Convective gravity waves and their interaction with QBO

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Quasi-Biennial Oscillation (QBO) is a predominant oscillation in the tropical stratosphere with a mean period of about 28 months, and plays an important role in the stratosphere and troposphere dynamics and chemical species. Recent progress in realistic simulations of QBO from general circulation models that include physically-based source-dependent convective gravity wave (CGW) parameterizations revealed that small-scale gravity waves contribute significantly to the momentum forcing required for QBO. In the present study, the interaction between CGWs and QBO is investigated from calculation of an off-line CGW parameterization for 32-years (1979-2010) using 1-hourly NCEP Climate Forecast System Reanalysis (CFSR) data. The CGW parameterization used is an updated version of Choi and Chun (2011) by including the nonlinearity forcing effect of CGWs at the cloud-top momentum flux spectrum. In the tropical stratosphere (20 hPa), various temporal scales of drag forcing of CGWs (CGWD) appear, with dominant peaks at 1 day, 1 yr, and 28 months. The lag correlation between the zonal-mean zonal wind and zonal CGWD is maximal of 0.83 at 3 months, implying that positive (negative) drag appears 3 months earlier than easterly (westerly) changes to be westerly (easterly). The mean magnitude of the positive (negative) forcing by CGWs is 2-4 m/s/month (1-4 m/s/month) for transition from easterly to westerly (westerly to easterly), and this is comparable to that by equatorial Kelvin (Rossby) waves, larger than inertio-GWs, and much larger than mixed-Rossby GWs reported by Kim and Chun (2015). The cloud-top momentum flux spectrum is influenced by QBO phase, through the changes in height and temperature of cloud top.

Key words: Convective Gravity Waves (CGWs), Quasi-Biennial Oscillation (QBO), Off-line CGW parameterization

References

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