



**MARINHA DO BRASIL  
DIRETORIA DE HIDROGRAFIA E NAVEGAÇÃO  
CENTRO DE HIDROGRAFIA DA MARINHA**

**National Report of Brazil: the GLOSS Program**

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## **1.0 Background**

The Diretoria de Hidrografia e Navegação (DHN) is the Brazilian Institution responsible for the coordination of IOC/UNESCO Ocean Services Programmes, such as GLOSS, one of the Brazilian contributions to the GOOS Program. The GLOSS Implementation Plan in Brazil, is coordinated by the Centro de Hidrografia da Marinha (CHM).

## **2.0 The GLOSS Program Implementation Plan in Brazil, a Summary**

The main objective of this Plan (PIG) is to join efforts from the most relevant Brazilian Institutions that depend on sea level observations for monitoring, research and their application activities. The objective of the Plan is to install and maintain 12 (twelve) tide gauges, on an operational basis, along the Brazilian coast and oceanic islands.

In this program, each member has their own responsibilities in maintaining one or more sea level stations as well as making available quality-controlled data for the international sea level centers. The following Brazilian Institutions take part in this Implementation Plan currently:

1. Diretoria de Hidrografia e Navegação (DHN) - Centro de Hidrografia da Marinha (CHM)\* - National Coordinator;
2. Instituto Brasileiro de Geografia e Estatística (IBGE)\*;
3. Instituto Nacional de Pesquisas Espaciais (INPE)\*;
4. Gerência Geral do Porto de Ponta da Madeira da Companhia Vale (VALE)\*;
5. Instituto Oceanográfico da Universidade de São Paulo (IOUSP)\*;
6. Fundação Universidade do Rio Grande (FURG)\*\*;

\* Institutions that keep stations under operation \*\* Institutions that will keep stations under operation in 2012

The Brazilian National Oceanographic Data Center (Banco Nacional de Dados Oceanográficos – BNDO), operated by CHM, is responsible for receiving data from GLOSS/ Brazil stations and for delivering this data to University of Hawaii Sea Level Center (UHSLC) and Permanent Service Mean Sea Level (PSMSL).

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### **3.0 Local Sea level Network**

Sea level data has been systematically collected in Brazil during the last seven decades. Within this period, there have been over 300 tide gauge sites in Brazil, and the majority of those data sets were for very short periods (40% a year, 60% a month) and did not have tide staff readings or regular geodetic leveling and, therefore, do not meet GLOSS requirements.

The Ilha Fiscal (maintained by CHM) and Cananéia (maintained by IOUSP) sites can be assumed as the Brazilian GLOSS sites with a fairly continuous long record. For Cananéia there are tidal data sets since 1954 and there are geodetic leveling CGPS data since 2006. For Ilha Fiscal there are tidal data sets since 1955, with some gaps, and the CGPS is going to be installed in 2012. From 2001, IBGE has installed RMPG-GLOSS stations for updating national altimetry datum, with reference to Imbituba, at Macaé, Imbituba,

Salvador and Fortaleza and they have made the C-GPS geodetic control for these three last stations. In 2009 INPE installed the first oceanic island tidal station in Arquipélago de São Pedro e São Paulo. Since 1991 VALE Company has kept the tidal station at Ponta da Madeira.

Table 1 lists the currently situation of the principal and secondary stations of the GLOSS network in Brazil, established in accordance to the Implementation Plan (2004), which locations indicated in Figure 1.



Figure 1: GLOSS/ Brazil Network (October 2011)

	Station	Responsible	Classification	Situation in 2011	Expected Situation in 2012	Expected Situation in 2013	Observations about tide gauges/ meteorological sensors	Observations about Continuous GPS (CGPS)/ Absolute Gravimetry (AG)	Data availability periods
1	Rio Grande (Cais da Praticagem)  Position to be defined	FURG	Secondary	Equipment purchased	To be installed  Radar Kalesto/ Encoder SE200 with Logosens datalogger (OTT).  Daily downloads via GSM / software Hiydras3 Basic_OTT	Under evaluation	-----	-----	-----
2	Imbituba (Porto de Imbituba)  28° 13,8 S 048° 39,0W	IBGE	Principal	Operational  Tide gauge upgrade needed (equipment purchased)	Operational and upgraded with Radar Kalesto/ Logosens datalogger (OTT).  Daily tidal data downloads via GSM / software Hiydras3 Basic_OTT	Operational	(1) Absolute pressure sensor (Druck/GE 1880, with Squitter datalogger) installed in Aug./2001  (2) Conventional (float/ weekly chart) back-up gauge, installed in June/1998  - Meteorological sensors (atm. pressure/ temp./humidity, wind, precipitation) with Squitter datalogger  - Daily downloads via fixed phone line	- CGPS station installed in Dec./2006 (top of a 20m tower) TG-CGPS distance = 650m TG-CGPS leveling accuracy = 5mm  CGPS week solutions (Bernese 5.0) integrated to the IGS structure  ftp://geoftp.ibge.gov.br/SIRGAS/  - No AG station	- Tides (1) 2001-2010  Historical data (1948-1971) to be integrated to the current time series

3	Cananéia  25° 01,0 S 047° 55,5W	USP	Secondary	Operational	Operational  Radar Kalesto in operation and real time data transmission(tides, meteorological data, CGPS, Gravimetry)	Operational	(1) Conventional (float daily chart)  - Meteorological sensors Vaissala	- CGPS station installed in Jan./2006 Belongs to IBGE  CGPS week solutions (Bernese 5.0) integrated to the IGS structure  - No AG station	-Tides (1) 1954-2011
4	Rio de Janeiro (Ilha Fiscal)  22° 53,8 S 043° 10,0W	CHM	Principal	Operational	Operational  Meteorological sensors installed	Operational  Near-Real time automatic data transmission	(1) Convencional (daily chart)  (2) Radar Kalesto/ (3) Encoder SE200 with Logosens datalogger (OTT) installed in 2008. Daily automaticly downloads via GSM / software Hiydras3 Default_OTT	- CGPS station is going to be installed in 2012  - no AG station	Tides: (1)1963-2011 (GAP in 1979-1980, 1985-1987)  (2) (3) 2008-2011
5	Macaé (Imbetiba/ Terminal da Petrobrás)  22° 23,1 S 041° 46,2W	IBGE	Secondary	Operational  Tide gauge upgrade needed (equipment purchased)	Operational and upgraded with Radar Kalesto/ with Logosens datalogger (OTT).  Daily tidal data downloads via GSM / software Hiydras3 Basic_OTT	Operational	(1) Absolute pressure sensor (Druck/GE 1880, with Squitter datalogger), installed in July/2001  (2) Conventional (float/ daily chart) back-up gauge, installed in Nov./1994, replaced by a (3) weekly chart gauge in 2007  - Daily downloads via phone line - No meteorological sensors	- CGPS station - no AG station	Tides: (1) 2001-2011  (2)(3) 1994- 2011

6	<p>Tubarão Harbor 20° 17,3 S 040° 14,6W</p> <p>It will depend on the Vale Company acceptance to participate of GLOSS Brasil network with this station</p>	VALE	Principal	Data and transmission under evaluation.	Operational Near-Real time automatic data transmission	Operational	<p>- Radar Kalesto/ Encoder SE200 with Logosens datalogger ( OTT ) , installed in 2008 following CHM specifications. Near-real time automatic data transmission</p> <p>- Meteorological sensors (atm pressure, wind, air temp, humidity, solar radiation, precipitation)</p>	<p>- no CGPS station</p> <p>- no AG station</p>	-----
7	<p>Salvador (Capitania dos Portos da Bahia)</p> <p>12° 58,4 S 038° 31,0W</p>	IBGE	Principal	Operational	Operational	Operational	<p>(1) Acoustic sensor installed in 2004 (stop in 2008)</p> <p>(2) a radar sensor (Vegapuls 62) and (3) Encoder with a Sutron Satlink datalogger with modem Installed in Apr./2008 by UHSLC/ VLIZ</p> <p>(4)Conventional (float/ weekly chart) back-up gauge, installed in Dec./2002</p> <p>- Near-Real time automatic data transmission directly to UHSLC via GOES</p> <p>- IBGE – daily downloads via direct (serial) connection</p> <p>- No meteorological sensors</p>	<p>- CGPS station installed in Apr./2007, (top of a 4m mast)</p> <p>- TG-CGPS distance = 150m</p> <p>- TG-CGPS leveling not performed yet</p> <p>- CGPS week solutions (Bernese 5.0) integrated to the IGS structure</p> <p><a href="ftp://geoftp.ibge.gov.br/SIRGAS">ftp://geoftp.ibge.gov.br/SIRGAS</a></p> <p>- no AG station</p>	<p>Tides: (1) 2004-2008 (2) (3) 2008-2011</p> <p>Historical data (1948-1971) to be integrated to the current time series</p>

8	Fortaleza de Mucuripe 03° 42,9 S 038° 28,6W	IBGE	Principal	Operational	Operational	Operational	<p>(1) Radar sensor (Vegapuls 62) and (2) Encoder with a Sutron Satlink datalogger, installed in Apr./2008</p> <p>(3) Conventional (float/weekly chart) back-up gauge, installed in Sept./2007</p> <p>- Near-Real time automatic data transmission directly to UHSLC/ VLIZ via GOES</p> <p>- IBGE –daily downloads via direct (serial) connection</p> <p>- No meteorological sensors</p>	<p>- CGPS station installed in Oct./2008, (rooftop of a two-story building)</p> <p>- TG-CGPS distance = 600m</p> <p>- TG-CGPS leveling accuracy = 1mm</p> <p>- CGPS week solutions (Bernese 5.0) integrated to the IGS structure</p> <p>ftp://geofp.ibge.gov.br/SIRGAS</p> <p>- no AG station</p>	<p>Tides: (1) 2008-2011</p> <p>Historical data (1948-1971) to be integrated to the current time series</p>
9	Ponta da Madeira (Cais da Vale) 02° 33,9 S 044° 22,7W	VALE	Secondary	Operational Tide gauge upgrade needed (equipments purchased)	Operational and upgraded with Radar Kalesto/ with Logosens datalogger (OTT).  Daily tidal data downloads via GSM / software Hiydras3 Basic_OTT	Operational  Operational Near-real time automatic data transmission	<p>(1) Conventional (Bi monthly chart)</p> <p>-Meteorological sensors (atm pressure, wind, air temp, humidity)</p>	<p>- no CGPS station</p> <p>- no AG station</p>	<p>Tides: (1) 1998-2011</p> <p>-----</p>

10	Ilha da Trindade 20° 30,5S 029° 18,6W To be confirmed at the time of installation	INPE CHM	Principal	Equipment purchased, under integration with meteo sensors	To be installed Under evaluation  (1) Radar gauge Kalesto (OTT) with Vaissala datalogger  - Meteorological sensors Vaissala (atm pressure, wind, air temp, humidity, solar radiation, precipitation)  -Near-real time automatic data satellite transmission (SCD2 satellite - INPE)	Operational	-----	- no CGPS station  - no AG station	-----
11	Ilha de Fernando de Noronha  From regular GPS position: 03°50'01.8''S 032°24'06.8'' W – 6 m)	INPE CHM	Principal	Tide staff installed	Under evaluation  (1) Radar Level Sensor - RLS (OTT) with Campbel (CR800) datalogger  -Near-real time automatic data satellite transmission (ARGOS/SCD2 satellite -INPE)	Operational	No meteorological sensors integrated. Meteorological information from weather station already installed in other site.	- no CGPS station  - no AG station	-----



12	Arquipélago de São Pedro e São Paulo 00° 55,2S 029° 20,6W	INPE CHM	Secondary	Under evaluation New equipment purchased, Under integration with meteorological station.	To be installed (1) Radar Level Sensor - RLS (OTT) with Campbell (CR1000) datalogger  - Meteorological sensors Vaissala/Young (atm pressure, wind, air temp, humidity, solar radiation, precipitation)  -Near-real time automatic data satellite transmission (ARGOS/SCD2 satellite –INPE)	Operational Near-real time automatic data transmission	(1) Radar gauge Kalesto(OTT) with Vaissala datalogger  - Meteorological sensors Vaissala (atm pressure, wind, air temp, humidity, solar radiation, precipitation)  -Near-real time automatic data satellite transmission (SCD2 satellite -INPE) Under evaluation/ not correct	- no CGPS station  - no AG station	Tides:  (1) 2008-2011
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Table 1: GLOSS / Brazil Network in October 2011

The criteria used to select these sites were:

- (a) to avoid regions of rough surf or strong currents;
- (b) to avoid fresh water runoff (rivers);
- (c) to be away from very active port operations that may damage the station;
- (d) to be in adequately deep water;
- (e) have a solid foundation (wharf, pier, jetty, etc) for supporting the station;
- (f) to be protected against vandalism;
- (g) ease access for the tide observer and station technicians; and
- (h) gauge site spacing of roughly 1000 km.

#### **4.0 Conclusions and Future Work**

During the last years some progress has been made regarding Brazilian participation in GLOSS, and as part of national tide gauge network. The milestones are:

- The GLOSS Implementation Plan in Brazil was concluded in October 2004 and forwarded to the IOC Secretariat.
- **Tidal stations**
  - Salvador (2002): site was established jointly by CHM and IBGE, and was upgraded with an acoustic gauge, donated from NOAA and the University of Hawaii Sea Level Center (UHSLC), with near real automatic data transmission.  
( 2008) it was uninstalled and had a new upgrade with a radar and encoder supported by UHSLC, with near real automatic data transmission;
  - Fortaleza (2008): it was installed a tidal station with a radar and encoder supported by UHSLC, with near real automatic data transmission;
  - Ilha Fiscal (2008): it was installed a tidal station with a radar and encoder; and
  - ASPS (2008) it was installed a tidal station with radar, with near real automatic data transmission, satellite.
- **CGPS stations:**
  - Imbituba was established in 2006, Salvador in 2007 and Fortaleza in 2008. It's is going to install in Rio de Janeiro in 2012.
- **Data Delivery:**
  - Ilha Fiscal: monthly data has been sent to UHSLC. Monthly and Annual MSL, observed data from 1955 to 2010 and associated documentation has been sent to the Permanent Service Mean Sea Level (PSMSL). Quality-controlled data from 2008 to 2010;
  - Ponta da Madeira: monthly and Annual MSL observed data from 1988 to 2010 and associated documentation has been sent to the PSMSL;
  - Cananéia: quality-controlled data from 1954 to 2006 and associated documentation has been sent to the PSMSL;
  - Salvador and Fortaleza: stations operate in near real time data transmitting directly to UHSLC/VLIZ;
    - Salvador: monthly and Annual MSL, quality-controlled data observed data from 2001 to 2007, raw observed data from 2008 to 2010 and associated documentation has been sent to the PSMSL;
    - Fortaleza: raw observed data from 2008 to 2010 and associated documentation has been sent to the PSMSL;

- Macaé and Imbituba : monthly and Annual MSL, quality-controlled data observed data from 2001 to 2007, raw observed data from 2008 to 2010 and associated documentation has been sent to the PSMSL;
- ASPSP (under evaluation): operates in near real time transmitting to INPE, but there some problems with data transmission to be fixed in 2012.
- **Capacity building**  
From 2003 to 2011 DHN has provided short-term Training Courses on conventional tide gauge operations and maintenance for the Brazilian community. It was included training in radar and encoder since 2008. IBGE and DHN had a short-term course of geodetic control of tidal stations in March 2009;
- **Regional GLOSS network**  
In 2007 Brazil together with, Argentina and Uruguay, took part of a regional network, with plans to join the existing tide gauge networks, aiming the support to Operational Oceanography in the region (GOOS Regional Alliance in the Upper Southwest and Tropical Atlantic - OCEATLAN) among other applications (remote sensing, climate monitoring etc.). No practical actions done yet.
- **Future Work**  
This includes:
  - to update and carrying on scheduled activities of the GLOSS Implementation Plan in Brazil;
  - the installation of six radar gauges and encoders, in the next two years, in these sites: Rio Grande, Imbituba, Macaé, Ponta da Madeira, Ilha de Fernando de Noronha and e Ilha da Trindade;
  - to get the acceptance from VALE for Porto de Tubarão to be a GLOSS Brazil station;
  - all GLOSS Brazil Program participants to provide processed tidal data sets according to GLOSS QUALITY CONTROL OF SEA LEVEL OBSERVATIONS Version 0.1 to Permanente Service Mean Sea Level (PSMSL);
  - to deliver observed tidal data in near real time from Arquipélago de São Pedro e São Paulo in the next year;
  - the installation of two CGPS stations in the next years at Ilha fiscal and Macaé, and the future installation of CGPS stations in Fernando de Noronha , Ilha da Trindade and Arquipélago de São Pedro e São Paulo; and
  - IBGE to provide the processed CGPS data sets from Imbituba, Salvador, Fortaleza and Ilha Fiscal to the Tide Gauge Benchmark Monitoring's Centers (TIGAS), according to proceedings defined by these Centers.

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