

National Report of Estonia

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1. National Geodetic Network

The National Geodetic Network, measured exclusively by GPS technique, is divided into I order, II order and densification networks according to the classification of geodetic networks in Estonia.

The average distance between adjacent points is 70-110 km in the I order and 15 km in the II order network with the number of points in networks being 13 and 199, respectively. The I and II order geodetic networks were completed in 1998 and are the densification of EUREF network in Estonia (results of EUREF-Estonia-1997 campaign (RÜDJA 1999))

The Densification Network (Fig. 1) was established area by area during the period 1992 - 2001 by companies RAS REI, OÜ REIB, AS PLANSERK, working under contract with the Estonian Land Board (ELB). The network consists of 3922 points established mainly in pairs with the average distance between the pairs being 5 km.

In measurements the Ashtech P-12, Ashtech Z-12, Javad Regency and Legacy GPS receivers were used. Choke ring antennas were used starting from the year 1999. The main characteristics of GPS measurements were as follows: average length of the measurement session 1^h 30^m, sampling rate 15^s, antenna cut of angle 10°. The data was evaluated using single baseline concept software GPPS from package PRISM (Ashtech Inc.), in calculations the broadcast ephemerides and troposphere model with standard parameters were used.

The compiled final network consisting totally of 15 692 GPS vectors was adjusted in two groups – Estonian mainland and West-Estonian islands (RÜDJA 2001a, RÜDJA 2001b) by AS PLANSERK in 2001. The adjustment based on the coordinates of I and II order networks. In adjustment the software package Global X-Positioning System (Inpho Technology OY) was used.

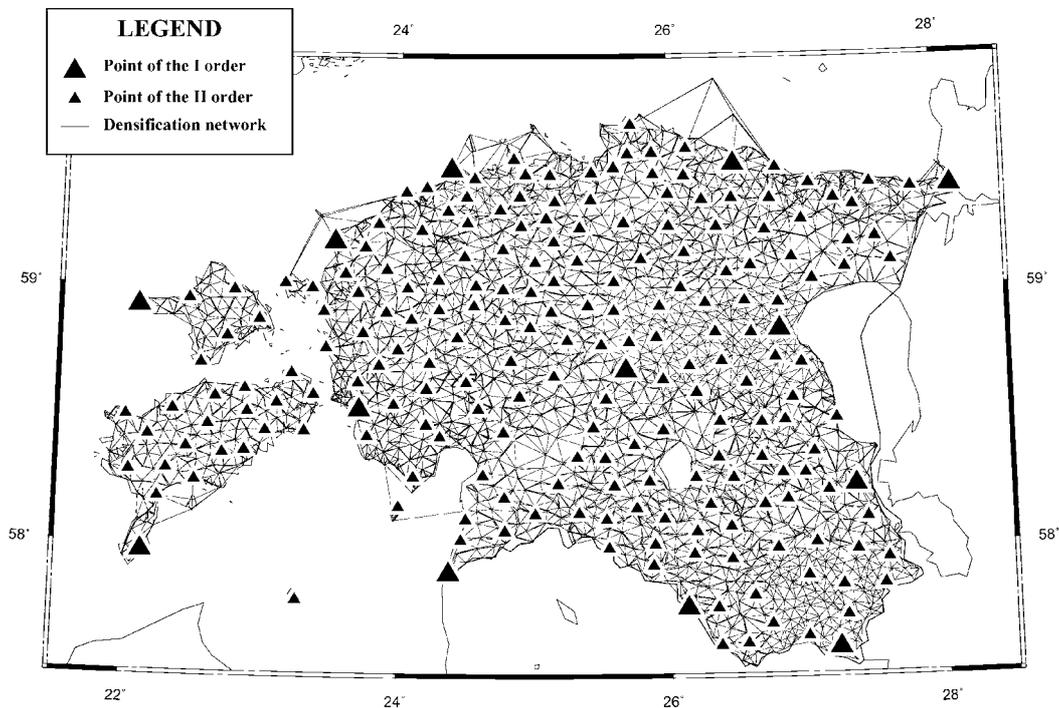


Fig. 1. The National Geodetic Network of Estonia.

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2. Local Geodetic Networks in Urban Areas

In the years 1940 – 1990 geodetic networks were established for 156 settlements, the coordinates were calculated in local systems derived either from Pulkovo 1942 or from local zero.

In connection with transforming to the National Reference System the corresponding parameters were determined and coordinates recalculated for a number of local networks, the local geodetic networks in 7 towns were renovated during the past 10 years. This work will be continued and the networks in 25 towns and settlements of Estonia will be fully renovated during the present and next year. The GPS and terrestrial methods will be combined in the measurements.

3. Levelling Network

First 31 km of I order levelling network were levelled in framework of the pilot project near Tallinn by AS PLANSERK working under the contract with ELB in 2001 (RÜDJA 2001c). In measurements the DiNi 11 digital level and invar rods of NEDO were used. The accuracy $O = \pm 0.14$ mm/km and $F = \pm 0.01$ mm/km was estimated for random and systematic errors, respectively.

Three more points from the II order and Densification Network were included following the concept of the integrated National Geodetic Network (RÜDJA 1996, RÜDJA 1999) during the levelling.

Furthermore, about 100 km of I order levelling lines was reconstructed in the same time.

4. Gravimetric Network

The II order relative gravimetric measurements were made (OJA 2002) between 71 points of the I, II and III order gravimetric network and points of the I and II order National Geodetic Network (Fig. 2) by ELB in 2001. In measurements the two LaCoste&Romberg gravimeters loaned from NIMA (National Imagery and Mapping Agency, USA) were used. The overall accuracy obtained was $\pm 10 \dots \pm 30$ mGal on average.

In framework of UEGN 2002 project the gravimetric data of network consisting of 7 I order and 70 II order points (average distance between the points 50 km) will be delivered for the joint European adjustment.

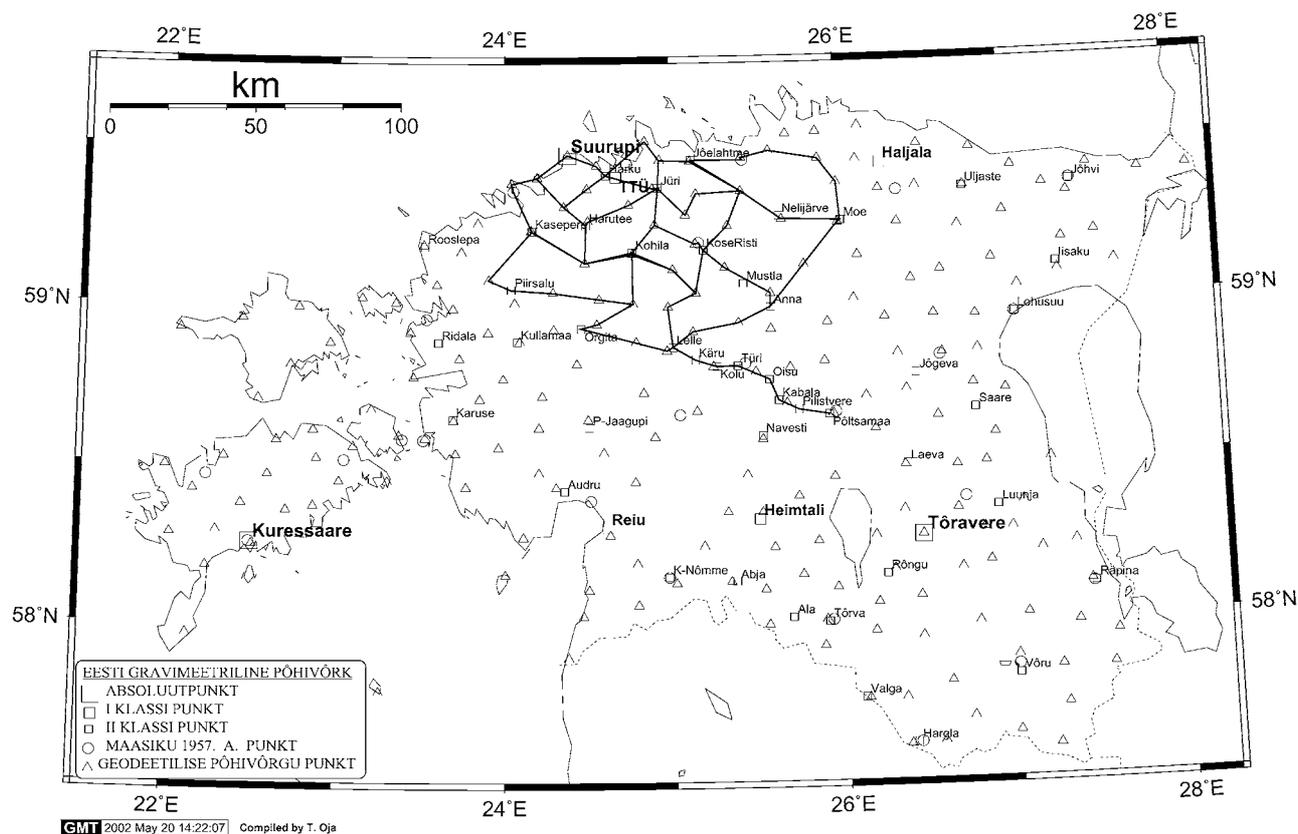


Fig. 2. Gravimetric measurements in 2001 (OJA 2002).

5. GPS-levelling points

Responding to the request of the EUREF TWG, information about the availability of GPS/levelling points in Estonia is given below.

A. The concept of the National Geodetic Network aims at creating the integrated georeference based on GPS, levelling, gravimetric networks and network of sea level stations. According to that, 126 points of the I and II order were planned to include directly into a high precision levelling network. From those points 5 were included and 23 connected by I order levelling (random errors $\sigma = \pm 0.5$ mm/km, systematic errors $F = \pm 0.05$ mm/km) so far. In case of connection only one levelling benchmark was used as fiducial loosing with that not necessarily the precision but reliability. In (RÜDJA 1999) the overview of GPS measurements and data evaluation in the I order GPS network was given. In case of the II order net the technology used is very

much the same having the difference in session lengths. The average distance between the points described is 45 km. The combined GPS+levelling error is about ± 1 cm.

B. In addition to the above-mentioned high precision GPS-levelling points, there are another 400 points. They are the old triangulation points included into a Densification Network. The normal heights of the points are from III and IV order levelling with corresponding accuracy as $\sigma = \pm 5$ mm/km and $\sigma = \pm 10$ mm/km, respectively. Technology of GPS measurements and data evaluation was described earlier in the present report. Accuracy and reliability of both, results of the GPS measurements and levelling are heterogeneous – the combined GPS+levelling error varied from about ± 2 up to ± 10 cm.

In Fig. 3 the geometry of the GPS-levelling points discussed are shown.

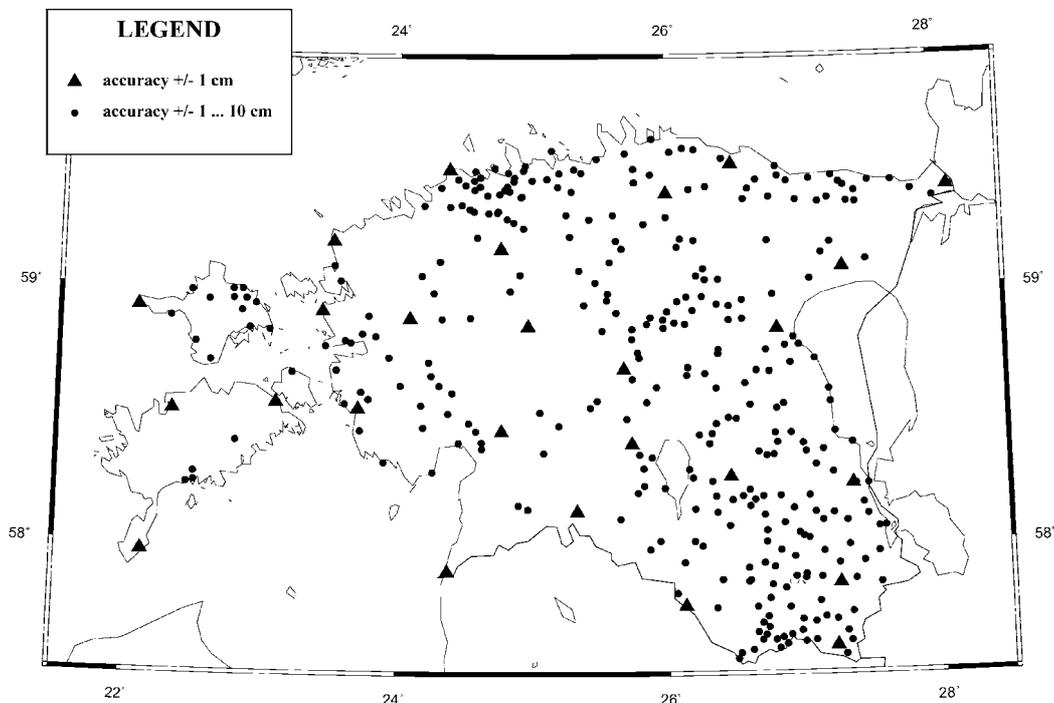


Fig. 3. The distribution of the GPS-levelling points in Estonia.

References

OJA, T. (2002), *Gravimetric measurements in 2001*. National Land Board, Tallinn 2002, in Estonian (manuscript).
 RÜDJA, A. (1996), *Project of the national geodetic network*. AS PLANSERK, Tallinn 1998, in Estonian (manuscript).
 RÜDJA, A. (1999), *A new ETRS89 system for Estonia*. In E. Gubler, Torres, J.A., Hornik, H. (eds): Report on the Symposium of the IAG Subcommission for the European Reference Frame (EUREF) held in Prague 2-5 June 1999. Veröff. Bayr. Komm. Intern. Erdmessung 60, EUREF Publ.No.8, München.

RÜDJA, A. (2001a), *Adjustment of the densification network (Estonian mainland)*. AS PLANSERK, Tallinn 2001, in Estonian (manuscript).
 RÜDJA, A. (2001b), *Adjustment of the densification network (West-Estonian islands)*. AS PLANSERK, Tallinn 2001, in Estonian (manuscript).
 RÜDJA, A. (2001c), *I order levelling of lines Keila-Suurupi-Tabasalu and Lasnamäe-Iru-Koogi*. AS PLANSERK, Tallinn 2001, in Estonian (manuscript).