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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 #2

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General comments

This paper addresses the causes of the decreasing levels of noctilucent clouds after a solar particle event. The paper investigates the effects of temperature, water vapor and ion chemistry on the behavior of NLCs using a one dimensional model and satellite data. The authors are to be commended for a clearly written description of the chemical, physical and charge coupled process that can potentially cause NLC change. The most solid conclusion of the study is one previously made by von Savigny et al., 2007, i.e. that the decrease in NLCs after a SPE is caused by increased upper mesospheric temperatures. The conclusion that sublimation of NLCs leads to significant changes in

the water vapor distribution in the upper mesosphere is certainly plausible, but it is not substantiated by the results shown in the paper. It could be that the major reason for this is the significantly degraded vertical resolution of the MLS satellite instrument that was the prime measurement data source used for this study.

Specific Comments

Page 1152, line 6: The sentence about sublimation is not proven in the opinion of this reviewer.

Page 1152, line 10: Suggest adding "much" in front of the word "stronger"

Page 1152, line 26: The sentence beginning with "Because" assumes that the particles have non-icy cores however, this is not yet proven. Suggest changing the sentence to read "Because the ice cores are likely to be non-ice, the term. . .."

Sections 2, 3 and 4 give excellent descriptions of the physical, chemical and charge coupled processes.

Page 1158, line 6: Make the word "time" plural

Page 1158, line 7: Change "is" to "are"

Page 1158, line 14: Make the word "time" plural

Page 1158, line 15: Change "is" to "are"

Page 1158, line 20: Delete "in detail"

Page 1158, line 22: Change "pictured" to "observed"

Page 1159, line 6: Make the word "time" plural and change "is" to "are"

Page 1160, line 5: Insert the words ". . ...instruments is several to many km . . .."

Page 1160, line 7: Insert "would" after "data"

Page 1160, line 11: Change sentence to read ". . .justifies use of a fixed H2O value

at. . .”

Page 1163, line 14: The AIMOS model used to calculate the ionization rates in Figure 2 should be referenced. Also, “ionization” is misspelled in the text and on the figure.

Page 1164, line 17: Delete the minus sign in front of the 2 K and replace “are” with “is” Page 1164, line 19: The paper suggests two reasons for data and model disagreement, i.e. satellite data uncertainties and deficiencies in the model. A third possibility is that the measurements on the limb give the line-of-sight mean temperature which generally is always higher than the ice temperature. See the paper by Hervig and Gordley, J. Geophys. Res, VOL. 115, D15208, 9 PP., 2010 doi:10.1029/2010JD013918. Page 1164, line 23: Insert “modeled” in front of “water” in the second sentence. Page 1164, line 26: Delete “Complementarily”

Page 1164, line 26: This sentence states that the water abundance above 82 km is small because of water uptake by ice particles but it does not consider photolysis which is the main reason for the decline in water with altitude. Maybe there is a point being missed here regarding what the authors are intending to say that can be clarified.

Page 1165, line 1: Figure 8 does not support the case for the cause of changes in water vapor after the SPE. MLS shows no increase at the 84km level during days 21-24 that is any greater than the increase that is seen for example around day 10. The small and broad increase in MLS data after about day 21 remains an increase through day 38 unlike the model which shows a rather sharp decline after day 30. Also, why is the low altitude model increase peak at around 84 km occurring before the 90 km peak by about 1.5 days? The model H2O time series without the vertical averaging shows these peaks occurring at the same time. The vertical resolution of the MLS data coupled with the model uncertainties make it very difficult to draw a solid conclusion about the effect of the SPE on water vapor caused by NLC sublimation.

Page 1165, line 4: Insert “MLS” in front of “water”

Page 1165, line 15: The authors are speculating about the accuracy of the MLS water versus the MIPAS water. It would be helpful to include a definitive statement about the MLS water accuracy based on a MLS validation paper that could be referenced.

Page 1165, line 27: The first complete sentence says that the H2O decrease at lower altitudes shown by the model is not present in the MIPAS data. However both the model and the MIPAS data show an increase at lower altitudes not a decrease.

Page 1166, line 6: Make “abundance” plural and change “is” to “are”

Page 1166, line 8: Insert “is” in front of “negligible”

Page 25, line 28: Insert “model calculations indicate that” after “Additionally”

Page 1167. line 1: Why does less water make sublimation more likely? The frost point is controlled only by temperature.

Page 1167. line 2: Delete “respectively”

Page 1167. line 3: Insert “on NLC occurrence” after “depletion”

Page 1167, line 7: Insert “model indicates” in front of “are”

Page 1167. line 11: The statement that the modeled water vapor generally agrees with the observations is not substantiated in the paper

Page 1167, line 13: Replace “somewhat” with “much”

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