

## ***Interactive comment on “Neutral air turbulence in the mesosphere and associated polar mesospheric summer echoes (PMSEs)” by Alireza Mahmoudian et al.***

### **Anonymous Referee #2**

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The paper is devoted to investigation of polar mesospheric summer echoes (PMSE) and aims at comparing simulations with radar observations. The title suggests that the main subject of this study will be the neutral air turbulence. The abstract further defines several key points which should be addressed in this work:

1. "four radar frequency observations of the PMSE region under varying neutral air turbulence conditions."
2. "effect of neutral air turbulence on the generation and strength of PMSE" as a function of "dust parameters"

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3. "neutral air turbulence in presence of heavy dust particles, can largely explain the observed radar cross-section at four radar frequencies"
4. "effect of initial turbulence amplitude" as dependence on "of various dust parameters"
5. "Several key parameters in dusty plasma responsible for the PMSE observations are determined"

The paper is badly organized, difficult to read, and contains vast of misleading formulations (wrong definitions and descriptions). As a result, it is difficult to follow the authors ideas and interpretations.

I did not find satisfactory answers on most of the defined above problems and cannot suggest a simple way of improving this manuscript. Therefore I suggest rejection.

General structure of the manuscript must be improved by separating model description, simulation results, its comparison with measurements, and conclusions. Currently everything is mixed in two sections 3 and 4.

PMSE study at three radar frequencies can be found in work of *Rapp et al.* (2008), where it was quantitatively shown based on measurements, that turbulence in presence of heavy aerosols well explains PMSE strength and frequency (Bragg scale) dependence. Also, scattering of radio waves as dependence on turbulence parameters was addressed in detail by *Lübken* (2014). Therefore, authors must show what is new in their paper.

However, I may admit that if measurements shown here were made in a true common volume (which is not clearly said in the manuscript) they are quite interesting and I would encourage authors to submit a more consistent and detailed study based on these data.

In what follows I give some more specific comments.

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- To point 1 above: I did not understand from the article how the "turbulence conditions" were "varying" during measurements and how it was inferred from those measurements. I've got an impression, that turbulence was not estimated from the measurements, however it might be possible, e.g., from spectral width of the radar measurements.
- The same is also valid for the second goal claimed in the abstract (point 2 above). Also, as I understand, the authors use "dust density fluctuation amplitude" as a measure of turbulence intensity. However, this relation is not justified or explained in the paper (e.g., at least by assessment of time constant). Also, I did not find, "effect on PMSE generation", e.g., range of "dust parameters" and turbulence intensity when PMSE is not generated, or threshold values, whatsoever.
- In abstract stated: "neutral air turbulence in presence of heavy dust particles, so-called fossil turbulence" (point 3 above). It is wrong formulation. You can name it dusty turbulence, but not fossil. Fossil turbulence can be characterized by presence of turbulent-like structures in scalar fields whereas the velocity field became laminar. Also, as mentioned above, this point was much better addressed by *Rapp et al.* (2008).
- To point 4 above: The term "various dust parameters" must be explained better, e.g., by a table of these parameters, or by sub-sectioning the paper explaining these dependencies subsequently. Also practical meaning of the "initial turbulence amplitude" in this study is unclear. Is it a pure feature of simulations or it can be used for interpretation of measurements?
- The last point in the list of goals mentioned above is not answered in this paper as well. However, this is already answered in numerous works published so far.

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## References

- Lübken, F.-J., Turbulent scattering for radars: A summary, *Journal of Atmospheric and Solar-Terrestrial Physics*, 107, 1 – 7, doi:<https://doi.org/10.1016/j.jastp.2013.10.015>, 2014.
- Rapp, M., I. Strelnikova, R. Latteck, P. Hoffmann, U.-P. Hoppe, I. Häggström, and M. Rietveld, Polar Mesosphere Summer Echoes (PMSE) studied at Bragg wavelengths of 2.8 m, 67 cm, and 16 cm, *J. Atmos. Solar-Terr. Phys.*, 70, 947–961, doi:[10.1016/j.jastp.2007.11.005](https://doi.org/10.1016/j.jastp.2007.11.005), 2008.

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