1 Response to Referee No.2

We sincerely thank the reviewer for devoting time and effort into reading the manuscript and suggesting ways in which it could be improved. The reviewer comments are listed below in italic and our responses corresponding to each are given in blue.

1.1 Overall comment

This paper tackles an important issue: how to efficiently and accurately recover temperature fluctuations due to gravity waves that are masked by large scale planetary and tidal wave values in satellite data. It is particularly important to understand the strengths/limitations of new satellite instruments. The methodology/algorithm for using 2D spectral decomposition to remove the large-scale components due to planetary waves and tides is well described and tested using simulated data. The recovery of gravity wave fluctuations is convincing. However, like any technique there will be instrumental limitations that constraint the range of gravity wave scales that can be observed, as summarized in Appendix A for a range of techniques. It would help the reader to understand these limitations if there was a diagram similar to Fig 8 in Alexander et al QJRMS 136: 1103–1124 (2010) that describes observational constraints. More information is required on what GW scales can be recovered with these proposed new satellite measurements.

Since the background removal method sets a limit only on the wavenumber and frequency of the large-scale waves that can be removed, the GW spectra that can be recovered mostly depends on the instrument design. So the aforementioned diagram is applicable here as well, without much changes. In the case of CAIRT, with its planned 1 km vertical, 50 km along-track, and 25 km across-track resolution, Rhode et al. (2024) resolved GWs with horizontal wavelengths above 100 km and vertical wavelengths above 2.8 km. To address these points, the following sentences have been added to Appendix B:

It should also be noted that the GW visibility limits depend on the instrument design as well. An overview of the general regions of the GW spectra that is observed by different measurement techniques is given in Fig. 8 of Alexander et al. (2010) and Fig. 9 of Preusse et al. (2008). For the observable spectrum of the CAIRT instrument used in this study, refer to Rhode et al. (2024).

1.2 Specific comments

There are some minor issues:

1. *Appendix A is not mentioned in the body of the text. Probably should be referenced in about line 31.*

   A paragraph was added to the 'Introduction' section of the manuscript to point to Appendix A which was not referenced in the main body:

   App. A presents some of the methods used in previous studies to extract these global wave modes which, along with the mean atmospheric state and seasonal trends, constitute the 'background'.

2. *L 69: What does it mean that a tide is a 'true resonant mode and propagating wave'?*

   The sentence was meant to convey that tides are forced by solar heating and have specific frequencies. For better clarity, it was rephrased to:

   Note that the tide is a true propagating wave mode driven by the sun that has a specific zonal wavenumber and frequency. Accordingly, at different altitudes, latitudes, or local times...

3. *L230 'date' not 'data'*

   The typo was fixed and the line was modified to:

   ...at the central date...

References

M. J. Alexander, M. Geller, C. McLandress, S. Polavarapu, P. Preusse, F. Sassi, K. Sato, S. Eckermann, M. Ern, A. Hertzog, Y. Kawatani, M. Pulido, T. A. Shaw, M. Sigmond, R. Vincent, and S. Watanabe. Recent developments in gravity-wave effects in climate models and the global distribution of gravity-wave momentum flux from observations and models. *Quart. J. Roy. Meteorol. Soc.*, 136:1103–1124, 2010. ISSN 0035-9009. doi: 10.1002/qj.637.

P. Preusse, S. D. Eckermann, and M. Ern. Transparency of the atmosphere to short horizontal wavelength gravity waves. *J. Geophys. Res.*, 113(D24104), 2008. doi: 10.1029/2007JD009682.

S. Rhode, P. Preusse, J. Ungermann, I. Polichtchouk, K. Sato, S. Watanabe, M. Ern, K. Nogai, B.-M. Sinnhuber, and M. Riese. Global scale gravity wave analysis methodology for the ESA Earth Explorer 11 candidate CAIRT. *Atmos. Meas. Tech.*, 17:5785–5819, 2024. doi: 10.5194/amt-17-5785-2024. URL `https://amt.copernicus.org/articles/17/5785/2024/`.