Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

On the lifetime of a pancake anticyclone in a rotating stratified flow GIULIO FACCHINI, MICHAEL LE BARS, Aix-Marseille University, CNRS, Ecole Centrale Marseille, Institut sur les Phenomenes Hors Equilibre, UMR 7342, Marseille, France — We present an experimental study of the time evolution of an isolated anticyclonic pancake vortex in a laboratory rotating stratified flow. Motivations come from the variety of compact anticyclones observed to form and persist for a strikingly long lifetime in geophysical and astrophysical settings combining rotation and stratification. We generate anticyclones by injecting a small amount of isodense fluid at the center of a rotating tank filled with salty water linearly stratified in density. Our two control parameters are the Coriolis parameter f and the Brunt-Väisälä frequency N. We observe that anticyclones always slowly decay by viscous diffusion, spreading mainly in the horizontal direction irrespective of the initial aspect ratio. This behavior is correctly explained by a linear analytical model in the limit of small Rossby and Ekman numbers, where density and velocity equations reduce to a single equation for the pressure. Direct numerical simulations further confirm the theoretical predictions. Notably, they show that the azimuthal shear stress generates secondary circulations, which advect the density anomaly: this mechanism is responsible for the slow time evolution, rather than the classical viscous dissipation of the azimuthal kinetic energy.

Aix-Marseille University, CNRS, Ecole Centrale Marseille, Institut sur les Phenomenes Hors Equilibre, UMR 73

Date submitted: 26 Jul 2016 Electronic form version 1.4