Steps on the way to UELN05 and Enhancements of the web-based Geodetic Information and Service System

Martina Sacher, Johannes Ihde, Gunter Liebsch, Jens Luthardt

Contents:

1. Current contents of the data base
2. Replacement of the Danish Network
3. New Epoch of the Netherlands
4. Future Datum of UELN
5. The Information System for European Coordinate Reference Systems (CRS-EU) – part Height

1. Content of the UELN/EVRS Data Base

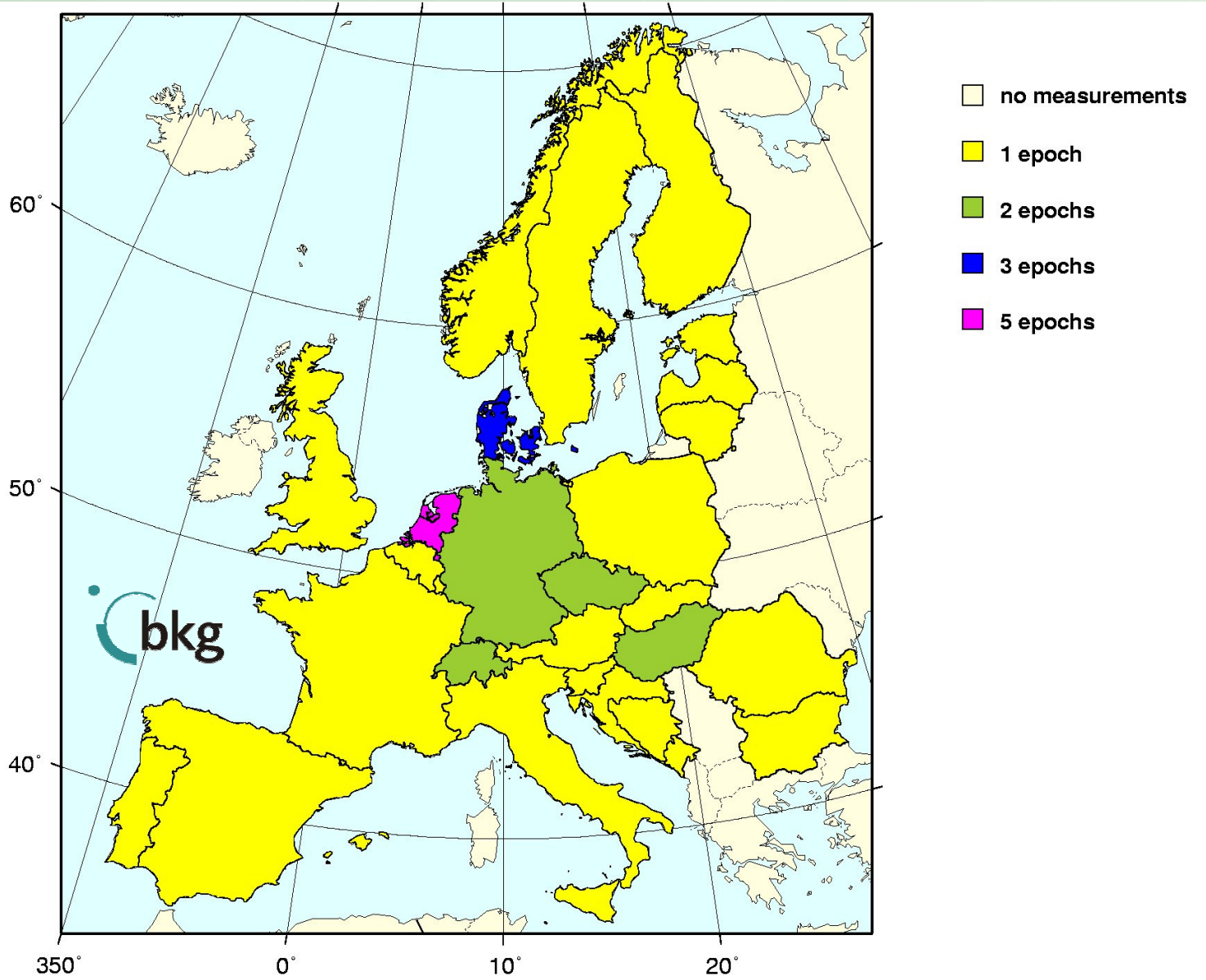
new data

- **May 2004: substitution of the Danish network with data of the same epoch (1980-1995) as in the last version**
- **December 2004: 5th primary Levelling of the Netherlands**

- **the data of the new levelling networks of Finland, Norway and Sweden are expected for the very next time**

Bundesamt für Kartographie und Geodäsie

Number of Epochs in the UELN/EVRS Data Base (status May 2005)



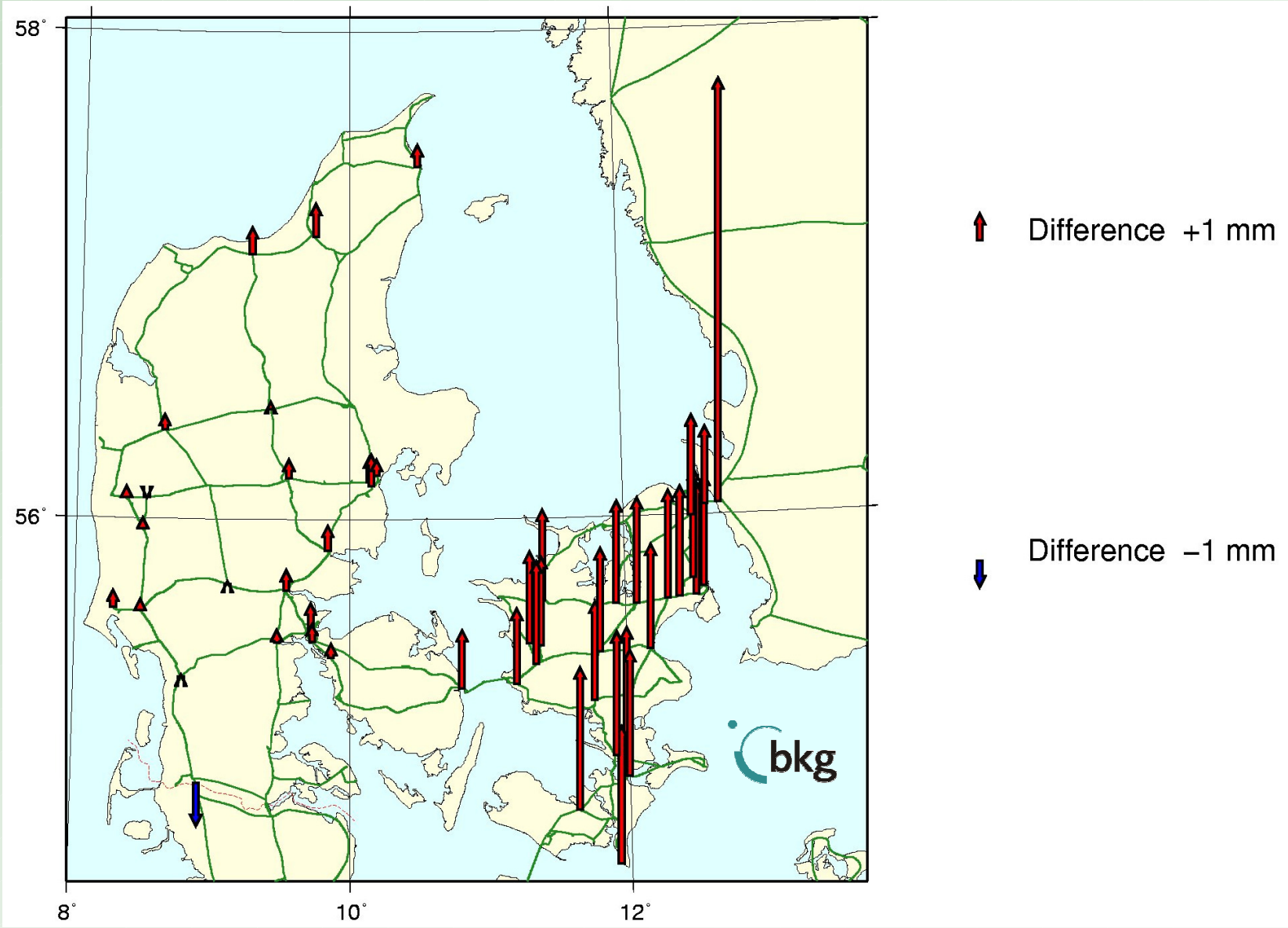
2. Replacement of the Danish Network

- new data set of the Danish levelling network (1980-1995) was handed over in May 2004
- in principle the same epoch of measurements as in the previous version from 1998, but
  - observations node to node were delivered
  - some corrections
  - new calculated weights
  - summarization of measurements – without groups of nodal points with very short distances ⇒ calculated accuracy more realistic
- comparison of the results:
  - old data set: 735 (nodal !) points and 1036 measurements, s_0=0.59 kgal·mm
  - new data set: 66 points and 100 measurements, s_0=0.88 kgal·mm

2. Replacement of the Danish Network (2)

- new connection across the bridge between Copenhagen and Malmö cannot be used yet because of old data set of Sweden in the data base
- only one connection between Helsingør and Helsingborg
- obviously the added corrections or summarization of measurements caused changes in some height differences
- after the replacement of the Danish data the height of the Danish connection point increased by almost 16 mm !
- $\Rightarrow$ increasing of the whole Scandinavian network block by the same 16 mm

Height Differences of the Points after Replacement of the Danish Network

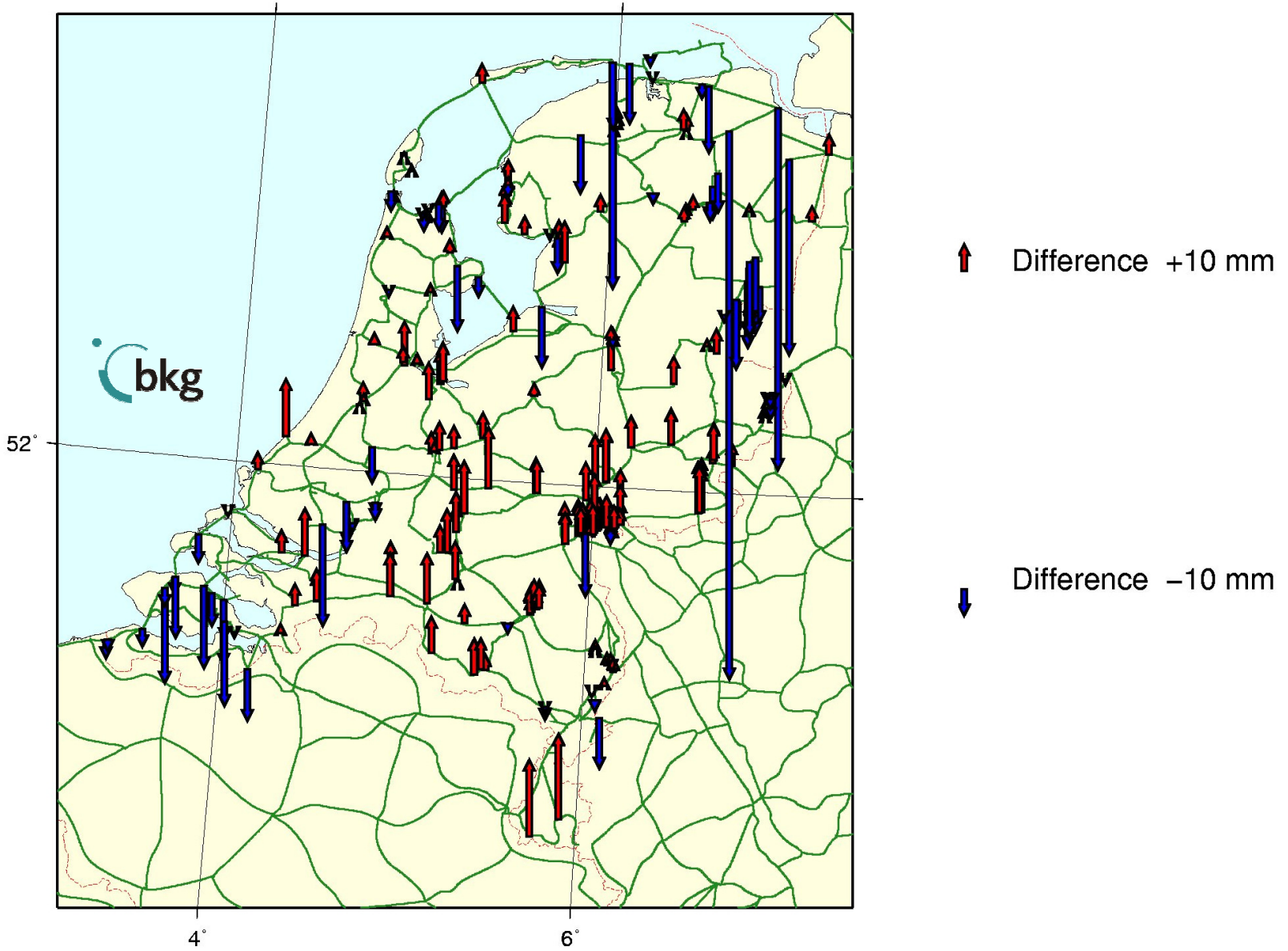


3. New Epoch of the Netherlands

- 5th Primary Levelling of the Netherlands (1996-1999)
- handing over of a total of 8615 points and 9286 measurements in December 2004
- 1106 nodal points with 1408 measurements
- test adjustment of the network block of the Netherlands
- unconstrained adjustment with 242 datum points (identical points to the previous network) with the geopotential numbers of the last UELN adjustment
- height changes with respect to the 4th epoch between about

  -200 mm and + 30 mm
- new data set without reference point of UELN 000A2530 (supposed or detected instability ?)

Height differences to the previous UELN heights after test adjustment of the new Dutch network

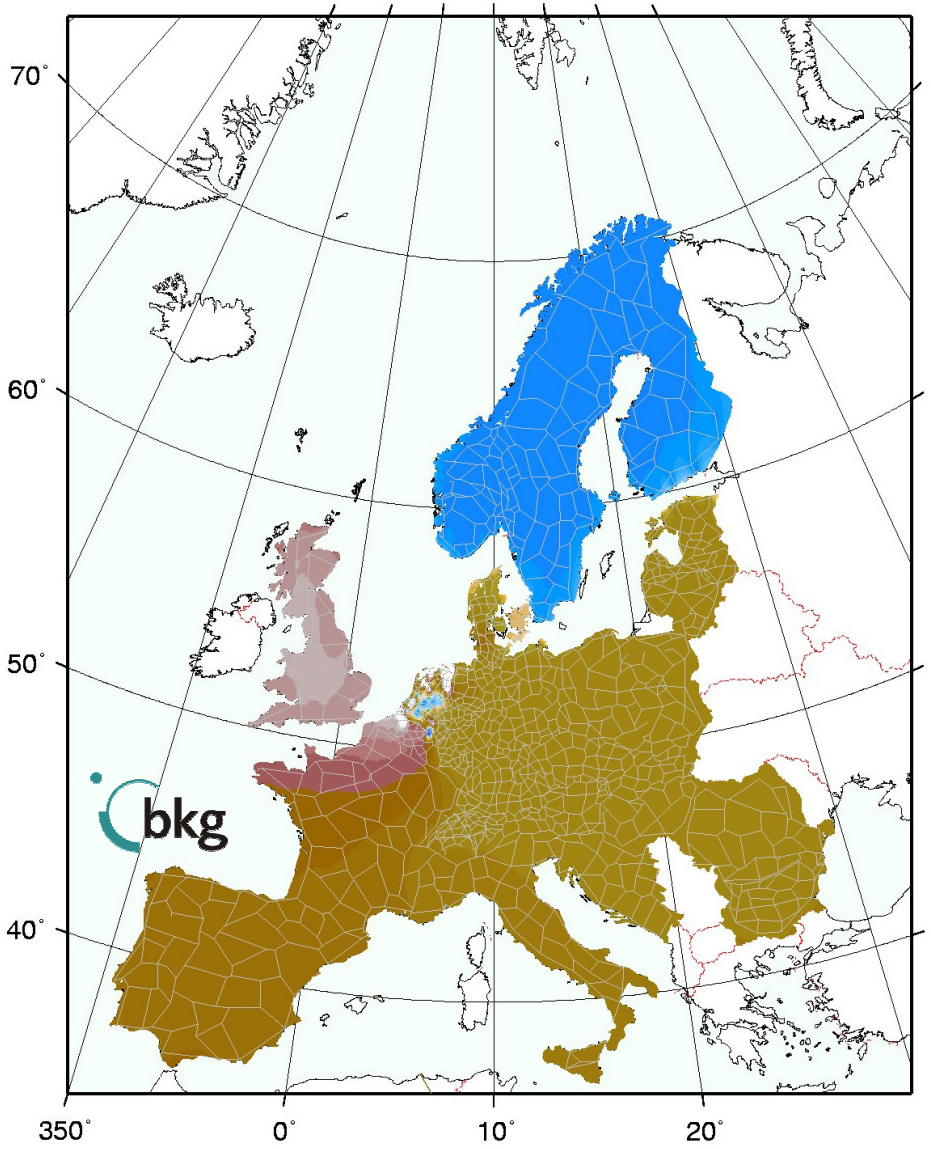


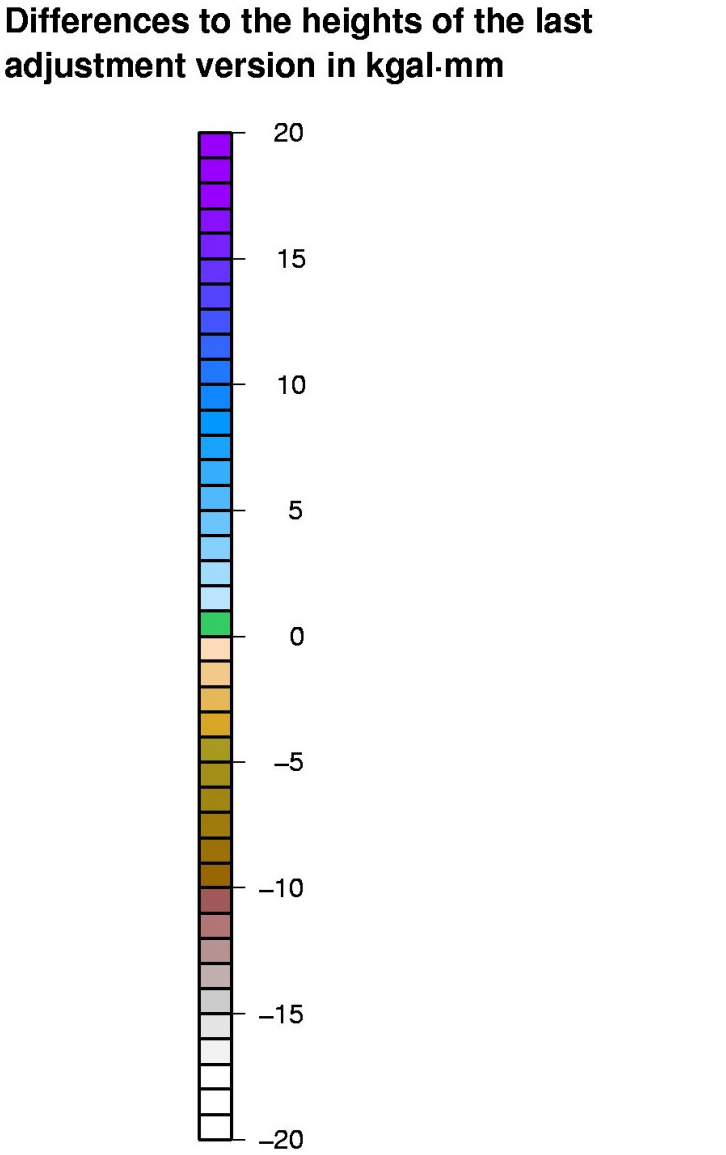
4. Future Datum of UELN

- new realization of the UELN datum necessary
- 2 alternatives were tested:
  a) one substitute point with minimal height change (000A1112) was fixed with the same height as in the last adjustment version
  b) unconstrained adjustment with 23 datum points all over Europe with the same height as in the last adjustment version
- In variant a) the height changes in the Dutch network are dispersed over the whole network and leads to height changes of about -7 mm also in Bulgaria. More height changes are to be expected in the future.
- In Variant b) the points farther from the Dutch network show lower height changes.

Differences to the heights of the last UELN adjustment

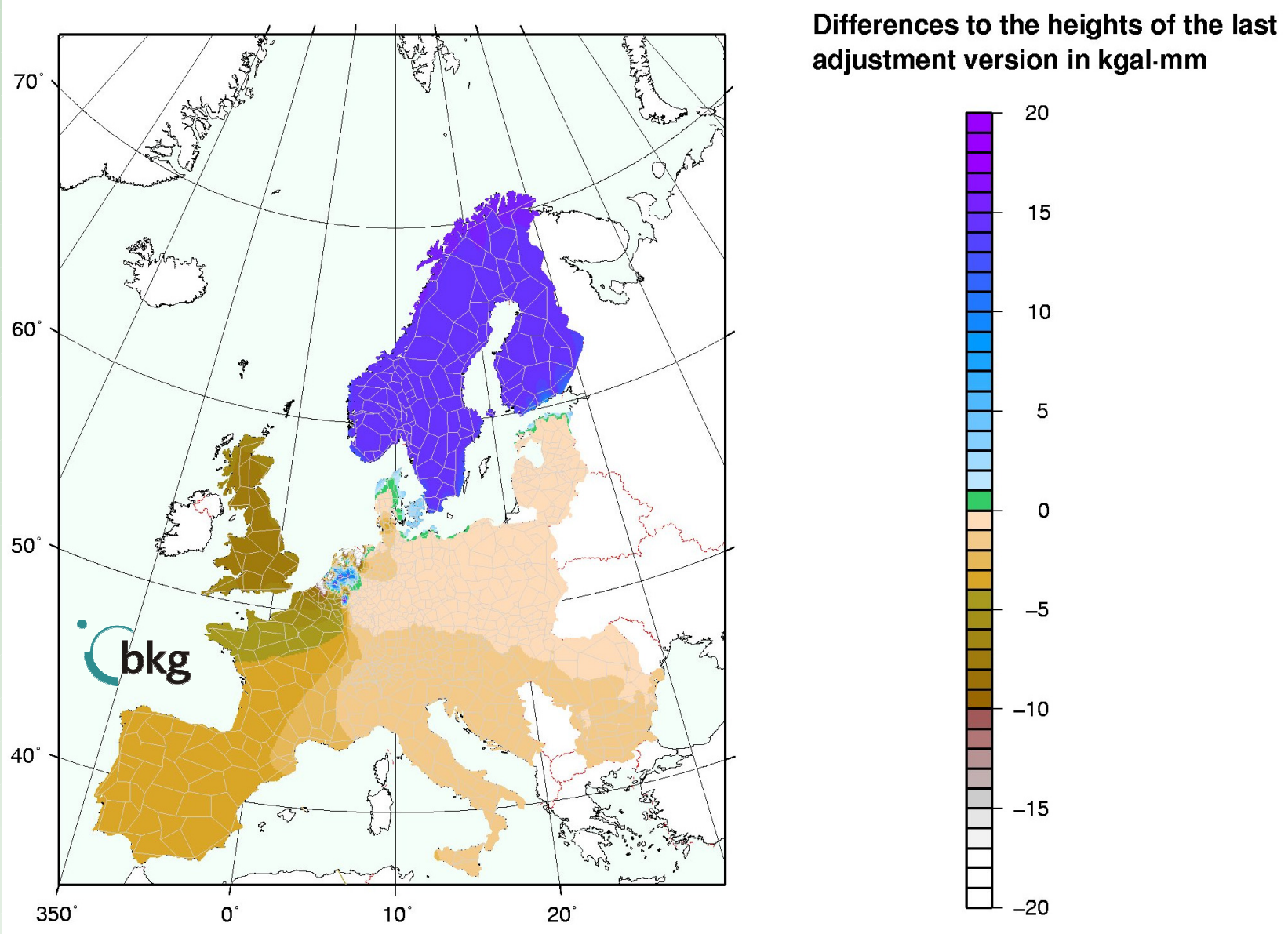
Version with reference point 000A1112 in NL





Differences to the heights of the last UELN adjustment

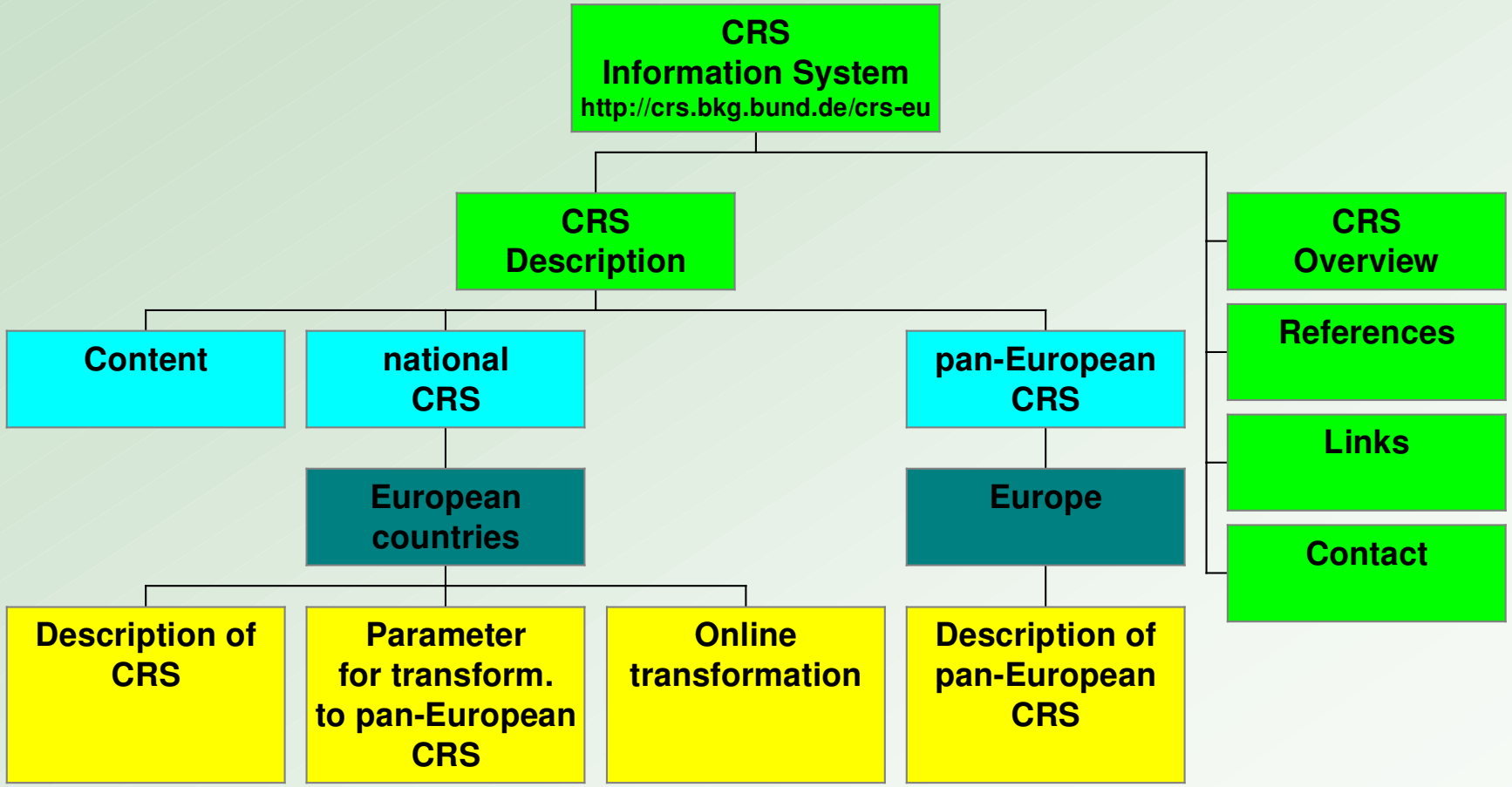
Version with 23 datum points all over Europe



4. Future Datum of UELN (2)

- irrespective of a new definition of the EVRS datum a new realization of the datum is necessary
- the realization of the datum by only one benchmark is neither contemporary nor advantageous
- the realization should be based on several benchmarks or tide gauges in Europe
- the choice of these benchmarks should be taken with regard to the decision about the EVRS datum

5. The Information System for European Coordinate Reference Systems (CRS)



5.1 Web-Address

- **Available at web-address**

  http://crs.bkg.bund.de/crs-eu

- **Former existing address**

  http://crs.ifag.de

  will be forwarded to the new address for some time via an information website.

5.2 Improvements since last symposium

- improved layout and structure for better access to the information
- verification data for transformation
- starting of realization of single point online transformation for position

5.3 Content for gravity related height

- descriptions of national height reference systems
- description of pan-European CRS for height – EVRF2000
- transformation parameters for height from national systems to EVRF2000

The information

- was prepared by BKG and agreed with NMA
- or provided from the National Mapping Agencies (NMA) themselves
- always unified and prepared regarding ISO-Standard 19111:2003

5.4 Examples

- choice of CRS for a country
- example for description of a CRS for height
- example for description of transformation parameters of a CRS for height

5.5 Verification data

- **verification data for transformation in position and height by some fictive points of the transformation area**
- **example for height:**

Poland (PL) - Testdata for Validation of Transformation

fictive points of transformation area

Coordinates in ETRS89 (DMS)		Heights (m)	
Lat	Lon	PL_KRON / NH	EVRF_AMST / NH
53 12 11	16 02 05	118.456	118.623
53 41 32	22 15 04	150.735	150.904
51 43 34	15 50 01	82.378	82.537
49 58 42	21 17 26	215.629	215.778

Bundesamt für Kartographie und Geodäsie

5.6 Available Information for European Countries (1)

Country	Country_ID	Height	
		CRS-Description	Transformation to EVRF2000
Albania	AL		
Austria	AT	**published**	**published**
Bosnia / Hercegovina	BA	**existing data**	**existing data**
Belgium	BE	**published**	**published**
Bulgaria	BG	**published**	**published**
Switzerland	CH	**published**	**published**
Cyprus	CY		
Czech Republic	CZ	**existing data**	**existing data**
Germany	DE	**published**	**published**
Denmark	DK	**published**	**published**
Estonia	EE	**published**	**published**
Spain	ES	**published**	**published**
Finland	FI	**published**	**published**
France	FR	**published**	**published**
Great Britain	GB	**published**	**published**
Gibraltar	GI		
Greece	GR	**existing data**	*no UELN*
Croatia	HR	**existing data**	**existing data**
Hungary	HU	**published**	**published**

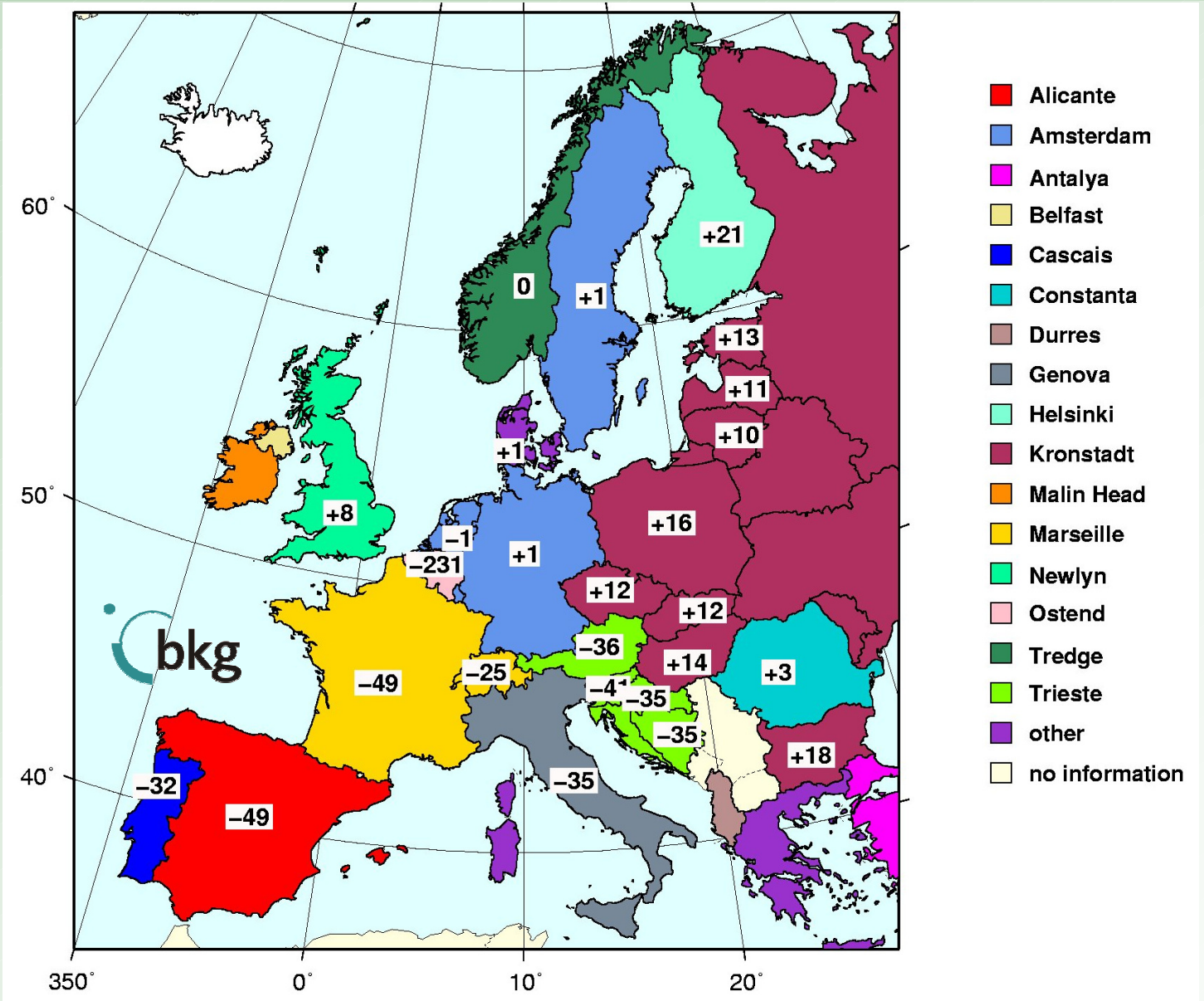
Bundesamt für Kartographie und Geodäsie

5.6 Available Information for European Countries (2)

Country	Country_ID	Height	
		CRS-Description	Transformation to EVRF2000
Ireland	IE	**published**	*no UELN*
Iceland	IS	no levelling network	
Italy	IT	**existing data**	**existing data**
Lithuania	LT	**published**	**published**
Luxembourg	LU	**published**	*no UELN*
Latvia	LV	**existing data**	**existing data**
Macedonia	MK		
Malta	MT		
Northern Ireland	NI	**existing data**	*no UELN*
Netherlands	NL	**published**	**published**
Norway	NO	**published**	**published**
Poland	PL	**existing data**	**existing data**
Portugal	PT	**published**	**published**
Romania	RO	**existing data**	**existing data**
Russia	RU	**existing data**	*no UELN*
Sweden	SE	**published**	**existing data**
Slovenia	SI	**published**	**published**
Slovak Republic	SK	**published**	**published**
Turkey	TR	**published**	*no UELN*
Ukraine	UA	**existing data**	*no UELN*

Bundesamt für
Kartographie und Geodäsie

Reference Tide Gauges in Europe and Transformation parameters to EVRF2000 in cm



Bundesamt für Kartographie und Geodäsie

5.7 Available transformation parameters for height

Country	Verification by the country	identical points	Parameters			RMS	residual deviations	
		number + kind	translation in cm	incl. in latitude in cm / 100km	incl. in longitude in cm / 100km	in cm	min in cm	max in cm
AT	x	114 UELN	- 35.6	- 2.8	- 2.8	3.1	-6.1	+6.1
BA/HR		40 UELN	- 34.5	- 0.3	- 0.9	0.7	-1.0	+1.4
BE	x	4 EUVN	- 231.1	- 0.8		0.2	-0.2	+0.2
BG	x	36 UELN	+ 18.2	+ 0.1	- 0.2	0.2	-0.6	+0.4
CH (LN02)	x	225 UELN	- 24.5	- 10.2	- 1.6	3.3	-8.6	+9.4
CZ		53 UELN	+ 11.6	+ 1.7		1.4	-3.5	+2.8
DE (DHHN92)	x	443 UELN	+ 1.4	- 0.1		0.2	-0.7	+0.6
DK	x	707 UELN	+ 1.1	+ 0.1	+ 0.5	0.3	-0.9	+0.8
EE	x	36 UELN	+ 13.3	- 0.7	+ 0.2	0.3	-0.5	+0.5
ES	x	70 UELN	- 48.6	- 0.2	+ 0.3	1.0	?	?
FI		66 UELN	+ 21.3			0.3	-0.7	+0.9
FR	x	8 EUVN	- 48.6			0.5	-0.4	+1.0
GB	x	5 EUVN	+ 8.1	- 2.7	- 1.1	1.9	-1.2	+2.2
HR		40 UELN	- 34.5	- 0.3	- 0.9	0.7	-1.0	+1.4
HU	x	35 UELN	+ 14.0	+ 0.4	- 0.1	0.3	-0.7	+0.6
IT		9 EUVN	- 35.3	+ 0.2	+ 0.3	0.7	-0.6	+1.1
LT	x	46 UELN	+ 10.2		+ 0.1	0.2	-0.2	+0.3
LV		123 UELN	+ 10.5		+ 0.2	0.7	-2.0	+2.2
NL	x	757 UELN	- 0.5			0.2	-2.1	+0.4
NO	x	117 UELN	- 0.1	- 0.5	+ 1.7	3.7	-7.6	+7.0
PL		98 UELN	+ 16.0	+ 0.5		0.5	-2.0	+0.9
PT	x	5 EUVN	- 31.5			1.3	-1.4	+2.1
RO		46 UELN	+ 2.8	+ 0.1	+ 0.1	0.2	-0.5	+0.9
SE		21 EUVN+Tide G	+ 1.0	- 0.6		1.1	-2.3	+2.0
SI	x	9 UELN	- 41.1	- 1.6	+ 0.4	0.3	-0.4	+0.4
SK		3 EUVN	+ 12.2	+ 1.0		0.2	-0.1	+0.1

5.8 Further developments

- step by step completion of information for the countries depending on their response / assistance
- in case of installation of new national height systems continue publishing the old data additionally ?
  - disadvantage: possibly promotion of using old systems
  - advantage: instruction of the users about the limits of the precision and topicality of old systems and the connected transformation parameters
- further step by step realization of single point online transformation of different CRS for test and verification purposes