

## ***Interactive comment on “On the origin of the mesospheric quasi-stationary planetary waves in the unusual Arctic winter 2015/16” by Vivien Matthias and Manfred Ern***

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Dear Referee #1,

we are grateful for your friendly and constructive review. Based on your comments and suggestions the manuscript is now improved. In the following point-by-point responses the reviewer comments are in italics, our responses are in blue.

(i): P. 7: It is written: "... as wave (a) which propagates from the stratosphere over the stratopause region (wave (b)). . . .", or "In other words the SPW 1 generated in the lower stratosphere could be propagated upward in midlatitudes until the upper strato-

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sphere." Similar statements have for the SPW2 as well in p. 8. Yes, the SPW phase analysis and EPF vectors indicate vertical and equatorward propagations however the presence of the waves (a) and (b) from Figures 2 and 3 represents actually the typical double-peak altitude structure of the SPWs in the field of the temperature. This issue is reported by Pancheva et al. (2009; please, see Figure 9 there) and is a consequence of the hydrostatic equation (Sassi et al., 2002). Moreover, this double-peak altitude structure is valid not only for the SPWs but for all PWs in the field of the temperature; for example, Pancheva et al. (2016) showed this feature for the quasi-2-day waves.

We thank the reviewer for this helpful note. We compared our temperature related amplitude results with that of the geopotential height (GPH) (see below). We found that the minimum between our wave (a) and (b) corresponds to the maximum of the stratospheric GPH wave in Figure 1, 2 and 3. Thus, wave/maximum (a) and (b) in the temperature amplitude belong to the same wave. We know that the calculation of the PW amplitudes from temperature is less common due to the double-peak issue. However, in our study it is useful since one can better retrace the path of the SPW into the subtropical mesosphere and the amplitude itself is better visible in the mesosphere. We added a note on the double-peak vs. single-peak relationship between temperature and GPH amplitudes on page 2 line 15-20 and line 25 and included the information that the temperature amplitude maxima (a) and (b) belong to the same wave. Additionally we added a GPH-Version of Figure 1 into the supplements (see Figure S1).

Figure 1: Latitude-Altitude cross-section of the amplitude of the SPW 1 and 2 in Period I and II. The amplitudes are calculated using GPH data from MLS.

Figure 2: Same as Figure 1 but estimated from MLS temperature data

(ii): I have some doubt about wave (d) from Fig. 3 that it is in situ generated. I think that the waves (c) and (d) represent the above mentioned double-peak altitude structure of the SPW2 in the field of the temperature. This could be checked by considering the SPW2 but in the field of the geopotential height; the latter should have a single peak

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maximum situated at an altitude coinciding approximately with the altitude of the minimum between the double-peak structures in the temperature. Both the phase structure and EPF vectors southward from 60°N show vertical and equatorward propagation of the SPW2; wave (d) is also above the region where  $n_2$  is negative. I agree that EPF vectors are not large at altitude of 80 km but below and above this altitude they are quite large. I think also that the barotropic and/or baroclinic as well as the GW drag may additionally strengthen the northern part of wave (d).

The reviewer is partly right. Wave (c) and (d) of the SPW 2 in Period II are the same southward of approximately 45°N. However, in the polar latitudes there is a different wave which very probably does not belong to wave (c) in the subtropical mesosphere. We added a note on page 2 line 27-31 regarding the south-north splitting of wave (d) and only referred to the northern part of wave (d) when talking about a possible origin of wave (d)

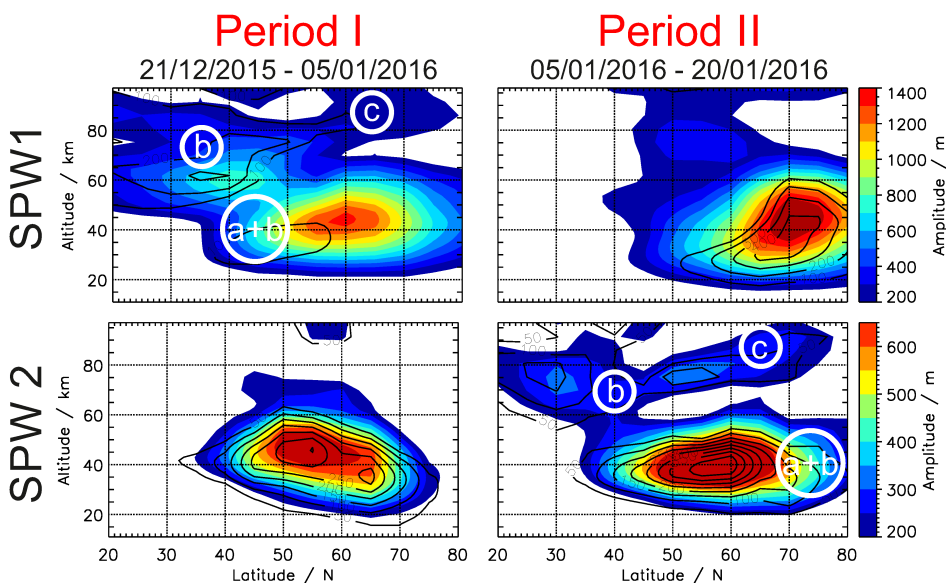
Typos: The text of Figure 7: Latitude-time. . . should be Longitude-time. . . Done

Please also note the supplement to this comment:

<https://www.atmos-chem-phys-discuss.net/acp-2017-1051/acp-2017-1051-AC1-supplement.pdf>

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2017-1051>, 2017.

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**Fig. 1.** Latitude-Altitude cross-section of the amplitude of the SPW 1 and 2 in Period I and II. The amplitudes are calculated using GPH data from MLS.

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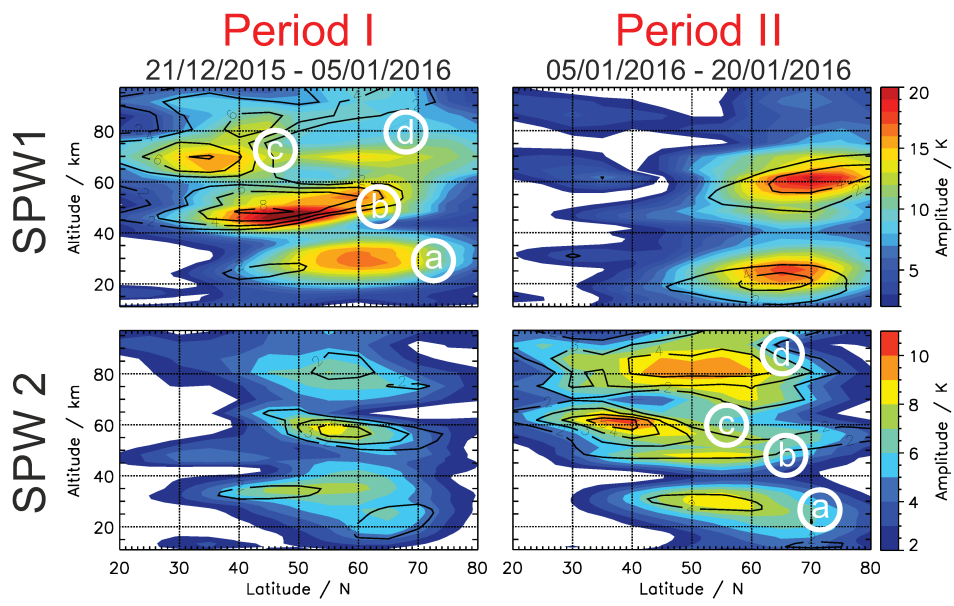


Fig. 2. Same as Figure 1 but estimated from MLS temperature data