Annales Geophysicae Discussions

Ann. Geophys. Discuss., referee comment RC2
https://doi.org/10.5194/angeo-2022-16-RC2, 2022

Comment on angeo-2022-16

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Referee 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-RC2, 2022

The authors display various aspects of observed PMSE under articial HF heating and stretching over ~4-6 hours each of several nights and a thorough analysis of the data. A simulation complements this analysis. Generally I also think that the main points do not become immediately obvious to the reader, owing to the large amount of presented material and the sometimes lengthy and too pondering language. Appendices show material that the authors consider as details and perhaps less important, which I think is a good division. Nevertheless, some "streamlining" of the opus could improve it.

Specifically,

Figure 3c and line 198: "Area 1" starts at 21:30 UT, but the PMSE seems be present already at the start of the measurements at 20:30 UT, partially with precipitation. What is the reason that this period was not included in "Area 1" or added as separate "Area"? The period would be perhaps be long enough to make a small difference for some of the statistical analysis.

Line 454: "... λirreg is the wavelength of the irregularity and is given by 2 ☐ λR (the radar wavelength) ..." According to the Bragg condition (https://en.wikipedia.org/wiki/Bragg%27s_law) the irregularity wavelength would be half of radar wavelength , i. e. "given by λR/2", just 67 cm for the EISCAT VHF.

Is this just a textual mistake, or are the columns "τdff at 0 sec" and "τdff at 48 sec" of Table 3, I think, too large by a factor 4? According to my rough calculation the latter is the case.

Which values of Te/Ti and Zd*nd0/ne0 in equation (1) were used to produce the numbers is Table 3?

Te/Ti: Were the temperatures obtained from the GUISDAP analysis? In the standard configuration GUISDAP would always give values Te=Ti≈150 K. However, the HF heating increases Te dramatically, which is the main cause of the suppression of PMSE at "heater on" and the overshoot following "heater off". This increase of Te probably cannot be estimated from the radar data. Chen and Scales (2005) had assumed that Te/Te0 (=Te/Ti) would reach 10. But the values in Table 3, ratio of columns "τdff at 0 sec" and "τdff at 48 sec", seem to be inconsistent with such large heating. A plot of the for the simulation assumed Te/Te0 over time might be helpful.

Similarly, which model of dust charging was simulated/assumed in the simulations? The numbers in Table 3 suggest that Zd*nd0/ne0 did not change much between 0 and 48 sec, but the overshoot would depend strongly on the amount of dust charging?

These minor issues perhaps don't affect the main conclusions of the paper, but should of course be checked and explained. Perhaps assuming a larger Te/Te0 and stronger dust charging could explain the large observed overshoots?

I tried to verify some of these details by looking at the code, but the link given on line 529 does not work for me.