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Atmospheric Chemistry and Physics Discussions

Interactive comment on "First detection of tidal behaviour in polar mesospheric water vapour by ground-based microwave spectroscopy" *by* K. Hallgren and P. Hartogh

Anonymous Referee #2

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This paper presents some nice measurements of diurnal variations of water vapor in the upper mesosphere from a high northern latitude site. The main area where the manuscript needs to be improved is in clarifying the accuracy of the measurements, and in specifying how much integration time it takes to achieve this accuracy (for a given altitude).

The abstract states that: "Daily variations of water vapour have been observed and due to the long chemical lifetime of water they are assumed to be caused by changing wind patterns which transport water-rich or poor air into the observed region." I think "Daily" should be "Diurnal", since, as far as I can tell, none of the data presented is from just a

single day.

The manuscript is actually unclear as to what time integration is required for these measurements. On the one hand, on page 31269 says: " Even during moderate atmospheric conditions (background temperatures ∼150 K) the high sensitivity of the instrument allows retrieval of reliable atmospheric profiles up to the mesosphere every six hours." Then Figure 1 shows averaging kernels that, by implication, seem to be from a 6-hour integration. But then, on page 31270 the authors state: "In order to detect variabilities at short time-scales in the upper region the usual integration time of six hours is not enough." They then go on to state that they add up measurements in 6-hours windows over a full month in order to get Figure 4. This makes sense, but it is seemingly at odds with the previous claims that only 6 hours are needed. I think the problem is that what the authors call a "reliable measurement" is still not of sufficient quality to detect tides. In order to clarify things the authors need to make a quantitative statement of the random error at 80 km of a single 6-hour measurement which can be compared to the variations in VMR observed in Figure 4. Also, it would be useful to know the influence of the a priori at this altitude.

31269 line 5 should be "acts", not "act"

Equation (1) – Is the spectral noise in the two spectrometers significantly different? Unless I'm missing something important here (and maybe I am) I don't see why this needs an equation. Simply state that the measurements are being added with weighting based on the spectral noise for each spectrometer.

31270 line 23 "have" should be "has"

Figure 4 is referenced before Fig. 2 and Fig. 3

"As expected from conservation of energy the amplitude of the tidal waves increase as the pressure decrease with altitude." I'm not sure how the authors can conclude this. The measurements show variations in VMR, and these will vary to a large extent based

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on the gradients (both horizontal and vertical) in H2O. There simply is not enough information available to draw this conclusion.

“Furthermore, the decreased sensitivity of the instrument at higher altitude will slightly drag the retrieved profile to the a priori profile and dampen deviations from the mean.” As mentioned previously, it would be good to know how important the a priori is. There are equations for calculating the influence of the a priori profile.

“In contrast to the strong seasonal variability (almost a factor of three at 70 km between summer and winter (Seele and Hartogh, 1999)) in the background levels of water vapour the absolute amplitudes of the tidal components are constant over the year.” I think what the authors are trying to say is that: “The variations in water vapor caused by tidal components are much smaller than the seasonal variability at 70 km”. The phrase “constant over the year” is particularly confusing, since, fractionally, there are very large changes in amplitude throughout the year.

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