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Comment on amt-2021-75

Anonymous Referee #1

Referee comment on "Deriving column-integrated thermospheric temperature with the N2 Lyman–Birge–Hopfield (2,0) band" by Clayton Cantrall and Tomoko Matsuo, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-75-RC1, 2021

Review on "Deriving column-integrated thermospheric temperature with the N2 Lyman–Birge–Hopfield (2,0) band" by Cantrall and Matsuo.

This paper presents a new method for retrieval of lower thermospheric temperatures using N2-LBH (2,0) band. It compares the retrieved products with GOLD level 2 temperatures, simulated data, and MSIS data. Overall, I find this manuscript interesting and can a potential AMT paper after addressing some major concerns listed below.

Major Comments:

- Lookup Table (Lines 161-162): The lookup-table data has not been provided anywhere. I would suggest including them as a part of publicly available data, so that someone interested in reproducing/verification by independent means can use/validate them.
- PCA of simulated LBH emissions: Line 115: "The second leading….(.. explained later)". This is not clear to me how the 2^{nd} leading mode would only contain the temperature variability. Why would it not contain, for example, the geomagnetic. variability? Can you use a bunch of simulated spectra corresponding to temperatures in the 300-1500 Kelvin range and show that the 2^{nd} leading mode is associated only with temperature changes?
- Line 126: Shot noise: It is said that the spectra are just simulated/model/synthetic spectra. How can a model/simulated spectra will contain shot noise? Are you using a set of spectra or introducing some random noise in the spectra and then calculating the shot noise? Please add more explanations.
- Lines 243-246: Variation in wavelength registration: Better used an atomic line but try to avoid OI-135.6 nm as it is very strong emission and on occasions degrades the detector. Variation in wavelength resolution: Again, better try to use some atomic line other than OI-135.6 nm.
- Line 183-185: GOLD case study: Why you are not using the errors available in the L1C data? Why do you need to simulate the error?
- Line 224: "T_{ci}^{G} is also….based on the SZA." In the previous section it is stated that sampling at peak altitudes introduces 30-90K error. Then why are you using MSIS sampled at peak altitudes. I would recommend calculating GOLD equivalent effective temperatures using MSIS profiles and contribution functions from radiative transfer

model. It will give better comparison with GOLD L2-Tdisk, particularly with version 3 TDISK. This can be presented as an additional row in the comparison (Figure 5).

- Section 4: The authors used the unbinned data from an old release version-2 (V2), which I cannot locate in the two GOLD repositories provided in the data availability section. As there is poor signal to noise (SNR) concern and potential bias concern, I would suggest revising the analysis and results with version 3 (V03) GOLD TDISK and 2x2 binned L1C data (L1C-V03). Specifically, revise Figure 5 with the V03 data.
- Lines 277: Previously the authors mentioned that this retrieval is unaffected by biases in emission intensities as the absolute values are not important, but the spectral shapes are. Then why would systematic errors in intensities, which will basically introduce some bias, would introduce bias in temperature calculation? This also contradict the conclusions in lines 318-322, which says absolute band intensities are not required.

Minor comments:

Line 107: The sentence may be revised for clarity.

Line 180-181: Provide reference?

Line 242: Full disk measurements goes on until 23 UTC.

Line 288: What is the x-axis in figure 7? Is it local time at all longitudes or local times at fixed longitude?