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Atmospheric Measurement Techniques Discussions

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

Anonymous Referee #1

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General comments:

The study describes an alternative strategy for estimating ZTDs from PPP. Whereas in the conventional approach the a prior zenith hydrostatic delay (ZHD) is fixed and the zenith wet delay (ZWD) is estimated (adjusted), in the alternative approach both the ZHD and the ZWD are estimated (adjusted). In fact, the conventional approach appears to be a special case of the alternative approach (if one puts a very tight constraint on the a prior ZHD in the alternative approach, i.e. fix the a prior ZHD, one ends up with the conventional approach). This point (see major comments) together with some other points (see specific comments) must be clarified.

Major comments:

(1) The conventional approach is a special case of the alternative approach (see my general comment). Is this true, or did i miss something? If this is true, please, write it down somewhere in the beginning of the manuscript.

(2) The reference solution is a DD solution (Table 3). This DD solution follows the conventional approach, i.e. the a prior ZHD (from VMF1G) is fixed and the ZWD is estimated. So, the reference for your alternative PPP approach is a conventional DD approach. Please write it down in section 2.2.

(3) Table 5 (the conventional approach) can be directly compared with table 7 (the alternative approach). Where do the huge biases and rmse ($\sim$ 6 cm) in table 5 come from? A blind model, e.g. the GPT2w, is much better (Table 1).

(4) In the alternative approach you also make use of an a prior ZHD. You also mention that the constraints for the ZHD and ZWD must be chosen 'very carefully'. I would like to see the following experiment: repeat the processing with various constraints for the ZHD and add the results in table 7. In particular, if you use some reasonable a prior ZHD (from GPT) and apply a very tight constraint on the ZHD you should obtain the results in table 5. In addition, i suggest to add the results for various constraints in Table 9 and 10.

Minor comments:

Page 3, line 13: In this context (slant tropospheric delays) you should add and comment on the following recent AMT paper:

Kačmařík, M., Douša, J., Dick, G., Zus, F., Brenot, H., Möller, G., Pottiaux, E., Kapłon, J., Hordyniec, P., Václavovic, P., and Morel, L.: Inter-technique validation of tropospheric slant total delays, Atmos. Meas. Tech., 10, 2183-2208, https://doi.org/10.5194/amt-10-2183-2017, 2017.

Page 3, line 21: '...All the tropospheric models used for providing the hydrostatic or

wet components rely on measured data to predict the tropospheric delay. However, they cannot account for weather variation and thus, cannot provide highly accurate estimates of the tropospheric delay. Furthermore, none of the tropospheric models account for the diurnal variations of the troposphere. For example, they assume that pressure will be stable for a particular day of the year and that...' Here you mean the blind tropospheric models mentioned in table 1? Please clarify this. Tropospheric models derived from weather models (VMF1, UNB-VMF1 etc.) or measurements take into account the diurnal variation, etc.

Page 5, Table 2:

Troposphere mapping function: Simply write 'New Mapping Function (Niell, 1996)'. There is no need to explicitly state that it provides separate wet and dry MF. This is standard.

Page 6, Table 3:

Troposphere: I suggest to replace 'a-prior modeling of troposphere effects using VMF1G and estimation using zenith path delay and gradient parameters.' by 'a-prior modeling of troposphere effects using VMF1G and estimating the zenith wet delay and gradient parameters.' This is the conventional approach. I also suggest to use the same items in Table 2 and 3 (one item for the tropsopheric mapping function and another item for the a-prior ZHD and ZWD).

Page 7, equation 5 and 6: Replace 'dtrop' by 'T' (see equation 1 and 2) and replace 'dh' by ZHD and 'dw' by ZWD.

Page 10, line 2: 'Table 5 shows the difference in the tropospheric models used for comparison with the ZTD from DD GPS. These results are consistent with the literature, e.g. Li et al. (2012) quote RMS differences of 5.4 cm, 5 cm and 4 cm for SBAS, UNB3m and IGGtrop respectively and Pace et al. (2010) quote residuals in the order 50-100 mm.' The results are inconsistent with many other studies. For example, the recent

study by Dousa et al 2016 AMT, shows that ZTDs from DD and PPP agree very well. I suggest to comment on that and add the following recent AMT reference:

Douša, J., Dick, G., Kačmařík, M., Brožková, R., Zus, F., Brenot, H., Stoycheva, A., Möller, G., and Kaplon, J.: Benchmark campaign and case study episode in central Europe for development and assessment of advanced GNSS tropospheric models and products, Atmos. Meas. Tech., 9, 2989-3008, https://doi.org/10.5194/amt-9-2989-2016, 2016.

Page 12, line 3: 'Similar PPP configurations were adopted, except that the tropospheric delay was estimated using the new strategy with initial values of 2.1 m and 0.1 m for the dry and wet components, respectively' Here, I strongly recommend to add additional experiments (see my major comment). For example, instead of 2.1 m and 0.1 m as initial values use the GPT, and instead of a very loose constraint for the ZHD use a very tight constraint for the ZHD, i.e. fix the ZHD. This procedure shows the transition from the alternative to the conventional approach.

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