Simulation of Thermal Discharge into Coastal Flow: An Example of CFD and GFD Hybrid Approach to Resolve Small-Scales

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In the few past decades, a number of geophysical fluid dynamics (GFD) models have been developed for coastal ocean flows, such as POM, ROMS, FVCOM, and ADCIRC. These models are basically designed for large-scale layer flows such as estuary circulations, and they have been greatly successful in many practical problems. In general, however, coastal ocean flows are multi-physics processes spanning a vast range of spatial and temporal scales and, in correspondence to many emerging issues such as the catastrophic Mexico Gulf oil leakage and harmful algae blooming in many waters, there is an urgent need to develop capability to simulate small-scale and really 3D phenomena. We propose a computational fluid dynamics (CFD) and GFD hybrid approach to predict small-scale problems in coastal flow settings (Wu and Tang, 2010). The former is used to capture local flow motions, and the latter is employed to compute the large-scale background currents. The hybrid approach is realized by two-way coupling of CFD and GFD models and domain decomposition method (zonal method) with Chimera overset grids (Tang *et al*., 2003; Tang *et al*., 2008). In this presentation, this approach couples FVCOM (Chen et al., 2003) and a CFD model and is applied to a seabed multiport thermal discharge, with full resolution of real configuration of the ports with 10 cm in diameters and the effluent plumes, into estuary with sizes in hundreds of kilometers. The results clearly illustrate the feasibility and potential of the proposed approach in prediction of multi-scale coastal ocean flows. Difficulty and unresolved issues will be discussed also (Tang and Zhou, 1999; Tang, 2006).

References

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