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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observation of Kelvin-Helmholtz Instabilities and gravity waves in the summer mesopause above Andenes in Northern Norway" *by* Gunter Stober et al.

Anonymous Referee #2

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The manuscript reports MST radar observations of KHI based on the structural evolution of PMSE. These are the first MST radar observations of the kind and thus, well worth publishing. The authors further provide a set of basic characteristics based on 15 wave events which are then compared to earlier observations of similar activity captured with different measurement techniques. Much of the information is well described in the manuscript but some further clarifications are necessary before publishing. Most of the questions below are asking for more explanations and discussion of the key features in the data plots.

Main comments:

- PMSE is a major side topic of the paper because it is used as a tracer. The manuscript would benefit from a short characterization / climatology section of PMSEs in the introduction to let the readers know what are the normal PMSE conditions, structure, thickness, lifetime, occurrence etc., so what are the KHI observations in this study compared to. The references to earlier work are given but their main results should be outlined.
- Figure 1 is said to show all beam positions as well as the ones for each experiment. However, the figure shows map projections of all beams. How were the 17 beams for each experiment chosen and what were they?
- A meteor removal procedure is explained in section 3. Is that a standard method with an existing reference to earlier work, or is it implemented here to improve the current analysis? In the latter case the thresholding would benefit from some justifications.
- Meteor radar data are used in addition to MAARSY data but the data description for meteor radar is very thin compared to that of MAARSY. In particular, a height range and resolution for meteor radar data should be included in the corresponding paragraph on page 4.
- When the first identification of KHI is presented (page 5, line 3), a short description of what the reader is supposed to look at in the figure would help a lot. What are the changes in the different parameters which give away the KHI occurrence? In the same paragraph earlier the meaning of: "several thin layers showing signs in the morphology" is unclear. Do you mean that the PMSE structure consists of several transient thin layers?

- The description of Figure 5 says that there are often low Ri values within the PMSE. Not sure what is low and high, but it is hard to see if there really is more high or low values in the two colour panel. Is there a way to justify that statement?
- What are the GW-like periods you focus on in Figure 8? It seems like there is significantly less wave activity during the latter KHI event?
- Line 8 on page 5 says:"The zonal and meridional winds are dominated by the tides." A sentence saying how the data plot supports this idea would be helpful.
- When Richardson number is being introduced in section 4.1, a brief reasoning for why that is a useful parameter in the KHI study would be good.
- Can you specify the meaning of "coherent wave-like structure" (page 7, line 23)? What is coherent enough?
- What is the significance or implication of the prevailing wind direction with respect to the ripple propagation direction? The observations and the plot are not really discussed.
- When introducing earlier observations by Demissie et al. (page 9, line 12), you mention that those are from different years. Does that mean that you would expect annual differences?

Minor comments:

- The introduction mentions "mesoscale" many times. It is a relative measure which depends on the observations, so it would be good to give a rough number or range for it.

- The paragraph change on page 1 and line 23–24 is unnecessary when the first sentence of the new paragraph refers to the last sentence of the previous paragraph.
- On page 2 and line 9, "and many other" is redundant since the reference list starts with "e.g.".
- On page 3 and line 21, Figure 2 is hardly a contour plot.
- On page 4 and line 4, should the "zenith distance" be a zenith angle since the rest of the sentence talks about degrees?
- Figured 3 has an "a)" as a panel marking but I do not see the panel labels b and c.
- The description of Figure 5 in the text says that there is Ri calculated from MAARSY and MR data (the plural s in "lower panels" seems redundant). The figure caption says that the panels are Ri from wind shear and Brunt-Väisälä frequency. Could you add the data source information in the figure caption to make it more self-explanatory?
- Figure 3 does not show any red boxes but based on the statement on the top of page 6, it might make a difference to generate the boxes.
- What is DNS simulation (page 6, line 9)?
- Does "rather common" (page 6, line 14) mean "not uncommon", or is there actually a description attached to it, which could be added to be a bit more precise?
- On page 6 and line 24: "than" should probably be "then"
- "Train of ripples" referring to Figure 7a seems right, but in Figure 7b it looks more like one single wave-like feature.

- Should be "wave-like" instead of "wave.like" on page 8 and line 16.
- On page 9 and line 8 the text blames weather conditions for not having other observations. Does that relate to a lack of optical observations due to the daylight conditions, or does it really mean weather?
- Seems like there is an extra "propagation direction" on page 10 and line 9.

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