This paper establishes a global empirical ZTD model considering the variations at different altitudes. The quality of the presented materials is sufficient to be published in Geoscientific Model Development, although some changes are required as explained below.

Respone: I would like to thank you for taking the time and effort to go through us paper and providing constructive criticisms which are extremely valuable for us. I appreciate your thoughtful review and am grateful for your valuable insights.

Revise the sentence in line 54 of the manuscript regarding ZTD data from the radiosonde station to specify the correct data source and avoid confusion, as radiosonde stations do not provide ZTD data directly.

We are grateful for the suggestion, and realize that the description here is not accurate enough. We have corrected it **in L66** as follow:

"The accuracy of the GGZTD-P model was evaluated by comparing it with profiled ZTD data from 545 radiosonde stations in 2017 and 2018, as well as the Modern-Era Retrospective analysis for Research and Applications, Version 2 (MERRA-2) atmospheric reanalysis data from 2017. It should be explained that the ZTD data of radiosonde and MERRA-2 is calculated by integration."

In section 3.4, please provide a more detailed introduction of the GGZTD-P model, such as a description of the data used for its establishment. This would enhance the reader's understanding, as data specifics are crucial.

We agree with the comment and re-wrote the sentence in the revised manuscript in **L202** as follow:

"ERA5 atmospheric reanalysis data ZTD on the surface will be uniformly converted to the position of the sliding window's average elevation. This conversion is based on the piecewise global ZTD vertical profile model, GZTD-P model, taking into account the elevation position of each window. The model is based on the ZTD values at the sliding window's average elevation. Utilizing the GZTD-P model, ZTD data for all window from 2012 to 2016 were vertically interpolated to calculate the ZTD value at the average elevation of each window after correction. The detailed process is shown in Fig. 7. To estimate the coefficients in each window, the least-squares adjustment is utilized, considering the annual, semi-annual, daily, and semi-daily variations, as well as the latitude factor. Finally, the global ZTD empirical grid model (GGZTD-P) is developed based on a piecewise expression, with a resolution of 1°×1°. The model can be expressed as follows:"

The full names of MERRA-2 and ZTD, mentioned in lines 69 and 86, were previously indicated when they first appeared in the preceding paragraph and need not be reemphasized.

Thank you very much for your comments. We'd like to apologize again for our carelessness, and we have changed it **in L77 and L95** as follow:

"MERRA-2 is a state-of-the-art atmospheric reanalysis dataset developed by NASA (Chen et al., 2019; Huang et al., 2022; Randles et al.,2017)."

"Atmospheric reanalysis data can provide meteorological parameters according to standard atmospheric pressure profiles. Integration method is used to calculate the ZTD."

P9, in section 4, Accuracy verification, the authors at least need to provide an explanation of how the GPT3 model was developed and disclose the data utilized in its formation. This information is crucial, especially considering the extensive use of the GPT3 model as a reference throughout the manuscript to assess the performance of their novel model estimates.

We appreciate for your effort to review our manuscript. In the introduction, we have described the development process of GPT3 model. In order to avoid repetition, we have added what data the GPT3 model is based on.We have changed it **in L225** as follow:

“In order to verify the stability of the established model in the global region, two sets of data are used as reference values and compared with the GPT3 model. The GPT3 model was developed utilizing a 15-year dataset of monthly average ERA-Interim profiles. Currently, it functions as a highly accurate tropospheric model.

$$M = S_0 + S_1 \cdot \cos\left(2\pi \frac{DOY}{365.25}\right) + S_2 \cdot \sin\left(2\pi \frac{DOY}{365.25}\right) + S_3 \cdot \cos\left(4\pi \frac{DOY}{365.25}\right) + S_4 \cdot \sin\left(4\pi \frac{DOY}{365.25}\right) \tag{9}$$

In Eq. (9), M represents the tropospheric meteorological parameters (temperature, water vapor pressure, specific humidity, etc), and S_i represents the annual mean value, annual and, semi-annual period coefficients. The Saastamoinen model and the Askne model were adopted to compute zenith hydrostatic delay (ZHD) and zenith wet delay (ZWD) with the obtained meteorological parameters.

$$ZHD = \frac{0.0022768P}{1\text{-}0.00266\cos(2\theta) - 0.00000028h} \tag{10}$$

$$ZWD = 10^{-6}(k_2^{'} + \frac{k_3}{T_m}) \cdot \frac{R_d}{(\lambda+1) \cdot g_m} \cdot e \tag{11}$$

In Eqs. (10) and (11), P stands for pressure, θ stands for latitude, h stands for elevation, g_m is the average acceleration of gravity, λ stands for the drop factor of water vapor pressure, T_m stands for the atmospheric weighted mean temperature, and $k_2^{'}$ = 22.97K/hPa, k_3 = 375463K^2/hPa, R_d = 287.054J/kg·K are all constant coefficients.”

Please ensure consistency in the naming format for figures and tables throughout the document, such as "Figure.1" and "Figure 1. "

We are grateful for the suggestion. After consulting multiple published papers in this journal, we unified the format used, as shown in Fig. 1. It has been amended in the whole manuscript.

In line 311, how do you define the term "significant bias"? Is a significant bias, in your view, characterized by a statistically significant difference from an expected value, as determined through statistical testing?

Thank you very much for your comments. We have neglected the problem. In fact, what we aim to illustrate is that this region exhibits a higher bias value compared to others. We have changed it **in L345** as follow:

“However, in the Asian region, a significant negative bias is observed (It exhibits a higher bias value when compared to other regions), suggesting that the ZTD values calculated by the combined GGZTD-P model are consistently lower than the ZTD values from radiosonde stations.”