

# Navigation Channel Depth for Ibaka Deep Seaport in Nigeria

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- Dr. Randall at TAMU for introduction into Dredging



# Introduction to Study Site

- Ibaka – Nigerian south-south coastal settlement (Centered on **N04.65°; E08.32°**)
- Population of 21,600, Land area of approx. 50 km<sup>2</sup> (2014 estimate)
- Average annual temperature of 28°C (82°F)
- Average annual Bay tidal range: 1.7 m
- Predominantly a fishing settlement
- The Bay opens directly into the Gulf of Guinea



**Ibaka fishing terminal**



## Timber River Port



**Beach Tennis court**



**Beach Swimming Pool**



**Beach relaxation center with local tents**

# Outline

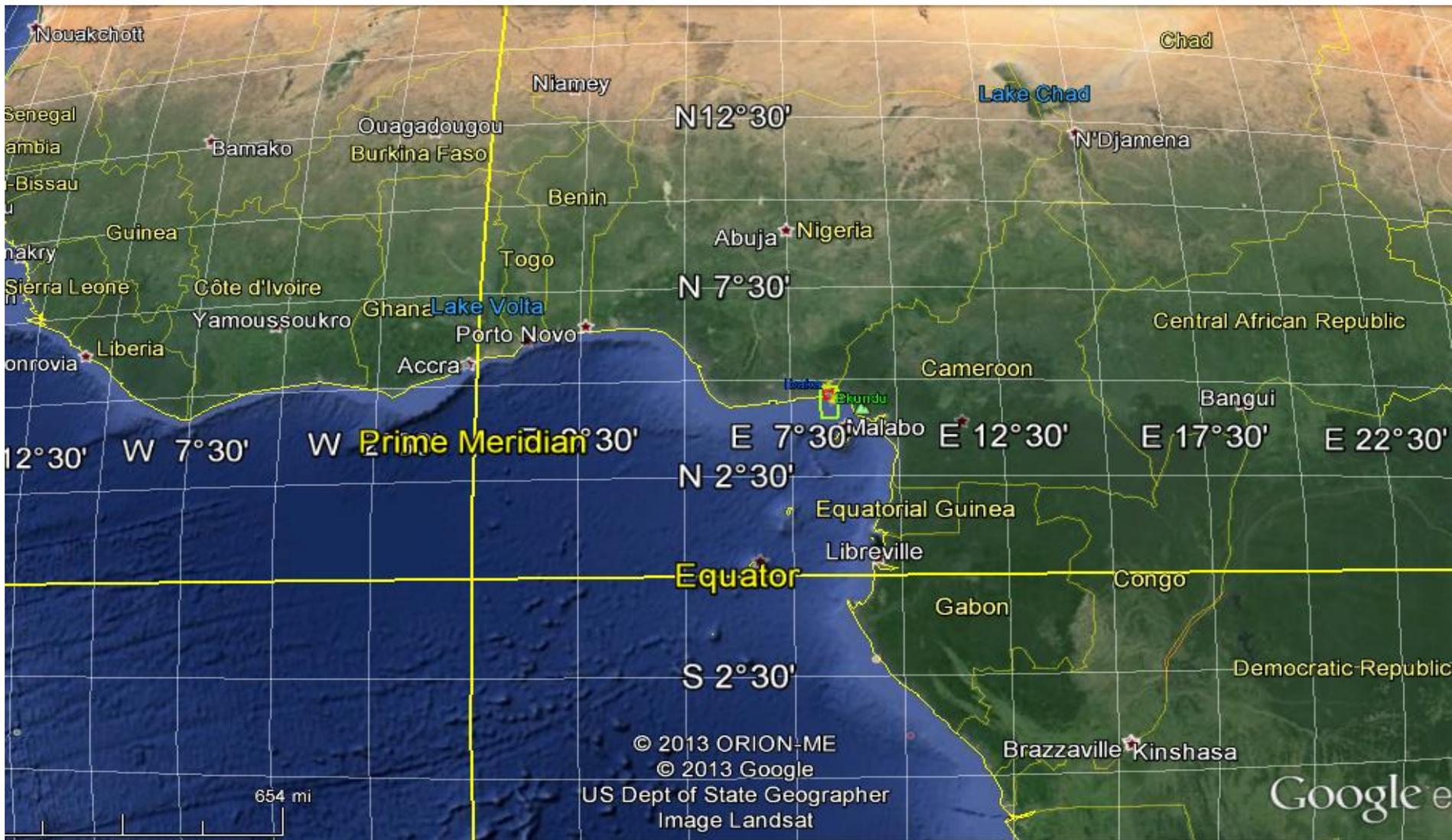
- Field Experiments
- Numerical modeling Results
- Summary of major findings
- Future research



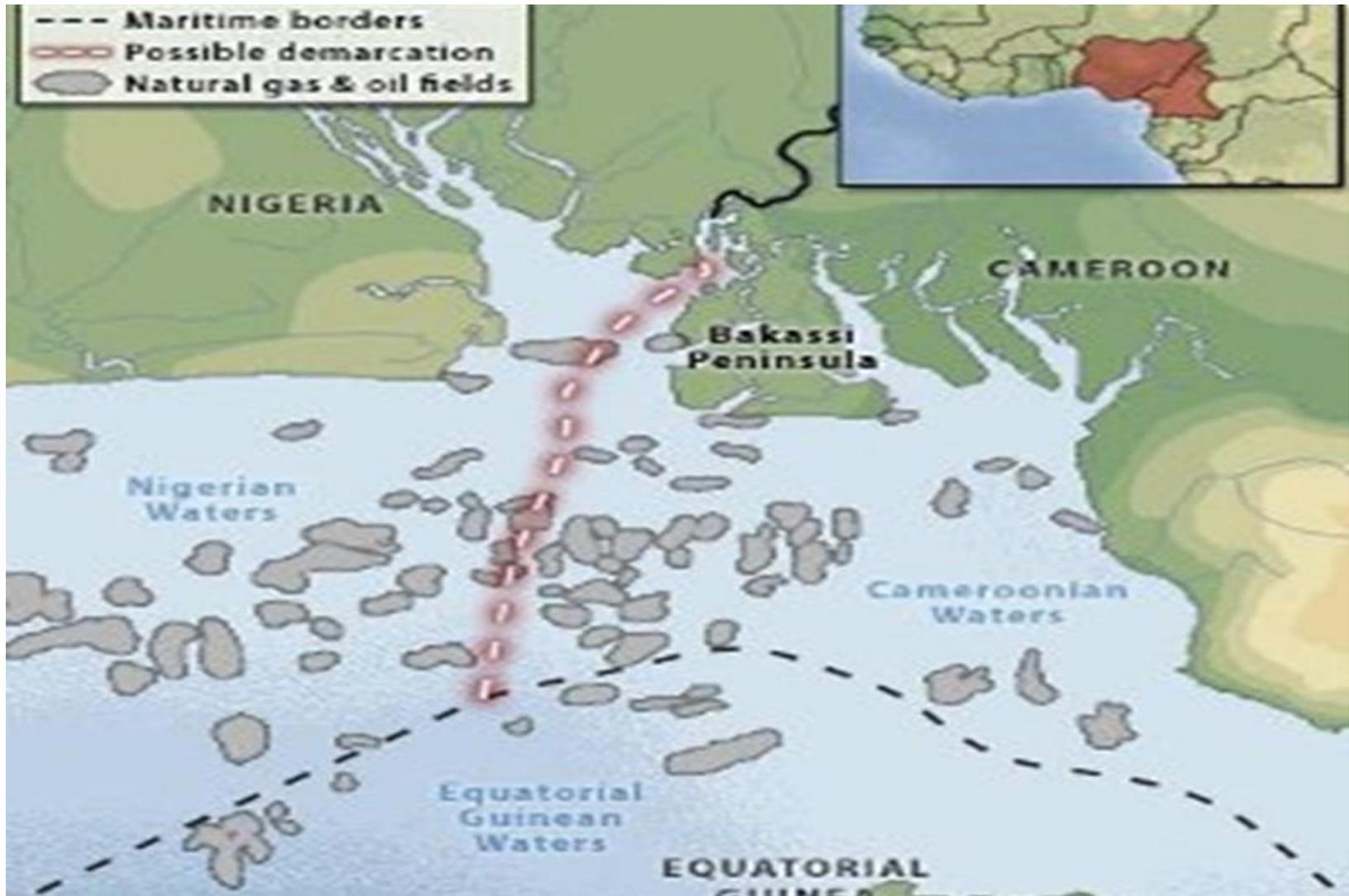
A physical map of Africa. The light blue arrow points to where Ibaka Bay is located. (Courtesy: [www.mapsofworld.com/africa](http://www.mapsofworld.com/africa))

# Problems and Needs

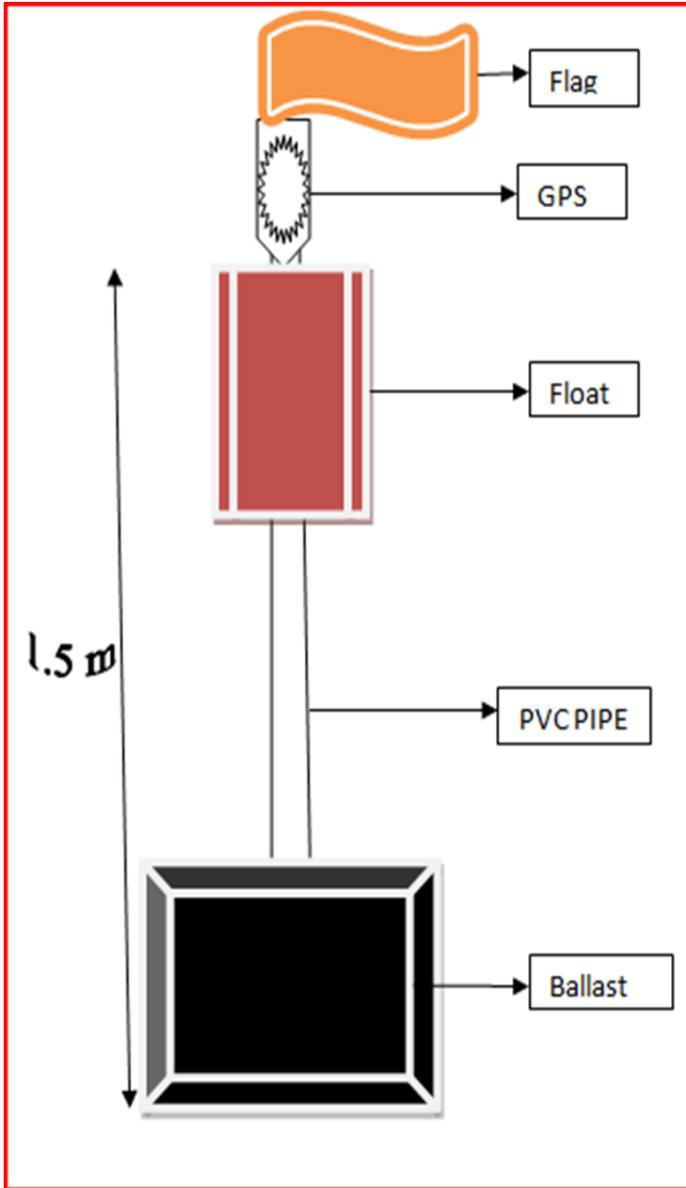
- Existing Nigerian ports are grossly inadequate to cater for the growing demands of high tonnage ships and tankers
- High economic growth rate (7.5%) in Nigeria requires a deep seaport that can accommodate at least 8,000 TEUs containerships and tankers of 100,000 – 200,000 DWT
- An efficient channel and harbor that could allow safe operation of the planned deep seaport, at least 95% of the time, is to be constructed



**Google Earth Map showing West and Central African coastlines in the Gulf of Guinea. Numerical study domains are indicated by the rectangles.**



**A section of the Gulf of Guinea showing national boundaries, Oil and Gas fields, and proposed new maritime border between Nigeria and Cameroon.**

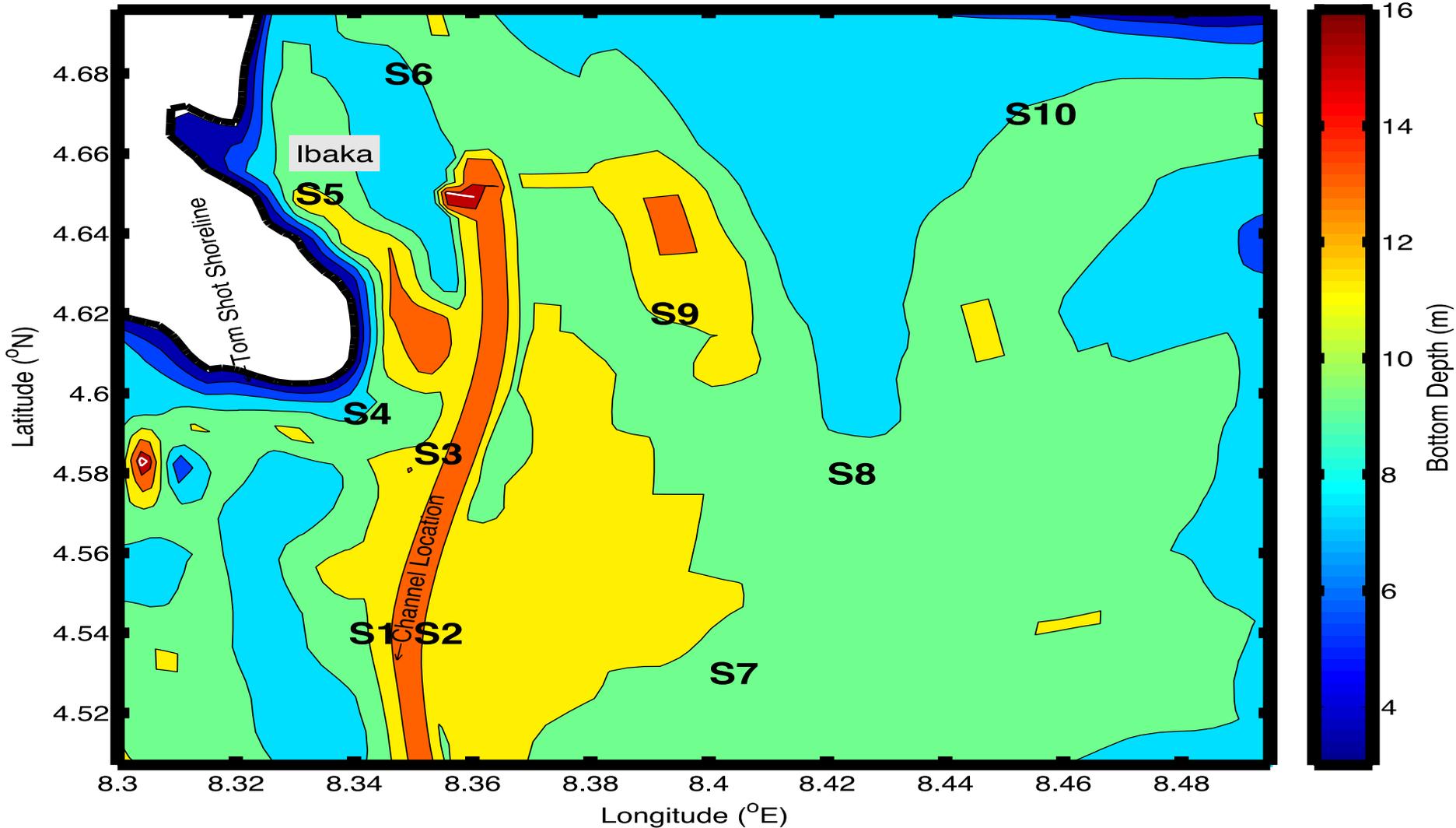


**Surface Drifter Design (left) and prototype (right)**



## **Some local boats engaged for drifter monitoring in Ibaka Bay**

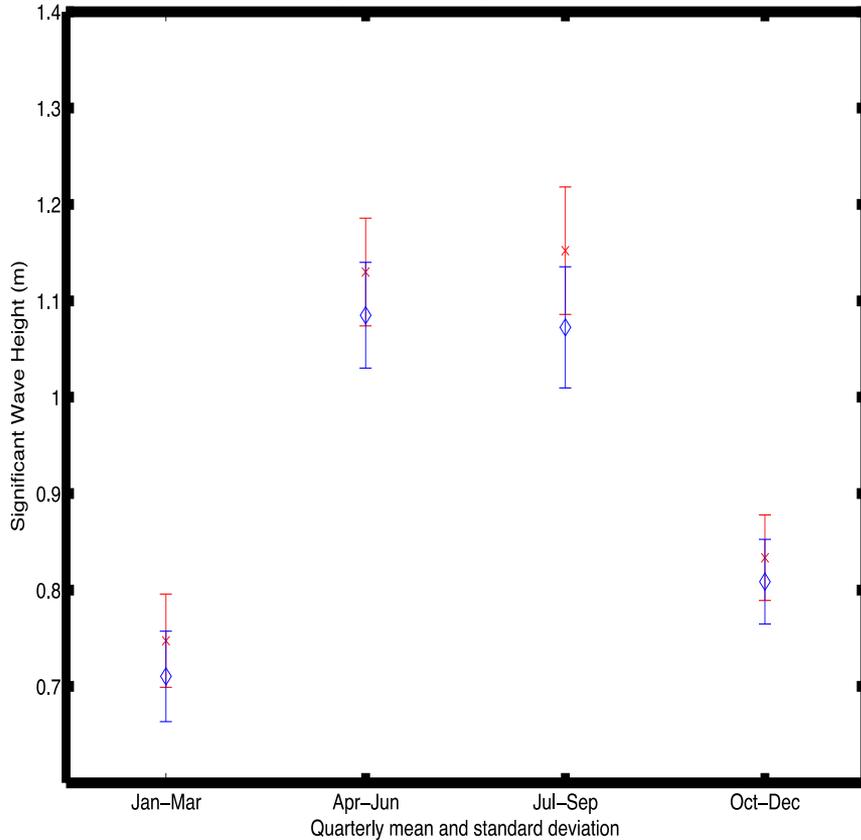
**Color: Bottom Depth (m) w/ channel and station locations (S = station)**



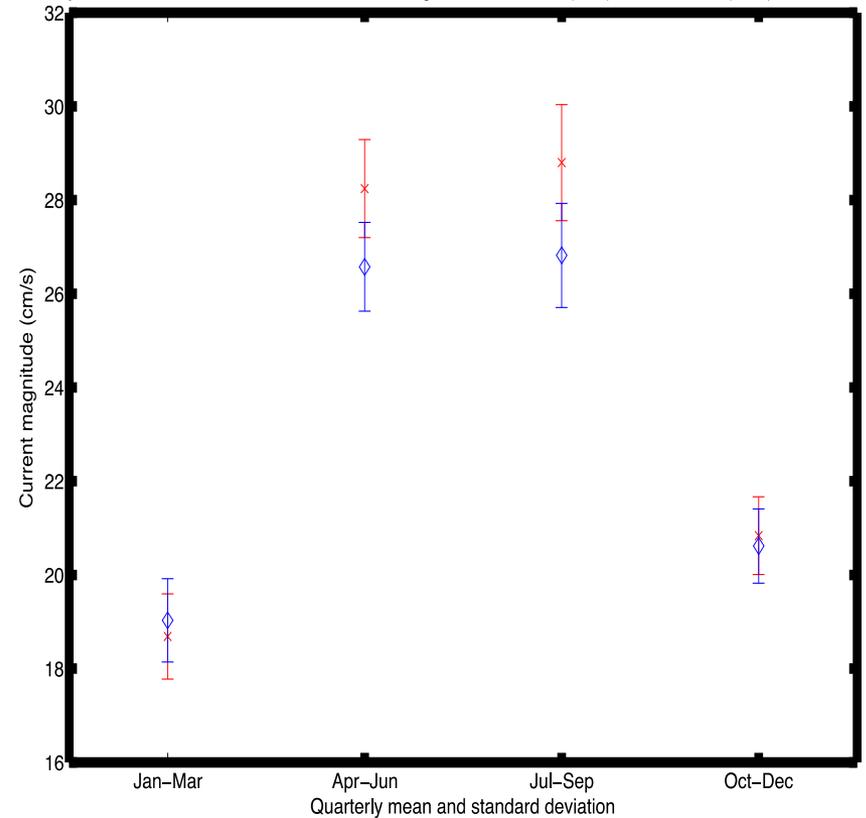
**Contoured bathymetry of study site showing proposed navigation channel, Ibaka Bay, and locations where model outputs were taken (S followed by the station number).**

# Experimental data and model comparison of significant wave heights and current in the study area

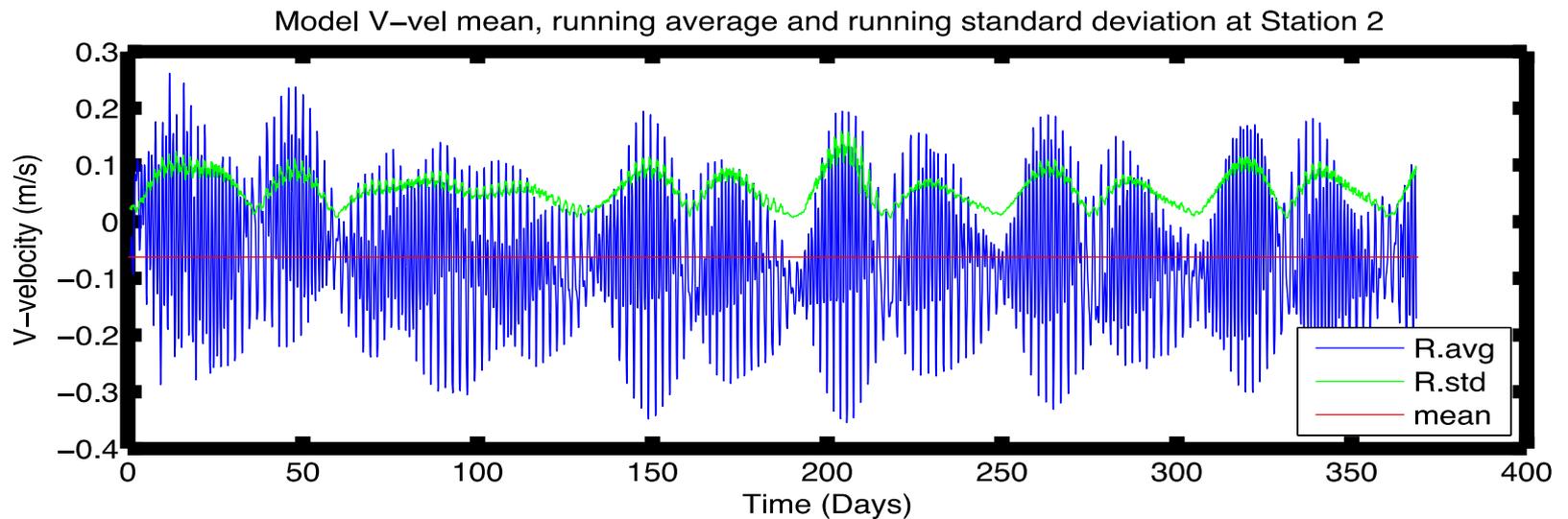
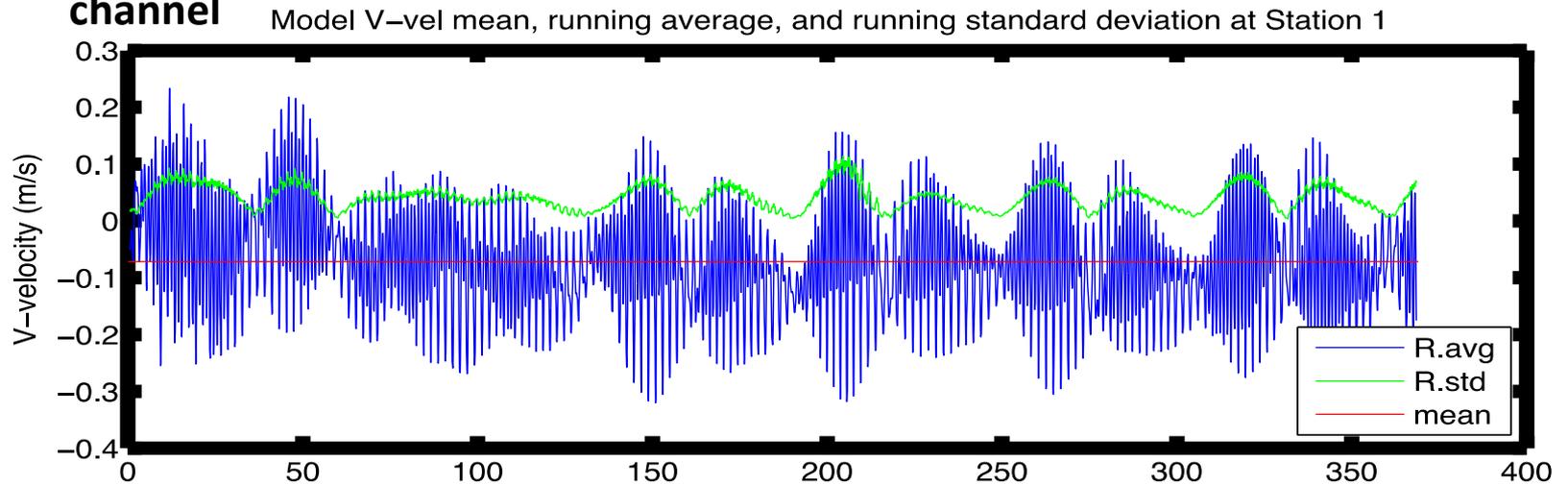
Quarterly Mean and standard deviation of Significant WaveHeight in Ekundu (Red) and Station 1 (Blue) from 2004 to 2008



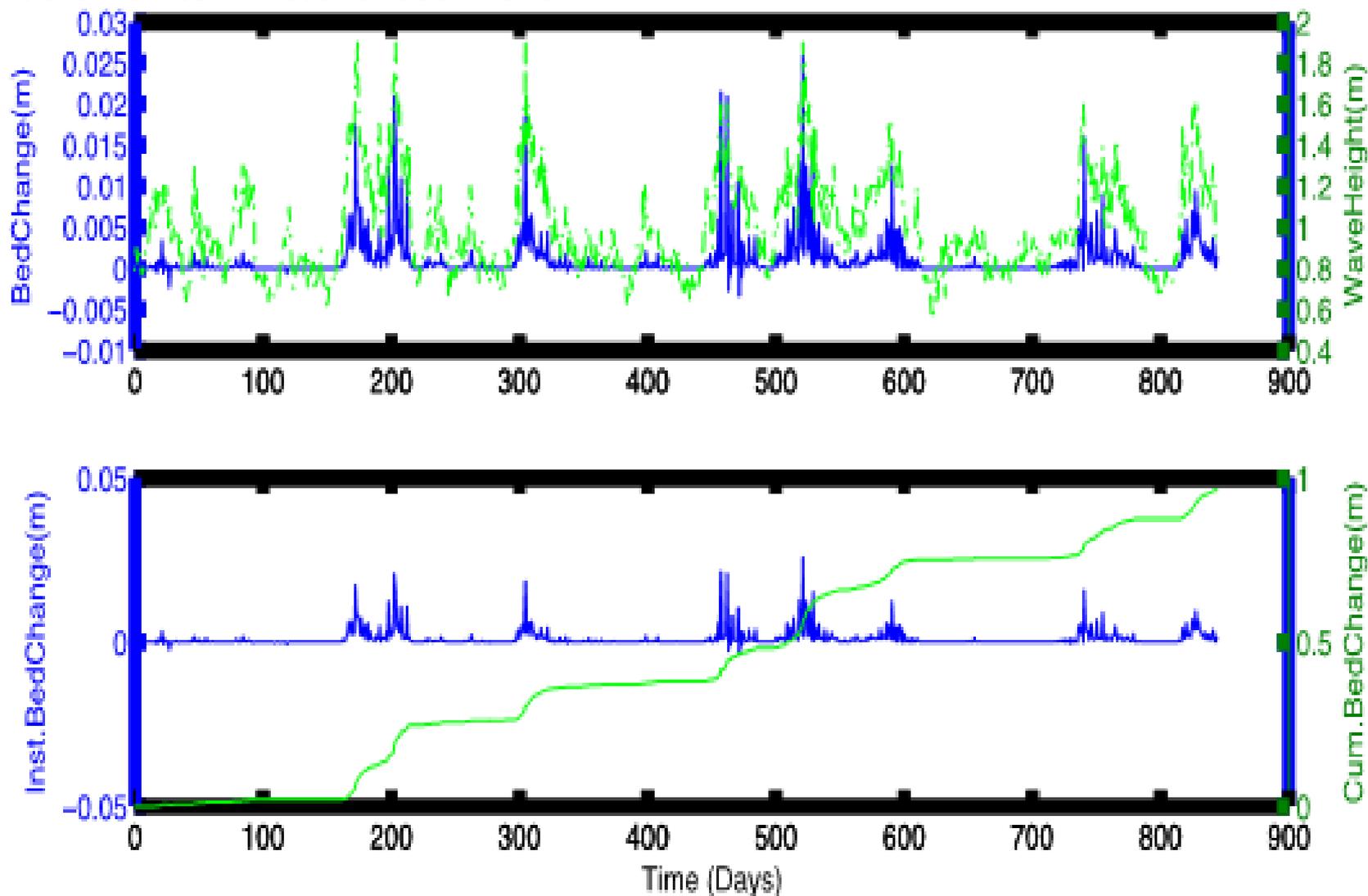
Quarterly Mean and standard deviation of Current Magnitude in Ekundu (Red) and Station 1 (Blue) from 2004 to 2008



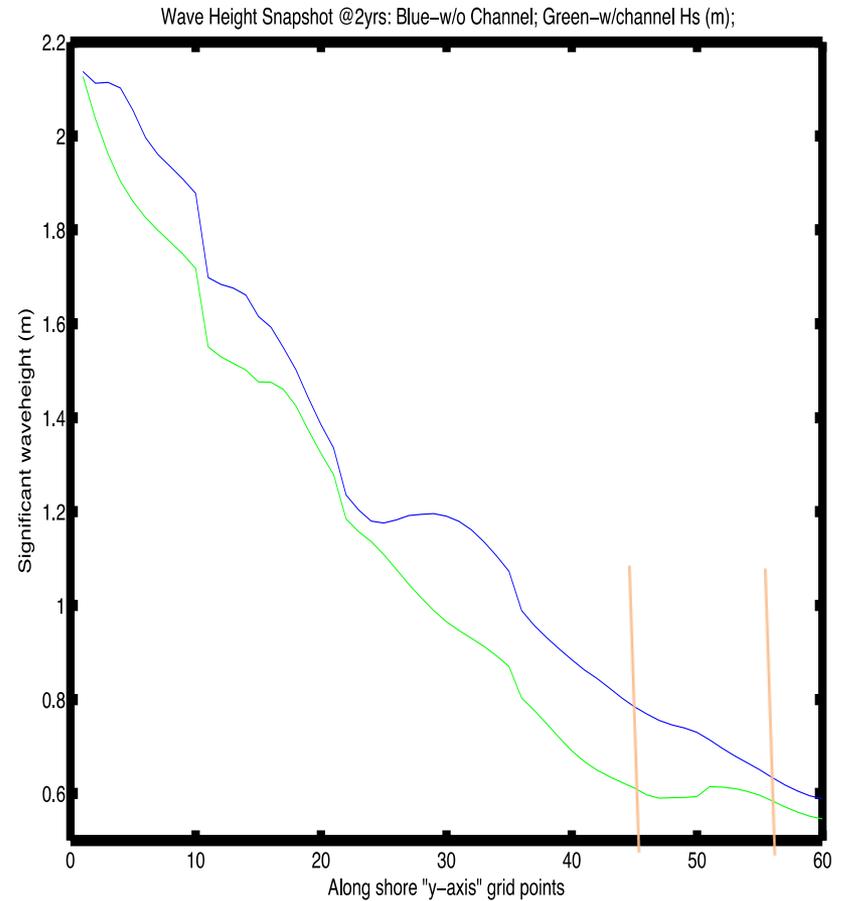
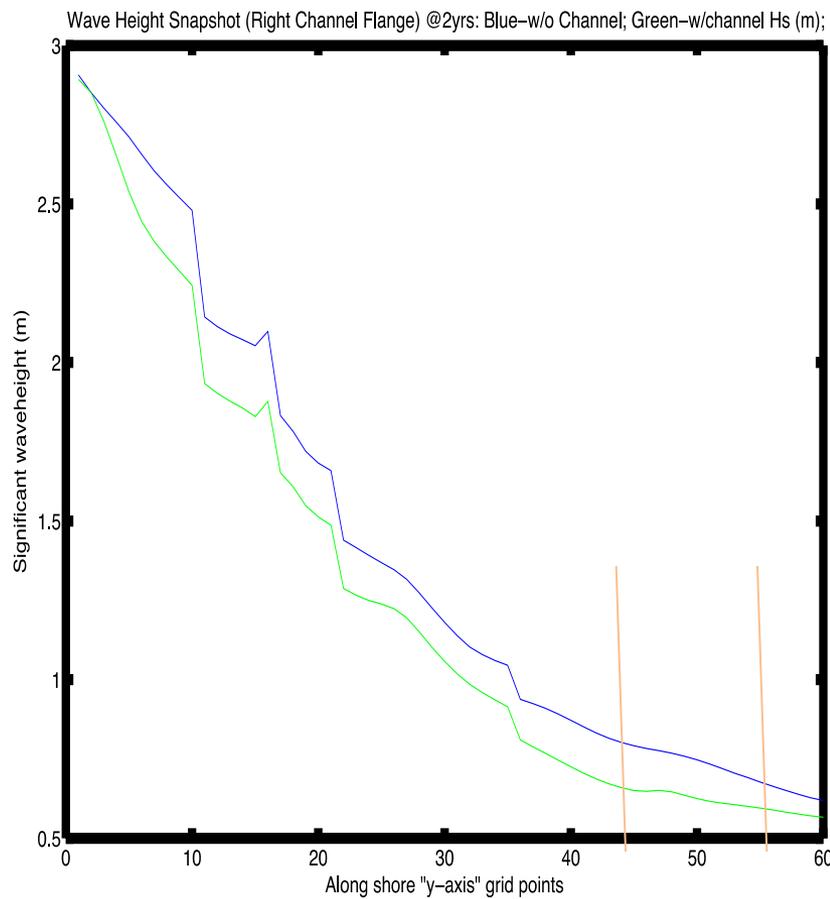
# Water current around the deep channel at stations 1 and 2. Long-term trend indicates net ebb flow, indicating flushing characteristic of the harbor and channel



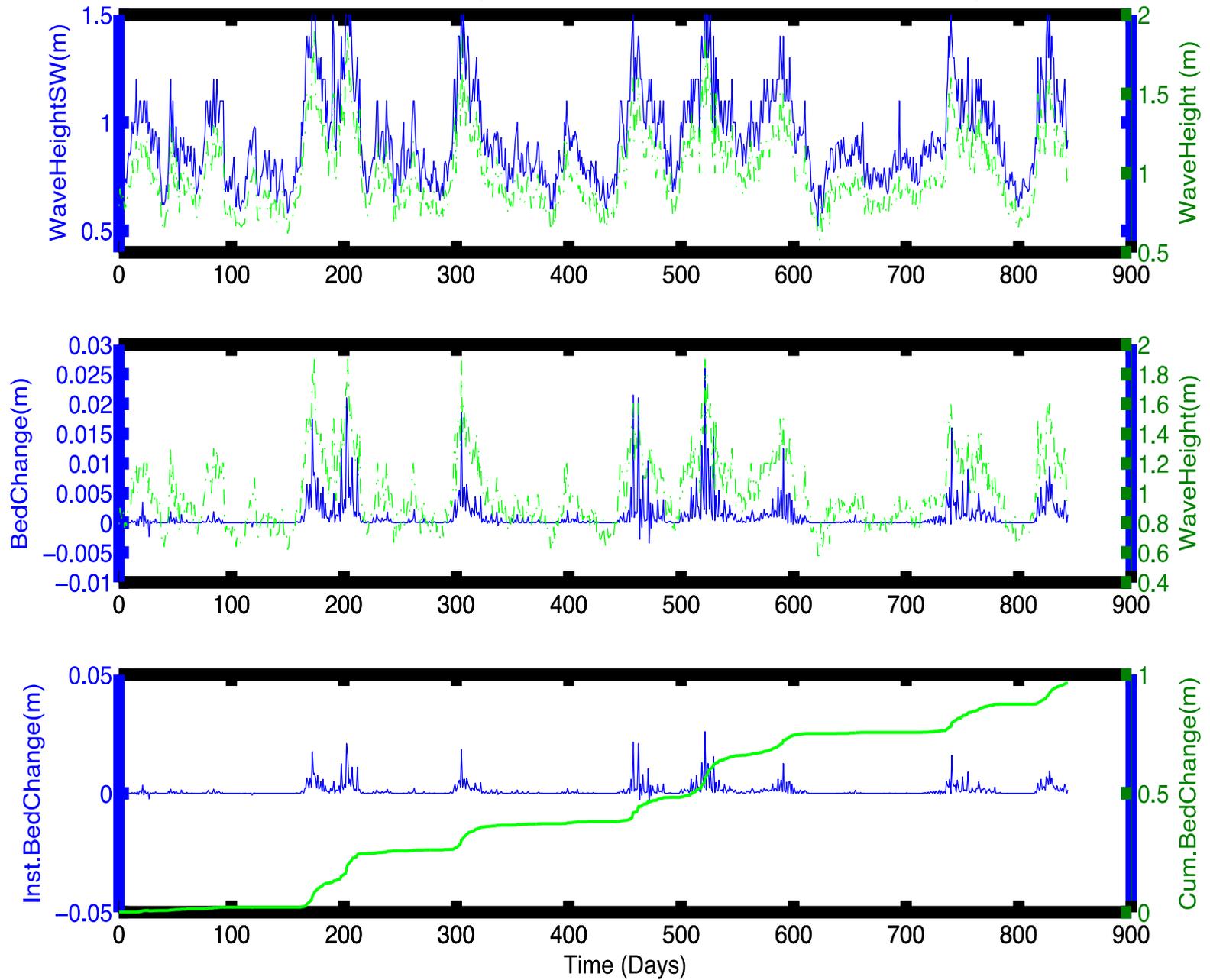
Wave height and seabed level changes in Ibaka Bay. A morphological factor of eight was applied to the bed level module. The harbor basin takes about ten years to accumulate 1 meter of sediment



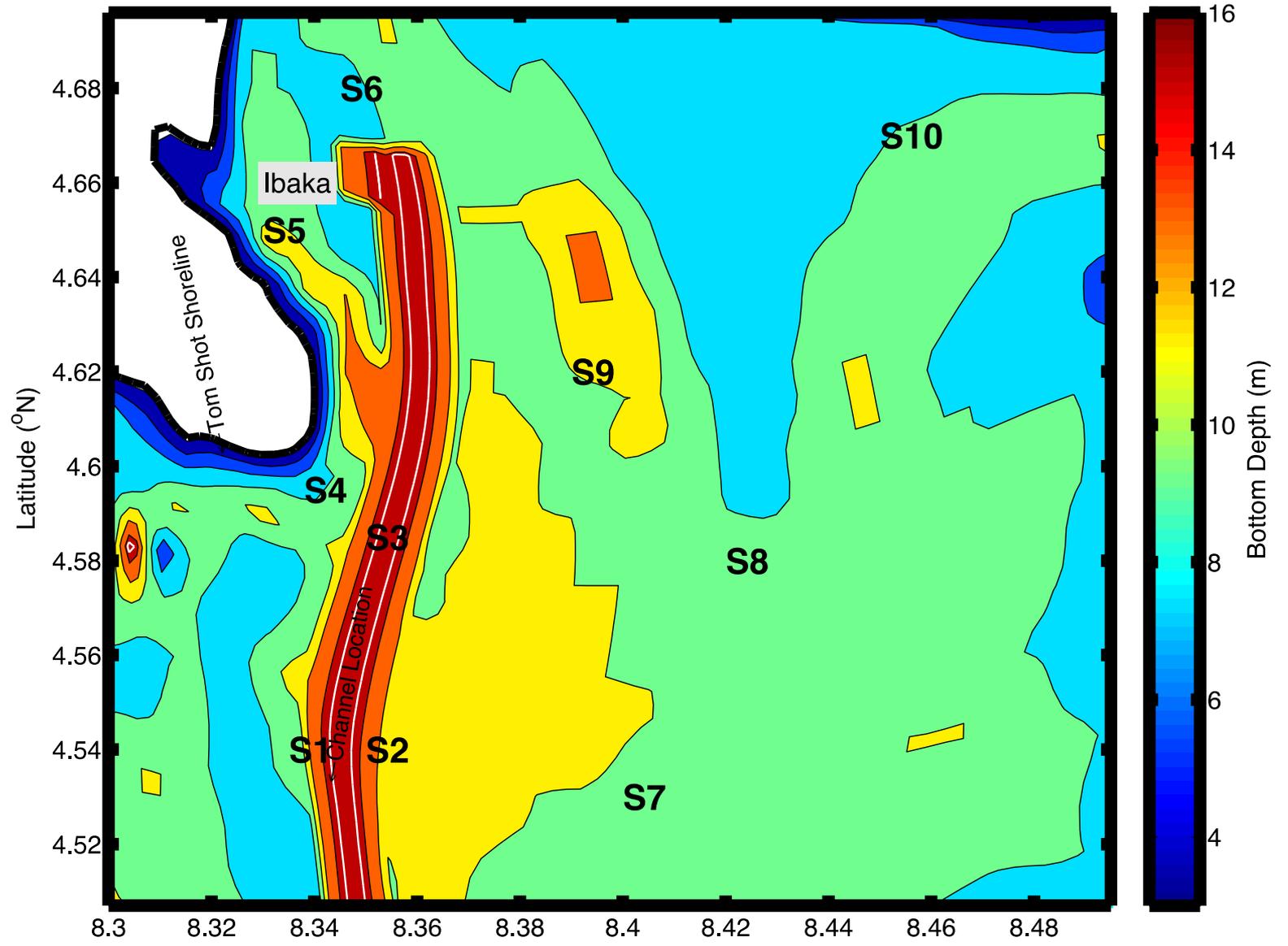
Geometry and bathymetric features of the estuary constrain maximum wave height (< 1.0 m) reaching harbor basin and shore. Model results indicate that only waves > 1.0 m drive sediment processes in the Bay



Station 1 Plots of Wave Height, Instantaneous and Cumulative Seabed Changes: (m)



Color: Bottom Depth (m) w/ channel showing stations(S = station)



### Most efficient channel design for the proposed Ibaka Deep Seaport

# Summary of Major Findings

- Ibaka Bay is a natural harbor: Tom shot Island shields the harbor from direct impacts of West African South-South-West swells
- Only rainy season conditions produce wave and currents that cause sediment transport in Ibaka Bay
- Deepening of ship navigation channel to contain higher Deadweight tonnage (200,000 DWT) vessels will not propagate higher wave energy towards shore
- Maintenance dredging of the ship channel will be minimal (approx. once in 5 years)
- Involvement and education of local residents are essential for a successful near shore field campaign

# Recommendations for future studies

- Finer Bay bathymetric sampling; Apply three-dimensional numerical models
- Get longer record site-specific data for model verifications
- Obtain final/approved port design, run model with all port infrastructures
- Allot more resources to information management and timely dissemination
- Utilize dredged materials for Ibaka beach development

# Thank you

- Questions?