Oceanic vortices in a jar : Laboratory experiments in stratified rotating flows

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Oceanic meso-scale lenticular vortices play an important role in the redistribution of heat, salt and momentum in oceans and thus contribute to the climate equilibrium on Earth. Moreover, because of their internal recirculations and of the upwelling they induce, they also isolate, mix, transport, nutriments and phytoplanktons and in consequence participate to the general ecological diversity of the oceans. These vortices are governed by geostrophic and hydrostatic balances between pressure gradients, Coriolis and buoyancy forces from where they get their shape and aspect ratio. We will first derive a relationship for the vortex aspect ratio (vertical half-thickness over horizontal length scale) for steady and slowly evolving vortices in rotating stratified fluids, as a function of the BruntVisl frequencies within the vortex and in the background fluid outside the vortex, the Coriolis parameter and the Rossby number of the vortex [**?**]. Our law significantly differs from the generally admitted conjecture derived from quasi-geostrophy. It is however verified by means of stratified flow experiments performed on a rotating table [2], but also with observations of Atlantic meddies and oceanic floatting lenses [3] described in the oceanographic literature. Our study also explains the exceptional longivity of these vortices in the oceans [4]. Finally, motivated by the understanding of the way energy escapes from the mesoscopic oceanic turbulence to feed the smallest oceanic scales where dissipation and mixing occurs, we will describe our ongoing experiments [5] on the unbalanced dynamics of the merging of two lenticular anticyclones where gravity waves emission and vorticity filamentation are expected [6,7,8].

Références

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