51th Meeting of the EUREF Technical Working Group in Padova, 13. October 2009

Next events:

– EUREF 2010 Spring Meeting: Vienna; Monday, March 8 (half day) – Tuesday, March 9 (full day)
– EUREF 2010 Symposium Meeting: Gävle; Tuesday, June 1 (full day)
– EUREF 2010 Symposium: Gävle; Wednesday, June 2 – Friday, June 4; technical excursion: Saturday, June 5

Meeting place: Palazzo del Bo, University headquarters, Via Otto Febbraio 1848 n. 2, Padova
Time schedule: Tuesday, October 13.2009, 08.30 - 17.30

Agenda

1. Opening
2. Minutes of the 50th TWG meeting in Florence
3. EUREF/EPN web
   a) EUREF home page
   b) EPN coordinates web pages
   c) On-line ITRS/ETRS89 transformations
   d) Monitoring of official national ETRF coordinates on EPN web
4. EUREF Permanent Network
   a) Update EPN Guidelines
   b) Continuous cumulative solutions of EPN LACs – synchronization of solutions and improving EPN combination
   c) Real-time analysis Special Project
5. INSPIRE
   a) Progress report
   b) Possible mechanism for recognition of height systems/frames from EUREF in the perspective of INSPIRE
6. ETRS89 Working Group
7. EVRF Developments
8. ECGN
9. EUVN_DA
   a) New Italian data set for the EUVN-DA project
   b) EUVN_DA status and final report
10. IAG WG “Regional Dense Velocity Fields”
11. EUREF Symposium 2010
    a) Organization
    b) Best student poster award
12. IAG Scientific Assembly
13. Progress on the ZTD evaluation data base
14. EUREF publications
    a) possible overlapping with a.i.14
    b) status EUREF2008 BGG publication
    c) EUREF 2009 BGG publication
15. Journal of Geodesy (JoG)

16. ICG4 report
17. CGPS vs. DInSAR analysis of Aquila earthquake
18. Next TWG Meeting
19. Action Items

Participants

ZUHEIR ALTAMIMI, Paris
ELMAR BROCKMANN, Berne
CARINE BRUYNINX, Brussels (Chair)
ALESSANDRO CAPORALI, Padova
JAN DOUSA, Prague
RUI FERNANDES, Covilhã
HEINZ HABRICH, Frankfurt a.M.
HELMUT HORNIK, Munich (Sub-comm. Secretary)
JOHANNES IHDE, Frankfurt a.M. (Sub-comm. Chair)
AMBRUS KENYERES, Budapest
MARTIN LIDBERG, Gävle
JAAKKO MÄKINEN, Helsinki
MARKKU POUTANEN, Helsinki
HERMANN SEEGER, Bad Neuenahr-Ahrweiler (hon. member)
WOLFGANG SÖHNE, Frankfurt a.M.
GÜNTER STANGL, Graz
JOAO AGRIA TORRES, Lisbon

apologized: WERNER GURTNER, Berne

Minutes

1. Opening

In her property as chairwoman of the EUREF Technical Working Group (TWG), C. BRUYNINX opens the 51th meeting of the EUREF TWG and welcomes the participants. On behalf of the TWG she thanks A. CAPORALI for hosting this meeting. A draft of the agenda has been distributed among the TWG, the participants accept the agenda.

2. Minutes of the 50th TWG meeting in Florence

The minutes of the last TWG Meeting in Florence, 26.05.2009, were distributed among the TWG members. Some few corrections are to be attached. The final text is published in the EUREF homepage <*http://www.euref-iag.net/TWG/EUREF%20TWG%20minutes/51-Padova2009/02-TWG-Florence-2009-minutes.pdf*>.

3. EUREF/EPN web

a) EUREF home page

It is stated that the EUREF Homepage did not develop very well in the recent time. C. BRUYNINX suggests to contact M. VASCONCELOS whether she is able to continue her work as web master parallel to her other duties or the homepage should be managed by someone other. If M. VASCONCELOS will continue, a letter will be written to the director of the Instituto Geográfico Português (IGP) to give more personal assistance to the web master.

b) EPN coordinates web pages

A draft has been distributed and the comments be collected. Any other remarks should be directed as soon as possible. The new website <*http://www.epncb.oma.be/*> will be installed in the next future.

c) On-line ITRS/ETRS89 transformations

C. BRUYNINX presents an example for the on-line coordinate transformation. The link in the EPN website will be sent to the TWG members within one week to check the function. The procedure will enable transformations between all appropriate systems. All colleagues are asked to check the link and give their feedback to C. BRUYNINX within one month. Then the draft will be merged with all comments to compile the final website. The procedure is planned to be developed further on for other tools, too. In order to avoid any misunderstandings by the users, E. BROCKMANN suggests to enclose clear examples.

d) Monitoring of official national ETRF coordinates on EPN web

As E. BROCKMANN reports, this project started on occasion of the LAC Meeting Frankfurt / TWG Meeting Munich (Oct./Nov. 2008): 15 countries delivered national official ETRF coordinates for their EPN stations. Then all other countries were asked to report on it in the national reports presented to the 2009 EUREF Symposium in Florence. Many of the countries

presented detailed information on this topic. A paper *Monitoring of official national ETRF coordinates on EPN web – Project of the EUREF TWG* by E. BROCKMANN was presented to the symposium, too. Subsequently a corresponding resolution (no. 3) was formulated. As reference solution for this call of participation, the ITRF05 densification solution of the EPN published in Dec. 2008 is used. This solution is

- aligned to ITRF2005 with minimum constraints
- data from 0860 – 1355 [same as ITRF2005, Dec. 2005; before Nov. 2006 (week 1400)] EPN_ITRF_C1355.SNX
- based on relative antenna phase center variation model, which is also true for many national reference frame realizations
- regarded as a *scientific* coordinate solution

Further reference solutions with more frequent updates are provided by A. Kenyeres based on every 15 weeks updates.

Since the Florence Symposium, Northern Ireland, the United Kingdom, France (update), Denmark and Croatia have submitted their data. So now 19 of altogether 30 countries involved in the EPN have made their data available. All these counties agreed to publish their coordinates on the EPN web page.

As planned activities E. BROCKMANN describes

- reminder (EUREF mail) to *Resolution 3*
- automated comparisons with scientific coordinates derived within EPN based on 15-weekly updated accumulated solution or last weekly EPN combination; possibly with an automated feedback to the countries
- preparation to make these *official national ETRF coordinates* and the results of the comparisons on the EPN web page visible (presentation at the next EUREF Symposium)
- Development of an update mechanism of coordinate changes (e.g. as established with station log)

An example file for the data is demonstrated in *http://www.swisstopo.admin.ch/swisstopo/geodesy/pnac/divers/etrf_monitor/CCC_YYYYMMDD.ETRF*.

In the discussion it is stated that the countries hardly will change their official coordinate sets due to the results of these investigations. However, the results provide a valuable tool to detect inhomogeneities and errors especially by long time series. Moreover the data can serve for future real-time applications providing a precise and quick access to the national systems and useful background information as well.

4. EUREF Permanent Network

a) Update EPN Guidelines

C. BRUYNINX presents her viewgraphs on the update of Guidelines for EPN Stations and Operational Centres. There are only some small changes, they refer

- real-time streams (introduced concept of multiple regional broadcasters, recommendation to stream ephemerides data)
- site pictures are mandatory
- introduction of on-line site log submission tool
- IERS DOMES number in RINEX header
- updated links.

C. BRUYNINX repeats the *300 km rule* introduced some years ago on request of the TWG to have not too many sites. This rule says that any EPN site must occupy a relevant location into the EUREF Permanent Network and a minimal distance of 300 km to already existing EPN stations is required, accepting the interest of each nation to have at least one EPN station. Exceptions to this rule are possible for stations submitting real-time data, multi-GNSS data, contributing to EPN Special Projects or co-located with other instruments relevant to the purposes of the EPN (e.g. tide gauges, time laboratories). J. IHDE interjects that the general goal fo EPN sites is to have data from other instruments together with multi GNSS, but the case for real time data should not be considered now as exceptional any more because these records meanwhile have become rather usual. M. POUTANEN adds that the geographical distribution of EPN sites still is rather unevenly, thus the NMAs etc should be urged to install sites on adequate places.

Concerning the installation of multi-GNSS antennae to record also Galileo, C. BRUYNINX proposes to wait with the installation till the system really will work. In any case it is recommended to operate for a certain time period the old and the new antenna parallel in order to avoid gaps due to an antenna change. M. POUTANEN recommends to formulate this demand clearly in the guidelines. He further adds that the EPN guidelines also have to be used for the ECGN and thus are to be adapted for this purpose.

It is agreed to wait for the reaction of the IGS and then to continue. Meanwhile a new version of EPN station guidelines concerning the discussed details will be compiled and be circulated among the TWG members. The TWG should send comments within one month. The topic will be discussed at the next TWG.

b) Continuous cumulative solutions of EPN LACs – synchronization of solutions and improving EPN combination

H. HABRICH informs on his activities on this topic. The work comprises

- analysis of existing EPN solutions (weekly LAC sub-networks and their combination)
- analysis of presented EPN solutions (single LAC and preliminary EPN cumulative solution / weekly time line)
- development of comparison methods (between LAC cumulative solutions / existing and new cumulative solutions)
- combination of weekly solutions
- FODITS tool (Find Outliers and Discontinuities in Time Series)
- synchronization of solutions
- comparison of coordinates and velocities yielded by different programmes.

Actually numerical problems in the conversion to SINEX format are investigated in detail. The coordinates are not changed, however, the co-variances are influenced. A common solution to test the ITRF2005 versus IGS05 is in preparation. Basing on the findings a report for each station will be generated and recommendations how to proceed with each individual station be formulated.

c) Real-time analysis Special Project

W. SÖHNE reports on the progress of the project. In the recent time two new sites in Poland joined the network. The project is now linked to the EPN website (*http://www.epncb.oma.be/_organisation/projects/RT_analysis/index.php*). Actually some problems with broad casters arose, the reason might be some still existing bugs in the programmes or in the hardware as well as a too large number of simultaneous accesses or even attacks by hackers. Moreover in the moment there is now only one top level caster and in the case of a break no more data would be produced at all. This non-satisfying situation will be solved by the installation of a so called stand-by to replace caster.

G. WEBER has developed a new concerning web page and implemented in BKG website. This website explains in detail the methods and instrumentation. A link to the EPN website will be installed. The TWG will then be informed by e-mail. W. SÖHNE will report on the topic at the next TWG.

5. INSPIRE

a) Progress report

At the Florence EUREF Symposium J. TORRES had presented a detailed report on INSPIRE. Several TWG members as well as other colleagues form the Working Group for INSPIRE Specifications on Coordinate Reference Systems – Guidelines. The group met in Florence, a draft for guidelines was discussed and compiled. A document has been sent to the INSPIRE Team, however, the concept has been mixed such that a new version has to be prepared.

The main part of INSPIRE refers the supply of 2d/3d-coordinate reference systems for practical use. Proposals for national laws for CRS's are prepared. J. TORRES states that within INSPIRE a large number of different interests meet and have to be unified under one umbrella, thus the products are not always optimal from the geodetic point of view, however, it has to be considered that this way represents a possibility to avoid a separation of interests and the publication of much worse products created by non-experts. The alignment of the ISO standard can be considered as a great effort anyway.

J. IHDE recommends to urge INSPIRE to imply the EPN coordinates and station velocities into the ISO data set as the currently best available one and to communicate that adequately to the public.

The TWG asks J. TORRES to inform M. CRAYMER on the EUREF activities and to arrange the transfer to competent members of the ISO group. Further J. TORRES will watch for expressions of interest where EUREF can play a role. The INSPIRE document will distributed to the TWG.

b) Possible mechanism for recognition of height systems/frames from EUREF in the perspective of INSPIRE

As background to this item M. LIDBERG explains the purpose of INSPIRE to develop rules regarding availability and format of spatial information within the European community. These rules will become mandatory and be included in European law. One important topic for such rules are geodetic reference frames. In these rules it is mandatory to use:

- ETRS89 for geographical coordinates, and as base for coordinates in map-projections
- EVRS for *gravity related heights*.

Stating these demands it has to be assured that ETRS89 and EVRS represent the best available systems. This implies a definition which coordinates and heights can be considered to fulfil the requirements for ETRS89 or EVRS. Concerning the ETRS89 it is usual to recognize and accept *national* realizations by EUREF through resolutions. For the EVRS, however, such a mechanism is missing.

Considering that ETRS89 and EVRS are EUREF *products*, the EUREF sub-commission has to take care for the practical use of these products.

Finally M. LIDBERG proposes

- EUREF should provide possibilities for accepting national realizations of height systems as improvements and/or densifications of EVRS e.g. through resolutions
- EVRF2007 is officially only available at the nodal points, more detailed data are considered as national densifications
- new levellings may be considered as improvements
- an uncertainty level may be stated in the resolution (similar to the *1 cm* sometimes mentioned for ETRS89)

These demands are also in accordance to the MoU between EUREF and EuroGeographics.

J. IHDE adds that the inclusion of new data from the countries is useful at all, the work, however, is enormously time and personnel consuming. On the other hand the offered data have to be accepted for use in order to avoid that other institutions than EUREF would become engaged and thus the common work would be splintered.

As conclusion the TWG asks G. STANGL, M. LIDBERG, J. MÄKINEN, J. TORRES and M. SACHER to work out a document *What does EUREF considers as a realization of EVRS?* and circulate it among the TWG for further discussion.

6. ETRS89 Working Group

M. LIDBERG gives a summarizing review of the tasks for the ETRS89 WG:

- document about the history of ETRS89
- inventory of the use of ETRS89
- ETRS89 concept and user requirements
- future development and implementation of ETRS89

He also mentions Resolution no. 6 of the 2009 EUREF Symposium in which the WG is requested to consider ways to foster the science and the methods employed by EUREF to a broader group of users. This insight implies that the development is getting too complicated and it is difficult for the user community to follow.

The WG met on the day before the symposium and discussed possibilities to fulfill the requirements to this WG. A specific proposal implies the establishment of a training school especially addressing the NMAs or the FIG. It is also stated that with the new procedure from EPN, coordinates and velocities of some 200 permanent GNSS-stations are derived and presented in regular time intervals. Thus a set of reliable stations with ITRF and ETRF coordinates on the Eurasian tectonic plate is available. This implies a considerably increased accuracy compared to the beginning of the 1990's when the current methodology for realization of ETRS89 was developed.

The TWG finally asks M. LIDBERG to prepare in cooperation with J. TORRES an updated list of countries where ETRS89 has been adopted. Further the NMAs should be addressed in this matter. The findings will be discussed at the next TWG meeting.

7. EVRF Developments

The recent progress of the EVRF is presented by J. IHDE. TsNIGAIIK in Moscow has announced to deliver the data for the whole 1.order leveling network of the European part of the Russian Federation. The border connections are not yet clear and will have to be found by the UELN data center. With the inclusion of the Russian data the old problem of closing the Baltic Ring hopefully will be solved. – Further the colleagues of the TsNIGAIIK communicated, that they have also contacted Belarus and organized the participation of Belarus in the UELN project.

Ukraine has decided to participate in the UELN project, the data preparation is in progress. Similar to the connection of Russia and Belarus the determination of border connections to neighbouring countries is not easy. The neighbouring countries were contacted in this matter and agreed to provide the missing data.

Spain has observed a new network between 2001 and 2008 and delivered point information on 136 nodal points, the measurements, however, are still missing. Moreover J. IHDE reports that Turkey has announced to join the UELN, too.

The data of Albania possibly might be available, however, in the moment there is no possibility to connect Albania to the network as Greece, Serbia, Macedonia (FYROM) and Montenegro did not join up to now.

8. ECGN

At present the ECGN Working Group comprises as TWG members M. POUTANEN (chair), C. BRUYNINX, J. IHDE, A. KENYERES, J. MÄKINEN and further the colleagues O. FRANCIS, S. SHIPMAN, J. SIMEK, S. WILLIAMS, H. WILMES. According to an action item of the Florence meeting, M. POUTANEN has sent out a circular to gather some further especially young colleagues. Unfortunately up to now no other colleagues followed this call for participation. Thus everybody is asked once more to engage active members for the WG. In the discussion it is emphasized that the call has to be formulated very carefully in order to convince potential members on the interesting items and possible applications of the ECGN. Therefore M. POUTANEN is asked to organize an ECGN WG meeting before issuing a new ECGN Call for Participation. The call should be sent out before the end of the year.

Another action item referred the revision of the ECGN guidelines and station criteria by the WG, a call for participation has been sent out <*http://www.bkg.bund.*

de/geodIS/ECGN/SharedDocs/Downloads/Publications/eg-Paper1stCall,templateId=raw,property=publicationFile.pdf/eg-Paper1stCall.pdf>. The present guidelines are to be found in <*http://www.bkg.bund.de/nn_162018/geodIS/ECGN/EN/GuidelinesForms/guidelines-forms__node.html__nnn=true*>. It is proposed to complete the update of the guidelines before sending out the new call for participation.

9. EUVN_DA

a) New Italian data set for the EUVN-DA project

A. CAPORALI gives an outlook on the Italian national height system. The height system can be considered as internally consistent, however, the relation to a mean European Height System is not sufficiently consistent. Within the activities in context with INSPIRE homogenization requirements as well as the EUVN_DA project a revision seems urgent. The new data set has to be based on a well selected set of points of known ETRF2000 coordinates (3D), gravity and orthometric height. The national vertical frame has to be connected and homogenised with the EVRS by use of the EGG08 gravimetric geoid and GPS sites with ETRF2000 coordinates being part of the new computed RDN (Italian Rete Dinamica Nazionale).

The hitherto data used for the EUVN had been provided by the IGM data set from 1992-1996. The investigations revealed a systematic deviation which has to be eliminated anyway.

A. KENYERES mentions that the initial plan to complete the EUVN_DA could not be realized, however, the new Italian data promise a great success for the project. – The TWG asks A. CAPORALI and R. MASEROLI to complete the new data set and submit it as soon as possible to the UELN data centre.

b) EUVN_DA status and final report

J. IHDE outlines the objectives of the EUVN densification and the related data (EVRF2007, ETRS89, EGG2007) as

- to provide better information on the national height datum differences
- to help identifying the gravimetric geoid, GPS and/or leveling errors
- to serve datum information to the European geoid determination
- to support the future realization(s) of the continental height reference surface gravimetric/GPS/levelling geoid.

The investigations carried out in the EUVN_DA project were very helpful to detect numerous discontinuities and (systematic) errors in the UELN. However, it has to be accepted that a height network being absolutely free of errors never will be achieved. Therefore J. IHDE recommends strongly to finish the EUVN_DA basing on the present state of art.

J. IHDE shows several examples of systematic deviations (UK, Spain, Portugal). These systematics may be caused by various reasons, in many cases insufficient connections with the main network or local ties may be a reason.

Upon these insights the TWG asks A. KENYERES, J. IHDE and M. SACHER to prepare definitely the final EUVN_DA report for next TWG meeting including new Italian data. This report also should list clearly the open questions which are not yet solved. After this step the improvement of the EUVN-DA aspects in the frame of the European levelling network should be continued under new label. J. MÄKINEN adds to take care for a consistent motivation for a new project in order to urge the concerned countries to give the necessary support.

10. IAG WG "Regional Dense Velocity Fields"

C. BRUYNINX reports on her (together with several co-authors) presentation A *Dense Global Velocity Field based on GNSS Observations: Preliminary Results* to the IAG 2009 Scientific Assembly. The corresponding Working *Group Regional Dense Velocity Fields* of *IAG sub-commission 1.3 Regional Reference Frames* was created on occasion of the XXIV IUGG General Assembly in Perugia/Italy for the period 2007-2011 <*http://www.epncb.oma.be/IAG*>.

The objective of the WG is to provide a globally referenced dense velocity field based on GNSS observations. As items are to be mentioned

- collect GNSS-based SINEX solutions and their meta-data,
- define specifications and quality standards for the submitted SINEX solutions,
- study the strengths and shortcomings of local/regional and continuous/epoch GNSS solutions to determine site velocities,
- define optimal strategies for the combination of regional and global SINEX solutions,
- provide the densification of the ITRF2005 (or its successor).

The work plan for the period 2007-2009 is to gather first experiences and define a strategy, the experiences are presented in the report submitted to the IAG. The second period 2009-2011 refers the practical computation of a dense velocity field.

Referring the strategy, the role of regional sub-commissions (Africa, Antarctica, Asia&Pacific, EUREF, NAREF, SIRGAS) has to be discussed. A. KENYERES has been nominated as region coordinator for Europe. Other questions refer the role of GNSS campaigns and the method how to combine the SINEX files to compute finally the velocities.

The guidelines describe the requests for the included sites, among the rules a minimum of 2 years of continuous data or 2 campaign epochs over a 4 year period is defined. In all, about 6000 sites are proposed to be included, more than 500 of them are located in Europe. The map shows a rather uneven distribution of the sites involved. In order to allow especially the inclusion of sites in less dense covered areas, the guidelines should not be applied too strict.

The experiences show that also in this project the usual problems occur, these are mainly inconsistent site names/dome numbers, inconsistent handling of the solution numbers and discontinuity epochs etc.

C. BRUYNINX emphasizes the enormous work needed to operate the project, so more personnel is urgently needed. Although it is tried to handle problems automatically as much as possible, many problems need to be solved manually.

An updated report will be prepared for the next TWG meeting, this report will especially consider the contribution of EUREF to the project.

11. EUREF Symposium 2010

a) Organization

M. LIDBERG reports on the organizational activities for the 2010 EUREF Symposium in Gävle. A very first version of a link in the EUREF webpage has been prepared. J. IHDE will contact EuroGeographics for a possible financial support for participants from economical weak countries. C. BRUYNINX, H. HORNIK, J. IHDE and M. LIDBERG are asked to propose the sessions titles as well as the nomination of session chairmen.

b) Best student poster award

J. TORRES is asked to contact C. CALVERT to possibly extend the best student poster award. In the case of a positive answer, H. HORNIK and M. LIDBERG will announce that in the webpage very soon to urge applications as many as possible. C. BRUYNINX proposes to mention the winners' names in the EUREF website.

12. IAG Scientific Assembly

J. TORRES, President of *IAG sub-commission 1.3 Regional Reference Frames* reports on the IAG Scientific General Assembly 2009 *Geodesy for Planet Earth* from 30.09.-04.10.2009 in Buenos Aires, Argentina. The sub-commissions were well presented, mainly from SIRGAS and EUREF numerous presentations were given. J. TORRES mentions a report by BE. RICHTER/BKG on metadata for GGOS as an interesting example of the handling of geographic information which could possibly also be applied for INSPIRE.

J. ALTAMIMI adds that the planned date for the *IAG School on Reference Frames* in the Aegean University, Mytilene, Lesvos, Greece, has been postponed due to the overlap with the 2010 EUREF Symposium for 07.- -12.06,2010 <*http://der.topo.auth.gr/school/*>. Moreover IAG Commission 1 - Reference Frames will hold a Symposium 2010 *Reference Frames for Applications in Geosciences (REFAG2010)* <*http://iag.ign.fr/index.php?id=140*> from 04.10-08.10.2010 in France. The exact venue of the symposium is not yet decided, but will be communicated as soon as possible.

13. Progress on the ZTD evaluation data base

J. DOUSA informs that the focus in his work is now to combine different items. The comparisons between the solutions resulting from GPS, GLONASS and DORIS show interesting details. The data are not public, but can be received on request. A detailed report on the results of long-term comparisons of different tropospheric information will be presented at the next TWG meeting.

14. EUREF publications

a) possible overlapping with a.i.14

No discussion.

b) status EUREF2008 BGG publication

C. BRUYNINX informs that altogether 3 issues of the BGG (Bulletin of Geodesy and Geomatics Information) for selected contributions to the EUREF2008 Symposium are is going on. One issue is already published, the second one in press and the third one will be published at the end of the year.

c) EUREF 2009 BGG publication

A. CAPORALI mentions that the BGG is still open for contributions to the EUREF 2009 Symposium in Florence. The participants are to be informed by an e-mail.

15. Journal of Geodesy (JoG)

H. HORNIK announces that R. KLEES as Editor in Chief of the JoG has expressed the desire to publish more articles on practical applications in geodesy besides the traditional papers on pure theoretical items. Therefore papers on EUREF would very welcome in the JoG. The waiting time between the submission of a contribution and the publication could be reduced considerably in the last time. Moreover, the *ISI (Institute for Scientific Information) Impact Factor* of the JoG had increased in 2008 to 1.689; the journal is now among the highest ones in the field of geo-sciences.

16. ICG4 report

J. IHDE gives a summarizing report on the Fourth Meeting of the *International Committee on Global*

Navigation Satellite Systems (ICG) held in Saint Petersburg, Russian Federation from 14.-18.09.2009.

The ICG had been established under the umbrella of the UN on a voluntary basis as an informal body to promote cooperation on matters of interest related to civil satellite-based positioning, navigation, timing and value-added services, as well as the compatibility and interoperability of global navigation satellite systems, while increasing their use to support sustainable development, particularly in developing countries.

The members represent the relevant countries which are operating GNSS systems or will do in the near future. Europe is represented by the EU. EUREF is among the associated members of the ICG.

The goals of the meeting were to continue reviewing and discussing developments in global navigation satellite systems (GNSS) and to allow ICG members, associate members and observers to consider matters of interest. Further GNSS science and innovative technology applications and future commercial applications were addressed.

The ICG Working Group D (WG D) on interaction with national and regional authorities and relevant international organizations successfully initiated the work of its Task Forces to develop processes to align and maintain geodetic and time references, which are fundamental to interoperability of GNSS for users. It was also agreed to hold additional workshops in between the annual ICG meetings.

17. CGPS vs. DInSAR analysis of Aquila earthquake

A. CAPORALI reports on the investigations in context with the strong Aquila earthquake (5.8 on the Richter scale) in the region of Abruzzo/Italy on 06.04.2009. Rather near to the epicentre a permanent GPS stations is located, fortunately the station was not damaged. Thus the displacements by the earthquake (up to several cm's) could be recorded very well. The CGPS results were compared with DInSAR (envisat) data as well as an elastic dislocation model. Iso-lines for horizontal and vertical displacements could be derived showing impressively the moment of displacement.

Concluding A. CAPORALI states that these investigations represent an interesting step in research which surely will be developed further on. DinSAR and CGPS both have proved to be sensitive to changes in position of points on the surface in the vertical resp. horizontal. CGPS offers absolute accuracy and better time resolution, it serves as the only technique to monitor frequently such events. DInSAR needs GPS calibration but gives more points, thus their combined use has the potential to provide a new approach to pre-, co-, and post-seismic deformation, and to monitor motions which lead to changes in coordinates.

M. Poutanen adds that the EGU is planing to hold a conference on occasion of the annual Vienna meeting *one year after L'Aquila*. A call for papers has been sent out.

18. Next TWG Meeting

On behalf of the Austrian colleagues, G. STANGL invites the TWG to hold its 2010 Spring Meeting in Vienna. Considering the long agenda, the TWG decides to extend the meeting to 1 ½ days. H. HORNIK will send out a questionnaire to the TWG members for the most suitable date. (The date has been fixed for Monday, April 8, noon – Tuesday, April 9, full day.)

19. Action Items

C. BRUYNINX and H. HORNIK will complete the action items and distribute them among the TWG by circular in the next days.