

General comments:

The manuscript describes novel method of exploiting external tropospheric corrections in standalone and multi-GNSS Precise Point Positioning and assesses the impact on position accuracy and the convergence time. The method is clearly described, results show positive impact of both multi-GNSS and NWM-constrained PPP compared to standard and standalone PPP which is clearly demonstrated in presented figures and described statistics (how the statistics were calculated and derived remained however unclear). The manuscript is well organized and understandable; however, Section 3.2 summarizing the results is difficult to follow. I would suggest completing/revising the manuscript with some more detail/clear descriptions in three directions:

- More details about PPP processing/modelling in Section 2.3 (see also Specific comments: constraining values, multi-GNSS observation weighting, random walk vs. piece-wise constant modelling, elevation-dependent weighting model etc, precise products and PPP software used).
- Specification of the methodology used for assessing the position accuracy and the convergence time (see also Specific comments: the reference position, criteria for the assessing of accuracy at 'decimetre/centimetre-level' and criteria for the estimating of convergence time, included/excluded stations or results in statistics). E.g. could be described at the beginning of Section 3.
- Extremely long part (~4 pages, Section 3.2 and Conclusion) concerns of the description on the assessment of convergence time and position accuracy which I found very difficult to following thoughtfully. I suggest shortening the part avoiding very similar phrasing (a reader gets easily lost here) while preferably adding more concise overview (e.g. table) about resulting statistics for the performance of standalone & multi-GNSS and standard & NWM-constrained PPP. In my opinion, it should significantly facilitate understanding presenting results and their representativeness.

Specific comments and technical corrections:

Page 2, line 33: Suggested to use 'PPP method' instead of 'PPP technique'.

Page 4, line 64: GPS + GLONASS + ... (space between GPS+)

Page 8, line 141: on 137 vertical model levels – is this correct? According to the documentation the ERA-Interim has 60 model (e.g. ERA Report series, The ERA-Interim archive Version 2).

Page 9, line 154: respectively; the capital (start with lower case)

Page 9,eq.1: missing explanation for b_r

Page 9, lines 160-161: use $I_{r,j}$ instead of I_j .

Page 11: Add information about how NWM parameters were interpolated in time.

Page 11: What value is used as the ZWD variance for constraining ZWD_{resi} ?

Page 11, line 197: Here it is written that ZWD_{resi} is modeled as a random walk process, later (Page 12, line 207) it is mentioned that ZWD_{resi} is modeled as piece-wise linear function. Please clarify.

Page 12, line 208: Please, comment use of 2-hour piece-wise constant in ZWD modeling since it is rather long interval for using constant value for modeling the troposphere and may cause the degradation in performance.

Page 12: What was a relative weighting (if any) applied for phase and code observations for different systems?

Page 12: Which elevation-dependent weighting function was used?

Page 12, line 219: add the reference to IGS tropo products (Byram et al., ION, 2011).

Page 13, line 227: ECMWF ZTDs show good agreement with the IGS ZTDs (plural otherwise shows)

Page 13, lines 245-250: A strong latitudinal dependency of ZTDs from the MetOffice UK global model with respect to GPS ZTDs was described in Dousa J and Bennitt G, GPS solutions, 2012.

Pages 15-16 + Fig 7: How were percentages 32%, 37.5%, 25% derived – supposed the values are calculated as representative over all the stations, but currently it seems they are reported for the station WIND (figure). Anyways, please provide more details about the calculation of statistics (i.e. underlying their representativeness) in terms of number of data/stations used (included/excluded), criteria applied for achieving the convergence, 'centimetre/decimetre-level' accuracy etc.

Page 17, line 306: ... before the convergence. (the article)

Page 17, line 305: ... position accuracy ... It should be also explained which reference values were used in the accuracy assessment. Here, I suppose the 'position accuracy' should mean 'North component accuracy' since East & Up follows and no more North.

Page 18, line 340: about:17 (add space)

Page 19, line 366: ... before the convergence (the article)

Page 20, line 367: ... 2.5%, 12.1% and 18.7% - only here it is mentioned the values are gained 'after' the reaching convergence (line 366). How the convergence time is determined? Neither abstract nor Section 3.2 mentioned it concerns the period after reaching the convergence.