The EUREF Permanent Network: Recent Developments and Key Issues

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Abstract. The EUREF Permanent GNSS Network is permanently evolving. This paper describes the changes in the network between June 2010 and May 2011.

Keywords. EUREF, GNSS, EPN

1 Introduction and Network Status

The EUREF Permanent Network (EPN) is a network of continuously operating GNSS reference stations maintained on a voluntary basis by EUREF members. The primary purpose of the EPN is to provide access to the European Terrestrial Reference System (ETRS89) by making publicly available the tracking data as well as the precise coordinates of all the EPN stations.

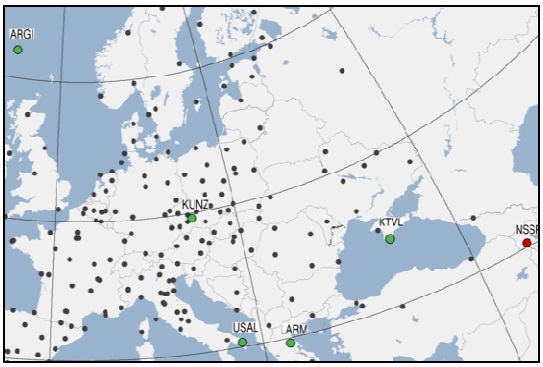

Fig. 1 : EUREF permanent GNSS tracking network (status June 2011); green dots: the stations added to the network since June 2010; red dots: station that was withdrawn from the EPN.

Today, the EPN network consists of 247 continuously operating GPS or GPS+GLONASS reference stations. The 5 new EPN stations that joined the EPN since June 2010 are shown in Figure 1. As can be seen from Table 1, most of them are equipped with GPS/GLONASS receivers. This brings the percentage of the EPN stations providing GPS+GLONASS data to 59% (Figure 2). In addition, 24 of the 27 new antennas/radomes (new stations or replacements at existing stations) introduced in the EPN since June 2010 are already capable to track multiple GNSS.

Table 1. Tracking stations added to the EPN since June 2010, RT: stations streaming real-time data, GLO: stations equipped with GPS+GLONASS receivers, Type: antenna/radome with absolute type calibrations; Indiv: antenna/radome with individual absolute calibrations.

Name	Location	Func-tion	Calib.	From
ARGI	Argir, Tórshavn, Faroe Islands	GLO	Type	27/02/11
KTVL	Katzively, Ukraine	GLO	Type	13/06/11
KUNZ	Kunzak, Czech Republic	--	Indiv.	12/12/10
LARM	Larisa, Greece	GLO GAL	Type	01/05/11
USAL	Lecce, Italy	RT GLO	Type	13/06/10

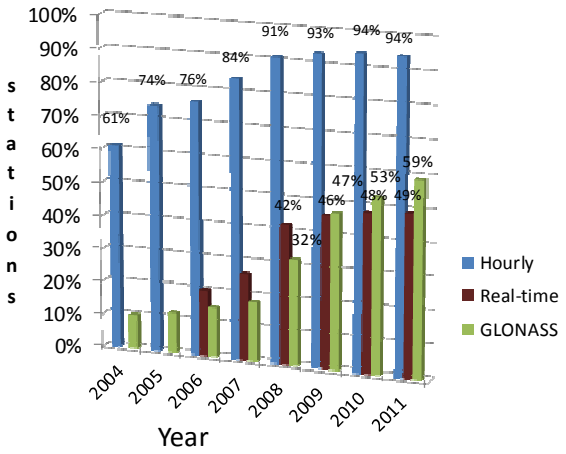

Fig. 2 : Evolution of the percentage of EPN stations providing hourly, real-time and GLONASS data.

All EPN stations should track both GPS L1 and L2 observables, but in addition, if the equipment allows it, it is recommended to also track new satellite signals, such as the GPS L5 signal. At the time of writing, June 20, 2011, GPS PRN 25 (first

Block II-F launched on May 27, 2010) is emitting L5. All following Block IIF satellites that will be launched will also emit L5.

GNSS research centres which are developing GNSS analysis software are in urgent need of these new L5 observables in order to test their software developments. For that purpose, a maximum number of EPN stations needs to track the L5 observable. However, presently a lot of EPN stations who have the capability of tracking L5 do not do so (see Figure 3).

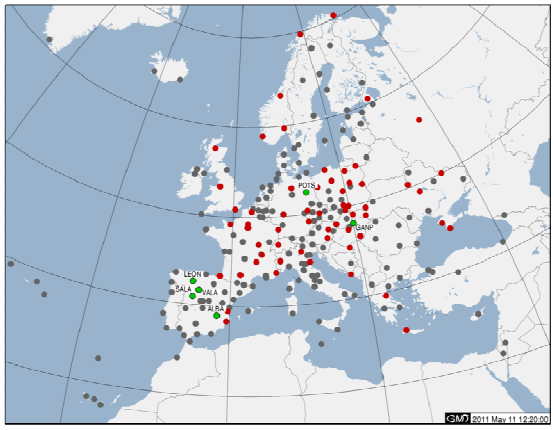

Fig. 3: Map of EPN with GNSS equipment capable of tracking L5. Stations in green include the L5 signal in their RINEX observation files; stations in red do not.

2 New Antenna Calibrations

At GPS week 1632 (April 17, 2011) a new set of antenna calibrations (igs08.atx) was introduced in the International GNSS Service (IGS). This new set of calibrations takes into account the new robot calibrations that were measured since the release of the igs05.atx. These new robot calibrations

- influence existing type mean robot calibrations (by the computation of a new mean),
- introduce new robot calibrations for antenna that previously did not have such calibrations,
- change the calibrations of antenna that are calibrated with respect to the AOAD/M_T antenna (whose type mean robot calibrations have changed).

Within the EPN, the switch to a new set of antenna calibrations is done simultaneously with the IGS and this is also the case for the introduction of the igs08.atx. The main difference with the IGS is that, within the EPN, individual receiver antenna calibrations (available from ftp://epncb.oma.be/pub/station/general/epnc.atx) are used whenever available. These individual calibrations will then be complemented with the calibrations available from igs08.atx. The file that merges the EPN individual calibrations with the igs08.atx is available from the EPN CB at ftp://epncb.oma.be/pub/station/general/epn_08.atx. Figure 4 summarises the changes to the antenna calibration by the switch from epn_05.atx to epn_08.atx.

As since GPS week 1632, the EPN products are computed with this new antenna calibration model, jumps could be seen in the station position time series. However, it is expected that these jumps will be small (few mm) or negligible compared to the jumps that were seen in the past when switching from the igs01.atx to igs05.atx model. For more information on the influence of this antenna calibration change on the EPN station positions, we refer to Baire et al. (2011).

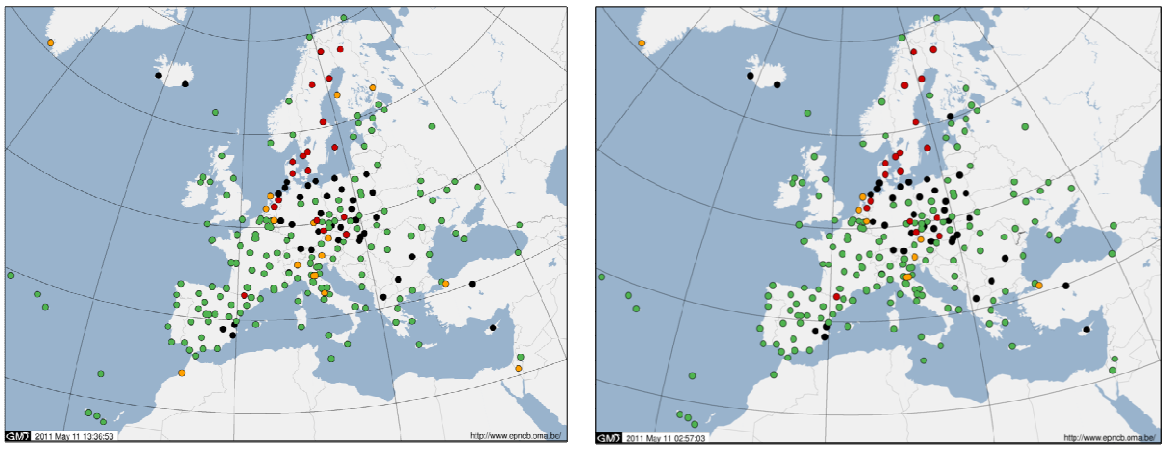

Fig. 4: Overview of the absolute receiver antenna calibrations used in the EPN analysis. Left: using epn_05.atx, right using epn_08.atx. Black: individual calibrations, green: robot calibrations, orange: from field/relative calibrations, red: uncalibrated radome. The circles indicate regions were a clear improvement is seen.

3 ITRF2008/IGS08 Frames

The ITRF2008 was released in May 2010 and the GNSS contribution to it is based on the weekly IGS solutions from Jan. 1997 till Dec. 2007. Compared to the ITRF2005, a lot more EPN stations are included in the ITRF2008 (see Figure 5). As the GNSS contribution to the ITRF2008 has been computed with the igs05.atx calibration model, it is incompatible with the igs08.atx model. For that reason, the IGS has released its own version (IGS08) of the ITRF2008 consisting of a sub-set of the ITRF2008 stations whose coordinates have been corrected (by applying an offset) to make

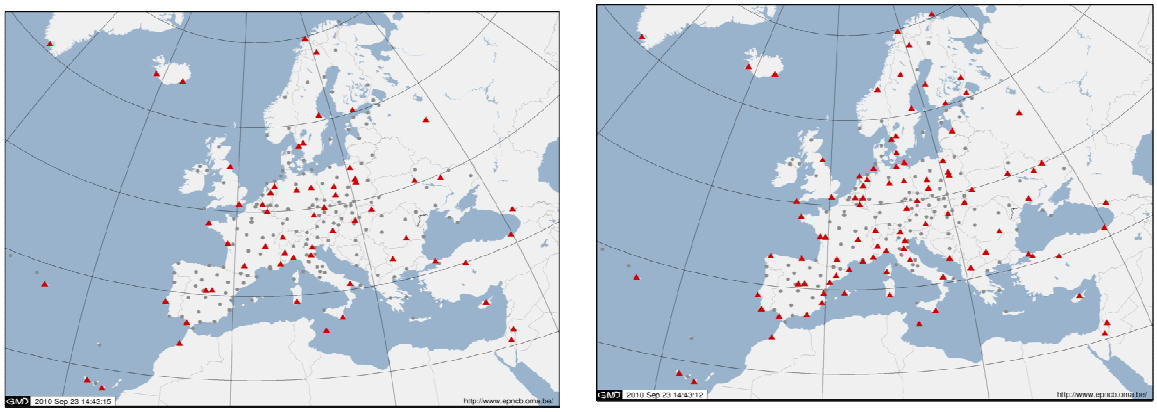

Fig 5 : EPN stations belonging to ITRFyy (red); Left: ITRF2005 (84 stations), right: ITRF2008 (121 stations)

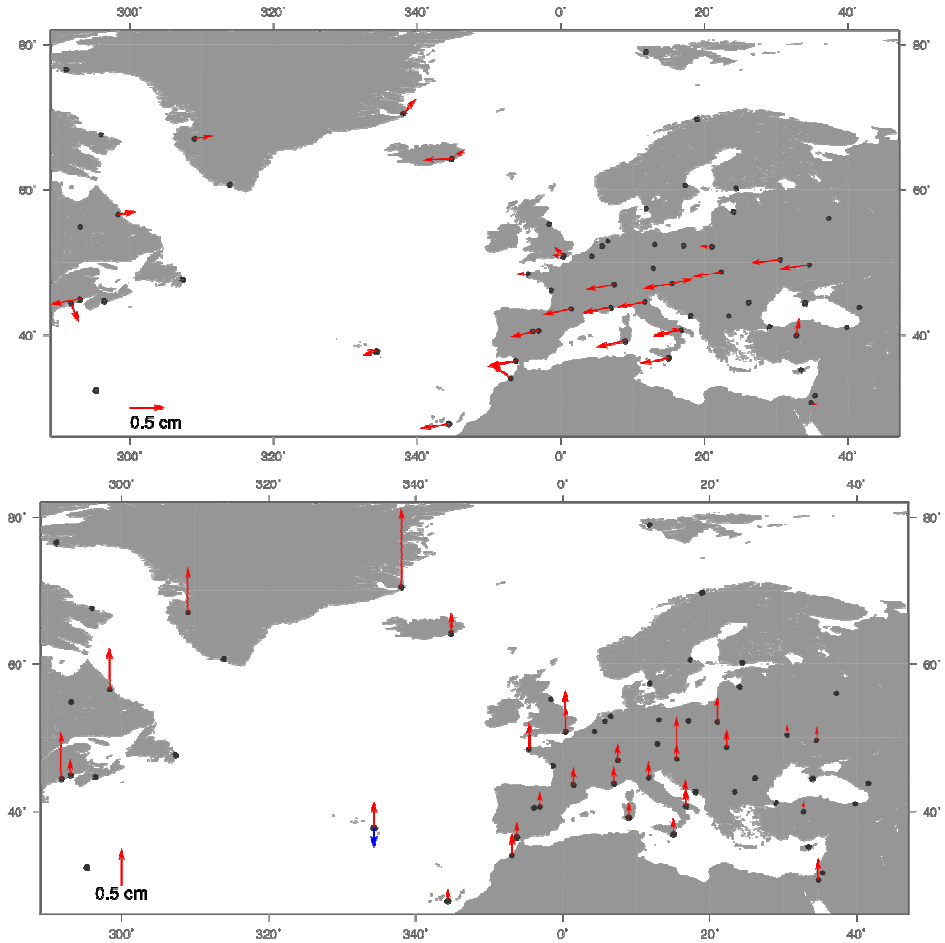

Fig. 6: Position differences between IGS08 and ITRF2008.

them consistent with the igs08.atx.

These corrections have only been applied for stations where the offset is considered as significant by the IGS. In practice this means: stations for which the horizontal offset exceeds 1.2 mm or the vertical offset exceeds 3 mm. The coordinate difference between the ITRF2008 and IGS08 only affects the positions (see the map in Figure 6) as the velocities are identical. Figure 7 shows that out of the 121 ITRF2008 stations in the EPN, 56 are also included in the IGS08.

Fig. 8: EPN stations belonging to ITRFyy (green) and to the IGS08 (red).

5 Summary

Within the last year, 5 new EPN stations joined the EPN bringing the total number of EPN stations to 247. The EPN tracking network is becoming a real multi-GNSS tracking network with a total of 59% of the EPN stations tracking GPS and GLONASS signals. In addition, also the large majority of the new antenna/radome pairs introduced in the EPN over the last year is capable of tracking multiple GNSS. However, stations should pay attention to tracking the unhealthy satellites, and if possible, activate L5 tracking.

With the introduction of a new set of antenna calibrations (epn_08.atx) in April, 2011, the number of EPN stations equipped with antenna/radome pairs with absolute calibrations still grows.

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References

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