

A Modified Velocity Projection Method for Estimating the Subsurface Velocity Structure of the Chesapeake Bay Outflow Plume

Prof. Avijit Gangopadhy

Associate Professor,
University of Massachusetts at Dartmouth
avijit@umassd.edu 508-910-6330

Dr. Colin Y. Shen

Scientist, Naval Research Laboratory
shen@nrl.navy.mil 202-767-2291

Dr. George O. Marmorino

Scientist, Naval Research Laboratory
marmorino@nrl.navy.mil 202-767-3756

Dr. Richard P. Mied

Scientist, Naval Research Laboratory
mied@nrl.navy.mil 202-767-3756

Dr. Thomas E. Evans

Scientist, Naval Research Laboratory
evans@nrl.navy.mil 202-767-3756

Abstract: We describe a methodology for estimating subsurface velocity structure in a buoyant outflow plume from a set of available observations. The observational data include HF Doppler radar, SST and sea surface color. In addition, plume-specific temperature and salinity information from in situ observations are used minimally, if available. Detail application of the methodology is shown via a case study for the Chesapeake Bay during November 1997.

The proposed methodology depends on developing a zero-order dynamical feature model for a typical plume. Theoretical models and past synoptic observational data sets are used to design the ‘plume feature model’. The feature model’s primary parameters include the location and extent of the frontal boundary, a simplified gravity current structure in the vertical with prescribed (or inferred) density stratification, and spatial gradient of salinity across the plume. These parameters are inferred from remote sensing or minimal strategic in situ observations.

For the Chesapeake Bay case study, a previously developed velocity projection method by Shen and Evans (2002), which obtains subsurface current structure within the Ekman layer depth from surface currents (HF Doppler radar) and wind observations, is employed in a modified configuration. The ‘feature model’ density stratification in shallow water is incorporated now in the dynamical projection equations. The resulting subsurface projected currents are compared with available ADCP profiles. The difference between the density-stratified estimate and ADCP is further used to calibrate and improve the zero-order dynamical feature model parameters. This synergistic approach can now be applied to other shallow water features such as salt lenses and other anomalous entities.