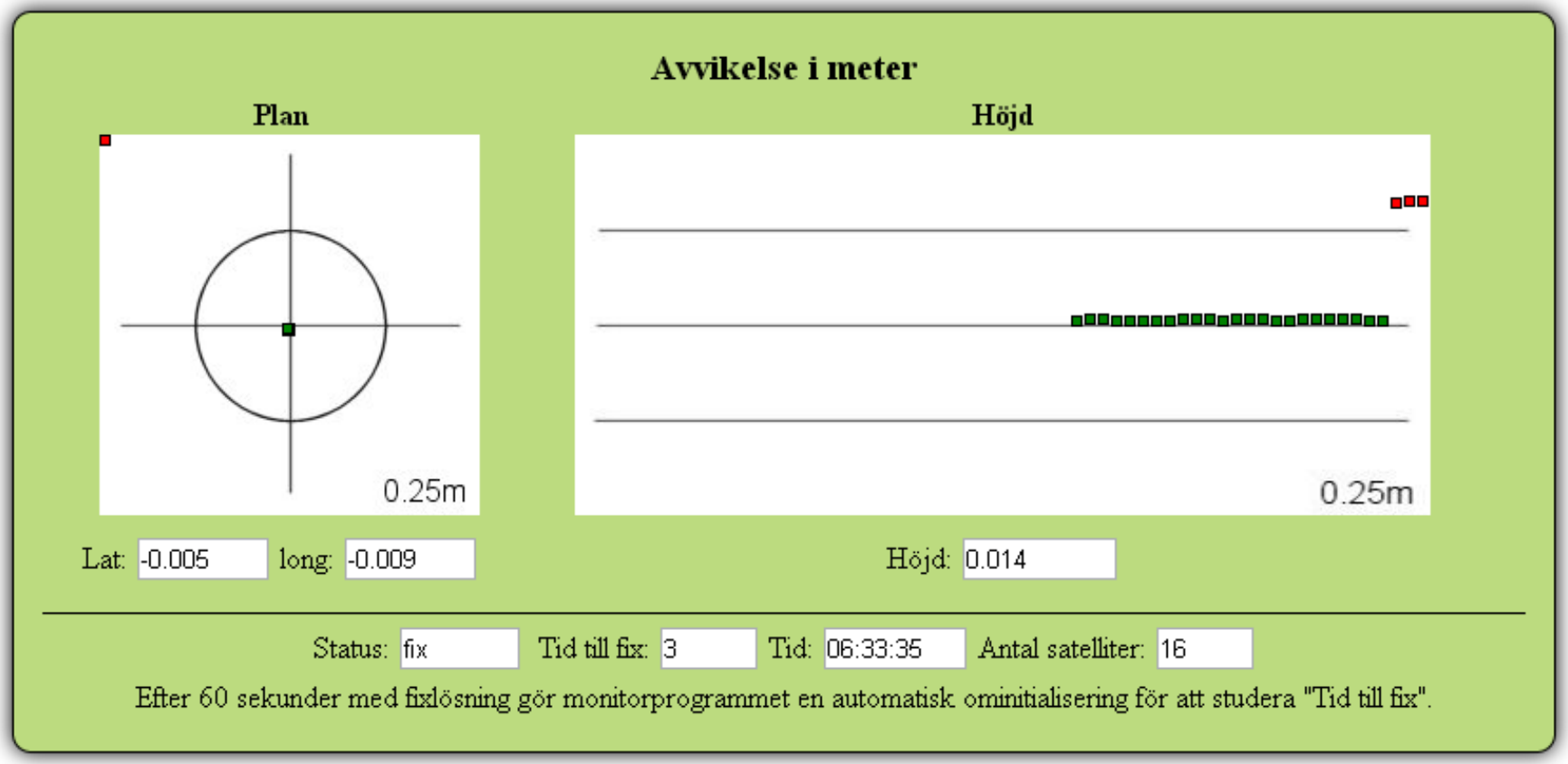
SWEPOS monitoring stations



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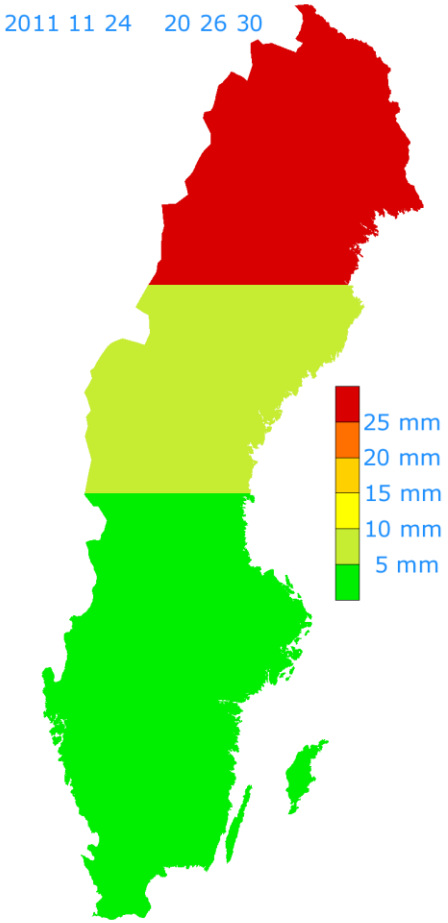
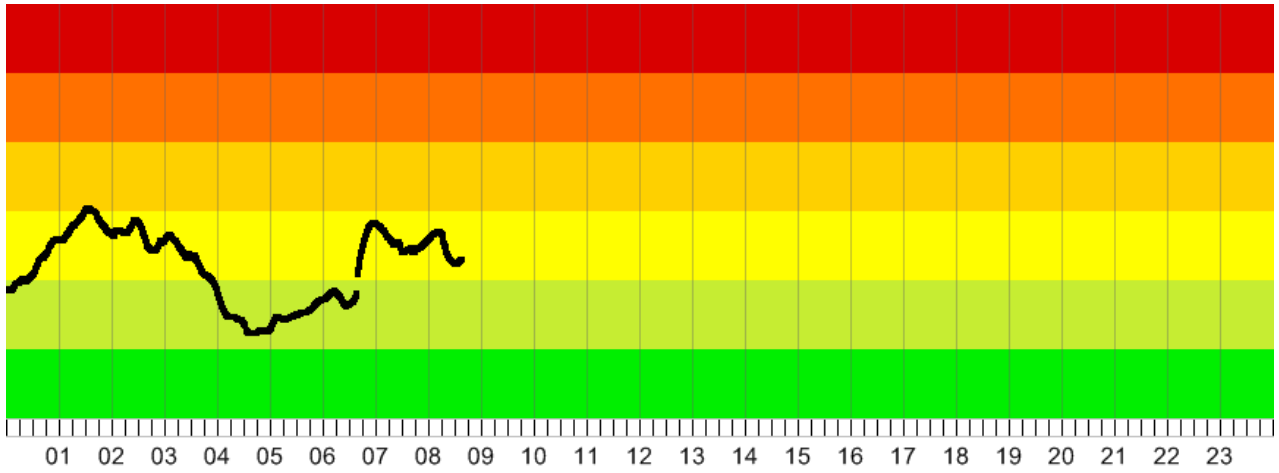
SWEPOS ionospheric monitor





ANDROID APP ON Google play

Available on the App Store

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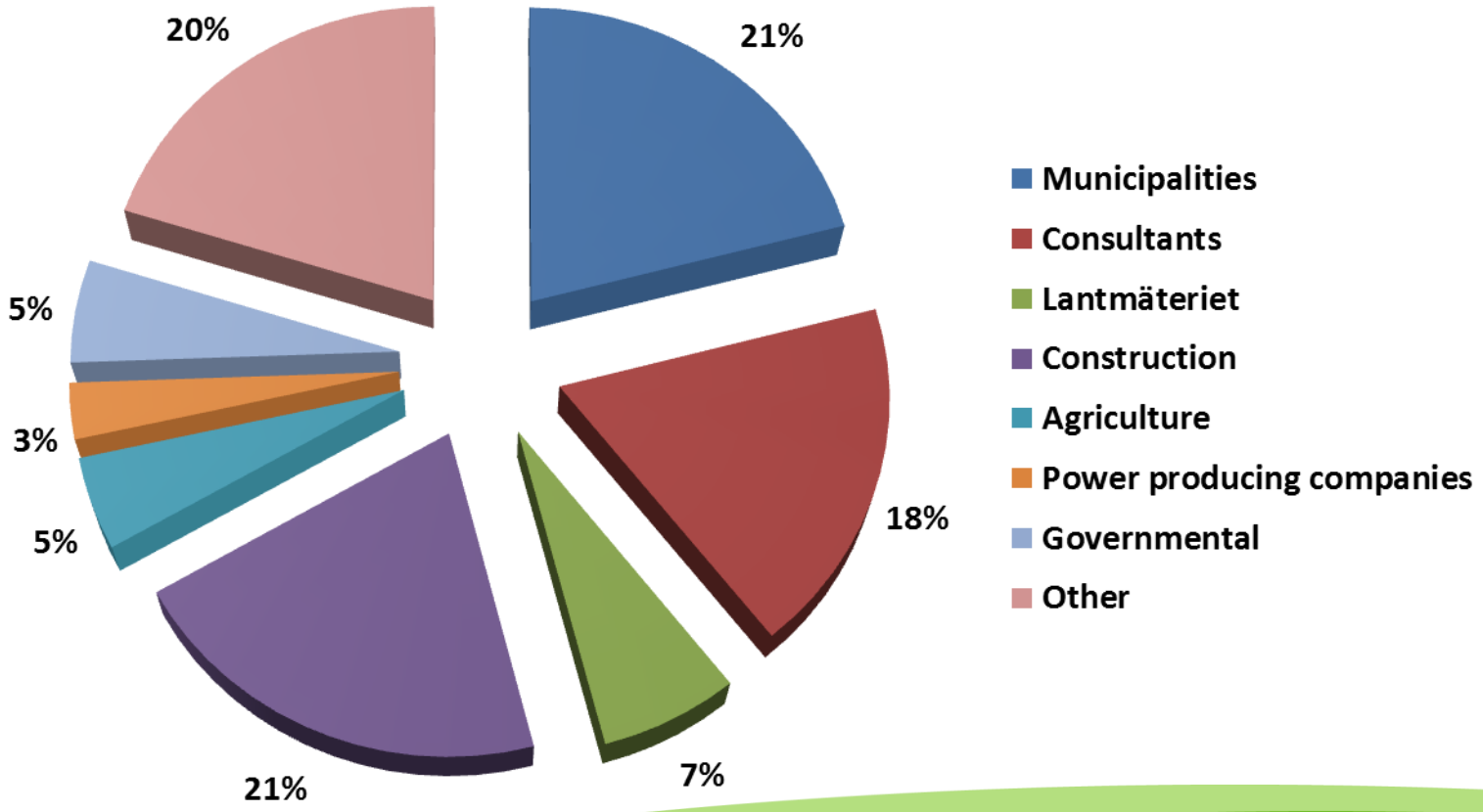
Users of SWEPOS Network RTK Service, totally 2400 subscriptions



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Partners

- Cooperation with Trimble VRS NOW, Leica SmartNet and Topcon TopNET live to increase the use of SWEPOS data
- To find new applications and widen the use of GNSS
- Use of one common geodetic infrastructure for GNSS, all users contribute to a common infrastructure. The users do not need to finance several separate geodetic infrastructures

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Future studies in cooperation with SP Technical Research Institute of Sweden

- Make a comparison between VRS, MAC and PPP with SWEPOS as infrastructure, to be able to meet future demands from the user community and new applications
- Improve CORS installation knowledge
- Guidelines on antenna calibration measurements analysis
- Improved user (rover) guidelines (Best Practise)
- Implement redundant IT systems

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Mapping and update of geographical databases

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Building and construction, setting out

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Documentation of sewer systems and cables etc.

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Documentation of sewer systems and cables etc.

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Cadastral surveying

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Machine guidance

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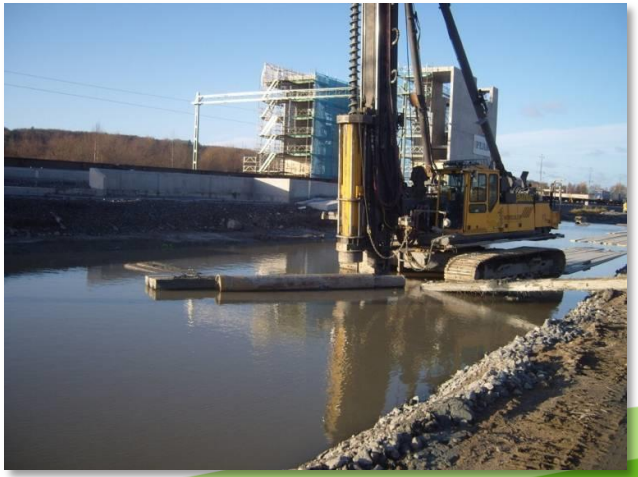
Machine guidance



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Agriculture applications (precision farming)

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Marine applications

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Aerial photography – establishment of control points for aerial photography

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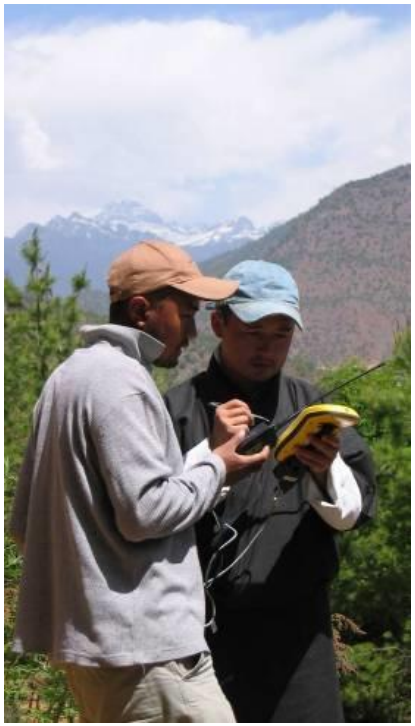
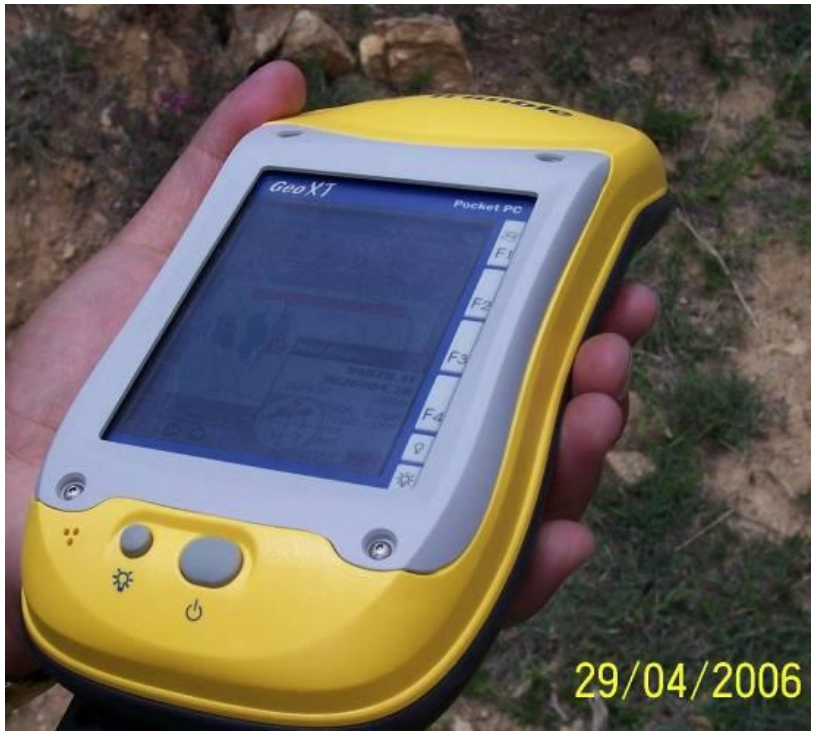
Surveying with DGNSS





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Geodesy 2010

- The Swedish strategic plan for Lantmäteriet's geodetic activities 2011–2020
- The vision is to be able to meet Swedish society's needs for a homogeneous, sustainable national geodetic infrastructure and to guarantee its availability and use

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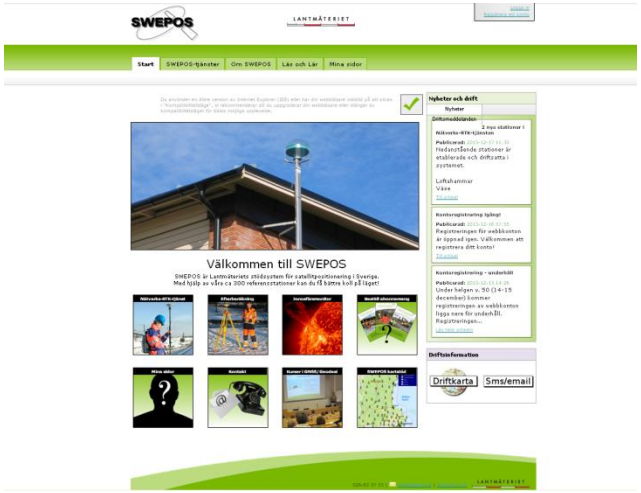
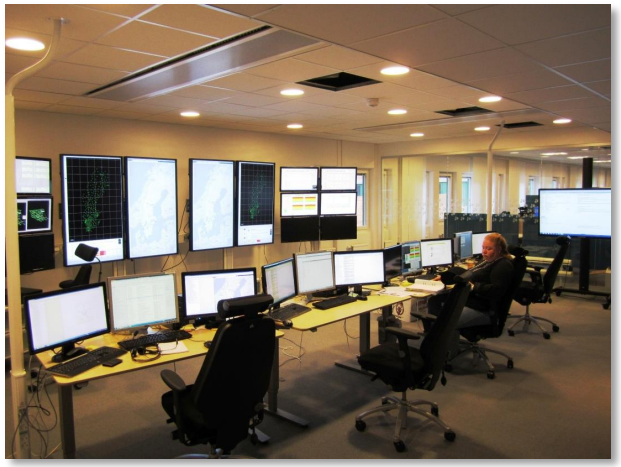
Information

Broschures etc.



www.lantmateriet.se
www.swepos.se



SWEPOS Control Centre
swepos@lm.se

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Questions?

Thank you for your attention!

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