Particle Image Velocimetry Measurements and Numerical Modeling of a Saline Density Current

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Abstract: Particle image velocimetry scalar measurements were carried out on the body of a stably stratified density current with an inlet Reynolds number of 2,300 and bulk Richardson number of 0.1. These measurements allowed the mass and momentum transport between the current and the less dense ambient fluid to be investigated. Reynolds stress, Reynolds flux, and shear production of turbulent kinetic-energy profiles revealed local maxima at the bed, as well as at the interface with the ambient fluid. Profiles of excess density variance and buoyancy production of turbulent kinetic energy revealed only local maxima at the interface with the ambient. These maxima decreased downstream as the stable density gradient reduced the turbulent intensities, until turbulence collapsed. A two-dimensional, unsteady, Reynolds-averaged Navier-Stokes (2DV-URANS) simulation was also performed on this density current. Good agreement was found between the modeled and measured normalized mean flow profiles. A comparison was also made between the measured and modeled outer flow scales of the density current.

ASCE Subject Headings:

- Density currents
- Flow measurement
- Turbulence
- Reynolds stress
- Diffusion
- Numerical models