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Interactive comment on "The signature of the tropospheric gravity wave background in observed mesoscale motion" *by* Claudia Christine Stephan and Alexis Mariaccia

Anonymous Referee #2

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This is an interesting and well written manuscript. The authors use observations collected by a sounding network to diagnose profiles of area-averaged mesoscale divergence and vorticity. Particularly, they show that the observed divergence magnitudes scale approximately inversely with the area equivalent radius, a relationship which is also confirmed in ERA5 reanalysis, and in a numerical simulation. Based on a series of assumptions, it is shown that in the numerical data, the energy spectra of inertia gravity (IG) waves might explain this scaling relationship. This paper is relevant and important for research on tropospheric mesoscale divergence and gravity waves, and their possible relationships and it fits for WCD. I have a few general points and some minor revisions to suggest.

General comments:

- The two most interesting findings of the paper are 1) the scaling of divergence amplitude with area equivalent radius, and 2) the possible explanation of this scaling by the wavenumber dependent IG energy spectra. While the former is robust and is confirmed in observations, reanalysis, and numerical simulation, the latter is based on a series of assumptions and is shown to be held only in the numerical data. I expect the authors to make this point clear in the text and, in particular, justify why this relationship does not hold in observations and reanalysis data.

- In the energy spectra of the numerical simulation, fitting a line with a slope of -2 on a very short segment of the spectral line (i.e., k=100-150) is not convincing, and is not justified in the text.

- Among the assumptions that have been made to derive the analytic relationship between energy spectra and divergence amplitudes, I am less convinced that IG waves should mainly propagate zonally. The authors show in section 3.2 that these waves are on average propagating eastward, however, it is also shown that there could be up to 30° difference between their results from the ships and HALO (why?).

- The authors propose that they will use the global energy spectra to explain why ERA5 has larger divergence amplitudes than ICON but it is not addressed in the paper. ERA5 also shows much larger variability in divergence amplitude at a given equivalent radius (Fig. 6).

Specific comments:

Line 80: data the surface -> data "cover" the surface

Line 114: It should be L/R > 2.

Line 220: thick dots -> thick blue dots

Line 237: I think you mean Fig. 7b instead of Fig. 6b.

Line 245: Add “of IG modes” after spectral slopes to make it clear.

Figure 6: Explain the magenta lines in the caption of the figure. I think it would be great if you could add a secondary x axis to this figure which shows zonal wavenumber. I assume part of the magenta line is based on σ(k)=-5/6, and part of it based on σ(k)=-1. Perhaps you could make it clear by using different color/line style.

Table 1: Please either add the column number to the table or add the column symbol to the caption.

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