Manuscript number: AMT-2023-61
OH airglow observations with two identical spectrometers: benefits of increased data homogeneity in the identification of the 11-year solar cycle-, QBO-induced and other variations

by Carsten Schmidt, Lisa Küchelbacher, Sabine Wüst, and Michael Bittner

Overall Summary:

The manuscript present the result obtained by a decade observation of OH(3-1) rotational temperature from UFS(47.42° N, 10.98° E) using two identical Spectrographs to avoid data gaps. In addition to the instrument failures the nightglow observation suffers from data gaps in summer month due to convective clouds. The authors deal with such data gaps and also issues related to the different observational duration, number of data sampling per nights, and time interval over which the observations are available to get the reliable nightly mean values. They have come up with the improved calculations of nightly and annual means using a decade average temperature for missing date as well as HA and MEM which take cares of short-term variations (GWs, Tides). They have then investigated AO, SAO, QBO, and solar cycle influences using nightly and annual OH(3-1) rotational temperature mean value.

The quality of the data, observation duration, and reliable calculation of the nightly mean is impressive and such data sets are rare in the world. Such data sets are required to understand seasonal influences, solar forcing, MLT dynamics, and long term trend in MLT region. After minor revision as suggested below this manuscript is strongly recommended for the publication in AMT.

Specific comments:

1. Page 6 line 128-135: Whether authors are talking about intensity calibration? What decides long term stability of the spectrographs? How intensity calibration affects the accuracy of derived rotational temperatures? Since InGaAs are known for their large dark currents getting a perfect dark frame is also a challenge which affect accuracy of the temperature measurement. Whether dark frames are generated daily?
2. Section 2.3: As it can be seen from equation 2.1 the derived temperature mainly depends on Einstein-A-coefficients and earlier literatures showed that it is less dependent on the term values. It is not clear to me the purpose of Figure 3 as this this expected, unless we use different set of A values and compare with an independent measurement and show which A values provide rotational temperatures that are close to that independent measurement which can be considered to be ambient temperature of the OH emission altitude (~87 km). In further analysis considering different A's will just add a constant value of the derived parameters (e.g. temperature values, amplitudes etc.).
3. Figures 4a and 4b: why the linear relationship matches well with MSISE in Figure 4a and does not match in Figure 4b?
4. Figure 5: Whether GRIPS 8 and GRIPS 7 data separately will show AO and SAO? Since, if AO and SAO are present in the rotational temperature data, it should be visible in

individual measurement as well so in OH intensities (e.g., Singh and Pallamraju, Ann. Geophys., 2017, doi:10.5194/angeo-35-227-2017).

Minor comments:

1. Page1 line 22: How the precise value depends on details of the analysis?
2. Page 2 line 55-56: sentence may be modified like→ If the instrument cannot be repaired it can be replaced with a similar new instrument.
3. Page 5 line 104 to resolve the P1-lines→ to resolve the first three P1-lines (as the first three P1 branch lines are used for the rotational temperature determination, so contamination from nearby P2 branch should not be there).
4. Page 6 line 116: I am just curious to know why GRIPS instruments have been operated with an oblique FoV? Since different FoV will see different part of the sky which needs to be taken care in the data analysis and interpretation of the results. What are the challenges in operating GRIPS in vertical direction in future?
5. Page 6 line 125: How a minor misalignment affects data cadence?
6. Page 9 line 223: observed volumina → observed volumes
7. Page 9 line 224; Wüst et al (2016) → Is it Wüst et al. (2017)?
8. Page 11 line 243: while keeping the 180° (tward) azimuth angle. Subset a) → while keeping the azimuth angle of 180°.
9. Figure 4: It is difficult to see dashed green triangle.
10. Page 11 line 43: Subset a) of Fig. 4 → Fig. 4a) here and elsewhere. e.g., Page 22 L 247: Subset b) → Fig. 4b)
11. Figure 5 caption: annual and semi-annual oscillation → annual and semi-annual oscillations; Harmonic Analysis → harmonic analysis
12. Page 15 line 348: Sorry for my ignorance but how authors have arrived at the true value of ΔT is often closer to ± 2 K (or ± 2.75 K/$\sqrt{2}$)?
13. Section 3.4 and Figure11: Replace quasi-biannual with quasi-biennial wherever it appeared in the text.