

## ***Interactive comment on “Mesospheric turbulence during PMWE-conducive conditions” by C. M. Hall et al.***

### **Anonymous Referee #2**

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In this paper, the authors present their analysis of four years of data from an MF radar operating at 2.78 MHz, and correlate this with proton flux information from the NOAA GOES satellite. Their main conclusions are that there is a correlation between enhanced proton flux and a) isolated lower mesospheric echoes (ILME) and b) enhanced mesospheric turbulence, while they find no correlation between ILME and turbulence. The authors also propose/hypothesize possible mechanisms behind the ILME and polar mesospheric winter echo (PMWE) phenomena.

I have some issues with the paper which I will briefly sum up in the following.

1. Page 7037, lines 9-11: “[...] comparing reports of MF-radar isolated lower mesospheric echoes (ILME) with VHF radar PMWE suggests that whenever ILME are

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observed, we may anticipate PMWE also". The authors do not make it clear what reports they refer to, and list no references.

2. On page 7041, lines 1-2, the authors state that "[...] one might perceive a suggestion of a weak dependence of  $\Delta\varepsilon'$  on proton flux, particularly in 2004 and 2006" while referring to the 3rd column of Fig. 4, and on Page 7043, in the Conclusions: "We do, on the other hand, find evidence for enhanced turbulence generation associated with enhanced proton flux." I am unable to see such a dependence in Fig. 4. Whether this is due to visual confusion arising from the very busy plots in the third column of the figure or simply due to a lack of correlation between the parameters, is hard to say. In any case, I think the authors' statement about a dependence between  $\Delta\varepsilon'$  and enhanced proton flux is not substantiated, given Fig. 4. If there is such a correlation, the authors must clarify the matter better, especially considering their statements on page 7040, lines 10-12 ("The third column attempts to identify any relationship between enhanced proton flux and enhanced turbulence, but does not offer an unambiguous answer") and on page 7042, lines 8-9 ("Enhancements in turbulence may therefore occur irrespective of high proton flux events"). Either way, Fig. 4 (especially the third column) is very hard to read, so a cleanup or an alternative representation of the figure is in place, to make it easier to read and interpret. In particular, each of the scatter plots in the third column contain too many superimposed colors, making it very hard to see any seasonal dependencies, and maybe even masking out any visible correlations.
3. The proposed/hypothesized ILME/PMWE mechanisms on pages 7042-7043 also sound plausible, given that the authors can actually prove or present better evidence for the connection between enhanced proton flux and enhanced turbulence.

From the Conclusions (page 7043):

4. The authors' conclusion that "*large proton fluxes indeed appear to coincide with turbulent energy dissipation rates in excess of monthly averages*" (lines 12-15) seems to be based on the list on pages 7041-7042 where they briefly discuss events during 8 selected months (out of 4 years), and not on actual statistics, and despite the problems with proton flux/turbulence correlation mentioned above. This conclusion needs better substantiation.
5. The authors state that "*Obviously, turbulence can be caused by a variety of atmospheric conditions, so finding enhanced turbulence when there is only normal proton flux is no surprise, and similarly large proton fluxes do not necessarily generate turbulence. Nevertheless large proton fluxes indeed appear to coincide with turbulent energy dissipation rates in excess of monthly averages.*" I find this conclusion too vague to be of any real use.

Lastly, I also have the following minor issues:

6. In their discussion of selected periods of increased turbulence and proton flux on pages 7041-7042, the authors list periods of enhanced turbulence, both correlated and uncorrelated with enhanced proton flux. The enhanced turbulence on 4 December 2006, just before the onset of enhanced proton flux starting on 5 December seems to have accidentally fallen out from the list (bullet point 4).
7. Figures 4 and 5: In these figures, the axis labels, legends and scales are so small as to be almost unreadable. In Figure 5, the colors coding the lowest values for  $\Delta\varepsilon'$  are very dark and somewhat difficult to distinguish from each other, especially 0-5 and 5-10 mW/kg. This should be corrected.

In sum, although the basic argument that there is correlation between enhanced proton flux and increased turbulence sounds plausible, I find the evidence and discussion presented in this paper somewhat lacking and not very convincing, and the conclusions

rather vague. It is therefore my opinion that the authors should improve the presentation of their data analysis and the discussion, and also present better statistics for the correlation between proton flux and turbulence.

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