Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Secondary Flows Within 3D Vortices SUYANG PEI, PEDRAM HASSANZADEH, PHILIP MARCUS, University of CA at Berkeley — Control volume analyses, analytic scaling arguments, and numerical modeling can all be used to show that in a dissipationless flow that there are classes of 3D vortices in which the fluid velocity is purely 2D. That is, in cylindrical coordinates the vortex occupies a finite region in z so that the vortex has a definite top and bottom, but the velocity in only in the r and ϕ directions. However, control volume analyses and scaling arguments show that if dissipation is present, these 3D vortices must have a 3D meridional, or secondary, circulation. The dissipation can be due to viscosity, or if the flow is temperature- or salt-stratified, the dissipation can be due to the diffusion of heat or salt. The best known secondary circulation in a 3D vortex is Ekman pumping, which requires that the 3D vortex is confined between upper and lower solid boundaries. We present numerical results of secondary flows within several classes of 3D vortices, including vortices that are not bound above and below by solid walls. We relate these results to geophysical vortices, including ocean meddies and planetary vortices.

Suyang Pei
University of CA at Berkeley

Date submitted: 06 Aug 2010 Electronic form version 1.4