NATIONAL REPORT ON SEA LEVEL STATUS IN NIGERIA

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1. INTRODUCTION

Sea level monitoring activities in Nigeria started as far back as the colonial years early in the 20th century. The primary objective of sea level monitoring activities at that time was for safe navigation into the ports of Lagos, Port Harcourt and Calabar (fig. 1). Tidal data were observed at these stations using graduated tidal staff and later upgraded to float types. Tidal predictions at that time were very crude but were sufficient to allow ships to navigate through the shallow estuaries and creeks to the ports.

2. THE TIDE GAUGE NETWORK IN NIGERIA

The list of gauge sites in the Nigeria cannot be ascertained because several oil companies maintain tide gauges either at their offshore platforms or at their estuary terminal. However, in the past sixty years, some coastal tide gauge stations supplied data to the Permanent Service for Mean Sea Level (PSMSL). These stations are:

a. Lagos
b. Lagos ii
c. Koko

d. Forcados

e. Port Harcourt

f. Bonny

g. Calabar.

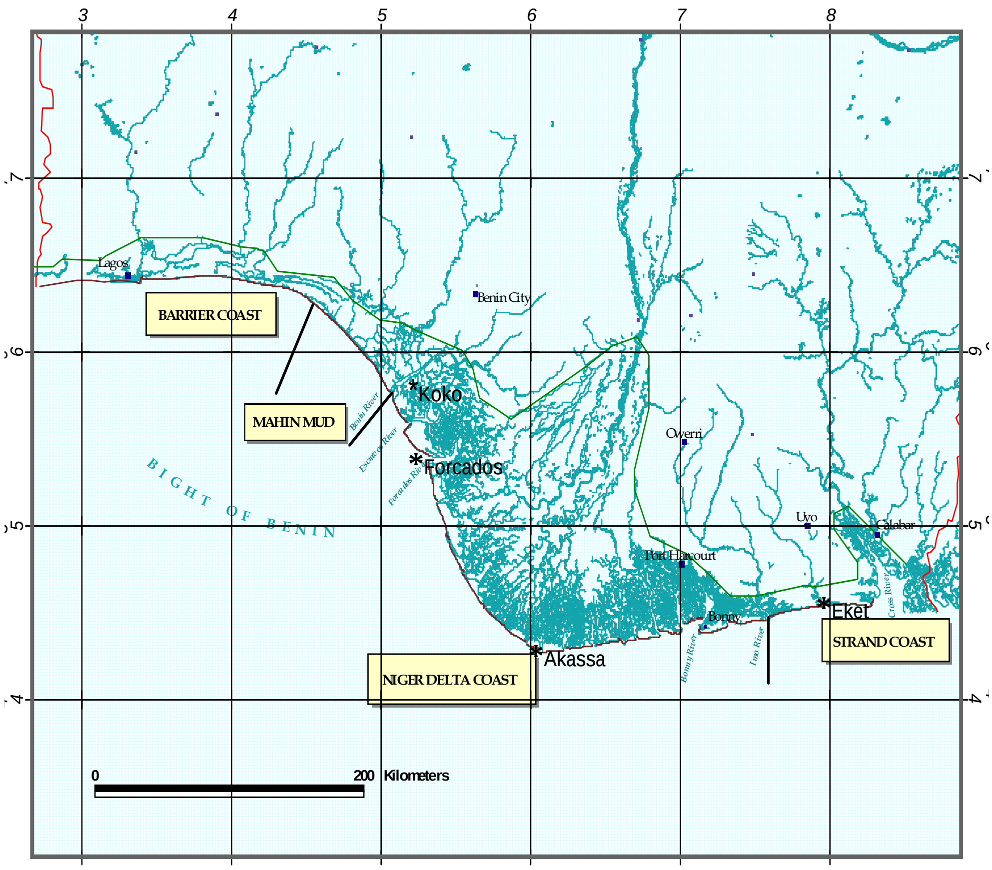


Figure 1. Map showing the Nigerian coastal zone and tide gauge stations.

Though the data collected by these tide gauges were not of high quality (because the tide gauge stations were not tied to an established datum as well as the fact that the data was not subjected to high quality control). Today, data from these stations though old are used to for tidal predictions.

The Lagos tide gauge station is a GLOSS designated station tied to a bench mark BM I. The station is located at the jetty of the Nigerian Institute for Oceanography and Marine Research (NIOMR) Lagos. Initially in 1985 a float type tide gauge was used (fig. 2). In October 1992, this tide gauge station was upgraded to an acoustic type: Next Generation Water Level Measuring System (NGWLMS). The NGWLMS consisted of an acoustic tide gauge device with ancillary sensors to measure the following met ocean parameters:

i. Primary water level (tide)
ii. Backup water level (tide) using a pressure system
iii. Water temperature
iv. Air temperature
v. Wind speed
vi. Wind Direction
vii. Wind Gust
viii. Barometric pressure

The above data originally in digital six seconds format are automatically averaged every six minutes and stored in electronic format in the data logger. Barometric pressure was automatically averaged every one hour. The table below shows the types and spread of the data collected by the NGWLMS.

Table 1. Types and duration of data collected by the NGWLMS

DATA TYPES	1992	1993	1994	1995	1996
1. TIDAL LEVEL 2. WIND DATA 3. BAROMETRIC PRESSURE 4. AIR AND WATER TEMPERATURE	October to December	January to December	i. January to September and ii. December	i. January to June, ii. August to September and iii. November to December	i. January to June and ii. August to December
NUMBER OF MONTHS OF DATA PER YEAR IN NIOMR DATABASE	**3**	**12**	**10**	**10**	**11**

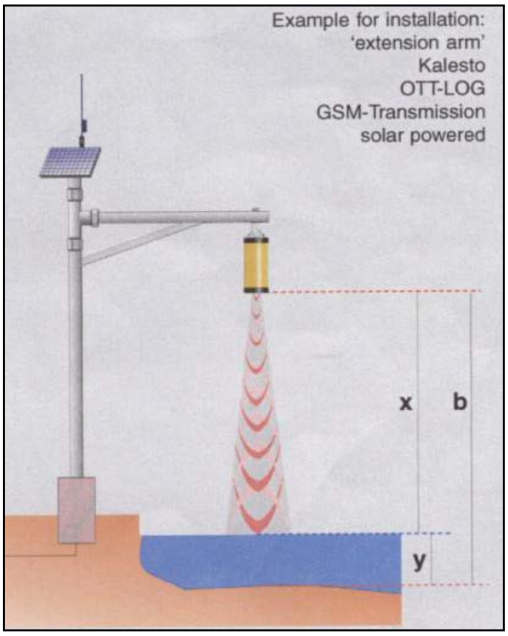
The total number of months for which data is available is **46 months.**

The equipment collected data from October 1992 to December 1996 (Table 1) but it later developed some technical problems in January 1998. The technical problem resulted in wide data gaps by 1997. NIOMR was in the process of correcting the problem when the Nigerian coast was hit by a very strong storm surge in July 2000. The storm surge resulted in high waters and strong waves that washed away the tide gauge platform, house and the stilling well of the equipment.

Figure 2. Picture of the Next Generation Water Level Measuring System (NGWLMS) installed at the NIOMR Jetty in the Commodore Channel Lagos before it was washed away during a storm in July 2000. (NGWLMS stilling well in white, analogue tide gauge stilling well in black under the housing, meteorological mast. NGWLMS computer and data logger inside housing).

3. NEW TIDE GAUGE STATION IN LAGOS

NIOMR using its own internally generated funds purchased a Kalestro tide gauge (fig. 3) with ancillary sensors for collecting meteorological data (wind speed and direction, air and water temperature, barometric pressure and conductivity. The platform and housing for the tide gauge has been constructed (fig. 4) while installation of the equipment is in progress.



- The water level is measured contact less from the air. The Kalestro sends radar waves (microwaves) perpendicular to water surface.
- An intelligent signal processor calculates the exact distance 'x' between the sensor and the surface of the water.
- The data logger calculates the water level 'y' out of the system length 'b' and the distance 'x' and makes the stored values available for further processing.

Figure 3. Kalestro tide gauge principles and functions

Figure 4. Newly constructed Kalestro tide gauge house at NIOMR jetty Lagos**.** (Entire Jetty is still awaiting rehabilitation)

4. SEA LEVEL RISE STUDIES IN NIGERIA: FUTURE PERSPECTIVES.

Nigeria being a maritime State is committed to collection of sea level data . The is more so because the coastal zone is low lying and subject to flooding during astronomical high tides and well as massive flooding during storm surges which are prevalent in the months of April to May and Sept to October annually.

The entire Nigerian coastline, which is low-lying, will be adversely affected by sea level rise (SLR). The impacts of SLR on the Nigerian coastal area were well articulated in Vulnerability Assessment case study of the impacts of SLR on the Nigerian coast. (Awosika et al., 1992, French and Awosika et al., 1995).

The Nigerian coast due to its characteristic low-lying nature is already experiencing the adverse effects of sea level rise through inundation and exacerbation of coastal erosion. According to the SLR case study three scenarios of SLR were used to quantify land loss and inundation on the entire Nigerian coast (tables 2 and 3). Table 2 shows the total land loss due to erosion and inundation assuming different SLR scenarios (Awosika et al 1992). The Niger Delta is expected to lose 2,846km^2 of land with a 0.2m SLR while with a SLR of 2.0m it is expected to lose about 18,398km^2 of land. This could lead to the displacement of between 1000 to over half a million people (table 3)

Table 2. Total land loss (Km^2 by shoreline type) due to erosion and inundation assuming different SLR scenarios. (Awosika et al., 1992, and French et al, 1995).

	LOW ESTIMATE				**HIGH ESTIMATE**			
SLR	**0.2m**	**0.5m**	**1.0m**	**2.0m**	**0.2m**	**0.5.m**	**1.0m**	**2.0m**
Barrier	177	284	584	1,167	118	289	602	1204
Mahin Mud	403	1,008	2,016	3,456	403	1,008	2,016	3,456
Niger Delta	2,846	7,453	15,125	18,398	2,865	7,500	15,332	18,803
Strand	79	197	395	575	85	212	446	677
Total	3,445	8,942	18,120	23,596	3,471	9,009	18,396	24,140

Table 3. Estimated number of people (in millions) to be displaced by sea level rise scenarios (Awosika et al., 1992 and French et al, 1995)

SLR SCENARIOS	0.2m	0.5m	1.0m	2.0m
BARRIER	0.6	1.5	3.0	6.0
MAHIN MUD	0.032	0.071	0.140	0.180
NIGER DELTA	0.10	0.25	0.47	0.51
STRAND	0.014	0.034	0.069	0.610
TOTAL	0.75	1.86	3.68	10.00
% TOTAL POP.	0.07	1.61	3.20	8.70

5. CONCLUSION

From the above it is apparent that sea level rise coupled with storm surges which can generate astronomical high tides (already occurring) will have great adverse impacts on the Nigeria coastal area. Hence, continuous collection, analysis of tidal data is important for the integrated management of the Nigeria Coastal areas. Along these lines NIOMR intends to install additional Kalestro tide gauges at two other stations at Bonny in the Niger Delta and Eket in the Strand Coast (fig. 1) in the future.

For this additional internal assistance in the provision of equipment, training and token funds will be needed.

REFERENCES

Awosika, L. F., Gregory T. French; Robert J. Nicholls and Ibe, C. E., (1992). The Impacts of Sea Level Rise on the Coastline of Nigeria: In Proc. *IPCC Symposium on the Rising Challenges of the Sea.* Margaritta, Venezuela 14 - 19 March, 1992. p.123-154.

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