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The gravity wave kinetic energy budget in the mesosphere

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We analyze the results of a mechanistic GCM with respect to the global horizontal kinetic energy (KE) budget. Our GCM has a standard spectral dynamical core, high vertical resolution from the boundary layer up to the lower thermosphere and includes a Richardson number based diffusion scheme that ensures a self-consistent wave-mean flow interaction of resolved gravity waves (GWs).
The KE budget is split into four terms according to the horizontal momentum equations: horizontal advection, vertical advection, adiabatic conversion, and momentum diffusion. In the climatological mean the total budget is close to zero. This balance of sources and sinks can be used to illuminate the energetics of GW breakdown (i.e. GW damping due to turbulent diffusion) in the mesosphere. We find that horizontal advection, which dominates the budget in the upper troposphere, is negligible in the mesosphere. Here, the KE of mesoscale GWs is maintained by adiabatic conversion (i.e. the conversion of enthalpy in KE) and drained by the sum of momentum diffusion and vertical advection. This climatological balance is shown to be consistent with the quasi-linear framework of conventional GW parameterization that are based on the single column and WKB approximations.