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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impacts of the January 2005 solar particle event on noctilucent clouds and water at the polar summer mesopause" *by* H. Winkler et al.

Anonymous Referee #1

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General Comments:

This paper is a case study on effects of the January 2005 solar particle event on the summer mesopause region, including the response of noctilucent clouds (NLCs) to this event. The authors find that the observed decrease in NLCs following the event can be directly related to an observed increase in temperature. They find that the sublimation of NLCs leads to changes in the vertical distribution of water vapor and that proton hydrates play only a minor role on the icy particles in response to these changes. The paper is well written and well organized, providing a useful model-data study with an emphasis on the response of proton hydrates during a solar particle

event. The authors furthermore show a good understanding of the limitations in both the data and in the model results. The reviewer recommends publication provided that the comments below are addressed by the authors.

Specific Comments:

1) P. 1159, lines 20-22. The reviewer is confused about the prescribed vertical winds. If they are using a two-dimensional atmospheric and chemistry transport model why do the authors not use vertical winds from that model for the sake of self-consistency? Please explain.

2) P. 1159, lines 19-20. Similarly, does the two-dimensional model calculate Kz and if so why is it not used here? Please explain and if the authors are choosing the Kz of Luebken (1992) please indicate the value explicitly and also indicate its altitude dependence.

3) P. 1161, lines 4-6. The authors should know that the MLS temperatures have been used in a global high-altitude data assimilation system, which accounts for the changing geolocation of the MLS (and SABER) measurements over time throughout the mesosphere. A sentence or two with a reference to this work would be appropriate here [Eckermann et al., JASTP, 71, 531, 2009]. The authors should consider these results and perhaps compare to what they are using. The output files are available through anonymous ftp at map.nrl.navy.mil and then "cd pub/nrl/aim9c". The January 2005 time period is available.

4) P. 1161, lines 12-13. A tidal amplitude of 2 K in the polar summer mesopause region is small compare to observations in the northern hemisphere. An amplitude of 4 K is more reasonable [Singer et al., Adv. Space Res., 31, 2055, 2003; Stevens et al., JGR, 115, D18209, doi:10.1029/2009JD013225, 2010]. Please comment on how the results change with a tidal amplitude that is twice as large.

5) PP. 1163-1164. There needs to be more discussion here on how the model is

compared to the data throughout this section of the paper. For example, is the model sampled only at the local times of the observations and what exactly are the local times included in the observations presented (see Technical Corrections below)?

Technical Corrections:

1) P. 1154, Lines 16-17. “the effects can clearly” should be “can the effects clearly”.

2) P. 1158, Lines 7-9 and Lines 15-17. The authors indicate the local time of the measurements used but do not indicate how the zonally averaged NLC occurrence rates or temperatures are averaged. Do the authors average observations from both nodes of the satellite orbit (all local times) together? Please be explicit.

3) P. 1159, Lines 6-7. As indicated above, please explicitly indicate how the water vapor observations were averaged together.

4) P. 1158, lines 17-18. Please indicate exactly how geopotential height is converted to geometric altitude with an equation or a reference that has the relationship explicitly written out.

5) P. 1161, line 19. Please explicitly state the radius value in the “smallest radius bin”. The reader needs to know the approximate sizes of the particles that are nucleating and the approximate size to which they grow so the authors should state this here as well.

6) P. 1164, lines 17-18. Please quote the MLS temperature uncertainty here explicitly.

7) P. 1165, lines 19-20. Please indicate the mismatch in mesopause altitude between MIPAS and MLS explicitly here.

8) Some of the references are not in alphabetical order. Please take care to review the reference list. Thank you.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 1151, 2012.