The Large Domain and High Resolution Storm Surge
/Inundation Simulation in the Atlantic and Gulf
Coasts

Harry Wang, Derek Loftis, David Forrest, and Carl
Hershner

Department of Physical Sciences,
Virginia Institute of Marine Science
College of William and Mary

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Outline

1. SELFE model applied in super-regional storm surge simulation
   • Performs SURA testbed in Atlantic and Gulf coasts combined model domain

2. Innovative sub-grid modeling for street-level inundation modeling
   • Demonstrates in the Upper Potomac for 1936 Great Flood

3. Examples of SELFE model storm surge and inundation modeling in the Chesapeake Bay for Hurricane Irene
Super-regional Testbed Coastal Inundation Project in Gulf Mexico

1. NOAA funded testbed project: participated include ADCIRC, FVCOM, SELFE, SLOSH, SWAN, UnSWAN, WWM wave model

2. Forcing with the best available wind and pressure field (data assimilated OWI and H*wind during Hurricane Ike)

3. Coupled circulation and wind wave models in 2D and 3D
Wind fields
Wave Heights
Water Elevation
Currents (m/s)
Inter-Code Tides Comparison: Statistics for All Constituents

Amplitude

All Amplitude ADCIRC

$R^2 = 0.811$

$\mu = 0.052$

$\sigma = 0.0272$

$c = 0.00386$

$K = 0.0081$

$\Delta = 0.05$

All Amplitude FVCOM

$R^2 = 0.784$

$\mu = 0.0758$

$\sigma = 0.0261$

$c = 0.00716$

$K = 0.012$

$\Delta = 0.05$

All Amplitude SELFE

$R^2 = 0.797$

$\mu = 0.0916$

$\sigma = 0.0258$

$c = 0.00278$

$K = 0.0156$

$\Delta = 0.05$

Phase

All Phase ADCIRC

$R^2 = 0.826$

$\mu = 0.8786$

$\sigma = 0.406$

$c = 0.084$

$K = 0.0289$

$\Delta = 0.20$

All Phase FVCOM

$R^2 = 0.809$

$\mu = 0.8506$

$\sigma = 0.426$

$c = 0.0451$

$K = 0.028$

$\Delta = 0.20$

All Phase SELFE

$R^2 = 0.842$

$\mu = 0.8528$

$\sigma = 0.40.5$

$c = 2.0$

$K = 0.0294$

$\Delta = 0.20$
Inter-Code Hurricane Ike Hindcast: Water Level Time Histories
Inter-Code Hurricane Ike Hindcast: Significant Wave Heights
Inter-Code Hurricane Ike Hindcast: Water Level Time Snaps
Sub-Grid Modeling for 1936 Great Flood

Harry Wang, Vincenzo Casulli, Christoph Lippert, and Derek Loftis
Washington DC Floods

1889

1936

1942

2006
200 X 200m Base Grid
The storm surge simulation for the Hurricane Irene, 2011

Harry Wang, Yi-cheng Teng, Derek Loftis, David Forrest, Yanqiu Meng, and Zhengui Wang

“VIMS estuarine and coastal modeling group”
Large Domain Storm Surge Model

High resolution nested inundation model
SLOSH Model Grid

VIMS Model Grid
Global Forecast System Gridpoints

Local WRF Model – 4 km Resolution

Global Forecast System Gridpoints
A snapshot of an animation for water level prediction including the wind-wave signature.
A snapshot for an animation of inundation at the Langley Air Force Base superimposed on a Google Map.
Where is the hot spots? The spatial distribution of the envelope of maximum water level above during a 30-hour forecast period.

*above MSL
August 29, 2011

Dr. John Wells
Virginia Institute of Marine Science
P.O. Box 1346
Gloucester Point, Virginia 23062

Dear Dr. Wells:

We at the National Weather Service would like to express our appreciation for all of the help and support provided by VIMS during Irene. Dr. Harry Wang contributed by producing 6 hourly runs of forecast storm surge. The details provided by his surge model enhanced the National Weather Service’s ability to provide critical forecast surge information to emergency managers. These forecast were particularly useful when examining various bays and tributaries along the lower sections of the Chesapeake Bay. The COMET funded project with Dr. John Brubaker provided an excellent web site for use in observing real time water levels and forecasting location specific storm tide. The constant updating of the observations provided quick feedback allowing us to verify forecasts and monitor rapidly rising water levels as Irene approached. The comparison between the extratropical storm surge model and VIMS model with real time data provided quick feedback as to how forecasts were verifying compared to observational data.

It must be noted that these services were all provided without any funding highlighting VIMS commitment to applying research into operations. The services directly contributed to improved forecasts and information for Virginia residents which had an impact on the protection of life and property. Thank you for all the hard work which helped to better serve the public.

Sincerely,

[Signature]

VIMS ECM group win 2011
Governor’s technology award