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Generation and propagation of inertia-gravity waves within baroclinic wave flows in thermally-driven, rotating annulus experiments

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It is being increasingly recognised that the generation of inertia-gravity wave (IGW) activity by processes leading to spontaneous imbalance within baroclinically unstable flows may be a major source of gravity waves in the atmosphere and oceans. The phenomenon has been demonstrated and studied in the laboratory during the past 5-10 years in 2-layer, mechanically-driven experiments on rotating fluids, in which relatively high levels of IGW activity have been shown to occur that scale quasi-linearly with Rossby number. In the present study, we have obtained new high resolution numerical simulations of baroclinic waves in a continuously stratified fluid in a rotating fluid annulus, subject to differential heating at the cylindrical side boundaries. For large enough Taylor and Rayleigh numbers, spontaneous emission of small-scale, propagating wave structures is seen to occur, especially close to the inner sidewall where the main meandering baroclinic jet stream detaches from the sidewall boundary layer. These small-scale waves appear to be consistent with propagating internal IGWs, and exhibit convectively unstable breaking events as they propagate into regions of strong horizontal deformation.

We present results from these simulations together with comparisons with available experimental measurements in the laboratory, and discuss their interpretation and pos-

sible implications for IGW generation in geophysical flows.