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momentum and energy conserving gravity wave drag parameterization in a general circulation model

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A momentum and energy conserving gravity wave (GW) drag parameterization is implemented in the Whole Atmosphere Community Climate Model (WACCM) and its impact on atmospheric circulations is examined. For convectively and frontally generated gravity waves, momentum fluxes are introduced at the prescribed altitude of wave source. Such momentum fluxes, in principle, should induce a net gain/loss of momentum below the wave source that is not accounted for in the current formulation. The new closure accounts for the time tendency of mean flow below the wave source based on the momentum conservation. In addition, the new closure adds a heating rate to the atmosphere below the wave source to ensure the total energy of the entire column of air remain unchanged.

Some recent studies indicated that depositing momentum at the model top could lead to significant improvement in simulating upper atmospheric circulations. In the new closure, the momentum fluxes carried by various gravity wave sources are set to zero. The impact of the new formulation on general circulations of the atmosphere and the climate system is addressed by long-term simulations.