

A FE coastal ocean model: Recent developments.

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abstract

An objective of this work is to develop a robust and efficient numerical model that can be used for large-scale high-resolution simulations of coastal ocean dynamics. The model RiCOM (River and Coastal Ocean Model) is a multipurpose 3D primitive equation hydrodynamic model that uses a semi-implicit time approximation, uses a semi-Lagrangian advection scheme, and uses a finite element spatial discretisation that is based on the RT0 triangular and quadrilateral elements. There are several recent developments that may be of interest to others. They are:

Grid generation: The grid generation method is now based on a node injection scheme with one or two passes of a frontal marching algorithm to develop a quality grid at the boundaries, and generation of variable size clusters in the interior. This method has the advantage of producing a quality triangulation globally and enables smooth grading of element areas.

Semi-Lagrange methods: A new method using a power series in time has been developed for calculating trajectories. The method is accurate and reasonably efficient, and can be applied to elements with constant spatial gradient in velocity such as triangles with linear bases and the RT0 triangular and quadrilateral elements. Other methods such as forward Euler and 2nd-order Runge-Kutta were also tested. A high-order interpolation method for unstructured grids has also been developed.

Non-hydrostatic solver: A new method of implementing non-hydrostatic pressure has been included as an optional module. The method is based on the ideas presented by Stelling and Zijlema (IJNMF, 2003) but is semi-implicit in time and uses unstructured grids (Walters, IJNMF 2005).

Field tests: A detailed comparison between RiCOM, Tide2d (a harmonic in time FE model), and a set of observations has been made for Cook Strait, New Zealand. In addition, a series of laboratory experiments with submarine landslides have been simulated with the non-hydrostatic version of the model.

Forecasts: The model is now embedded into a forecasting system in New Zealand that includes a Local Area Weather Model, the ssh model, and a wave model.