

Interactive comment on “Alternative Strategy for Estimating Zenith Tropospheric Delay from Precise Point Positioning” by Jareer Mohammed et al.

Anonymous Referee #3

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General Comments This paper intents to describe an alternative strategy to the conventional one used to estimate ZTD. The proposed alternative strategy is interesting and deserves to be evaluated. However, I think that the manuscript needs major revision before being ready for publication. The following aspects need to be improved. First, throughout the manuscript there is a lack of explanation of the obtained results. They are mainly presented in form of tables and figures with very short and poor text of critical discussion. Second, the proposed alternative strategy is supposed to improve both post-processed and Real-Time ZTD estimation. Post-Processed and Real-Time analysis have different requirements in term of latency and accuracy that should be discussed and considered. I have the feeling that the in the manuscript post-processed,

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near-real time and real time issues, along with the related products used for data reduction and evaluation, are sometimes mixed up.

Below specific comments for each section of the manuscript.

Abstract Page 1 - line 17: Delete 'GPS' before ZTD Page 1 - line 18 Delete 'PPP' before GPS, GLO and GPS+GLO. How the differences are computed? Is it 'DD-PPP' or 'PPP-DD'? Page 1 - - line 19- 21: 'Validation was also performed through comparison with the IGS ZTD values, for 12 weeks, with an overall RMS of 5.9 mm and against IGS real-time products with an overall RMS of 8.1 mm' I think that in the first part of this sentence the authors are referring to 'IGS final ZTD estimates' (<http://www.igs.org/products>) while in the second part to the 'IGS real-time orbit and clock products' (<http://www.igs.org/rts/products>) delivered in the framework of the IGS Real-Time Service and used for Real-Time PPP. If it is so, the sentence has to be properly rewritten. Anyway a clarification is necessary.

Introduction Page 2 - line 15. '....an agreement of 1.7 cm' in terms of mean or standard deviation? Page 2 – line 27. Use the reference: B. Pace, R. Pacione, C. Sciarretta, G. Bianco, "Computation of Zenith Total Delay Correction Fields using Ground-Based GNSS estimates", IAG Symposia Series. vol 137-2012/ IAGS-D-13-00021 instead of Pace et al. (2010). Page 3 – Line 1-7. The authors should add a reference of the cited models along with a brief description of their characteristics and differences in order to let the reader to understand the results presented. Page 3 - Line 19. I suggest replacing Table 1 with a brief summary of the results of Böhm et al. (2014) that are relevant to the present manuscript. Page 4 - Line 8. '..static and real-time situation' I think it is post-processed and real-time situation. Page 4 - Line 10. Sentences on the organization and structure of the paper must be added.

PPP Daily Solution Methodology Page 5 - Line 15. Table 2. Please consider that:
1. ANTEX from IGS the proper reference to the ANTEX file is M. Rothacher, R. Schmid: ANTEX: The Antenna Exchange Format, Version 1.4, 15 September 2010,

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ftp://igs.org/pub/station/general/antex14.txt Which antex file is used? Is the same antex file used to process DD data of Table 3 in section 2.2? 2. Troposphere: Using Saastamoinen model for the hydrostatic component and estimate the wet as a state, unless otherwise mentioned. Please explain the meaning of 'state'. What is the ZTD sampling rate? 3. Troposphere mapping function: drop 'new'

Page 6 - Line 9. Table 3. Please consider that: 1. Troposphere. What is the ZTD sampling rate?

There are several differences in the models summarized in table 2 and table 3: mapping function, carrier phase ambiguities, and products. Please add a comment on these diversities and on their potential impact on the estimated ZTD.

New Strategy for Estimating Tropospheric Delay Page 7 - Line 18-19. On which ground the values for the random-walk process noise were chosen? Did the authors test other values?

Datasets for Comparing the Two Methods Page 8 - Line 10.'... with optimum 24-h observations' What do you mean with optimum?

Results using the Traditional Strategy Page 9 - Line 9. Is it 'static' or 'post-processed'? Page 9 - Line 17. I suggest to consider also the site coordinate repeatability as an internal quality metric to check the different solutions.

Validation for One Continuous Week Page 10 - Line 19. Typo 'tropospheric' Page 10 - Line 24. The authors are testing the new strategy over 1 week continuous solution, they are not averaging 7-daily solutions to get the weekly solution. A comment on how the GNSS orbits are handled is required since GNSS orbits over 1 week are available as 7 independent daily solutions with a possible jump at midnight between consecutive days. Page 11 - Line 1. Table 6. The ZTD agreement is -6.3 mm mean and 5.8 mm std. Is this a 'good' agreement' or there is room for improvement? In post-processing the expected agreement, in terms of std, between different sw/solutions is about 2 mm.

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(see Pacione et al: Atmos. Meas. Tech., 10, 1689-1705, <https://doi.org/10.5194/amt-10-1689-2017>, 2017) Page 11 - Line 7. Fig. 2. Could the authors explain why PPP ZTD is systematically larger than DD ZTD? Are there any boundary problems in the PPP ZTD at the beginning and end of the 7-day period?

Long-Term Validation of the New Strategy Page 13 - Line 9 and Fig. 3. To demonstrate that there is no seasonal behavior in the proposed strategy, one average value for the whole year is not enough. One value per month or one value for season should be considered.

Global Validation using IGS Stations Page 14 - Line 11-13. Could you please better explain which products you used? According to what listed in <http://www.igs.org/products> IGS is not delivering NRT ZTD. Global Validation using Real-Time Products Page 16 - Line 5. I suggest the following references for Real time ZTD estimation and performance 1. Dousa J, Vaclavovic P (2014) Real-time zenith tropospheric delays in support of numerical weather prediction applications. *Advances in Space Research* (2014), Vol 53, No 9, pp 1347-1358, doi:10.1016/j.asr.2014.02.021 2. Ahmed F et al Comparative analysis of real-time precise point positioning zenith total delay estimates, 2014 GPS Solut. DOI 10.1007/s10291-014-0427-z

Conclusions Page 20 – Line 1-4. I think that what the authors are assessing is very strong. The new proposed strategy is interesting but needs to be checked and tested more deeply before drawing this conclusion.

References When possible, replace the reference listed as 'proceeding' with a peer review publication.

Other comments: 1. All the acronyms in the text have to be explained and the same abbreviation should be used to refer to the same thing, for example sometimes is used 'GLONASS' sometimes 'GLO'. 2. In the tables the sign of the considered difference has to be reported.

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