

Dr. Cenlin He
Topic Editor
Geophysical Model Development

October 13, 2025

Response to Reviewer 2 and Editor

Dear Editor,

We would like to sincerely thank the reviewers for their thorough evaluation of our manuscript and for the constructive comments and suggestions provided. We deeply appreciate the time and effort devoted to reviewing our work. The feedback has contributed significantly to improving the quality and clarity of the manuscript. Below, we address each of the comments in detail.

Reviewer 2, minor corrections:

- **Reviewer Comment:** *Because the current title explicitly mentions "data assimilation", readers may expect DA experiments. The authors may consider removing it from the title.*

Response: We considered the referee's suggestion and removed "for Satellite Data Assimilation" from the title. The new title is: *"Automatic Optical Depth Parametrization in Radiative Transfer Model RTTOV v13 via LASSO-Induced Sparsity"*

- **Reviewer Comment:** *In the Conclusion section, it would be helpful to add a paragraph that: discusses the potential application of the new approach in DA (the authors' response to the relevant comment could be used here); and clarifies that DA experiments may be conducted in the future.*

Response: We agree with this suggestion. At lines 528-533, we added the following paragraph:

"The numerical results obtained at different levels of validation, particularly the output from the proposed model indicating a high proportion of profiles with errors below the instrument's NEdT, provide strong evidence of its suitability and potential for satellite data assimilation. Nevertheless, applying sparsity-inducing models in this context requires a careful evaluation of the sensitivity of simulated

radiances to the underlying model state variables. This evaluation, in practical scenarios such as the satellite data assimilation of radiances from the proposed Fast-RT model, will be carried out in future work."

- **Reviewer Comment:** *I couldn't verify the code stored in Zenodo (<https://doi.org/10.5281/zenodo.14990818>), as it is restricted to users with access.*

Response: The code and data files are already publicly available. The version used for the revised manuscript is available at <https://doi.org/10.5281/zenodo.17050361> (September 3, 2025, Version v3). The link to Zenodo has been updated in the manuscript reference.

- **Reviewer Comment:** *In Appendix B, the numbering of the predictors starts at 1, whereas in the figures it starts at 0.*

Response: The predictor numbered 0 corresponds to the Case II of the statistical threshold parametrization, that is, $X_{0i} = 1$, with parameter $w_{i0}^{gl} = \bar{d}_i^{gl}$. This is not an original RTTOV v13 predictor, but it has been included in the tables in Appendix B for clarity. The predictor "â0â" has been added to the table with the following caption:

"(*) Not an original RTTOV v13 predictor. This predictor corresponds to Case II of the statistical threshold parametrization."

Editor's corrections:

- **Comment:** *(1) Please address the remaining minor suggestions from Reviewer #2 for the technical corrections.*

Authors Response: Each of the points suggested by Reviewer #2 has been addressed.

- **Comment:** *(2) Please ensure your discussion on the limitation/future direction of this study mentioned in your responses to Reviewer #1 are also summarized and discussed in your main text, including "no direct comparison or benchmarking of their approach against existing fast RTMs" and "does not discuss scenarios where the assumptions of the method might break down (for extreme conditions)".*

Changes: We included, in the header of the Numerical Results section (lines 284-286), the following paragraph:

"The numerical experiments do not include direct benchmarking against other existing Fast-RT models, only against standard RTTOV v13. It also does not evaluate scenarios where the assumptions of the method might break down, such as extreme atmospheric conditions, including extreme pollution events and environments with high volcanic activity"

And, in the Conclusion section, as future work (lines 534-536), the following paragraph has been added:

"Additionally, future directions may include a benchmark comparison against other existing Fast-RT models and more general scenarios with extreme atmospheric conditions, considering strong absorption due to extreme pollution events and incorporating variable SO₂ concentrations in environments with high volcanic activity."

With kind regards,

Juan Carlos De los Reyes and Franklin Vargas