

NUMERICAL METHODS FOR THE SIMULATION OF  
HYDRODYNAMIC AND ECOLOGICAL PROCESSES,  
WITH APPLICATION TO KANEOHE BAY, OAHU, HAWAII

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## ABSTRACT

Efficient techniques are presented for the simulation of hydrodynamic and ecological processes. The hydrodynamic model solves the vertically integrated Navier-Stokes equations. The ecosystem model consists of an arbitrary number of equations, one for each trophic level or population, coupled to the vertically integrated transport equation. The numerical techniques utilize a hybrid finite element-finite difference procedure. The procedures are highly stable and apparently independent of explicit stability requirements. The techniques are tested to insure that they accurately solve the governing equations. The models are compared with existing methods and are found to be superior both from the standpoint of cost and of mathematical rigor. Hydrodynamic simulations of the southeastern sector of Kaneohe Bay are presented for both tradewind and no-wind conditions, with the current field estimated in the tradewind simulation compared with observations. Preliminary ecosystem simulations of the southeastern sector of Kaneohe Bay are also presented.