

Comments on the ACPD manuscript entitled "The quasi 16-day wave in mesospheric water vapor during boreal winter 2011/2012" by Dominik Scheiben, Brigitte Tschanz, Klemens Hocke, Niklaus Kämpfer, Soohyun Ka and Jung Jin Oh.

The present paper describes the analysis of the quasi 16 day variation in water vapour in the upper stratosphere and mesosphere during boreal winter 2011/2012 based on observations by three ground-based radiometers located at mid- and high latitudes. The results are complemented by and compared to observations by the Microwave Limb Sounder instrument aboard the Aura satellite. In general the paper is well written. Occasionally there could be some more information to guide the reader better but overall I have only few comments. Once addressed I recommend the publication of the manuscript in ACP, fitting well into the scope of the journal.

Section 1 - Introduction:

- ▶ Lines 21 - 22: "*The dynamical regime ... is characterised by global-scale planetary waves ...*" - That seems a little bit too much of credit for planetary waves, in particular in the mesosphere where gravity waves play a decisive role for the dynamics and the overturning circulation.
- ▶ Lines 33 - 34: "... known to be a major driver of atmospheric dynamics in the winter-time middle atmosphere ..." - To me, it looks like this is attributed to all planetary waves listed in line 30 and 31. I just like to add for consideration that, for example, the quasi 2-day is more pronounced during summer time (e.g. Limpasuvan and Wu, 2003). Also the quasi 5-day wave plays an important role during summer (e.g. Sonnemann et al., 2008).
- ▶ Line 64: "... atmospheric tides (e.g. ..." - Here I would definitely add a reference to the paper by your close colleague Alexander Haefele and co-workers (2009), who to my knowledge was the first to address this topic.

Section 2 - Data:

- ▶ Lines 80 - 82: Other factors that immediately come to my mind, defining the vertical range of the observations, are the band width and spectral resolution of the radiometer. Maybe it is worthwhile to mention that already here and not, as done, later on. Also the integration time has some influence. Which integration time has been used, anyway? I did not find this information.

Section 3 - Methods:

- ▶ Section 3.1: Which terms are included in the regression? Only offset and sine and cosine? Or also a linear term? Maybe an equation would be a good idea? What is resolution of the time series? 12 hours? What is the measurement coverage during the time period in question? It is certainly not 100%, but how much is it?
- ▶ Section 3.2: According to Figure 2 now also data from November 2011 is used. That feels a bit inconsistent.
- ▶ Line 165: "Therefore only wave numbers up to ± 4 are shown." - This sentence is redundant.

Section 4 - Results:

- ▶ Figure 1: In addition it would be very interesting to see those results not only in absolute but also in relative terms. Adding some significance contours would be helpful to distinguish between noise and real results.
- ▶ Figure 3: Which criterion did you use to define the onset of the SSW?
- ▶ Section 4.3: How are the Aura/MLS data compiled? Are time period and resolution consistent with the ground-based data? The discrepancy between the results from water vapour and geopotential height is somewhat puzzling. I think that deserves some discussion.
- ▶ Section 4.4: From Figure 5 it looks like that the Aura/MLS data are binned into 20° longitude bins. That should be at least mentioned in the text somewhere. Also, there is some mismatch between the altitude resolution of the Aura/MLS and ground-based observations. In Section 2 an altitude resolution of 17 km is mentioned for the ground-based observations in the middle mesosphere, while based on the averaging kernels given on "<https://mls.jpl.nasa.gov/data/ak/>" the altitude resolution of Aura/MLS is in the order of 6 km - 8 km at 0.05 hPa. Since there are pronounced gradients in the water vapour profile around this pressure level, I would expect, at least, some differences in the comparisons. I would recommend one test time series where you degrade the Aura/MLS onto the vertical resolution of the ground-based observations to check what influence the resolution really has. Otherwise, I guess, using relative amplitudes helps masking any potential issues.
- ▶ Figure 5: Personally, I found it confusing to not constrain the phase plot to $-180^\circ - 180^\circ$.

- ▶ Line 299: "... but shows two distinct regions with two different phases." - I am not sure I would come to the very same conclusion?
- ▶ Lines 301 - 303: "The phase difference in Seoul can be explained by the fact that the 20-day wave above Seoul is practically inexistent and therefore the phase difference is insignificant." - Yet, the amplitude at 37°N/110°E is even smaller but the phase looks very reasonable. So, that is certainly not the best chain of arguments. Looking at the phase in Figure 5 and 6 the Seoul data point (in Figure 5) really seems to be the only one that sticks out completely. Somehow that gives a sneaky feeling that there may be something fishy with the data and/or analysis. Sorry, I cannot help this suspicion. If not, it seems very unfortunate, as everything else looks very consistent.
- ▶ Lines 314 - 315: To me the quality of ECMWF at 0.05 hPa is very questionable. Even while their output contains those levels it does not mean that the data are reliable in any way. There are essentially no observational constraints and certainly some sponge layer issues. I would feel more comfortable with analyses from the NOGAPS-ALPHA model where actually mesospheric TIMED/SABER and Aura/MLS data are assimilated. It seems even better to use the Aura/MLS GPH data themselves, even though there is a gap polewards of 82°N. Even though I surely believe that the position of the wave amplitude is related to the vortex centre, as stated in Lines 327 - 329, so far there is no rock solid evidence to support that.

Section 5 - Summary:

- ▶ All fine!

References:

- ▶ There are some inconsistencies regarding the digital object identifier doi. Sometimes they are there, sometimes not. I guess that will be fixed later by Copernicus in the final production stages.

Typos:

- ▶ Line 181: "North" should read "north".
- ▶ Line 333: "... related with the ..." should read "... related to the ...".

My references:

- ▶ Limpasuvan and Wu, “*Two-day wave observations of UARS Microwave Limb Sounder mesospheric water vapor and temperature*”, Journal of Geophysical Research, Volume 108, doi:10.1029/2002JD002903, 2003.
- ▶ Sonnemann et al., “*The quasi 5-day signal in the mesospheric water vapor concentration at high latitudes in 2003 - A comparison between observations at ALOMAR and calculations*”, Journal of Geophysical Research, Volume 113, doi:10.1029/2007JD008875, 2008.