Response of the manuscript "A Bias Correction Scheme for FY-3E/HIRAS-II Observation Data Assimilation (Chen and Guan, 2024)"

Thank you for your professional comments. To confirm that systematic model errors do not get larger, we compare each assimilated analysis with ERA5 and calculate the average RMSE profile of temperature and water vapor in the revised manuscript. We have also made corresponding revisions to many details that do not follow the AMT guidelines. Furthermore, we will also supplement the "Code availability" and "Data availability" in the revised manuscript. Below are the specific responses, highlighted in blue:

Specific comments

1. L79: There is another paper (Liu et al., 2024) about data assimilation of FY-3E/HIRAS-II, and model total column water vapor is not used as air-mass predictors in that paper. It could be important to quote the paper to clarify the importance of this paper.

Re: We read this paper and decided to quote it in revised manuscript.

2. L109: In the manuscript, the observation data in clear-sky scene is selected to estimate bias correction and assimilate. There is no specific description that radiation is simulated assuming clear-sky condition, but I guess that clear-sky condition is assumed in the simulation of radiation. It is necessary to clarify about it in the manuscript. For example, the phrase 'assuming clear-sky condition' could be added at the end of the sentence in L109.

Re: Yes, the radiation is simulated assuming clear-sky condition. We will add the phrase 'assuming clear-sky condition' at the end of the sentence in L109 to illustrate it.

3. L117-119: The region of the training data seems to be limited by the region of FY-4A/AGRI cloud mask product. Where is the specific region when expressed by longitude and latitude?

Re: Yes, the spatial matching of FY-4A/AGRI and FY-3E/HIRAS-II has regional limitations. When the viewing angle of the satellite is large, the field of view becomes distorted and spatial resolution decreases. To minimize the impact of field-of-view deviation, this study selects only the observations from the FY-4A/AGRI with a zenith angle less than 60 ° (The region is approximately from 55 °S to 55 °N and from 50 °E to 155 °E) for matching. The specific latitude and longitude ranges are add in revised manuscript.

4. L130-131: Why is the central FOV within each FOR selected for data thinning? Is the central FOV the best in some aspects of data quality?

Re: The central FOV is chosen mainly because it is located in the center of FOR and has good observation quality. For example, figure 1 shows the NEdT (Noise Equivalent Delta Temperature) spectrum distribution of FY-3E/HIRAS-II measured at 2010 UTC 08 Dec 2021. Different colored lines are different FOVs. Figure 1 shows that the NEdT for FOV5 is minimal in almost all channels.
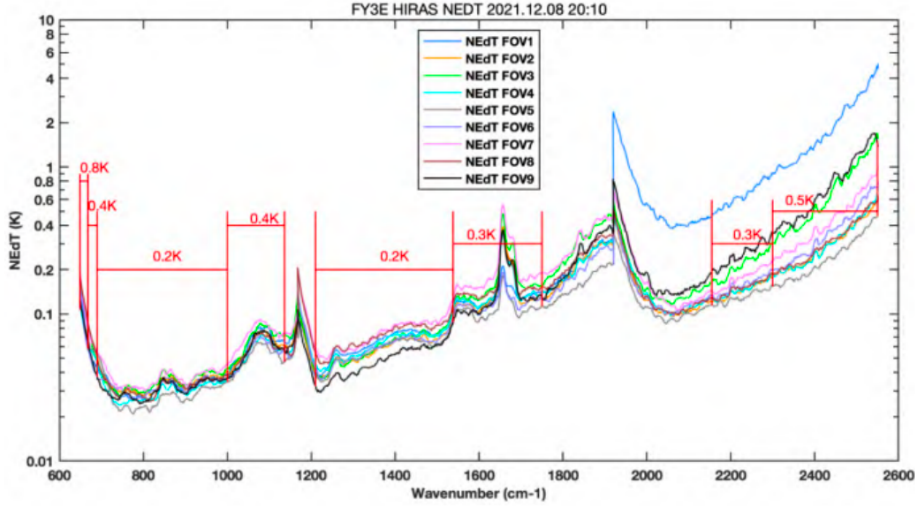
Fig 1. The NEDT distribution of FY-3E HIRAS-II on 8 December，2021.

5. L143-144: It is better to explain explicitly in section 4 in advance that the offline static correction is adopted, although section 7 includes the statement.

Re: We will explain explicitly in section 4 in advance that the offline static correction is adopted.

6. L174: The definitions of thickness and t_v are different from those generally used in meteorology. Please check if Eq. (4) and Eq. (5) are correct.

Re: The equations we provide are based on the WRFDA source code. In WRFDA, the thickness is calculated assuming under the condition of moist air. In addition, the GFS data and RTTOV used in this study are based on the atmospheric level (not layer), so need 'full-level to half-level'. However, the equations given in paper are wrong, and we will change Eq. (4) and Eq. (5) as follows:

The Parameter thickness is calculated as

$$Pred_{thickness} = kth \times \sum_{i}^{N-1} tv(i) \times \ln \frac{P(i)}{P(i+1)} \quad (4)$$

Here, $kth = gas_{constant}/gravity (gas_{constant} = 287.0 \, J \, K^{-1} \, kg^{-1}, \, gravity = 9.81 \, N \, kg^{-1})$, N is atmosphere levels, P is atmospheric pressure, tv is the parameter characterizing atmospheric temperature and humidity and calculated as

$$tv(i) = \frac{T(i)+T(i+1)}{2} \times \left[1.0 + 0.608 \times \frac{q(i)+q(i+1)}{2}\right] \quad (5)$$

Where, T and q represent RTM level temperatures and moistures, respectively.

The WRFDA code for computing thickness can be found in
https://www2.mmm.ucar.edu/wrf/users/wrfda/code_viewer/html_WRFDA_v4.3/index.html .
(htmlized code: radiance; radiance index: DA_PREDICTOR_RTTOV)

7. L204-206: Are the diagnostic coefficients the coefficients of determination?

Re: The diagnostic coefficients are not the coefficients of determination.

8. Fig.1: The assimilated channels should be listed in a table in an appendix to clarify

Re: We will give the assimilated channels in the attachment.

9. L253-254: In L210-211, there is the sentence 'Data assimilation systems generally do not

assimilate strong O_3 absorption channels at present and the water vapor content in upper atmosphere is scarce, so a predictor combination including model surface skin temperature, model total column water vapor, thickness of 1000-300 hPa and thickness of 200-50 hPa is selected to correct the air-mass biases for HIRAS-II in this research.' Why are O3 channels assimilated in the experiments?

Re: With the development of NWP mode, the top of the mode keeps increasing (ECMWF:0.01 hPa). O3 channels (the peak height of the weight function ranges from 5 to 20hPa) can provide upper-air meteorological information that cannot be provided by conventional data. Therefore, we still choose these channels for assimilation although the data assimilation system generally does not assimilate O3 channels at present.

10. L265-L330: These sentences follow section 5, 'DATA ASSIMILATION SYSTEM AND EXPERIMENTAL DESIGN'. Some people may misunderstand that these sentences explain results of data assimilation experiments. I suggest explaining these sentences in section 4 to avoid confusing.

Re: I agree with your comment, it will be modified in revised manuscript.

11. About data availability and code availability: Authors are required to provide a statement on how their underlying software can be accessed. This must be placed as the section "Code availability" at the end of the manuscript. In the manuscript, the data corresponds to RTTOV v12.3 and WARFDA V4.4. Also, authors are required to provide a statement on how their underlying research data can be accessed. This must be placed as the section "Data availability" at the end of the manuscript. In the manuscript, the data corresponds to FY-3E/HIRAS-II Level 1 data, FY-4A/AGRI Level 2 cloud mask product, NCEP GFS forecast data and analysis data (NCEP FNL (Final) analysis data?) for verification. See the data policy page and the guideline page on the AMT website.

Re: We will provide "Code availability" and "Data availability" at the end of the revised manuscript.

Minor comments

1. L85: '… a one-month assimilation experiment.' -> "… one-month assimilation experiments.' because three assimilation experiments were run.

Re: I agree with your comment, it will be modified in revised manuscript.

2. L89: '3041 channels'-> '3041 channels (after apodization)'to clarify the number of channels is after apodization

Re: I agree with your comment, it will be modified in revised manuscript.

3. L98: The link has expired.

Re: We update the link (https://rda.ucar.edu/datasets/d084001/).

4. L108: A period is necessary after '(Saunders et al., 2018)'.

Re: Thank you for your careful comment, it will be modified in revised manuscript.

5. L164: Vectors should be printed in bold italics.

Re: Thank you for your careful comment, it will be modified in revised manuscript.

6. L175: The unit of the gas constant is J K^{-1} kg^{-1}. Units must be written exponentially. 'N/kg'-> 'N kg^{-1}'

Re: I agree with your comment, it will be modified in revised manuscript.

7. L196 and L201: A space must be included between number and unit in eachdescription, '737.5cm^{-1}, 900cm^{-1}, 1040cm^{-1}, 1279.375cm^{-1}, 1476.25cm^{-1} and 1809.375cm^{-1}'.

Re: Thank you for your careful comment, it will be modified in revised manuscript.

8. Fig.1 (c) and Fig.2 (b): The spelling of the word should be consistent in the manuscript.'water vapour'-> 'water vapor'

Re: Thank you for your careful comment, Fig.1 (c) and Fig.2 (b) will be updated in revised manuscript.

9. L231 and L242: A space must be included between number and unit in the description, '1809.375cm-1'.

Re: Thank you for your careful comment, it will be modified in revised manuscript.

10. Fig.2 (b): Units must be written exponentially. 'kg/kg'-> 'kg kg^{-1}'

Re: I agree with your comment, Fig.2 (b) will be update in revised manuscript.

11. L248 and L292: In the text, equations should be referred to by the abbreviation "Eq." and the respective number in parentheses. However, when the reference comes at the beginning of a sentence, the unabbreviated word "Equation" should be used. 'Equation (6)' -> 'Eq. (6)' and 'Equation (3)' -> 'Eq. (3)'

Re: I agree with your comment, it will be modified in revised manuscript.

12. L249: Matrices should be printed in boldface, and vectors should be printed in bold italics. The multiplication sign in the second term can be omitted as well as that in first term.

Re: Thank you for your careful comment, it will be modified in revised manuscript.

13. L257: Coordinates need a degree sign and a space when naming the direction. The description 'from 0°N to 60°N and from 70°E to 150°E' does not follow the format.

Re: Thank you for your careful comment, it will be modified in revised manuscript.

14. L260: The period of assimilation experiments seems wrong. The period '17 to 31 August 2023'-> '1 to 31 August 2023'

Re: I agree with your comment, it will be modified in revised manuscript.

15. L265-266: '… from January 1 to January 14, 2023.' and '… from January 15 to January 31 2023 …'-> '… from 1 January to14 January, 2023.' and '… from 15 January to 31 January 2023 …', respectively

Re: I agree with your comment, it will be modified in revised manuscript.

16. Fig.3 and Fig.5: A space must be included between number and unit in the labels such as

'737.5 cm^{-1}'.

Re: Thank you for your careful comment, we update Fig.3 and Fig.5 in revised manuscript.

17. L296-297: 'From Figure 4 (a), (b) and (d), …' But, there is no Figure 4 (d).

Re: We update the Figure 4 to address the issue, each subgraph in the updated figure has its own serial number

18. L298: In the sentence '…, while water vapor channels with …', are these water vapor channels channel 1323 and 1855?

Re: Yes, we added '(Figure 4 (e-f))' after the sentence 'water vapor channels with a higher height of weight function ' to make our expression more clear.

19. Fig.4: If the figures are between 2 pages, a caption is necessary in each page. Furthermore, it may be better to use the words 'Observed BT' and 'Simulated BT'rather than 'Obs BT' and 'Bak BT'respectively in the axis labels.

Re: To address this issue, we merge the two figures into a single composite figure. In addition, we use the words 'Observed BT' and 'Simulated BT' in the axis labels, respectively.

20. Table4: If the table is between 2 pages, the table title is necessary in each page.

Re: I agree with your comment, it will be modified in revised manuscript.

21. L342, L343, L349 and L352: 'O3' -> 'O$_3$'

Re: Thank you for your careful comment, it will be modified in revised manuscript.

22. L350 and L352: 'CO2'-> 'CO$_2$'

Re: Thank you for your careful comment, it will be modified in revised manuscript.

23. L353: The sentence should be aligned left.

Re: Thank you for your careful comment, it will be modified in revised manuscript.

24. L368: Coordinates need a degree sign and a space when naming the direction. The description '0°N to 30°N' does not follow the format.

Re: Thank you for your careful comment, it will be modified in revised manuscript.

25. L361: The sentence '…, a data assimilation experiment at 0000 UTC 7 August 2023 was…'-> '…., three data assimilation experiments at 0000 UTC 7 August 2023 were …'?

Re: Yes, it will be modified in revised manuscript.

26. L369: '… is a significant.'-> '… is significant.'

Re: It will be modified in revised manuscript.

27. L362-364 and L382-384: The word colors generally include white and black. The word shading generally means not only black shading but also colorful shading. To clarify the words, 'the colors'-> 'the colored dots', 'spatial distributions'-> 'spatial distributions (colored dots)' and 'the shading'-> 'the black shading

Re: I agree with your comment, it will be modified in revised manuscript.

28. Fig.8: Units must be written exponentially. 'g/kg'-> 'g kg-1' and 'm/s'-> 'm s-1'

Re: I agree with your comment, it will be modified in revised manuscript.

29. L391: '… from January 1 to January 31, 2023 …'-> '… from 1 January to 31 January, 2023…

Re: It will be modified in revised manuscript.

Thank you again for your professional and meticulous comments.