Dear reviewer,

Thanks for your valuable comments and suggestions. We have carefully revised our previous manuscript in accordance with your suggestions. A point-by-point response is given as follows.

Point 1:

In the revised version the authors have responded adequately to most of the points raised in the first review round, and the revised manuscript is more robust in many aspects.

Nevertheless, some adjustments are still needed. Here some further recommendations:

1) Regarding to the point 9) of the previous review, I have to disagree with the authors on part of the explanation provided for neglecting some of the terms of the radiative transfer equation. Indeed, for all the molecules analyzed, the paper considers spectral intervals dominated or heavily affected by up- and downwelling thermal radiation emitted by the atmosphere, rather than solar radiance. Therefore, neglecting some thermal contribution will yield a bias which needs to be at least quantified. This is especially true in case, e.g., of clear sky and low emissivity (=high reflectance), where sensitivity can be significantly affected by reflected radiance contribution.

This issue must be addressed, either using actual data from satellite instruments (e.g. IASI, AIRS) to verify the validity of this hypothesis in different conditions, or working with the full radiative transfer equation on the cases already presented.

Response 1:

I do agree that the contribution of the downwelling thermal radiation emitted by the atmosphere is an important part in radiative transfer calculation.

![Spectral radiance at sensor aperture through unpolluted atmospheres](image)a  
(b) Surface type: Barren or Sparsely Vegetated

Figure 1. Spectral radiance at sensor aperture through unpolluted atmospheres

The impact of the downwelling thermal radiation on total spectral radiance is related to the surface reflectivity and emissivity, as shown Figure 1. Thus, it is inappropriate to...
neglect the corresponding terms of the radiative transfer equation. The downwelling thermal radiation is included in our calculation code. To validate the impact of the downwelling thermal radiation on band selection result. The results of CO are given in Figures 2 and 3.

(a) Contrast matrix  (b) Contrast curve with central wavelength of 4.606 μm
Figure 2. Band selection results including downwelling thermal radiation

(a) Contrast matrix  (b) Contrast curve with central wavelength of 4.606 μm
Figure 3. Band selection results excluding downwelling thermal radiation

For Figures 2 and 3, the optimal bands locate at the central wavelength of 4.606 μm and the bandwidth of 0.01 μm. This is the reason we claimed that “the mentioned radiance has negligible impacts.” However, for the integrity of the radiative transfer model and the applicability of the proposed procedure, the downwelling thermal radiation should be included. We rechecked our code and redid the simulation to ensure the correctness. The corresponding equations are corrected while a few figures are redrawn.
Special thanks for this valuable suggestion.

Point 2:

2) The discussion of O3 absorption (lines 458-465) is confusing. The positive/negative values in the difference (Figure 9b) are not necessarily related to ozone concentration, but they can be definitely related to other influencing factors, such as ground
emissivity and temperature, and temperature gradients between the stratospheric ozone layer and the tropopause. These aspects need to be stressed better in the paper, and they still evidence that a comparison with real satellite data would benefit the robustness of the paper.

Response 2:

The paragraph is written as “As it can be seen Figure 8(b), the spectral radiance difference between the O\textsubscript{3} contaminated atmosphere and the unpolluted atmosphere can be either positive or negative in the given spectrum. This phenomenon is related to many influencing factors, including ozone concentration, ground emissivity and temperature, and temperature gradients between the stratospheric ozone layer and tropopause. When the ozone concentration increases, the atmospheric radiance becomes more intense while the ground radiance is weaker. As the total spectral radiance varies nonlinearly with the ozone concentration, both positive and negative values can be seen in the difference.” I agree that the comparison would benefit the robustness of the paper. This is an important work in the future.

Point 3:

3) Regarding point 1) of the review, the authors have correctly specified the meaning of "scale height". However, now this is not related to the meaning of z\textsubscript{0} in Eq. (14), which has to be specified as a "vertical profile scaling parameter".

Response 3:

The corrections are made and highlighted in yellow.

Thank you again and best regards.

Yours sincerely,
Xiaoyu He