NYS RISE Contributions to Enhance Resiliency of New York State Against Impacts of Sandy-like Storms

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NYS RISE

- New York State Resiliency Institute for Storms and Emergencies (NYS RISE)
 - A consortium of Stony Brook University, New York University, Columbia University, Cornell University, City University of New York, and Brookhaven National Laboratory
 - Mission objectives include
 - » Improvement of rapid warning
 - » Enhancement of near-term and long-range forecasts
 - » Scenario of extreme weather events
 - » Impacts of climate change
 - Emphasizes end-to-end research and products that can be used by policymakers and stakeholders



3 EXAMPLES OF NYS RISE CONTRIBUTIONS

- Across multiple timescales
 - Short range: Storm surge scenarios as guidance for emergency responders and policy makers
 - Seasonal range: Seasonal prediction of tropical cyclone activity affecting New York State
 - Climate range: Impacts of sea level rise under different climate change scenarios



SHORT RANGE: STORM SURGE SCENARIOS

- Construct proof of concept dataset for evacuation and graphical display: Ensemble WRF/ADCIRC simulations of hurricane Sandy.
- Illustrate how relatively small changes in the track and intensity can lead to relatively large water level differences—good for evacuation scenario tests.
- Develop a mapping approach using LIDAR data and predictions to flood at street level for various storm surge scenarios.
- Display water level predictions in Virtual Reality Deck.
- Results will be used to drive evacuation models



3-km WRF EnKF Runs Analyzed Control: 26/00Z – 28/00Z + 28/00-31/00Z Runs Random 11 "Good" Members from 26/00Z



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Advanced Circulation Model (ADCIRC)

- * Run 3D Mode (3 or 5-levels)
- 184,534 nodes
 -> 20 m to 70 km
- * Couple with

SWAN wave model







Battery: Ensemble Storm Surge (in meters)



Battery: Ensemble Total Water Level (MSL)



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Probability of Flooding Greater than Sandy (red area) for "Good Members"



NYC Observed flooding vs ADCIRC for CTL run (using 1-ft DEM from LIDAR)



THE REALITY DECK



- Reality Deck Immersive Gigapixel Display
- 416 Monitors 18-node cluster
- Supports interactive 3D visualization applications

INLAND FLOODING SIMULATION



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SEASONAL RANGE: SEASONAL PREDICTION

- Annual number of tropical cyclones (TCs) affecting New York State uncorrelated with basin-wide activity
- Novel seasonal prediction models have been developed based on relationship between NYS TC activity and sea surface temperature anomalies
- Pure statistical model based on observed April-May SSTA
- Hybrid statistical-dynamical model based on NOAA CFSv2 predicted April-May SSTA from Jan to early Feb
- Forecast for 2014: below average activity: verified





Tracks of all TCs that crossed New York State (1979-2013)

Color relates to maximum wind speed Green: < 34 kts Orange: 34-63 kts Red: 64-95 kts Purple: > 95 kts

During 1979-2013

- 18 TCs passed over New York State during any time of their lifecycle
- 1 hurricane (Gloria 1985), 7 TSs, 3 TDs, 7 ETs
- All but 2 (1 TS, 1 TD) provided high impact weather
 - Heavy precip, high winds, storm surge

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Existing Seasonal TC Predictions

- Basin-wide
- NYS statistics not correlated with basin-wide statistics
 - Even perfect basin-wide forecasts not useful for NYS
- Hence new seasonal prediction models need to be developed



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Physical Basis for Seasonal TC Prediction

Seasonal number of TCs crossing NYS significantly correlated with Pacific SST anomalies - For both pre-season (April-May) and concurrent (June-Oct) SSTA



Pure Statistical Prediction

- Use observed Apr-May SSTA as predictor
- Can be issued in early June



Hybrid Statistical-Dynamical Prediction

- Use CFSv2 predicted Apr-May SSTA as predictor
- Ensemble of 24 forecasts made between January 11 and February 5
- Can be issued before mid <u>February</u>



Statistical prediction for 2014

- Forecast based on observed Apr-May SSTA
- Number of TCs crossing NYS: 0.33
- Probability of 1 or more TCs crossing NYS: 30%
- Climatology: 0.51 and 43%
- Actual observed activity: 0 TCs
- Prediction of below average TC activity is validated



LONG RANGE: IMPACTS OF SEA LEVEL RISE

- Sea level rise (SLR) under different climate scenarios over NYC/Long Island region is quantified
 - Includes dynamic, thermosteric, eustatic, and isostatic components
- SLR will be included in ADCIRC storm surge model
 - Visualization of SLR + storm surge in Virtual Reality Deck
 - Results will be used to drive evacuation model



Risks of Flooding: Relative Water Level

Normal High Tide + Storm Surge + Breaking Waves + SLR



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SLR at Battery Park and Montauk









Current 100-year flood zone in southern part of Nassau County, and impact of climate change under RCP 8.5 scenario for 2050s and 2090s.

Sea level rise data will be

- Included in storm surge model
- Used to drive evacuation model
- Visualized in Virtual Reality Deck



NYS RISE Investigators

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