Abstract View

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A Numerical Technique to Incorporate Frontal Boundaries in Two-Dimensional Layer Models of Ocean Dynamics

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ABSTRACT

This paper describes a novel numerical technique that exploits the method of bicharacteristics to allow small fronts to he included in numerical layer models of the ocean. The approach treats a front as a free boundary and solves the interior problem using a standard finite difference scheme; it employs a method based on the bicharacteristics of the equations to locate the boundary and enforce the boundary conditions. The bicharacteristics for the nonlinear shallow water wave equations are derived and their application to the problem is outlined. The method is demonstrated and evaluated by compared calculated approximate solutions first, to the exact solution of a simple problem, and second, to a numerical solution of the more complicated problem of the radially symmetric discharge of a buoyant fluid into a stationary, deep ambient fluid obtained using a simple alternative method.

The scheme is then successfully applied to investigate the effect of a uniform crossflow in the ambient fluid on the buoyant plume created by a radial discharge. Several calculations demonstrating the consequences of interfacial friction, entrainment and Coriolis acceleration are presented and discussed.