Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-1050-RC3, 2017

Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Quasi 18-hour wave activity in ground-based observed mesospheric H_2O over Bern, Switzerland" *by* Martin Lainer et al.

Anonymous Referee #4

Received and published: 22 May 2017

The submitted paper mainly deals with observations of ground based mesospheric water vapour using the MIAWARA experiment near Bern (46.88° N) during 12 winter months from Oct 2014 – March 2015 and from Oct 2015 –March 2016. The authors found in 7 of these 12 months dominating oscillations with periods between 15 and 21 h. To interpret these oscillations, they used

a) additional nudged SD –WACCM simulations,

b) for case studies zonal winds from the Doppler wind radiometer WIRA at the same location, and

c) temperature profiles derived from Aura MLS satellite observations.

The combination of these datasets itself is valuable and suitable for publication in ACP.

However the structure and the conclusions of this paper requires substantial improvements.

From the reviewer point the highlights of the paper are:

(a) The high quality of continuous MIAWARA water vapour measurements (Fig 1).

(b) The observed monthly mean oscillations above 0.1 hPa during the winter months (Figs 3 and 4), but see also remark 4.

(c) The similarity and significant correlation between the bandpass filtered wave amplitudes derived from MIAWARA and the corresponding water mixing ratio derived from SD WACCM simulations (Figs 6 - 10) see remark 5.

(d) The case study from 5 – 9 Dec 2015 using MIAWARA (water vapour), WIRA (u), and SD WACCM (u) (Fig 11), see remark 6.

(e) The case study from 16 -26 Jan 2016 using MIAWARA (water vapour), and SD WACCM (u and v) (Fig 12), see remark 7.

General Remarks

1) Whereas the authors wrote in the introduction at page 5 lines 10 -12 "To our knowledge and made efforts, artificial effects leading to the observed 18-hour variability can be excluded and therefore the wave is expected to be of atmospheric origin. We aim to report on findings based on middle atmospheric observations and model simulations. Revealing possible sources of an 18-hour inertia-gravity wave is beyond the scope of this paper." However, in the following they are only focussing on an 18-hour inertia-gravity wave based on a single case study (Figs. 12 and 13). From the reviewer point, this generalization on all events is not valid because the difference between the observed period (∼18h) and the inertial period of 16.4 h as upper limit for the intrinsic period at the latitude of Bern (46.88°N) requires more or less at least constant background winds to get the Doppler shift of the intrinsic GW frequencies which has not been shown here.

2) An oscillation with a period of about 18h can also be the result of a nonlinear wave-wave interaction of two waves, e.g. between quasi two day wave and the semidiurnal tide or between the semidiurnal and terdiurnal tide. This must be checked and considered as a possible reason for the obtained oscillations.

3) In contrast to Figs 3 and 4, the SD WACCM spectra show diurnal tidal waves with a poor spectral resolution, but no dominant oscillations between 15 and 21 h. It is surprising that there is such a similarity and significant correlation between the bandpass filtered wave amplitudes derived from MIAWARA and the corresponding water mixing ratio derived from SD WACCM simulations (Figs 6 - 10). Can you comment this?

4) Please explain and/or improve the spectral resolution presented in Figs 3-5.

5) Please define the term “relative amplitudes” as used in Figs 6 – 10.

6) The case study (d) from 5 - 9 Dec 2015 (Fig 11) shows similar wave amplitudes between MIAWARA (water vapour), WIRA (u), and SD WACCM (u) and gives confidence that, with meridional winds from WIRA, a better wave estimation at the same location will be possible. In the frame of the used title focussing on 18h waves, however, Fig 4 c show during this period only tides (12h, 24h) but nothing between 15 – 21 h

7) The hodographs in Figs 13 and the derived possible characteristics of a monochromatic gravity wave are based on band pass filtered model simulations. It is not clear for the reviewer, how realistic are these simulated amplitudes, where the gravity waves are handled consistent a parametrization (see Page 6, lines 21 – 26). The cited papers of Baumgarten et al. (2015) and Li et al. (2007) used LIDAR data with a high resolution to estimate their hodographs. Please consider also a Stokes parameter analysis to get a more averaged GW description instead of the “snapshot” hodograph of a single monochromatic wave. Furthermore it is recommended to add the dispersion and Doppler equation to the wave parameter estimation to improve the readability.

8) The AURA MLS temperatures and water vapour profiles are important for the MI-

AWARA data as described in Sec 2.1 (page 4). However, at altitudes of about 0.1 hPa , where the observed 18h oscillations have their maxima, the vertical resolution lies between deltah 5.5 and 6 km (see page 6, line 6) , so that only waves with vertical wavelengths larger than 2 x deltah (11 – 12 km) can be resolved. From this point, the filtered temperature profiles with vertical wavelengths < 6 km are questionable, at least above 0.1 hPa.

Technical corrections

9) Page 2 line 8 please add wind

10) Page 7 line 13 bandpass

11) Page 8 line 32 are given in the next Section.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1050, 2017.