

## National Report of Peru to the XVIII<sup>th</sup> GLOSS Group of Experts 11 to 14 March 2025 Peruvian Sea Level Network: Current State

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The Directorate of Hydrography and Navigation, as the governing body of Oceanography in Peru and responsible for the National and Regional Tsunami Warning Center, has as one of its main activities the measurement and monitoring of sea levels and for this purpose it maintains and operates a network of tide gauge stations installed along the Peruvian coast.

The study of sea level is an exclusive activity carried out by this Directorate, which is the official and technical authority responsible for the installation and maintenance of the network of tide gauges on the Peruvian coast. It is also responsible for the processing and analysis of data for multiple operational and scientific applications, as well as for its archiving and dissemination.

Sea level measurements in Peru date back to the years 1942 to 1985, and in mid-2010 the automation and modernization of the national tide gauge network was achieved, continuing the historical series of these stations.

Currently, the national tide gauge network has 23 automatic continuous recording stations, of which 21 are located along the coast and 2 are on islands (Figure 1, Table 1).

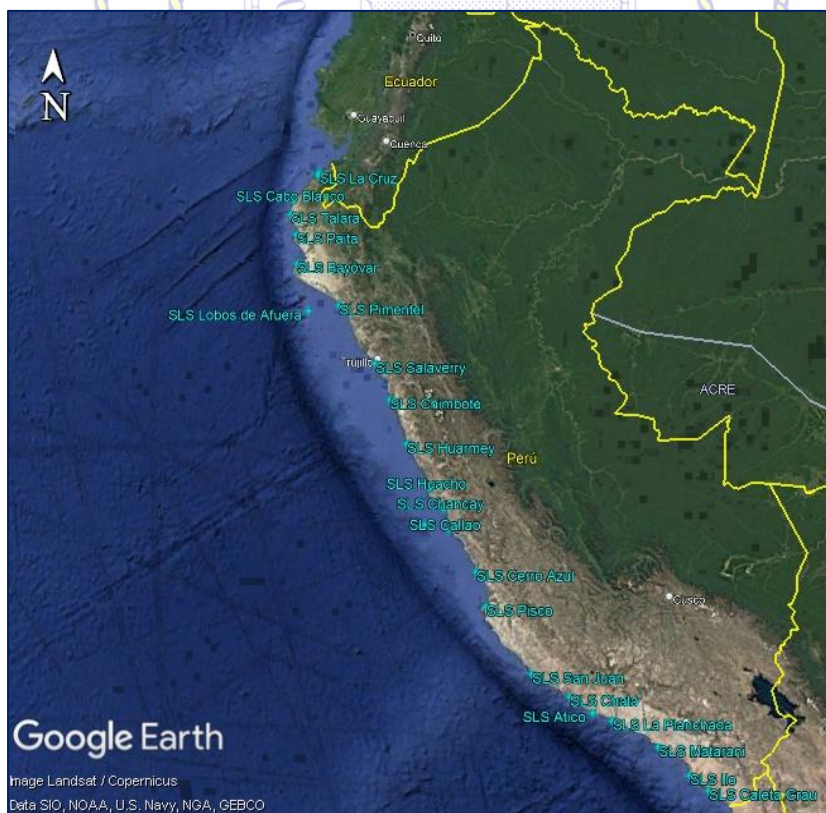


Figure 1. Peruvian Sea Level Network.



Station	Latitude S	Longitude W	Creation date	Sensor type	Register interval	Transmit interval	Telemetry	Code
La Cruz	03°38'01"	080°35'15"	2015	Acoustic echo sounder	1 minute	5 minute	GPRS	lacr
Cabo Blanco	04°14'55"	081°13'51"	2024	Radar	1 minute	5-10 minutes	GPRS/INMARSAT	---
Talara	04°34'30"	081°16'57"	1942	Radar/pressure	1 minute	5-10 minutes	GPRS/INMARSAT/GOES	tala/UHSLC 092/PSMSL 2186/PSMSL 475/1194PE
Paita	05°05'01"	081°06'27"	1981	Pressure	1 minute	5-10 minutes	GPRS/INMARSAT/GOES	paita/UHSLC 678/PSMSL 1539/PSMSL 1737/1195PE
Bayóvar	05°47'38"	081°03'16"	2015	Acoustic echo sounder	1 minute	5 minute	GPRS	bayo
Pimentel	06°50'17"	079°56'26"	2024	Radar	1 minute	5-10 minutes	GPRS/INMARSAT	---
Lobos de Afuera	06°56'12"	080°43'29"	1982	Radar	1 minute	5-10 minutes	INMARSAT/GOES	lobos/UHSLC 084/2986 PE
Salaverry	08°13'40"	078°58'54"	2010	Radar/pressure	1 minute	5-10 minutes	GPRS/GOES	salav/UHSLC 685/1196 PE
Chimbote	09°04'34"	078°36'45"	1955	Radar/pressure	1 minute	5-10 minutes	GPRS/INMARSAT/GOES	chimb/UHSLC 095/1197 PE
Huarmey	10°05'57"	078°10'54"	2015	Acoustic echo sounder	1 minute	5 minute	GPRS	Huarm
Huacho	11°07'18"	077°36'58"	2015	Acoustic echo sounder	1 minute	5 minute	GPRS	Huach
Chancay	11°35'05"	077°16'23"	2024	Radar/pressure	1 minute	5-10 minutes	GPRS/GOES	---
Hormigas de Afuera	11°57'24"	077°44'01"	2020	Pressure	1 minute	5-10 minutes	GOES	lsHor
Callao	12°04'08"	077°10'00"	1942	Radar/pressure/float	1 minute	5-10 minutes	GPRS/INMARSAT/GOES	call/GLOSS 173/UHSLC 093/PSMSL:1274, 480, 629, 739/1198 PE
Cerro Azul	13°01'33"	076°29'07"	2015	Acoustic echo sounder	1 minute	5 minute	GPRS	cazul
Pisco	13°49'10"	076°15'07"	1985	Radar/pressure	1 minute	5-10 minutes	GPRS/GOES	pisco/UHSLC 683/1199 PE
San Juan	15°21'19"	075°09'37"	1958	Radar/pressure	1 minute	5-10 minutes	GPRS/INMARSAT/GOES	sjuan/UHSLC 096/1200 PE
Chala	15°51'58"	074°14'53"	2012	Radar	1 minute	5 minute	GPRS	chala/2985 PE
Atico	16°13'52"	073°41'39"	2015	Acoustic echo sounder	1 minute	5 minute	GPRS	atic/UHSLC 097
La Planchada	16°24'17"	073°13'15"	2015	Radar	1 minute	5 minute	GPRS/INMARSAT	---
Matarani	17°00'03"	072°06'31"	1942	Radar/pressure/float	1 minute	5-10 minutes	GPRS/INMARSAT/GOES	mata/UHSLC 094/PSMSL: 2188, 458/1201 PE
Ilo	17°38'41"	071°20'58"	2010	Radar/pressure	1 minute	5-10 minutes	INMARSAT/GOES	ilom/1202 PE
Caleta Grau	17°59'36"	070°53'03"	2015	Acoustic echo sounder	1 minute	5 minute	GPRS	pgrau

Table 1. Main information from sea level data collection platforms with real time transmission system.

Each station has one or two measuring instruments, which can be radar, acoustic echo sounder and pressure type, which perform continuous measurements averaged per minute, and are received in almost real time, at the facilities of the Hydrography Directorate, through a double transmission system: every 10 minutes via GPRS cellular network, which is how it is commonly done, and every 1 to 5 minutes via the INMARSAT and GOES satellite, which is activated in case of a tsunami.

Likewise, a single data management and visualization system is currently being implemented and strengthened, through the Polaris platform, which allows information to be managed in almost real time from the facilities of the Hydrography Directorate.

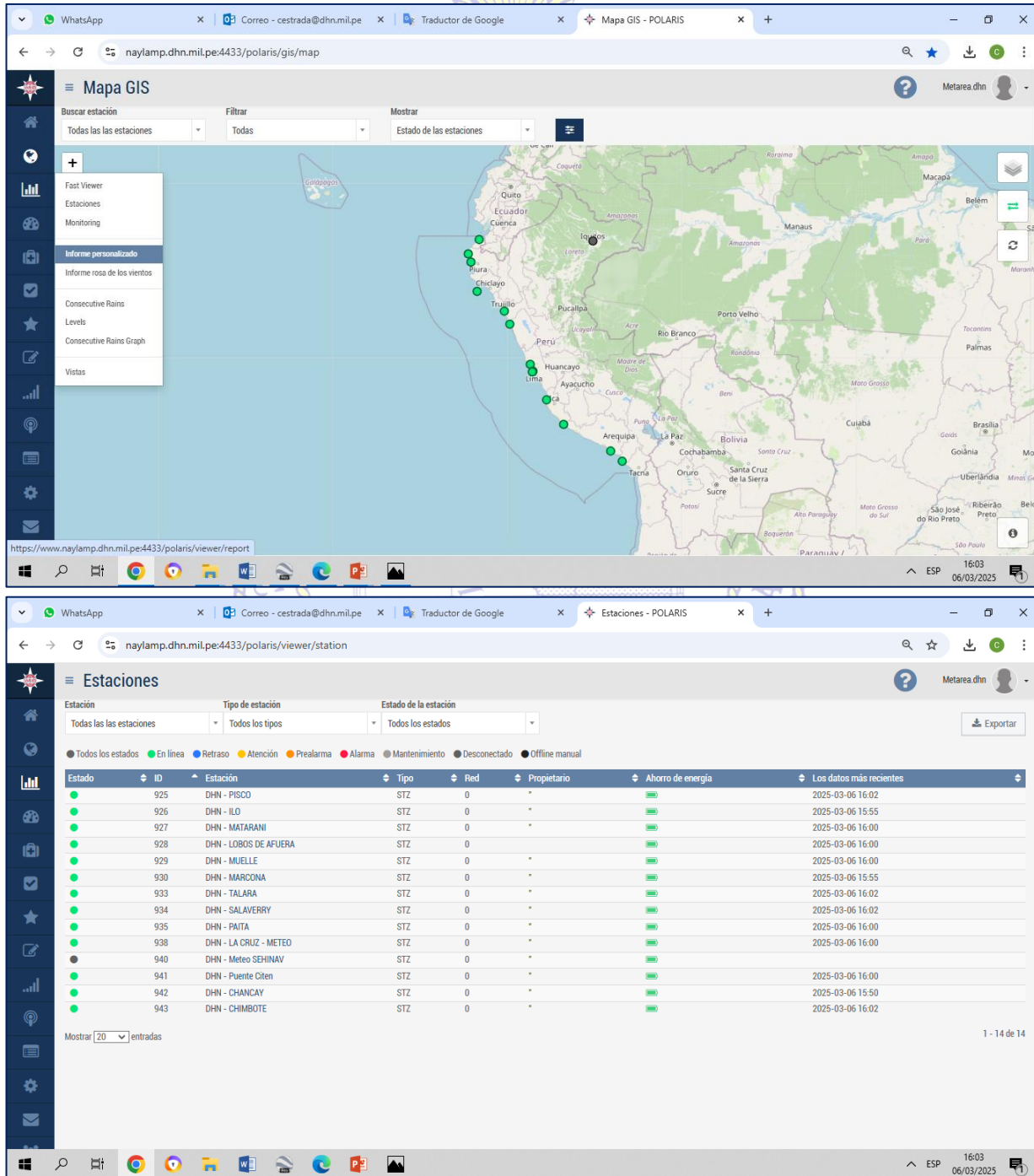


Figure 2. "Polaris" data management and visualization platform.



Station updates and monitoring of sea level records allow for the provision of data for both operational and maritime purposes, as well as for use in research, such as monitoring and preventing recurrent El Niño and La Niña events, the study of sea level rise associated with climate change ("Evidence of sea level rise on the Peruvian coast (1942-2019)" article published in the international scientific research journal Science of the Total Environment), in the detection and monitoring of tsunamis, and in the forecasting of flooding due to anomalous waves, among others.

Table 2 shows the availability of sea level information for Peru, which has been displayed on six web platforms:

Location	Website	Station
IOC Sea Level Monitoring Service (VLIZ)	<a href="https://www.ioc-sealevelmonitoring.org/map.php">https://www.ioc-sealevelmonitoring.org/map.php</a>	La Cruz, Talara, Paita, Bayóvar, Lobos de Afuera, Salaverry, Chimbote, Huarmey, Huacho, Callao, Cerro Azul, Pisco, San Juan, Chala, Atico, Matarani, Ilo, Caleta Grau
Global Sea Level Observing System	<a href="https://psmsl.org/products/gloss/glossmap.html">https://psmsl.org/products/gloss/glossmap.html</a>	Callao
British Oceanographic Data Centre	<a href="https://www.bodc.ac.uk/data/hosted_data_systems/sea_level/international/south_pacific">https://www.bodc.ac.uk/data/hosted_data_systems/sea_level/international/south_pacific</a>	Lobos de Afuera, Callao
University of Hawaii Sea Level Center	<a href="https://uhslc.soest.hawaii.edu/network/">https://uhslc.soest.hawaii.edu/network/</a>	Talara, Paita, Lobos, Chimbote, Callao, Pisco, San Juan, Matarani
GOOS Regional Alliance for the South Pacific (Oceanographic and Antarctic Institute of the Ecuadorian Navy)	<a href="https://coos.inocar.mil.ec/visores/red_mareografica/">https://coos.inocar.mil.ec/visores/red_mareografica/</a>	Talara, Paita, Lobos, Chimbote, Callao, Pisco, San Juan, Matarani
Directorate of Hydrography and Navigation	<a href="https://www.naylamp.dhn.mil.pe/dhn/est_mareograficas/">https://www.naylamp.dhn.mil.pe/dhn/est_mareograficas/</a> <a href="https://www.naylamp.dhn.mil.pe:4433/polaris/dashboard">https://www.naylamp.dhn.mil.pe:4433/polaris/dashboard</a>	La Cruz, Cabo Blanco, Talara, Paita, Bayóvar, Pimentel, Lobos de Afuera, Salaverry, Chimbote, Huarmey, Huacho, Chancay, Callao, Cerro Azul, Pisco, San Juan, Chala, Atico, La Planchada, Matarani, Ilo, Caleta Grau

Table 2. Sea level information on web platforms.

### Status of GLOSS Station in Perú

This Directorate participates in the GLOSS program only with the Callao tide gauge station, whose data are sent automatically; however, the incorporation of the National Tide Gauge Network to the GLOSS Network is desired, since we currently have modern stations available for regional integration.

GLOSS ID	Location	Status
173	<p><b>Callao</b></p> <p>12°04'08" S 077°10'00" W</p> 	<p>Operated by: Directorate of Hydrography and Navigation</p> <p>First observation: 1942</p> <p>Last observation: ongoing</p> <p>Sensor: Radar Vega Puls62, Geónica datalogger model Datamar 2000C Radar, pressure, float SUTRON</p> <p>Data transmission: 5-10 minutes, GOES/GPRS</p> <p>GNSS: GNSS station since 2012</p> <p>Comment: hourly height data up to 2023 has been sent to UHSLC/NOAA</p> <p>Contact: <a href="mailto:evarea@dhn.mil.pe">evarea@dhn.mil.pe</a>; <a href="mailto:cestrada@dhn.mil.pe">cestrada@dhn.mil.pe</a></p>



### GLOSS requirements & the Peruvian stations

Station	Type	Digital	Precision	Control	Meteo	Last observation	GNSS	Real-time
La Cruz	Acoustic echo sounder	Yes	+/- 3 mm	Semestrial	---	06/01/2025	Yes	GPRS
Cabo Blanco	Radar	Yes	+/- 2 mm	Semestrial	---	---	No	GPRS/INMARSAT
Talara	Radar/pressure	Yes	≤ 2 mm	Semestrial	Temperature, humidity, pressure, precipitation, wind direction and speed	Ongoing	Yes	GPRS/INMARSAT/GOES
Paíta	Pressure	Yes	≤ 2 mm	Semestrial	Temperature, humidity, pressure, precipitation, wind direction and speed	Ongoing	Yes	GPRS/INMARSAT/GOES
Bayóvar	Acoustic echo sounder	Yes	+/- 3 mm	Semestrial	---	19/11/2024	Yes	GPRS
Pimentel	Radar	Yes	+/- 2 mm	Semestrial	---	---	No	GPRS/INMARSAT
Lobos de Afuera	Radar	Yes	≤ 2 mm	Semestrial	---	01/09/2024	No	INMARSAT/GOES
Salaverry	Radar/pressure	Yes	≤ 2 mm	Semestrial	Temperature, humidity, pressure, precipitation, wind direction and speed	16/05/2024	Yes	GPRS/GOES
Chimbote	Radar/pressure	Yes	≤ 2 mm	Semestrial	Temperature, humidity, pressure, precipitation, wind direction and speed	04/11/2024	Yes	GPRS/INMARSAT/GOES
Huarmey	Acoustic echo sounder	Yes	+/- 3 mm	Semestrial	---	01/03/2024	Yes	GPRS
Huacho	Acoustic echo sounder	Yes	+/- 3 mm	Semestrial	---	30/08/2023	Yes	GPRS
Chancay	Radar/pressure	Yes	≤ 2 mm	Semestrial	Temperature, humidity, pressure, precipitation, wind direction and speed	---	No	GPRS/GOES
Hormigas de Afuera	Pressure	Yes	+/- 2 mm	>Annual	---	---	No	GOES
Callao	Radar/pressure/float	Yes	+/- 2 mm	Semestrial	---	Ongoing	Yes	GPRS/INMARSAT/GOES
Cerro Azul	Acoustic echo sounder	Yes	+/- 3 mm	Semestrial	---	01/03/2025	Yes	GPRS
Pisco	Radar/pressure	Yes	≤ 2 mm	Semestrial	Temperature, humidity, pressure, precipitation, wind direction and speed	02/02/2025	Yes	GPRS/GOES
San Juan	Radar/pressure	Yes	≤ 2 mm	Semestrial	Temperature, humidity, pressure, precipitation, wind direction and speed	08/10/2024	Yes	GPRS/INMARSAT/GOES
Chala	Radar	Yes	+/- 2 mm	Semestrial	---	Ongoing	No	GPRS
Atico	Acoustic echo sounder	Yes	+/- 3 mm	Semestrial	---	01/03/2025	Yes	GPRS
La Planchada	Radar	Yes	+/- 2 mm	Semestrial	---	---	No	GPRS/INMARSAT
Matarani	Radar/pressure/float	Yes	≤ 2 mm	Semestrial	Temperature, humidity, pressure, precipitation, wind direction and speed	Ongoing	Yes	GPRS/INMARSAT/GOES
Ilo	Radar/pressure	Yes	≤ 2 mm	Semestrial	Temperature, humidity, pressure, precipitation, wind direction and speed	14/01/2025	Yes	INMARSAT/GOES
Caleta Grau	Acoustic echo sounder	Yes	+/- 3 mm	Semestrial	---	01/03/2025	Yes	GPRS

Table 3. Stations status regarding the GLOSS requirements for core stations (IOC 2012).



## Monitoring Tsunamis

In relation to the use of the sea level measurement network for tsunami detection and warning, in recent years we have been actively participating in:

- Provide training to operators of the National Tsunami Warning Center (CNAT) for the correct interpretation of tide records related to tsunami monitoring and confirmation.
- The update of the CNAT Operating Protocol with the detailed specification of the Conventional Method that comes from the manuals and specifications of the International Tsunami Information Center (ITIC) and the Tsunami publications of the Intergovernmental Oceanographic Commission (IOC/UNESCO), which have been carried out over the years in post-tsunami reports, and which is important for the activation and cancellation of the alert.
- The development of an application to filter tsunami waves in real time at the request of the CNAT.
- Workshops and training programs (September 2022 and August 2024), promoted by the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG PTWS) and the International Tsunami Information Center (ITIC).

## Future Plans

The Hydrography Directorate plans to carry out the following activities in the medium term:

- Complete the implementation of the "Polaris" visual platform for the management and administration of ocean meteorological information, which includes all sea level measurement sensors.
- Acquisition of twelve radar and pressure sea level measurement sensors, with 5G telephone transmission for their replacement, compatible with the existing visualization platform.
- Acquisition and installation of three tide gauge stations in El Salto, Pucusana and Caleta Quilca, with radar and pressure sensors, with 5G telephone transmission, compatible with the existing visualization platform, thus covering the entire Peruvian coast.
- Maintenance and improvement of the Hormigas de Afuera station transmission system, essential for reducing response and evacuation time in the event of a tsunami. Also, manage a cooperation agreement that allows financing the transfer costs for the maintenance of the station on this difficult-to-access island.
- Comply with the technical specifications on the operation and functioning of the National Tide Networks, and thus, guarantee the reliability of the information for use in the different disciplines of global ocean and climate research.
- Make available the information from its GNSS (Global Navigation Satellite System) receivers of the tide network that could be derived to the database of the Coastal Water Level Observation System (SONEL) for the calibration of satellite altimeters, as part of the global provision of data.
- Incorporation of the National Tide Network to the GLOSS Network and to the different sea level databases. Updating of the Web services that allow the continued visualization of sea level information from the operating Peruvian stations.