Gravity waves: long-duration balloon observations and parameterization in climate models

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In-situ meteorological observations collected by stratospheric long-duration balloons that drift with the winds provide unique information to study gravity waves over wide geographical areas. During balloon flights performed in 2010 both in the tropics and in the Southern Hemisphere polar vortex, meteorological measurements were performed every 30 s, which enables us to virtually resolve the whole gravity-wave spectrum. Methods recently updated to analyze this high-resolution dataset give access to the full wave characteristics (direction of propagation, horizontal and vertical wavelengths, phase speeds, etc). The balloon observations are used to report on the vertical fluxes of horizontal momentum carried by gravity waves, as well as on their intermittency. The sporadic nature of wave events observed in balloon timeseries has fostered the development of stochastic parameterizations for non-orographic gravity waves in general circulation models (GCM). These parameterizations are tied to convective and frontal wave sources in the troposphere, and thus generate waves with variable amplitudes in agreement with observed probability density functions. In this approach, the parameterized waves interact with the background atmosphere in a broader altitude range than with parameterizations assuming constant momentum fluxes at the source level, and tend to improve the GCM behavior in the stratosphere.

Key words: gravity waves, intermittency, parameterizations, long-duration balloons.