



**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);

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. In 2017 the tidal station at Macaé was moved to Arraial do Cabo.

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 (July 2017)

	Station	Responsible	Classification	Situation in 2017	Expected Situation in 2018	Expected Situation in 2013	Observations about tide gauges/ meteorological sensors	Observations about Continuous GPS (CGPS)/ Absolute Gravimetry (AG)	Data availability periods
1	Rio Grande	CHM	Secondary	Operational	Operational with Radar Kalesto/ with Logosens datalogger (OTT). Daily downloads via software Hiydras3 Basic_OTT	Under evaluation	-----	-----	Since NOV2014
2	Imbituba (Porto de Imbituba) 28° 13,8 S 048° 39,0W	IBGE	Principal	Operational	Operational Daily tidal data downloads	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) 2001-2017 Historical data (1948-1971) to be integrated to the current time series
3	Cananéia 25° 01,0 S 047° 55,5W	USP	Principal	Operational	Operational Radar Kalesto in operation and real time data	Operational	(1) Conventional (float daily chart) - Meteorological sensors	- CGPS station installed in Jan./2006 Belongs to IBGE	-Tides (1) 1954-2017

					transmission(tides, meteorological data, CGPS, Gravimetry)		Vaissala	CGPS week solutions (Bernese 5.0) integrated to the IGS structure - No AG station	
4	Ubatuba	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) 2010-2017
5	Rio de Janeiro (Ilha Fiscal) 22° 53,8 S 043° 10,0W	CHM	Principal	Operational	Operational	Operational	(1) Convencional (daily chart) (2) Radar Kalesto/ (3) Encoder SE200 with Logosens datalogger (OTT) installed in 2008. Daily automaticly downloads via GSM / software Hydras3 Default_OTT	- CGPS station is going to be installed in 2018 - no AG station	Tides: (1)1963-2011 (GAP in 1979-1980, 1985-1987) (2) (3) 2008-2017
6	Arraial do Cabo	IBGE	Secondary	Operational	Operational	Operational		- CGPS station - no AG station	
7	Tubarão Harbor 20° 17,3 S 040° 14,6W	VALE	Secondary	Operational	Operational Near-Real time automatic data transmission	Operational	- Radar Kalesto/ Encoder SE200 with Logosens datalogger (OTT) , installed in 2008 following CHM specifications. Near-real time automatic	- no CGPS station - no AG station	Since NOV2008

							<p>data transmission</p> <ul style="list-style-type: none"> - Meteorological sensors (atm pressure, wind, air temp, humidity, solar radiation, precipitation) 		
8	<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</p> <p>Installed in Apr./2008 by UHSLC/ VLIZ</p> <p>(4) Conventional (float/ weekly chart) back-up gauge, installed in Dec./2002</p> <ul style="list-style-type: none"> - Near-Real time automatic data transmission directly to UHSLC via GOES - IBGE – daily downloads via direct (serial) connection - No meteorological sensors 	<ul style="list-style-type: none"> - CGPS station installed in Apr./2007, (top of a 4m mast) - TG-CGPS distance = 150m - TG-CGPS leveling not performed yet - CGPS week solutions (Bernese 5.0) integrated to the IGS structure <p>ftp://geoftp.ibge.gov.br/SIRGAS</p> <ul style="list-style-type: none"> - no AG station 	<p>Tides:</p> <p>(1) 2004-2008 (2) (3) 2008-2017</p> <p>Historical data (1948-1971) to be integrated to the current time series</p>
9	<p>Fortaleza (Porto de Mucuripe)</p> <p>03° 42,9 S 038° 28,6W</p>	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</p>	<ul style="list-style-type: none"> - CGPS station installed in Oct./2008, (rooftop of a two-story building) - TG-CGPS distance = 600m 	<p>Tides:</p> <p>(1) 2008-2017</p> <p>Historical data (1948-1971) to be</p>

							<p>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>- 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>	integrated to the current time series
10	Ponta da Madeira (Cais da Vale) 02° 33,9 S 044° 22,7W	VALE	Secondary	Operational	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	(1) Conventional (Bi monthly chart) -Meteorological sensors (atm pressure, wind, air temp, humidity)	- no CGPS station - no AG station	Tides: (1) 1998-2017 -----
11	Ilha da Trindade 20° 30,5S 029° 18,6W To be confirmed at the time of installation	INPE CHM	Principal	Destroyed due to a storm Will be re-instaled in 2018	To be installed Under evaluation		-----	- no CGPS station - no AG station	-----
12	Ilha de Fernando de Noronha From regular	INPE CHM	Principal	Under evaluation	Under evaluation (1) Radar Level Sensor - RLS (OTT)		No meteorological sensors integrated. Meteorological information from	- no CGPS station - no AG station	-----

	GPS position: 03°50'01.8''S 032°24'06.8'' W – 6 m)				with Campbel (CR800) datalogger -Near-real time automatic data satellite transmission (ARGOS/SCD2 satellite -INPE)		weather station already installed in other site.		
13	Arquipélago de São Pedro e São Paulo 00° 55,2S 029° 20,6W	INPE CHM	Secondary	Operational	(1) Radar Level Sensor - RLS (OTT) with Campbel (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) 2008-2017

Table 1: GLOSS / Brazil Network in July 2017

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 2016;
 - Ponta da Madeira: monthly and Annual MSL observed data from 1988 to 2016 and associated documentation has been sent to the PSMSL;
 - Cananéia: quality-controlled data from 1954 to 2016 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 2016 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 2016 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 in the next year, from Arquipélago de São Pedro e São Paulo;

- 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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