This paper introduces an empirical model designed to estimate tropospheric delay at various altitudes, employing a set of complex modeling equations to express variations in ZTD. The model is developed based on ERA5 atmospheric reanalysis data, utilizing MERRA-2 and Radiosonde data as reference values. It demonstrates enhanced accuracy when compared to the GPT3 model across different spatiotemporal resolutions on a global scale. However, the manuscript still contains several issues that require attention and improvement. Here are my comments for enhancement:

Response: Thanks for your valuable comments and suggestions on our manuscript, which are very helpful for improving our manuscript. We have carefully revised our manuscript as suggested to meet the journal's requirements. The detailed revisions and responses are listed below:

L13, 'propose' should be corrected to 'proposed'.

Thank you for your suggestion. We have modified it **in L13** as follow:

"To address these limitations, we proposed a global piecewise ZTD empirical grid (GGZTD-P) model. This model considers the daily-cycle variation and latitude factor of ZTD, using the sliding window algorithm based on fifth-generation European Centre for Medium Range Weather Forecasts (ERA5) atmospheric reanalysis data."

In the introduction, it is advisable to cite recent articles that reflect the current state of the field. You may consider adding descriptions or references.
doi: 10.1007/s00190-022-01630-z
doi: 10.1007/s00190-021-01535-3

Based on your suggestion, we have added and substituted the following content in **L27 and L40**:

"Accurate Zenith Tropospheric Delay (ZTD) information can improve GNSS positioning precision (Nafisi et al., 2012; Zhang et al., 2021; Zhao et al., 2023a; Zhang et al., 2020; Zhou et al., 2021)."

"To overcome this limitation, researchers have developed several empirical models that do not rely on measured meteorological parameters (Li et al., 2020; Zhang et al., 2021)."

L45, the first occurrence of 'GPT' should explicitly mention its full name.

Thank you very much for your comments. We have modified it **in L46** as follow:

"The Global Pressure and Temperature (GPT) series models (Böhm et al., 2007; Lagler et al., 2013; Böhm et al., 2015; Landskron et al., 2018) are based on European medium-term prediction center (ECMWF) atmospheric reanalysis data and consider the temperature and pressure in cycles."

L80, what is the accuracy of radiosonde data, please also include some references.

Thank you for your suggestion. We cited some papers to show the accuracy of the data of the radiosonde station. We have modified it **in L88** as follows:

"Radiosonde data offers precise meteorological observations acquired through direct measurements. Zhao et al. (2019) found that ZTD derived from radiosonde is validated using GNSS data, with RMS errors of 19.1 mm. Shangguan et al. (2022) discovered that the bias and RMS of the ZTD data from 180 radiosonde stations compared with data from ERA5 worldwide were 8.5 mm and 13.2 mm, respectively."

Zhao, Q., Yao, Y., Yao, W., and Zhang, S.: GNSS-derived PWV and comparison with radiosonde and ECMWF ERA-Interim data over mainland China. Journal of Atmospheric and Solar-Terrestrial Physics, 182, 85-92. https://doi.org/10.1016/j.jastp.2018.11.004. 2019.

Shangguan, M., Cheng, X., Pan, X., Dang, M., Wu, L., and Xie, Z.: Assessments of global tropospheric delay retrieval from reanalysis based on GNSS data. Chinese Journal of Geophysics (in Chinese), 66(3), 939-950, https://doi.org/10.6038/cjg2022Q0023. 2023.

L98, clarify the unit of K3=375463 in line 98 of the manuscript; it appears to be a typographical error and should be K^2.

Thank you for your suggestion, this is our negligence. We have modified it **in L108** as follow:

"k_1 = 77.604K/Pa, k_2 = 64.79K/Pa, k_2' = 22.97K/hPa and k_3 = 375463K^2/hPa are all constant coefficients."

In section 3.3, the vertical correction grid model has a horizontal resolution of 2°×2°, but in section 3.4, the empirical grid model has a horizontal resolution of 1°×1°. Please clarify why empirical model and vertical profile model have different resolutions.

Thank you very much for your valuable comments. The rationale behind selecting varying resolutions is to finely optimize the model parameters, consequently enhancing the model's applicability with minimal loss of accuracy.

In Figure 3, it should be noted that the presence of a daily period variations cannot be conclusively demonstrated based on only the three grid points. At least select some grid points at the eastern hemisphere or at low latitude regions.

Thank you for your suggestion. We have modified it **in L135** as follows:

"To further confirm the daily period variations of ZTD, six ERA5 atmospheric reanalysis data grid points are selected randomly for on January 1, 2015. The results are presented in Fig. 3.

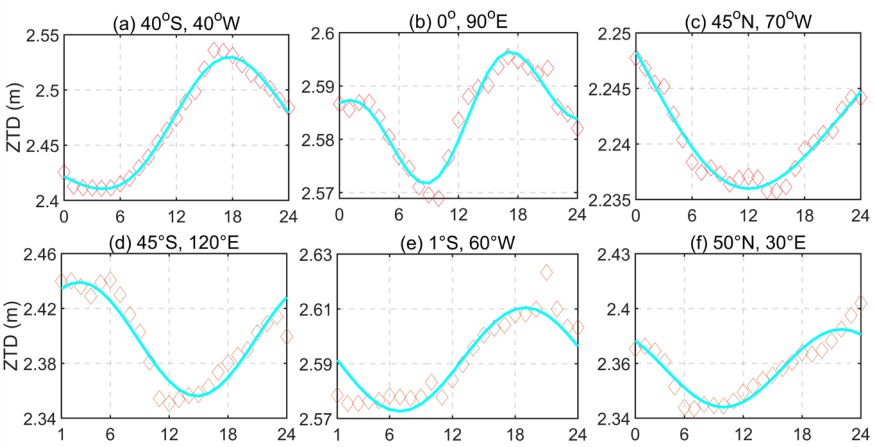

Figure 3. Time series of daily variations of ZTD.

Fig. 3 reveals that ZTD exhibits significant daily period variations in the six selected grid points, particularly at the grid points (0°, 90°E) and (1°S, 60°W) where significant daily period characteristics are observed. Thus, when constructing global ZTD models, it is important to consider daily period variations."

In Figure 7, the developed model is compared with the GPT3 model, while in Figure 9, the developed model is compared with the GPT3 model with different spatial resolution. I do not understand why you compare the results to the same reference model GPT3, but with different spatial resolution. As the results show, the GPT3-1 model has almost the same RMS with GPT3-5 model.

Your suggestion will help us a lot to improve our manuscript. We have deleted the GPT3-5 resolution results and only retain the GPT3-1 resolution results for comparison.