



INSTITUTO HIDROGRÁFICO

<http://www.hidrografico.pt/>

2022

PORTUGAL

National Report

This report describes the main technical activities and developments at Instituto Hidrográfico (IHPT), the Portuguese Hydrographic Office, during the period from September 2021 to September 2022. It is to be presented at the 17th EAthC Meeting in accordance with IHO Resolution 2/1997 as amended.



17th MEETING OF THE EASTERN ATLANTIC HYDROGRAPHIC COMMISSION (EatHC)

Plenary meeting 28th to 30th September 2022



TABLE OF CONTENTS

1-	HYDROGRAPHIC OFFICE.....	1
2-	SURVEYS	2
3-	NEW CHARTS & UPDATES	7
4-	NEW PUBLICATIONS AND UPDATES	12
5-	MARITIME SAFETY INFORMATION	13
6-	C-55	16
7-	CAPACITY BUILDING	16
8-	OCEANOGRAPHIC ACTIVITIES.....	17
9-	SPATIAL DATA INFRASTRUCTURES	21
10-	INNOVATION.....	26
11-	OTHER ACTIVITIES	28
12-	FINAL REMARKS	34

References:

- IHO Resolution 2/1997 as amended.
- Decision No.9 of A-2, 2020.

1- HYDROGRAPHIC OFFICE

Established in 1960, Instituto Hidrográfico (IHPT) is both an organization within the Portuguese Navy and a national marine research laboratory. It is the national hydrographic service, provides environmental support to naval operations and does research and development activities in physical and chemical oceanography, marine geology, hydrography, safety of navigation and marine data management.

IHPT is focused on the ocean observation, mapping its several scientific dimensions and predicting its behavior in the short, medium and long term. It is committed to open data policies and sharing its capabilities with the society to faster research, development and knowledge of the ocean.

The main objectives of IHPT activities are the safety of navigation, the environmental monitoring and the protection of the marine environment. It is permanently involved in several R&D projects, which ultimately contribute to the climate change analysis and the development of the blue economy. It has established a Quality Management System recognized by an independent, credible and competent external entity, according to the normative reference (NP EN ISO 9001). The Quality Policy includes a commitment to meeting regulatory requirements and continually improving to meet customer needs.

Among these activities, the training provided by the Hydrography and Oceanography School stands out, with FIG/IHO/ICA category A and B courses. Its students are Navy officers and civilian technicians, from Portugal and Portuguese-speaking African countries, as well as from other friendly nations.

Detailed information to update IHO Publication P-5 has been submitted using the online system, by Commander João Paulo Delgado Vicente, Head of the Hydrographic Division (dt.hi.chf@hidrografico.pt).

In EAtHC region, IHPT is the Primary Cartographic Authority (PCA) in Cape Verde, Guinea-Bissau and S. Tomé and Príncipe.

2- SURVEYS

a) Coverage of new surveys

The main hydrographic program of IHPT, “SEAMAP 2030: Mapping of the Portuguese Sea” (<http://www.hidrografico.pt/iprojeto/16>) is in progress. This program, which is focused on high-resolution mapping of Portuguese waters of interest, will contribute to the conservation and sustainable use of the sea, supporting research, and promoting development. It is aligned with the SEABED 2030 project and the United Nations Decade of Ocean Science for Sustainable Development.

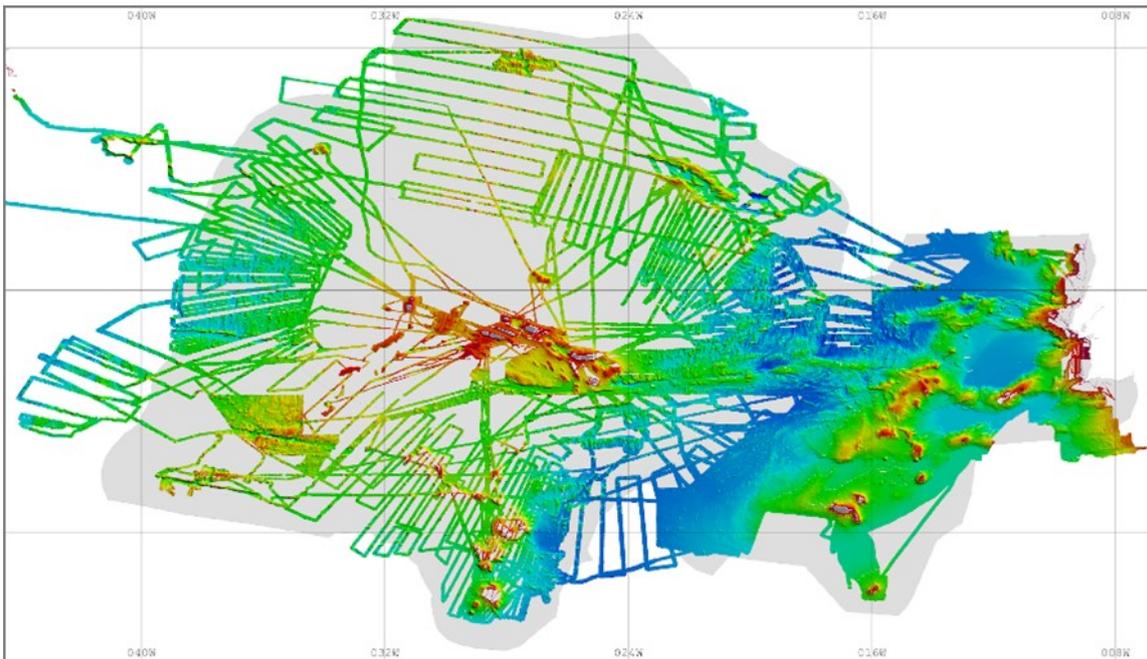


Figure 1 – SEAMAP 2030 actual coverage with multibeam surveys.

Considering this report’s period, Portugal has focused its surveys on the Portuguese maritime areas, updating existing charts and contributing to the goal of the long-term project SEAMAP 2030 (it is Portugal’s intention to have all Portuguese maritime areas under its sovereignty and jurisdiction surveyed with high resolution by 2030). Over this cycle, Portugal has executed 26 hydrographic surveys, including 10 harbors and port entrances, coastal and deep-sea area surveys and specific projects surveys. On the course of the period of this report, surveys were accomplished in continental Portugal, and Madeira and Azores archipelago areas. Despite the focus on Portuguese waters, hydrographic surveys were also made in Portuguese speaking African countries, namely Angola and Cape Verde (where Portugal has cartographic responsibilities, and specific agreements for cooperation).

With reference to harbor surveys, Portugal has spread its attention throughout the Portuguese coast, with Lisbon entrance, Setúbal entrance and harbor, Faro channel and bar, Sines harbor, Madeira (Funchal, Porto Santo and Caniçal harbors), Azores (Praia da Vitória and Angra do Heroísmo harbors).

Regarding other survey areas, including coastal and deep-sea surveys it is important to mention São Torpes area monitoring, Garajau area (Madeira) coastal survey, Azores (Terceira and Faial islands), Azores and Madeira seamounts surveys, with some areas having shared relevance both to the SEAMAP 2030 and specific surveying projects for biological, sovereignty and geological purposes.

Concerning specific projects, several areas are of broad importance as Sines harbor environmental and jetty monitoring, Viana do Castelo coast for submarine cable inspection or Azores seamounts for scientific purposes.

All surveys conducted on Portuguese waters are shown in Figure 2.

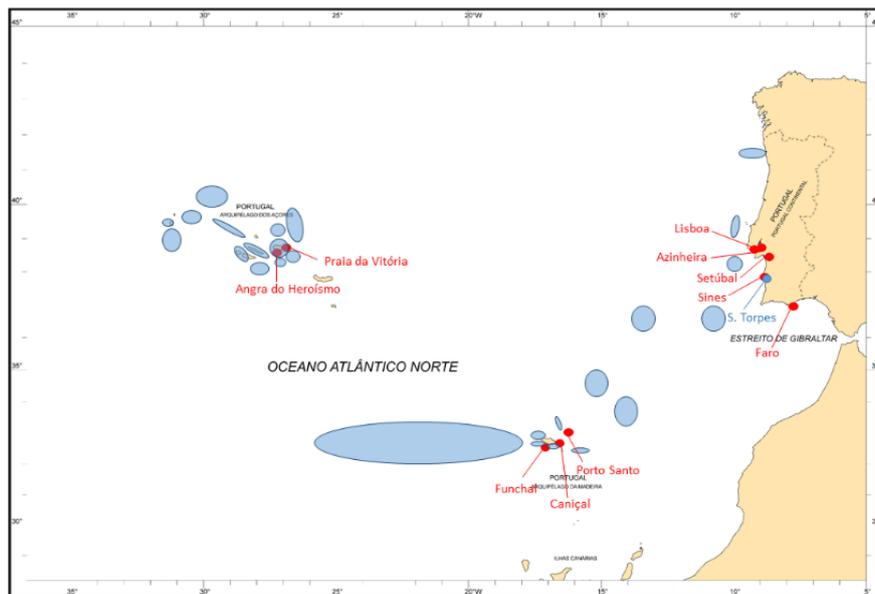


Figure 2 – Continental Portugal surveys

The use of Portuguese Navy survey ship “D. Carlos I” out of area, also allowed for hydrographic surveys in Africa in cooperation with Cape Verde and Angola. In Angola, Luanda harbor was surveyed, and in Cape Verde the channel between Santo Antão and São Vicente, as well as some areas along the coast of Boavista and Santiago Islands.

All considered, Portugal has made significant efforts conducting hydrographic surveys, both for cartographic purposes and for science purposes, endeavoring distinct objectives, such as adding new and updated cartography to existing folios, either in Portugal or in Africa’s Portuguese responsibility areas, or maintaining an updated hydrographic scenario on most dynamic harbors or coastal areas, and also augmenting the hydrographic awareness in the Portuguese waters, expanding the already significant surveyed area of the Portuguese sea.

The following images show some of the surveyed areas.

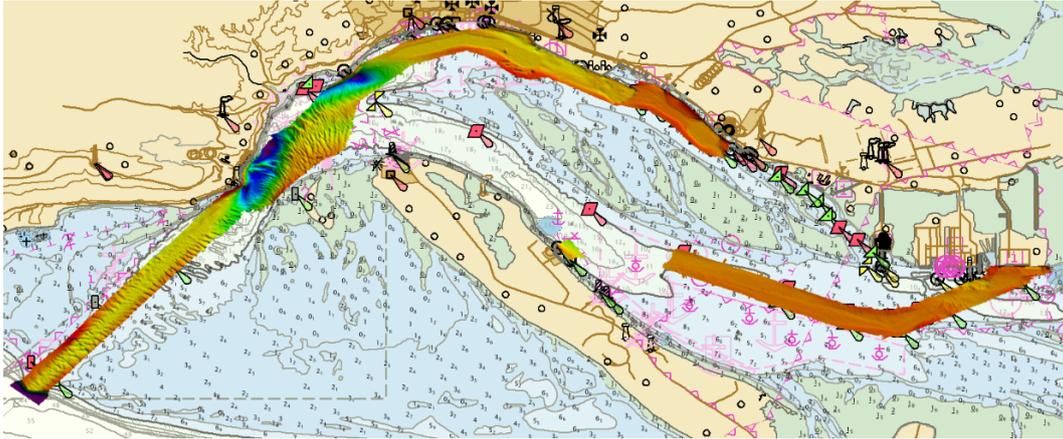


Figure 3 – Example of a survey for harbor depth monitoring (Setubal area).

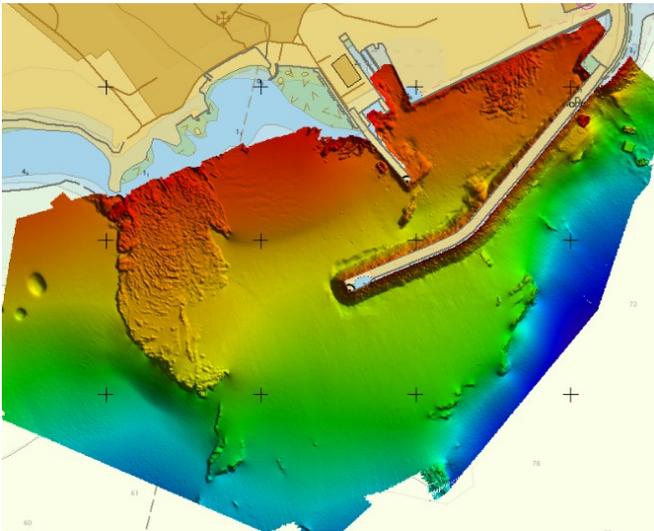


Figure 4 – Example of a survey for nautical chart update (Madeira area).

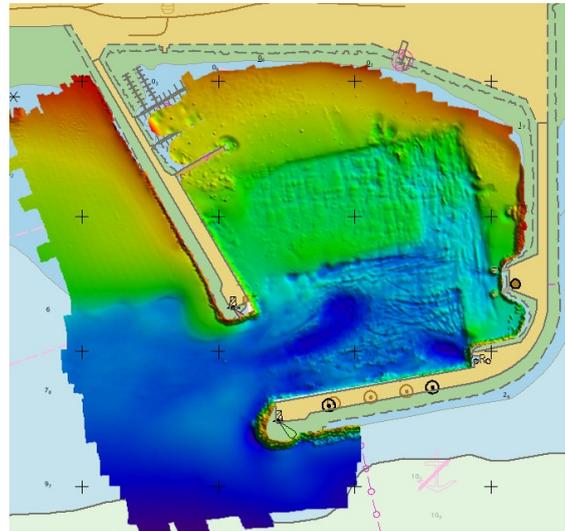


Figure 5 – Example of a survey for nautical chart update (Porto Santo area).

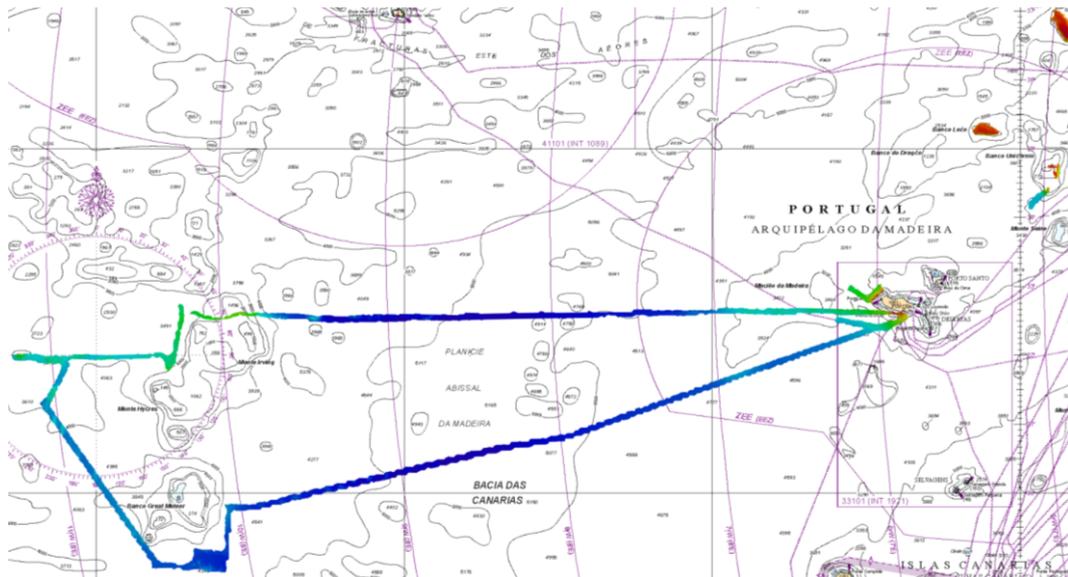


Figure 6 – Madeira surveyed areas.

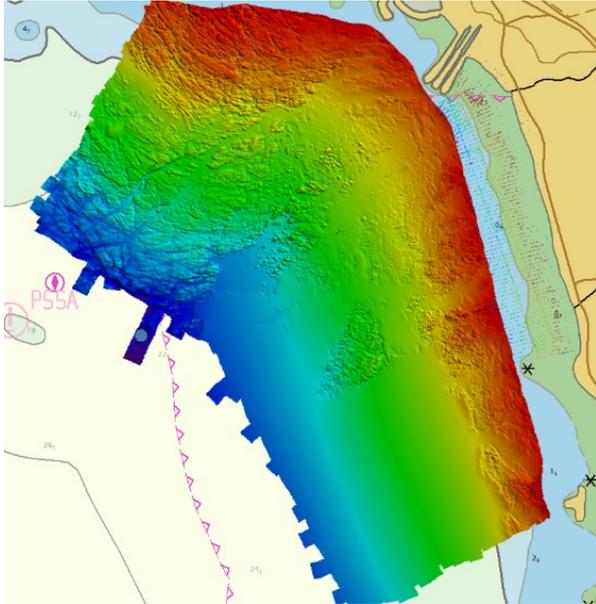


Figure 7 – Sines Survey for seafloor monitoring.

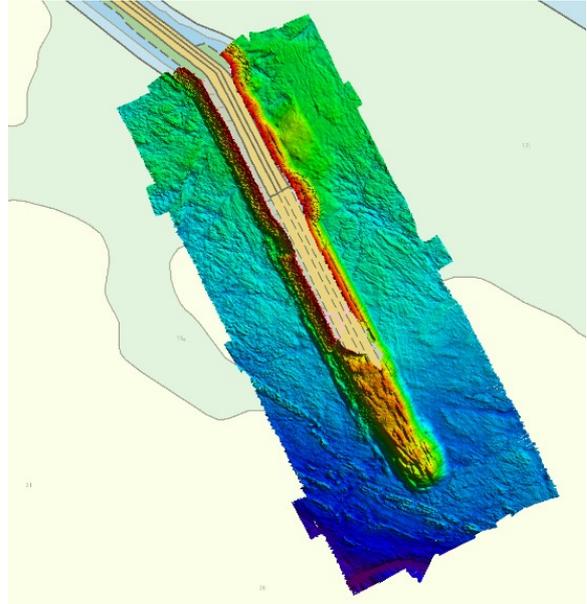


Figure 8 – Sines Survey for jetty monitoring.

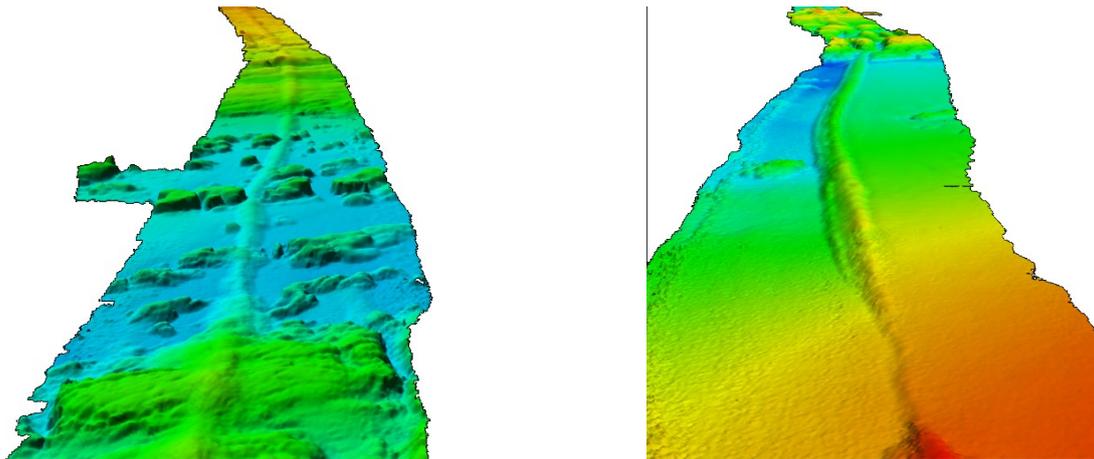


Figure 9 – Viana do Castelo Survey for submarine cable inspection.

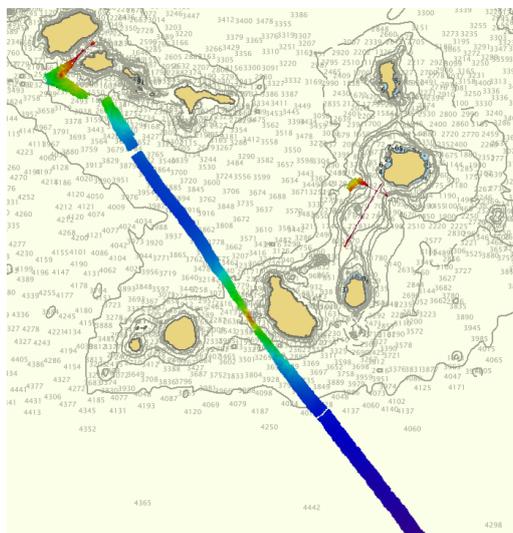


Figure 10 – Cape Verde survey

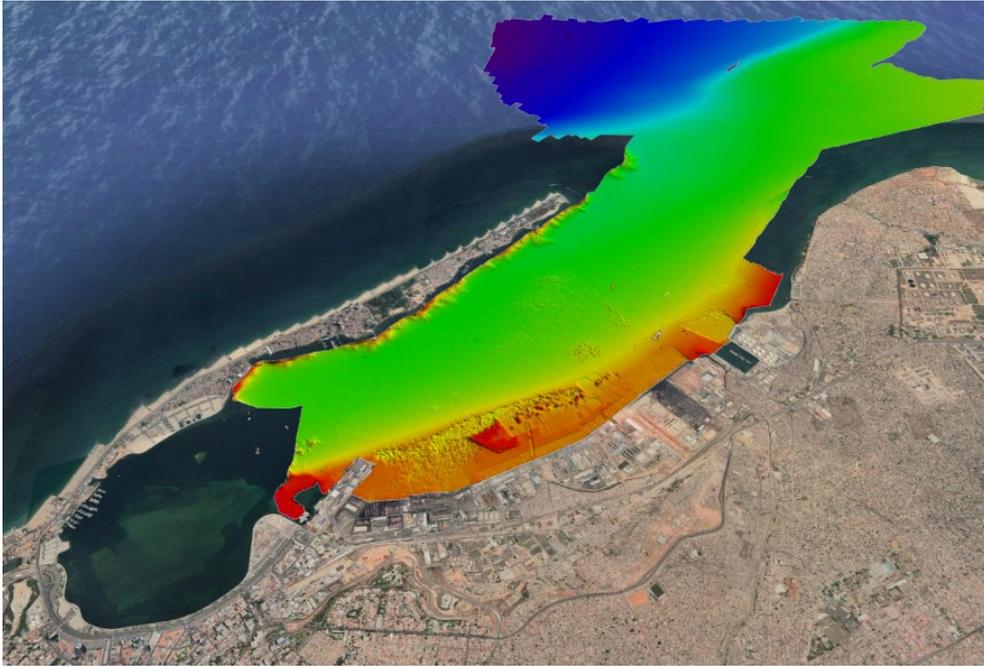


Figure 11 – Luanda harbor survey (Angola)

b) New technologies and /or equipment

On the technological line, Portugal is using top of the shelf acoustic systems for hydrographic surveys. New methodologies based on satellite imagery and low flying vehicles imagery are being used and currently being developed. Portugal is also using third party surveys data, the quality control of which has been made.

For the future, Portugal has the challenge of completing the SEAMAP 2030 and several demands such as focusing on more regular use of crowdsourced data, and the usage of bathymetry derived from remote imaging data for cartographic usage. A regular updated service of coastal bathymetry is also one objective for the coming years.

c) New ships

NTR.

d) Crowdsourced and satellite-derived bathymetry - national policy

NTR.

e) Challenges and achievements

Obtaining funding for new surveys off Cape Verde, Guinea-Bissau, S. Tomé and Príncipe and Angola, in conjunction with those countries, is considered the greatest challenge.

Together with the Angolan hydrographic service, IHPT conducted a hydrographic survey in Luanda harbor (Angola) and the acquired data was used to update to produce a new edition of the Luanda harbor nautical chart.

Portugal is also using bathymetric data acquired and shared from international Scientific Cruises.

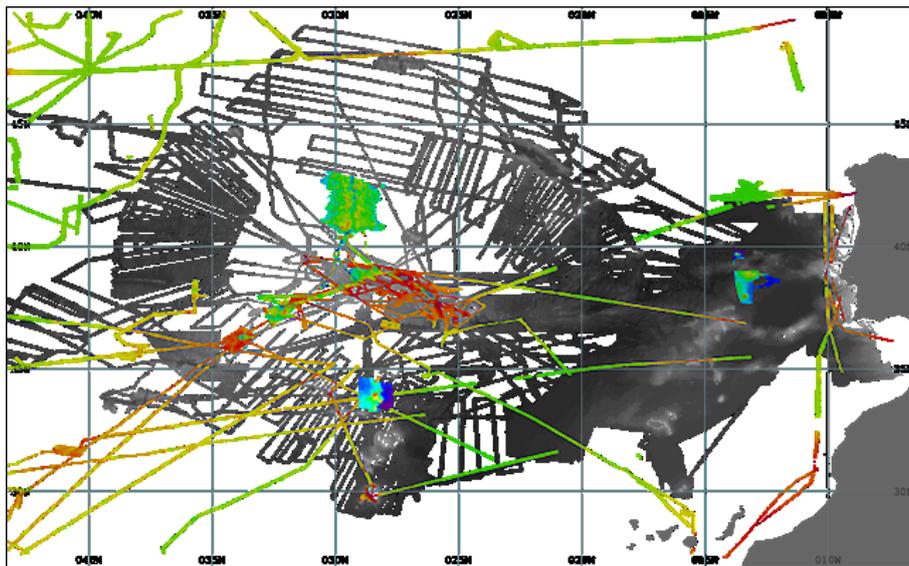


Figure 12 – Compilation of third parties’ sources contributions of bathymetric information (scientific cruises multibeam coverage), namely by NOAA, BSH, NIOZ, SHOM and IFREMER.

3- NEW CHARTS & UPDATES

All IHPT Electronic Navigational Charts (ENC) and updates are produced according to the S-57 standard. All new Nautical Charts (NC) and new editions are bilingual (Portuguese and English) and follow INT specifications, whether or not they belong to INT series. Presently, IHPT provides its Nautical Charts using a Print-on-Demand system. All charts are continuously updated according to the published “Notices to Mariners”.

a) ENC coverage, gaps and overlaps

The current PT ENC coverage for EAtHC region is shown in Figure 13. Each ENC is broadly equivalent to a paper chart, both in terms of its coverage area and its content. There are no gaps or overlaps to be reported.

The complete PT ENCs folio in G area comprises ninety-eight (98) cells, according to the navigational purposes shown in the following table:

	UB1	UB2	UB3	UB4	UB5	78	UB7	
	Overview	General	Coastal	Approach	Harbour		River	
Portugal	1	3	11	18	45		66	
Cabo Verde	0	2	1	2	12	17	0	
Guiné-Bissau	0	0	0	0	1	1	0	
São Tomé e Príncipe	0	0	0	1	1	2	0	
TOTAL	1	5	12	21	59	98	66*	152

*Free download: <https://www.hidrografico.pt/vn.douro> & <https://www.hidrografico.pt/cart.guadiana>

Since the last meeting, were produced one (1) new ENC cell and eighteen (18) new editions, depicted in Figure 13 and in the following table:

	UB1	UB2	UB3	UB4	UB5	
	Overview	General	Coastal	Approach	Harbour	
Oct2021-Dec2021	1	2	3	0	5	11
Jan2022-Sep2022	0	0	1	1	6	8
TOTAL	1	2	4	1	11	19
Sep2022-Dec2022	0	0	1*	1	7*	9

* One New ENC Cell/UB3 and UB5

A list of the nineteen (19) ENC cells (new cells in light blue on the table below) produced by IHPT during the report's period, is presented in the following table:

New Editions and New ENCs from OCT2021 to SEP2022			
Edition/Year	Number	Scale	Title
7/2021	PT111101	1 500 000	Portugal
4/2021	PT221101	700 000	Monte de S. Gian a Ayamonte
3/2021	PT241101	700 000	Arquipélago dos Açores
7/2021	PT324201	90 000	Vila Praia de Âncora ao Furadouro
6/2021	PT324204	90 000	Ericeira à Praia das Areias Brancas
4/2021	PT343103	180 000	Arquipélago dos Açores – Grupo Oriental
9/2021	PT526303	12 000	Barras do Porto de Lisboa e Baía de Cascais
6/2021	PT526306	12 000	Porto de Lisboa (Cais do Sodré a Sacavém)
3/2021	PT526309	12 000	Porto de Setúbal (Carraca à Ilha do Cavalo)
5/2021	PT526311	12 000	Barras e Portos de Faro e Olhão
3/2021	PT528507	8 000	Porto da Figueira da Foz
8/2022	PT324206	90 000	Ponta do Altar à Ilha Cristina
4/2022	PT426401	22 000	Aproximações a Caminha e Viana do Castelo
5/2022	PT526308	12 000	Barra e Porto de Setúbal
6/2022	PT526311	12 000	Barras e Portos de Faro e Olhão
1/2022	PT528409	8 000	Porto de Caminha
4/2022	PT528510	8 000	Porto de Peniche
2/2022	PT528516	12 000	Ponta da Piedade à Praia do Vau
3/2022	PT538504	8 000	Portos de Machico e Caniçal
1/2022**	PT363204	180 000	Cabo Verde – Ilhas Santiago, Brava, Fogo, Maio e Ilhéus
6/2022**	PT526308	12 000	Barra e Porto de Setúbal
4/2022**	PT526309	12 000	Porto de Setúbal (Da Carraca à Ilha do Cavalo)
5/2022**	PT446401	45 000	Arquipélago dos Açores – Ilha das Flores e Ilha do Corvo
4/2022**	PT548501	4 000	Ilha do Corvo – Porto da Casa
4/2022**	PT548502	8 000	Ilha das Flores – Porto de Santa Cruz das Flores
4/2022**	PT548503	4 000	Ilha das Flores – Porto das Lajes das Flores

** **Planned to be published until the end of 2022**

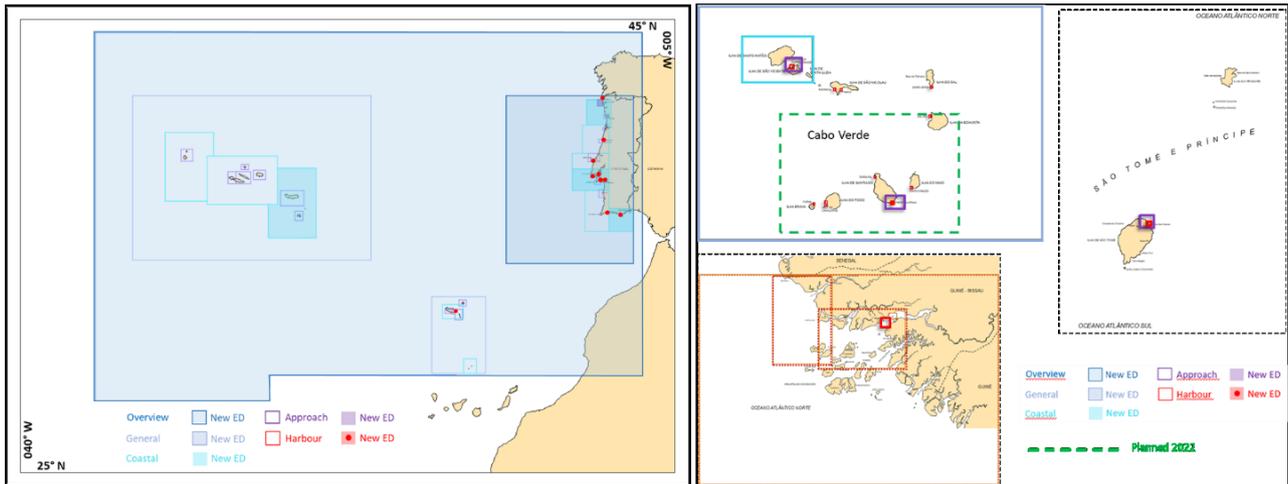


Figure 13 - PT ENC coverage for EAtHC region (Portugal and North African Portuguese Speaking Countries) and production

b) ENC_Distribution method

Portuguese ENCs are distributed through a RENC, the IC-ENC, of which IHPT is a member and participates in the respective work together with other Hydrographic Services, including in its Technical Experts Working Groups.

Presently, for EAtHC region, ninety-eight (98) PT ENC cells are available for distribution through the IC-ENC as shown in the tables and diagrams above.

Douro and Guadiana rivers cells (inland ENC) are available for free download on the IHPT portal.

c) RNC

NTR.

d) INT Charts

Since the last meeting, one (1) new edition has been produced, depicted in the following table:

New Editions and New INT charts from OCT2021 to SEP2022				
Edition/Year	Number		Scale	Title
	INT	National		
3/2022	1885	26311	15 000	Barra e Portos de Faro e Olhão

New editions under construction:

5/2022**	1880	26308	15 000	Barra e Porto de Setúbal
4/2022**	1881	26309	15 000	Porto de Setúbal (Da Carraca à Ilha do Cavalo)
10/2022**	1875	26303	15 000	Baía de Cascais e Barras do Rio Tejo (Porto de Lisboa)

New charts under construction:

1/2022**	1963	63203	250 000	Cabo Verde - Ilhas Brava, Fogo, Santiago, Maio e Ilhéus Rombos
1/2022**	1955	63210	350 000	Cabo Roxo ao Cabo Verga

** Planned to be published until the end of 2022

Gaps:

INT charts not yet published are the ones presented in brown and orange in the following diagram (Figure 14).

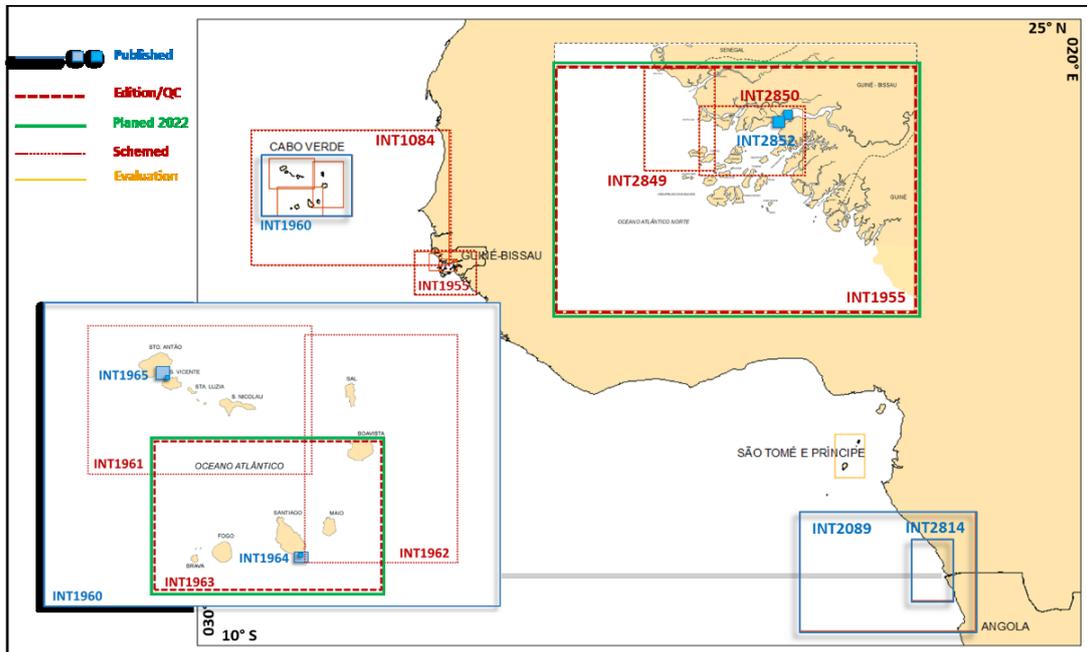


Figure 14 – INT charts gaps.

e) National paper charts

Since the last meeting, one (1) new edition has been produced by IHPT for the report’s period, depicted in the following tables and Figure 15.

New Editions and New INT charts from OCT2021 to SEP2022				
Edition/Year	National Number		Scale	Title
2/2022	26409***	Main	40 000	Aproximações à Barra do Rio Minho
		Plan A	10 000	Barra do Rio Minho, Caminha
		Plan B	10 000	Porto de Vila Praia de Âncora

***Data acquisition, compilation and production in cooperation with IHM (Spain)

Under construction:

2/2022**	46401	Main	75 000	Ilhas das Flores e Corvo
		Plan A	5 000	Porto das Lajes das Flores
		Plan B	10 000	Porto de Santa Cruz das Flores
		PlanC	10 000	Porto da Casa

** Planned to be published until the end of 2022

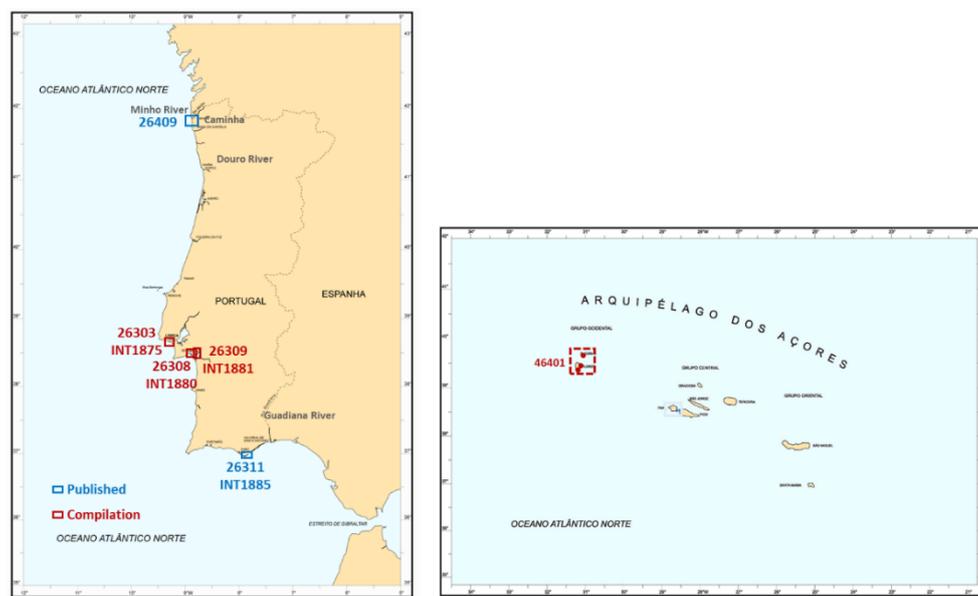


Figure 15 – New charts and new editions, Portuguese Territory.

f) Other charts, e.g. for pleasure craft

IHPT produces some other type of charts, namely the ones belonging to the series listed in the flowing table. All those charts are also in accordance with IHO specifications and were very well accepted by the users.

Series	Scale	Purposes
Fishery (Pescas)	Medium	Charts to support fishing activity
Recreational (Recreio)	Medium	Charts for pleasure crafts
Sedimentological (surface sediments)	Medium	Representation of the geographic distribution of the surface sediments of the submarine seafloor.
Training (Instrução)	Medium	For training in navigation exercises
Special (Especial)	Small/Medium	For scientific, administrative/jurisdiction or decision support purposes

g) Challenges and achievements

Some cartographic coverage schemes related to the geographical areas of Guinea-Bissau and São Tomé e Príncipe territories were identified for analysis and a rectification proposal is being prepared.

IHPT intends to complete the INT charts coverage in order to eliminate the gaps that still exist. The gaps reported are directly linked to the difficulty of obtaining data that allows the elaboration of the nautical cartography.

New hydrographic data coverage in Cape Verde will allow the chart production of the new cartographic coverage already schemed.

IHPT sees the implementation of the S-100 as a major challenge, particularly with what regards to the establishment of S-101 ENC schemes and respective production.

4- NEW PUBLICATIONS AND UPDATES

a) **New Publications**

Since the last meeting IHPT published the Annual Group of Notices to Mariners (2022), as well as, every month, the Monthly Group of Notices to Mariners.

Annually, IHPT publishes the Tide Tables for the main harbors of Portugal, including the Azores and Madeira Archipelagos. IHPT also publishes, annually, the Tide Tables for the African Portuguese Speaking Countries which, in the EAthC region, includes the main harbors of Cape Verde, Guinea Bissau Angola and São Tomé and Príncipe.

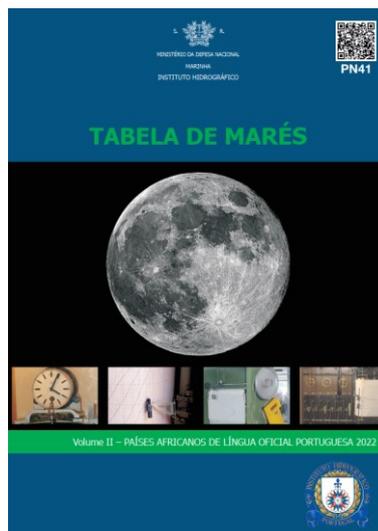


Figure 16 - Tide table for the African Portuguese Speaking Countries.

b) **Updated publications**

Since February 2021, the “Charts and Nautical Publications Catalogue” is freely available online in PDF format to be consulted or downloaded. It is kept up to date. The link to this publication is as follows: <https://loja.hidrografico.pt/?product=catalogo-de-cartas-e-publicacoes-nauticas-digital>. In the future it will also be available on the new ANAVNET platform.

c) **Means of delivery, e.g. paper, digital**

Digital or paper, as requested.

d) **Challenges and achievements**

IHO has released an English /Portuguese version of the 6th Edition of the special publication S-44 'IHO Standards for Hydrographic Surveys'. This English /Portuguese version is the result of a productive cooperation and input from Brazil (DHN) and Portugal (IHPT). Available on: https://iho.int/uploads/user/pubs/standards/s-44/20211216_S-44_Ed6_2.0.1_Portugues_v2F.pdf.

5- MARITIME SAFETY INFORMATION

a) Existing infrastructure for transmission

IHPT is the national coordinator for the Maritime Safety Information (MSI) and the navigational warnings are elaborated by COMAR (the Portuguese Centre for Maritime Operations – 24H service), under the supervision of IHPT and in cooperation with the NAVAREA II coordinator. IHPT have the responsibility over the MSI broadcast through the NAVTEX service, which is made simultaneously in English and Portuguese. The NAVTEX antennas (stations) are physically located in Penalva (near Lisbon), São Miguel Island (in the Azores Archipelago) and Porto Santo Island (in the Madeira Archipelago), and broadcast the navigational and meteorological warnings in daily basis through 10 minutes slots duration, distributed by 6 distinct periods, internationally known. Figure 17 presents the range of the 6 VHF NAVTEX stations.

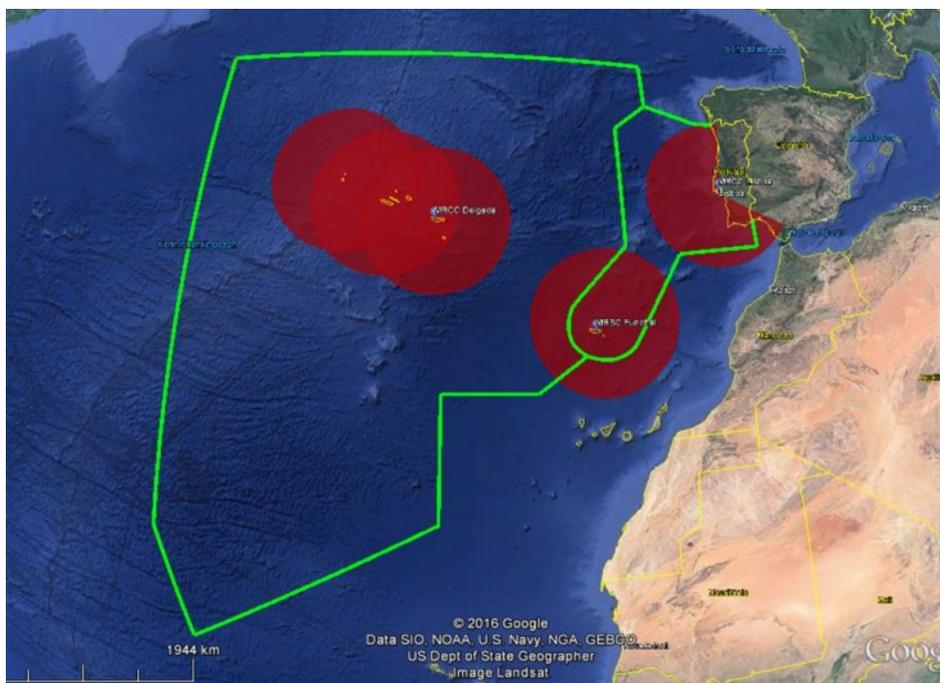


Figure 17 – Portuguese VHF NAVTEX stations range.

Monthly, IHPT publishes the NtM monthly group, containing all permanent, preliminary, and temporary warnings in force for the corresponding period. This information covers all navigation charts (paper and electronic) and publications of Portugal, Angola, Cape Verde, Guinea-Bissau, Mozambique and São Tomé e Príncipe, and is available on the web site (<http://www.hidrografico.pt>).

IHPT on-line application ANAVNET (<https://geoanavnet.hidrografico.pt/>) provides either entire NtM publications, or single NtM affecting individual documents; allowing in any case consultation and printing, including entire correction pages of nautical publications and graphical annexes to paste on charts. Regarding Navigational Warnings, ANAVNET allows consultation of warnings broadcasted by

any of the Portuguese NAVTEX stations, both in Portuguese and English languages. The local warnings are also displayed in ANAVNET.

Portugal has also three AIS coastal stations in Continental Portugal and in Azores and Madeira Archipelagos.

b) Statistics on work of the National Coordinator

As the national coordinator for the MSI dissemination, IHPT is responsible for the broadcast of all MSI information throughout the maritime community. The following table present the statistic of the coastal warnings (navigational and meteorological) broadcasted by the Portuguese NAVTEX stations for 2021 and 2022.

PORTUGAL NAVTEX metrics		2021			2022 *		
COUNTRY and NAVTEX station	B1 Character [518 / 490] kHz	Total number warnings broadcast	Number warnings broadcast with URGENT priority (EGC) or vital (NAVTEX)	Total number of warnings broadcast, including repetitions	Total number warnings broadcast	Number warnings broadcast with URGENT priority (EGC) or vital (NAVTEX)	Total number of warnings broadcast, including repetitions
PORTUGAL AÇORES S. MIGUEL	[F] [J]	3375	924	10840	1764	168	6845
PORTUGAL MADEIRA Porto Santo	[P] [M]	2256	276	6429	1148	57	3676
PORTUGAL CONTINENTAL Penalva	[R] [G]	5274	793	22610	3015	146	12799

* Data only up to July 2022.

c) New infrastructure in accordance with GMDSS Master Plan

The GMDSS coverage is not completed yet, but is planned to be until the first quarter of 2023, covering all the Portuguese maritime territory. The Digital Selective Call (DSC) capability keep full-time watch on VHF DSC CH 70 in Sea Area A1. The operational and planned VHF DSC coast stations are distributed as follows:

- 7 stations in Portugal Continental;
- 3 stations in Azores archipelagos (2 more stations planned to be implemented until MAR2023);
- 3 stations planned to be implemented in Madeira archipelago (MAR2023).

Regarding the MF DSC coast stations for Sea Area A2, three (3) more stations are planned to be implemented until the end of 2022, namely:

- Apúlia (Tx) – MRCC LISBOA;

- Sagres (Rx) – MRCC LISBOA;
- Lajes da Flores (Tx) – MRCC DELGADA.

d) Challenges and achievements

During the last 6 months, IHPT has implemented a new ANAVNET system, which now allow a more user-friendly access to MSI information, as well as access to georeferenced safety information (Figure 18). The new portal is accessible on: <https://geoanavnet.hidrografico.pt>. There are available 4 distinct warnings (Figure 19):

- Notice to Mariners (Annual and Monthly groups – each notice can be consulted individually);
- Coastal Navigational Warnings;
- Local Navigational Warnings;
- Meteorological Warnings.



Figure 18 – ANAVNET application layout.

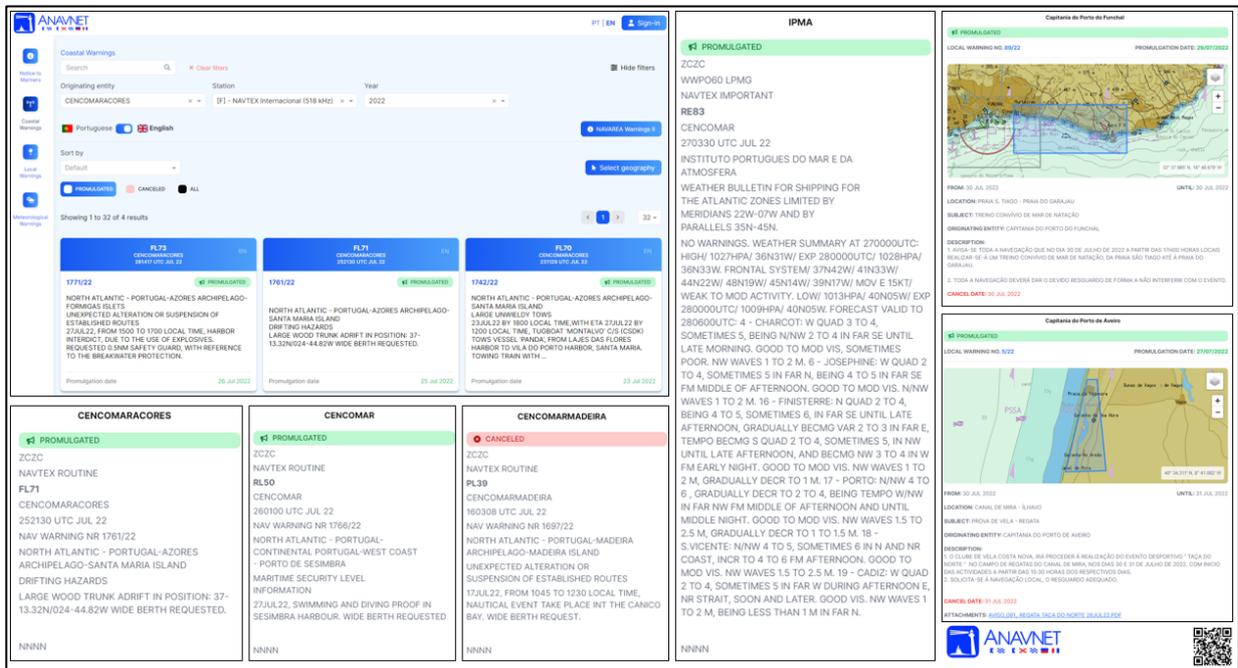


Figure 19 – ANAVNET navigational warnings and Notice to Mariners layout.

6- C-55

An update of C-55 was sent to IHO using the online system.

The following tables shows the updates.

Survey Status (updates aug 2022)	Depth < 200m			Depth > 200m		
	A	B	C	A	B	C
Portugal	100	0	0	99	0	1
Portugal Azores	75	25	0	64	0	36
Portugal Madeira	81	0	19	72	0	28
Angola	1	99	0	52	48	0
Cape Verde	91	0	9	25	0	75
Guinea-Bissau	1	94	5	4	0	96
São Tomé and Príncipe	6	94	0	1	30	69
Observations: Values calculated by IHPT A: Adequately surveyed / B: Re-survey required / C: Never systematically surveyed						

Charting Status Updated Ago2022	< 1 M			1 M to 75 000			> 75 000			Paper charts - depths in meters	WGS84
	A	B	C	A	B	C	A	B	C		
Portugal Continental	100	0	100	100	0	100	100	0	100	100	90
Arquipélago dos Açores	100	0	100	100	0	100	100	0	100	100	77
Arquipélago da Madeira	100	0	100	100	0	100	100	0	100	100	71
Cabo Verde	100	0	100	35	0	26	100	0	100	100	75
Guiné-Bissau	100	0	100	0	0	75	10	0	100	100	5
São Tomé e Príncipe	100	0	0	25	0	0	17	0	100	100	12
A: INT and others S-4 / B: RNC / C: ENC S-57 Note: Values relating only to charts produced by IHPT.											

7- CAPACITY BUILDING

a) Offer of and/or demand for Capacity Building

The School of Hydrography and Oceanography (<https://www.hidrografico.pt/op/23>) is a Navy Specialization School, and the department of the Hydrographic Institute dedicated to the training of Navy officers and sergeants and civilian technicians necessary for the Hydrographic and Oceanographic activities, or to these with that interest to the Navy and the Country. The training provided by the Hydrography and Oceanography School stands out, with FIG/IHO/ICA category A and B courses.

The next courses available start:

- September 2022: CAT B
- September 2023: CAT A

b) Training received, needed, offered

IHPT recommends a strong commitment to the training of EAtHC members in the development and production of the new generation of S-100 products and services. These activities should be coordinated in the next years by the Regions in order to include as many participants as possible, as well as to influence the standardization of training.

IHPT is also part of a Trans-National Access (TNA) initiative, among some international partners, to develop knowledge and capability to operate gliders and AUVs. IH operational teams have been enrolled in some deployments where all the deployment procedures are tested and trained. The goal is to implement a “Glider Lab” in IH facilities to maintain and calibrate not only our futures vehicles, but also the ones from our partners.

c) Status of national, bilateral, multilateral or regional development projects with a hydrographic component.

NTR.

d) Definition of proposals and requests to the IHO CBSC

IHPT proposed this year a Technical Visit to Guinea-Bissau with following generic objectives:

- Advice on a way forward for Guinea-Bissau to develop its hydrographic services (MSI first & other national hydrographic services), in accordance with IHO standards, to fulfill SOLAS obligations. Particular attention should be made to the establishment of an efficient MSI organization as very little nautical information is relayed by the maritime authorities of Guinea-Bissau (very few warnings transmitted to the NAVAREA II coordinator in the last 3 years for example).
- Definition of a plan to update Guinea-Bissau's nautical cartography.

IHPT proposed a Technical Visit to São Tomé e Príncipe in 2023.

8- OCEANOGRAPHIC ACTIVITIES

a) General

IHPT has regular and robust activity in respect to physical, geological and chemical oceanography, participating in national and European Union research projects in those fields. In the last year IHPT was

involved in several projects, which allowed to play an increasingly important role in the European scenario.

Besides that, IHPT acts as an oceanographic data provider among several organizations, such as COPERNICUS, IBI-ROOS, EMODNet, GEOHFRADAR and others. IHPT also has an important role on the discussion of the European strategy for the ocean, due to an active enrolment on initiatives such as JERICO-DS and JERICO-S3 or EOOS.

More locally, managing and co-managing some coastal oceanographic observatories, such as RAI, MONICAN and OCASO provides IHPT the expertise that a national observatory, such as MONIZEE (an IHPT EEZ environmental monitoring and predicting program), demands.

b) GEBCO/IBC's activities

IHPT has been providing bathymetric data to IHO DCDB and GEBCO through EMODNet, the European Marine Observation and Data Network. With this participation in European level multidisciplinary projects IHPT learns and keeps its alignment with the best procedures in the MSDI research developments.

A harmonized EMODnet Digital Terrain Model (DTM) has been generated for European sea regions from selected bathymetric survey data sets, composite DTMs, Satellite Derive Bathymetry (SDB) data products, while gaps with no data coverage are completed by integrating the GEBCO Digital Bathymetry.

In 2021 and within the scope of SEAMAP 2030, specific products were developed, such as bathymetric grids at variable resolutions which cover the entire Portuguese maritime area. They are available for free download through the IHPT geospatial data and information infrastructure Hidrografico+ (<https://gridmar.hidrografico.pt>) and through the OHI DCDB portal.

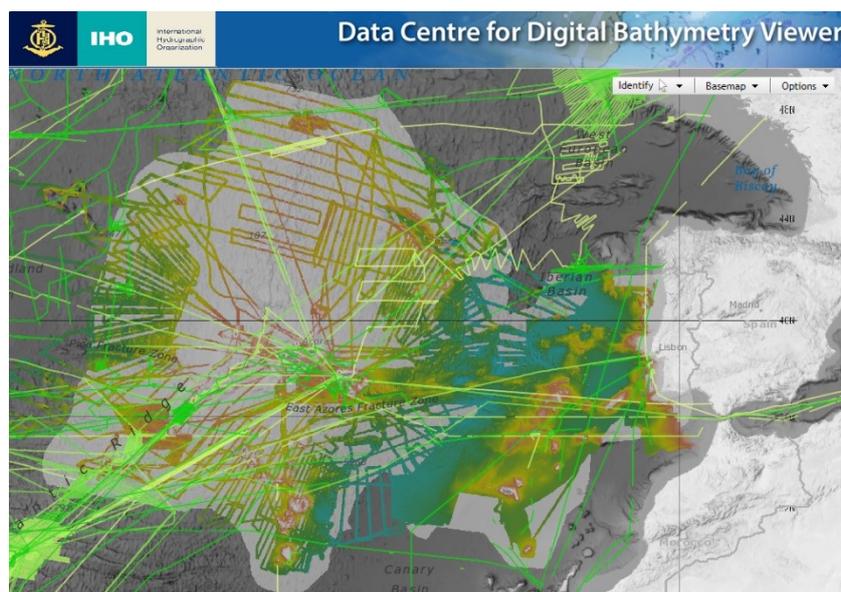


Figure 20 – IHO DCDB Viewer (https://www.ncei.noaa.gov/maps/iho_dcdb/)

c) Tide gauge and other monitoring equipment network

Four different networks compose the Portuguese Ocean Monitoring Network, named MONIZEE. Chronologically, the first one was the Tide Gauge network, distributed along the mainland coastline and both archipelagos, Madeira and Azores, comprehend more than 22 tide gauges, gathering data, some for over 100 years. The present system configuration consists of acoustic or laser sensors to measure the water level and air pressure sensors with all of them having online communications. Some of them contribute to the National Tsunami Warning System, providing data every 30 seconds.

In the early 80's, the coastal wave buoy network, was implemented. Initially only in the mainland and a few years later expanded to Madeira and Azores, with the purpose of monitoring the wave pattern in the middle/inner shelf.



Figure 21 – Multiparametric Buoy (left) – Coastal Wave Buoy (right).

Twenty years later, in the beginning of the XXI century, IHPT started a new wave buoy network. This new network, with the purpose of monitoring waves, currents, meteorological conditions and water quality outside the continental shelf, makes use of OCEANOR WAVESCAN buoys with a very comprehensive payload. Beyond the basic wave monitoring sensors, the buoys are equipped with wind, air pressure, air temperature and air humidity sensors for the meteorological part, acoustic current profilers for currents, thermistors along the mooring line and several water quality sensors such as oxygen, chlorophyll and hydrocarbons. More recently, a HF Radar network started to be designed and implemented. For the 20 HF Radar stations, six are already operational. For this network, IHPT decided to adopt the CODAR SEASONDE systems.

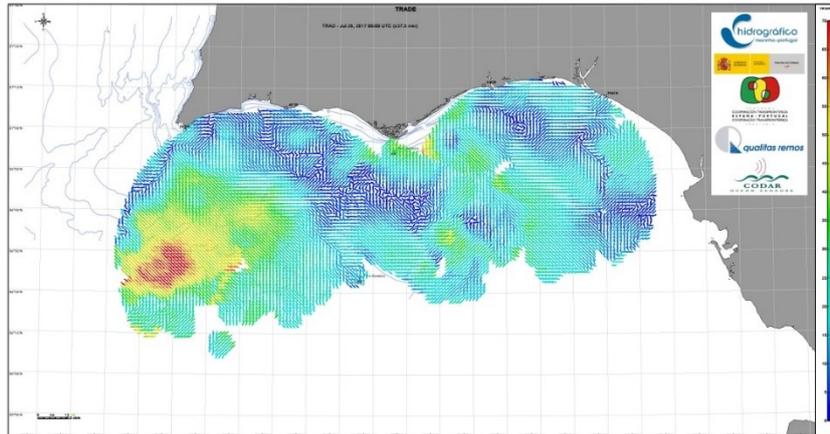


Figure 22 – Hourly Surface Current Map, from three HF Radar station combined- Algarve.

From this network, one can obtain an hourly surface current map, a 10min wave information, and at one particularly station, at Alfanzina, a 2min tsunami probability index is also calculated.



Figure 23 – MONIZEE – Portuguese Monitoring Network.

d) New equipment

Along the period covered by this report, some new equipment was updated and, in some areas, the network was reinforced by adding more instruments/sensors.

Regarding the coastal buoy system, new receivers and new motion sensors replaced the outdated ones.

e) Challenges and achievements:

Regarding to the monitoring network, the IHPT main challenge is its sustainability.

Concerning the scientific challenges, IHPT is very focused on observing and measure ocean acidity, micro plastics and noise. IHPT has submitted some projects to European Union financing, and is waiting the evaluation results, to allow us to develop tools and means to achieve those capabilities.

The harmonic constants used on Volume II of Tide Table are not updated since the 70's for Cape Verde, Guinea-Bissau and São Tomé and Príncipe. Only a few harbors in Mozambique were updated in the 80's. A process is ongoing to update the harmonic constants of Angola. This lack of update is due to the absence of data needed to be provided by the concerned countries' national authorities.

IHPT is collaborating with the MALMON DeSira project (<https://www.malmon-desira.com/>). One of the tasks to support this project is the installation of several tide gauges in Guinea-Bissau. IHPT hopes that the data obtained by this tide gauge network can be used to update tidal information in the area.

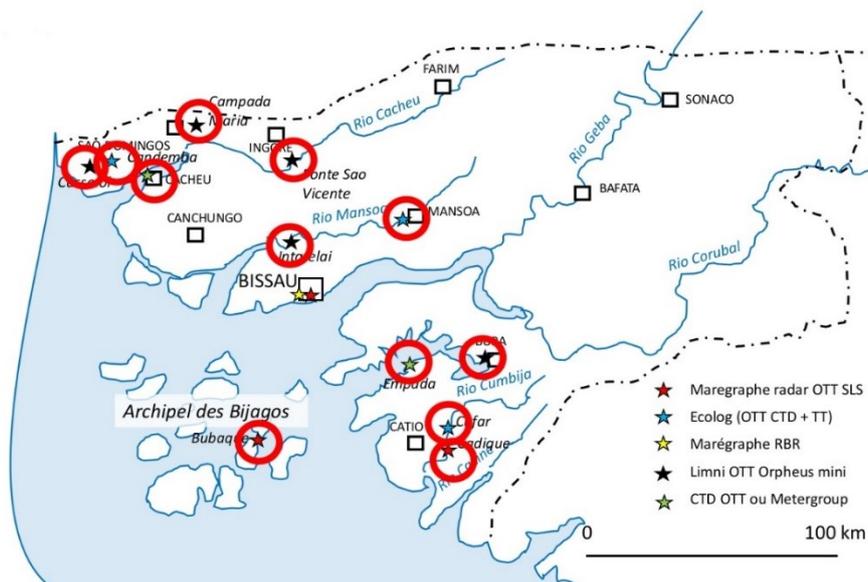


Figure 24 – MALMON DeSira project tide gauges network

9- SPATIAL DATA INFRASTRUCTURES

The Portuguese Hydrographic Institute is in all aspects a data driven organization. To address the geospatial data needs for improvement the Portuguese Hydrographic Institute has built a Marine Spatial Data Infrastructure (MSDI), through the Hidrografico Plus project, having granted funding from SAMA2020 program (POCI-02-0550-FEDER-035422). This MSDI is aligned with the IHO, UN-GGIM, INSPIRE, IODE best practices to improve the data management, metadata creation, data search services and optimized data access services. The MSDI frontend is a centralized webGIS – Hidrografico Plus (<https://geomar.hidrografico.pt>). In the portal users can find several marine and hydrographic datasets: environment observations at sea, forecasts, nautical charts and hydrographic information.

a) Status of MSDI

Hidrografico + MSDI integrates the software components presented in the Figure . This service-oriented architecture implements the MSDI functionalities, principles and pillars. Human and machine actors can access marine data through OGC services and custom APIs. The infrastructure presents a full integration between the portal and the metadata catalogue, this integration optimizes data access by National Spatial Data Infrastructure (SDI) – SNIG Portal - and INSPIRE Geoportal.

The MSDI has been designed to support blue economy sector clients such as maritime users, fisheries, aquaculture, green energy operators, etc. At this point, the users recognize the potential of this new tool as an organizational asset capable of support diverse scientific projects and clients – human and machines.

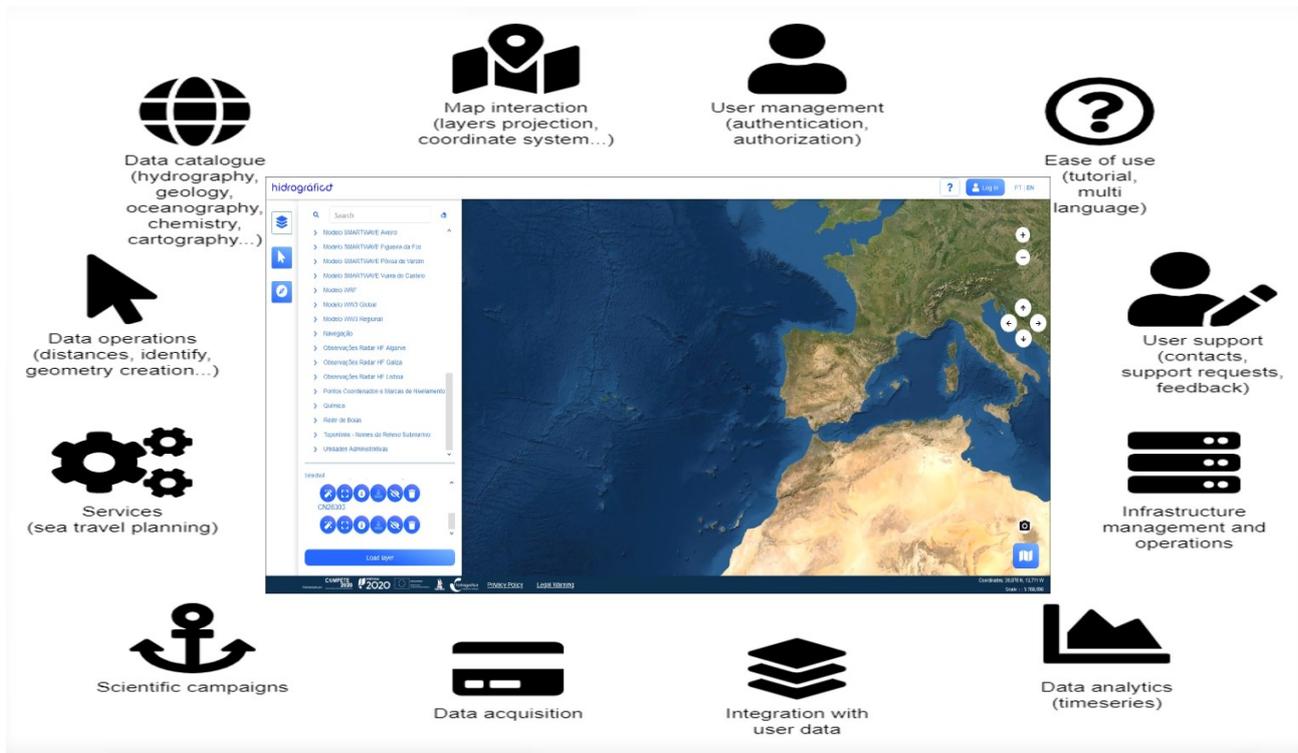


Figure 25 – Hidrográfico Plus MSDI functionalities and components

From the systems architecture (Figure) point of view the PT MSDI implements several open-source technologies. This allows IH to be compliant with INSPIRE and IHO MSDI requirements and to publish diverse data sources and formats through web services.

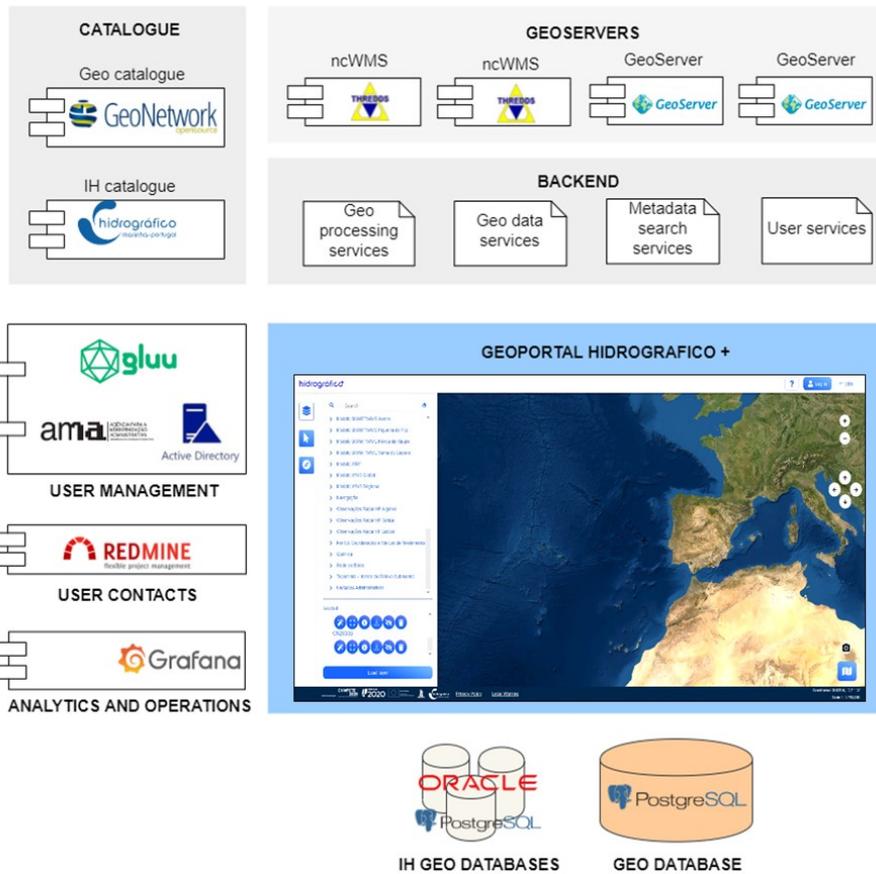


Figure 26 - Hidrografico Plus MSDI architecture

The Portuguese Hydrographic Institute MSDI will support goals 2 and 3 identified in the OHI strategic plan (Figure).



Figure 27 - OHI Strategic Plan (2021 – 2026)

Notices to Mariners and Navigational Warnings are also available at IHPT Internet portal ANAVNET (<https://geonavnet.hidrografico.pt>), as well as general information on the Portuguese Nautical Charts and Nautical Publications.

The Portuguese Hydrographic Office is now working to expand the MSDI capabilities to support augmented reality applications for mariners, develop the integration of analytical tools for marine data exploration and data extraction, transformation and harmonization for special purposes such as the S-100 hydrographic model.

b) Relationship with the NSDI

IH data is available through Open Geospatial Consortium (OGC) web services in the Portuguese National Spatial Data Infrastructure (NSDI) – Sistema Nacional de Informação Geográfica (SNIG): <https://snig.dgterritorio.gov.pt/>. SNIG maintains a centralized metadata catalogue with all national data providers and is linked to the EU INSPIRE Portal. The metadata is shared between the different infrastructures through automatic harvesting process. This approach assures data access for different clients.

c) Involvement in regional or global MSDI efforts

IHPT works in the SNIG Working Groups for a common effort in the INSPIRE implementation principles and provides geospatial data services to other portals like the Marine Spatial Data Portal – Geoportal do Mar Português (<https://webgis.dgrm.mm.gov.pt/portal/apps/webappviewer/index.html?id=df8accb510bc4f33963d9b03bf3674b8>).

d) National implementation of the Shared Data Principles – including any national data policy and impact on marine data.

Several Portuguese organizations have been implementing the common European directives and orientations such as INSPIRE, Marine Directive Framework, the European Strategy for Data Policy and the Directive on open data and the re-use of public sector information, also known as the ‘Open Data Directive’ (Directive (EU) 2019/1024).

The main driver in the SDI and MSDI has been the European community and the regional initiatives. SNIG follows the INSPIRE directive and the Implementation Working Groups. IH combined the needs to implement the INSPIRE directive with the IHO and IMO principles and requirements to build up the Hidrografico Plus MSDI capable of serving multiple users, needs and uses. Portugal does not have a national common marine data policy. However, data producers and providers have their own organizational data policies aligned with national and European legislation compliant with international data management best practices.

The Hidrografico Plus platform currently delivers free data, for visualization, and download. Some of the data is not available for download, as in the future a paid access will be required for downloading that data.

e) MSDI national portal

Currently there is no single portal considered to be the national MSDI. That may be the best approach for the implementation of MSDI federate principles based on a network of geospatial services and aggregated metadata access points such as SNIG and INSPIRE portals.

f) Best practices and lessons learned

The Hidrografico Plus MSDI follows the best practices and requirements identified from several recognized institutions/organizations: INSPIRE (<https://inspire.ec.europa.eu/>), OHI MSDIWG (<https://iho.int/en/body-of-knowledge>), OGC (<https://www.ogc.org/>) and IOC OceanBestPractices (<https://repository.oceanbestpractices.org/handle/11329/139>), among others. The main lessons learned are the need to maintain a good human resources capacity building program and to maintain the internal competences and technical skills aligned with the MSDI principles and implementation models.

g) Challenges and achievements.

Hidrografico Plus MSDI components are used to support internal technical and scientific geospatial data management processes and to feed external clients with near real time data. This MSDI supports the organization mission as marine national laboratory and hydrographic chart authority. Being a navy unit, IHPT supports maritime operations that are extremely dependent of geospatial data.

Hidrografico Plus, since its internet deployment has proved its value. The IH developed this project taking into account marine user needs. This MSDI is now in production phase and Portugal has great expectations about its role for decreasing the ocean knowledge gap at National, European and Global level. This MSDI implements all common identified requirements needed for interoperability. For sure it will potentiate the access to IH blue geospatial data and has potential for private sector applications development. In this way, IH will manage one infrastructure ready to be used in the Open Data Directive umbrella and aligned with INSPIRE requirements. This is one of the IH contributions for Ocean Decade sustainable development goals and for national blue economy development.

The Hidrografico Plus is rapidly becoming a consolidated platform of geographic ocean data, by making easily available, the value of the data produced by IH, to a number of different community of users, and also by integrating into a network of other geospatial European initiatives, where all those stakeholders can work together for the benefit of all.

The main challenges will be to keep the MSDI aligned with digital data strategies at different levels. This is a digital environment with a continuous evolution which requires a rapid adaptation to new clients and stakeholders. Data harmonization and development of S-100 based web services will be for sure a challenge in the future.

10- INNOVATION

a) Use of new technologies

In accordance with the United Nations Ocean Decade, IH is actively engaged in producing a Digital Twin of the Ocean (DTO) to support decision-making and sustainable development (SDG 14) regarding the blue economy. In this sense, it is following several global initiatives (Destination Earth (<https://digital-strategy.ec.europa.eu/en/policies/destination-earth>), Iliad (<https://www.ocean-twin.eu>) and DITTO (<https://ditto-oceandecade.org>) in order to learn and apply the best practices in developing its own DTO pilot.

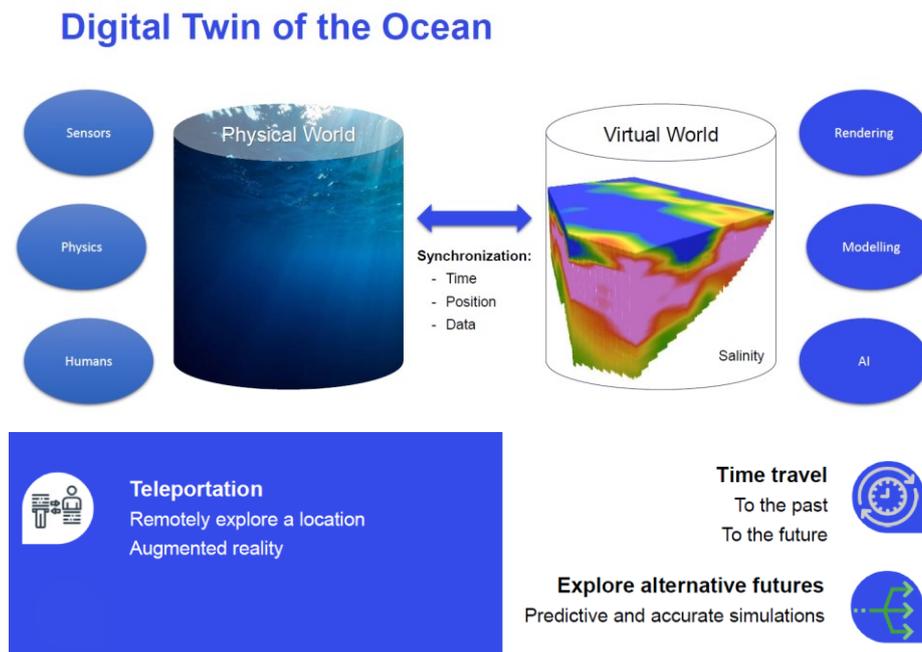


FIG 28 – DTO concept and benefits

Considering the use of new technologies for hydrographic surveys, Portugal has put new work power to developing and using current satellite technology for the acquisition of bathymetric information. In house software development allowed the use of satellite images to bring in new survey techniques. Multispectral remote detection images are now used for bathymetry where this approach is considered viable and needed. Following this implementation, new tasks have been set up, to develop a similar technique using remotely acquired imaging from low flying vehicles such as unmanned aerial vehicles.

Portugal is currently working on Horizon2020 European Project “4S - Satellite Seafloor Survey Suite” focused on using techniques for having Bathymetry and Seafloor Classification from remotely acquired multispectral images.

Furthermore, other methods are being developed, such as using the wave field inversion for calculating depth and thus achieving another bathymetric survey technique. Considering the development of this methods using newer technology, Portugal is currently working on several European projects focused specifically on these purposes.

As a statement of those capabilities is the fact that IHPT is now a “beta-tester” for the new ESA products.

For oceanographic surveys, IHPT also used new technologies. The one that stands out is the low cost ocean drifters developed under the scope of the MELOA project. Those drifters, that were baptized with the name WAVY, have three different generations, the basic, the littoral and the ocean. Some are ready for deployment, allowing the use of massive drifters with a low investment.



Figure 29 – Wavy Ocean ready for deployment

b) Risk assessment

IHPT is conducting Risk Assessment of some of the waterways in order to identify areas of improvement for the safety of navigation. These assessments are performed in accordance with the recommendations and guidelines of IALA.

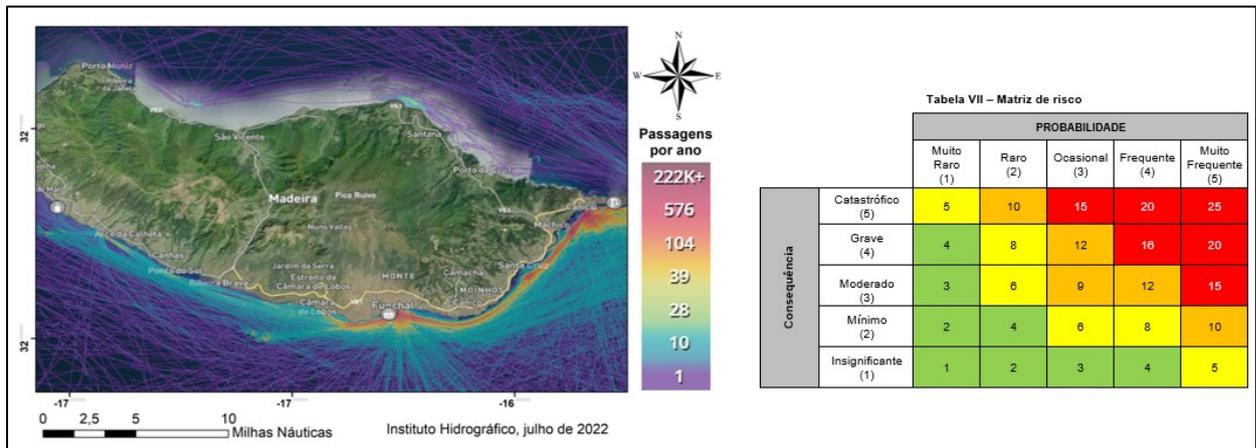


Figure 30 – Risk assessment for Funchal harbor.

c) Policy matters.

NTR.

11- OTHER ACTIVITIES

a) Participation in IHO Meetings

Due to its primary charting responsibilities, Portugal, represented by IHPT, is a member of EAHC and Associated Member of SAIHC. Since September 2020 Portugal has the Chair of the EAHC commission.

The detail of IHPT involvement in other IHO activities/working groups is listed in the table hereafter.

	Description	IHPT representation
IRCC	Inter-Regional Coordination Committee	RAdm Mário José Simões Marques
CBWG	Capacity Building Working Group	CDR João Vicente
MSDIWG	Marine Spatial Data Infrastructure Working Group	LtCDR Telmo Dias
WENDWG	Worldwide ENC Database Working Group	Eng. ^a Paula Sanches
CSBWG	Crowdsource bathymetry Working Group	Eng. ^a Leonor Veiga and LtCDR Telmo Dias
GEBCO-SCUFN	Gebco Sub-Committee on Undersea Feature Names	Eng. ^a Paula Sanches
IENWG	IHO-European Union Working Group	Captain Miguel Bessa Pacheco
HSSC	Hydrographic Services and Standards Committee	CDR João Vicente and Eng. ^a Paula Sanches
HSWG	Hydrographic Surveys Working Group	CDR Carlos Marques (HSWG Secretary)
S100WG	S-100 Working Group	Eng. ^a Paula Sanches
S101PT	S-101 Project Team	Eng. ^a Paula Sanches
DQWG	Data Quality Working Group	Eng. ^a Paula Sanches

b) Meteorological data collection

NTR.

c) Geospatial studies

Since 2019, the IHPT is monitoring the evolution of the coastal area surrounding the harbor of Sines, the only deep-water port located in national protected areas, and which includes São Torpes beach. The 5 years monitoring plan for the beaches of São Torpes, requires frequent surveys to describe the morpho-sedimentary characteristics of the system (beach and inner shelf) after winter, spring, summer and autumn. The comparison of data acquired during the different seasonal situations allows quantifying and predicting the evolution in terms of topography and bottom sediments. In addition, the dominant oceanographic regime is characterized in order to understand the physical forcing of the observed changes.

d) Preparation for responses to disasters

IHPT, with regard to disaster response, created a multidisciplinary team within its many scientific/marine science capabilities (such as hydrography, physical oceanography, marine geology, chemistry and pollution and Data center) combined with the expertise in marine technology and ocean engineering.

The purpose of the Equipa Hidrográfica de Intervenção Rápida (Quick Response Hydrographic Team) is to support the national emergency coordinator in case of a natural or manmade disaster or emergency and also in Portuguese Naval Operations.

e) Environmental protection

EMODnet

The European Maritime Observation and Data Network (EMODnet), an initiative of the European Commission's Directorate-General for Maritime Affairs and Fisheries (DG MARE), is composed of a partnership of more than one hundred of European organizations working together to gather marine data from a variety of sources, with the aim of making them more accessible and interoperable.

Part of the work involves linking to national, regional or thematic data repositories in which lies the basic information and the creation of outreach products. Thematic groups have been set up to organize the data available from various sources, assess their quality, ensure that they are accompanied by metadata and provide such data through thematic portals in the areas of bathymetry, geology, habitats, biology, chemistry, physical oceanography, and human activities.

IHPT has been collaborating with this project for more than a decade, providing bathymetric and chemistry data in the Atlantic, Azores and Madeira regions.

The High Resolution Seabed Mapping (HRSM) project aims to create and maintain an operational service that provides free and open access to the seabed and coastal sea basin bathymetric models at the best resolution possible.

The overall objective is to bring together bathymetric surveys of European seas and to produce, publish and serve a harmonized and high-resolution Digital Terrain Model (DTM) of all European basins.



Figure 31– EMODnet Bathymetry Portal.

EMODnet Chemistry first goal is to provide interoperable, high quality and publicly available data and products on marine water quality issues. Its activity is firstly to collect, validate, and guarantee access to marine pollution data streams, and secondly generate and publish corresponding data products.

EMODnet Chemistry is focused on eutrophication, ocean acidification, contamination, and marine litter issues which are relevant to the Marine Strategy Framework Directive and to global climate change. The data have been brought together for different group of variables in seawater, sediment and biota.

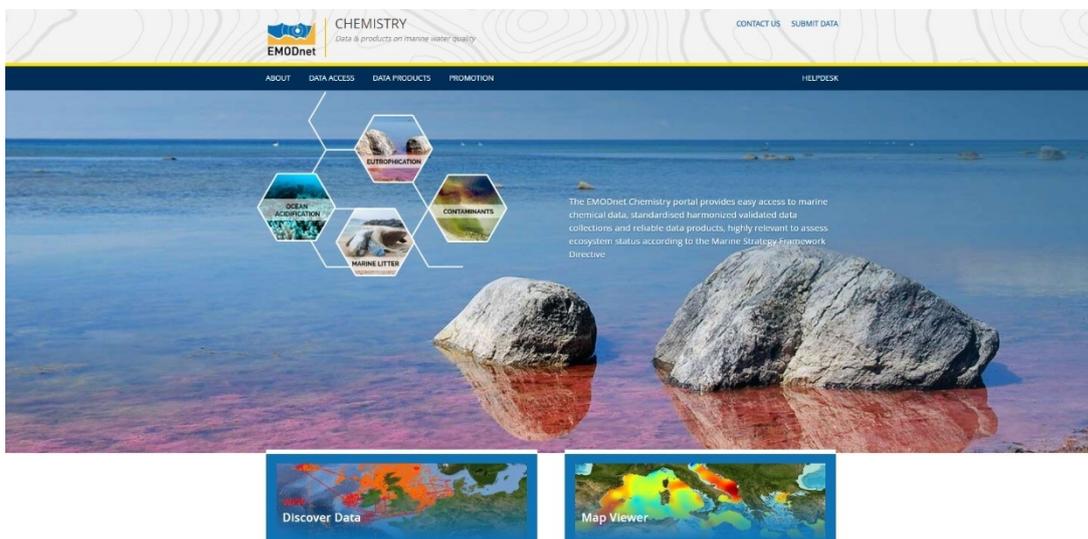


Figure 32 – EMODnet – Chemistry Portal (<https://www.emodnet-chemistry.eu>)

AQUIMAR

The project AQUIMAR (Marine Knowledge supporting Aquaculture, <https://aquimar.hidrografico.pt/>), coordinated by IHPT, started in August 2018 with the main goals of characterizing the oceanographic, hydrodynamic and biogeochemical conditions of selected areas of the Portuguese coast (continental platform and estuaries); and to identify the best suited locations, in these selected areas, for the settlement of aquaculture infrastructures. Between October 2018 and February 2021, four oceanic surveys (each one covering the five areas marked in yellow on Figure 33) and 16 estuarine surveys (covering the four estuaries – Ria de Aveiro, Mondego, Mira and Ria Formosa – marked with red dots on the same Figure) were conducted.

Currently, the information collected during the surveys is being processed and integrated. The final report will be finished at the end of 2022.



Figure 33 – AQUIMAR project – surveyed areas

i-plastic

The i-plastic project (Dispersion and impacts of micro- and nano-plastics in the tropical and temperate oceans: from regional land-ocean interface to the open ocean), in which IHPT is a partner, started in September 2020 and has its term planned for august 2023. The project intends to assess the dispersion and impacts of micro- and nano-plastics in the tropical and temperate oceans, from the

regional land-ocean interface to the open ocean, and to elaborate models of plastics dispersion at the Atlantic scale. Between September 2020 and April 2022, five oceanic surveys were conducted.

SEDMAR

A sustainable use of the natural resources requires management policies founded in scientific knowledge. Knowledge of the nature of the seabed is mandatory for activities of environmental protection measurements, scientific and economic development linked to the sea, namely actions to preserve marine biodiversity (through the detection of any sensitive marine ecosystems or the harmful effects of human activity), inventorying, rational management of marine resources (energy, living and non-living), and other economic activities.

The aim of the seabed mapping in what concerns its physical properties (morphology and geology) grows on the need to increase the scientific knowledge of the coastal margins, so the proper measures to exploit natural resources, preserve marine biodiversity, and protect endangered ecosystems, can be adopted.

The ongoing “Mapeamento dos Sedimentos Marinhos – SEDMAR” project is the successor of the “Sedimentos Superficiais da Plataforma Continental - SEPLAT program” (1974-2010), executed at the Hydrographic Institute and fully financed by the MDN, which produced 8 sedimentological maps of the Portuguese continental shelf between the coastline and 500m depth, at scale 1 : 150 000.

These mapping programs are complemented with additional studies and projects that adopt multidisciplinary approaches, using acoustic and geophysical methods, such as lateral sonars, high-resolution seismic reflection systems and magnetometry.

f) Engagement with the Maritime Administration

Under this topic, IHPT, with the help of 3 other partners such as Portuguese National Maritime Authority (AMN), created a support system for Maritime Surveillance in the access to port areas; Developed a decision support tool for use by AMN using harbors of Vila do Conde, Nazaré and Portimão as case studies (SAGA project).

Also, IHPT is working continuously with harbor administrations in order to keep charts updated with the most recent information.

g) Aids to Navigation matters.

NTR.

h) Magnetic/Gravity surveys

NTR.

i) International engagements

IHPT has bilateral agreements with other Hydrographic Offices, Instituto Hidrográfico de la Marina – Spain (IHM), Service Hydrographique et Océanographique de la Marine - France (SHOM) and United Kingdom Hydrographic Office (UKHO). The agreement with IHM is under revision. The agreement with UKHO was revised in the end of 2021.

Spain:

IHPT and the IHM hold regular technical meetings (on an annual basis) in order to define joint cooperation actions, namely the surveys and the cartography in the national maritime border's areas. The last meeting took place last May in Cádiz and served to publish the nautical charts co-produced by the IHPT and the IHM:

- IHPT: New Edition of Nautical Chart 26409 - 2nd Edition April 2022 "Approaches to the Minho River Bar (Caminha Port Plan)"
- IHM: Nautical Chart 4171, 1st Edition April 2022, "A Guarda and Pasaxe Ports".

The publication of these charts resulted from a joint effort in carrying out hydrographic surveys, sharing hydrographic and cartographic information and standardizing cartographic representation in border areas.



Figure 34 – IHPT and IHM delegations (2022 bilateral meeting)

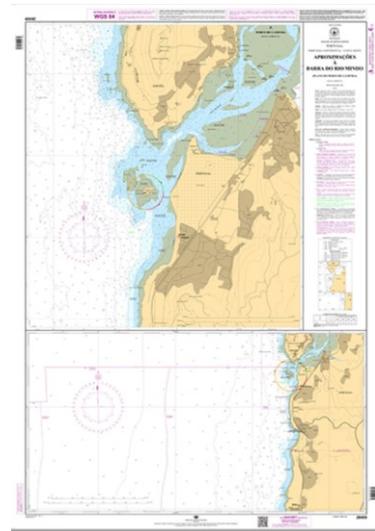


Figure 35 – Chart 26409: 2nd Edition April 2022 "Approaches to the Minho River Bar (Caminha Port Plan)"

Cape Verde:

IHPT signed, on 30th November 2017, a protocol with the Instituto Marítimo e Portuário of Cabo Verde. This protocol came to formalize and reinforce the cooperation between the two countries in the hydrography works. In addition to updating Cape Verde cartography, this protocol will develop technical cooperation, institutional capacity building and training of technical staff of that country.

Guinea-Bissau:

IHPT signed, on 17th June 2015, a protocol with the Instituto Marítimo e Portuário of Guiné-Bissau. This protocol came to formalize and reinforce the cooperation between the two countries in the hydrography works. In addition to updating Guinea-Bissau cartography, this protocol will develop technical cooperation, institutional capacity building and training of technical staff of that country.

São Tomé and Príncipe:

Portugal signed, on 8th November 1988, a protocol with São Tomé and Príncipe in the fields of maritime development, hydrography, oceanography, safety of navigation and maritime signaling. This protocol needs to be revised.

j) Others - Naval Meteorological and Oceanographic Center

IHPT has developed state of the art tools and operational systems in the field of meteorological and oceanographic forecast, in-situ ocean observation networks and remote sensing techniques, along the Portuguese margin and coastal areas.

In November 2017, IHPT activated the new GEOMETOC center of the PRT Navy, named CGEOMETOC (Naval Geospatial, Meteorological and Oceanographic Center), under the direction of IHPT's Director-general.

12- FINAL REMARKS

a) Areas of significant achievement

In July 2022, IHPT hosted the first Hydrographic Conference for the Community of Portuguese-Speaking Countries (CPLP). The creation of a platform for promotion and development of Hydrography between the countries from CPLP was one of the main achievements, highlighting the need for cooperation and training in the area of hydrography and scientific areas within the community, to increase the safety of navigation and for the development of national hydrographic services.

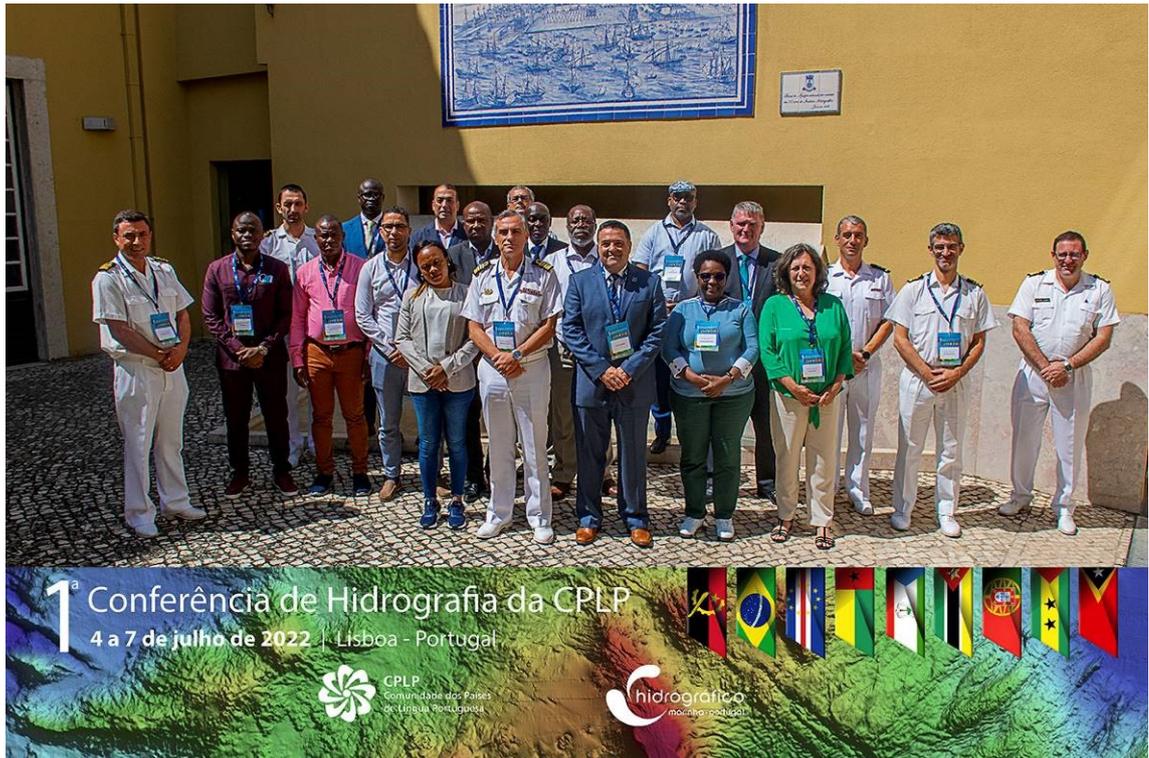


Figure 36 – Delegations to the first Hydrographic Conference for the Community of Portuguese-Speaking Countries

b) Areas of particular concern

- Access and sharing data of the scientific cruises made in areas of some local countries it is difficult due to National Authorities authorizations bureaucracy or lack of response.
- S-100 implementation namely for non ENC products and services (timetable, data, resources).

c) Any other matters of interest to the EAHC

NTR.