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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.

Tao Yuan et al.

titus.yuan@usu.edu

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L1: "underside" sounds strange, to me, as if it were from the perspective "from above". However, there is no problem in L10. The alternative "bottom side" would be free from this perspective bias, in my feeling. Answer: We replace the "underside" with "bottom side" throughout the paper.

L13: "mesosphere lower thermosphere", missing "and" or " / ". Answer: We change it to "mesosphere and lower thermosphere"

L20: here, "underside" should better be replaced by "below", and "larger" by "more strongly". Answer: We change it accordingly.

L32: missing "the" before "full diurnal cycle". Answer: We change it accordingly.

L41: "(2012)" -> "[2012]" for consistency with citation style (also some other places). Answer: We use square bracket throughout the paper in the revision.

L45-48: this argument and its relation to the present study are here not easy to understand. Isn't that explained more clearly in lines 77-82? Answer: The two sections discuss different issues. line 45-48 is to reveal that, based on previous study [Yuan et al., 2012], the Na density tidal period perturbations near the bottom side of the Na layer do not appear to follow the form of dynamic driven by the tidal waves. Line 77-82 is strictly describing the lidar observation of Na changes during the sunrise.

L49/50: change "in the characterizing the underside" to "for characterizing the...". Answer: We change it accordingly.

L51: "which models show are" -> "which models show to be". Answer: We change it accordingly.

L59, 224, 271: H20 is a chemical product of CH4 diffusing upwards from the troposphere. I ask myself if this fact, and maybe its concentration as used in the model, should be mentioned somewhere. Answer: We add a statement in line 15-117 in the revision.

L80/81: "...implicates...during the process of sunrise", better, change to read "... implies ... during sunrise". L83: missing "the" before "mesospheric Na layer". L85: better, replace "at the USU location" with "for the USU location", because the model could run on a computer anywhere in the world. L111, 113: use citation format square brackets, for Hurrell et al. and Kinnison et al. references. L118, 120: missing plural "s" in "... different vertical resolution[s]". Answer: We have made these changes/corrections accordingly in the revision.

L120-123: explanation in parentheses "(ie.,..." is long and hard to swallow. Can you simplify?Missing ")" at the end. Answer: We made some adjustment. Please see line 123-126 in the revision.

L131, 132: what could possibly be meant by "nighttime uses the same daytime"? Answer: We made some adjustment. Please see line 134 in the revision.

L141: missing "one" between "stronger" and "occurs". Answer: We change it accordingly.

188: the different time info (start in LT, end in UT) must be a bug. Figure 4 suggests the line should read "15:00 LT". Answer: We correct it in the revision.

L192: after all the details already given in the previous paragraph, the only newsworthy info here is "results are shown in Figure 4, and time resolution is 10 minutes". Answer: The first paragraph mostly describes the set up of the lidar system. The lidar measurements include temperature and wind as well, while only the observed Na density is shown in figure 4. We change it slightly in the revision, but overall, we feel this arrangement is appropriate.

L202: the authors mean to say "recovery phase", don't they? Answer: We change it to "recovery".

L205: missing "it" before "went back". Answer: We correct it.

L206: change to read "A similar behavior...", and "all constant density lines". Answer: We have made the change accordingly.

L208: "as much as" already implies approximation, so that "about" is not needed (or, replace "as much as" by "by", keeping the "about"). Answer: We deleted "as much as".

L212: style/elegance suggestion "The temperature change during the solar eclipse is expected to be that small when considering...". Answer: We have made the change accordingly.

L240: no need to repeat "reaction" in parentheses since this is what it refers to -> "(which is pressure-dependent}". Answer: We delete the word "reaction".

L245: in my feeling, the phrase in parentheses should start with "observed over ..." to

relate it clearly to the main sentence. Answer: We change it accordingly.

L251: IMHO, better replace "period where" by "time when"; and the end of the sentence in L252 may need to be moved after "change in the layer and hence...", so that the explanation "because ..." does not interrupt the main argument. Answer: We make some adjustment, please see line 253-255 in the revision.

L287: missing plural "s"! L295: missing "Sol.-" in JASTP. L311: abbrev. journal name (consistenly, everywhere). L318: missing newline L319: -> 26(4), ... L326: -> 54(32), 9469-... L354: -> 104(D3), 3773-... L361: missing "Sol.-" in JASTP. L391: Yuan et al. 2014b is the only Yuan 2014 paper in the list -> change to "2014". Answer: We make these changes accordingly.

L418: don't understand how black line is meant to be interpreted, until I see that it's the top scale as a function of altitude, but has nothing to do with the time scale of the bottom abscissa. Caption should explain this better. Answer: We modify the figure caption in the revision.

Figure 1. The Na density (cm-3) variation between 75 km and 105 km in MLT during sunrise between August 20th and September 30th (contour plot) in 2011-2016. Zero hour marks time of the sunrise at the mesopause (bottom abscissa). The solid black profile is the ratio between the Na density 3 hours after sunrise to that 3 hours before sunrise (its tick marks is plotted in top abscissa).

L432: "yellow solid line"? Must be the red line; yellow would probably be more difficult to see. Answer: Should be red line. corrected in the revision.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2018-1017/acp-2018-1017-AC1-supplement.pdf

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2018.

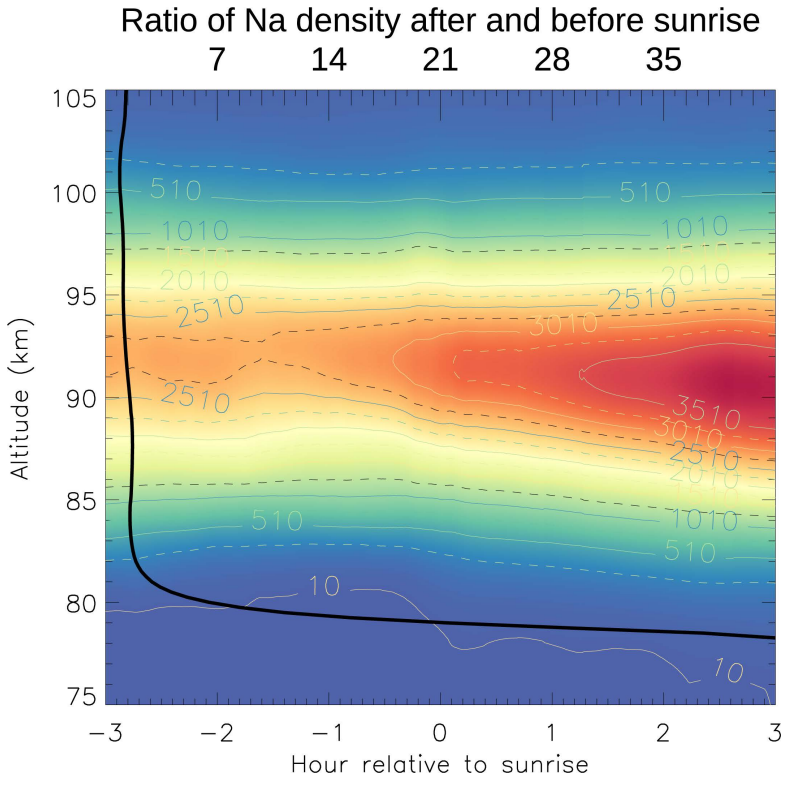
Ratio of Na density after and before sunrise
7
14
21
28
35
105
100
95
90
85
80
75
Altitude (km)
−3
−2
−1
0
1
2
3
Hour relative to sunrise
510
1010
2010
2510
3010
3510
10

Fig. 1.

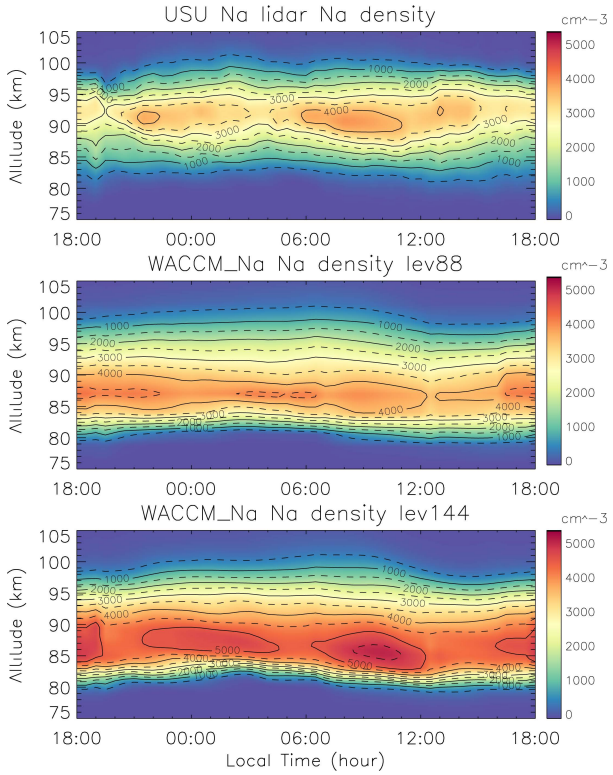
USU Na lidar Na density
WACCM_Na Na density lev88
WACCM_Na Na density lev144
Altitude (km)
cm^-3
Local Time (hour)
18:00
00:00
06:00
12:00

Fig. 2.

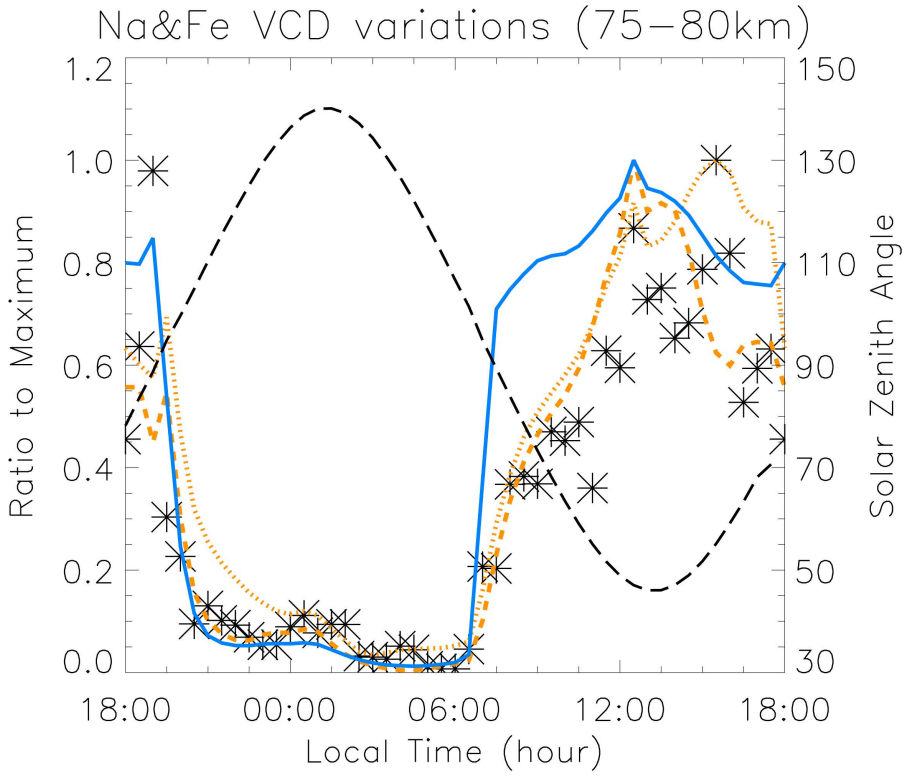
Na&Fe VCD variations (75–80km)
Ratio to Maximum
Solar Zenith Angle
Local Time (hour)
18:00
00:00
06:00
12:00

Fig. 3.

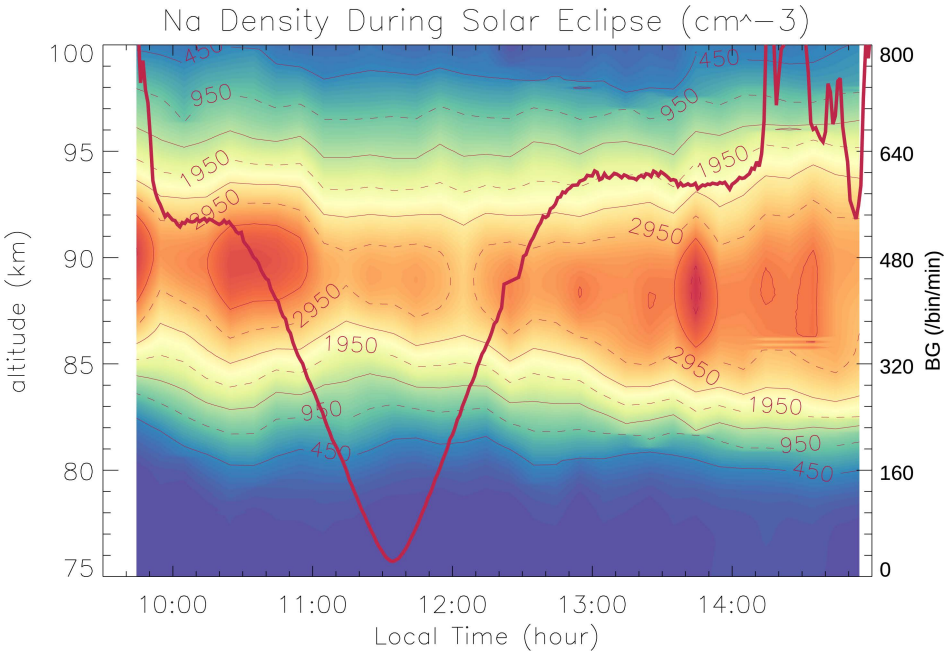
Na Density During Solar Eclipse (cm^-3)
altitude (km)
BG (/bin/min)
Local Time (hour)
10:00
11:00
12:00
13:00
14:00
100
95
90
85
80
75
800
640
480
320
160
0
450
950
1950
2950

Fig. 4.

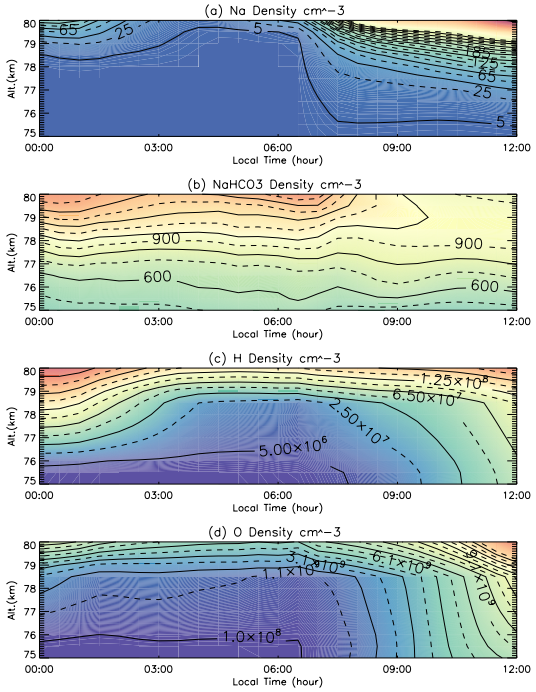
(a) Na Density cm^-3
(b) NaHCO3 Density cm^-3
(c) H Density cm^-3
(d) O Density cm^-3
Alt.(km)
Local Time (hour)
00:00
03:00
06:00
09:00
12:00
65
25
5
900
600
1.25×10^8
6.50×10^7
2.50×10^7
5.00×10^6
1.1×10^9
6.1×10^9
1.0×10^8

Fig. 5.

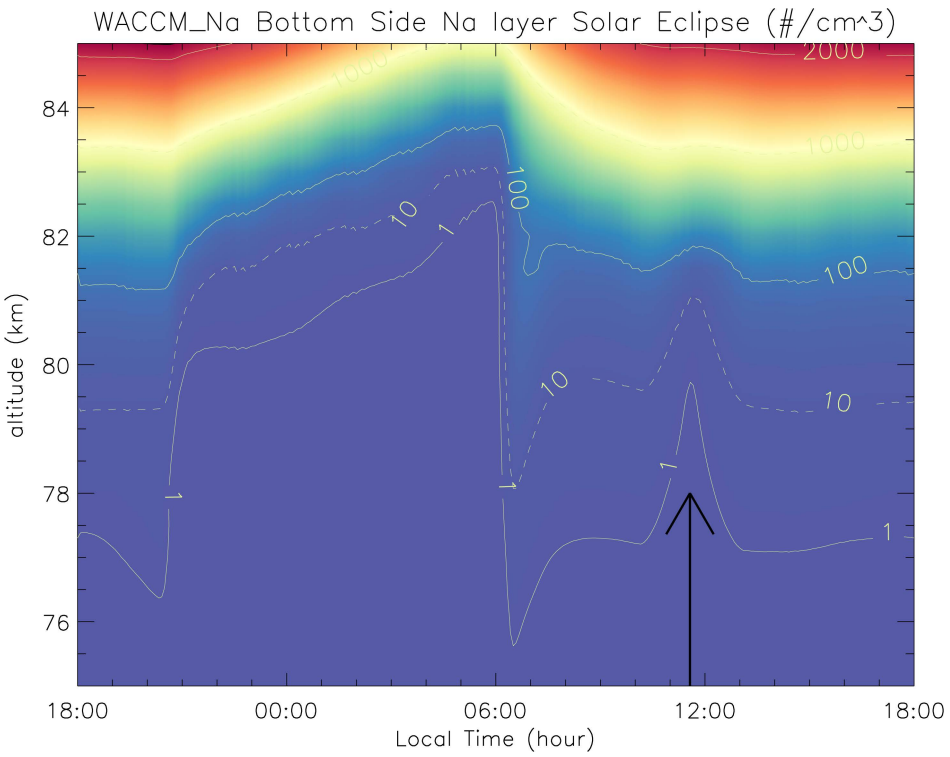
WACCM_Na Bottom Side Na layer Solar Eclipse (#/cm^3)
altitude (km)
84
82
80
78
76
18:00
00:00
06:00
12:00
18:00
Local Time (hour)
2000
1000
100
10
1

Fig. 6.