

Interactive comment on “Interannual variability of the stratospheric wave driving during northern winter” by A. J. Haklander et al.

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Thank you very much for your comments. We agree that starting the analysis before the introduction of satellite data in the assimilation process is difficult to justify, especially in the stratosphere. Therefore, we will confine our analysis to the 1979-2002 period, as you suggest.

>> p. 71, l.19-24: A more extensive explanation of this interpretation would help. <<

With this example, we aim to give a more physical interpretation of the zonal correlation coefficient for v and T . Suppose that v^* is given by $A^* \sin(mx + f_1)$ and T^* is given by $B^* \sin(nx + f_2)$. Then, the zonal standard deviations of v and T are $A/\sqrt{2}$ and $B/\sqrt{2}$, respectively. The product of both zonal standard deviations is $(AB/2)$. Also, $[v^*T^*]$ can be shown to be given by $(AB/2) \cos(|f_1 - f_2|)$, provided that m and n are

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identical, non-zero integers. Therefore, by Eq. (4), the zonal correlation coefficient equals $\text{Cos}(|f_1 - f_2|)$ in this case. The larger the correlation coefficient of v with T , the smaller the phase difference between the v and T fields, and the more efficiently heat is transported poleward by the waves. This point will be clarified in the text.

>> p. 72, l. 20-end: Note that averaged over 1979-2002, the trend doesn't seem to be statistically significant either. Hu and Tung (2003) did find highly significant trends in H100, but they averaged over JFM instead of JF. The trends therefore seem to be very sensitive to the chosen averaging months, most likely due to the mechanisms driving the trend described in Hu and Tung (2003). <<

That is correct, the 1979-2002 trend in H100 is not statistically significant. We will add this note to the text.

>> p.74: I agree with the authors that wave activity could originate or end up outside the 40-80N band. However, including the area 0-40N could lead to an unnecessary dilution of the signals. The area 0-40N is a very large area, much larger than the 40-80N area! Correlating with the heat flux averaged over 20-90N instead of the entire NH might be a better approach. <<

We agree with this remark and the suggested approach will be taken in the revised paper.

>> p.76, l. 2: Do you have a suggestion for the physical reason that there is no coupling between H100 and the tropospheric waves 3 and higher? <<

The refractive index for waves 3 and higher exhibits a vertical layer of negative values. Therefore, meridional refraction and reflection of the wave 3+ activity is taking place below 100 hPa. The amount of $s > 2$ wave activity reaching 100 hPa from below is relatively small compared with the $s = 1, 2$ waves, so that H100 is dominated by waves 1 and 2. This point will be clarified in the revised paper.

>> p. 77, l. 19: The mid-latitude tropospheric refractive index ridge is hard to distin-

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guish in Fig. 5a. You could adapt the contours to make it more clear, or use shading instead of contours. Alternatively, you could draw a line in Fig. 5a which denotes the approximate location of the ridge. <<

Since we will confine our analysis to the period from 1979 onwards in the revised paper, the climatological pattern of the refractive index will become different from what is now shown in Fig. 5. Changing the analysis period may have implications for the interpretation of the patterns in Fig. 4. We will try to make the features that are mentioned in the text easier to identify from Fig. 5.

>> p 78, l.2-3: Is this consistent with the refractive index for $s=2$? <<

The lower-tropospheric refractive index field is very jumpy at higher latitudes, where the zonal-mean zonal wind is very close to zero. By definition, this zero-wind critical line is not sensitive to the zonal wavenumber of the refractive index. Therefore, the high-latitude tropospheric correlation maximum in Figs. 4c and 4f is difficult to interpret using Fig 5.

>> p. 78, line 14: How would you interpret the fact that the correlation of H100 with the tropospheric heat flux around 30N is negative? <<

The stationary wave-1 component of the poleward heat flux in the upper troposphere exhibits a strong anti-correlation between 32.5°N and 55°N (e.g., $r = -0.55$ at 400 hPa, 1958-2002). A strong positive correlation of H100 with the tropospheric heat flux around 55N is therefore likely to be associated with a negative correlation around 30N. This will be addressed in the revised paper.

>> Technical corrections: p. 68 line. 27: Eyring (2005) -> Eyring et al. (2005); p. 72, line 3: Siegmund (1994) -> Siegmund(1995); p. 72: I would suggest to number the section before 3.1 as 3.1, and to adapt the rest of the sections accordingly.; p. 81, line 12: In my opinion, it's a bit odd to refer to the abstract in the summary section <<

Thank you, we will correct these issues.

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