QUIETSEAS - Assisting (sub) regional cooperation for the practical implementation of the MSFD second cycle by providing methods and tools for D11 (underwater noise)

D4.1. Definition of regional specificities of a risk-based approach for continuous sound assessment in the Mediterranean Sea and Black Sea regions

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2	Permanent Secretariat of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area	ACCOBAMS	Monaco
3	Service hydrographique et océanographique de la marine	Shom	France
4	Politecnico di Milano-Department of Civil and Environmental Engineering	POLIMI-DICA	Italy
5	Hellenic Centre for Marine Research	HCMR	Greece
6	Inštitut za vode Republike Slovenije/Institute for water of the Republic of Slovenia	IZVRS	Slovenia
7	Specially Protected Areas Regional Activity Centre	SPA/RAC	Tunisia
8	Maritime Hydrographic Directorate	MHD	Romania
9	Department of Fisheries and Marine Research	DFMR	Cyprus
10	International Council for the Exploration of the Sea	ICES	Denmark

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Abstract

This document is the Deliverable "D4.1 Definition of regional specificities of a risk-based approach for continuous sound assessment in the Mediterranean Sea and Black Sea regions (17th May 2022)" of the QUIETSEAS project funded by the DG Environment of the European Commission within the call "DG ENV/MSFD 2020 call". This call funds projects to support the implementation of the second cycle of the Marine Strategy Framework Directive (2008/56/EC) (hereinafter referred to as MSFD), in particular to implement the new GES Decision (Commission Decision (EU) 2017/848 of 17 May 2017) laying down criteria and methodological standards on Good Environmental Status (GES) of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU) and Programmes of Measures according Article 13 of the MSFD. QUIETSEAS aims to support the practical development of the second implementation cycle under the MSFD for D11 (underwater noise).

The object of this document is to define the regional specificities that need to be considered to carry out robust a risk-based approach for continuous sound assessment in the Mediterranean Sea and Black Sea regions.

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CTN	Centro Tecnológico Naval y del Mar
ACCOBAMS	Permanent Secretariat of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
DFMR	Department of Fisheries and Marine Research
IZVRS	Inštitut za vode Republike Slovenije/Institute for water of the Republic of Slovenia
HCMR	Hellenic Centre for Marine Research
UM	University of Malta -The Conservation Biology Research Group
POLIMI-DICA	Politecnico di Milano-Department of Civil and Environmental Engineering
SPA/RAC	Specially Protected Areas Regional Activity Centre
ICES	International Council for the Exploration of the Sea
Shom	Service hydrographique et océanographique de la marine
MHD	Maritime Hydrographic Directorate
MSFD	Marine Strategy Framework Directive
GES	Good Environmental Status
MS	Member States
MED	Mediterranean Sea
BS	Black Sea
CA	Competent Authority
NR	National representative
MRU	Marine Reporting Units

1. Introduction

The QUIETSEAS Project is funded by DG Environment of the European Commission within the call “DG ENV/MSFD 2020”. This call funds MSFD development, in particular, the preparation of the next 6-year cycle of implementation. The QUIETSEAS project aims to enhance cooperation among Member States (MS) in the Mediterranean Sea Region (MED) to implement the third Cycle of the Marine Directive and in particular to support Competent Authorities and strength strengthen cooperation and collaboration in the Mediterranean Sea and Black Sea regions.

This deliverable is the result of work done on Activity 4. Specificities for the practical implementation of the Assessment Framework for Continuous Noise (D11C2) at (sub)regional level (Mediterranean Sea and Black Sea Regions), and support the achievement of the following specific objectives of the project:

- Specific objective 1 (SO1): To identify relevant indicators for criterion D11C2 (Anthropogenic continuous low-frequency sound in water).
- Specific objective 2 (SO2): To promote the consolidation of relevant indicators for D11 and support the operationalisation of indicators on the state, pressure and impacts of underwater noise in close coordination with TG Noise.
- Specific objective 3 (SO3): To promote harmonisation of regional work on threshold values with TG Noise recommendations.

The project is developed by a consortium made up of 10 entities coordinated by CTN and it has a duration of 24 months starting on 1st February 2021.

The object of this document is to define regional specificities related to the implementation of a risk-based approach for continuous sound assessment in the Mediterranean Sea and Black Sea regions.

2. Connection with TG Noise-compatible risk-based approach(es) for the assessment of continuous sound

TG Noise Deliverable 3 (Assessment Framework for EU Threshold Values for continuous underwater sound) is inclusive as regards the approaches for the assessment of continuous underwater sound. This was ensured by:

- The procedure followed (dedicated working group for DL3 with representatives from all European regional Seas, multiple internal meetings and TG Noise meetings, dedicated scientific seminar)
- The recommended stepwise approach which includes both modelling and measurements for monitoring purposes, masking and behavioural disturbance as the basic potential adverse effects, two different methods for evaluating the condition of a grid cell.
- Eight annexes, amended to the main DL3 text, explaining adequately critical issues of the assessment framework: explaining the concept of the risk-based approach (Annex 1), clarifying the three geographical assessment steps (grid cell, habitat, MRU) and allowing the determination of the status of single- and multi-species habitats (Annex 2), explaining the selection of masking and disturbance as the main potential adverse effects (Annex 3), explaining the rationale of the grid cell and allowing different relevant geographical units (Annex 4), detailing the assessment of acoustic status by modelling and measurements (Annex 5), providing alternative assessment metrics (Annex 6), proposing an assessment framework for impacts on habitats and populations of marine animals (Annex 7), and indicating conditions/areas where the assessment may be particularly challenging (Annex 8).

Hence, the existence of regional specificities in the Mediterranean and Black Sea regions is not expected to exhibit any formidable barrier to the implementation of a coherent assessment across those regions. However, these specificities need to be described and potential difficulties identified to tackle them as efficiently as possible.

3. The Mediterranean Sea and Black Sea regions

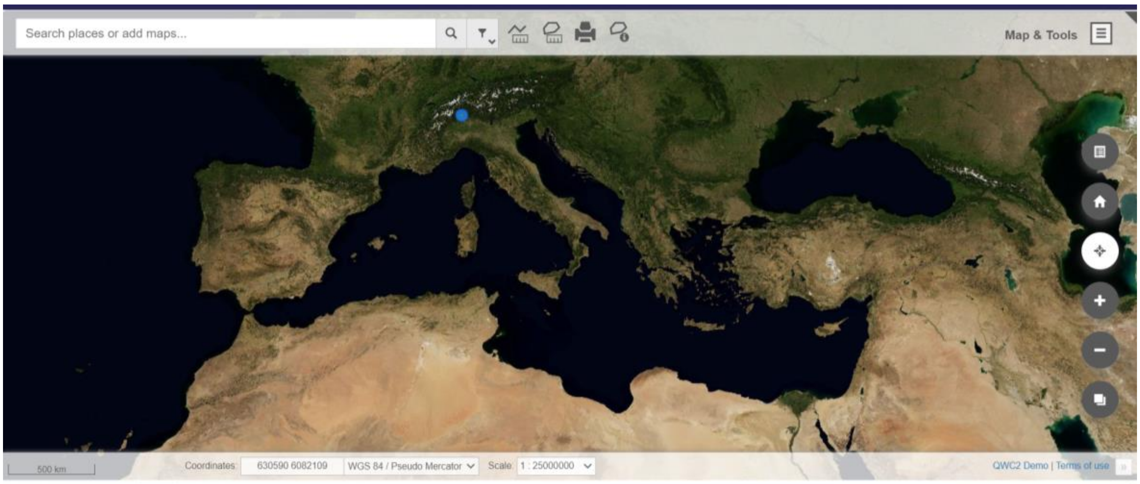

Figure 1. Overview of Mediterranean and Black Sea.

The Mediterranean Sea (MED) and Black Sea (BS) cover around 3 million km² (2,5 and 0,5 respectively). With regards to assessing continuous underwater noise, these areas can be described with the following characteristics:

- **Technical characteristics influencing underwater sound propagation and its effects on biodiversity**:
    - The choice of means, techniques, and plans to monitor and simulate sound levels needs to be done based on the complex physical and geographical characteristic of the MED and BS regions.
    - Bioecological characteristics are also relevant as they determine the endpoint of a risk-based assessment approach.

- **Human activity patterns regarding continuous sound sources and how these contribute to underwater ambient noise levels**.
    - Ship traffic patterns, as ship traffic is generally considered the main contributors to underwater ambient noise.
    - Seasonal variations due to tourism, especially related to ferry activity and large recreational craft, as this may have a noticeable though largely understudied effect in several Mediterranean areas,
    - Fishing vessel activity, to be considered for the potential seasonal effects, also largely understudied.

  The contribution of construction activities that generate continuous noise such as dredging and drilling activities may also be considered in specific situations (e.g., small-sized coastal Marine Reporting Units, or for areas with many ports and maritime construction works close each other). However, such local specificities can be found all over EU waters and are not specific to the MED and BS. They are not addressed in detail in this report.

- **Geopolitical characteristics influencing the governance of the area:**
  - Disparity of means and capacities between North-South and East-West countries Areas with several countries close each other, including EU MS and non-EU countries, implying that underwater noise pollution affecting the waters of a country might be produced in neighbouring countries.
  - Both MED and BS regions are bordered by more non-EU countries than EU MS, implying a crucial role of Regional Seas Conventions (Barcelona Convention Bucharest Convention).
  - Specificities related to the geographical scope of Regional Seas Conventions, whereby some local seas may remain uncovered, affecting the effectiveness of monitoring, assessment and eventually of measures.

Such specificities are briefly analysed in the following chapter and recommendations on how to consider them are drawn.

3.1. Technical specificities

We identified technical specificities that mainly concern the choice and parametrization of shipping noise modelling used in the assessment framework, but also further elements such as the siting of monitoring stations. We have classed them in three categories: topography, oceanography, and biodiversity.

3.1.1. Topography

Specificities related to topographic features are identified in the following elements:

- MED and BS are almost completely enclosed basins. In this respect, they resemble the Baltic Sea. Shipping noise is trapped in the basins. Particular areas exhibit increased complexity, such as the Archipelago of Aegean Sea (214,000 km2) with the presence of more than 1 000 islands and islets.
- With regards to depth, MED presents specificities in all subregions. With mean depth of 1,500 m, marine areas vary from shallow water (Northern Adriatic in the subregion of Adriatic Sea, up to 100 m depth; marine area offshore Tunisia in the subregion of Ionian and Central Mediterranean Sea, up to 150 m depth) to very deep waters over 5,000 m (Maximum depth: Calypso Deep, 5,267 m in the Hellenic Trench, Ionian Sea, Central Mediterranean subregion).
- Underwater canyons and steep slopes exist all over the region reaching 3,000 or 4,000 m depth within a few tens of km from the coast. Furthermore, highly complex topographic features are present in some specific areas, e.g., the archipelago of the Aegean Sea and southern Thyrrenian Sea.
- BS bathymetry also varies from very shallow waters (northwestern shelf, up to 100 m) to depths greater than 2,000 m (which cover most of the BS marine area), where the transition from shallow to deep water often encounters large slopes.

3.1.2. Oceanography

Seasonal variations of the temperature and salinity directly affect the sound speed profile, one of the main input data for the implementation of a noise modelling approach. The salinity is much lower in the BS than in the MED basin which instead presents higher levels than in the oceans.

With regards to the MED, the surface layer presents a horizontal salinity gradient with lower levels near Gibraltar (34 PSU) and higher in the Levantine basin (36 PSU). The annual average MED sea surface temperatures (SST) is calculated 19.7±1.3◦C, with a similar horizontal gradient presenting colder waters westward and warmer waters eastward. Coldest areas are found in the Gulf of Lion and in the northern Adriatic. These characteristics affect the sound speed which presents the same northwest to southeast gradient with lower speed northwest (e.g., 1506-1508 m/s in the Gulf of Lion) and higher southeast (1527 m/s on the easternmost MED coast).

Concerning the BS, the salinity of the surface waters is about the half (18 PSU) of the values found in the MED and the interior has higher salinity than the periphery. Salinity increases along with depth. The sea's deepest parts, below 150 meters, are distinguished by highly stable temperatures between 8.5 and 9 °C and salinities representing of about 22 gr/kg. The average sound speed of the BS basin is equal to 1487 m/s. In the layer 0–300 m is about 1469.8 m/s and in the layer 400–2000 m records the value of 1490.2 m/s.

3.1.3. **Biodiversity**

MED is a biodiversity hotspot where several noise-sensitive species live and especially 9 species of cetaceans considered as resident. This assigns a great conservation value to the region, but also adds complexity to the assessment (e.g., the target species will vary according to local ecology and different threshold levels may apply). Moreover, Black and North Aegean Seas host a subspecies of the harbour porpoise (*Phocoena phocoena relicta*), i.e., one of the most noise-sensitive cetacean species worldwide.

With regards to the assessment framework for continuous noise outlined in DL3 [*Methodology report - Assessment Framework for EU Threshold Values for continuous underwater sound, TG Noise 2021*] the definition of the Level for Onset of Biologically Significant Adverse Effects (LOSE) might therefore be challenging due to scientific knowledge gaps.

3.2. Human activity patterns

Activities considered here regarding ship traffic, ferries, recreational craft and fishing vessels. Other offshore activities generating continuous noise, such as operating wind farms and other marine renewables, are disregarded as a very little number of such installations exist in MED and BS.

3.2.1. **Ship traffic**

- The MED and BS regions are crossed by thousands of ships every day. The traffic is spread over the two basins but there are several lanes which can be clearly distinguished that concentrates most of the traffic. The biggest lane appears to be the paths linking the Gibraltar Strait to the Canal of Suez, but several others appear as well. Between such lanes, many lower traffic areas exist and especially offshore. Moreover, the vast majority of coastal areas exhibit high traffic levels.

- Based on such considerations, there is no evident hindrance to perform the so called 'Category A' and 'Category B' monitoring (see Dekeling et al. 2014) for most part of the MED and BS areas. However, the following situations requires special attention:
    - It could be a challenge for countries having small-sized maritime spaces, such as Slovenia and Monaco, to meet TG-Noise requirements for Category A monitoring (though not impossible), as all their maritime space is covered by high ship traffic density levels. In such specific cases, cooperation with neighbouring countries appears desirable.
    - Also, for Maltese waters, all coastal areas appear covered by high ship traffic levels. The southern/south-eastern part appears more favourable though completely offshore and partly in deep waters, where logistical issues would be faced implying careful consideration with regards to deployment.
    - Finally, the case of the Marmara Sea (Turkish waters) is that of an almost enclosed area lying between the MED and the BS where, again, suitable place for Category A monitoring seems hard to be found based on available ship traffic maps.

3.2.2. Geographical and seasonal differences due to tourism

- Ferry traffic is almost exclusively located in northern MED and in the BS. Also, as ferry activity is tightly linked to tourism, ferry traffic levels rise notably during summer (June to September, with highest levels in July and August).
- Recreational craft, and especially super- and mega-yachting consisting of motorboats of more than 100-feet long, may increase ambient noise levels locally during summer. This activity may deserve attention, as it has been little studied and because several mooring spots in the MED get extremely crowded during summer (e.g., more than 500 leisure boats can be at the same spot and same time near St Tropez, France).

3.2.3. Fishing activity

Although the major contribution to underwater ambient noise is acknowledged to be commercial shipping (Hildebrand, 2009), the effective contribution of fishing vessels and the related effects on the marine environment have been little studied, especially in MED and BS. Considering the distribution of fishing effort relative to the different métiers seems worth considering as it may contribute to local and periodic increase of underwater noise levels and hence the risk induced on marine fauna. Maps presented in chapter 3.4 (ACCOBAMS data, unpublished) provide an insight into the distribution of fishing effort derived from AIS data, limited to vessels with flag of EU MS. Also, effort maps based on VMS data for Greek waters are added to show the contribution of VMS to complete AIS data. VMS were not available for the rest of the MED and BS areas and therefore they are used here to show the differences and that potential gaps may exist for the rest of MED and BS areas. The distribution of fishing effort in the MED and BS, as illustrated in the maps, can be described as follows:

- Central and northern Spanish coastal waters appear as the most exploited for the 4 types of activities shown (trawlers, nets, longline, seine) as well as the area south of the Balearic Islands. Several spots within Italian waters also appear to be covered by high levels of fishing effort: the Sicilian Channel and south Sardinia, different areas of the Adriatic Sea and the Thyrrenian and Ligurian Seas.
- It is worth also noticing the increase of longline fishing in Cyprus in summer compared to winter fishing effort in the same area.
- Finally, AIS data show lower fishing activity levels in Maltese, Greek, Bulgarian and Romanian waters, where the contribution of fishing activities to underwater ambient noise levels is likely to be less important than for the other areas.

However, these conclusions should be reviewed after consideration of VMS data. Most of the fishing vessels (above 12 m long) are equipped indeed with VMS and not AIS. However, VMS data are harder to find than AIS and hence a dedicated effort is necessary to better understand the contribution of fishing activities to the overall underwater noise picture.

3.3. Geopolitical specificities

3.3.1. North-South and East-West differences

As already pointed out during QUIETMED2(Deliverable 5.2 *Summary report of national and regional barriers and difficulties for getting data about cetacean populations and habitats and their distribution*), and CeNoBS (Deliverable 3.2 Detailed Report of the Regional training workshop on D11 monitoring) disparity of means and capacities are observed between North-South and East-West countries in the MED, not only about data collection about cetacean population but also concerning noise monitoring, analysis and assessment. To a lesser extent, this applies for BS too, especially about propagation modelling. The following issues need consideration in priority:

- Difficulties as regards shipping noise modelling: availability of infrastructure especially for southern MED and BS. This could be overcome by making available an open-source model with input data (bathymetry, temperature, salinity, seafloor properties, AIS, etc.) through an existing platform such as EMODnet or similar. Even this scenario appears difficult as regards its implementation.
- Difficulties as regards measurements related to costs for permanent stations and their maintenance.
- With regards to analyses, based on feedback collected during the CeNoBS project by ACCOBAMS (Deliverable 3.2), means and tools for analysing recordings taken on the field are available, as well as skilled personnel.
- Finally, again from the CeNoBS project (Deliverables 3.1 and 3.3), it appears that point measurements from boat were the preferred technique in Romanian

waters in the first phase of implementation (until 2018), and that this choice may be renewed in the next years. However, this raises questions about the adequacy (representativeness) of such point measurements in relationship to the assessment framework recently developed by TG-Noise (DL3).

3.3.2. Many countries close each other with small maritime space

Areas with several countries close each other having reduced maritime spaces are rather frequent in MED and BS. Moreover, such areas generally include EU Member States and non-EU countries. In such a geopolitical context, underwater noise pollution assessed in a country is very likely to have been produced in neighbouring countries. This is an issue related to assessment scale, whereby the subregion scale as defined under the MSFD scope appears to be the minimum adequate assessment scale.

A common example of such a situation is the Adriatic Sea; the easternmost Levantine Sea may also represent such a situation. For both cases data should be collected for the subregion to address this issue regarding the assessment of continuous noise.

3.3.3. Regional legal framework vs. MSFD regions and subregions

Both MED and BS regions are bordered by more non-EU countries than EU Member States, implying a crucial role in regional legal frameworks, and especially the so-called Regional Seas Conventions (Barcelona Convention and Bucharest Convention) and ACCOBAMS (the Agreement on the Conservation of Cetaceans in the Black Sea, the Mediterranean Sea and the adjacent Atlantic area).

Specificities related to the geographical scope of such regional legal frameworks also exist: some local seas which remain uncovered in one legal framework are covered by another, and this may affect the effectiveness of monitoring, assessment and eventually of measures.

- **Under the scope of the MSFD**

The Mediterranean basin is a region divided into 4 subregions, while BS constitutes a region without lower subdivision. Based on the latest data on MSFD marine regions and subregions[1], the region of the Black Sea includes the Azov and Marmara Seas.

- **The Barcelona Convention**

All countries bordering MED are Parties to the Barcelona Convention. The geographical scope spans from the Gibraltar Strait to the Bosporus, thus excluding the Marmara Sea.

- **The Bucharest Convention**

All countries bordering BS are Parties to the Bucharest Convention, but the Marmara Sea and the Azov Sea are not under its geographical scope.

- **The ACCOBAMS Agreement**

[1] Report on the "Delineation of the MSFD Article 4 marine regions and subregions", downloadable here

The Agreement area covers BS including the Azov Sea and the Marmara Sea, the whole MED, and the Atlantic area including the Gulf of Cadiz, southern Portuguese waters and northern Moroccan waters in the Atlantic. The Agreement also contemplates an extension area covering waters in front of mainland Portugal and southern Bay of Biscay.

- In 2022, 24 countries are Parties to ACCOBAMS: Albania, Algeria, Bulgaria, Croatia, Cyprus, Egypt, France, Georgia, Greece, Italy, Lebanon, Libya, Malta, Monaco, Montenegro, Morocco, Portugal, Romania, Slovenia, Spain, Syria, Tunisia, Turkey and Ukraine.**With regards to UNCLOS**

Certain dispositions of the UN Convention on the Law of the Sea (UNCLOS) are challenged by Turkey. The disagreement is especially on rules governing the declaration of the Economic Exclusive Zones. This fact is of particular importance for the Aegean Sea, where the vast majority of islands and islets, including very close to Turkish coasts, are Greek territories.

3.4. Atlas of specificities

BATHYMETRY

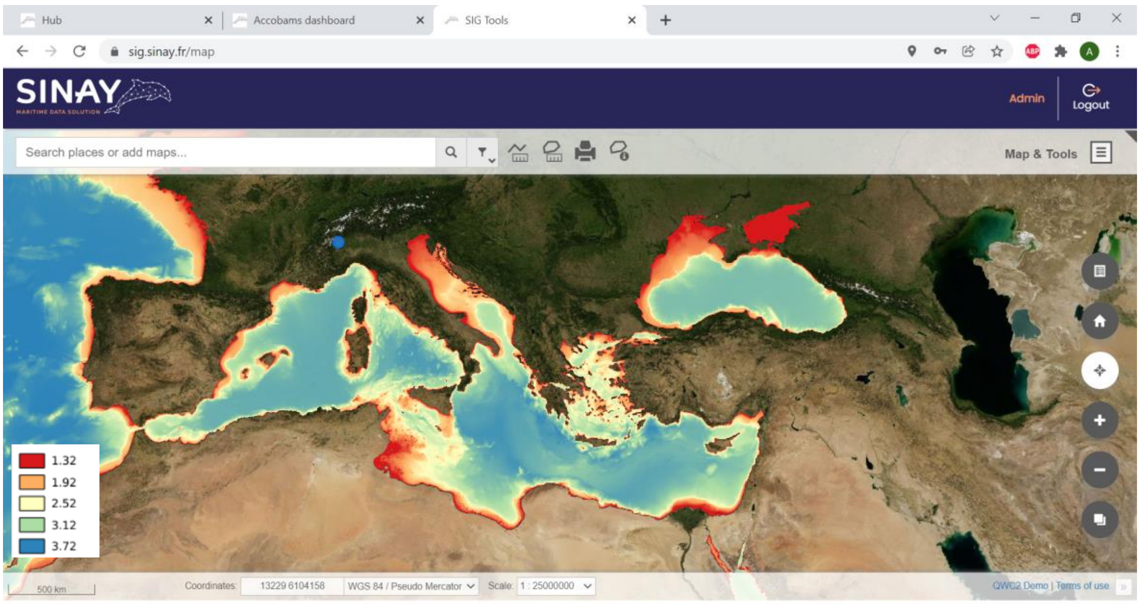

Figure 2. Bathymetric map (source: https://hub.sinay.ai/accobams/home, based on EMODnet data). Values in the legend are log10-transformed.

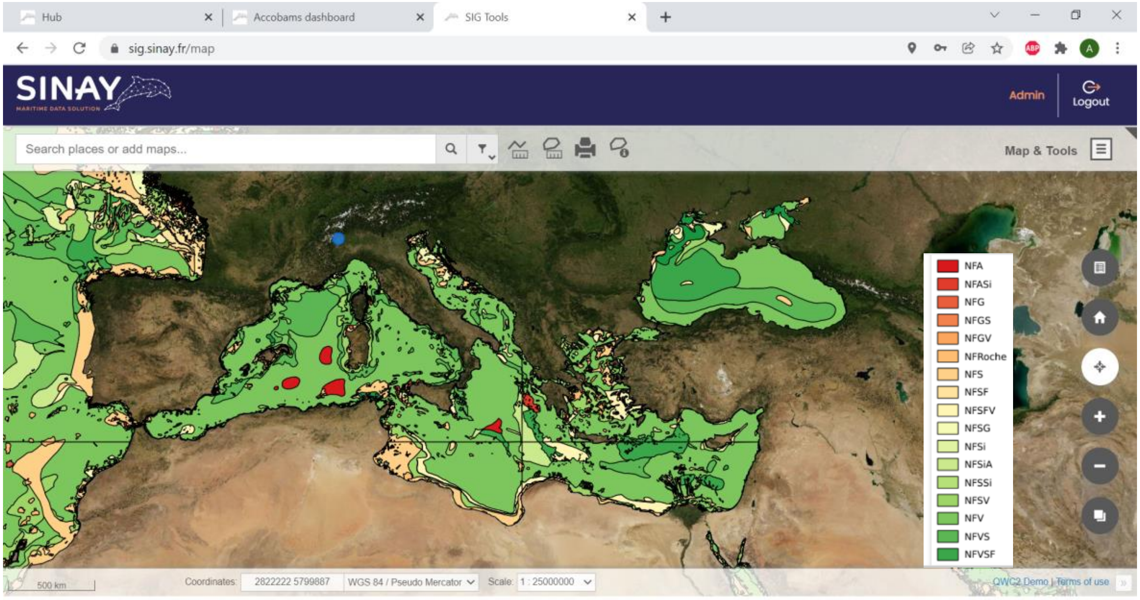

Figure 3. Seabed sediment complexity (source: https://hub.sinay.ai/accobams/home, based on SHOM data). Legend description[2] (in French only)

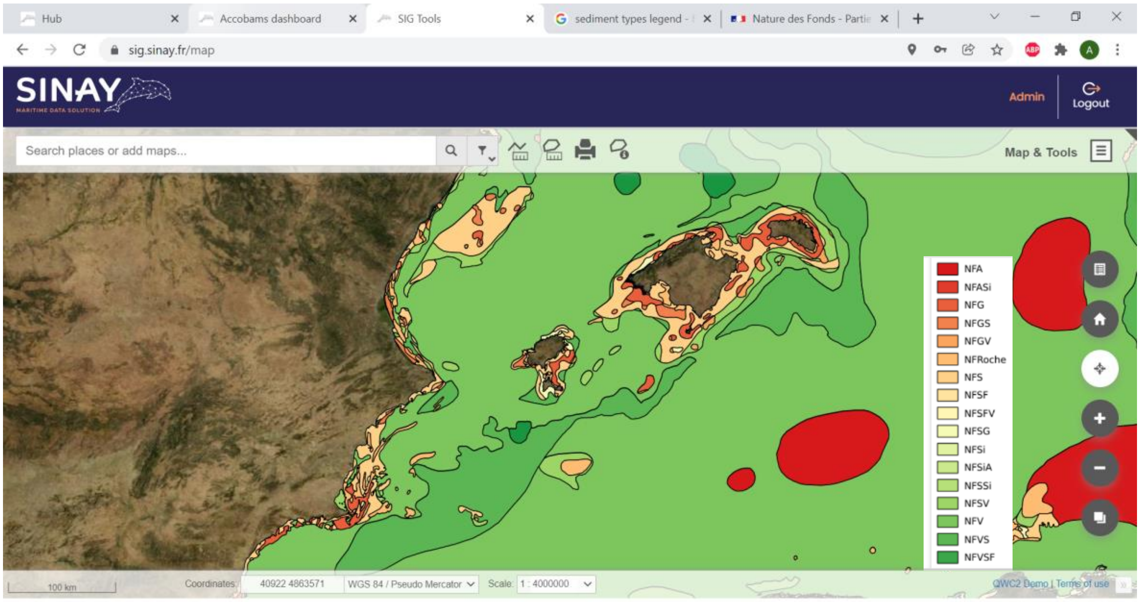

Figure 4. Focus on Spanish continental margin and Balearic Islands Source: https://hub.sinay.ai/accobams/home, based on SHOM data). Legend description[2] (in French only).

[2] Légende : NFRoche : Roche NFC : Cailloutis, Cailloutis purs NFCG : Cailloutis et graviers NFCS : Cailloutis sables NFCV : Cailloutis envasés NFG : Graviers, Graviers purs NFGC : Graviers et cailloutis NFGS : Graviers et sables NFGV : Graviers envasés NFS : Sables, Sables purs NFSG : Sables et graviers NFV : Vases NFVG : Vases et graviers NFVS : Vases sableuse NFVSF : Vases et sables fins NFSiA : Silts argileux NFASi : Argiles silteuses NFSi : Silts NFA : Argiles NFSV : Sables vaseux NFSSi : Sables et silts NFSF : Sables fins, Sables fins purs NFSFC : Sables fins et cailloutis NFSFV : Sables fins vaseux NFSFSi : Sables fins et silts

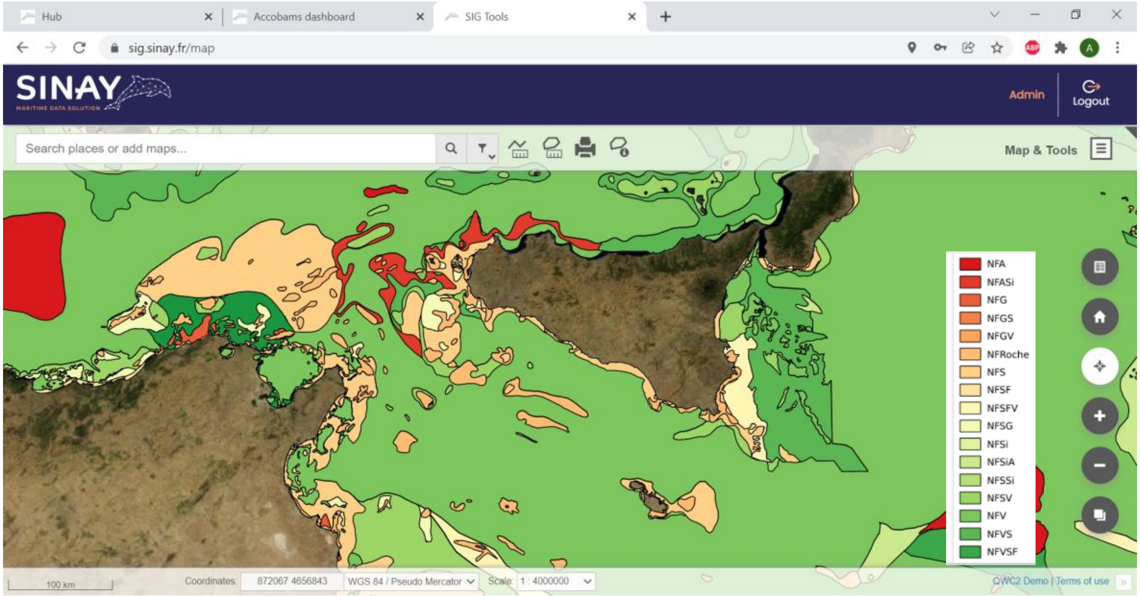

Figure 5. Focus on the Strait of Sicily. Source: https://hub.sinay.ai/accobams/home, based on SHOM data. Legend description[2] (in French only).

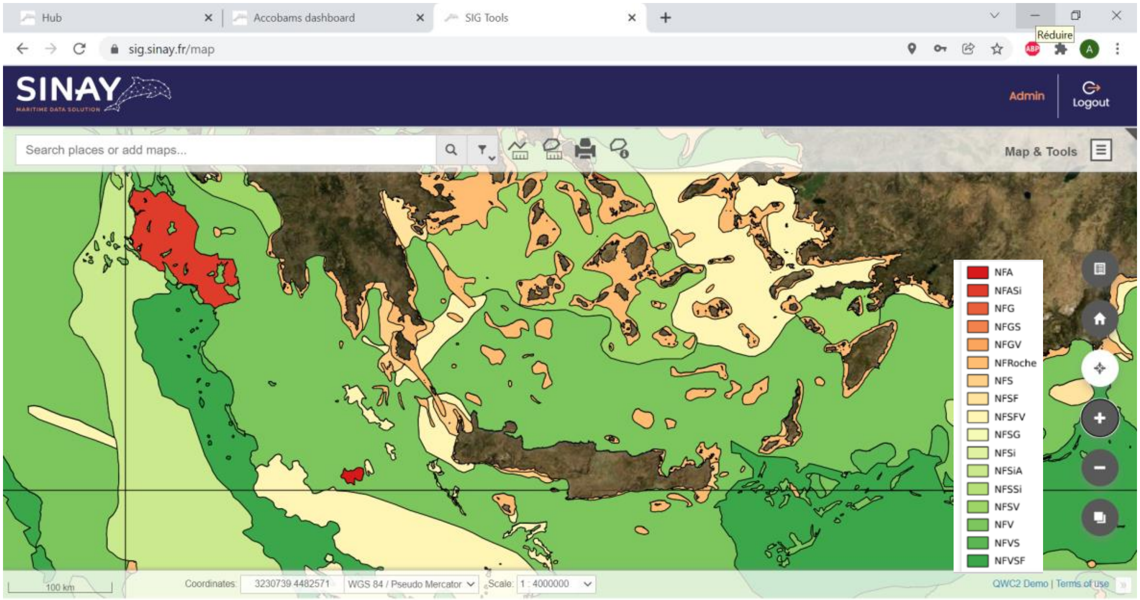

Figure 6. Focus on the southern Aegean and Hellenic Trench areas. Source: https://hub.sinay.ai/accobams/home, based on SHOM data. Legend description[2] (in French only).

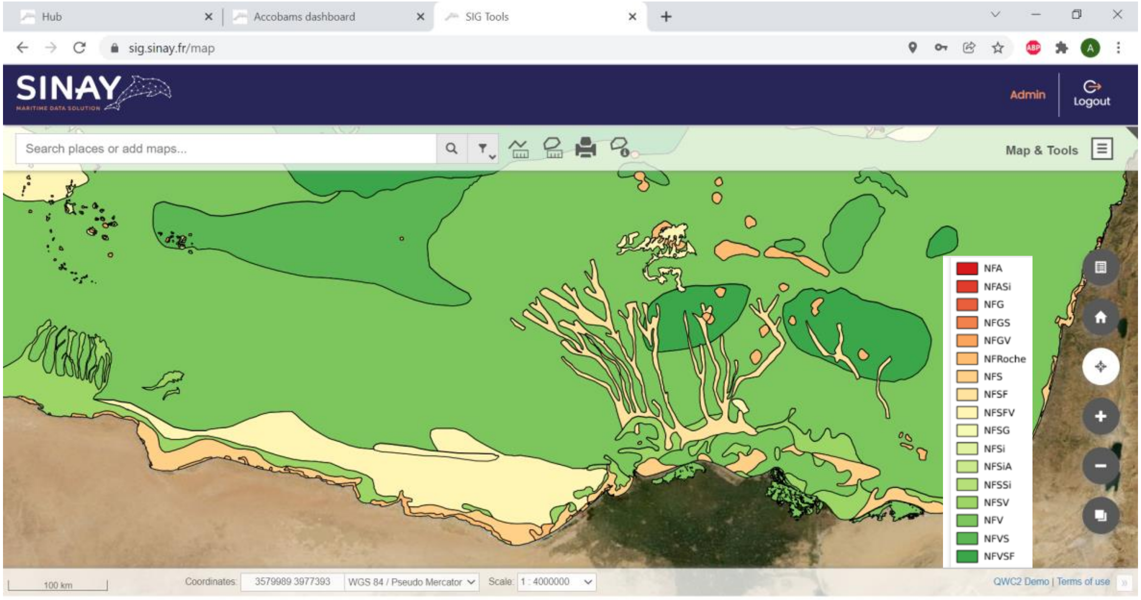

Figure 7. Focus on the Nile delta area. Source: https://hub.sinay.ai/accobams/home, based on SHOM data. Legend description[2] (in French only).

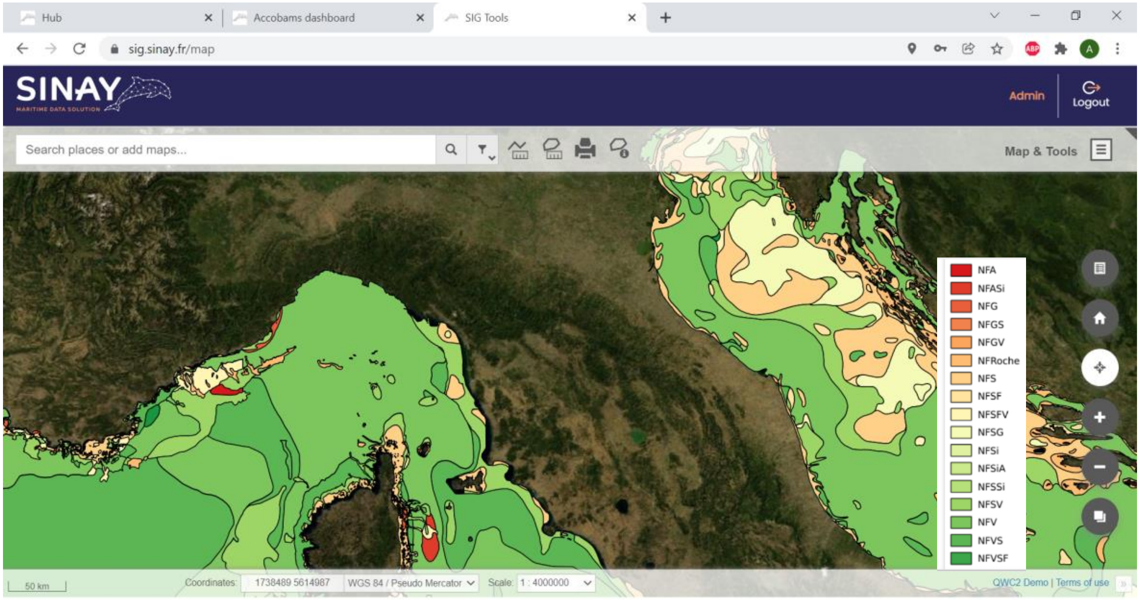

Figure 8. Focus on the Ligurian Sea and northern Adriatic Sea. Source: https://hub.sinay.ai/accobams/home, based on SHOM data. Legend description[2] (in French only).

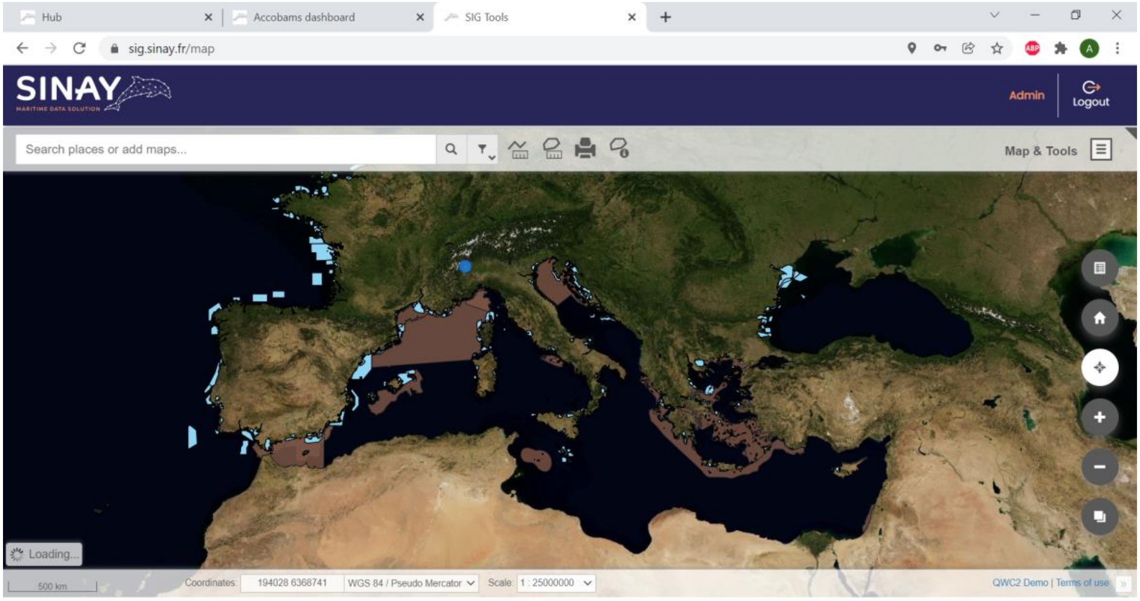

Figure 9. Marine Protected Areas under HABITATS Directive (NATURA 2000) in blue, and Important Marine Mammal Areas (IMMAs) in brown. Source: https://hub.sinay.ai/accobams/home

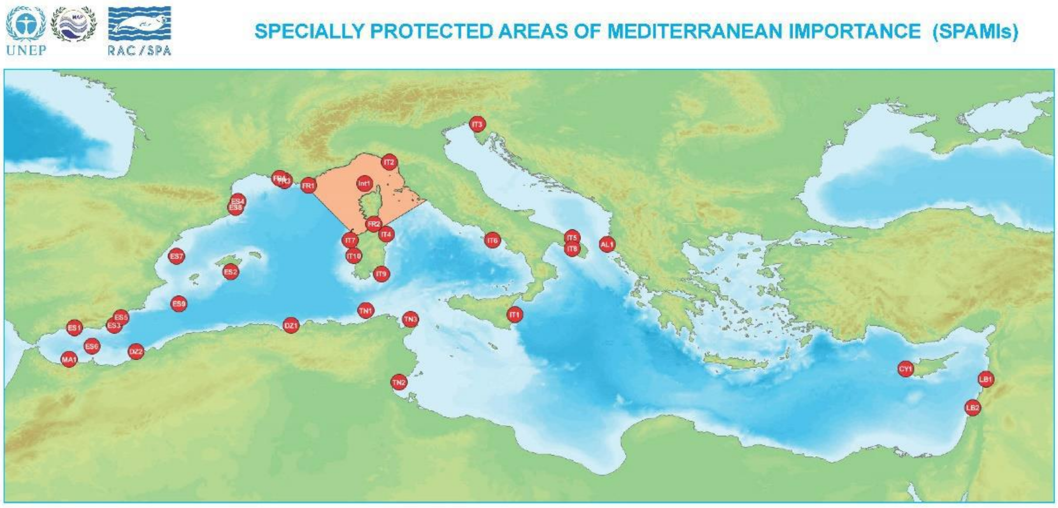

Figure 10. Specially Protected Areas of Mediterranean Importance (SPAMIs) under the Barcelona Convention framework. Source: www.rac-spa.org.

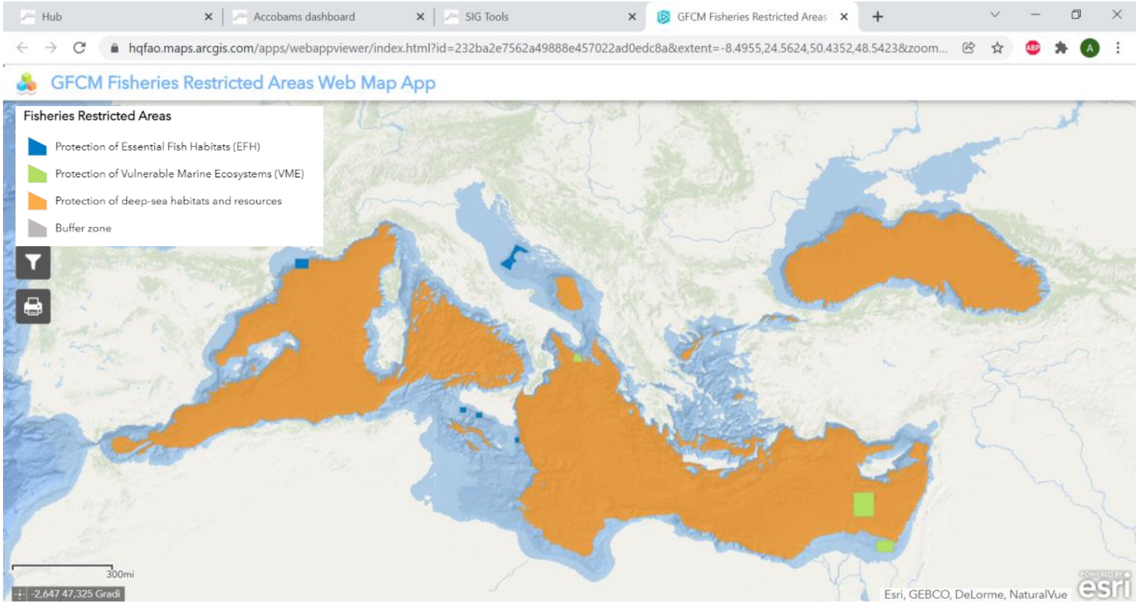

Figure 11. Fisheries Restricted Areas (FRAs) under the framework established by the General Fisheries Commission for the Mediterranean (GFCM). Source : www.fao.org

SOUND SPEED PROFILE (TEMPERATURE AND SALINITY)

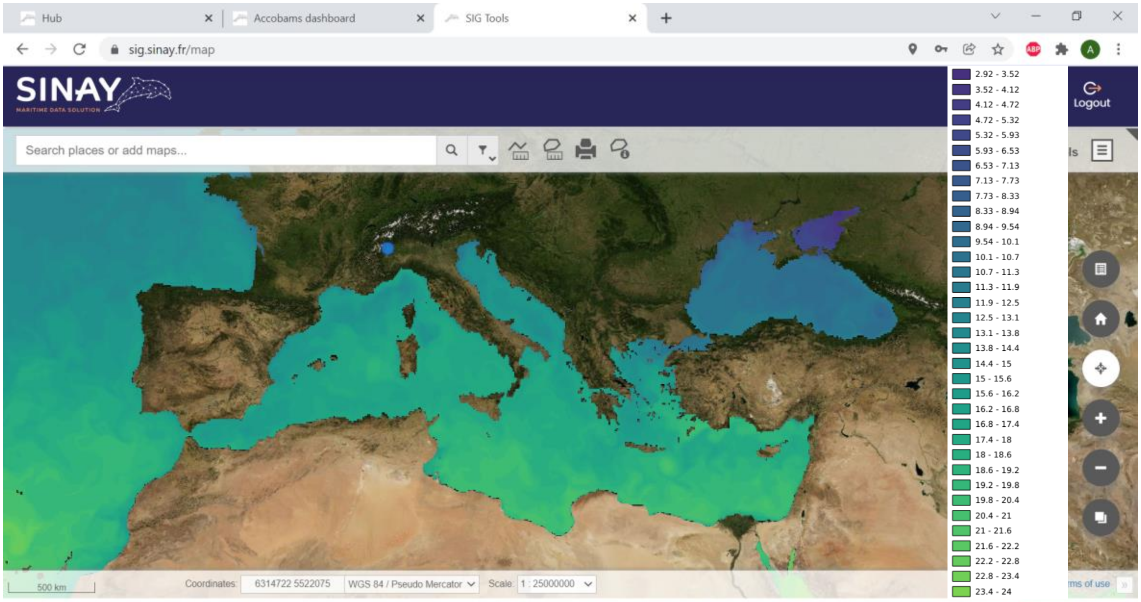

Figure 12. Average Sea Surface Temperature since 1950. Source: https://hub.sinay.ai/accobams/home, based on Copernicus Marine Service data.

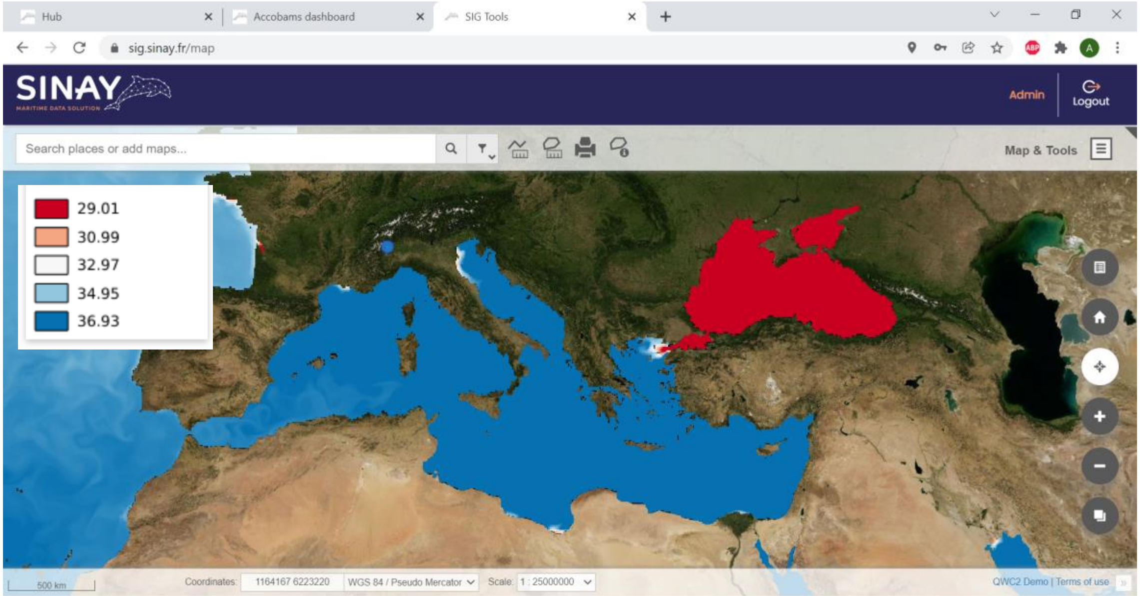

Figure 13. . Average Salinity values at surface. Source: https://hub.sinay.ai/accobams/home, based on Copernicus Marine Service data. Values are in g/kg (= psu, practical salinity units).

VESSEL TRAFFIC

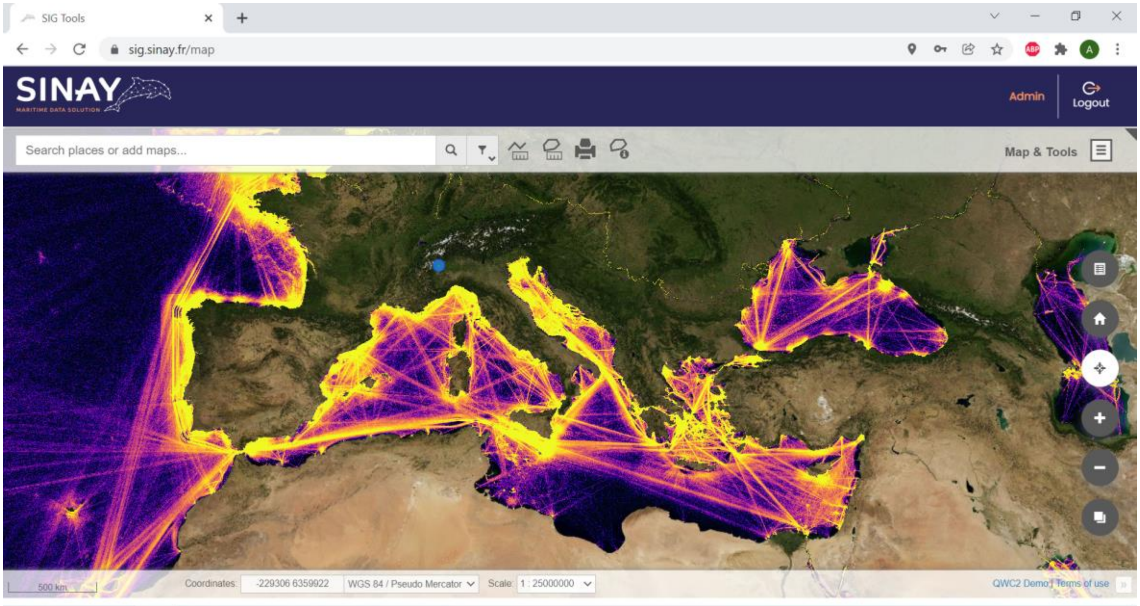

Figure 14. Ship Traffic based on 1-year-round AIS-data in 2017. Source: https://sig.sinay.fr/map based on *Spire* data.

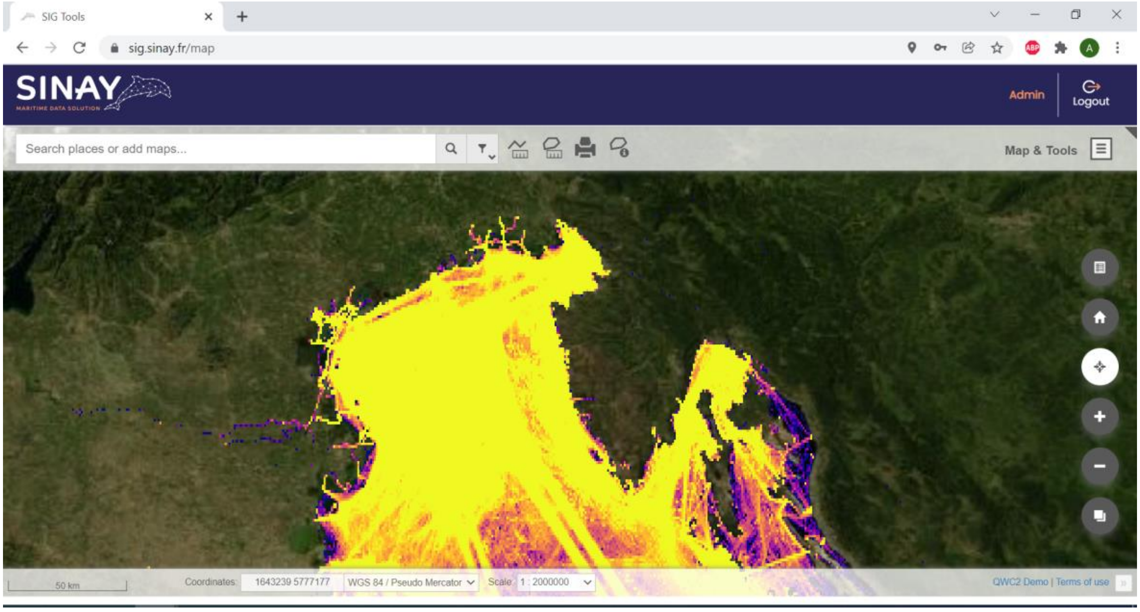

Figure 15. Focus on the northern Adriatic Sea where finding a suitable place for Category A monitoring is challenging. Source: https://sig.sinay.fr/map

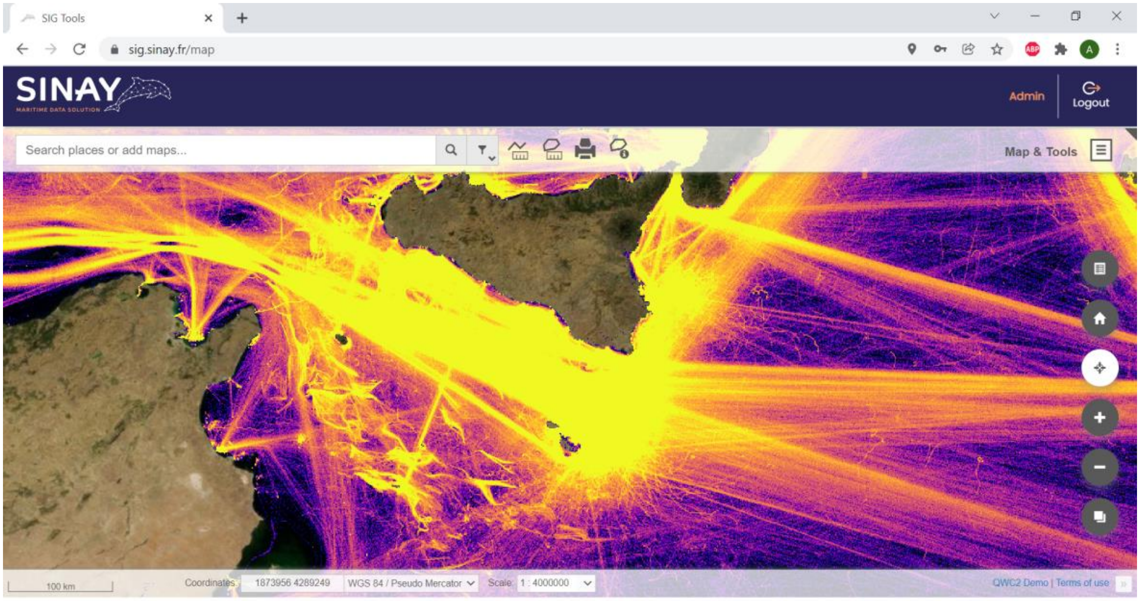

Figure 16. Focus on the Strait of Sicily where finding a suitable place for Category A monitoring in Maltese waters is challenging. Source: https://sig.sinay.fr/map

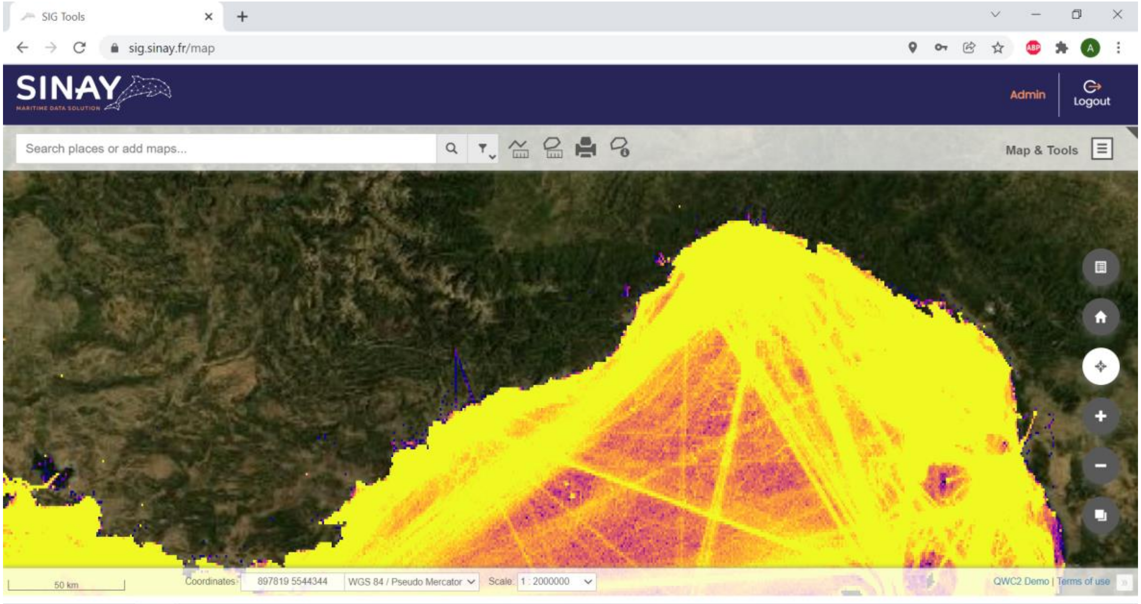

Figure 17. Focus on the Ligurian Sea where finding a suitable place for Category A monitoring in Monegasque waters is challenging. Source: https://sig.sinay.fr/map

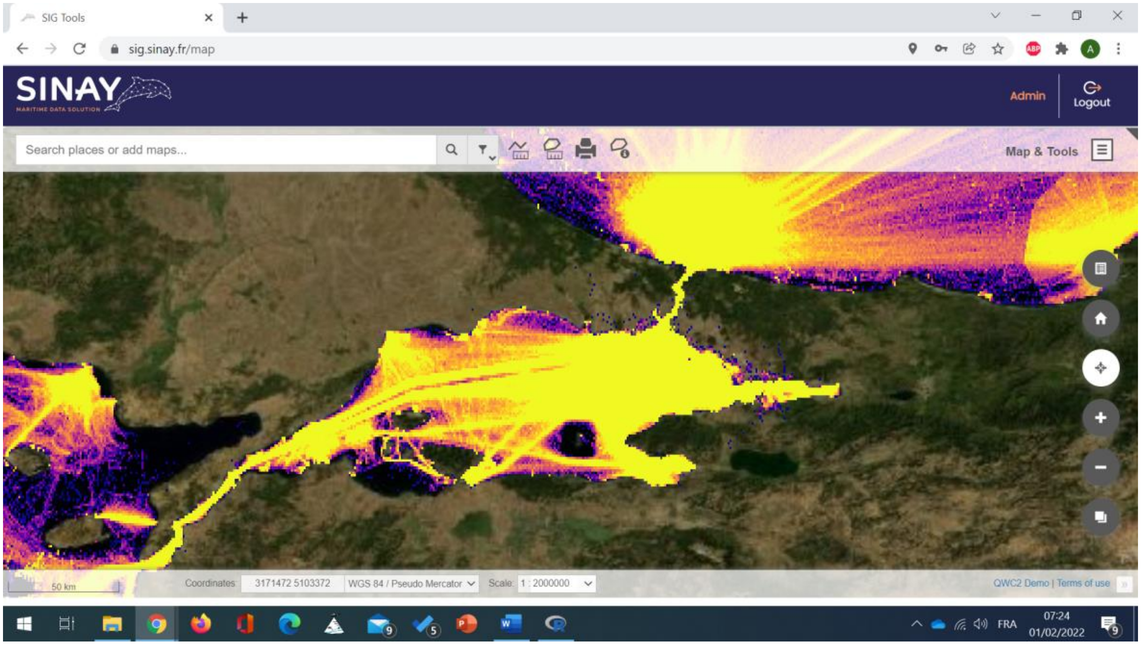

Figure 18. Focus on the Marmara Sea, where finding a suitable place for Category A monitoring is challenging. Source: https://sig.sinay.fr/map

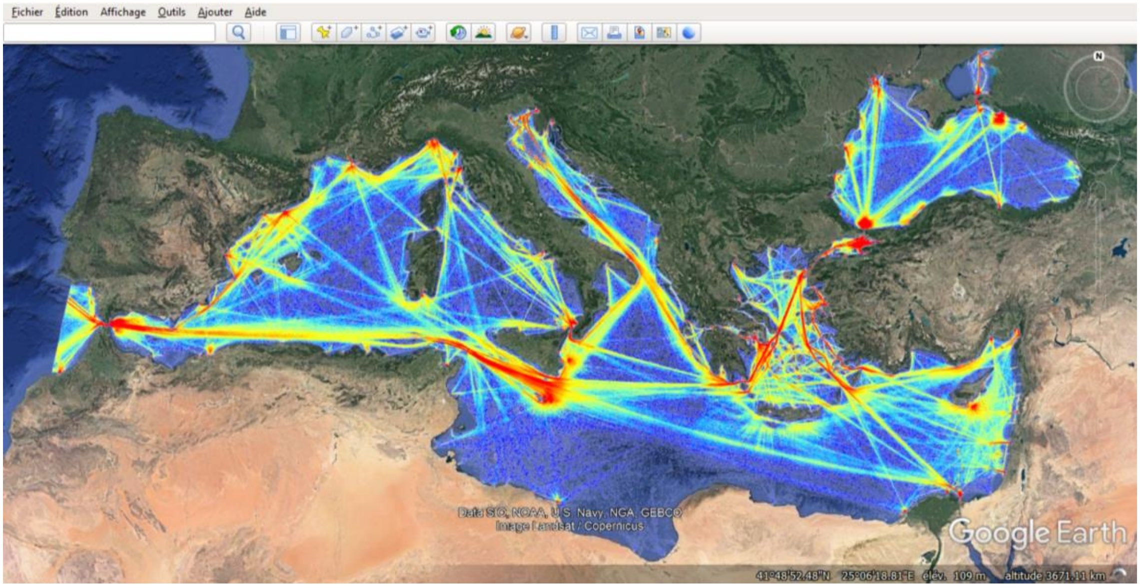

Figure 19. Cargo Traffic in 2017. Source: i) Spire (AIS data); ii) Sinay (cargo traffic density map); Presented at the ACCOBAMS Workshop on threat-based management of IMMAs (2017).

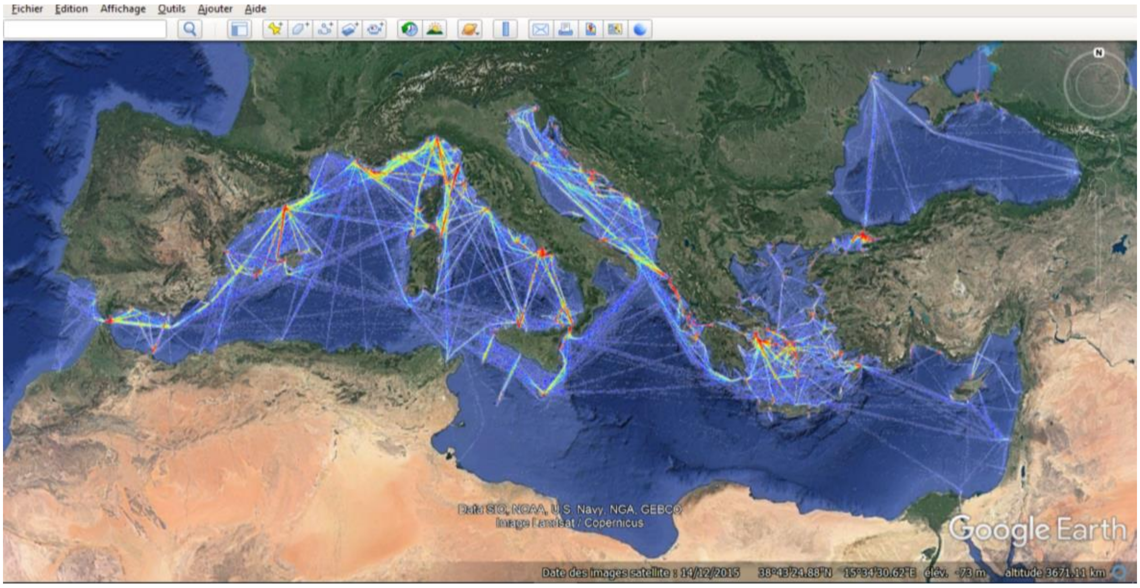

Figure 20. Ferry Traffic in 2017. Sources: i) Spire (AIS data); ii) Sinay (ferry traffic density map); Presented at the ACCOBAMS Workshop on threat-based management of IMMAs (2017).

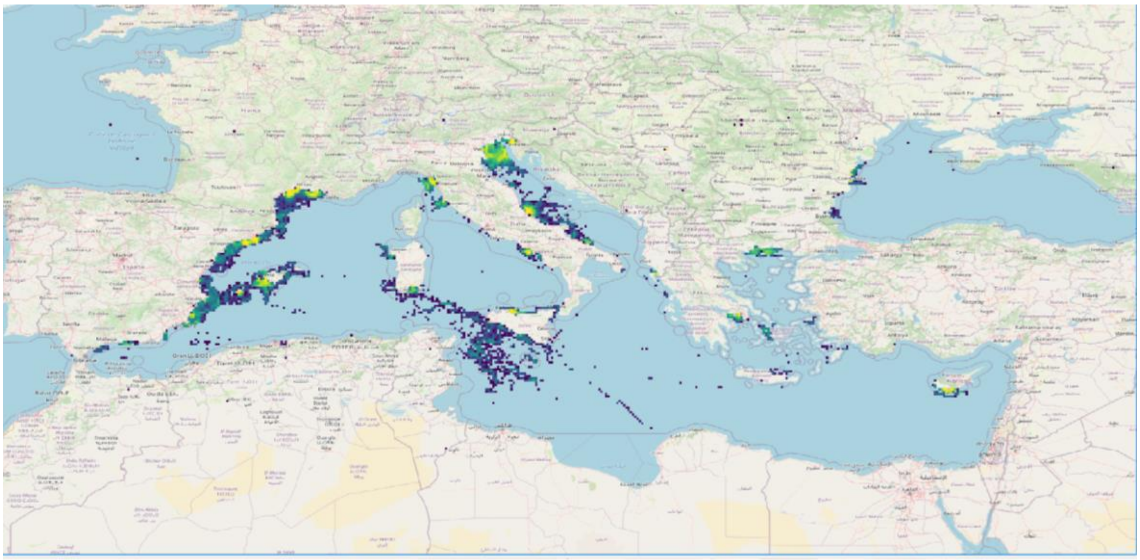

Figure 21. Seasonal differences in fishery activities: **trawlers**, January to March and November-December 2018. Source; i) Spire (AIS data); ii) Sinay (fishing vessel density maps). Unpublished data.

Figure 22. Seasonal differences in fishery activities: **trawlers**, April to October 2018. Source: i) Spire (AIS data); ii) Sinay (fishing vessel density maps). Unpublished data.

Figure 23. Seasonal differences in fishery activities: **Seines**, January to March and November-December 2018. Source: i) Spire (AIS data); ii) Sinay (fishing vessel density maps). Unpublished data.

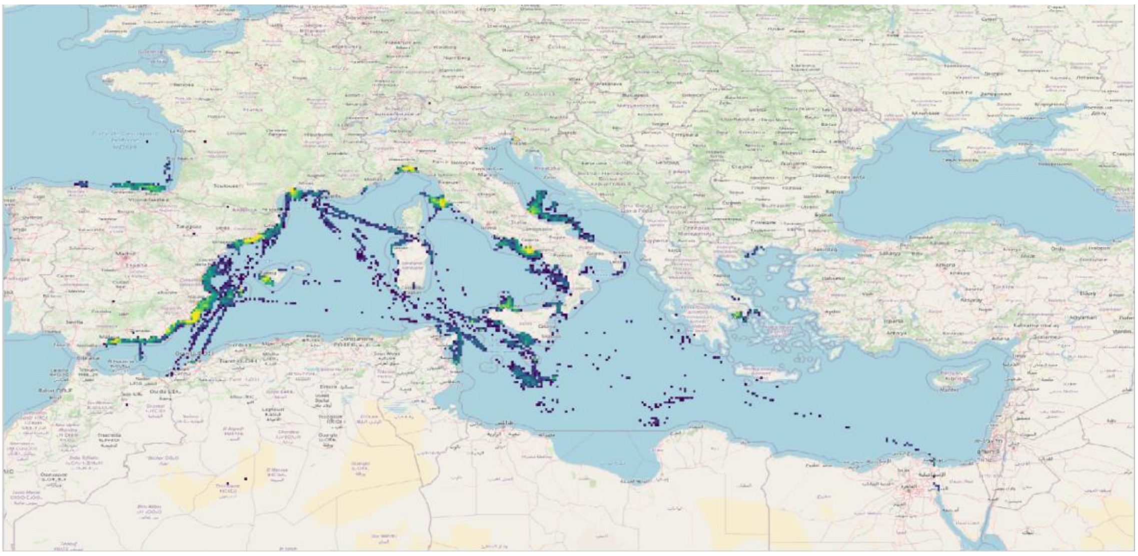

Figure 24. Seasonal differences in fishery activities: **Seines**, April to October 2018. Source: i) Spire (AIS data); ii) Sinay (fishing vessel density maps). Unpublished data.

Figure 25. Seasonal differences in fishery activities: **Longline**, January to March and November-December 2018. Source: i) Spire (AIS data); ii) Sinay (fishing vessel density maps). Unpublished data.

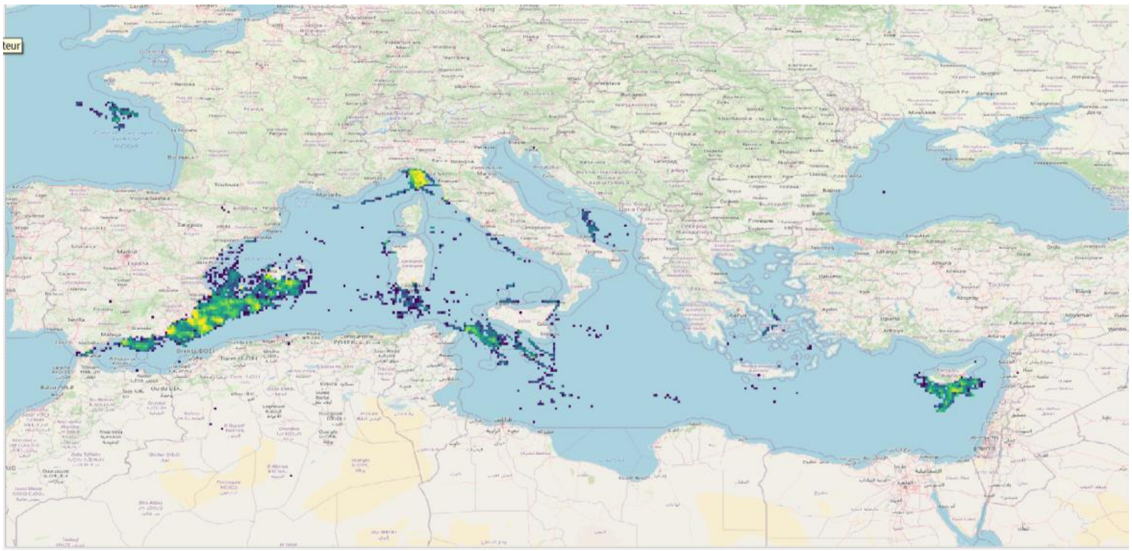

Figure 26. Seasonal differences in fishery activities: **Longline**, April to October 2018. Source: i) Spire (AIS data); ii) Sinay (fishing vessel density maps). Unpublished data.

Figure 27. Seasonal differences in fishery activities: **Nets** (gillnet, trammel etc.), April to October 2018. Source: i) Spire (AIS data); ii) Sinay (fishing vessel density maps). Unpublished data.

Figure 28. Seasonal differences in fishery activities: **Nets** (gillnet, trammel etc.), January to March and November-December 2018. Source: i) Spire (AIS data); ii) Sinay (fishing vessel density maps). Unpublished data.

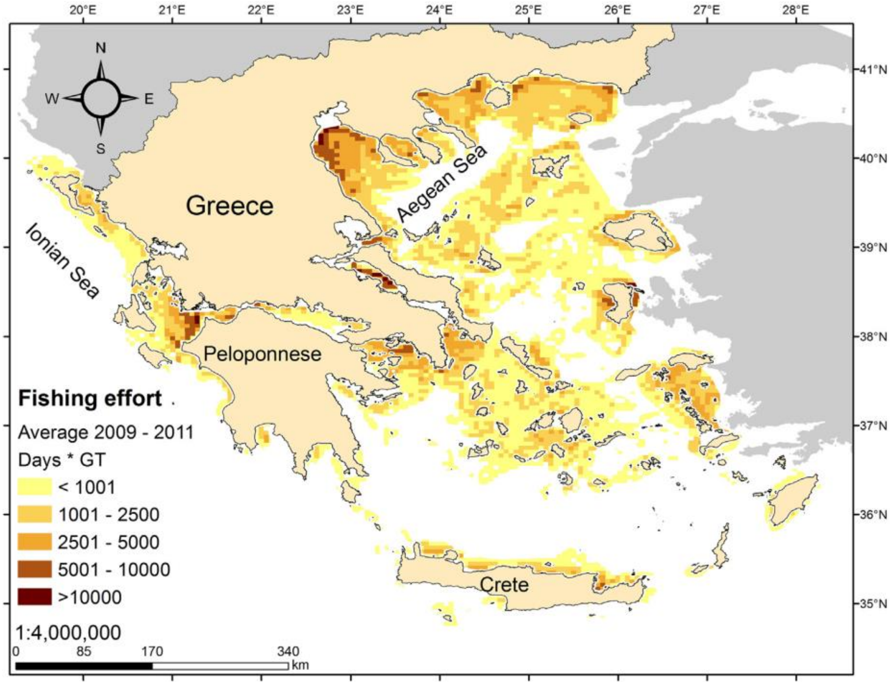

Figure 29. Fishing effort of bottom trawlers estimated by VMS data in Greek waters (source: Maina et al., 2016). To be compared with Figure 21 and 22 of the present document in order to highlight the differences between AIS- and VMS-based analyses of fishing effort.

REGIONAL GOVERNANCE

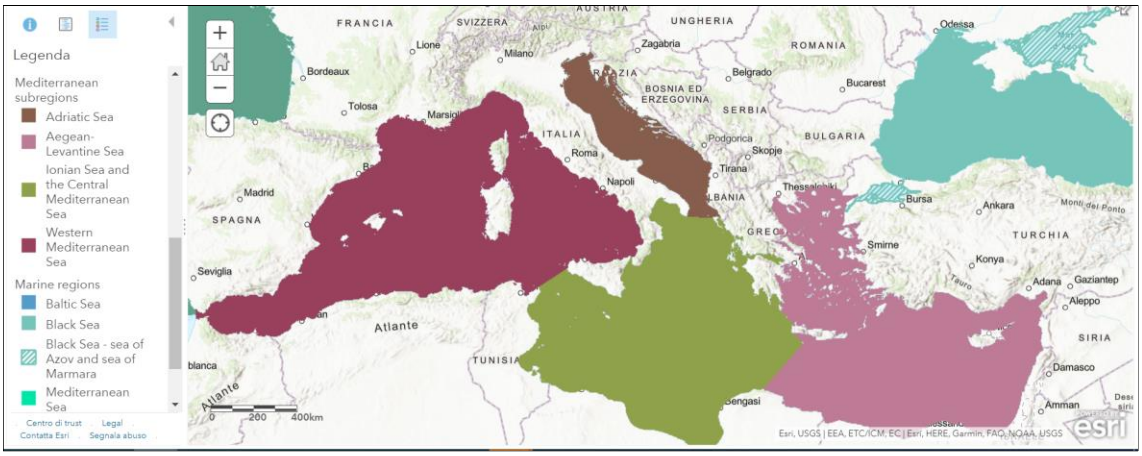

Figure 30. Marine regions and subregions under the MSFD scope with a focus on MED and BS. Source: https://www.ices.dk/news-and-events/news-archive/news/Pages/Marine-regions-map-published.aspx. The Azov and Marmara seas are hatched as they do not fall under the scope of the Bucharest Convention, but they are considered as part of the Black Sea region under the scope of the MSFD.

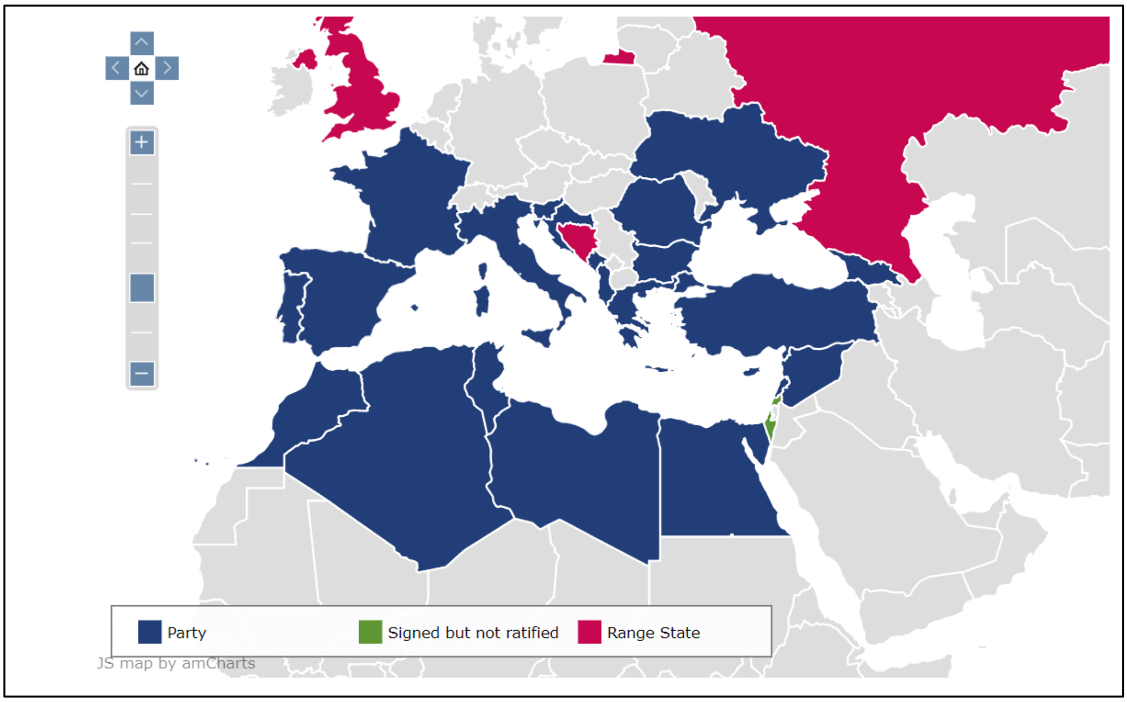

Figure 31. ACCOBAMS Parties and Range States. Source: https://www.cms.int/en/legalinstrument/accobams. Portugal is a Party. UK is a Range State because of Gibraltar.

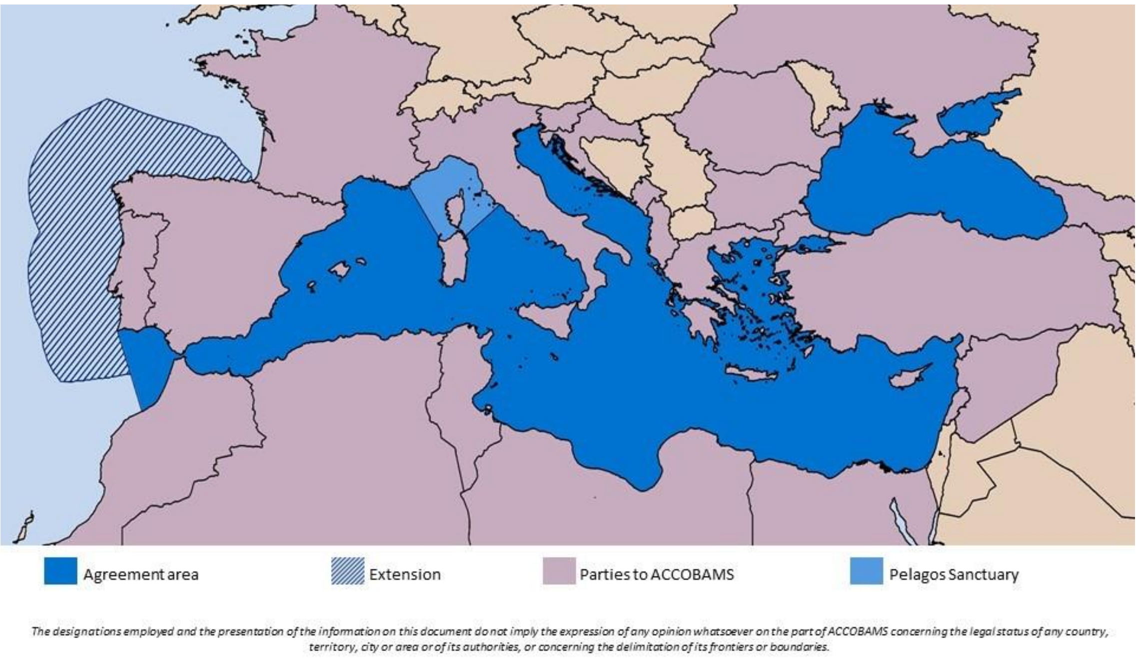

Figure 32. ACCOBAMS Agreement area and Contracting Parties. Source: https://accobams.org/about/introduction/carte-accobams_en/. The Agreement Area includes the Marmara and Azov seas.

Figure 33. Contracting Parties to the Barcelona Convention. Source: By Padraic Ryan, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=2968107. The Marmara Sea is not covered by the Convention. Portugal is not Party to the Convention as not in the range of the Convention.

Figure 34. Geographical scope of the Bucharest Convention. The Marmara Sea and the Azov Sea are not included in the geographical scope of the Convention. Source: http://www.blacksea-commission.org/

4. Considerations to address regional specificities of the Mediterranean and Black Sea for continuous noise assessment

4.1. About technical specificities

- **Topography and oceanography**: A main tool which can be widely used in the assessment methodology for continuous noise, being greatly influenced by topography and oceanographic parameters, is the propagation of sound and hence the choice and parametrization of the shipping noise modelling framework. Such topic is extensively discussed in QUIETSEAS Deliverable 4.2, which includes recommendations on the choice of acoustic propagation models according to topographic and oceanographic specificities with regards to the general shipping noise modelling framework. The reader should refer to QUIETSEAS Deliverable 4.2 for recommendations on this topic.

  Moreover, the siting of monitoring stations is obviously influenced by topography as mooring recorders in deep waters may be challenging and expensive. In this regard, existing observatories (e.g., EMSO-ERIC) should be considered as an interesting opportunity to collect data on sound levels in deep waters (see Annex 8 of TG Noise DL3).

  - Impact of specificities on the MSFD process: **a) monitoring programmes (both modelling and measurements)**.

- **Biodiversity**. The presence of a wide variety of marine species acknowledged to be noise-sensitive is a characteristic that adds value to the area in terms of environmental conservation but may also increase complexity of the assessment.

  With regards to scale of assessment, if a risk-based approach is used with wide-ranging species as ecological endpoints (e.g., cetaceans), and given that noise travels long distances, the subregion seems to be the minimum scale to carry out meaningful assessments.

- Concerning the high number of species potentially used as ecological endpoint in a risk-based assessment, QUIETMED2 Deliverable 5.1 (*Set of cetacean species representative at national, subregional and regional level in the Mediterranean Region*) provide an interesting insight into the methodology for species selection related to the sensitivity to sound and hearing capabilities. This document is focused on cetaceans and was developed for the assessment of underwater impulsive noise; however, the description of the methodology can be useful also for continuous noise in case other species than cetaceans are envisaged. The reader is invited to refer to QUIETMED2 Deliverable 5.2 for recommendations on this topic. Further reading concerning the state-of-the-art on studies about the impact of ship noise on cetaceans is the review from Erbe et al. (2019).

  The case of selecting more than one species should be anticipated in order to decide on the environmental status of an area (GES/non-GES). For example, given that two representative (e.g., endangered) species of equal importance (ranking) are used as ecological endpoints in a habitat (or MRU), the habitat could be at tolerable status as regards the one species and at not tolerable as regards the other. In such a case, either a specific procedure should be anticipated in a forthcoming methodology on threshold values (TG Noise DL4) or apply the precautionary principle suggesting that the decisions should be based on the most sensitive species.

- Impact of specificities on the MSFD process: **b) GES assessment (Habitat status determination and MRU assessment)**.

4.2. About human activities generating continuous noise

- **Ship traffic** patterns have implication on the siting of the monitoring stations (beyond obvious implications on sound levels) with regards to perform the so called 'Category A' and 'Category B' monitoring (see Dekeling et al. 2014). Based on known ship traffic patterns (see maps in Chapter 3.4), there is no evident hindrance for most part of the MED and BS areas related to the possibility to perform both monitoring categories. Since technical requirements contained in the TG-Noise Monitoring Guidance appear rather easy to be met throughout the MED, the siting of monitoring stations can be done mainly based on logistical and practical factors, i.e., choosing sites that are easier to reach, requiring less means for mooring instruments, implying lower costs, and so forth. Again, the recommendation would be to consider existing subsea observatories which may already be equipped to carry out noise monitoring, including deep waters (like EMSO-ERIC).

  However, for countries and areas where suitable siting for Category A-monitoring stations appears hard to find (see Chapter 3.2.1 and maps in Chapter 3.4), the main solution consists in cooperating with neighbouring countries and/or in international initiatives.

  - Impact of specificities on the MSFD process: **a) monitoring programmes (measurements)**.

- **Ferries and recreational craft**. Given the seasonal and geographical specificities highlighted in 3.2.2., it may be necessary for northern MED countries to study the contribution of ferries and recreational craft to ambient noise levels. However, if ferries are AIS-'visible', and hence the use of modelling is possible, the reliability of AIS for recreational craft is uncertain, especially for motor-boat smaller than super- and/or mega-yachts. Therefore, studying the contribution of recreational craft to underwater noise levels would require the deployment of monitoring stations in suitable sites.

Results obtained from these studies may have implication regarding the programmes of measures, which might address not only shipping (in terms of large ship categories), but also ferries and recreational craft.

- Impact with regards to MSFD process: **a) monitoring programmes (modelling and measurements)**; **c) programmes of measures**.

- **Fishing**. The effective contribution of fishing vessels and the related effects on the marine environment have been little studied. Also, source parameters (levels and spectra) that would be necessary for using propagation models are very poorly known and need further research. As shown in the maps of fishing effort (chapter 3.4), high concentrations of vessels in some areas of the MED may deserve specific studies based on relevant literature (e.g., Maina et al., 2018; Parsons et al., 2021). The same consideration would apply for Romanian and Bulgarian waters limited to trawlers as these seem to be the main fishing activity throughout the year.

  Results obtained from these studies may have implication regarding the programmes of measures, which might address not only shipping (in terms of large ship categories), but also fishing (e.g., incentivising the use of electric engines as appropriate).

  - Impact with regards to MSFD process: **a) monitoring programmes (modelling and measurements)**; **c) programmes of measures**.

4.3. About Geopolitical specificities and maritime policy

- **North-South and East-West differences**: the main recommendation to increase the availability of infrastructures, means and skills, is to step up capacity building initiatives and regional cooperation. Innovative solutions such as open-source tools to be made available through EMODnet or similar networks should also be explored.

  - Impact with regards to MSFD process: **a) monitoring programmes; b) GES assessment**

- **Countries close each other with small maritime space**. This specificity can be addressed by assessing continuous noise at the subregional scale as defined under the MSFD scope. With regards to the Programmes of Measures, finding solutions to reduce noise from shipping in countries where such pollution is not produced would require cooperating with IMO and regional legal framework.

  - Impact with regards to MSFD process: **b) GES assessment**; **c) programmes of measures**

- **Legal framework vs. MSFD regions and subregions**. ACCOBAMS is the legal framework that appears most suitable to take the lead on supporting noise monitoring and assessment in MED and BS due to the following reasons:
  - The Agreement area covers all regions and subregions in the MED and BS areas, including Azov Sea and Marmara Sea.
  - There is a recognized working group on underwater noise
  - A Memorandum of Understanding with UNEP/MAP on Ecological Objective 11 (energy including underwater noise) is in force[3].
  - ACCOBAMS has two Subregional Coordination Units in the two subregions of the Agreement (MED and BS): the Secretariat of the Bucharest Convention and the Regional Activity Centre for Specially Protected Areas for the Mediterranean Sea, respectively.

However, the Barcelona Convention and Bucharest Convention include all Range States as Contracting Parties, while 3 countries are missing from the ACCOBAMS Agreement. Therefore, not only the action of ACCOBAMS should be supported, but the collaboration between the three treaties should get stronger.

The last specificity pointed out in Chapter 3.3.3 regards the Economic Exclusive Zones under the UNCLOS Convention. However, we consider that issues related to UNCLOS should be tackled at different level and would require other means than those available in projects such as QUIETSEAS. Therefore, while it is worth mentioning this important issue, no specific recommendation is provided related thereto.

- Impact with regards to MSFD process: **b) GES assessment**; **c) programmes of measures**

4.4. Assembling potential concerns in the implementation of the TG Noise assessment framework in MED and BS

This section aims at exploiting the information provided in the previous sections to assemble potential issues in the implementation of TG Noise assessment framework (DL3) in the MED and the BS regions, focusing on the steps described therein, and also considering specific points that are expected to be addressed in the forthcoming TG Noise recommendations as regards the options for threshold values for continuous noise (DL4).

- *Define indicator species and its habitat*. Addressed in section 4.1-Biodiversity. The co-existence of several indicator species (even for cetaceans only) rather refers to the suggestion of the multi-species approach of the Habitat (see Annex 2 of TG Noise DL3). However, this does not preclude the possibility of the single-species approach in case that a specific species has to be studied thoroughly for a particular reason.

[3] Further information on Ecological Objective 11 available here.

- *Define the Level for Onset of Biologically Significant Adverse Effects (LOSE)*. It is expected challenging for several indicator species as mentioned in section 3.1.3-Biodiversity. According to TG Noise DL3, LOSE should preferably be determined on the basis of empirical evidence from studies on indicator species or closely related species. For masking it is expressed in the metric excess level, while for behavioral disturbance it is expressed as a sound pressure level (which can be frequency weighted) corresponding to a behavioral reaction threshold (see relevant Annex 6 of TG Noise DL3).

- *Assess the acoustic state by monitoring*. This is a major multi-parametric issue. It is addressed in section 4.1 (Topography and Oceanography); sections 3.2.1-3.2.3 and 4.2; sections 3.3.1 and 4.3 (N-S and E-W differences).

- *Establish the Reference Condition (RC)*. RC could be estimated either by modelling or by measurements. As regards the latter, difficulties are encountered in many areas of MED and BS, where “quiet” locations (slightly or less affected by shipping noise) being representative for the selected habitats are difficult to be identified due to the high ship traffic; see also sections 3.2.1 and 4.2. This is not a “privilege” of MED and BS, but it is also met in many areas of the other MSFD regions. An alternative solution for those cases is estimating RC through modelling. Given that a complex modelling approach could be a barrier for some EU MS but also for many non-EU countries, a simplified model estimating only the wind effect could be an accepted compromise.

- *Establish the Current Condition*. Addressed in the same sections with those mentioned in *Assess the acoustic state by monitoring* (see above). This also implicates the two main effects (masking and disturbance) and definition of LOSE (see above).

- *Evaluate the condition of the Grid Cell*. Available information on the population level could be challenging. Little or no data might be available to assess the potential impacts of noise on the population level when it exceeds LOSE for several indicator species. In most of the cases, it is expected that LOSE will be based on studies made on individual animals (see relevant Annex 7 of TG Noise DL3).

- *Determine the status of the Habitat*. The status of a Habitat depends on three parameters: LOSE, tolerable area (fraction of habitat where LOSE can be exceeded) and tolerable duration (fraction of time where LOSE can be exceeded). The implementation of this step depends on the procedure of setting spatial (tolerable area) and temporal (tolerable duration) thresholds. This is an open issue and TG Noise recommendations are left for DL4 (Options for threshold values for continuous noise). The approach suggested for setting these spatial and temporal thresholds as regards impulsive noise in QUIETMED2 (Deliverable 6.2 Joint proposal of a methodology to establish thresholds values for impulsive noise in the Mediterranean Sea Region) is a simple decision tree implicating both thresholds with a specific prioritization rationale. The reader could refer to that Deliverable for more information. It is likely that the same principle could be applied in MED and BS for continuous noise as well.

- *Linking habitats with MRUs*. The step from the determination of habitats' status to the MRUs' assessment (at GES or not at GES) is an important issue left for TG Noise DL4 (Options for threshold values for continuous noise). However, since many indicator species of MED and BS are wide-range cetaceans and their habitats are extended to large spatial scales, this issue should at least be mentioned here. So, for this kind of species, taking also into account that shipping noise travels long distances, we might consider that habitats and suggested MRUs (subregions) are of similar scale (see also section 4.1-Biodiversity). In any case, this issue needs further consideration and alignment with TG Noise developments.
- *Regional cooperation*. This may sound very common and trivial, but it is actually a very essential cross-cutting principle concerning all considerations described in sections 4.1, 4.2 and 4.3. However, little practical steps have been made till now towards this direction, thus rendering regional cooperation a major drawback not only for the southern MED and BS countries, but for the northern MED countries as well. Solid and effective actions should be undertaken in the framework of joint research programmes (e.g., bilateral cooperations, territorial cooperation INTERREG projects that have been proved to be a mainspring of progress in Northern Europe, and new specific European calls for strengthening research capacity and collaboration in MED and BS), but also at geopolitical level as suggested in section 4.3.

5. Cited literature

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