

The GLOSS-Brazil Implementation Plan

1.0 – INTRODUCTION

Brazil has a vast coastline larger than 7,400 km. Understanding variations in sea level is important for protecting life and property, supporting research in environmental sciences, and improving social and economic planning. Information regarding tidal variations and departures from the mean sea level due to weather or ocean currents are utilized by a wide range of interests, such as port operations, fisheries, aquaculture, exploration of mineral resources, coastal development, tourism and recreation.

Several programmes, in worldwide level, conduct ocean research activities. One of those is the Global Sea Level Observing System (GLOSS), an international programme conducted under the auspices of the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC). The main objective of GLOSS is therefore to provide a long term strategic and planning system for the monitoring of global sea level changes (COI, 1997).

Diverse public and private institutions participate in sea level monitoring efforts in Brazil. However, interaction among those groups were weak, until a better standardization of procedures for collection, processing, quality-controlling and archiving of sea level data has been established, under a national project that is likely to improve efficiency of those activities, and to the benefit of all end-users in the country.

The VI Sectorial Plan for the Resources of the Sea (VI PSRM), under the umbrella of the Inter-ministerial Commission for the Resources of Mar (CIRM), has been recently approved in the sphere of the Federal Government. In this Plan, it is contemplated, as one of its actions, the establishment of oceanographic and meteorological monitoring, whose tool of implementation is the GOOS-Brazil Program (the Brazilian component of the Global Ocean Observing System). Among the GOOS-Brazil activities, is the implementation of the Permanent Brazilian Network of Sea Level Monitoring, within the GLOSS-Brazil Program.

Aiming at the union of efforts, the standardization of procedures, the interchange of information and the unified formation of qualified staff, the Directorate of Hydrography and Navigation (DHN), of the Brazilian Navy, organized and coordinated meetings of a group of representatives of the technical and scientific Brazilian community interested in studies and monitoring of the sea level variations, with the basic intention to elaborate the present GLOSS-Brazil Program.

The structure and objectives of the GLOSS-Brazil Project are presented in chapter two of this document. Technical information on the requirements for setting up GLOSS are described in chapter three, while chapter four deals with data and information exchange, as well as on capacity building requirements for qualifying personnel to operate GLOSS stations. Chapter five presents the implementation schedule of activities under GLOSS - Brazil for the next four years, starting 2005. The obligations of Brazil, as an IOC Member State engaged in GLOSS are described in chapter six. Finally, chapter seven deals with financial requirements for the implementation of this national project.

All provisions contained in this document were based on the GLOSS Implementation Plan - IOC Series N° 50 (1997), where more detailed information on the agreed procedures to be followed by institutions engaged in GLOSS can be found.

2.0 - THE GLOSS-BRAZIL PROGRAM

The Directorate of Hydrography and Navigation (DHN) of the Brazilian Navy is the National Institution responsible for the co-ordination of IOC/UNESCO Ocean Services and Ocean Observations programmes in the country, as well as to serve as the national Oceanographic Data and Information Center, according to a Presidential Decree dated 05.January 1994.

2.1 - GLOSS-Brazil Objectives

The GLOSS-Brazil Project encompasses activities related to sea level monitoring in Brazilian maritime waters, with the following objectives:

- i. To implement a Permanent Brazilian Sea Level Monitoring Network called GLOSS-Brazil Network;
- ii. To generate reliable data for the determination and definition long-term trends of mean sea level, through the GLOSS-Brazil Network;
- iii. To concentrate and manage sea level data in the country, as part of the Brazilian National Oceanographic Data Center (Banco Nacional de Dados Oceanográficos - BNDO) activities;
- iv. To disseminate timely data for international centers recognized by IOC/UNESCO (i.e. PSMSL and UHSLC);
- v. To introduce updated technology that ultimately leads to the improvement of sea level monitoring, including real time data and its transmission for the main interested agencies and end-users;
- vi. To conduct capacity building activities towards qualification of staff and technicians engaged in sea level studies and processing of sea level data and information;
- vii. To promote Sea Level data and information exchange, including internet resources, through the formal education system and technical events;
- viii. To promote interaction between GLOSS and other oceanographic and technological Brazilian projects and programs;
- ix. To promote the involvement of the community of users of the sea level information (ports, private initiative, institutions of research, and others) for ends of practical applications, including, but are not limited to:
 - Estimating global sea level rise;
 - Establishing datums for topography and bathymetry;
 - Estimating flow through straits and passages;
 - Characterizing coastal expressions of phenomena like ENSO;
 - Supporting coastal engineering needs;
 - Calibrating satellite altimetry;
 - Determining tidal components for prediction;
 - Supporting safe navigation and harbor activities;
 - Measuring and predicting storm surges; and
 - Supporting tsunami warning.
- x. To help recover historical sea level data along the Brazilian coast

- xi. To participate in the efforts to disseminate sea level data near real time via internet; and
- xii. To recommend the establishment of redundant sea level monitoring sites, so as to provide coastal monitoring information with applications in biodiversity, coastal erosion and management, among others.

2.2 - The GLOSS-Brazil Structure

The GLOSS-Brazil Project is a subprogram of GOOS in Brazil, composed by a cooperative network of public and private institutions that operate, finance, maintain and disseminate sea level measurements, according to the standards established by IOC/UNESCO.

Management of the GLOSS-Brazil project is conducted by an Executive Sub-Committee on Sea Level Monitoring (Comite Executivo de Monitoramento do Nível do Mar – CEMNM, in Portuguese), that operates as part of the mandate attributed to the Executive Committee of the GOOS-Brazil Program. It is coordinated by the Centre for Hydrography of DHN (CHM), and is presently composed by representatives from the following public and private institutions:

1. Diretoria de Hidrografia e Navegação (DHN) - Centro de Hidrografia da Marinha (Coordinator);
2. Instituto Brasileiro de Geografia e Estatística (IBGE);
3. Instituto Oceanográfico da Universidade de São Paulo (IOUSP);
4. Centro de Estudos do Mar da Universidade Federal do Paraná (CEM);
5. Coordenação de Programas de Pós Graduação em Engenharia da Universidade Federal do Rio de Janeiro (COPPE);
6. Fundação Universidade do Rio Grande (FURG);
7. Gerência Geral do Porto de Ponta da Madeira (Companhia do Vale do Rio Doce);
8. Terminal Especializado de Barra do Riacho (PORTOCEL);
9. Instituto Nacional de Pesquisas Espaciais (INPE);
10. Instituto de Pesquisas Hidroviárias (INPH);
11. Universidade Federal de Pernambuco - UFPE;
12. Universidade Federal do Pará – UFPA; and
13. Universidade Federal do Espírito Santo – UFES.

The Terms of Reference to the CEMNM are:

- i. To co-ordinate the joint activities towards the implementation and fulfillment of the objectives of GLOSS-Brazil Project;
- ii. To manage the agreed responsibilities of each of the participant institutions;
- iii. To establish an internal regulation;
- iv. To consider the creation of specific working groups for specific subjects, if necessary;
- v. To edit and to disseminate titles and publications of interest to the GLOSS-Brazil community;
- vi. To organize regular meetings, with a maximum interval of six months; and
- vii. To set up a Technical Secretariat so as to supervise and to organize the administrative activities of the sub-committee; to elaborate guidelines and reports from meetings; and to assist in the many activities of the group.

3.0 THE GLOSS-BRAZIL NETWORK STRUCTURE

The stations that are part of the GLOSS-Brazil Network, together with the responsible institution for its operations and its current operational classification are listed below. It is expected to have all the stations listed below installed and fully operational by 2007:

n°	Station	Responsible	Classification	Expected Situation in 2006	Expected Situation in 2007
1	Rio Grande	FURG	Secondary	To be installed	Under evaluation
2	Imbituba	IBGE	Principal	Operational	Operational
3	Cananéia	USP	Principal	Operational	Operational
4	Ilha Fiscal	CHM	Principal	Operational	Operational
5	Macaé (Imbetiba)	IBGE	Secondary	Operational	Operational
6	Barra do Riacho	PORTOCEL	Principal	Under evaluation	Operational
7	Salvador	IBGE-CHM	Principal	Operational	Operational
8	Fortaleza	IBGE	Principal	To be installed	Under evaluation
9	Ponta da Madeira	CVRD	Secondary	Operational	Operational
10	Ilha Trindade	CHM	Principal	To be installed	Under evaluation
11	Ilha de Fernando de Noronha	CHM	Principal	To be installed	Under evaluation
12	Estação São Pedro e São Paulo	INPE	Secondary	To be installed	Under evaluation

Table 1: GLOSS-Brasil Network

Operational means that the data already had been accepted for the GLOSS programme

The choice of network stations were considered taking into account the international standards established by the GLOSS Implementation Plan (IOC Series N° 50, 1997), especially with regard to the establishment of a minimal distance between stations to the order of 500 to 1000 km.

Other institutions that may be interested in participating in the GLOSS-Brazil project shall satisfy the following requirements that will in due course be considered by the GLOSS Executive Sub-Committee, and satisfying the following conditions:

- i. to operate tide gauges in accordance with the guidelines provided in this document;
- ii. to participate of some pertinent activity to the GLOSS-Brazil program; and
- iii. to make systematic use of sea level information.

Currently there is no polar stations (Antarctic) pertaining to the GLOSS-Brazil Program. Future implantation of such site would be of importance to climate studies, and of global nature. Considering peculiarities of this region, it is advisable that, in a first phase, should be given priority to the establishment and operationalization of the stations listed in the table above.

The Rio Grande station, located in the Southernmost extremity of the Brazilian coast, sits in the interior of the Lagoa dos Patos, a region where there is an amphidromic point of the M2 component in the South Atlantic. The Cananéia station, also located in the interior of an estuary from where river flow is low, is one of the most important Brazilian tide gauge stations, in what refers to the long time-series of more than 50 years of continuous measurements, since 1954. Data representativity of this site regarding open sea data have been observed by diverse authors (Johannessen et al (1967), Lorenzetti, J. A. (1976), Mesquita (1983), Mesquita e Harari (2003).

To take care of to the criteria of space distribution of the GLOSS-Brazil stations it makes necessary the installation of stations in the regions north and northeast. This becomes more important in function of its oceanographic and geological characteristics that are sufficiently distinct of the regions south and Southeastern.

The group of Monitoramento, Modelagem Erosão e Ocupação Costeira (MMEOC) of the project Uso e Apropriação de Recursos Costeiros (RECOS) financed by the Institute of the Milênio/CNPq counts on a net of meteo-oceanographic stations along the Brazilian coast. The MMEOC coordination offered to take part in the GLOSS-Brazil sea level data network. As a first moment, the GLOSS-Brazil project will consider enhancing the sea level network by encompassing the stations of Salinópolis-Pará, (Universidade Federal do Pará - UFPA) and Recife- Universidade Federal de Pernambuco - UFPE).

The stations located in the oceanic islands represent strategic observatory points that are essential for for scientific applications of the GLOSS-Brazil network, data mostly with respect to altimetry and satellite calibration measurements, due to absence of the inherent disturbances of the coastal stations.

3.1 - Stations Configuration

The basic equipment of a sea level station is the tide gauge, that consists of a measuring system which detects and registers this variable by using different systems, like: float gauges, pressure sensors, electrical sensors, acoustic gauges, bubbler gauges, radar and etc.

Three IOC Manuals, from 1985, 1993 and 2002, and Woodworth et al. (1996) provide detailed descriptions of each technique, advice on operational methods, as well as the quality control procedures regarding those techniques.

It is extremely important that GLOSS site measurements be associates not only with redundant measurements of the sea level, but also atmospheric observations and other oceanographic parameters (atmospheric pressure, air and water temperatures, rain, evaporation, wind direction and intensity). It is recommended that continuous GPS measurements and regular absolute gravimetry measurements should be used. They should be carried out in order to monitor vertical and horizontal crust movements.

The sites for the Brazilian continental GLOSS network should: be permanent in order to well represent the open sea conditions, avoiding regions of rough surf or strong currents; avoid fresh water runoff (rivers). They must be away from very active port operations that may damage the station. They must be at adequately deep water; have solid foundation (wharf, pier, jetty, etc) for supporting the station; have insurance against vandalism (station observer or port authority cooperation); and be of ease access for the tide observer and station technicians.

In addition to recording on site, the GLOSS sites should be equipped for automatic data transmission to data centres, by using a regular communications system available.

The aim of any tide gauge recording should be to operate a gauge which is accurate to the 1 cm at all times, i.e. in all conditions of tide, waves, currents, weather etc. This requires dedicated attention to gauge maintenance and data quality control. Timing accuracy should be better than one minute, the minimum sampling interval, in all circumstances, should be one hour. Measurements should happen for long periods and must be made relative to a fixed and permanent local Tide Gauge Benchmark, in order to provide long term data sets.

New technology gauges are to be gradually sought, bearing in mind that provided, by definition, less well understood than old ones, and they must always be operated alongside the older ones, perhaps for several years, until sufficient experience has been obtained.

Geodetic control of each site must include periodic high precision geometric leveling, with intervals of 6 months to 1 year. Measurements must be taken following the Brazilian rules and requirements regarding to this matter.

4.0 DATA AND INFORMATION EXCHANGE AND PERSONNEL TRAINING

Sea level data and associated parameters that reach DHN must be sent to the International Data Centres (PSMSL and UHSLC), as well as to the national data center, and, preferably, made available over the internet, all in accordance to IOC Series No. 50, Even those responsible institutions charged with stations that use automated data transmission have the obligation of sending a copy of the transmitted data to BNDO-DHN.

IOC Series 50 presents the following requirements regarding data exchange:

1. monthly and annual MSL data, and associated documentation (equipments placed on the site, location description of the place, DATUM, etc.), must be sent to the PSMSL. Data should be sent by July of the year following the data-year; and
2. raw data sets must be sent, at each 6 months, to PSMSL or to UHSLC.

4.1 - Dissemination of Information

The University of São Paulo (USP) keeps together with the COI/UNESCO, a "newsletter" denominated Afro-America GLOSS News (AAGN), that aims at spreading articles about sea level measurements and analysis of pertinent oceanographic and meteorological data (www.mares.io.usp.br - Icon GLOSS). It contemplates the communities of Africa and Americas that speaks Portuguese and Spanish.

Articles in English Language also are accepted for distribution. This is one "fórum" where all the accomplishments of GLOSS-Brazil will have also to be registered and disseminated.

4.2 - Training Courses

The Directorate of Hydrography and Navigation offers training for qualification in tide gauge operations and maintenances of tide gauge stations, for professionals of average level of the component institutions of the Program GLOSS-Brazil.

The Oceanographic Institute of the University of São Paulo (IOUSP) will have to offer, as an institutional counterpart to this post-graduate program "Latu Sensu" to all the professionals of superior level of the GLOSS-Brazil community.

The IBGE, similarly to DHN, considers the possibility of offering training courses at the technical level, also including geodetic control.

Other institutions, especially those located near GLOSS stations, will have to be approached again and offered complementary courses that are directed to the improving of techniques for sea level monitoring and data analysis, which approval will be submitted to the GLOSS Executive Committee.

5.0 - GOALS TO BE REACHED

In the execution the GLOSS-Brazil program, a few goals must be considered:

- i. Operationalization of the stations in accordance with the chronological order stated in table 1;
- ii. To the end of 4 years it is expected to get results on sea level measurements along all the Brazilian network of this program;
- iii. To offer, annually, technical training courses of middle level and at each two years level of after-graduation training courses; and
- iv. Modernization of the network as ofplanned by the Executive Sub-Committee.

6.0 - OBLIGATIONS OF BRAZIL AS AN IOC MEMBER STATE, AND COMMITED TO GLOSS

IOC Member States that apply and agree to participate in GLOSS, in accordance with the contained in the GLOSS Implementation Plan - IOC Series N° 50 (1997), have a number of responsibilities which must be met from national resources.

The Federative Republic of Brazil is required to:

- i. Designate GLOSS National Contacts with the duties as described in the GLOSS Implementation Plan - IOC Series N° 50 (1997);
- ii. Provide to the international centers, as soon as possible, selected data requested;
- iii. Assist in the development and/or the distribution of a range of altimetric, tide gauge, GPS and absolute gravimetric and combined sea level products to universities and research institutions;
- iv. participate in and contribute to GLOSS in its widest sense through training courses and provide proper coordination with IOC with regard to GLOSS requirements and to the development of regional programmes;
- v. Enable National and Regional GLOSS Contacts to fulfil their obligations by providing adequate funding and resources to them.
- vi. Complete, annually the questionnaire in Annex I of the GLOSS Implementation Plan - IOC Series N° 50 (1997), as realistically as possible;
- vii. Provide the integration between GLOSS program and other programs and activities, in the national and regional levels, associated or not wit other programs within the IOC/UNESCO.

7.0- BUDGET

The Executive Committee shall elaborate on an annual basis the budget forecast of the project and submit it for approval by the GOOS-Brazil Executive Committee, that directs it to the Interministerial Commission for the Resources of the Sea (CIRM), for final approval. Other forms for collecting extra-budgetary resources are sought and must be of Governmental funds, via GOOS Executive Committee.

The annual appropriation bills will have to include, mandatory, the following items of expenses:

1. Trips of researchers in the country and abroad, in order to attend conferences and scientific events;
2. Installation and maintenance of stations, including expenses with staff and equipment;
3. Acquisition of equipment (sensory the hardware among others);

4. Processing, quality control, storage and data transmission;
5. Accomplishment of meetings of the Executive Committee; and
6. Formation of human resources (courses, training, seminars, etc).

8.0 REFERENCES

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