



EGUsphere, referee comment RC2
<https://doi.org/10.5194/egusphere-2022-187-RC2>, 2022
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Comment on egusphere-2022-187

Anonymous Referee #2

Referee comment on "Comparison of middle- and low-latitude sodium layer from a ground-based lidar network, the Odin satellite, and WACCM–Na model" by Bingkun Yu et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-187-RC2>, 2022

This paper utilizes the ground-based observations of Na, together with low-earth-orbiting satellite, and a general circulation model to study Na behavior globally. They not only provide the seasonal and latitudinal variation of Na, but also carry out data-model comparison, and provide explanation on it. This type of work (using ground based observation, satellite observation and model together) has never been carried out before, and it shall be a potentially crucial contribution to the study of metal atoms in the MLT region. The paper shall be published after a minor revision is made.

Line 38-56, in this paragraph, the author introduces the previous studies of sporadic Na layer. However, the author shall acknowledge the work of Cai et al., 2019b, which propose crucial conclusion on the seasonal occurrence of sporadic Na that has not been realized by other previous papers. As argued by Cai et al., 2019b, the summer Nas occurrence is higher in mid and mid-low latitudes because: 1 Na main layer density is lower in summer, which makes the sporadic na layer easier to be observer in a weaker main layer background. While in the winter, main layer is denser, and thicker. Therefore, it is much difficult to observe sporadic Na layer. **Another aspect is that there is almost no difference of the neutralization of Na⁺ to Na in winter and summer.** And the wind shear with convergence can also be formed in both winter and summer But the wind shear convergence formed in winter is below 90 km with much stronger neutralization, which makes the Na⁺ transferred into Na and being overwhelmed in the main Na layer. These crucial conclusions shall at least be mentioned.

In the introduction, the author give a summary of the shortages of these previous studies.

This summary is not very clear in the current introduction. After this, the author shall then introduce their advantages (such as the first-time (maybe this is not accurate) data-model comparison between Lidar and waccmx)

When introducing the Na lidar, the author shall clarify whether the Na lidar has the Faraday filter that can allow diurnal measurements, or can only allow nocturnal measurements??

Line 88 monthly variation is not accurate, please correct into the monthly distribution

Since the author introduce several observation method and models, I suggest the author use the subsection to introduce each of them. The whole data and method without subsection look a mess. For example, 2.1 Na Lidar in CMP. 2.2 Odin satellite 2.3 COSMIC-1 RO 2.4 WACCM-Na.

Line 115-116 Qiu et al., 2018 is not about the ion-neutral coupling, it just point out the

Finally, the error and uncertainty of the observations shall be pointed out, not just mention the previous papers.

Line 128-129 is the result calculated by averaging the longitude mean? Please clarify

Line 132 add 'which is' before 'consistent with'

Lines 145 and 156-157 the author had better point out the longitude range, rather than just saying the certain geographic name. Since these name means large area.

Line 160 this is not true. There are only several local observations of Na. Therefore, the author shall correct it into 'several local ground observations'

Line 163-164 the temperature is not directly related to Na. It is the neutral chemistry of Na, which depends on neutral temperature, that influence the final Na density. Please clarify here to avoid misunderstanding.

Line 201 note that the fountain effect and the drifting along the field line occur simultaneously (Balan et al., 2018). Please remove 'then'.

Line 221 replace 'altitudes' with 'latitudes'. Also for these local observations, the author shall add these near line 160, which states the local observations of Na

In all, section 3.2 is too long, and makes reader overwhelmed with a lot of information. I strongly suggest the author divide the section 3.2 into several shorter sections. Such as section 3.3: diurnal variations 3.4 seasonal variations 3.5 correlation between Es and SSL.

The author has presented many results of Na from local observation, satellite observation and the WACCM-Na. However, what I have seen now is a pile of observation and comparison. The author shall add a discussion section to provide explanation on these observations. I think this is not difficult for the author to carry this out.