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Pathway to model oceanic overflow: experimental study of stratified flows

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ABSTRACT:

Mixing and entrainment processes significantly influence global oceanic circulation, where the shear dominates the stabilizing effect of the stratification and the flow at the stratification interface becomes unstable, resulting in turbulent mixing. Owing to limited spatial resolution in global-scale ocean/climate simulations, the sub-grid scale mixing dynamics must be properly parameterized. The mixing process is first investigated in laboratory experiments by generating gravity currents flowing into a steady ambient medium along an inclined plate. The level of turbulence is experimentally enhanced using active grids. Experiments are conducted at different Richardson number by varying the density stratification and flow rate. A second set of experiments examines the mixing in a stratified jet. In both experiments, Particle Image Velocimetry (PIV) and Planar Laser Induced Fluorescence (PLIF) are combined to measure velocity and density fields simultaneously at high resolution, thus enable detailed investigation of the flux term and turbulent energetics. The obtained data are used to evaluate the Richardson number dependence of entrainment rate and compared with the prediction of different parameterizations, as well as to examine the mixing efficiency and the physics for developing improved parameterization models.

BIOGRAPHY:

Dr. Jun Chen received his B.S. degree and M.S. degree in aerospace engineering from Beijing University of Aeronautics and Astronautics. He obtained his PhD degree in mechanical engineering from Johns Hopkins University in 2005. After that he conducted postdoctoral research in Los Alamos National Laboratory. He joined Purdue faculty of School of Mechanical Engineering in 2008. Dr. Chen's research interests are in the area of experimental and applied fluid dynamics, including development of advanced flow diagnostic techniques, turbulent flow measurements and modeling, stratified flows, cardiovascular flow dynamics, wind energy, etc. His research projects were funded by by DOE, NIH, NASA, DoEd, etc.