Masters Defense

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ON SPIN UP AND SPIN DOWN
IN AXISYMMETRIC CONTAINERS

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Abstract

Large scale oceanic flows are greatly affected by the Earths' rotation. Although studies have been carried out on the nature of shear layers in rotating flows, there has not been an extensive study on the interaction between rotation, density stratification and slope of the topography. As part of a larger project with the aim of providing laboratory benchmarks to numerical models, experiments were carried out at Laboratoire des Ecoulements Géophysiques et Industriels (LEGI), Grenoble and Arizona State University Environmental Fluid Dynamics (ASU EFD) lab to obtain estimates of bottom shear stress in oceanic flows over sloping surfaces. Laboratory modeling of said flows was done through studies of decay of momentum in impulsively started rotating flows under the influence of a background rotation. This thesis presents some theoretical analysis of such flows. The theory for a homogeneous fluid assumes a geostrophic interior flow, the absence of any large scale eddies and a stable laminar Ekman boundary layer on the bottom topography to relate the interior velocities to the shear stress. The analysis indicates that over sloping surfaces, the decay of momentum is faster than over flat surfaces. It is further indicated that the decay process is faster for downwelling (spin down) favorable flows than for upwelling (spin up) favorable. Laboratory experiments confirm this interaction between topography and rotating flows.