

The Mozambican national sea level report

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I. Introduction

There is a growing concern about the need to improve the quantity and quality of sea level data provided to the Permanent Service for Mean Sea Level as input to studies of long term sea level changes, as well as to provide the key data needed for international research programs. To face with this, the IOC (International Oceanographic Commission) has established a Global Sea Level Observing System (GLOSS), which is committed to transform and sustain its core network, to establish in the future an operational global network of sea level gauges. To accomplish these goals, the GLOSS is working with and through the member states of IOC. Mozambique as member of the IOC has been evolving in the GLOSS program. Among other goals, the main at this stage is to standardize the sea level data, for usage in global, regional, and national level. Through this goal, Mozambique has benefited of a number of supports, since the provision of equipments to participation in training courses.

With this report prepared for the “10th session of the Group of Experts for the Global Sea Level Observing System (GLOSS) which will be held in Paris from 6-8 June, 2007; we would like to present an overview of the extents to which sea level have been monitored in Mozambique by tide gauge to date. We start by giving an overview of the Mozambican map of tide gauge network, and then the lists of operational tide gauges. Afterward the gauge technologies employed in the network are also given. The report is finalized by a general description of the other technologies employed in the network as well as the web, other address of data bank used to store the sea level data and recommendations.

II. Maps of tide gauges Network

The National Institute for Hydrograph and Navigation (INAHINA) is the Mozambican Institute (under the Ministry of Transports and Communications), responsible for the installation, and maintenance of the tide gauge stations, as well as, for the acquisition, processing, archiving and dissemination of the sea level data. This institution has a network of sea level stations which consists of thirteen stations from which, only four (Maputo, Inhambane, Nacala and Pemba) are nowadays operational, meaning that the maintenance, acquisition, processing, archiving and disseminations is been doing only for these stations. The data processing is been doing according to the international standards based on the basic procedures of sea level measurement and interpretation (UNESCO, 1985).

To standardize the tide network, in 2005, Mozambique has upgraded two GLOSS stations in Pemba and Inhambane, during the ODINAFRICA III project in collaboration between INAHINA, SANHO and POL. The project was funded by IOC, and the main propose of this upgrade was to records Sea Level for Monitoring Coastal Zones and Impacts of Global Change in Africa providing near real-time observations of sea level. These two GLOSS stations were operational, since 2005 to the beginning of 2006. Bearing in mind the difficult on maintenance (difficult on acquiring the accessories for the replacement when needed), as well as, the absence of a regular maintenance by a local operator, these stations were partially operating until March 2007. To face with this, the INAHINA has contracted, two local operators, who among other activities, they perform the basic maintenance of this equipment, and carry out the regular measurement - crucial to be used for calibration of the radar gauges.

Apart from this, the INAHINA has acquired two other digital tide gauges. One of them was installed in the Maputo harbor, and the second one is intended to be installed Beira Harbors in the next couple of months.

To give an elucidatory vision of the Mozambican tide gauge network, the figure 1 illustrates the map of Mozambique, as well as all the gauge stations, including those which are still not operational.



Figure 1: Mozambique Map. The red circles show where the stations composing the Mozambican tide gauge network are located.

III. List of tide gauge sites

A list of the stations and the corresponding coordinates, are provided in the table 1.

Table 1: The stations where the tide gauges were installed previously and are not currently working

Station	Location (Latitude; Longitude)
Inhambane	(-25.87°; 35.38°)
Chinde	(-18.57°; 36.45°)
Macuse	(-17.43°; 37.11°)
Moma	(-16.47°; 39.16°)
Ilha de Moçambique	(-15.03°; 40.74°)
Beira	(-19.82°; 34.83°)
Quelimane	(-18.00°; 36.97°)
Pebane	(-17.27°; 38.13°)
Angoche	(-16.23°; 39.90°)
Mocímboa da Praia	(-11.34°; 40.37°)
Maputo	(-25.96°; 32.56°)
Nacala	(-14.46°; 40.68°)
Pemba	(-12.96°; 40.48°)

The Mozambican tide gauge network, were primarily installed to provide aids to navigation to the vessels sailing to and from the harbors, not for scientific proposes. Besides the need to establish the previous network full operational, there is presently a need of installing the new tide gauge, in places that can bring more conclusive results in the research fields.

IV. Gauge technologies employed in the network

The Nacala and Pemba stations are equipped with floating gauges of model OTT R20; in which the recording pen is driven by float which moves vertically in the well connected to the sea through a relative small hole or narrow pipe. Since 2005, in Inhambane and Pemba stations were installed a radar tide gauge of type Kalesto. The data

collected from Pemba and Inhambane were been sent from 2005 to 2006 March to PSLM (Permanent Sea Level Measurement) site. A part from the radar tide gauges of type Kalesto, a secondary sensor measuring water pressure and temperature were installed in Pemba and Inhambane stations. Regarding the Maputo station, since 2007, the Maputo float gauge was replaced by a digital radar gauge.



Figure 1: The Mozambique map, the red circle show the locations where the OTT R20 tide type were installed; the yellow circles show the locations where the radar tide gauges were installed (GLOSS stations), and the Blue circles show the stations where INAHINA will install the radar tide gauges.

Table2: List of the operational tide gauges.

Station Name	Location latitude; longitude	Tide gauge model-SN	Year of Installation	Responsible
Maputo	25°58.5' S; 32°34.2'E	Radar Gauge	1994/2007	INAHINA
Nacala	14°27.8' S; 40°40.8'E	OTT R20 - 20102	1995	INAHINA
Pemba	12°58.' S; 40°29.3'E	OTT R20- 20102/Radar gauge	1992/2005	INAHINA
Inhambane	(-25.87 ; 35.38)	Radar Gauge	2005	

V. Other technologies employed in the network

For both GLOSS stations, was coupled (from 2005 to 2006) a GPS antenna which enable the ORBCOMM unit to obtain accurate time and position information, so that logging occurs in a accurate time, in relation to other tide stations none of them have a tide gauge along with GPS receiver. There is a proceeding to connect the Maputo Radar gauge through a Modem and then dial in via the telephone modem, so that the data will be retrieved in the INAHINA head office. This last technology was also used up to 2006 to retrieve the pressure sensor data in both Inhambane and Pemba Stations.

VI. Web, e-Mail, address of data banks and sources of further information

The tide gauge data are recorded hourly for those stations which are equipped with floating gauges. These data are available in both digital and hardy copy format at INAHINA. A copy of the data is sent to Portuguese Hydrographic Institute, in Lisbon and till 2005, it was used to produce a tide table for several harbors in Mozambique. The tide table is available in INAHINA in printed version.

Data from GLOSS stations are recorded in every fifteen minutes. These data were sent to the world data center through the following address sites:

http://www.pol.ac.uk/ntslf/sadata_african_ntslf_radar.php?code=1001&span=1 for Pemba station and

http://www.pol.ac.uk/ntslf/sadata_african_ntslf_radar.php?code=1002&span=1 for Inhambane station

To make the data useful on the Indian Ocean Tsunami Earning System (IOTES), there was a need to transmit and make available the data every 15 minutes or in higher frequency. In order to adjust the equipments in the GLOSS stations with the IOTES requirements, in April 2007 the INAHINA in collaboration with Proudman Oceanographic Laboratory - POL have upgrade the existing ORBCOMM radar tide gauge to an OTT HDR radar tide gauge. The DCP was provided by IOC. With this new upgrade, data coming from GLOSS stations can be visualized in the following site: http://oiswww.eumetsat.org/SDDI/webapps/publicdcp/mainMenuAction.do?action=DCP_ADMIN

VII. Recomendations:

At this stage there are some aspects that should be poited out to obtain a national tide gauge network full operational, and make available the data for the end users. Below are described some of these aspects:

- The need to continue developing national capacity for installation and maintenance of tide gauges
- The need to continue developing national capacity for analysis and quality control of data coming from the new equipment (radar tide gauge).
- The need to develop local capacity to mantain regurarly the bench marks and update the leveling measurements.
- The need to associate the sea level data with the environmental data and develop capacity for analysy, interpretation of data for end users.