Executive Summary: Coastal Hazards System

INTRODUCTION

The North Atlantic Coast Comprehensive Study (NACCS) numerical modeling and statistical analysis effort generated a tremendous amount of storm forcing conditions, model results and statistical analysis products for the coastal regions from Virginia to Maine. These data and data products will serve the coastal engineering and coastal management communities in the North Atlantic for at least the next decade. Managing and providing access to this vast quantity of information is made possible via the Coastal Hazards System (CHS). CHS is a national, coastal, storm-hazard data storage and mining system (Figure 1). It stores comprehensive, high-fidelity, storm-response computer modeling results including climatology, surge, total water levels, and waves as well as measurements. Extremal statistics and epistemic uncertainties of the processes are also stored, and the data are easily accessed, mined, plotted, and downloaded through a user-friendly web interface.

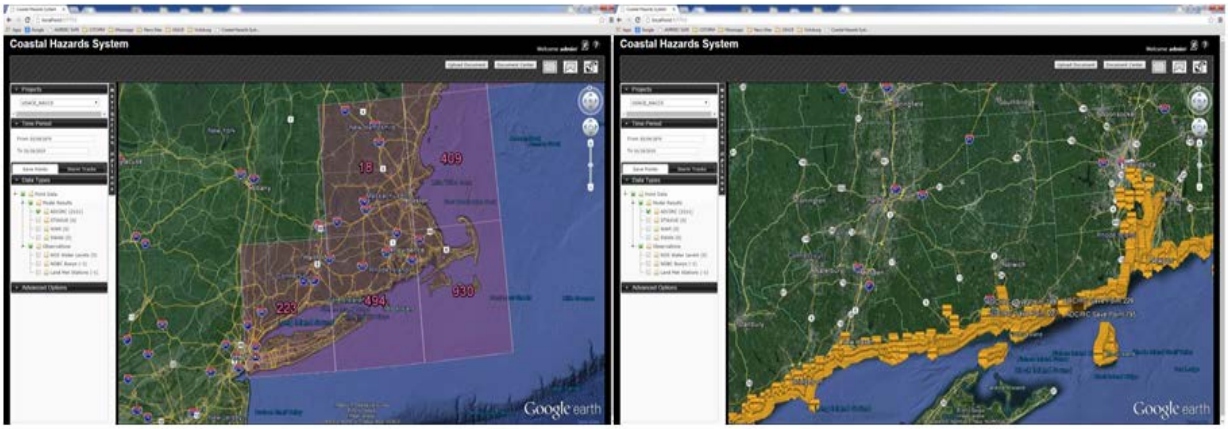

Figure 1. CHS for the NACCS sub-region with point panels (left) and model save point locations (right)

The CHS stores and distributes U.S. Army Corps of Engineers (USACE) and Federal Emergency Management Agency (FEMA) high-fidelity coastal storm data from formalized regional studies such as the FEMA National Flood Insurance Program and the USACE NACCS. Modeling results and associated measurements are converted into consistent and efficient standards and formats and stored in a centralized system that is relatively easily maintained due to an innovative big-data design. The user-friendly web interface includes a multi-access environment where the user can screen data through a map interface or through a text-based navigation window or some arbitrary combination of the two.

CHS DATA RESOURCES

CHS regional data are comprehensive, uniformly spanning the coastal region and practical probability space. The data are stored and accessed by project and projects are usually regional. Each project contains sub-regions to better segregate the data.

The types of data that are distributed include the following:

- ADCIRC model output (1 time series and 1 peak file for each save point location):
    - Storm surge
    - Total water level
    - Tides
    - Current speed
    - Current direction
    - Wind speed
    - Wind direction
- STWAVE and SWAN model output (1 time series and 1 peak file for each save point location):
    - Significant wave height
    - Peak wave period
    - Mean wave direction
    - Water elevation
    - Wind magnitude
    - Wind direction
- WAM model output (1 time series and 1 peak file for each save point location);
    - Drag coefficient
    - First moment wave period swell
    - First moment wave period total sea
    - First moment wave period wind sea
    - Friction velocity
    - Mean wave direction swell
    - Mean wave direction total sea
    - Mean wave direction wind sea
    - Mean wave period swell
    - Mean wave period total sea
    - Mean wave period wind sea
    - Normalized wave stress
    - Peak spectral wave period swell
    - Peak spectral wave period total sea

        - Peak spectral wave period wind sea
        - Second moment wave period swell
        - Second moment wave period total sea
        - Second moment wave period wind sea
        - Significant wave height swell
        - Significant wave height total sea
        - Significant wave height wind sea
        - Spectral wave period swell
        - Spectral wave period total sea
        - Spectral wave period wind sea
        - Wave directional spread swell
        - Wave directional spread total sea
        - Wave directional spread wind sea
        - Wind direction
        - Wind speed
- Storm track files (1 time series file for each storm):
    - Minimum Central Atmospheric Pressure
    - Far-Field Atmospheric Pressure
    - Storm Track Location: Latitude And Longitude
    - Heading Direction
    - Storm Speed
    - Radius To Maximum Winds
    - Holland B parameter
- Storm response statistics files:
    - Storm probability (1 file for each sub-region)
    - Response statistics (1 file for each sub-region)
        - Average recurrence intervals: 13 ari values representing 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, and 10000 years
        - Uncertainty: expected value, 68%, 90%, 95% confidence intervals
- Model grids and wind and pressure files
- Observations
- There are more types of files within the data resource that will be distributed through the web application in the future.

Both time-varying and maxima data are stored by save point location. Responses for all storms for a specific save point are stored in a unique file. The CHS native file formats are self-describing compressed HDF5. Matlab code snippets for reading and writing the data are available in the online help. In the future, online conversion to CSV formats will be provided.

In addition, aleatory and epistemic uncertainties are stored for each numerical model save point location and each observation. Model input files such as grids, wind and pressure files and other inputs are stored in the Documents folder on the CHS system. Documentation for the system, data and file formats is contained in technical reports in the Documents folder of the CHS.

ACCESS

The CHS web application (https://chs.erdc.dren.mil) can be accessed through the CHS web site from the USACE Engineer Research and Development Center Coastal and Hydraulics web site. In addition, a CHS wiki provides the latest up-to-date information on the system (https://wiki.erdc.dren.mil/Coastal_Hazards_System).

CONCLUSION

USACE and other Federal coastal projects, R&D studies, flood-risk mapping, and emergency response activities require storm data and extensive high-fidelity modeling in a statistical context in order to plan, design, and ascertain risk. These data are usually generated for each study at great expense. A typical coastal engineering study produces vast amounts of modeling or measurements that include time- and spatially-varying waves, water level, wind, atmospheric pressure, and currents, among other data types. The CHS provides comprehensive coastal data and the associated uncertainties in easily ingestible standardized formats producing great potential for monetary savings as well as improved understanding of the complex processes by Federal, State, and local governments and the public at large.

CHS file formats will be supported in the near future by the Surface Water Modeling System (SMS) and Generation 2 Coastal Risk Model (G2CRM).