We would like to thank the reviewers for the valuable comments and suggestions. We have studied all comments carefully and revised the manuscript accordingly. We mark the major changes in red in the revised manuscript. The point-by-point answers to the comments are shown below in blue fonts.

Referee #1

This version of the paper is much improved because of the inclusion of the new part of Section 3, and Figure 6, which show that the observed Na_S layer can probably be explained by the established ion-molecule chemistry of Na^+ ions in a descending sporadic E layer. Therefore, as the authors conclude, it is not necessary to invoke a mechanism involving lightning. However, this does not mean that lightning does not enhance Na_S production. This is a novel idea and the publication of the paper will stimulate further interest - in particular, the regarding the precise way in which electric field reversal could cause or amplify Na_S formation needs to be modelled properly, and this is beyond the scope of this paper.

I have several suggestions to improve the current version, but these are all minor revisions:

Abstract. These two sentences should be changed: "Our results suggest that lightning strokes would probably have an influence on the ionosphere and thus affecting the occurrence of Na_S, with the overturning of electric field playing an important role. Statistical results reveal that the sporadic E layers (E_S) could hardly be formed or maintained when the atmospheric electric field turns upward."

I suggest something like: "Our results suggest that a lightning stroke could trigger or amplify the formation of a Na_S layer in a descending sporadic E layer, through a mechanism that involves overturning of the electric field. This is based on our observation that, statistically, sporadic E layers disappear rapidly when the atmospheric electric field turns upward".

Reply: Thanks for the comment. We have modified the two sentences in the abstract following the reviewer's suggestions.

page 7, line 4: "Normally", not "Nominally"

Reply: Thanks for the comment. We have modified this word.

page 7, line 21: "equates", not "equivalents"

Reply: Thanks for the comment. We have changed "equivalents" to "equates".

page 8, line 8: "do the opposite"

Reply: Thanks for the comment. We have added "the".

page 8, line 25: "The electrons would reverse rapidly before the ions can respond similar to the velocity overshoot effect for electrons. During the relaxation phase, the 25 recombination between electrons and ions would probably be triggered through collisions, not unlike how moving cars will crash in a traffic accident if the car behind suddenly accelerates."

I do not understand the second sentence. Ion-electron recombination reactions, whether dissociative or radiative, have small negative temperature dependences i.e. the reactions get slower at higher temperatures, because the impact velocity increases and the long-range attraction between the ion and electron is less effective.
Reply: Thanks for the comment. We have modified the description according to the reviewer's suggestions.

Figure 6. This would be much clearer if you use a log scale for the abscissa (x-axis), for both (a) and (b)
Reply: Thanks for the comment. We have changed the x-axis to a logarithmic coordinate.

Thanks again for all the contributions made by this kind and wise reviewer.

Referee #2

I am very glad to see that the authors have answered almost all my questions and revised the manuscript under my suggestions. I also support that the authors added a simulation of the chemical reactions to explain the efficient neutralization of Na ions in this Nas case study, which is actually that the enough Na ions were neutralized to from Nas layer, as I have indicated in last referee report. Now the manuscript is rather perfect, but a few issues are needed to be considered:

1. Page 2 line 9, the authors wrote "With an active chemical property and high abundance of sodium atoms, the sodium layer has been widely observed and studied all over the world (Marsh et al., 2013; Collins et al., 2002; Plane, 2003; Plane et al., 1999)." Here, I need to indicate that there is another reason to the sodium layer has been extensively explored: The sodium atom has large resonant backscatter cross section (especially compare to the cross sections of Fe and Ni atoms). (Collins et al., 2002)

Reply: Thanks for the comment. We have added the cross section around line 7 on page 2 in the revised manuscript.

2. In the last version, the differences of sodium density between Figure 1a and Figure 1b were quite large. Now I understand that the reason is the difference of the two lidar directions. The wide band lidar provides the vertical sodium density, while the narrowband lidar observes the oblique direction. In this version, the authors discard the bad data by the wide band lidar. But many parts in paper still mentioned two lidars. (For example: page1 line 26 and page 3 line23). Please check the manuscript carefully and revise these mistakes.

Reply: Thanks for the comment. We have checked these mistakes throughout the manuscript.

3. The difference between Figure 2 and Figure 5: From Figure 2, the Es was not present between 13:20 to 14:20. But from Figure 5, the obvious Es was observed at 14:00. From Fig.5, the foEs at 1400 UT is about 4.5MHz, and at 1530UT is about 5MHz. But these foEs were not marked in Fig.2.

Reply: Thanks for the comment. We are sorry for the confusing descriptions of these two figures. First, we would like to explain the frequencies recorded by the ionogram. The refractive index (RI) in a cold collisionless plasma is given by the Appleton-Hartree equation:

$$\mu^2 = 1 - \frac{X}{1 - \frac{Y_T^2}{2(1-X)} \pm \sqrt{Y_L^2 + \frac{Y_T^4}{4(1-X)^2}}} \,, \qquad (1)^*$$

where $X = \frac{{\omega_p}^2}{\omega^2}$, with the electron plasma frequency $\omega_p = \sqrt{\frac{Ne^2}{m_e \varepsilon_0}}$ and the incidence wave frequency ω;

$Y = \frac{\omega_B}{\omega}$, with the electron gyro-frequency $\omega_B = \frac{eB}{m}$;

$Y_L = Y\cos\theta$;

and $Y_T = Y\sin\theta$.

When the wave vector $\vec{k} \parallel \vec{B}$ ($\theta = 0$), the signs $\pm$ are referred to the left-hand and right-hand wave with circular polarization.

When $\vec{k} \perp \vec{B}$ ($\theta = \frac{\pi}{2}$), the A-H equation (1)* would be given as:

$$\mu^2 = 1 - X \qquad (2)^*$$

and

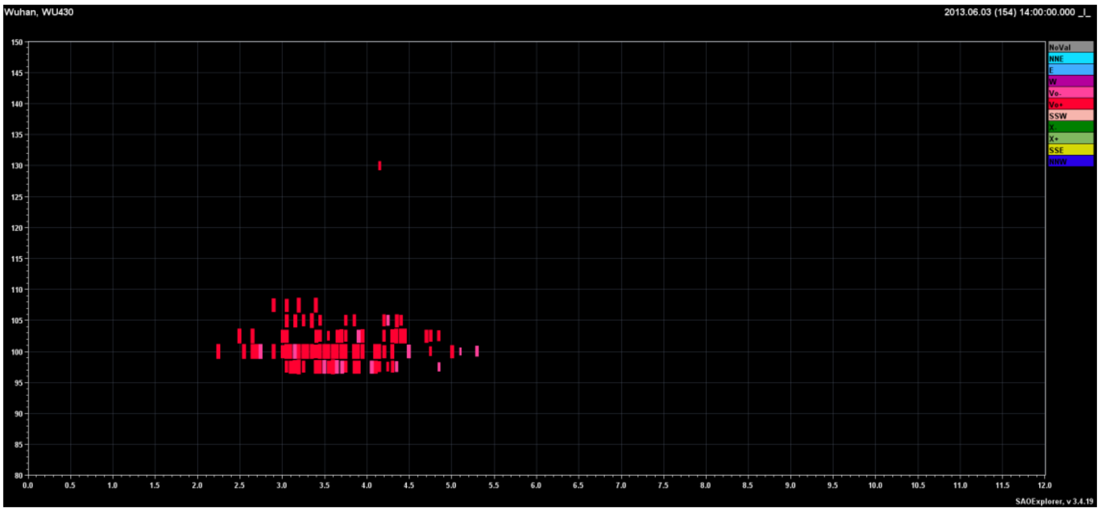
$$\mu^2 = 1 - \frac{X}{1 - \frac{Y^2}{1-X}} \qquad (3)^*$$

Then the wave determined by equation (2)* is called the ordinary wave (O-wave), which is unrelated to the magnetic field. Equation (3)* corresponds to the extraordinary wave (X-wave), indicating a dependence on the magnetic field because of the value Y. The ionograms of Fig.5 mainly display the ordinary (marked by "O" with pink and red colors) and extraordinary (marked by "X" with dark and light green colors) waves. These wave frequencies are used for calculations of f_oE_S, f_bE_S, f_oE, f_zE, f_xE, and so on. According to the Handbook of Ionogram Interpretation and Reduction (Section 4, Piggott W.R., and Raver K., 2nd, Elesvier, 1987), foE_S equals to the maxima frequency of the O-wave.

Then we checked the original data files carefully, and found the SAO-Explorer gave some wrong values of foE_S. We have calibrated the foE_S values on 14:00 UT and 15:30 UT again. We subtract all the other modes of waves, and leave the O-wave alone (shown by the following figures). The upper image indicates f_oE_S=4.99MHz at 14:00 UT, and the lower picture shows a value of 5.28 MHz at 15:30 UT.

We have modified Fig. 2 in the manuscript, adding the new calculated foE_S values.

Thanks again for all the contributions made by this kind and wise reviewer.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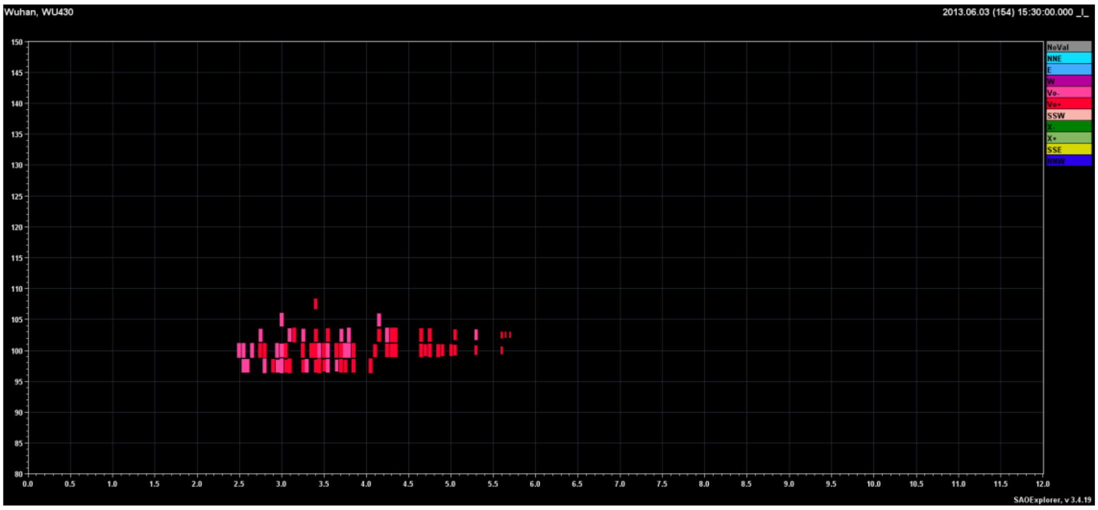
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