

Response to Editor and Reviewers

Dear editor and reviewers,

Thank you for offering us an opportunity to improve the quality of our submitted manuscript titled “**A hybrid-grid global model for the estimation of atmospheric weighted mean temperature considering time-varying vertical adjustment rate in GNSS precipitable water vapor retrieval**” (gmd-2024-21). We appreciated very much your constructive and insightful comments. In the following, we include a point-by-point response to the comments. We hope the revised manuscript has now met the publication standard of your journal. Please note that the phrase “lapse rate” has been changed to “vertical adjustment rate” in the title.

Comment 1: I strongly suggest that the authors should not use the phrase “T_m lapse rate”. If you are referring to time-varying or horizontally-varying changes in T_m, that is ok. But you apply the vertical adjustment to consider the altitude difference. I would suggest naming gamma as the vertical adjustment rate.

- Line 166: Again, T_m is a vertically integrated value. There is no T_m variation in “vertical direction”.

Response 1: Thanks for your suggestion. We have named gamma as the vertical adjustment rate.

- Line 166: To avoid confusing readers, we have deleted this sentence “the T_m variation in the vertical direction is much larger than that in the horizontal direction”. Deleting this sentence will not change the meaning of the paragraph.

Comment 2: The authors emphasize the feasibility of the NGGT_m model in calculating T_m in real-time, but there are still sentences that are confusing to the readers.

- Line 244: T_m_G uses reanalysis data. I assume that this is for subsection 3.3(?). As the authors introduce section 4, T_m_G should be calculated by Eqs. (11) and (12). Please provide clarification about the use of reanalysis data for T_m_G.

Response 2: Thank you for pointing this out. We have revised the sentences you mentioned.

- Line 244: Yes, this is for section 3.3. We have clarified the use of reanalysis data for T_m_S, note that T_m_G has been changed to T_m_S.

Comment 3: Confusing sentences about the definition of "height". As the authors have defined T_m , please refer to h_{bot} when talking about "height" or surface. If the authors want to use "layered" T_m data, please provide a clear definition, such as the h_{bot} starting at different heights.

- Line 278: "It is necessary to develop a surface T_m model whose height is at the surface". Did the authors mean h_{bot} is now surface (e.g., zero height)?

- Line 296: "Therefore, a new hybrid-grid global T_m model considering time-varying lapse rate was developed on the basis of the NGGTm-H1 model, which used surface data of ERA5 reanalysis recorded from 2012 to 2016". Did the authors mean the "NGGTm-H model" used the surface data of ERA5 reanalysis or the new hybrid-grid T_m model? In the authors' response to my previous comments, the authors specifically clarified that the "grid-level" is "NOT" the surface. Please rewrite this sentence.

- Line 312: "Eq. (11) and (12) to calculate the T_m at the height of the grid points". I assume that Eqs. (11) and (12) are for the T_m whose h_{bot} are at the surface. If yes, please revise this sentence (height of the grid points \rightarrow surface).

Response 3: Thank you for pointing this out. We have referred to h_{bot} when talking about "height" or surface and provided a clear definition for "layered" T_m data.

- Line 278: Yes, h_{bot} is now surface. We have revised the word "height" to " h_{bot} " (see line 295).

- Line 296: The new hybrid-grid T_m model used the surface data of ERA5 reanalysis. We have revised this sentence to "therefore, a new global T_m model considering time-varying vertical adjustment rate was developed which used the integrated surface T_m of ERA5 reanalysis recorded from 2012 to 2016 on the basis of NGGTm-H1 model".

- Line 312: Yes, Eqs. (11) and (12) are for the T_m whose h_{bot} are at the surface. We have revised the phrase "height of the grid points" to the word "surface".

Comment 4: In conclusion, please add one sentence to emphasize the concept of "hybrid grid". The term "hybrid grid" is only mentioned in the title but not adequately explained in the text (e.g., line 295).

Response 4: Thanks for your suggestion. We have added one sentence to emphasize the concept of "hybrid grid".

Minor:

Comment 5: Line 298: I don't see significant horizontal variations in Figs 5a and 6a. Please make sure this is not a typo.

Response 5: Thank you for pointing this out. This is indeed a typo. We have revised "Fig. 6 (a)" to "Fig. 3 (a)".

Comment 6: I don't know why the number model coefficient is 10. Did the authors mean 100 (25 coefficients x 4 surrounding grids)?

Response 6: Thank you for pointing this out. The number of model coefficients is 100 (25 coefficients x 4 surrounding grids) instead of 10.

Thanks again for your constructive and insightful comments.