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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Stationary planetary wave propagation in Northern Hemisphere winter – climatological analysis of the refractive index" *by* Q. Li et al.

Q. Li et al.

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First of all, we thank the referee for the comments and ideas, which help to clarify further this study.

The response with each comment listed:

1. Abstract: (1). Line 5-8 ("This analysis shows the control of the atmospheric state on planetary wave propagation. It is found that not only the variability of atmospheric stability with altitudes, but also the variability with latitudes has significant influence on planetary wave propagation."). The analysis of frequency of negative refractive index squared (FNRIS) addresses the control of the atmospheric state on planetary wave propagation. The first sentence will be changed to "This analysis addresses the

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control of the atmospheric state on planetary wave propagation". The analysis of the atmospheric control on planetary wave propagation used to mainly focus on the control of zonal mean zonal wind and vertical shear of zonal mean zonal wind on planetary wave propagation. The buoyancy frequency was generally treated in a too simple way such as a constant or as a variability of altitude only. In this study, we found that the variation of buoyancy frequency with not only altitude but also latitude has influence on planetary wave propagation.

(2). Line 11-16 ("In Northern Hemisphere winter the atmosphere shows a large possibility for stationary planetary waves to propagate from the troposphere to the stratosphere. On the other hand, waves induce eddy momentum flux in the subtropical troposphere and eddy heat flux in the subpolar stratosphere. Waves also exert eddy momentum forcing on the mean flow in the troposphere and stratosphere at middle and high latitude."). The first sentence can be drawn from the analysis of FNRIS (Fig.2) and it should be addressed that the results show the possibility for planetary wave propagation. For the second and the third sentences, the results can be drawn from the analysis of E-P flux and its divergence (Fig.5).

(3). Line 17-19 ("Anomalies of stratospheric circulation affect planetary wave propagation and waves also play an important role in constructing and maintaining of interannual variations of stratospheric circulation.") In this study, the anomalies the stratospheric polar vortex - strong polar vortex regime (SVR) and weak polar vortex regime (WVR) have been analyzed. It should be indicated that the observed SVR and WVR have by definition time scales of at least 30 days, which exceeds those of shorter lived sudden warmings or of radiative cooling. Therefore these vortex regimes can be thought as interannual variability, and it is reasonable to treat them as climatological phenomena which are maintained by planetary waves interacting of with the zonal mean circulation of the strong and weak vortex regimes. This sentence ("Anomalies of Ĕ") addressed that maintaining of polar vortex regimes by planetary wave propagation.

2. Discussion (p9042, lines 1-10): It is argued that a high FNRIS area above the sub-

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tropical tropopause is related to an area with extreme negative vertical wind shear. The impedance of vertical shear of zonal mean zonal wind on can be found in equation (1), (2) and (3) (P9038). It can be observed that on the meridional plane, the climatological mean of the negative vertical wind shear distributes around the subtropical tropopause (Fig.3b). The small area of FNRIS around the subtropical tropopause can also be observed (Fig.1). On the other hand, the analysis of FNRIS shows the frequency of negative refractive index squared during the boreal winter from 1958-2002, while the analysis of vertical shear of zonal mean zonal wind (Fig.3b) shows the climatological mean from 1958-2002. It is reasonable to find that the positions of center of high FNRIS and center of negative vertical wind shear are not exactly same.

3. Summary: p9045, lines 19-25, p9052, line 12-16. Same as reply of 1.(2).

4. “Correlation” analysis (section 4.3). Same discussion has been addressed in the reply to referee 4 (point 3).

5. P9052, line 28: explain what is meant by “propagation structures of planetary waves”. The different distribution of E-P flux and its divergence on meridional plane can be observed in SVR and WVR, respectively. Therefore, the “propagation structures of planetary waves” were applied here.

6. Terminology: Since FNRIS just describes “propagation conditions”, terms about the analysis of FNRIS like “propagation properties” or “propagation characteristics” should be replaced by “propagation conditions”. Comments accepted.

7. Expression p9035, line 24-35: Sentence will be modified to “On the other hand, based on the wave-mean flow interaction theorem, planetary waves also have strong influence on winds.”

8. Figures: (1). The authors will suggest making bigger figures when the paper is finally published.

(2). Fig.1, legend “refractive index squaredĚ for mean of 44 boreal wintersĚ”; and

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p9040, line 8 “mean of refractive index squared of 44 boreal wintersĚ”. Here the refractive index squared was computed for everything single day in every single winter from 1958 to 2002. The mean was calculated for every winter then all 44 winters. So the latter is more precise. The first one will be modified.

9. Technical corrections: (1). P9034, line 10: forcing of zonal The divergence of E-P flux represents the eddy zonal momentum forcing on mean flow. So here we prefer to use “forcing on zonalĚ”.

(2). P9038, line 19 to 20: “quadratic vertical wind shear” It will be changed to “quadratic vertical shear of zonal mean zonal wind”.

(3). P9046, line 19 to21: incompleted sentence. Line 19, “Ě, he found that Ě” will be changed to “Ě, he foundĚ”.

(4). P9047, line 11, (65o) It will be changed to (65o)).

(5). P9050, line 25 It will be changed to “from the troposphere to the stratosphere”.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 9033, 2006.