THE HYDRODYNAMIC FLUXES OF THE ESCRAVOS AND FORCADOS RIVERS: IMPLICATIONS FOR TRANSPORT AND CIRCULATION PATTERNS OFF THE WESTERN NIGER DELTA

BY

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INTRODUCTION

- The Escravos and Forcados River estuaries are distributaries of the Niger River located in the western Niger Delta.
- These river systems are interconnected flowing at an average distance of 129km ending at the Bight of Benin of the Gulf of Guinea where they open and discharge into the Atlantic ocean.

- The River estuaries from a complex system where seawater is diluted with freshwater from land runoff (Dyer 1997).
- The dilution process takes place at different mixing levels due to many forcing mechanisms like tides, tidal currents, and waves induced motion.

- The River estuaries had served as navigation routes for vessels and commercial activities of oil companies who have their terminal stations along the River channel.

- Due to periodic increase of navigation and commercial activities in the Rivers their water fluxes are affected influencing the hydrodynamics of the River system.
AIM AND OBJECTIVES

- The aim of this work is to evaluate water fluxes in Escravos and Forcados River estuaries

OBJECTIVES ARE:

- To analyse for current velocity and direction offshore western Niger Delta
- To analyse the water circulation from the Conductivity Temperature Depth (CTD) profiles
- To investigate the tidal fluxes influence on the river discharge.
OCEANOGRAPHIC CONDITIONS OF NIGER DELTA

- Tide
- Tidal current
- Waves
- Longshore current
- Ocean current
BATHYMETRIC MAP OF THE STUDY AREA WITH PATTERNS OF PREVAILING OCEANOGRAPHIC FORCES
DESCRIPTION OF THE STUDY AREA

The Esravos River lie at the 5° 35' 0" N and 5° 10' 0" E and the Forcados River at 5° 0 18’30” and 6° 0 25” E. The station S2 is located at 5° 42” 10N and Longitude 4° 56’ 40”E offshore the Benin River.
DATA COLLECTION

- ADCP, CTD and River discharge data for one year were extracted from database on shallow current measurement conducted along Nigerian coastline sponsored by Mobil Producing Nigeria Unlimited in consultation with Evans Hamilton Incorporated (EHI) and the Nigerian Institute for Oceanography and Marine Research, Lagos and University of Calabar, Calabar.

- Tidal data for Escravos and Forcados Rivers for one year was extracted from Tidal prediction table obtained from the Nigerian Hydrographic Survey, Apapa, Lagos.
MATERIALS AND METHODS:

- Field measurements were conducted using RD 300 KHz ADCP deployed at a Benin River at station S2 (shallow water depth of 15.8m) within 4° 56’ 40”E and 5° 42’ 10”N near the mouth of Escravos and Forcados Rivers.
- CTD were done at cross shelf profiles at varying depth between 15m to 70m water.
River discharge measurements was conducted using RD River Grand 600 KHz ADCP mounted on the side of a boat and transect from bank-to-bank in the Escravos and Forcados Rivers to cover the low and high tide.
DATA ANALYSIS

DATA ANALYSIS:

- Matlab software was used for analysing the ADCP data acquired at Station S2 (Shallow water) for current speed and direction.
- Win River software was used to view and compute the River discharge data to analyse for average intensity, water speed and velocity magnitude.
- Excel spreadsheet was used to plot the tidal curve.
RESULTS

Current polar plots for station S2 (15.8m water depth) between 19 April 2000 and 4 February 2001. Bin 3 is 2.3m from sea bottom, Bin 13 is 7.3m above the sea bed. Bin 22 is 11.8m above the sea bed.

Bin 3 (2.3m)  
Bin 13 (7.3m)  
Bin 22 (11.8m)

Bin 22 show higher amplitude and long period of oscillation, compared to the Bin 3 and Bin 13 with a mean velocities of 0.12 m/s.
- Homogenous surface layer with temperature ranging from 29°C-30°C
- Salinity range of 29PSU to 34.5 PSU within the mixed layer
- Thermocline is about 20m-30m corresponding to the pycnocline
Conductivity Temperature Depth Plot for Rainy Season

CTD Profile at Cruise2, Line2 (July)

- Homogenous surface layer with temperature ranging from 25°C-26°C
- Salinity range of 30 PSU to 34 PSU within the mixed layer
- Thermocline is about 28m to 40m corresponding to the pycnocline

Evans Hamilton (2001)
Homogenous surface layer with temperature ranging from $27^\circ$C-$28^\circ$C

Salinity range of 23 PSU to 34 PSU within the mixed layer

Thermocline is about 60-70m deep corresponding to the pycnocline

Evans Hamilton (2001)
Homogenous surface layer with temperature ranging from 27°C-29°C

Salinity range of 29.7 PSU to 34 PSU within the mixed layer

Thermocline is about 40m-50m deep corresponding to the pycnocline

Evans Hamilton (2001)
CTD Profile at Cruise 4 Line 2 (May)

- Homogenous surface layer with temperature ranging from 29°C-30°C
- Salinity range of 30 PSU to 35 PSU within the mixed layer
- Thermocline is between 20m-40m deep corresponding to the pycnocline

Evans Hamilton (2001)
Escravos River Discharge for rainy season 23/07/2000

Flood
Total Q = 12,358.24m³/s

Ebb
Total Q = 16,142.98m³/s

Tidal curve
Escravos River Discharge for dry season 19/12/2000

Ebb tide
Total Q = 9,938.58 m³/s

Flood tide
Total Q = 5893.62 m³/s

Tidal curve
Forcados River Discharge for dry season (22/12/2000)

**Ebb tide**
- Total Q = 10,427.35 m³/s

**Flood**
- Total Q = 8,851.79 m³/s

**Tidal curve**
Forcados River Discharge for rainy season 26/07/2000

Flood tide
Total Q = 10,421.38 m³/s

Ebb tide
Total Q = 10,513.48 m³/s

Tidal curve
SUMMARY OF FINDINGS

- The near surface currents observed offshore in the western Niger Delta shows that long period of oscillating current was observed at Bin 22 (11.8m) when compared to other Bin 3 and Bin 7.

- The variation in the mixing level observed from the CTD plot show that the river discharge and tidal currents are forcing mechanism controlling the estuary circulation.

- The evaluation of the Escravos and Forcaodos water fluxes show that river discharge during rainy season has higher value compared to that of Dry season.
CONCLUSION

- The results from the study shows that the current offshore are observed to be moving parallel direction to the coastline. While the river discharge and tidal generated current mixes the river estuaries progressive toward the offshore.

- Thus, the understanding of the dynamics of along shelf current and tidal current can be used to trace the path of the water transport, dispersal, deposition of pollutants, sediments and nutrients across and offshore the rivers.
THANKS FOR LISTENING