Simulation of Coastal Changes in Thailand
Phase I

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(National Electronics and Computer Technology Center)

THAILAND

A Driving Force for National Science and Technology Capability

Outline

- Introduction
- Tools
- Simulation processes
- Some preliminary results
- Ongoing work and needs

Coastlines of Thailand

The length of the coastline of Thailand is approximately 2,637 km.

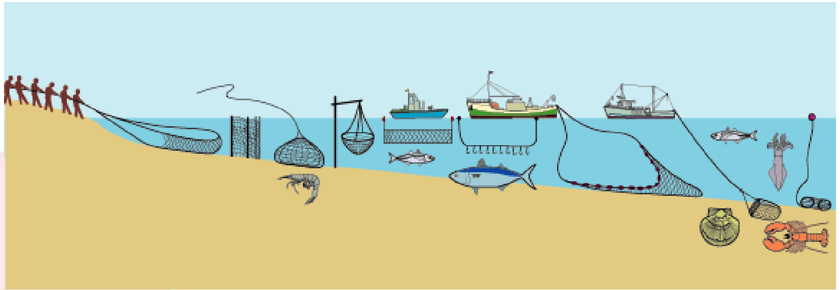
- The Gulf of Thailand coastline covers 17 provinces. The total length is approximately 1,700 km.
- The Andaman sea coastline covers 6 provinces . The total length is approximately 937 km.

12 millions people reside near or long the coastline.

Economic Impacts

In 2001, coastal and estuary fishery businesses generated more than 2 Billions baht (counted only for Sea bass, Giant sea perch, Grouper, Bloody Cockle, Swimming crabs, Mud crabs)

In 2007, the revenue from the coastal related tourism businesses and areas are more than 200 Billions baht (Phuket 94 Bb, Krabi 24 Bb , Rayong 13 Bb , Chonburi 61 Bb and etc) compared to the revenue of 68 Bb from whole northern provinces

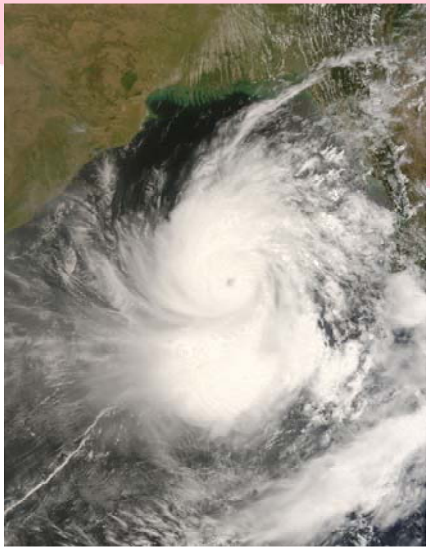


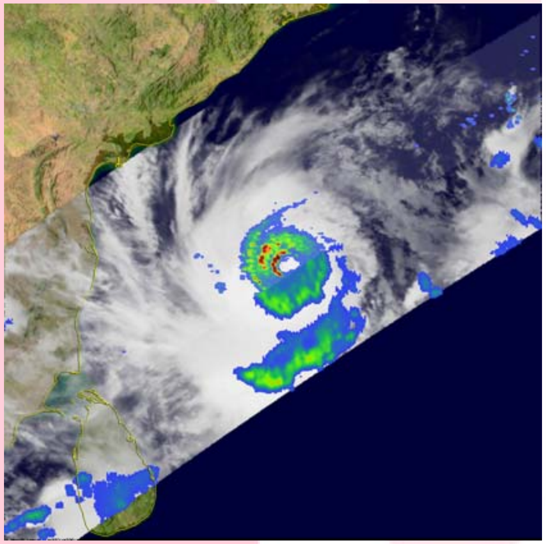
Simulation of Coastal Changes in Thailand Phase I

- In this phase we are focusing on threats on the coasts like storm surges, coastal floods.
- The effects of global warming like sea-level rise to the coastal regions will be also studied in this phase.
- In the mean time, we are also collecting all vital data needed in the second phase for the sediment transport process simulation

Storm surges and coastal floods

- Storm surge is simply water that is pushed toward the shore by the force of the winds swirling around the storm.
- This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 5 metres or more.

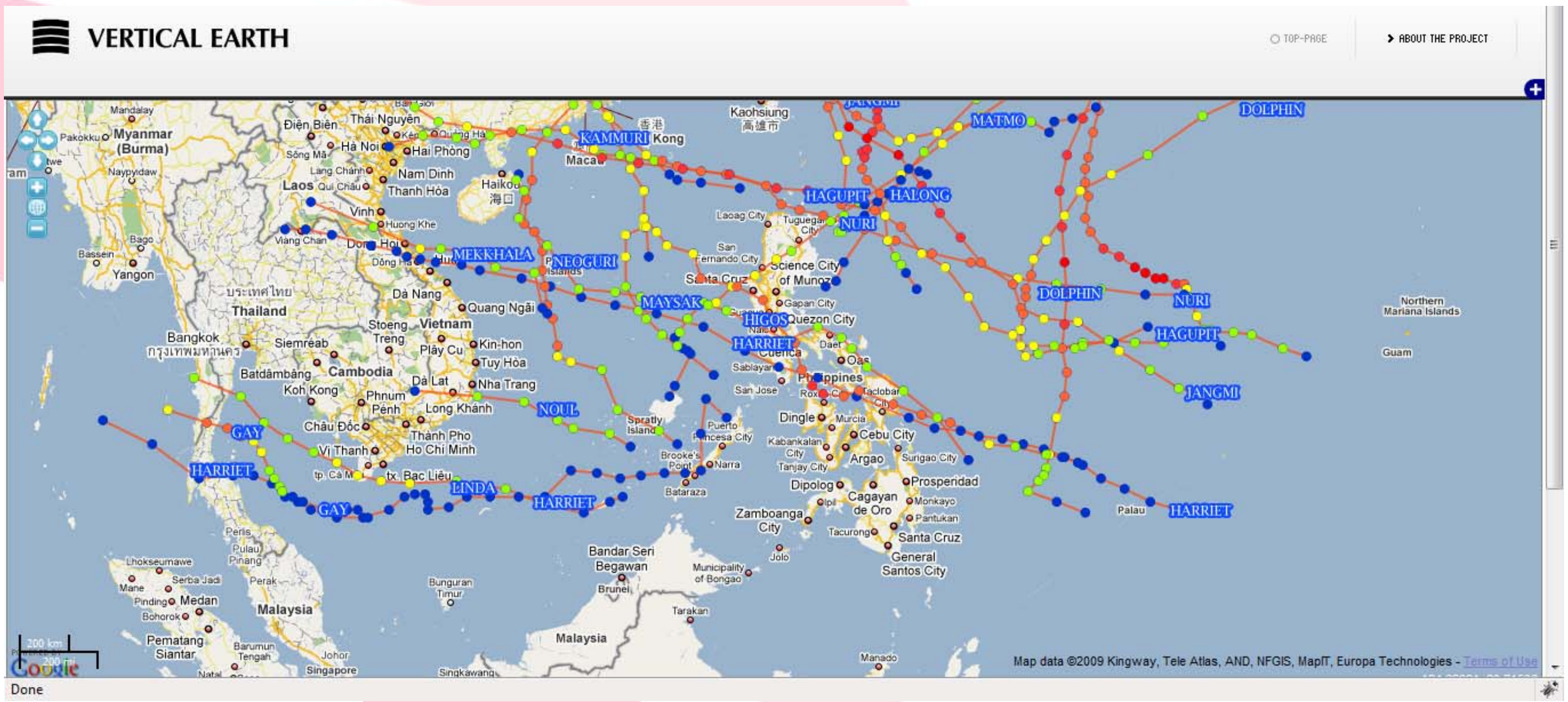




http://www.nhc.noaa.gov/HAW2/english/storm_surge.shtml, images source: http://www.nasa.gov

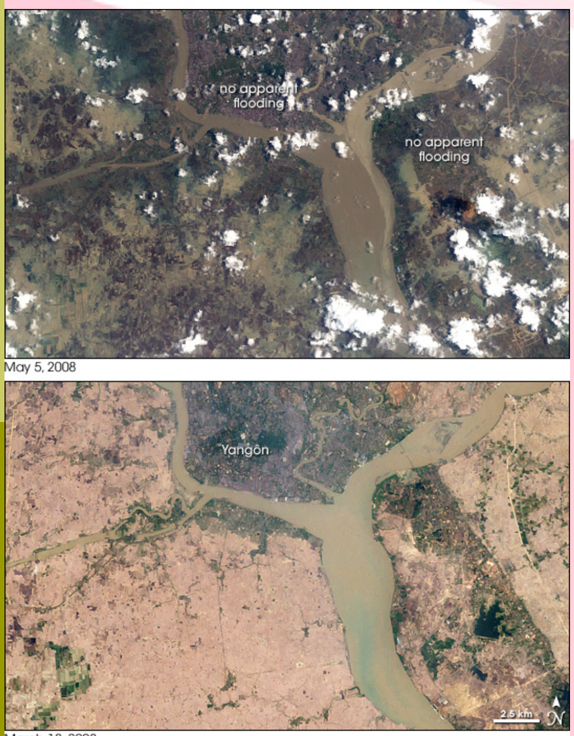
Introduction: Storm surges and coastal floods

- Statistically, there have been a few storm systems that created storm surges in Thailand but coastal floods are much more frequent



Introduction: Storm surges and coastal floods

- However, one of few of those events can cause catastrophic damage to economic, social and environment of the coastal communities.



Tools and related data

- Tools
  - Coastal Ocean Simulator
  - Geophysical data
    - Shoreline
    - Bathymetry
    - Tidal and meteorological forcing data
    - Data from tidal gauges (for verification)
  - Target area:
    - The gulf of Thailand
    - Then move to the study area: Pak Panang

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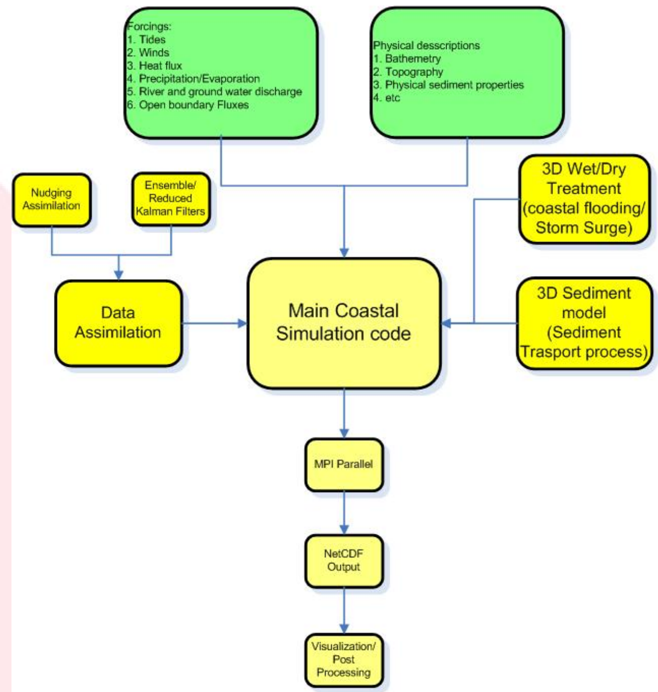
Methodology: Simulator

- The keys for obtaining an accurate prediction include:
  - A good physical coastal oceanography model with accurate wet/dry treatment capability.
  - High resolution of bathymetry and topography data as well as model ability to handle complex data
  - Accurate wind and pressure data to drive the model



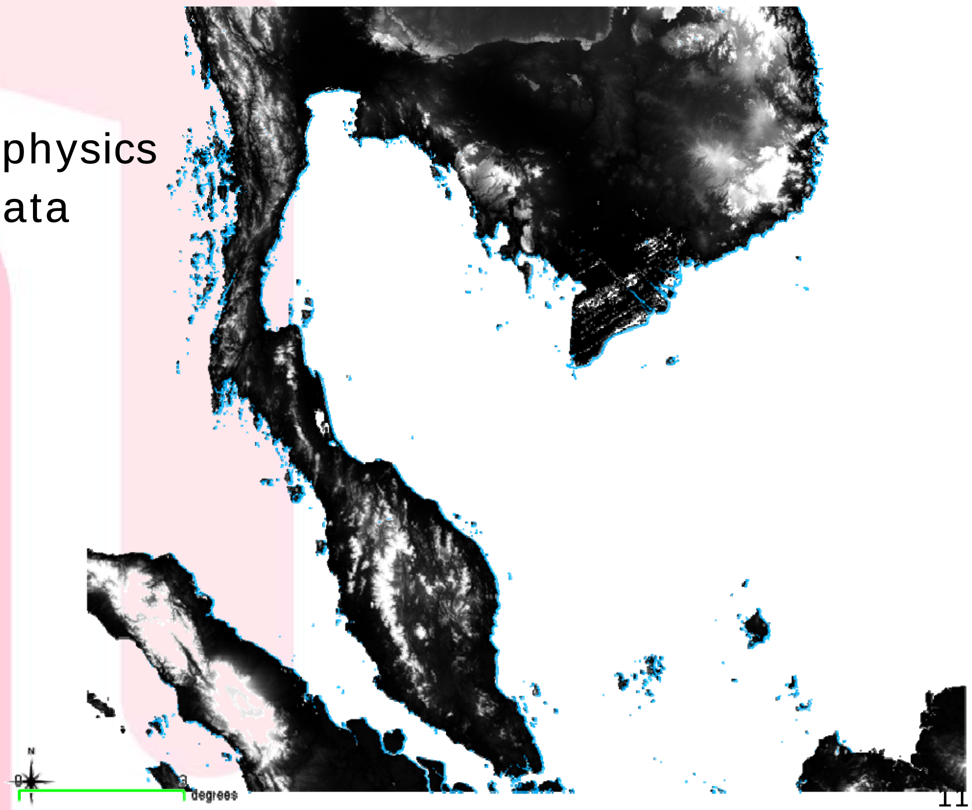
- We thus select FVCOM as our coastal simulator
  - FVCOM is a prognostic, unstructured-grid, finite-volume, free-surface, 3-D primitive equation coastal ocean circulation model developed by UMASSD-WHOI joint efforts. The project is led by Prof. Changsheng Chen

http://fvcom.smast.umassd.edu/FVCOM

Geophysical data

- Shoreline data:
  - Obtained from NOAA's National Geophysical Data Center (NGDC)

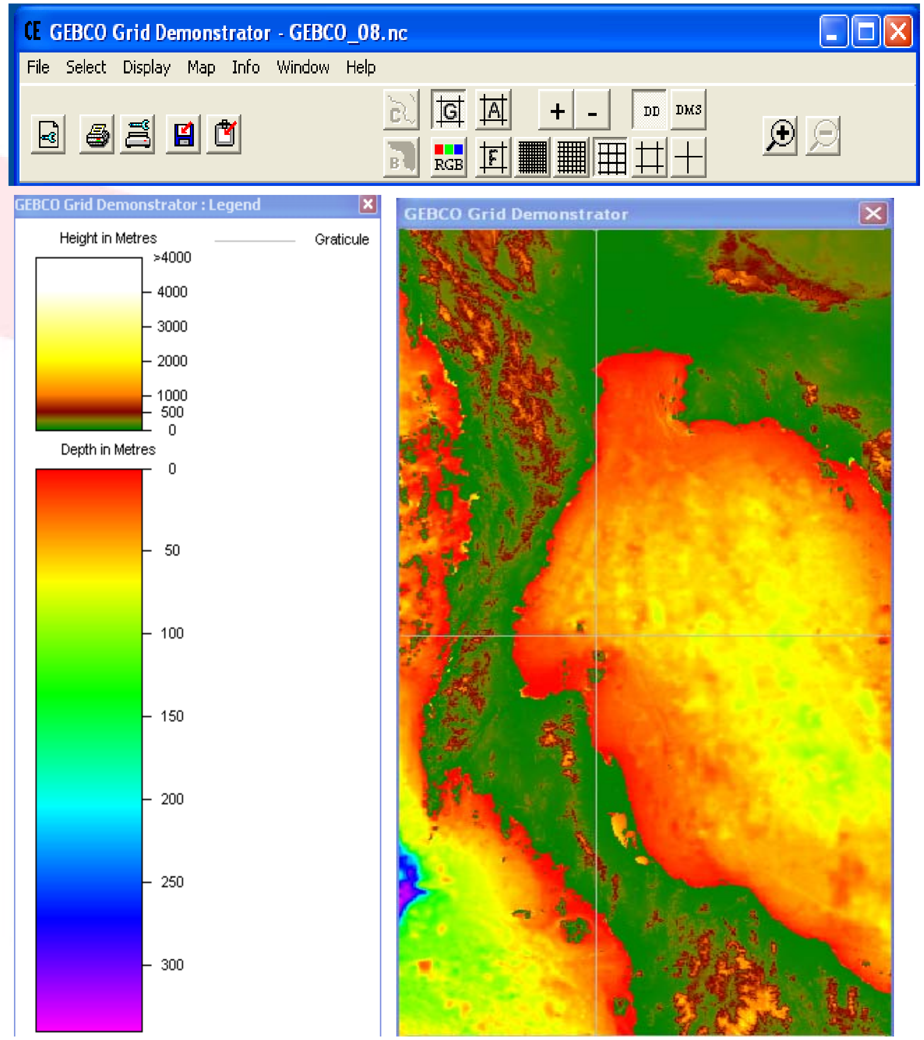
  - This center provides:
    - Marine Geology & Geophysics
    - Shoreline /Coastline Data



www.ngdc.noaa.gov/mgg/shorelines/shorelines.html

Geophysical data

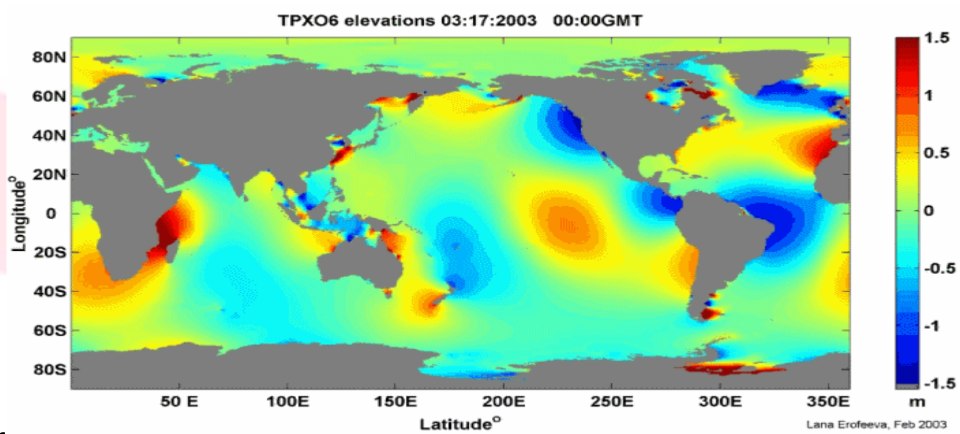
- Bathymetric data:
  - Obtained from The General Bathymetric Chart of the Oceans (GEBCO)
  - This center also provides:
    - A wide range of bathymetric data sets and other data products.

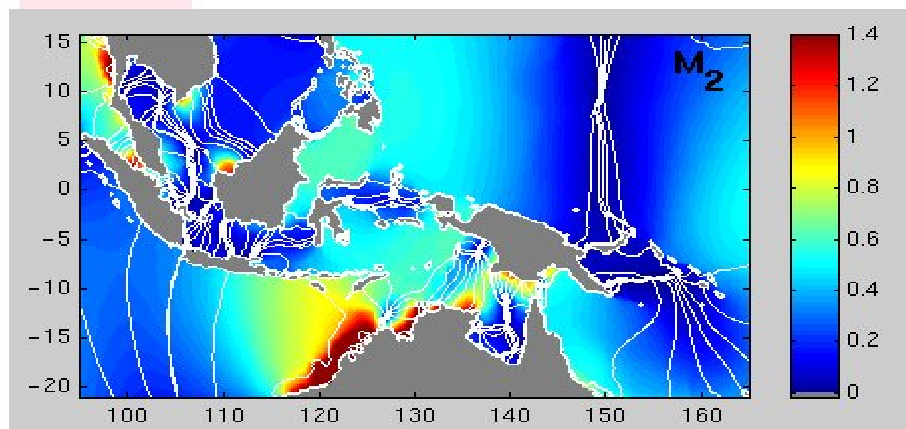


http://www.gebco.net/

Geophysical data

- Tidal forcing data:
  - Obtained from OTIS
  - This tool provides:
    - Tidal harmonic constants for all tidal constituents
    - It can also predict tide for each given time and date for specific coastal area

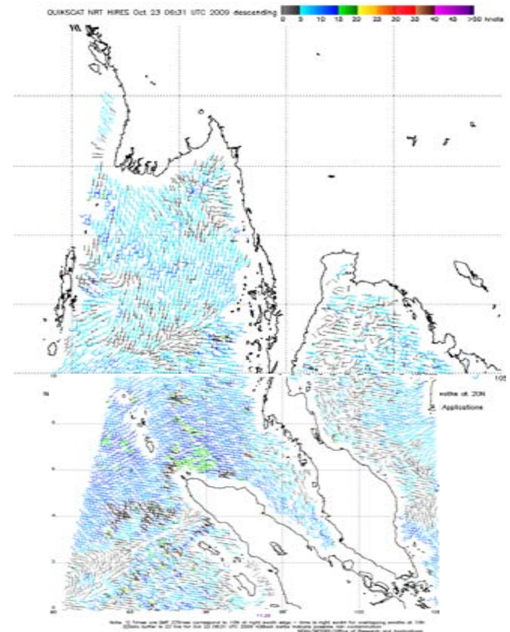


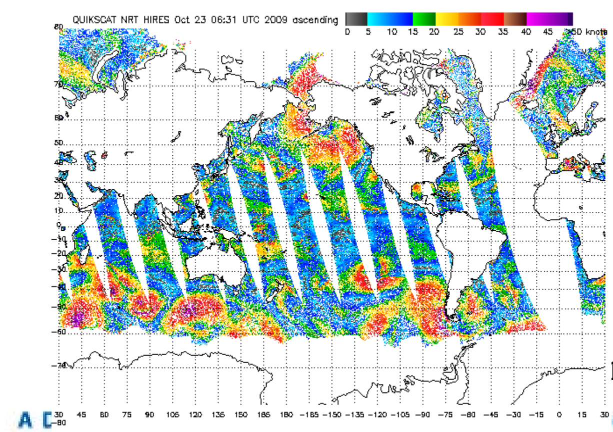


http://www.oce.orst.edu/research/po/research/tide/otis.html

Geophysical data

- Wind (meteorological) forcing data:
  - Obtained from SEAWINDS on Quickscat project (NASA) project as well as OSI SAF Global Wind products (The Royal Netherlands Meteorological Institute)
  - These institutions provide:
    - A QC wind data
    - Ocean surface winds (10 m) derived from the SeaWinds Scatterometer
    - Various resolutions the highest on is 12.5 km



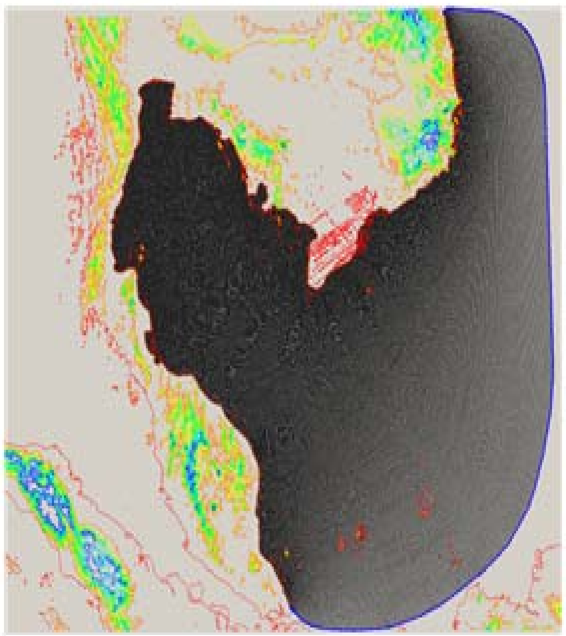


http://manati.orbit.nesdis.noaa.gov/quikscat/
http://www.knmi.nl/scatterometer/osisaf/

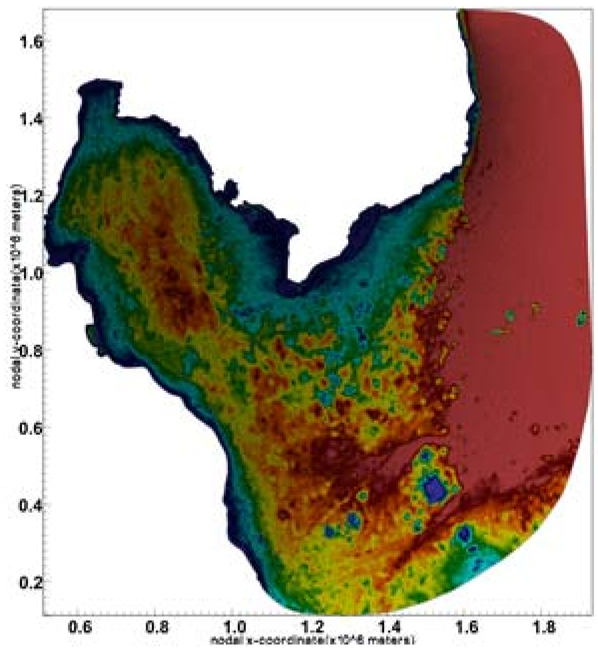
Simulation processes: Preprocessing

- Build mesh from bathymetric and shoreline data sets

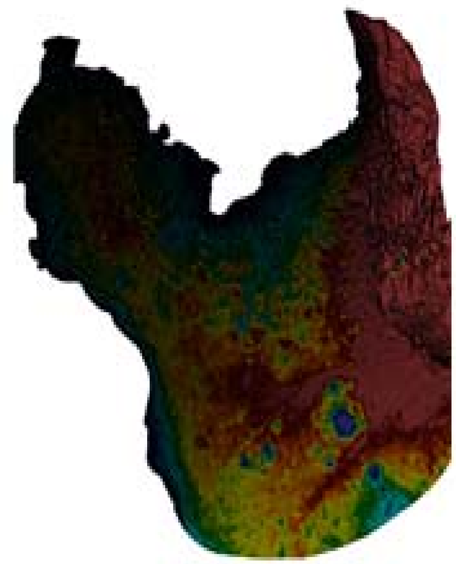
1.Create geometry by using NGDC shoreline



2. Interpolating bathymetric data to mesh

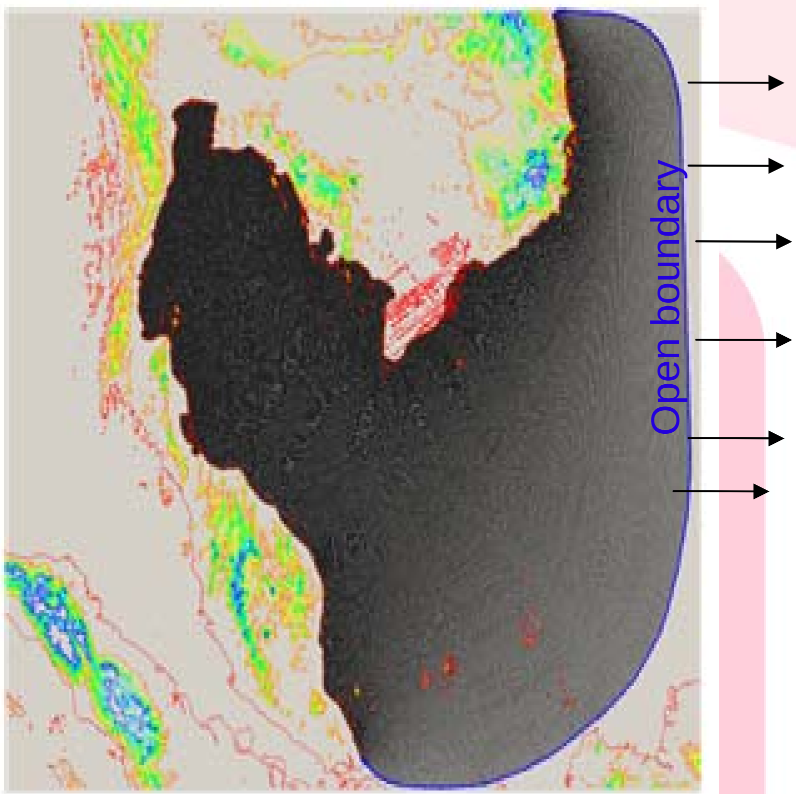


3. Final mesh



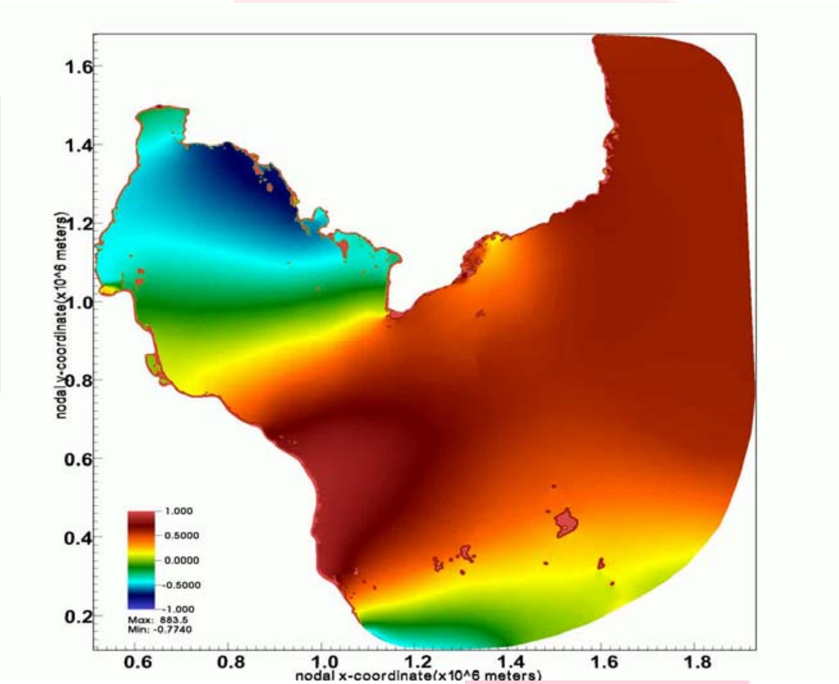
Simulation processes: Preprocessing

- Generate forcing for open boundaries

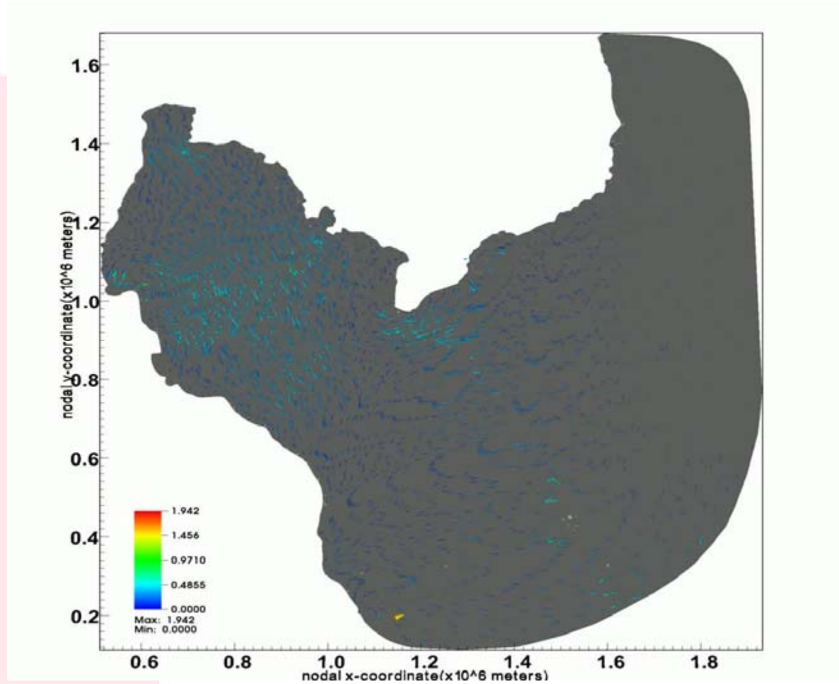


- Retrieve the harmonic constants for each constituents from OTIS
- We use 8 constituents
- Apply those constants to to the open boundary of the domain

Preliminary results



Water depth



Current

Ongoing works and needs

- Perform result verification to tidal gauges
- Investigate the amphidromic systems
- Add wind forcing, perform hindcast and verify results
- Perform forecast scenarios of the coastal and estuary flooding behaviors effected from storm surge and sea level rise

Lot of works ahead, we need:

- Access to bigger, faster HPC resources
  - Right now, we spend about 6 hours (Wall clock) for predicting 6 days (Simulated time) Very slow !!