Interactive comment on "EPN Repro2: A reference GNSS tropospheric dataset over Europe" by Rosa Pacione et al.

Response to Review #2

Overview

The article contributes to an important issue on homogenization and processing of GNSS tropospheric products for climate research. The article is timely and actual. It gives systematic overview about the reprocessing campaign and combination of data products from different ACs with additional attention on impact of GLONASS data, different antenna calibration models and non-tidal atmospheric loading. The results are evaluated with independent data sources (radiosondes and ERA-Interim) and illustrated with appropriate figures and tables. The article includes adequate references on related scientific research papers. The manuscript needs some minor revision before getting ready for publication.

Authors' Response

The authors would like to thank Reviewer#2 for his/her constructive comments. We have considered them in the revised version to improve the quality of the paper.

Detailed Comments

Reviewer # 2

Figure 1: could look better with smaller markers.

Authors' Response
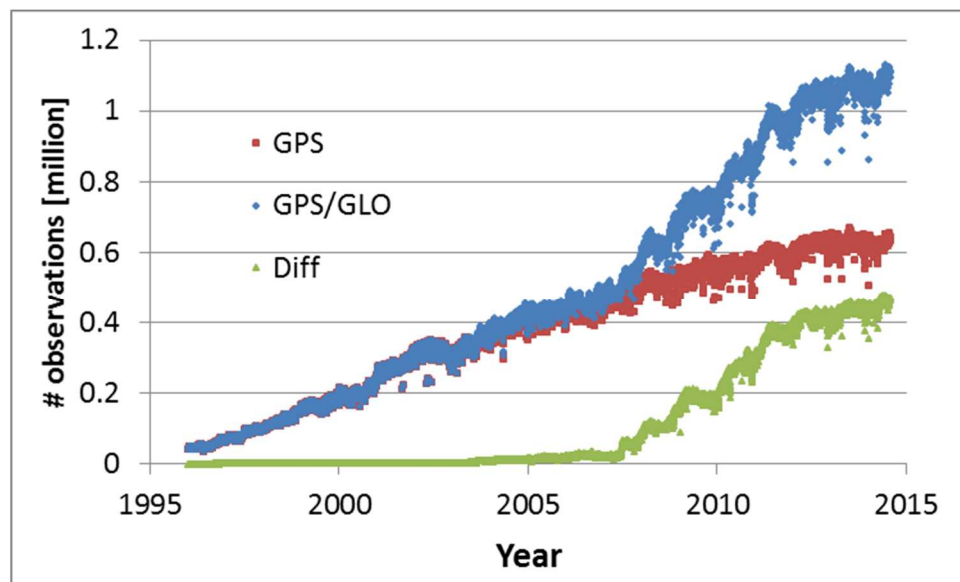
We have improved Figure 1 as below:

Figure 1. Time series of the number of GNSS observations for the period 1996-2014. GPS observations are shown in red, GPS+GLONASS in blue and their differences in green. The difference is significant starting 2008.

Reviewer # 2

The http-links should be checked. However, they may be broken only in this version of discussion paper due to automatic document processing during its upload. In this case the remark on the next 3 links is not relevant.

Line 36: https://www.iers.org/IERS/EN/Organization/AnalysisCoordinator/SinexFormat/sinex.html

Line 45: http://www.euref.eu/documentation/MoU/EUREF-EUMETNET-MoU.pdf

Line566:http://www.epncb.oma.be/_documentation/papers/eurefsymposium2011/an_update_on_epn_reprocessing_project_current_achievement_and_status

Authors' Response

Thank you for pointing this. We will check http-links in the final version of the manuscript.

Reviewer # 2

Line 230: small TYPO ": : : homogeneously reprocessed solutions (seeTable 2)".

Authors' Response

Correct.

Reviewer # 2

Lines 346-352: Compared Repro1 and Repro2 with ERA-Interim, Figure 11, distribution of station means and standard deviations – over which time period the mean is calculated? ERA-Interim has 6 hrs time resolution, Repro1 and Repro2 have 1 hrs (Table 2). Could the result depend on interpolation made for synchronisation of timestamps for ERA-Interim and Repro2?

Authors' Response

The mean in Figure 11 is computed for the period 1996-2014. The Repro1 dataset was completed with EUREF operational products after GPS week 1406 (December 23, 2006). For the comparison versus ERA-Interim we extracted 4 values per day at 00, 06, 12, 18 from Repro1 and Repro2 GNSS datasets using the linear approximation from values -/+ 30 min as EUREF solutions stores ZTDs in HR:30 only.

Datasets with different time resolutions affect the final comparison. However, both GNSS ZTD datasets (Repro1 and Repro2) have the same time resolution (1 hour) of values expressed at HR:30 and the interpolation affects both in the same way. Therefore, we can assume that both comparisons are compatible and the inter-comparison reflects principally the quality of products.

The following descriptions were improved in the manuscript:

Lines 305-312 changed:

"… software (Zus et al., 2014). Combined EUREF Repro1 and Repro2 products as well as individual ACs tropospheric parameters were assessed with the corresponding parameters estimated from the NWM re-analysis. The comparisons was done for the period 1996-2014 using the GOP-TropDB (Gyori and Dousa, 2016) via calculating parameter differences for pairs of stations and using values at every 6 hours (00:00, 6:00, 12:00 and 18:00) as available from the NWM product. A linear interpolation from values -/+ 30 min was thus necessarily applied for all GNSS products providing HH:30 timestamps as required for the combination

process. As all compared GNSS products has the same time resolution (1 hour), the interpolation is assumed to affect all products in the same way. Therefore, we assume all inter-comparisons to a common reference (NWM) principally reflects the quality of the products. No vertical corrections were applied since NWM parameters were estimated for the long-term antenna reference position of each station."

Lines 346-352 changed:

"For completeness, we evaluated also EPN Repro1 ZTD product with respect to the ERA-Interim using the same period, i.e. 1996-2014 when completed with the EUREF operational product after GPS week 1407 (December 30, 2006). Comparing Repro1 and Repro2 with the numerical weather re-analysis showed the 8-9% improvement of the latter in both overall standard deviation and systematic error. Figure 11 shows distributions of station means and standard deviations of EPN Repro1 and Repro2 ZTDs compared to NWM ZTDs using the whole period 1996-2014. Common reductions of both statistical characteristics are clearly visible for the majority of all stations."

Reviewer # 2

Lines 353-360: monthly mean biases, ZTD mean biases, Figure 12 – "There is no seasonal signal observed in time series of ZTD mean biases …..:", but looking at the figure (upper part – monthly mean biases) – if it isn't a seasonal signal, then what is it?

Authors' Response

In Figure 12: description of the subplots is swapped. The caption of Figure 12 is correct as follows: "Time series of monthly mean biases (lower part) and standard deviations (upper part) for ZTD differences of EPN Repro2 and NWM re-analysis. Uncertainties are calculated over all the stations"

Lines 359-360 changed:

"There is almost no seasonal signal observed in time series of ZTD mean biases or the uncertainty, but clearly in ZTD standard deviation and the uncertainty."