The authors presented a PWV vertical correction grid model using the Random Forest and ERA5 monthly average hourly data. The performance of the new model was evaluated with ERA5 and radiosonde pressure levels PWV and the newly developed PWV vertical correction model (C-PWVC1) in aspects of seasonal and spatial locations and height differences. The results denoted that the new model is superior to C-PWVC1 across the research regions. Overall, the paper is written well and logically. Therefore, a minor revision is recommended for this manuscript before acceptance. However, to improve the quality of the paper, the following comments should be solved.

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, and the detailed revisions and responses are listed below:

1. L29-30: The discussion of “inconsistent pressure levels (heights) for storing PWV data from different sources hinder the fusion and reliability analysis of PWV multi-source data.” is not convincing enough because lack of approved references.

Response: Sorry for the confusion. We have added references in L30-32 as follows: "However, inconsistent pressure levels (heights) for storing PWV data from different sources hinder the fusion and reliability analysis of PWV multi-source data (Chen et al., 2023b; Yang et al., 2023)".

References:

Chen, B. Y., Tan, J. S., Wang, W., Dai, W. J., Ao, M. S., and Chen, C. H.: Tomographic Reconstruction of Water Vapor Density Fields From the Integration of GNSS Observations and Fengyun-4A Products, IEEE Trans. Geosci. Remote Sensing, 61, 12, 10.1109/tgrs.2023.3239392, 2023b

Yang, F., Sun, Y. L., Meng, X. L., Guo, J. M., and Gong, X.: Assessment of tomographic window and sampling rate effects on GNSS water vapor tomography, Satell. Navig., 4, 12, 10.1186/s43020-023-00096-4, 2023.

2. Why Random Forest (RF) is employed for modeling, but not the commonly used Backpropagation (BP) neural network or other machine learning algorithms?

Response: Sorry for the confusion. We have added the reason for the Random Forest (RF) is employed for modeling. We have clarified this in L143-149 in the revised manuscript like: " The Random Forest, an ensemble learning method that combines multiple weak learners to form a single strong learner, typically improves generalization performance and model robustness. (Breiman, 2001;Sagi and Rokach, 2018). Compared to the Backpropagation neural network (BPNN), random forests are less prone to overfitting, especially with noisier datasets like PWV. Random forests handle noisy data and outliers more efficiently, making new models more robust and often easier to tune (Wang et al., 2016a;Tyralis et al., 2019). In addition, our previous study has shown that RF outperforms a popular algorithm of machine learning (BPNN) in modeling spatiotemporal variability in tropospheric parameters (Li et al., 2023). Thus, RF is employed to model the height dependency of PWV. "

References:

Breiman, L.: Random forests, Mach. Learn., 45, 5-32, 10.1023/a:1010933404324, 2001.

Sagi, O. and Rokach, L.: Ensemble learning: A survey, Wiley Interdiscip. Rev.-Data Mining Knowl. Discov., 8, 18, 10.1002/widm.1249, 2018.

Wang, L. A., Zhou, X. D., Zhu, X. K., Dong, Z. D., and Guo, W. S.: Estimation of biomass in wheat using random forest regression algorithm and remote sensing data, Crop J., 4, 212-219,

10.1016/j.cj.2016.01.008, 2016a

Tyralis, H., Papacharalampous, G., and Langousis, A.: A Brief Review of Random Forests for Water Scientists and Practitioners and Their Recent History in Water Resources, Water, 11, 37, 10.3390/w11050910, 2019.

Li, J. Y., Zhang, Q. L., Liu, L. L., Yao, Y. B., Huang, L. K., Chen, F. D., Zhou, L., and Zhang, B.: A refined zenith tropospheric delay model for Mainland China based on the global pressure and temperature 3 (GPT3) model and random forest, GPS Solut, 27, 13, 10.1007/s10291-023-01513-6, 2023.

3. L54: The first appearance of "RMSE" should explicitly refer to its full name. Additionally, please review all abbreviations to ensure they are defined at their first appearance (except in the abstract).

Response: Thank you for your reminder. We checked the manuscript and made the following modified in L77-78: " This model outperformed the Chinese Tropospheric Model (CTrop) and Global Pressure and Temperature 3 (GPT3), reducing Root Mean Square Error (RMSE) by 86% and 83%, respectively. "

4. L89: Please confirm the units for the explanation of g in Eq (2).

Response: Thanks for your suggestion. We have modified it in L115-116 as follows: " g is the gravitational acceleration (m/s^2), φ denotes the latitude (rad). "

5. L143: What I am interested in is what are the respective 'day of the year (doy)' corresponding to the monthly average hourly dataset for each month when training the model. Please clarify these.

Response: Sorry for the confusion. We have analyzed the ERA5 monthly average hourly data and found that the "day of the year" is the first day of the corresponding month. We have clarified this in L192-194 in the revised manuscript like:" The input data included year, day of the year (doy is the first day of the corresponding month), hour of the day (hod), and ΔGPH; the output data were ΔPWV."

6. L149: 'Subsequently, the target point.'. Rephrase this sentence.

Response: Sorry for the confusion. According to your and another reviewer's comments, we have deleted this sentence in L211 to maintain a logical structure and improve the readability of this manuscript.

7. L193: We suggest that the color bar range for RMSE in Figure 4 should start from 0. The same is true of Figure 7.

Response: Thanks for your suggestion. According to your and another reviewer's comments, we have revised the color bar range for RMSE in Figure 4 and Figure 7, like: "

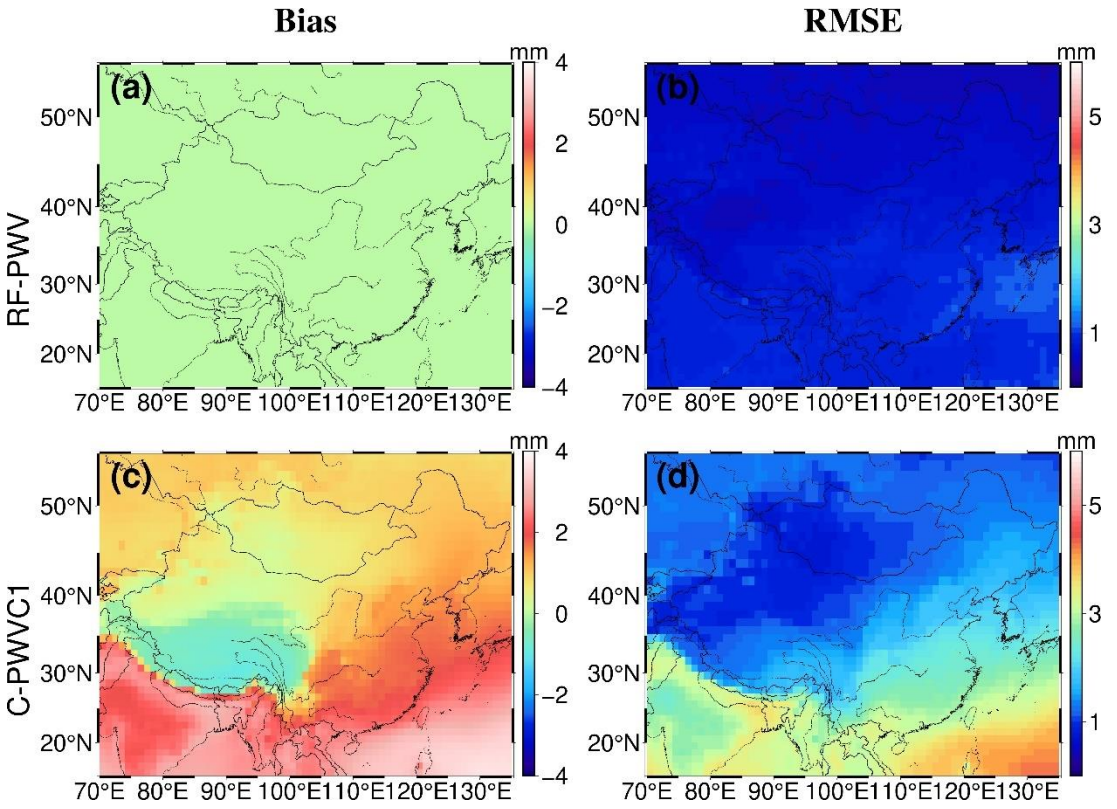

Figure 4. Distributions of Bias and RMSE for the RF-PWV and C-PWVC1 with respect to the ERA5 data

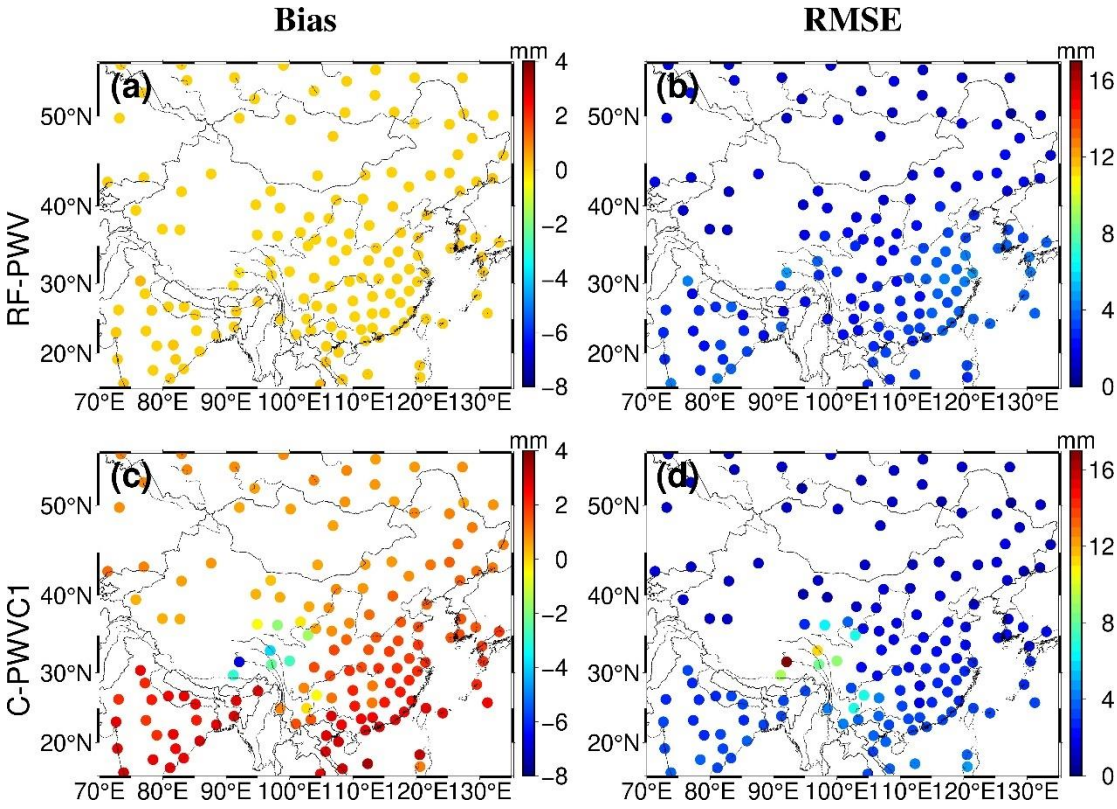

Figure 7. Distributions of Bias and RMSE for the RF-PWV and C-PWVC1 with respect to the RS data"

8.L244: What is the output of the four grid point model around the RS station? Please clarify it to help readers repeat your experiments.

Response: Sorry for the confusion. We have revised it in L352-378: " The datum PWV is the PWV corresponding to the surface height of the RS station. For each RS station, the four nearest grid points ($1° \times 1°$) were selected, and the ΔPWV_i (i =1,2,3,4, i denotes the four nearest grid points) of the target height relative to the datum height computed based on the RF model of each grid point. Then ΔPWV_i were bilinearly interpolated to the corresponding location of the RS station to obtain the RF-PWV result. "

9. L257-259: The text about Figure 7b is not consistent with the fact.

Response: Thank you for your suggestion, this is our negligence. We checked the manuscript and made the following modified in L392-393: "As depicted in Figures 7a and 7c, C-PWVC1 exhibits a positive Bias on almost all stations except for the RS stations in the Yunnan-Guizhou Plateau, where the Bias is less pronounced. "