National Report of France to the XVIth GLOSS Group of Experts 11-13 April 2019

Coordinated in ***March 2019*** *by*

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1 French context and overview of its contribution to GLOSS

In 2019, **15 French tide gauges** are contributing to the GLOSS core network (Table 1). During the XVth GLOSS Group of Experts meeting, **four new tide gauges** in the Pacific were accepted as new GLOSS stations (see sections 2.4 and 2.5), namely: **Leava** (Futuna Island), **Rangiroa**, **Makemo** and **Tubuaï** (French Polynesia). Decision regarding these stations is pending formal approval by the French national representative to the IOC.

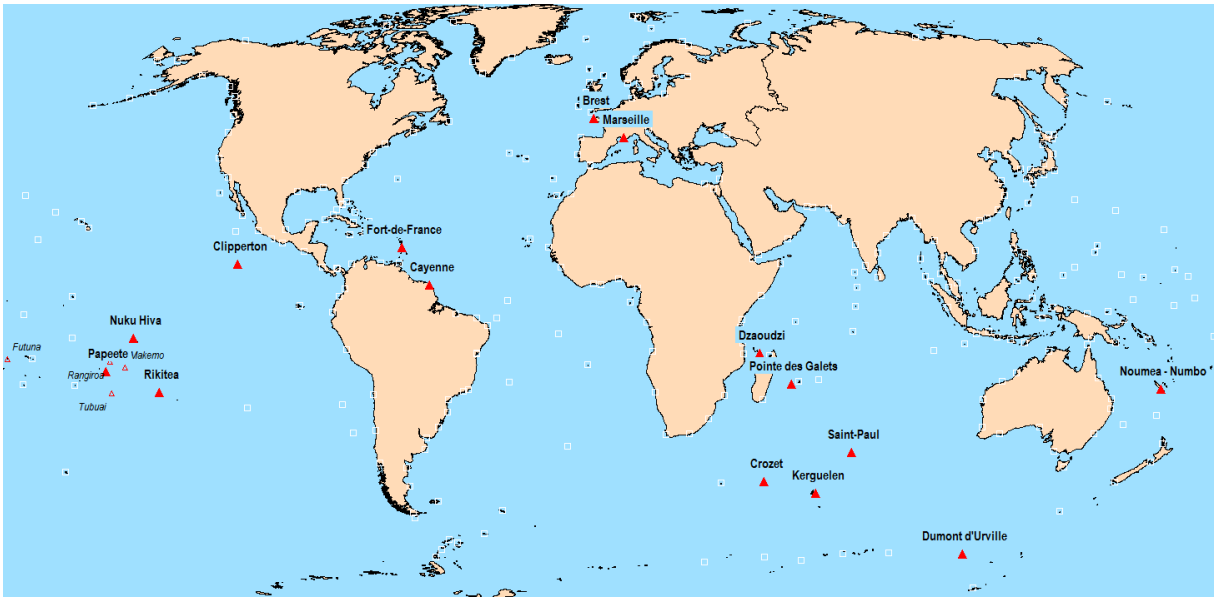


Figure 1: Geographical distribution of the French stations committed to GLOSS (white squares represents the other GLOSS stations of the core network)

Shom has been assigned in 2010 by the French government as coordinator for the national in situ sea level observation. It led to the creation of REFMAR (http://refmar.shom.fr/en) with the main following mission:

- Collect the sea level observations conducted by French public establishments and services;
- Manage and archive the collected observations as delayed mode data;
- Define the networks and minimum specifications for observing the sea level;
- Define and promote appropriate means of operational transmission;
- Coordinate the real-time and delayed mode distribution;
- Quality control the received observations;
- Contribute to the definition of national and international standards;

In the past years, REFMAR has been contacting French sea level data producers to draw an inventory of all the French sea level stations operated by Port Authorities, Research institutes, universities, flood warning systems, local authorities, and so on. REFMAR pays particular attention to general data access and data policy conditions. Through REFMAR website and meetings, Shom also aims at providing advice and recommendations to producers and promotes state-of-the-art measurement practices. REFMAR has created a set of teaching technical sheets to describe how to install a tide staff, what is a sea level observatory, etc. These sheets are available in French at:
http://refmar.shom.fr/documentation/recommandations/fiches-techniques

Since 2017, REFMAR has been working in order to include more sea-level data producers into the network. Tide gauges from Bordeaux, Rouen and Nantes harbors are now available for visualization and download data on Shom's website (cf. 4. Access to data). In the meantime, Shom has been ramping up its own tide gauge network RONIM with 2 new stations installed in 2018 at Audierne and Saint-Quay-Portrieux, west of France. In 2019 Shom's RONIM network counts 50 tide gauges in mainland France and in overseas territories.

SONEL originally stands (in French) for Système d'Observation du Niveau des Eaux Littorales. That is, a research observation infrastructure whose basic activities are assembling, quality-controlling, and disseminating (www.sonel.org) high-quality continuous measurements of sea and land levels at the coast from French tide gauges and from a global (international) network of space geodetic stations (GNSS and DORIS) at or near tide gauges. SONEL also acts as the data assembly centre for GLOSS regarding observations from GNSS stations co-located with tide gauges. The GNSS at Tide Gauge Activities is described in a dedicated report to this GLOSS Group of Experts.

GLOSS Id.	Station Name	Operator	Network
017	Pointe des Galets (Réunion Is.)	Shom	RONIM
021	Crozet	LEGOS/INSU	ROSAME (disabled)
023	Kerguelen	LEGOS/INSU	ROSAME
024	Amsterdam St Paul	LEGOS/INSU	ROSAME
096	Dzaoudzi	Shom	RONIM
123	Nouméa	Shom	RONIM
131	Dumont d'Urville	LEGOS/INSU	ROSAME
138	Rikitea	UHSLC	
140	Papeete Fare Ute (Tahiti)	UHSLC	
142	Nuku Hiva (Marquesas Is.)	UHSLC	
165	Clipperton	Shom	Non-permanent
202	Ile Royale (Fr. Guyana)	Shom	RONIM
204	Fort-de-France	Shom	RONIM
205	Marseille	Shom	RONIM
242	Brest	Shom	RONIM
260	Sao Tomé	LEGOS / IRD	Decommissioned

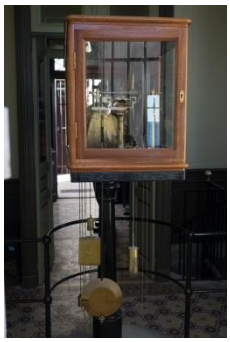
Table 1: GLOSS stations on French territories

2 Status of French sea level stations committed to GLOSS

2.1 Atlantic Ocean & Mediterranean Sea

GLOSS 205: MARSEILLE

- **Operated by:** **IGN and Shom (RONIM TG Network).**
- **First observation:** **1849**
- **Last observation:** **Ongoing**
- **Contributing to** **IOC- ICG/NEAMTWS, GLOSS**

- **Sensor**: Krohne Optiflex radar sensor. Legacy floating gauge is still operating.
- **Data transmission**: 1s to NEAMTWS + 1 min. real-time internet.
- **GNSS**: One GPS station operational since July 1998.
- **Comment**: Manual controls several times a year by IGN
- **Contact**: ronim@shom.fr

GLOSS 242: BREST

- **Operated by:** **Shom (RONIM TG Network)**
- **First observation:** **1846**
- **Last observation:** **Ongoing**
- **Contributing to** **IOC – ICG/NEAMTWS, GLOSS**

- **Sensor**: Krohne Optiflex 1300C radar sensor
- **Data transmission**: 1s to NEAMTWS + 1 min. real-time internet.
- **GNSS**: One GPS station operating continuously since 1998. The distance between the GPS and the tide gauge is about 350 meters. Leveling operations are regularly carried out
- **Comment:** Manual controls several times a year. Last maintenance in 2018.
- **Contact:** ronim@shom.fr

GLOSS 204: FORT-DE-FRANCE, MARTINIQUE

- **Operated by:** **Shom (RONIM TG Network)**
- **First observation:** **1912 (continuous since 2005)**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/CARIBE-EWS, GLOSS**
- **Sensor**: Krohne Optiwave radar since 2005
- **Data transmission**: 1 min. real-time GTS + internet.
- **GNSS**: One permanent GNSS station since 2011
- **Comment:** Routine maintenance by local partners. Complete control operations in 2015.
- **Contact:** ronim@shom.fr

GLOSS 202: CAYENNE-ILE ROYALE-ILES DU SALUT, (French Guyana)

- **Operated by:** **Shom (RONIM TG Network)**
- **First observation:** **1896 (continuous since 2006)**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/CARIBE-EWS, GLOSS**
- **Sensor**: Krohne Optiflex radar sensor
- **Data transmission**: 1 min. real-time GTS + internet.
- **GNSS**: Permanent GNSS station since 2012
- **Comment:** Routine maintenance by local partners. Complete control operations in 2018.
- **Contact:** ronim@shom.fr

GLOSS 260: SAO TOME

- **Operated by:** **LEGOS (France)**
- **First observation:** **2004**
- **Last observation:** **2010**
- **Contributing to:** **GLOSS, PIRATA Network-**
- **Sensor**: Aanderaa bottom pressure gauge
- **Data transmission**:
- **GNSS**: Episodic GNSS campaigns
- **Comment:** This station was maintained by France but is now decommissioned

2.2 Indian Ocean & Antarctica

GLOSS 017: POINTE DES GALETS, LA REUNION

- **Operated by:** **Shom (RONIM TG Network)**
- **First observation:** **1900 (continuous since 2007)**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/IOTWS, GLOSS**

- **Sensor**: Krohne Optiflex radar sensor
- **Data transmission**: 1 min. real-time GTS + internet.
- **GNSS**: No permanent GNSS station (due to terrain masking the sky visibility). GNSS measurements performed during leveling operations
- **Comment:** Routine maintenance by local partners. Complete control operation in 2017.
- **Contact:** ronim@shom.fr

GLOSS 096: DZAOUDZI, MAYOTTE

- **Operated by:** **Shom (RONIM TG Network)**
- **First observation:** **1962**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/IOTWS, GLOSS**
- **Sensor**: Krohne Optiflex radar sensor (since 2008)

- **Data transmission**: 1 min. real-time GTS + internet.
- **GNSS**: Permanent GNSS station since 2013
- **Comment:** Routine maintenance by local partners. Complete control operation in 2017.
- **Contact:** ronim@shom.fr

South Indian Ocean

GLOSS-023: KERGUELEN

- Operated by : LEGOS (ROSAME TG Network)
- First observation : First observation in 1959 continuous since 1993
- Last observation : Ongoing
- Contributing to : IOC – ICG/IOTWS, GLOSS
- Sensor : KER3 (radar Krohne Optiwave) + KER2 (pressure + Krohne optiflex)
- Data transmission : 1 min. real time GTS and internet + 1h ARGOS for KER2
- GNSS : 1 co-located GPS + 2 nearby GNSS + a DORIS station
- Comment : Tide pole readings and GNSS buoy sessions are made several times a year
- Contact : philippe.techine@legos.obs-mip.fr

GLOSS-021: CROZET

- **Operated by:** **LEGOS (ROSAME TG Network)**
- **First observation:** **1995**
- **Last observation:** **2013**
- **Contributing to:** **GLOSS**
- **Sensor**: Disabled (previously pressure gauge)
- **Data transmission**: ARGOS
- **GNSS**: -1 GNSS nearby
- **Comment:** Station was lost to a storm in 2015. This site is particularly difficult to maintain and a relocation of the station is under study.
- **Contact:** philippe.techine@legos.obs-mip.fr

GLOSS-024: SAINT-PAUL

- **Operated by:** **LEGOS (ROSAME TG Network)**
- **First observation:** **1994**
- **Last observation:** **ongoing**
- **Contributing to:** **GLOSS**
- **Sensor**: Krohne radar sensor
- **Data transmission**: ARGOS
- **GNSS**: Permanent GNSS station since 2011
- **Comment:** This station faces power supply issue since 2009 and is partially active.
- **Contact:** philippe.techine@legos.obs-mip.fr

GLOSS-131: DUMONT D'URVILLE

- **Operated by:** **LEGOS (ROSAME TG Network)**
- **First observation:** **1997**
- **Last observation:** **Ongoing**
- **Contributing to:** **GLOSS**
- **Sensor**: Bottom pressure gauge
- **Data transmission**: ARGOS and Ethernet

- **GNSS**: 2 nearby GNSS stations
- **Comment:** Last control operation in 2019
- **Contact:** philippe.techine@legos.obs-mip.fr

2.3 Pacific Ocean

GLOSS 165: CLIPPERTON (non-permanent)

- **First observation:** **2007**
- **Last observation:** **2012**
- **Contributing to:** **GLOSS**
- **Sensor**: None
- **Data transmission**: None
- **GNSS**: Episodic campaigns (2007, 2012 and 2015)
- **Comment:** Non-permanent station. Observation campaigns were carried out between 2007 and 2015.
- **Contact:** ronim@shom.fr

2.4 New Caledonia and Wallis-et- Futuna Islands

GLOSS 123: NOUMEA-NUMBO

- **Operated by:** **Shom (RONIM TG Network)**
- **First observation:** **1967**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/PTWS, GLOSS**

- **Sensor**: Krohne Optiflex radar sensor
- **Data transmission**: 1 min. real-time internet.
- **GNSS**: Permanent GNSS station since 2015
- **Comment:** Routine maintenance by Shom. Complete control operation in 2019.
- **Contact:** ronim@shom.fr

NEW: LEAVA, FUTUNA ISLAND

- **Operated by:** **Shom**
- **First observation:** **1986**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/PTWS, GLOSS**
- **Sensor**: Vaisala QHR-104 radar sensor and Druck pressure sensor
- **Data transmission**: 1 min. real-time GTS.
- **GNSS**: Permanent GNSS station
- **Comment:** Station regularly visited by Shom's technicians. Decision to be included in GLOSS GCN during GE15 in 2017 (ID pending)
- **Contact:** ronim@shom.fr

2.5 French Polynesia

The University of Hawaii maintains three stations in Rikitea, Papeete and Nuku Hiva.

GLOSS 138: RIKITEA

- **Operated by:** **Shom and UPF**
- **First observation:** **1965**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/PTWS, GLOSS**
- **Sensor**: Vaisala QHR-104 radar sensor and Druck pressure sensor
- **Data transmission**: 1 min. real-time GTS.
- **GNSS**: Permanent GNSS station since 2011
- **Comment:** A UHSLC tide gauge is installed nearby. Shom and UPF station is regularly visited by Shom's technicians and was controlled in 2019.
- **Contact:** ronim@shom.fr

GLOSS 140: PAPEETE FARE UTE

- **Operated by:** **UHSLC**
- **First observation:** **1975**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/PTWS, GLOSS**
- **Sensor**: Several sensors, including a Vegapuls 62 radar
- **Data transmission**: 1 min. real-time GTS.
- **GNSS**: A CNES permanent GNSS station co-located since 2003
- **Comment:** Last known control in 2013

GLOSS 142: NUKU HIVA

- **Operated by:** **UHSLC**
- **First observation:** **1982**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/PTWS, GLOSS**
- **Sensor**: Bubbler sensor, Vegapuls 62 radar and a Sutron RLR radar
- **Data transmission**: 1 min. real-time GTS.
- **GNSS**: Permanent GNSS station since 2011 (installed by Shom and UPF)
- **Comment:** Last known control in 2009

NEW: RANGIROA

- **Operated by:** **Shom and UPF**
- **First observation:** **1966 (permanent since 2009)**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/PTWS, GLOSS**
- **Sensor**: Druck pressure sensor and a Vaisala QHR-104 radar sensor
- **Data transmission**: 1 min. real-time GTS.
- **GNSS**: Permanent GNSS station co-located
- **Comment:** Regularly visited by Shom's technicians. Last complete control operation in 2018
- **Contact:** ronim@shom.fr

NEW: MAKEMO

- **Operated by:** **Shom and UPF**

- **First observation:** **1990 (permanent since 2013)**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/PTWS, GLOSS**
- **Sensor**: Druck pressure sensor and Vaisala QHR-104 radar sensor
- **Data transmission**: 1 min. real-time GTS.
- **GNSS**: Permanent GNSS station co-located
- **Comment:** Regularly visited by Shom's technicians. Last complete control operation in 2018
- **Contact:** ronim@shom.fr

NEW: TUBUAI

- **Operated by:** **Shom and UPF**
- **First observation:** **2009**
- **Last observation:** **Ongoing**
- **Contributing to:** **IOC – ICG/PTWS**
- **Sensor**: Keller pressure sensor and a Vaisala radar sensor
- **Data transmission**: 1 min. real-time GTS.
- **GNSS**: Permanent GNSS station co-located
- **Comment:** Regularly visited by Shom's technicians. Last complete control operation in 2019.
- **Contact:** ronim@shom.fr

3 GLOSS requirements & the French stations

The table below provides a synthetic overview of the station status regarding the GLOSS requirement (IOC 2012).

Station	Type	Digital	Precision	Control	Meteo	Last Levelling	CGPS	Real-time
La Réunion	Radar	Yes	1cm	Semestrial	Pressure	2017	No	ADSL + GTS
Crozet	Pressure	Yes	1cm	<Annual	Pressure	2010	Yes	ARGOS (disabled)
Kerguelen	Pressure Radar	Yes	<1cm	Monthly	Pressure	2018	Yes	ARGOS ADSL GTS
St Paul	Pressure Radar	Yes	<1cm	Annual	Pressure	2018	Yes	ARGOS
Dzaoudzi	Radar	Yes	1cm	Semestrial	Pressure	2017	**Yes**	GPRS + GTS
Nouméa - Numbo	Radar	Yes	1cm	Semestrial	Pressure	2019	**Yes**	ADSL
Dumont D'Urville	Pressure	Yes	1cm	Annual	Pressure	2019	Yes	ARGOS ADSL
Rikitea	Radar Pressure	Yes	1cm	SHOM/ UHSLC		2019	Yes	GTS
Papeete	Radar Pressure	Yes	1cm	UHSLC		2013	Yes	GTS
Nuku Hiva	Radar	Yes	1cm	UHSLC		2009	Yes	GTS
Clipperton	Pressure 2005, 2006-2008, 2011-2012	Yes	5cm	Annual	model	2015	No	No
Ile Royale	Radar	Yes	1cm	Semestrial	Pressure	2018	**Yes**	GPRS + GTS
Fort-de-France	Radar	Yes	1cm	Semestrial	Pressure	2015	Yes	ADSL + GTS
Marseille	Radar Float	Yes	1cm	Semestrial	Pressure	2015	Yes	ADSL
Brest	Radar	Yes	1cm	Semestrial	Pressure	2018	Yes	ADSL
Sao Tomé	Pressure	Yes	1cm	<Annual	Pressure	2010	No	ARGOS (disabled)
Leava, Futuna Island	Radar Pressure	Yes	1cm	Annual	Pressure	2019	Yes	GTS
Rangiroa	Radar Pressure	Yes	1cm	Annual	Pressure	2018	Yes	GTS
Makemo	Radar Pressure	Yes	1cm	Annual	Pressure	2018	Yes	GTS
Tubuai	Radar Pressure	Yes	1cm	Annual	Pressure	2019	Yes	GTS

4 Access to tide-gauge data

The website (data.shom.fr) provides a unique data portal that collects and distributes tide gauge high frequency data from the various French sea level producers. Different levels of data (raw, real time, validated, etc.) are available on the portal. For GLOSS applications, hourly sea level data from the French stations committed to GLOSS are provided directly to the University of Hawaii Sea Level Centre (UHSLC). Mean sea levels and GPS data at the tide gauges are available at SONEL (www.sonel.org) which also acts as IGS/TIGA data centre and as GLOSS data assembly centre for GNSS at tide gauges. Through SONEL webportal, mean sea levels are also provided to the PSMSL (www.psmsl.org).

The table below provides links to main data sources of French GLOSS stations.

GLOSS ID	Station	Status (March 2019)	Shom Real-time + Research Quality	IOC	SONEL	
17	La Réunion	OK	http://data.shom.fr/donnees/refmar/110	http://www.ioc-sealevelmonitoring.org/station.php?code=reun	https://www.sonel.org/?page=maregraphe&idStation=1827	
21	Crozet	Disabled	https://data.shom.fr/donnees/refmar/173		https://www.sonel.org/?page=maregraphe&idStation=1752	
23	Kerguelen	OK	https://data.shom.fr/donnees/refmar/23	http://www.ioc-sealevelmonitoring.org/station.php?code=kerg2	https://www.sonel.org/?page=maregraphe&idStation=1780	
24	St Paul	OK	https://data.shom.fr/donnees/refmar/194	http://www.ioc-sealevelmonitoring.org/station.php?code=stpa	https://www.sonel.org/?page=maregraphe&idStation=1837	
96	Dzaoudzi	OK	https://data.shom.fr/donnees/refmar/30	http://www.ioc-sealevelmonitoring.org/station.php?code=dzao	https://www.sonel.org/?page=maregraphe&idStation=1903	
123	Nouméa - Numbo	OK	https://data.shom.fr/donnees/refmar/659	http://www.ioc-sealevelmonitoring.org/station.php?code=numbo	https://www.sonel.org/?page=maregraphe&idStation=1863	
131	Dumont d'Urville	NOK	https://data.shom.fr/donnees/refmar/108	http://www.ioc-sealevelmonitoring.org/station.php?code=dumo	https://www.sonel.org/?page=maregraphe&idStation=1756	
138	Rikitea	OK	https://data.shom.fr/donnees/refmar/43	http://www.ioc-sealevelmonitoring.org/station.php?code=riki	https://www.sonel.org/?page=maregraphe&idStation=3410	
140	Papeete	OK	https://data.shom.fr/donnees/refmar/383	http://www.ioc-sealevelmonitoring.org/station.php?code=pape	https://www.sonel.org/?page=maregraphe&idStation=1820	
142	Nuku Hiva	OK	https://data.shom.fr/donnees/refmar/795	http://www.ioc-sealevelmonitoring.org/station.php?code=nuku	https://www.sonel.org/?page=maregraphe&idStation=2257	
165	Clipperton	No permanent TG	https://data.shom.fr/donnees/refmar/797	-	https://www.sonel.org/?page=maregraphe&idStation=2853	
202	Ile Royale	OK	https://data.shom.fr/donnees/refmar/749	http://www.ioc-sealevelmonitoring.org/station.php?code=iler2	https://www.sonel.org/?page=maregraphe&idStation=1867	
204	Fort-de-France	OK	https://data.shom.fr/donnees/refmar/126	http://www.ioc-sealevelmonitoring.org/station.php?code=ftfr	https://www.sonel.org/?page=maregraphe&idStation=1764	
205	Marseille	NOK (real time KO)	https://data.shom.fr/donnees/refmar/524	http://www.ioc-sealevelmonitoring.org/station.php?code=mars	https://www.sonel.org/?page=maregraphe&idStation=1802	
242	Brest	OK	https://data.shom.fr/donnees/refmar/3	http://www.ioc-sealevelmonitoring.org/station.php?code=bres	https://www.sonel.org/?page=maregraphe&idStation=1736	
260	Sao Tomé	Disabled	-	http://www.ioc-sealevelmonitoring.org/station.php?code=saot	https://www.sonel.org/?page=maregraphe&idStation=1864	
	Leava, Futuna Island	OK	https://data.shom.fr/donnees/refmar/501	http://www.ioc-sealevelmonitoring.org/station.php?code=futu	https://www.sonel.org/?page=maregraphe&idStation=3112	
	Rangiroa	OK	https://data.shom.fr/donnees/refmar/78	http://www.ioc-sealevelmonitoring.org/st	https://www.sonel.org/?page=maregraphe&i	

				ation.php?code=rangi	dStation=2259	
	Makemo	OK	https://data.shom.fr/donnees/refmar/586	http://www.ioc-sealevelmonitoring.org/station.php?code=make	https://www.sonel.org/?page=maregraphe&idStation=3416	
	Tubuai	OK	https://data.shom.fr/donnees/refmar/113	http://www.ioc-sealevelmonitoring.org/station.php?code=tubua	https://www.sonel.org/?page=maregraphe&idStation=2258	

5 Data rescue activities

In France, systematic sea level observations by mechanical tide gauge started in the mid-1800s (Pouvreau, 2008). Within SONEL framework, an extensive work is undertaken at Shom, aiming at recovering the French scientific and cultural heritage on sea level observations. This initiative fulfills the recommendations of GLOSS on the recovery of forgotten sea level measurements (Bradshaw et al., 2015).

Data rescue performed at Shom firstly implies to inventory documents related to water level measurement (marigrams, ledgers): more than **60.000 documents** have been identified and inventoried, and about 50% have already been scanned, but thousands of documents still remain to inventory and scan. These old tide gauge measurements are mainly related to French ports (about 300 sites with a total of about 1,000 years of cumulated sea level measurements) but also to locations around the world (about 240 sites with a total of about 470 years of cumulated sea level measurements). Time-series duration may vary from days/weeks/months (observations for hydrographic purpose) to several decades. Longest time series can be used to assess long term sea level evolution and shorter datasets could be used to quantify historical storm surges if occurred during measurements, allowing the improvement of estimation and prediction of extreme coastal water levels (Bulteau et al., 2015).
As of April 2019, Shom has made available the results of recent inventory works:
http://refmar.shom.fr/dataRescue/. An English version of the site should be available soon.

6 Technical developments

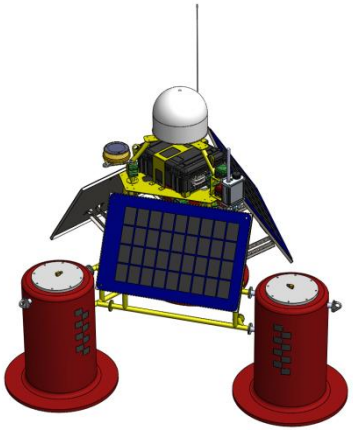
6.1 Mobile Tide Gauge

In order to improve sea-level observation capacities, Shom has developed a prototype of mobile radar tide gauge named EPONIM (*Equipement ponctuel pour l'observation du niveau de la mer*). This system is to be installed at locations where permanent systems are not required or authorized (in touristic areas for instance). Using an autonomous, solar-powered, radar-equipped tide gauge, it is capable of several months of continuous operation much like its permanent counterpart. It only lacks data transmission which should be possible in the next and final version. Installation of EPONIM is a one-hour process and requires one or two technicians. The structure has adaptable feet and arms in order to insure steadiness and adaptability to many situations (large tidal amplitude, sloppy ground, non-vertical wharf). Stability can be achieved by bolts attaching the feet to the ground, or by the use of lead blocks mounted to the feet in order to ballast the structure. The complete tide gauge weighs less than 35kg and can be easily transported in a car or by plane.

EPONIM mobile tide gauge in Saint-Jean-de-Luz (credit: Shom)

6.2 GNSS Buoy

Shom is developing a GNSS buoy capable of long-term (> 1 year) deployments.



Characteristics are the following:

- Weight: 250-300kg
- Span: 2.5m
- GNSS receiver Septentrio AsterX4, GPS, GALILEO et GLONASS
- GNSS Antenna Leica AR25 rev 4
- Attitude SBG Systems Ellipse
- Radar sensor Paratronic Cruzoé CR420/6 for height above sea-level

The system is autonomous in energy and transmits data in NRT via 3G/4G connection.
Data processing based on PPP technique is twofold:

- Rapid solution: 1-day delay sampling 5 minutes
- Final solution: 2-week delay sampling 30 seconds

Processing workflow from the buoy up to Shom's diffusion website has already been developed. 95% uncertainty is estimated better than 10cm on sea-level ellipsoidal height raw measurement.
First deployment is expected in 2020 off Toulon (south-east France).

Related publications

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