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Momentum and Energy Transport by Gravity Waves in a Stochastically Driven Jet

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Understanding the physical mechanisms sustaining the statistical equilibrium gravity wave fluxes in the atmosphere presents a theoretically challenging problem involving knowledge of source characteristics, in addition to understanding and modelling of wave-mean flow and wave-wave interactions that influence and filter the emitted wave spectrum. An advantageous conceptual and mathematical framework for studying the wave mean flow interactions is the generalized stability theory (GST), as it separates on the one hand the non-linear mechanisms and other processes that enter as forcing and the growth and dissipation processes on the other. Proceeding from the observation that a variety of sources can generate gravity waves with a wide range of frequencies and spatial scales, we parameterize the sources as stochastic forcing, allowing the system to select the frequencies and structures that will play important roles in momentum and energy transports. Studying the generalized stability of a linear two-dimensional gaussian jet, revealed a tendency for radiation of momentum and energy away from the jet. Wave radiation not only influences the middle atmosphere circulation through momentum deposition in the upper atmosphere, but also the statistical steady state momentum flux divergence produces a significant net drag on the tropospheric and low stratospheric jet, a result that proved to be robust regardless of changes in the temporal and spatial correlation of the forcing and in the static stability of the background flow across the tropopause. In addition, the mean flow does not only passively filter the emitted wave spectrum, but also actively participates in the gravity wave generation leading to enhanced radiated gravity wave energy fluxes in agreement with observations that link enhanced variance with regions of high velocities. We finally let the zonal jet respond to the resulting wave forcing and present some preliminary results showing the evolution of the coupled wave field - mean flow system.