# **National Report of the Netherlands**

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# **Redefinition of the Reference Systems of the Netherlands**

Last year we have reported at the EUREF meeting on the introduction of ETRS89 and the corresponding changes of the national horizontal (RD) and vertical system (NAP), see [Buren, J. van et al. 2000] and figure 1.



Differences between the existing horizontal coordinates and ETRS89-coordinates in the same map-projection. Notice the strong regional correlation. The sizes of the vectors do not exceed 25 cm. All differences are within the criteria for the existing coordinates.



Distribution of differences between the existing heights of NAP benchmarks and the heights derived from the 5th Primary Levelling (Amsterdam fixed). The differences vary between minus 3 cm (West coast) and plus 2 cm (East border with Germany). The red arrow shows the effect of a correction for land subsidence to the former computation base in Amsterdam.

# Figure 1: Part of the poster of the EUREF 2000 symposium

The results of the 5<sup>th</sup> primary levelling campaign are ready to be sent to the European data centre. Corresponding changes of regular NAP benchmark heights and publication of a new geoid model for the Netherlands have been delayed and are now expected by January 2002.

### Securing access to the national reference system by validating GPS-services

In previous years, the Dutch national reference frames have been updated to provide a link with the European reference system (ETRS89) and to facilitate GPS-measurements. We have reported on this at the EUREF-meetings in 1999 and 2000 [Molendijk, R. et al. (1999), Buren, J. van et al. (2000)]. Currently, the use of GPS for surveying is increasing. Moreover, a number of parties is considering to implement a nation-wide GPS-RTK reference network. This would lead to a further increase in the use of GPS-RTK. This years national report focuses on how these GPS-networks will be embedded in the national geometric infrastructure and on how every-day users can establish a link with the national and European reference systems.

# GPS networks in the Netherlands

Currently four types of active GPS networks are operational in the Netherlands (cf. figure 3):

- Active GPS Reference System of the Netherlands (www.agrs.nl). This network consists of five stations (four of which are IGS / EUREF-stations) and is operated by the Survey Department of Rijkswaterstaat and the Kadaster. The AGRS.NL is used to maintain ETRS89 in the Netherlands (since 2000 the official (3D-) reference system of the Netherlands) and the (derived) national triangulation network (RD-system). Furthermore, it is used to monitor long-term stability of the Netherlands' reference frame including the Amsterdam Ordnance Datum (NAP). AGRS-GPS-data can be downloaded by its subscribers for postprocessing.
- 2. Commercially operated local reference networks for GPS-RTK positioning. These networks are primarily operated in the western, densely populated part of the Netherlands for general surveying purposes. Currently various private parties are investigating the prospects for a nationwide network using virtual reference station methodology.
- 3. Project oriented networks for the construction of e.g. high-speed railway lines. These networks are set up primarily for the construction contractors for temporary use.
- 4. Networks for dedicated tasks in the management of waterways and estuaries. These networks are meant primarily for maintenance tasks and are operated by the Ministry of Transport, Public Works and Water Management.

## Policy on GPS validation

It is foreseen that in the near future a number of GPS-RTK networks (local and/or national) will become operational. The official survey agencies in the Netherlands (the Kadaster and the Survey Department of Rijkswaterstaat) have chosen not to operate GPS-RTK networks themselves. The government policy is to provide a basic, high-quality and secured access to the national geometric infrastructure. Services based on this infrastructure are to be provided by industry on a commercial basis. Government agencies will only consider operating GPS-RTK networks if the initiatives by industry are not commercially viable or not available in certain regions.

Given this policy, the Survey Department and the Kadaster have embarked on a policy of validating the GPS-RTK service providers (see figure 2). As a result, users will have a sufficient degree of certainty that they can connect properly to the national reference systems (RD and NAP) and ETRS89. Validation is a service directed to the users (customers) of the GPS service providers. Validation is executed on a voluntary basis; there is no legal obligation to validate. The Survey Department and the Kadaster operate this service based on their mandate to facilitate access to and maintain the national geometric infrastructure. By executing the validation as transparently as possible, we think the validation service will prove itself and will be accepted by the users of GPS-services as a quality assurance.



Figure 2: Roles of parties in the GPS network validation process



Figure 3: Overview of active GPS reference stations in the Netherlands (January 2001).

## **GPS** network validation

For the time being the validation process consists of a validation of the system and its individual stations. Basically validation will consist of three steps:

- 1. Validation of the system and its stations. This step is aimed at the hardware. The stations, receivers and antennae have to fulfil certain aspects of stability, accessibility and duration of service. (See for example also the NGS Cooperative CORS details at [3]).
- 2. Determination of the station coordinates. This is a crucial step in embedding the network stations in the national reference system. The station coordinates are determined by processing three days of data in a network solution using the Active GPS Reference System (AGRS.NL). In this step also some basic quality checks on the (RINEX) data will be performed.
- 3. Publication of the validated stations (and networks) on the internet-site for the national geometric infrastructure (www.rdnap.nl). This site will serve as a catalogue of GPS-services.

The validation is valid for one year. After one year at least the coordinate determination has to be repeated.

In the future we think a more active validation is possible by monitoring the systems in (near-)real-time. This option could be of interest to the GPS-service providers. The validation of the GPS-services has not been considered (e.g. fees, access, type of GPS-service). The validation is focused on maintaining the integrity of the GPS-positioning with respect to the existing geometric infrastructure.

### References

- [1] Molendijk, R., G. Van Willigen, J. van Buren, M. Salzmann, H. van der Marel (1999). National report of the Netherlands. In: Proceedings of the EUREF Symposium held in Prague, June 2-5. Heft 60 of the Astronomische Geodätische Arbeiten, Veröffentlichungen der Bayrischen Kommission für die internationale Erdmessung, München, 1999.
- [2] Buren J van, H. van der Marel, R. Molendijk (2000). Redefinition of the Reference Systems of the Netherlands, poster presented at the EUREF Symposium held in Tromsö, June 22-24
- [3] www.ngs.noaa.gov/CORS/Coop/Coop\_details.html

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