Geodetic activities at the National Land Survey of Sweden

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1. Introduction

At the National Land Survey of Sweden the activity in the field of reference frames and reference networks is focused on a new certified ETRS 89 realisation in Sweden, the ongoing projects RIX 95, SWEPOS, the third precise levelling, and projects towards network RTK services.

2. New ETRS 89 realisation

SWEREF 93 has been used as the Swedish EUREF realisation since 1994. SWEREF 93 is aligned to EUREF by a fit to the original EUREF 89 campaign and has until now mainly been used for intermediate steps in GPS processing. We have now decided to upgrade SWEREF according to the EUREF guidelines, and then introduce it as our official national reference system.

The primary demand on the new Swedish ETRS 89 is that it should be accurate, homogeneous and consistent with normal GPS processing, so that an ordinary GPS user not will run into problems due to the reference system. The new Swedish ETRS 89 should also agree as well as possible with the ETRS 89 realisations used in our neighbouring countries – Denmark, Norway and Finland. It might also be an advantage if the new Swedish ETRS 89 has a specific epoch. This is important as we later on intend to model movements in the crust (e.g. land uplift) within Sweden to increase the lifetime of our new reference frame.

Since the new ETRS 89 realisation will be used as our official national reference frame, we need also an official map projection. The map projection is not just a question for geodesists. It has to be handled and decided by a wide group with representatives from different kind of users.

3. RIX 95

Since 1995, a project involving GPS measurements on triangulation stations (RIX 95) has been in operation. This is supported by a group of authorities as the National Railway Administration, the National Road Administration, the National Maritime Administration, the Telecommunications Administration, the Swedish Defence and the Association of Local Authorities. The principal aims are to establish transformation formulas between local co-ordinate systems and the national reference system, and to establish new points easily accessible for local GPS measurements. The project is to go on for 10 years; each year about 400 triangulation stations and 550 new points are measured.

4. SWEPOS

Since 1 July 1998 the Swedish network of permanent reference stations, SWEPOS, is operational in IOC mode, i. e. positioning in real time on the meter level and by post-processing on the centimetre level. Future plans are positioning in real-time on the centimetre/decimetre level.

The purpose of SWEPOS is to:

- provide single- and dual-frequency data for relative GPS measurements.
- provide DGPS corrections and RTK data for broadcasting to real-time users.
- act as high precision control points for Swedish GPS users.
- provide data for geophysical research.
- monitor the integrity of the GPS system.

Twenty-one of the SWEPOS-stations are full stations i. e. they are monumented on bedrock and have redundant equipment for GNSS-observations, communications, power supply etc. and four stations are "simple" i. e. the are located on top of buildings and with less redundant equipment. The simple stations are used to improve real time services.

All the SWEPOS stations have real time connections to the control centre in Gävle through TCP/IP connections.

To investigate the conditions for a national service for real-time positioning on the centimetre/decimetre level, National Land Survey, Onsala Space Observatory and Teracom have decided to co-operate in a project called NeW-RTK (NetWork RTK). The plans are to study the conditions for such a service with respect to the modelling of atmospheric effects and multipath errors, predicted orbit information, the DARC channel on the FM-Radio network and the SWEPOS network.

In a Nordic co-operation, steps towards a Nordic positioning service have been taken.

Currently single station RTK-data is distributed on DARC channel on the FM-radio network from seven SWEPOS-stations.

The SWEPOS-stations Onsala, Visby, Mårtsbo, Vilhelmina and Kiruna are included in the permanent EUREF network. Onsala and Kiruna are also included in the IGS network.

5. Third Precise Levelling of Sweden

The third precise levelling of Sweden is progressing according to plan. The project started in 1979 and the levellings are planned to be finished in the few coming years. We only have a few connections to Norway left to level. The main production work this season is towards relevelling lines where the levelling data is not believed to have the same high quality as in the rest of the net.

The final network will consist of about 50 000 bench marks representing roughly 50 000 km double run precise levelling.

The motorised levelling technique is used for the project.

Maintenance in 1999 of the primary height network was done in southern Sweden during the spring time according to plan and approximately 300 km was levelled. The reason for this is the fact that ½ - 1 % of the bench marks are destroyed every year. There will be no maintenance this year in the same way as the last years since our efforts will be put in the levelling of weaker parts of the net.

Preparation for the computation of a new height system has started. Most effort has so far been put on finding gross errors in the observations. Next step is to study possible systematic errors. The work to build up more knowledge on the more theoretical aspects of a new height system is going on.

6. Geodesy 2000

A program for geodetic activities in Sweden for the first decade of the 21st century is currently in preparation.

References

Jivall Lotti: An updated EUREF realisation for Sweden. Presented at the EUREF meeting in Tromsø, Norway 2000-06-22-24.