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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Photochemistry on the under side of the mesospheric Na layer" *by* Tao Yuan et al.

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l. 70 / Figure 1: The authors introduce the topic by a 40-d-average between 20 Aug and 30 September. Later they use a sounding that is at the end of this period. Why not using a period centered on the end of September for the first figure? Answer: The 50-day average is to represent climatologically how Na density changes during the course of sunrise during fall season. Since fall season at USU starts in the second half of August, based on the previous climatology studies [She et al., 2002; Yuan et al., 2008], we choose 8/20 and 9/30 period. The 7-day lidar run in fall 2012 provided a great continuous dataset to compare with WACCM multi-day simulation during the same period for validation. l. 102-106: Please provide some estimate for the statistical uncertainty of the measurement. Answer: Based on our calculation, the standard

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deviations are between ∼ 10 and 40% of the mean between 85-95 km. l. 120-123: This section is somewhat hard to comprehend. I suggest rephrasing (and closing the round bracket). Answer: We modify this sentence. Please see line 213-126 in the revision.

Figure 2 and 3: Is there any reason (beside "higher resolution performs better") that the diurnal variation of main layer and bottomside is better represented in the lev144 version? Frankly speaking: Why showing the lev88 data if lev144 performs better? Answer: We do not have a concrete reply for this, but we think high resolution run tend to reveal the dynamic or chemical features that are missing in the run with coarse resolution. The detailed mechanism need further investigations that are out of the scope of this paper. l. 131: What do you mean by "the modelled nighttime uses the same daytime"? Answer: We have made the modification in the revision, please check line 131-135 in the revision.

Solar eclipse event: I am somewhat confused about the results of the sounding during solar eclipse. You describe a general decrease of Na density during the eclipse (and in fact the density is decreasing in the whole layer up to 95 km) and focus then on the bottomside, where the density nicely correlates with solar irradiation. This behavior is reproduced in your model study. On the other hand you write that the variation is within natural variability (l. 252 and 276). Please make clear whether you see a photochemical effect (similar to sunrise/sunset but maybe weaker) or not. Answer: The Na density variation in the bottom side of Na layer experiences the natural disturbances, such as due to large amplitude gravity waves. The magnitude of the changes due to eclipse is within that of these other disturbances.

l. 211: Please provide a number for the integration time. Answer: We add the integration time. Please see line 214 in the revision.

l. 213-215: Please check the phrasing. Answer: We rephrase it. Please see line 215-216 in the revision.

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Figure 5: The isoline numbering in c) and d) is hard to read. Please improve if possible. Answer: We change the line color in the new figure.

Typo: l. 77: “uncharged” should read “unchanged” Answer: We correct it. Please see line 77.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2018-1017/acp-2018-1017-AC2-supplement.pdf

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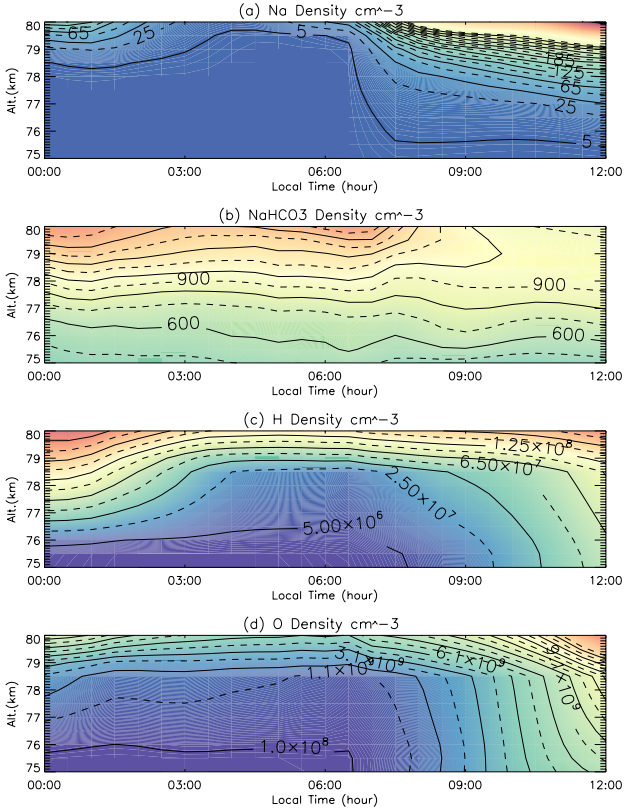

Fig. 1.

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