

A Real-time Forecasting System To Predict Coastal Storm Impacts

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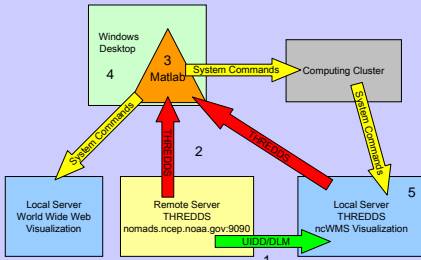
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Abstract

In the coastal zone, storms are one of the primary environmental forces causing coastal change. These discrete events often produce large waves, storm surges, and flooding, resulting in coastal erosion. In addition, strong storm-generated currents may pose threats to life, property, and navigation. The ability to predict these events, their location, duration, and magnitude allows resource managers to better prepare for the storm impacts as well as guide post-storm survey assessments and recovery efforts.

As a step towards increasing our capability for prediction of these events we have developed an automated system to run the Coupled Ocean – Atmosphere – Wave – Sediment Transport (COAWST) Modeling System as a daily forecast. Management of the system is controlled by the Windows Scheduler to start Matlab® and run scripts and functions. Data required by the modeling system include daily modeled wave, wind, atmospheric surface inputs, and climatology fields. The Unidata Internet Data Distribution/Local Data Manager is used to download NCEP GFS global 5 degree data and NCEP NAM Conus 12km data to a local server. The Matlab “structs” tool and NJ-Toolbox are used to access these large data sets on the local server as well as data sets available on the Nomads <http://nomads.ncep.noaa.gov> site. The data are used to create the required inputs for the WRF, ROMS and SWAN models. Currently the output from the coupled ROMS-SWAN system is displayed at <http://woodshole.er.usgs.gov/project-pages/cccp/public/COAWST.htm>.

Model Control

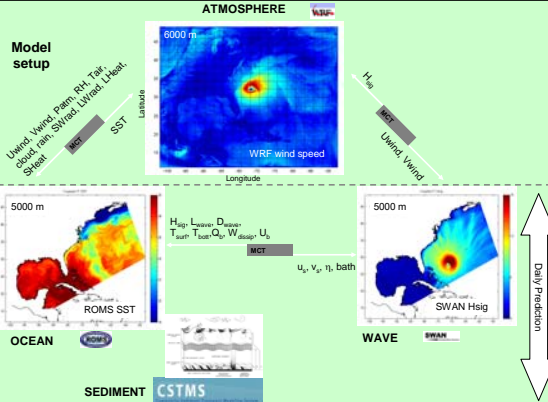


Data Acquisition

The system accesses daily global and regional modeled data sets provided through NCEP. These data are used to create the gridded model forcing for the daily forecast.

- 1. The Unidata Internet Data Distribution/Local Data Manager (UIDD/LDM)** (<http://www.unidata.ucar.edu/software/ldm/>) is set up on a local server to download the NCEP GFS global 5 degree data and NCEP NAM Conus 12km data.
- 2. A THREDDS Data Server** (Thematic Realtime Environmental Distributed Data Services) has been set up on our local server so that model data and NCEP data can be accessed from the server through the web. <http://www.unidata.ucar.edu/projects/THREDDS/>
- 3. NJ-Toolbox** (available; <http://sourceforge.net/apps/track/ntbx/>) and the **matlab structs tool** (available; <http://openpand.org/download/ml-structs.html>) are used in the Matlab @ environment to access data available on the local server and the nomads.ncep.noaa.gov:9090 DODS

Data	Location	Usage
Wind	UIDD/DLM to local server	ROMS/SWAN wind forcing
Waves	nomads.ncep.noaa.gov:9090	SWAN wave boundary forcing
Climate	nomads.ncep.noaa.gov:9090 nomad1.ncep.noaa.gov:9090	ROMS climatology & boundary forcing
Atmosphere	UIDD/DLM to local server	ROMS atmospheric forcing



COAWST Modeling System

We have developed a Coupled Ocean – Atmosphere – Wave – Sediment Transport (COAWST) Modeling System to investigate the impacts of storms on coastal environments.

- C = Coupled MCT <http://www-unix.mcs.anl.gov/mct/>
- O = Ocean ROMS <http://www.myroms.org/>
- A = Atmosphere WRF <http://www.wrf-model.org/>
- W = Wave SWAN <http://lm089.citg.tudelft.nl/swan>
- ST = Sediment Transport CSTMS <http://woodshole.er.usgs.gov/project-pages/sediment-transport/Modeling System>

Automating the System

3. MATLAB® m-files are used to create a system which loads daily modeled wave, wind, atmospheric surface input, and climatology data and creates input and forcing files for the COAWST system. The data is used to create the INPUT files, TPAR files, climatology and wind files for the WRF, ROMS and SWAN models used in the COAWST system. **System commands** are used to copy files to the cluster and start the script that runs the model.

4. Windows Scheduled Tasks are created to start the scripts which automate the system. The tasks are enabled to run at a specific time and will wake the computer up to run the task.



Data Storage and Access

5. Currently model output is stored indefinitely in the form of NetCDF files on the local server. Restart files are kept for one day on the cluster. Forcing and Input files are not kept.

To access the model output using **THREDDS** an NetML XML document is created to act as a catalog for the model runs. Within this catalog a **Forecast Model Run Collection (FMRC)** is created using the NetML XML representation of netCDF metadata. The FMRC is a “virtual” NetCDF data set which aggregates the individual NetCDF files into one lengthy time series.

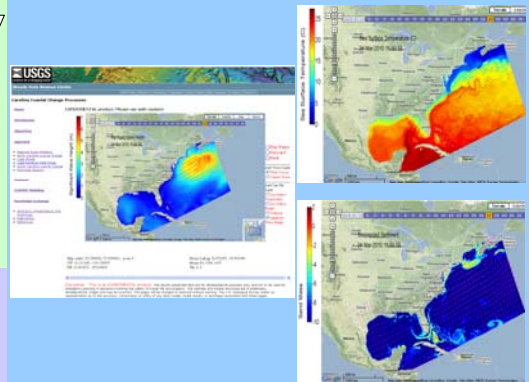
More information on NetML and the FMRC can be found at <http://www.unidata.ucar.edu/software/netcdf/netcdf/v2.2/FmrcAggregation.html>

Visualization

The output NetCDF files are used to create a series of gif files with transparent backgrounds for wave height, sea surface height, surface temperature, current magnitude, wind and current vectors. The gif files are copied over to a proxy folder, which mirrors them onto the public web server. A public server is required for the Google Maps API.

The **Google Maps API** and Google code are used to create Overlays of the gif files, projecting them according to approximated latitude and longitude for the corners of the image. **JAVA** script is used to create a loop of the Overlays which are projected over the Google maps tile. The API allows the end user to view, zoom, pan and change the background tile images. The end user can rewind, play, stop and move forward using a set of buttons created using **JAVA** script.

This Google Maps mashup can be viewed at <http://woodshole.er.usgs.gov/project-pages/cccp/public/COAWST.htm>



The data is also available to the **NetCDF web map service (ncWMS)** located on the local server. ncWMS is integrated with the **THREDDS Data Server**. More information on ncWMS can be found at <http://www.resc.rdg.ac.uk/trac/ncWMS/>.

The ncWMS service gives the user access to the whole data set, all variables, dates and times. COAWST data can be visualized at <http://geoport.whoi.edu:8082/ncWMS/godiva2.html#>.

