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Global distribution of atmospheric waves in the equatorial upper troposphere and lower stratosphere: AGCM simulation of sources and propagation

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The global distribution, sources, and propagation of atmospheric waves in the equatorial upper troposphere and lower stratosphere were investigated using an atmospheric general circulation model with T106L60 resolution (120-km horizontal and 550-m vertical resolution). The quasi-biennial oscillation (QBO) with a period of ~1.5-2 years was simulated well without gravity wave drag parameterization. The zonal wavenumber vs. the frequency spectra of simulated precipitation represent realistic signals of convectively coupled equatorial trapped waves (EQWs). The temperature spectra in the stratosphere also indicate dominant signals of EQWs. EQWs with equivalent depths in the range of 8-90 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. The propagations of Kelvin waves and n = 0 eastward/westward propagating EQWs are strongly influenced by the Walker circulation and the phase of the QBO. Potential energy associated with EQWs is generally larger in the westerly than in the easterly shear phase of the QBO. EQWs with vertical wavelengths $\leq$ 7 km contribute up to ~30% of total potential energy $\leq$ 7 km over the equator at an altitude of 20-30 km. Gravity waves generated by cumulus convection with periods $\leq$ 24 h are clearly visible over areas of Africa, the Amazon, and around Indonesia, and result in localized PE distributions in areas short distances from the source region. Comparisons of the AGCM results and recent satellite observations are discussed.