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Atmospheric Measurement Techniques Discussions

Interactive comment on "Intra-annual variations of spectrally resolved gravity wave activity in the UMLT region" *by* René Sedlak et al.

Anonymous Referee #1

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The authors apply wavelet analysis to time series data of OH* rotational temperatures from eight different locations (7 northern hemisphere and 1 southern hemisphere) to extract information on the dominant periods in the data.

The periods recovered from the analysis for all eight stations have been assigned to three main categories, namely, periods less than 60 minutes, periods in the range 60-240 minutes and periods longer than 240 minutes up to the limit of the maximum data length examined (480 minutes).

Examining the pattern of gravity waves detected on an annual basis for each of the stations for the three different period classes showed no overall pattern for waves less than 25 minutes, a semi-annual cycle for waves with periods greater than 60 minutes, while waves with period greater than 200 minutes tended to show an annual cycle.

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Discussion paper

The uniformity of the pattern of gravity wave periods at different locations is interpreted by the authors as being likely to result from a large-scale mechanism such as atmospheric wind filtering.

The manuscript is well organised and the intention of the authors is clear. The methods used to address data gaps and to calculate the periods are clear and valid. The work is suitable for publication in AMT, provided that the specific points below are addressed.

Major Comments

The focus of the manuscript is on the classification of observed GW periods, and interpretation of the annual variation. The finding that no annual pattern was observed for period less than 25 minutes may be related to the fact that such waves may have a vertical wavelength that is less than the average depth of the OH layer, and the OH spectrometer may not be capable of detecting such waves. This may even apply to waves with periods up to 60 minutes (Page 11, line 14; "There is hardly any seasonal variation for periods shorter than 60 min."). The author should discuss this point. In doing so they might cite the results of a study by Wüst et al. (2018), and also the work of Taylor et al. (2009) and Rourke et al. (2017) who reported a relationship between the horizontal wavelength (in km) and the period (in minutes) for a range of gravity waves at several stations.

Page 8, lines 12-15; Some of the stations have a wide variation in the number of observations per month as discussed in the manuscript. How have the authors ensured that this variation does not contribute to the annual pattern recovered in the three different period categories?

Page 10, lines 8-14; the inter-comparison of the GW results from the different sites is far too short. Different possible mechanisms are mentioned earlier in the discussion (page 9, lines 8-32) but these should be considered as they apply specifically at each station in this section.

Page 11, line 14 (following page 9, lines 26-32); Why do the authors not observe substantial minima at the equinoxes for period less than 60 minutes?

Figures 3, 4 and 5 have y-axes with arbitrary units. This is rather unsatisfactory. Can the authors please include units that may enable others to make comparisons with their results?

Minor comments

Page 6, line 7; "resolution of 1 min in both domains". Should this not be a sampling rate of 1 min. in both domains. The Nyquist frequency is half the sampling frequency.

Page 6, line 27; please quantify and explain the origin of this effect.

Page 8, line 33; what period range was considered by Offermann et al. (2009)?

Page 9, line 3; what altitude range was considered by Hoffmann et al. (2010)?

References Rourke et al., (2017) A climatological study of short-period gravity waves and ripples at Davis Station, Antarctica (68°S, 78°E), during the (austral winter February–October) period 1999–2013. Journal of Geophysical Research: Atmospheres, 122. https://doi.org/ 10.1002/2017JD026998

Taylor et al., (2009), Characteristics of mesospheric gravity waves near the magnetic equator, Brazil, during the SpreadFEx campaign, Ann. Geophys., 27(2), 461–472, doi:10.5194/angeo-27-461-2009.

Wüst et al. (2018), Derivation of gravity wave intrinsic parameters and vertical wavelengths using a single scanning (OH(3-1) airglow spectrometer, Atmos. Meas. Tech., 11, 2937-2947, doi.org/10.5194/amt-11-2937-2018.

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