The Implementation of the ECGN stations – Status of the 1st Call for participation

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Abstract

The **E**uropean **C**ombined **G**eodetic **N**etwork (ECGN) is a European Network for the integration of time series of spatial/geometric observations (GNSS-GPS/GLONSS and in the future GALILEO), gravity field related observations and parameters (precise levelling, tide gauge records, gravity observations, earth and ocean tides), and supplementary information (meteorological parameters, surrounding information of the stations, e.g. eccentricities and ground water level).

The objectives of ECGN as an integrated European Reference System for Spatial Reference and Gravity are the maintenance of the terrestrial reference system with long-term stability for Europe especially in the height component, in-situ combination of geometric positioning (GPS) with physical height and other Earth gravity parameters in 1 cm accuracy level and the modelling of influences of time depended parameters of the solid Earth of the Earth gravity field, the atmosphere, the oceans, the hydrosphere for different applications of positioning.

In order to ensure the long-time stability of the terrestrial reference system with an accuracy of 10^{-9} in the global and continental scale, the interactions between different time dependent influences of the system Earth to the terrestrial reference system and the related observation have to be considered in the evaluation models. The ECGN integrates the spatial and height reference system into the Earth gravity field parameter estimation. This is in agreement with the planned IAG project of an Integrated Global Geodetic Observation System (IGGOS).

The first call for participation in the project was directed to the implementation of the ECGN stations. These stations include the standard observation techniques GNSS (GPS/GLONASS and in future GALILEO), gravity (super conducting gravimeter and/or absolute gravimeter), levelling connections to nodal points of the European levelling network (UELN) and meteorological parameters.
The second call will relate to the detailed analysis of the different observation types. It will investigate the differences between the applied techniques, will try to describe the reasons and will develop correction models to be used in a combined analysis.

1 Introduction

It is proposed to establish a kinematic European Combined Geodetic Network (ECGN) to integrate the spatial and height reference system into the Earth gravity field parameter estimation. This is in agreement with the planned IAG project of IGGOS - Integrated Global Geodetic Observation System (Rummel et. al., 2000 and 2002). In geodetic fundamental stations ECGN will establish a European network for the continuation of time series of spatial/geometric observations (GNSS - GPS/ GLONASS and in the future GALILEO), precise levelling and tide gauge records with gravity field related observations and parameters (gravity, Earth tides), and supplementary information (meteorological parameters, surrounding information of the stations e.g. eccentricities and ground water level).

The objectives of ECGN as Integrated European Reference System for Spatial Reference and Gravity are

- maintenance of long time stability of the terrestrial reference system with an accuracy 10^{-9} for Europe especially in the height component
- in-situ combination of geometric positioning (GPS) with physical heights and other Earth gravity parameters in 1 cm-accuracy level
- modelling of influences of time depended parameters of the solid Earth of the Earth gravity field, the atmosphere, the oceans, the hydrosphere for different applications of positioning

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- contribution to the European gravity field modelling as part of a global gravity model
- modelling of gravity field components to validate the satellite gravity missions CHAMP, GRACE and GOCE
- platform for further geo-components (GMES, GEOSS, GGOS).

Since the EUREF Symposium 2003, where the concept and status of the ECGN project were presented (Ihde et al., 2003), two meetings of the ECGN working group took place. In September 4-5, 2003 in Frankfurt/Main (Germany) the first ECGN Working Group meeting considered:

Status of the 1st Call for Proposals, elements of the ECGN station implementation (space techniques, gravity techniques, levelling, tide gauges, local ties), agreement about the criteria for evaluation and selection of the proposals, evaluation and selection of the proposals, ECGN metadata base. Main result was the evaluation of the proposed ECGN stations.

After the first ECGN Working Group meeting the technical guidelines were completed and published at the ECGN home page. Each participating organization received a letter explaining the criteria for the station evaluation and the results for the proposed ECGN stations in October 2003. At the same time they got the information about the technical requirements for the different measurement techniques and a request to fill out the metadata forms for their stations. The metadata forms for stations in Great Britain, Switzerland and Germany were received before the second ECGN Working Group meeting.

In Walferdange (Luxembourg) in May 17-18, 2004 the second ECGN Working Group meeting took place with the main items: Status of the ECGN station establishment, possible complements to the network, topicality of the guidelines for the different measuring techniques, questions concerning the organization of the absolute gravimeter measurements and comparisons, establishment of the data base for absolute gravimeter measurements and reparation of the 2nd Call for Participation.

2 Status of the ECGN stations and possible complements

The call for participation is structured in two stages. The first call is directed to the implementation of the ECGN stations following the concept of the project. In parallel the ECGN working group will prepare the second call for analysis and investigations. In the first step, the main action of the ECGN working group will be a pilot study for the combination of the different observations using available collocations at stations e.g. Medicina, Wettzell etc. and by this to get experiences in the combination of spatial information with gravity field related data.

Implementation of the ECGN stations (First Call)

This call concerns the establishment of the observation network of ECGN stations. The ECGN stations have the standard observation techniques:

- GNSS (GPS/GLONASS, GALILEO) - permanent
- gravity (super-conducting gravimeter and/or absolute gravimeter) - permanent or repeated
- levelling connections to the UELN/EVRS - repeated
- meteorological parameters - permanent.

For the realisation of the EVRS (Ihde, Augath, 2000 and 2002), the connection to tide gauge projects and the recording of vertical changes between sea level and the solid Earth surface, it is necessary to include selected tide gauges (permanent) along European coast lines.

Standard for the ECGN stations is a local network for the determination of eccentricities at a 1.0 mm accuracy level in all three spatial components (repeated). All types of observation techniques at an ECGN station should be situated within a distance of about 1 km.

Optional are the establishment of ground water gauges at gravity stations and absolute gravity observations at tide gauge stations.

Validation of the 1st Call proposals

At the first ECGN working group meeting on September 4-5, 2003 in Frankfurt/Main the proposed stations were evaluated. Proposed were 74 Stations in 21 European countries. The members of the working group agreed on criteria for the four station categories:

- core station - if the criteria of ECGN are fulfilled and additional special conditions exist like fundamental station/observatory and/or measurements of a Super Conducting Gravimeter
- station ok - if criteria are fulfilled at present or will fulfilled in the future respectively are planned
- candidate station - few of the criteria are not fulfilled (e.g. permanent GPS not yet realised)
- proposed station - at present several criteria are not fulfilled and not likely in the future.

Considering the situation of the proposed network, 8 stations were selected as core stations, 42 have the "ok"-status. As result we have in summary 50 ECGN stations. 7 Stations were identified as candidates and 17 proposed stations.

New proposals for the station Brest (France), Tscherlling, Ijmuiden, and Westerbork (Netherlands) were received and included in the ECGN station list. The necessity of additional stations of the ECGN in France (Grasse, Marseilles, Chite), Hungary (Penc), Luxembourg (Walferdange), Poland, Slovakia and Iceland is emphasized.

The actual distribution of ECGN stations in Europe is shown in figure 1. Detailed information about the status, measurements in the different technologies can be found in the list of ECGN stations in annex 1. Also the status of metadata forms is visible.

ECGN - Stations

Status: 2005-03-24

Status and Techniques (Standard: GPS, absolute gravity, levelling)

core station	●	super conducting gravimeter	○
station	•	tide gauge	△
candidate station	■		
proposed station	✦		

Figure 1: ECGN – Stations

3 ECGN Standards and Guidelines

For each main observation technique (GPS, gravity measurements, levelling, tide gauge) guidelines and forms for acquisition of data were prepared. They include details about the execution of measurements, the expected accuracy as well as information about collecting of data. Generally already existing data bases will be used for the ECGN project.

All ECGN stations are or should become part of the EPN (Bruyninx et al., 2002 and 2003; Habrich 2003). For GNSS observations and data flow, the guidelines for EPN stations & Operational Centres have to be fulfilled (http://www.epncb.oma.be/_organisation/guidelines/).

For absolute gravity measurements, agreements and standards are in preparation, including data formats for archiving (see ECGN Website http://www.bkg.bund.de/ecgn – Guidelines / Forms). For the absolute gravity measurements an own data base will be established (see clause 5).

For super conducting gravimeter observations, the agreements and standards of the Global Geodynamic Project (GGP) are definite (http://www.eas.slu.edu/GGP/ggpas.html).

All ECGN stations should be connected to the United European Levelling Network – UELN (Sacher et al, 1999, 2002, 2003). The rules for connection the ECGN station to UELN are described in the guideline and the corresponding measurements data should be registered in the ECGN Levelling Form (see ECGN Website – Guidelines / Forms)

The tide gauges have to be realised following the requirements of the Permanent Service of Mean Sea Level – PSMSL (http://www.pol.ac.uk/psmsl/datainfo/contrib.html).

At an ECGN station the observation points of the different techniques should be located in close distance. According to the conditions of the ECGN station each type of observation has its own marker and one marker becomes the main reference. Local ties to this marker the need to be determined, confer ECGN Standards for Local Ties Determination (on ECGN Website – Guidelines / Forms).

4 Organization of absolute gravimeter measurements at the ECGN stations and comparison of absolute gravimeter instruments

Related to the international metre convention and the requirements of the IAG the “Working Group of the Consultative Committee on Mass and Related Quantities (CCM)” organized a “Working Group on Gravimetry (WGG)” at BIPM and the IAG Sub-Commission 2.1 “Gravimetry and Gravity Networks” established the “IAG Study Group 2.1.1 on Comparison of Absolute Gravimeters”. As a result international comparisons of absolute gravimeters are organized and carried out in four-yearly intervals at the BIPM in Sèvres (France).

A service, which supports and coordinates the realization of absolute gravimeter measurements and the exchange of experiences and results on the international level is still missing. Generally, the absolute gravimeter measurements need to be organized and financed by the owners of the instruments on a national level. Measurements in countries with no absolute gravimeter instrument need to be organized in bilateral cooperation.

For that reason, the responsibility for the realization of the absolute gravimeter measurements at the ECGN stations generally belongs to the station owner respectively the organization, which suggested the station for ECGN. The countries or agencies, who are not owners of an absolute gravimeter instrument have to make agreements with the corresponding institutions.

In principle, about 10 absolute gravimeter instruments potentially could be used for the measurements at the ECGN stations. This means, that each instrument has to measure at 5…9 stations per year, taking into account the number of about 70 stations and the repetition rate of 0.5…2 observations per station and year. The absolute gravimeter instruments, which are used for the measurements at the ECGN stations, have to be compared. It is be recommended to take part in intercomparison campaigns once per year in general, but at least once in two years.

The BIPM (in Serves) carries out such comparisons every 4 years. Also the ECGS is doing regular comparisons of.

5 Establishments of a data base for absolute gravimeter measurements

For the ECGN a data base for absolute gravimeter measurements is necessary. The ECGN Working Group suggested to collect the project output file of the g-software, a gravity station description file and a graphical representation of the observations (“set”-output file). Additionally, information about the single absolute gravimeter instruments, the results of the instruments at comparison campaigns etc. have to be collected. Advantages and disadvantages of a centralized/decentralized data bank were discussed. The model of a decentralized data bank was favoured as an easier solution. That means, each station owner and each instrument owner should provide the necessary information in a common format on a local web page accessible from the ECGN web site realisation. In this way, the centralized part of the data bank can be reduced to a collection of links at the ECGN home page to the individual web pages of the participants. This model warranties the most actual and valid information, avoids problems with the data policy and minimises the effort to host the common data pool.

During the meeting on September 4-5, 2003 it was agreed that the absolute gravity data format for archiv-

ing as proposed by BGI has not yet reached a status that it might be applicable for the groups working with the FG5 gravimeters within the ECGN project. The necessary specifications for the ECGN project should be fulfilled in an easy way making use of the procedures already applied by the majority of applicants and avoiding additional effort by reformatting or duplicating the information which is already available after the measurements.

Therefore, a specification in three levels was presented. This proposal is based upon the assumption that all participating groups use measurements with the FG5 gravimeter and apply the producer-provided observation software.

1st level:

The lowest and most complete level of the data storage would be the *raw data measurement files*. It is assumed that every absolute gravity team store the own data according to an own data base system. Part of this lowest level would be the gravity estimate for each single drop measurement.

2nd level:

This level would comprise the so-called *project files* and the *set-files*.

The *project file* holds every information related to the measurement station, instrument, actual measurement campaign and the data evaluation.

The *set-file* presents the processing results as a time series of hourly least squares results with statistical information about the single drop dispersion, and includes all relevant applied corrections in the reprocessing execution as separate quantities.
see enclose files:

3rd level:

The most condensed level of the gravity determination includes the gravity result of the complete station occupation at a certain epoch for a specified reference height with an error estimate. A graphical representation makes the time variation of the gravity series visible. In addition it is proposed to include photos of the station outside and the instrument setup at the site to be able to detect occupation-specific influences upon the gravity determination.

In addition it was identified that some additional information will be important for the interpretation of the gravity determination like

- reductions for eccentric occupations
- environmental data (ground water etc.)

The general situation at each station will be described in a site description form which has to be agreed on. It should be added that agreements have to be found concerning processing parameters, error estimates and best correction models for external influences etc.

6 Preparation of the 2nd Call for Participation

The possibilities of the ECGN project are especially defined in the combination of different observation techniques, which enables a cross-validation of the results of the single techniques. The re-computation of the **E**UREF **P**ermanent **N**etwork (EPN) for investigations of secular height changes at the ECGN station seems useful. This can only be realized on the basis of a reanalysis of the IGS network, which is currently running. Generally, this project could provide the basis for a recomputation of a continental network (homogeneous reference frame, satellite orbits, earth orientation parameters etc. on the whole observation period). In a possible re-computation, all observations at the ECGN have to be included, that means also observations, which were made before the use of the station in the EPN network.

For the second call the following commitments and additional information should be considered:

- possible cooperation with the European groups of IVS and ILS
- combination of Super Conducting Gravimeter and Absolute Gravimeter measurements (which should be in the responsibility of the ECGN station owner)
- data policy of Super Conducting Gravimeter measurements
- comparison of time series of Absolute Gravimeter measurements, GPS and tide gauges
- Absolute Gravimeter observations near space geodetic techniques give independent measurements of vertical rates; this could help to solve the space geodetic problem of the stability of the reference frame
- compare EPN at coastlines with geological rates and tide gauge rates
- due to the GPS problem with the reference frame, the height variation is not always correct; this is the case for regional and global networks

ECGN is related to the long-term stability of the geometrical reference frame especially in the vertical component. Many stations in the ITRS get a vertical velocity set to zero, so it is clear that there is no real convention on how to deal with the vertical component. GPS vertical rates have an accuracy of only 2-3 mm/year due to the reference frame problems. There are scale differences between SLR and GPS; different height velocity signals (even with opposite signs at some stations) have been observed. Using gravity observations, you could use an additional independent observation (esp. absolute gravity) of the height change. We should try to compare both data types and try to find the reason for the differences. As a result we will be able to distinguish between land uplift and sea-level change.

Ask for an Analysis Center that will (re)analyze ECGN stations together with stations from a global network in order to improve long-term stability of the GPS-based height component of the ECGN stations.

7 Summary and conclusions

Summarising all aspects, it was decided that the intended 2nd call focussing on the methodology and data analysis has to be postponed because the currently available extent of information for the ECGN stations and their quality has to be improved first (metadata forms, availability of measurements, data policy, reanalysis of GPS observations etc.) in order to reach the goals of the project.

In general the ECGN project bases upon existing projects and data files in a certain combination.

A service, which coordinates and supports the realization of absolute gravimeter measurements and the exchange of experiences on an international level is still missing. Generally, the absolute gravimeter measurements should organized and financed on a national level by the owners of the instruments. Measurements in countries with no absolute gravimeter instrument need to be organized in bilateral cooperation. The absolute gravimeters available for ECGN measurements have to be compared. It will be recommended to take part in comparisons or calibration campaigns ones per year in general, but at least every two years.

The ECGN Working Group is preparing standards for an absolute gravity data base. The model of a decentralized ECGN data bank was favoured. That means, that each station owner and each instrument owner should provide the necessary information in a common format on the own web page.

Only the information about the availability of the data, i.e. the metadata should be collected:

- therefore in the metadata form the availability of the data and the access to the data should be described
- the local ties are also a part of the ECGN metadata form (see ECGN Website – Guidelines / Forms)

Additional stations in France (Montpellier, Grasse, La Rochelle, Marseilles, Chite), Hungary (Penc), Luxembourg (Walferdange), Poland, Slovakia and Iceland are necessary complements to the network. A recomputation of the EPN network for investigations of secular height changes at the ECGN station is necessary.

At the ECGN Home Page with address http://www.bkg.bund.de/ecgn the actual map and list of ECGN stations, the guidelines, forms and other relevant information can be found.

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Annex 1 List of ECGN Stations

Status: 2005-03-24
Status of Proposals: 2004-09-29, # Countries: 21, # Stations: 74

Country	Site Name	Station Code (GPS)	GPS Status (EPN)	absolute gravity measurement	Super conducting gravimeter (SG)	Levelling	Tide Gauge	EUVN point (close toECGN point)	SLR	VLBI	Meteorology	other Technologies	Comment	Status	Metadata form
		[..] code not available, temporary defined code	(p) = planned			1=UELN 2=national network							necessary supple-ments/ arrangements	core ok c = candidate p = proposed	
AT	Graz	GRAZ	EPN	1998, 2001		1	no	GRAZ	permanent		yes	SLR		ok	yes
AT	Hafelekar	HFLK	perm (IGS)	2003, 2004	no	not possible	no	no	no	no			EPN	ok	
AT	Kops	[KOPS]	perm (p) 09/2003	2004	no	planned	no	no	no	no			EPN, UELN	1	
AT	Pfaender, Moos, Bregenz	PFAN	EPN	1988 Bregenz, 2004	no	1	no	PFAN	no	no				ok	yes
AT	Trafelberg	[TRAF]	perm	2003	planned for 2004	planned	no	no	no	no	yes	seismometer	EPN, UELN	ok	yes
AT	Vienna	[VIEN]	perm		(yes)		no	no						1	
AT															
BE	Brussels	BRUS	EPN	1995,1997 now own FG5		1	no	BRUS						1	
BE	Dentergem	DENT	EPN			1	no	DENT						1	
BE	Membach	[MEMB]	perm	time series	yes		no	no						1	
BE														1	
BG	Rojen	[ROJE]	perm (p)	planned			no	no						p	
BG	Sofia	SOFI	EPN	1998, 2001 form UNIGRACE Station PLANA ~9 km		2	no	BG03					eccentricity, UELN	ok	
BG	Varna	[VARN]	perm (p)	UNIGRACE Station		2	yes	BG04						p	
BG															
CH	Zimmerwald L+T 88	ZIMM	EPN	1997, 2004, time series planned		1	no	ZIMM	permanent		yes	Earth tide gravimeter, astro measurements (zenith camera), astronomic project CQSSP - link to astron. reference system), meas. of high-frequency gravity variations		core	yes
CH															
CZ	Pecny, Ondrejov, Geodetic Observatory	GOPE	EPN	time series since 1978, now own FG5		1	no	GOPE			yes	relative gravity measurements, tidal gravity variations		core	
CZ															
DE	Bad Homburg	[HOMB]	perm (p)	time series	since 1983		no	no						p	yes
DE	Borkum	BORK	EPN	2001			yes (1)	no						1	
DE	Braunschweig	PTBB	EPN	1977, 1994, 2000,			no	no						1	
DE	Dresden	DRES	EPN	1994,			no	no						1	
DE	Helgoland Island	HELG	EPN	1997, 2001, 2003	no	2 1 - planned	yes (since 1924)	no	no	no				ok	yes
DE	Karlsruhe	KARL	EPN	1988, 1993, 1994, 1995			no	no						1	
DE	Kloppenheim	KLOP	EPN	time series Bad Homburg?			no	no						1	

Country	Site Name	Station Code (GPS)	GPS Status (EPN)	absolute gravity measurement	Super conducting gravimeter (SG)	Levelling	Tide Gauge	EUVN point (close toECGN point)	SLR	VLBI	Meteorology	other Technologies	Comment	Status	Metadata form
		[..] code not available, temporary defined code	(p) = planned			1=UELN 2=national network							necessary supple-ments/ arrangements	core ok c = candidate p = proposed	
DE	Moxa	MOXA	perm	2001, Nov. 2002, May 2003	yes	planned	no	no	no	no	yes		EPN, UELN	ok	yes
DE	Potsdam, Geo-forschungszentrum	POTS	EPN	1976, 1978, 1980, 1983, 1986, 1988, 1990, 1994, 1997		1	no	POTS						1	
DE	Sassnitz	SASS	EPN	May 2003	planned	2	yes (since 1882)	no	no	no	yes		UELN	ok	yes
DE	Wettzell	WTZR	EPN	twice a year	yes	1	no	WTZR	permanent since 1988	permanent since 1983	yes			core	yes
DE															
DK	Kellyville (Kangerlu)	KELY	EPN	1995, 1996, 1997, 1998, 1999				no						1	
DK	Qaqortoq, Greenland	QAQ1	EPN	planned			yes	no			yes		AG	ok	
DK	Smidstrup	SMID	EPN	planned		2	no	no					AG, UELN	ok	yes (LevForm)
DK	Suldrup	SULD	EPN	planned		2	no	no					AG, UELN	ok	yes (LevForm)
DK	Thule AFB, Greenland	THU1	perm	1988				no						1	
DK															
EE	Suurupi	[SUUR]	perm (com-muni-cation problems)	1995 + planned		1		EE02					EPN	ok	
EE															
ES	A Coruna	ACOR	EPN	in study		1	yes	ES05					AG	c	
ES	Albacete	ALBA	perm	in study			no	no						p	
ES	Alicante	ALAC	EPN	1998, planned for 2003		1	yes	ES01						ok	
ES	Almeria	ALME	EPN	planned for 2003		1	yes	ES02					AG	ok	
ES	Caceres	CACE	EPN	in study			no	no						p	
ES	Ceuta	CEUT	EPN	1994, 1998			yes	no					UELN	ok	
ES	Ebre	EBRE	EPN			1	yes (3)	EBRE						1	
ES	Huelva	HUEL	perm	in study			yes	no						p	
ES	La Palma	LPAL	EPN			Island	no	no						p	
ES	La Rioja	RIOJ	perm	2002			no	no					EPN, UELN	c	
ES	Madrid MAD2	MAD2	perm	1989, 1998, now own FG5		1	no	MADE						1	
ES	Madrid MADR	MADR	perm	1989, 1998, now own FG5		1	no	MADE						1	
ES	Malaga	MALA	perm	2002			yes	no					EPN, UELN	c	
ES	Palma de Mallorca	MALL	EPN	in study		2 Island	yes	ES06					AG, UELN	c	
ES	San Fernando	SFER	EPN	1994, 1998		1		SFER	permanent					1	
ES	Santander	CANT	EPN	planned for 2003		1	yes	ES08					AG	ok	
ES	Sonseca	SONS	perm	2002			no	no				seismograph	EPN, UELN	c	
ES	Valencia	VALE	EPN	2002			yes	no					UELN	ok	
ES	Vigo	VIGO	perm	in study			yes	no						p	
ES	Yebes	YEBE	EPN	planned for 2003			no	no		permanent		radioastronomy	AG, UELN	ok	
ES															
FI	Degerby	[DEGE]	perm			1	yes	FI01					EPN, AG	ok	
FI	Joensuu	JOEN	EPN	1999		1	no	JOEN						ok	

Country	Site Name	Station Code (GPS)	GPS Status (EPN)	absolute gravity measurement	Super conducting gravimeter (SG)	Levelling	Tide Gauge	EUVN point (close toECGN point)	SLR	VLBI	Meteorology	other Technologies	Comment	Status	Metadata form
		[..] code not available, temporary defined code	(p) = planned			1=UELN 2=national network							necessary supple-ments/ arrangements	core ok c = candidate p = proposed	
FI	Metsähovi	METS	EPN	time series	yes	1	yes	METS	permanent	mobile (1989), permanent in 2003		DORIS (permanent), GLONASS		core	
FI	Sodankylä	SODA	EPN	1976, 1980, 1988, 1992, 1998		1	no	SODA						ok	
FI	Vaasa	VAAS	EPN	1995, 1999		1	yes	VAAS						ok	
FI															
FR	Ajaccio	AJAC	EPN			2	yes (2)	FR01	mobile					1	
FR	Brest	BRST	EPN	1998, 1999, 2001, 2003		1	yes	FR04		mobile	in study			ok	
FR	Dourbes	DOUR	EPN				no	no						1	
FR	Marseille	MARS	EPN			1	yes (1)	FR06						1	
FR	Strasbourg STJ9	STJ9	perm	time series, 1997 - ongoing	yes		no	no				water table gauge 1987- ongogin, relative grav. measurements, seisometer	EPN, UELN	core	
FR	Toulouse	TOUL	perm			1	no	TOUL						1	
FR	Welschbruch, Vogese Mountains	WELS	perm	time series, 1997 - ongoing			no	no					EPN, UELN	ok	
FR															
GB	Herstmonceux	HERS	EPN	yes (Spring 2005)		1	no	HERS	yes					ok	yes
GB	Newlyn	[NEWL]	perm	1995-2003		1	yes, funda-mental tide gauge for GB	GB08 (10 m)					EPN	ok	yes
GB															
HR	Dubrovnik	DUBR	EPN	1999, 2000		1	yes (1)	HR03						1	
HR	Osijek	OSJE	EPN	2000			no	no						1	
HR														1	
HU	Penc, FOMI Satellite Geodetic Observ.	PENC	EPN	1998, 2000,		1	no	PENC						1	
HU														1	
IS	Hoefn	HOFN	EPN	1997, 1998		no		HOFN		mobile (1992)		PRARE (permanent)		p	
IS	Reykjavik	REYK	EPN	1988, 1997		no	yes	REYK				DORIS (permanent)		p	
IS															
IT	Bologna	BOLG	EPN	Jan 2002, Jan 2003, Aug 2003		1	no				yes	INSAR-data		ok	
IT	Genova	GENO	EPN			1	yes (2)	IT05						1	
IT	Matera	MATE	EPN			1	no	MATE	permanent	permanent		PRARE		1	
IT	Medicina (University of Bologna)	MSEL	EPN	time series since 1996	yes		no	MEDI		yes	yes	axis bi-axial tiltmeters, INSAR-data, geological surveys, water tabel level variations	UELN	(core)	
IT	Noto - Radioastronom	NOTO	perm			1		NOTO						1	
IT	Padova, University	UPAD	perm			1	no	UPAD						1	
IT															
LT	Vilnius	VLNS	EPN	1994, 2002Exz. GPS-Grav ~8 km		1	no	LT02					eccentricity	ok	
LT															
LU	Walferdange	[WALF]	perm	time series	yes		no	no						1	
LU														1	
LV	Irbene	[IRBE]	perm			1		LV04		yes		radioastronomy	EPN, AG	ok	
LV	Riga	RIGA	EPN	1995, 1996, 2004		1	yes	RIGA	permanent					ok	
LV															
MD	Balti	[BALT]	no				no	no						p	

Country	Site Name	Station Code (GPS)	GPS Status (EPN)	absolute gravity measurement	Super conducting gravimeter (SG)	Levelling	Tide Gauge	EUVN point (close toECGN point)	SLR	VLBI	Meteorology	other Technologies	Comment	Status	Metadata form
		[..] code not available, temporary defined code	(p) = planned			1=UELN 2=national network							necessary supple-ments/ arrangements	core ok c = candidate p = proposed	
MD	Chisinau	[CHIS]	no				no	no						p	
MD	Comrat	[COMR]	no				no	no						p	
MD															
NL	Ijmuiden	[IJMU]	perm (p)			2	yes						EPN, UELN	ok	
NL	Terschelling	TERS	EPN			1	yes	TERS						ok	
NL	Westerbork	WSRT	EPN	yes	planned	1	no	WSRT	infra-structure available	yes	yes	Earth tide gravimeter		ok	
NL															
NO	Bodø	[BODO]	perm					no						p	
NO	Ny-Alesund NYAL	NYAL	perm	1998, 2000, 2001, time series	yes		yes (2)	NYAL	yes			DORIS, PRARE		1	
NO	Ny-Alesund NYA1(EPN) / NYAL	NYA1 / NYAL	EPN	1998, 2000, 2001, time series	yes		yes	NYAL	yes	permanent		DORIS, PRARE	UELN	core	
NO	Stavanger STAV	STAV	perm	1991, 1993, 1995		1	yes (1)	NO02						1	
NO	Stavanger STAS (EPN) / STAV	STAS / STAV	EPN	1991, 1993, 1995		1	yes	NO02						ok	
NO	Tromsoe TRO1	TRO1	EPN	1992, 1993, 1995, 1998			yes	TROM	mobile	mobile (Aug 1997)		SATREF	UELN	ok	
NO	Tromsoe TROM	TROM	perm	1992, 1993, 1995, 1998			yes (2)	TROM	mobile	mobile (Aug 1997)		SATREF		1	
NO	Trondheim TRON	TRON	perm	1995, 1998			yes (3)	no		mobile				1	
NO	Trondheim TRDS (EPN) / TRON	TRDS / TRON	EPN	1995, 1998			yes	no		mobile			UELN	ok	
NO	Trysil	[TRYS]	perm	1991,1993,1998, 2001,2003			no	no		mobile			UELN, EPN	ok	
NO	Vardø	VARS	EPN			1	yes	NO12						p	
NO															
PL	Borowa Gora	BOGO	EPN	1980, 1992, 1995, 1996, 1997, 2000		1	no	BOGI				permanent magnetic station, astronomic observ., earth tide registration 2004, SLR		ok	status report announced
PL	Jozesfoslaw	JOZE	EPN	time series		1	no	JOZE						1	
PL															
PT	Cascais	CASC	EPN			1	yes	PT02			yes		AG	c	yes
PT	Gaia	GAIA	EPN				yes	no			yes			p	yes
PT	Lagos	LAGO	EPN			1	yes	PT05			yes		AG	c	yes
PT															
RU	Zelenchukskaya	ZECK	EPN	1994			no	no						1	
RU														1	
SE	Borås	SPT0	EPN	2003		2		no			yes	GLONASS	UELN	ok	
SE	Kiruna KIR0	KIR0	EPN	1995, 2003, 2004		1	no	KIR0				GLONASS		ok	
SE	Kiruna KIRU	KIRU	EPN	1995			no	no						1	
SE	Mårtsbo	MAR6	EPN	1993, 1995, 2003, 2004		1	yes	MAR6				GLONASS		ok	
SE	Onsala	ONSA	EPN	1993, 1995, 1998, 2003, 2004		1	13 km	ONSA		permanent	yes	GLONASS, Radiometer		core	
SE	Skelleftea, Fu-ruögrund	SKE0	EPN	1993, 1995, 1998, 2003, 2004		1	yes	SE05				GLONASS		ok	
SE	Vilhelmina	VIL0	EPN			1		VIL0						1	
SE	Visby	VIS0	EPN	2004		1	yes	VIS0						p	
SE															