Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
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Comment on amt-2021-75

Anonymous Referee #2

Referee comment on "Deriving column-integrated thermospheric temperature with the N_2 Lyman–Birge–Hopfield (2,0) band" by Clayton Cantrall and Tomoko Matsuo, Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-75-RC2, 2021

General comments

- The technique for determining temperatures from disk LBH emissions that is described in this manuscript represents an important new tool that may enable both further analysis of data from GOLD, but also potentially future instrumentation. The method has several strengths over existing techniques, including not requiring knowledge of the absolute brightness of the emission, not requiring a broad portion of the LBH bands to be sampled, and not requiring the kind of spectral resolution that has underpinned some other techniques. As such, this work should be of great interest to those interested in thermospheric observations, and techniques for analyzing such observations.
- The manuscript includes a good description of the uncertainties, related to instrument wavelength and noise.
- The detailed description in Section 3 of how the disk temperature should be interpreted as column temperatures is particularly important and as these and similar data utilized by a broader community this kind of consideration is essential.
- The particular case study, utilizing data from multiple spacecraft and centered around a moderate geogmagnetic storm provides a good demonstration of how the temperatures retrieved from the technique introduced here vary under such conditions, and demonstrates their utility to the broader scientific community.

Specific comments

- Line 90 – Is the factor of 1.6 mentioned here an issue with the current approach? My understanding form later sections is that it is not. If this is the case, I believe it would be worth explicitly stating that here.
- Line 177 – Is this statement true, if the model for LBH with temperature is imperfect?
- Line 180 – I believe that the O_2 absorption cross-section also varies (albeit not strongly) as a function of temperature. This will further complicate this factor, although it is likely still minor.
- Line 182 – It is certainly true that the shot noise, which is proportional to the square

root of the emission signal, is a major part of the instrumental noise. However, particle noise is, at least at some times, an additional random noise source. Importantly, it's behavior is not the same as the shot noise as it is unrelated to the brightness of the signal being observed. See for example the description of the particle background and its associated flag in GOLD Release Notes Revision 4 - https://gold.cs.ucf.edu/wp-content/documentation/GOLD_Release_Notes_Rev4.1.pdf. This may, potentially, be an important consideration in the case study presented in this manuscript.

- Line 267 – The east-west gradient that is described here is not clear to me in Figure 5. I would recommend that this be demonstrated more clearly, perhaps in a line-figure such as Figure 6, as I believe it is an important point that current, at least I struggle to see from the image.
- Figure 5 – The range over the disk where T_ci_G appear is smaller than that of Tdisk. Is the origin of this a differences in the solar zenith angle ranges, or some other criteria used in the approach described here that differs from the publicly available Tdisk?

Technical errors

- None noted.