NWS Storm Surge Forecasting

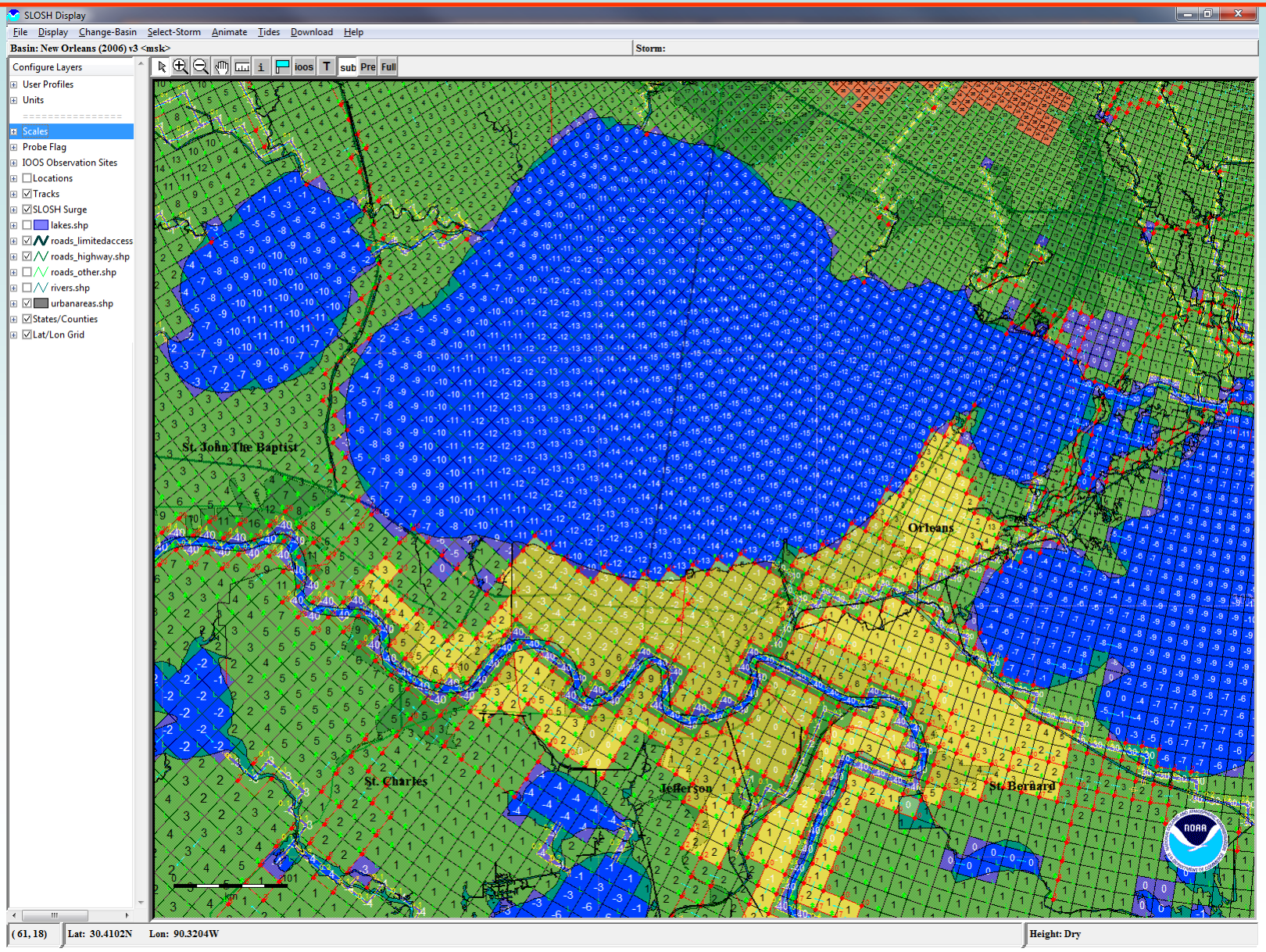
AMS Students
Silver Spring, MD (July 20, 2011)

Arthur Taylor – MDL/NWS/NOAA

SLOSH

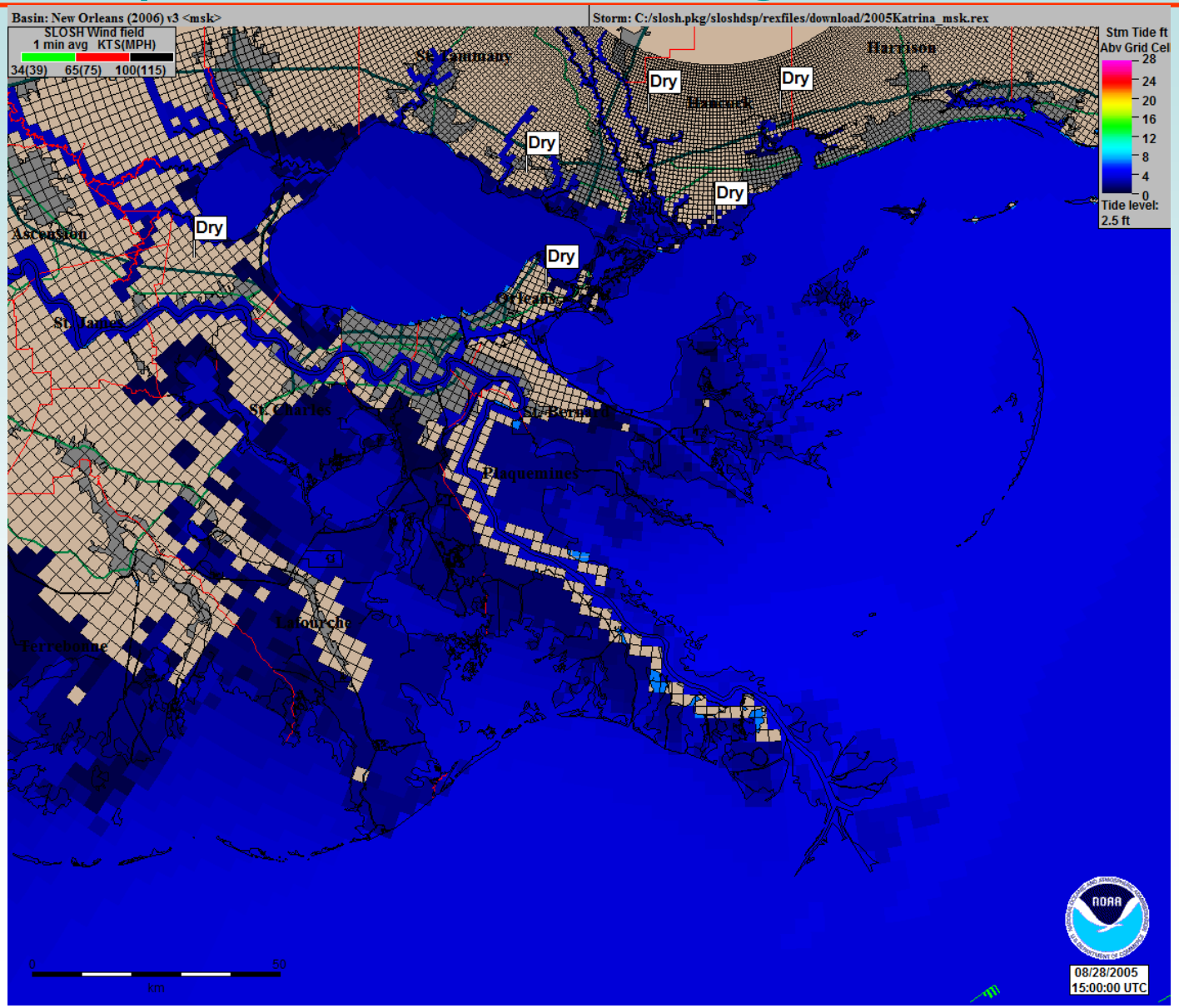
- Sea, Lake and Overland Surges from Hurricanes
  - Finite differencing model developed by the Meteorological Development Laboratory to predict storm surge heights from historical, hypothetical or predicted hurricanes
  - Overland flooding
  - Parametric wind model for forcing
  - Structured grid with finer resolution overland, and coarser offshore
  - Models sub-grid features with flows though barriers and cuts
- Does not include
  - Tides, waves, river flow
    - Tides can be conservatively estimated by initializing the grid at high tide

SLOSH Basin

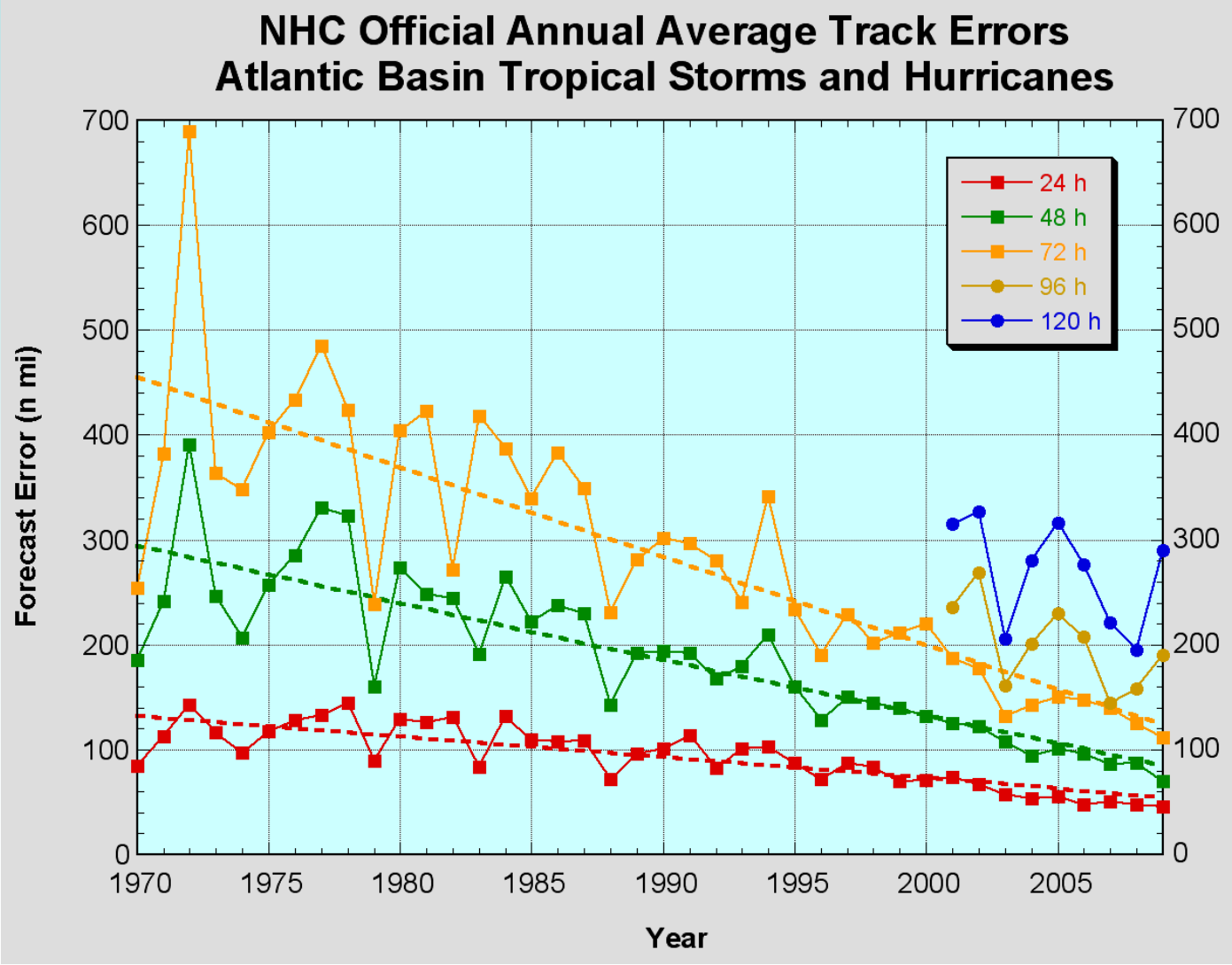

SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: New Orleans (2006) v3 <msk>
Storm:
Configure Layers
User Profiles
Units
Scales
Probe Flag
IOOS Observation Sites
Locations
Tracks
SLOSH Surge
lakes.shp
roads_limitedaccess
roads_highway.shp
roads_other.shp
rivers.shp
urbanareas.shp
States/Counties
Lat/Lon Grid
ioos
T
sub
Pre
Full
St. John The Baptist
Orleans
St. Charles
Jefferson
St. Bernard
(61, 18)
Lat: 30.4102N
Lon: 90.3204W
Height: Dry

SLOSH Display Program

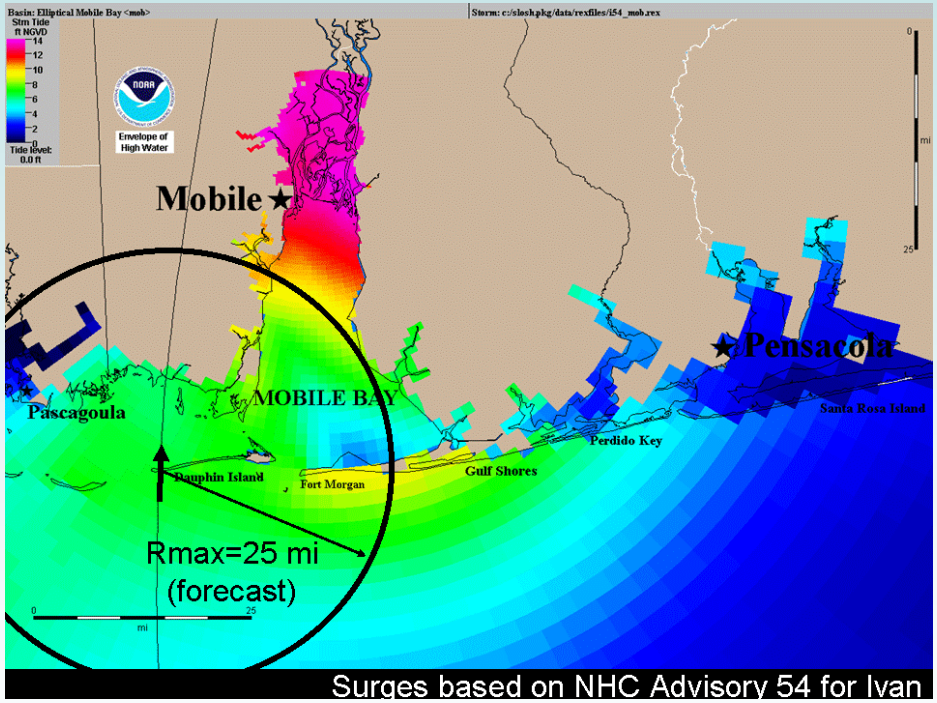
http://slosh.nws.noaa.gov/sloshPub/



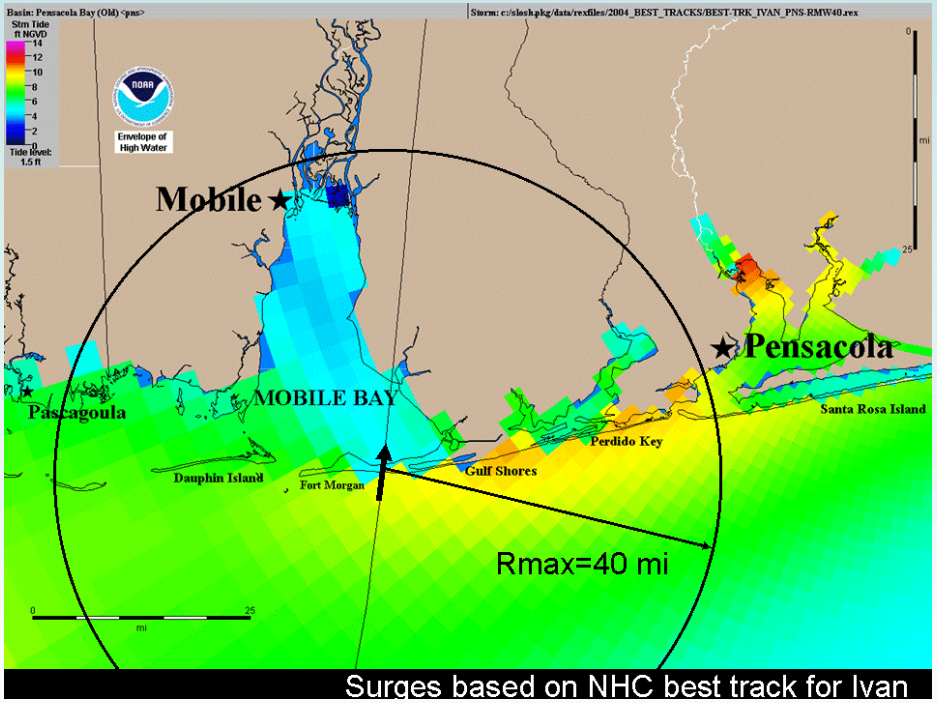
Forecast Uncertainty



Hurricane Ivan: A case study



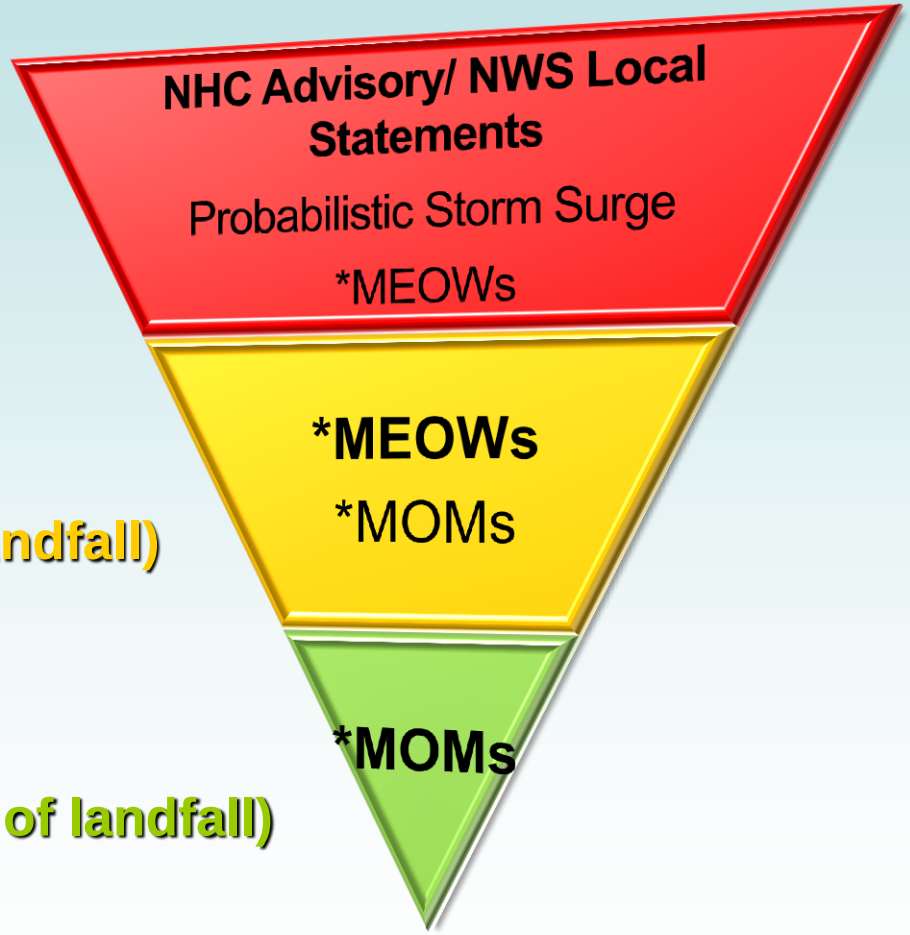
Surges based on NHC Advisory 54 for Ivan



Surges based on NHC best track for Ivan

SLOSH Products

- Deterministic / Historic Runs
- P-Surge
  - Probabilistic Storm Surge
  - **Response (<48 hr of landfall)**
- MEOW
  - Maximum Envelope Of Water
  - **Readiness (48hr – 120 hr of landfall)**
- MOM
  - Maximum Of the MEOWs
  - **Planning / Mitigation (>120 hr of landfall)**



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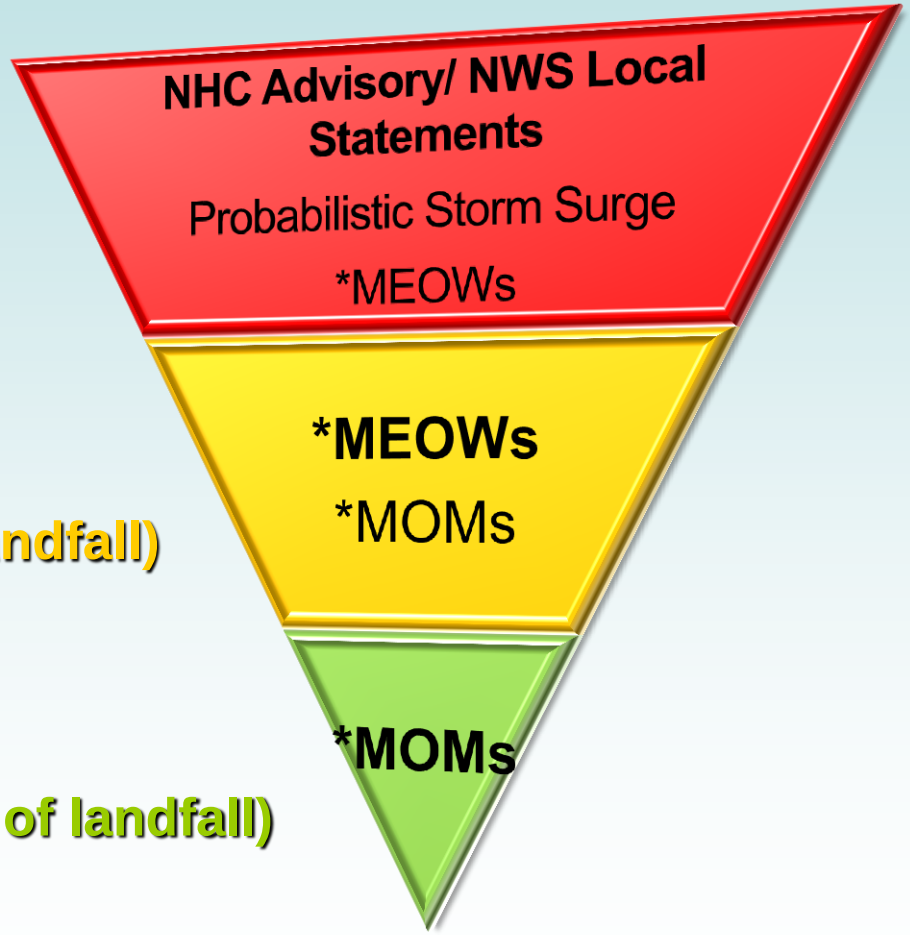
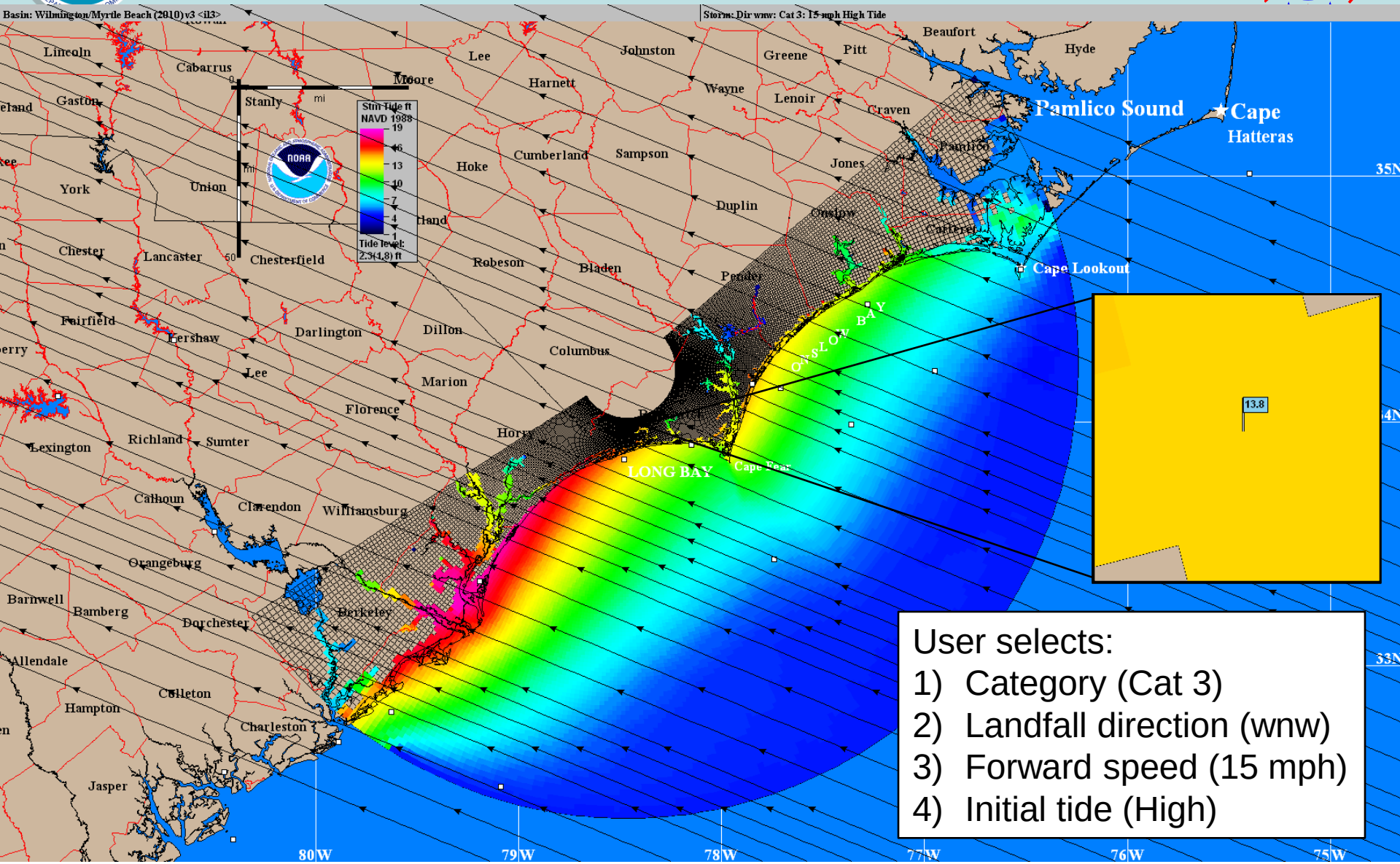


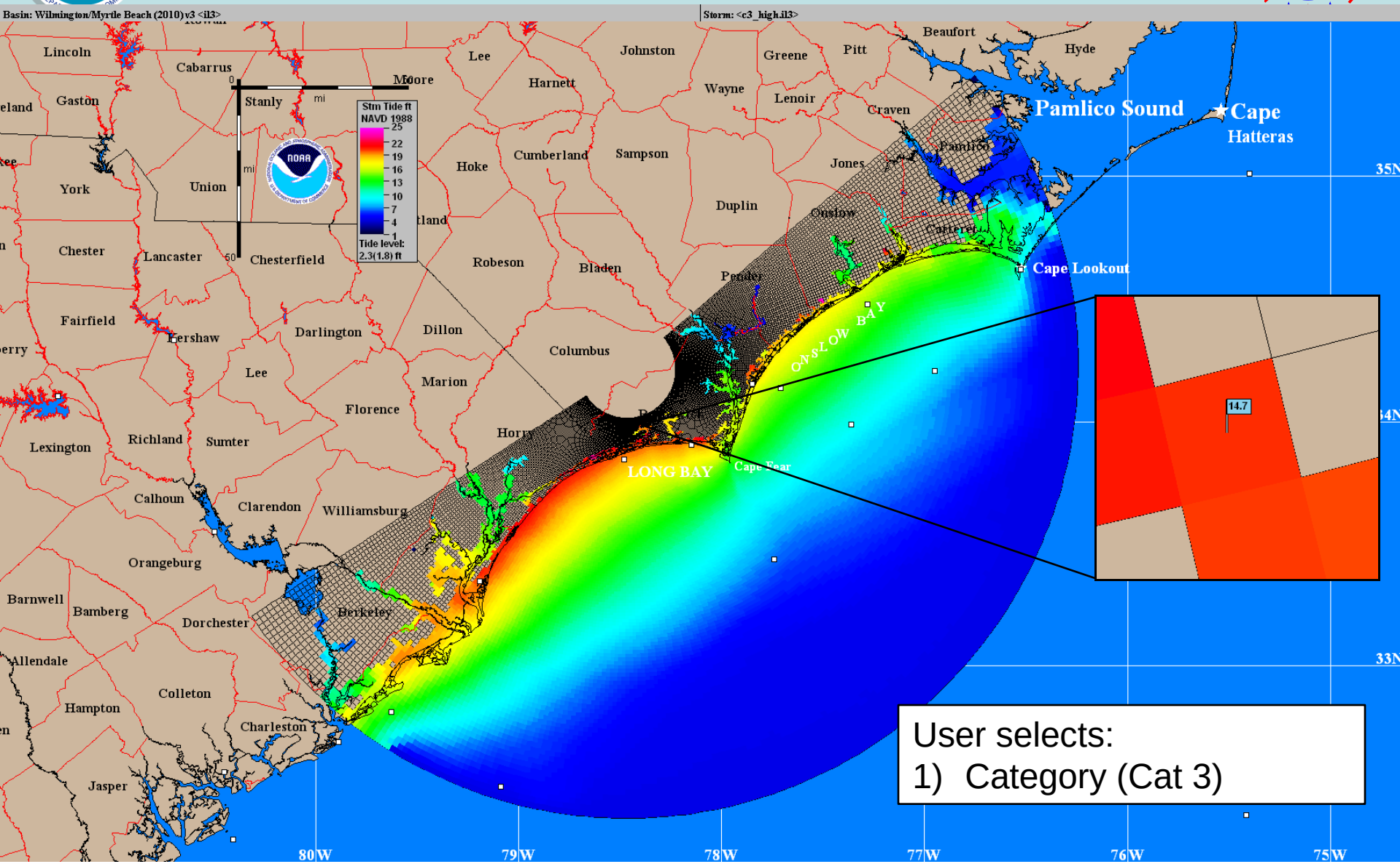
Maximum Envelope Of Water



User selects:

1) Category (Cat 3)
2) Landfall direction (wnw)
3) Forward speed (15 mph)
4) Initial tide (High)

MOM: Maximum Of MEOWs



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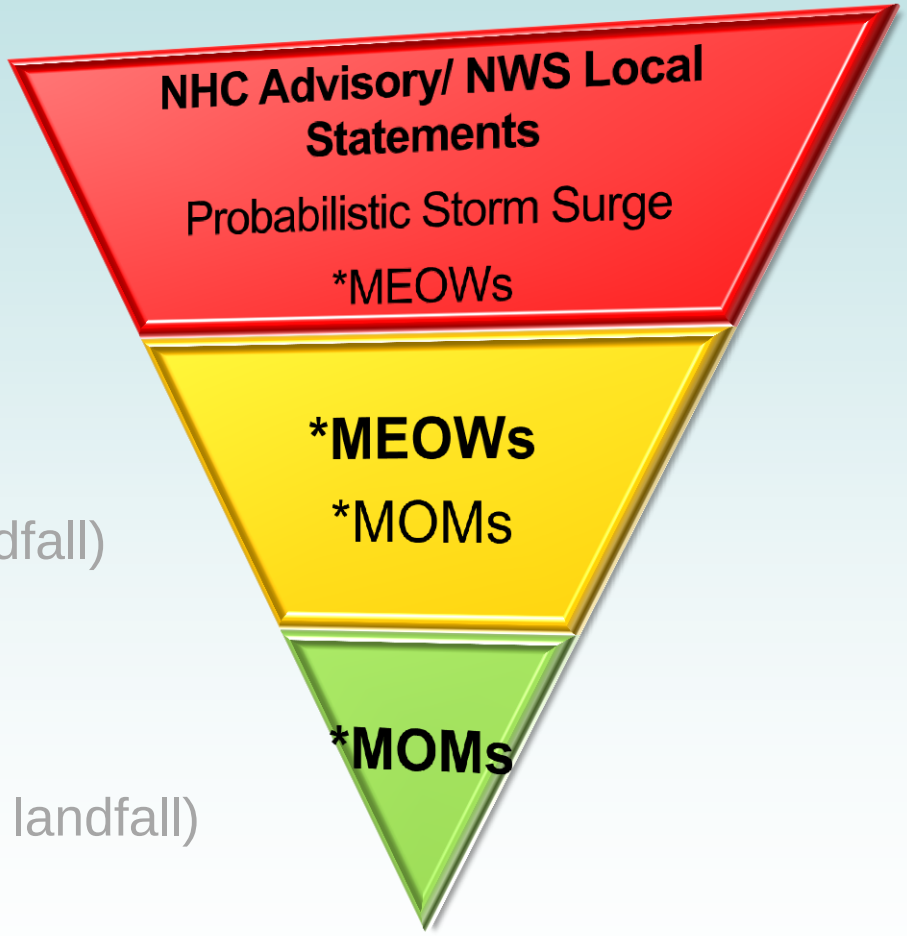
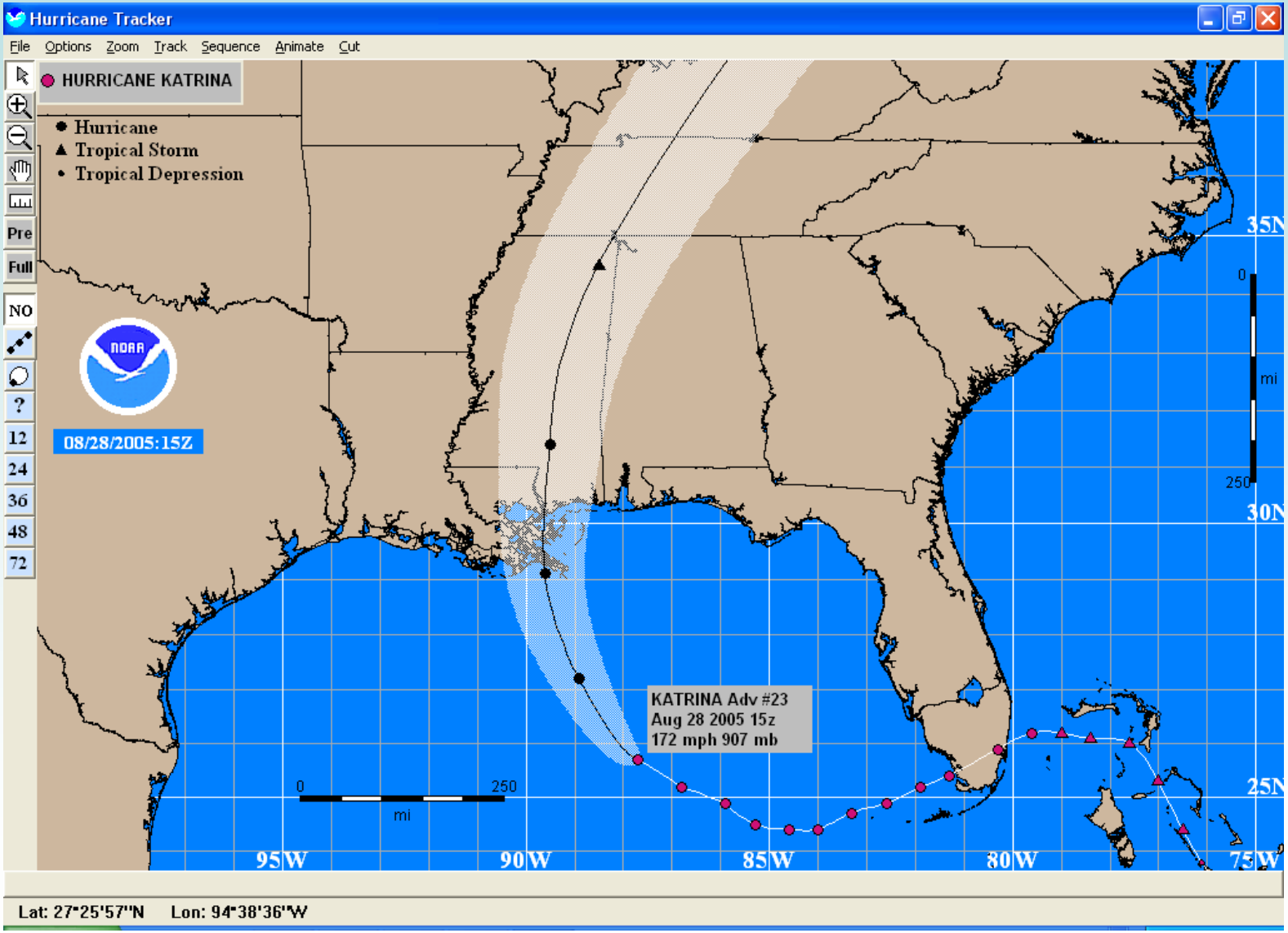
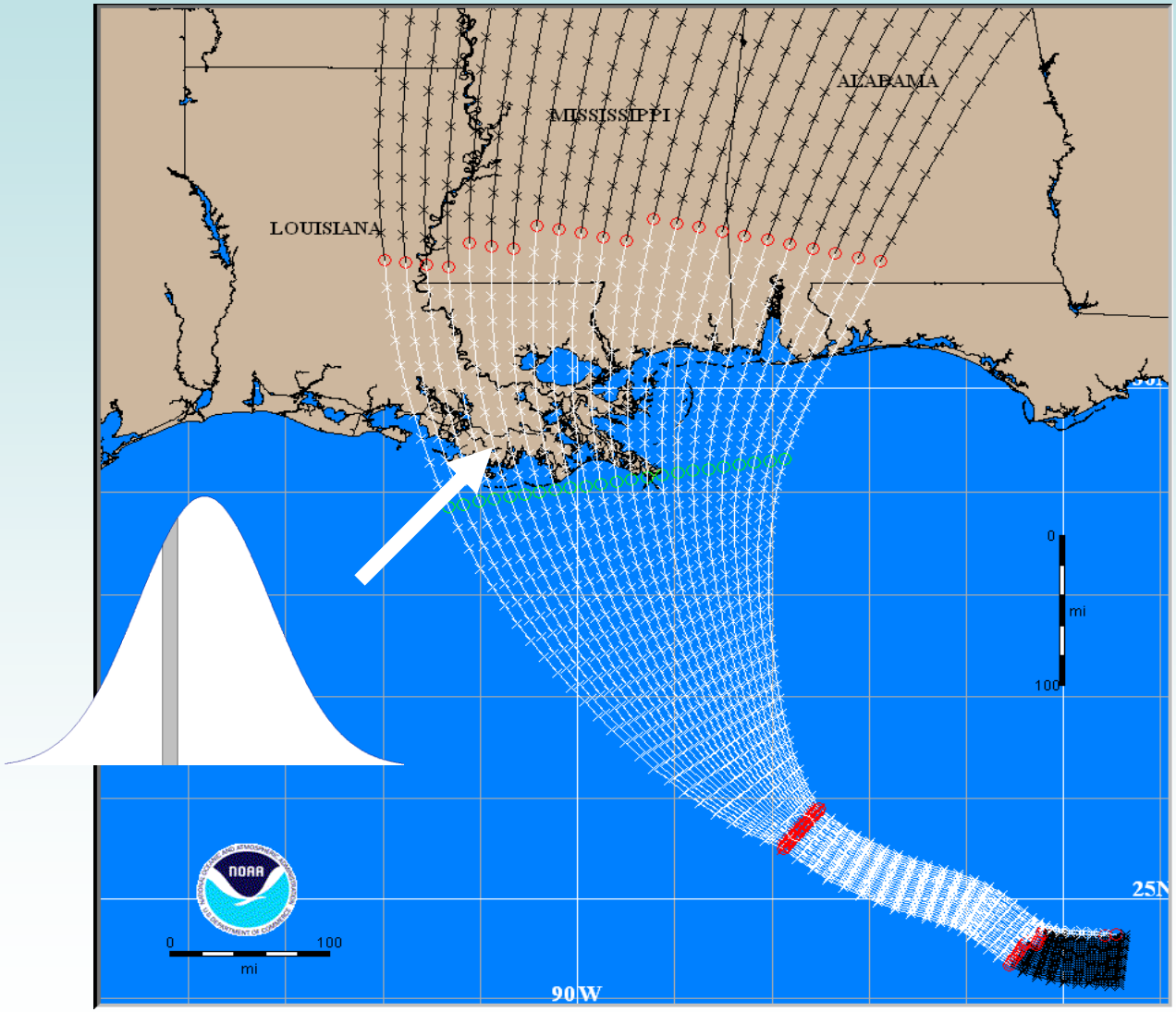


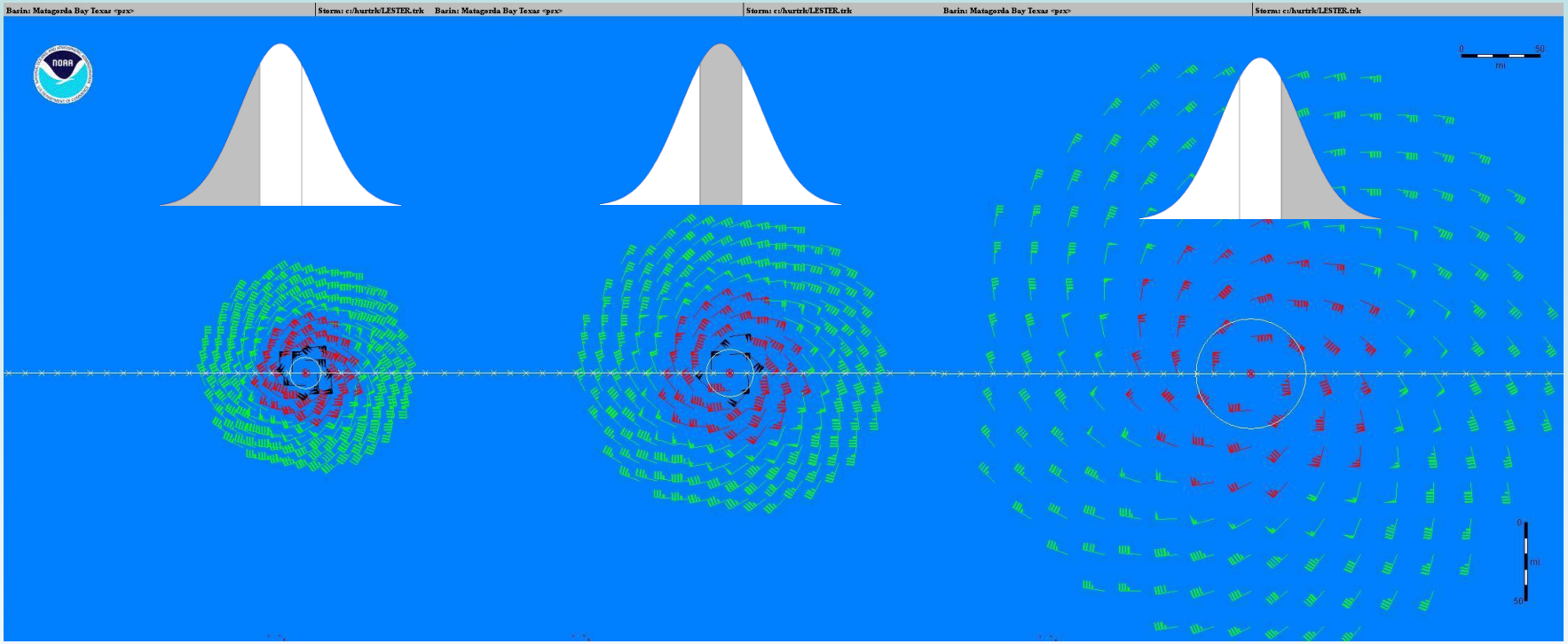
Katrina Advisory 23



P-surge - Vary Cross Track



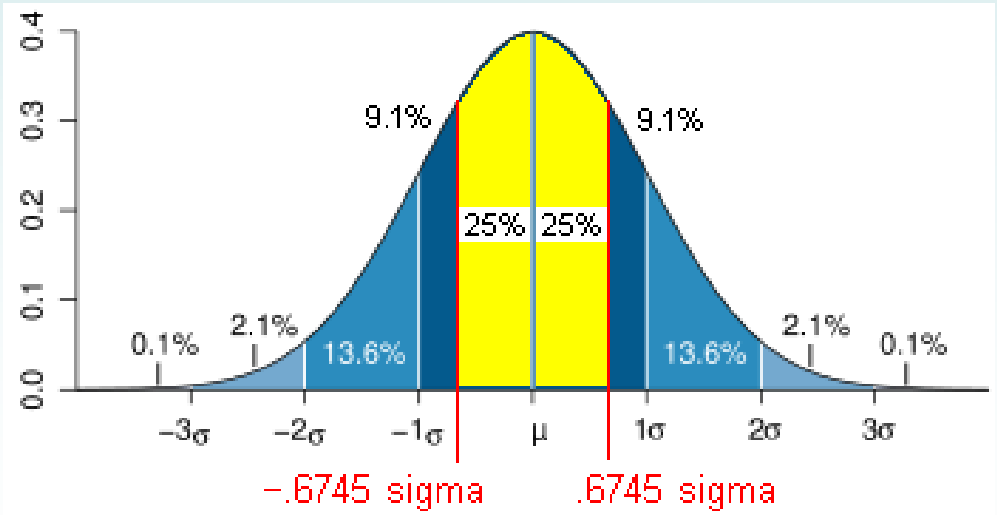
P-Surge – Vary Other Variables



- Size: Small (30%), Medium (40%), Large (30%)
- Forward Speed: Fast (30%), Medium (40%), Slow (30%)
- Intensity: Strong (30%), Medium (40%), Weak (30%)

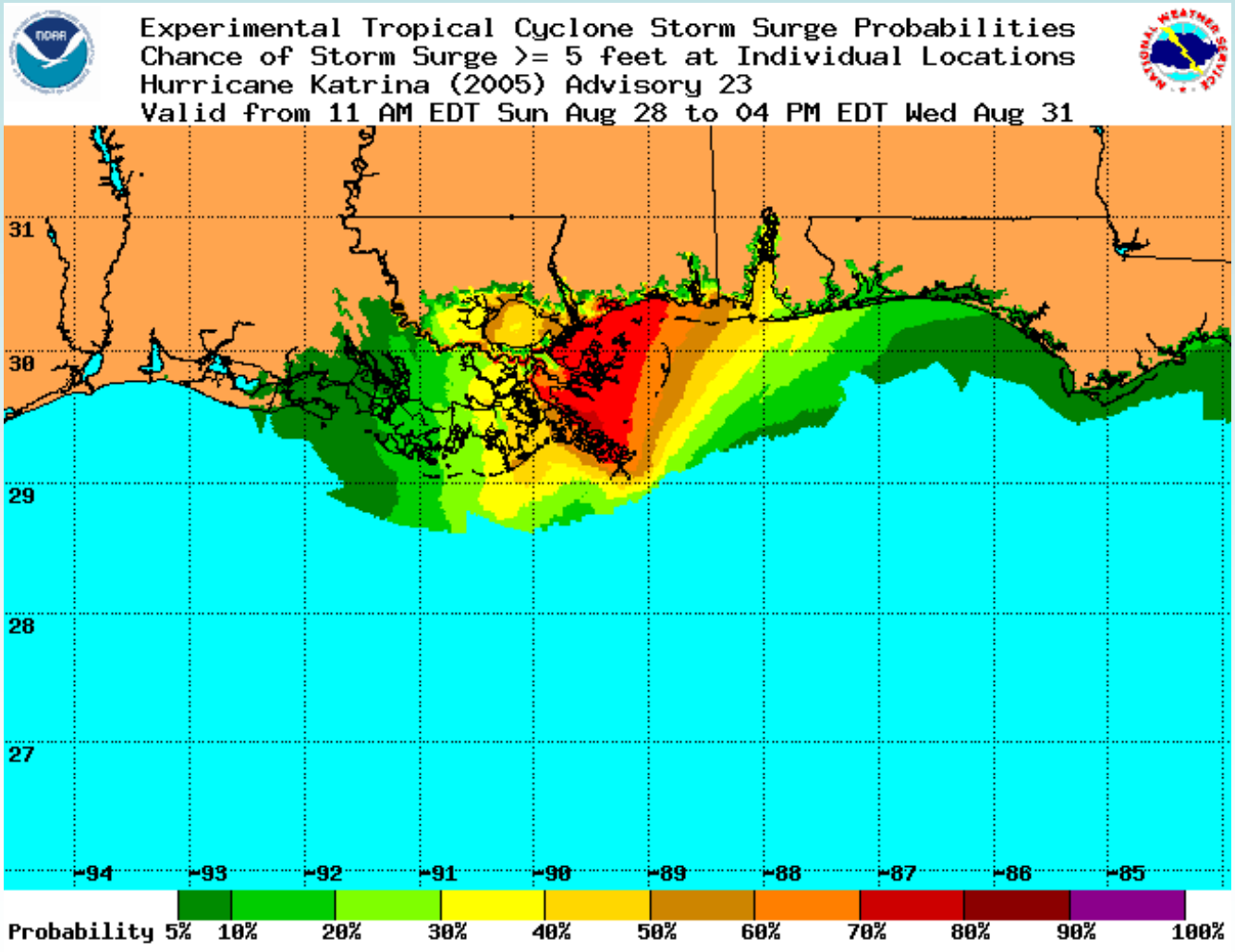
P-surge Error Distributions

- Error distributions are computed for cross track, along track and intensity by:
  - Assuming a normal distribution
  - Using a 5-year “mean absolute error” and getting the standard deviation (sigma) from:

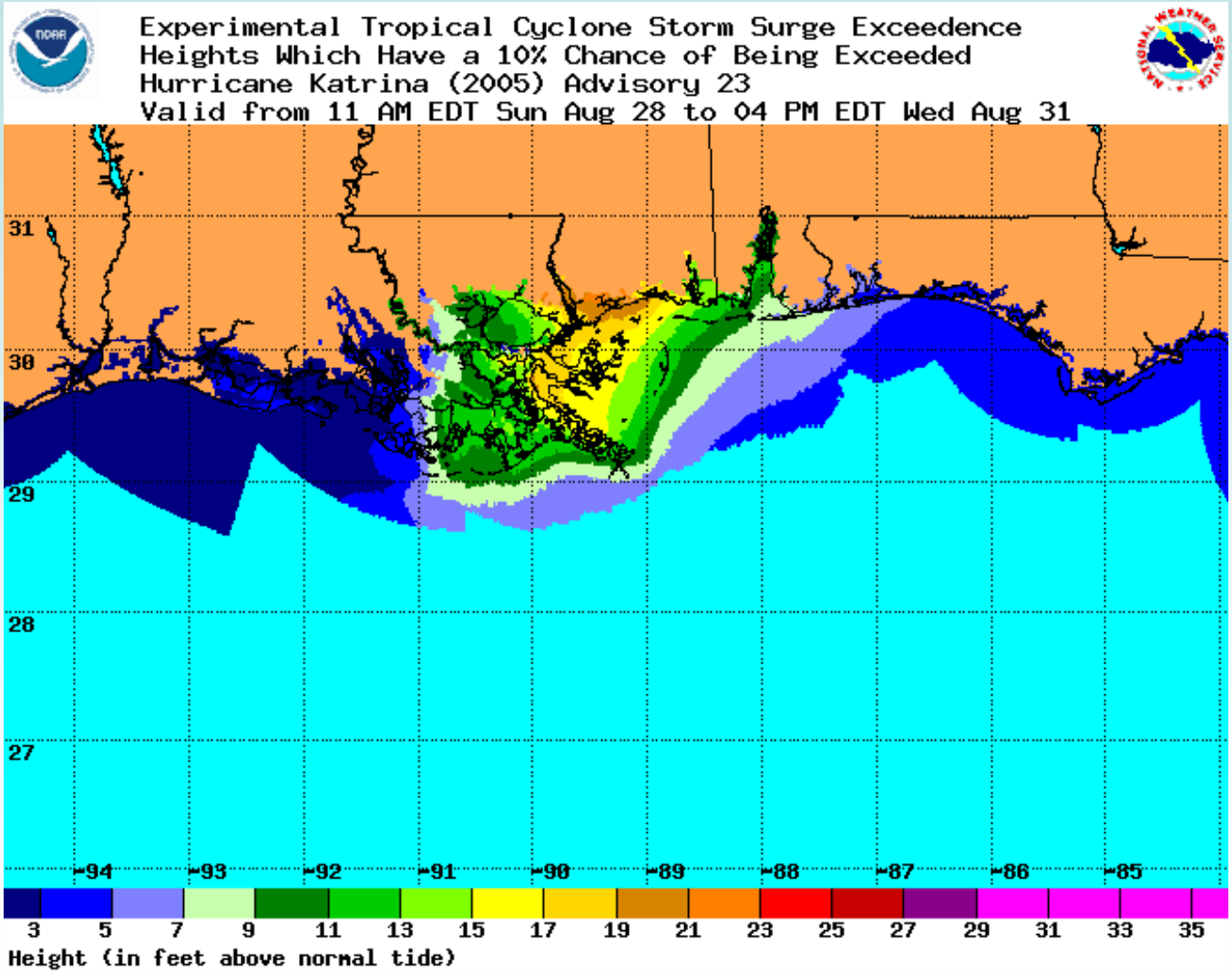


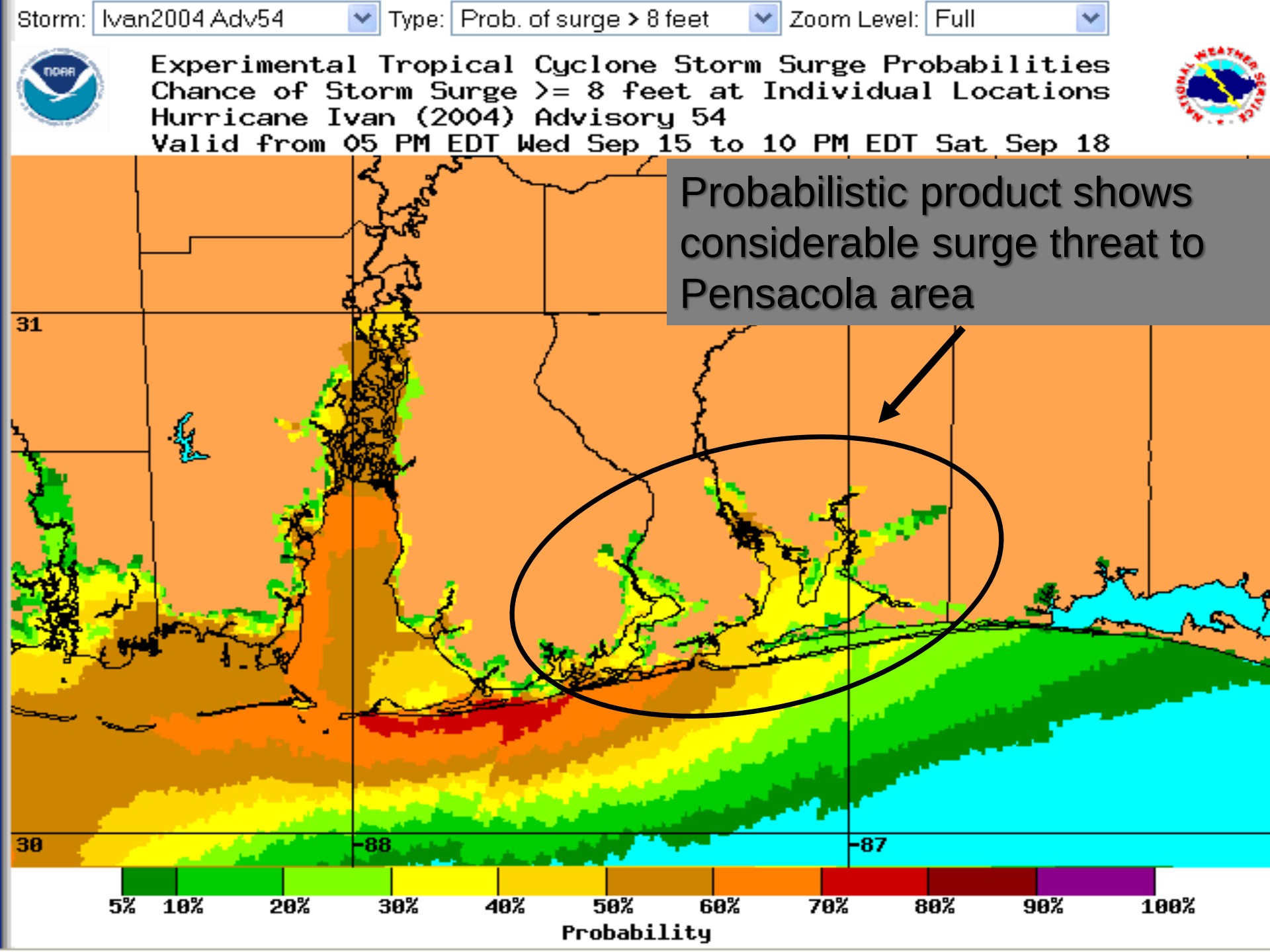
Mean absolute error occurs at .6745 sigma

Probability of >= 5 feet of Surge



Surge Height Exceeded by 10% of Ensemble Members




Storm: Ivan2004 Adv54
Type: Prob. of surge > 8 feet
Zoom Level: Full
Experimental Tropical Cyclone Storm Surge Probabilities
Chance of Storm Surge >= 8 feet at Individual Locations
Hurricane Ivan (2004) Advisory 54
Valid from 05 PM EDT Wed Sep 15 to 10 PM EDT Sat Sep 18
Probabilistic product shows considerable surge threat to Pensacola area
31
30
-88
-87
5%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Probability

Extra-Tropical Storm Surge

- Extra-Tropical Storm Surge (ETSS)
  - Finite differencing model developed by the Meteorological Development Laboratory
  - Modified SLOSH to predict storm surge heights from extra-tropical storms
  - Global Forecast System for wind forcing
  - Structured grid with finer resolution overland, and coarser offshore
- Does not include
  - Tides, waves, river flow
  - Overland storm surge

Extratropical Storm Surge Website

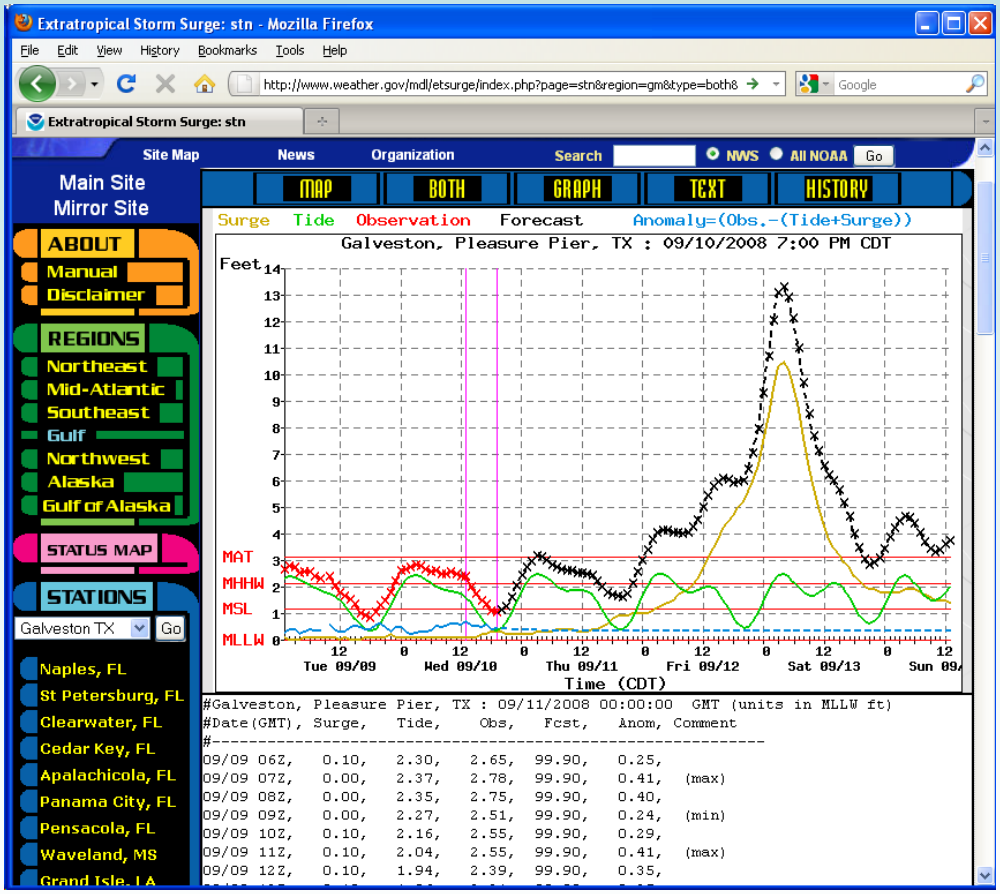
Combine the ETSS output with:

- Observations from NOS / CO-OPs
- Tides computed from constituents provided by NOS/CO-Ops
- Uses a 5 day running average error to improve total water level forecast
- Provides guidance on flooding (when total water level exceeds the HAT)

NOS/OPC also has ETSS model output

- http://www.opc.ncep.noaa.gov/et_surge/et_surge_info.shtml
- Animations of maps of ETSS output with GFS pressure fields

http://www.weather.gov/mdl/etsurge



Review: NWS's Storm Surge Products

- Tropical
  1. [potential Warning]
  2. NHC / WFO forecast
  3. Deterministic guidance
  4. Real-time ensemble guidance (P-surge)
  5. Climatological ensemble guidance (MEOW/MOM)

- Extratropical
  1. Coastal Flood Warning/Advisory
  2. WFO forecast
  3. Deterministic guidance (ETSS)
  4. [potential Real-time ensemble guidance]
  5. [potential Climatological ensemble guidance]