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Interactive comment on "Variations of the 630.0 nm airglow emission with meridional neutral wind and neutral temperature around midnight" *by* Chih-Yu Chiang et al.

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Comment: In this paper, volume emission rate of the 630-nm airglow is calculated using the SAMI2 model, which is a numerical model of the ionosphere. The authors investigate effects of the neutral winds and temperatures on the volume emission rate, but their argument is still only qualitative. This reviewer considers that quantitative investigation is needed. Therefore, major revision is needed before its publication.

Answer: We would like to thank Referee #1 for reading our article carefully and providing us helpful and valuable suggestions for improving our manuscript. About quantitative investigation, we have added new figures and addressed it in detail in our

manuscript. We have also revised the manuscript accordingly by taking into account the Referee's comments. We hope that Referee #1 now finds the manuscript acceptable for publication.

Comment: Although the authors describe that effect of the meridional neutral wind is dominant, it is obvious from the equation of the volume emission rate because the volume emission rate is proportional to a product of the plasma and atomic oxygen densities. Meridional neutral winds move the plasma along the magnetic field line and modify plasma density distribution. Consequently, effects of the neutral winds is dominant. This reviewer recommends the author to calculate the 630-nm airglow intensity by integrating the volume emission rate along the altitude, and show it as a function of the neutral temperature and meridional neutral winds. The, the authors should argue quantitatively how much the neutral temperature affect the 630-nm airglow intensity compared to the effects of the neutral winds.

Answer: Thanks for Referee #1's nice suggestion, we have added the suggested quantitative investigation in our manuscript as follows: In order to quantitatively describe the effects of neutral temperature and meridional neutral winds, we calculate the 630-nm airglow intensity by integrating the volume emission rate along the altitude. So we make two new plots [Fig. (a) and Fig. (b)] to show how the integrated emission rates vary with the increasing neutral temperature and neutral winds, respectively.

Fig. (a) shows the result regarding the integrated emission rate as affected by neutral temperature (at -5° geomagnetic latitude on February 1, 2007). The curve in red is fitted as 2nd-order polynomial : ΔI=(0.1354$\pm$0.0069)$\times\Delta$T-(4.6835E(-4)$\pm$2.6524E(-5))$\times(\Delta$T)ˆ2 where ΔI (/cmˆ3*s) is the change in integrated emission rate and ΔT (K) is the increase in neutral temperature, compared with the standard conditions of 650 K neutral temperature and zero neutral wind.

Fig. (b) shows the result regarding the integrated emission rate as affected by neutral wind. The results are obtained based on the same standard conditions

as those considered in Fig. (a). The curve in red fits an exponential function : ΔI=(64.8883±0.7772)×(1-exp(-(0.0885±0.0041)×ΔW)) , where ΔI (/cmˆ3*s) is the change in integrated emission rate and ΔW (m/s) is the change in neutral wind velocity.

Therefore, we combine the results of the two fitting functions to approximate the overall change in the integrated emission rate due to the two effects: ΔI=0.1354×ΔT-4.6835E(-4)×(ΔT)ˆ2+64.8883×(1-exp(-0.0885×ΔW)) Based on the function, we can quantitatively compare the neutral temperature effect with the neutral wind effect. In Fig. (a), the maximum change of the integrated emission rate by increasing the neutral temperature is 9.7859 (/cm3*s) at 145 K. To get the same changes of the emission rate by varying the neutral wind, it just requires a neutral wind velocity of 1.85 m/s. Above such a velocity, the neutral wind effect would certainly be larger than that of the neutral temperature for this case.

Comment: Minor comments: - Figure 1:Arrows representing wind velocity is not seen clearly.

Answer: We have replotted the figure as follows (Fig. (c)), thank you.

Comment: - L. 916, Figure 2 –> Figure 3

Answer: Our manuscript does not have Line 916. We searched all the “Figure 2” in our article but did not find a similar typo as mentioned. If Referee #1 can still identify the typo, please let us know again. We would revise it. Thank you.

Please also note the supplement to this comment:
https://www.ann-geophys-discuss.net/angeo-2018-5/angeo-2018-5-AC1-supplement.pdf

Interactive comment on Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2018-5, 2018.

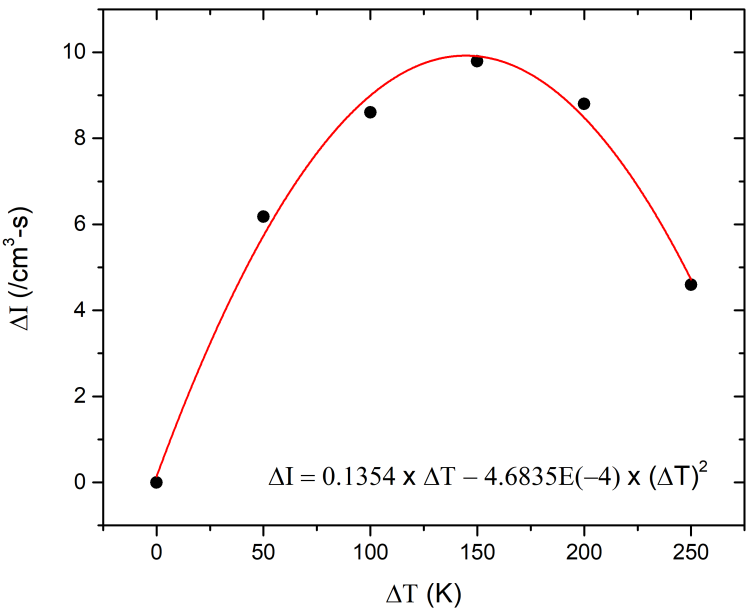

Fig. 1. Figure (a)

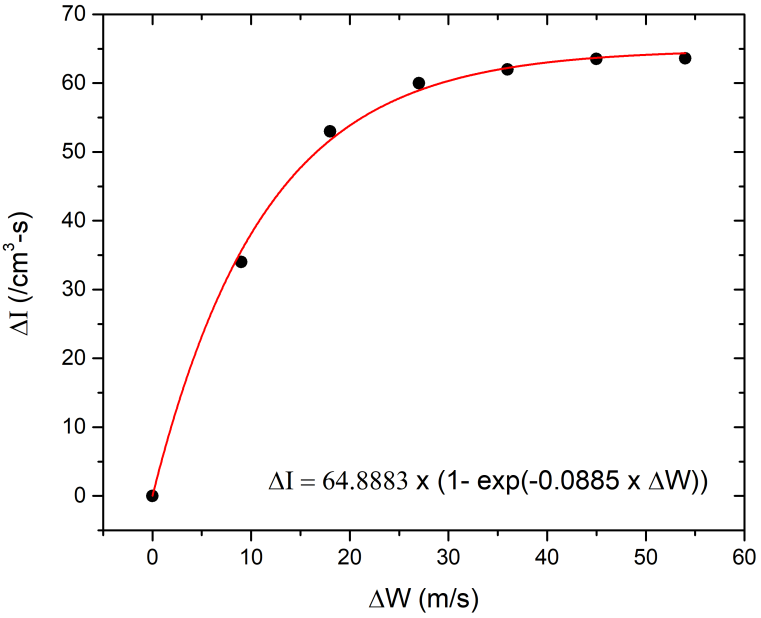

Fig. 2. Figure (b)

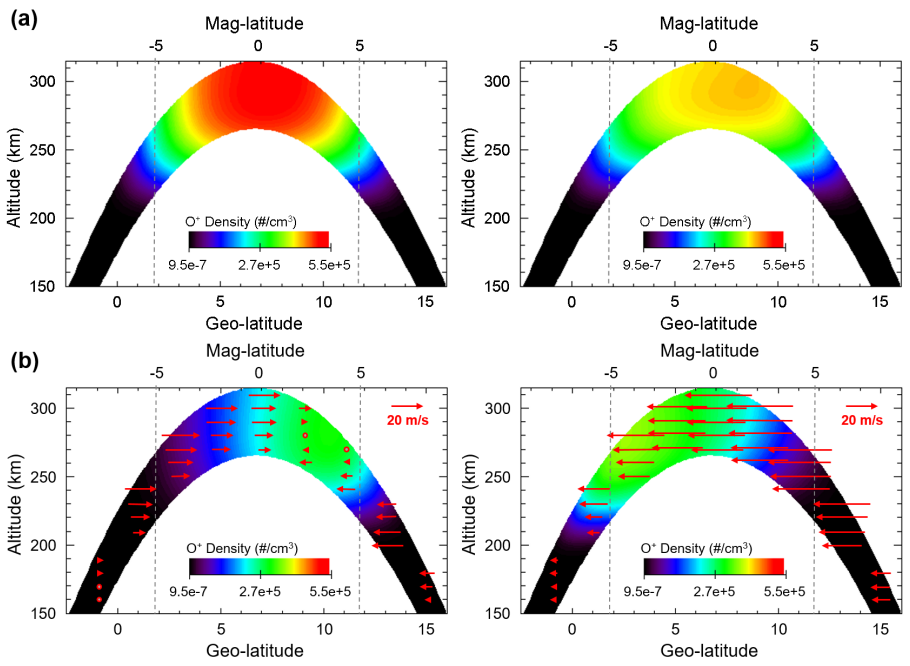

Fig. 3. Figure (c)