# SLOSH Display Program (SDP) 101

Storm Surge Workshop
Mobile - May 26, 2011

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NOAA - NWS - OST - MDL

# SLOSH Display Program (SDP)

- What is the SDP?
  - A GIS provided by NOAA to display storm surge output and related information such as tides and observations
- What should it be used for?
  - Examine MOMs and MEOWs
  - Look at vulnerability of critical locations/sites
  - Animate real-time and historic Rex Files
  - Convince management that there's a problem

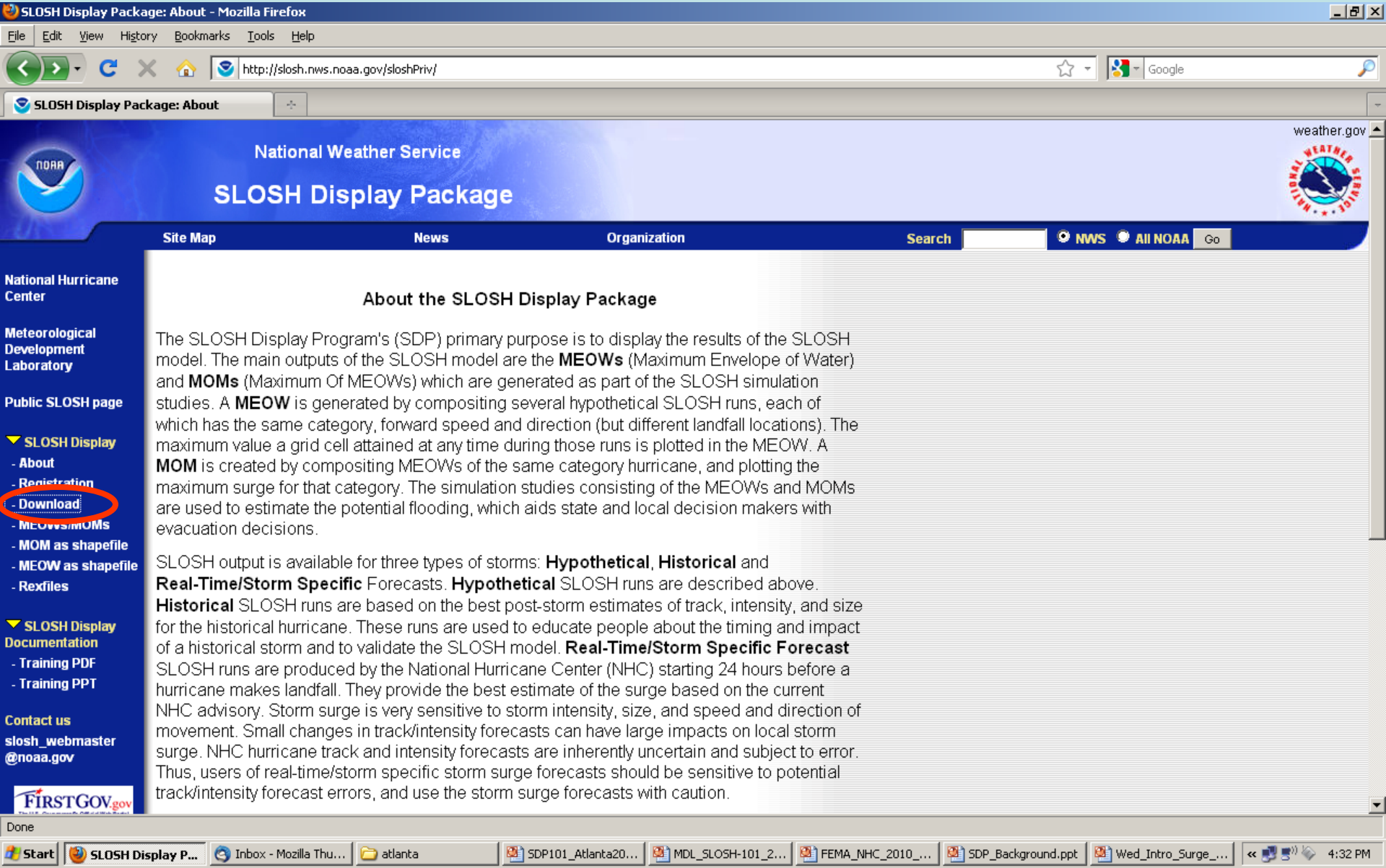
# How to get the SDP

- URL for downloading the SDP
  - http://slosh.nws.noaa.gov/sloshPriv/
    - Username = Gustav2008, Password = Ike2008

- More information on the SLOSH model
  - http://www.nhc.noaa.gov/ssurge/ssurge_slosh.shtml
  - http://slosh.nws.noaa.gov/sloshPub/

# http://slosh.nws.noaa.gov/sloshPriv

user = Gustav2008, pass = Ike2008



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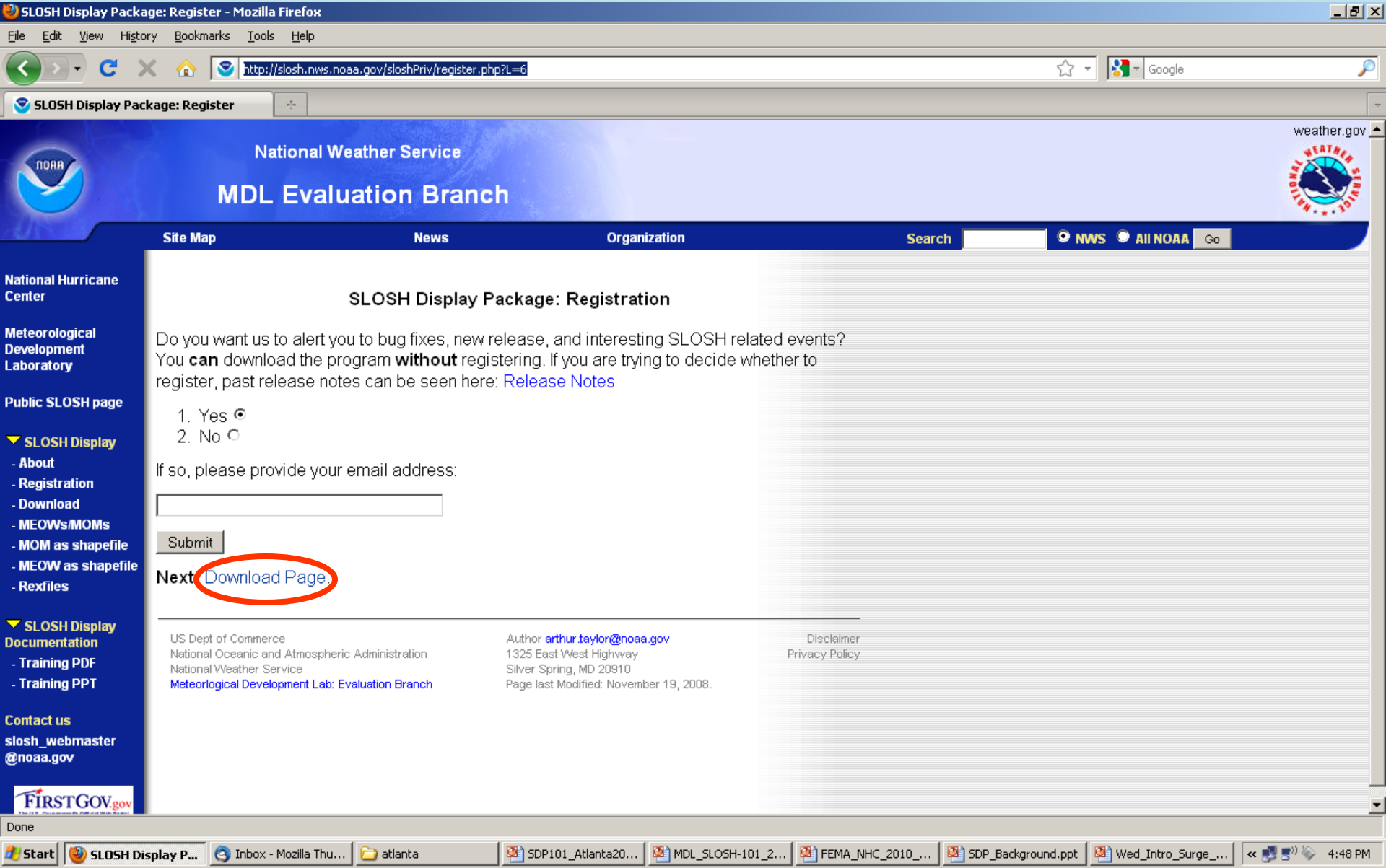

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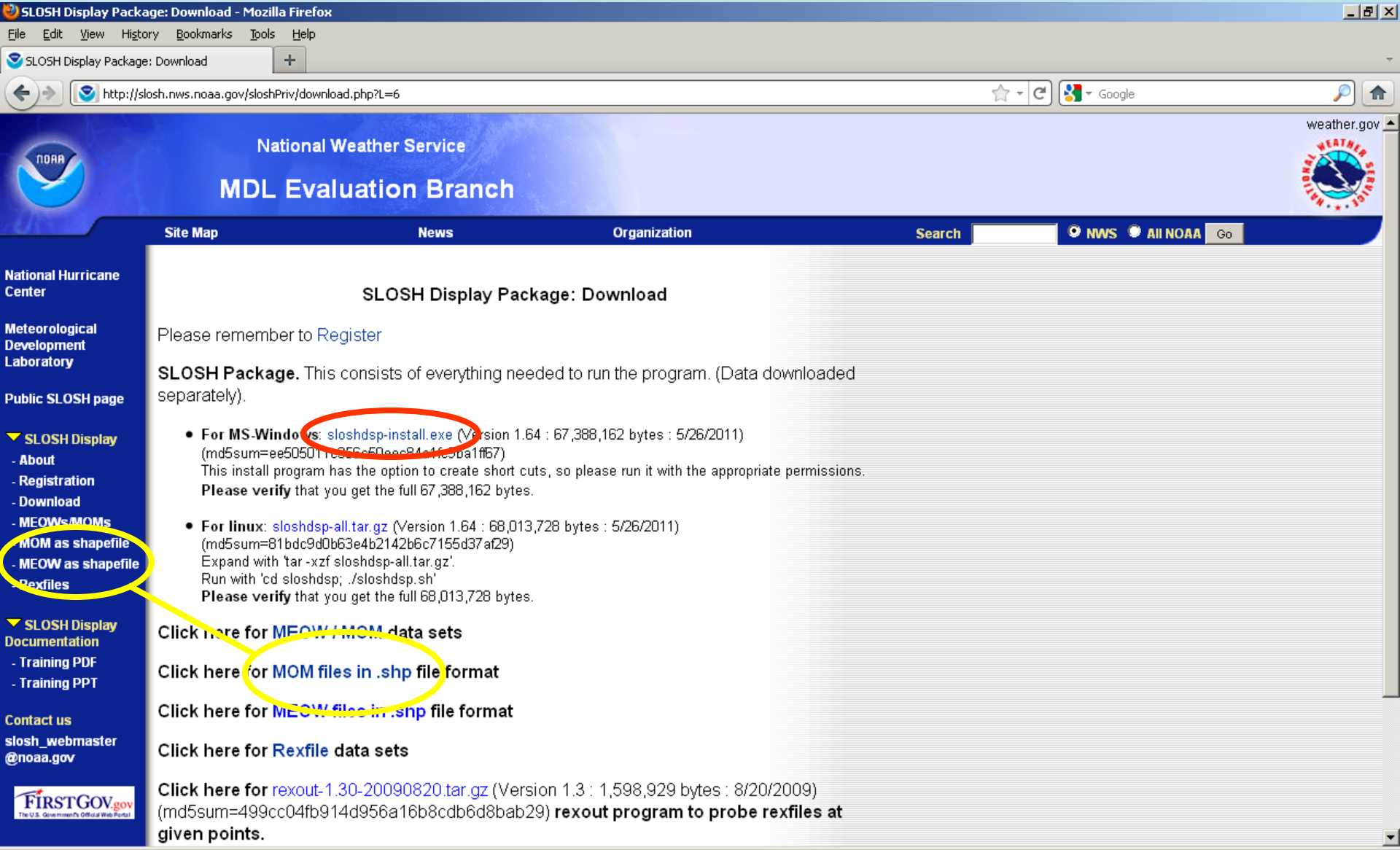
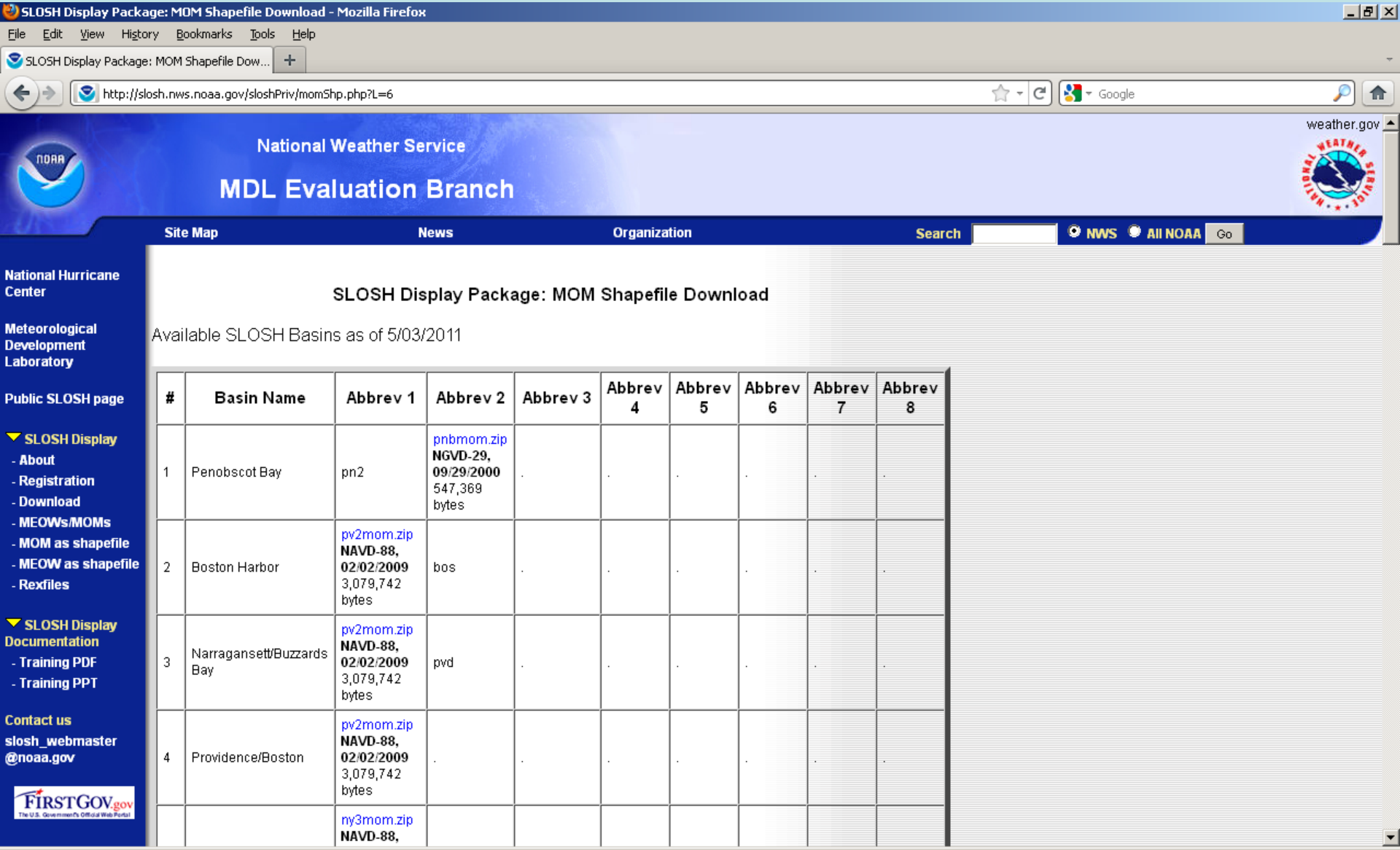


# http://slosh.nws.noaa.gov/sloshPriv/momShp.php



SLOSH Display Package: MOM Shapefile Download - Mozilla Firefox

File Edit View History Bookmarks Tools Help

SLOSH Display Package: MOM Shapefile Dow...

http://slosh.nws.noaa.gov/sloshPriv/momShp.php?L=6

Google

National Weather Service

MDL Evaluation Branch

weather.gov

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National Hurricane Center

Meteorological Development Laboratory

Public SLOSH page

SLOSH Display
- About
- Registration
- Download
- MEOWs/MOMs
- MOM as shapefile
- MEOW as shapefile
- Rexfiles

SLOSH Display Documentation
- Training PDF
- Training PPT

Contact us
slosh_webmaster @noaa.gov

FIRSTGOV.gov The U.S. Government's Official Web Portal

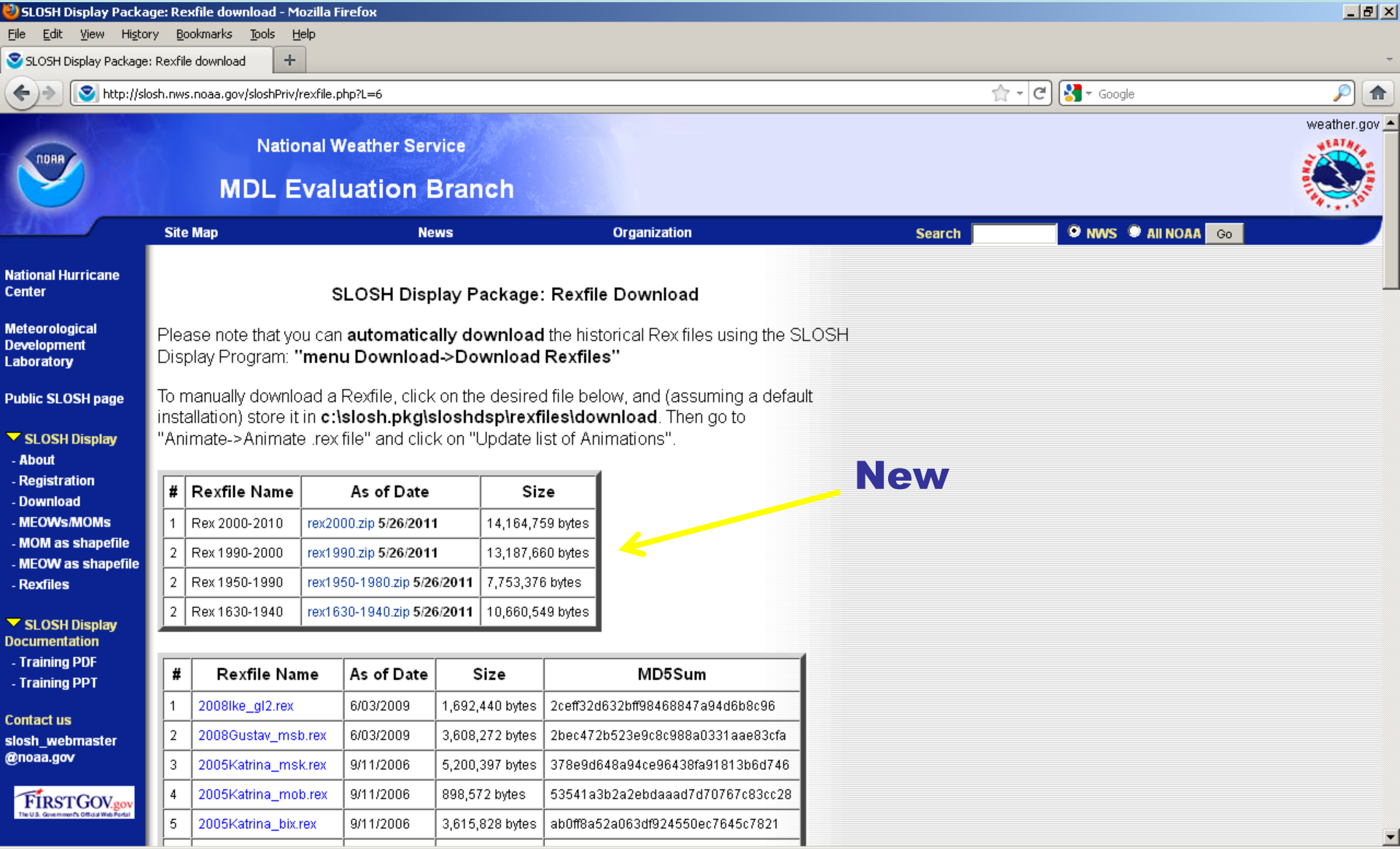
## SLOSH Display Package: MOM Shapefile Download

Available SLOSH Basins as of 5/03/2011

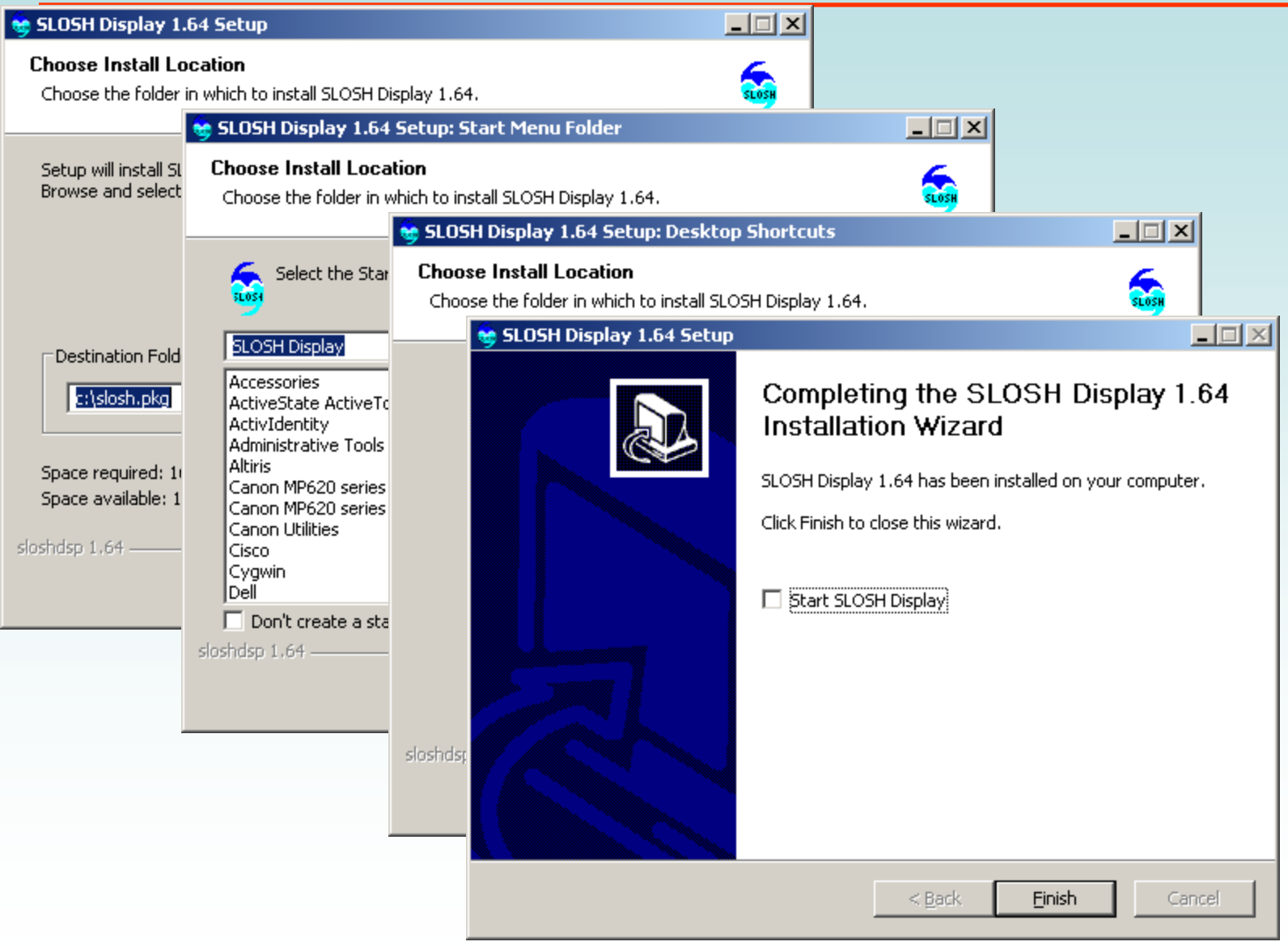
| # | Basin Name | Abbrev 1 | Abbrev 2 | Abbrev 3 | Abbrev 4 | Abbrev 5 | Abbrev 6 | Abbrev 7 | Abbrev 8 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Penobscot Bay | pn2 | pnbmom.zip **NGVD-29, 09/29/2000** 547,369 bytes | . | . | . | . | . | . |
| 2 | Boston Harbor | pv2mom.zip **NAVD-88, 02/02/2009** 3,079,742 bytes | bos | . | . | . | . | . | . |
| 3 | Narragansett/Buzzards Bay | pv2mom.zip **NAVD-88, 02/02/2009** 3,079,742 bytes | pvd | . | . | . | . | . | . |
| 4 | Providence/Boston | pv2mom.zip **NAVD-88, 02/02/2009** 3,079,742 bytes | . | . | . | . | . | . | . |
| | | ny3mom.zip **NAVD-88,** | | | | | | | |

Start SLOSH Display Packa... SDP101_SSWorkshop_M... untitled - Paint 6:33 AM

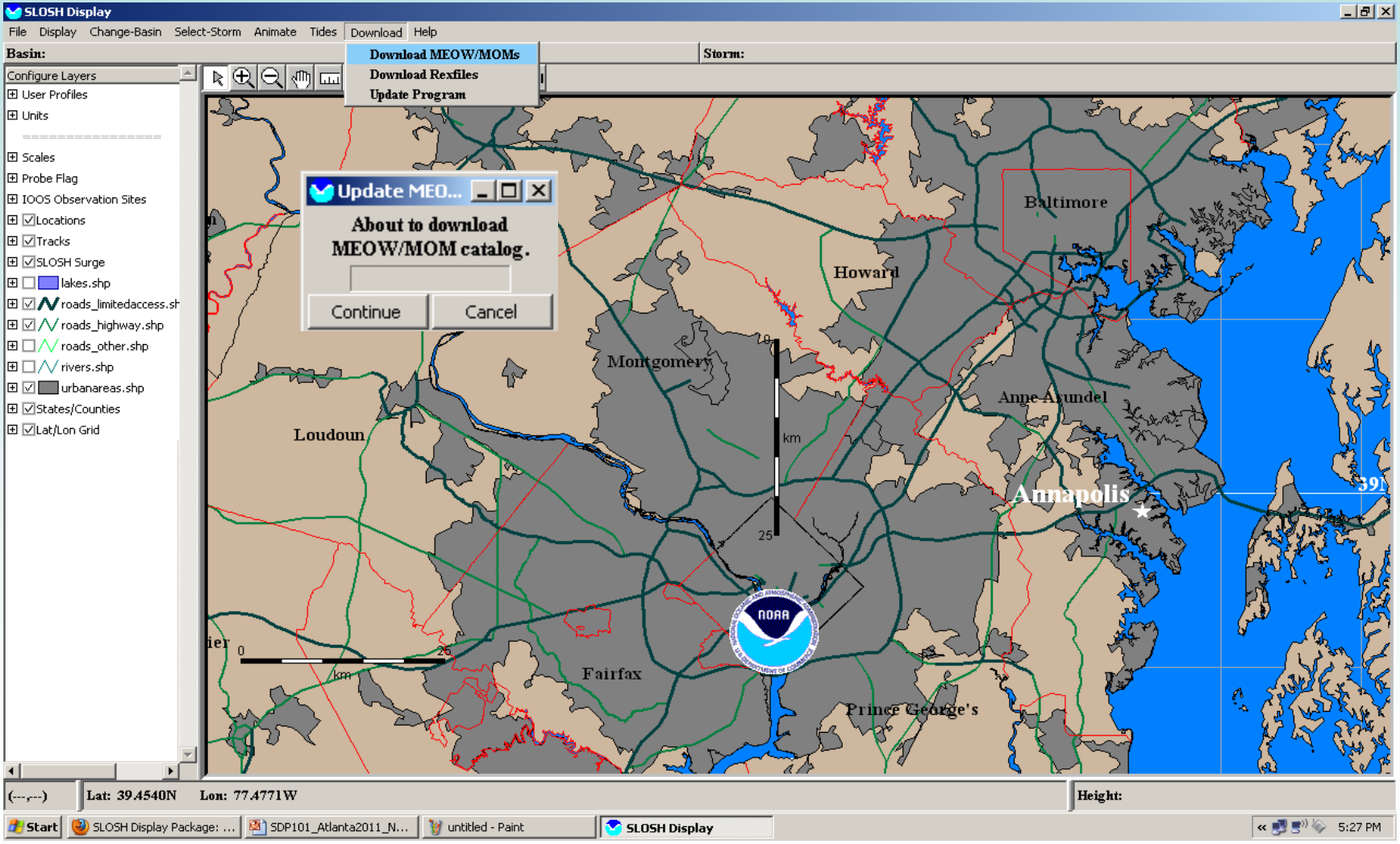
# http://slosh.nws.noaa.gov/sloshPriv/rexfile.php



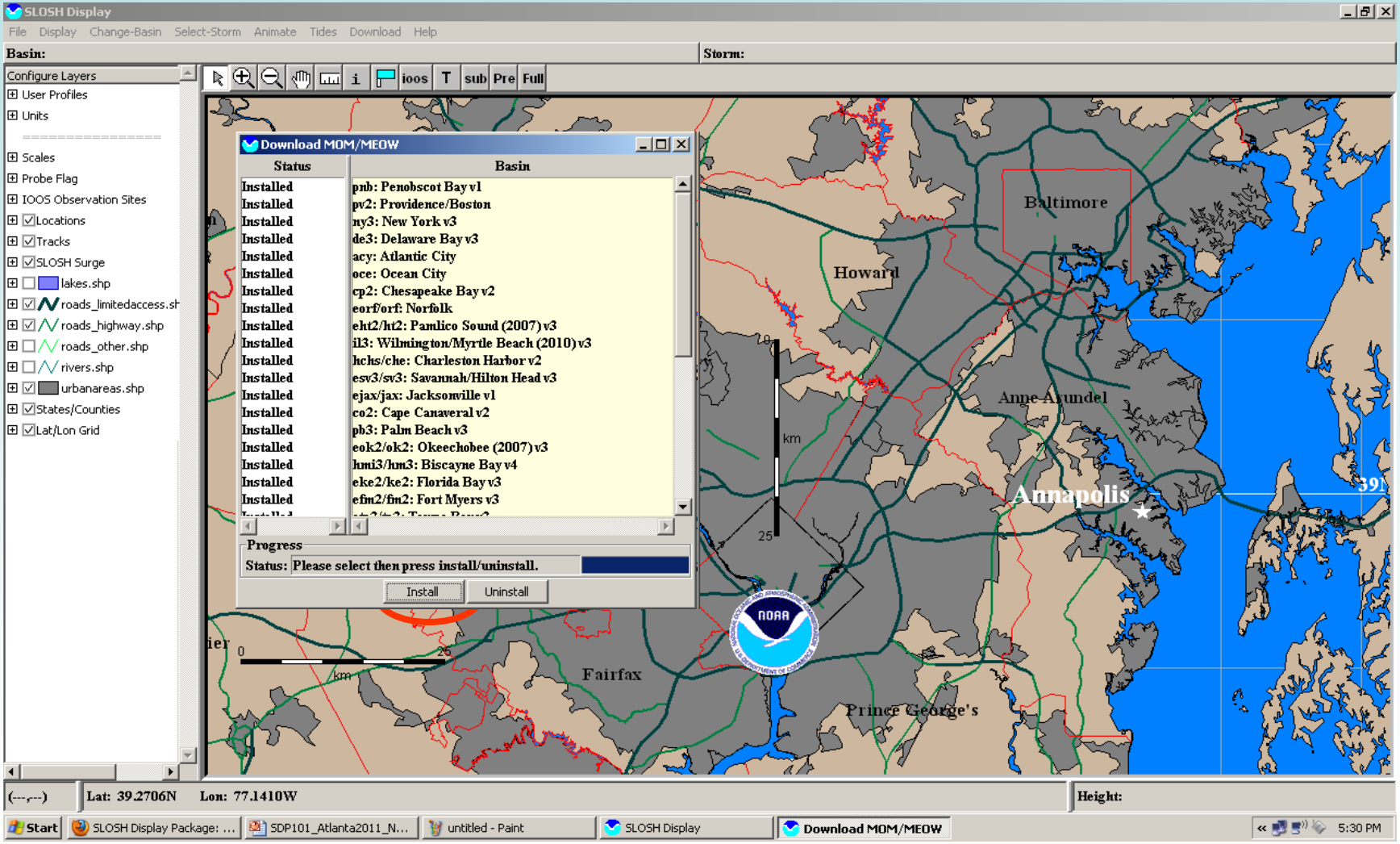
# Install


SLOSH Display 1.64 Setup
Choose Install Location
Choose the folder in which to install SLOSH Display 1.64.
SLOSH Display 1.64 Setup: Start Menu Folder
Choose Install Location
Choose the folder in which to install SLOSH Display 1.64.
SLOSH Display 1.64 Setup: Desktop Shortcuts
Choose Install Location
Choose the folder in which to install SLOSH Display 1.64.
SLOSH Display 1.64 Setup
Completing the SLOSH Display 1.64 Installation Wizard
SLOSH Display 1.64 has been installed on your computer.
Click Finish to close this wizard.
Start SLOSH Display
< Back
Finish
Cancel

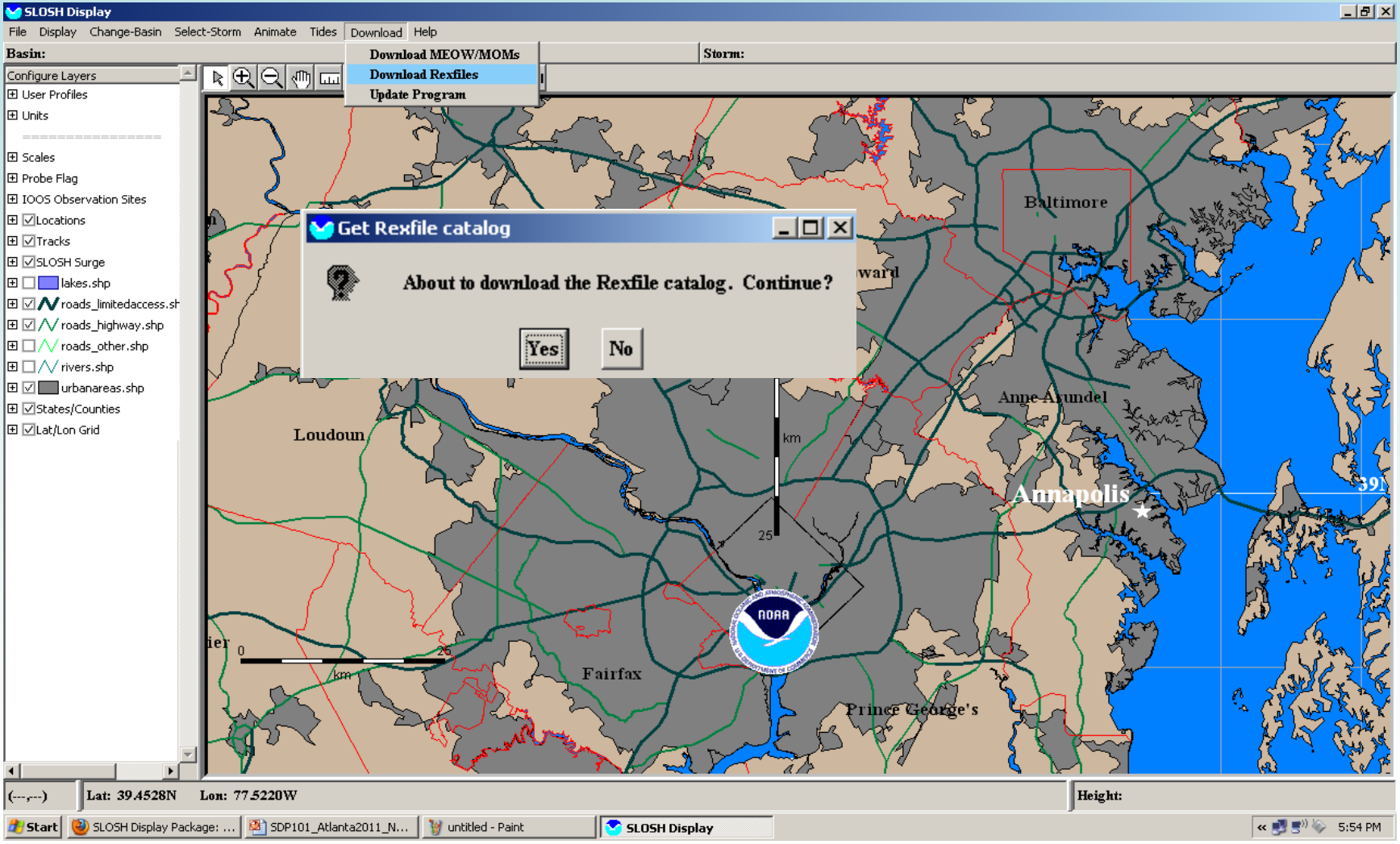
# Get Data (MEOW/MOM)



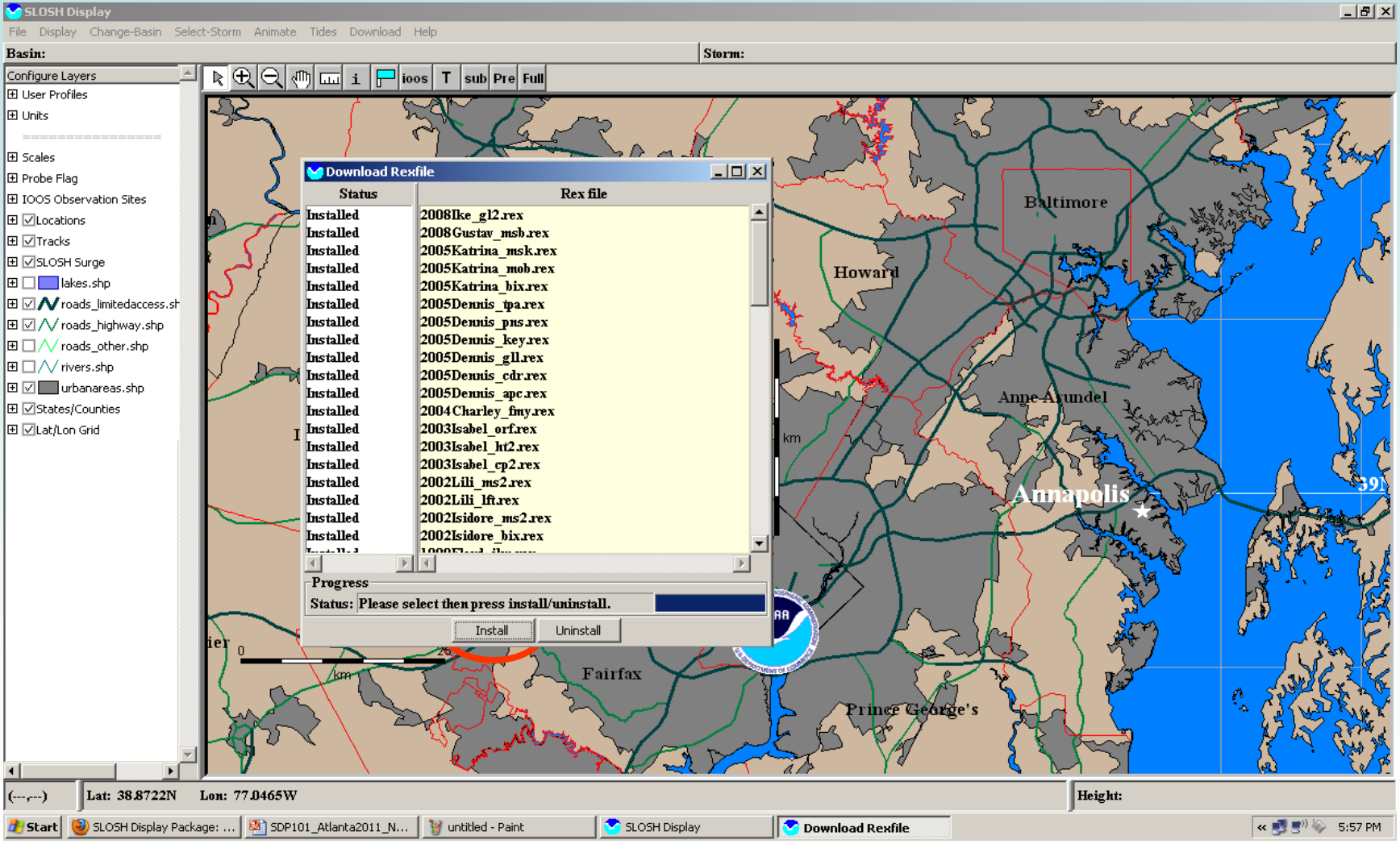
# Get Data (MEOW/MOM)



# Get Data (Rex File)



# Get Data (Rex File)

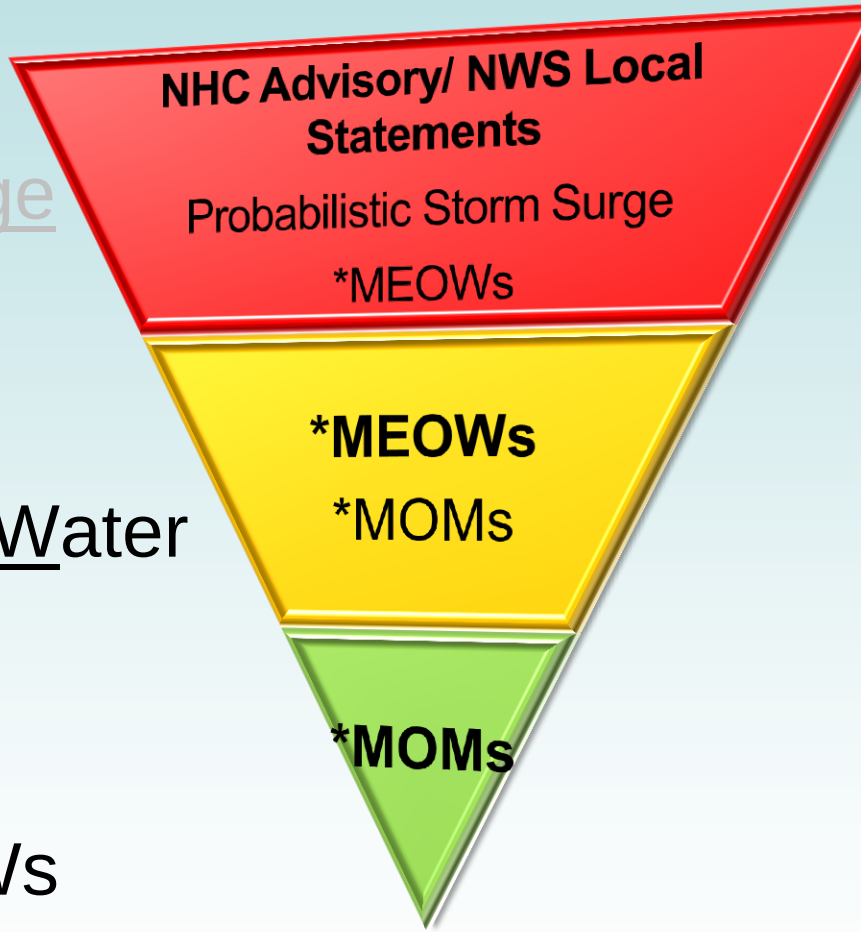


# MEOW / MOM Module

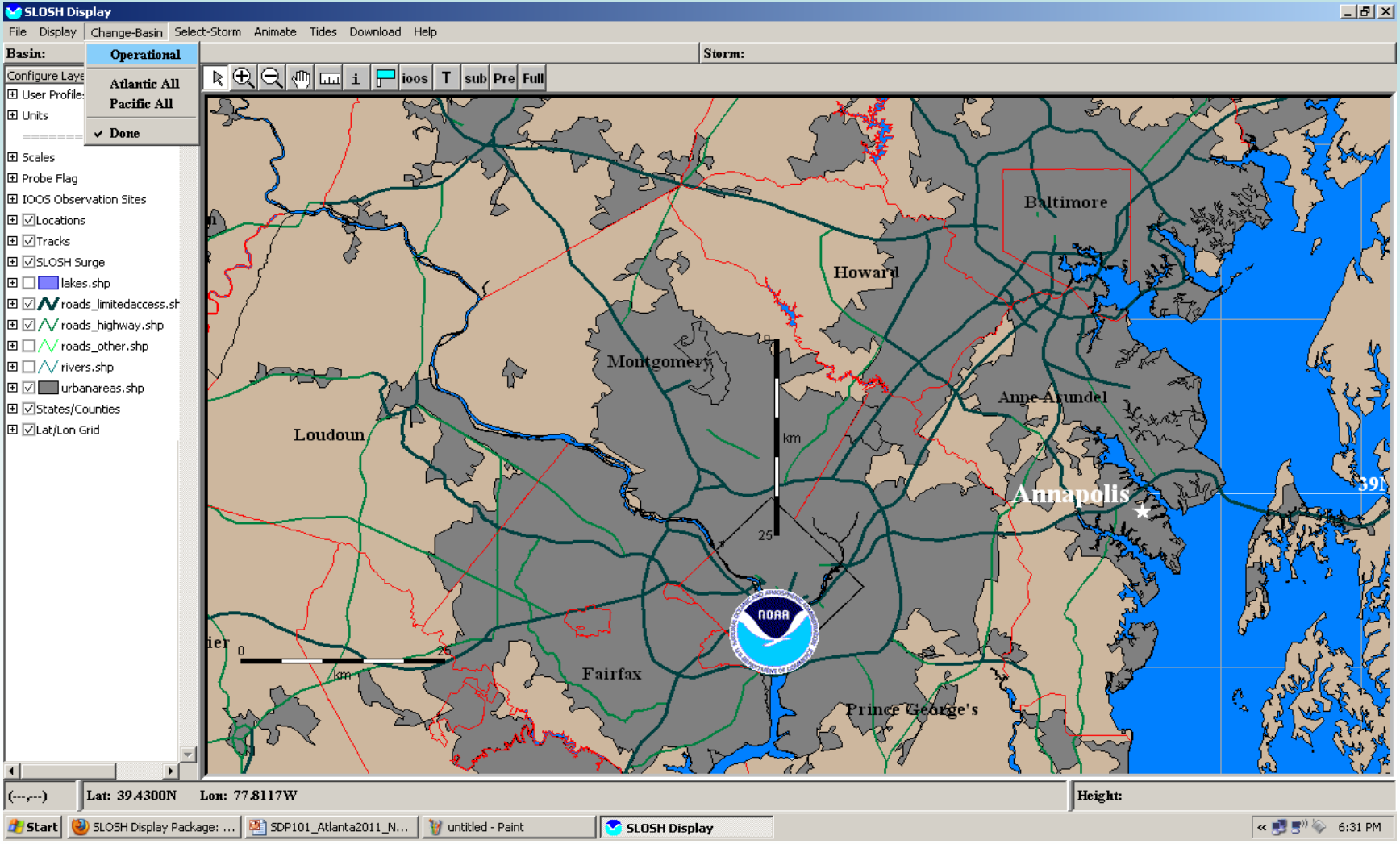
- P-Surge
  - Probabilistic Storm Surge

- MEOW
  - Maximum Envelope Of Water

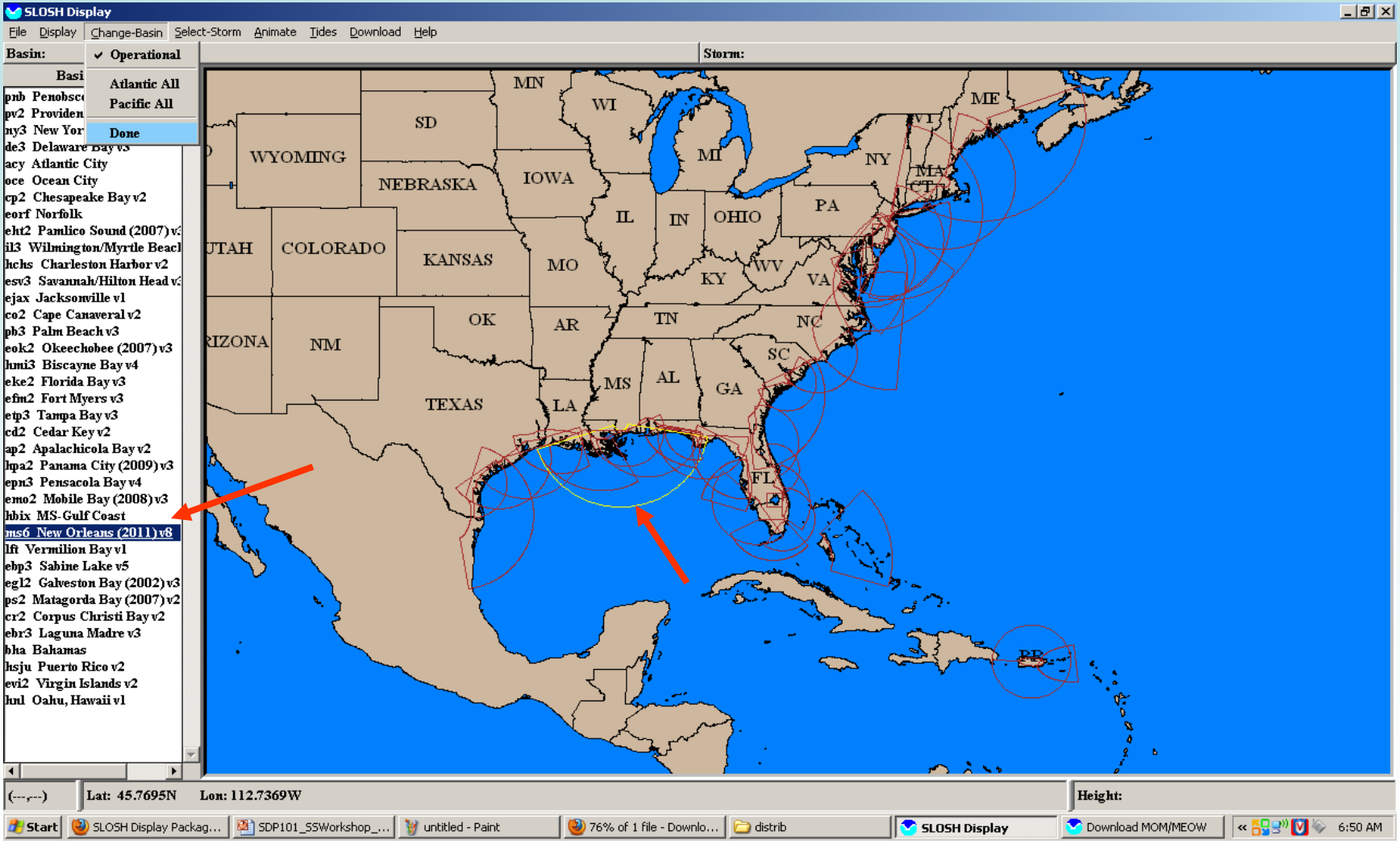
- MOM
  - Maximum Of the MEOWs



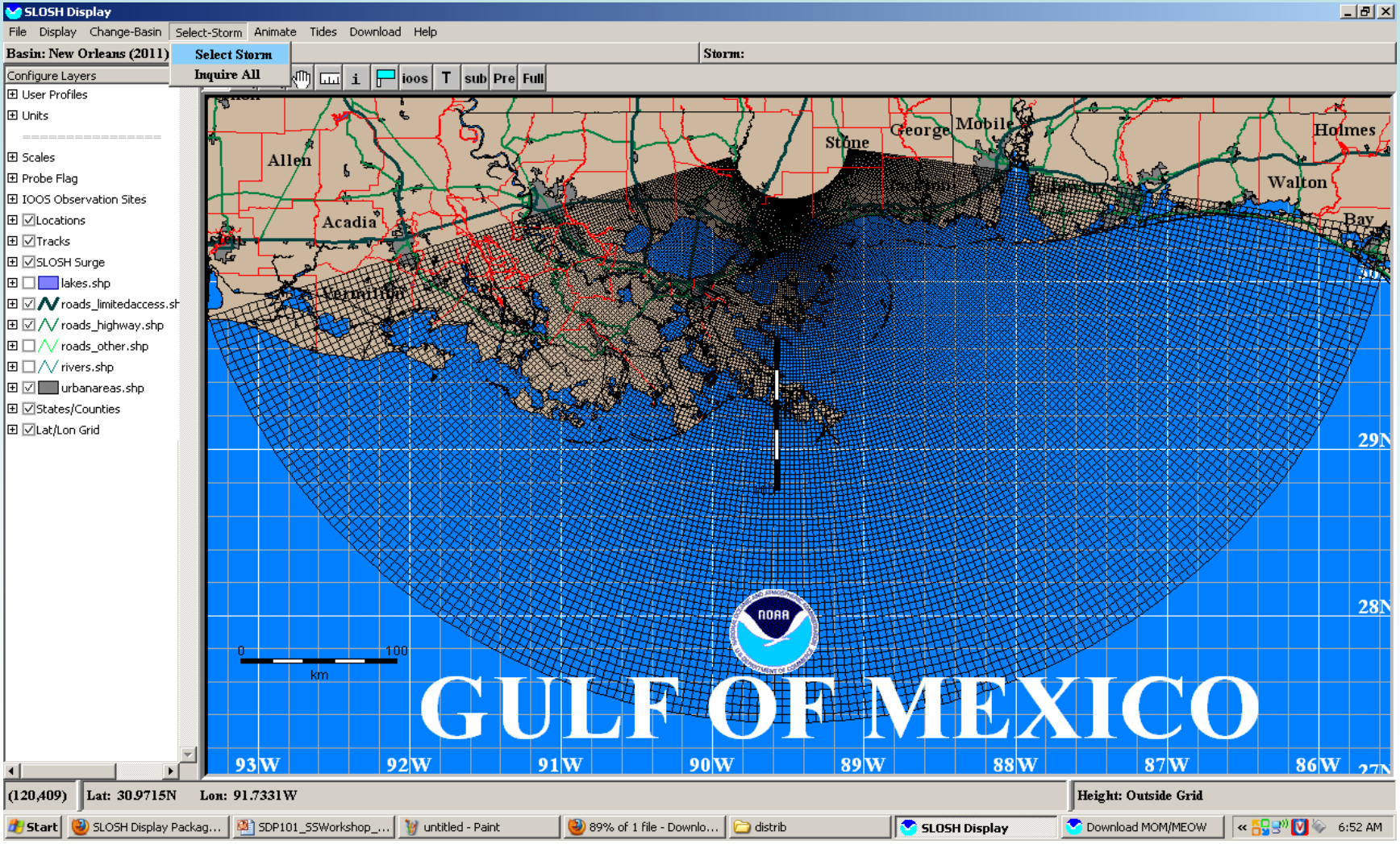
# Select Basin



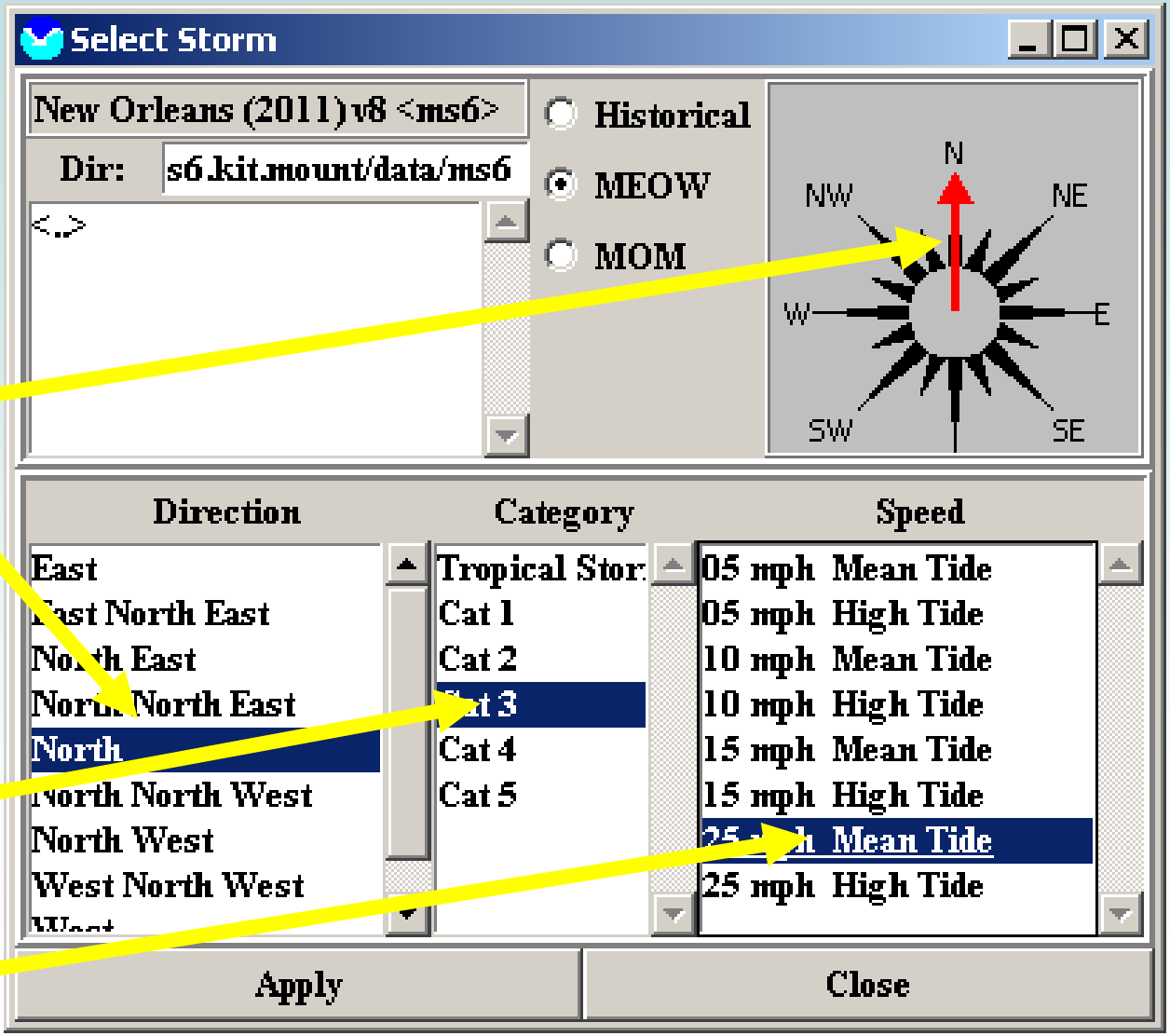
# Select Basin



# Select Storm (MEOW)



# **Select Storm (MEOW)** Direction: N, Category: 3,Speed: 25 MPH (Mean)

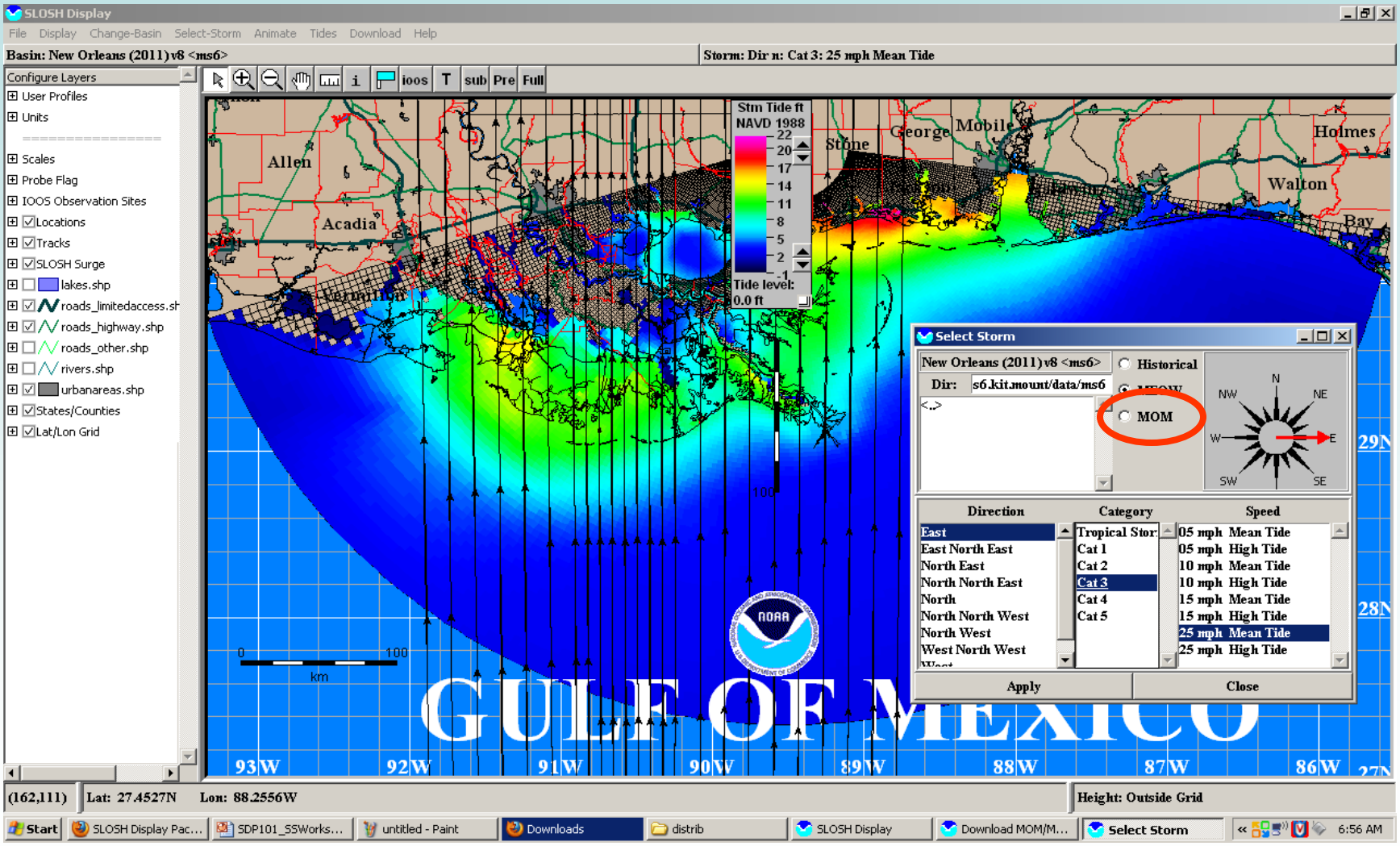



**Direction of Hurricane Track**

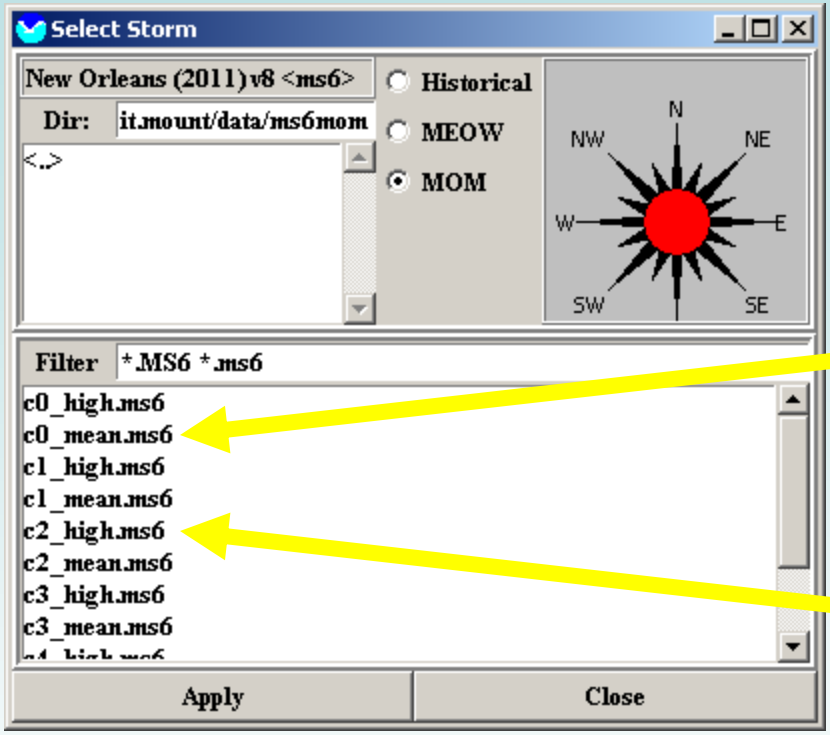
**Category of Hurricane**

**Speed of Hurricane**

# Select Storm (MEOW)



# Select Storm (MOM)




**MOMs for Each Category at Mean Tide**

**MOMs for Each Category at High Tide**

**C3_MEAN.MS6**

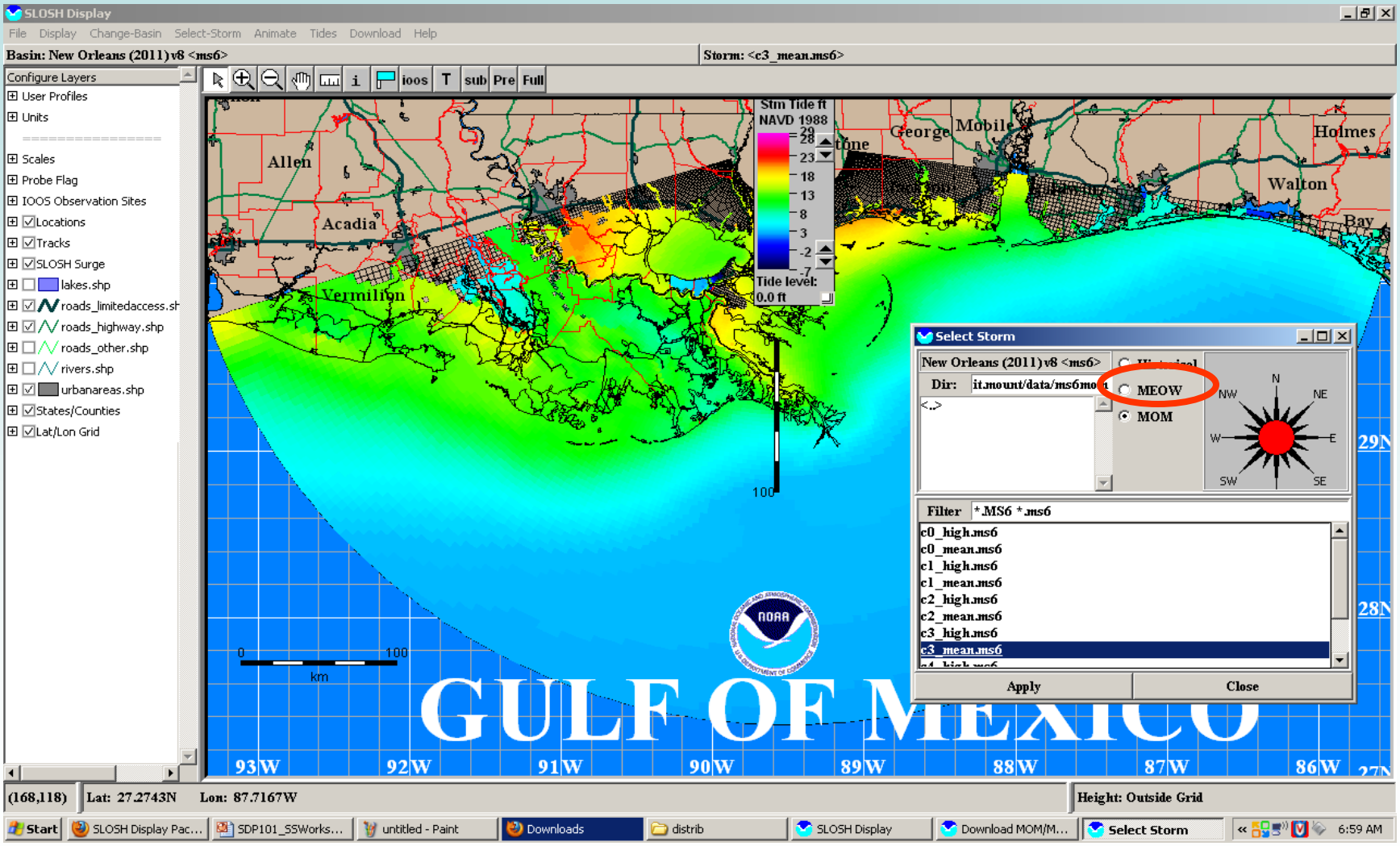
**C3_HIGH.MS6**

**CATEGORY 3**

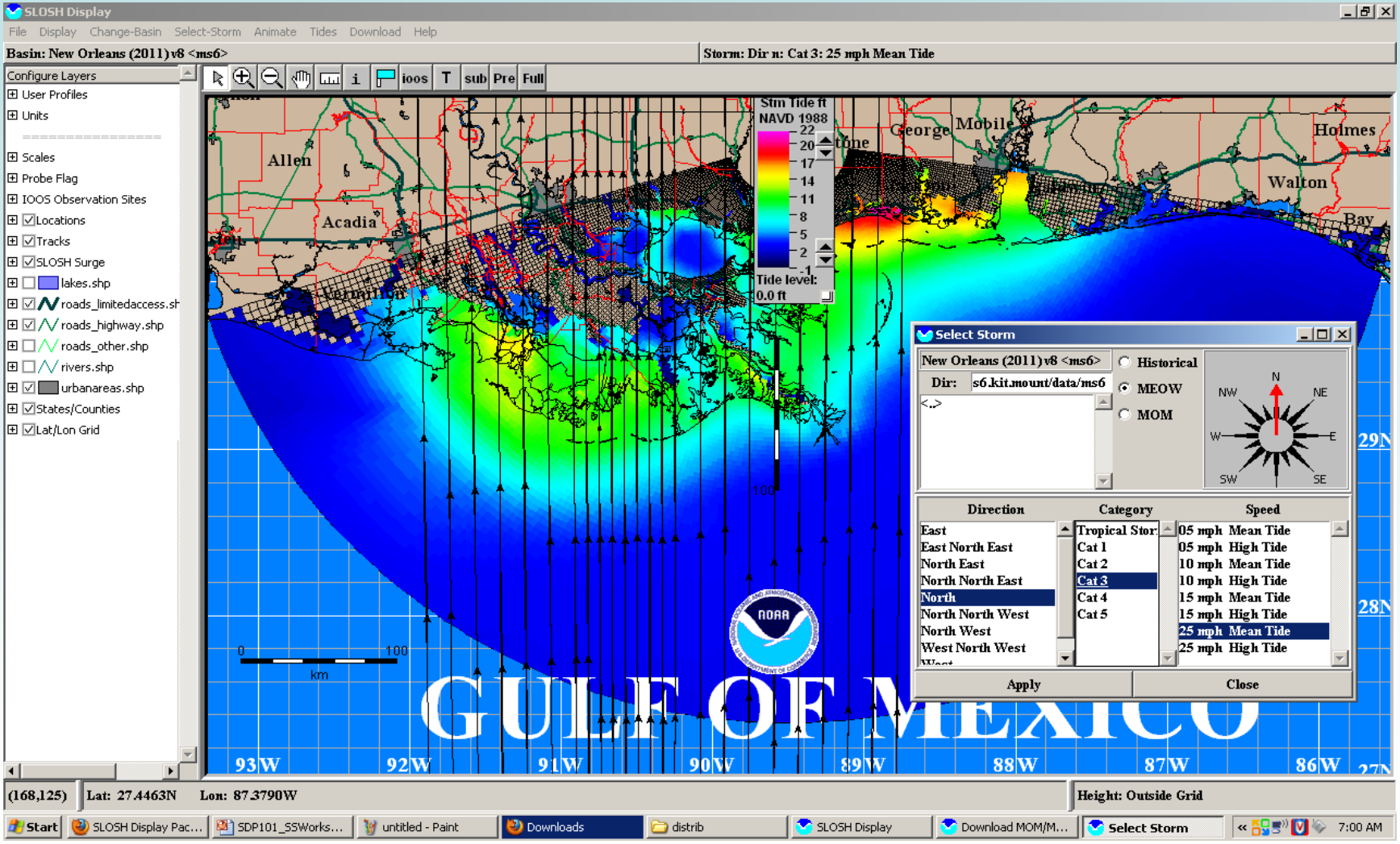
**TIDE LEVEL = MEAN**

**TIDE LEVEL = HIGH**

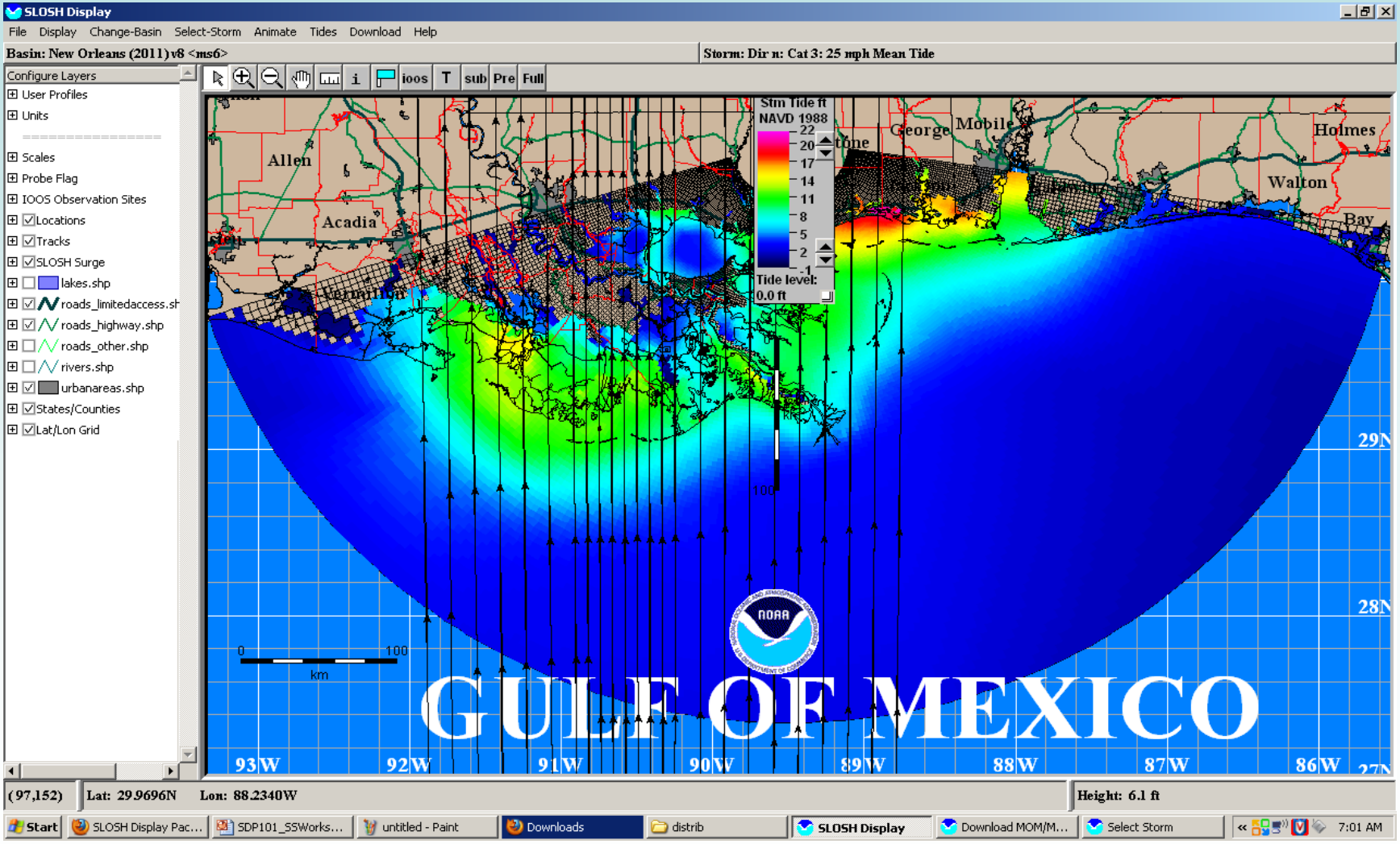
# Select Storm (MOM)



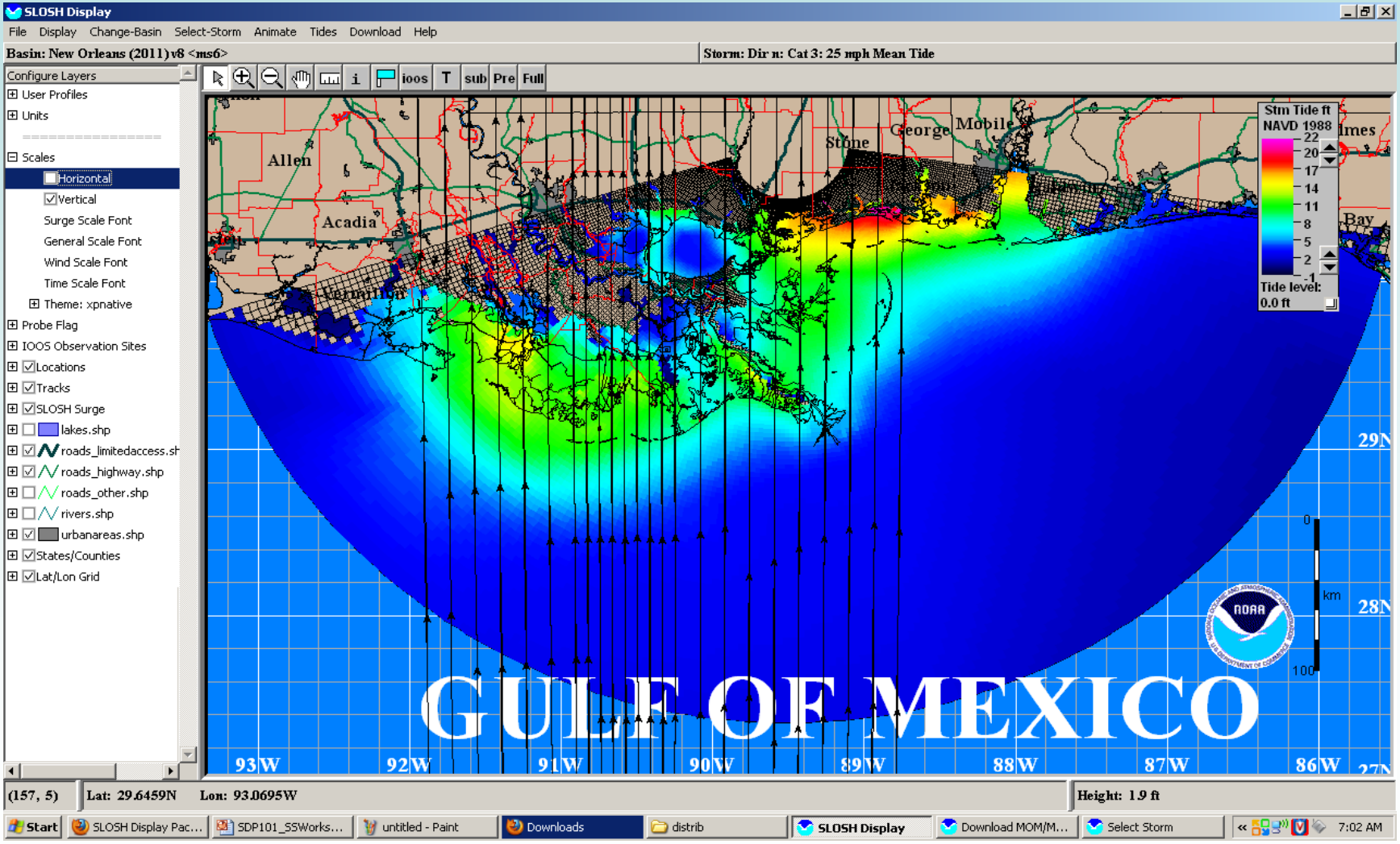
# Select Storm (MEOW)



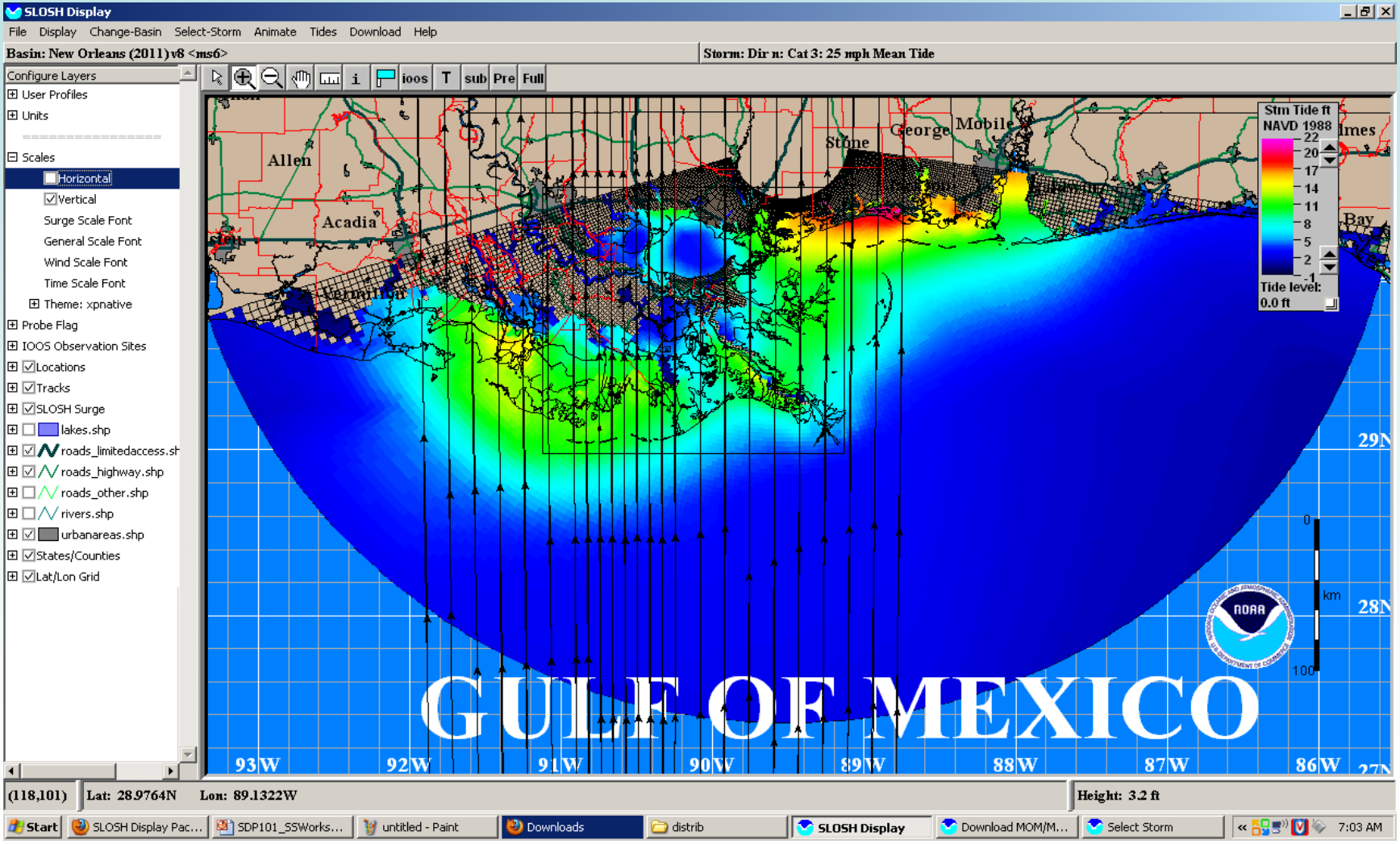
# Select Storm (MEOW)



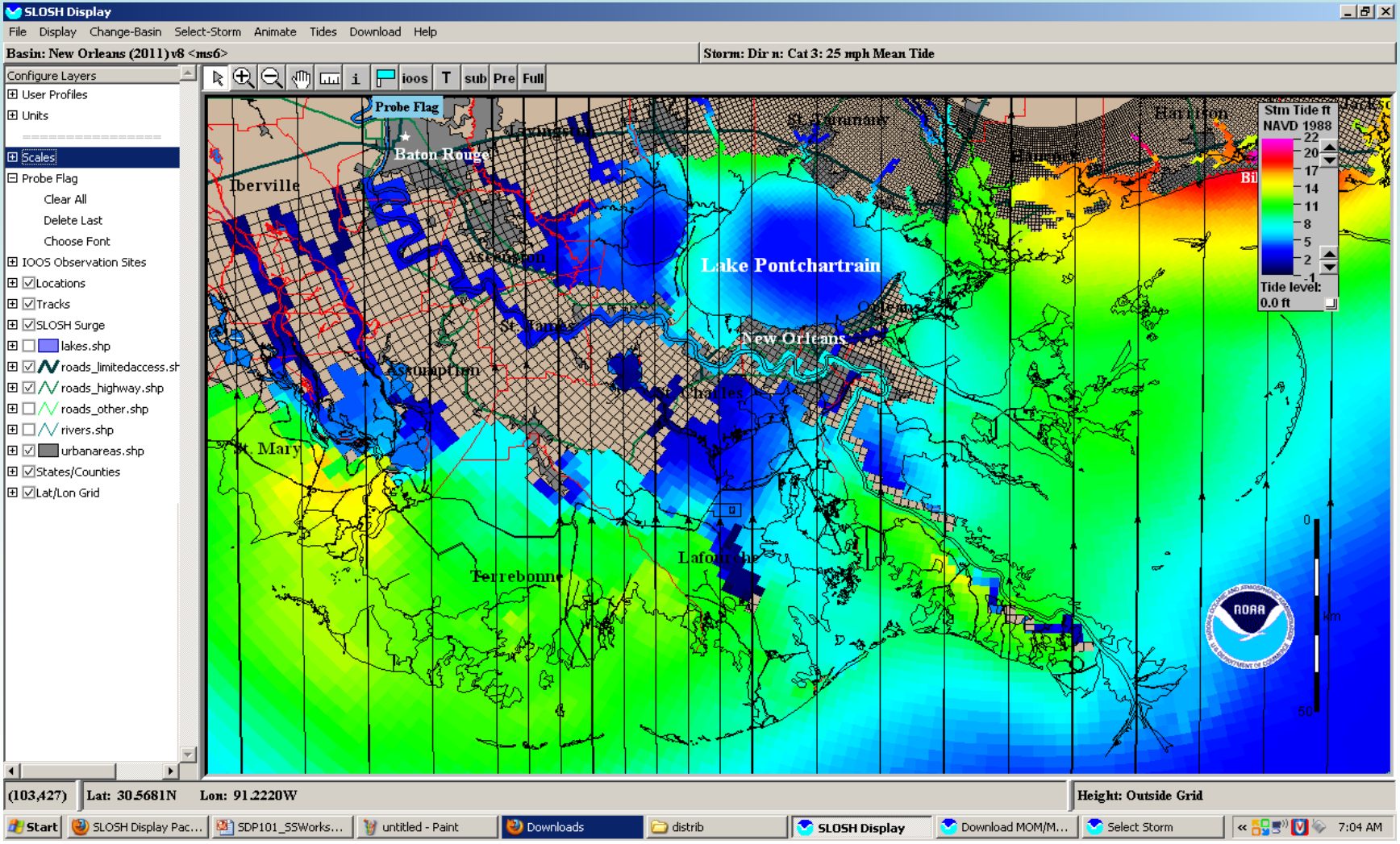
# Move Labels


SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: New Orleans (2011) v8 <ms6>
Storm: Dir n: Cat 3: 25 mph Mean Tide
Configure Layers
User Profiles
Units
Scales
Horizontal
Vertical
Surge Scale Font
General Scale Font
Wind Scale Font
Time Scale Font
Theme: xpnative
Probe Flag
IOOS Observation Sites
Locations
Tracks
SLOSH Surge
lakes.shp
roads_limitedaccess.sh
roads_highway.shp
roads_other.shp
rivers.shp
urbanareas.shp
States/Counties
Lat/Lon Grid
ioos T sub Pre Full
Stm Tide ft NAVD 1988
22 20 17 14 11 8 5 2 -1
Tide level: 0.0 ft
Allen
Acadia
Vermilion
Stone
George
Mobile
Bay
GULF OF MEXICO
93W 92W 91W 90W 89W 88W 87W 86W
29N
28N
0 km 100
(157, 5)
Lat: 29.6459N Lon: 93.0695W
Height: 1.9 ft
Start
SLOSH Display Pac...
SDP101_SSWorks...
untitled - Paint
Downloads
distrib
SLOSH Display
Download MOM/M...
Select Storm
7:02 AM

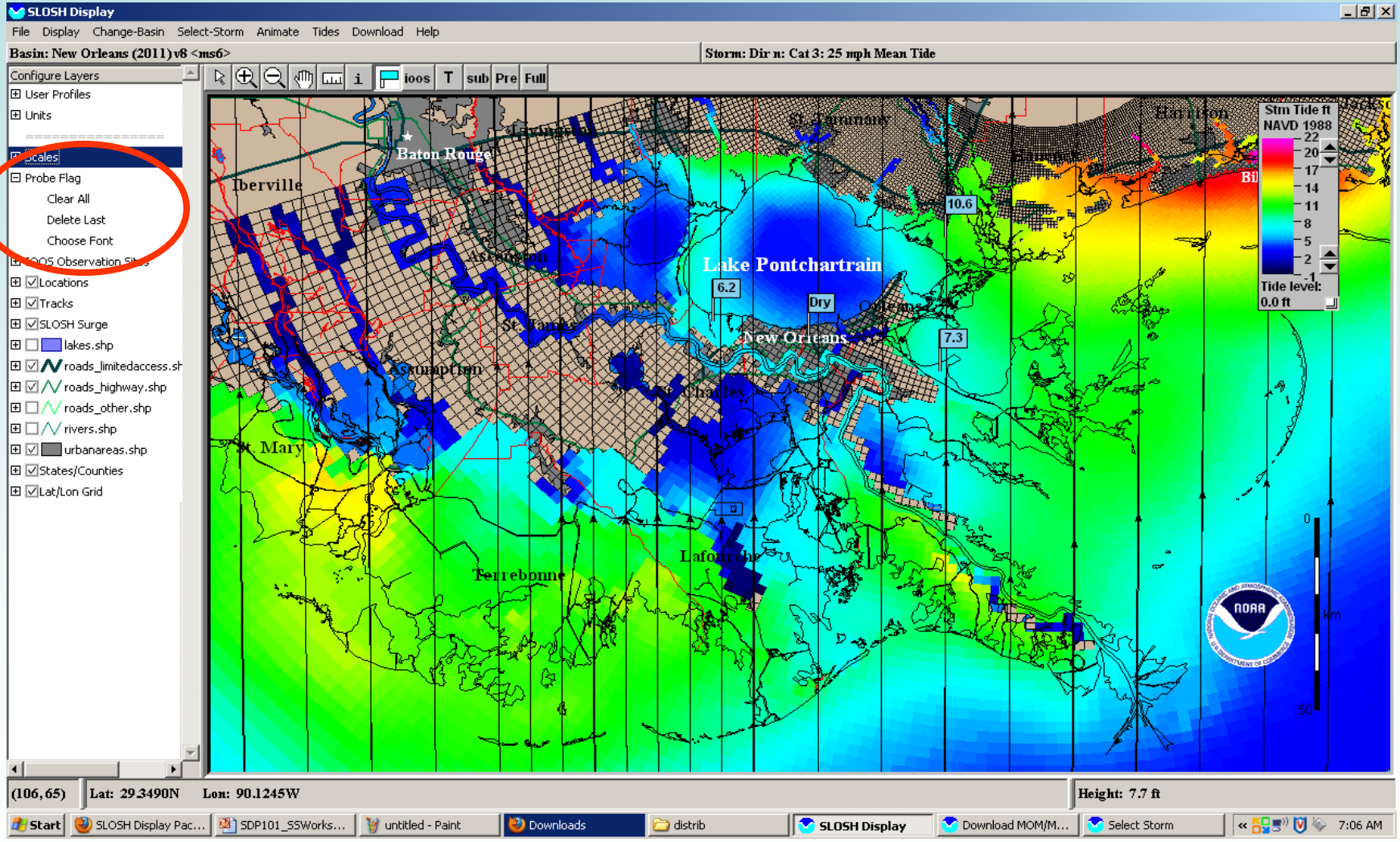
# Zoom In


SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: New Orleans (2011) v8 <ms6>
Storm: Dir n: Cat 3: 25 mph Mean Tide
Configure Layers
User Profiles
Units
Scales
Horizontal
Vertical
Surge Scale Font
General Scale Font
Wind Scale Font
Time Scale Font
Theme: xpnative
Probe Flag
IOOS Observation Sites
Locations
Tracks
SLOSH Surge
lakes.shp
roads_limitedaccess.sh
roads_highway.shp
roads_other.shp
rivers.shp
urbanareas.shp
States/Counties
Lat/Lon Grid
Stm Tide ft
NAVD 1988
Tide level:
0.0 ft
Allen
Acadia
Vermilion
Stone
George
Mobile
GULF OF MEXICO
93W
92W
91W
90W
89W
88W
87W
86W
29N
28N
km
(118,101)
Lat: 28.9764N
Lon: 89.1322W
Height: 3.2 ft
Start
SLOSH Display Pac...
SDP101_SSWorks...
untitled - Paint
Downloads
distrib
SLOSH Display
Download MOM/M...
Select Storm
7:03 AM

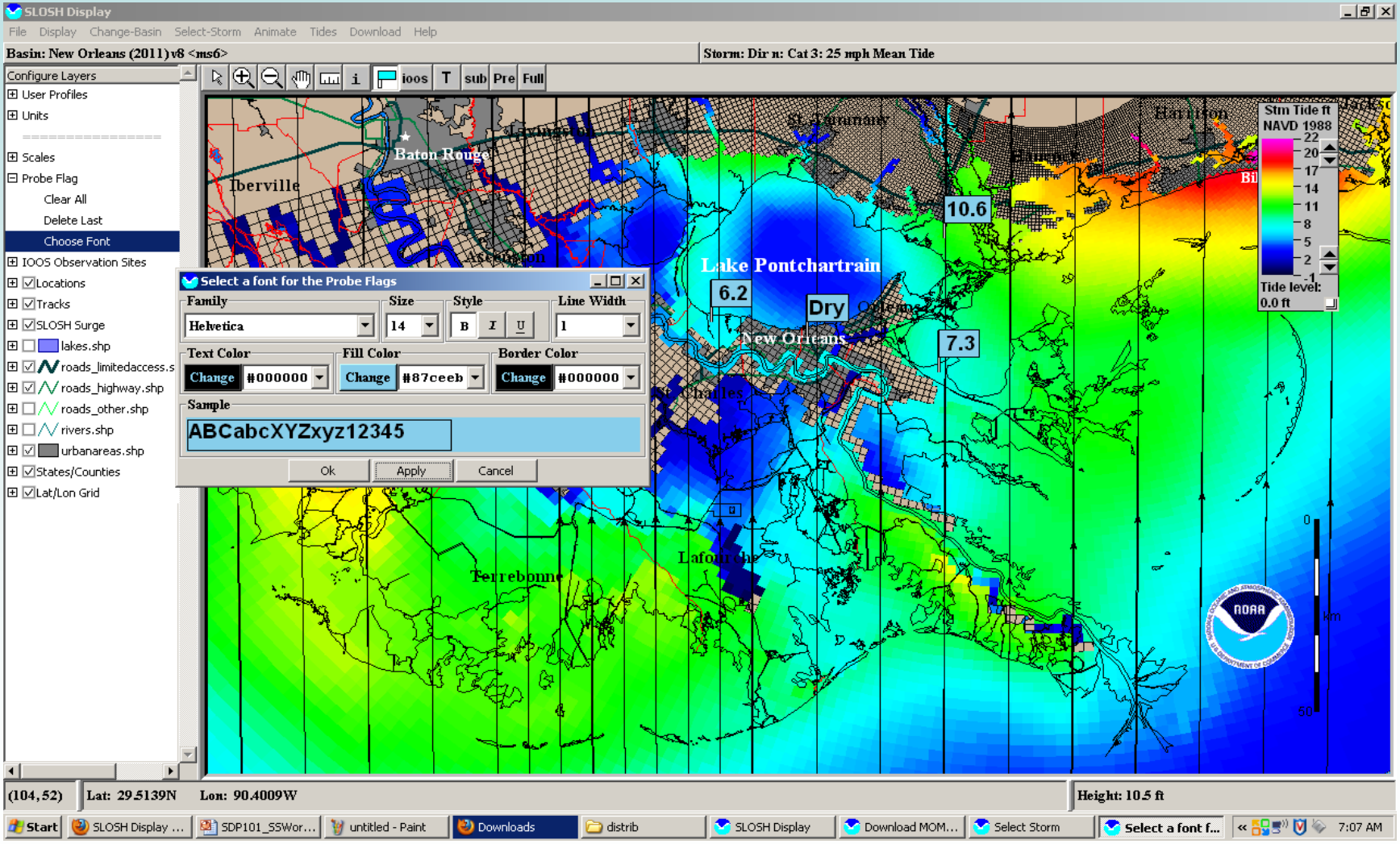
# Probe Points



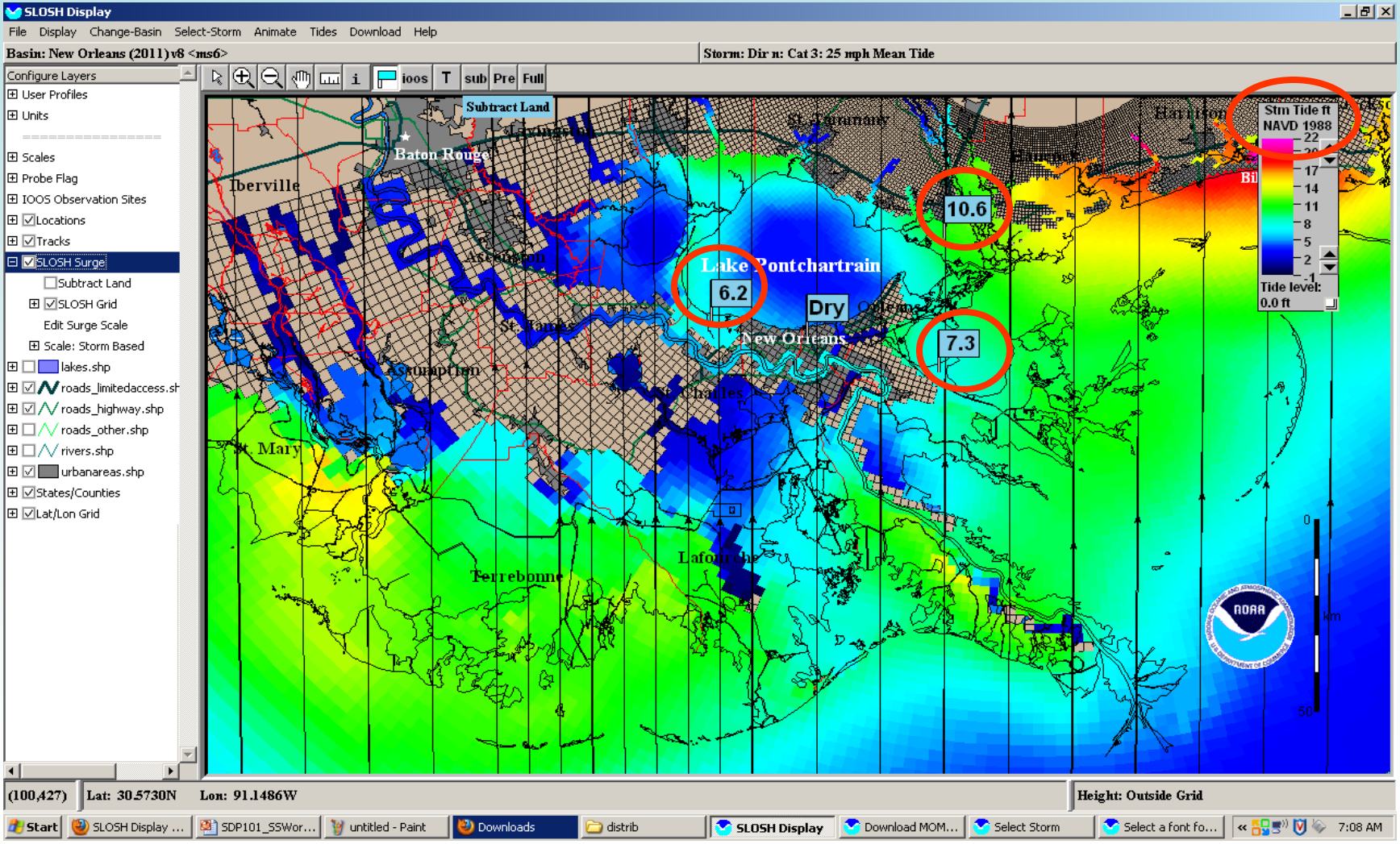
# Probe Points



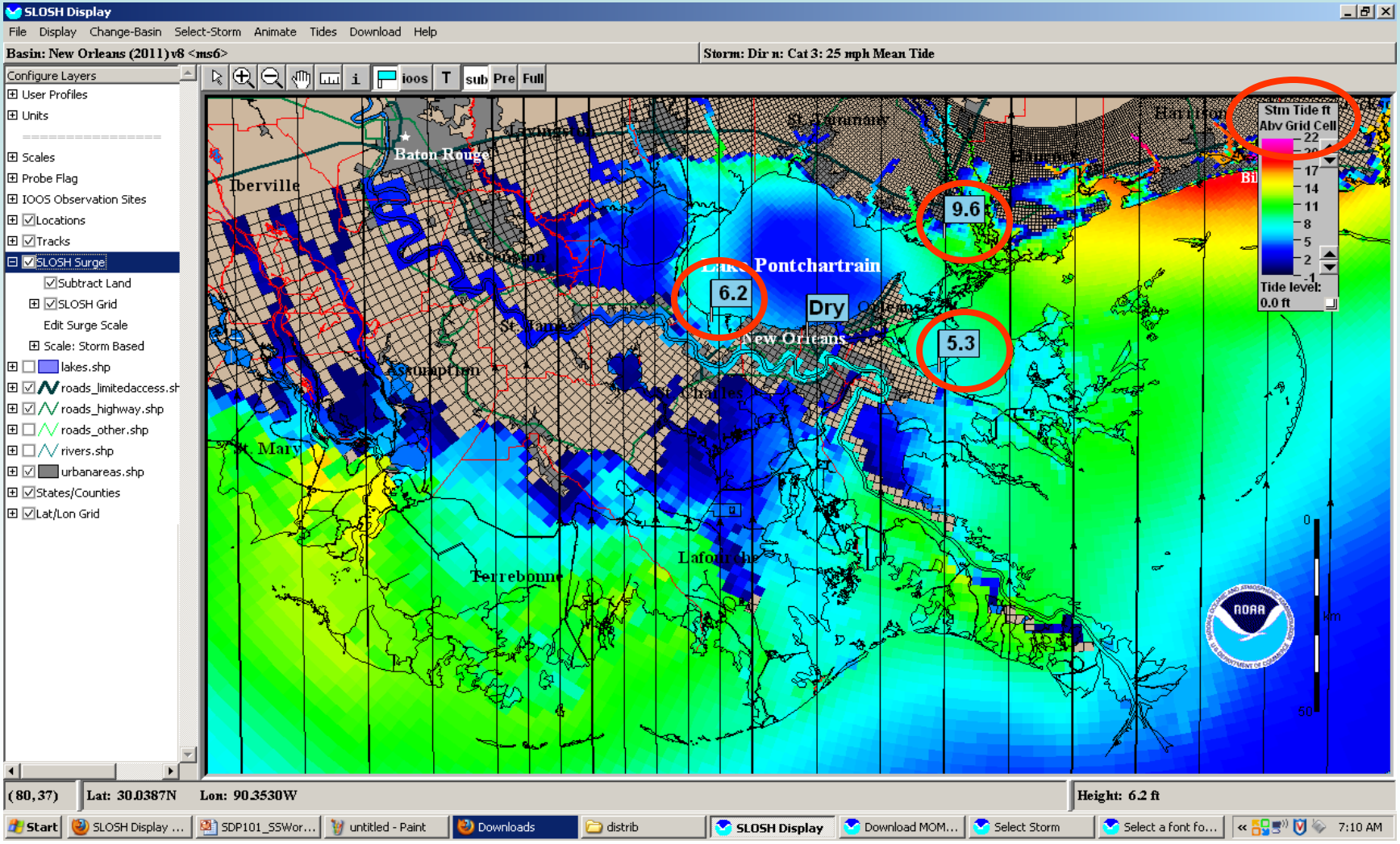
# Probe Points



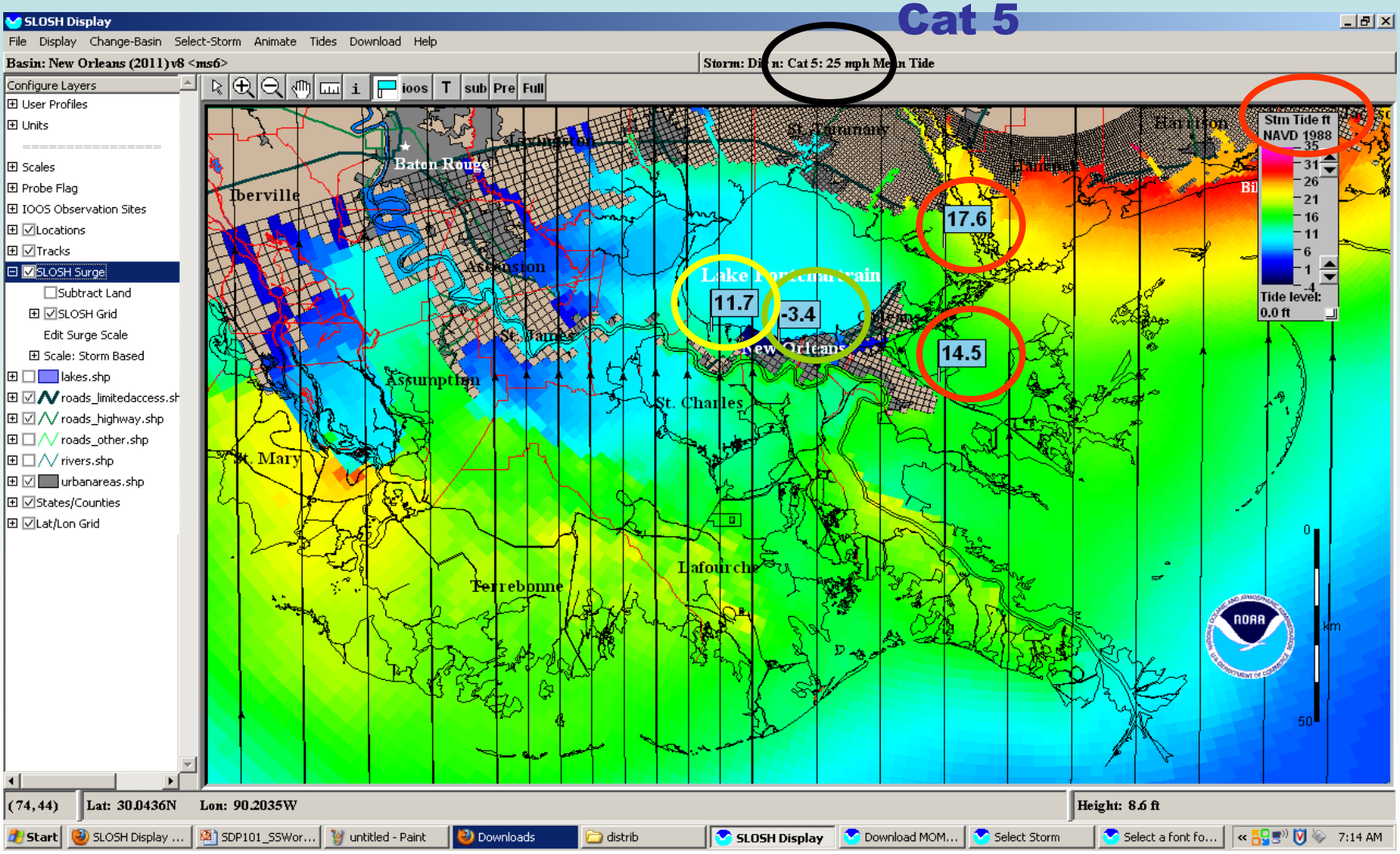
# Subtract Land



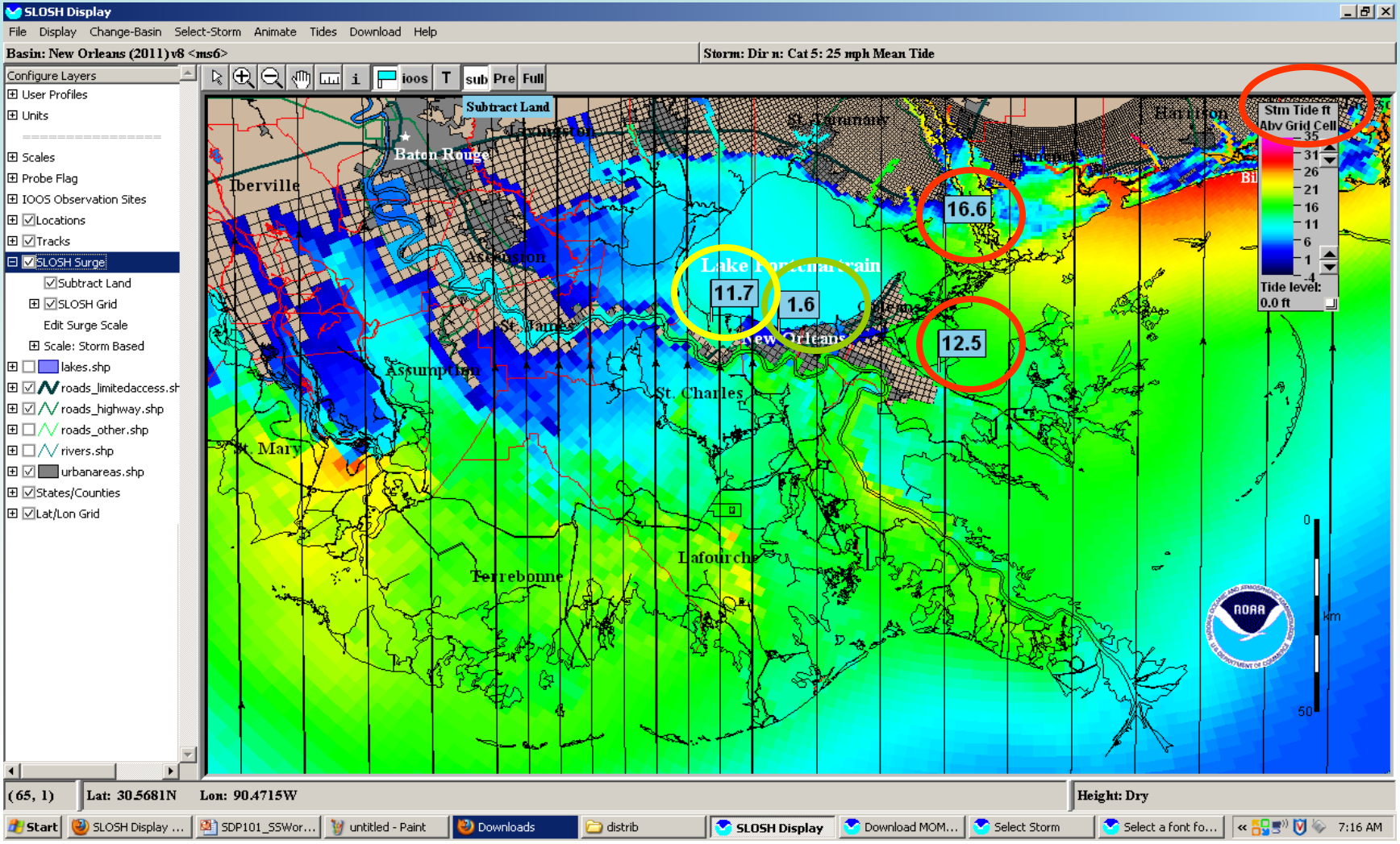
# Subtract Land



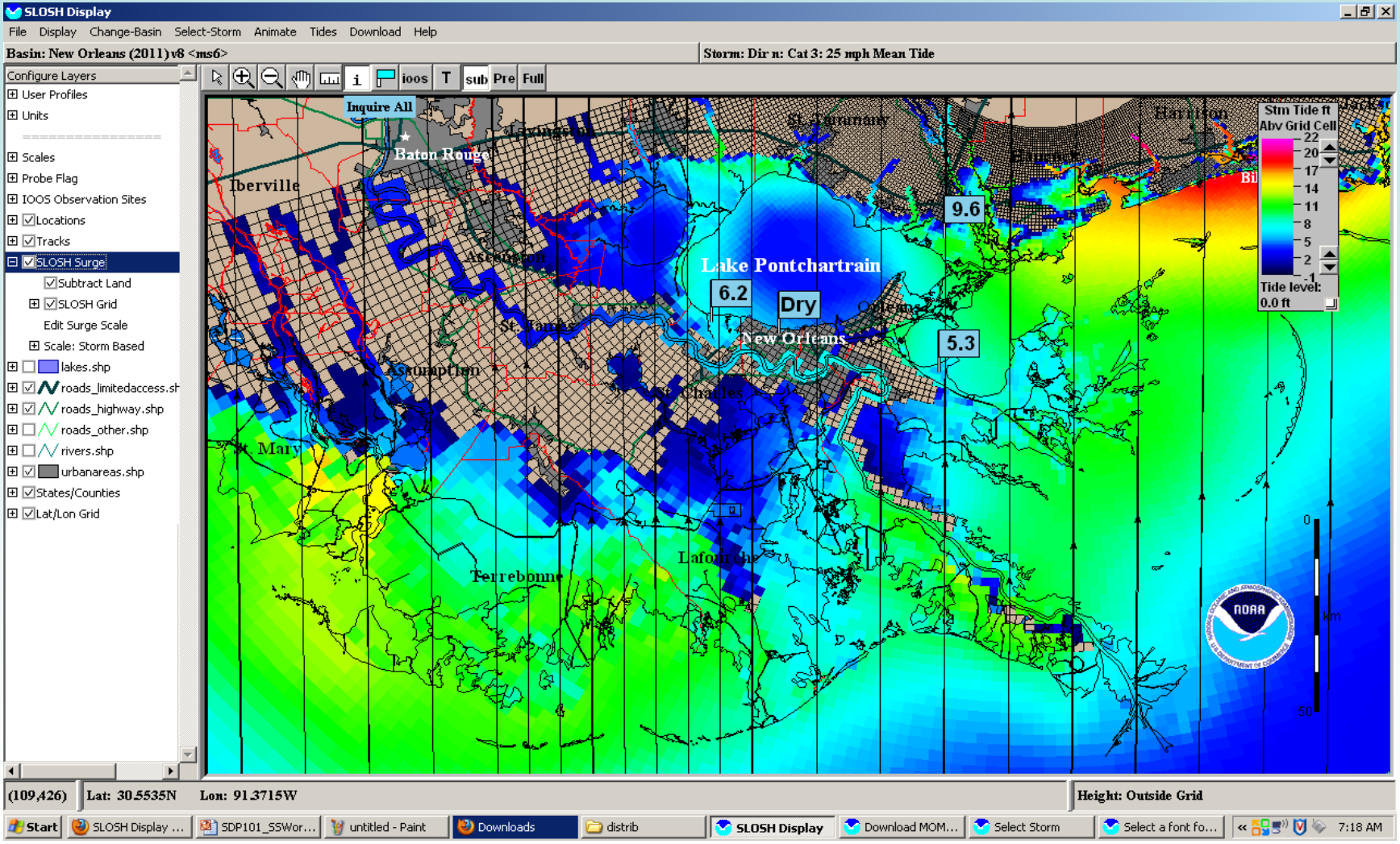
# Subtract Land (New Orleans)



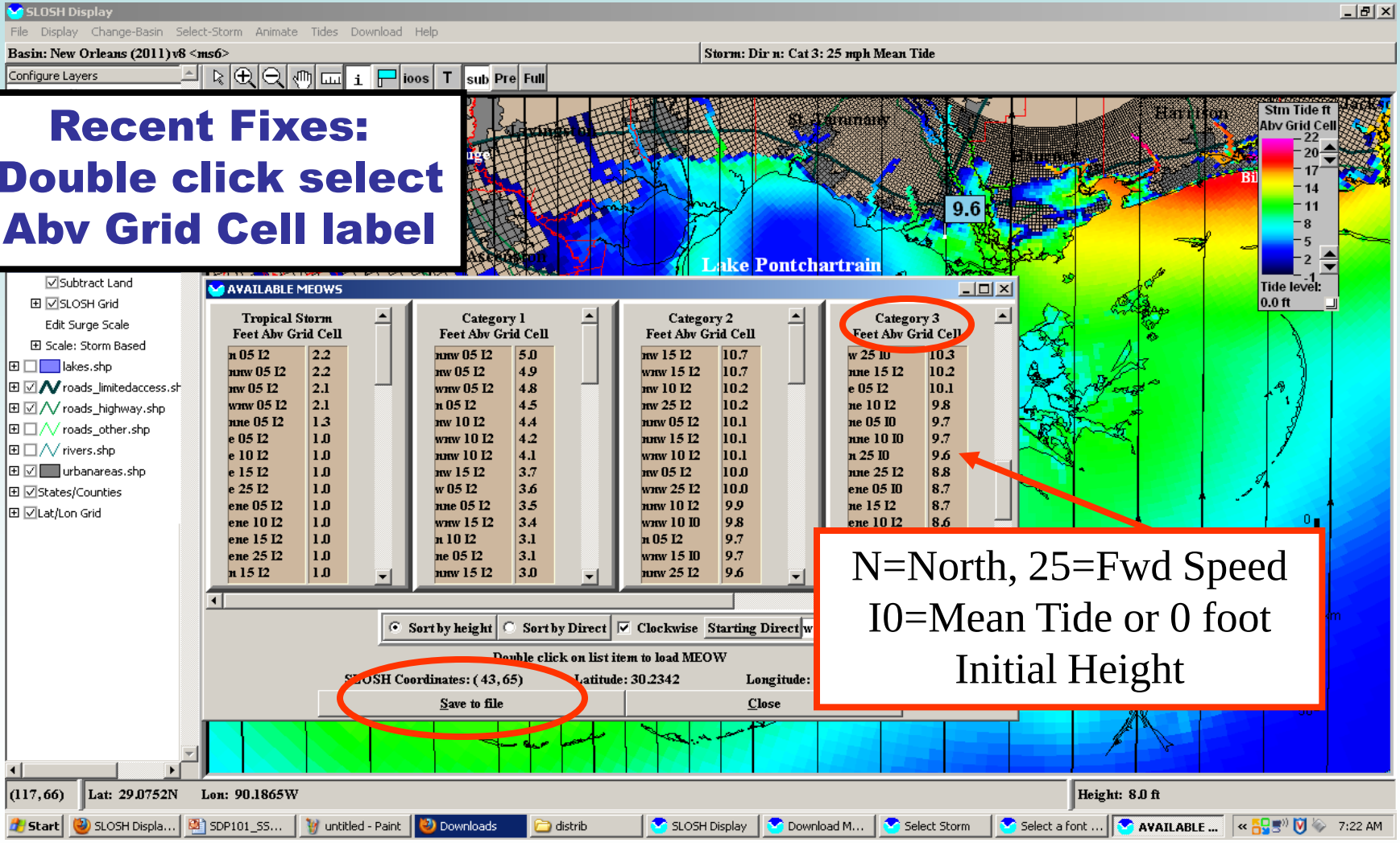
# Subtract Land (New Orleans)



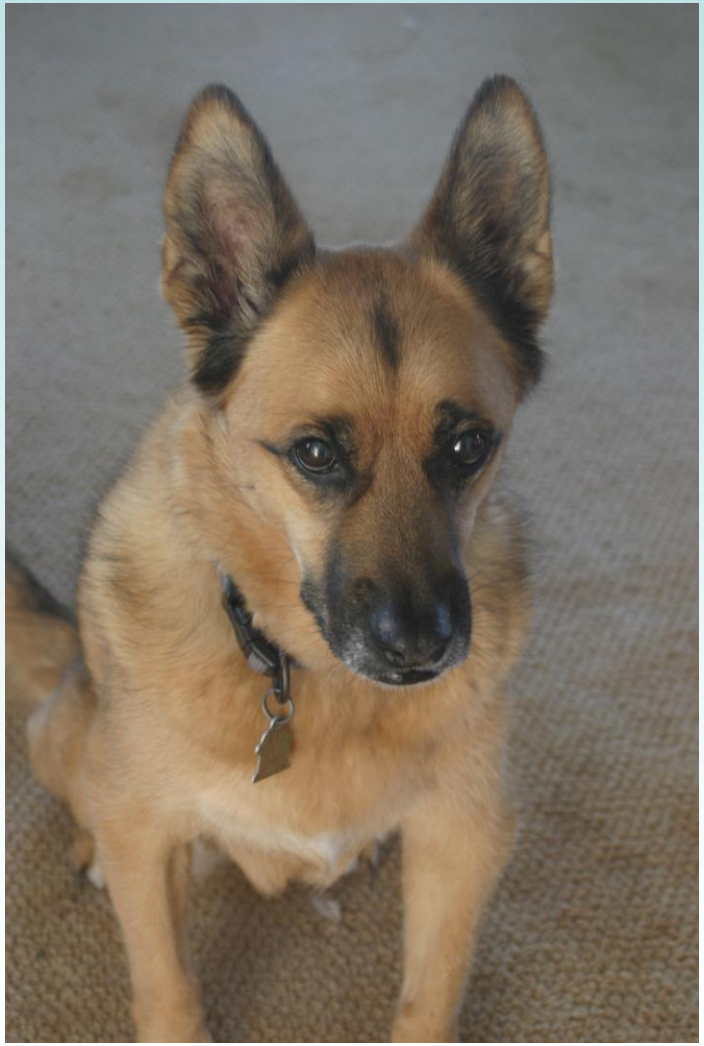
# Inquire All


SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: New Orleans (2011) v8 <ms6>
Storm: Dir n: Cat 3: 25 mph Mean Tide
Configure Layers
User Profiles
Units
Scales
Probe Flag
IOOS Observation Sites
Locations
Tracks
SLOSH Surge
Subtract Land
SLOSH Grid
Edit Surge Scale
Scale: Storm Based
lakes.shp
roads_limitedaccess.sh
roads_highway.shp
roads_other.shp
rivers.shp
urbanareas.shp
States/Counties
Lat/Lon Grid
Inquire All
Baton Rouge
Iberville
Lake Pontchartrain
New Orleans
Dry
9.6
6.2
5.3
Stm Tide ft Abv Grid Cell
Tide level: 0.0 ft
(109,426)
Lat: 30.5535N
Lon: 91.3715W
Height: Outside Grid
Start
7:18 AM

# Inquire All

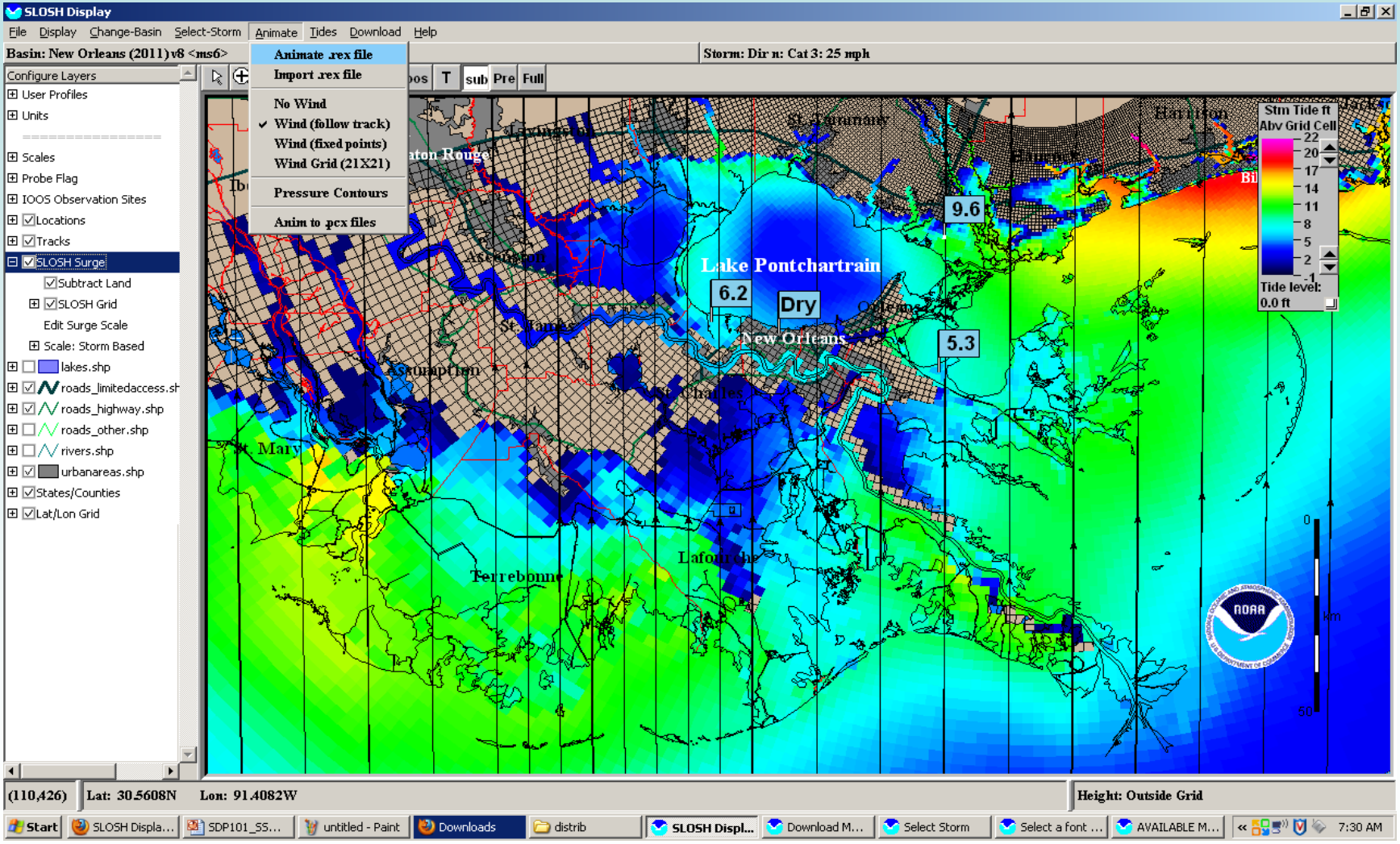

Recent Fixes:
•Double click select
•Abv Grid Cell label
SLOSH Display
Basin: New Orleans (2011) v8 <ms6>
Storm: Dir n: Cat 3: 25 mph Mean Tide
Lake Pontchartrain
9.6
Stm Tide ft Abv Grid Cell
Tide level: 0.0 ft
AVAILABLE MEOWS
Tropical Storm Feet Abv Grid Cell
Category 1 Feet Abv Grid Cell
Category 2 Feet Abv Grid Cell
Category 3 Feet Abv Grid Cell
Sort by height
Sort by Direct
Clockwise
Starting Direct
Double click on list item to load MEOW
Save to file
Close
N=North, 25=Fwd Speed
I0=Mean Tide or 0 foot
Initial Height

# Rex Module

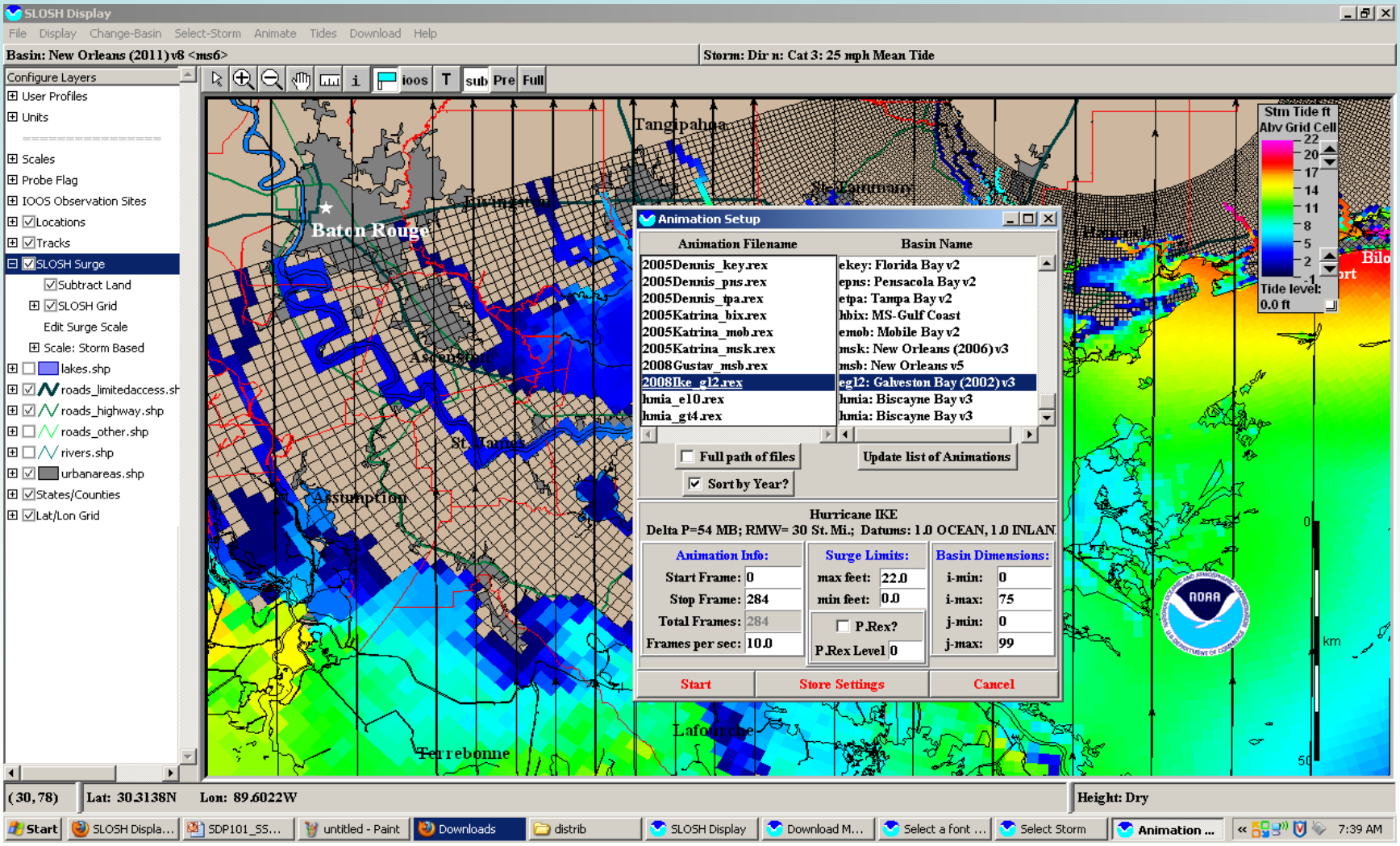


- While thinking about animation files and walking my dog Rex in ‘97, I asked: If its raining “Cats and Dogs”, we’ve got Cats, where are the Dogs?
- Thus was created the “Rex File”

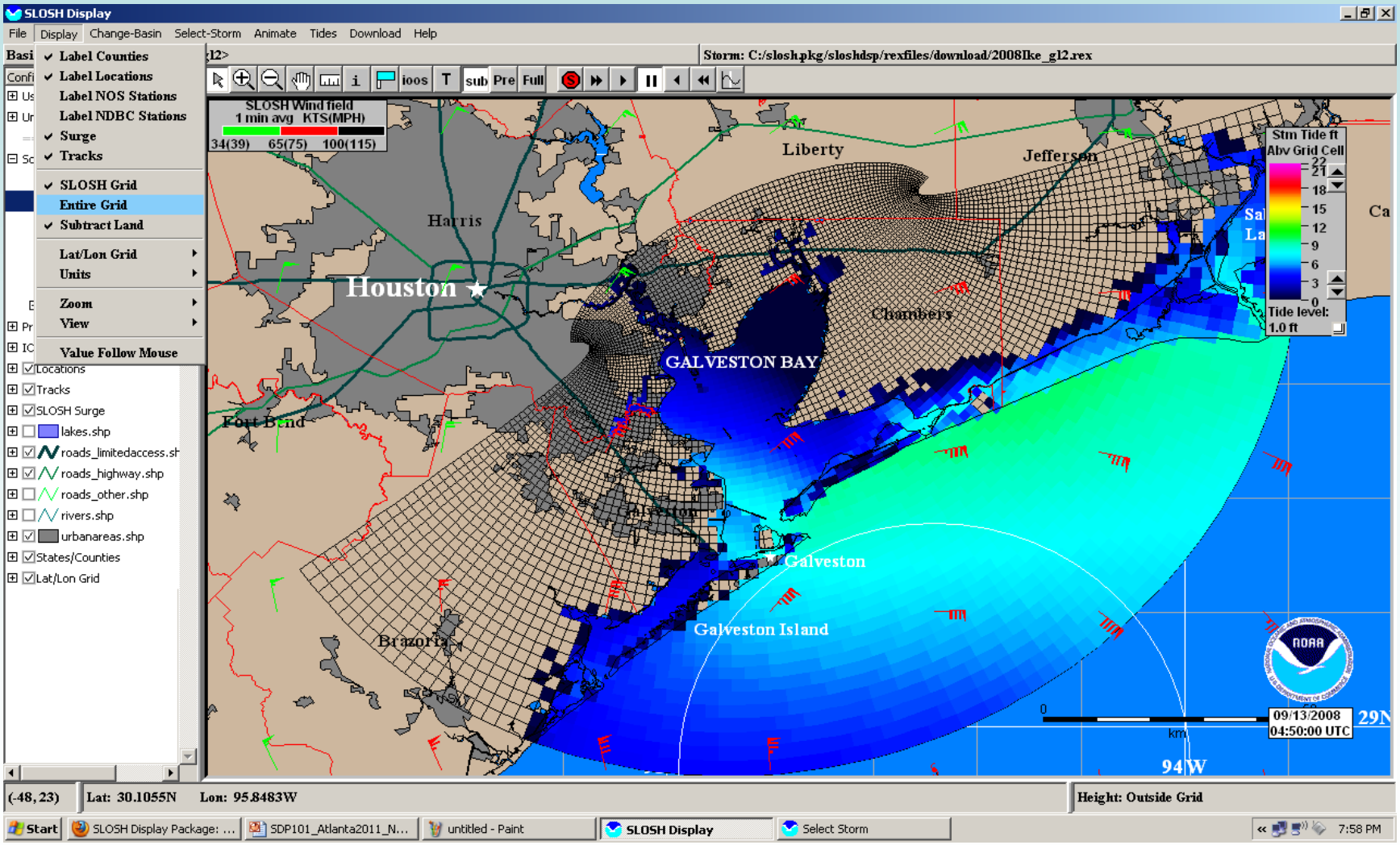
# Animate a Rex File



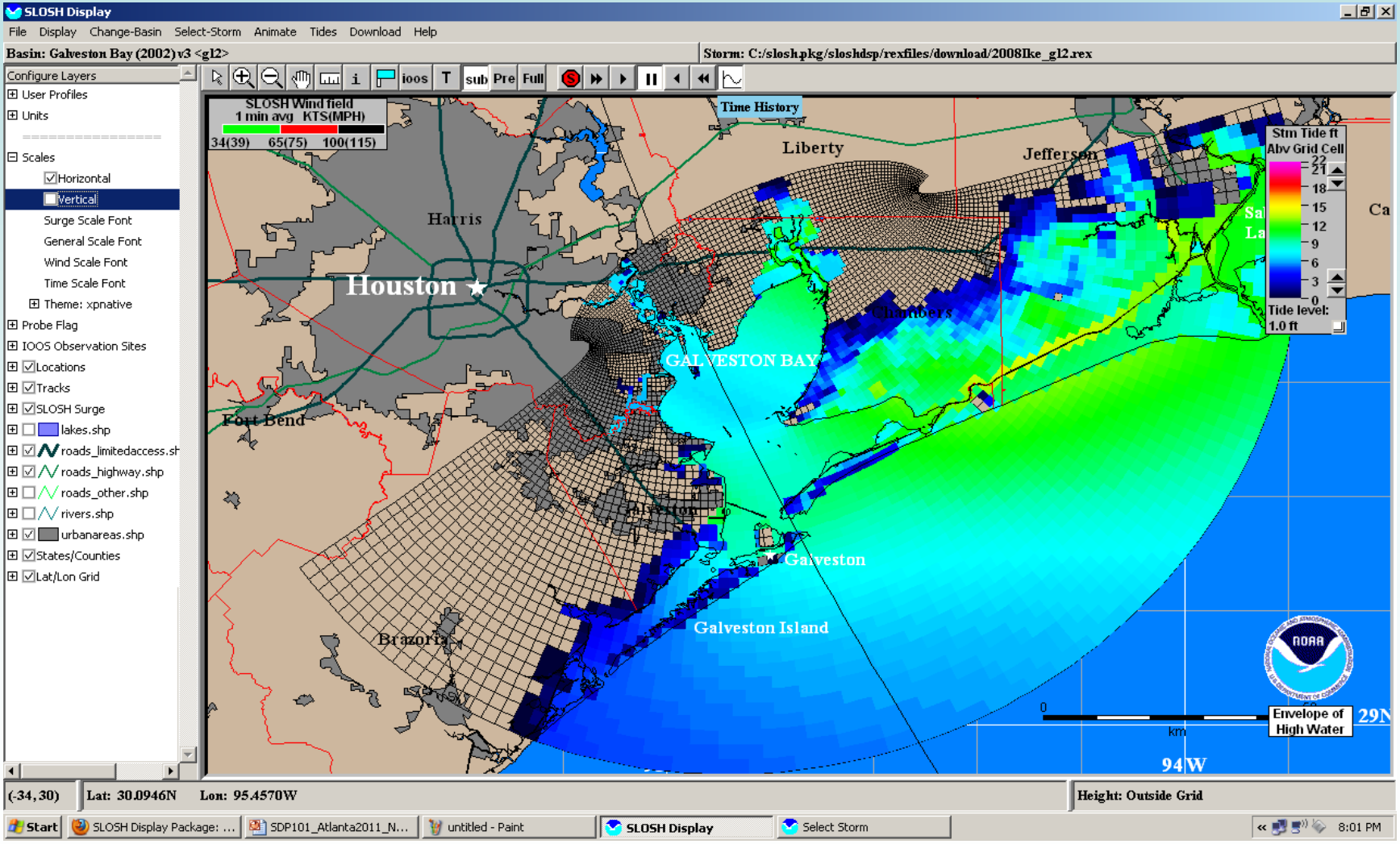
# Animate a Rex File



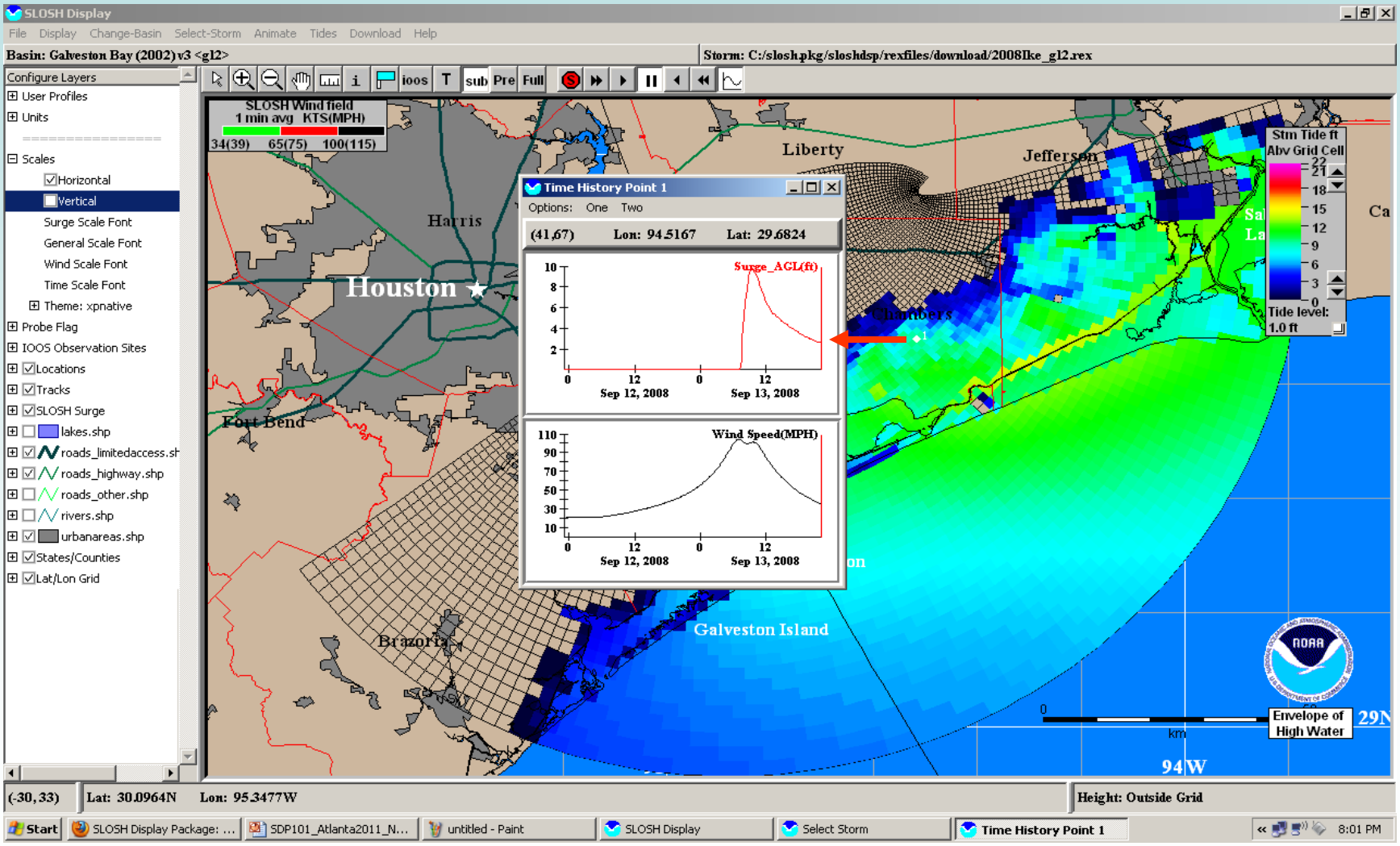
# Animate a Rex File



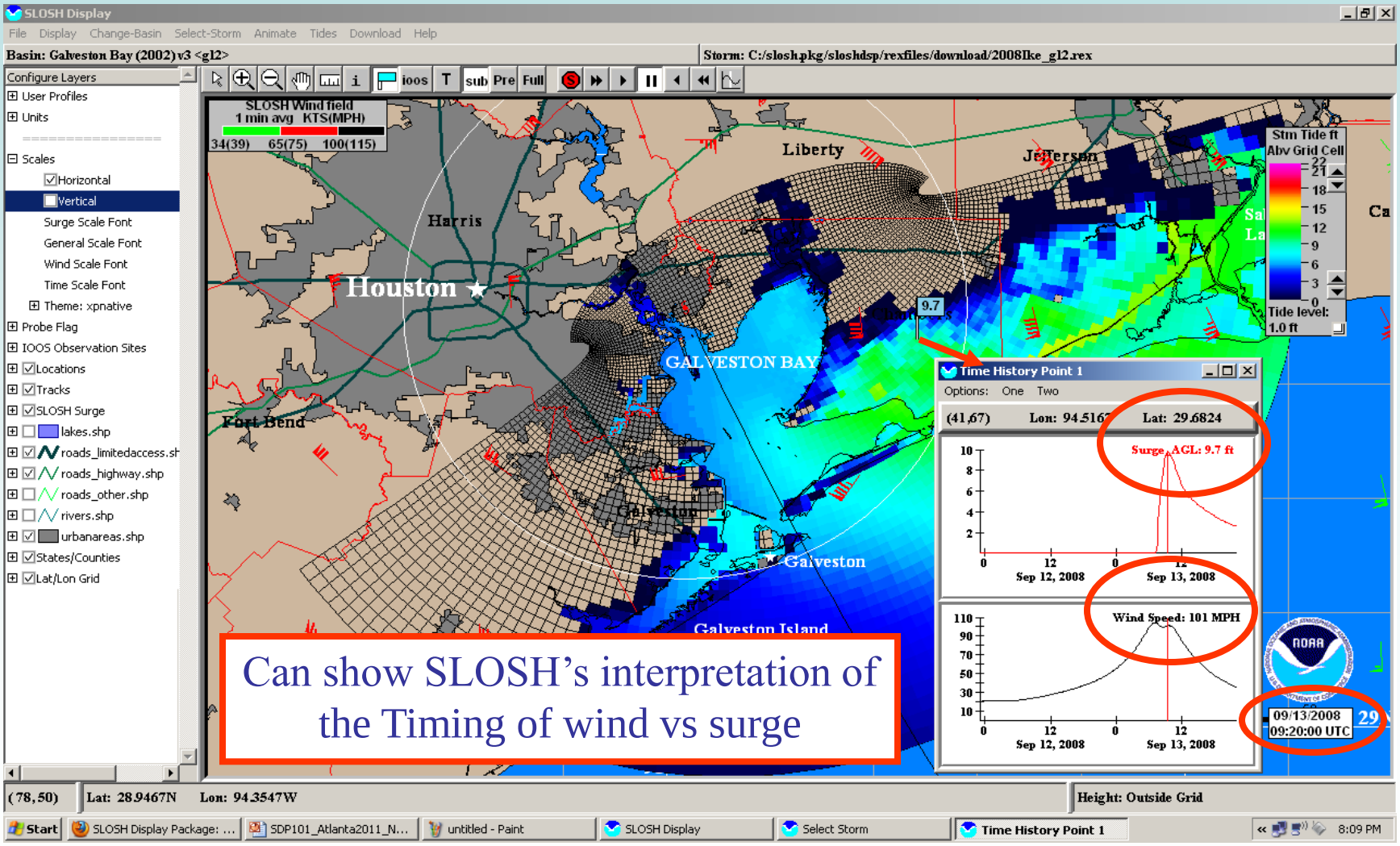
# Animate a Rex File



# Time History Point

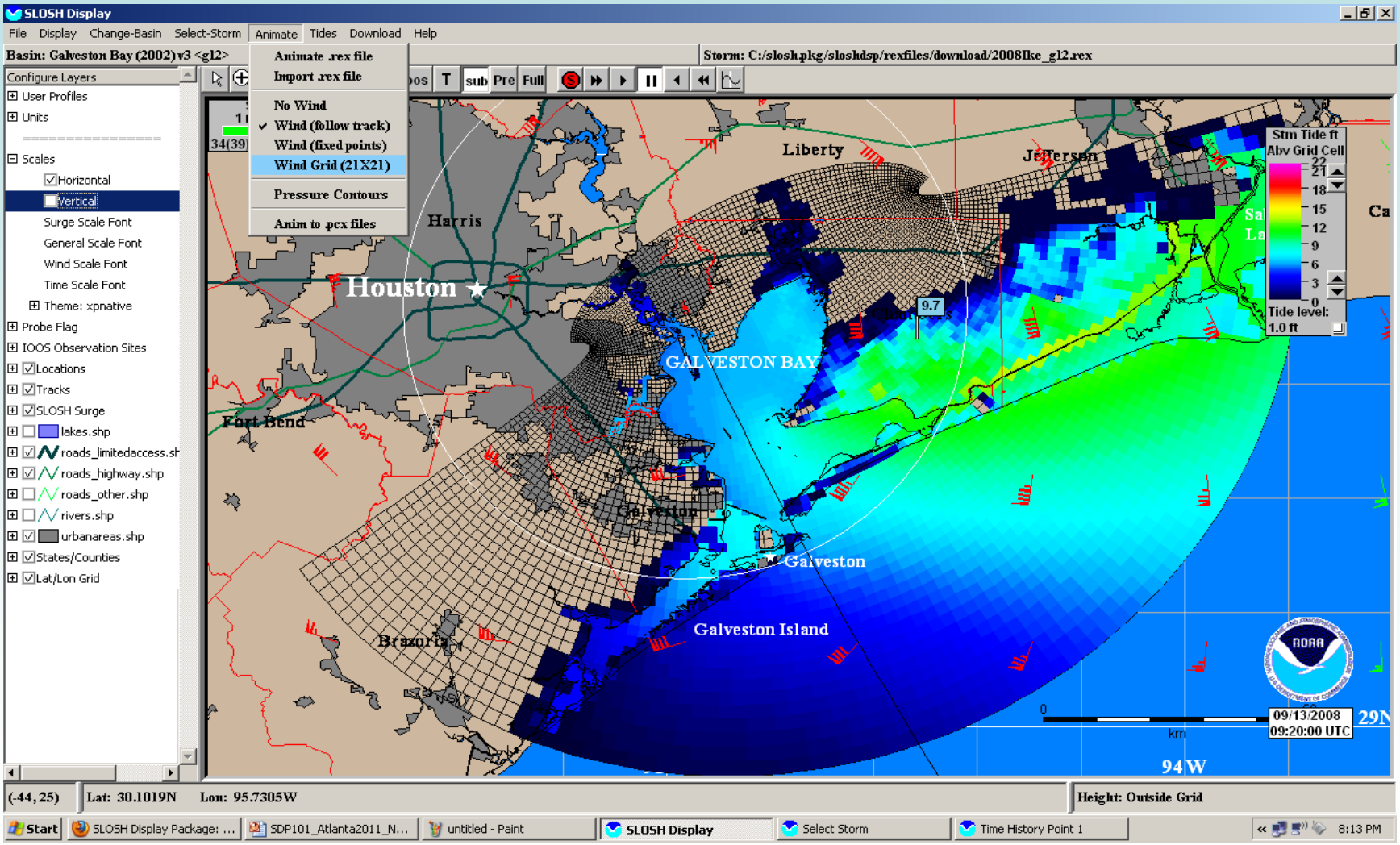


# Time History Point

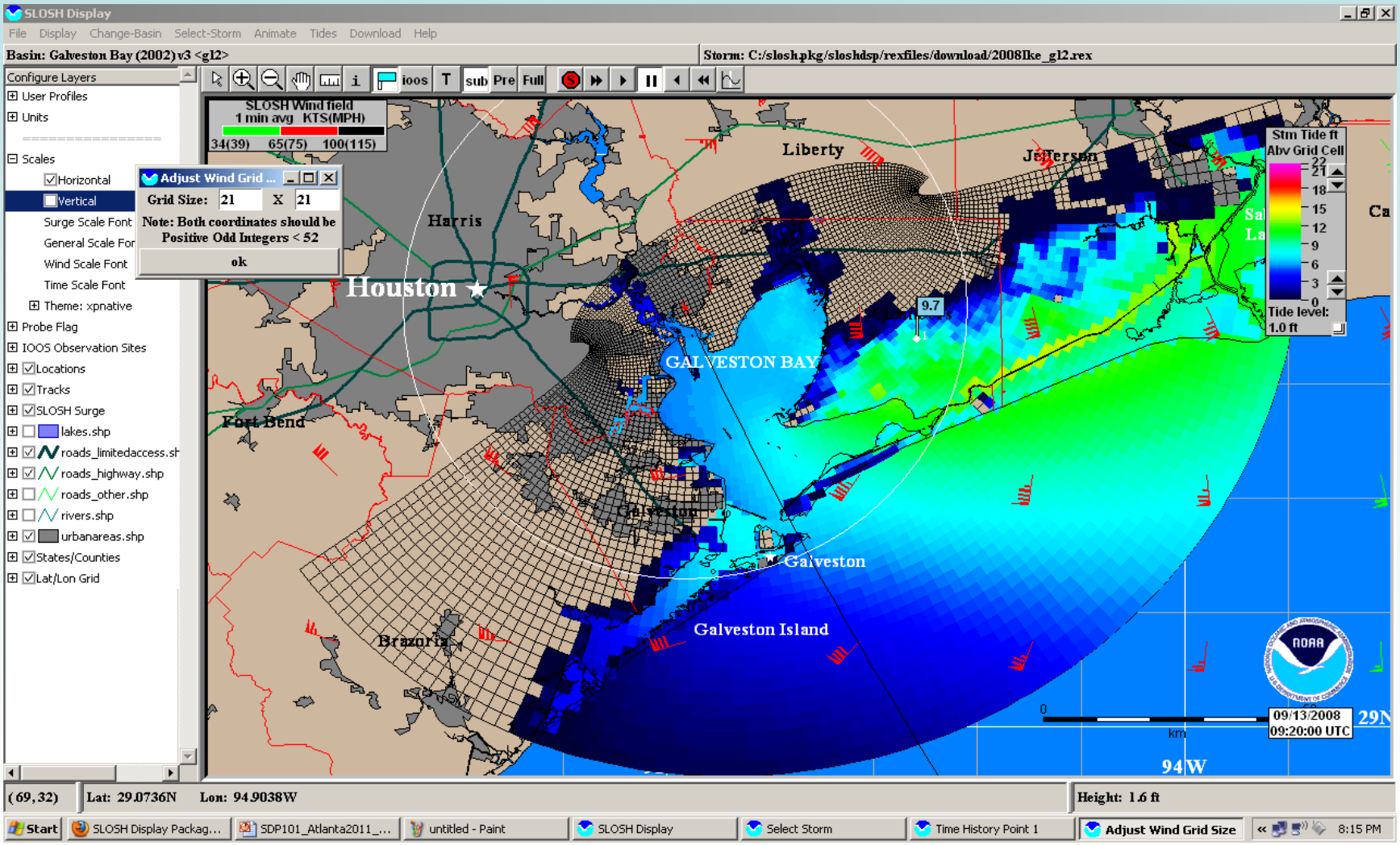



Can show SLOSH's interpretation of the Timing of wind vs surge

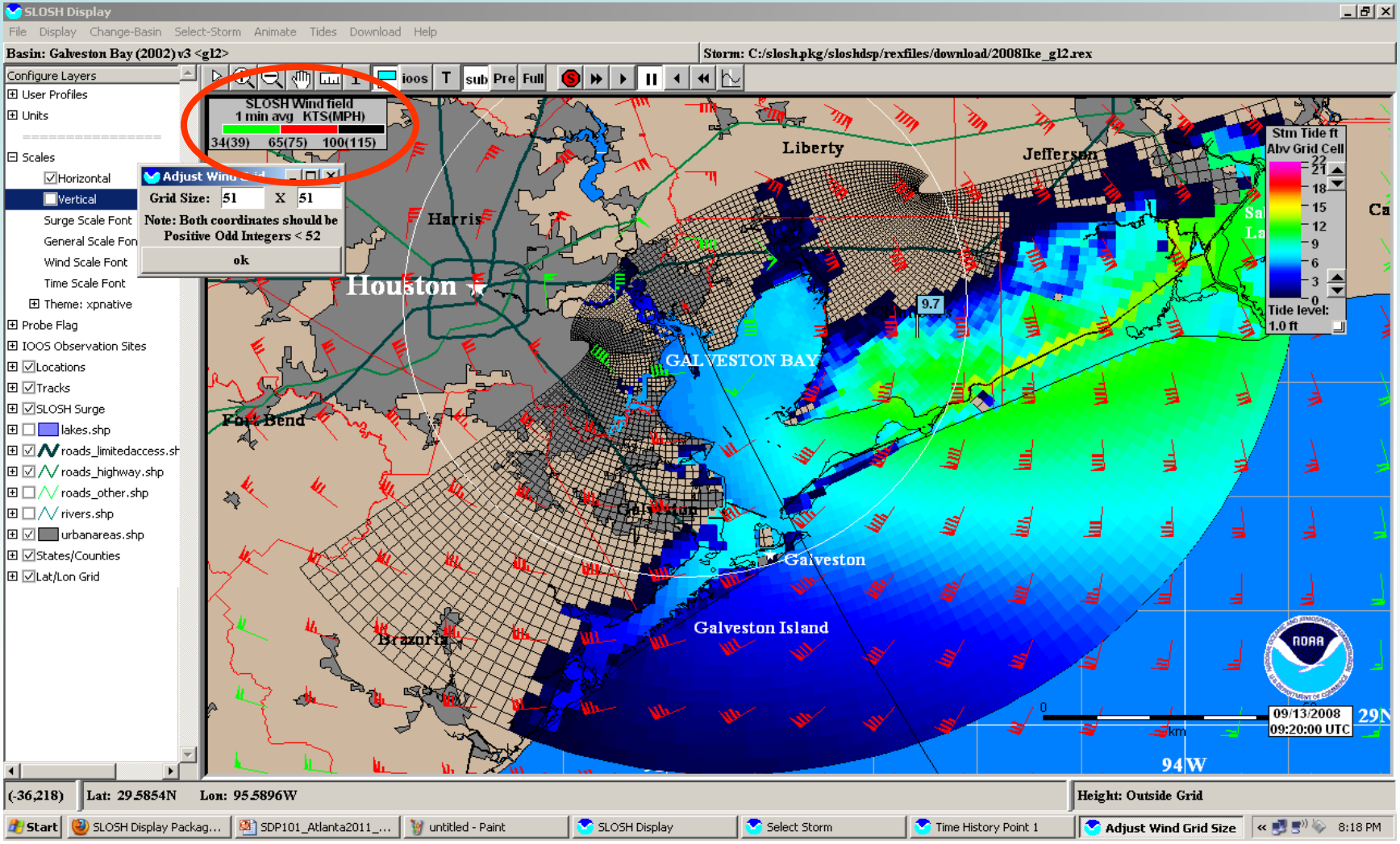
# Wind Barbs


SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: Galveston Bay (2002) v3 <gl2>
Storm: C:/slosh.pkg/sloshdsp/rexfiles/download/2008Ike_gl2.rex
Animate .rex file
Import .rex file
No Wind
Wind (follow track)
Wind (fixed points)
Wind Grid (21X21)
Pressure Contours
Anim to .pcx files
Configure Layers
User Profiles
Units
Scales
Horizontal
Vertical
Surge Scale Font
General Scale Font
Wind Scale Font
Time Scale Font
Theme: xpnative
Probe Flag
IOOS Observation Sites
Locations
Tracks
SLOSH Surge
lakes.shp
roads_limitedaccess.sh
roads_highway.shp
roads_other.shp
rivers.shp
urbanareas.shp
States/Counties
Lat/Lon Grid
Liberty
Jefferson
Harris
Houston
Fort Bend
GALVESTON BAY
Galveston
Galveston Island
Brazoria
9.7
Stm Tide ft Abv Grid Cell
Tide level: 1.0 ft
09/13/2008 09:20:00 UTC
94W
(-44, 25)
Lat: 30.1019N
Lon: 95.7305W
Height: Outside Grid
Start
SLOSH Display Package: ...
SDP101_Atlanta2011_N...
untitled - Paint
SLOSH Display
Select Storm
Time History Point 1
8:13 PM

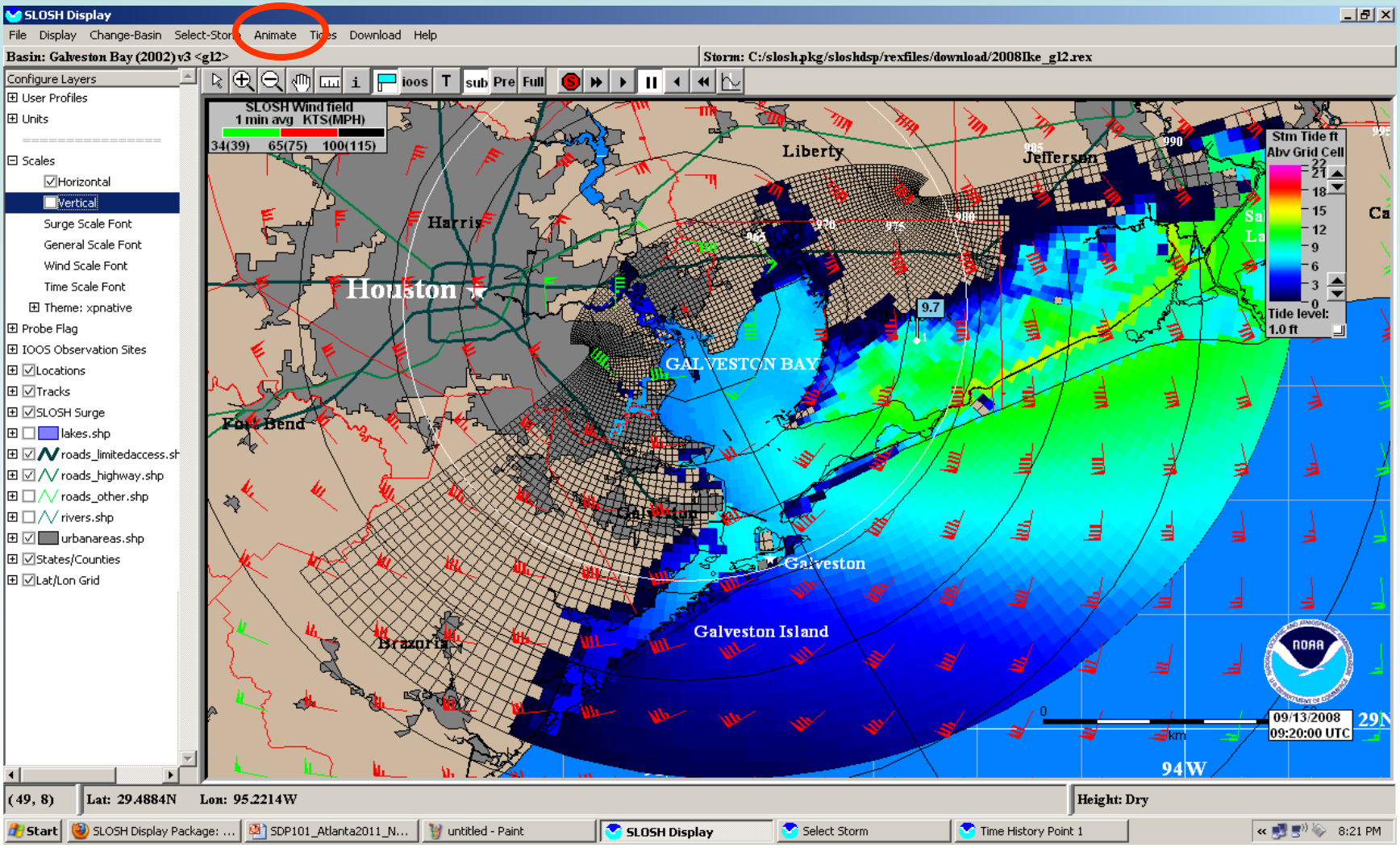
# Wind Barbs


SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: Galveston Bay (2002) v3 <gl2>
Storm: C:/slosh.pkg/sloshdsp/rexfiles/download/2008Ike_gl2.rex
Configure Layers
User Profiles
Units
Scales
Horizontal
Vertical
Surge Scale Font
General Scale For
Wind Scale Font
Time Scale Font
Theme: xpnative
Probe Flag
IOOS Observation Sites
Locations
Tracks
SLOSH Surge
lakes.shp
roads_limitedaccess.sh
roads_highway.shp
roads_other.shp
rivers.shp
urbanareas.shp
States/Counties
Lat/Lon Grid
SLOSH Wind field
1 min avg KTS(MPH)
34(39) 65(75) 100(115)
Adjust Wind Grid ...
Grid Size: 21 X 21
Note: Both coordinates should be Positive Odd Integers < 52
ok
Houston
Harris
Liberty
Jefferson
Fort Bend
Brazoria
Galveston
Galveston Island
GALVESTON BAY
9.7
Stm Tide ft Abv Grid Cell
Tide level: 1.0 ft
09/13/2008 09:20:00 UTC
94W
(69,32)
Lat: 29.0736N Lon: 94.9038W
Height: 1.6 ft
Start
SLOSH Display Packag...
SDP101_Atlanta2011_...
untitled - Paint
SLOSH Display
Select Storm
Time History Point 1
Adjust Wind Grid Size
8:15 PM

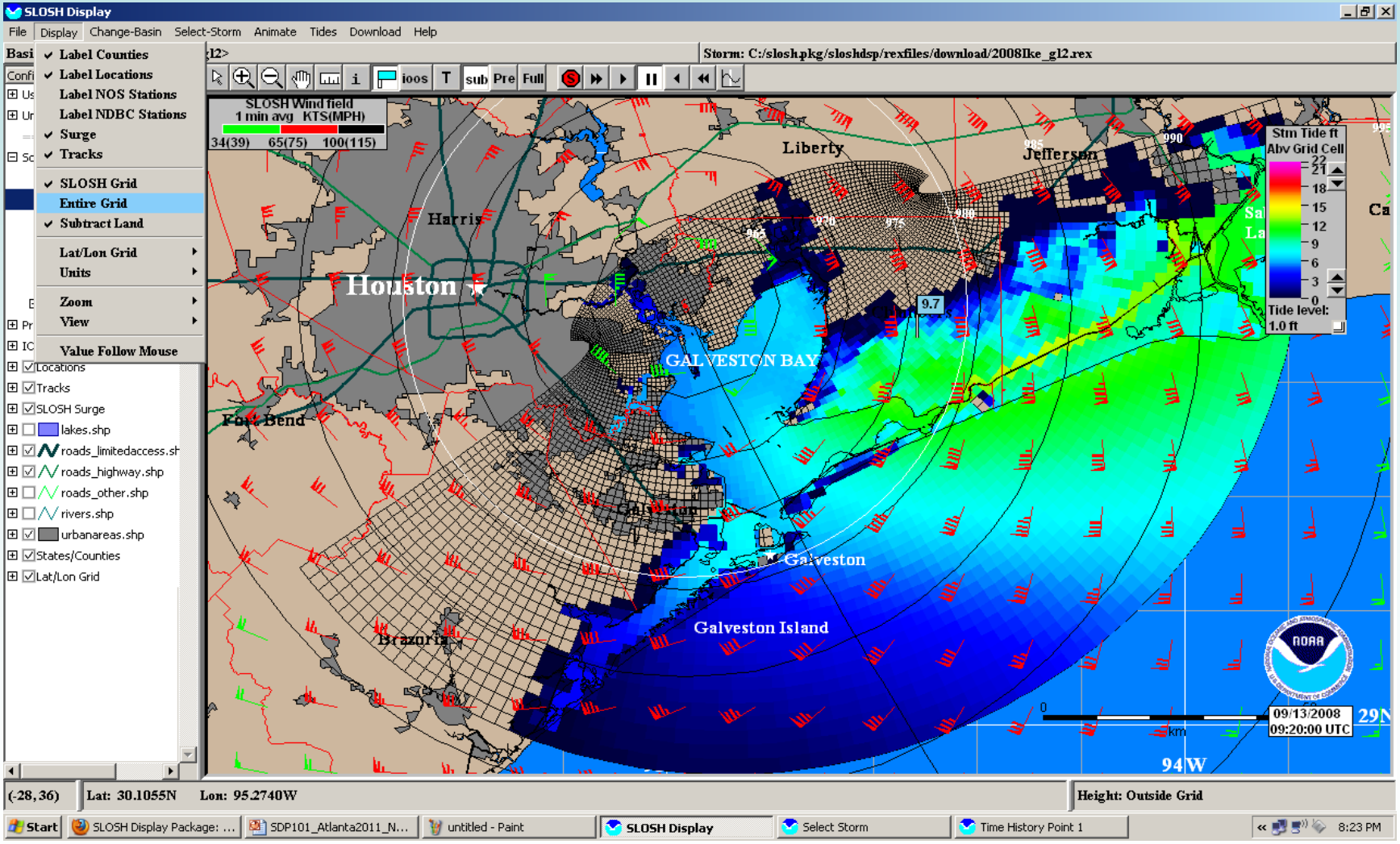
# Wind Barbs


SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: Galveston Bay (2002) v3 <gl2>
Storm: C:/slosh.pkg/sloshdsp/rexfiles/download/2008Ike_gl2.rex
Configure Layers
User Profiles
Units
Scales
Horizontal
Vertical
Surge Scale Font
General Scale Fon
Wind Scale Font
Time Scale Font
Theme: xpnative
Probe Flag
IOOS Observation Sites
Locations
Tracks
SLOSH Surge
lakes.shp
roads_limitedaccess.sh
roads_highway.shp
roads_other.shp
rivers.shp
urbanareas.shp
States/Counties
Lat/Lon Grid
SLOSH Wind field
1 min avg KTS(MPH)
34(39) 65(75) 100(115)
Adjust Wind
Grid Size: 51 X 51
Note: Both coordinates should be Positive Odd Integers < 52
ok
Stm Tide ft Abv Grid Cell
Tide level: 1.0 ft
Houston
Harris
Liberty
Jefferson
Fort Bend
Brazoria
GALVESTON BAY
Galveston
Galveston Island
9.7
09/13/2008
09:20:00 UTC
94W
(-36,218)
Lat: 29.5854N Lon: 95.5896W
Height: Outside Grid
Start
SLOSH Display Packag...
SDP101_Atlanta2011_...
untitled - Paint
SLOSH Display
Select Storm
Time History Point 1
Adjust Wind Grid Size
8:18 PM

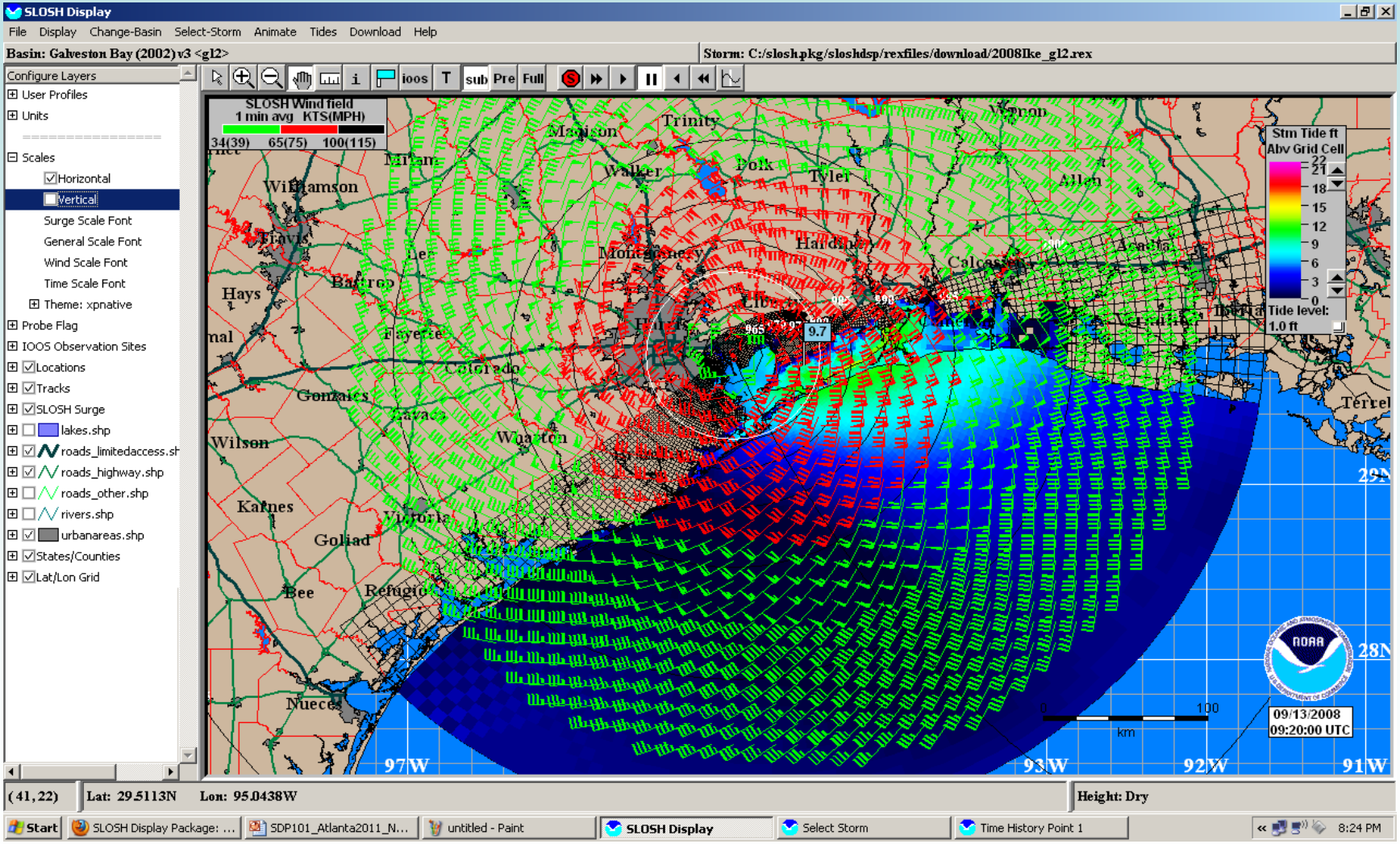
# Pressure Contours



# Entire Grid

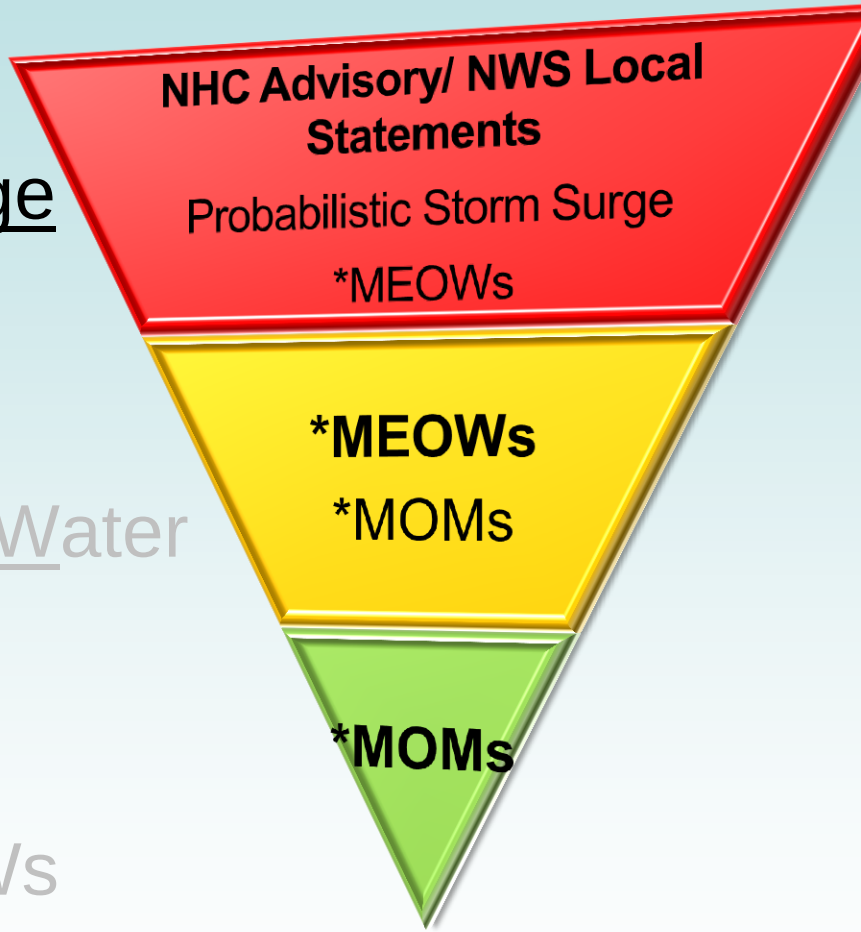

SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Label Counties
Label Locations
Label NOS Stations
Label NDBC Stations
Surge
Tracks
SLOSH Grid
Entire Grid
Subtract Land
Lat/Lon Grid
Units
Zoom
View
Value Follow Mouse
Storm: C:/slosh.pkg/sloshdsp/rexfiles/download/2008Ike_gl2.rex
SLOSH Wind field
1 min avg KTS(MPH)
34(39) 65(75) 100(115)
Stm Tide ft
Abv Grid Cell
Tide level:
1.0 ft
Liberty
Jefferson
Harris
Houston
GALVESTON BAY
Fort Bend
Galveston
Galveston Island
Brazoria
09/13/2008
09:20:00 UTC
94W
(-28,36)
Lat: 30.1055N Lon: 95.2740W
Height: Outside Grid
Start
SLOSH Display
Select Storm
Time History Point 1
8:23 PM

# Entire Grid

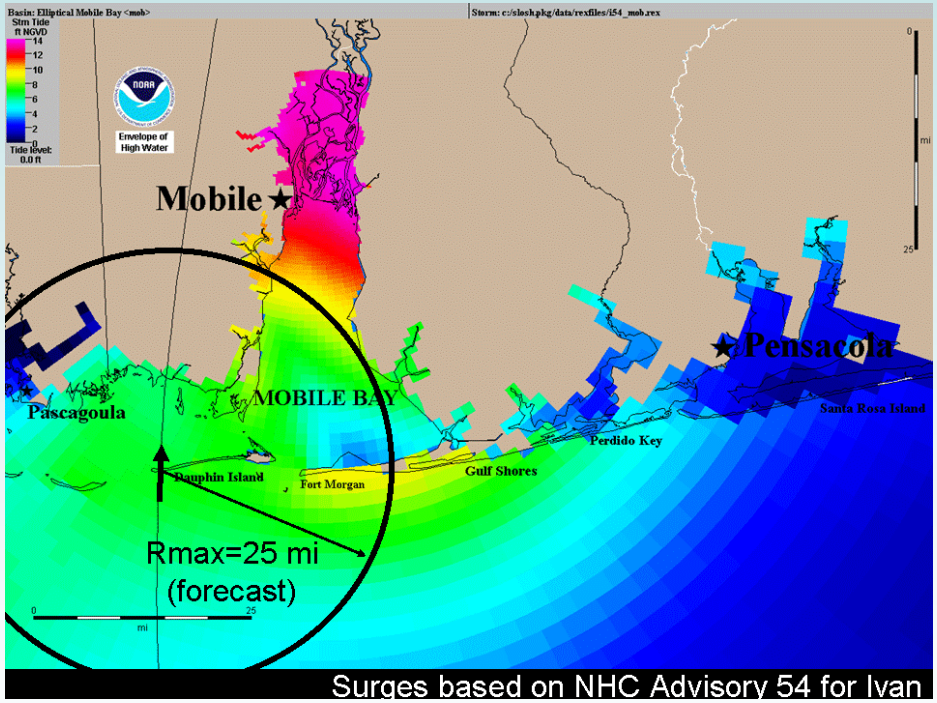

SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: Galveston Bay (2002) v3 <gl2>
Storm: C:/slosh.pkg/sloshdsp/rexfiles/download/2008Ike_gl2.rex
Configure Layers
User Profiles
Units
Scales
Horizontal
Vertical
Surge Scale Font
General Scale Font
Wind Scale Font
Time Scale Font
Theme: xpnative
Probe Flag
IOOS Observation Sites
Locations
Tracks
SLOSH Surge
lakes.shp
roads_limitedaccess.sh
roads_highway.shp
roads_other.shp
rivers.shp
urbanareas.shp
States/Counties
Lat/Lon Grid
SLOSH Wind field
1 min avg KTS(MPH)
34(39) 65(75) 100(115)
Stm Tide ft
Abv Grid Cell
Tide level:
1.0 ft
Madison
Trinity
Walker
Polk
Tyler
Williamson
Montgomery
Hardin
Calcasieu
Hays
Fayette
Colorado
Gonzales
Wilson
Karnes
Goliad
Bee
Refugio
Nueces
Terrel
09/13/2008
09:20:00 UTC
97W
93W
92W
91W
(41,22)
Lat: 29.5113N
Lon: 95.0438W
Height: Dry
Start
SLOSH Display Package: ...
SDP101_Atlanta2011_N...
untitled - Paint
SLOSH Display
Select Storm
Time History Point 1
8:24 PM

# Ensemble Products

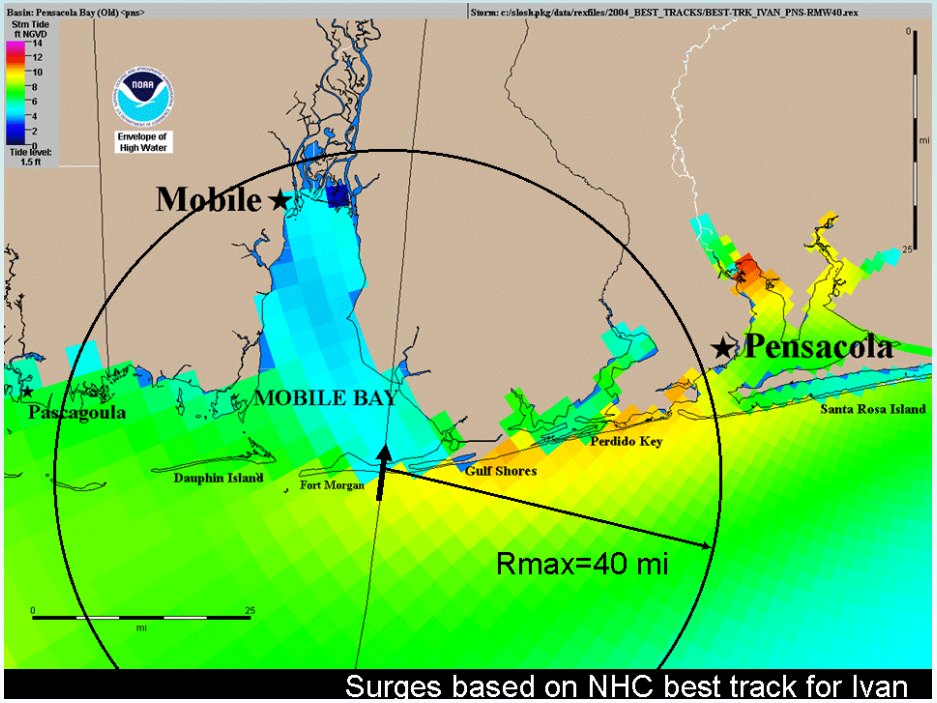
- P-Surge
  - Probabilistic Storm Surge
- MEOW
  - Maximum Envelope Of Water
- MOM
  - Maximum Of the MEOWs



# Hurricane Ivan: A case study

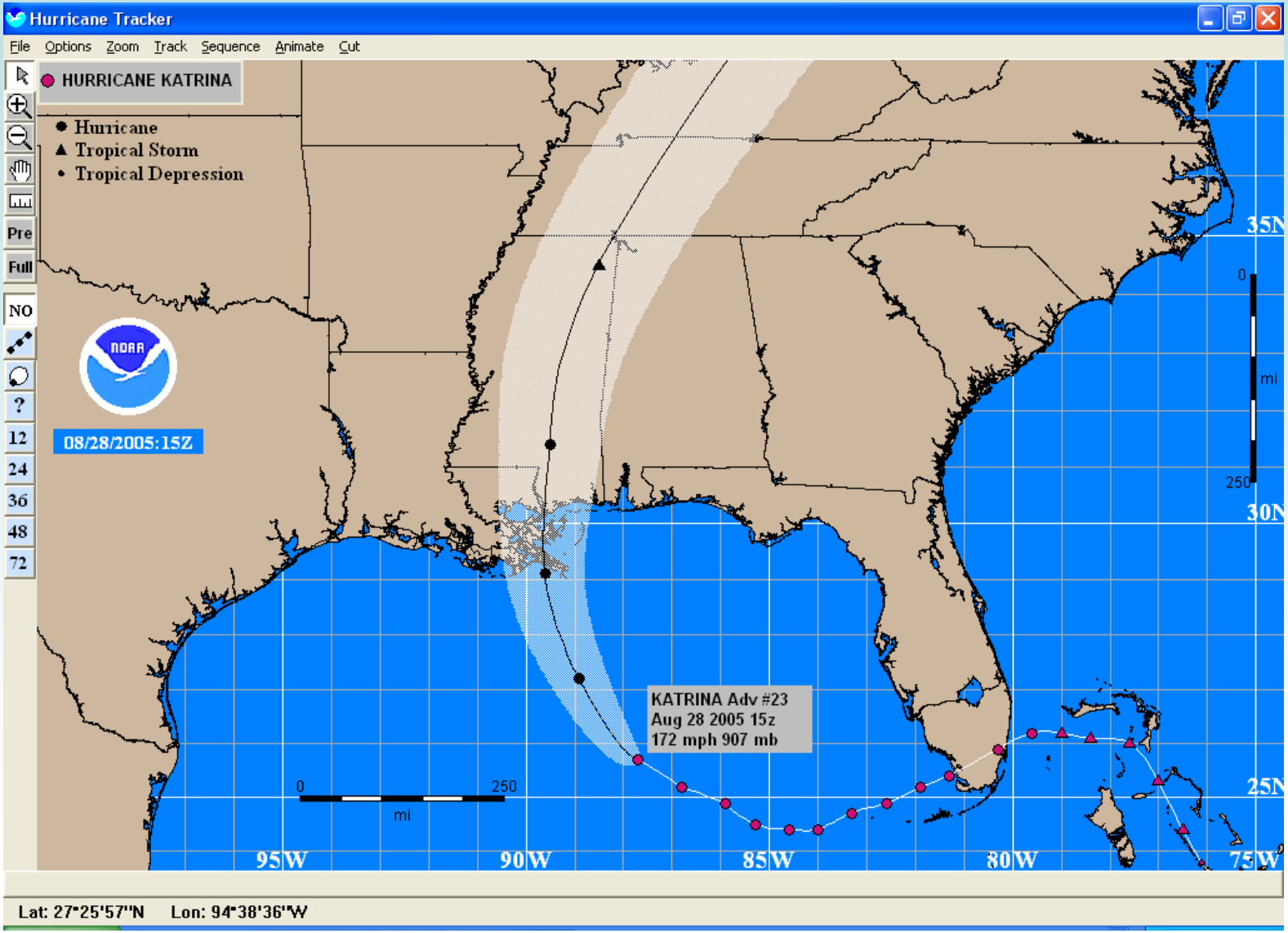


Surges based on NHC Advisory 54 for Ivan

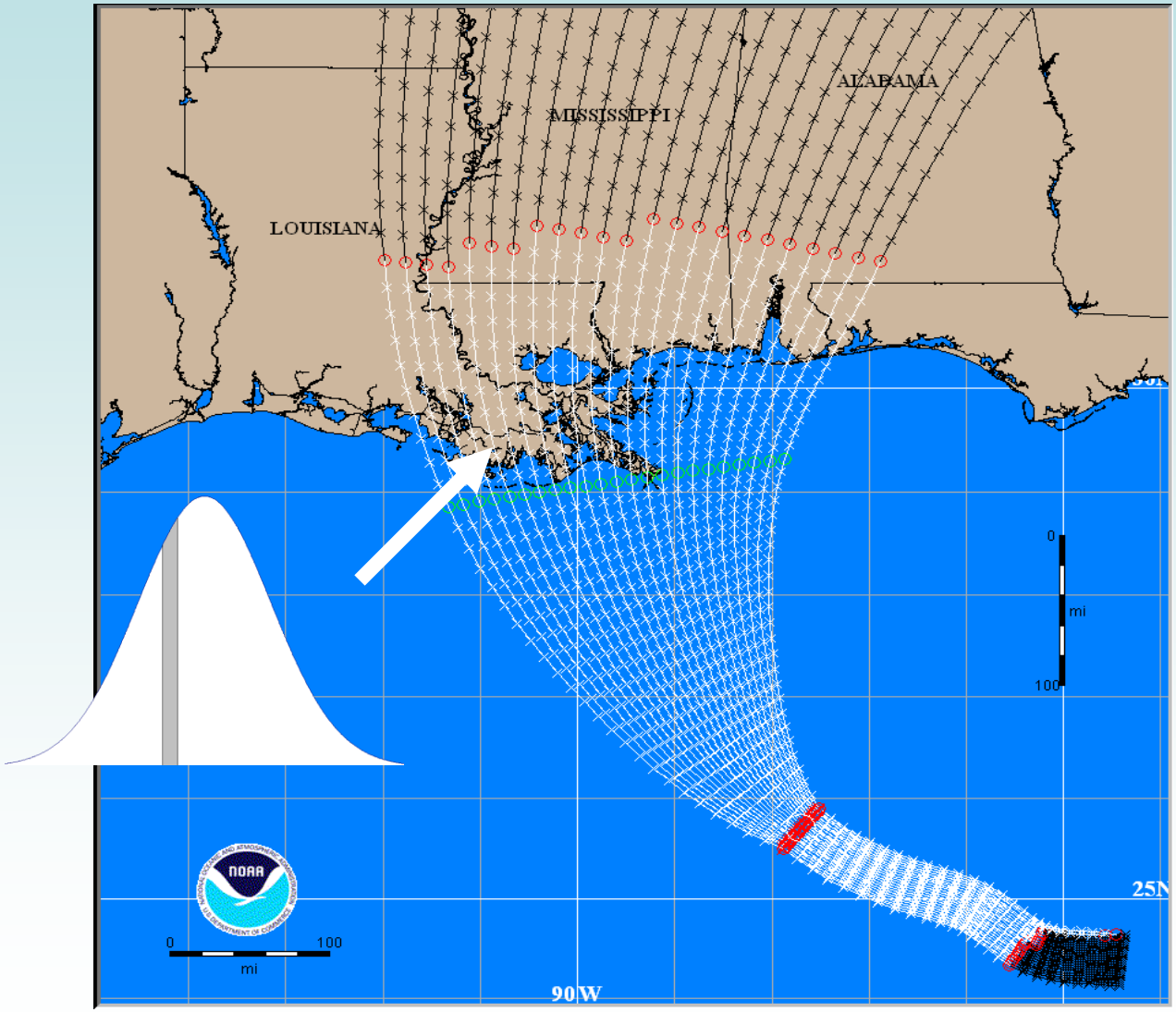


Surges based on NHC best track for Ivan

# Katrina Advisory 23



# P-surge - Vary Cross Track



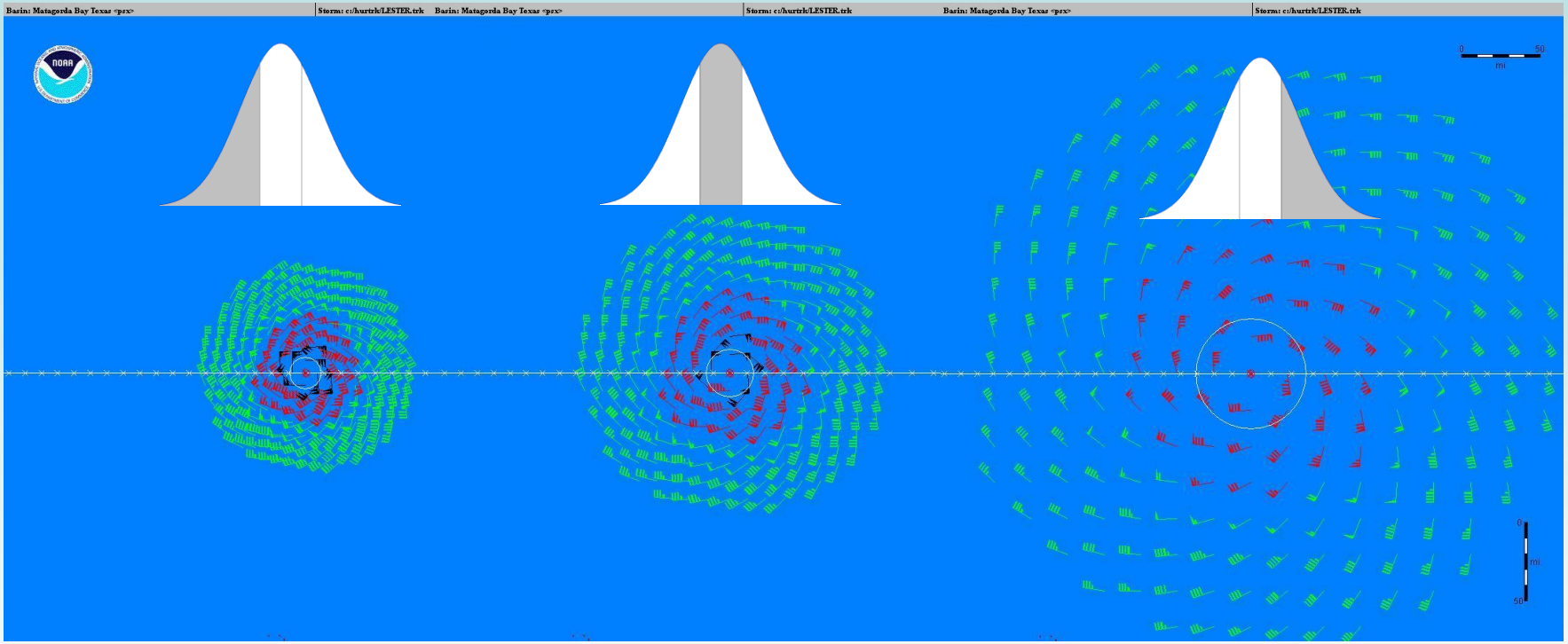
# But wait, I have more dogs (all adopted from shelters)

**Adventure: Small, Intense, Slower**

**Buddy: Large, Laid Back, Medium speed**

**Sandy: Medium Size, Medium Intensity, Fast**

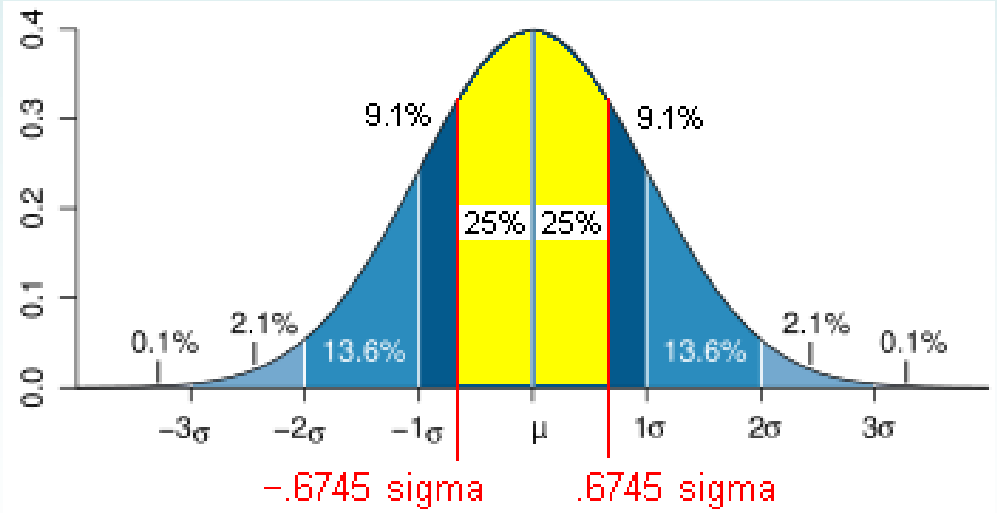
# P-Surge – Vary Other Variables




- 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

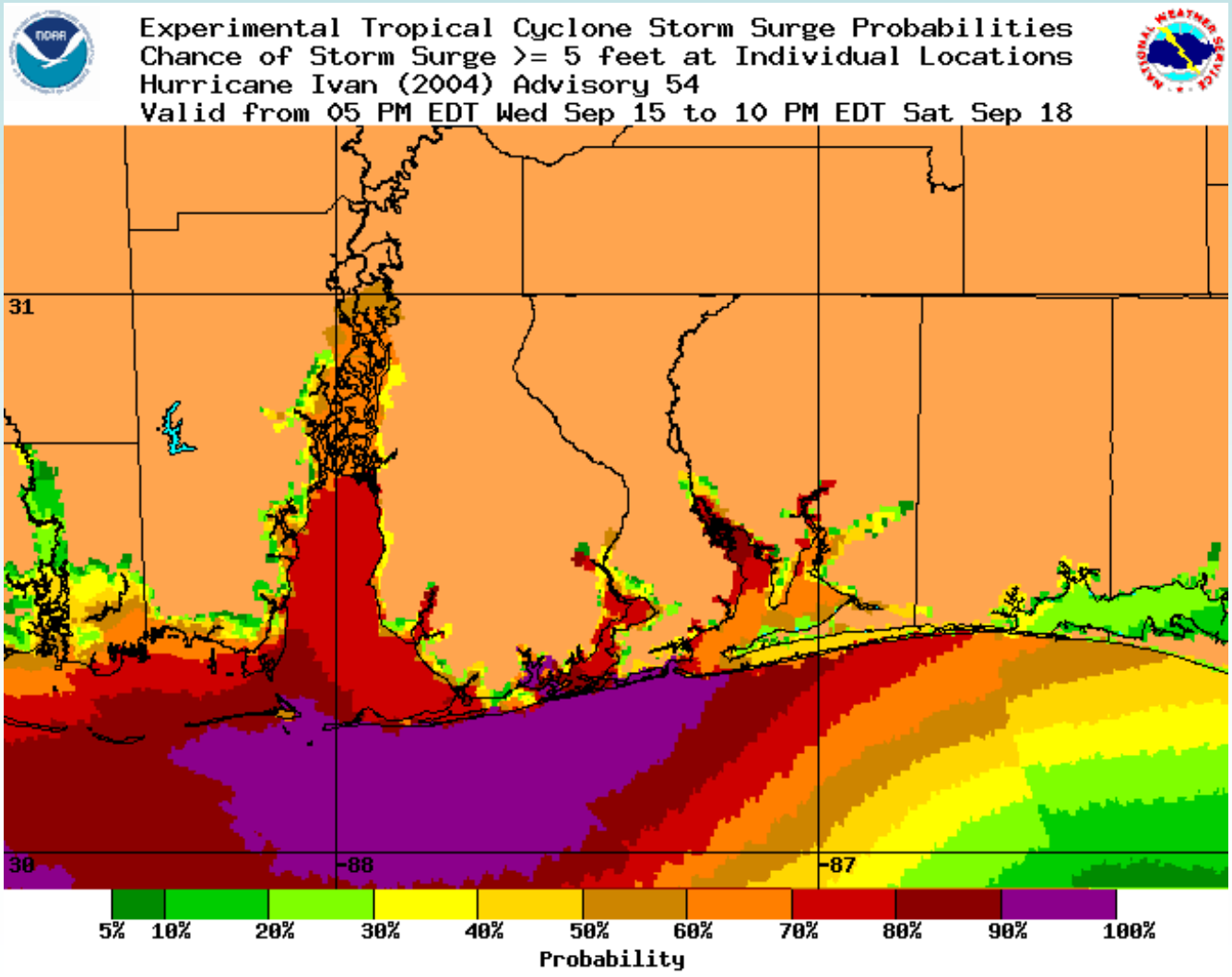
- Error distributions are computed for cross track, along track and intensity by:
  - Assuming a normal distribution
  - Using a 5-year “mean absolute error” and getting the standard deviation (sigma) from:




**Mean absolute error occurs at .6745 sigma**

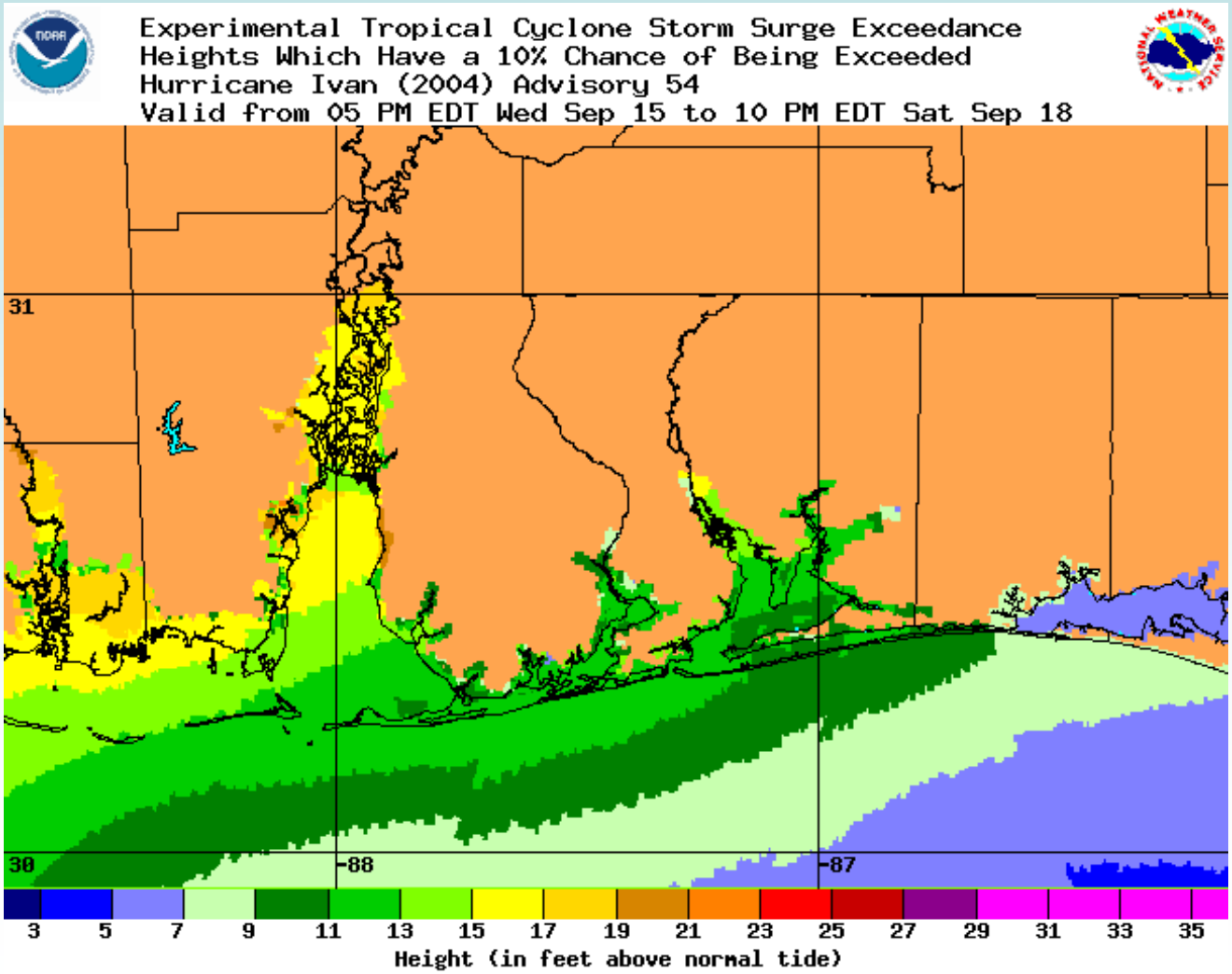
# Probability of >= 5 feet of Surge

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



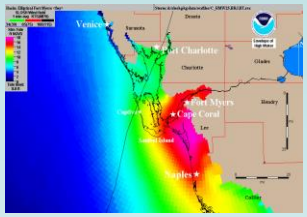
# Surge Height Exceeded by 10% of Ensemble Members

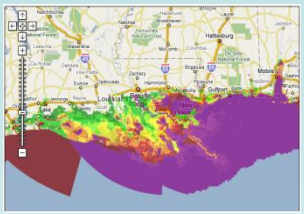
http://www.weather.gov/mdl/psurge/



# Observation & Tide Module

- Mix Surge model output



- with Tide predictions

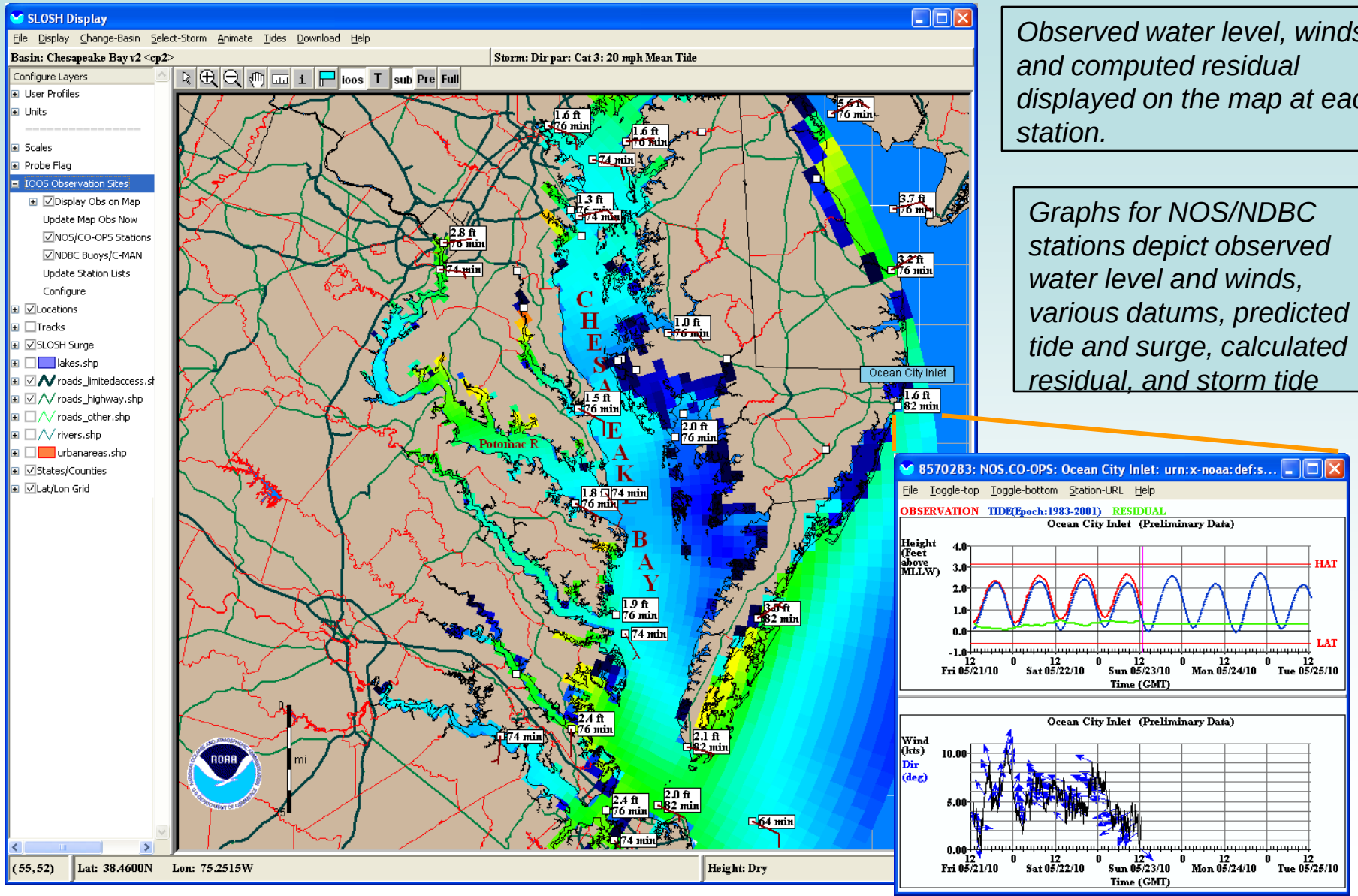
**Tides**
**NOAA-NOS**
**(CO-OPS)**

- and compare to Observations

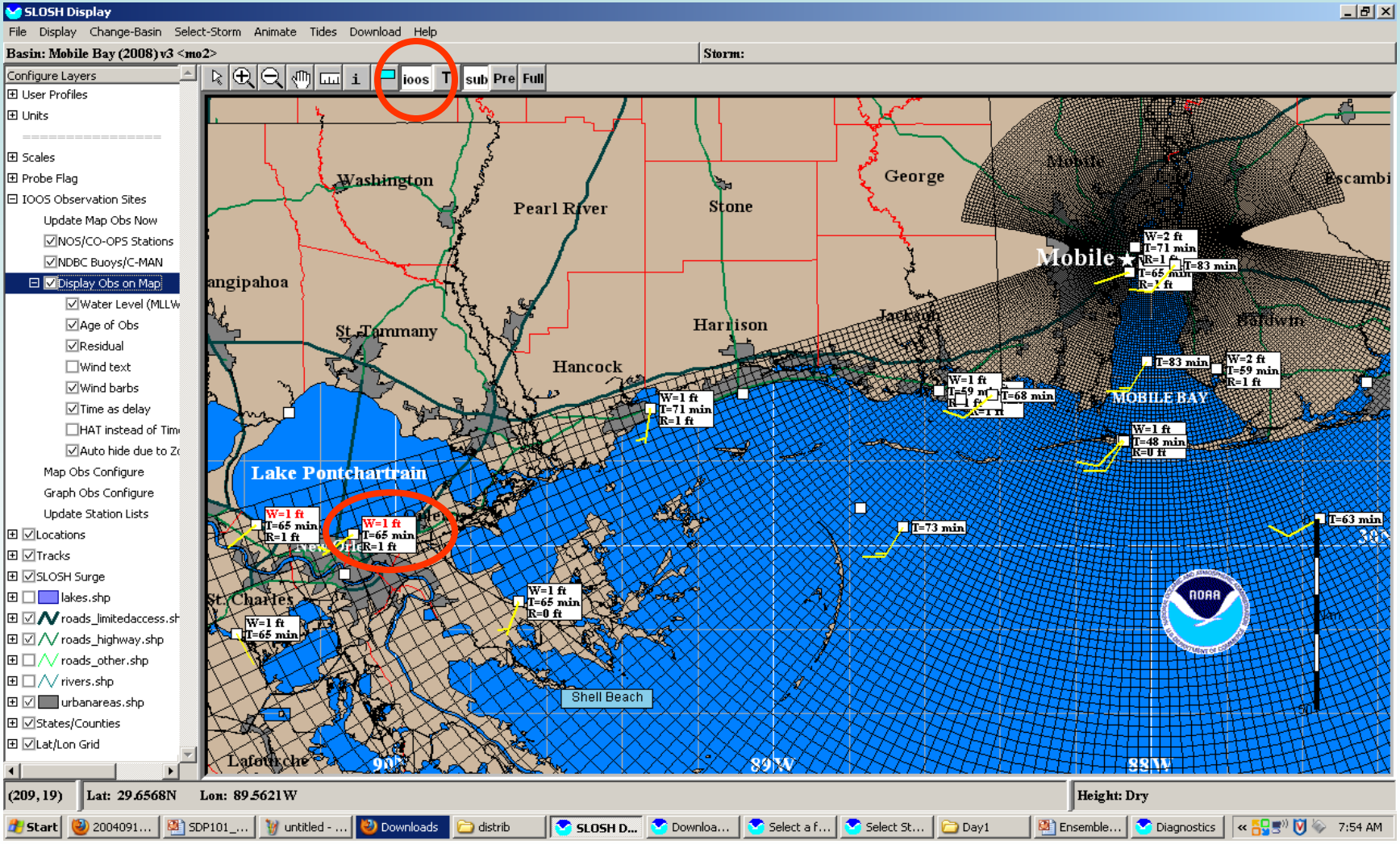
# Observational Enhancements to SDP

*Observed water level, winds, and computed residual displayed on the map at each station.*

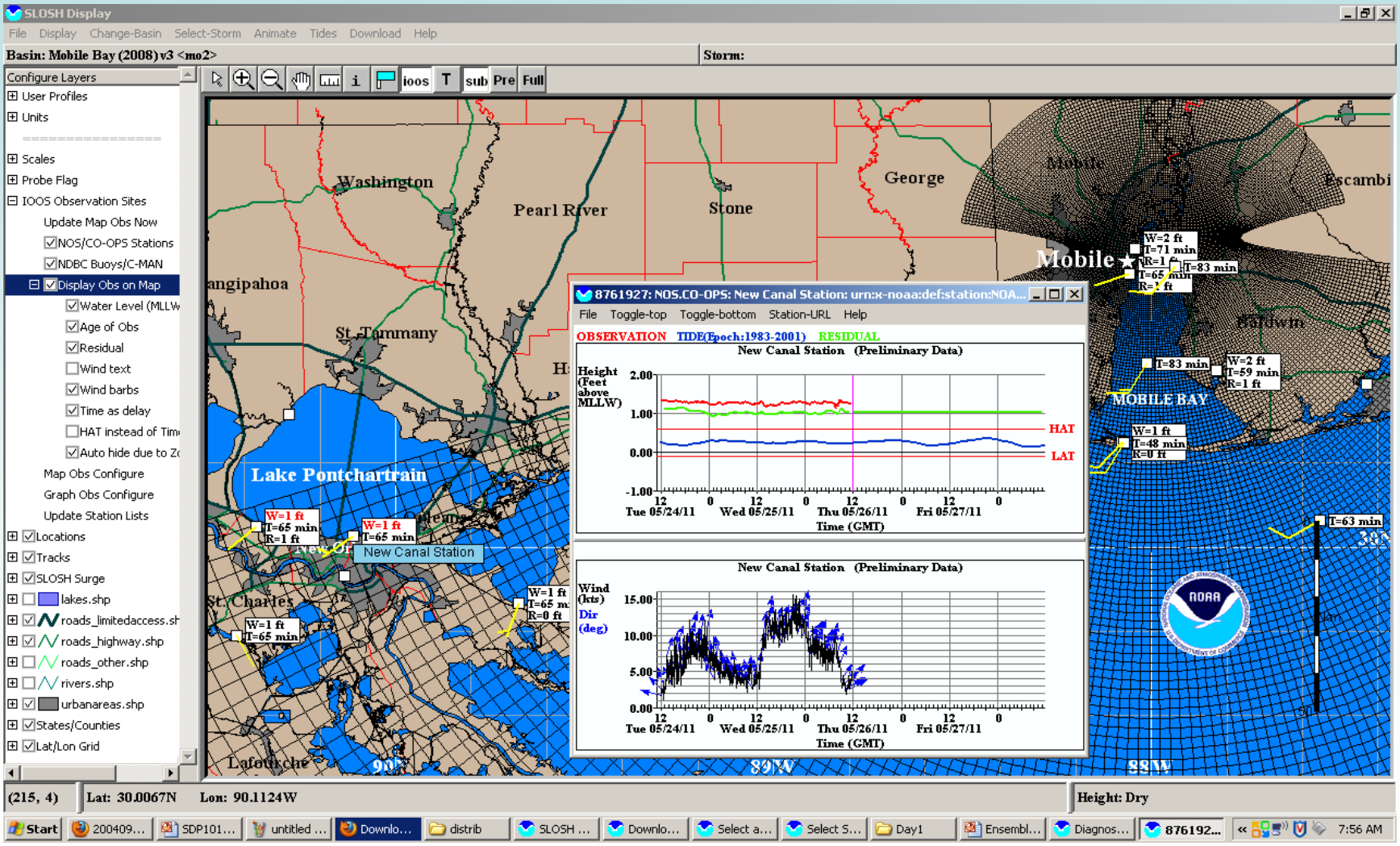
*Graphs for NOS/NDBC stations depict observed water level and winds, various datums, predicted tide and surge, calculated residual, and storm tide*



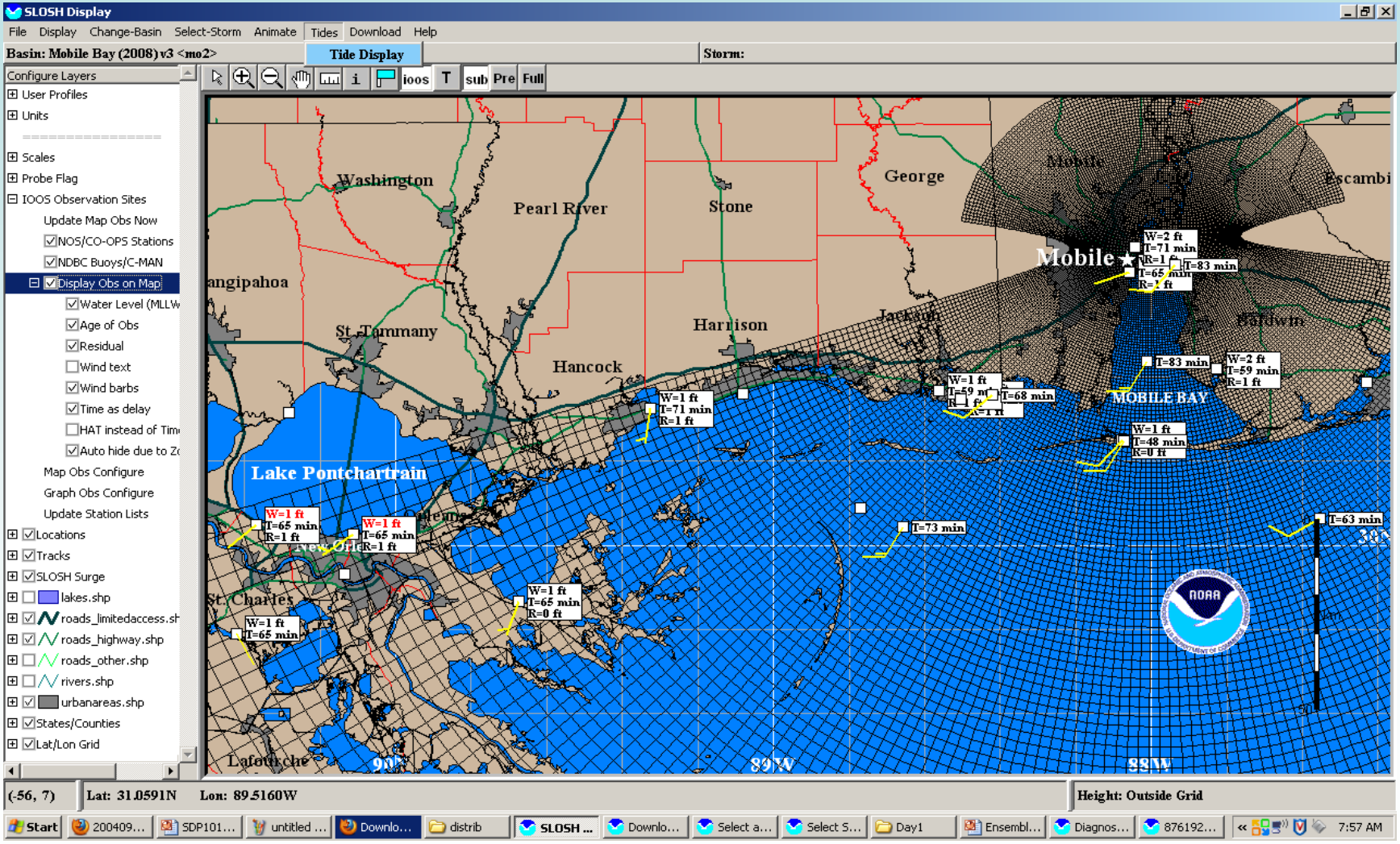
# *Observed water level, winds, and computed residual displayed on the map*



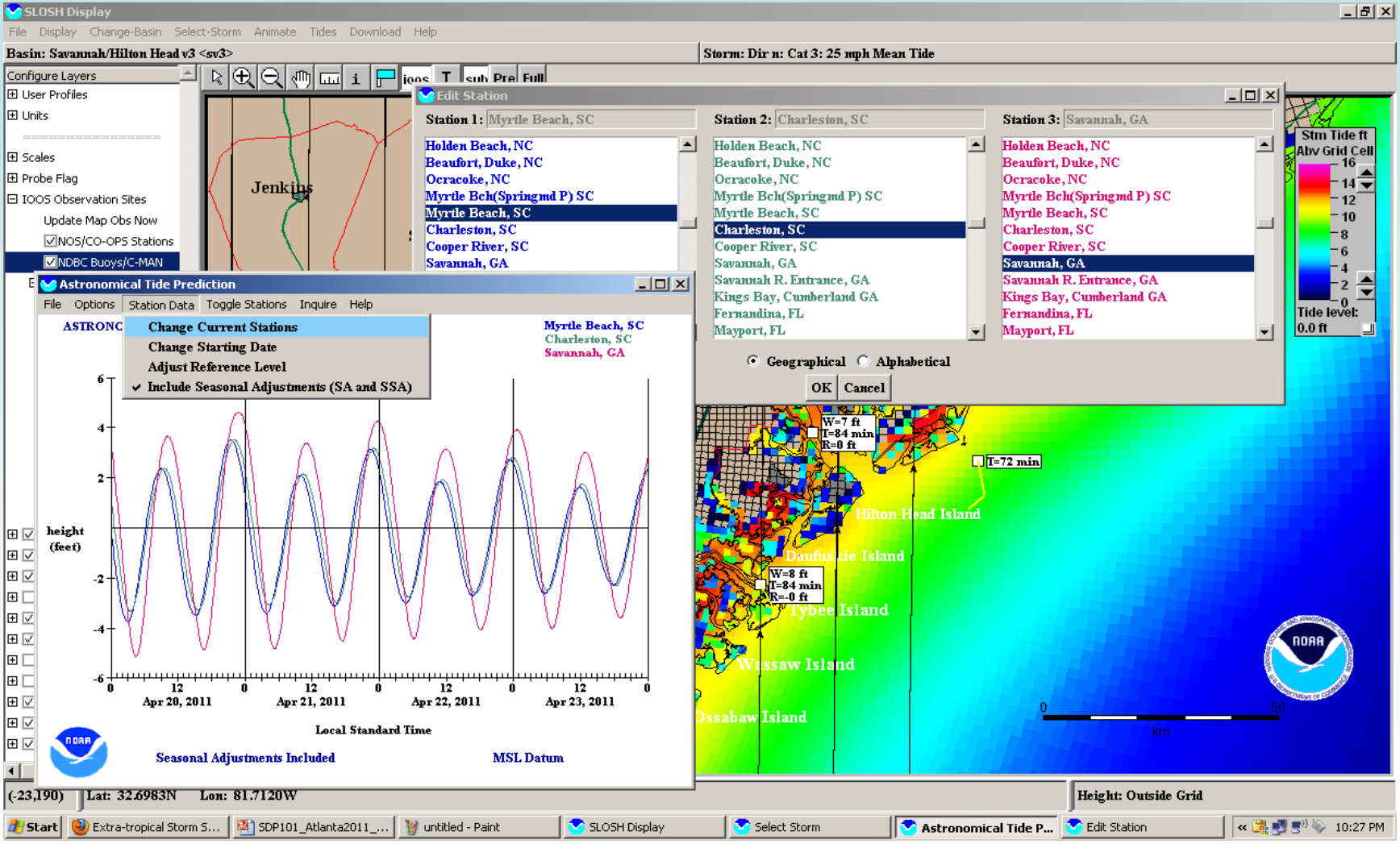
# Observational Enhancements to SDP



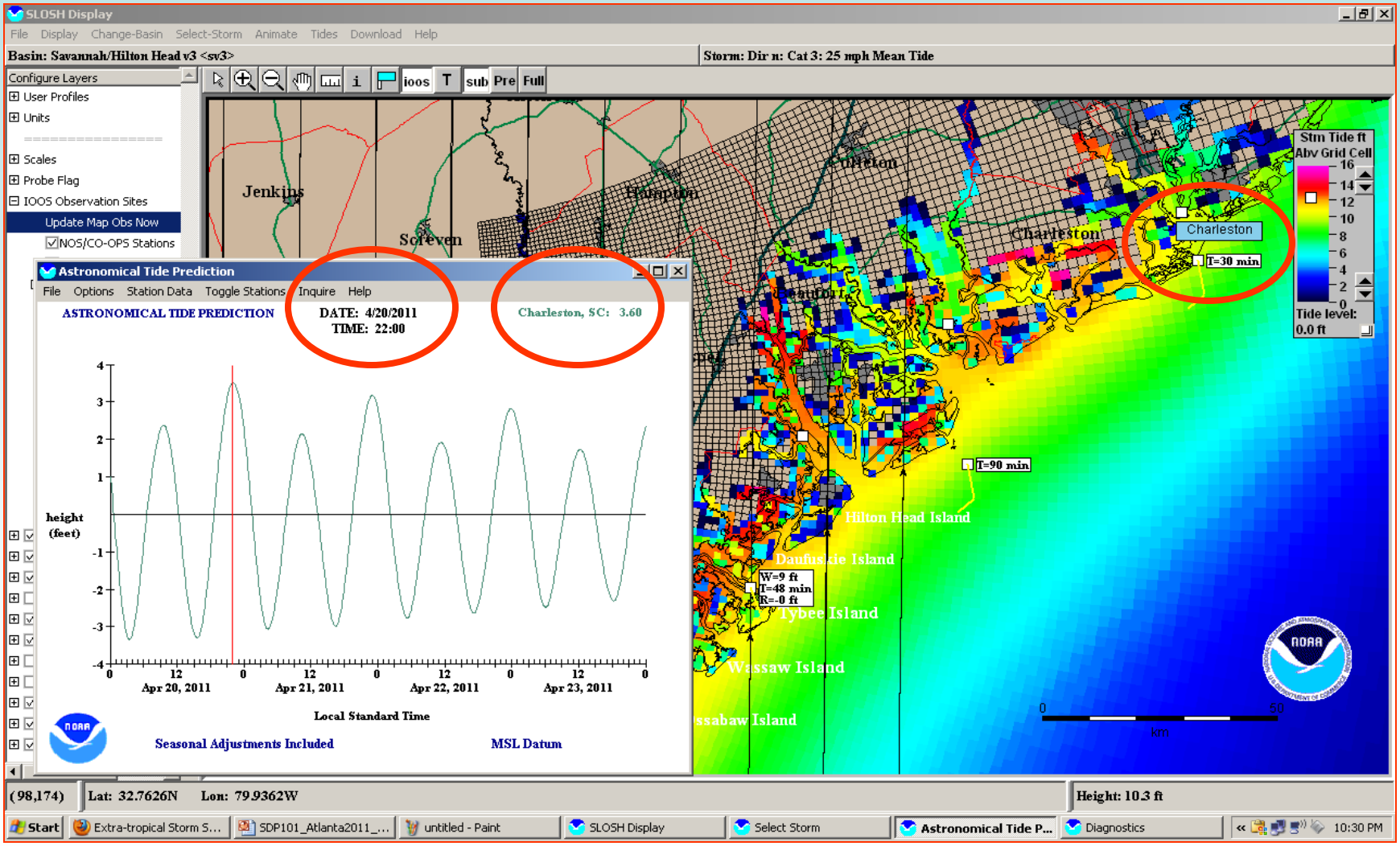
# Tide Program



# Tide Program



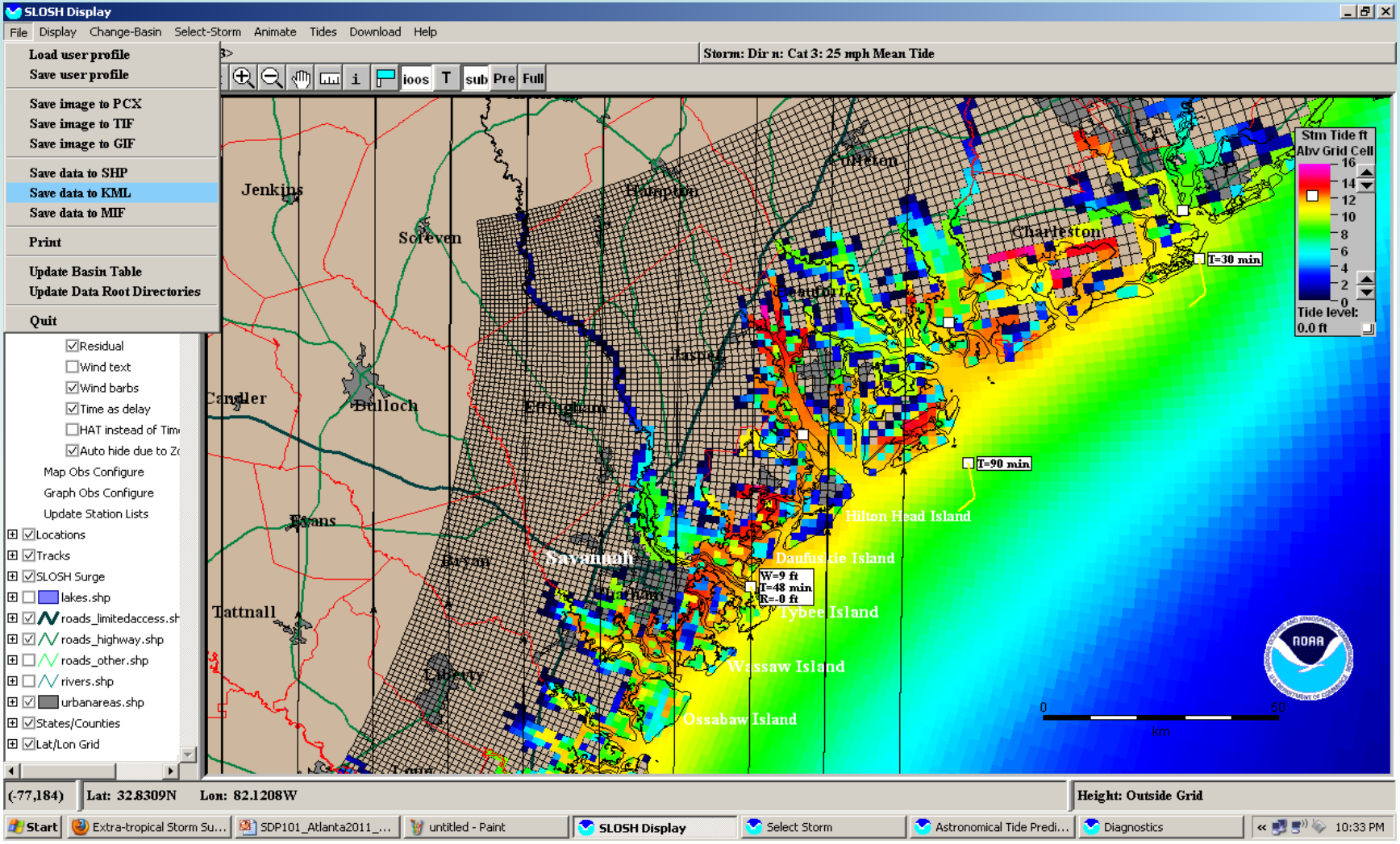
# Tide Program



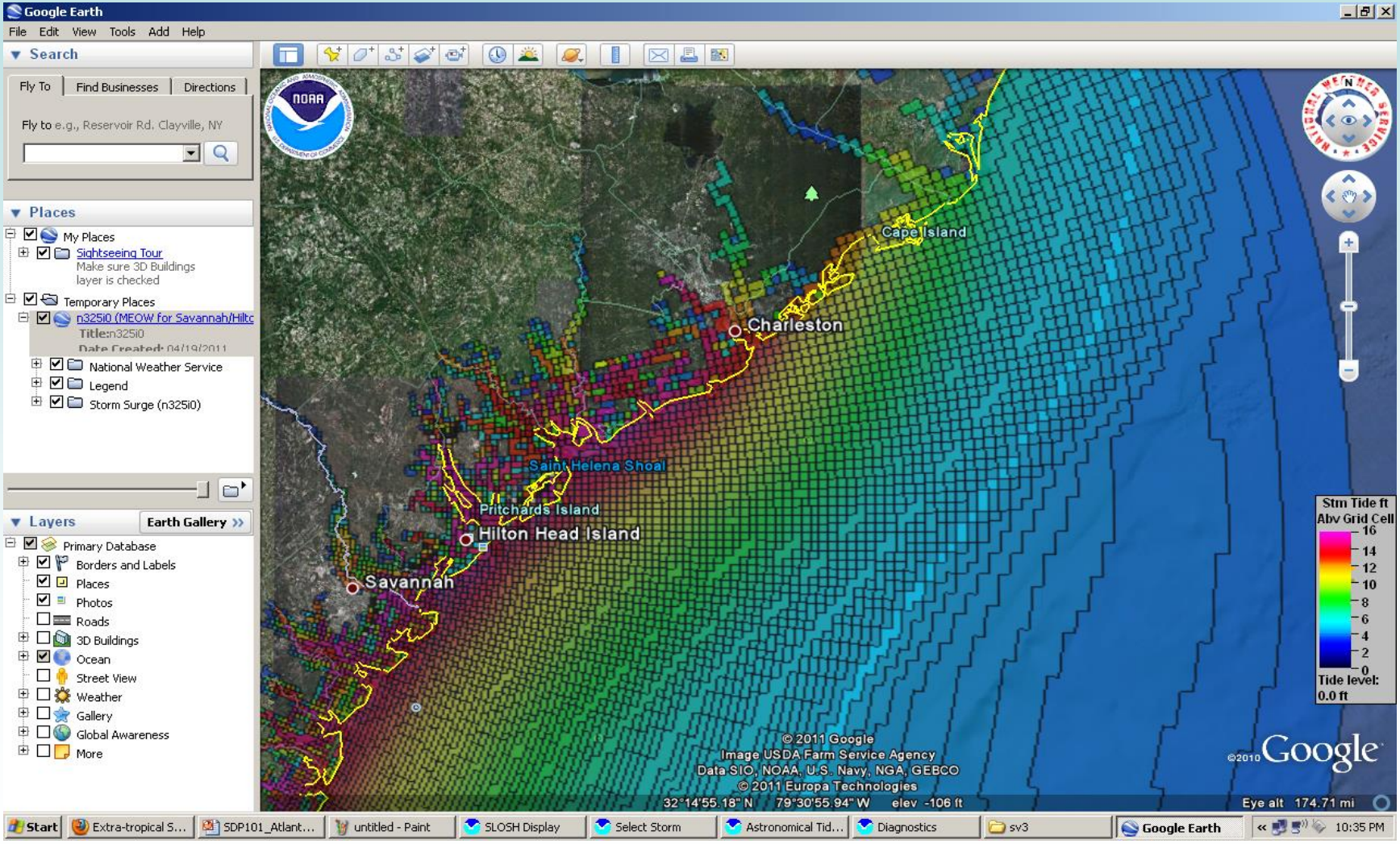
# What's Left?

Kitchen sink

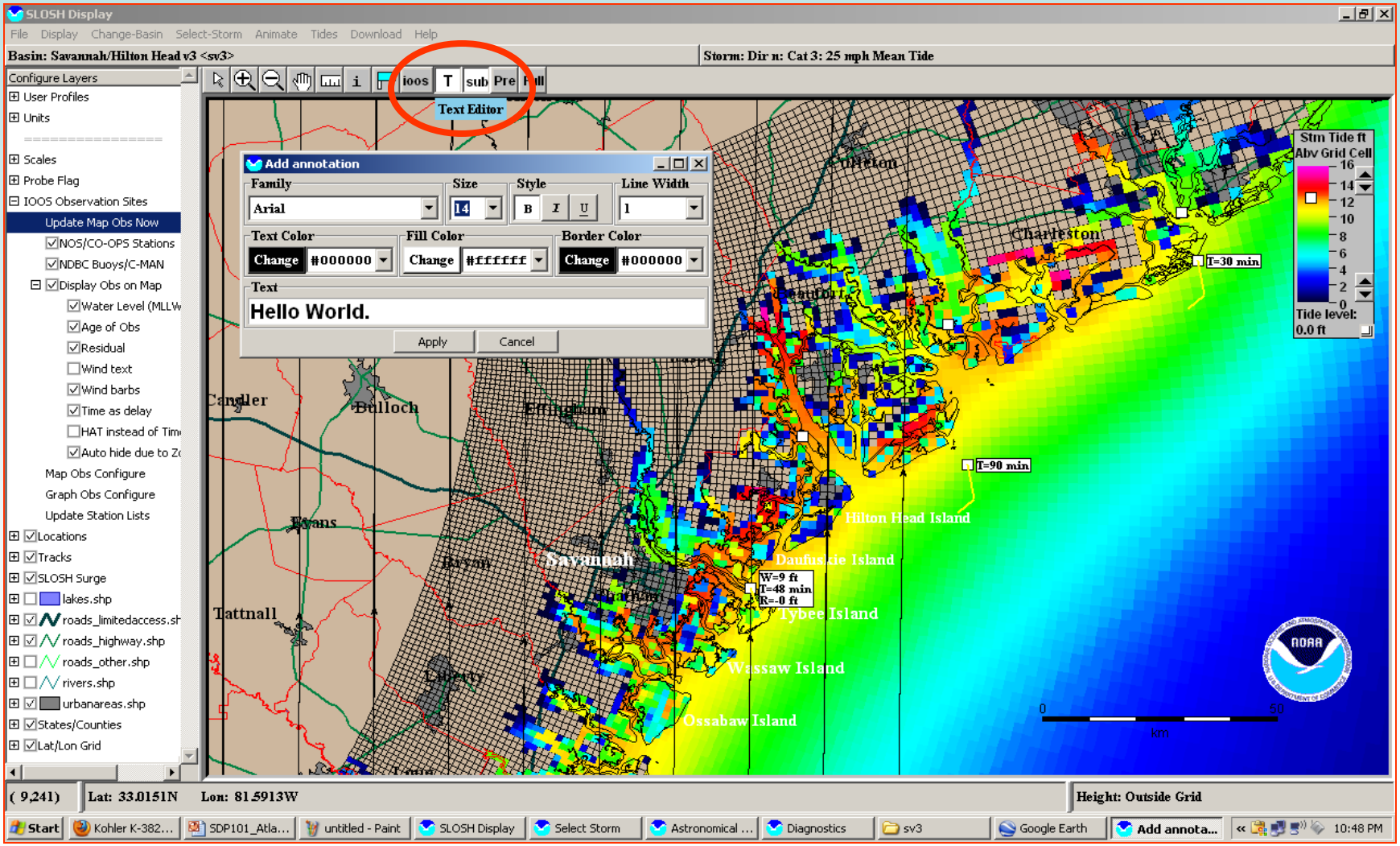
# Save to KML, Shp, MIF, PCX, TIF, GIF and Printing



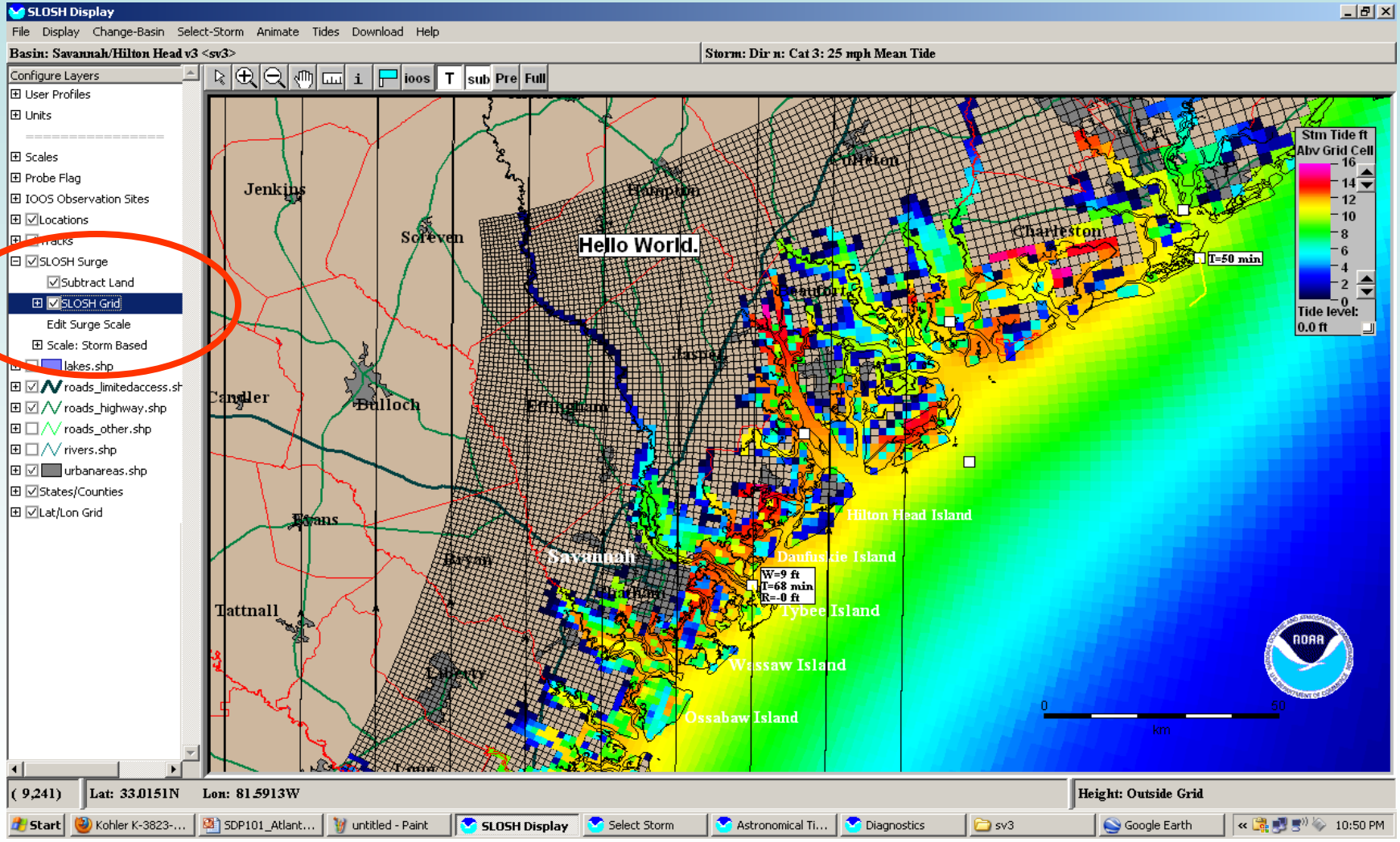
# Save to KML


Google Earth
File Edit View Tools Add Help
Search
Fly To
Find Businesses
Directions
Fly to e.g., Reservoir Rd, Clayville, NY
Places
My Places
Sightseeing Tour
Make sure 3D Buildings layer is checked
Temporary Places
n325i0 (MEOW for Savannah/Hiltc
Title:n325i0
Date Created: 04/19/2011
National Weather Service
Legend
Storm Surge (n325i0)
Layers
Earth Gallery
Primary Database
Borders and Labels
Places
Photos
Roads
3D Buildings
Ocean
Street View
Weather
Gallery
Global Awareness
More
Cape Island
Charleston
Saint Helena Shoal
Pritchards Island
Hilton Head Island
Savannah
Stm Tide ft Abv Grid Cell
16
14
12
10
8
6
4
2
0
Tide level:
0.0 ft
© 2011 Google
Image USDA Farm Service Agency
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Europa Technologies
32°14'55.18" N 79°30'55.94" W elev -106 ft
Eye alt 174.71 mi
©2010 Google
Start
Extra-tropical S...
SDP101_Atlant...
untitled - Paint
SLOSH Display
Select Storm
Astronomical Tid...
Diagnostics
sv3
Google Earth
10:35 PM

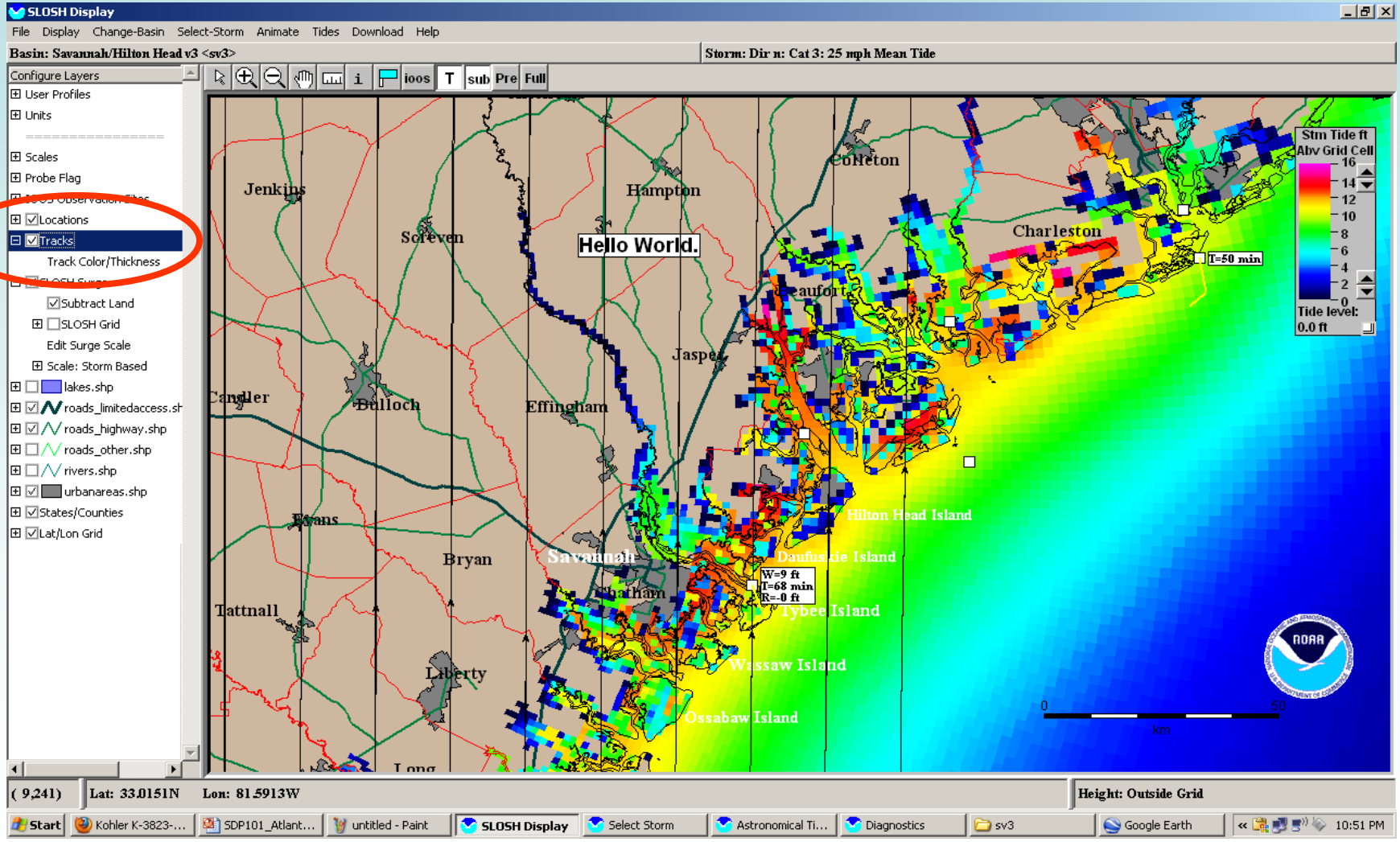
# Annotation


SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: Savannah/Hilton Head v3 <sv3>
Storm: Dir n: Cat 3: 25 mph Mean Tide
Configure Layers
User Profiles
Units
Scales
Probe Flag
IOOS Observation Sites
Update Map Obs Now
NOS/CO-OPS Stations
NDBC Buoys/C-MAN
Display Obs on Map
Water Level (MLLW
Age of Obs
Residual
Wind text
Wind barbs
Time as delay
HAT instead of Tim
Auto hide due to Z
Map Obs Configure
Graph Obs Configure
Update Station Lists
Locations
Tracks
SLOSH Surge
lakes.shp
roads_limitedaccess.sh
roads_highway.shp
roads_other.shp
rivers.shp
urbanareas.shp
States/Counties
Lat/Lon Grid
Text Editor
Add annotation
Family
Arial
Size
14
Style
Line Width
1
Text Color
Change
#000000
Fill Color
Change
#ffffff
Border Color
Change
#000000
Text
Hello World.
Apply
Cancel
Stm Tide ft Abv Grid Cell
Tide level: 0.0 ft
T=30 min
T=90 min
W=9 ft
T=48 min
R=-0 ft
Hilton Head Island
Tybee Island
Wassaw Island
Ossabaw Island
Savannah
Tattnall
Bulloch
Evans
Bryan
Liberty
Charleston
km
( 9,241)
Lat: 33.0151N
Lon: 81.5913W
Height: Outside Grid
Start
Kohler K-382...
SDP101_Atla...
untitled - Paint
SLOSH Display
Select Storm
Astronomical ...
Diagnostics
sv3
Google Earth
Add annota...
10:48 PM

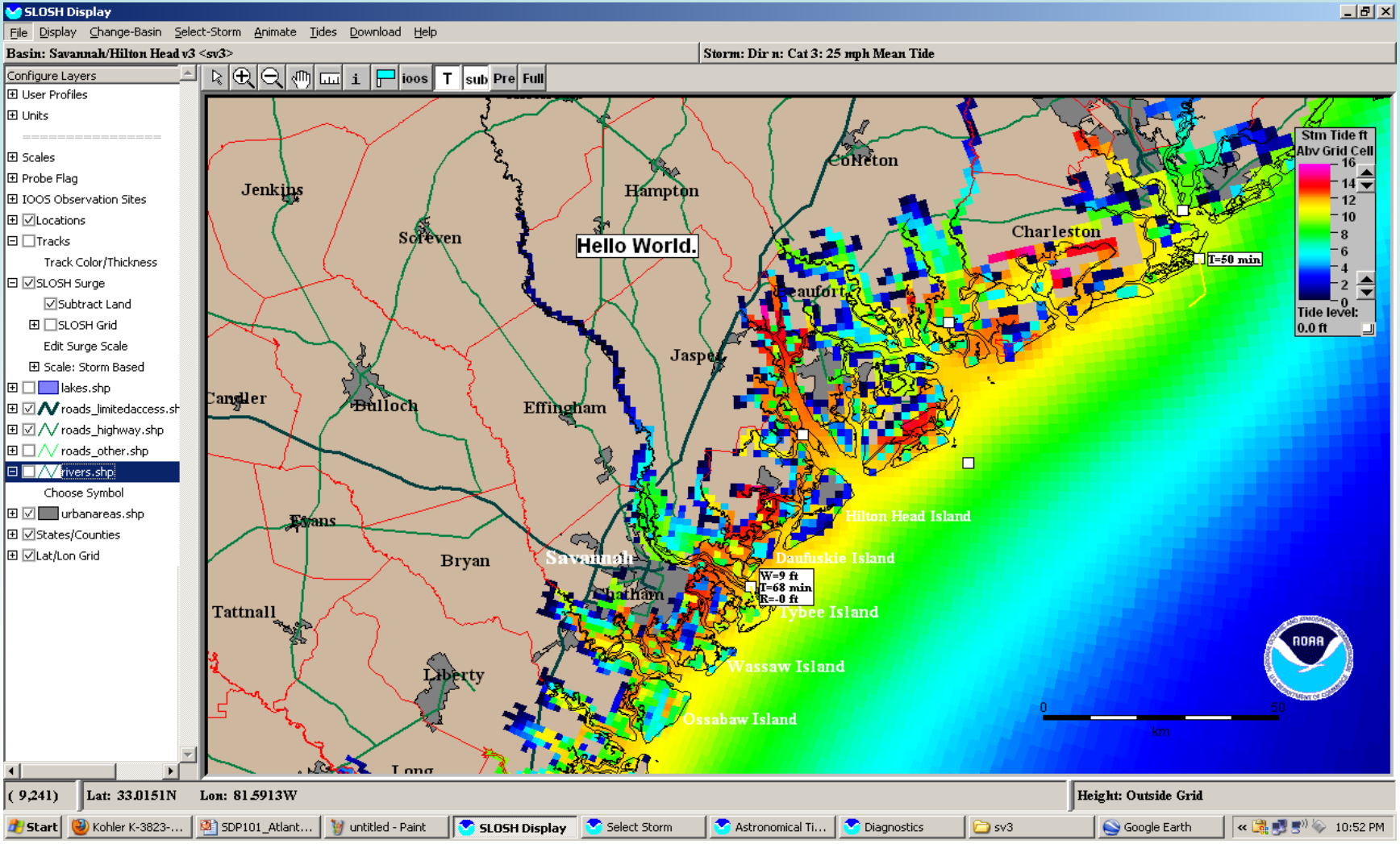
# Toggle Grid off



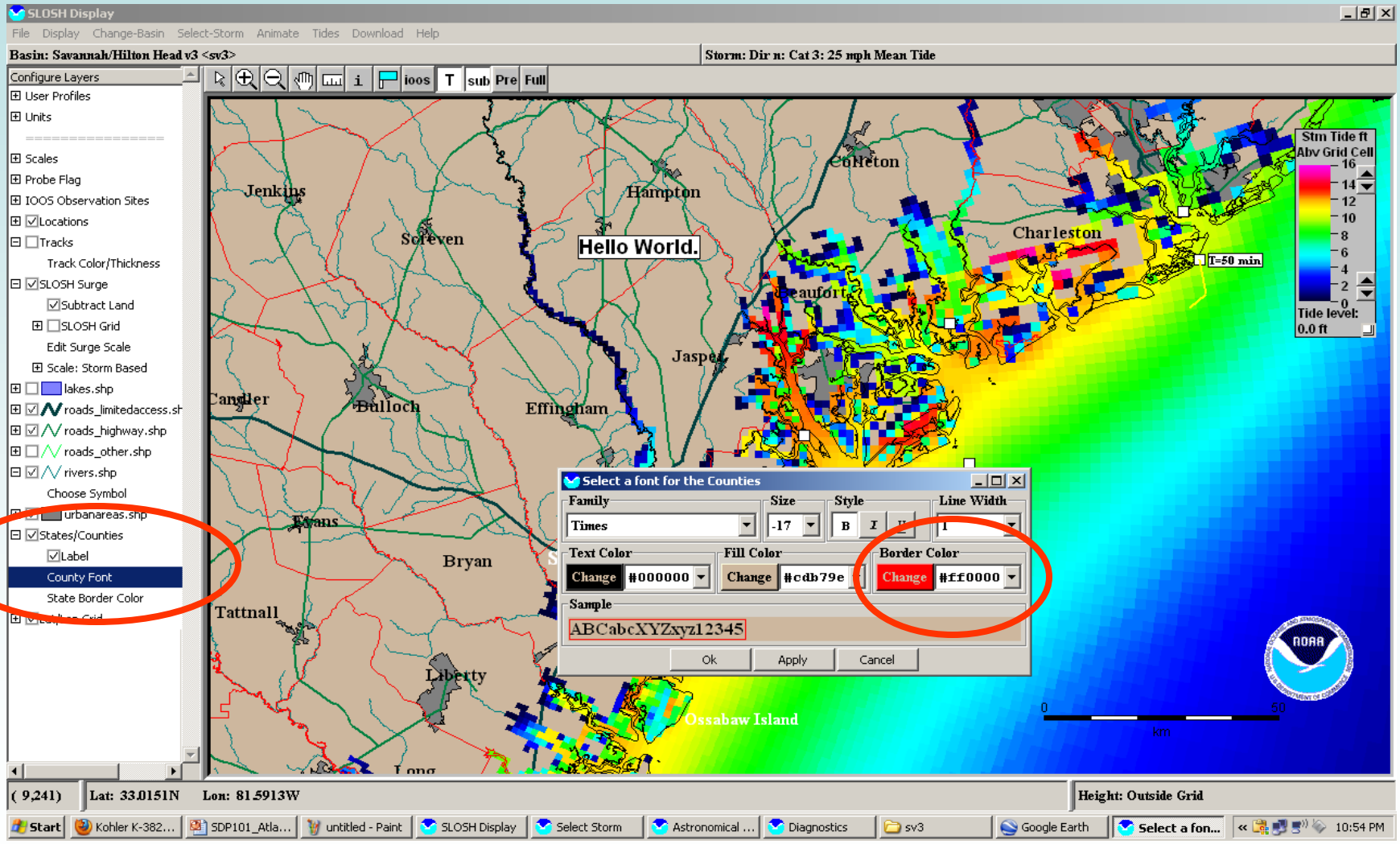
# Toggle Tracks off



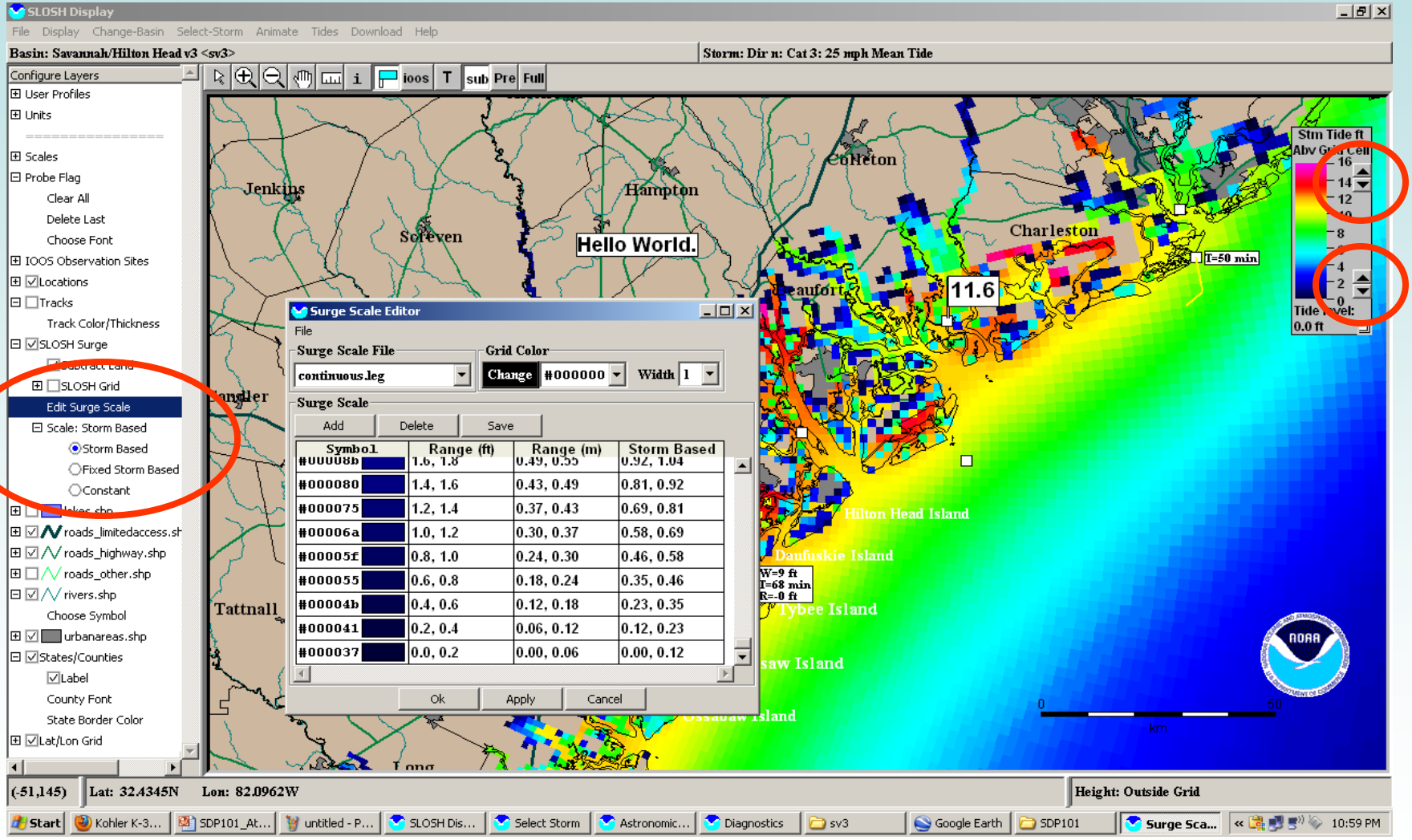
# Toggle Rivers on



# Change County Border Color

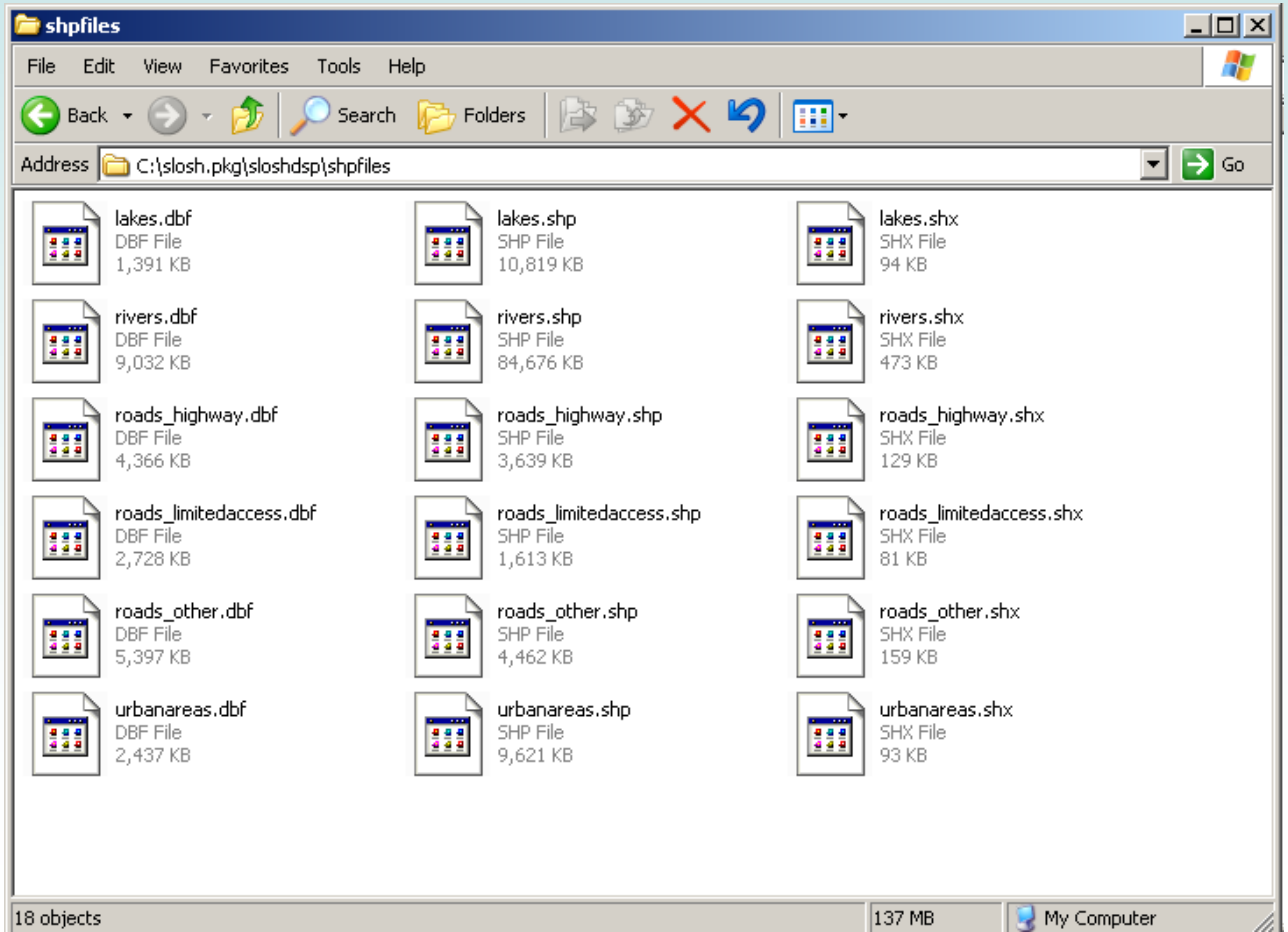


# Color Scale


SLOSH Display
File Display Change-Basin Select-Storm Animate Tides Download Help
Basin: Savannah/Hilton Head v3 <sv3>
Storm: Dir n: Cat 3: 25 mph Mean Tide
Configure Layers
User Profiles
Units
Scales
Probe Flag
Clear All
Delete Last
Choose Font
IOOS Observation Sites
Locations
Tracks
Track Color/Thickness
SLOSH Surge
SLOSH Grid
Edit Surge Scale
Scale: Storm Based
Storm Based
Fixed Storm Based
Constant
roads_limitedaccess.sh
roads_highway.shp
roads_other.shp
rivers.shp
Choose Symbol
urbanareas.shp
States/Counties
Label
County Font
State Border Color
Lat/Lon Grid
Surge Scale Editor
File
Surge Scale File
continuous.leg
Grid Color
Change
#000000
Width
1
Surge Scale
Add
Delete
Save
Symbol
Range (ft)
Range (m)
Storm Based
#000080 1.4, 1.6 0.43, 0.49 0.81, 0.92
#000075 1.2, 1.4 0.37, 0.43 0.69, 0.81
#00006a 1.0, 1.2 0.30, 0.37 0.58, 0.69
#00005f 0.8, 1.0 0.24, 0.30 0.46, 0.58
#000055 0.6, 0.8 0.18, 0.24 0.35, 0.46
#00004b 0.4, 0.6 0.12, 0.18 0.23, 0.35
#000041 0.2, 0.4 0.06, 0.12 0.12, 0.23
#000037 0.0, 0.2 0.00, 0.06 0.00, 0.12
Ok
Apply
Cancel
Hello World.
11.6
Stm Tide ft
Tide Level:
0.0 ft
Jenkins
Screven
Hampton
Colleton
Charleston
Beaufort
Hilton Head Island
Daufuskie Island
Tybee Island
Tattnall
(-51,145)
Lat: 32.4345N
Lon: 82.0962W
Height: Outside Grid
Start
Kohler K-3...
SDP101_At...
untitled - P...
SLOSH Dis...
Select Storm
Astronomic...
Diagnostics
sv3
Google Earth
SDP101
Surge Sca...
10:59 PM

# User Provided Shp files

- Place your own data in “c:/slosh.pkg/sloshdsp/shpfiles



# Backup

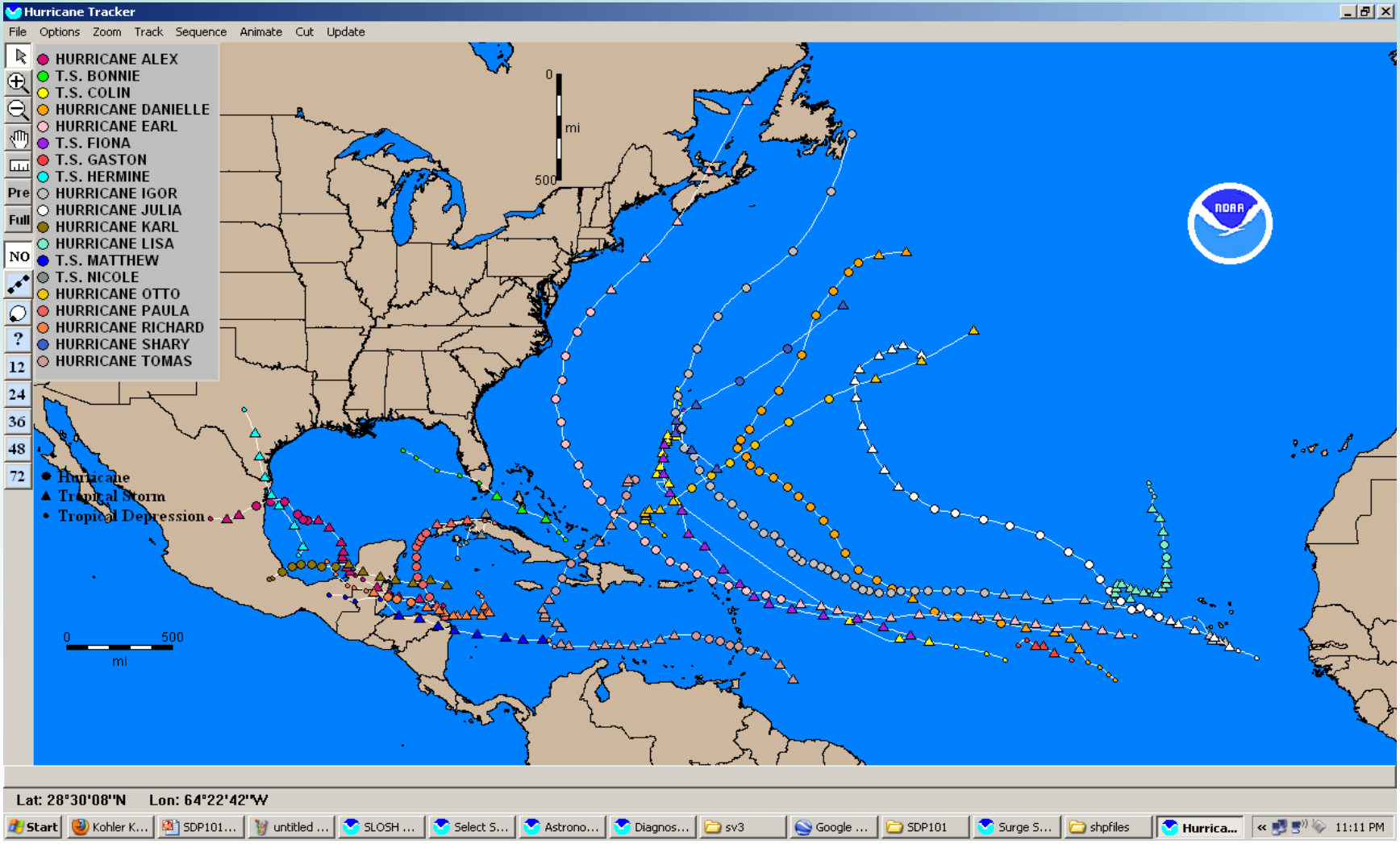
# Storm Surge Cheat Sheet

- Highest surges usually occur to the right of the storm track
- Fast moving = high surges along the open coast
- Slow moving = greater flooding inside bays and estuaries
- Direction of storm approach often impacts the extent of flooding

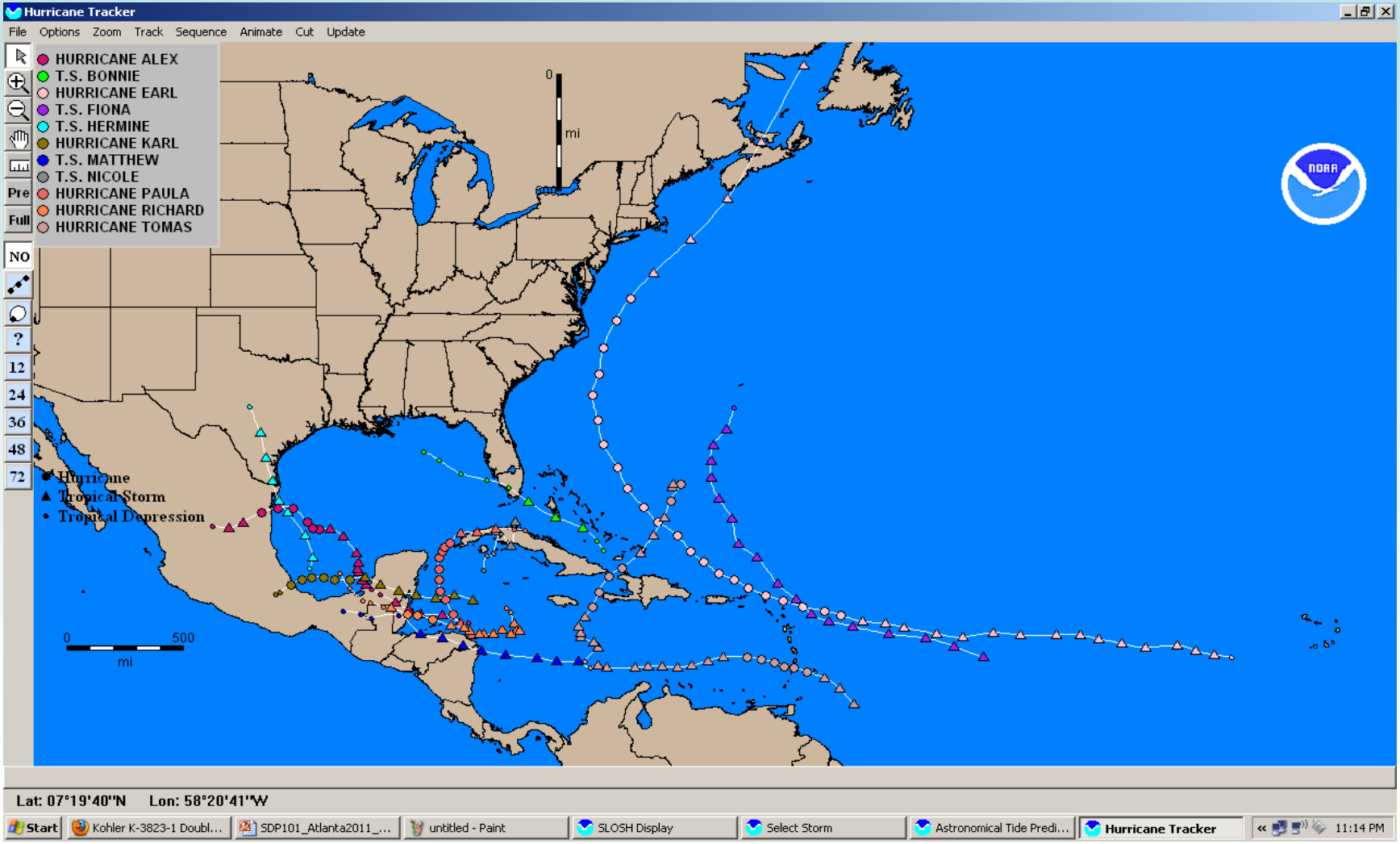
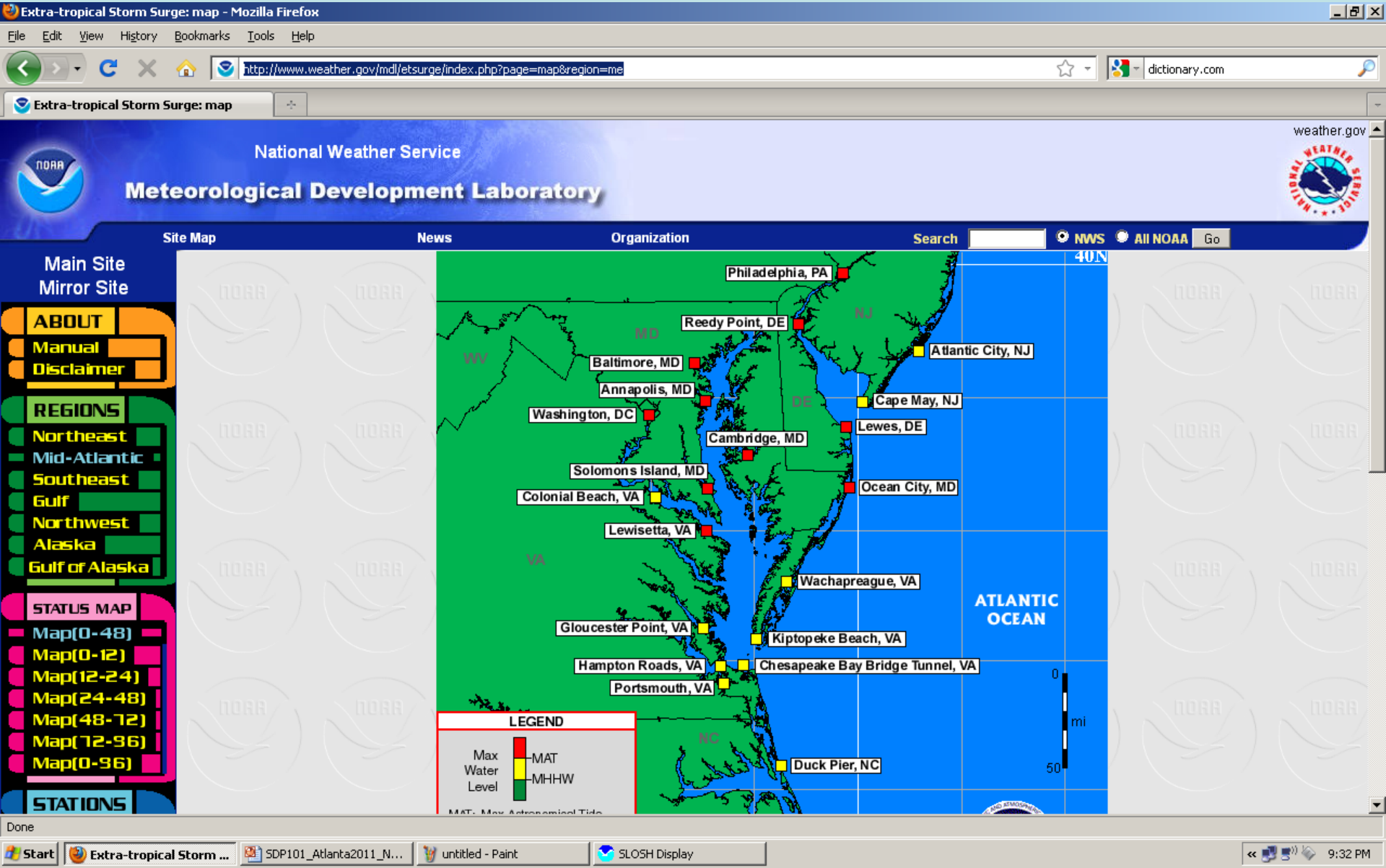
- More intense storms cause higher surges
- Larger storms affect longer stretches of coastline

- Shallow coastal slopes allow greater storm surge with small waves
- Steeper coastal slopes cause less storm surge, but larger breaking waves can occur.

# Bonus: SLOSH Track Program



# Bonus: SLOSH Track Program



# http://www.weather.gov/mdl/etsurge/index.php?page=map&region=me