

Status of EVRF 2007

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Abstract

Already in 2006 a new EVRF realization has been announced. Because of the substantial quantity of expected new data the planned new realization of the EVRS was postponed to the second half of 2007. Several preliminary adjustments were performed with the currently available data and different sets of datum points that had been proposed by the participating countries. The height variations compared with the results of the UELN-95/98 solution were in the most cases less than 10 mm.

1. Contents of the UELN database

1.1 Development from 1998 to 2005

The last results of a UELN adjustment were handed over to the participating countries in January 1999. The name of the solution is UELN-95/98 (SACHER et al. 1998). This solution was the base for the first realization of a European Vertical Reference System (EVRS). Since that time a lot of new data was included into the network (see Figure 1). UELN has been extended to the East by the first order levelling networks of

- Estonia (1999)
- Latvia (1999)
- Romania (1999)
- Lithuania (2000)
- Bulgaria (2003)

Additionally the network blocks of some countries have been replaced by new data, which are more topical. The following countries are concerned (SACHER et al. 2006):

- Switzerland (2002)
- Denmark (2004 - new pre-processed data of the epoch 1980-1995)
- The Netherlands (2004)
- Finland (2005)
- Norway (2005)
- Sweden (2005)

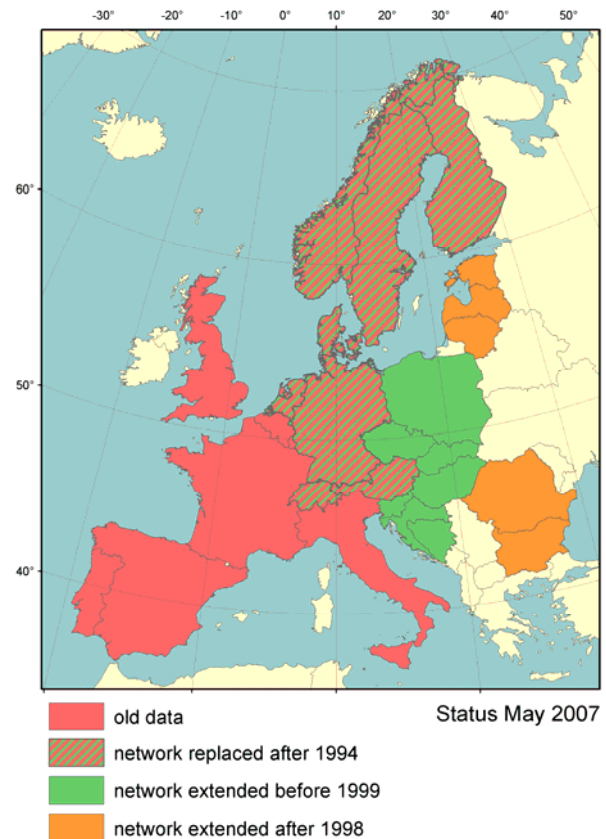


Figure 1: Development of UELN 1999-2006

1.2 New data since 2006

At the EUREF symposium in Riga 2006 several countries announced new levelling data that couldn't be delivered up to the EUREF symposium in June 2007 (see figure 2):

- Poland (expected for the next weeks)
- France
- Portugal
- Lithuania (expected for July 2007)
- Spain (expected at the earliest for 2008)

Instead, Slovakia handed over the first order levellings of the epoch 1997-2002. Up to the time of the symposium the analysis of the data was not completed yet.

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Because of the substantial quantity of expected new data the planned new realization of the EVRS was postponed to the second half of 2007.

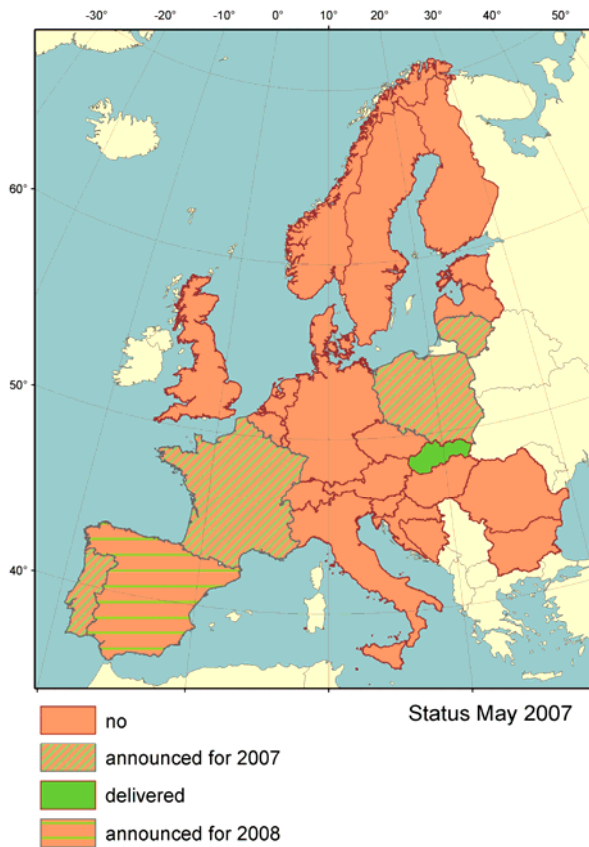


Figure 2: New data since 2006

2. Datum of EVRF2007

The previous datum of the EVRS based on the UELN-95/98 solution, which was realized by one benchmark in the Netherlands that represented the NAP level. The same point had been used already as datum in the UELN-73/86 adjustment (EHRNSPERGER and KOK, 1986). The identifier of the UELN datum point was 000A2530 (not to be confused with the datum point of the national network 000A2350). In 2004 the previous network block of the Netherlands was replaced by the data of the 5th Primary Levelling, which was observed between 1996 and 1999 (SACHER et al. 2005). This data set doesn't contain the old UELN datum point. A preliminary substitute point was chosen which is located in the near of the old one and didn't move between the different measurement epochs of the Netherlands.

The EVRS07 datum is intended to be realized by various datum points distributed over Europe. We strive to keep the level of the EVRF2000 datum in the EVRF07. Therefore the new UELN adjustment will fit to the EVRF2000 solution by choosing a couple of datum points and introducing their UELN 95/98 heights in the free adjustment of the current network. For this purpose

it is important to choose stably marked points located in a stable part of the European plate. The future time evolution of EVRS will be monitored by observing time series on selected ECGN stations.

Therefore in December 2006 the chairman of EUREF sent letters to all countries participating in the UELN project asking them for proposals of

- UELN nodal points that were already part of the UELN 95/98 solution for using them as datum points in the next adjustment. The points have to be stably marked and located in a stable part of the European plate.
- ECGN stations for monitoring the future time evolution of EVRS. Requirements for these stations are the availability of permanent GNSS observations, periodic absolute gravity measurements and periodic precise levelling connections to UELN.

Table 1: Responses to the circular letter (June 2007)

Country	answer	proposed datum point	proposed ECGN station
AT	x	102105	GRAZ, TRFB
BE	x	200038	BRUS
CH	x	not expedient	ZIMM
DE	x	401110, 401668	SASS, WTZR, BADH
DK			
ES	x	600157, 600224	ALAC, YEBE, RIOJ
FR	x	700359	MARS
IT	x	800432, 800441	MSEL
NL	x	913000, 913011, 913018	WSRT
PT			
HU	x	1103000	PENC
CS			
GB	x	1300364, 1300383	NEWL, HERS
NO	x	not expedient	STAS, TRO1, Trysil
SE	x	not expedient	SPT0, KIRO, MAR6, ONSA, SKE0, VIS0
FI	x	not expedient	METS, JOEN, SODA, VAAS
PL	x		
SI			
SK	x	EH-V	
HR	x		
LV	x	not applicable	
EE		not applicable	
RO	x	not applicable	
LT	x	not applicable	VLNS, Klaipeda
BG	x	not applicable	SOFI

Table 1 shows the responses to the circular letter. 80 % of the countries sent an answer – most of them with a proposal. The national networks that were integrated after 1998 are not applicable to provide datum points.

Also the use of Scandinavian points is not expedient because of the land uplift (ÅGREN and SVENSSON, 2006). Finally Switzerland was in the solution of 1998 with only a few points and none of these points is expedient as datum point because of their instability (SACHER et al. 2003). Some countries proposed stations that don't fulfill all requirements on an ECGN station. Figure 3 shows the proposed stations in a map.

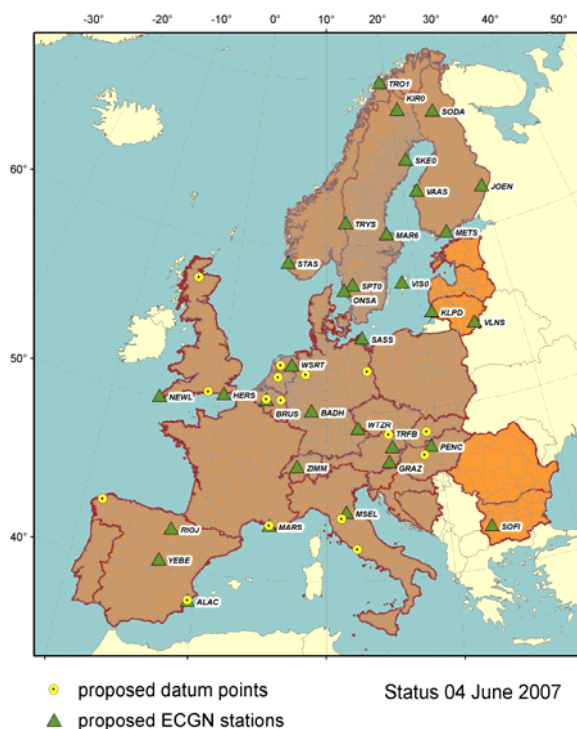


Figure 3: Proposed datum points and ECGN stations

In some adjustments with the current data the effect of different sets of the proposed datum points was analyzed:

- one point in NL
- another point in NL
- 9 datum points (AT, BE, 2DE, FR, HU, 3 NL)
- 8 datum points (AT, BE, 2DE, FR, HU, 2 NL)
- 13 datum points (AT, BE, 2DE, FR, HU, 2 NL+2 IT, 2 GB)
- 11 datum points (AT, BE, 2DE, FR, HU, 2 NL+2 IT)

For comparison two versions were computed each with only one datum point. Two different points in the Netherlands were used to show the dependence of the result on the choice of the point. Many of the proposals came in the last minute - so the first variant was computed with 9 datum points. One point of the 3 in the NL differs considerably from the others and so in the next computation only 2 points in NL were used. After incoming of new proposals a variant with 13 datum points was adjusted. This variant contains 2 datum points in Great Britain. But Great Britain is only connected by one uncertain height difference to the continental network. After a possible including of a measured height difference through the tunnel considerable variations are to be expected and would influence the

whole network similar to the height changes in the Netherlands. That's why a variant without the British points was computed.

Figure 4 shows the distribution of the proposed datum points and additional sample points for observing the height variations in countries or areas without datum points. The proposed Spanish datum points couldn't be included in the adjustments because the UELN data center received this proposal only some days before the symposium. For the same reason these points aren't displayed in figure 4 and figure 5.

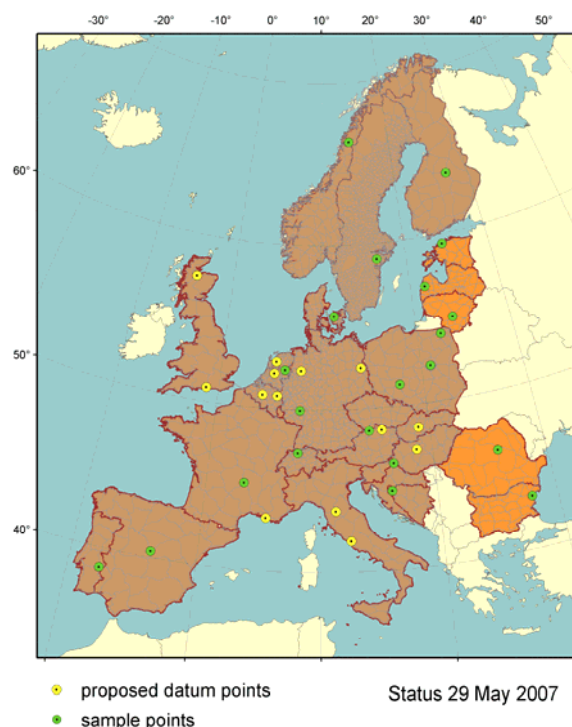


Figure 4: Distribution of sample points and datum points

The diagram in figure 5 shows the height variations to the solution 95/98 for the different variants. For Latvia, Lithuania, Estonia, Romania and Bulgaria the differences to the adjustment of 2003 are displayed. The height variations of the Scandinavian countries aren't displayed. They are in another magnitude because of the influence of the land uplift.

Singling for instance the results with the datum point NL_1 (yellow) and with 11 datum points (magenta) one can see that the differences between the variants are small. But the more stable datum points in the network the less the network will be affected by possible changing of data.

Table 2 shows the mean height variations of all participating countries resulting from the adjustment with 11 datum points. In most of the countries excepting Scandinavia the differences are less than 1 cm. The differences in Switzerland are caused by the changing of the Swiss data itself.

Table 2: Height variations in the countries

	mean difference to UELN-95/98 [kgal·mm]	mean difference to adjustment 2003 [kgal·mm]
Austria	0.6	-2.2
Belgium	-7.5	-7.3
Switzerland	-29.7	-2.8
Germany	-1.8	-2.1
Denmark	-4.8	0.4
Spain	-5.8	-4.2
France	-6.3	-4.7
Italy	3.6	-2.4
Netherlands	-0.7	-0.6
Portugal	-5.8	-4.2
Hungary	0.5	-1.4
Czech Republik	0.3	-2.2
Great Britain	-9.0	-8.6
Norway	78.1	84.6
Sweden	178.5	184.9
Finland	83.9	67.0
Poland	-1.2	-2.1
Slovenia	0.5	-5.1
Slovakia	0.3	-2.2
Croatia	0.6	-2.2
Latvia		-2.1
Estonia		-2.2
Romania		-2.1
Lithuania		-2.1
Bulgaria		-2.1

3. Conclusions and Outlook

The new EVRS realization will be finished probably in the second half of 2007. Therefore any new data should be handed over as soon as possible to the UELN database. After analyzing of all new data and all proposed datum points the Technical Working Group of EUREF will make a decision about the final EVRF2007 datum. Height differences will be in the most cases less than 10 mm except for Scandinavia.

Before handing over of the data we have to clarify some points as:

We need a decision about the handling of the permanent tides (MÄKINEN 2004). In the past the UELN data centre applied no corrections. Some countries, which corrected their levelling data, sent especially data regarding to the mean geoid to the UELN data centre. For most of the countries we can more or less be sure that their UELN data are referring to the mean geoid. This is in contradiction to the EVRS2000 definition where EVRS is defined as zero tidal system (IHDE and AUGATH, 2002).

Furthermore we need a decision about data policy. In 1998 every participating country got only the heights of the points on its own territory. There doesn't exist an agreement about data exchange.

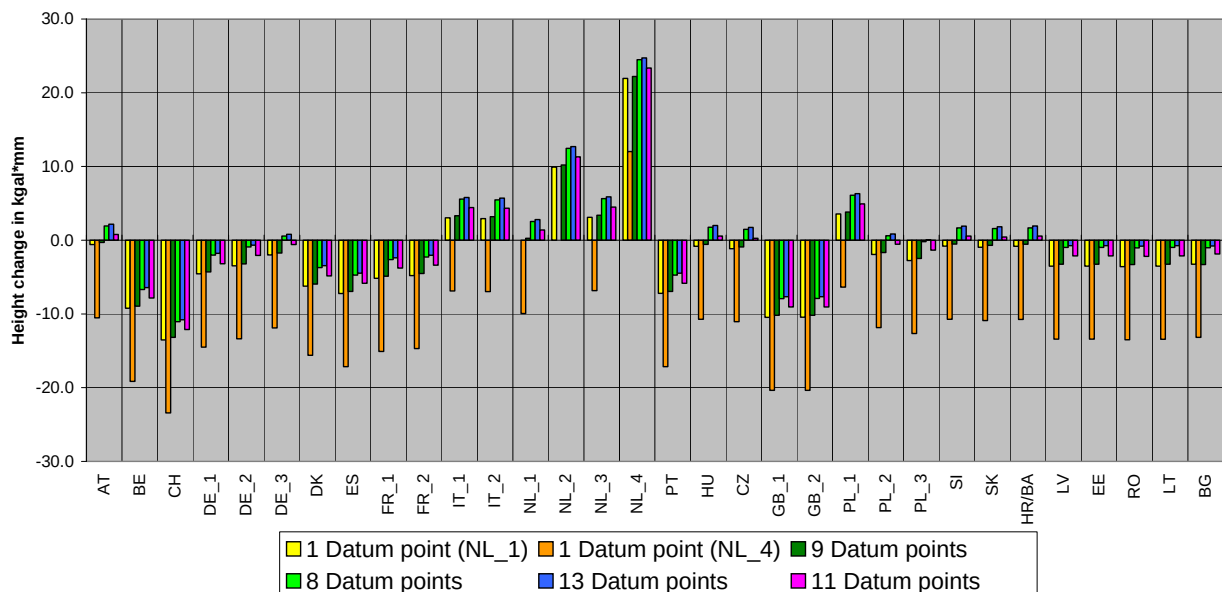


Figure 5: Height changes to UELN-95/98 depending on datum realization

5. References

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