

# THE TANZANIAN NATIONAL SEA LEVEL REPORT

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## 1. INTRODUCTION

This report has been prepared for the IOC/GLOSS Training Workshop on Sea Level Measurement, Interpretation and Related Fields held in Tokyo (Japan) from 15-26 May 2006 at the Headquarters of the Japan Meteorological Agency (JMA). The report presents an overview of the extent to which sea levels have been monitored in Tanzania by tide gauges to-date.

## 2. STATUS OF SEA LEVEL STATIONS

The network of sea level stations in Tanzania consists of only two operational stations of Zanzibar (GLOSS Station No. 297) and Dar es Salaam. Zanzibar has a satellite transmitting station while Dar es Salaam has a mechanical float gauge. Four tide gauges were also installed in the past at Mtwara (GLOSS Station No. 9), Tanga, Latham Island and Mkoani in Pemba, but they are now not operational (historical stations). All these tide gauge stations, including those that are non-operational, were installed in harbour sites (Figures 1 & 2). The tide gauges were primarily installed to provide aid to navigation to the vessels sailing to and from the harbours, and not much for scientific interest.

Of all the tide gauge stations in Tanzania, the Zanzibar station has been operating quite well since 1984. The station is linked to UHSLC and IOC/GLOSS, and is also considered as one of the prime Indian Ocean stations for monitoring long term changes in world sea level. An IOCINCWIO workshop held in Mombassa (Kenya) in 1991 recommended the establishment of Dar es Salaam and Tanga as GLOSS stations, out of 15 extra GLOSS stations that were proposed in the region. IOCINCWIO stands for the IOC Regional Committee for the Co-operative Investigation in the North and Central Western Indian Ocean. Furthermore, Mtwara, Tanga and Mkoani stations were identified by GOOS–AFRICA in 2002 among 33 new stations proposed for installation along the African coastline including the Island states.

There is no GPS technology employed in the network. However, periodic levelling is carried out in the operational stations. Maintenance and levelling was last performed in February 2003 for Zanzibar station, and in July 1997 for Dar es Salaam station.

Fig. 1 The map of Tanzania

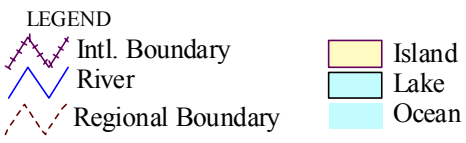
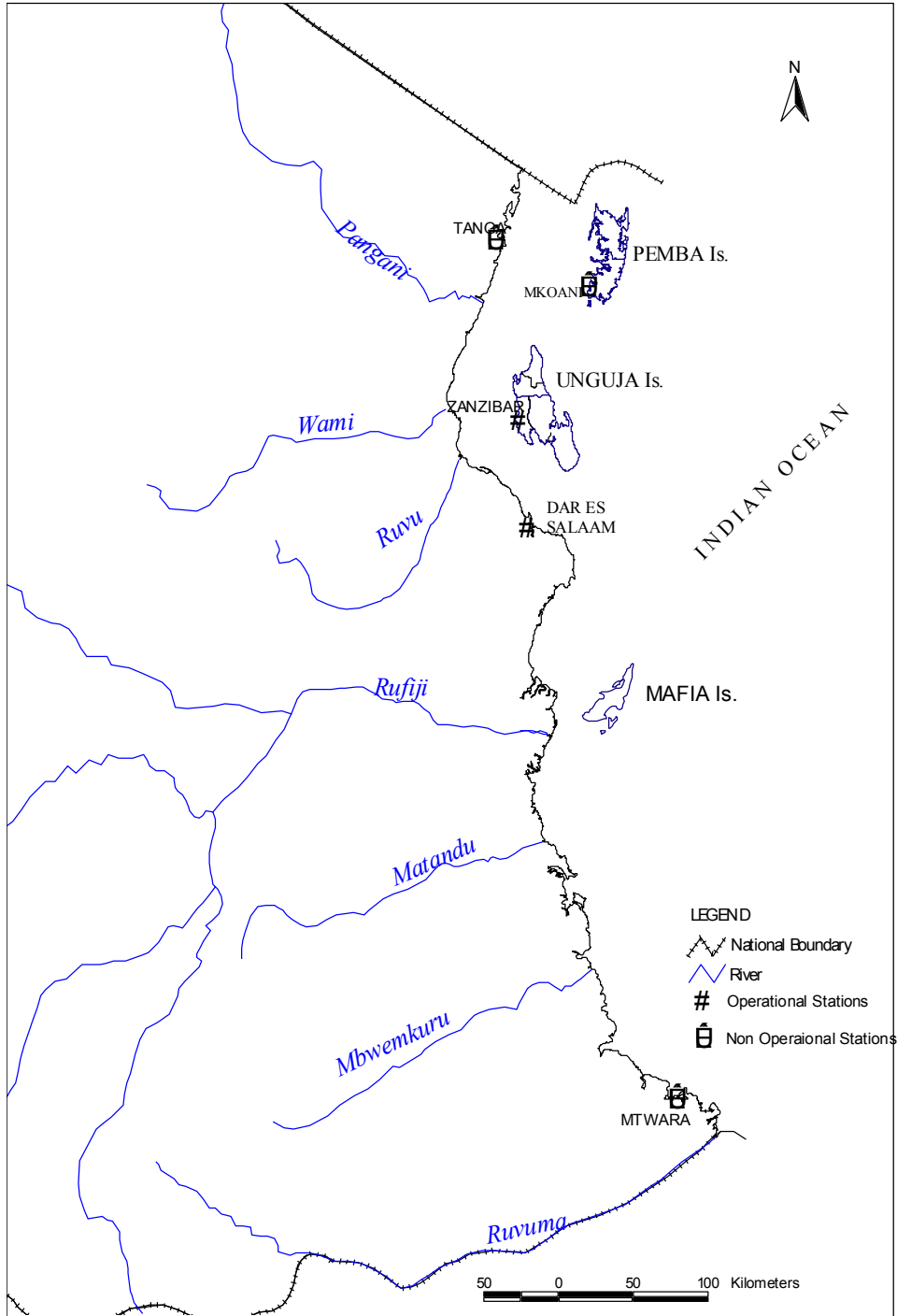


Fig. 2. The Tanzania Tide Gauge Network of Stations.



### 3. RESPONSIBLE AGENCIES

The Zanzibar tide gauge station is managed by the Zanzibar Department of Surveys and Urban Planning. The old tide gauge station at Mkoani in Pemba Island was also managed by the same department. The Dar es Salaam tide gauge station is administered by Tanzania Ports Authority (TPA), previously known as the Tanzania Harbours Authority (THA). Before installation of the new gauge in 1997, the Dar es Salaam Station was under the Institute of Marine Sciences of the University of Dar es Salaam. Old tide gauge stations of Mtwara, Tanga and Latham Island were both under the Division of Surveys and Mapping of the Ministry of Lands, Housing and Urban Development.

### 4. THE TIDE GAUGE STATIONS

#### 4.1 OPERATIONAL STATIONS

##### Zanzibar Station



The tide gauge in Zanzibar is located on the seaward end of the main jetty in Zanzibar Harbour, off the coast of Zanzibar town ( $6^{\circ} 09.3'$ ;  $39^{\circ} 11.4'E$ ). No information is available on when this station was first established. A Munro IH40 instrument was in operation on an established site on the seaward end of the main jetty in Zanzibar Harbour until the mid 1950's. At some stage the stilling well broke up, due to corrosion and lack of support. A Munro IH109 tide gauge with a digitization interval of one hour was installed in 1983, but was later relocated to another site in 1990 due to harbour expansion.

A satellite sea level transmitting station (tide logger, float type) was installed in February 1993 at the same site and the two instruments worked simultaneously. After relocation, the old instrument worked for a few months when the stilling well broke due to corrosion. The new tide gauge is equipped with two channels: Handar Encoder 436A

(ENC) and Handar Encoder 436B (ENB) with datalogger (ENO). The digitization intervals are 4 min (ENC) and 15 min (ENB, ENO), respectively. Satellite transmission interval is once per hour.

The UHSL intends to upgrade the station to 15-minute transmission intervals around July 2006. After the planned upgrade, there will be three channels of water level data collected and transmitted every 15 minutes. The channels will be recording at 1, 3 and 15 minute intervals, respectively. But according to UHSLC, “there are many logistical issues to resolve before the plans are firm”.

### **Dar es Salaam Station**



The Dar es Salaam tide gauge is located on the Ferry Terminal of Dar es Salaam Harbour ( $06^{\circ} 49.2'S$ ;  $039^{\circ} 17.3'E$ ). From 1986, the station had a Leupold and Stevens float gauge (Model A-71) which worked well until 1990 after the stilling well was damaged by a boat. The digitizing interval for the analogue charts was hourly, daily values were obtained by filtering of the hourly data. A simple average of all daily values was used to obtain the monthly data; calculated if 7 or fewer days were missing.

In 1997, an instrument known as Vertical Water Level Recorder ALPHA (manufactured by SEBA Hydrometrie) was installed with a recording interval of 10 minutes. However, the analogue charts have not been digitized to-date.

## 4.2 HISTORICAL STATIONS

### **Mtwara Station**

The tide gauge was located in Mtwara Harbour (10° 17'S; 040° 11'E). The tide gauge at this station was a Munro IH 40, which was in operation from 1956 to 1957. This was later replaced with a Munro IH 109 float type, which worked from 1959 to 1962.

### **Tanga Station**

The tide gauge was located in Tanga Harbour (05° 04'S; 039° 06'E). A Munro IH 40 float type tide gauge that was installed in Tanga Harbour worked from 1962 to 1966.

### **Mkoani Station (Pemba)**

The tide gauge was located on the Mkoani Harbour (5° 21'S; 39° 38'E). A Munro IH 109 float type tide gauge was incorrectly installed at Mkoani in July 1991 and so it never worked. According to the Department of Surveys and Urban Planning, the drum rotated once in seven days, hence it was not easy to record hourly heights. There was also no tide staff at the station. It has to be noted however that, Pemba has no suitable location for installation of a tide gauge. Under the terms of the United Kingdom-Zanzibar Survey and Mapping Project, which came into effect in 1977, a total of three tide gauges were to be installed on the islands of Zanzibar and Pemba. Following field observations by the UK Hydrographic Office, it was decided that there was only one site currently available which did not dry out at low tide, namely the jetty at Zanzibar Harbour.

### **Latham Island Station**

The tide gauge at Latham Island (6.50°S; 39.50°E) was installed as an offshore station and it was operational during the colonial period (prior to 1961). No further information is available on this station. Latham Island, locally known as Fungu Kizimkazi, is a tiny, uninhabited island barely 300 m long. It lies 60 km east of Dar es Salaam and 66 km south-east of Zanzibar. The island is oceanic and Tanzania's nearest proximation to an atoll as it lies off the continental shelf, surrounded by deep water.

## 5. AVAILABILITY OF DATA FROM THE STATIONS

### **Available Data and Format**

Data at the Zanzibar station is available in hourly, monthly and annual mean sea levels in digital form. Historical records from Mtwara, Dar es Salaam and Tanga are also available in digital form. The span and sources of data are shown in Table 1, and a profile of the operational stations of Zanzibar and Dar es Salaam is shown in Table 2.

TABLE 1: SPAN OF DATA AND SOURCES

Station	Span of Data	Data Sources
Zanzibar	1 March 1984 to-date	UHSLC, PSMSL, NODC, JASL, GLOSS
Dar es Salaam	6 July 1986 to 30 September 1990	UHSLC, PSMSL, JASL
	8 July 1997 to-date (Unprocessed)	TPA
Mtwara	1956-1957; 1959-1962	PSMSL, GLOSS
Tanga	1962-1966	PSMSL

UHSLC: University of Hawaii Sea Level Centre

Website: <http://www.ilikai.soest.hawaii.edu>

PSMSL: Permanent Service for Mean Sea Level

Website: <http://www.pol.ac.uk/psmsl>

NODC: National Oceanographic Data Centre (US)

Website: <http://www.nodc.noaa.gov>

JASL: Joint Archive for Sea Level

Website: <http://www.uhslc.soest.hawaii.edu/uhslc/jasl.html>

GLOSS: Global Sea Level Observing System

Website: <http://www.pol.ac.uk/psmsl/programmes/gloss.info.html>

TPA: Tanzania Ports Authority

Website: <http://www.tanzaniaports.com>

TABLE 2: PROFILE OF THE OPERATIONAL STATIONS

Station	Responsible Organisation	Organisation Performing Maintenance	Performance of Tide Predictions	Data Centres to which data is sent	Data Format	Data communication at Station
Zanzibar	Department of Surveys and Urban Planning, Commission for Lands and Environment, P.O. Box 811, Zanzibar, Tanzania. Email: stonetown@zanzinet.com; surveyplan@hotmail.com	Jerard Jardin, Field Engineer UHSLC, Email: ziggy@hawaii.edu; jerald@hawaii.edu	UHSLC (Tide Tables and Tidal constants)	UHSLC on monthly Basis	Diskettes	Airmail, Email, Fax, Satellite Altimetry
Dar es Salaam	Tanzania Ports Authority (TPA), P.O. Box 9184, Dar es Salaam, Tanzania. Tel: 255 22 221212 Fax: 255 22 232066 Email: nhnyete@tanzaniaports.com	TPA and UK Hydrographic Office (UKHO), Admiralty Way, Taunton, Somerset, TA1 2DN, UK Tel: 44(0)1823 337900 Fax:44(0) 1823 284077	TPA; UKHO	UKHO	Analogue charts	Airmail

