Dear Referee #2,
We are grateful for you 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.

The only issue I have is that I am not convinced that the authors showed sufficient evidence that wavenumber 2 is generated by in situ gravity wave drag at the high latitudes.
As we wrote in the paper, we are not able to proof that the polar mesospheric SPWs Period II and especially in Period I are generated by in situ GWD at the high latitudes since we have the absolute GWD only and some other limitations. However our results support the assumption that especially the SPW 2 is in situ generated by longitudinally filtered GWD. We strengthen the emphasis in the appropriate text passages and in the conclusions that our results "only" support the assumption of in situ generation by GWs and instabilities and not prove it.

Page 1, line 15: change to ". . .show that all three mechanisms. . ." Done

Page 1, line 24: change to "In addition to these global anomalies. . ." Done

Page 3, line 8: change to "longitudinally variably" or "variably in longitude" Done

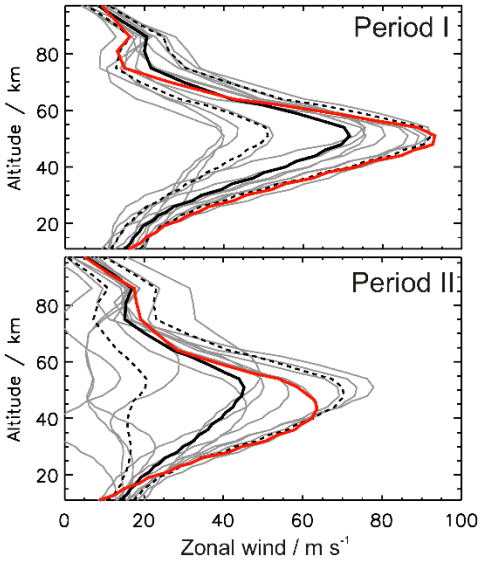
Page 3, line 10: change the word order to ". . .how favorable the conditions are in the. . ." Done

Page 3, line 11: awkward word order, change to ". . . in situ generation of the quasi 2-day wave, for example." Done

Page 4, line 3-4: change "in all latitudes. . ." to "at all latitudes" Done

Page 4, line 14: should be "atmospheric parameters"? Done

Page 6, Figure 2: Yes the PNJ is much stronger than the 12-year mean, but is this surprising? Doesn't the NH PNJ move around a lot from year to year, so that the 12-year mean is of course a little washed out? It would make a stronger case that this PNJ is exceptional if the figure showed the spread of all 12 years instead of just the mean. So for example, a line plot of the zonal mean zonal wind averaged between 50 and 60 N and 40 and 60 km versus time for the entire Period I.



The reviewer is right, the mean of the PNJ has a large standard deviation in the northern hemisphere as shown left in the zonal mean zonal wind profiles averaged between 50 and 60°N for both periods. However, for our explanations of the vertical and horizontal propagation of the SPWs into the subtropical mesosphere, we need the latitude-altitude cross-section of the zonal wind. We added a figure of the zonal mean zonal wind vertical profile averaged between 50 and 60°N for Period I and II in the Supplements and added an appropriate text phrase on page 6 line 7/8 and on page 8 line 16/17.

Page 7, line 17: change word order to "used here" Done

Page 7, line 21: change "shift in vertical" to "shift in the vertical" or "vertical shift" Done

Page 8, line 24 and 26: change to "in the vertical" Done

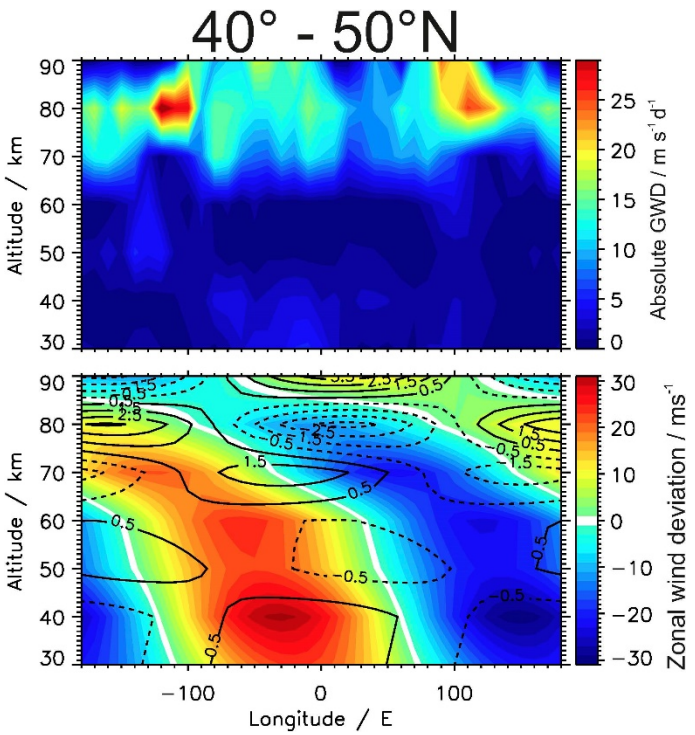
Page 10, section 5 heading: change to "Why does the SPW 2 dominate in Period II?" Done

Page 11, line 12: change to ". . .only possible in a weak zonal mean zonal wind." Done

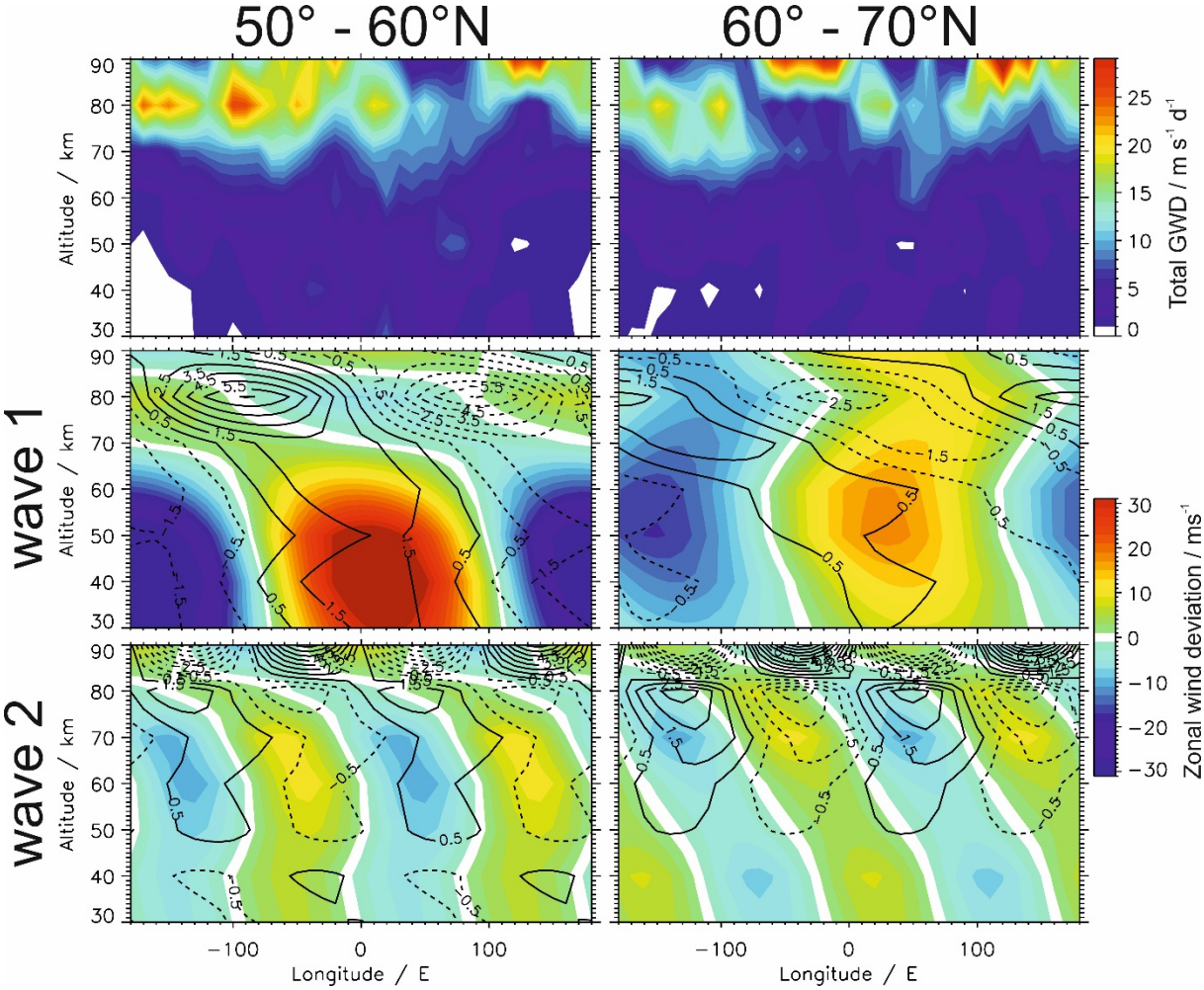
Page 14, Figure 7 caption: The date range of the SABER data should be added to the caption. Is it the entire Period II? This was not clear in the text either. Done

Page 14, Figure 7: I'm not convinced that it makes sense to filter the GW drag for wavenumber 2. If wavenumber 2 is the dominant wavenumber in the zonal wind, and if the GW drag is the cause of this, then the unfiltered GWD should show that. It might be more interesting to see what the unfiltered GWD looks like, because the wind doesn't just feel the wavenumber 2 GWD. The numbers are also very small for the GWD. On the order of 0.5 to maybe 2 m/s/d it looks like, an order of magnitude smaller than those from Smith 2003 for example. Again, it might be more fair to show the GWD from all wavenumbers.

The reviewer might be right that showing the GWD from all wavenumbers is fairer to the reader. However, we think that it is confusing to show all wavenumbers when looking for the origin of wavenumber 2 only. We decided to add two figures to the supplements (see below) including the unfiltered absolute GWD and, similar to Figure 7 in the paper, the filtered zonal wind and absolute GWD for wavenumber 1 in Period I and for wavenumber 1 and 2 in Period II. We hope that this satisfies the reviewer.



This figure shows that there is a non-uniform GW drag between 40° and 50 °N in Period I, the northernmost latitude band available in Period I due to the southern yaw cycle of SABER in that time period. The geostrophic winds from MLS in polar latitudes give a hint, that there could be an in situ generation by GWs between 60° and 70°N and an additional in situ forcing by instabilities between 50° and 60°N. This is supported by non-uniform GWD at 40°-50°N but as we already said: It is not a proof.



In Period II the GW drag filtered for wavenumber 2 is stronger and in a more robust phase relation with the zonal wind compared to the wavenumber 1 filtered GW drag and zonal wind in 60° to 70°N. The amplitude of the GW drag is indeed much lower in our case compared to Smith et al. 2003 but so is the amplitude of the SPW. Additionally SABER "sees" only a part of the GW spectrum. For a sensitivity function see Ern et al. (2018), Fig. 3d. Further, there is a low bias on the observable GW drag (cf. Ern et al., 2004, 2011). We added an appropriate discussion on page 16 line 20 - 23.

Page 15, line 18: change "primary" to "primarily" Done

Page 16, line 14: change to "raises the question" Done