Comparison of Receiver Antenna Calibration Models used in the EPN

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Abstract. A new set of igs08.atx antenna calibrations have been released this year. This paper investigates the impact of the introduction of the new calibrations on the estimated EPN station coordinates.

Keywords. EUREF, GNSS, Antenna, Calibration

1 Introduction

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).

The Figure 1 summarizes those changes on the analysis of the EPN Network.

Similar to the switch from igs01.atx to igs05.atx, we expect that this switch will also introduce jumps in the coordinate time series of GNSS stations. However, compared to the previous switch, the size of these jumps is expected to be smaller (few mm) or negligible. A similar study on the switch from igs05.atx to igs08.atx performed by the IGS (made by IGN France, Rebischung 2011) for the IGS08 stations showed that jumps in the coordinates times series can reach up to 4 mm in horizontal and up to 10 mm in vertical. In addition, the IGS considered only biases exceeding 1.2 mm in the horizontal component or 3 mm in the vertical component as significant which is the case for 125 of the 194 antenna radome pair analyzed.

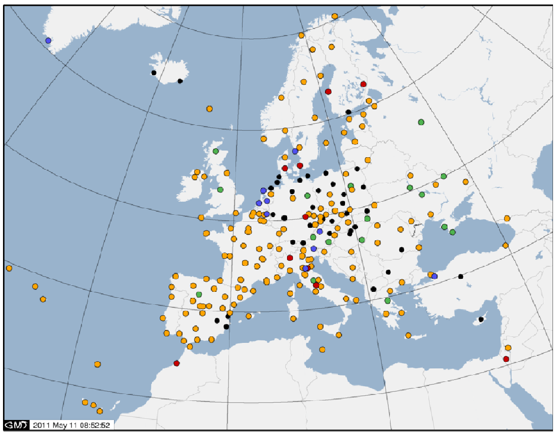

Fig. 1 : Influence of the change from igs05.atx to igs08.atx on the calibration values used in the EPN analysis. For stations with black dots individual calibrations are used, the green dots are stations were the used calibrations values do not change, and the orange dots are stations were updated robot calibrations are used. The red dots indicate stations were new robot calibrations are used and the blue dots are the ones where the calibrations change due to a change of the calibration of the AOAD/M_T antenna.

This preliminary study focuses on the EPN stations and assesses the impact of the switch of calibration on this network. We also investigate the need to take the position bias into account.

2 Data Analysis

For this preliminary study, the GPS data of the EPN stations without antenna change during 2010 have been used. We have used Precise Point Positioning (PPP) to compute the influence of the switch of antenna calibration on the position (called ‘coordinate jumps’ hereafter).

Two separates runs of PPP are made on the data set: the first using the igs05.atx file for the receiver antenna calibrations and the second using the igs08.atx file for the receiver antenna calibrations. All other processing options (satellite antenna calibrations, REPRO1 orbits and clocks, etc…) were identical in both runs. The difference between the daily positions obtained by both PPP runs will give us a daily estimate of the coordinate jump caused by the changed receiver antenna calibration model. The final coordinate jump of a station is then obtained by taking the mean of the daily estimates over the considered data set of that station.

In order to validate the method, two different PPP software have been used to compute the daily estimates: the Atomium software (Baire et al., 2010) and the Bernese GPS software (Dach et al., 2005). The mean differences between the daily coordinate jumps estimated by both are at the level of 0.1 ± 0.2 mm in horizontal and 0.2 ± 0.3 mm in vertical and can consequently be considered as identical (within the noise level). This allows to say that the coordinate jumps are estimated with a millimetric accuracy. Hence, all the results presented in this study are based on the Bernese PPP.

3 Results

For each station (with a specific antenna/radome pair), the daily computed coordinate jump is very constant over time. Over the full data set, their mean repeatability is 0.2 mm in the horizontal component and 0.4 mm in the vertical component. Since this analysis was made only for 2010, we don’t have enough data to discuss the threshold chosen by the IGS.

Figure 2 presents for each station the mean coordinate jumps (north in red, east in green and up in blue). Over the full EPN, their mean values are

- 0.0 mm in the north component with a dispersion of 0.5 mm
- -0.8 mm in the east component with a dispersion of 1.6 mm
- 0.6 mm in the up component with a dispersion of 2.3 mm

They include also the biases judged as not significant by the IGS. We can observe that for the EPN the impact on the north component is negligible. The greater dispersion on the east component is mainly caused by the TRM26659.00/NONE antenna/radome pair which experiences a mean coordinate jump of -4 mm in the east, explaining the value of -4 mm in the east component of figure 2. Moreover, this antenna is mainly installed in the southern part of the EPN. The update of calibration will therefore induce a displacement towards east in the southern part of Europe. The dispersion is still greater for the vertical component. It indicates that the switch from igs05.atx to igs08.atx affects significantly the up component, with values up to 10 mm (only 1 station is concerned and therefore not visible on Figure 2).

If we apply the significance criteria chosen by the IGS (coordinate jumps reaching at least 1.2 mm in horizontal or 3 mm in vertical), only 30 % of the compute coordinate jumps are still considered as significant. Even though they are judged as significant, most of the value of those biases remains below 1 cm. Consequently, they will affect only applications requiring sub- millimetric positioning.

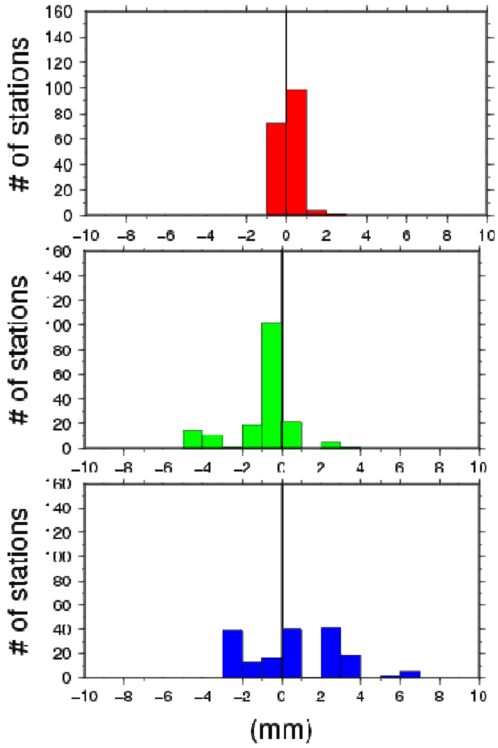

Fig. 2: Computed coordinate jumps induced by the switch from the igs05.atx to igs08.atx calibration model for the EPN stations in 2010 without antenna changes. In red for the north component, in green for the east component and in blue for the up component.

4 Conclusions

The update of receiver antenna calibrations from igs05.atx to igs08.atx induces a jump in the coordinates of the EPN stations. Using the EPN data from 2010, the size of this jump varies from 0 to 4 mm in the horizontal component and from 0 to 10 mm in the vertical component.

When applying the threshold chosen by the IGS, only 30% of the computed coordinate jumps are still considered as significant.

Our study has shown that these coordinate jumps are not relevant for many applications. It should only be taken into account for sub-mm positioning and mm/year velocity estimations. This study will be pushed forward by taking all the historical EPN data into account.

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