

Review: An improved global zenith tropospheric delay model GZTD2 considering diurnal variations

The paper describes an improved method to compute the Zenith Tropospheric Delay, based on statistics of ZTD data on the global scale. It is an updated version of a previous model, which now includes the effects of the diurnal cycle.

1 General comments

From a general point of view, the addition made by this model are well presented and the results show that the accuracy of the model improves.

The text is comprehensible everywhere, however, the manuscript would benefit from copy-editing for English grammar and usage.

Subject to the comments below, the manuscript would be appropriate for publication.

2 Scientific questions

ln 32-33 – ‘... by iono-free combination techniques’: a citation about such techniques should be useful, given the general audience to which the journal refers to.

ln 37 – ‘A more reliable’. The use of this expression would imply the fact that a model has already been presented above in the text (maybe ‘more’ could be dropped). Also, the use of ‘In order to better exploit the modern development of geodetic techniques’ and ‘to improve the accuracy and efficiency of [...] based on geodesy technique’ in the same phrase is a bit redundant.

line 40-57 – A (very) short description on the basic principles on which each model presented here is based (real time data, averaged trend from database, empirical considerations...) would be helpful, along with their accuracy (which is already present).

ln 58 – ‘... required a number of’ Which number? A large number of parameters? (If I correctly understand the context)

ln 87 – ‘the theoretical necessity’. I think that the use of analysis of data should show more the practical necessity, or the expression can just be omitted.

In 116 – Do they represent the regions in the sense that they are representative? Or are they just example on how an expected diurnal cycle at different latitude should qualitatively be?

In 118 – The first time that day of the year (doy) is written, it should be written in the extended form.

Figure 2, captions and/or description – It is not very clear what error are represented by the vertical bars. Are they one standard deviation from the average?

lines 171 - 179 – The fact that the new model is presented before its previous version makes this part not too easy to follow, at first. Maybe a swap between the two sentences, where the features of the older model are presented before the new ones could simplify things.

If I may add a comment, since the previous model has appeared only in (Yao et al.,2013) which is accessible only to chinese readers, a short introduction of this model at the beginning of this section (like the counterpart of formulae 1 and 2) can be useful.

line 181 – I don't get what this sence mean, exactly. It is stated that the GZTD horizontal resolution is 18 degrees, but it is not clear if the diurnal variation above 5mm refers to the GZTD model or the expected diurnal variation which the model should usually solve. There are a couple of questions that should be answered, even if shortly, to clarify this part: how the horizontal resolution and ZTD resolution are related and what should be an optimal horizontal accuracy to get the most of the diurnal effects?

In 214 – I would drop the last 'in theory'.

In 265 – I am confused by the term 'climate change'. Do you mean that the statistics of the previous years that you include to set the parameter of GZTD2 and the other model are not representative of the year that you are using for the test? To me, the fact that the change in the ZTD has a relation with deep moist convection effects, whose specific occurrence is impossible to predict using averaged data, and that are much more intense at the tropics, would seem sufficient to explain the increased error near the equator, at least qualitatively (so that they are related more to weather changes than to climate changes). If you are connecting it to climate change please explain better, possibly including some references.

line 345 and line 368 – '... is obviously superior ...': I think that, even if 'obviously' is here clearly intended with the meaning of 'easily seen', its more common meaning of 'of course' can be a little misleading. I suggest to change it in some way.

In 373 - 376 – This phrase needs some adjustment, with more clear logical connections between the part that are now simply separated by commas.

In 378 – The sentence starting with 'The testing results ...' is not very clear. I suggest to simplify and organize the informations better.

3 Technical corrections

line 12 – Even if somewhat well known, I think that GNSS should be expressed with its full name at least one time.

ln 20 – It should be written Root Mean Square the first time it is used.

ln 56 – Predication → Prediction

ln 72-73 – ‘... parameters for storage like *the* above grid models ...’

ln 79 – girds → grids

ln 146 – ‘..., and is featured ...’: ‘and’ should be removed.

ln 162 – ‘ P_{nm} is ...’ → ‘ P_{nm} are ...’

ln 171 – ‘Different from’ → ‘In contrast with’.

ln 215 – ‘GZTD model ...’ → ‘The GZTD model ...’

ln 289 – ‘followed’ → ‘follows’.

ln 325 – ‘The reduce for RMS ...’ → ‘The reduction of RMS ...’

ln 340 – ‘the Bias and RMS are lager with height less than 500 m ...’ → ‘the Bias and RMS are larger for height less than 500 m ...’

ln 369 – ‘improve’ → ‘improves’

ln 377 – ‘testing with ZTD grid data’ → ‘testing with GGOS ZTD grid data’
(since in this statement both the sources of data used are explicitly listed).

ln 383 – ‘show the Bias ...’ → ‘show that the Bias’

ln 384 – ‘that of GZTD’ → ‘those of GZTD’