

Summary

Kalicinsky et al. have identified a strong, large-scale wave perturbing the temperature field of the mesopause region in the northern hemisphere winter 2016/2017. The disturbance was observed with ground-based OH-spectrometers located at three different sites in Germany: Greifswald, Wuppertal, and Hohenpeißenberg. By combining these measurements with satellite observations supplied by SABER on the TIMED satellite and MLS on the Aura satellite, Kalicinsky et al. argue that the observed disturbance agrees well with the expected behaviour of a propagating Rossby (1,4) normal mode wave. Bringing together the different observations, they support their hypothesis in a clear and concise way. The article is well-written, and I would recommend publication after a few questions are addressed and some improvements are considered.

Comments

Comment 1 – Lines 19-21

To emphasise that atmospheric quantities are modified at a wide range of periodicities some previous studies are mentioned. It might ultimately come down to preference, but including almost 4 lines of previous publications is perhaps touching on some upper limit? An alternative might be to point the reader in the direction of a handful of illustrative examples.

Comment 2 – 2.1 *OH*(3,1) rotational temperature observations*

The ground stations are introduced in detail. For interpretation of the studied event, the placement of the stations is relevant and it would be of interest for the reader if a map illustrating the placement of the stations, and perhaps the distances between them would be supplied.

Comment 3 – 2.2 SABER observations

The SABER observations were not compared to the station at Hohenpeißenberg, but there is no explanation why.

Comment 4 – 2.3 *MLS observations*

In general, this part is not as well written as the descriptions of the other observing systems. First, the bias with respect to SABER is described using pressure as a vertical coordinate, and while this is reasonable, a pointer at some approximate geometric altitude (km) would connect this better to the previous segments. Secondly, the data selection described with Lines 87-91 could perhaps be motivated more clearly. Concepts such as “status field” and “convergence field” are not explained. An explanation of positive precision requirement, and a motivation of the ice-water content criteria would be useful.

Comment 5 – Figure 2

The statement “compare red curve in Fig. 1”? is not clear. Some words may be missing. Also “plus minus” as “plus-minus” or “ $\pm$ ”.

Comment 6 – Lines 99-100

An idea is to emphasise the black lines as the temperature residuals → “See black lines of Fig. 1). Later in the text, lines 114-115, the reader is told to focus on the red lines.

Comment 7 – Lines 105-106

I am wondering if the *larger* amplitude at Greifswald is more fitting, rather than *increased*? Also, the “*increased* temporal coverage of the data due to weather conditions” should be explained as this is new information. Did the other stations have less observations in the considered time period?

Comment 8 – Line 118

“... of the unusual dynamical situation during winter 2016/2017”; is it the wave event that we are discussing that is the unusual situation?

Comment 9 – Lines 121-123

I don't think there was any explanation why the running mean of specifically 41 days was selected? What was the motivation behind this?

Comment 10 – Line 134

The seasonal fit described by Eq (1)?

Comment 11 – Figure 3

To simplify interpretation I would suggest adding a zero-line. Consider making the lines thinner (or adjusting the alphas) so that they can be more easily distinguished. Finally, the abbreviations HGW and WUP in the legend do not match anything mentioned in the article.

Comment 12 – Line 144

The study of the meridional structure is largely based on sinusoidal fits performed in the longitude range 0E to 30E and at the specific altitude of 84 km. Could you comment on this. Is there a span of altitudes that give similar results or is it specifically this altitude? Can the expected vertical structure of the Rossby (1,4) be observed in this component?

Comment 13 – Lines 155-158

A few things regarding the phase analysis could be clarified.

Could the phase be expressed as a number between 0 and the period, for simplified interpretation? It would be easier to interpret the results and see that there is approximately half a period between the two groups. “The phase, expressed as DOY of the first positive maximum after DOY 365 ..” is there a reason for this reference?

A sign difference in the amplitude with antiphase signals, is that not two sides of the same coin, i.e. a negative amplitude and “372 DOY phase”, is the same as positive amplitude and “385 DOY phase”? This could be better explained, maybe with an equation? I presume it is related to phases being “assigned” negative/positive amplitudes.

Comment 14 – Figure 8

See comment on Figure 3.

Technical corrections

Line 116

Satellite-based observations of *the* wave event?

Line 118

“.. temperature observations *derived from* the MLS instrument .. ?

Line 148

Fig. 5a-c.

Line 150

Fig. 5d-f.

Figure 1

The naming of the items in the legend could be improved, i.e. instead of “data” something like temperature residuals / residuals, and capitalised.

Figure 4

No units on the horizontal axis.

Figure 5

Missing labels and units on axes.

Figure 7

No labels or units on axes.