OVERARCHING THEMES for Marine Working Group and CSDMS

The Marine Working Group deals with challenges of representing shelf, carbonate, slope, and deep marine environments within surface dynamics models, as well as linking oceanographic processes to surface dynamics in neighboring and coupled systems, like coastal, atmospheric, and fluvial systems. The working group recently identified the following large scale goals and research issues for the coming decade.

* **Enable coupling of atmospheric, wave, ocean, sediment and biogeochemistry models.**
* **Develop an understanding of global variability** of shelf morphology, stratigraphy, and margin transfer processes as a function of external forcings (e.g., river discharge, coastal energy, etc.) under past and present and future conditions.
* **Produce tools for** **quantifying human impacts** to the global ocean and coastal regions (including estuaries) including ramifications of climate change, sea level rise, pollution and nutrient input.
* **Advance interdisciplinary models**, including multiple disciplinary inputs and expertise and their ramifications in ecosystems and biogeochemical processing.
* **Link models across time scales** as well as length scales. Develop methods for transferring information from models working at small scales into larger time and space scale models.

**Intermediate – to – long term goal:**

A key advantage of CSDMS is the coupling it allows, and in the next phase of the program we should identify research problems where advances can be facilitated by ease of coupling. Now that CSDMS has reached some level of maturity, we encourage proposals that include investigators from multiple working groups. Toward this, the Marine Working Group should:

* Identify research issues that could most benefit from improved connections between the marine domain and other disciplines (coastal, terrestrial, carbonate, etc.).

Encourage proposals involve Marine Working Group members and researchers from other working groups. The Carbonate Working Group, for example, expressed an interest in having access to a set of marine sediment transport modules.

**Short Term Goals**

Effort during 2008 – 2012 was expended to incorporate version(s) of the Regional Ocean Modeling System (ROMS) within CSDMS, with the idea that the Marine Working Group and other Working Groups would have available a marine hydrodynamic and sediment transport model within CSDMS. ROMS, however, has a steep learning curve and includes features that are not necessarily relevant to all CSDMS applications, including multiple advection schemes, data assimilation, etc. Additionally, ROMS is research code that continues to be updated. To capitalize on the previous effort and facilitate the use of a marine hydrodynamic / sediment transport model within CSDMS, the Marine Working Group recommends that

* CSDMS provide a stable version of a hydrodynamic model for research and teaching. This could be a simplified version of ROMS. CDMS should provide inputs and sample output for archetypal estuary and shelf configurations, which are available as ROMS test cases. Students and researchers should be able to quickly get the code, run it, modify model inputs, and generate reasonable hydrodynamic and sediment transport fields.
* A second ocean model be incorporated, perhaps a finite-volume model like FVCOM, or one with a large user base like Delft-3D., Another alternative would be a one-dimensional (vertical) model instead of a three-dimensional model. Candidates include Wiberg (1994) and the SEDTRANS code of Li, Amos, and colleagues.

Other short term goals include efforts that should benefit marine surface dynamics modeling efforts in general, aside from the choice of hydrodynamic model used. These include

* The CSDMS should provide a translate module from Matlab code to Python, because many marine reasearchers use Matlab for model development and processing of data.
* A wind model be added to the CSDMS repository, because coastal hydrodynamics are especially sensitive to wind forcing. Some suggested that the WRF (Weather Research and Forecasting) model would be an acceptable choice.

CSDMS can encourage the development of proposals and studies that involve Marine Working Group expertise, in concert with researchers from other disciplines. While the possibilities are endless, members of the Marine Working Group are especially excited by the following ideas for capitalizing on CSDMS capabilities to address compelling research questions.

* Evaluate coupling between land use practices and estuarine water quality. To study the feedbacks in such systems, a land-use model that predicts freshwater, sediment, and nutrient runoff could be coupled into a estuarine hydrodynamic / water quality model. The CSDMS Chesapeake Focus Research Group has expertise in this area and could work to link land use models to, for example, the ChesROMS community model.
* Subaqueous delta evolution involves feedbacks between fluvial discharge and shallow marine circulation, but many geomorphic and hydrodynamic models neglect this coupling. CSDMS could be used to link shelf and river circulation and sediment transport to the evolution of subaqueous deltas.
* Sediment routing from fluvial and coastal sources to offshore sinks is poorly represented by models, and the processes that trigger transport episodes have not been decisively identified. To address this, CSDMS could provide a platform for coupling turbidite and / or contourite models to hydrodynamic circulation and sediment transport models.
* The evolution of carbonate systems respond strongly to conditions in their shallow marine environment, and likewise impact hydrodynamics and mixing there. To explore these feedbacks, the CSDMS could be used to link carbonate production and morphology to ocean circulation, turbidity, nutrients, light penetration, etc. using a hydrodynamic model coupled to a carbonate model.

Members attending the first Marine Working Group Meeting (March 8, 2008) identified the following processes as essential marine components in CSDMS. In 2013, the Marine Working Group revisited this list, and took stock of the degree to which research programs have focused on these issues.

* + From this list, the community acknowledges that research programs in the CSDMS have focused on dynamics of muddy seabeds (including biological mixing and); dynamics of sandy seabeds (including bed form dynamics); dynamics of mixed sediment-size/composition beds; gravity-driven flows; bedload and suspended load transport (including nepheloid layers); isostasy; subsidence; and tectonics.
  + Conversely, several topics that highlighted in 2008 do not seem to have received much research focus, and we encourage research in these areas in the near future: particle aggregation/disaggregation; dynamics of muddy seabeds (including irrigation, diagenesis); dynamics of carbonate sediments (including effects on porewater chemistry, seabed scour); and sediment-related ice dynamics.