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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Airborne measurements and large-eddy simulations of small-scale Gravity Waves at the tropopause inversion layer over Scandinavia" *by* Sonja Gisinger et al.

Anonymous Referee #1

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[letterpaper, 12pt]article

1. **General Comments**

   This is an excellent paper that melds analysis of data from recent field campaigns with idealized numerical modelling to obtain insight into apparent interfacial waves in the tropopause inversion layer. I find it to be well written and enlightening from a scientific point of view, and it deserves publication in ACP. Nonetheless, I do have several (mostly minor) comments and questions.

2. **Specific Comments**

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Discussion paper

- In RF08 FL1, there is also a region of positive MF at $\lambda = 30$-40 km and $x = 200$-250 km that is almost equal in magnitude to the region of negative MF perturbations at $\lambda = 40$-50 km and $x = 120$ km. The latter region is attributed to vertically propagating waves in the text, but is there any explanation for the positive MF region?
- How long are the simulations run for? Are they at approximately steady-state?
- The initial profiles for the more realistic idealized simulations appear that they may be capable of supporting trapped waves due to the wind shear in the troposphere. There appear to be trapped-wave-like structures in the troposphere in both the no-TIL and TIL cases, which may also be leaking into the stratosphere, particularly in the TIL inversion case where there is an even larger Scorer parameter in the inversion. Where do these perturbations appear in the wavelet analysis? Could leakage of waves from the troposphere complicate the attribution of perturbations in the TIL to interfacial waves?
- When discussing waves with wavelength of ~ 8 km, it is very difficult to gain an appreciation of the structure with the aspect ratio in the vertical velocity plots. It would be nice to stretch out the horizontal axis a bit more for ease of interpretation.
- It might be nice to show one or two example soundings (with θ) for the idealized cases outlined in Table 1, which would help illustrate the exact setup of the inversion.
- Line 45: The sentence beginning here is oddly worded. I think it would be better to make clear that "they" here refers to the fundamental characteristics of the hydrostatic approximation. At first reading it initially seems like "they" refers to the findings.

- Line 146: The ρ_0 of the Boussinesq approximation is not actually defined in the text.
- Line 175: It might be useful to note that the "critical horizontal wavelength" is also referred to as the Scorer parameter, especially since the Scorer parameter is referenced elsewhere in the text. It may also be helpful to have the equation for the Scorer parameter written in the paper as well.
- Line 194: I think it would be good to have a citation for alternating momentum fluxes being an indication of reflected and trapped waves.
- Line 280: "Interfacial small 280 scale waves are absent in the troposphere below the TIL (Fig. 15i) and in the case of no TIL (RUN 5, Fig. 14c and Fig. 15a, c)." For the no-TIL simulation, are you referencing below the would-be TIL or above or both? The referenced figures imply above, but text seems to imply either below or both.

3. **Technical Corrections**

- Line 304: Second word should be "were" instead of "where"
- Line 305: Extra "to" in "range of to"