**Atmospheric
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Discussions**

Interactive comment on "Diurnal variations in middle atmospheric water vapor by ground-based microwave radiometry" *by* D. Scheiben et al.

Anonymous Referee #2

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Review of Scheiben et al., "Diurnal variations in middle atmospheric water vapor by ground-based microwave radiometry".

The diurnal variations of mesospheric water vapour measured at 22 GHz are compared with WACCM model calculations. I find the paper quite interesting and recommend publication after moderate revision.

Detailed review:

Page 3860, line 21: "The highest diurnal variations are found in the mesopause. . ." Is this relevant here? The instrument sounds only up to 75 km. At least it should be clarified that this is derived from WACCM simulations only.

Page 3862, lines 7-9: The long term water vapour analysis of Hartogh et al., J. Geo-

phys. Res., 115, D00I17, doi:10.1029/2009JD012364, 2010 and the first paper on stratospheric warmings seen in water vapour at 22 GHz of Seele & Hartogh Geophys. Res. Lett., 27(20), 3309–3312, 2000 should be mentioned here, too.

Page 3864, line 21: "For every retrieval, the measured spectra are integrated until they reach a noise level of 0.01." From my understanding you also calibrated the spectra before you integrated them in order to reach the required noise level. So please add this (". . . the measured and calibrated. . .", or just ..."the calibrated. . .)

Line 5: Information about the spectral resolution is missing here. Please add what spectral resolution is baseline here.

Line 8: ". . .can introduce a baseline on. . .." The correct term here would be "baseline ripple", since there is always a baseline, even without ripple.

Lines 10-11: ". . . a polynomial fit of order 3 and a sine-fot with 6 periods . . .". What are the periods? How did you determine them? You should mention here that you fitted phases and amplitudes (I guess you did). How did you make sure that the line shape information was not modified incorrectly? Taking into account 9 fit parameters just for the baseline ripple: did you fit with fixed amplitudes and phases over the whole data set? If not, how can you assure that the diurnal variation you see is not an artifact of the baseline ripple fit (since the baseline ripple is depending on the tropospheric opacity as you mention above). Which baseline ripple fitting algorithm did you use and why? Please describe what you did in more detail, addressing these questions.

Page 3865, lines 8-10: for readers not familiar with WACCM: why was this configuration used? What does "free-running" mean? Does it mean that no nudging/data assimilation was used? Please clarify.

Lines 24-25: moving average: better use the term "running mean", or even better say that you applied a 1 day low pass filter, i.e. you convolved the data set with a 24 h time window.

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Page 3866, lines 22-24: "The remaining terms on the right hand side are the. . ." Better: ". . .on the right hand side determine how the temporal changes are modulated due to zonal, meridional. . .."

Page 3867, line 9: replace "month" by "months".

Line 21: ". . .cycle remains constant in each data set." Perhaps better ". . . cycle persists in each data set".

Page 3868, line 25: I miss an interpretation here. Any idea why the amplitudes may be much larger?

Page 3869, lines 2-3: "Going down. . . in the morning". The significance seems not to be very high taking into account the small amplitudes of the diurnal variation. Not convincing at all. Please discuss the significance.

Lines 8-10: "Similar to . . . in Fig 4." It is very difficult to distinguish between the different WACCM months data. A slight expansion of the plots and/or use of colors for the individual months rather than symbols may increase to ability to evaluate the WACCM variations.

Lines 13-14: It seems not to be very obvious that the diurnal WACCM amplitude increases after convolution with the microwave radiometer averaging kernels. If this is not a mistake, please explain the effect behind this behavior.

Lines 20-22: How were the amplitudes determined (pp or rms)? Is it really WACCM or WACCM convolved?

Page 3870, lines 1-2: How? Does it mean that water richer air replaces the photochemically destroyed water? Where does the information come from that the vertical advection damps the chemical induced amplitude? Is this information derived from the plot?

Lines 11-12: Here a short discussion would be helpful. Obviously there is a strong

annual variation of water vapour in the upper mesosphere. The strongest relative diurnal variation due to chemistry appears certainly above the mesopause. This is not reflected in the absolute variation plots. For clarification it would be helpful to add a figure about the relative variation. i.e. the absolute variation/vmr or at least a discussion including numbers.

Page 3872, lines 25-27: An interpretation of these results would be nice (vertical and horizontal water vapour gradients, chemistry, etc.).

Fig. 2 caption: please mention here and in Fig. 4 that the black WACCM curve represents the 5-months average (e.g. WACCM average, same with the convolved data).

Fig. 4: How is it possible that the convolved WACCM curve at 0.05 hPa shows a larger amplitude than the original curve (see also comments above)?

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 3859, 2013.

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