Developing Optimal and Open Research Support for the Black Sea

DOORS

BLACK SEA

DOORS Harmonisation Manual

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DOORS WP2 main objective: *Development of a manual of Harmonized Methods of Data Collection, Storage and Handling.*

To establish best practices guidelines and recommendations for studying the parameters of the state of the marine basin in the form of adapted guidelines for the needs of the Black Sea.

These guidelines are transferred to research institutions active in the Black Sea, as well as to all categories of stakeholders, for comments (D2.5, M46).

The final version of the "Manual of Harmonized Methods of Data Collection, Storage and Handling" (D2.7, M48) will be published and will be made available on the project website for free distribution and dissemination, with support from WP9.

Compare and adapt the guidelines to the Black Sea needs, ensuring compatibility with the MSFD and BSIMAP (EcAp) requirements.

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Developing Optimal and Open Research Support for the Black Sea

Draft manual of Harmonized Methods of Data Collection, Storage and Handling, according to specific and adapted guidelines and recommendations for Black Sea

Deliverable no: D2.5

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MAIN OUTCOME of WP2-Harmonisation:

Harmonisation Manual (in WP2 so far the knowledge gaps and needs were highlighted–in D2.1, an inventory was created of all existing database- in D.2.2, a catalogue prepared of methods used by the Black Sea countries-in D2.3, Intercalibration exercises conducted in D2.6**).**

Most basic groups of parameters:

- Biodiversity and Habitat (including NIS),
- Eutrophication
- Marine litter
- Coastal Zone Dynamics and its Management
- Good Water Quality and Contaminants
- Exploited fish and shellfish

- Methane
- Climate change

Note: Parameters were grouped based on the concept of Assessment Elements which were created by combining the EcoQOs for BSIMAP and the MSFD descriptors, together with additional objectives relating to the Coastal zone, especially in relation to climate change

Harmonisation, Standardization & Intercalibration

- ***HARMONISATION** involves achieving or improving comparability of similar measures collected by separate studies or databases for different individuals. Differs from **STANDARDISATION** in that it does not impose a single methodology or norm, but rather seeks to find ways of integrating or making "an agreeable effect" from information gathered through disparate methodologies.*

- *Intercalibration is the **process** of calibrating (= **checking**) two or more **measuring instruments** or sets of **records** to **see** if they are **accurate** in **relation** to each other*:

  Examples:

  - **Intercalibration of satellite instruments is critical for monitoring climate change.**
  - **The intercalibration of the two sensors is a challenge.**
  - **The aim is to develop ecological assessment tools and carry out a European inter-calibration exercise.**

- We will present you three case studies of our effort to develop the harmomisation manual:

  *One more mature case (**eutrophication-chlorophyll**),*
  *a less mature but promising **(marine litter**),*
  and climate change.

They also are:

- Part of intrecalibration exercises,
- Part of the training courses

Reduce EUTROPHICATION

- Common Definition in legal documents BSIMAP and MSFD, WFD;
- Common mandatory parameters including nutrients, transparency, dis. oxygen, **chlorophyll,** phytoplankton and macrophytobentos.

- **Although several projects developed inventories, diagnostic reports, and overviews it remains a challenge to harmonize and implement them through the Black Sea Commission due to the lack of political consensus**

- Establish a common framework;
- Improve data sharing;
- Use a common monitoring approach;
- Develop a regional eutrophication assessment; (will this be BEAST?)
- Promote stakeholder engagement.

HARMONISATION EXERCISE: CHLOROPHYLL

There is a variety of methods for sampling (including methodological standards) and laboratory analysis reported by the countries. Bulgaria, Romania and Türkiye are sampling by NISKIN bottles mounted on CTD and the laboratory analysis is spectrophotometric.

Georgia (results not validated) and Ukraine reported probe and satellite images measurement.

However, the use of *in* situ measurements, as reported by Bulgaria, or remote sensing methods, as reported by Ukraine, might result in different assessment outcomes, therefore intercalibration is needed.

Eutrophication

Chlorophyll-a

Country	Sampling Methodological standards	Field Sampling method	Laboratory methods
Bulgaria	ISO 10260 (1992E)	CTD 911	Spectrophotometry
Georgia		EXO - ADVANCED WATER QUALITY MONITORING PROBE (results are not validated)	Satellite images
Romania	Aminot and Rey, 2002	CTD – Niskin bottles	Spectrophotometry
Ukraine			Satellite images
Türkiye	Standard Methods 10200 (2005)	Rosette Sampler/Niskin Bottles	Spectrophotometer

Comparison of analytical methods for Chlorophyll- a analysis applied by Bulgaria, Romania and Turkey for inter-comparison exercise carried out in the frame of MISIS project (after Vasiliu D. et al, 2014)

	Bulgaria (IO-BAS)	Romania (NIMRD&GeoEcoMar)	Turkey (TUBITAK)
Filters	GF/F filter 0.7 µm pore size	nitrocellulose membrane, 0.8 µm pore size	GF/F filter 0.7 µm pore size
Extraction solvent	90 % acetone, homogenization (grinding)	90 % acetone, soaking overnight- NIMRD 90 % acetone, homogenization (stirring) and sonicating-	90 % acetone, homogenization (grinding)
Spectrophotometric methods	Trichromatic	Trichromatic	Trichromatic
Chl a computation	Jeffrey-Humphrey (1975)	SCOR-UNESCO (1966)- NIMRD Jeffrey-Humphrey (1975)- GeoEcoMar	Jeffrey-Humphrey (1975)

Ocean colour remote sensing for Chl- a retrieval

The optical complexity of the Black Sea is the reason why the standard bio-optical algorithms developed for Case 1 waters, are the source of large uncertainties (of the order of hundreds of percent) of chlorophyll a concentration in the coastal areas (Sancak *et al.,* 2005, Oguz, & Ediger, 2006, Slabakova *et al.,* 2021).

Besides standard operational algorithms, there are regional/local algorithms for the Black Sea that can produce Chl-a-related products that produce better estimation of chlorophyll retrieval for specific Black Sea regions or water types (Zibordi *et al*, 2015; Suslin & Churilova, 2016; Kopelevich *et al*, 2013, Slabakova *et al*., 2021).

The intercalibration exercise done by Bulgaria (IO-BAS), Romania (GeoEcoMar & NIMRD) and Turkey (TUBITAK) in the frame of MISIS project reveals satisfactory agreements between Chl-a measurements of the participating laboratories, despite of some differences in terms of methodological aspects

Can Georgia and Ukraine adopt the same methods (spectrophotometric) as Bulgaria Romania and Turkey for determination of Chlorophyll-a?

If not, are the outputs compatible for the results to be considered inferentially equivalent? Have there been any intercalibration exercise to validate compatibilities?

When not able to do field monitoring are the above algorithms sufficient to cover the needs – especially for Georgia and Ukraine?

Are these methods described in the implementation documents as alternatives?

Marine Litter - Coastal

Sampling Meth**odological** standards	**Country**
EU MSFD TG10 “Guidance on Monitoring of Marine Litter in European Seas-2013-JRC Scientific and Policy Reports”	BG, RO, TR, UA GE: No info / Not monitored
Field Sampling method	**Country**
Visual identification (beach sector of 100 m length)	BG, RO, TR, UA GE: No info

Harmonisation across BS countries: **YES *4/5*** (ANEMONE project)

Novel methods (remote sensing , drones)?

Marine Litter: Macro-litter Floating

Sampling Methodological standards	Country
EU MSFD TG10 “Guidance on Monitoring of Marine Litter in European Seas-2013-JRC Scientific and Policy Reports“	BG, RO, TR UA: No monitoring GE: No monitoring
Field sampling method (s)	**Country**
Identification of macroplastics: visual observed cca. 250 m around the research vessel (during cruises).	BG, RO, TR

Harmonisation across BS countries: 3/5

Marine Litter: Macro-litter - sediment

Sampling Methodological standards	Country
EU MSFD TG10 “Guidance on Monitoring of Marine Litter in European Seas-2013-JRC Scientific and Policy Reports“	BG, TR GE: No monitoring UA: No monitoring
Field sampling method (s)	**Country**
Trawling	BG, TR

Harmonisation across BS countries: 2/5

Marine Litter: MicroPlastics Floating

Sampling Methodological standards	Country
EU MSFD TG10 “Guidance on Monitoring of Marine Litter in European Seas-2013-JRC Scientific and Policy Reports	RO, TR BG,GE,UA: No monitoring
Field sampling method(s)	**Country**
Surface water layer: collected with Neuston /plankton net[RO], Manta net[TR] Niskin bottles[TR]	RO,TR
Laboratory method(s)	Country
Visual identification of microplastic particles: stereomicroscope at 4.5x – 50x magnification [RO, TR,] Spectroscopic investigations of microplastic polymeric types by RAMAN micro-spectroscopy [RO] FTIR/Spectroscopy, GC-MS (Gas Chromatography – Mass Spectrometry) [TR]	RO TR

Harmonisation across BS countries: 2/5 **Different Sampling & Laboratory methods**

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Marine Litter: microplastic in sediment

Sampling Methodological standards	Country
EU MSFD TG10 “Guidance on Monitoring of Marine Litter in European Seas-2013-JRC Scientific and Policy Reports“	RO, TR, UA BG: No monitoring
Field sampling method (s)	**Country**
Sediments collected by grabs (Van Veen [RO, TR,UA] EKMAN[TR]), box corers [RO] , Multi corer[UA]	RO,UA,TR
Laboratory method (s)	Country
Visual identification of microplastic particles: stereomicroscope at 4.5x–50x magnification [RO, TR, UA] Spectroscopic investigations of microplastic polymeric types: RAMAN micro-spectroscopy [UA] FTIR/Spectroscopy, GC-MS (Gas Chromatography– Mass Spectrometry) [UA,TR]	RO TR

Harmonisation across BS countries: 3/5, Different Sampling & Laboratory methods

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Climate Change Assessment

Though many MSFD descriptors may be impacted by climate change, including biodiversity (D1), food webs (D4), eutrophication (D5), non-indigenous species (D2), and underwater noise (D11), currently climate change is not listed as a pressure in the MSFD (or BSIMAP).

Here are some steps that could be taken:

1. **Collaborative Research**: Encourage research institutions and universities in Black Sea countries to collaborate on monitoring and research efforts related to marine climate change.
2. **Data Sharing**: Promote the sharing of data on climate parameters and ecosystem health among countries, possibly through a centralized data repository or platform.
3. **Methodology Standardization**: Work toward standardizing measurement techniques and data collection methodologies to ensure consistency and comparability of results.
4. **Policy Coordination**: Facilitate policy coordination among countries to address climate change and marine conservation collectively.
5. **Capacity Building**: Support the development of local expertise and resources for monitoring and addressing marine climate change.

By implementing these steps, countries in the Black Sea region can work together to better understand and respond to the challenges posed by marine climate change.

Parameters needed for the climate-ocean system

Parameter	Characteristics	Influence of Climate Change	Instruments to be Used	Country Reference
Temperature	Seasonal and spatial variations in sea surface and water column temperatures.	Increase of sea surface temperatures affect marine life, circulation patterns, ecosystems.	Temperature probes, CTD	Local oceanographic institutions, national meteorological agencies.
Salinity	Varies with river inputs and evaporation/ precipitation balance.	Altered precipitation patterns can impact salinity.	CTD sensors, Salinometers.	Local oceanographic institutions, national hydrological agencies.
Ocean Acidification	Changes in seawater chemistry due to increased CO_2 absorption.	Marine organisms (especially with calcium carbonate shells).	pH sensors, Total Alkalinity measurement instruments.	Environmental research institutions, marine chemistry labs.
Sea Level Rise	Gradual rise due to thermal expansion and glacier melt.	Sea level rise can lead to coastal erosion and inundation.	Tide gauges, satellite altimetry.	National oceanographic agencies, satellite data sources.
Ocean Circulation	Currents and circulation patterns play a vital role in the Black Sea ecosystem.	CC can alter circulation patterns and affect transport of heat and nutrients.	Current meters, Acoustic Doppler Current Profilers (ADCPs).	Oceanography research centers, coastal monitoring networks.
Ecosystem Health	The abundance and distribution of marine species, including fisheries.	CC affects species migration and ecosystem balance.	Fisheries data, underwater cameras, biodiversity surveys.	National fisheries agencies, marine research institutes.

Overall, the chosen parameters include:

- Sea Surface Temperature (SST),
- Depth of the Cold Intermediate Layer (CIL),
- Ocean Heat Content (OHC),
- Salinity, Sea Level Rise,
- Dissolved Oxygen (DO),
- Partial pressure of Carbon Dioxide (pCO_2),
- Ocean Acidity (pH),
- Total Alkalinity (TA),
- Dissolved Inorganic Carbon (DIC).

For the methodology standardization, **step 3** mentioned above, there was a request to the BS countries to fill in the table which includes which of these parameters are monitored/measured and with which method. Their importance is thoroughly described below:

	BG		GE		RO		TR		UA	
	Instrument/Method	**Reference/publication of method followed**	**Instrument/Method**	**Reference/publication of method followed**	**Instrument/ Method**	**Reference/publication of method followed**	**Instrument/ Method**	**Reference/publication of method followed**	**Instrument/ Method**	**Reference/publication of method followed**
Sea Surface Temperature	Satellite data/CTD	Valcheva & Slabakova, 2020; Valcheva & Palazov, 2010			SBE-911Plus CTD with SBE 3F Temperature sensor	Protocols_Procedures_Data_Products_QAQC_Cal_Physical_Samples_OOI	CTD/ Temperature probe	Seabird		
Ocean Heat Content	-	-								
Cold Intermediate Layer (CIL)	Shipboard CTD and ARGO floats observations	Valcheva *et al*, 2021			SBE-911Plus CTD with SBE 3F Temperature sensor	https://www.seabird.com/real-time-ocean-observing-systems	CTD/ temperature probe	Seabird		
Salinity	CTD	Valcheva & Palazov, 2010			SBE-911Plus CTD with SBE 4C Conductivity sensor		CTD/ conductivity probe, mareograph	Seabird	Electrometric probe for Salinity	
Sea Level Rise		Pérez Gómez *et al*., 2022						TUDES Portal (harita.gov.tr)		

	BG		GE		RO		TR		UA	
	Instrument/Method	Reference/publication of method followed	Instrument/Method	Reference/ publication of method followed	Instrument/ Method	Reference/ publication of method followed	Instrument/ Method	Reference/publication of method followed	Instrument/Method	Reference/ publication of method followed
Dissolved Oxygen	Iodometric method-Winkler procedure	БДС EN 25813:2004 (ISO 5813:1983)			SBE-911Plus CTD with SBE 43 Oxygen sensor	Sea-Bird Electronic Manual for oxygen	Winkler titration	APHA/AWWA/ WEF (2017)	Winkler titration	IOC. Manuals & guides, No 12, UNESCO. 1983. p. 6-11.
Dissolved Inorganic Carbon (DIC)	TOC analyser	БДС EN 1484: 2001 Adopted from EN 1484: 1997								
Ocean Acidity (pH)	pH meter	БДС EN ISO 10523: 2012			SBE-911Plus CTD with SBE 27 pH sensor	Sea-Bird electronic Manual for pH	pH sensors	APHA/AWWA/ WEF (2017))	Potentiometric determination	IOC. Manuals and guides, No 12. UNESCO, 1983. p. 2-6
Total alkalinity (AT or TA)	Titration method	БДС EN ISO 9963-1:2000					Titration	APHA/AWWA/ WEF (2017))		
pCO_2	-	-			Picarro G-2301 sensor	Rella 2010, Picarro white paper				

GENERAL CONCLUSIONS AND RECOMMENDATIONS

All Black Sea countries need to design and implement monitoring programs, in accordance to MSFD, WFD and BSIMAP requirements. These programs need to ensure in relation to be coherent and coordinated that:

- Technical specifications and monitoring methods to be **consistent** across the (sub)region, in order **to provide comparable results;**
- Both in national and international level in Black Sea **sampling strategies** (equipment, frequencies, sampling area coverage) **to be implemented regularly;**
- **Develop monitoring** towards elements that are not or poorly monitored. Introduce use of **automated observations systems**, **remote sensing**, and **avoid overlapping monitoring activities by promoting national and international collaboration;**
- **Data analysis needs harmonisation of analytical methods** (as statistical, models, etc) at national and international level;
- **Harmonisation of data management within countries and among countries;**

GENERAL CONCLUSIONS AND RECOMMENDATIONS

- **Comparability among assessment methods** is also needed within and between Black Sea subregions. **National assessment methods need to be harmonized at the regional level;**
- **Indicators must be developed at national or regional levels** and to agree for calculation according to common or comparable methods, in order **to facilitate decision making**;
- **Harmonised setting of reference/threshold values is needed;**
- **Assessments of ecological status need to be published for wider use;**
- **Communication of research results** need to be promoted for development of **public awareness**, also;
- **QA/QC in all BS countries** need to be employed in all countries not only **in chemical parameters but also in biol**ogy. Sufficient **intercalibration exercises** need to be organized within and between countries, in compliance with existing guidelines by international organisations;

GENERAL CONCLUSIONS AND RECOMMENDATIONS

- **Data reporting and sharing**. Most data remain for internal use. Harmonisation of data reporting using same formats for **FAIR data** is needed. **Data accessibility must increase** and **centralized databases** must be encouraged;
- **Data bases need to be accessible easily. Data Products need to be provided;**
- **QA/QC is needed also for data reliability;**
- **Increase financing for monitoring needs**, in order to establish regular geographical and parameters covering;
- Also, the increased monitoring financing is needed for **capacity building** (training in novel methods, sensors, etc.) and **up to date instruments and general equipment purchase;**
- **Coordination, synergies and collaboration** is needed among institutions involved in monitoring **with competent authorities and policy makers**, in general. A **stable networking** is needed among these players related to governance, funding, implementation of monitoring, **to promote efficient use of resources**, ensure implementation of laws and policies in national and international level.

The message:

A. Through DOORS H2020 we have identified a series of data gaps and have produced a manual to guide minimisation of these gaps through harmonisation of research efforts and knowledge sharing between the BS countries. This is a necessary step to comply with the MSFD and BSMAP assessments, which can be identified as the environmental pillars of a sustainable management of the Black Sea, considering that Research and Innovation are central to fostering it. The availability of harmonised and quality controlled marine data will enhance the understanding of marine ecosystems and their cumulative consequences.

B. Include monitoring, evaluation reporting and measures in a strategic operational plan for sustainable management. Eliminate misalignment across countries by establishing common monitoring programs through regional agreements. Establish and enhance pressures' monitoring activities related to the **high interest sectors** (fisheries, aquaculture, wind energy), for which there are high data gaps. Finance, for example, a number of **ARGO** floats profiling the Black Sea for constant observation and share data in open data platform as **SoS.**

C. The harmonisation and integration of existing and new ocean knowledge will increase the availability of credible scientific evidence to inform industry and help reduce the impact of human activities on the ocean, it will also reduce the risks and enable better planning.

Thank you for your attention

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