TAEG Comments on IOOS Modeling Testbed for Year 1 Final Report

Summary: The IOOS Modeling Testbed in Year 1 has made significant progress in developing a framework for improving predictive capability in the coastal ocean. It has used a four-pronged approach: (1) development of skill metrics for specific issues of societal importance, (2) assessment of modeling system components and parameterizations against these skill metrics, (3) development of tools to make assessment easier, and (4) building collaboration between academic modeling research and operational development personnel.

The Testbed PIs, Management and team members have successfully worked in the difficult area between research and operations, and have delivered significant advancements in modeling capabilities, process-understanding, and community- building in Inundation, Shelf Hypoxia, Estuarine Hypoxia and Cyberinfrastructure, as outlined in the Final Report. They have acquired significant technical and management experience, in a pilot study sense, that should inform the design and evaluation of the next stage of IOOS testbed activity.

The TAEG believes that possible next steps for the testbed could be focusing on metrics and assessment driven by the needs of operational centers and IOOS Regional Associations, which may include the assessment of real-time operational forecast systems and approaches to data assimilation. A long term goal should be to use Observing System Simulation Experiments to defining observing system requirements to support specified levels of predictive skill.

Narrative: The testbed was envisioned to provide a framework for improved forecasts and simulations of the coastal ocean. Since it's difficult to measure improvement without metrics, the first challenge was to develop meaningful metrics for each of the three modeling focus areas. Once skill metrics were established, teams worked to establish sets of measurements against which the modeling systems could be evaluated. Even though hindcast periods were selected during which relatively large amounts of data had already been collected, this ended up being a larger task than anticipated due to a large variety of formats and metadata. With the observational data sets assembled, the three teams assessed the skill of numerous modeling systems, varying model frameworks, components and parameterizations with joint operational and research community teams. A fourth team developed framework cyberinfrastructure which both tested and expanded existing IOOS standard services and directly supported testbed activities.

With this approach, remarkable progress was made. Here is just one example from each team:

The Estuarine Hypoxia team determined that a simple constant-biology model simulation was able to reproduce the seasonal variability of hypoxia within the Chesapeake Bay nearly as well as models including multiple complex biological processes. This simple model is currently being evaluated for operational forecast use by NOAA CSDL & CO-OPS.

The Shelf Hypoxia team discovered that bottom boundary layer dynamics strongly affect hypoxia along the Northern Gulf of Mexico shelf, and that while areal extent of hypoxia may be reasonably simulated, the exact temporal and spatial evolution of hypoxia is poorly simulated. This is important information for decision makers who need to know how to best use model simulations. In addition, the best hypoxia algorithms from the testbed are being incorporated into the new NOAA CSDL & CO-OPS operational model of the Northern Gulf.

The Inundation team found that accurate storm surge predictions depended on wave modeling and the ability to simulate hurricane forerunner water levels in addition to the locally driven storm surge. The operational NWS NHC SLOSH model does not include waves and did not generate the significant forerunner for Hurricane Ike. Possible means to include these effects within the practical constraints of NHC's operational modeling needs (e.g., rapid run times, limited computing resources, limited operator intervention) are currently under investigation.

The Cyberinfrastructure team played an important role in the development of the first standard for representation of unstructured grids, and the development of a toolbox for both unstructured and structured grids that allows jobs that previously took weeks of development time to be replaced with a few lines of code that take minutes to execute.

An unexpected benefit arising from this effort was the synergism achieved through the interaction of the academic researchers with NOAA personnel from the development, transition and operational centers. We feel all groups came away with a much better understanding and respect for the challenges, capabilities and approaches faced by the two communities.

The TAEG feels that the program achieved significant accomplishments in a short time and that this bodes well for even more progress in the future. In this initial phase the team necessarily focused on issues that matched the capabilities of the research leads and participants. The topics addressed in this phase, hypoxia in shelf and estuarine environments and inundation are unquestionably important society issues. Nevertheless, we anticipate that future Testbed studies will respond to priorities identified by the operational centers and IOOS Regional Associations. This will assist the operational and research forecast groups in evaluating and improving their products. The IOOS Regional Associations focus on observing systems. Thus future Testbed efforts will contribute to observational requirements as well as assimilation of disparate data sets into predictive models and superior model skill assessments.

The IOOS Modeling Testbed has been an exciting and productive program thus far, and the TAEG has been pleased to be a part of it. Keep up the good work!

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