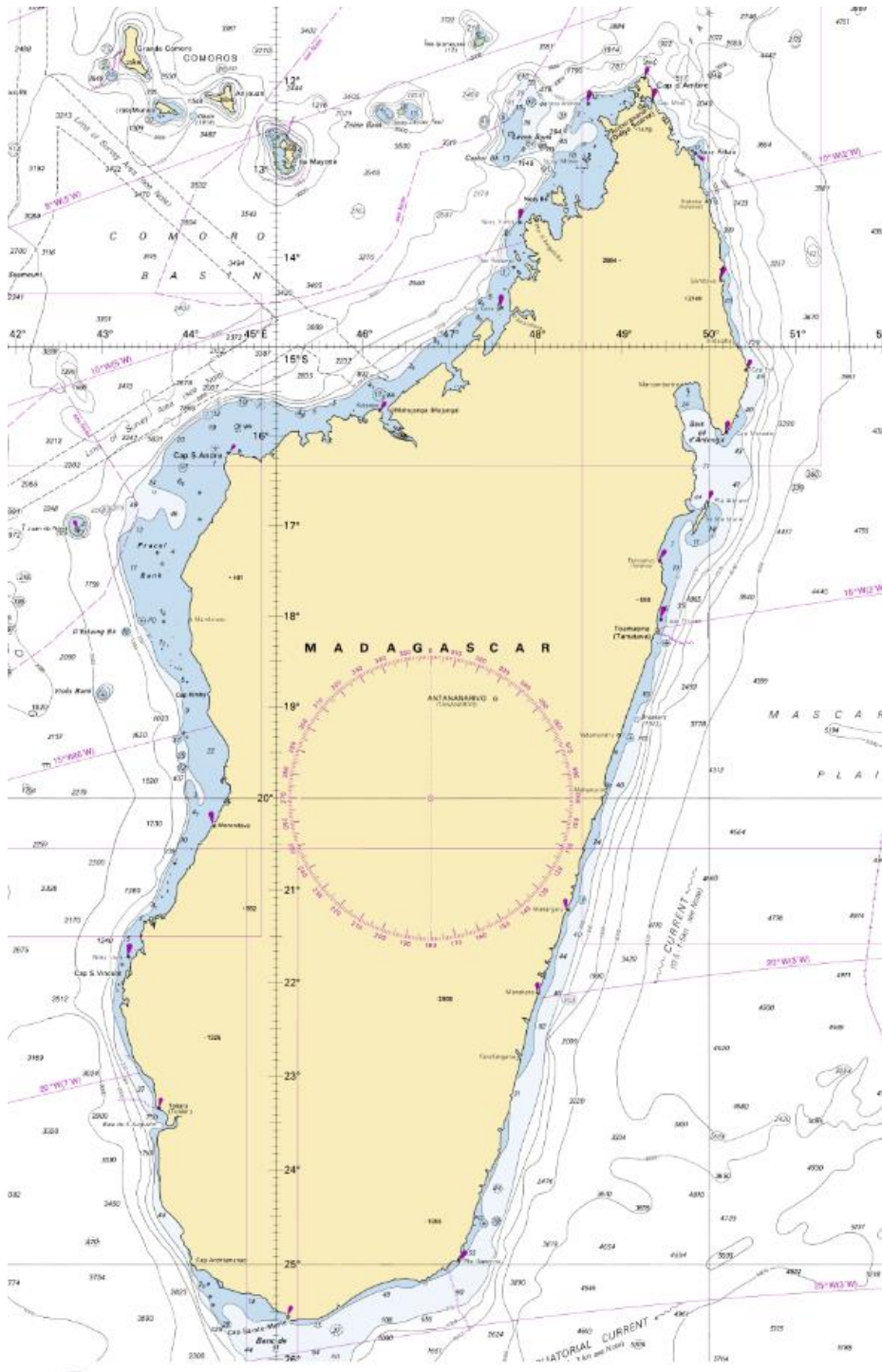




**IHO - Capacity Building  
Work Programme  
TECHNICAL VISIT  
IN MADAGASCAR  
REPORT  
13 - 21 Février 2023**



**Our thanks to .../...**



Madagascar  
From INTERNATIONAL chart N°701



**Ministère de l'Aménagement du Territoire et des Services Fonciers**



**Ministère des Transports et de la Météorologie**



**Ministère de le Défense Nationale**



**Ministère de l'Environnement et du Développement Durable**



**Ministère de la Pêche et de l'Économie Bleue**



**Foiben-Taosarintanin'i Madagasikara Institut Géographique et Hydrographique**



**Agence Portuaire Maritime et Fluviale**



**Société du Port à Gestion Autonome de Toamasina**



**Marine Nationale**

With the participation of :



Japan International Cooperation Agency



With the concours of :



**Service hydrographique et océanographique de la marine (France)**



**Southern African and Islands Hydrographic Commission (SAIHC)  
Commission Hydrographique de l'Afrique et des Iles Australes (CHAIA)  
Capacity Building coordinator (United Kingdom)**



**Secrétariat de l'OHI (Monaco)**

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## FOREWORD

### Will this report be more useful than the previous ones?

Development attempts are not lacking with studies that spanned 1970, 1991, 2006, 2008, the last dating from 2011. These studies, sponsored by international but also Malagasy institutions, were able to say what should have been done. The risk of repetition is there!

### What to do?

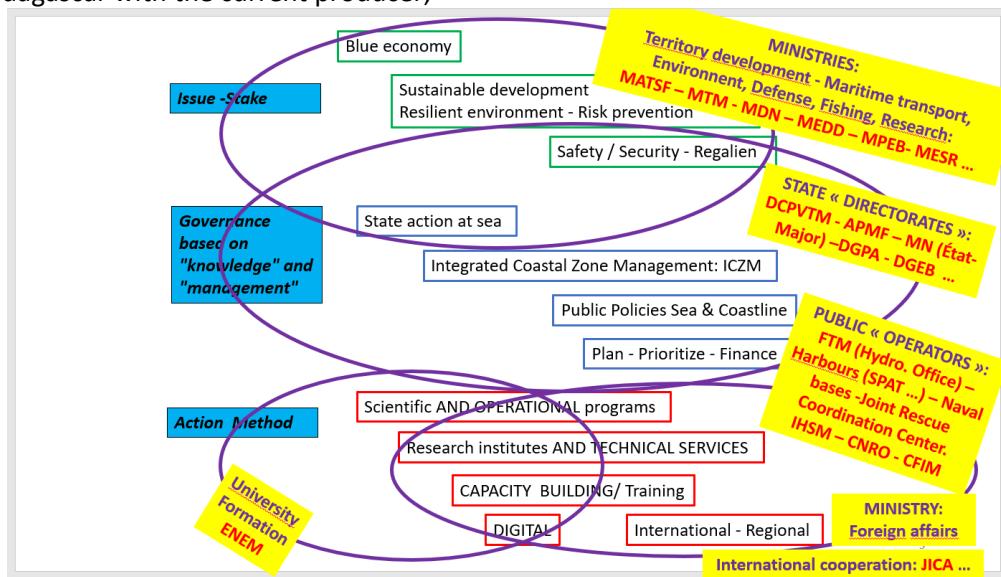
It is first necessary that the Malagasy organizations concerned appropriate it through targeted extracts, possibly criticized, and complete it with ideas which certainly escaped the editor. It was agreed that this report would be distributed in Madagascar by the FTM, the official Hydrographic Service of the country and correspondent of the IHO.

The involvement of the APMF (remarkably present during the Technical Visit), correspondent of the IMO, will be decisive in carrying out actions related to maritime development. Beyond the safety of navigation, it would be inefficient not to now integrate the issues of security, the marine environment, risk prevention, oceanographic research and economic development, so much hydrographic, oceanographic and charts products contribute to this. We must therefore share all this, it is the meaning to be given to the National Hydrographic Committee that must be resuscitated.

### Why do better now?

If there are weaknesses such as the human and financial resources of the FTM, administrative roughness like everywhere, there are also opportunities to be seized such as:

- high-level recognition that all governance is also based on knowledge, here the physical description of the sea and the coastline;
- that there are many things to share: ambitions, solutions, material resources (including boats) and human resources that can be shared. An idea already shared by FTM and APMF;
- a whole youth that is eager to innovate through science and digital technology;
- the very wide availability of satellite data dedicated to the ocean and free of charge;
- international cooperation which can be developed on the themes of economic development and climate change. We will add the desire to co-publish the official nautical charts of Madagascar with the current producer;



### How to start ?

By the easiest, least expensive and shortest things because first of all the country have to restart. There is no shortage of them that can be conducted with the current means of the country

### See also medium and long term

A huge country don't escape to the launch of major projects whose size will require the support of international donors.

## ABSTRACT

The development of Madagascar in terms of hydrography and nautical cartography must be reset:

- firstly, by remobilizing and supporting the organization which is officially responsible for it: the FTM (Foiben-Taosarintanin'i Madagasikara - Geographical and Hydrographic Institute of Madagascar);
- through an all-encompassing approach integrating, in addition to hydrography: physical oceanography, integrated management of coastal zones, nautical cartography, fishing, State Action at Sea;
- by mobilizing new players other than those in the maritime transport chain mainly represented by the APMF, the Agence Portuaire Maritime et Fluviale: environment, defence, research and university training. Actors with very related interests who can only play win/win by cooperating together on shared projects with pooled resources and skills;
- as already said, provided that all the institutional and operational actors can meet at least in a National Hydrographic coordination Committee, allowing the efficient sharing of issues, projects, human and material resources and finally results for socio-economic purposes.

This report does not claim to be exhaustive, there are certainly potentialities which have not been inventoried and which should have been considered, it nevertheless offers some recommendations which are based on successful experiences elsewhere in Europe and Africa.

Concerning maritime navigation, with regard to ratified international conventions, in particular SOLAS (providing hydrographic services in order to establish and disseminate the information and nautical documentation necessary for the safety of navigation in its waters), Madagascar's capacities are in terms of development:

- **to be confirmed for phase 1:** collection and transmission of **maritime safety information/nautical information (MSI)** to NAVAREA VII. The transmission of corrections to nautical documents, in particular nautical charts, to the Shom is also essential;
- **not acquired for phase 2: hydro-oceanographic surveys** through the acquisition and archiving of data. **Above all, it is necessary to be able to verify or correctly specify the depths of the port areas and their accesses; A joint APMF/FTM activity already seems likely to be fruitful at this level;**
- **not acquired for phase 3, namely the production of official nautical charts (it could be ensured in co-edition with a third country).**

There are therefore still actions to be taken so that Madagascar can comply with the SOLAS convention (cartography) and thus prepare for the IMO audit (IMSAS) scheduled for 2024. These may be simply regulatory measures such as - this is recommended by the IHO - the signing of a cooperation agreement (Administrative Arrangement) with the country's current chart producer. This same agreement stating that, while waiting for complete autonomy, the nautical charts of Madagascar are already co-published (presence of Malagasy logos on the chart).



## MAIN COMMENTS, RECOMMENDATIONS

The majority of the recommendations are to be followed within the National Coordination Committee and therefore to be included on the agenda of the first meetings

Object	Comments – Recommendations
	<b>Phases 1,2,3 of development</b>
<b>Phase 1 development Maritime Safety Information (MSI)</b>	<ul style="list-style-type: none"> <li>• Clearly identify all the players in the maritime world who can know, observe events and provide nautical information and benefit from it: National Navy, fisheries surveillance, maritime pilots, APMF (coastal surveillance) ...</li> <li>• In order to consolidate the current execution, in accordance with the international regulations (IMO-IHO) and the national texts, specify by an interministerial instruction the methods of the collection and the diffusion (urgent, fast, deferred) of the information nautical (MSI: Maritime Safety Information)</li> <li>• Ports of national interest (PIN: Toamasina, Antsiranana, Mahajanga, Toliara) and regional (PIR) must be responsible for issuing local AVURNAVS</li> <li>• Maintain regular contact with:               <ul style="list-style-type: none"> <li>○ NAVAREA VII (South African Navy Hydrographic Office: SANHO): (fast broadcast on Inmarsat)</li> <li>○ And the current nautical chart producer (Naval Hydrographic and Oceanographic Service: Shom): timely updating of nautical publications, in particular by notice to mariners.</li> </ul> </li> <li>• Note: these recommendations can complement those that ALA has been able to express for its part on aids to navigation during evaluation missions.</li> </ul>
<b>Phase 2 development Hydro-oceanographic surveys from data acquisition to archiving</b>	<ul style="list-style-type: none"> <li>• Identify all national needs (with socio-economic issues) in terms of surveys (ports, cabotage, development of aquaculture and fishing, coastal environment, marine protected areas, security, etc.) and prioritize them</li> <li>• Identify (catalog whose drafting was recommended by the APMF and the FTM) all the possibilities of pooling material means (ships/boats) (GPS, sounders, tide scales, etc.) and human resources (geomatians, hydrographers, oceanographers, cartographers, computer scientists, logisticians, managers). It will be necessary :</li> </ul>

	<ul style="list-style-type: none"> <li>○ to have portable systems (inter-port use) for port hydrography (shallow-water single-beam echosounder)</li> <li>○ to train a few additional hydrographers for the acquisition of hydro-oceanographic data: that of a category B IHO certified hydrographer is strongly recommended</li> <li>● Regarding floating means (boats), Madagascar is not lacking (APMF, National Navy, fisheries surveillance, etc.)</li> <li>● Betting on satellite bathymetry</li> <li>● It is fundamental that Madagascar archives all survey data in a permanent way for shared valuations. The constitution of unique national databases (by parameter such as: bathymetry, tide, coastline, nature of the bottom, etc.) is essential.</li> <li>● This responsibility includes taking charge of the collection, qualification, provision of hydrographic and oceanographic data (depths, tides, type of bottom, topography of the coast, landmarks, beaconing, etc.). This database must be initialized with existing data (including historical data from Shom)</li> <li>● Designate one or more national referents per type of data. It would already be up to the FTM to manage the bathymetry and the tides</li> </ul>
<p><b>Phase 3 development</b> <b>Cartographic production</b></p>	<ul style="list-style-type: none"> <li>● The co-publishing of nautical charts with the Shom must be set up within the framework of an Administrative Arrangement</li> <li>● It is nevertheless logical and necessary for Madagascar to be able to gradually gain autonomy and already respond independently to specific cartographic needs such as sovereignty maps of State Action at Sea (institutional limits, EEZ, continental shelf extension, fishing zones, ...) or those of marine protected areas (Madagascar already produces Atlases to which the FTM can bring its added value). Nautical cartography contributes to the support of maritime policies</li> <li>● It is therefore necessary to properly identify the capacities that already exist through the drafting of a catalog already mentioned. In terms of terrestrial mapping, the FTM is already equipped, although insufficiently. However, other organizations also have geomatics resources that can be pooled through joint projects</li> <li>● Also train new expert agents in nautical cartography without delay: that of marine cartographer certified IHO category B will deserve to be followed in parallel with the development of phase 2 (hydrographic surveys)</li> </ul>

	<b>International relations : IHO Regional/SAIHC, France</b>
<b>Involvement in the Regional Hydrographic Commission (SAIHC)</b>	<p><b>Be present at the regional level</b></p> <ul style="list-style-type: none"> <li>• Participate in the next SAIHC (19th) plenary of 2023: <a href="https://iho.int/en/southern-african-and-islands-hc">https://iho.int/en/southern-african-and-islands-hc</a></li> <li>• In particular, participate in the seminar which will precede at the same place and which will focus on “Raising Hydrographic Awareness (for SAIHC Associate and Non-Members)”</li> <li>• Contact point: <a href="mailto:lucy.fieldhouse@ukho.gov.uk">lucy.fieldhouse@ukho.gov.uk</a></li> <li>• Important note: take advantage of the fact that the host country is Mauritius to discuss the successful process of hydrographic development (success story)</li> </ul>
<b>Administrative Arrangement (AA) with France</b>	<ul style="list-style-type: none"> <li>• This arrangement, which is still in the validation phase, will allow Madagascar to be in compliance with SOLAS</li> <li>• AA which will promote the progressive autonomy of Madagascar in terms of nautical cartography</li> <li>• Beyond the topics of cooperation already indicated, it will be appropriate to address the subject of databases, the importance of which was mentioned during the Technical Visit.</li> </ul>
<b>Surveys - results:</b> Updating nautical charts	<ul style="list-style-type: none"> <li>• As long as it is responsible for production and editing, it is essential to provide Shom with all available data (port surveys, new infrastructures, etc.) accompanied by quality files (metadata on the means used during the survey)</li> <li>• Contact all operators who have survey data and send them to Shom with the metadata (archive these data in Madagascar)</li> <li>• It should be noted that without the explicit authorization of the owners of the data, their use by the Shom is restricted to updating nautical charts. They are neither disseminated nor used in other products without the express written consent of the owners.</li> </ul>
	<b>Formation</b>
<b>Basic training (CAT B) for technicians in hydrography or cartography</b>	<p>Training in hydrography (data acquisition) remains fundamental, just like, in parallel, to accelerate the development of the country, that in cartography. Realistic objective given the existence, favorable, of an organization responsible for mapping the land, the coast and the sea (FTM)</p> <p>Requests for training in this direction should be re-launched with organizations having training courses approved by the IHO. The financial support of international cooperation organizations will be decisive in meeting the logistical and educational costs of these training courses which take place abroad.</p> <p>Once the numbers of senior technicians have been reconstituted, it will be time to train Category A hydrographers.</p>

	<b>Madagascar</b>
	<p>As written in the preamble, it is above all necessary that the Malagasy organizations concerned take ownership of the ideas that may have been exchanged during the Technical Visit. These ideas can be criticized, supplemented, reformulated by the FTM and its partners already within the framework of the work of the National Hydrographic Committee, to be convened as soon as possible.</p>

## Economic model of development

### Costs

The revival of Malagasy hydrography and charting will have an initial cost. The financial effort that international organizations should be able to make will be limited in time.

### Return on investments

An initial cost, then a sure return on national and international investments. This report already shows that organizations with commercial activities such as ports will be the first beneficiaries. Less measurable, it is a whole set of services, sovereign in particular, for the benefit of the State, its administration and its public establishments which will also generate a return on investment.

### How to prove it?

#### A business model first

By recalling that the search for the most economical solutions is part of the development model (already pooling).

### Quality governance

Then by communicating on the quality of governance (project management, budget sustainability, durability of results, etc.) that will be put in place. The role of the National Hydrographic Committee extended to physical oceanography and aids to navigation could be enhanced. For example, this governance will be particularly attentive to the following two subjects:

1. **Maintenance in Operational Condition (MCO)** of equipment: Concerning the equipment (which many organizations complain of financing with lost funds) it will be demonstrated that the country:
  - a. will be able to maintain them: the famous MCO, which must be proven to have been put in place with equipped specialists. It is the "support" function of any company that must be supported by an operating budget
  - b. will be able to provide for their replacement in its provisional budgets (investment budget).
2. **New income in perspective.** Concerning the viability/sustainability of the aid: a new controlled economic model will be specified:
  - a. as this is a public service activity, the Malagasy State will naturally have to continue to contribute to the FTM budget and augment it (e.g. salaries) to finance the recruitment of necessary hydrographers and marine cartographers;
  - b. that in addition, the production of nautical charts will generate income (sale of electronic charts in particular) that it does not currently have (it is France, the current producer, which receives this income). In addition to the autonomous production of nautical charts, there are related activities such as thematic charts (State Action at Sea, environment, etc.) and above all intellectual services based on know-how, of course, but also on all the reference data (geodesy, satellites, bathymetry, tide ...) that the FTM structures in databases, the base of any valuable knowledge.



### Maritime Safety Information : NAVAREA VII

*The South African Navy Hydrographic Office (SANHO), Coordinator of NAVAREA VII, in conjunction with the South African Meteorological Service, promulgates and disseminates shipping safety messages and weather information. Cape Town Radio, via Telkom Radio*

*services, is the GMDSS service provider and as such, transmits all MSI on behalf of the Coordinator*

Southern Africa – Indian Ocean (IOR):

10° 30'S, 055° 00'E (Mozambique international border with Tanzania, (East Coast) to

30° 00'S, 055° 00'E to

30° 00'S, 080° 00'E to the coast of Antarctica.

Operational Point of Contact for the National Coordinator within NAVAREA VII is:

Country	Institution	Telephone	Facsimile	Email
South Africa	South African Navy Hydrographic Office	+27 21 787 2445 +27 21 787 2408	+27 21 787 2233	hydrosan@iafrica.com

Port Control Vessel Traffic Services in South African hub ports provide information necessary for safe navigation within VTS routes and port approaches. However, a concerted effort is to be made to promote the dissemination of local warnings regarding hazards inside of the fairway buoy of any harbours by local port authorities within NAVAREA VII for safe navigation within VTS routes and port approaches. This would reduce the requirement to disseminate this information via Voice or NAVTEX or SafetyNET broadcasts via Cape Town Radio. SafetyNET coverage is available through the NAVAREA VII Coordinator for Angola, Namibia, Mozambique and Madagascar.

### Non-urgent nautical information: :

Survey, mapof ports : [bri@shom.fr](mailto:bri@shom.fr) / copy : [na-om@shom.fr](mailto:na-om@shom.fr) and [dmi-rex-d@shom.fr](mailto:dmi-rex-d@shom.fr)

**Postal address :**

Département « Informations et Ouvrages Nautiques »

Service hydrographique et océanographique de la marine (Shom)

CS 92803 - 29228 BREST CEDEX 2

FRANCE

## INTRODUCTION

### 1 Preparation of the technical visit

The visit was planned as part of the IHO Capacity Development Activity Program for the year 2023 :

- *CBWP 2023: action A-03 - « Technical Visit to Madagascar».*

It was initiated in close relationship with Mrs. NARY HERINIRINA IARIVO, Director of Geographical and Hydrographic Infrastructure at the FTM.

The terms of reference of the visit are recalled in Annex B.

### 2 Composition of the team

For the IHO, the visiting team consisted of :

<u>Name</u>	<u>Function</u>
Henri DOLOU	Project manager at Shom for capacity development in Africa (France under the IHO)

Were closely associated (participation in all visits) :

- Mr. Jean Désiré RAJAONARISON, Managing Director of the FTM (except on Toamasina);
- Mrs. NARY HERINIRINA IARIVO already mentioned;
- M Misan'ny Farany ANDRIANARISON, Head of Department, Geodesy, Hydrography, Leveling (CAT B)

In addition to that of the FTM, the involvement of the APMF, in particular its Managing Director Mr. Jean Edmond RANDRIANANTENAINA, was decisive.

The Navy also provided support (lieutenant commander Laurent-Napoléon Lazzari).

## PART A – OVERALL ASSESSMENT OF THE SITUATION IN THE REGION

### 3 Effectiveness of the Technical Visit

The follow-up of actions resulting from written recommendations will make it possible to measure the real effectiveness of the visit in the long term. A progress report can be made at the next meeting of SAIHC in 2023. The fact remains:

- That it could have been prepared prior to the TV through exchanges and analyzes of existing reports and texts;
- That the issues of hydrography, oceanography and nautical cartography have been addressed in terms of maritime navigation, the environment and the blue economy;
- The following appointments (Antananarivo, Toamasina) were held (chronological order, Annex E specifies the main authorities met):
  1. FTM : Foiben-Taosarintanin'i Madagasikara (Institut Géographique et Hydrographique Madagascar) du MATSF (Ministère de l'Aménagement du Territoire et des Services Fonciers) ;
  2. MDN/SG : Secrétaire Général du MDN (Ministère de la Défense Nationale) ;
  3. APMF : Agence Portuaire Maritime et Fluviale du MTM (Ministère des Transports et de la Météorologie) ;
  4. DGTMFA : Direction Générale des Transports Maritime Fluvial et Aérien du MTM
  5. Monsieur le Ministre du MATSF ;
  6. DCPVTM : Direction de la Coordination, de la Planification et de la Valorisation du Territoire Maritime du MATSF ;
  7. MN : Marine Nationale du MDN ;
  8. SPAT/DG : Société du Port à Gestion Autonome de Toamasina – Directeur Général (du MTM) ;
  9. SPAT/DT-DC : Direction technique et Direction de la capitainerie (Pilotage) ;
  10. Météorologie Madagascar à Toamasina du MTM ;
  11. APMF (Toamasina) ;
  12. Visite du port fluvial à Toamasina ;
  13. Aires Marines Protégées du MEDD (Ministre de l'Environnement et du Développement Durable) ;
  14. MPEB/ Direction Générale « Pêche et aquaculture » du MPEB (Ministère de la Pêche et de l'Économie Bleue) ;
  15. MPEB/ Direction Générale « Économie Bleue » du MPEB ;
  16. JICA (Japan International Cooperation Agency).
- That a restitution meeting (conclusions – recommendations) at the end of the visit could take place at the FTM. It was chaired by its Managing Director with strong involvement from the APMF Managing Director. The following stakeholders were represented: FTM, APMF, MN, MPEB, MATSF, MEDD;



- That the actors able to collect nautical information were again made aware of the SOLAS obligations ensured by Madagascar in connection with South Africa (NAVAREA VII) and France (current producer of the nautical documentation in force in the waters under Malagasy jurisdiction);

Reusable communication media have been provided dealing with :

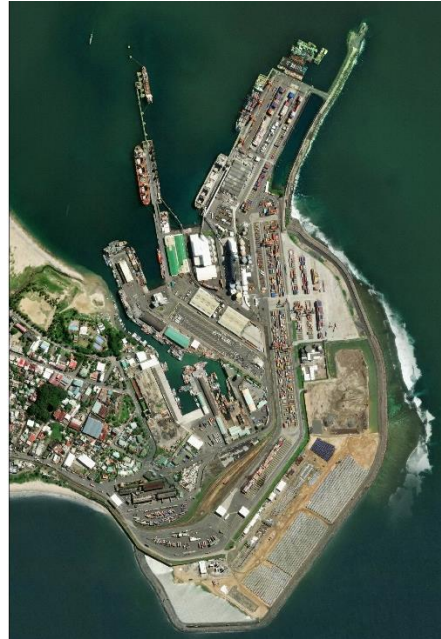
- On issues and governance (institutional context);
- On hydro-oceanography-marine cartography (challenges and professions);
- On the current description, in Madagascar, of the development (according to IHO standards) of hydrography and nautical cartography;
- Finally on the main lessons learned immediately at the end of the Technical Visit.

The discussions were professional and constructive. Recommendations have been made. Some of them, shared during the summary meeting, can be conducted in the short term such as (selection):

- In accordance with international regulations (IMO-IHO) and national texts, specify by an interministerial instruction the methods of **collection and dissemination (urgent, rapid, deferred) of nautical information (MSI: Maritime Safety Information)** for all waters under Malagasy sovereignty. It is essentially a question of validating and verifying the complementarity of actions that can be carried out by the main actors at sea (international commercial vessels, cabotage, Navy, fisheries surveillance, rescue at sea by the APMF, etc.). Given its missions, its involvement in the GMDSS, it is proposed that the APMF lead this action;
- Via the FTM, for **updating nautical charts and ENCs**, inform the Shom of port developments in Toamasina: supply of a georeferenced plan that can be used directly in a GIS. Occasionally promote exchanges between Shom and FTM cartographers and thus initiate the process of skills transfer;



**Extension plan (not georeferenced) of the port of Toamasina Source: Mr. RAJAONASY Emmanuel Julio Head of the New Works Department SPAT Technical Department**



**Orthophoto at 0.5 m du FTM**

- To stay in the port of Toamasina, take up the tide gauge folder, a fundamental subject (even more so for the ports on the West coast where the tidal ranges are greater than in the East) on which many parties stakeholders (those of the National Hydrographic Committee) will be able to meet.

It should be noted that the technical exchanges focused on the obligations of the SOLAS convention (chapter V) as well as on the expected socio-economic benefits. As such, hydrographic investments can generate very substantial and very rapid financial savings, in particular via:

- minimization of dredging operations;
- optimization of ship loading;
- the reception of new vessels with greater capacities but with much more demanding dimensions in terms of navigation constraints.

They also focused on the expected benefits in terms of the marine environment, in particular at the level of the land-sea interface (coastal development – coastal protection) as well as in terms of the development of cruising.

#### **4 International and regional cooperation – Defense**

a. [International and Regional Organizations]


OHI/IHO Status	Regional Hydrographic Commission	OMI/IMO	AISM/IALA
Non Member	Associated Member SAIHC	Member	Non Member


b. [Defence and security arrangements]: Topic not covered during the visit.



## PART B – MADAGASCAR - EVALUATION

### 5 Involvement in the Regional Hydrographic Commission (SAIHC)

	<p>Southern African and Islands Hydrographic Commission (SAIHC) Commission hydrographique de l’Afrique et des îles australes (CHAIA)</p>
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Constats	Actions
<p>As associate member, Madagascar (then represented by FTM) participated in the last commission in May 2022. Its last online national report (IHO) dates from this year. It was stated there:</p> <ul style="list-style-type: none"> <li>• that the signing of an Administrative Arrangement with France, such as membership of the IHO, were still pending.</li> <li>• that the activities of the National Hydrographic Committee (text being updated) were in the making</li> <li>• that Madagascar was awaiting the IHO Technical Visit (February 2023)</li> </ul>	<ul style="list-style-type: none"> <li>• Participate in the next commission of 2023 (SAIHC19)</li> <li>• <a href="https://iho.int/en/southern-african-and-islands-hc">https://iho.int/en/southern-african-and-islands-hc</a></li> <li>• Report on the decisions and actions taken following the recommendations of the Technical Visit of February 2023</li> </ul>
	<ul style="list-style-type: none"> <li>• In particular, participate in the “Raising Hydrographic Awareness (for SAIHC Associate and Non-Members)” seminar which will precede SAIHC19.</li> <li>• Seminar planned at the CBWP in 2023 (action P-07)</li> <li>• Contact point: <a href="mailto:lucy.fieldhouse@ukho.gov.uk">lucy.fieldhouse@ukho.gov.uk</a></li> </ul>
	<ul style="list-style-type: none"> <li>• Reference: link at (<a href="https://iho.int/en/saihc18-2022">https://iho.int/en/saihc18-2022</a>) <a href="https://iho.int/uploads/user/InterRegional%20Coordination/RHC/SAIHC/SAIHC18/SAIHC18_2022_6.4%20National_Report_Mauritius.pdf">https://iho.int/uploads/user/InterRegional%20Coordination/RHC/SAIHC/SAIHC18/SAIHC18_2022_6.4%20National_Report_Mauritius.pdf</a></li> <li>• As already proposed for the Comoros (VT of 2022, § 15 of the report) the representatives of Madagascar will be able to contact Mauritius (MHS: Mauritius Hydrographic Service) which has its own resources worth knowing about to identify the types of basic equipment and software to be purchased in order to start a data acquisition activity.</li> <li>• The reference report is also interesting to know (or even draw inspiration from) their development trajectory (how and at what pace to build a hydro-oceanographic capacity?) in an open national framework. The MHS does not act alone. It has "stakeholders" and "parastatal bodies"</li> </ul>

	<p>where we find the types of organizations deserving to integrate the National Hydrographic Coordination Committee.</p> <ul style="list-style-type: none"> <li>• It is suggested to back to the next SAIHC19 two additional working days dedicated solely to this activity. This would suppose on the one hand an agreement of the Mauritian party and the additional financing (hotel, meals) of additional days on site within the framework of action P-07 of the CBWP 2023:</li> <li>• “Raising Hydrographic Awareness (for SAIHC Associates and Non-Members)”</li> </ul>
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## 6 Preliminary contacts

The visit was mainly prepared through exchanges with FTM and the collection of open information on the Internet.

Shom was consulted as a producer and publisher of nautical charts and nautical publications (a permanent role).

Shom provided copies (GeoTiff and paper on site) of nautical charts.

SANHO (NAVAREA VII) was consulted for maritime safety information.

## 7 Technical Visit Contact Points – IHO Focal Points (P5-Yearbook)

The Technical Visit contact points are listed in Appendix D.

Concerning the IHO publication P5, an update is necessary: it is provided in annex G. Current IHO Yearbook reference (page 304):

[https://iho.int/uploads/user/pubs/periodical/P5YEARBOOK\\_ANNUAIRE.pdf](https://iho.int/uploads/user/pubs/periodical/P5YEARBOOK_ANNUAIRE.pdf)

The appointment of state and technical officials to the National Hydrographic Coordination Committee (Hydrography, Physical Oceanography, Cartography, Aids to Navigation) will be likely to review these representations if necessary.

## DESCRIPTION OF MARITIME ACTIVITIES

### 8 National Maritime Affairs - Actors

The duration of the visit (7 working days) made it possible to meet important players in the maritime transport chain but also in defence, the environment and the blue economy.

The talks focused on the issues associated with hydrography: beyond safety of navigation (international commitments – SOLAS), socio-economic performance through port capacities for receiving ships (including larger ones) and the optimization of their loading (through the depths shown on the nautical charts).

It was recalled that hydrography is an applied science dealing with the measurement and description of the physical elements of the seas and coastal areas. That its mastery necessarily intervenes in coastal protection (coastal development) thus underlining the transversal character of hydrography (physical oceanography is part of it) and consequently, at the governmental level, its interministerial ambition.

In terms of capabilities, according to the IHO criteria (The three phases: maritime safety information, surveys, cartography), the levels of development of the IHO are described in the chapter “PROPOSAL FOR COORDINATION AND DEVELOPMENT OF CAPACITIES”

#### 8.1 Main players

**8.1.1 Foiben-Taosarintanin'i Madagasikara (FTM) - Institut Géographique et Hydrographique Madagascar [Hydrographic Office]**



Reference : Décret n° 2020 – 1682 du 9 décembre 2020



FTM

From left to right : Narizo RAHAINGOALISON, Misan'ny Farany ANDRIANARISON, NARY HERINIRINA IARIVO, Henri DOLOU, Jean Désiré RAJAONARISON (DG)

**FTM is an EPA** (Public establishment of an administrative nature with a scientific, technical and research vocation) responsible for the control of geographical, hydrographic and cartographic information.

FTM is the National Authority for Cartography and the **National Geographic and Hydrographic Data Infrastructure (Infrastructure Nationale de Données Géographiques et Hydrographiques: INDGH)**.

The FTM includes within it:

- the National Center for Remote Sensing and Geographic Information (**Centre National de Télédétection et d'Information Géographique : CNTIG**)
- and an Advisory, Studies, Training and Geographic Information Unit (**Unité de Conseil, d'Études, de Formations et d'Information Géographique : CEFA-FTM**)

The equipment of the national territory and its maritime zones with a geographical and hydrographic reference data infrastructure called **INDGH**, unique, precise and homogeneous is assigned to FTM.

As such, FTM is responsible, exclusively, as a service of general interest as a Hydrographic Service:

- Install and maintain **tide gauges**,
- to carry out **bathymetric surveys** of the coast, ports and approaches, to carry out the work of geographical delimitation of maritime spaces and to establish **and update the nautical charts** of the maritime zones of Madagasikara;
- To represent Madagasikara with **regional and international organizations** in the field of hydrography;

FTM as a National Authority must ensure **the delegated public service** project management in terms of geographic and hydrographic data infrastructure, including:

- The **coordination and control** of all works of a hydrographic and cartographic geographical nature concerning the national territory and its maritime zones, ordered by the administrations, local authorities and public establishments as well as the **archiving and conservation of documents / data** relating thereto;
- **Publicity, dissemination** of basic topographic maps, **nautical charts**, derived maps, geographic and hydrographic reference **databases** and intermediate products subject to **cost recovery**;
- The completion of studies and technical assistance in relation to its missions for the benefit of public administrations and establishments and local communities
- To contribute to the development and exploitation of the results of the activities defined above.

The development of FTM naturally depends on its financial capacity for operation and investment. The sale of nautical charts and ENCs (obligatorily by the official hydrographic service of the country) may eventually generate additional income. Morocco's experience in this area can be analyzed knowing that there is no escaping an investment

**Note :** FTM maintains a geodetic network necessary for hydrography (localization at sea in WGS 84)

**For memory :** <https://www.facebook.com/FTMMadagascar>

**8.1.2 Ministère de l'Aménagement du Territoire et des Services Fonciers (MATSF) - Direction de la coordination, de la planification et de la valorisation du Territoire Maritime (MATSF/DCPVTM) [Ministry, top level parent organisation]**



**Source : Décret du MATSF : Décret n° 2020 – 081 du 5 février 2020**



**MATSF**

**Center : Monsieur le Ministre RAMAHOLIMASY Holder**

The Minister was able to insist on the importance of new technologies which "advance at full speed" and of which "we must keep pace".

This report probably does not deal enough about it. Meetings with the world of research (oceanography in particular) would have made it possible to do so. This report nevertheless recalls the importance of digital technology and discusses the innovative solutions provided by Earth observation satellites (Satellite Derived Bathymetry).



**MATSF/DCPVTM**

**Director first from right RANDRIANARISON Fanomezantsoa**



The Maritime Territory Coordination, Planning and Development Department (Direction de la coordination, de la planification et de la valorisation du Territoire Maritime DCPVTM) is responsible for:

- Develop and implement the plan for planning and enhancing the Malagasy territory as well as marine spatial planning;
- Initiate reflections and studies on the development of the Malagasy maritime territory;
- Ensure the regularization of the Malagasy continental shelf;
- Harmonize the actions of the ministerial departments concerned with the development of the maritime territory.

### 8.1.3 Agence Portuaire Maritime et Fluviale (APMF) [Maritime Affairs]



#### 8.1.3.1 Agence Portuaire Maritime et Fluviale (APMF) : Antananarivo



**Agence Portuaire Maritime et Fluviale (APMF) et Direction Générale des Transports Maritime Fluvial et Aérien (DGTMFA) du Ministère des Transports et de la Météorologie (MTM)**

**Front row, 3<sup>th</sup> from left : M Jean Edmond RANDRIANANTENAINA (APMF/DG)**

**Front row, 2<sup>nd</sup> from left: Jean Patrick RANDRIANASOLO (DGTMFA/DG)**

APMF is a public establishment of an industrial and commercial nature (EPIC) created by Decree No. 2003-659 of June 4, 2003, administratively, technically and financially autonomous, under the technical supervision of the Ministry in charge of Transport.

It is the authority responsible for implementing the general policy of the State according to the strategies adopted by the Ministry in charge of Transport concerning the port, maritime and river sub-sector.

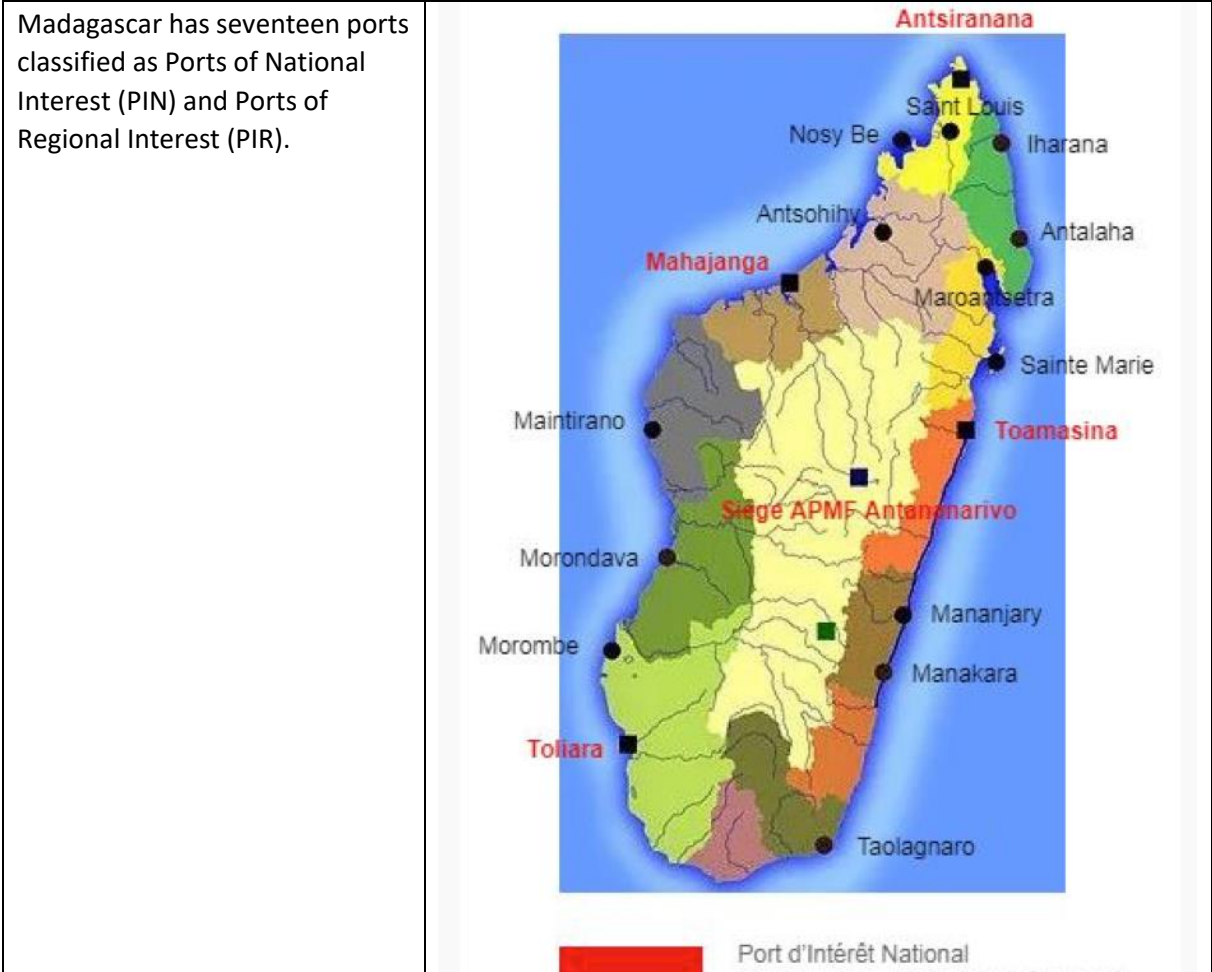
APMF is the maritime authority responsible for regulating the port, maritime and river sub-sector. Consequently, it coordinates the implementation of the national policy in the field of the said sub-sector.

In particular, it ensures:

- Administration of port, maritime and river affairs
- **Maritime and river "security and safety"**
- Regulation and management of port, maritime and river public domains
- **Protection of the coast and the marine environment**
- the development and promotion of the sub-sector

APMF is self-financing by paying for services provided to users of ports and maritime transport. The priority actions of the APMF in the port sub-sector are in particular the following:

- Upgrade port infrastructure and maritime **aids to navigation**
- Rehabilitate degraded infrastructure
- provide Madagascar with a master plan for ports



**Rescue at sea**

As part of its missions, APMF is also responsible for conducting search and rescue operations in the event of an accident at sea or in the river.

A selection of APMF vessels is presented in Annex I

**8.1.3.2 Agence Portuaire Maritime et Fluviale (APMF) : Toamasina**



**APMF direction régionale  
Right : Directeur M RAKOTOZAFIARIMAMY Ronsard Franck  
Officier de la marine marchande**



**Misan'ny Farany ANDRIANARISON (Chef de service, géodésie, hydrographie, nivellement) du FTM  
en discussion avec Razakatiana Jacquinot (pilote de pousseur au port fluvial de Manangazera) de  
l'APMF**



**From left to right : Tata Hasimbola Mamy Représentant de l'APMF au port fluvial de Manangareza  
(Canal de Pangalanes) et Razakatiana Jacquinot (pilote)**

#### 8.1.4 Marine Nationale (MN) [Navy]



Reference : DECRET N° 2003-1118 du 02 décembre 2003 portant création du Commandement des Forces Navales.



Marine Nationale (MN) du MDN

2<sup>nd</sup> from right: Contre-amiral Jacqy Honoré GA Chef d'État-Major

2<sup>nd</sup> from left à: Capitaine de vaisseau Leonide ANDRIANIRINA HERY Chef du bureau Opérations et renseignement

Article 4. Having operational infrastructures and ships, the Naval Forces Command has Naval Bases, Naval Units and Surveillance Flotilla Bases

Article 9. The Naval Forces Command is responsible for the following missions:

- monitoring and safeguarding national interests in territorial waters and in **the exclusive economic zone**;
- **support and backing for state bodies** in administrative, police, security or economic missions, formally ordered by the Commander-in-Chief of the Malagasy Army;
- **public sector transport and maritime works assistance**;
- humanitarian actions and assistance in the event of a disaster at sea or in coastal areas, particularly in the context of international obligations at sea;
- the protection of the **maritime environment**;
- naval intervention in the event of a cataclysm or catastrophe.

Article 10. The specific missions of the Command of the Naval Forces relating to the action of the State at sea, in particular the missions of administrative police and economic police at sea, as well as the attributions of the Commander of the Naval Forces and the Commanders of the ships relating to these missions will be fixed by specific texts

A selection of Navy vessels is presented in Annex I.



Navy's involvement in national hydrography could go beyond the provision of its boats. One of its officers could follow the Shom CAT B hydrographer training (to be done with the French Embassy). It could then be possible to make this hydrographer available to the FTM.

#### 8.1.5 Ministère de la Défense Nationale (MDN) – Secrétaire Général



The topics discussed with the Secretary General of MDN (certified hydrographer) focused on:

- The extension of the continental shelf;
- The blue economy (including the issue of cruise ship insurance which depends on the risks incurred in poorly surveyed waters);
- The floating means and crews of the Navy that can be placed at the service of national hydrography
- State Action at Sea (AEM);
- The integrated strategy with the General Secretariat for the Sea (SGMer) project. Thirteen ministerial departments are concerned with the sea;
- Ongoing renovations at the Antsiranana naval base (AEM);
- For “security” matters, the Malagasy CFIM (Maritime Information Fusion Center) and the Regional Coordination Center (CRCO) in the Seychelles.



**MDN**

**Center : Vice-Amiral Louis Antoine de Padoue RANAIVOSEHENO Secrétaire Général du MDN**  
**Right : Lieutenant- Colonel Henry-Sébastien DUPETY attaché de défense près l’ambassade de France**

**8.1.6 Société du Port à Gestion Autonome de Toamasina (SPAT) –  
Coopération SPAT/FTM [Port]**



**SPAT**

**Directeur Général 3<sup>th</sup> from left : M Christian Eddy AVELLIN**



**SPAT**

**Direction technique et Direction de la capitainerie (Pilotage)**

The Société du Port à Gestion Autonome de Toamasina (SPAT) is the authority in charge of the management and operation of the Port of Toamasina. It is a public establishment of an industrial and commercial nature, governed by the common rights of public limited companies. Its technical and administrative supervision is provided by the Ministry responsible for transport. The Port of Toamasina is the first Port of Madagascar (76% of international maritime traffic). Established in the Atsinanana region and is located on the East coast some 370 km from the capital of Madagascar.

The Port of Toamasina is classified as a "Port of National Interest" (PIN) with sufficiently adequate port infrastructure (quay, draft, embankment, storage warehouses), allowing the carrying out of commercial loading and unloading of long-distance ships.

JICA participates in the Toamasina Port Development Project (concessional loan).



Technical Visit team OHI – FTM at Toamasina

8.1.6.1 *Coopération SPAT/FTM : Cartographie haute définition du port*

Now that the port extension works are very advanced, the official nautical chart of the port (currently produced by the Shom) needs to be updated.



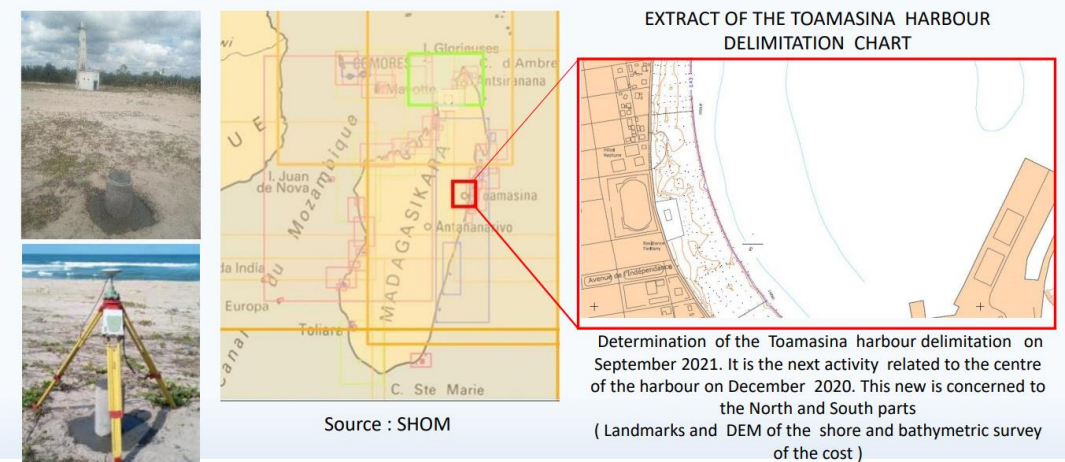
Toamasina Port Expansion Plan  
 Source: Mr. RAJAONASY Emmanuel Julio Head of the New Works Department SPT/ Technical Department

The above plan must reach Shom’s cartographers who are currently updating nautical charts. For technical reasons (georeferencing in WGS 84) and legal reasons (the FTM is the official hydrographic service of Madagascar) it is suggested that FTM organize itself with the SPAT to have a georeferenced digital plan which would then be transmitted to the Shom . A montage exploiting the orthophotos of the FTM at 0.5 m would give added value to the current plan of the SPAT.



The idea is also to promote exchanges between marine cartographers from Shom and the FTM so that the latter benefits from a transfer of skills. Ultimately, it is the port of Toamasina that will benefit in terms of responsiveness in updating nautical documents (eventually it is the FTM that will produce the Toamasina charts).

Note: FTM has already intervened for the benefit of the SPAT in order to delimit the limits of the port:



**8.1.6.2 Coopération SPAT/FTM : images satellites**

SPAT's interest in satellite images is completely legitimate, especially since free geolocated images (at 12 m) are now available, such as Sentinel-2 (10 m pixel) whose measurement repetitiveness is of 5 days.

Reference: <https://www.copernicus.eu/fr/acces-aux-donnees>

Knowing the experience that the FTM has in terms of remote sensing, it is also suggested here that SPAT should be closer to the FTM.



**Lighthouse of Toamasina**



**Our friends from FTM know how to take care of their geodesic network**

8.1.7 Centre régional de la météorologie (Toamasina) – Marégraphie [Tides]



Météorologie Madagascar  
2<sup>nd</sup> from left: Rhino RAJAONARIVONY



Actual tide recorder of the port  
The one put in place by Shom is no longer operational following backfilling work

Discussions focused on the many applications of tidal observation.

Of course, the correction of the depths measured at the port to bring them back to the lowest astronomical tide level on the nautical charts (Bathymetry).

But also the study of marine surges (difference between observed water heights and astronomical tide) and variations in mean sea level (climate change framework among others). These studies are essential when it is necessary to define (altitudes) port structures: minimum coasts/altitudes to be reached to cope with future extreme climatic events.

Without forgetting the navigation since the ships accessing the port have drafts approaching the depths of the nautical charts and the tide must be considered (even if it is relatively low as in Toamasina). This is indeed increasingly the case in many ports, with increasingly large container ship. Dredging solutions, extremely expensive, are not necessarily economical to optimize arrivals and departures from ports.

The tide must therefore be of interest to many organizations and professions: hydrographers, oceanographers, climatologists, maritime pilots, surveyors/geodesians (for the General Leveling of Madagascar: NGM), design offices for port engineering.

It is also very often of interest to young students looking for subjects and data as part of their training.

Unfortunately, everything had to be redone following the filling of the port and the disappearance of the permanent tide gauge known as the "Shom". This tide gauge was installed by Shom in 2010 as part of the GLOSS program (Global Sea Level Observing System) of the IOC (Intergovernmental Oceanographic Commission). It operated (monitored by Shom and Météo Madagascar) intermittently due to difficulties in transmitting data in real time by telephone.

There is indeed a new tide gauge whose installation could last only during the current major port extension works.

The current situation must therefore be clarified (status and description of the current tide gauge) then evolve to restore to the port the capacity of permanent observatory that it had.

As this is a local activity of national interest, the question arises of the identification of the stakeholders who will want to take part in the control of tidal observations (quality control, maintenance), their exploitation, their archiving (FTM which capitalizes all geodetic and leveling references including hydrographic zeros common to tide directories and nautical charts), etc.

A subject that deserves to be put on the agenda of the next meeting of the National Hydrographic Committee. It also makes it possible to find international cooperation on the promising theme of climate change.

The role that Météo-Madagascar can play with the FTM remains important (just as Météo France and the Shom - national tidal data manager - collaborate together on meteo-oceanographic subjects).

For memory :

- tide predictions for Toamasina are available at: <https://maree.shom.fr/>
- data already recorded (in addition to those available at Shom) can be accessed at: <http://www.ioc-sealevelmonitoring.org/ssc/>



**8.1.8 Ministère de l'Environnement et du Développement Durable (MEDD) : Aires Marines Protégées (AMP) [Environment and Sustainable Development]**



**MEDD : Ministère de l'Environnement et du Développement Durable**

Right : Liva Hariniaina RAMIANDRARIVO Coordonnateur du projet AMP : Aires Marines Protégées (about 10 in Madagascar)

The discussions focused on the one hand on data acquisition at sea and on the other hand on cartographic products.

There is indeed a potential for pooling to intervene at sea (implementation of various sensors from the same boat) to the archiving of data and their exploitation (production of thematic maps or atlases based on the same dedicated tools navigation charts).

The sharing of projects between FTM AMP can only be beneficial. It can be organized within the framework of Maritime Spatial Planning.

The fact that AMP is in contact with the MESR (Ministry of Higher Education and Research) can also be a source of data and innovation sharing between this ministry and FTM.

**8.1.9 Ministère de la Pêche et de l'Économie Bleue (MPEB)**



**MPEB : Ministère de la Pêche et de l'Économie Bleue**

3<sup>th</sup> from left : Rado RAKOTOSOA Directeur Général de l'Économie Bleue

5<sup>th</sup> from left : Etienne BEMANAJA Directeur Général de la Pêche et de l'Aquaculture

The interviews focused on:

- Fisheries surveillance patrol boats (the largest being in Mahajanga);
- Their employment potential, subject to financing the costs incurred by the hydro-oceanographic activity (eg fuel);
- Relations with the IHSM, the Fisheries Institute of Marine Sciences (University of Toliara) on which the CNDO depends (National Oceanographic Data Center – member of UNESCO-COI)
- According to: <https://www.ihsm.mg/event/jeudi-des-oceans-le-centre-national-de-donnees-oceanographiques/> : The National Oceanographic Data Center (CNDO) aims to collect, archive, quality control and disseminate oceanographic data and information in a variety of formats to users. This center has existed for about twenty years and has collected oceanographic data all over Madagascar
- For information: existence of a high-level committee, namely the “national multisectoral coordination structure for the blue economy and ocean governance in Madagascar”. Structure (tourism, transport, regional planning, NGO, etc.) to be considered for its interactions with the CNH (National Hydrography Committee).

A selection of vessels from the Fisheries Monitoring Center (CSP, Centre de Surveillance des pêches, which depends on the MPEB) is presented in Annex I

## 8.2 International cooperation

<p><b>8.2.1</b> Agence Japonaise de Coopération Internationale (JICA)</p>	 <p>Japan International Cooperation Agency</p>
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**JICA**

**1<sup>st</sup> from left : Mme Manoela RAZAFIMAHEFA Chargée de programme**

**4<sup>th</sup> from left : M Kozo KAWATA Adjoint au représentant résident**

The following suggestions could be made:

#### **8.2.1.1 Toamasina nautical chart update**

**Objective: update the nautical chart of Toamasina upon completion of the extension works.**

**Durably with each modification of the infrastructures and depths**

**Method: phase 1: acquire bathymetric data (depths of the port corrected of tides), topography (position of the quays, coastline ...) and aids to navigation**

- this must be organized with national resources without waiting for the very occasional arrivals of foreign survey vessels
- it's necessary:
  - boats (SPAT have)
  - data acquisition equipment: echosounder, GPS, tide gauge, digital acquisition system (APMF, SPAT and FTM combine, although unique, a minimum of equipment)
  - qualified Malagasy hydrographic operators (there are qualifying training courses approved by IHO in many developed countries: UK, US, India, France, Japan, etc.)

**Method: phase 2: update the nautical chart of Toamasina**

- With regard to updating an existing chart, the co-production with France must first be organised. This is being prepared with the signing of an Administrative Arrangement (IHO model) Madagascar / France. This arrangement puts in place the conditions for a gradual transfer of capabilities in hydrography and cartography. Fairly long process that requires material and human investments over time
- It's necessary :
  - data (see phase 1) qualified and managed in national databases (FTM has the capacity and above all the responsibility according to its constitutive decree);
  - get Malagasy marine cartographers (which presupposes having some) and French marine cartographers to work together (thus ensuring the transfer of skills and existing data);
  - this therefore also supposes having qualified Malagasy marine cartographer operators (as for "hydrography" there are qualifying training courses in "cartography" approved by the IHO in many developed countries: UK, US, India, France, Japan, etc.)

**JICA/JHOD (Hydrographic and Oceanographic Department -Japan Coast Guard): Training course.**

*The JHOD is conducting group training course "Hydrography for Charting, Disaster Management" (Internationally accredited Category B for Hydrographic Survey). This training course is implemented as part of the technical cooperation by the Japanese Government for developing countries through the JICA.*

### 8.2.1.2 Development of national hydrography

**For the record: A “success story” in the region:** 1999-2003: Mauritius: Establishment of Hydrographic Unit (JICA). Example of successful development already reported by IHO during a Technical Visit to the Comoros in 2022.

#### **Beyond the specific project in Toamasina: the development of national hydrography**

Based on a successful operation in Toamasina, build national capacity for the whole country. Mainly all its ports and cabotage waterways. Another necessity given the obsolescence of many nautical charts. An ambitious objective with high technical, economic (facilitating marine transport at a lower cost, in safety), environmental (hydrographic and physical oceanographic data such as marine currents are also used to control marine environments) and ultimately social value. Ambitious but achievable given the potential offered elsewhere by new technologies such as space remote sensing which makes it possible to make "spatial charts" (Satellite Derived Bathymetry). FTM already has a National Center for Remote Sensing and Geographic Information (CNTIG). Supporting it can only accelerate its development.

### 8.2.2 Marins Sans Frontières [Sailors Without Borders]



The actions of Marins Sans Frontières (an administrator in relation with APMF was contacted) are only discussed here insofar as the rescue boats at sea transferred to the APMF (which operates and maintains them) could (depending on their rate of employment in their primary mission which is rescue at sea) also be used for other public service missions such as national hydrography and therefore nautical cartography for the purposes of maritime safety for all users of the sea in Malagasy waters. These last missions are also complementary to the vocations of Marins Sans Frontières, in fact these are:

*“bring assistance and relief in developing countries to populations isolated by the sea or by a waterway and who depend on them. The association endeavors to improve by its maritime and river means their living and health conditions by facilitating human, economic and technical exchanges. »*

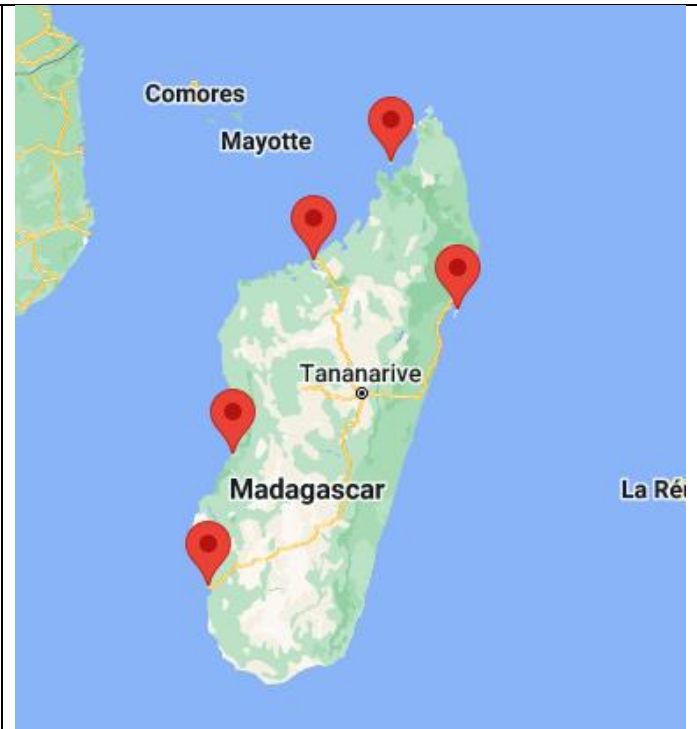
This complementarity can already be understood in the observation that the launches (embarcations) must be able to navigate safely in their areas of intervention thanks to up-to-dated nautical charts. They may have to intervene in areas that are currently unknown from a hydrographic point of view. As with all other floating means of intervention at sea (National Navy, fisheries surveillance, ports, etc.), their condition of availability for hydrography should also be established by protocol (additional costs such as fuel included).



Currently 5 launches :

- AÏDA (Mahajanga)
- TOSCA( Nosy Be)
- STELLA (Morondava)
- NORMA (Toliara/Tulear)
- DIVA (Nosy Boraha/(Ste Marie)

These launches are presented in Annex I



**Diva (Sainte Marie)**

### **8.3 Coordination: AEM and coordination relating to aids to navigation, hydrography, oceanography and nautical charting". The CHN: National Hydrographic Committee**

#### **8.3.1 State Action at Sea (AEM) – Project of the General Secretariat for the Sea**

The subject was not directly addressed.

Discussions are nevertheless underway as part of the country's integrated strategy through the establishment of an inter-ministerial General Secretariat for the Sea.

The objective is to harmonize the actions of 13 ministerial departments concerned by the sea "who (sic) do not speak to each other".

Infrastructure works are underway in the naval base of Antsiranana (Diégo-Suarez) within the framework of the AEM (blue economy context indicated).

### 8.3.2 Coordination relating to aids to navigation, hydrography, oceanography and nautical cartography": the CHN: National Hydrographic Committee

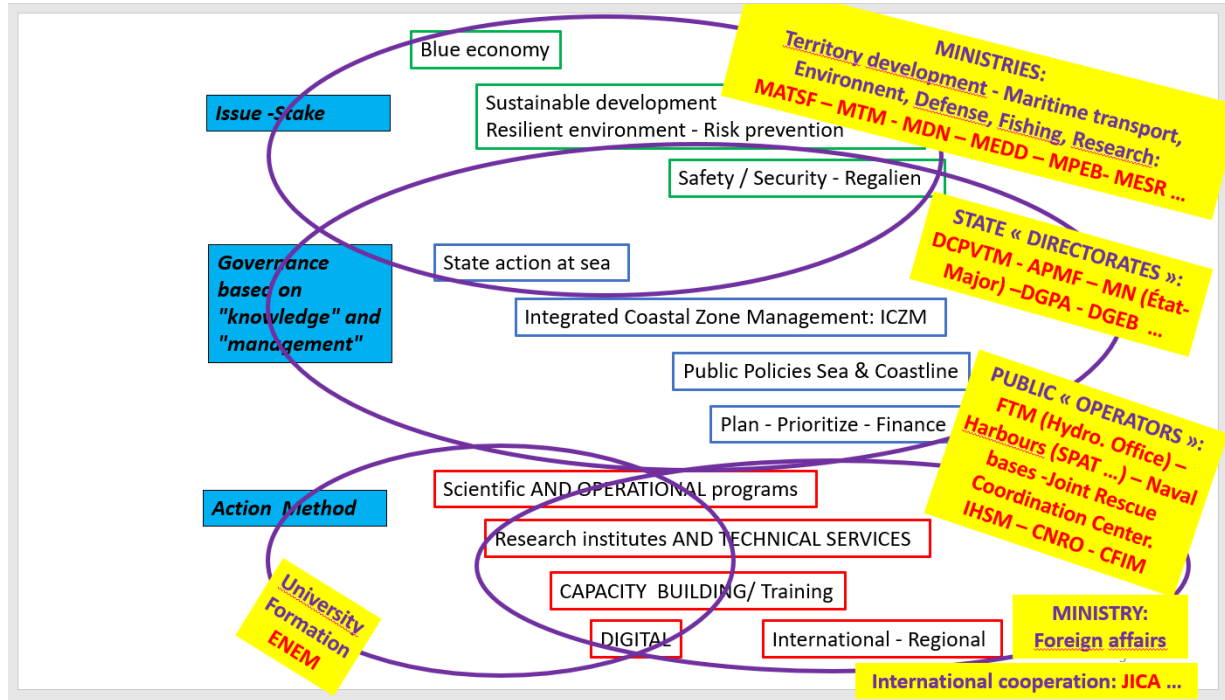
Reference : Décret N° 2011-120 du 07 mars 2011 de création du Comité Hydrographique National (Ministère de l'Aménagement du Territoire et de la Décentralisation) (Ministère des transports)

See chapter :

COORDINATION AND CAPACITY DEVELOPMENT PROPOSAL

/ National Coordination/Consultation Committee (Hydrography, Physical Oceanography, Marine Cartography, Aids to Navigation)

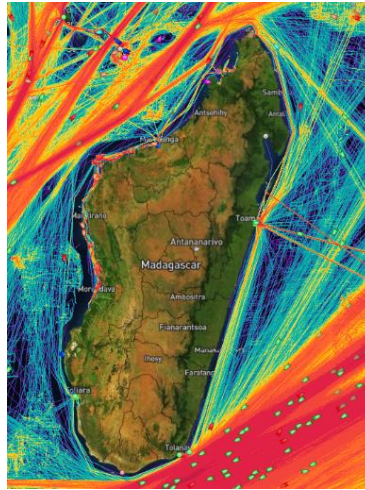
- Its necessity is recognised: many common needs, shareable skills, means to pool (through protocols, budgetary compensation if necessary);
- Its multidisciplinary (transport/navigation, coastal environment, safety/security, maritime fishing, research and education in oceanography, etc.) and inter-ministerial nature was underlined;
- Note: such a committee does not, however, constitute an operational national body for research, development and hydro-oceano-cartographic production. This CHN needs a strong arm: it is the official role of the FTM, which must first and foremost provide it with human resources. This presupposes a minimum budgetary support for lack of being able to benefit from all the resources listed in article 34 of its constitutive decree, in particular from royalties.



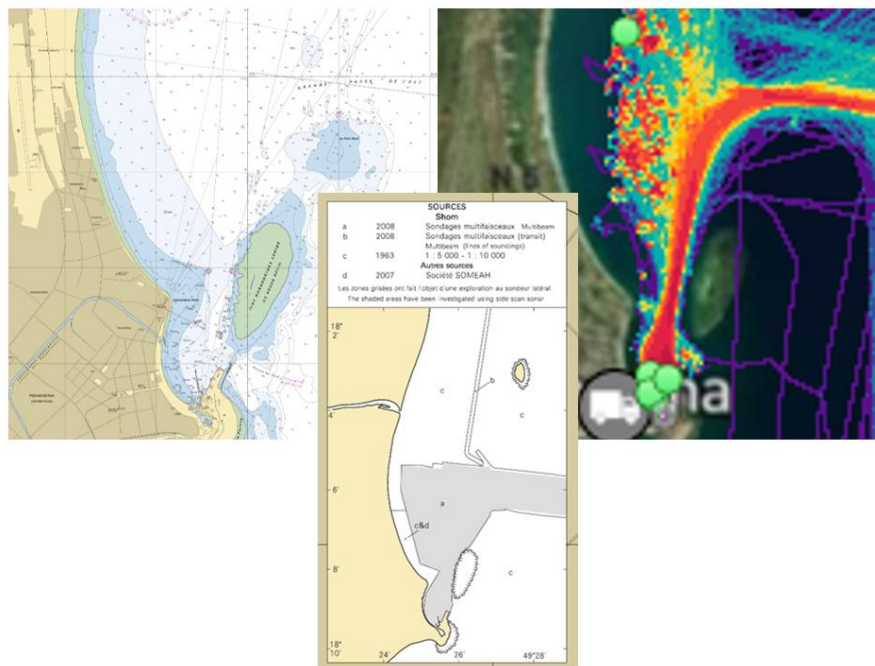
## 9 Maritime Trade and Traffic – Nautical Cartography/CATZOC

### 9.1 Traffic maritime

AIS data (source : <https://www.marinetraffic.com> )



General situation of maritime traffic around Madagascar



Access to Toamasina (Tamatave)

### 9.2 Marine/CATZOC charting

#### 9.2.1 Official cartography of Madagascar (see Annex H)

France ensures in fact (pending greater autonomy from Madagascar) the function of "Primary Chart Authority" through the production of nautical documentation made by the Shom on Malagasy waters. This cartographic responsibility must be recorded (SOLAS constraint) in order, already initially, to move to a Madagascar/France co-publishing stage, through an Administrative Arrangement currently being drawn up.

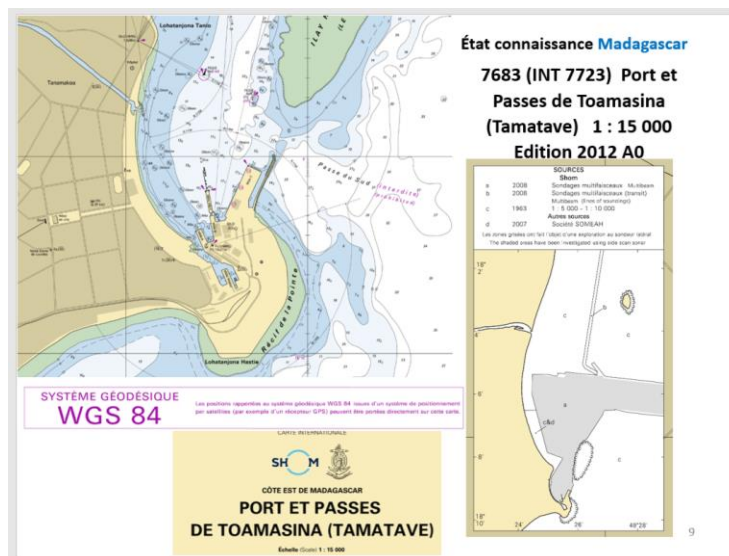
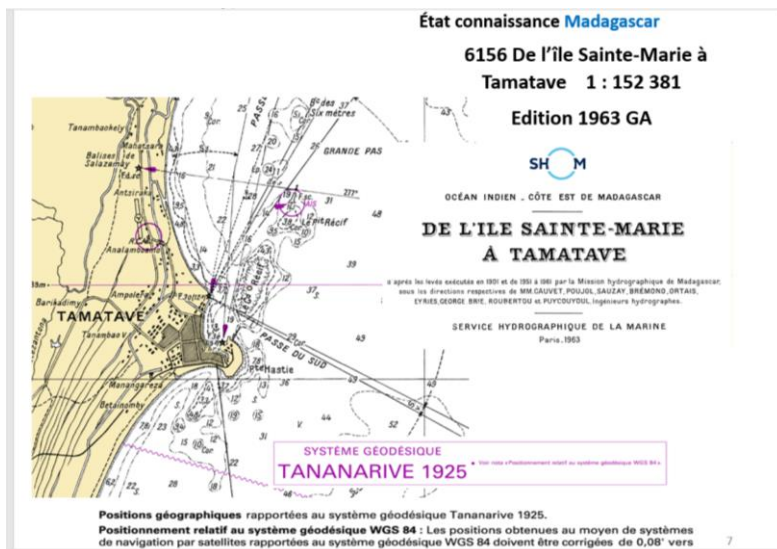
Malagasy waters are covered by a set consisting of paper charts, digital rasters in GeoTiff format and electronic navigational charts (ENC).

In reality, these products only cover (based on sufficiently recent hydrographic data) some accesses to major international ports. Cabotage is neglected. The quality of these maps can be assessed by the states of knowledge described in the following chapter. Concerning maritime navigation (access to ports, waiting and anchorage areas, quays) it depends fundamentally on regular bathymetric updates. Updates that are insufficient (see notes on the development of phase 2 concerning hydrographic surveys).

### 9.2.2 State of knowledge

La qualité des cartes est très diverse. Cela va de cartes qui ne sont pas encore dans le système

The quality of charts is very diverse. This ranges from charts which are not yet in the WGS84 geodetic system (the use of GPS is not easy) to charts which have recently benefited from hydrographic surveys conforming to current IHO standards and which have been reproduced in WGS84.





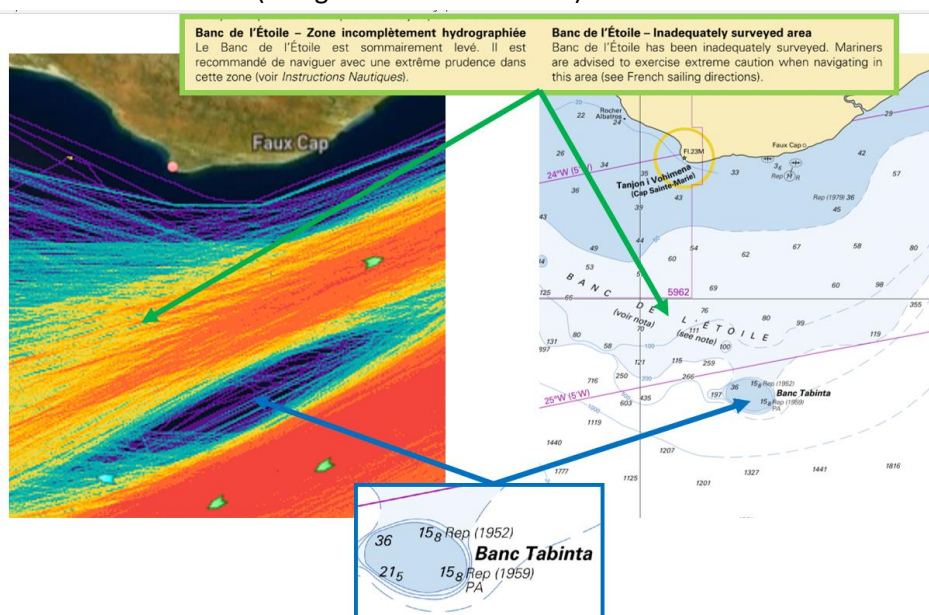
Source : <https://iho.int/uploads/user/pubs/cb/c-55/c55.pdf>

## Madagascar (H)

Nautical charting / Cartographie marine / Cartografía náutica		Offshore passage Navigation au large Pasaje offshore			Landfall and Coastal passage Atterrissage et navigation côtière Recalada y Pasaje costero			Approaches and Ports Approches et ports Aproches y puertos		
Coverage of charts published Couverture des cartes publiées Cobertura de cartas publicadas		100	0	100	100	0	100	80	0	80
<p>100% Covered by INT or other paper charts meeting S-4 Couvert par des cartes papier INT ou autres conformes S-4 Cubiertas por cartas de papel INT o otras cumpliendo S-4</p> <p>100% Covered by RNC meeting S-61 Couvert par des RNC conformes S-61 Cubiertas por RNC cumpliendo S-61</p> <p>100% Covered by ENC meeting S-57 Couvert par des ENC conformes S-57 Cubiertas por ENC cumpliendo S-57</p>		INT	RNC	ENC	INT	RNC	ENC	INT	RNC	ENC
Paper charts showing depth in meters Cartes papier avec les profondeurs en mètres Cartas de papel con profundidades en metros	100 %	Paper charts referenced to a satellite datum Cartes papier rapportées à un système géodésique satellitaire Cartas de papel referidas a un datum satelital			100 %	Data source Source des données Origen de los datos		France		
Notes Notes Notas	<p>1. Figures provided by France, courtesy of Madagascar.</p> <p>2. Large scale Paper coverage: missing (non INT scheme charts) Antsiranana, Tulear, Mahajanga, Taolanaro (Fort-Dauphin).</p> <p>3. Medium scale Paper coverage by US charts.</p> <p>4. Small, medium and large ENC coverage ensured by GB ENCs.</p>									

### Comments :

- There is good coverage of the country for offshore navigation
- Concerning coastal navigation, if there is 80% coverage, it should probably be checked that this satisfies cabotage and that the quality of these charts is based on sufficient hydrographic knowledge (see C-55 surveys)
- There are areas where hydrographic knowledge is insufficient or even non-existent. By correlating this knowledge with the current (including cabotage) and especially planned navigation zones, it will be possible to conduct a risk analysis and prioritize the national hydrographic surveys to be carried out. This is again a subject to be submitted to the coordination committee (navigational aids included).



**Banc de l'Étoile (incompletely surveyed) et Banc Tabinta (1952, approximate position)**

## **10 Responsibility for navigation (safety)**

Sur le plan étatique et réglementaire, cette responsabilité relève du Ministère des Transports et de la  
At the state and regulatory level, this responsibility falls to the Ministry of Transport and  
Meteorology (MTM) on which the Maritime and River Port Agency (APMF) depends. This agency  
ensures in particular compliance with the application of the maritime conventions of the  
International Maritime Organization (IMO).

## **11 Defense Force Responsibilities**

See the chapter dedicated to the Malagasy Navy (MN of MDN). The exercise of the AEM (civilian and  
military) requires support in terms of hydrography and nautical charting

## **12 Coastal zone management and environmental protection**

The subject was not specifically addressed.

However, the creation of marine protected areas has been reported, which necessarily requires:


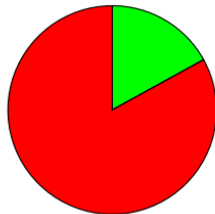
- to be managed (e.g. ecological monitoring), georeferenced data acquired at sea and on the coast (their acquisition and restitution are based on common techniques with hydrography and cartography);
- to have their limits plotted on charts, maps and atlases.

## INDICATORS C-55

### 13 Status of hydrographic surveys in the national maritime area

Source : <https://iho.int/uploads/user/pubs/cb/c-55/c55.pdf>

#### Madagascar (H)

Hydrographic surveying / Levés hydrographiques / Levantamientos hidrográficos							
Survey coverage Couverture hydrographique Cobertura hidrográfica		Depth < 200m Profondeur < 200m Profundidad < 200m			Depth > 200m Profondeur > 200m Profundidad > 200m		
<span style="color: green;">■</span> %	Adequately surveyed Correctement hydrographié Adecuadamente levantado	1	9	90	17	0	83
<span style="color: yellow;">■</span> %	Re-survey required Nécessitant de nouveaux levés Requiere nuevo levantamiento						
<span style="color: red;">■</span> %	Never systematically surveyed Jamais hydrographié systématiquement Nunca levantado sistemáticamente						
Notes Notes Notas	Figures provided by France, courtesy of Madagascar.						

**Note:**

- these indicators are solely based on the data available to Shom: there may be surveys carried out by oceanographic research organizations or by private companies, which are not known by Shom and therefore not used on nautical charts and in the C-55 indicator;
- they clearly show the lack of hydrographic knowledge in depths lower or higher than 200 m;
- hydrographic knowledge is particularly insufficient near the coasts (many areas with very low or no hydrography).

### 14 Collection and circulation of nautical information

It is appropriate for the main observers at sea (Navy, fisheries surveillance, maritime pilots, APMF/rescue at sea, etc.) to provide information to:

- South Africa to issue, if necessary, NAVAREA VII messages (rapid broadcast on Inmarsat);
- France (Shom via the FTM) in order to update nautical publications in a timely manner, in particular by notice to mariners. The transmission should be based on a state organization (interministerial text ensuring the complementarity of all actors) to be put in place (APMF).

The flow of information must relate to:

- nautical charts (eg: new depths, guaranteed dredging threshold, new quays, new aids to navigation, wrecks removed, submarine cables, etc.);
- sailing directions;
- list of lights;
- tides. The harmonic constants used for predictions must be made more reliable and precise using observations of water heights (tide gauges currently non-existent or insufficiently operational).



## 15 Hydrographic survey capability

This capacity is almost non-existent given the size of the country.

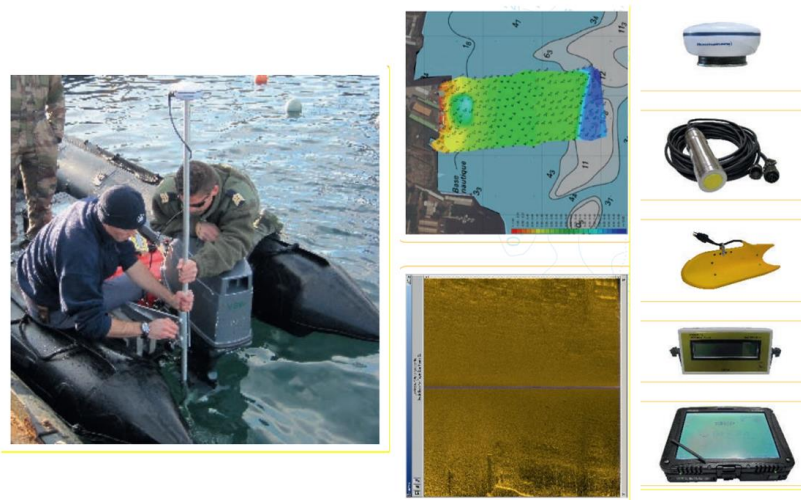
The consequences can already be very harmful in terms of port operations (arrival and loading of poorly controlled ships due to lack of knowledge of the seabed: depth, nature, obstructions) and ultimately the maritime economy.

It is possible to develop this capacity at a lower cost with an extremely short return on investment.

This supposes above all organization (see the National Hydrographic Committee) and financing to complete the existing equipment (divided between different organizations) These abilities (minimum to begin with) consist of:

- floating means (embarkations , floating boats): they exist (see Annex I
- an acoustic echo sounder (single beam sufficient)
- a side scan sonar for detecting obstructions
- a location GPS
- a data acquisition system (Personal computer and specific software)
- tide ladder and leveling means
- boat handling skills (sailors for navigation)
- human skills in the acquisition and processing of hydrographic data (hydrographer, geomatician)

Concerning this specific equipment, there are therefore portable integrated systems (in suitcases that can be moved by plane to be deployed from Antananarivo on the entire Malagasy coast) which are marketed.



## 16 Independent Nautical Chart Production Capability

There are no official capacities for the production of nautical charts, nor for their updating and distribution. This is entrusted to France (Shom), without it being however already formalized within the framework of an Administrative Arrangement “SOLAS” integrating the conditions of development of the country through training.

## COORDINATION AND CAPACITY DEVELOPMENT PROPOSAL

### 17 National Hydrographic Committee: CHN (Coordination/Consultation on Hydrography, Physical Oceanography, Marine Cartography, and Aids to Navigation)

The necessary hydro-oceanographic activities will not be able to develop without pooling resources at country level. Charge to the organizations carrying out related activities to integrate the current and future needs extended to the whole country.

At the heart of pooling:

- acquisitions of hydro-oceanographic data at sea (coast) and in ports with existing ships or embarkations;
- their qualifications, archiving, shared distribution;
- shared projects (navigation, marine environment, safety, infrastructure development, etc.) on the creation of a “marine geosciences” knowledge base.

A NHC (CHN) already exists, created by decree N° 2011-120 of March 07, 2011. It didn't get together much.

It is understood that the National Authority in charge of the Hydrographic Data Infrastructure is the FTM. It is therefore he who provides the secretariat and the presidency of the NHC.

Coordination must be well organized (strong IHO recommendation for all countries). The multidisciplinary and interministerial nature of the issues must also be organized around AEM (State Action at Sea).

This committee (inter-ministerial, inter-agency) is an essential link in the operational organization of the Malagasy State (technical services for study, data management, production, etc.) to be sustained (and therefore financed) for the execution of development programs in hydrography, oceanography, nautical cartography (sea and coast) and aids to navigation.

The organization and execution of training in Madagascar and abroad are part of the development programs and therefore the subjects of the committee.

#### Propositions :

- First of all, bring together the actors of this committee again around a table and recall its mandate. The IHO publication M2 makes recommendations to the IHO “The need for national hydrographic services”: [https://iho.int/uploads/user/pubs/misc/M-2\\_3.0.7\\_E\\_06142018.pdf](https://iho.int/uploads/user/pubs/misc/M-2_3.0.7_E_06142018.pdf);
- It is a question of relaunching a dynamic at the institutional and technical levels, by redefining the corresponding actors: hydrographers, oceanographers, aids to navigation, surveyors, geomaticians, cartographers without forgetting the support functions in particular in computer science;

- The collection of needs (navigation, environment, etc.) in products (eg charts) and services (eg tide predictions, extreme coastal events, etc.) will naturally lead to specifying the needs for the acquisition of hydrographic and oceanographic data. An essential step before prioritizing these acquisitions, and planning them by identifying the organizations (to be supported) or companies (to be contracted) that can carry them out;
- The collection of data is only economically conceivable if these are widely shared (one data - several applications – the SOLAS application through nautical documents being only one among others) and exploited. This raises the problem of archiving and disseminating data at the national level. Techniques and tools are better and better mastered with databases and communication and download portals. The fact remains that this requires IT structures and dedicated skills to be set up. This is a fundamental structural point to put on the agenda of the first meeting: setting up a Maritime Spatial Data Infrastructure (MSDI). Here too, it must be possible to rely on what already exists.

## 18 Phase 1 Hydrographic Capabilities: MSI and GMDSS

### 18.1 Introduction

Maritime Safety Information (MSI), as defined in International Maritime Organization Resolution A.705(17) and detailed in the joint IHO/IMO/WMO Handbook on MSI (IHO Special Publication S-53), consist of the collection and dissemination of navigational and weather warnings, search and rescue information and other urgent safety information, including nautical information relating to nautical documentation.

The dissemination of these MSI is based on the Global Maritime Distress and Safety System (GMDSS) an international system that uses telecommunications means for search and rescue at sea (SAR) and the prevention of maritime accidents.

In addition, MSIs in their broadest sense include the updating of navigation charts and other nautical publications (list of lights, radio signal, sailing directions, etc.). The MSIs need an organization (procedures for collecting, transcribing and transmitting information, maintained equipment, trained personnel) with a national MSI coordinator in relation with the navigators, the cartographic authority (France /Shom) and NAVAREA VII (South Africa/SANHO).

### 18.2 The role of APMF

During the summary meeting at the end of the Technical Visit, APMF (MTM) was able to present its activities within the framework of the search and rescue system in Madagascar (SOLAS and SAR convention in particular). The organization in place has been described with its 13 VHF (AIS) coastal stations, its 3 MF/HF stations (Toamasina, Mahajanga, Toliara) and the MRCC of Antananarivo (in progress). The maritime traffic management tools mentioned are: SeaVision, ExactEarth shipview, IORIS platform).

Among the prospects mentioned is the implementation of the Navtex system for coastal MSI.

The embarkations available at APMF are presented in Annex I.



Presentation of M Mamy Thierry RANDRIANAVONY Directeur des Opérations en Mer (DOM) de l'APMF

### 18.3 Level of Development - Summary

Phase	Object	Level of development – Comments
1	Collection and transmission of Maritime Safety Information/Nautical Information (MSI) to NAVAREA VII. Transmission of corrections to nautical publications, in particular nautical charts to Shom	<b>T confirm</b> <i>“The country fulfils its national obligations in a sustainable manner”<sup>1</sup></i> It is not proven that all MSI are communicated to the NAVAREA VII coordinator (South Africa). Shom can receive information for updating charts. An inter-ministerial instruction where efficiency must above all count, may specify the roles of the stakeholders: observers at sea, APMF, FTM, etc.

Reference : « MSI Assessment for NAVAREA VII » sur :

[https://iho.int/uploads/user/Inter-Regional%20Coordination/WWNWS/WWNWS14/WWNWS14\\_2-1\\_VII\\_2022\\_NAVAREA\\_VII\\_SA.pdf](https://iho.int/uploads/user/Inter-Regional%20Coordination/WWNWS/WWNWS14/WWNWS14_2-1_VII_2022_NAVAREA_VII_SA.pdf)

## 19 Phase 2 Hydrographic Capabilities: Conducting Surveys

### 19.1 Introduction

#### 19.1.1 Classic bathymetry (ships, echo sounders, etc.)

These capacities mainly consist in conducting bathymetric surveys (depths brought back to the level of the lowest astronomical tide (LAT) taking into account the tide). Capacities can be classified into 3

<sup>1</sup> Référence : <https://iho.int/uploads/user/Inter-Regional%20Coordination/CBSC/MISC/Templates%20Procedures/PDF/Procedure%2011.pdf>

categories: the open sea (the surveys for the legal extension of the continental shelf fall into this category), the coastal (for example for cabotage), the ports and their immediate accesses.

As indicated in the chapter “Status of hydrographic surveys in the national maritime zone”, given the size of the country, there is a lot to be done and for a long time.

However, are these hydrographic capabilities non-existent?

It all depends on what you want to do and what priorities you set. If it seems difficult to conduct offshore bathymetric surveys (need for dedicated hydrographic vessels), it seems much more accessible to conduct port surveys.

As indicated in the summary meeting, a “catalogue” of existing material and human resources must be drawn up. This work was not done in depth during the visit.

The fact remains that APMF (boats, echo-sounder, GIS specialist, topographical surveyor, etc.) and FTM (geodesy, geolocation, levelling, OHI CAT B qualified hydrographer, geomaticians, etc.) already seem to be able to constitute, together, a capacity pooled enough to undertake the first hydrographic surveys, for example in Toamasina and Mahajanga, to name only two ports of economic importance.

Once set up and made operational on a targeted project (initially Toamasina), this mixed capacity can be developed to undertake coastal surveys (including marine protected areas) on a larger scale involving other partners such as the Navy or the fishing surveillance.

**19.1.2 Satellite Derived Bathymetry (SDB)**

This method was quickly exposed as a complement to traditional bathymetry using acoustic sounders (the SPAT took an interest in it). The vastness of the areas to be explored encourages the use of satellite data, some of which is free (Sentinel-2). Depth knowledge needs expressed by the MPEM (Fisheries) could, for example, support the development of aquaculture. The country is not without capacity in remote sensing (FTM for example). What may be missing is the availability, in Madagascar, of algorithms to invert the radiance (color of the water) measured by satellites in depth. The technique is already implemented in private companies and hydrographic offices around the world. A subject that should interest FTM and other Malagasy organizations specialized in oceanography to provide the country with this capacity. To approach the subject, it is already suggested to consult the articles of "The International Hydrographic Review" to get an idea: <https://ihr.iho.int/> ( <https://ihr.iho.int/?s=satellite>

**19.2 Level of Development - Summary**

Phase	Object	Level of development – Comments
2	Hydrographic and oceanographic surveys through data acquisition	<p><b>Eventually for offshore surveys</b></p> <p><b>Immediately for port surveys</b></p> <p><i>“The country is aware of its national obligations but does not have “national” means to do it”</i></p>

		<p>It is sorely lacking in bathymetry resources to deal with the immensity of the country. The actual depths in the ports (along the quays) can be uncertain, generating both risks (lower depths than the soundings on the official nautical charts) and port under-exploitation (estimated depths lower than reality).</p> <p>Obstructions (anchors, chains, containers, etc.) could exist in navigation, waiting or even mooring areas.</p> <p>Tides, for lack of observatory, but also of skills is not mastered.</p> <p>Among other things, it is necessary to define the hydrographic vertical datums (levels of the lowest astronomical tides referenced on nautical charts) wherever hydrographic surveys must be conducted (and the tides predicted).</p> <p>As nevertheless specified in the introduction, it is possible to get started (port surveys to begin with) even if the existing equipment is not yet complete. All that is missing is a not necessarily very expensive obstruction detection sonar and tide gauges while waiting for digital tide gauges. The problem is that the existing equipment, boats and human skills are distributed between different organizations coming under different ministries between which cooperation can be reduced for lack of protocols or more prosaically of financial means of compensation.</p> <p>The country does not lack embarkations. What may be lacking are funds to meet marginal additional costs.</p> <p>Once launched on simple operations (the port) it will be easier to conduct coastal surveys which are also not out of reach once all the stakeholders have taken the time to meet, share their needs and pool their resources.</p> <p>This is above all the interest of the National Hydrographic Committee (CHN) for coordination (we will add oceanography, nautical cartography and aids to navigation) to be set up.</p> <p><b>PHASE 2 (raised by small funds) IS A PRIORITY</b></p> <p>Please note that mastering the conduct of hydro-oceanographic surveys includes their specification (upstream) and their qualification (ultimately downstream). Two skills that are also essential when operations are outsourced. It is indeed necessary to be in a position to obtain just enough at the right price (subcontractors must not be judge and judged as for example, often, for dredging).</p>
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## 20 Phase 3 Hydrographic capabilities: production of nautical charts

### 20.1 Introduction

This is, above all, to provide mariners with official nautical charts that meet SOLAS requirements. This provision can be provided by Madagascar or in an organized manner with a third country. Due to less significant regulatory constraints (standards, updating and dissemination), cartographic documents (geomatics) for various applications such as coastal development, management of marine protected areas, environmental monitoring or specific AEM maps, must be able to be produced by Madagascar itself.

### 20.2 Level of Development - Summary

Phase	Object	Level of development – Comments
3	Production of charts and nautical publication	<p><b>Eventually</b>  <i>“The country fulfils its national obligations through a third party”</i></p> <p>The completion of the Administrative cooperation Arrangement project with France would in particular make it possible to comply with the SOLAS convention and prepare for the future. It is indeed logical and necessary for Madagascar to be able to gradually gain autonomy and already meet specific cartographic needs such as sovereignty maps of State Action at Sea and those of marine protected areas. It is therefore necessary to clearly identify the already existing capacities in terms of geomatics (FTM national geographic service does not lack them) to pool them through joint projects. This constitutes one of the first actions to be carried out within the National Hydrographic coordination Committee. It is by exchanging data (and metadata) with the Shom, and simultaneously checking how these are used to update nautical charts, that the transfer of skills can be initiated.</p>

## 21 Summary of National Hydrographic Capability Assessment - Table

IHO	SAIHC	NHC (1)	Phase 1 (2) Capacity	Phase 2 (3) Capacity	Phase 3 Capacity
NON Member	Associated Member	YES ... but	YES	VERY LIMITED (3)	NO (4)

- (1) National Hydrographic Committee (coordination role and national decision). The NHC has not met for a long time, however.
- (2) Maritime Safety Information. It remains to consolidate the organization in place to operationalize exchanges with NAVAREA VII (South Africa) and the current producer of nautical charts "SOLAS" for updates (France)
- (3) Hydro-oceanographic surveys (priority to be given to ports) through data acquisition and archiving.
- (4) "SOLAS" charting. Co-publishing with France (Shom) to be set up within the framework of an Administrative Arrangement



## FORMATION

### 22 Basic training of senior hydrographic technicians (not only!)

#### 22.1 Initial training of hydrographers

This is fundamental.

Madagascar, according to the information gathered, currently only has one manager who has had sufficient specific training in hydrography (at FTM - CAT B).

It is now a question of being able to have hydrographers in sufficient quantity and quality. This could be a pool of hydrographers from administrations involved in the development of hydrography and physical oceanography.

This is a topic about:

- staff recruitment (and retention). This could be done opportunely among young people who already have experience in geomatics, geodesy, physical oceanography or even maritime navigation. The financing of corresponding salaries may be a prerequisite;
- and their training (specialization)
  - The recommended training is that offered by schools whose programs are approved by the FIG/IHO/ICA (International Federation of Surveyors, International Hydrographic Organization, International Cartographic Association) with Category B (CAT B).
  - List of recognized programs at: <https://iho.int/en/ibsc-recognized-programmes>  
There are many programs in English (Indian Ocean countries such as Bangladesh, India, Indonesia or even Japan a little further with JHOD/JICA) and French (Canada, France)
  - These trainings will give enough versatility to satisfy almost all the skills needed for data acquisition at sea and on the coast. The CAT B hydrographer will be able on his return to his country to train the "aid-hydrographers" that the country needs ("CAT C")
  - The practical training which supplements the theoretical training of the schools will be, for the hydrographers with a port vocation, opportunely carried out in a port operating dredging and having a service in charge of hydrography.

Note :. The human investment must be accompanied by an investment in equipment so that the trained personnel can immediately after their training put their knowledge into practice.

#### 22.2 Initial training of "marine" cartographers

This is also a goal to keep in mind. Ultimately, even if it is essential to build a base of hydrographic reference data, the country does need quality cartographic products and services to cover the waters under its sovereignty. The idea that first hydrographers specialized in data acquisition and only then marine cartographers is not relevant. Proceeding sequentially will take more time for the country to achieve its autonomy in terms of production, updating, distribution and sale of nautical charts (ENC included).

It is moreover this "cartographic" desire that will generate the need for data and therefore for hydrographic surveys.

The progressive part that Madagascar will take in the production of nautical charts (therefore in connection with the Shom), its own capacity to produce sovereignty charts for the AEM, can only benefit from solid training in cartography dedicated to maritime navigation. A category B training (CAT B) is therefore recommended.

List of approved programs (fewer than in hydrography) on:

<https://iho.int/en/ibsc-recognized-programmes> .

### **22.3 Also have "support" and "managerial" skills - Apply**

The personnel, once trained, will have to quickly put their theoretical knowledge (school) into practice and then validate their practical qualification after two years: that is to say, move on to operations by conducting surveys exploited by marine cartographers and marine environment specialists.

It is also recalled the importance:

- the "Support" function in specific equipment (GPS, echo sounders, tide gauges, etc.): maintenance in operational condition of equipment, IT (software, databases, webmaster, etc.).
- the "management" function which will be very important to coordinate (committee) in a global way at the national level (inter organizations) the development of hydrography and nautical cartography of the country:
  - completeness of the needs (to be planned) to be met (navigation, coastal development, coastal protection, etc.); Definition of the corresponding products (charts in particular);
  - identification of all stakeholders (public and private) who have an interest in cooperating to derive benefits (they come together to pool capacities);
  - definition of the production systems to be implemented: hydro-oceanographic, cartographic and support functions (logistics);
  - definition of the means of intervention at sea (boats ...);
  - definition of infrastructures on land for data processing and archiving;
  - definition of governance (supervision, contracts of objectives and means, therefore financing, agreements);
  - definition of human resources needs in sufficient quantity and quality for all structures and all professions combined;
  - Definition of financial needs.

## **23 Continuous training in hydro-oceanography - cartography and related activities (aids to navigation, port infrastructure works and coastal protection) - Management**

### **At the international level in hydrography**

There are actually many opportunities and facilities to maintain knowledge in hydrography. It is still necessary to know them and be encouraged to follow them.

- IHO:
  - which offers training materials at: <https://iho.int/fr/publications-sur-le-renforcement-des-capacites> . In particular, there is a high-quality hydrography manual;

- who organizes seminars. In particular, SAIHC will organize a seminar "Raising Hydrographic Awareness (for SAIHC Associate and Non-Members)" which will precede CHAIA19 in 2023 (<https://iho.int/en/southern-african-and-islands-hc> )
- Shom (<https://www.shom.fr/> ) which in addition to the statutory training of its school (CAT B) also offers opportunities for training in tide gauges (<https://www.sonel.org/> );
- AFHy: Association Francophone d'Hydrographie (<https://www.afhy.fr/> ) where in particular hydro-cartographers of ports and rivers meet.

**Note :**

- Also identify the E-learning opportunities that will develop (at Shom in particular in French);
- There is a need for regional training schools (Central and Southern Africa) in hydro-oceanography-cartography. It is necessary to get out of the current situation where there would be no other alternative than to enroll the agents to be trained in hydrographic schools outside the African continent.
- They may be French or English speaking.
- The technical visit did not address this fundamental subject and therefore did not make it possible to identify the structures (schools, academies, etc.) ready (immediately or in the long term) to host, in the region (Central and Southern Africa, Ocean South Indian) certified hydrographer and cartographer training.

**Various at national level (Madagascar)**

It is likely that national skills (public, private) were not inventoried in a sufficiently exhaustive manner during the Technical Visit, such as:

- qualified surveyors, specialists in remote sensing (a means widely used in hydrography) and in GIS (Geographic Information Systems - in support of the professions mentioned above) elsewhere than at the FTM;
- IT specialists skilled in databases or even distribution websites;
- engineers and technicians from engineering companies.
- What the TV has especially lacked are exchanges with oceanographers and the academic world (research and training). This would have required more time and planning other trips outside Antananarivo.

These are transversal skills essential to the development of Malagasy hydro-oceanography-charting that cannot be brought together in a single organization.

These skills will be particularly important within the National Hydrographic coordination Committee. Participation in IHO meetings and more particularly in SAIHC meetings and seminars makes it possible to exchange with counterparts from other coastal States of southern Africa and the Indian Ocean.

Editor



Henri DOLOU

## ANNEXES

### Annex A : Abbreviations

AEM	Action de l'État en Mer
APMF	Agence Portuaire Maritime et Fluviale
CATZOC	<i>Category Zone of Confidence</i>
CBSC	<i>Capacity Building Sub-Committee (IHO)</i> Sous-comité de renforcement des capacités (OHI)
CBWP	<i>Capacity Building Work Programme (IHO)</i> Programme de travail de renforcement des capacités (OHI)
CEFA-FTM	Conseil, d'Études, de Formations et d'Information Géographique (FTM)
CFIM	Centre de Fusion d'Informations Maritimes (sûreté)
CHN	Comité Hydrographique National
CNTIG	Centre National de Télédétection et d'Information Géographique (FTM)
CNDO	Centre national de données océanographiques (IHSM)
CNRO	Centre National de Recherches Océanographiques (MESR)
CHAIA SAIHC	Commission Hydrographique de l'Afrique et des Iles Australes <i>Southern African and Islands Hydrographic Commission</i>
CSP	Centre de Surveillance des pêches (MPEB)
ECDIS	<i>Electronic Charts Display Information System</i>
ENC	<i>Electronic Navigational Chart (sea)</i> Carte électronique de navigation (mer)
ENEM	Ecole Nationale d'Enseignement Maritime (APMF/MTM)
FTM	<i>Foiben-Taosarintanin'i Madagasikara</i> Institut Géographique et Hydrographique
GMDSS SMDSM	<i>Global Maritime Distress and Safety System</i> Système Mondial de Détresse et de Sécurité en Mer
IALA AISM	<i>International Association of Marine Aids to Navigation and Lighthouse Authorities</i> Association Internationale de Signalisation Maritime
IHO OHI	<i>International Hydrographic Organization</i> Organisation Hydrographique Internationale
IMO OMI	<i>International Maritime Organization</i> Organisation Maritime Internationale
IHSM	Institut Halieutique des Sciences Marines (Université de Toliara)
INDGH	Infrastructure Nationale de Données Géographiques et Hydrographiques (FTM)
IOC COI	<i>Intergovernmental Oceanographic Commission</i> Commission Océanographique Intergouvernementale
IOC	<i>Indian Ocean Commission</i>
JHOD	<i>Hydrographic and Oceanographic Department, Japan Coast Guard</i>
JICA	<i>Japan International Cooperation Agency</i> Agence Japonaise de Coopération Internationale
MATSF	Ministère de l'Aménagement du Territoire et des Services Fonciers
MDN	Ministère de la Défense Nationale
MEDD	Ministère de l'Environnement et du Développement Durable
MESR	Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
MPEB	Ministère de la Pêche et de l'Économie Bleue
MTM	Ministère des Transports et de la Météorologie

MSI RSM	<i>Maritime Safety Information</i> Renseignement de Sécurité Maritime
MRCC	<i>Maritime Rescue Coordination Centre</i>
MSDI	<i>Maritime Spatial Data Infrastructure</i> Infrastructures de données spatiales maritimes
NAVAREA	<i>NAVigational AREAs (WWNWS)</i> Zones de navigation (SMAN) NAVAREA national coordinator: responsible for dissemination of MSI (RSM)
NC CM	<u><i>Nautical Charts</i></u> Carte marine
NHC CHN	<i>National Hydrographic Committee</i> Comité Hydrographique National
NtMs	<i>Notice to Mariners</i> Avis aux navigateurs
PCA	<i>Primary Charting Authority</i> Autorité cartographique principale
RHC CHR	<i>Regional Hydrographic Commission (SAIHC)</i> Commission Hydrographique Régionale (CHAIA)
Shom	Service hydrographique et océanographique de la marine (France) <i>French Hydrographic and Oceanographic Service (French national hydrographic office)</i>
SMAN	Système mondial d'avertissement de navigation <i>Worldwide Navigational Warning Service (WWNWS)</i>
SMDSM	Système mondial de détresse et de sécurité en mer <i>Global Maritime Distress and Safety System (GMDSS)</i>
SOLAS	<i>[United Nations] Convention for the Safety of Life at Sea</i> Convention pour la sauvegarde de la vie humaine en mer
SPAT	Société du Port à Gestion Autonome de Toamasina
UKHO	<i>United Kingdom Hydrographic Office</i>



## Annex B : Terms of reference of the visit team of the Regional Hydrographic Commission (SAIHC)



### Context

The IHO (International Hydrographic Organization) Capacity Building Program aims to coordinate the development of the capacities of Member and Associate States in the field of hydrography and nautical cartography in order to meet the objectives of IHO and the obligations related to Chapter V of the SOLAS Convention, the United Nations Convention on the Law of the Sea and other international instruments.

It was thus decided:

- to promote regional cooperation in capacity building in South of Africa and islands (SAIHC: IHO Southern African and Islands Hydrographic Commission)
- to identify the potential of national and regional training centers;
- to study the possibilities of organizing regional seminars.

On the proposal of France, related to United-Kingdom which coordinates the IHO capacity building program for SAIHC, the IHO Capacity Building Sub-Committee proposes to conduct a technical visit to the country.

### Goals

The general objectives of the technical visits are as follows:

- discussions with the decision-making authorities of the country visited, emphasizing the importance of hydrography for coastal states and therefore the need to include associated hydrographic and nautical cartography activities in national plans;
- support the development of a national system for the collection and diffusion of maritime safety information (MSI) integrated within the Worldwide Navigational Warning Service (WWNWS);
- assessment of national capacities in terms of planning and carrying out the collection and use of hydrographic data in order to allow the production and updating of the nautical documentation essential for the safety of navigation and in support of others uses (infrastructure management, environmental protection, development of the blue economy, etc.);
- development of recommendations with the actors of the visited country in order to strengthen these capacities in a long-lasting and sustainable manner;
- preparation of IMO audits (IMSAS) and follow-up of recommendations in connection with hydrographic services;
- promote the emergence of development projects in the field of hydrography and nautical cartography in conjunction with IHO secretariat, IMO and funding agencies in order to obtain the sustainable establishment of capacities.

### Report

A report on the activities and recommendations of the team will be submitted to the president of the Regional Hydrographic Commission after the visits.

## Annex C : Reference texts

Note : this list (in French) is not exhaustive

### Textes de référence de Madagascar

Objet	Référence officielle
Décret définissant les nouveaux statuts du Foiben-Taosarintanin'i Madagasikara (FTM) et fixant son organisation, son fonctionnement et ses attributions	Décret N° 2020 – 1682 du 9 décembre 2020
Décret portant restructuration de l'Agence Portuaire, Maritime et Fluviale (APMF), fixant ses Statuts, ses modalités de financement, portant création du Conseil Supérieur des Ports, des Transports Maritime et Fluvial et du Centre d'Appui et d'Opération Maritimes.	Décret N°2012-391 du 23 avril 2012
Décret conférant au port de Toamasina le statut de port d'intérêt national à gestion autonome, délimitant sa circonscription ...	Décret N°2004-702 du 14 juillet 2004 ( <a href="https://www.memoireonline.com/11/13/7862/m_Optimisation-de-l-exploitation-et-de-la-logistique-portuaire-Cas-du-port-de-Toamasina--Madagascar39.html">https://www.memoireonline.com/11/13/7862/m_Optimisation-de-l-exploitation-et-de-la-logistique-portuaire-Cas-du-port-de-Toamasina--Madagascar39.html</a> )
Ministère de l'Aménagement du Territoire et des Services Fonciers Décret fixant les attributions du MATP ainsi que- l'organisation-générale de son Ministère	Décret N°2020 - 081 du 5 février 2020
Création du Comité Hydrographique National	Décret N° 2011-120 du 07 mars 2011 (Ministère de l'Aménagement du Territoire et de la Décentralisation) (Ministère des transports)

### Texte de référence commun à la France (Shom) et Madagascar (FTM) [Projet]

Objet	Référence officielle
Coopération entre Madagascar et la France en matière d'hydrographie, d'océanographie et de cartographie marine	Projet d'Arrangement administratif entre la République française et la République de Madagascar

## Annex D : List of main contacts -Telephones - Mails

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## Annex E : Agenda – Events

- MATSF : Ministère de l'Aménagement du Territoire et des Services Fonciers
- MDN : Ministère de la Défense Nationale
- MTM : Ministère des Transports et de la Météorologie
- MEDD : Ministère de l'Environnement et du Développement Durable
- MPEB : Ministère de la Pêche et de l'Économie Bleue

Objet – Events	Observations
<b>J1 : Monday 13 February 2023</b>	<b>Antananarivo</b>
➤ FTM : Foiben-Taosarintanin'i Madagasikara (Institut Géographique et Hydrographique Madagascar) du MATSF	Jean Désiré RAJAONARISON (Directeur Général)
➤ MDN/SG : Secrétaire Général du MDN	Vice-Amiral Louis Antoine de Padoue RANAIVOSEHENO (Secrétaire Général)
➤ APMF : Agence Portuaire Maritime et Fluviale ➤ DGTMFA : Direction Générale des Transports Maritime Fluvial et Aérien Organismes du MTM	Jean Edmond RANDRIANANTENAINA (DG) Jean Patrick RANDRIANASOLO (DG)
<b>J2 : Tuesday 14 February 2023</b>	<b>Antananarivo</b>
➤ Ministre du MATSF	M le ministre RAMAHOLIMASY Holder
➤ DCPVTM : Direction de la Coordination, de la Planification et de la Valorisation du Territoire Maritime du MATSF	RANDRIANARISON Fanomezantsoa
<b>J3 : Wednesday 15 February 2023</b>	<b>Antananarivo - Toamasina</b>
➤ MN : Marine Nationale du MDN	Contre-amiral Jacquy Honoré GA Chef d'Etat-Major
➤ Déplacement d'Antananarivo à Toamasina	OHI + 2 FTM
<b>J4 : Thursday 16 February 2023</b>	<b>Toamasina</b>
➤ SPAT/DG : Société du Port à Gestion Autonome de Toamasina (du MTM)	Christian Eddy AVELLIN (Directeur Général)
➤ SPAT/DT-DC : Direction technique et Direction de la capitainerie (Pilotage)	Samuel RANAIVOJAONA Directeur Technique + Directeur de la capitainerie
➤ Météorologie Madagascar	Rhino RAJAONARIVONY
<b>J5 : Friday 17 February 2023</b>	<b>Toamasina Antananarivo</b>
➤ APMF (Toamasina)	Directeur régional RAKOTOZAFIARIMAMY Ronsard Franck
➤ Visite du port fluvial	Rhino RAJAONARIVONY
➤ Déplacement de Toamasina à Antananarivo	
<b>J6 : Monday 20 February 2023</b>	<b>Antananarivo</b>
➤ MEDD (Aires Marines Protégées)	Liva Hariniaina RAMIANDRARIVO
➤ MPEB/ DG Pêche et Aquaculture ➤ MPEB/ DG Économie Bleue	Etienne BEMANAJA Rado RAKOTOSOA
<b>J7 : Tuesday 21 February 2023</b>	<b>Antananarivo</b>
➤ JICA	Kozo KAWATA Manoela RAZAFIMAHEFA
➤ Réunion de synthèse	Jean Désiré RAJAONARISON Jean Edmond RANDRIANANTENAINA

## Annex F : History of hydrographic missions (1887-1965) and expert visits (1970 – 2011)

### Annex F-1 : History of hydrographic missions

Note: this history is only an overview. The consultation of the hydrographic annals of Shom and especially its mission reports will allow to deepen the subject. The French hydrographic missions took place almost continuously in three periods summarized as follows:

- From 1887 to 1912
- From 1937 to 1939
- From 1946 to 1965 (dissolution of hydrographic missions in Africa and Madagascar, while much remained to be done)

These missions were the subject of data production (geodesy, bathymetry, topography, tide, etc.) and reports (hydrographic annals) available at Shom. These data are mainly those on which many nautical charts of Madagascar are still based.



**l' "Alidade" en baie d'Antongil à Madagascar**



**Rentrée de sondage d'une vedette à la voile après une panne de moteur Région Morondava**



**Tour géodésique de 27 m élevé par l'IGN dans l'arrière-pays de Morombé sur la côte ouest de Madagascar**



**Balise Hydrographique à Morombé à Madagascar**



**Signal de triangulation sur le haut de la plage à Madagascar**

It will be necessary to wait until the 2000s for the hydrographic surveys of Shom to resume, however in very occasional and very targeted ways on only a few important ports. This may have made it possible to update some major nautical charts for maritime navigation. This did not make it possible to survey the many areas never discovered nor to update areas initially only explored (therefore insufficiently to ensure safe navigation).



**Beautemps-Beaupré (2010)**

## Annex F-2 : Expert visits, reports

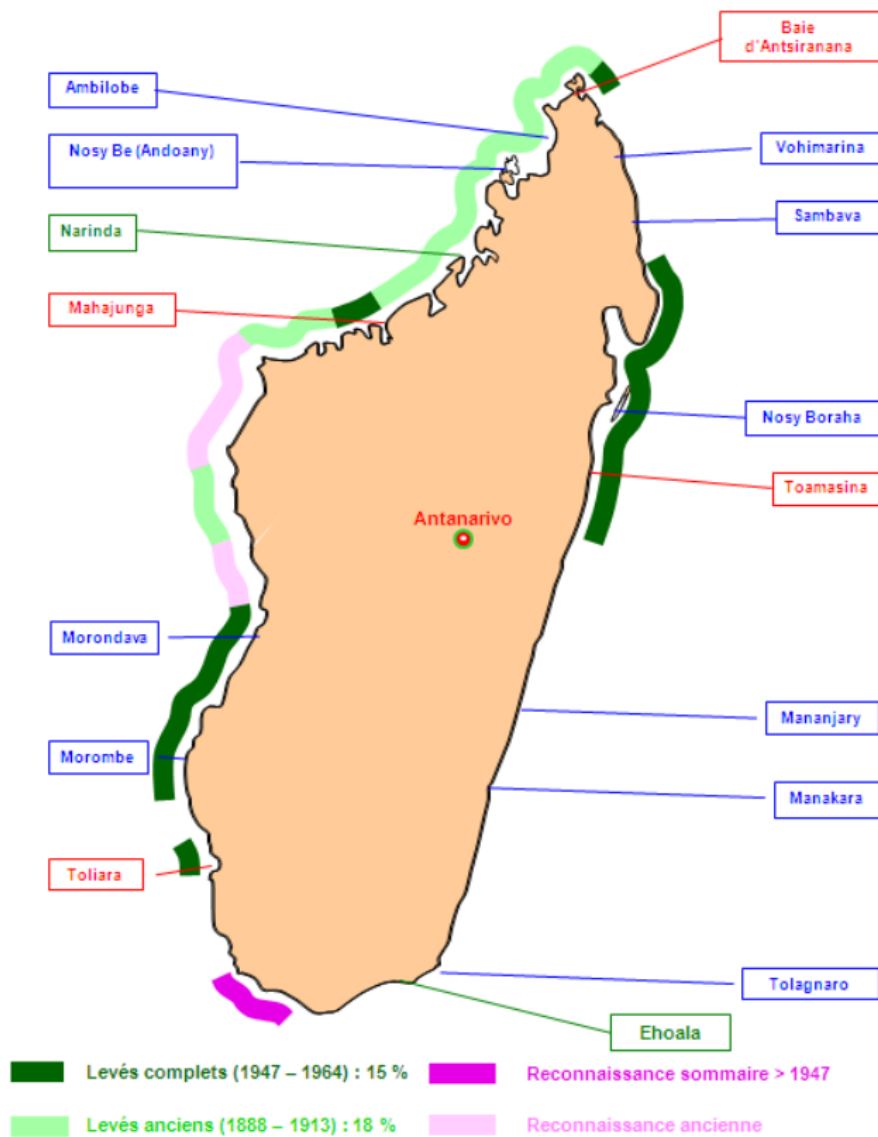
This annex is far from exhaustive and does not include the FTM's own studies such as:

- Projet de renforcement de l'activité hydrographique et océanographique à Madagascar (FTM – juin 2003)
- Projet de requête pour la révision de la carte marine et topographique de base de Madagascar et la création des bases de données correspondantes (FTM – juin 2006)

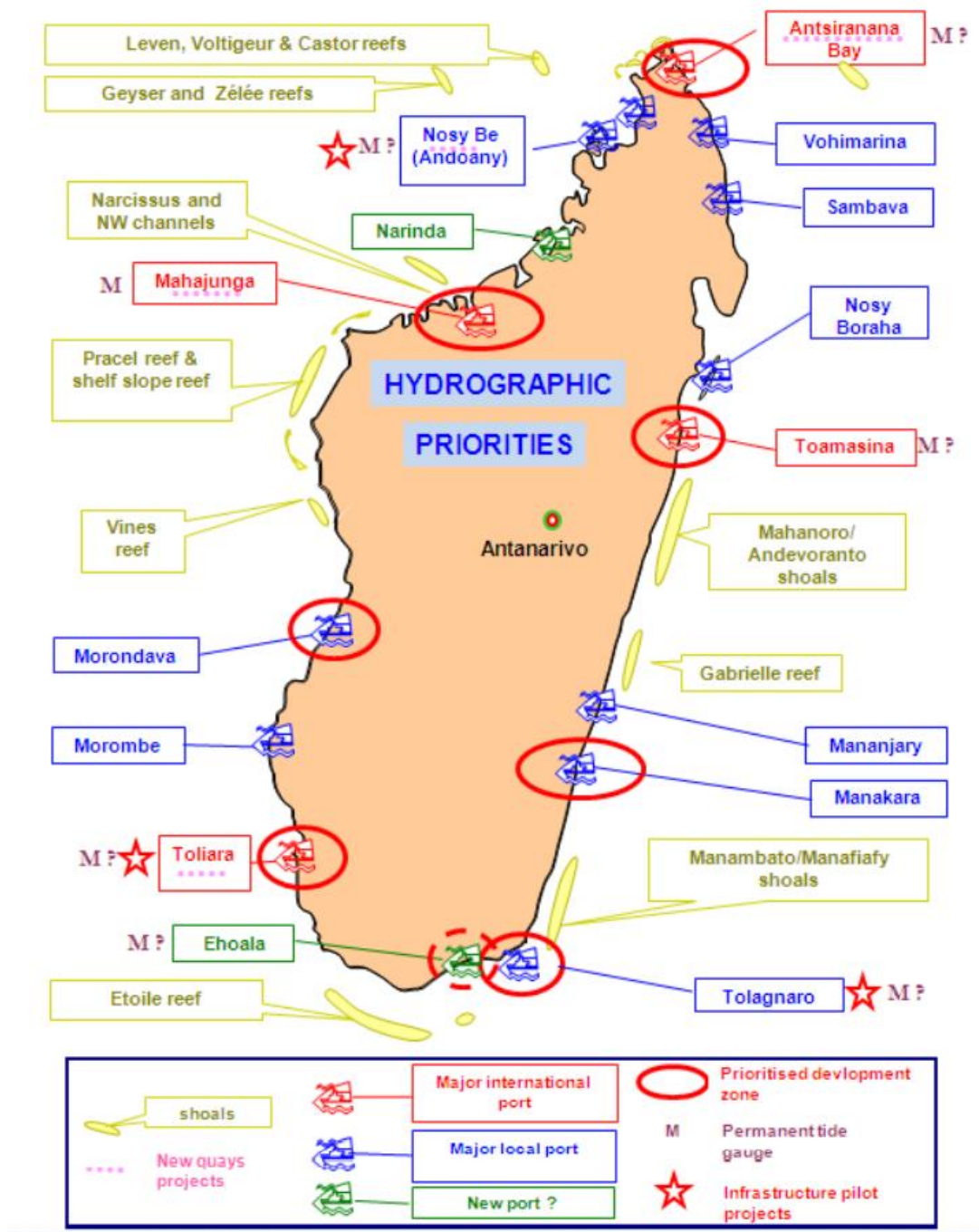
<b>Dates</b>	<b>Objets</b>	<b>Auteurs</b>	<b>Références (Fichiers fournis au FTM)</b>
15 Avril 1970	Étude sur la création d'un service hydrographique malgache	Shom – Nations Unies André COMOLET-TIRMAN Ingénieur hydrographe Expert auprès des Nations Unies	2 fichiers (non disponibles sur internet)
Juin 1991	ETUDE SUR LA CONTRIBUTION DES FORCES AERONAVALES AU DEVELOPPEMENT DE L'HYDROGRAPHIE A MADAGASCAR	Etat-Major des Forces Aeronavales Madagascar Enseigne de Vaisseau de 1ère Classe RANAIVOSEHENO Louis Antoine de Padoue	1 fichier (non disponible sur internet)
Mai 2006	Coopération technique en hydrographie et cartographie marine à Madagascar	UNESCO/COI BHI SHOM	Une lettre N° 190 SHOM/EG/DR du 23 mai 2006
19 janvier 2007	Préparation du schéma directeur de l'hydrographie malgache		1 fichier (non disponible sur internet)
June 2008	Building Coastal Resilience to Ocean-based Extreme Events through Improved	UNESCO/IOC – IHO - Italy (IO COAST-MAP Join Project)	Technical Visit SAIHC/CHAIA <a href="https://iho.int/en/capacity-building-assessment">https://iho.int/en/capacity-building-assessment</a>

	Coastal Mapping Capacity in the Indian Ocean		(tableau 2008)
26 August 2011	REPORT ON THE STATUS OF HYDROGRAPHY IN MADAGASCAR AND OF AtoN IN THE PORT OF MAHAJANGA	Banque Mondiale Jean Laporte Pierre Mouscardès	Technical Visit SAIHC/CHAIA <a href="https://iho.int/en/capacity-building-assessment">https://iho.int/en/capacity-building-assessment</a> (tableau 2011)

Extracts from 2011 report



History of surveys



Priorités économiques



## Annex G : Contact IHO (Publication P5 – Annuaire/Yearbook)

### Madagascar / Madagascar

Declared National Tonnage -Tonnage national déclaré -Tonelaje Nacional Declarado	
National day -Fête nationale -Fiesta nacional	26 juin

### Foiben-Taosarintanin'i Madagasikara (FTM) Institut Géographique et Hydrographique de Madagascar

Contact information / Informations de contact / Información de contacto

- National Hydrographer or equivalent - Hydrographe national ou équivalent - Hidrógrafo Nacional o equivalente	- M Jean Désiré RAJAONARISON (Directeur Général) o (+261) 34 48 635 88 o <a href="mailto:jdrajaona@gmail.com">jdrajaona@gmail.com</a> o <a href="mailto:ftm@moov.mg">ftm@moov.mg</a> (Adresse officielle du FTM)
- Other point(s) of contact - Autre(s) point(s) de contact - Otros punto(s) de contacto	- Mme NARY HERINIRINA IARIVO (Directeur de l'Infrastructure Géographique et Hydrographique) o (+261) 34 11 22 925 o <a href="mailto:narynini@gmail.com">narynini@gmail.com</a> - M Narizo RAHAINGOALISON (Directeur de la Maitrise d'ouvrage et services publics) o (+261) 34 11 22 920, o <a href="mailto:rahaingoalison.narizo@gmail.com">rahaingoalison.narizo@gmail.com</a> - M Misan'ny Farany ANDRIANARISON (Chef de service, géodésie, hydrographie, nivellement) o (+261) 34 11 229 22 o <a href="mailto:misan_andrianarison@yahoo.fr">misan_andrianarison@yahoo.fr</a>
- Web site - site web - sitio web	- <a href="https://www.facebook.com/FTMMadagascar">https://www.facebook.com/FTMMadagascar</a>

Agency information / Information sur l'agence / Información sobre la agencia

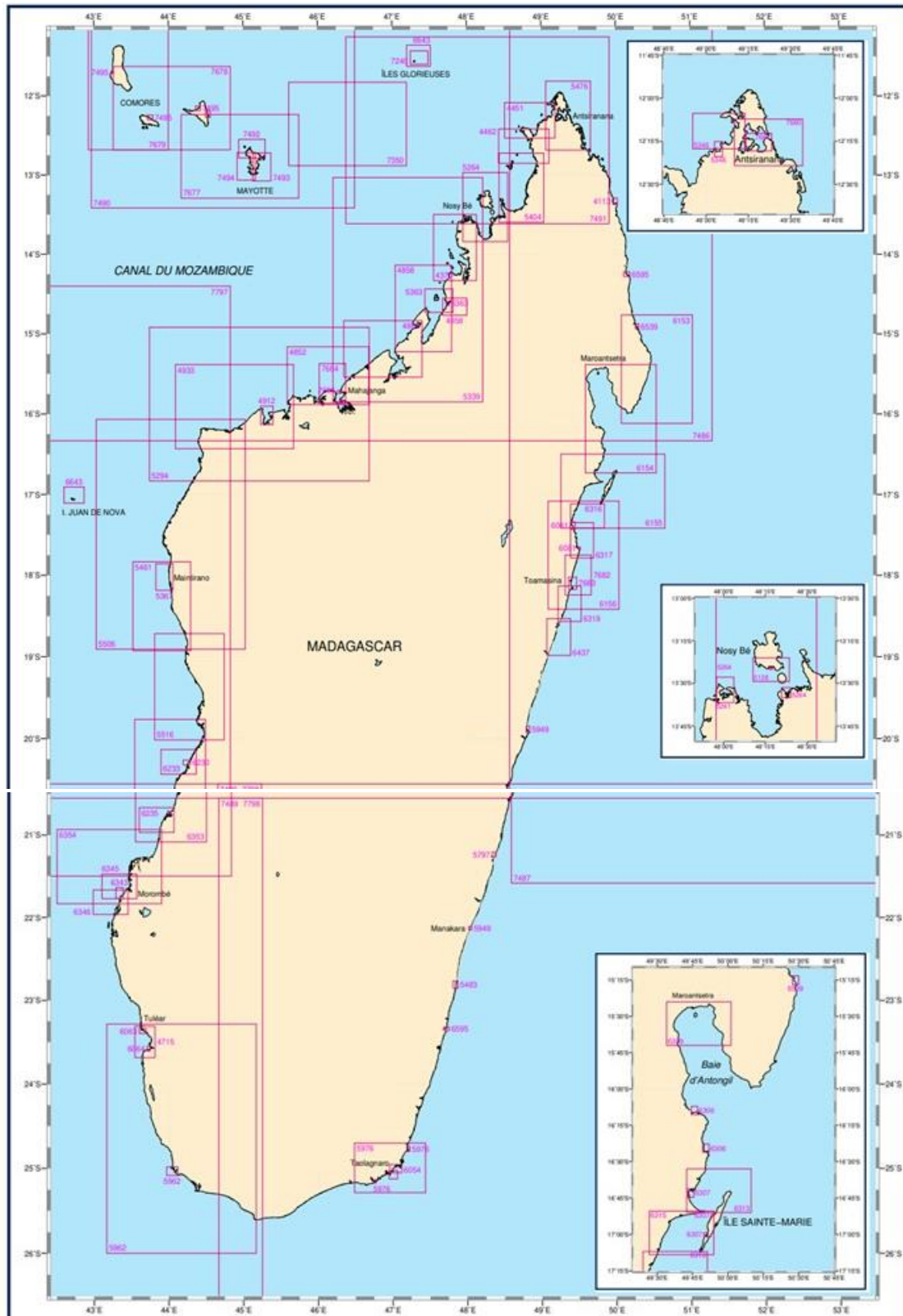
- Top level parent organization - Organisme mère - Organización asociada de nivel superior	- Ministère de l'Aménagement du Territoire et des Services Fonciers (MATSF)
- Principal functions of the organization or the department - Attributions principales de l'organisme ou du département - Principales funciones de la Organización o el departamento	- Planter et entretenir les marégraphes - Exécuter les levés bathymétriques du littoral, des ports et approches - Réaliser les travaux de délimitation géographique des espaces maritimes, établir et mettre à jour les cartes marines des zones maritimes de Madagasikara ;

	<ul style="list-style-type: none"> <li>- Représenter Madagasikara auprès des organisations régionales et internationales en matière d'hydrographie ;</li> <li>- Coordonner et contrôler tous travaux à caractère géographique hydrographique et cartographique concernant le territoire national et ses zones maritimes, commandées par les administrations, les collectivités locales et les établissements publics</li> <li>- Archiver et conserver des documents/données s'y rapportant</li> <li>- Diffuser des cartes topographiques de base, des cartes marines, des cartes dérivées, des bases de données géographiques et hydrographiques de référence et des produits intermédiaires</li> </ul>
<p><b>-Other information of interest</b>  <b>-Autres informations utiles</b>  <b>-Otra información de interés</b></p>	
<p><b>-Total number of staff employed</b>  <b>-Effectifs totaux</b>  <b>-Numero total de personal empleado</b></p>	82

## Annex H : Charts (extracts of catalogues)

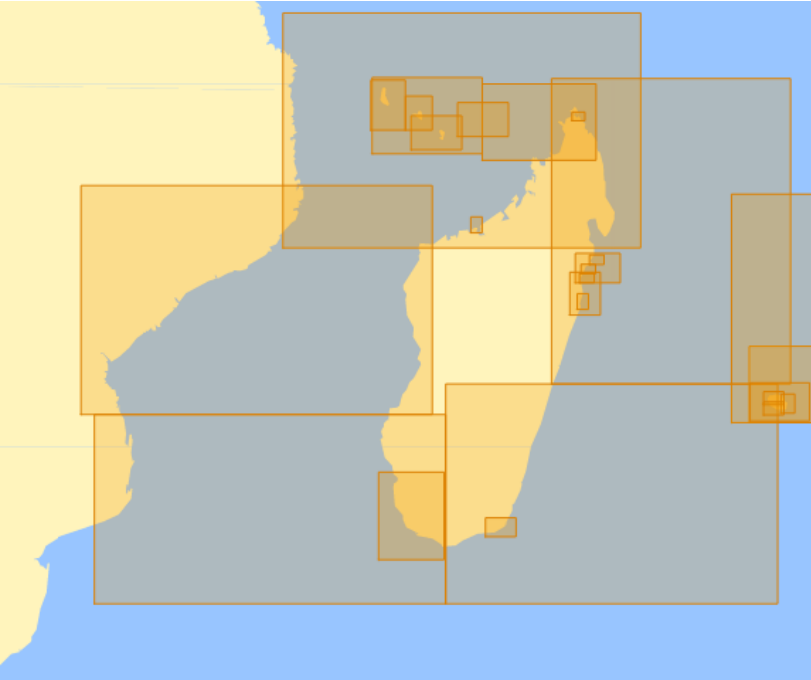
### Annex H-1 : Paper charts

Source : Shom : <https://diffusion.shom.fr/catalogues>



**Annex H-2 : Electronic charts (ENC)**

Source : PRIMAR : <https://primar.ecc.no/primar/portal/cc/mapClient.jsf> (and Shom)



## Annex I : Example of ships and embarkations likely to support hydrographic systems (MN, APMF, CSP)

Note:

- the feasibility of using the boats and embarkations mentioned has not been verified. The fact remains that there are portable hydrographic systems adaptable to many floating means ;
- not having been studied, this list does not include the resources of the Gendarmerie, the Ministry of the Environment and Customs;
- inflatable boats (usable for port survey) are not listed

### Marine Nationale (MN) [MDN]

The Navy has tugboats, patrol boats, pushers and lifeboats. Not all are available.



**Patrouilleurs (Tselatra et Malaky)**



**Patrouilleur léger (metal shark 45) Akio**



**Vedette Mazava**

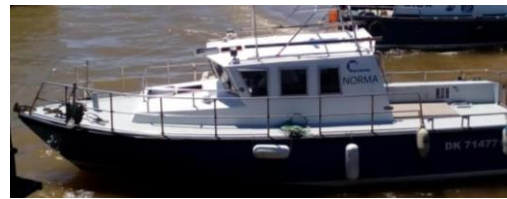
### Agence Portuaire Maritime et Fluviale (APMF) [MTM]



**Aida (Mahajanga)**



**Stella (Monroondava)**



**Norma (Toliara)**



**Tosca (Nosy Be)**



**Diva (Sainte Marie)**

### Centre de surveillance des pêches (CSP) [MPEB]



**Patrouilleur Atsantsa**



**Une des 7 vedettes rapides du CSP**

## Annex J : Additional capacity catalog to annex I (nautical means)

It was proposed to establish a Malagasy capability catalog meeting the needs in terms of hydrography (including physical oceanography) and nautical cartography. This annex does not constitute an answer. Its purpose is to begin to list these capacities without yet specifying whether they are acquired and by whom:

- Managerial skills
  - Founding texts (e.g. decrees relating to the functioning of the organizations concerned)
  - Funding (public subsidies and proceeds from sales or services)
  - Operation of the CHN (National Hydrographic Committee). The inter-ministerial, pooling of resources...
  - Establishment of protocols:
    - between Malagasy organizations (Research and development, pooling of resources, cost sharing)
    - between Madagascar and international cooperation organizations (development aid, capacity transfer)
  - Project management (control of objectives, means, costs, deadlines). Understands the ability to write the technical specifications (objectives) of a hydro-oceanographic survey
- Capacity in boats (maintenance capacity included): see annex I
- Capacities in hydro-oceanography equipment (maintenance capacity included)
  - Acoustic echo sounders
  - Obstruction detection side sonars
  - Global positioning systems (GPS)
  - Tide gauges (minimum tide ladder) and leveling equipment
- Digital data acquisition and processing systems (the IT support function is often decisive)
- Capabilities in the creation of databases and products
  - Professional database and information and dissemination portals (software and network). Associated GIS
  - Remote sensing (Satellite Derived Bathymetry for innovation)
  - Cartography (“marine” geomatics software): editions, printing, updates by means of notices to mariners, etc.
- Last but not least behind all these abilities of men and women:
  - Manager
  - Hydrographers and marine cartographers
  - Electronics
  - Computer scientists
  - Various support functions (finance, secretariat, logisticians, etc.)



APMF : He was able to inform about his recent hydrographic means presented below

**Hi-Target**  
Surveying the World. Mapping the Future

**V90 PLUS**  
SYSTEME GNSS RTK

**SOUTH**  
Target your success

**SDE-28S+**  
Single Frequency Digital Echo Sounder

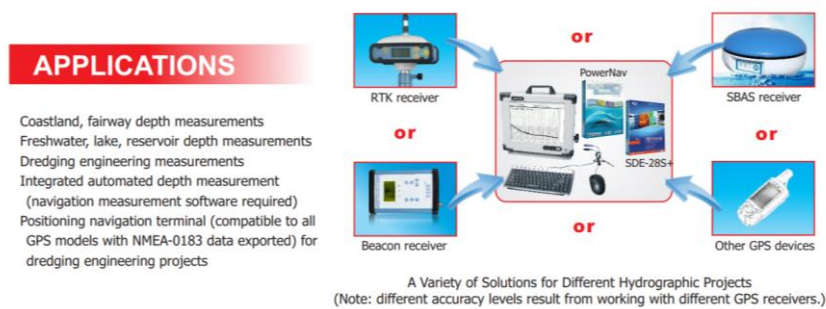
**STANDARD CONFIGURATION**

1. Echo Sounder SDE-28S+	1pc
2. Carrying Case (for echo sounder)	1pc
3. 200kHz Transducer	1pc
4. Transducer Pole	1pc
5. Carrying Case for Transducer	1pc
6. Double RS-232 Communication Cable	1pc
7. 220V External Power Supply Cable	1pc
8. 220V External Power Supply Cable Adapter	1pc
9. 12V External Power Supply Transfer Cable	1pc
10. Keyboard (USB)	1pc
11. Mouse (USB)	1pc
12. Adapter Cable for Mouse & Keyboard	1pc
13. Pen Drive	1pc
14. SDE-28S+ Software	on board
15. PowerNav Software (with dongle key)	on board

Dealer info

**SOUTH**  
Target your success

**SDE-28S+**  
Single Frequency Digital Echo Sounder



FTM : As a geographic service, already has capabilities in geodesy and levelling, remote sensing, cartography (including printing) and data management. It also has a single-beam echo sounder (old) and various hydrographic survey equipment (tide ladder, etc.).