AMS 2016 14th Symposium on the Coastal Environment Summary

The theme of this year's Coastal Environment Symposium was "Earth System Science in Service to Society". The sessions contained within our symposium related to this broad topic in a variety of specific ways, focusing on ensemble forecasting in the coastal zone, novel oceanographic observational techniques, and interaction of earth system processes in the coastal environment. Our symposium also included several joint sessions with the Special Symposium on Hurricane Katrina: Progress in Leveraging Science, Enhancing Response, and Improving Resilience. Attendance at all of our sessions was strong, and discussions were vibrant. In particular, the attendees and co-chairs gave excellent feedback to graduate student presentations and were eager to interact with each other during the discussion portion of each talk. The session co-chairs were very pleased with this year's symposium, and aspire to achieve a similar level of success during next year's AMS meeting.

Short Course on Coastal Surge and Inundation Modeling

On the tenth anniversary of Hurricane Katrina, the AMS Committee on Coastal Environment coordinated a *Coastal Surge and Inundation Modeling Short Course* on Sunday, January 10, 2016. The instructors were Pat Fitzpatrick, Mississippi State University; Arthur Taylor, NOAA/NWS/MDL; Rick Luettich, University of North Carolina; and Jason Fleming, Seahorse Coastal Consulting. The class began with a lecture by Fitzpatrick on storm surge physics in the 1D and 2D context, which included a1D surge model (in FORTRAN or python). The lecture also supplied a spreadsheet exercise for computing storm surge on a simplified continental shelf slope. Taylor next gave an overview on the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model. SLOSH is a computationally efficient finite difference model which provides fast guidance to NOAA stakeholders based on National Hurricane Center forecasts for tropical cyclones. An altered version also uses GFS forcing for extratropical cyclones, known as the Extra-Tropical Storm Surge (ETSS) model. The grids have national coverage on grids of hyperbolic, elliptical, or polar formulation. Recent improvements include tide options, inundation output relative to land, and larger grid domains. Luettich then provided background material on the ADvanced CIRCulation (ADCIRC) finite element model. ADCIRC is designed for high-resolution surge modeling to capture conveyance through channels and channels, barrier influences, and barrier overflow. Wave coupling is included with the Simulating WAves Nearshore (SWAN) model. While it can be run in serial mode, the code is targetted for scalable parallel computing. ADCIRC is most often used for hazard/risk mitigation and levee/barrier engineering designs (using metrics such as return level), and research. However, NOAA EMC is running ADCIRC for extratropical cyclones, and has plans to adopt it for tropical cyclone forecasts. Universities and companies are also running ADCIRC operationally with the ADCIRC Surge Guidance System (ASGS) interface.

The lectures then dealt with conveying uncertainty using ensemble and multi-scenario products. These products are encouraged over deterministic forecasts in real-time operations, since surge is very sensitive to track and wind forecast errors. Taylor described the Probabilistic Storm Surge (P-SURGE), Maximum Envelope of Water (MEOW), and Maximum Of the MEOWs

(MOM) products. MOMs are used for planning/mitigation, MEOWs for readiness (48-120 h from landfall), and P-Surge within two days of landfall. P-SURGE products consist of a series of storm surge height graphics for the Gulf of Mexico and Atlantic coastal areas. The graphics indicate the storm surge heights which will be exceeded by a given percentage of storms. The suite of graphics range from 10 to 90 percent, at 10 percent intervals. P-SURGE utilizes an ensemble of SLOSH runs, with hundreds of combination of track, radius of maximum wind, intensity, and speed.

Luettich then discussed a methodology called surrogate modeling that produces a fast quasi-deterministic run or yield a suite of fast runs. Surrogate modeling is the utilization of a suite of parameters based on a statistical analysis of hundreds of ADCIRC runs. It may be a least squares approach, low-dimensional spline interpolation, response functions, response surface, neural networks, or kriging. Luettich then described how the response surface method has been applied in his research group for North Carolina runs in a product called ADCIRC_Lite. He then gave examples of other techniques. Fitzpatrick concluded the session with an overview on joint probability methods to storm surge studies, contrasting the "brute force" technique - often used for SLOSH but not practical for ADCIRC – versus optimal sampling techniques used in ADCIRC such as response JPM-OS functions and quadrature JPM-OS. Usage includes: flood insurance studies for the National Flood Insurance Program; flood control studies such as the determination of 100-year levee heights; flood mitigation studies such as assessing whether coastal nuclear power plants meet 1 in 10,000 year flood protection criteria; and flood impact studies from man-made hydrology changes. Fitzpatrick gave a detailed JPM-OS example used for the rebuilding for the New Orleans levees after Katrina. Fitzpatrick provided additional background material for off-site reading.

After lunch, classroom instruction was devoted for running and processing SLOSH and ADCIRC on Windows laptops. Fleming provided a Windows laptop graphical user interface for running the serial version of ADCIRC known as the Surface water Modeling System (SMS). SMS can also produce ADCIRC input files and visualization of model output. Fleming provided a "chalk talk" discussing the technical options for running ADCIRC. More details on ADCIRC settings are in the user's manual section at: http://adcirc.org/home/documentation/ . More information on SMS is available at: http://www.aquaveo.com/software/sms-surface-water-modeling-system-introduction .

After the ADCIRC session, Taylor conducted a laptop session on SLOSH. Taylor provided an installation for running SLOSH with a GUI. Steps includes defining the basin; choosing a storm track from the archives (example in class was Hurricane Betsy (1965)) or create a track using a built-in table for location, intensity, and R_{max}; options for choosing tide (or no tide); and running the model (with surge results visualized during the run). Model speed depends on graphical display options, with the fastest run occurring when no graphics are shown during the run. He also discussed the SLOSH Display Program.