The relationship between the stratospheric QBO and tropospheric circulation in the Northern hemisphere autumn

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The influence of the stratospheric quasi-biennial oscillation (QBO) on tropospheric circulation over the Northern hemisphere is studied over a 25-year period (1980-2004), using NCEP/NCAR reanalysis data. Seasonal evolution of the interaction between the stratospheric QBO and tropospheric circulation is focused in the Northern hemisphere autumn (Sep-Oct-Nov). All analyses are shown as the differences in the easterly phase and westerly phase of the QBO.

The analyses of the zonal-mean zonal wind indicate significant easterly anomalies at the high latitudes (50-70N), westerly anomalies over mid-latitudes (30-50N) and easterly anomalies in the low latitudes (0-30N). Each term of the transformed Eulerian-mean (TEM) equation was calculated for the differences of the QBO to examine the cause of the significant wind anomalies. The diagnosis of Eliassen-Palm fluxes and their divergence reveals that both transient eddies and stationary waves are dominant in westerly acceleration at mid-latitudes, while easterly acceleration in the low latitude is responsible for only stationary waves. The local time change of zonal wind is positive in the mid-latitudes and negative in the low latitudes during autumn. These activities seem to establish a part of Holton-Tan oscillation in winter.

Next, the horizontal distribution of zonal wind was examined. Significant westerly anomalies in mid-latitudes and easterly anomalies in the low latitudes can be seen at 200 hPa in the upper troposphere over Asia. To analyze the structure in detail, the wave activity flux formulated by Plumb (1986) was estimated. Both easterly acceleration in the low latitudes and westerly acceleration in mid-latitudes are associated with stationary waves. At the high latitudes, transient eddies are not also negligible. These results suggest that the local distribution of zonal wind and wave activities over Asia is reflected in those of zonal averaged field.