Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Three dimensional vorticity dynamics in rotating fluids M.D. PATTERSON, Yale University — Motivated by studies of ageostrophic dynamics associated with wind-forced anticyclonic oceanic vortices, transient spin up problems, and vortex interactions, we revisit a recently studied problem using new methodology. Wells, Clercx and van Heijst. (J. Fluid Mech. 573, 339, 2007) performed an experimental and two-dimensional numerical study of the evolution of vortices in oscillating spin-up. A rich dynamics of vortices interacting in the interior is produced in their square cell if the period of a modulation of the overall steady rotation rate is longer than the half-width advection time scale for corner vortices. They observed the evolution of dye in a horizontal slice near the free surface and treated the dynamics in the context of two-dimensional simulations. Here we interrogate the two-dimensional velocity field of the fluid at multiple levels simultaneously thereby producing a three-dimensional view of the flow. Among other things, this reveals that the vortices are launched into the interior of the fluid from the free-surface downward rather than being simultaneously released along the depth of the cell wall. Hence, from their very birth the vortices have three-dimensional structure. Vertical slices of the velocity field reveal highly localized up and downwellings, consistent with the simulations of Koszalka, Bracco and Provenzale (subjudice, 2007). Finally, our quantitative probing produces continuous velocity fields amenable to direct comparison with simulations.

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Date submitted: 02 Aug 2007 Electronic form version 1.4