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New constraints on gravity wave momentum fluxes for climate model applications

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We present the results of an international collaboration to compare gravity wave properties using a variety of observations and climate models. Parameterizations of gravity wave drag are employed in most modern climate models to simulate the circulation effects of small-scale gravity waves that remain unresolved in these models. These unresolved circulation effects change the propagation pathways of planetary waves that affect regional and seasonal climate predictions, and parameterized gravity wave drag also influences polar stratospheric temperatures, seasonal ozone loss, and long-term changes in the transport of stratospheric water vapor and other trace gases. Six different parameterization methods and 5 different climate models are included in our collaborative comparison including some high-resolution models that resolve gravity waves explicitly. Results of observational analyses that provide global information on gravity wave momentum fluxes in the lower stratosphere are also employed, including satellite and balloon-borne techniques. The observations best constrain the total absolute momentum flux at levels in the stratosphere. We examine seasonal and interannual variations, global patterns, zonal means, and variations with height. Some remarkable similarities emerge from this comparison, which reinforce the idea that a variety of different parameterization methods can be employed to obtain realistic simulations of modern-day climate. Interesting differences are also found, which lead us to suggest some changes to current parameterization methods. The gravity wave resolving models show patterns related to explicitly resolved gravity wave sources and give measures of how unresolved fluxes vary with model resolution. The presentation will highlight key features in global gravity wave momentum flux that emerge from these comparisons, which point to several new constraints for future climate model applications and to the need for future measurements to provide further constraints.