Report to the Seventeen Session of the IOC Group of Experts On the Global Sea Level Observing System (GLOSS)

Chilean Sea Level Network: Current State

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Introduction

The Chilean Navy Hydrographic and Oceanographic Service (SHOA) has a robust network of sea level stations, which is now 81 years old and has undergone important technology updates, highlighting the first satellite transmissions in 1999. This network currently comprises 46 sea level recorders covering a long coast of more than 4000 kilometers in the mainland, as well as in some islands and in the Antarctic Continent (fig.1, tab. 1).

Since the network constitutes a fundamental support of the National Tsunami Warning System, all the sea level stations operate with a primary and a secondary sea level sensor (mainly a hydrostatic pressure sensor and a radar sensor), as well as redundant transmission system for the collected data.

Regarding telemetry systems, text messages through cell phone GPRS network remains the main data transmission system and GOES, is used as a secondary telemetry system. It should be noted that sea level stations of Caleta Meteoro (Lat: 52º 58' 00"S ; Long: 74º 03' 58"W), Puerto Soberania (Lat: 62º 28' 00"S ; Long: 59º 39' 00"'W) and San Felix island (Lat: 26º 17' 32"S ; Long: 80º 06' 31"W) , are the only stations that have just satellite telemetry systems, GOES and INMARSAT-BGAN, due to the absence in these sectors of GPRS network.

The sampling interval of sea level data is set to 1 minute. The data transmission frequency mostly ranges from 1 to 5 minutes. Usually data is transmitted every 5 minutes via the GOES satellite system and GPRS, while transmission is every 1 minute in those stations that have Inmarsat BGAN antennas.

Additionally, at SHOA headquarters more powerful servers to implement a new data management and visualization system were installed. The use of the Amazon web service has strengthened the capabilities in data availability and response within the framework of the National Tsunami Warning System.

The stations capabilities have allowed SHOA to achieve a reliable network supplying data for operational and scientific purposes.

Figure 1 : Chilean Sea Level Network

The data collected at the Chilean Sea Level Network are available through the website developed and maintained by VLIZ for UNESCO/IOC. Additionally, data can be accessed in real time through SHOA's website through the link: http://www.shoa.cl/ and through the GOOS Regional Alliance for the South Pacific (GRASP) portal website "Regional Network Sea Level Stations", making use of the website developed and maintained by the Oceanographic and Antarctic Institute of the Ecuadorian Navy (INOCAR) https://coos.inocar.mil.ec/visores/red_mareografica/ .

Chilean Sea Level Stations with real time telemetry

The next table summarizes the principal information of data collection platforms with real time sea level data transmissions.

STATION	LATITUDE	LONGITUDE	TELEMETRY	SENSOR TYPE	REGISTER INTERVAL	SAMPLING INTERVAL	TRANSMIT INTERVAL	DATE INSTALL. SATELLITE PLATFORM	VLIZ/IOC CODE	GLOSS ID
Arica	18° 28' 32.89" S	70° 19' 23.64" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	aric	---
Pisagua	19° 35' 48.92" S	70° 12' 56.33" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2010	pisa	---
Iquique	20° 12' 16.49" S	70° 8' 52.18" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	iqui	---
Patache	20° 48' 11.57" S	70° 11' 52.89" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2011	pata	---
Tocopilla	22° 5' 37.51" S	70° 12' 41.55" W	GPRS/ BGAN	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2010	toco3	---
Mejillones	23° 5' 51.78" S	70° 27' 2.36" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2011	meji	---
Antofagasta	23° 39' 15.17" S	70° 24' 16.63" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	anto	**174**
Paposo	25° 0' 32.36" S	70° 28' 7.42" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2013	papo	---
Taltal	25° 24' 26.17" S	70° 29' 23.26" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2010	talt	---
Isla San Félix	26° 17' 32" S	80° 6' 31" W	GOES/ BGAN	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 1 [min]	1999	sanf	**177**
Chañaral	26° 21' 6.34" S	70° 38' 1.53" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2012	chnr	---
Caldera	27° 3' 52.63" S	70° 49' 29" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	cald	---
Huasco	28° 28' 7.69" S	71° 14' 59.09" W	GPRS/ BGAN	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2010	huas2	---
Isla de Pascua	27° 9' 17.42" S	109° 26' 21.93" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	east	**137**
Punta de Choros	29° 14' 45.09" S	71° 28' 7.14" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2019	ptch	---
Coquimbo	29° 56' 58.89" S	71° 20' 6.86" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	coqu	---
Puerto Aldea	30° 17' 32.28" S	71° 36' 27.23" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2018	ptal	---
Pichidangui	32° 8' 8.2" S	71° 31' 45.49" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2010	pich	---
Quintero	32° 46' 31.76" S	71° 31' 31.51" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2011	qtro	---

STATION	LATITUDE	LONGITUDE	TELEMETRY	SENSOR TYPE	REGISTER INTERVAL	SAMPLING INTERVAL	TRANSMIT INTERVAL	DATE INST. SATELLITE PLATFORM	VLIZ/IOC CODE	GLOSS ID
Valparaíso	33° 1' 39.62" S	71° 37' 40.34" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	valp	175
San Antonio	33° 34' 53.81" S	71° 37' 5.41" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	sano	---
Arch. Juan Fernández	33° 38' 9.74" S	78° 49' 47.54" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	juan	176
Boyeruca	34° 41' 14.30" S	72° 3' 28.30" W	GPRS/ GOES	Pressure / Pressure	1 / 1 [min]	0.5 / 0.5 [s]	5 / 5 [min]	2021	boye	---
Constitución	35° 21' 20.61" S	72° 27' 25.31" W	GPRS/ GOES	Radar / Radar	1 / 1 [min]	0.25 / 0.25 [s]	5 / 5 [min]	2010	const	---
Coliumo	36° 32' 16.62" S	72° 57' 25.7" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2018	coli	---
Isla Quiriquina	36° 38' 10.11" S	73° 3' 26.1" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2013	quir	---
Talcahuano	36° 42' 3.36" S	73° 6' 21.57" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	talc	---
Coronel	37° 1' 42.9" S	73° 9' 6.22" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2012	crnl	---
Lebu	37° 35' 38.72" S	73° 39' 50.8" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2010	lebu	---
Nehuentue	38° 44' 59.73" S	73° 24' 29.18" W	GPRS/ GOES	Pressure / Pressure	1 / 1 [min]	0.5 / 0.5 [s]	5 / 5 [min]	2017	ntue	---
Queule	39° 23' 51.42" S	73° 12' 54.19" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2013	quel	---
Corral	39° 53' 11.78" S	73° 25' 38.92" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	corr	---
Bahía Mansa	40° 34' 51.39" S	73° 44' 13.33" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2011	bmsa	---
Puerto Montt	41° 29' 5.75" S	72° 57' 39.09" W	GPRS/ GOES	Radar / Radar	1 / 1 [min]	0.25 / 0.25 [s]	15 / 5 [min]	1999	pmon	178
Ancud	41° 52' 2.55"S	73° 49' 58.37" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	ancu	---
Castro	42° 28' 51.23" S	73° 45' 29.46" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	10 / 5 [min]	2011	cstr	---
Puerto Melinka	43° 53' 54.3" S	73° 44' 53.61" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2011	pmel	---
Puerto Chacabuco	45° 28' 1.5" S	72° 49' 12.15" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2001	pcha	---

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Puerto Aguirre	45° 9' 52.42" S	73° 31' 15.92" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2021	pagi	---
Puerto Edén	49° 7' 47.23" S	74° 24' 31.1" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2011	pedn	---
Bahía Gregorio	52° 38' 53" S	70° 12' 33" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	2014	greg	---
Caleta Meteoro	52° 57' 39.67" S	74° 4' 19.76" W	GOES/ BGAN	Pressure / Pressure	1 / 1 [min]	0.5 / 0.5 [s]	15 / 1 [min]	2011	cmet	---
Punta Arenas	53° 7' 25.39" S	70° 51' 43.18" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 15 [min]	2001	ptar	---
Puerto Williams	54° 55' 58.35" S	67° 36' 29.58" W	GPRS/ GOES	Pressure / Radar	1 / 1 [min]	0.5 / 0.25 [s]	5 / 5 [min]	1999	pwil	---
Base Prat	62° 28' 45.65" S	59° 39' 43.29" W	GOES/ BGAN	Pressure / Pressure	1 / 1 [min]	0.5 / 0.5 [s]	5 / 1 [min]	2013	prat3	**189**
Base O'Higgins	63° 19' 13.13" S	57° 53' 55.43" W	GOES/ BGAN	Pressure / Pressure	1 / 1 [min]	0.5 / 0.5 [s]	5 / 1 [min]	2020	ohig3	---

Status of GLOSS Stations in Chile

The seven Chilean stations that have been considered in the GLOSS core network are as follows:

GLOSS ID.	Location	Status
137	I. de Pascua Lat : 27º 09' S Lon: 109º 27' W	• Field Unit : VAISALA MAWS110 • Sea Level Sensors : - Differential Pressure Transducer DRUCK PTX1830 - Radar model VEGAPULSE62 • Record Spans : 1970 – 2021 • Gaps : 1980 ; 1982 ; 1983 • Monthtly Height Data-up to 2021, has been sent to PSMSL • Hourly Height Data up to 2021, has been sent to UHSLC
174	Antofagasta Lat : 23º 39' S Lon: 70º 24' W	• Field Unit : VAISALA MAWS110 • Sea Level Sensors : - Differential Pressure Transducer DRUCK PTX1830 - Radar model VEGAPULSE62 • Record Spans : 1970 – 2021 • Gaps : / • Monthtly Height Data up to 2021, has been sent to PSMSL • Hourly Height Data up to 2021, has been sent to UHSLC
175	Valparaíso Lat : 33º 02' S Lon: 71º 37' W	• Field Unit : VAISALA MAWS110 • Sea Level Sensors : - Differential Pressure Transducer DRUCK PTX1830 - Radar model VEGAPULSE62 • Record Spans : 1944 – 2021 • Gaps : 1971 - 1981 • Monthtly Height Data up to 2021, has been sent to PSMSL • Hourly Height Data up to 2021, has been sent to UHSLC
176	Arch.J.Fernández Lat : 33º 37' S Lon: 78º 50' W	• Field Unit : VAISALA MAWS110 • Sea Level Sensors : - Differential Pressure Transducer DRUCK PTX1830 - Radar model VEGAPULSE62 • Record Spans : 1985 – 2021 • Gaps : / • Monthtly Height Data up to 2021, has been sent to PSMSL • Hourly Height Data up to 2021, has been sent to UHSLC
177	I. San Félix Lat : 26º 17' S Lon: 80º 07' W	• Field Unit : VAISALA MAWS110 • Sea Level Sensors : - Differential Pressure Transducer DRUCK PTX1830 - Radar model VEGAPULSE62 • Record Spans : 1989 – 2021 • Gaps : / • Monthtly Height Data up to 2021, has been sent to PSMSL • Hourly Height Data up to 2021, has been sent to UHSLC

GLOSS ID.	Location	Status
178	P.Montt Lat : 41º 29' S Lon: 72º 58' W	• Field Unit : VAISALA MAWS110 • Sea Level Sensors : Radar (2) model VEGAPULSE62 • Record Spans : 1945 – 2021 • Gaps : / • Monthtly Height Data up to 2021, has been sent to PSMSL • Hourly Height Data up to 2021, has been sent to UHSLC
189	P. Soberanía (Base Prat) Lat : 62º 29' S Lon: 59º 38' W	• Field Unit : VAISALA MAWS110 • Sea Level Sensors : Differential Pressure Transducer (2) DRUCK PTX1830 • Record Spans : 1984 – 2021 • Gaps : 2004 – 2008 • Station closed in January 2004 and reactivated in January 2009. • Monthtly Height Data up to 2021, has been sent to PSMSL • Hourly Height Data up to 2021, has been sent to UHSLC

Data Streams

Chile contributes to GLOSS through SHOA, maintaining an adequate data streams to GLOSS archiving Centres.

We have delivered to Permanent Service for Mean Sea Level (PSMSL), the following monthly mean sea level data for some specific locations along the Chilean coast:

Location	Record
Arica	1992 – 2021
Iquique	1984 – 2021
Caldera	1992 – 2021
Talcahuano	1992 – 2021
Corral	1984 – 2021
Ancud	1999 – 2021
Puerto Melinka	2011 – 2021
Punta Arenas	1988 – 2021
Puerto Williams	1971 – 2021

Additionally, oceanographic data and related information obtained by various oceanographic research institutions in Chile are archived at SHOA in the National Hydrographic and Oceanographic Center (CENDHOC). Monthly mean sea level data for the all sea level network are available at the website: **http://bit.ly/UCRiSo .**

Monitoring Tsunamis

In the last two years, there have been two transoceanic tsunamis that have been recorded by the Chilean sea level stations, the tsunami product of the 8.1 Mw earthquake of March 4, 2021 in the Kermadec-Tonga subduction zone, and the tsunami product of the volcano eruption Tonga-Hunga Ha'apai that occurred on January 15, 2022 in Tonga.

Product of that last unprecedented event, SHOA with the support of the Intergovernmental Oceanographic Commission of Unesco (UNESCO/IOC) and the Flanders Marine Institute (VLIZ) hosted the workshop "Shared Access to Data on Continuous Observation of Sea Levels: Tool for Effective Regional Response to Tsunami Emergencies", took place at SHOA in September 2022.. The training brought together the representatives of the National Tsunami Warning Centers of Chile, Colombia, Ecuador and Peru who participate in the Pacific Tsunami Warning Center (PTWC). The aim of the workshop was to enhance the capabilities of the countries of the South Pacific to share in real time the data from their Sea Level stations as a practical tool for risk management and warning in the event of a Tsunami threat. This workshop strengthens international cooperation in emergency situations under the Intergovernmental Coordination Group of the Pacific Tsunami Warning and Mitigation System (ICG PTWS), and serves as an example for continued cooperation on Tsunami warning in other regions.
(http://ioc-tsunami.org/index.php?option=com_content&view=article&id=524)

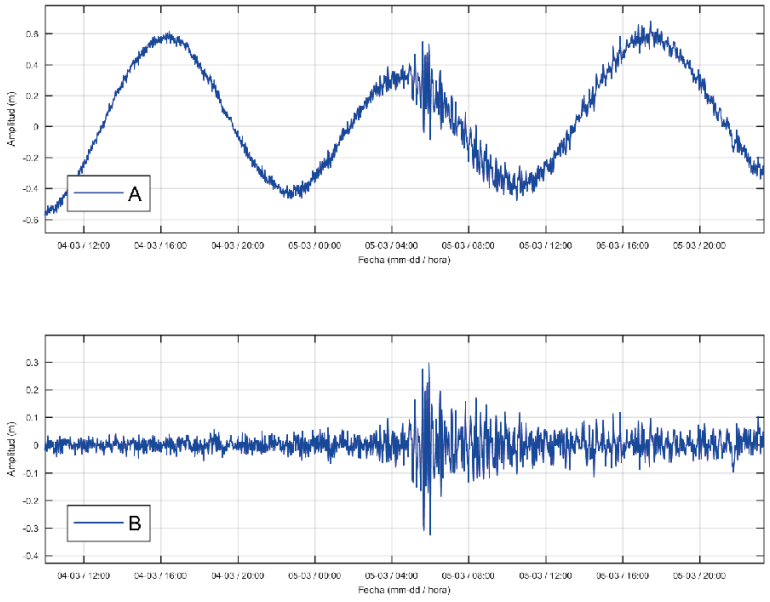

Figure 2 : top) Sea Level and bottom) Tsunami amplitude, recorded on March 5, 2021 at the Bahía Mansa station.

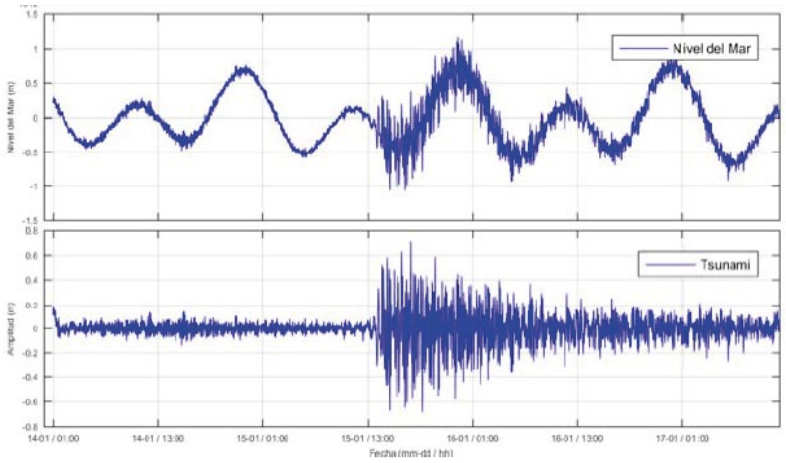

Figure 3 : top) Sea Level and bottom) Tsunami amplitude, recorded on January 15, 2022 at the Bahía Mansa station.

Future Plans

During the first term of 2023, SHOA has planned the installation of one new stations with real time telemetry in Puerto Natales (Lat: 51º 43’ 45”S ; Long: 72º 30’ 57”W).

Additionally, from the second term of 2023, the gradual updating of all the collector platforms will begin, from VAISALA MAWS 110 to MAWS 310.