RESPONSE TO REFEREE 2

All authors sincerely thank Referee 2 for the time and care spent reviewing this manuscript, and for the constructive comments provided. Please find our detailed, point-by-point responses.

This study presents a multi-resolution analysis (MRA) approach using the 8th-order Daubechies wavelet to analyse gravity waves in lidar data for a single case event. The MRA is compared with traditional methods such as mean background atmospheric temperature, polynomial fitting, Butterworth spectral filtering, and the variance method. The authors demonstrate that MRA outperforms these methods when applied to lidar temperature data. For wind analysis, only MRA is used.

This work introduces a promising tool for gravity wave analysis that could contribute to the understanding of multi-scale atmospheric dynamics. The manuscript is well written; however, it requires additional clarification and explanation of certain choices.

General comments:

- Why are the chosen windows different between methods? It needs some justification.

We aimed to match the passbands of the different methods as closely as possible to isolate the dominant GWs with a vertical wavelength of 5 km. This point is emphasized in lines 275-277.

- It would be useful to see a comparison of the MRA to a conventional wind analysis.

We updated the results presented in the section *"Application to wind lidar profiles"* by including additional outputs from the conventional analysis methods. Specifically, we added results on wind perturbations, gravity wave kinetic energy (GWKE), and the kinetic-to-potential energy ratio to provide a more comprehensive comparison with the MRA results.

- *Section 3.1 Case Study*: Several mentions are made of wind, tides, and GWs observed on the day, but the corresponding figures are not shown. Since the paper focuses on the method and the case study, including these figures would help the reader follow the discussion without having to rely solely on the authors' statements.

As also noted by Reviewer 1, we have added Figure 2, which shows gravity wave activity over La Réunion from 20 to 25 November 2023, derived from ERA5 analyses.

- Throughout the article, the same method is called differently, e.g. 'butterworth filter' and 'spectral filtering'. Select one way of calling it and use it everywhere.

We use 'spectral filtering' throughout the entire article.

- There is a misuse of GW and GWPE throughout the entire article. GWPE is defined but then used as GW potential energy. Please change it everywhere, and remove densities after GWPE.

Modifications have been done. We defined and used GWPE and GWKE.

- The summary, conclusions and perspectives need some emphasis on the method comparisons and their weaknesses.

The summary, conclusions and perspectives section has been revised with clearer discussion of the method comparisons, their limitations, and the advantages of MRA.

Specific comments:

Figure 4: It could be useful to see a plot with the difference between the temperature and method next to the temperature one.

Figure 4 has been renumbered as Figure 3, and we have added a new subplot showing temperature perturbations derived by removing the background from the original profile for each method.

L007: In an abstract, you should try to avoid the use of acronyms to help readability. It's okay to use them; however, don't use an acronym for defining another acronym GW potential energy (GWPE). You are not space-limited, so avoid this practice.

L010 : The sentence has been changed into "In terms of gravity waves potential energy (GWPE)..."

L017-021: Paragraph small, only one citation.

The paragraph has been changed (L021 - L031) and we add new citations.

L023: Here the 'e.g.' is used. If you are giving an example, only one or two citations are enough. It could be one old and a new one. Instead, 10 are given and not even one is a recent one (2020+). I suggest removing e.g. and adding a later one too.

The 'e.g.' has been removed. We add a later citation (L035).

L024: Duck et al. 2001, the link is broken.

The DOI link is now active.

L025: I agree that Lidar observations are capable of inferring long-term trends; however, some of the cited publications are campaigns or techniques, which aren't studies in long-term trends.

Additional references to studies on long-term trends have been included.

L028-29: Same as before, there are newer studies of GW with Lidar observations.

We have added citations of newer studies of GW with lidar observations (L039-40).

L085: cal/val is only used twice and in the same sentence. If it is not used later, it is unnecessary to define it.

L107 : The sentence was revised to: "Lidar data are primarily used for long-term monitoring of the middle atmosphere and have also supported recent calibration activities, such as those conducted for the European Space Agency's ADM-Aeolus satellite mission dedicated to global wind observations"

L150: verticalsinterval

L171: This error has been corrected in the revised manuscript.

L163/164: You defined MRA in the second sentence but use it in the first sentence, please switch.

L184/185 : The modification has been done.

L190: eq:3 is the equation of the gravity wave potential energy. Remove density and all the references to it. You have already defined GWPE, so now you can use it.

We have used GWPE.

L200: The reference to the figure is there, but no in-text full explanation of the figure.

For improved clarity, we have replaced the figure with a table that summarizes the vertical wavelength intervals corresponding to all methods.

Fig2: caption double km.

Figure 2 has been renumbered to Figure 1 and the caption has been modified.

L205: Again, defining an acronym with an acronym and it should be defined before. Particularly in this case, you don't need it because it's the GWPE.

We define GWKE as Gravity Wave Kinetic Energy.

L207: GWE?

We have replaced the abbreviation "GWE" with its full form, "Gravity Wave Energy," for improved clarity.

Fig. 3: second line: "above" La Réunion, it sounds narrower than actually is. Change to centred over or similar. And the longitude is written with a ","

Figure 3 has been renumbered as Figure 2. We have replaced Figure 2 with a height–time cross section of temperature and wind perturbations from ERA5 over La Réunion, which confirms the presence of gravity wave structures above the island.

Figure 8: red dots? Only one is shown at which I guess is the start.

In accordance with Reviewer 1's request, we have removed the hodograph analysis.

Figures 7 and 8: Increase label size.

Figure 7 has been renumbered as Figure 6, and its labels have been resized. Additionally, Figure 8, presenting the hodograph analysis, has been removed from the article.