SLON model and its applications to Singapore and Johor Straits

OLEKSANDR NESTEROV[1] and PAVEL TKALICH[1]

[1]*Tropical Marine Science Institute, National University of Singapore*

SLON (Sigma Layers Offing Numerics) model is being developed in TMSI, NUS as further evolution of the numerical model THREETOX [1]. Hydrodynamics of SLON is formulated by 3-D free-surface hydrostatic equations. Vertical viscosity and diffusivity coefficients are calculated using the k/ε turbulence model, while horizontal coefficients are parameterized by Smagorinsky formula. SLON includes coupled calculation of temperature, salinity, water quality parameters and suspended sediments concentrations. Therefore, the feedback influence of these parameters on hydrodynamics allows, in particular, simulation of baroclinic motion and selfshading effect of the substances depending on available sun light and water temperature. Implemented advanced schemes of heat, momentum and mass fluxes through water surface use standard meteorological conditions for model forcing. Equations are written in double sigma vertical coordinate system, which gives significant advantage for modeling of stratified flows in areas with complex bottom topography in comparison with the single sigma coordinate system. Recently developed advection scheme for horizontal velocity components based on van Leer scheme [2] ensures the same properties as the last one for a scalar in staggered grids. Low-cost parallelization is achieved by horizontal domain decomposition and using MPI (Message Passing Interface) for data exchange on each integration time step. SLON is used intensively for variety applications in Singapore waters as a research and forecasting tool. The model is being calibrated taking into account some poorquantified but very important bed-forms such as mangroves. Comparison of simulation results with measurements shows good overall performance of the model.

Keywords: coastal hydrodynamics; free-surface hydrostatic models; k/ε turbulence model; stratified flows; parallel computations; van Leer advection scheme; MPI

References

[1] Margvelashvili N., Maderich V., Zheleznyak M. THREETOX - computer code to simulate three-dimensional dispersion of radionuclides in homogeneous and stratified water bodies. *Radiation Protection Dosimetry*, **73**, 177-180 (1997).

[2] Lin, S.J., W.C. Chao, Y.C. Sud, and G.K. Walker, A Class of the van Leer type transport schemes and its application to the moisture transport in a general circulation model, *Mon. Wea. Rev*., **122**, 1575-1593 (1994).