

NATIONAL REPORT OF PORTUGAL

Joana Reis

Instituto Hidrográfico, Rua das Trinas, 49, 1249-093 Lisboa, Portugal
joana.reis@hidrografico.pt; www.hidrografico.pt

1. Introduction

The Portuguese Hydrographic Institute (IHPT) is the Portuguese Navy's Laboratory of Ocean Sciences and is the main responsible for the installation and maintenance of sea level stations as well as acquisition, processing, archiving and dissemination of sea level data.

This Report describes Portugal's Sea Level Network including GLOSS stations, and gives some details about the technology employed, data availability and future projects.

2. National Sea Level Network

2.1. Sea Level Stations

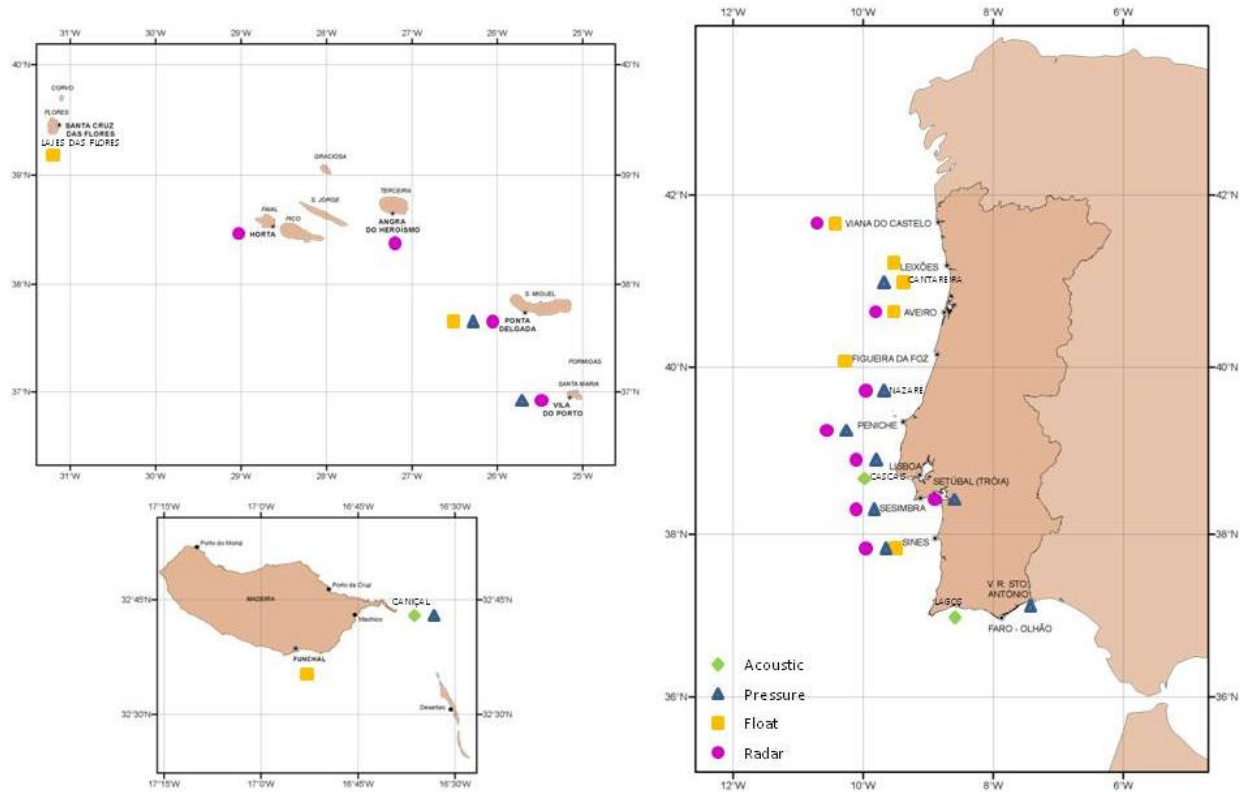


Figure 1 – National sea level network (symbols identify tide gauge technology)

At the moment, there are 21 operational sea level stations in Portugal. Figure 1 gives the location of these stations. IHPT is responsible for most of the stations. However, Cascais and Lagos sea level stations belong to the Portuguese Geographic Institute (IGP) while Horta and Angra do Heroísmo stations belong to the Department of Oceanography and Fisheries (DOP) of the University of the Azores.

Although some of these stations belong to other Institutions, IHPT continues to analyse and process sea level data from these stations in order to generate tide predictions that will be published in the Official Portuguese Tide Tables.

2.2. Current Status

A list of Portugal's sea level stations can be found in the Appendix. This list gives some details about gauge technology, station specifications and sampling interval. At the moment, all stations are operational apart from Barra de Faro/Olhão that was temporarily deactivated due to harbour constructions and Santa Cruz das Flores that was destroyed during a heavy storm in December 2010.

Efforts are being done to upgrade sea level stations with radar sensors and one minute sampling. During 2009 to 2011 the stations of Viana do Castelo, Aveiro, Nazaré, Peniche, Lisboa and Setúbal/Tróia have been upgraded with this technology.

Most of the stations that have radar sensors are transmitting one minute averages in real time through GPRS. IHPT sea level database was also upgraded during 2010 to 2011 so it could be able to receive data in real time.

2.3. GLOSS Stations

Portugal has 4 sea level stations committed to GLOSS: Cascais (Continental Portugal), Funchal (Madeira Island), Ponta Delgada (Azores, S. Miguel Island) and Santa Cruz das Flores (Azores, Flores Island).

Santa Cruz das Flores sea level station was very exposed to the sea and suffered from high degradation. This led to its destruction in December 2010 due to a heavy storm. Lajes das Flores sea level station, in the southern part of the same island, is now considered the only and main station of Flores Island. Leveling works connecting both stations were done in October 2010, just before the destruction of Santa Cruz das Flores station. Therefore, IHPT will start sending sea level data to GLOSS and PSMSL from Lajes das Flores station instead, beginning in the end of 2011, concerning data from 2006 to the present year. At the moment, Lajes das Flores has only a float gauge with digital record, transmitting six minute averages once a day. However, IHPT plans to upgrade this station with a radar gauge collecting and sending one minute averages in real time.

At Funchal sea level station a radar sensor will be installed by the end of this year. This station will be recording one minute averages and sending them in real time through a GPRS connection. At the moment, a float gauge with digital recording, transmitting six minute averages every day is installed. In Madeira Island IHPT has also a sea level station in Caniçal, with an acoustic gauge recording data every one minute. However, there is still no level connection with the tide gauge in Funchal.

In the beginning of 2008 a radar gauge, with a pressure sensor and a shaft encoder (float gauge) were installed in Ponta Delgada by the University of Hawaii Sea Level Centre (UHSLC). The radar and the pressure sensors have a sampling interval of 1 minute while the encoder has a 5 minute sampling interval.

Cascais tidal station was upgraded in the beginning of 2009, by decreasing the sampling interval from 6 to 3 minutes. In order to be integrated in the North-eastern Atlantic, the Mediterranean and connected seas Tsunami Warning System (NEAMTWS), the data logger of this station also supplies 5 second raw data.

2.4. GPS Technology

GPS technology is not yet disseminated through the entire Portuguese sea level network. However, at Leixões, Ponta Delgada, Horta and Angra do Heroísmo sea level stations have a GPS receiver installed.

At Cascais and Lagos, IGP has two GPS permanent stations, which belong to the European network EPN from EUREF. Here receivers and Leica GNSS antennas are installed. The GPS permanent station of Cascais is 275 m apart from the acoustic gauge. Lagos GPS station is 138 m apart from the tidal station.

2.5. Data availability

Cascais float gauge, which was installed in 1882, is the oldest tide gauge in operation in Portugal. IGP has analog records since that time. Concerning the other 3 GLOSS stations, IHPT has data since the following years: 1962 for Funchal, 1976 for Santa Cruz das Flores and 1978 for Ponta Delgada. From Lajes das Flores sea level station data is available since 2006.

Sea level data from the Portuguese GLOSS stations are available at the GLOSS and PSMSL websites. Since the stations of Ponta Delgada and Cascais have real time connections, the data from these stations are also available in near real time on the internet. Data from Ponta Delgada can be found at the UHSLC, at the Sea Level Station Monitoring Facility (VLIZ) and at the Sea Level along the European Atlantic Coast Line (SLEAC) websites. Data from Cascais is available at the VLIZ and SLEAC websites. IGP has also an ftp page where data from Cascais can be downloaded with a sampling interval of 3 minutes or 5 seconds.

3. Sources of Further Information

Data from the Portuguese GLOSS stations can be found at the following websites, which give also a short description of the tide gauge stations:

<http://www.vliz.be/gauges/map.php> (Cascais and Ponta Delgada)

<http://ilikai.soest.hawaii.edu/RSL1/index.html> (Ponta Delgada)

<http://ilikai.soest.hawaii.edu/uhslc/datai.html> (all Portuguese GLOSS stations)

http://www.gloss-sealevel.org/station_handbook/ (all Portuguese GLOSS stations)

<http://www.sleac.org/> (Cascais and Ponta Delgada)

<ftp://www.igeo.pt/Cascais/maregrafo> (Cascais)

Monthly and annual mean sea levels can be found at the PSMSL website:

http://www.pol.ac.uk/psmsl/psmsl-individual_stations.html

Tide predictions for the Portuguese coast as well as some details about the tide in Portuguese territory

can be found at the IHPT website: <http://www.hidrografico.pt/>

4. Future Projects

IHPT will continue to upgrade the Portuguese sea level network by installing radar sensors and real time connections to the stations. Funchal sea level station will have a radar gauge sending one minute samplings by the end of 2011. Leixões, Figueira da Foz, Vila Real de Santo António and Lajes das Flores will also be upgraded between the end of 2011 and first semester of 2012.

Changes to the configuration of some stations, that already have one minute sampling, are being done in order to send real time data directly to IHPT database, through GPRS.

Concerning projects like the NEAMTWS, IHPT is working on a real time access to the stations of Peniche and Leixões that will be incorporated in the system.

APPENDIX – List of Sea Level Stations in Portugal (November 2011)

Station Name	Coordinates (WGS84)	Responsible Institution	Gauge Technology	Current Sample (min)	Type of Transmission	Network
Viana do Castelo	41°41,10'N 8°50,38'W	IHPT	Radar (Vega) Float (OTT)	1 (radar); 6 (float)	GPRS	
Leixões	41°11,20'N 8°42,27'W	IHPT	Float (OTT)	6 (OTT Thales); Continuous analog record digitised at 60 minute intervals (OTT MXX)	GSM	
Cantareira (Douro River)	41°08,78'N 8°40,01'W	IHPT	Pressure (Druck) Float (OTT)	1 (pressure); Continuous analog record digitised at 60 minute intervals (OTT MXX)	GSM	
Aveiro	40°38,60'N 8°44,97'W	IHPT	Radar (Vega) Float (OTT)	1 (radar); 6 (OTT Thales); Continuous analog record digitised at 60 minute intervals (OTT R20)	GPRS	
Figueira da Foz	40°08,90'N 8°51,37'W	IHPT	Float (OTT)	6 (OTT Thales); Continuous analog record digitised at 60 minute intervals (OTT R20)	GSM	
Nazaré	39°35,08'N 9°04,43'W	IHPT	Radar (Vega) Pressure (Esterline)	1	GPRS	
Peniche	39°21,22'N 9°22,47'W	IHPT	Radar (Krohne; Vega)	1	GPRS	
Cascais	38°41,60'N 9°25,10'W	IGP	Acoustic (Aquatrak) Float	3 min (for tidal purposes) or 5 seconds (for NEAMTWS)	Internet	GLOSS; NEAMTWS
Lisboa	38°42,63'N 9°09,66'W	IHPT	Radar (Krohne) Pressure (Druck)	1	GSM	
Sesimbra	38°26,29'N 9°06,77'W	IHPT	Radar (Krohne) Pressure (Druck)	1	GSM	
Setúbal/Tróia	38°29,69'N 8°54,17'W	IHPT	Radar (Krohne) Pressure (Druck)	1	GSM	
Sines	37°56,89'N 8°53,27'W	IHPT	Radar (Krohne) Pressure (Druck) Float (OTT)	Radar and pressure: 1 min (for tidal purposes) or 15 seconds (for NEAMTWS); 6 (OTT Thales); Continuous analog record digitised at 60 minute intervals (OTT R20)	Internet	NEAMTWS
Lagos	37°05,93'N 8°40,10'W	IGP	Acoustic (Aquatrak)	3 min (for tidal purposes) or 5 seconds (for NEAMTWS)	Internet	NEAMTWS
Vila Real de Santo António	37°11,39'N 7°24,77'W	IHPT	Pressure (Druck)	1	GSM	

APPENDIX (cont.) – List of Sea Level Stations in Portugal (November 2011)

Station Name	Coordinates (WGS84)	Responsible Institution	Gauge Technology	Current Sample (min)	Type of Transmission	Network
Funchal	Analog: 32°38,51'N 16°54,43'W Digital: 32°38,64'N 16°54,78'W	IHPT	Float (OTT)	6 (OTT Thales); Continuous analog record digitised at 60 minute intervals (OTT MXX)	GSM	GLOSS
Canical	32°44,17'N 16°44,06'W	IHPT	Acoustic (Aquatrak) Pressure (Druck)	1	GSM	
Lajes das Flores	39°22,70'N 31°10,12'W	IHPT	Float (OTT)	6	GSM	GLOSS
Horta	38°32,04'N 28°37,31'W	DOP	Radar (Vega)	4	GPRS	
Angra do Heroísmo	38°39,03'N 27°13,31'W	DOP	Radar (Vega)	4	GPRS	
Ponta Delgada	37°44,16'N 25°40,27'W	UHSLC / IHPT	Radar (Vega) Pressure (Druck) Float	1 (Radar, Pressure); 5 (Float)	GTS	GLOSS; NEAMTWS
Vila do Porto	36°56,75'N 25°08,87'W	IHPT	Radar (Krohne) Pressure (Druck)	1	GSM	

Acronyms:

IHPT – Portuguese Hydrographic Institute

IGP – Portuguese Geographic Institute

DOP – Department of Oceanography and Fisheries of the University of the Azores

UHSLC – University of Hawaii Sea Level Centre

NEAMTWS – North-eastern Atlantic, the Mediterranean and connected seas Tsunami Warning System