National Report of the Netherlands

In the Netherlands, activities of the following organisations are related to EUREF:

Delft University of Technology

contact: HANS VAN DER MAREL (H.vanderMarel@ geo.tudelft.nl)

Cadastre

The Triangulation Department of the Cadastre is by law responsible for the horizontal control network (Rijksdriehoeksmeting, RD) of the Netherlands.

contact: MARTIN SALZMANN (Martin.Salzmann@kadaster.nl)

JOOP VAN BUREN (Joop.vanBuren@kadaster.nl)

<u>RWS Survey Department</u> (Ministry of Transport, Public Works and Water Management)

The Survey Department of Rijkswaterstaat is responsible for the vertical datum (Amsterdam Ordnance datum, NAP) in the Netherlands.

contact: GERT VAN WILLIGEN (G.W.vWilligen@mdi.rws.minvenw.nl)

RONALD MOLENDIJK (R.E.Molendijk@mdi.rws.minvenw.nl)

Topographic Service (Ministry of Defense)

For many years, the Topographic Service (TDN) has produced the official maps of the Netherlands. As National Mapping Agency the TDN is represented in CERCO. The Cadastre and the Survey department of Rijkswaterstaat as "National Survey Agencies" are together responsible for the implementation of ETRS89 in the Netherlands. At the same time they are, in close cooperation with the Delft University of Technology, responsible for the exploitation of the Dutch permanent GPS network AGRS.NL.

All mentioned organisations coordinate their activities in a sub-commission of the Netherlands Geodetic Commission, member of the Royal Netherlands Academy of Arts and Sciences KNAW (www.ncg.knaw.nl)

The following activities in the past year should be mentioned:

Redefinition of the horizontal coordinate system RD – The RD-system is now based on ETRS89 through the stations of the Active GPS Reference System of the Netherlands (AGRS.NL) and a new transformation procedure RDNAPTRANS.

Revision of the vertical reference system, the Amsterdam Ordnance datum NAP – Land subsidence has caused a distortion in NAP heights. A corresponding revision of NAP heights has been considered and the (gravity related) definition of the NAP as height system has been examined.

The Active GPS Reference System of the Netherlands – All stations of the Dutch permanent GPS network are included in the EUREF permanent network. This year the Rogue receivers of the five AGRS.NL stations had been replaced by new TRIMBLE receivers and are working properly.

The items above has been extensively described in a separate poster and presentation: *Redefinition of the Reference Systems of the Netherlands*.

Redefinition of the Reference Systems of the Netherlands

J. V. BUREN¹, H. V. D. MAREL², R. MOLENDIJK³

Redefinition of the horizontal coordinate system

The national triangulation service (Rijksdriehoeksmeting or briefly RD) has chosen to redefine the national RDcoordinate system and to introduce ETRS89 as the official 3D-reference system of the Netherlands. The increasing use of GPS and consequently the demand for a 3D-reference and the de facto acceptance of ETRS89 have lead to this decision. The new definition of the RD-system is based on ETRS89 through the stations of the Active GPS Reference System of the Netherlands (AGRS.NL) and the transformation procedure RDNAPTRANS. This procedure takes in account the distortions of the existing RD-reference frame. The distortion model is based on the differences found in 415 GPS-points over the Netherlands. The distortions are small in magnitude (<25 cm) and show strong regional correlations.

The existing frame satisfied most users in the field of geoinformation. The GPS-community on the other hand wished a truly 3D-reference frame of the highest quality. The proposed solution is welcomed by the users of geo-information because it leaves the existing (high quality) databases unchanged, whereas the GPS-community can achieve maximum accuracy by linking up with ETRS89.

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.

The Amsterdams Ordnance datum (NAP) upto-date

During the 5th Primary Levelling campaign (1996-1999) a new, precise set of levelling, GPS and gravity data has been collected to verify the heights of the first order NAP underground benchmarks. Comparison with older data confirmed the suspicion of significant distortions due to e.g. land subsidence.

Two problems had to be solved accordingly. First a corresponding revision of NAP heights has been considered, this is not an easy task because of the amount of regulations and legislation explicitly referring to NAP heights. Secondly

the geodetic (and gravity related) definition of the NAP as height system had been examined. To deal with future motion of underground benchmarks the zero level (Amsterdam tide gauge) will be fixed at epoch 1928 and a separate datum point will be added to deal with vertical motions. Accordingly, the Amsterdam benchmark will get a new height and the NAP will be almost a kinematic height system.

Additionally, analysis of the GPS and levelling data showed differences of several centimeters with the geoid model of the Netherlands. The systematic behaviour of these differences has likely been caused by the old GPS/levelling connection and the minor quality of the gravimetric geoid in the Southern part of the Netherlands. New gravity data from Belgium together with the present GPS/levelling measurements will result in a new geoid model this year providing GPS users with a link of (sub-)cm quality between ETRS89 and NAP.

The Dutch Active GPS Reference System (AGRS.NL)

Since the beginning of 1997 continuous GPS observations are performed at five stations in the Netherlands. The network serves as a high precision reference network for monitoring height and sea-level change, episodic campaigns, reference frame maintenance, surveying and remote sensing applications.

The data is sent every hour to a computing centre, where it is processed, checked and made available on the Internet using a flexible World Wide Web interface.

The Delft University of Technology, using precise orbits from IGS, computes on a daily basis:

- the positions of the reference stations in ETRS89;
- (sub-)hourly estimates of integrated water vapour (for KNMI).

In addition, data is made available to IGS and EUREF for further processing.

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Monument stability and site related effects

Several small (mm) but significant differences can be observed between individual time series of the stations. These mainly reflect differences in the construction and antenna environment of the station.

For example, the station in Delft, which is located on the roof of a six floor high concrete building, is affected by multipath and possibly structure deformations. The other stations in the Netherlands are located on steel towers of different height: Eijsden 6 m, Kootwijk Observatory for Satellite Geodesy (KOSG) 10 m, tide gauge West-Terschelling 12 m and Westerbork Synthesis Radio Telescope (WSRT) 23m. The towers are designed in such a way that by a windforce of 8 Beaufort the position of the antenna is not changed by more than 1.8 mm.

Although the antenna on top of the tower in Westerbork is stabilized in height by an invar-wire, there is a seasonal effect in height.

The complete poster including coloured figures is published in the EUREF homepage *http://homepage.oma.be/eurefnew/ EurefHome.html*