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Reply on RC1

Tinna L. Gunnarsdottir et al.

Author comment on "Modulation of polar mesospheric summer echoes (PMSEs) with high-frequency heating during low solar illumination" by Tinna L. Gunnarsdottir et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2022-16-AC1>, 2022

Dear Anonymous Referee #1

We the authors thank you for the time you have taken to read and review our preprint as well as your detailed comments and suggestions. We agree that the paper and title needs to be better focused on the main point of the paper. In addition, the overall language/grammar will be revised. We will remove the sporadic E discussion since it is not relevant to the paper as well as the table of contents and shorten the appendix where possible.

Comments:

Line 61: Yes that is better.

Line 69: The sizes and possibly also the charge states are possibly different between summer and winter echoes but yes you are right, this sentence makes it sound like there is no previous work done when that is not the case. We will change this to better reflect previous work and current understanding on the subject.

Line 130: Yes thank you for highlighting this point, we will make sure that the modified version will include a more detailed description of the solar illumination and the UV flux for these sets of observations. The solar zenith angles are all in the range 88-97 degrees with the main part of the observations larger than 90 degrees. This would mean that the sun is below the horizon but only by a few degrees.

Line 138: Yes we can consider this for the analysis and give relevant estimates.

Line 139-144: We can keep this on the shorter side. Yes you are right, we cannot conclude that there were no NLC present for the observations with bad weather. For the 15-16 of august 2018 observation however, there were no NLC visible above the EISCAT site.

Figure 2 and lines 145+: For Fig.2a, the horizontal distance between these profiles and Tromsø is 490 km. For Fig. 2b, the horizontal distance is 293 km. The geographical coordinates are in the figures but we forgot to specify this. We can include this information

in the text for the reader.

Lines 153-160: Thank you for your example, we will review the text as a whole and make the necessary changes. In addition, add in the reference of the EISCAT documentation.

Line 167: Yes we can remove this.

Line 185+: We will investigate if it is possible that the system power could have influenced the analysis for this observation. As the modulation is visible only in this area of low electron precipitation and not at others we assumed that this is due to the heater modulating the higher electron density in this altitude range.

Our suggestion here was that if there would not have been heating there most likely would not have been PMSE visible in area 1 and that the overshoot caused by the heating make the faint PMSE visible.

There were some operational problems in the early part of observation 3 that should be fixed before start of area 1. We will investigate if there was any lingering problems that caused the modulation of the sporadic E and could have influenced area 1 and 2.

Line 220+: Yes we can add them to the main body.

Line 223: We use this threshold since other authors have used it to indicate the presence of PMSE and thus we can better compare our results to theirs. In addition, by lowering the threshold we would introduce many instances of data were there is no PMSE present.

Line 262 and elsewhere: Yes we can include this.

Lines 388 onwards: The simulations are set at 150 K and the heating temperature calculated as a multiple of that initial temperature. By using 150 K the simulations can be compared to previous publications that have simulated the overshoot since many use 150 K as an initial temperature. This value was also quite close to both the IRI model values as well as the satellite temperature measurements from figure 2. We can look into using EISCAT data for estimating the temperature around the PMSE layers.

The simulation was run for several dust sizes and 3 nm deemed the best match – judged by eye.

Figure 16: This is just to show that the simulation goes back to equilibrium when you let it run longer. This is also what we expect from the simulations. For interval A the simulation suggest that this takes longer than what the observations suggests.

Line 472+: Yes you are right, we will review our statements here and make it more clear how confident we are in the analysis and determine if absorption can have a determinable effect.

Thank you for this the suggestion to the Havnes et al (2015) paper; this is a very interesting paper with relevant aspects. We will make sure to include it in our discussion.