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Baroclinic wave laboratory experiment with radial heating and vertical stratification to study IGW emission from baroclinic fronts

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The differentially heated rotating annulus is a widely studied experimental apparatus for modelling large- scale features of the mid-latitude atmosphere. In the classic set-up, the instability is studied using a homogeneous fluid. In the present work, we study a modified version of the classical baroclinic experiment where the working fluid consists of sodium-chloride/de-ionized water solution. A continuously stratified salinity profile is initially prepared in the annular cavity with the standard double-bucket technique.
The vertical salt stratification opposes the thermal convective motions until the ratio of the (horizontal) thermal density difference and the (vertical) salinity-induced density difference exceeds a certain critical threshold. Then double-diffusive convection rolls develop in thin layers located at top and bottom, where the salt stratification is weaker. This laboratory arrangement mimics the presence of a stratosphere above a baroclinic unstable troposphere. PIV velocity maps describe the wavy flow pattern at different altitudes. A baroclinic wave on top, and one at the bottom arise, but with different azimuthal wave numbers. These waves are decoupled by the presence of the motionless stratified layer between them.
In some regimes, small scale wave trains have been detected along the baroclinic wave front. These waves might be traces of Internal Gravity Waves generated by the fluid motions in the baroclinic unstable layers.