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Interactive comment on "Effect of neutral winds on the creation of non-specular meteor trail echoes" *by* Freddy Galindo et al.

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Authors' response to the comments of reviewer 1:

We thank the reviewer for the suggestions and comments. Below, we present our responses to each of those comments. We have repeated the relevant comments for convenience in each response and then provide the text (in blue) we intend to add in the revised manuscript.

General Comments: The manuscript discusses the effect of horizontal neutral wind on the generation and duration of nonspecular meteor echoes. The authors compare the simulation results from the nonspecular meteor trail echo simulator with radar observations, and report a threshold of horizontal neutral wind velocity 0.6 m/s controlling the

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generation of meteor trail irregularities. The results are important for understanding the nonspecular meteor echoes and associated meteor trail plasma instabilities. However, the physical process that how the horizontal wind affects or controls the generation of trail irregularities is not stated clearly and needs more clarification.

Response: The physics of the model is described in several papers: Dyrud et al. (2002), Oppenheim et al. (2001), Oppenheim et al. (2003), Dyrud et al. (2005), and Dyrud et al. (2007). In the revised version, we will add a summary of what physics in this model, so readers do not need to return to these papers. We will modify the text between lines 55-60 to provide a summary of meteor physics included in the model as follows.

As explained in these papers, the model starts by computing the amount of ablated particles created behind the meteoroid body. These energetic particles are then used to calculate the amount of ionization made in the trail. Here we assume that the ionization created in the trail is initially distributed in a cylindrical volume defined by the initial radius. At this point, the trail is expanded by either ambipolar diffusion or turbulent diffusion to simulate the absence or presence of plasma instabilities in the trail during its evolution (Dyrud et al., 2001; Yee and Close, 2013). The plasma instability analysis is based on meteor Farley-Buneman Gradient-Drift (FBGD) instability reported in Dyrud et al. (2002), Oppenheim et al. (2001), and Oppenheim et al. (2003). NSMES assumes that a non-specular meteor trail echo is created because the trail becomes Bragg reflective at altitudes, where plasma instabilities can develop (Dyrud et al., 2002). The simulations produce artificial radar range-time-intensity (RTI) images that we use as proxies to help us in the analysis of Coqui-II and Jicamarca meteor observations.

Specific comments

lines 5-10: "for horizontal winds stronger than 1 m/s, a 0.316 μg meteoroid traveling at 35 km/s can produce meteor trail echo which is visible". Besides the properties of meteor trail itself, the radar detection capability also determines whether the meteor trail is visible or not. In the comparison of the simulation results and observations, measurements from both small and large radars were used. It is not clear how the authors determine the visible/invisible meteor trail echo.

Response: This paper focuses on simulations of meteor trail echoes due to the meteoroid properties and the background atmosphere. The neutral velocity threshold illustrates how simulations show that no trail echo is created below a critical wind value. We agree with the reviewer that any radar echo is a function of both the instrument transfer function and the physics of the targets it is probing in practice. So, the critical wind value can't be mapped directly to radar observations but can be used to shed light on the physics of meteor trails and improve their modeling. We will add the paragraph below near line 10 to make it clear what we mean by visible/invisible meteor trails echo.

The neutral velocity threshold illustrates how simulations show that no trail echo is created below a critical wind value. This critical wind value is not mapped directly to radar observations but it is used to shed light on the physics of meteor trails and improve their modeling.

lines 101-103 and 160-162: Please explain in more detail how the horizontal winds produce and sustain plasma instabilities.

Response: As we indicated in the response to general comments, the physics of the model is described in several papers. We will add these references near line 103 to clarify this comment.

Dyrud et al. (2002), Oppenheim et al. (2001), and Oppenheim et al. (2003).

And add these references near 162.

Dyrud et al. (2002), Oppenheim et al. (2001).

It is seen from Figure 5 that the trail echoes last the longest around 95 km altitude where the horizontal wind is small. Please explain.

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Response: Notice that neutral winds values are very small near 96 km but its magnitude rapidly increases below this altitude so near 95 km neutral winds exhibit values larger than 4 m/s. We point out this effect in a broader sense in Figure 4. We will add this clarification in the manuscript near line 127.

lines 187-189 and Figure 8: Is it possible to derive the neutral wind from the non-specular meteor echoes by using the method proposed by Oppenheim et al. (2009) and thus demonstrate the neutral wind shear? By using the meteor head echo, the meteoroid properties (e.g., mass, velocity) could also be derived. This provides a good chance to verify the simulation results.

Response: This is an excellent observation. That would be the next step. It isn't a trivial problem since neutral winds estimates proposed in Oppenheim et al. (2009) need to be validated with other techniques first. We indicated that that is our intention in lines 189-191 of the manuscript.

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