ERDC
Engineer Research and Development Center

ERDC's Coastal Storm (CSTORM) Modeling & Database System

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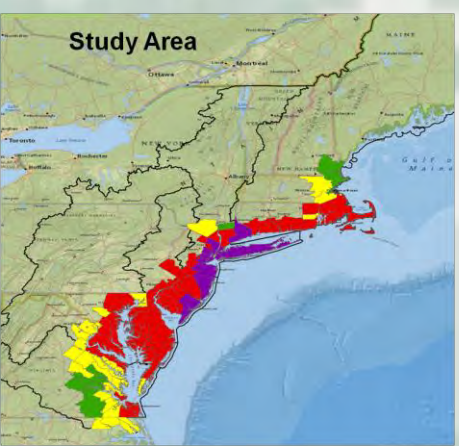
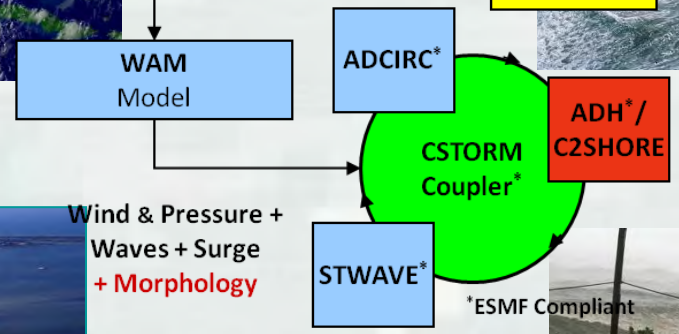


ERDC's Coastal Storm-Modeling System

(ERDC CSTORM-MS)

Application of high-resolution, highly skilled numerical models in a tightly integrated modeling system with user friendly interfaces

Not just hurricanes and not just in the Gulf of Mexico.



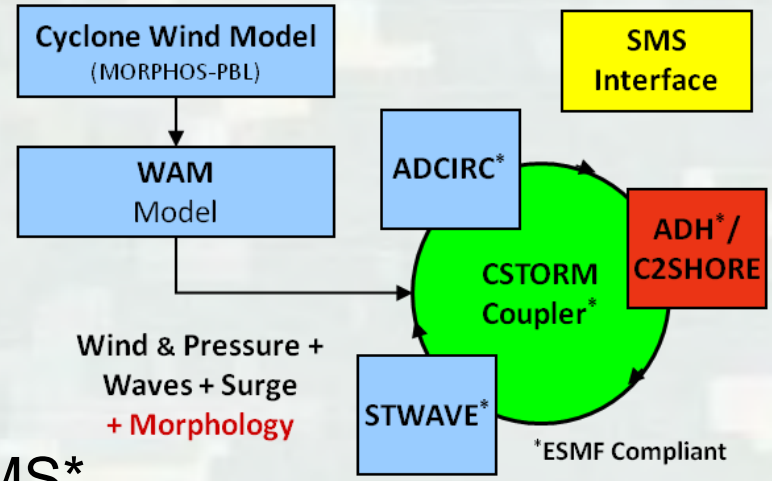
Expandable and upgradeable system.

Next Generation Workflow

Provides for a robust, standardized approach to establishing the risk of coastal communities to future occurrences of storm events.

CSTORM System Components 2013

- **Winds/Pressure:** PBL Cyclone Model
- **Waves:**
  - Regional: WAM
  - Nearshore: STWAVE*
- **Circulation/Surge:**
  - ADCIRC*
  - ADH*
- **Morphology:** SEDLIB/C2Shore
- **Coupling Framework:** CSTORM-MS*
- **Graphical User Interface:** SMS
- **Overland Flow** – Tightly Integrated – FY14?



Earth System Modeling Framework (ESMF) Compliance

- Multiple federal agency support ESMF
- ESMF compliant models are readily available to be linked with each other and with other agencies' ESMF compliant models.
- Individual models stay virtually autonomous when coupling.

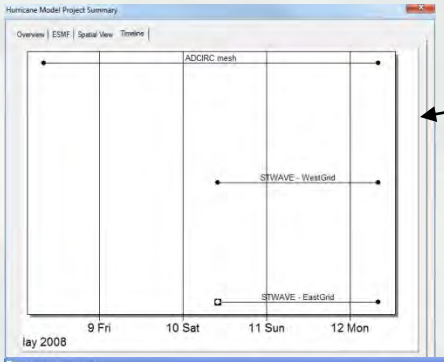
BUILDING

RDC

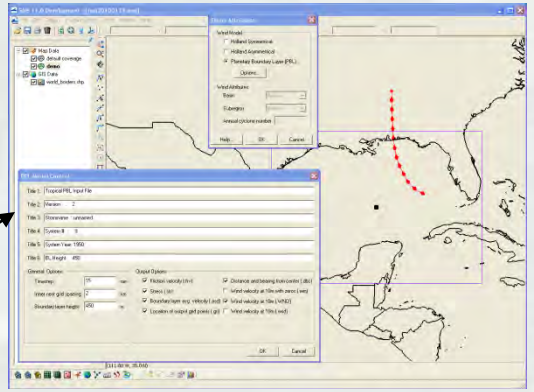
fer, better world

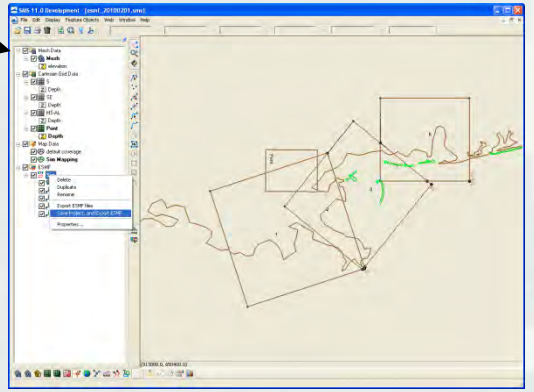
SMS GUI's

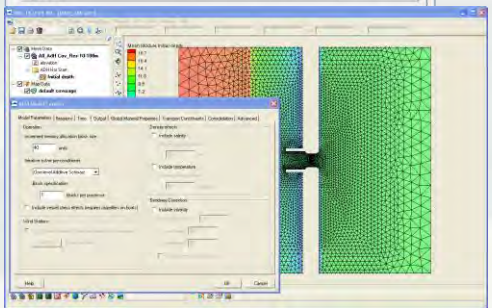
Through the SMS GUI's users can setup and execute models as well as visualize model results.

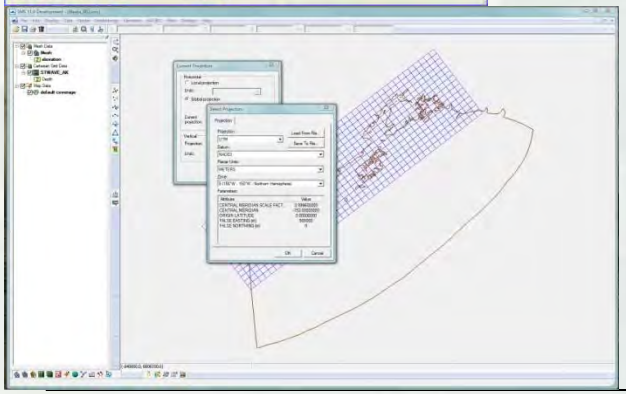


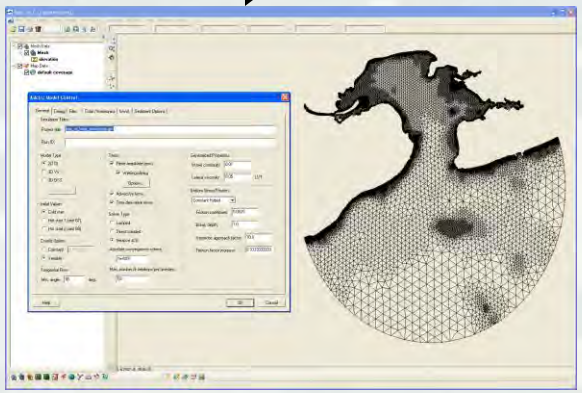
- New GUI for Project Overview
- New GUI for MORPHOS PBL Cyclone Model
- New GUI for CSTORM Coupled Models
- Updated GUI for AdH
- New GUI for WAM Wave Model
- Updated GUI for STWAVE
- Updated GUI for ADCIRC

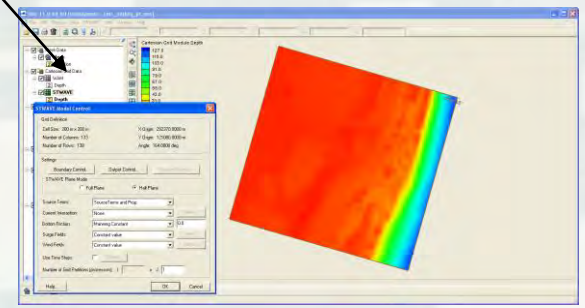












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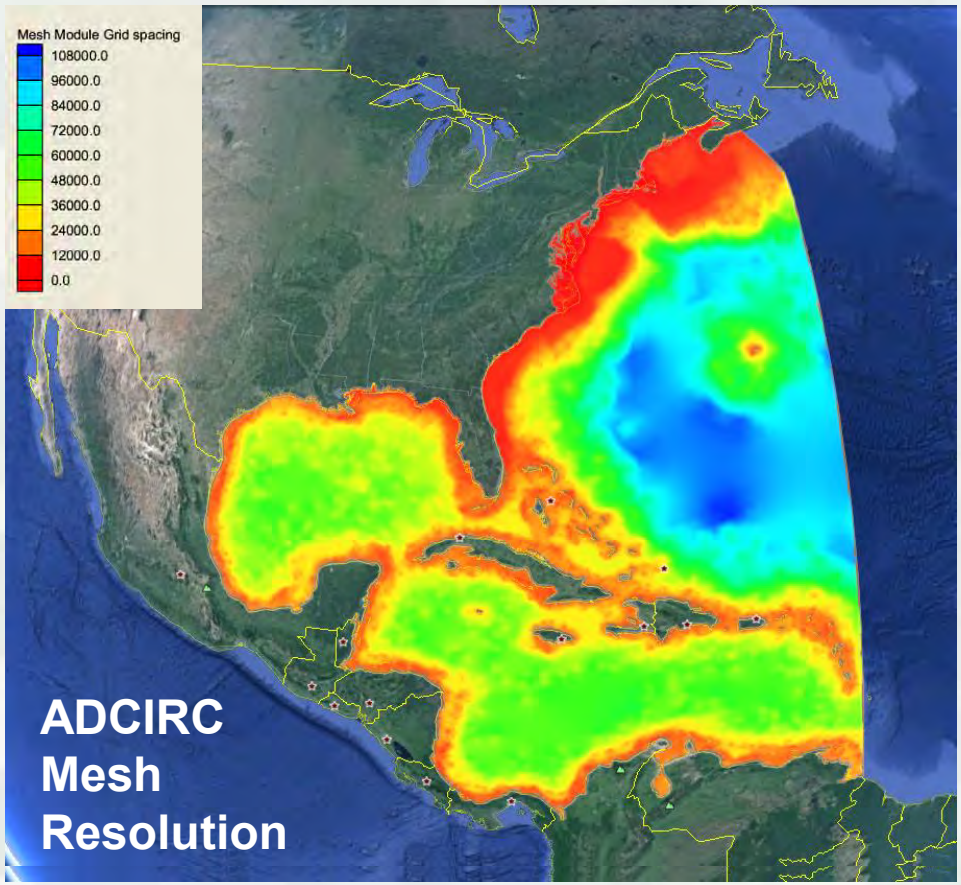
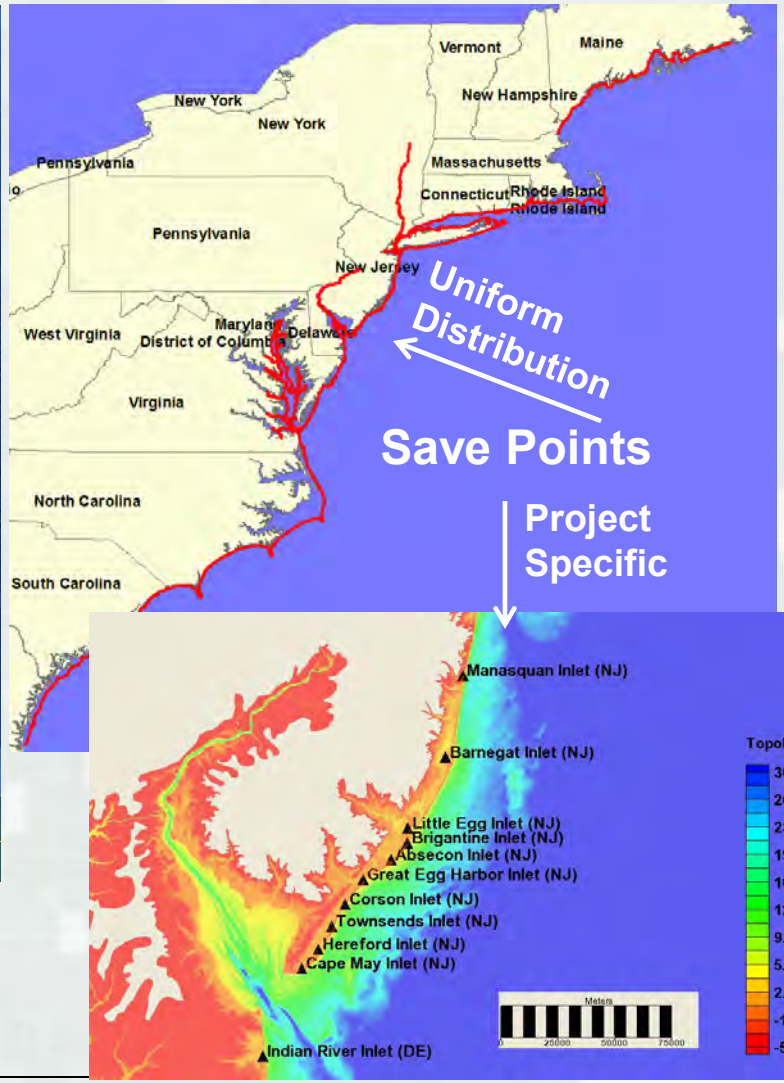
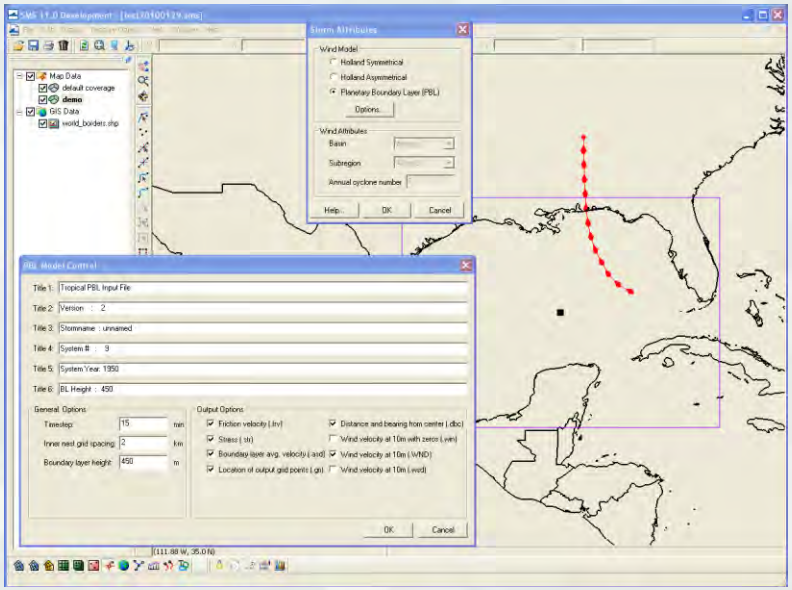
Grids and Save Points





~ 6.2 million nodes
Resolution from 10 m to 100 km

SMS GUI for Cyclone Models

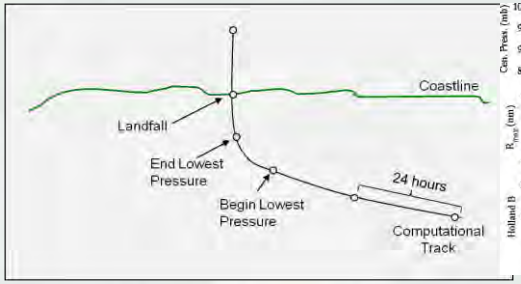


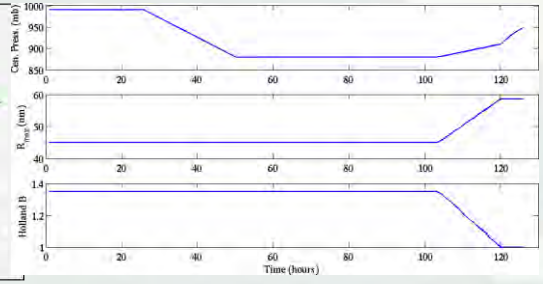
- Setup and run the MORPHOS-PBL Cyclone Wind Model*

*Updated version of TC96

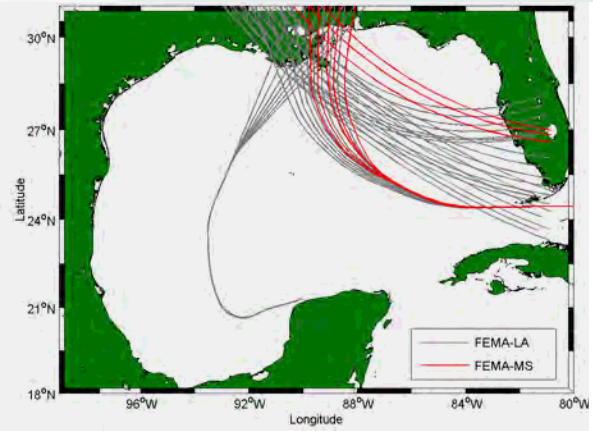
- Import storms from HURDAT

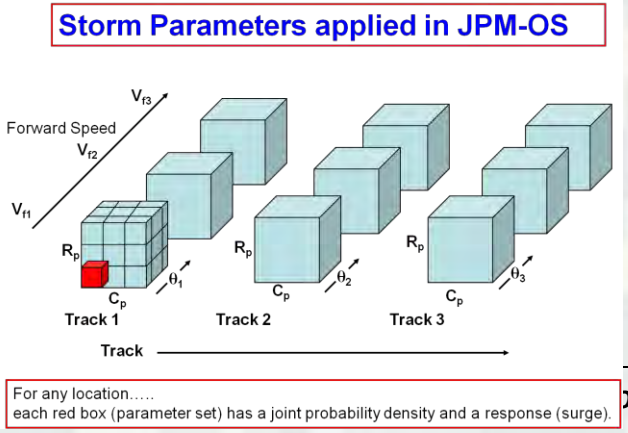
Synthetic storm profile generation routine

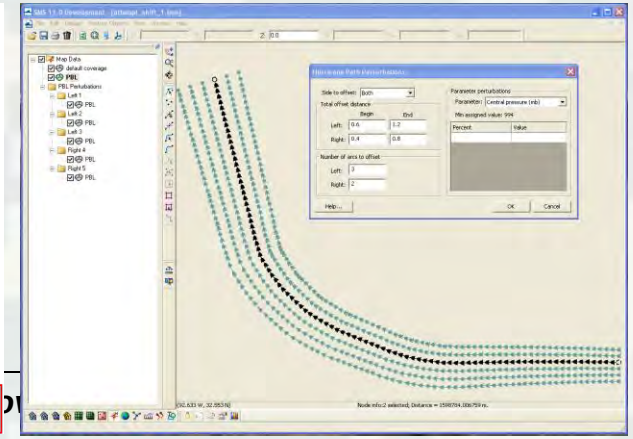




Easily create perturbations for storm track/characteristic

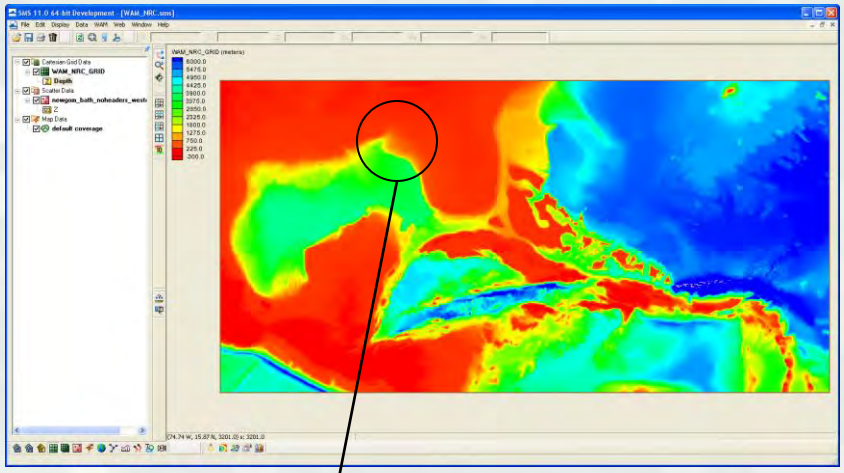






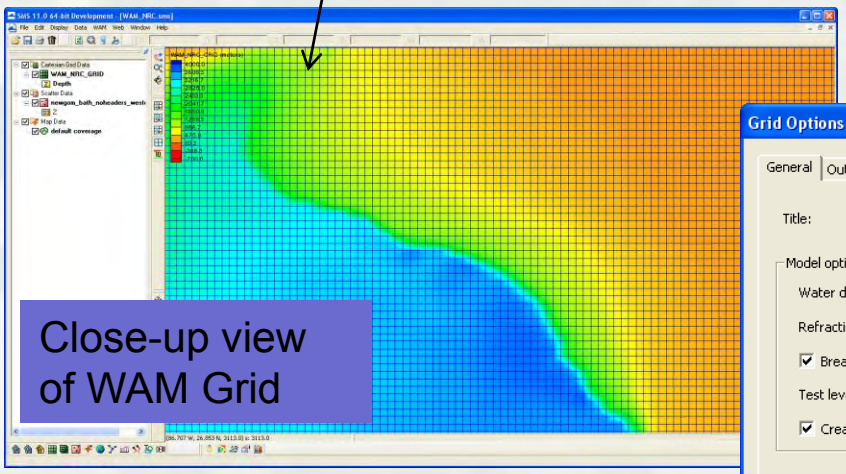
WAM

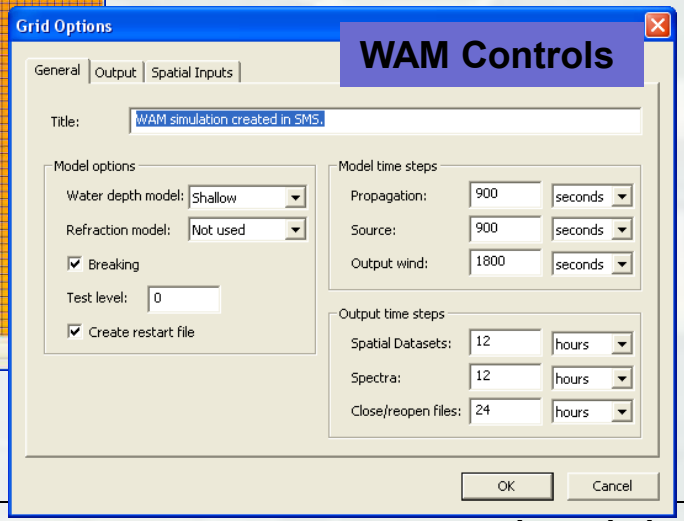
WAM is a third generation global ocean wave prediction model.



Model Assumptions

- Time dependent wave action balance equation.
- Wave growth based on sea surface roughness and wind characteristics.
- Nonlinear wave and wave interaction by Discrete Interaction Approximation (DIA).
- Free form of spectral shape.
- High dissipation rate to short waves.





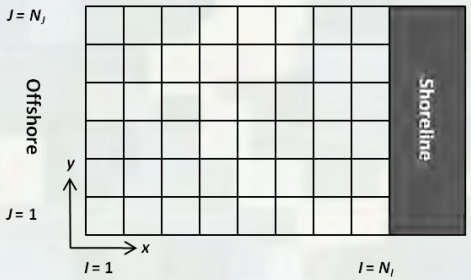
SMS GUI for WAM

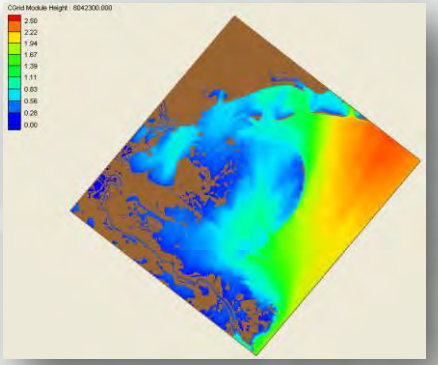
- Create and visualize WAM grids and model results
- Setup input/control files
- Execute WAM

STWAVE Version 6.0

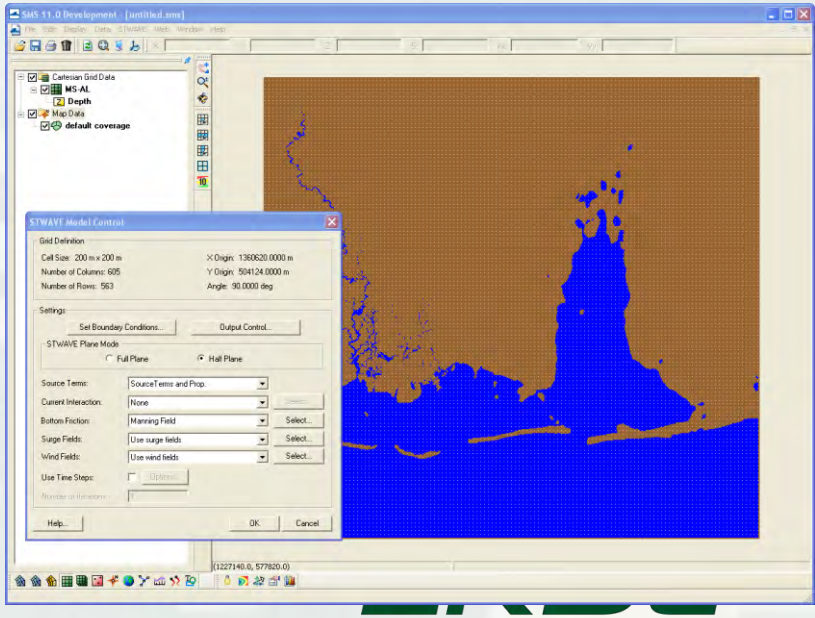
- STWAVE is a steady-state finite difference model based on the wave action balance equation.

- The model is used to compute wave transformation (refraction, shoaling, and breaking) and wind-wave generation.





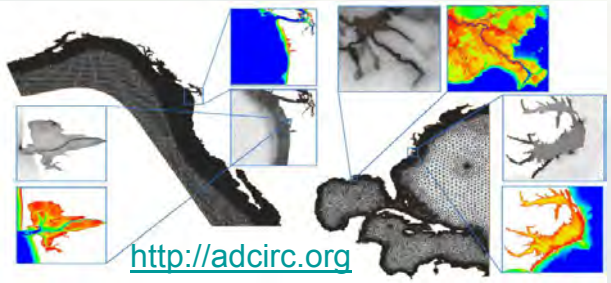
SMS GUI for STWAVE



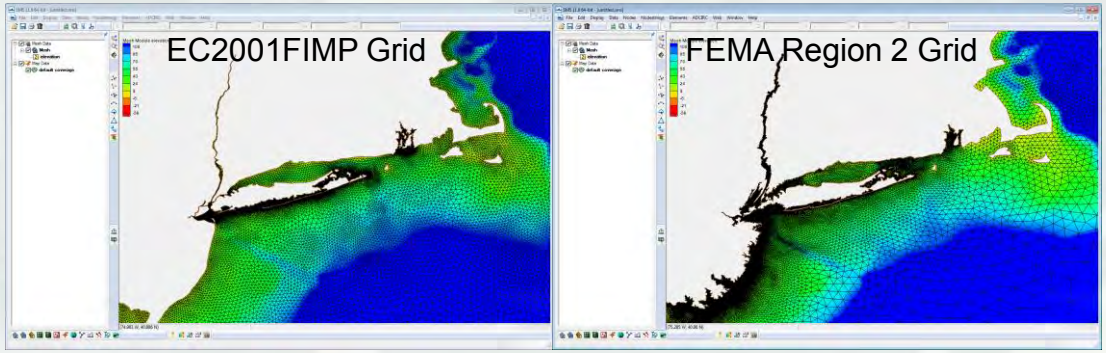
Some features of the full-plane model include:

- Wave transformation and generation on the full 360-deg plane.
- Option for spatially variable winds and surge.
- Option for spatially constant or spatially variable bottom friction.
- Option for one-dimensional wave transformation on lateral boundaries.

ADCIRC Coastal Circulation and Storm Surge Model



- An unstructured finite element hydrodynamics model
- 2D and 3D simulations
- Wetting/Drying algorithm allows for storm surge inundation over previously dry land
- Highly portable code
- Tides, Rivers, Winds/Pressure, and Waves
- A part of ERDC's Coastal Storm Modeling System

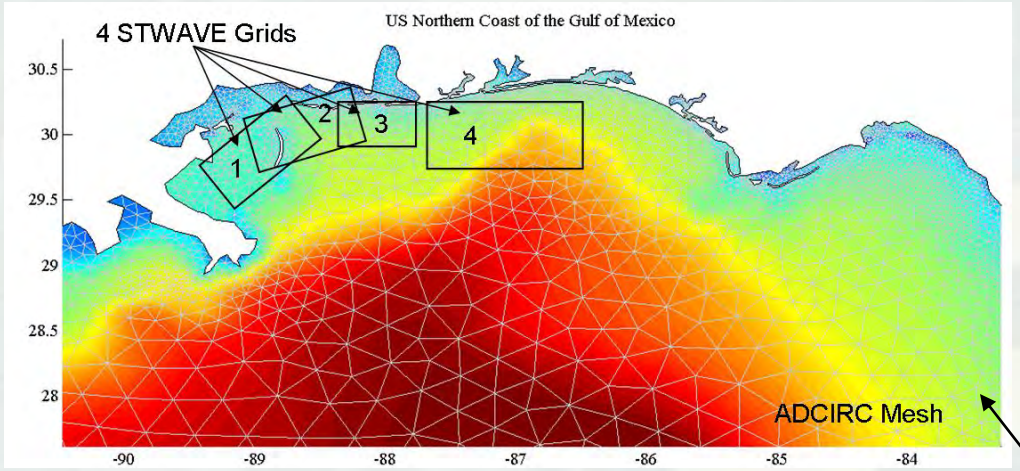


Preliminary Surge Modeling for Sandy

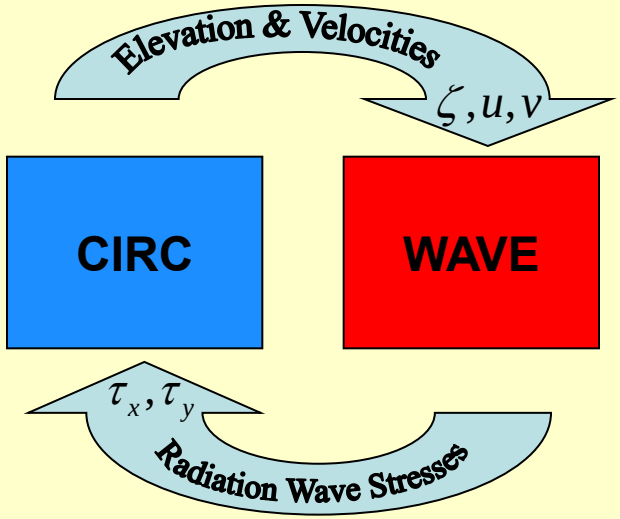
- Used two meshes
  - EC2001FIMP Grid
  - FEMA Region 2 Grid
- Used tidal forcing
- Used an imbedded asymmetric vortex Holland wind/pressure model with inputs derived from the NHC forecast using the ASGS
- Used winds/pressure from NOAA's GFDL models

Tight Two-Way Coupling Circulation ←→ Wave

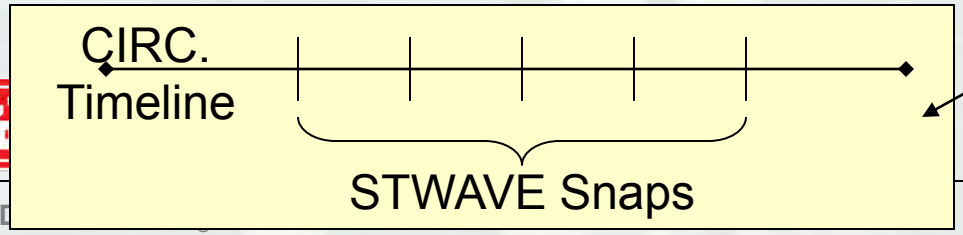
- One unstructured finite element circulation mesh
  - A single instance of ADCIRC/ADH
- One or more structured wave grids
  - Multiple instances of STWAVE
    - Half-Plane
    - Full-Plane



Information to Exchange

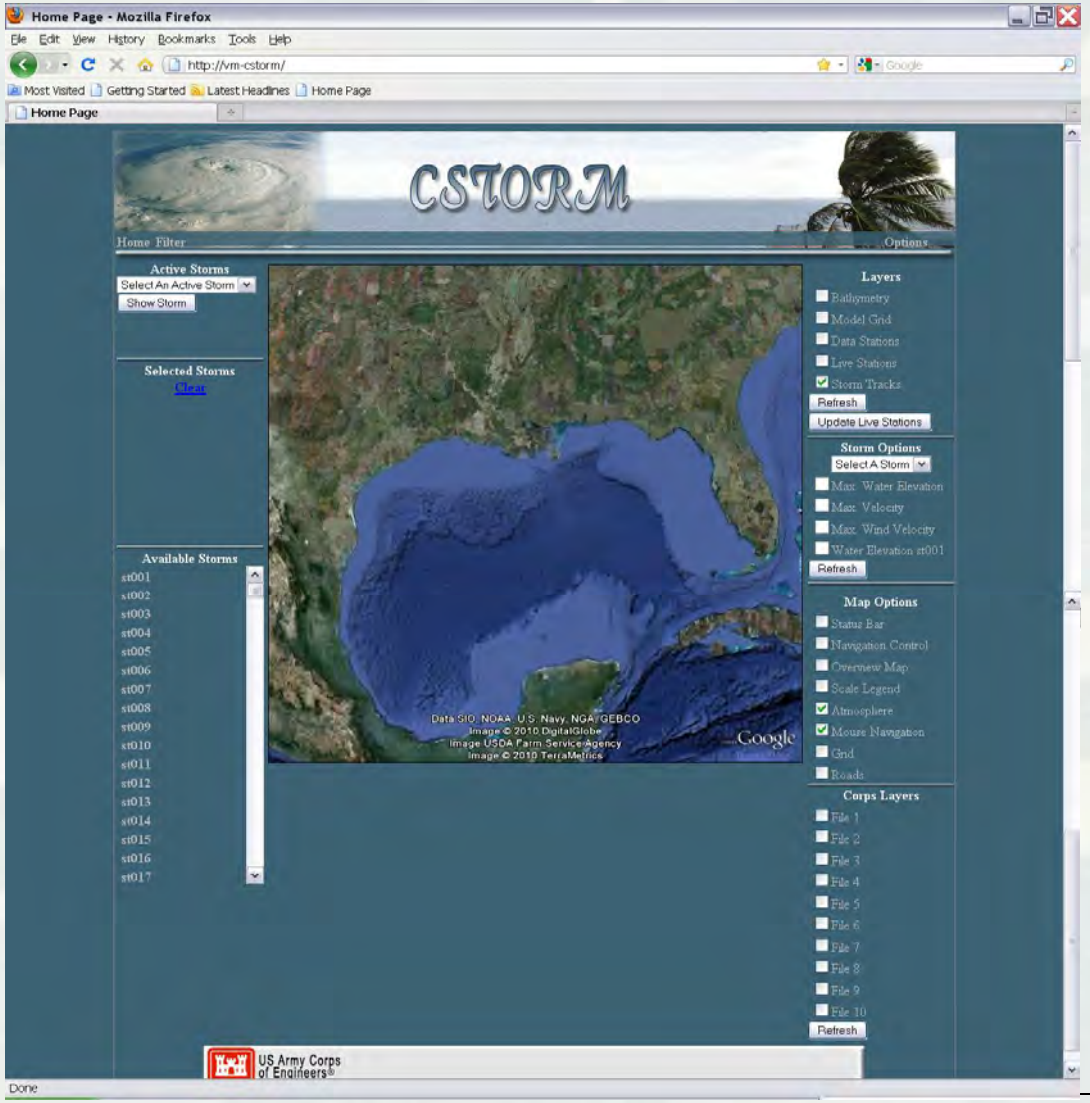


For consistency use the same winds and bathymetry (can be passed also)



Need to be able to synchronize both time and spatial frames of reference.

Coastal Storm - Database and Data Mining Tool



Goals

- Develop long-term archive/database of measured and modeled coastal storm data
- Make data easily accessible and understandable to team members
- Integrate contextual data products and tools that support federal decision making
  - Emergency management
  - Risk management/assessment/communication
  - Project design and evaluation

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CSTORM-DB Initial Screen

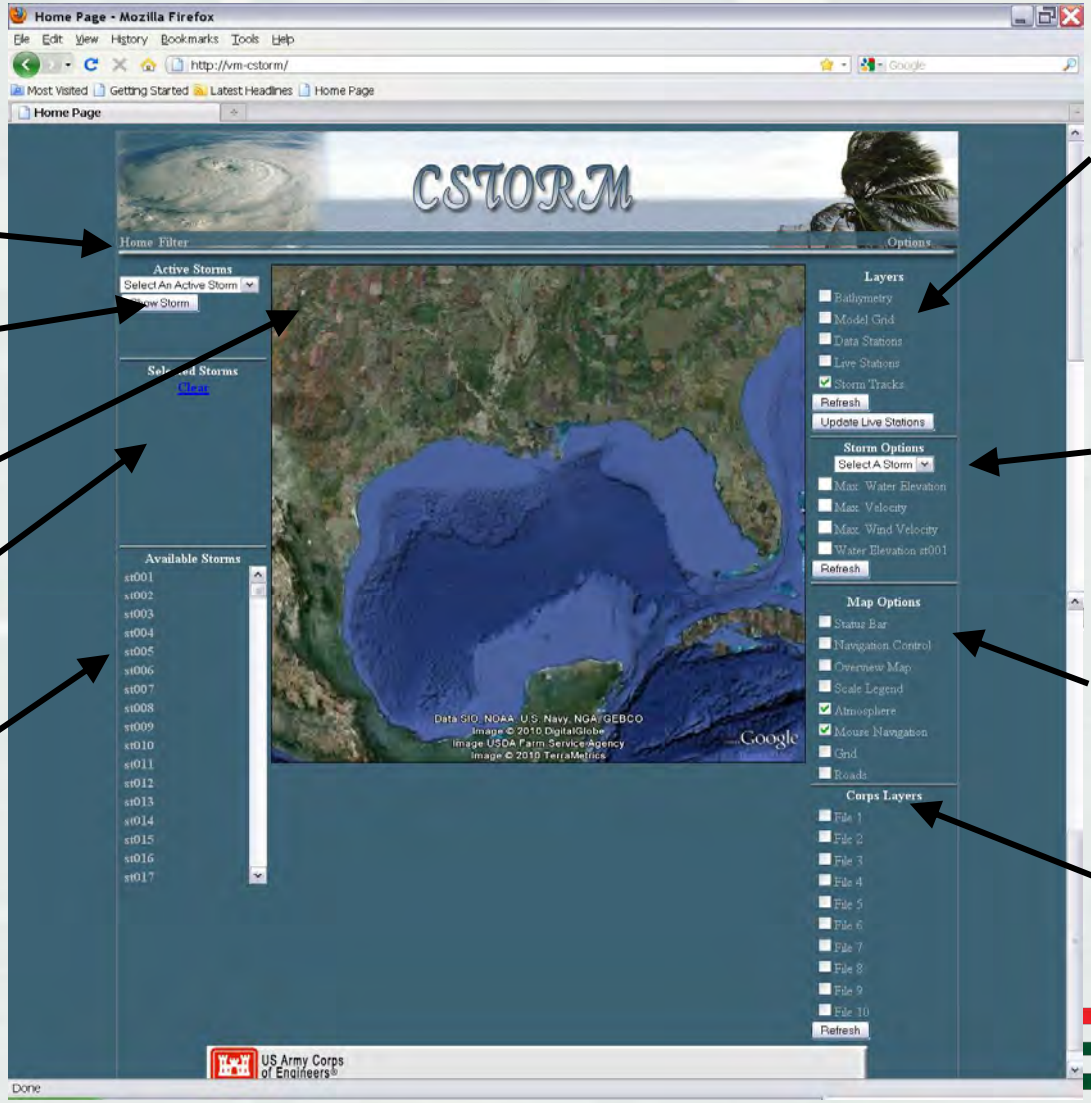
Home
Storm query tool

Add existing storm to map

Google Earth client map

List of selected storms

List of storms available for that region



Turn on and off various layers such as bathymetry, model grid, model save stations, and live gages

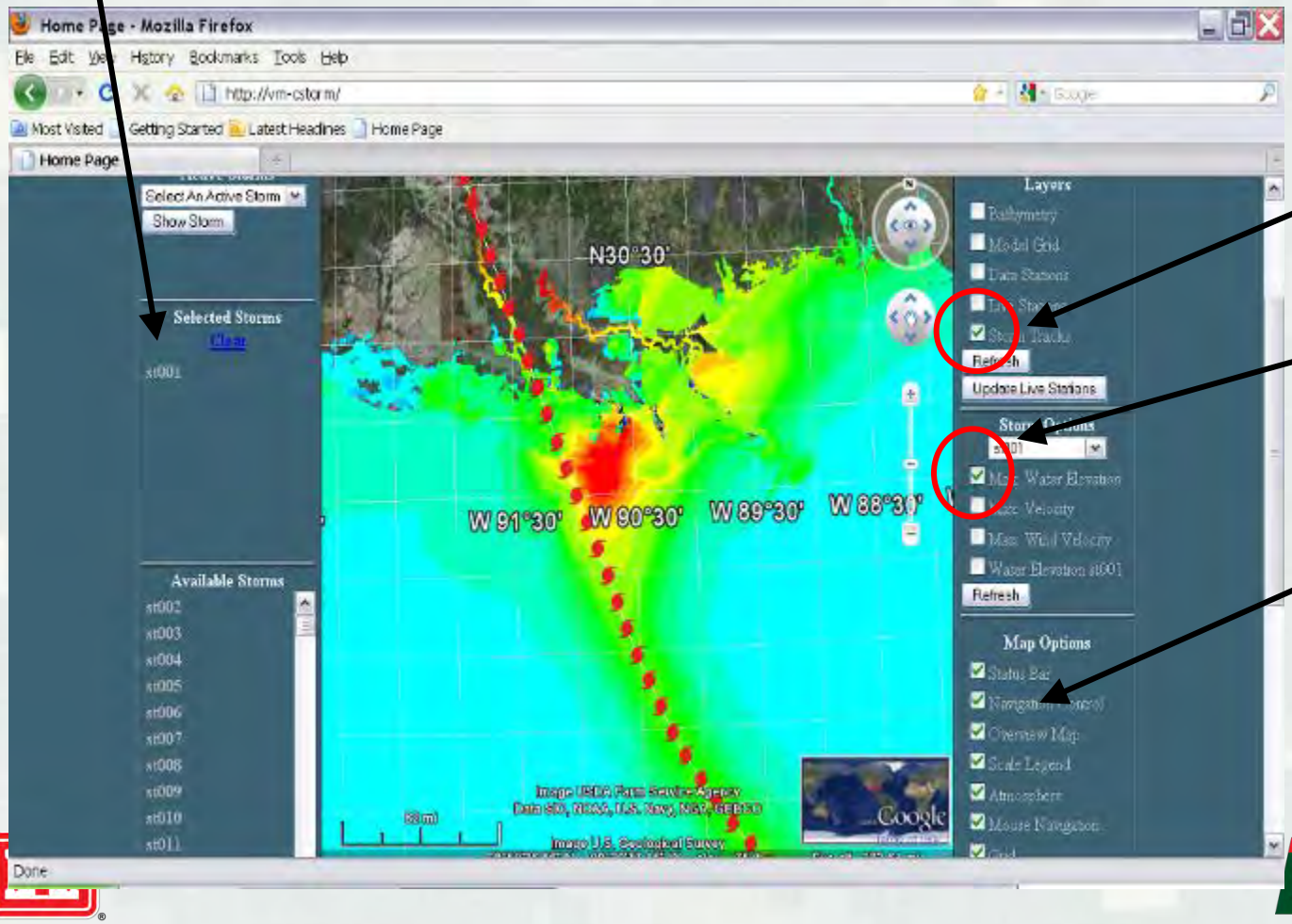
For a select storm, turn on and off maximum contour plots: water level, wind speed, wave height, animations

Turn on and off standard Google Earth map tools

Add any user-defined layer to map

Maximum Water Level Elevation in CSTORM-DB

Select Storm 1



Turn on track

Turn on maximum water elevation contour plot

Turn on standard Google Earth map tools

Unified File & Metadata Standards

The eXtensible Data Model and Format (XDMF) is a library providing a standard way to access data.

- Distinguishes between the metadata (**Light**) and the data itself (**Heavy**)
- **Light Data** – Is stored in a human/machine readable format known as **XML** (Extensible Markup Language)
  - Metadata – units, times, descriptions
  - Ancillary data – max, min, average

- **Heavy Data** – Typically stored in **HDF5** format which is platform independent and compact. Heavy data is read by using the “instructions” in the Light data
  - This allows for one reader for all the models
- Division of Light and Heavy data will help tools like CSTORM-DB and IMEDS and facility access from “cloud” servers
- **Metadata**: ISO 191** is a set of Metadata standards for geographical information

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CSTORM-MS Members
Cary B
- View All

You may know...
Guillermo R
Jerry R
Kelly B
Martin H
Zeki D

Invite Someone
Enter Email Address...
Send Invite

My Communities
- Manage
- View All
- Create

Adaptive Hydraulics
Civil Works R&D: ...
CSTORM-MS
Knowledge Hub Users
SMS

Recommended Communities
Buffalo District ...
Civil Works R&D: ...
Civil Works R&D: ...
GSSHA User Community
Invasive Species ...

Imagery courtesy of NASA's Visible Earth

Latest Videos
4_Application_E10...
4_Application_E6_...
4_Application_E7_...
4_Application_E8_...
4_Application_E9_...
- Watch Videos

Latest Documents
14_Bouss.pdf
CSTORM Workshop V...
CSTORM Workshop V...
EngineeringHurric...
EngineeringHurric...
- View Documents

External Links
Aquaveo: SMS: ADC...
ADCIRC: Coastal C...
Aquaveo: SMS: BOU...
Aquaveo: SMS: STW...

Updates | File Manager | Videos | Community

CSTORM-MS COASTAL STORM MODELING SYSTEM

ERDC's Coastal Storm-Modeling System (ERDC-CSTORM-MS),formerly known as MORPHOS, is a physics-based modeling capability for simulating tropical and extra-tropical storm, wind, wave, water level and coastal response (erosion, breaching, and accretion). Its goal is to more rigorously

Find Information. Get Tutorials. Contribute.

HPC Resources

For this project two separate DSRC systems will be used, ERDC's Garnet and AFRL's Spirit

Garnet's is a Cray XE6

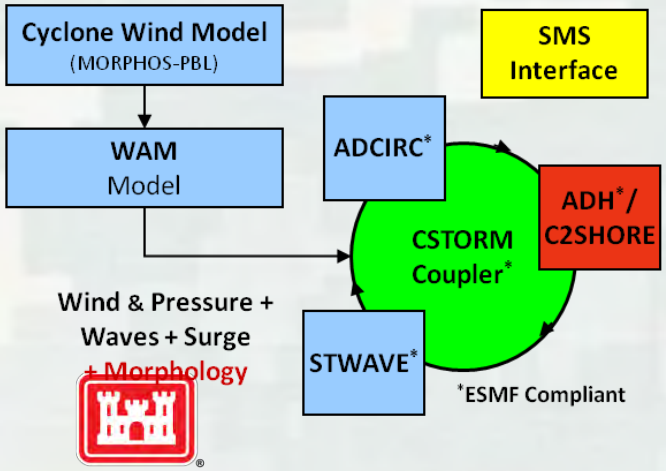
4716 compute nodes with 32 cores/node = 150,912 processors

Spirit is an SGI Ice X

4590 compute nodes with 16 cores/node = 73,440 processors

Summary

- CSTORM-MS is an efficient, robust, extensible modeling system for quantifying the risk of coastal communities to storm events
- Its' streamlined workflow saves time and reduces both computational and personnel cost
- Model data feeds into CSTORM-DB for easy access and reuse purposes
- Stay connected to other users and get help via the Knowledge Hub



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