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MULTI-SCALE NUMERICAL SOLVER FOR AN ESTUARY RIVER FLOW USING CIP-SOROBAN METHOD

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ABSTRACT

In this work, a new three-dimensional numerical model for an estuary river flow is proposed.

Because a river flow in an estuary is essentially affected by a bay connecting with the river due to a time evolution of tidal level and so on, in order to solve a estuary river flow reasonably, it is required that a numerical model has a capability to treat simultaneously those two regions (river and bay) that have quite difference spatial scales.

Furthermore, because an estuary water flow is also strongly affected by a density flow due to an existence of dense saline water, the numerical model has to solve a discontinuity around a saline-fresh water interface in a fine spatial resolution.

One of simple and typical solutions to these difficulties is adoption of a fine computational mesh system. However, especially in a three-dimensional simulation, this approach often cannot be putted into practice because of a huge computational cost.

As a new approach to overcome these difficulties, we propose a new three-dimensional numerical model being based on the Constrained Interpolated Profile (CIP) scheme and the Soroban computational grid system[1,2].

While time evolutions of water flow are calculated by the CIP scheme according to three-dimensional k-e turbulent equations with a quite low numerical diffusion error, by using Soroban grid system, computational grid points can be rearranged and gathered freely around an arbitrary region according to the topography and a position of a saline layer even after a computation starts.

As a result of this excellent numerical feature, the proposed model can be expected to solve a reasonable estuary water flow even if a coarse computational mesh system is employed. For instance, by gathering some computational grid points around the interface, a sharp discontinuity at the fresh-saline water interface can be represented very well.

The proposed model is applied to an estuary flow in the Tone River downstream from the estuary barrier with actual geometry conditions. As a result of comparisons with field observation data[3], it is verified that the proposed model can solve the actual density flow in an estuary in reasonable accuracy.

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