Swedish municipalities implementing the new national height system RH 2000

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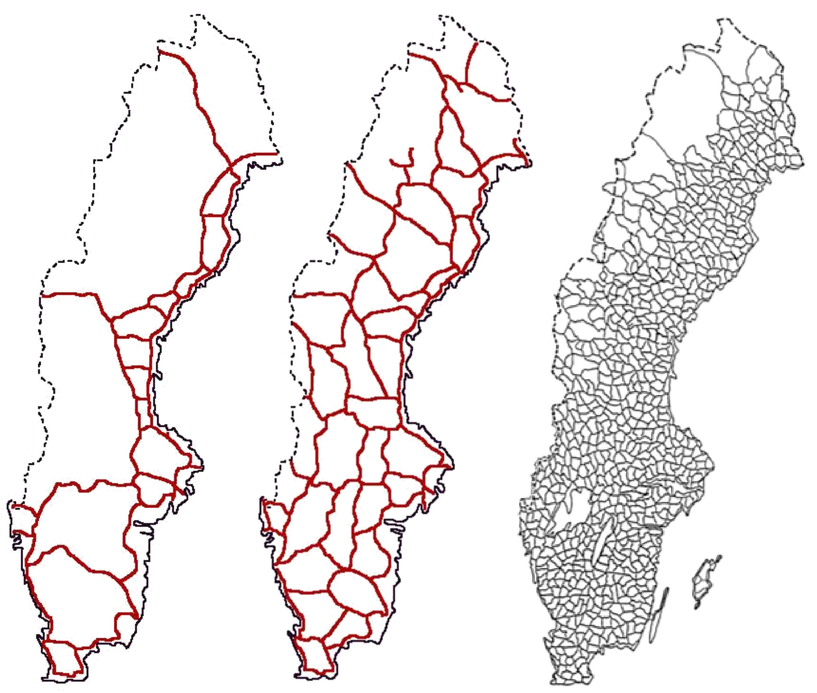
Sweden consists of some 300 municipalities, all of them more or less having used their own unique height system. The transition from these local height systems to the new national height system, RH 2000, is now going on. Around 50% of the municipalities have already started to use the national height system also locally, to make more efficient use of GNSS in their own organisation and to harmonise their data with the existing regional and national data. Lantmäteriet can provide readjustment of the old local levelling networks in the new national RH 2000 frame, possibly with some supplementary measurements accomplished by the municipality.

Here we describe this transition process, seen in the light of the municipalities being self-governing to a large extent and Lantmäteriet, the national geodetic authority, only having an advisory role.

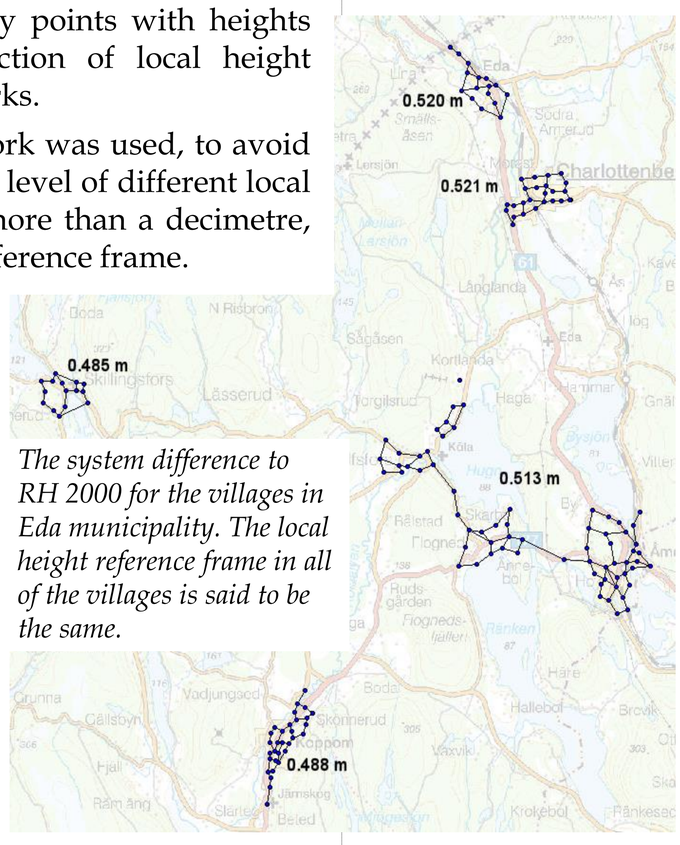
Background

The first height control networks for municipalities were established in the beginning of the last century and most of them were in a very weak way connected to the national network available.

- National precise levelling networks were not sufficiently dense, and were densified by primary and secondary levelling lines of much lower accuracy.
- The benchmarks of the densification lines were the only points with heights available, so they were nevertheless used for connection of local height networks, causing distortions of many local height networks.
- In some cases, only one benchmark of the national network was used, to avoid distortion of the local network, leading to the fact that the level of different local height networks can differ by a few centimetres up to more than a decimetre, even though they are said to be established in the same reference frame.



From left to right: The first (1886-1905), second (1951-1967) and third (1979-2001) precise levelling networks, respectively.



The system difference to RH 2000 for the villages in Eda municipality. The local height reference frame in all of the villages is said to be the same.

The third precise levelling

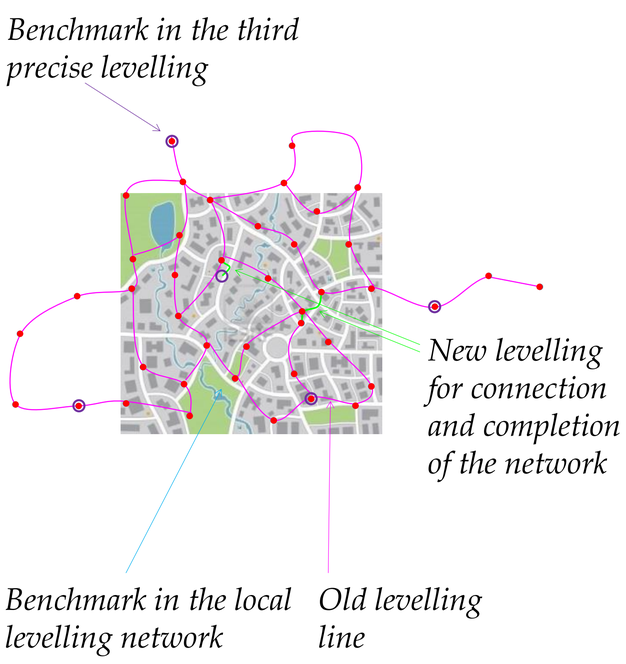
The dense third precise levelling network was a prerequisite to start the transition to the new national height system also on local level.

The aim of the third precise levelling was to create a network covering the whole country, dense enough to allow all local users to connect their measurements to easily accessible benchmarks.

Preferred method for transition

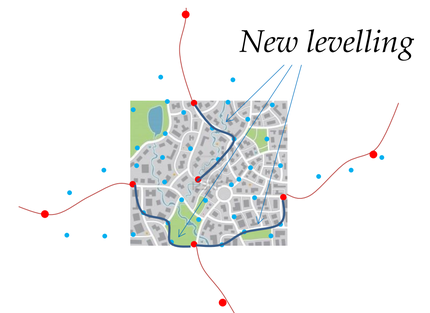
The levelling data of the local height networks are normally of high accuracy, also in older networks, why readjustment of old data using RH 2000 heights from the third precise levelling as fixed, is the method recommended in the first place.

- Listing of levelling data in given format, by the municipality. Local heights and coordinates of the local benchmarks are also required.
- The network is drawn on a map to facilitate the search for gross errors.
- Lantmäteriet finds out which benchmarks of the local network are common with third precise levelling benchmarks, or where supplementary connection points are needed.
- The network is readjusted, using the RH 2000 heights from the third precise levelling as fixed.

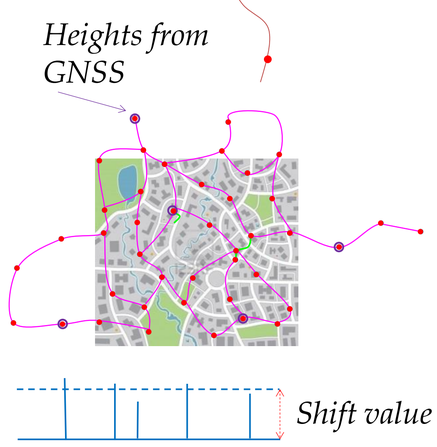


Alternative methods

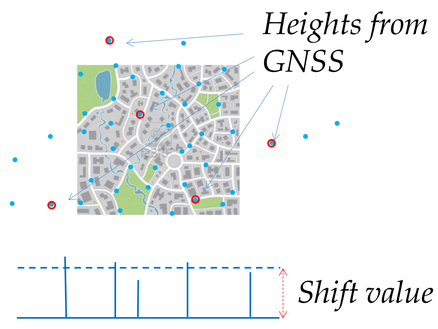
- If no local levelling data, but national precise levelling is available: Level loops of local benchmarks to obtain a number of RH 2000 heights, and a system difference for other data.



- If national precise levelling is not available: Survey local benchmarks by GNSS to obtain absolute RH 2000 position, and adjust the old levelling data with minimal constraints.



- If neither local levelling data, nor national precise levelling is available: Obtain RH 2000 heights by GNSS for a number of local benchmarks, to get system difference, for transformation of height data only.



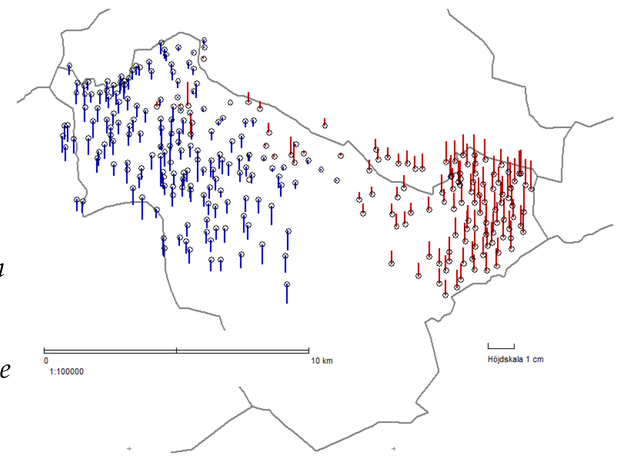
Comparison of heights

The new RH 2000 heights of the local network are compared to the old local heights.

- A clear view of the distortions of the local height system is obtained.
- An average system difference – translation – between RH 2000 and the local system can be computed, for transformation of other height data than the high quality benchmarks.

One translation can be used for the whole network or municipality or – if the distortions are large – separate translations can be computed for different areas.

The vectors show the deviation of each point from the average system difference. When the distortions of the local height system became clear, two different translations were computed – one for the western part and one for the eastern part.



Concluding remarks

- By analysing the local height system, a good knowledge of existing deficiencies is obtained
- Transition to RH 2000 gives further advantages
  - Same height reference in all parts of the municipality
  - Decreased risk of mixing different height systems
  - Data in a well-known high quality reference frame is more attractive to external users
  - Data exchange between users/producers is facilitated
  - Opportunity to use GNSS technology – in combination with national geoid model – for a wider range of applications
- Information activities are crucial

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