Advancing Storm Surge Modeling:

DRAFT Long-Term Vision for NOAA Tropical Storm Surge

HFIP Annual Meeting
November 9, 2017

Nicole P. Kurkowski (NWS)
OSTI Storm Surge Program Manager

Outline

1 Current Capabilities

2 Evolving Needs (P-Surge and HSOFS)

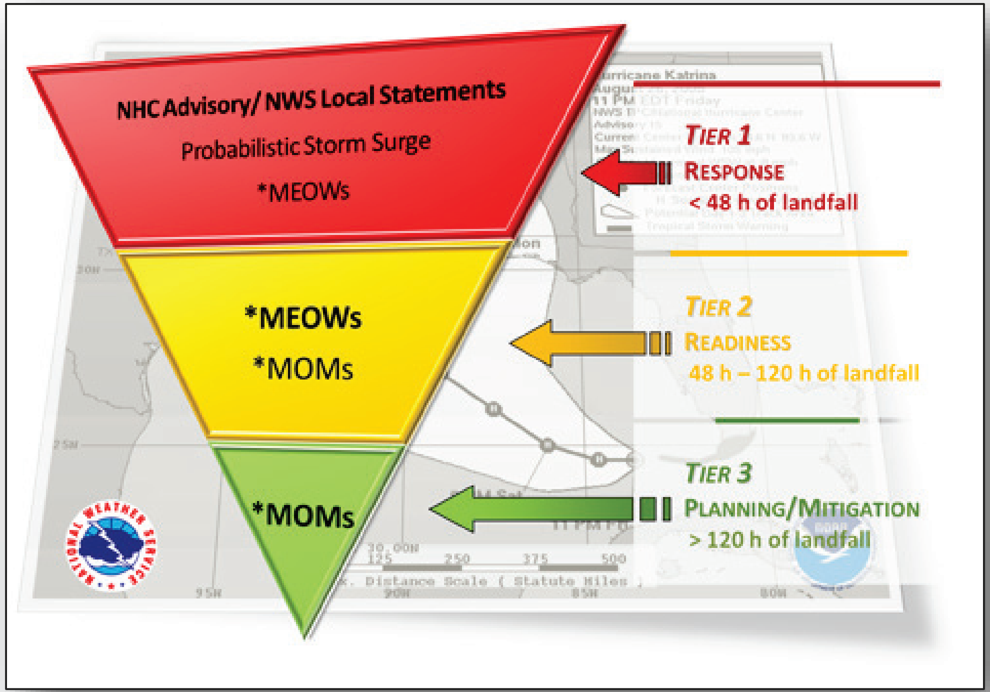
3 HFIP Tropical Storm Surge Goals and Key Strategies

4 DRAFT Long-Term Vision

1. Current Capabilities

- **SLOSH-based models:**
  - **SLOSH MOMs** for planning / mitigation
  - **SLOSH MOMs / MEOWS** generated for operational readiness (48- to 120-hours)
  - **P-Surge** for real-time operational forecasts; issuance of storm surge watch / warning products

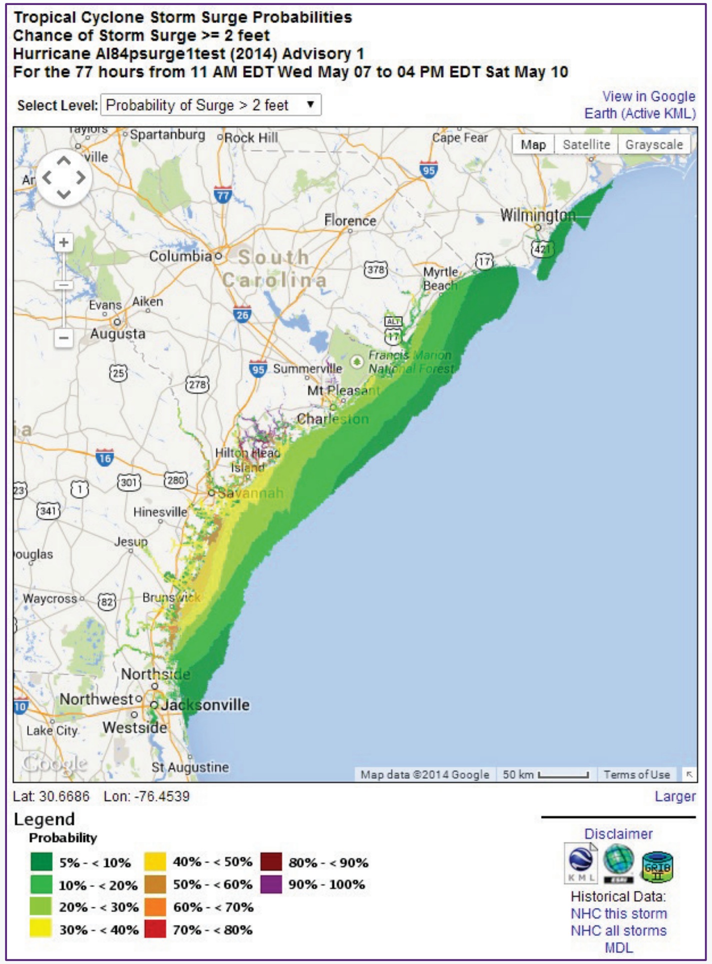
- **HSOFS (ADCIRC-based) model:**
  - providing accurate hindcasts near/after landfall
  - chosen as COASTAL Act NSEM storm surge model, coupled to WAVEWATCH III and the NWM



Validation effort underway at NOS
  - best- practices / skill assessment techniques
  - standardization of observations

2. Evolving Needs (P-Surge)

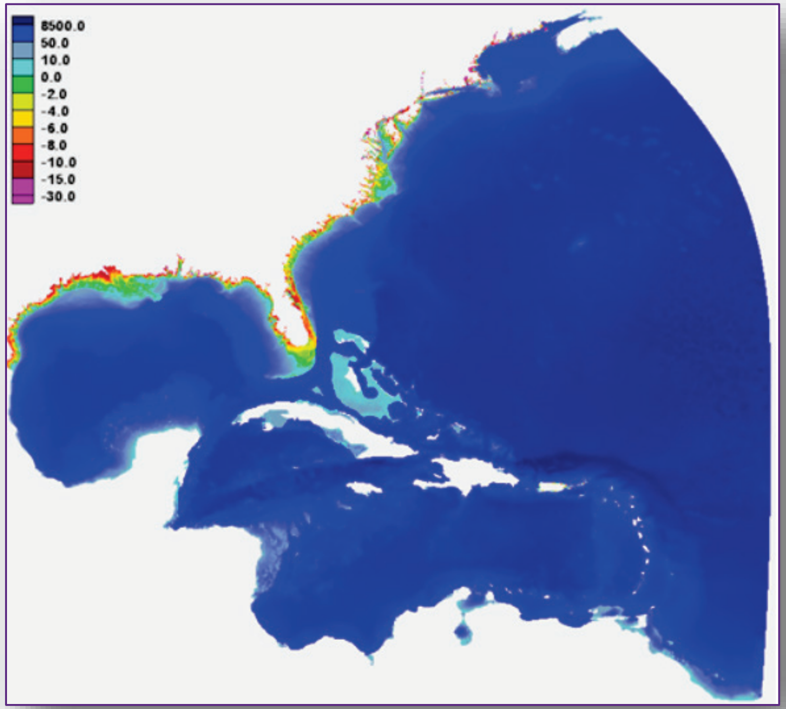
- Short-term operational needs (e.g. OCONUS, waves, meteorological drivers)
- Evolve from employing a parametric wind model to an atmospheric dynamically-driven wind model
- Update track and intensity statistics
- Extensive validation effort required
- Establishment of a 3-5 year baseline
- Inclusion of waves
- Coupling with freshwater
- Code optimization/parallelization for future upgrades/improvements
- Address axisymmetric wind structure in the SLOSH model
- Develop fully dynamical ensembles for P-Surge
- Increase lead times from 2 to 3 days



2. Evolving Needs (HSOFS)

- Optimization of code for operational runtime requirements
- Increased number of ensembles, to include along-track, cross-track, structure, intensity pertubations
- On-demand capability to submit/execute ensembles
- Adaptive gridding structure
- Wave coupling
- Coupling with freshwater
- Include HSOFS output in AWIPS II / SBN

*** Feasibility study needed to see determine suitability of HSOFS to run for real-time operational forecasts**



3. HFIP Tropical Storm Surge Goals and Key Strategies

"Improve hazard guidance products and warnings, including storm surge, sustained wind, gusts, rainfall, and locally severe weather, at lead-times to 3-days"

Subgoal:

Extend storm surge guidance to 72-hours with the same skill currently at 48-hours and disseminate seamless inundation guidance for all areas of responsibility, including Puerto Rico, the Virgin Islands, and Pacific (Hawaiian islands, Guam, American Samoa)

Strategies w/short-term solutions:

(1) Improve storm surge model initial conditions to accurately represent meteorological state:

- Incorporate real-time RMW information from observation/HWM to improve initial inputs and further improve storm surge probabilistic forecasts
- Re-work parametric relationship in SLOSH to accommodate real-time RMW information by utilizing Vmax and RMW, leaving delta-P to be computed

(2) Account for asymmetries in wind forcings within storm surge model:

- Create a gridded vector field that establishes an asymmetric structure and is representative of observation

3. HFIP Tropical Storm Surge Goals and Key Strategies

"Improve hazard guidance products and warnings, including storm surge, sustained wind, gusts, rainfall, and locally severe weather, at lead-times to 3-days"

Strategies w/short-term solutions:

(4) Adopt a dynamical ensemble approach

(5) Increase lead times for 2 days to 3 days

(6) Extend storm surge forecasting capabilities for OCONUS

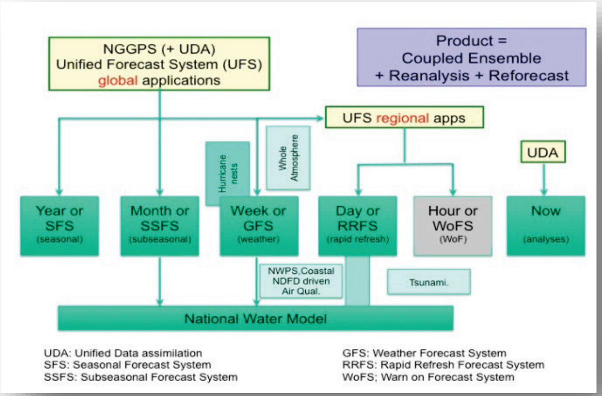
- Evaluate an efficient parametric wave model to couple with SLOSH to be utilized within P-Surge
- Utilize parametric models that reduce the full solution space and incorporate simplified physics to help decrease the computational cost but maintain predictability

4. Long-term vision

P-Surge

- Short-term operational needs (OCONUS, waves, meteorological drivers)
- P-Surge code optimization
- Increase lead times from 2 to 3 days
- Incorporation of 2013-2017 track and intensity statistics; extensive validation; establish 3-5 year baseline
- Evolve to an atmospheric dynamically-driven wind model
- Develop fully dynamical ensembles for P-Surge
- Address axisymmetric wind structure in the SLOSH model
- Inclusion of waves
- Coupling with freshwater

Complete extensive validation



High-level Unified Production Suite at NCEP design

Decision Points:

(1) Determine future for supporting **response and readiness via operational forecasts/warnings** by way of **next generation storm surge model**:

- P-Surge continues to produce forecasts informing operational products/services
- HSOFS replaces P-Surge to produce operational forecasts
- With code optimization (and potentially leveraging exascale computing), utilize a multi-model ensemble based on both the HSOFS and P-Surge models

(2) HSOFS likely to replace SLOSH-based models in support of landfall response / recovery; post-storm assessments (hindcasts), based on model accuracy, leniency on runtimes, as well as significant COASTAL Act investment.

HSOFS

- Bias correction
- Initiate feasibility study; Establish metrics; Perform validation
- ADCIRC code optimization
- Increase number of ensembles to account for along-track, structure, and intensity
- On-demand capability to submit / execute ensembles
- HSOFS in AWIPS II / SBN
- Adaptive gridding structure
- Coupling of HSOFS with WAVEWATCH III and National Water Model

Feasibility study; Validation

Questions