# Instabilities and transition within a baroclinic cavity

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**Abstract**

Baroclinic instability is recognized to be one of the dominant energetic processes in the large-scale atmospheric and oceanic circulations. Since the pioneering works of Hide and Fultz in the late 1950s, the differentially heated rotating cylindrical annulus, the so-called *"baroclinic cavity"*, has proven a powerful means for studying the characteristics of baroclinic instability in the laboratory. The flow regimes have been classified into three main families : the axisymmetric regimes, the regular wave flows and the geostrophic turbulence (or irregular waves). According to the experimental investigations of Hide (1958) using liquids, the fluid properties, in particular via the Prandtl number, do not significantly affect the change from axisymmetric to regular wave flows, but do play an important role during the transition towards irregular waves. Improving our knowledge of the modes of chaotic behaviour associated with fully developed baroclinic processes is of great importance for understanding what determines the predictability of weather and climate systems.

To show the influence of fluid properties on the flows, we have considered two specific fluids: air with $Pr = 0.7$ and a liquid defined by $Pr = 16$. After a brief description of the governing equations and the solution method, we present the different bifurcations sequences arising during the regular wave regimes up to the transition zone. We focus our attention particularly to the nature of the small-scale fluctuations responsible for the spatio-temporal chaos leading to the transition towards geostrophic turbulence. Comparisons between computed solutions and available experimental data are carried out for the liquid. Finally, some preliminary results of the flow structures obtained within a water-filled cavity having an upper free surface are discussed.