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The roles of 3-dimensional propagating gravity waves and equatorial trapped waves on driving the Quasi Biennial Oscillation

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The role of 3-dimensional propagating gravity waves (3-D gravity waves) and equatorial trapped gravity waves (EQWs) on driving the QBO are investigated using a high resolution Atmospheric General Circulation model with T213L256 resolution (60-km horizontal and 300-m vertical resolution) integrated for 3-years. The model without gravity wave drag parameterizations includes QBO-like oscillations and SAO. The simulated QBO-like oscillations have shorter periods than those in the real atmosphere, but their amplitudes and the bottom levels are fairly realistic. The zonal wavenumber versus the frequency spectra of simulated precipitation represent realistic signals of convectively coupled EQWs. EQWs with equivalent depths in the range of 2-90 m from the n = -1 mode to n = 2 mode were extracted separately. Each EQW in the stratosphere generally corresponded well with the source of each convectively coupled EQW activity in the troposphere. In the eastward shear of the QBO, Kelvin waves are dominant forcing among EQWs around the altitude of 0 m/s of zonal wind, contributing to drive the QBO up to 30-50%. On the other hand, westward propagating EQWs (i.e., Rossby-gravity waves, n=1 and 2 westward propagating inertia-gravity waves, equatorial Rossby waves) contribute a little to driving the QBO in the westward shear phase; 3-D gravity waves with zonal wavelength less than 1000 km mainly contribute. The wave forcing to drive the QBO does not show zonally uniform distributions but has large dependence in zonal direction, which is shown by 3-D wave activity flux applicable to inertio-gravity waves. Meridional momentum transport by EQWs is also discussed.