Gravity Wave Generation and Propagation in the Middle Atmosphere Revealed by a High-Resolution GCM

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Gravity waves are one of primary components of the atmospheric dynamics, in particular, in the middle atmosphere. A lot of observational studies using radars, lidars, radiosondes, and satellites have been made to elucidate various aspects of dynamical characteristics of gravity waves so far. However, because observable quantities and observable frequency and wavenumber ranges are limited depending on the sounding instruments, overall characteristics of gravity wave generation and propagation have not been fully understood. With the aid of recently available super-computer technique, we developed a gravity-wave resolving GCM having T213 spectral horizontal resolution and 256 vertical levels extending from the surface to a height of 85 km with a uniform vertical spacing of 300 m. Analyzing hourly data over three model years obtained by our simulation, we make reinterpretation of our knowledge on the gravity wave characteristics fragmented in a real or spectral space that obtained by previous observation studies. According to our analysis, important sources of gravity waves penetrating into the middle atmosphere are steep mountains and strong tropospheric we sterly jets in winter and vigorous monsoon convection in summer. It is also shown that poleward propagation of gravity waves from the source region is important, which is not included in the gravity wave parameterizations used in most climate models.