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Transition from geostrophic flows to inertia-gravity waves in the spectrum of a differentially heated rotating annulus experiment.

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Inertia-gravity waves (IGWs) are known to play an essential role in the terrestrial atmospheric dynamics as they can lead to energy and momentum flux when they propagate upwards. An open question is to which extent nearly linear IGWs contribute to the total energy and to flattening of the energy spectrum observed at the mesoscale.

In this work, we present an experimental investigation of the energy distribution between the large-scale balanced flow and the small-scale imbalanced flow. Weakly nonlinear IGWs emitted from baroclinic jets are observed in the differentially heated rotating annulus experiment. Similar to the atmospheric spectra, the experimental kinetic energy spectra reveal the typical subdivision into two distinct regimes with slopes k^{-3} for the large scales and $k^{-5/3}$ for smaller scales. By separating the spectra into a vortex and wave part, it emerges that at the largest scales in the mesoscale range the gravity waves observed in the experiment cause a flattening of the spectra and provide most of the energy. At smaller scales, our data analysis suggests a transition towards a turbulent regime with a forward energy cascade up to where dissipation by diffusive processes occurs.

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