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Atmospheric Measurement Techniques Discussions

Interactive comment on "Derivation of horizontal and vertical wavelengths using a scanning OH(3-1) airglow spectrometer" *by* Sabine Wüst et al.

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This work is an analysis of gravity wave horizontal and vertical wavelength based on a spectroscopy measurement of OH vibrational temperature at 4 directions, 3 off-zenith and 1 at zenith. The horizontal wavelengths were derived based on phase differences among different directions. The vertical wavelength was derived based on gravity wave linear theory, and a nearby meteor radar wind measurements, together with assumed climatological Brunt-Väisälä frequency. The derived vertical wavelength was also compared with those derived from SABER temperature profiles. Error analysis of vertical wavelength was performed based on estimated errors of other parameters in the gravity wave dispersion relation.

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Discussion paper

The major additional work from a previous 3-direction measurement is to the derive vertical wavelength. This, in my opinion, does not provide any useful information. The derived vertical wavelengths have large errors, and have no consistency when compared with SABER. The measurement of a single airglow layer temperature can perhaps derive horizontal wavelength and period, when done very carefully, but it does not actually provide any information on the vertical wavelength. The inferred vertical wavelength is critically based on wind measurement elsewhere, and the dispersion relation. The major contribution from the OH measurement in addition to the wave period is the horizontal wavelength, which has already be published. Hence, I do not see value in publishing this work. If the authors like to improve on the current work, I'd recommend addressing on the improvement that a 4-direction measurement can make over the previous 3-direction measurement. In the following I list several major problems with vertical wavelength derivations, which I think cannot be mitigated because it's intrinsic to the limit of the measurements.

The mean difference of 4 km (Fig.4), over a mean vertical wavelength of 12.5 km (Fig.2) is quite large. The fact that the OH vertical wavelength has an error of 59%, ever larger than the mean difference from SABER (at 41%) means the comparison with SABER is meaningless. The difference cannot possibility be smaller than the error. It shows that these values are purely incidental.

page 9: The possibility that the intrinsic frequency is very close to f is not addressed. Since the uncertainties in u and v is 20 m/s, and the measured phase velocities are mostly between 20-40 m/s (10,5-6), some waves could have very small intrinsic phase speed and frequency. When this happens, all the errors in eqs.(4)-(8) will be huge, and the linear approximation in the error analysis does not apply anymore.

How will the emission height affect the derived horizontal wavelength, and thus vertical wavelength? Its effect is not considered in the error analysis. The height is known to vary, especially with tidal motion, by several km.

page 4, line 12: Since the 4 directions were measured at different times, how do this affect the derivation of horizontal wavelength? Is the 15 s or longer lag between different directions taken into account? How does this affect the errors?

page 5, line 6,11: 60-80 km temperature from SABER is used to derive vertical wavelength, but this region does not overlap with the airglow region. The reason given is that the temperature is sharply changing around 86 km in summer. This shows a problem with deriving vertical wavelength using a snap shot of temperature profile. Without temporal revolution, one cannot tell whether a sharp gradient is due to a wave or a more permanent feature. Therefore, the SABER derived vertical wavelength itself is not reliable either. Furthermore, if a large gradient does exist in the airglow region, the vertical wavelength derived below 80 km is not a reliable comparison, because waves propagating into a large N square region (a strong inversion layer below the mesopause) will change vertical wavelength.

page 2, line 25: Only one OH spectrometer, is in contrast with .., but implies that no other measurements are needed. This is not true, since meteor radar wind was used, and N2 is approximated.

page 4,line 10-11: not clear what the FoV size of the triangle means. They are several hundred km, much larger than the length of the triangle.

Table 2 only lists SABER vertical wavelength. Why not put the OH vertical wavelength as an additional column for direct comparison?

Why use monthly mean N square, not use the SABER temperature to derive N square?

page 2, line 15: 'maximum' is ambiguous. I suppose this means 'maximum number of waves'

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