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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Climatology and trends in the forcing of the stratospheric zonal-mean flow" *by* E. Monier and B. C. Weare

Anonymous Referee #1

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Review of the paper entitled "Climatology and trends in the forcing of the stratospheric zonal-mean flow" by Monier and Weare

This paper investigated the momentum budget from the reanalysis of ERA-40 in the TEM equation in detail. The results indicated that unresolved gravity waves contribute considerably to the forcing of the zonal-mean flow. They also found delaying trends of the breakdown of polar vortex in both hemispheres and suggested that such trends are caused by wave-mean flow interactions of stationary waves in the SH and transient waves in NH. The trend in wave forcing of the mean zonal flow is one of the important key issues concerning the global warming, and their study of trends seems to be beneficial to the community. Some discussions however, are speculative and need to be more legitimate. Thus, I recommend the publication of the manuscript after major

revisions.

Major points

1. The authors say in the abstract, “Ozone depletion causes a reduction in wave activity in high latitudes.” I do not simply agree with it. The strong polar vortex corresponds to a baroclinically unstable situation, in which synoptic disturbances develop rapidly. Also, the strong westerly wind tends to excite topographically forced planetary waves. These must be compared with the mechanisms which suppress wave activity.

2. Even though the residual tendency in zonal mean momentum equation is attributed considerably to gravity wave drag, it is still unknown whether the trend of the residual force comes from the trend of gravity wave drag. The trend of residual tendency estimated from the reanalysis during about twenty years is much smaller than the residual tendency itself. It may be contaminated from various sources of systematic errors in the data assimilation.

3. In Fig. 6, the authors concluded from the spatial correlation between the mean Coriolis force and the residual forcing that the gravity wave drag substantially drives the stratospheric B-D circulation. If the B-D circulation is noisier, the negative correlation is larger. In this case, the negative correlation does not indicate that the residual force is the driving force of B-D circulation.

Comments P11650.L12: It is unknown for me whether or not strengthening westerly winds actually causes a reduction in wave activity. (major point 1)

P11650.L15: More discussions are necessary for identification of the trend in the gravity waves (major point 2)

P.11656L19: Please briefly note the method of vertical average from 100hPa to 10 hPa. The air mass density should be considered in the average for conserving the budget.

P.11660L8: The latitudinal band of 30S-40N is asymmetric and seems to be somewhat wider to see the effects of equatorial waves. I would like to know the reason for this

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choice.

P.11663L11: In Fig. 6, the negative correlation between the Coriolis force and residual force does not indicate that the residual force mainly drives B-D circulation (see major 3).

P.11664L5: Considering the smaller contribution of gravity waves to the driving B-D circulation in the SH, it seems to be natural that correlations with the residual forcing is different between the two hemispheres.

P.11666L2: In Fig. 8, please draw line indicators more clearly.

P.11670L5: Again, I would like to note that correlations with residual terms may be sensitive to the magnitude of noises. (major point 3)

P. 11671L2: More careful discussions are needed to conclude that the ozone depletion actually suppresses wave activity. (major point 1)

P. 11672L24: It is really important to confirm conclusions obtained in the other reanalyses (major point 3)

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 11649, 2011.