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Comment on angeo-2021-52

Anonymous Referee #1

Referee comment on "Responses of intermediate layers to geomagnetic activity during the 2009 deep solar minimum over the Brazilian low-latitude sector" by Ângela M. Santos et al., Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2021-52-RC1, 2021

Review of "Intermediate layers responses to geomagnetic activity during the 2009 deep solar minimum over the Brazil low latitude sector" by Santos, Brun, Batista, Sobral, Abu and Souza

The paper has interesting results about "intermediate layers" but I find the physical explanation wanting. I suggest that the authors do a little more research to establish the physical cause of the ILs in a more convincing way.

Major Comments

If the authors read JGR, 113, A05311, 2008, doi:10.1029/2007JA012879 carefullly, you will find that in the model/theory, northward interplanetary magnetic fields will lead to dusk to dawn electric fields that will cause downward convection of the dayside equatorial ionosphere. This is not "overshielding", but simple PPEF inputs (see their Figure 7). This electric field will cause upward convection on the nightside. Thus, if this is your scenario, the term "overshielding" is being misused.

On the other hand, if the interplanetary magnetic field is southward and the dayside near equatorial ionosphere is indeed convected downward, this would indeed be due to "overshielding" effects. So in that case, the term would be used correctly.

The paper is very confusing in that both scenarios are quoted, which cannot be correct. My suggestion is to look at the interplanetary magnetic field direction during some of your IL formations and show them to your readership. Then there should not be any confusion. Unless of course you see both cases? But then you should state so in the paper.

In any, case the above paper should be cited, which it is not at the present time.

Minor Comments.

Lines 44 to 48. "overshielding is used in the correct sense here.

Line 83. An upward movement of an IL would be consistent with a dawn to dusk electric PPEF caused by a southward IMF.

Line 90-91. This is an okay description of a PPEF and southward IMF.

Lines 103-104. Kp is not the best parameter to use to study this effect. Why don't you simple use the interplanetary magnetic field to do this study? There are many causes of geomagnetic activity, not only southward magnetic fields. Solar wind pressure pulses can cause substorms, even during northward IMFs. And some scientists believe that northward turnings of the IMF trigger substorms.

Lines 165-166. The paper AG, 29, 839-849, 2011 should be quoted here. This paper points out the low geomagnetic activity during this extreme solar minimum, which is of importance for your paper.

Line 190. See above comment.

Lines 220-222. These altitudes are regions where precipitating electrons deposit their energy. I think you need to tell the reader why you think this is not a problem.

Lines 288-289. Here "overshielding electric fields" and northward turnings of the IMF Bz are contradictory.

Lines 303-304. An eastward electric field would be consistent with a rise of the ILs if the IMF were southward. However if the IMF were northward and overshielding occurred you could get this eastward electric field as well.

Lines 310-313. Such shielding/overshieding competition has not been observed in major magnetic storms caused by sheaths and ICMEs. See example in GRL, 32, L12S02, 2005. Doi:10.1029/2004GL021467. On the other hand if these events occurred in high speed solar wind streams, such IMF north-south reversals are common. See JGR, 111, A07S01, 2006. Doi:10.1029/2005JA011273. Both of these examples are typical. It would help if you identified what type of solar winds your geomagnetic activity occurred in.