Response to Reviewer 1:

This article reports on the effect of OH atmospheric emissions on the retrievals of wind and temperature from the 1.27 µm O_2 dayglow. The topic is very interesting and would deserve publication. However, I have some concern that the authors would need to consider before publishing:

Our reply: We would like to thank the reviewer for his/her overall positive comments and the effort he/she spent on our manuscript.

MAIN CONCERNS:

(1) It is written that "The OH radiance will surely affect the spectral integral intensity of the O_2 emission line near 7823cm^{-1} especially for altitudes between 80 to 90 km where the OH radiance is relatively strong." Given the relative lines intensities, it is difficult to believe that OH contaminate the 1.27 µm O_2 dayglow. Figures 1 and 2 show that OH is not very strong. Therefore, the author should bring more convincing arguments about the need to consider OH.

Our reply: Thank the Referee for the important comment and good suggestion. We have brought more convincing arguments about the need to consider OH dayglow due to its contribution to the increase of wind error and temperature error in the revised manuscript as suggested.

The total spectral irradiance including the weak group of the O_2 dayglow and the OH dayglow is shown in Fig. 3. The third emission line of the O_2 dayglow near 7823 cm^{-1} is too close to the OH lines $RR_{2.5e}$ and $RR_{2.5f}$ (less than 0.05 nm) to be well optically isolated. As can be seen, the OH dayglow affects the observation of the O_2 mission line near 7823 cm^{-1} especially for altitudes between 80 to 90 km where the OH radiance is relatively strong.

The Doppler wavenumber shift in the emission line due to wind velocity is measured as a phase shift of the interferogram, and accurate temperature measurement is determined from the ratio of the integrated absorbances of two isolated emission lines. However, the intensity variation caused by Doppler shift or temperature change is very small. The relative Doppler shift is w/c, where w denotes the motion of the background atmosphere and c is the velocity of light. If winds are to be measured to an accuracy of 3 m/s, a desirable value for the mesosphere and stratosphere, the measurement must be made to one part in 10^8 of the velocity of light. For the central wavelength of 1270 nm, that means the measurement of the wavelength shift is about 12 fm (femtometre). Since a linewidth of the O_2 dayglow is of the order of 0.003 nm, the wavelength shift is 4×10^{-3} of the linewidth. Therefore, the intensity variation of the band radiance near 7823 cm^{-1} caused by the existence of the OH dayglow will surely contribute to the increase of wind error, as well as the temperature error.

(2) The method to compute errors, with and without the knowledge of OH, is not explained in details. It could be useful to describe the method in annex.

Our reply: Thank the Referee for the important comment and good suggestion. We have described the method to compute wind and temperature errors, with and without the knowledge of OH dayglow detailly in the revised manuscript as suggested.

The error standard deviation of inverted wind due to the presence of OH emission is found from the relation

$$\sigma_v = c\,\frac{\sqrt{J_2^2\sigma_{J_3}^2 + J_3^2\sigma_{J_2}^2}}{2\pi\nu_0\Delta(J_2^2 + J_3^2)}$$

Where $\sigma_{J_2}^2$ and $\sigma_{J_3}^2$ represents the variance of the Fourier coefficients J_2 and J_3 due to the lack of knowledge on OH emission.

The error standard deviation of inverted temperature due to the presence of OH emission can be written as

$$\sigma_T = \frac{\Delta T}{T} = \frac{R_{AB}}{T}\frac{dT}{dR_{AB}}\sqrt{\sigma_{J_{1A}}^2 + \sigma_{J_{1B}}^2}$$

Where $\sigma_{J_{1A}}^2$ and $\sigma_{J_{1B}}^2$ represent the variance of the Fourier coefficients J_1 of two emission lines *A* and *B* of the weak group of the O_2 dayglow, and R_{AB} is the ratio of the measured integral absorbances of this two lines, $R_{AB}= J_{1A}/J_{1B}$.

MINOR CONCERNS:

(1) P2L33 two sets of three emission lines. What are the 2 sets exactly?

Our reply: Thank the Reviewer for the very important comment. The two sets of three emission lines mentioned here refer to the weak group and the strong one shown in Fig. 1 of the sixth reference of our manuscript. We have made them clear by referring the corresponding reference in the revised manuscript.

(2) Section 2.1: Is there any auroral excitation of molecular oxygen which can lead to the 1.27 μm emission?

Our reply: Thank the Reviewer for the very important comment. There are auroral enhancements of the infrared atmospheric band emission ($a^1\Delta_g \rightarrow X^3\Sigma_g$) of O_2 near 1.27 μm. The very large aurora1 enhancements in the infrared atmospheric band of O_2 have been reported in the early1970s, such as the rocket measurements of Megill et al. (*J. Geophys. Res.* VOL. 75, 4775, 1970) and the observations by Noxon from an aircraft (*J. Geophys. Res.* VOL. 75, 1879, 1970). More recently, Mertens et al. (*Geophys. Res. Lett.* VOL. 35, L17106, 2008) demonstrated for the first time that $O_2^+ + NO$ charge transfer produces $NO^+(\mathrm{v})$. This mechanism identifies a new source of auroral infrared emission at 4.3 μm, which provides a major step forward in understanding auroral processes and a new context for understanding previously observed auroral enhancements in $O_2(a^1\Delta_g)$ band.

(3) Caption Fig 1: Should not be "Photons" instead of "Photos"?

Our reply: Thank the Referee for careful reading the manuscript and pointing out this problem. We have corrected this mistake in the revised manuscript as suggested.

(4) Figure 2: The caption should say what are the panels a) and b). I assume that a) is O_2 while b) is OH. The caption should explain what the zoom in panel a) is. The X axis of a) and b) should be aligned, such that we see where the overlap between the lines is.

Our reply: Thank the Referee for careful reading the manuscript and pointing out this problem. We have done this in the revised manuscript as suggested. The caption has been said what are the panels and has been explained what the zooms in the panels are. The X axis of a) and b) has been aligned.

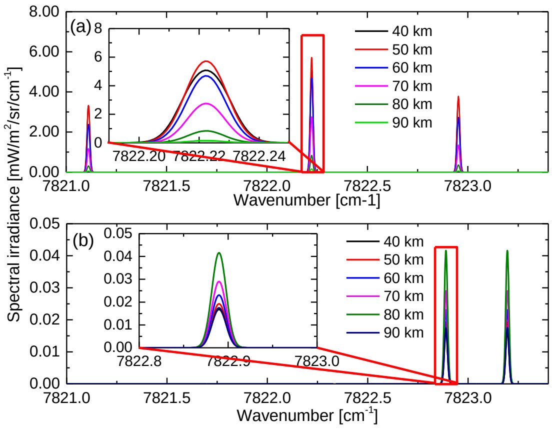

Figure. 2: The spectral irradiance of the three emission lines of O2 dayglow and the two emission lines of OH dayglow at tangent heights of 40 km, 50 km, 60 km, 70 km, 80 km and 90 km. (a) three emission lines of O_2 dayglow. (b) two emission lines of OH dayglow. Inset to (a) or (b) shows a magnified view of a certain emission line of O_2 or OH dayglow, from which the linewidth and intensity varying with tangent heights can see more clearly.

(5) It would be useful to add a plot with: Y axis: Altitude X axis: Ratio between OH and O_2 VER (or radiance), in log scale. In order to see the importance (or not) of the OH lines.

Our reply: Thank the Referee for careful reading the manuscript and pointing out this problem. We have done this in the revised manuscript as suggested (please see Fig. 3(b)).

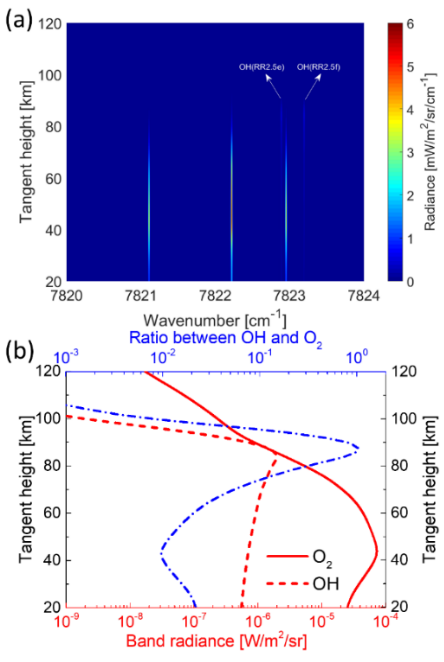

Figure. 3: The total spectral irradiance and band radiance as a function of tangent height. (a) the total spectral irradiance containing $O_2(a^1\Delta_g)$ and OH dayglow as a function of tangent height. (b) the band radiance profiles of the $O_2(a^1\Delta_g)$ and OH dayglow and their ratio.

(6) Figures 6/7: The errors with and without the knowledge of the OH radiance should be drawn in one plot. That will be easier to compare. It is weird not to see the full curve, i.e. around 85 km the scale is too small.

Our reply: Thank the Referee for careful reading the manuscript and pointing out this problem. We have done this in the revised manuscript as suggested (please see Fig. 6).

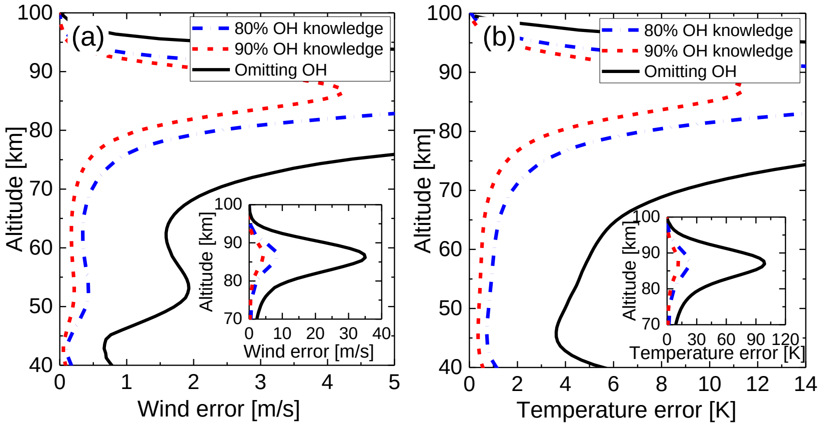

Figure. 6: Inversion errors in wind and temperature due to omitting the presence of OH dayglow (black curve) and with 80% and 90% knowledge of the OH dayglow (blue short dash dot and the red short dash). (a) the wind error profiles. (b) the temperature error profiles. Inset to (a) or (b) shows the wind or temperature error in the altitude range 70-100 km.