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QBO influence on the boreal winter vortex in MAECHAM5 GCM

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The sensitivity of the Northern Hemisphere polar vortex to the quasi-biennial oscillation (QBO) has been analysed using the MAECHAM5 general circulation model. The experiment used simulates the QBO as an internal mode of variability and contains 12 complete QBO cycles. Composites for the westerly and easterly QBO phase at 30hPa and 10hPa have been computed for winter months. Results show tropical and mid latitude patterns in wind and temperature that are related to the secondary meridional circulation of the QBO. They extends up to the upper stratosphere/lower mesosphere and towards the winter pole. At high latitudes, the model reveals a weaker (stronger) polar vortex accompanied by a polar warming (cooling) and a descending (ascending) of the stratospheric branch of the Brewer-Dobson circulation in the pole during the easterly (westerly) QBO phase. However, these anomalies are only significant for the easterly QBO phase at 30hPa. The different behaviour observed between phases is related to the anomalies in the Rossby wave propagation and dissipation at middle and high latitudes. The analysis of the EP fluxes indicates that in the easterly QBO phase wave propagation and dissipation occur upwards and polewards, where waves deposit easterly momentum, decelerate the polar vortex and make the polar stratosphere warmer. In the westerly phase, however, waves bend equatorward and dissipate at lower latitudes and lower heights than in the east QBO which makes the polar vortex stronger. The comparison of the QBO signal between early winter (Nov-Dec) and late winter (Jan-Feb) show mesospheric QBO signature only in early winter. Nevertheless, the influence of the QBO on the polar vortex is much larger during January and February: larger anomalies are observed in both zonal winds and temperature patterns at high latitudes that are significant only in the easterly QBO phase. The EP fluxes corroborate these results as they show larger anomalies during late winter.