FM25L_11391

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Instabilities of a Vortex Pair in a Stratified and Rotating Fluid

Paul Billant(1), Augustin Colette(2), Jean-Marc Chomaz(1)

(1) *LadHyX, École Polytechnique, France*
(2) *CNRM, France*

We present laboratory experiments on the instabilities developing on a counter-rotating vertical vortex pair in a stratified and rotating fluid. Four distinct types of three-dimensional instability have been identified. For large Rossby number, both vortices are subjected to the zigzag instability at low Froude number and to the elliptic instability at large Froude number. For moderate Rossby number, the elliptic instability is observed only on the cyclone while the anticyclone is subjected to a centrifugal instability which produces toroidal Taylor-like vortices and to an oscillatory instability with an azimuthal wavenumber $m = 1$. To understand the physical mechanism of this new instability, the stability of the Lamb-Oseen vortex in a stratified rotating fluid has been investigated both numerically and theoretically. These analyses demonstrate that this oscillatory instability is a non-axisymmetric centrifugal instability. The numerical and experimental results are in good agreement.

View the extended summary