

## **5 Year Topic 2: Coupling Between Physical, Biological and Human Processes in Earth Surface and Ocean Dynamics:**

### **-- Group 3 of 3: In Shelf/Estuarine Environments with Complex 3D Flows (Longer version)**

**Questions:** In shelf and estuarine environments with complex 3D flows, how can we advance understanding and application of knowledge regarding water quality (hypoxia, dead zones, pollution, larval transport, oil spills), sediment transport, morphological change and the effects of all of these on ecological function and ecosystem health.

**One-Way Couplings:** Some important couplings are largely one-way -- linking “external” models of varying complexity developed by other experts (e.g., land use (especially), atmospheric forcing, oceanic forcing, stratigraphic evolution, particle tracking and visualization) to a core 3D shelf/estuarine model.

**Feedbacks:** The clearest feedback would be morphological change in regions of complex 3D circulation, feeding back to affect biology, water quality and further hydrodynamic change. Morphodynamics incorporating complex 3D transport of fine sediment has been understudied. Policy driven efforts/failures which improve/degrade water quality (by reducing/changing land-use/sediment properties) could also initiate/effect this morphodynamic feedback loop.

**Key Existing Models:** The key existing 3D “core” community models include ROMS, FVCOM, SELFE, Delft-3D and a few others. In the near-term, the advantages of ROMS include its use by the largest number of Marine group CSDMS members, the progress made already in implementing it within CSDMS tools, and the state-of-the-art USGS-CSTMS (with a “T”) suite of fine sediment transport processes already incorporated into ROMS.

**Model (Approaches) That Are Needed:** CSDMS can link ROMS with multiple exchangeable land use/river models, atmospheric models, ocean boundary models, tidal forcing models, particle tracking models, etc. CSDMS can facilitate the rapid exchange of different grid resolutions, advection choices, turbulence closures, etc. CSDMS can provide community access to multiple biological/water quality formulations, and sediment transport formulations (via USGS-CSTMS).

**Long-Term Model Options:** The approach with ROMS would be the first of parallel efforts to be done with other “core” 3D hydrodynamic community models such as FVCOM, SELFE, etc.