EMODnet

European Marine Observation and Data Network

EMODnet Thematic Lot n°4 – Chemistry

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EMODnet Phase IV – Interim Report

Reporting Period: 3/10/2019 – 2/10/2020

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Contents

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Executive summary

[Provide a short summary of the key achievements and/or events of interest to a wider audience since the start of the project phase (provide the date) you wish to highlight. You can also consider the indicators or any other of the reporting sections. Provide a bullet list of maximum 10 main points with short explanations. Max 2 pages.]

This report describes the activities and results achieved during the first year of EMODnet Chemistry Phase IV contract, which runs for two years from 3rd October 2019. It is a follow-up of the earlier developments in EMODnet Chemistry projects, which took place since June 2009, and that resulted in the portal: http://www.emodnet-chemistry.eu.

EMODnet Chemistry Phase IV has the overall objective of providing access to marine chemistry data sets and derived data products concerning **eutrophication**, ocean acidification, **contaminants** and **marine litter** from 3 matrices: water, biota and sediment. In particular, marine litter data has a focus on marine litter as collected on beaches, in fishermen's nets, or in specific surveys. **All major European sea regions are covered**: Norwegian Sea, Barents Sea, Baltic Sea, N.E. Atlantic Ocean (Celtic Seas, Iberian coast and Bay of Biscay and Macaronesia), Greater North Sea, Mediterranean Sea and Black Sea, adopting the geographical definitions of MSFD.

Phase IV aims at a continuation and improvement of services, assembling, processing and making accessible more measurements and deriving products of chemical substances for eutrophication and contaminants, exploring an extension of the scope and focus on marine litter with microlitter, floating macrolitter, and ROV/AUV multimedia data on seafloor macrolitter, as well as increased engagement and cooperation with the MSFD process and Copernicus services. Phase IV marks a major step in the implementation of the activities, given the adoption of EMODnet Chemistry as the European data platform in support of the assessment of Descriptor 10 (Marine Litter), thus increasing confidence, and having achieved acceptance in the databases, and in the derived data products and data services by the MSFD community, including EU services, Regional Sea Conventions, and Member States.

EMODnet Chemistry Phase IV advanced on the following activities:

- **Consolidation** of the process to create regional standardised, harmonized, validated data collections for all European seas for Eutrophication and Ocean Acidification, Contaminants, Beach and Seafloor Litter from the data sets as gathered and managed in the EMODnet Chemistry CDI service and the European databases for beach respectively seafloor litter;
- **Expansion** of the number of data sets in the EMODnet Chemistry CDI service from circa 1.000.000 to circa 1.066.000 CDI entries of which currently circa 900.000 in the European seas, whereby major activities have taken place for checking and improving the quality of the metadata and data, both for syntax as for content.
- **Expansion** of the pan-European marine litter databases for beach litter, for seafloor litter and for floating micro-litter. In total, they contain data on 8610 beach surveys, 4346 seafloor trawls and 215 floating micro-litter surveys. Beach litter data collection was undertaken in cooperation with Member States contributing with MSFD official monitoring data. **Consolidation** of the on line tools for beach litter and seafloor litter data formatting, to the unified data model, and data validation.
- **Customisation** of EMODnet Chemistry portal, to improve users' friendliness, in particular on its viewing and downloading services. A simplified layout, giving direct access to the data services, and new contents were implemented increasing the focus on data and data products for the three chemical themes. This includes regular updating of the portal content and posting of latest news and events, presenting marine litter, contaminants, ocean acidification and eutrophication in dedicated

sections, extension of CDI interface to allow additional search criteria, extension in data and metadata format to show information requested by EEA and Copernicus (as data quality, instrument and platform information).

- **Innovation** of the CDI service by adopting and adapting the new generation CDI service as upgraded in the EU SeaDataCloud project as well as expanding the metadata with additional fields, derived automatically from linked directories, for making it more fit for MSFD and CMEMS communities (see customisation above). Furthermore, initiating the development of a new service to facilitate exploring, subsetting, visualizing, and extracting data sets in multiple formats from the harmonized, standardized, validated data collections that EMODnet Chemistry is regularly producing and publishing for all European sea basins for eutrophication and contaminants. For this new service an adaptation is being made of the WebODV service as developed in the EU SeaDataCloud project. The first version of this new service will be released soon.

During Phase IV, EMODnet Chemistry consolidated several important milestones, improving EMODnet Chemistry visibility and consideration:

- EEA followed-up on the use of EMODnet Chemistry data for its three indicators (i.e. 'Hazardous substances in marine organisms', 'Nutrients in TCM waters' and 'Chlorophyll in TCM waters'). This confirmed EMODnet Chemistry as a source of qualified data and updated information, complementing OSPAR and HELCOM data available at ICES, and representing an alternative data resource for the Mediterranean Sea and Black Sea;
- MSFD TG-ML endorsed EMODnet Chemistry marine litter database system for gathering beach litter data on a European scale. As main results:
    - A subset of the EMODnet Chemistry pan-European Marine Litter database including the official monitoring data on beach litter 2012-2016 has been used to compute both the EU Marine Litter quantitative Baselines and Threshold values;
    - EMODnet updated the collection of monitoring data by all EU Member States covering 2016 to 2020. In addition, the approach has been extended to marine micro – litter starting with the overview of available data on beaches, in surface water, water column, sediment and biota;
- EMODnet Chemistry started the close cooperation with Copernicus by sharing oxygen, chlorophyll-a, and nutrients aggregated, validated and harmonized data collections and validation methods.

1. Introduction

[Provide a short (max 2 pages) introduction to set the stage (start date, main goals, background, consortium, key components and characteristics of the lot). Max 2 pages.]

EMODnet Chemistry IV contract first objective is to expand and further improve the products and services developed in the previous phases, working towards interoperability with services developed by other thematic groups and with the INSPIRE Directive, and being open to receive data provided through EMODnet data ingestion facility. The approach is focused on seeking engagement with and direct involvement of the Regional Sea Cconventions (RSCs) and Marine Strategy Framework Directive (MSFD) experts, customised following the mandate to contribute to MSFD implementation.

EMODnet Chemistry Phase IV requires developing and maintaining:

- a common method of access to data held in repositories;
- products constructed from one or more data sources that provide users with information about the distribution of parameters in time and space;
- procedures for machine-to-machine connections to data and data products;
- a web portal allowing users to find, visualise and download data;
- coherence with efforts of Regional Sea Conventions;
- interoperability with data distributed by non-EU organisations;
- a process to monitor performance and deal with user feedback;
- a help desk offering support to users.

EMODnet Chemistry Phase IV consortium brings together **13 partners and 3 subcontractors** from **11 countries** along European seas, mostly national marine monitoring agencies and major marine research institutes. The partners combine long-standing expertise and experiences of collecting, processing, quality controlling and managing marine chemistry data and data products together with expertise in distributed data infrastructure development and operation, provision of discovery, access and viewing services following INSPIRE implementation rules and international standards (ISO, OGC). Furthermore, the consortium mobilised a group of 28 institutes willing to provide support to the initiative, to give advice on planned activities and to contribute with chemical observation data sets as acquired for the water, sediment and biota compartments. For this reason, it was decided to set an open Advisory Forum that combines a wealth of national and regional expertise and knowledge about the chemistry data and their possible use for contributing to GES indicators and the MSFD implementation.

EMODnet Chemistry has to make available data of concentrations of chemicals in seawater, sediment and biota, particularly those relevant to the Marine Strategy Framework Directive or to global climate change as identified in the following:

- pesticides and biocides (such as DDT, HCB)
- antifoulants (such as TBT, TPT)
- pharmaceuticals (such as oxytetracycline)
- heavy metals (such as mercury, cadmium, lead)
- hydrocarbons (such as anthracene, fluoroanthene)

- radionuclides (such as 137Cs, 239Pu)
- fertilisers (such as nitrogen (DIN, TN), phosphorus (DIP, TP))
- organic matter e.g. from sewers or mariculture (such as total carbon (TOC))
- chlorophyll
- silicates
- partial pressures of dissolved gases (such as oxygen, carbon dioxide)
- plastics (such as polyethylene, polypropylene)
- acidity (from pH, pCO2, Total Inorganic Carbon, alkalinity)
- marine litter (collected on beaches, in fishermen's nets, or in specific surveys). This shall include macro-objects (nets, bottles etc.) as well as fragments and microparticles in the water column, sediments and beaches
- microplastics
- nutrient loads (nitrogen and phosphorus) to regional seas by major rivers

The geographical scope shall cover metadata, data and data products over:

1) Water column and seabed for the complete coverage of the Baltic, Barents, Black, Mediterranean, and North Seas, for the coverage of jurisdictional waters (including continental shelf and claimed extended continental shelf) of Member States and Norway for the North East Atlantic (Celtic Seas, Iberian Coast and Bay of Biscay, Macaronesia and Norwegian Sea);

2) Coastline for EU Member States plus Norway and all Baltic countries,

2. Update on the Tasks

*[Please make sure that progress in each of the tasks **specified in the relevant Tender Specifications** since the start of the project phase (provide the date) is listed. For those tasks not experiencing progress, please provide an explanation. Max 2 pages.]*

The progress in each tasks detailed in the Tender Specifications under Section 1.4.1 since the start of the project phase (from 3rd October 2019 to 2nd October 2020) is listed below:

Task 1: Develop a common method of access to data held in repositories:

- EMODnet Chemistry gathers measurement datasets on seawater quality from many data sources and makes them findable, accessible, interoperable and reusable. This is achieved by making use of the SeaDataNet Common Data Index (CDI) data discovery and access service. In the reporting year, the number of data sets in the EMODnet Chemistry CDI service has increased from circa 1.000.000 to circa 1.066.000 CDI entries of which currently circa 900.000 in the European seas, while major activities have taken place for checking and improving the quality of the metadata and data, both for syntax as for content.
- In addition, marine litter data for beach litter and seafloor litter, also coming from different sources, are managed in two central databases, involving considerable efforts for validation, classification, and metadata documenting. The CDI service allows users to browse data sets in more detail, to narrow down their query and to download a selection of data sets. Data gathering activities are particularly relevant in the first year, also facilitated by meetings with data providers organised at regional scale. At the end of the reporting period, the Marine Litter databases contain data on 8610 beach surveys, 4346 seafloor trawls and 215 floating micro-litter surveys.

Task 2: Construct products from one or more data sources that provide users with information about the distribution of parameters in time and space:

- Measurement data are harmonized, standardized, validated and made available as regional and global data collections for Eutrophication (nutrients, chlorophyll and oxygen) and Ocean Acidification (alkalinity and pH) in seawater, for Contaminants in seawater, biota and sediment and for Marine Litter in seawater and sediment. 6-year analysis give the distribution of selected eutrophication parameters, interpolated on a regular grid, in time and space, while dedicated maps display the distribution of contaminants and marine litter at measurement points. The Map viewer shows all products, also interrogated in the catalogue service. During the first year, two harmonised and aggregated data collections were produced and released by the Regional Coordinators upon requests of the EEA. These concerned a collection for eutrophication, based upon a harvest of data sets from the CDI service in January 2020; followed by a collection of contaminants, based upon a harvest of data sets in May 2020. All data products were mapped to BODC vocabularies for offering a better search filters in data products catalogue: Matrix Categories - L04 and Themes - P36. Currently, activities are well progressed for a new round of data harvests from the CDI service, that will provide the basis for new releases of both eutrophication and contaminants validated collections, planned for March 2021.

Task 3: Develop procedures for machine-to-machine connections to data and data products:

- Machine-to-machine connections to data and data products are upgraded following the Technical Guidance for the implementation of INSPIRE View Services. EMODnet Chemistry products catalogue provides the INSPIRE metadata fields requested for enabling machine-to-machine connections, by including information on OGS services and data URL. The INSPIRE validator tool is used for validating the service. All MetadataURL point to standard XML and to a human readable text.

Task 4: Maintain and further develop a thematic web portal allowing users to find, visualise and download data and promote the data and data products of the portal:

- The EMODnet Chemistry portal has been reviewed and restyled following the observations received from the EU DG MARE and the EMODnet Secretariat. The section ABOUT is completely updated and rewritten. The section DATA ACCESS provides quick and easy access to the harmonized and validated data collections, while measurement data, as delivered by the originators, are available through a Data Discovery and Access service. The section DATA PRODUCTS, enriched with clear descriptions of all available results, allows the user to browse, visualise and download data products. Four thematic hexagons were made active and provide quick access to dedicated information and, in the case of marine litter, to a set of data management tools used to format (from a syntactic and semantic point of view) and validate beach and seafloor litter data. News and events, distributed with all promotional materials, are continuously updated (twenty additions during the first year) as well as the other promotional sections (use cases, publications, etc.) and the technical sections (Guidelines, Reports to EU, Project meetings). Good progress is being made with a new service based upon WebODV to facilitate exploring, subsetting, visualizing, and extracting data sets in multiple formats from the harmonized, standardized, validated data collections for eutrophication and contaminants. The first version of this new service will be released soon as a GUI, while further work is planned for an API version too.

Task 5: Ensure the involvement of Regional Sea Conventions:

- Dialogue with four Regional Sea Conventions has been maintained through the participation in the MSFD Technical Groups (on Contaminants and Marine Litter), where a regular dialogue is established, and through the MSFD Board of experts, consulted prior to the release of new products.

Task 6: Install a process to monitor performance and deal with user feedback:

- Procedures are up and running. COVID-19 emergency did not affect the functionality. OGS has developed a new web service that collects download metrics for the indicators. During the first year, the map viewer, the DOI landing page and data products catalogue progressively used this new web service.

Task 7: Operate a help desk offering support to users:

- The helpdesk is kept operational in the reporting period. COVID-19 emergency did not affect the functionality. All support requests received via the Help desk are listed in Section 6.

To make the execution of the contract easier and more effective, a Work Plan is implemented that groups specific tasks, comparable in nature, under the same Work Packages (WP):

WP No.	Work Package Title	Covering tasks
WP1	Project Management	Task 8: Coordination
WP2	Data access	Task 1: Develop a common method of access to data held in repositories
WP3	Generation of data products, including collections	Task 2: Construct products from one or more data sources that provide users with information about the distribution of parameters in time and space
WP4	Technical development and operation of portal, services and tools	Task 3: Develop procedures for machine-to-machine connections to data and data products Task 4: Maintain and further develop a thematic web portal

		Task 6: Install a process to monitor performance and deal with user feedback
WP5	MSFD, Regional and European uptake and interaction	Task 5: Ensure the involvement of regional sea conventions Task 7: Operate a help desk offering support to users
WP6	Outreach and promotion	Task 6: Monitor performance and deal with user feedback Task 9: Promotion and dissemination

Details on the WP activities and tasks are presented in Chapter 3.

3. Work Package updates

[Provide in the table a list of all Milestones and Deliverables as from the technical workplan, the date due and status. Then, using the Work Package as a header, list the activities that occurred since the start of the project phase. When describing each Work Package, please also refer to the corresponding Tender task(s) (specified in the relevant Tender Specifications). Max 2 pages per work package.]

This section provides a list of all Milestones and Deliverables as from the technical work plan in the table below and the activities that occurred during the first year, using the work package as a header.

Status of the Milestones and Deliverables listed in the workplan			
Milestone/Deliverable	WP	Date due	Status (Pending/Resolved)
MS1: Chemistry (contaminants and eutrophication) CDI metadata and data sets included in CDI Service	WP2	2/4/2020	Resolved
MS2: Marine litter and microlitter data sets from data providers, OSPAR, EEA, DeFishGear, ICES, MEDITS and Member States included in the EMODnet databases	WP2	2/10/2020	Pending
MS3: First version concentration maps of marine and beach litter	WP3	2/10/2020	Resolved
MS4: Updated data collections for contaminants and eutrophication to EEA	WP3	2/10/2020	Resolved
D1.1: Quarterly concise progress reports	WP1	15/1/2020, 15/4/2020, 15/7/2020, 15/10/2020	Resolved
D1.2: Annual Interim report	WP1	2/11/2020	Resolved
D2.1: Revised guidelines for contaminants data management	WP2	2/11/2020	Resolved
D2.2: Remote technical workshop to train DC in contaminants data management	WP2	2/11/2020	
D2.3: Guidelines for QC for contaminants	WP2	2/4/2020	Resolved
D2.4: Close data harvesting for contaminants	WP2	2/4/2020	Resolved
D2.5: Close data harvesting for eutrophication	WP2	2/4/2020	Resolved
D2.6: Guidelines for new marine litter formats (floating macro and microplastics)	WP2	2/4/2020	Resolved
D3.1: Release of validated collections for contaminants to EEA	WP3	2/10/2020	Resolved
D3.4: Release of validated collections for eutrophication to EEA	WP3	2/10/2020	Resolved
D3.8: First version concentration maps of marine and beach litter	WP3	2/10/2020	Resolved
D4.1: EMODnet Chemistry portal upgraded with extra functionalities	WP4	2/4/2020	Resolved
D4.2: Upgraded databases for marine litter	WP4	2/8/2020	Pending
D4.4: Set-up viewing services for contaminants	WP4	2/10/2020	Pending
D4.5: Adoption of SDC Collaborative Virtual Environment (CVE) prototype	WP4	2/10/2020	Pending
D4.7: Monitoring data about visits and usage	WP4	Continuously	
D5.1: Operate Help-desk	WP5	Continuously	
D5.3: International cooperation and interoperability	WP5	Continuously	
D6.1: Promotional plan, with listing of events	WP6	2/1/2020	Pending

D6.2: Promotional material handout	WP6	2/4/2020	Pending
D6.3: Implementation of promotional plan	WP6	2/4/2020	Pending
D6.4: Animation with existing products explaining the role of EMD Chem in the MSFD plan	WP6	2/10/2020	Pending
D6.5: Presentations at relevant conferences	WP6	Regularly	Pending

WP1 – Project Management (OGS)

The project management and the coordination of EMODnet Chemistry consortium including all project activities aims at ensuring timely delivery of outcomes and high quality of documentation, tools, results and products. Project management includes the collaboration with the other EMODnet thematic portals, with the Central portal group and larger EMODnet organisation.

As soon as the positive evaluation of the procurement procedure was received on 30/07/2019, the coordination activity started. The first actions concerned the collection of all administrative documents, integrating the evidence already provided in the submission phase, sent to EASME on 09/09/2019 and on 19/09/2019. The contract was counter-signed on 03/10/2019 marking the official start of the contract.

The 1st Steering Committee meeting, foreseen for month 1 was held in Rome (Italy) on 29-30/10/2019. As reported in the minutes, the SC agreed to close the data harvesting at the end of November 2019 (M2) to be ready for an internal delivery of the harmonized validated data collections to EEA in spring 2020. Furthermore, the first Full Group meeting (originally planned for M6=march 2020) was shifted to 21-25/9/2020 (M12) to have it back-to-back with the EMODnet Jamboree, and a Steering Committee meeting was organised in March 2020 (M6). These changes in data delivery and meeting timing were communicated to DG MARE/EASME in the quarterly report.

To keep communication, the Project Office defined several new mailing lists:

- info@emodnet-chemistry.eu
- partners@emodnet-chemistry.eu
- subcontractors@emodnet-chemistry.eu
- advisory@emodnet-chemistry.eu (open Advisory Forum)
- all@emodnet-chemistry.eu (merging the three lists partners+subcontractors+advisory)
- board-msfd@emodnet-chemistry.eu (board of MSFD experts)

In parallel, the Consortium Agreement (CA) was circulated among the 13 partners and the Subcontract template was bilaterally exchanged with the three subcontractors. The CA was finalised on 11/11/2019 and a signed copy is available on the Extranet since 19/2/2020. The three bilateral Subcontracts are finalised and are available on Extranet as well. In addition, an official agreement was sent to all participants of the Advisory Forum to underline their role and the expected budget, to be countersigned by each participant to underpin their commitment.

The first meeting between CMEMS and EMODnet Chemistry (following the MoU signed on June 2019) was organised in Brussels on 12-13/2/2020, to work on a common methodology for processing oxygen and chlorophyll data sets, and to formulate metadata richness as required by CMEMS.

Due to COVID-19 pandemic, the March SC meeting was organised on line back-to-back with the first Technical Group Meeting. The full group meeting was rescheduled as a series of regional meetings, half day each, in June 2020, to explain the importance to continue populating new CDI and data records and motivate data providers for their essential role in EMODnet Chemistry. Moreover, these meetings were used to provide feedback from Regional Coordinators to the data providers about issues found in

harvested data and how to undertake actions for correcting these in existing data sets and preventing these in future data submissions.

Agendas, presentations and minutes of the above-mentioned meetings are made available on the Chemistry portal.

Regular meetings with the six Regional Leaders started with the release of the first data harvest and continued on monthly basis. These events are crucial to coordinate the development of the regional datasets and data products and guarantee the adoption of shared protocols and tools.

Active collaboration with EMODnet Data Ingestion project is ensured with constant dialogue and participation to the on-line plenary meeting.

The coordinator and the technical coordinator actively engaged to EMODnet Steering Committee meetings, to Technical Working Groups meetings, to Communication meetings and to bilateral ad hoc meetings organised by the Secretariat upon need. They participated in the MSFD Technical Group on Marine Litter (TG ML) and on Contaminants (D8 and D9). The project results were presented to several events (meeting or workshop) as listed in Chapter 7 and 8.

Quarterly progress reports were regularly submitted by email and approved by EU EASME.

WP2 – Data access, including marine litter (MARIS)

EMODnet Chemistry makes use of a large pan-European network of data centres from marine research institutes and governmental monitoring agencies for gathering measurement datasets on seawater quality from many data sources and to make these findable, accessible, interoperable and reusable (FAIR). This is achieved by making use of the SeaDataNet Common Data Index (CDI) data discovery and access service. From the start of the new EMODnet Chemistry IV contract, all data providers were encouraged by MARIS as WP2 leader to be active in checking the formats of existing CDI - data sets using the SeaDataNet OCTOPUS software and to give a follow up to issues as identified earlier by Regional Coordinators and the overall SeaDataNet checks for existing CDI – data sets.

Moreover, all data providers were encouraged and supported to proceed with new data submissions and thereby to make use of the latest SeaDataNet tools, MIKADO for CDI metadata entries, NEMO for converting local data files to ODV formats, Vocabularies for mapping local terms to common terms, OCTOPUS for checking formats of data files before submission, and to install and configure the latest version of the new Replication Manager for arranging automatic connectivity between Data Centres and the CDI service.

In addition, following requests from EEA and Copernicus CMEMS for additional metadata, a plan was made for enriching the CDI metadata with fields for PlatformCode (L06), and Shipcode (C17), where applicable, using the relation with the Cruise Summary Reports (CSR) directory, for Type of Project (monitoring versus research), using the relation with the Projects (EDMERP) directory, and for various regional codes. The latter concern region codes for OSPAR, HELCOM, and MSDFD areas, which can be derived automatically by means of the given coordinates in the CDI records. Moreover, local water depths for CDIs for point data with empty values fields can be derived automatically, using the REST service from the EMODnet Bathymetry DTM service. Finally, measures were taken for improving the coherence between the P01 parameters as used in the ODV data files and the P02 parameter groups as used in the CDIs. The P01s, in particular those with measurement values, can be extracted from the ODV files in the new central data cache and from internal buffers with restricted data sets (see WP4 for more information) and then used for establishing the correct P02s in the CDIs following the P01-P02 thesaurus relations. These enrichments

are now done automatically during the import of new and updated CDIs. However, all data providers were informed and requested to add, where possible and applicable, relations to Cruise Summary Reports (CSR) and Projects (EDMERP) and where needed to populate first extra entries to those SeaDataNet directories too. Moreover, data providers were asked to complete as much as possible the existing CDI field on instruments with terms from the L05 Vocabulary as well detailed information on QA-QC procedures and methodologies that had been applied on the samples for deriving the parameters (P01) and their values. Finally, data providers were asked to reconsider their possible data restrictions and to strive for more open data, where possible and in dialogue with their data originators and institutes.

Two guidance manual 'EMODnet Phase IV - How to include information in the CDIs – guidelines' and 'EMODnet Phase IV - Updated guidelines for SeaDataNet ODV production' were produced and published at the EMODNet Chemistry portal, while MARIS set-up the automatic procedures as part of the CDI – data import process, and IFREMER made some upgrades to the MIKADO and OCTOPUS software.

In addition, a series of meetings were organised between the Regional Coordinators (RCs) and the data providers for the relevant regions, to discuss the findings of RCs in harvested data collections, to discuss the required corrections and to refine their data population activities.

Overall, in the reporting year, the number of data sets in the EMODnet Chemistry CDI service has increased from circa 1.000.000 to circa 1.066.000 CDI entries of which currently circa 900.000 in the European seas. That is a considerable increase, while also the overall quality of the metadata and data has considerably been improved, both for syntax as for content.

In order to collect marine litter data from relevant EMODnet Chemistry consortium members and others, the earlier Guidelines and Forms for gathering beach litter (nets, bottles etc) and seafloor litter (i.e. litter collected by fish trawl surveys) were refined and published at the EMODnet Chemistry portal. This concerns the 'Seafloor data format template' and 'Beach data format template' which were published at the start of the new contract and which were promoted to potential data providers within the EMODnet Chemistry consortium, but also to the members of TG-ML and beyond. Later on additional guidelines and formats were formulated and published such as: a) Microlitter data format template; b) Guidelines for gathering Microlitter datasets; c) Guidelines and forms for gathering marine litter data; d) Guidelines and forms for gathering marine litter data. In all cases, this is done in cooperation with the TG-ML for developing and publishing these forms and guidelines, as the TG-ML and DG Environment have adopted EMODnet Chemistry as the European facility for gathering and compiling databases for Marine Litter. For that purpose, there is also an intense cooperation between OGS as manager and validator of the ML databases and EU-JRC as co-chair of TG-ML and which gives great support for gathering ML submissions from Member States and other sources, coordinated through TG-ML. Considerable efforts are required and have been spent in the reporting year for validation, classification, and metadata documenting of the incoming ML submissions. OGS also makes CDI entries for all accepted submissions. This way, users can browse data sets in more detail, narrow down their query and download a selection of data sets. At the end of the reporting period, the Marine Litter databases contain data on 8610 beach surveys, 4346 seafloor trawls and 215 floating micro-litter surveys. OGS is exploring options for also handling other types of ML data. In that framework, a new data management proposal for handling seafloor litter images and videos has been produced and is under revision for taking into production.

WP3 – Generation of data products, including collections (RLs)

After consultation with EEA, the scheduling of WP3 was slightly revised, planning to close the first (interim) data harvesting at the end of November 2019 (M2) and shifting the consolidated project output to November 2020 (M12). In this way, data providers will not be able to give their contribution to improve

the first harvest but they will contribute to the second one, planned for November 2020. In parallel, the six Regional Leaders will be engaged to generate harmonised, aggregated and validated data collections for eutrophication and contaminants. Details of the activity performed during the first year are provided in the Appendix.

The first harvests were made by MARIS from the CDI service in January – February 2020 for eutrophication and in May 2020 for contaminants, and handed over to the Regional Coordinators for their validation and aggregation actrivities. As a result, at the end of June 2020 and at the end of July 2020 we released to EEA the aggregated and validated collection for eutrophication and contaminants, respectively.

Quality control and harmonization of marine litter data, as performed during the first quarter of the first year, have revealed several errors in both beach and seafloor litter as delivered by OSPAR (MCS) and ICES (DATRAS). The providers undertook a major revision of the data that required to remove the entire delivery and to correct inconsistencies. On 22nd September 2020 and on 7th October 2020 the OSPAR and ICES released the correct datasets, complementing beach litter data from 2016 to 2020 submitted by EU Member States (as part of the EU JRC data call), marine litter and micro-litter harvested by EMODnet Chemistry network. This activity was undertaken in synergy with MSFD TG ML as part of the MSFD monitoring data collection. The coverage has recently been extended to marine micro-litter, with the overview of official monitoring data on beaches, in surface water, water column, sediment and biota.

WP4 – Technical development and operation of portal, services and tools (MARIS with ULg and AWI)

The technical infrastructure for EMODnet Chemistry comprises a number of components, which are developed, maintained, and operated by a number of technical partners. These partners are members of the Technical Working Group which had a progress / coordination meeting, 10 March 2020. Technical activities have taken place on the following topics.

Checking present status and upgrading of basis functionality of portal and services:

DG MARE and Secretariat made an assessment of the EMODnet Chemistry portal in February 2020, which resulted in a request for improvement of the website and making access to data and data products easier. As follow-up, a document was prepared with an amended layout and navigation of the EMODnet Chemistry portal, simplifying the homepage, and improving focus and access to services and to aggregated collections. As next step, the changes to the portal were deployed. As part of this reshuffling, also it was decided to place the CDI Data Discovery and Access service somewhat at a lower place, as the focus should be more on the data products and the three topics 'eutrophication, contaminants, and marine litter'. Furthermore, a matrix of downloadable validated data collections per MSFD region has been implemented prominently, while simplifying and lowering the presentation of the CDI matrix user interface. The MapViewer (new name for OceanBrowser) and the Product Catalogue (new name for Sextant catalogue) were maintained for publishing and giving access to all the products. Furthermore, developments were initiated for a Data Collection discovery and extractor service, adopting and adapting from the WebODV development of AWI in the SeaDataCloud project (see more details below).

Upgrading of CDI Data Discovery and Access service:

As indicated earlier in WP2, EMODnet Chemistry make use of the SeaDataNet Common Data Index (CDI) Data Discovery and Access service for gathering the chemistry observation data sets from in-situ observations and samples, and their successive laboratory analyses, by means of a large network of data centres. The CDI service also provides a central catalogue and shopping mechanism for finding and

retrieving the gathered 'raw' data sets at granule level, which regularly are harvested for providing input to the Regional Coordinators as part of WP3 activities.

The CDI metadata format is based on the the ISO 19115 – 19139 standards for metadata, and is INSPIRE compliant (more explanation later) and made fit for describing marine data in a FAIR (Findable, Accessible, Interoperable, and Reusable) way. For the CDI data discovery and access service a major upgrading had taken place in the EU H2020 SeaDataCloud project and this upgrade was adopted and adapted for EMODnet Chemistry. The upgraded SeaDataNet CDI service was launched in October 2019, and the derived EMODnet Chemistry version was released early November 2019. The upgrade has been achieved by joint developments of the SeaDataNet network of NODCs and EUDAT, a leading European network of academic computing centres. The new architecture makes a distinction between the front-end with discovery, shopping and downloading of data sets by users, and the back-end for importing new and updated CDI metadata and related data entries (including versioning) by data centres. The separation is achieved by introducing a central data cloud, which holds copies of all unrestricted data sets by replication from the connected data centres, and which serves as a central data cache for efficiently executing user shopping requests. While restricted data sets still are stored only at the connected data centres and transferred through the new system to users for downloading, once the data provider has agreed with providing access.

CDI service components

- **Local software tools** at data centres to prepare metadata and data files in standsrd SeaDataNet formats, from local data resources
- **Replication Manager** at data centres for importing CDI metadata to **Central CDI catalogue** and associated data files to **Data Cache cloud,** orchestrated by the **CDI Import Manager**
- Data Cache at EUDAT with replicates of all unrestricted data sets
- Upgraded **CDI User Interface** and **facilities for shopping and tracking of shopping requests**, by users and data centres

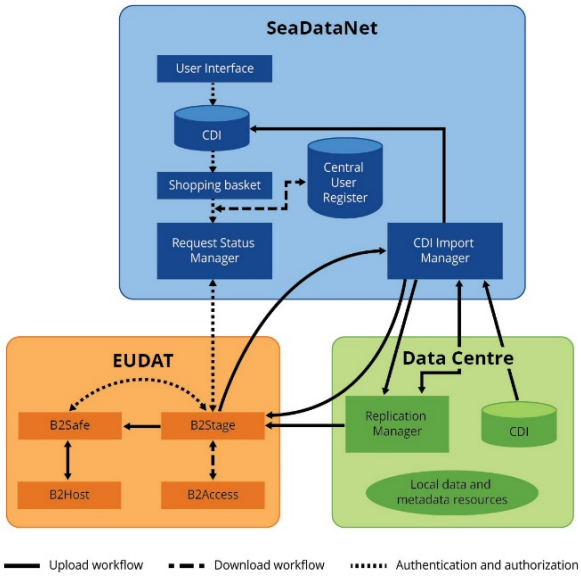


Figure: Architecture of upgraded CDI service

Data centres can populate the CDI service with updated and new entries. For that purpose, the data centres should be registered as CDI nodes and be connected to the CDI system. Most data centres make use of direct connections, which require the installation and configuration of the Replication Manager (RM), a local software component. The RM has replaced the previously used Download Manager. The RM facilitates automatic import of CDI metadata from the data centre to the Central CDI catalogue and associated (unrestricted) data files to the Data Cache cloud, which is orchestrated by the CDI Import Manager service. The direct connection ensures that data sets can be delivered to users through the CDI service, fully automatic for unrestricted data, and semi-automatic for restricted data. Moreover, that data centres can manage imports for population themselves.

The new CDI User Interface gives users powerful search options by combining free search, facet search and geographic search options, powered by Elastic Search, SQL search, and Geo Server. The data access

function comprises a simple and effective data shopping, tracking and download service mechanism. All functions for both users and data providers can be reached from a new MySeaDataNet dashboard, depending on the Marine-ID credentials of users, and associated registered functions and roles. Searching and browsing can be done anonymously, while shopping by users and import by data providers require authorisation and authentication by means of the Marine-ID AAI service, which is operated by SeaDataNet. Login is required for logistic reasons, and because many data providers require justification of the use of their data. Through the MySeaDataNet dashboard, the shopping process now has an integrated dialogue instead of having to go to separate applications and URLs, for example for searching, registering, checking shopping progress, and retrieving data sets. This makes the dialogues for users and providers much more efficient, and easy to understand and perform. Furthermore, several processes and functionalities have been reviewed and optimised, including performances, which again is in favour of the users and data providers.

Data providers of EMODnet Chemistry were actively engaged in the uptake of the upgraded system and for learning how to populate updated and new CDI entries for relevant chemical substances. This was done by data providers joining the SeaDataCloud workshops for training in the latest tools, formats, and quality procedures, and by supporting data providers in the adoption and configuration of the new services for import and format checking.

The user interface for EMODnet Chemistry is different from the overall user interface for SeaDataNet as it has several search criteria which are purely focused and relevant for the Chemistry data collection and its users. This includes criteria for searching on matrix (water column, sediments, biota), chemistry substances (P36 vocabulary with terms such as 'heavy metals', 'fertilisers', 'Pesticides and biocides' , and others), ICES areas, HELCOM areas, OSPAR areas, and MSFD regions as special terms next to the regular where, when, who, and how search criteria in order to satisfy MSFD user requirements.

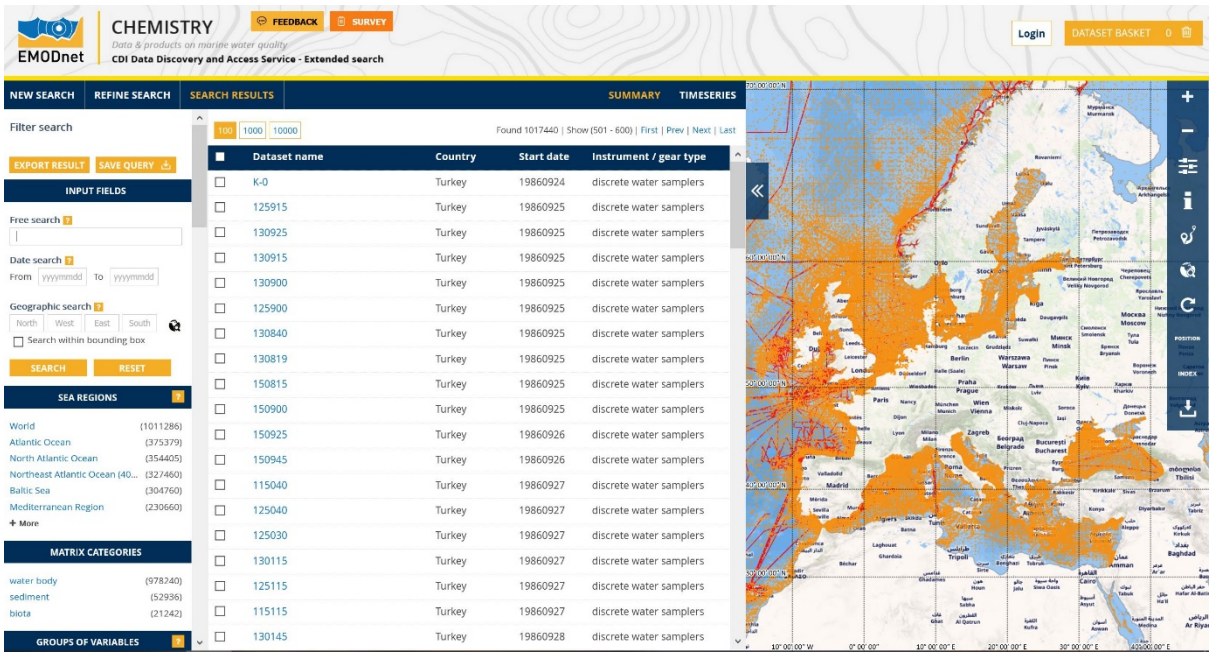


Figure: User Interface of upgraded CDI service

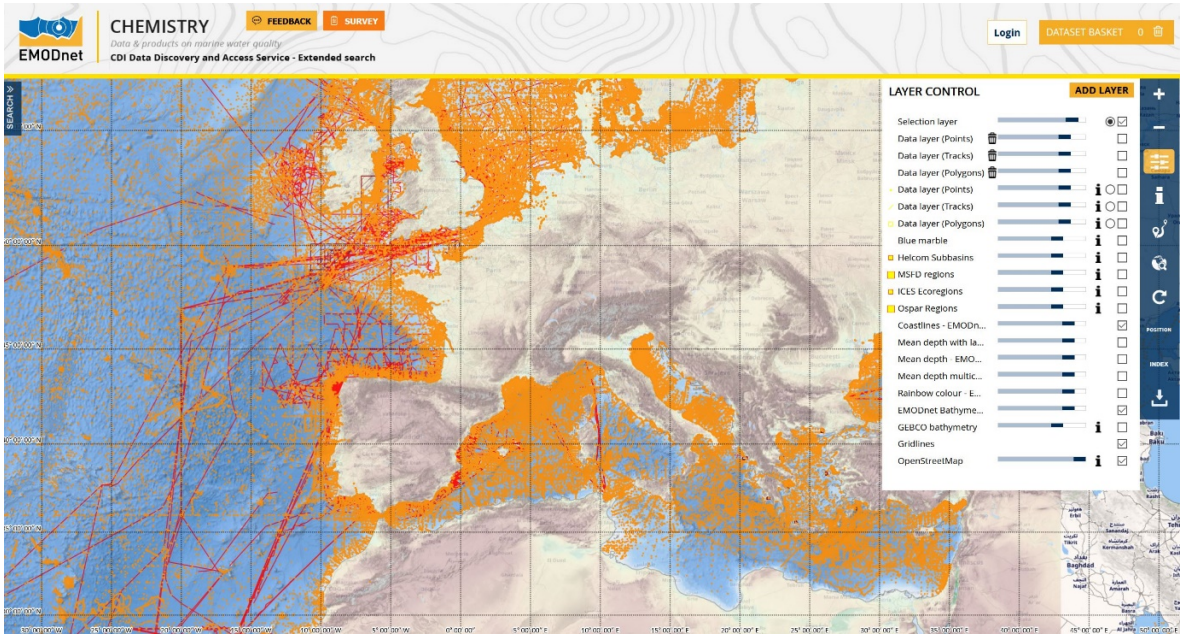


Figure: Large mapping interface as part of the User Interface of upgraded CDI service

MSFD regions:

The MSFD regions are used for tagging CDI records and for harvesting data sets, which then are provided as 'raw' data collections to the Regional Coordinators for their validation, aggregation, and harmonisation activities. The first version of boundaries of MSFD regions was given by EEA to the project during the previous project. However, overtime a new formulation became available which consists of four main regions (Black Sea, Mediterranean, Baltic Sea, and North-West Atlantic Ocean (including Greater North Sea)). Due to this change, a new tagging had to be prepared for all CDI entries and for amending the filters for the buffers which are used for regularly harvesting the relevant data collections. The new MSFD region coverage is included as a map layer in the CDI service interface.

INSPIRE WMS-WFS services:

Upon request of the EMODnet Secretariat a number of activities were undertaken for the OGC WMS – WFS services of EMODnet Chemistry to make them INSPIRE compliant by including metadata for data URLs and metadata URLs for each map layer using the GeoServer CMS and by extra entries in the Sextant catalogue service.

Web forms harmonisation:

There are several ways for downloading products, namely directly from the new products matrix, Sextant catalogue, and Map Viewer. The web order forms were harmonised and all support handling registered users via Marine-ID or free text with mandatory email address.

Marine Litter database system and products generation and publishing:

Currently, EMODnet Chemistry has procedures and protocols for gathering and processing of three types of Marine Litter, namely beach litter, seafloor litter, and floating micro litter. For formats, classifications, and gathering procedures, cooperation and tuning takes place with TG-ML and EU-JRC. For the first two ML types, two central databases have been set-up at OGS, while for floating micro litter use is made of CDI and amended ODV formats. For access, use is made of the CDI service for all three ML types, whereby OGS generates the CDIs from the two central databases, acknowledging the data curators in the CDI metadata. While, in addition mapping products are generated and published as map layers.

For **Beach Litter** there was no structured QC loop towards data providers as already in place for other kinds of data (such as eutrophication and contaminants). Quality check are done by OGS before and after db ingestion, when also CDI and ODV files are made and populated and data products are generated. Quality issues concern: wrong beaches/surveys coordinates (on land), missing EDMOs (originator)/ beach country (excluding MLW), missing EDMERP, and duplicate data received from different collators. This gives delays in data publication, updates and/or deactivation of CDIs which is resources consuming and not meeting project deadlines.

For **Seafloor Litter** there is a comparable situation and process as for Beach Litter. Quality issues concern: for ICES and DeFishGear data: doubtful/wrong hauls lengths/coordinates/ trawling distance (zero or too long, on land); tracks on land. These give again delays in data publication, updates and/or deactivation of CDIs which is resources consuming and not meeting project deadlines.

Actions were started for solving these issues. Formats were updated, where needed, and QA-QC of beach and seafloor litter input was improved, among others by keeping more contact with data providers, further structuring of the organisation of data gathering and reporting, in cooperation with TG-ML, JRC, and involved data aggregators such as MCS, ICES, MEDITS, UNEP-MAP, and others. And with ICES the procedure for harvesting of Datras Seafloor Litter data was discussed and improved.

A new data type under study is **Floating Macro Litter** (FMML). This seems to be only relevant for the Mediterranean Sea as OSPAR and HELCOM do not consider FMML as an indicator. Items should be > 2,5 cm. In February 2019 the JRC- FMML-Workshop was held at ISPRA and active communities were identified. Currently, there are two slightly different reporting forms in use, one for coastal areas (Italian form), and one for open seas (English form). At the Workshop there was interest for possibly adopting and adapting the CDI and ODV format as done already for Floating Micro Litter. This activity is progressed by OGS, in discussion and cooperation with TG-ML, and JRC.

Another new ML data type are **Seafloor Litter Images and Videos**. These are collected by a number of institutes such as IFREMER in its RAMOGE cruise and ISPRA. Possible we can learn from JAMSTEC (Japan) which has set up a info system for such data. There are quite some challenges for setting up such a system in EMODnet Chemistry, in particular considering the possible volumes and required bandwidth. OGS already made a list of possible relevant metadata, which should be expanded with info on collector (EDMO), framework (EDMERP), cruise (CSR), and possible other items.

Marine Litter data are used to produce **Aggregated Collections**: for **beach** respectively **seafloor** litter, in EMODnet Beach litter data format Version 1.0 (spreadsheet file composed of 4 sheets: beach metadata, survey metadata, animals and litter) respectively in EMODnet Sea-floor litter data format Version 1.0 (csv format, tab separated values). These products are included in the EMODnet Chemistry Products catalogue with metadata and DOI. While **ML maps** are generated at intervals for beach litter and seafloor litter data collections, and these are published through the Map Viewer while documented in the Products Catalogue. A paper was written and published on this: **https://doi.org/10.6092/ef4901d2-642a-4881-ba81-6b2607f5485e.** Further steps were taken for fully streamlining the process: 1) input data collections are delivered from OGS to IFREMER; 2) IFREMER loads these files into a local GIS for a number of analytics and statistics, resulting in the EMODnet maps; 3) integration in the Map Viewer is done by OGC WMS – WFS, and as Shape files and PNGs for downloading.

Streamlining the process for generation and publishing of Contaminants maps:

Contaminant maps are produced on the basis of the harmonised contaminants data collections as produced by the Regional Leaders. Additional central validation and harmonization is needed between the regional data collections. For instance, new P01 registrations should be moderated to keep more balance in use of P01s and for educating somewhat different data providers. For that purpose, OGS

prepared and shared a document with extra instructions to Regional Leaders and OGS cooperates with ISPRA to optimize the input for the maps process. For the latter, ISPRA has set a workflow for producing the different contaminant maps once the correct data collections have been delivered. For this purpose, ISPRA has set up a GeoDB for loading the data sets and then performing analytical processing for the maps. Also, ISPRA has set up a spatial infrastructure for publishing the resulting maps in WMS, WFS, and sharing as images, for integration into the Map Viewer.

Making use of SDC VRE developments for extraction of regional data collections:

As part of the H2020 SeaDataCloud project a prototype VRE has been developed, which recently has been launched at: https://www.seadatanet.org/Software/VRE. It includes the WebODV application as developed by AWI, which is an online version of the highly successful ODV software. Derived from WebODV, AWI has made steps forward for a WebODV Extractor which allows to subset data from ODV data collections. Considering the earlier discussion with EU and EMODnet Secretariat for making the finding and extracting of data sets easier for all kinds of users, it was decided to adopt and adapt the WebODV Extractor for facilitating to explore, subset, visualize, and extract data sets in multiple formats from the harmonized, standardized, validated data collections that EMODnet Chemistry is regularly producing and publishing for all European sea basins for **eutrophication** and **contaminants**. This development is progress well and soon in November 2020, the first release of this easy and powerful service will be released at the EMODnet Chemistry portal. While additional functionalities, including an API, have been specified and are under further development by AWI.

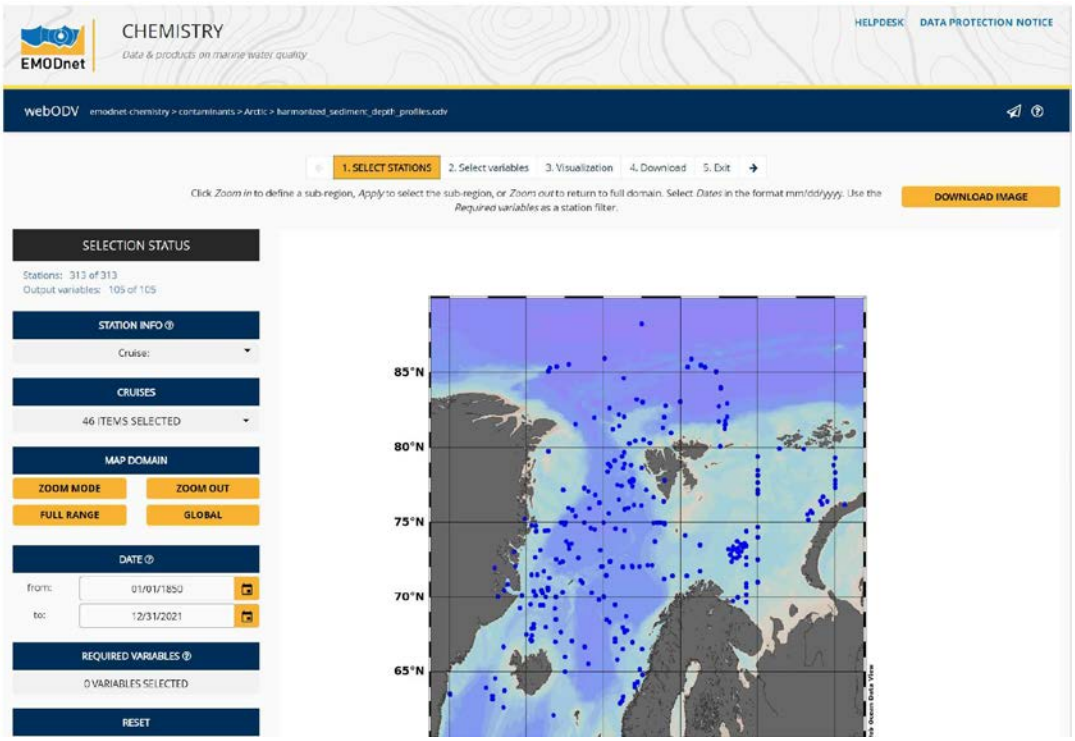


Figure: Preview of new WebODV Extractor service for harmonised data collections (1st release planned in November 2020)

INSPIRE Compliance:

The SeaDataNet CDI metadata schema is based upon the ISO 19115 content standard, while for XML encoding it is based upon the ISO 19139 Schemas, which are also the basis for the INSPIRE metadata

standards. Through earlier contacts with the INSPIRE team of the EU-Joint Research Centre (JRC) it was ensured that the CDI schema is INSPIRE compliant since 2013. However, around 2018, the INSPIRE ISO 19139 metadata schema (V11) has been updated, but also the INSPIRE metadata validator was replaced. Again, tests were undertaken with the INSPIRE Executable Test Framework (ETF) metadata validation reporter. It appeared, that the validator was not able to accept CDI XML documents any more, which were earlier ok. From this moment, a constructive discussion took place between the SeaDataNet/EMODnet community and the INSPIRE JRC team to help solving the different issues, such as 'XML encoding test', 'Metadata for discovery test', and 'Metadata for interoperability'. As a consequence, an updated version of the SeaDataNet CDI XML schema (Version 12.1.0) was released in December 2019 which included several changes. Likewise, the release of an upgraded version of the ETF INSPIRE metadata validator service (http://inspire.ec.europa.eu/validator/) was made by the INSPIRE team. Tests were undertaken, which highlighted the conformance of the updated SeaDataNet CDI XML schema (Version 12.1.0) with the current INSPIRE metadata validator. As a result, all XML outputs of the CDI services at SeaDataNet, EMODnet Bathymetry, EMODnet Chemistry and EMODnet Physics portals are now fully INSPIRE compliant again, which makes all the contributors of these portals also fully compliant with INSPIRE. However, there is an ongoing discussion at INSPIRE with proponents and opponents of accepting community profiles. This implicates, that we have to monitor these developments and be prepared to make new amendments, if needed in the near future, as the INSPIRE standards are not stable.

WP5 – MSFD, Regional and European uptake and interaction (ICES)

Helpdesk

The help service consists of a helpdesk and help information published at the portal. The helpdesk is easily accessible by: a) online chat, b) email, c) telephone. Both users and partners can have an immediate contact with a support agent, or also leave a message while the service is offline. The telephone and online chat service operate during European working hours, while e-mails get answered within two working days. All queries are tracked and a record is kept of all queries received. The help-desk is operated by OGS. The questions have different grades, like answer immediately, forward to internal experts for answering, and forward to consortium experts for answering. For the reporting period, 23 requests for support were received by the helpdesk (recording an average of two requests per month).

Interaction and regular dialogue with MSFD stakeholders

Within EMODnet Chemistry 3 a dedicated 'Board of MSFD experts' was set up to give advice on products and to monitor development of thematic products and services from the MSFD perspective, this board and its membership has been carried over into phase 4. A number of Board sessions dedicated to marine litter, eutrophication and hazardous substances respectively will be convened remotely during the project to both inform the Board of new developments, but also to get critical input to improve the products for the MSFD/Regional Sea use cases that the experts envisage. The challenge in phase 4 is that the main discussion points for the Board of experts are related to the data products that will be released only after 12 months from the inception of phase 4. This means that there have been no meetings of the board within the reporting period, as it would be difficult to engage them on specifics without the draft products to base discussions on.

Therefore the focus in the first year has been on specific discussion and interactions related to quality control of data and data products that have potential for use in the regional sea and MSFD setting. ICES has been active as an intermediary for tuning with OSPAR, HELCOM, and EEA system developments, and

OGS has performed a similar function for the JRC (see next section). At the HELCOM STATE and CONSERVATION meeting (5-9 October 2020) a discussion on the use of Beach litter data for the Baltic holistic assessment (HOLAS III) resulted in the conclusion that HELCOM would support the use of the EMODnet database (EMODnet Chemistry) for HOLAS III in the short term, but agreed to explore the use of the ICES database for the longer term. At the ICES Expert Group meeting on Marine Litter (WGML) which met online in October 2020, there is a draft recommendation that was elaborated after a brainstorming where it was suggested that WGML could liaise with EMODnet Chemistry to perform a quality control check report, with recommendations that EMODnet Chemistry could use to improve the overall quality of micro-plastics data that are made available through the EMODnet portal. This cooperation will be similar in design to the existing model used for the EEA indicators dataflow, where ICES performs QC reports that are fed back to EMODnet Chemistry in order to increase the quality of eutrophication and hazardous substances dataflows.

Maintain international cooperation and interoperability

During the last phase of EMODnet Chemistry, the EEA put a greater focus on using data from EMODnet for both its State of the Environment report, and the core indicators for Eutrophication and Contaminants. In addition, a greater uptake of marine litter data between the EEA and EMODnet was desired by both entities. OGS supported by ICES have had a number of dialogues with the EEA and also participated in the Marine Litter Watch workshops hosted by the EEA. At this stage, although there is willingness to cooperate, there is no clear description from the EEA on what indicator it proposed for marine litter, and it is therefore not possible to elaborate a suitable data product until this is concluded through their Marine Litter Watch network.

As outlined in WP3, there is a continued synergy and technical support being given to TG-Marine Litter, and the continuous interaction with this group, and the JRC, beyond just the technical issues is needed to ensure recognition of the role of EMODnet, but also to keep a European coordination of the harmonization of these data.

The planned EU MSFD meetings, WGDIKE and TG DATA have been much reduced in 2020 due to COVID 19. The last meeting of TGDATA in October 2019 focussed on the then pressing issues of Directive reporting, there was however a presentation by Giordano Giorgi (ISPRA, Italy) related to EcAp Pilot System data management for IMAP (Mediterranean) common indicators, which highlighted the use of EMODnet Chemistry to provide data management services. The upcoming meeting of TGDATA in November 2020 will feature a presentation by EMODnet Chemistry on the INSPIRE transformation services that are developed through SeaDataNet and applied to chemical contaminants data in EMODnet Chemistry.

WP6 – Outreach and promotion (RBINS with OGS)

All promotional activities and communications are performed in close coordination with the EMODnet Secretariat, in order to guarantee the consistency of the message and to avoid overlapping initiatives. All new designs respect the 2017 EMODnet Visual Identity Guidelines. Hereafter main actions are synthesized:

- Improving the coordination to reply to the Secretariat requests;
- Monitoring the functionality of the web portal and its services on a regular basis.

Engagement with the industry

EMODnet-Chemistry has initiated contacts with the industry to solicit win-win opportunities.

The next annual event of the World Ocean Council has been identified as an opportunity for strengthening links through communication (online event, Sustainable Ocean Summit, 9-11 December 2020, https://www.sustainableoceansummit.org/).

Widening the international scientific cooperation

Since the beginning of the current phase, the relationship with the Copernicus Marine Services has been enhanced and made more operational. A joint EMODnet Chemistry - CMEMS INSTAC meeting was held in February 2020, to share expertise and biogeochemical data, and to plan joint products and solve metadata issues. As a result, a draft joint EMODnet – CMEMS MSFD portfolio was produced, and shared with EEA. EMODnet Secretariat and EMODnet Chemistry were asked to join as experts in a dedicated Working Group of the global SDG14 education project with Mercator Ocean International, in order to identify EMODnet as a significant EU contribution to the upcoming UN Decade of Ocean Science for Sustainable Development.

Global promotion activities

The dissemination uses a variety of media, including promotional items which are designed and produced by partner RBINS. COVID crisis, preventing physical meetings during the winter 2020, and the change of responsible people at RBINS for promotion activities at the end of May 2020, brought about a delay in the preparation of new products and plans. To speed up the learning curve of the new RBINS colleague in charge of promotion, there was a strong coordination with the EMODnet Secretariat on the preparation of all communication products as of July 2020. Nevertheless, RBINS was able to design the promotional plan agreed by the Secretariat.

Since the persistence of COVID-19 pandemic, focus was put on new digital material such as videos (on the 3 services WebODV data extractor, Search and download data, and Map Viewer) and digital newsletters, as well as useful material during video conferences (digital backgrounds). In the second year, the focus will be put on the active dissemination to the wide range of audiences identified of new content, quarterly newsletters and thematic newsletters, dissemination of a first movie and production of a second movie, and the active (social) media dissemination of these in partnership with the EMODnet Secretariat.

4. Identified issues: status and actions taken

[Provide an overview of the issues identified by EASME (Table A), if any, since the start of the project phase (provide date), the status of those issues and actions taken to address them and/or roadmap with remaining actions planned to resolve the issues. in Table B, provide information about issues and challenges identified by yourself, if any.]

A. Priority issue(s) identified and communicated by EASME/ DG MARE/ SECRETARIAT				
Priority issue	Status (Pending/Resolved)	Action(s) taken / remaining actions planned	Date due	Date resolved
INSPIRE metadata fields (metadata and data url) should be filled in order to facilitate discovery and usage of OGC Web services (WMS, WFS, WCS)	Resolved	EMODnet Chemistry products catalogue provides the requested INSPIRE metadata fields. For instance, for marine litters, a metadata is also available through a **metadata URL** and this metadata provides users with **OGC services** available on this product. In the example above, two OGS services are available: - a **WMS**, which allows the product to be displayed in Ocean Browser (or others web GIS infrastructures) is provided in the metadata (visible in the XML) - and a **WFS**, allowing to download the product, is also described in the metadata. For DIVA maps it includes the following Metadata section: <MetadataURL type="TC211"> <Format>text/html</Format> <OnlineResource xlink:type="simple" xlink:href="http://www.emodnet-chemistry.eu/products/catalogue#/metadata/cc471ea1-f7be-11e8-93d9-f859715d4cd2"/> </MetadataURL> The entry to the Sextant catalogue includes the following DataURL in the netCDF format (https://www.opengeospatial.org/standards/netcdf) and OpenDAP URLs: <DataURL> <Format>application/x-netcdf</Format> <OnlineResource xlink:type="simple" xlink:href="http://ec.oceanbrowser.net/data/emodnet-domains/Arctic region/Autumn (September-November) - 6-years running averages/Water body chlorophyll-a.4Danl.nc"/> </DataURL> <DataURL> <Format>text/html</Format><OnlineResource xlink:type="simple" xlink:href="http://ec.oceanbrowser.net:8081/data/emodnet-domains/Arctic region/Autumn (September-		31/12/2019

		November) - 6-years running averages/Water body chlorophyll-a.4Danl.nc.html"/> </DataURL>		
Compliance with applicable data protection rules	Resolved	The action plan for achieving the compliance has been implemented. New data protection notice and cookies notice were posted on the Chemistry portal		31/12/2019
Make data easier to access, with interfaces, also fit for non-professionals, to visualise data	Pending	Adopt and adapt webODV components for discovery, subsetting by several criteria, visualising and exporting the subsets in a number of formats, all in an easy way and fast	9/2020	
Improve the user focus of portal (less info, more services)	Resolved	Review and reshuffle the portal, placing the products and their services more centrally as major output from EMODnet Chemistry	5/2020	31/05/2020
INSPIRE metadata fields (metadata and data url) should be filled in order to facilitate discovery and usage of OGC Web services (WMS, WFS, WCS)	Resolved	EMODnet Chemistry products catalogue provides the requested INSPIRE metadata fields. The products include a **data URL** and a **metadata URL** and this metadata description provides users with **OGC services** available on the product, as WMS and WFS services.	3/2020	31/03/2020
Compliance with applicable data protection rules	Resolved	The action plan for achieving the compliance has been implemented. New data protection notice and cookies notice were posted on the Chemistry portal. Google Analytics is removed.	3/2020	31/03/2020

B. Issues / challenges identified by the thematic assembly group itself				
Priority issue / challenge	Status (Pending/Resolved)	Action(s) taken / remaining actions planned	Date due	Date resolved
Get correction on the data following the regional data validation process	Resolved	Motivate data centers with dedicated meeting at regional scale	9/2020	30/09/2020
Get additional metadata to fulfil EEA and CMEMS needs	Resolved	Release of updated guidelines with clear instructions	9/2020	30/09/2020
Get new recent data in the system	Resolved	Motivate data centers with personal contacts (remote meeting and email)	9/2020	30/09/2020

5. Allocation of project resources

[Provide information about the efforts spent since the start of the project phase (provide the date) on achieving the main objectives and tasks of the project. Provide an overview of resource usage (percentage of project resources) divided into the following categories (if no precise information is available, provide estimate indication instead).]

Information on the allocation of project resources	
Categories	Resource usage[1] (%)
Making data and metadata interoperable and available (WP2)	20 %
Preparing data products (WP3)	12.5 %
Preparing web-pages, viewing or search facilities (WP4)	10 %
Interaction with MSFD community (WP5)	2.5 %
Project management (WP1)	7.5 %
Outreach and communication activities (WP6)	5 %

[1] Provide the workings of your calculations, *i.e.* percentage allocation of the total amount awarded.

6. User feedback (Contact us form, online chat & other communication means)

[Provide a list of all user feedback received on your portal in chronological order since the start of the project (provide date). Indicate the type of the feedback received, a clear description of the query, and the actions undertaken to resolve the issue (e.g. update of metadata, fixing a particular issue with the map viewer). Indicate the status of the query (i.e. has the query been resolved or not yet), and if not provide an explanation why. List any feedback you received on the portal that can be used to build EMODnet use cases.]

Overview of user feedback and/or requests received in this quarter							
Date	Organisation	Type of user feedback (e.g. technical, case study, etc.) and short description of the feedback received	Means of contact	Response time	Status of user query: resolved/pending	Measures taken to resolve the query	Status: if not (yet) resolved/pending, explain reason why and expected timeline
01/10/19	Private	Contact by e-mail to propose to provide marine litter data	E-mail	6 days	Resolved	Explanation of way forward	
02/10/2019, 07/11/2019, 18/11/2019	Mercator Ocean	Personal contact to develop e joint MSFD portfolio with CMMS and EMODnet Chemistry products	E-mail	Immediate	Resolved	Meeting planned	
17/10/2019	CNR	Ask contribution to BLUEMED Pilot for Plastic	E-mail	Immediate	Resolved	Agreed on cooperation	
28/10/2019	Ifremer	Ask to set a joint CMEMS-EMODnet Chemistry meeting	E-mail	3 days	Resolved	Done	
11/11/2019	JRC	Hosting longer term data of MSFD eutrophication relevant parameters	E-mail	1 hour	Resolved	Agreed	
11/11/2019	JRC	Dataset from the Black Sea	E-mail	3 days	Resolved	Taken onboard	
09/12/2019	EEA, ICES	Tuning timing for the release of EMODnet Chemistry aggregated datasets in line with EEA needs for reporting	E-mail	Immediate	Resolved	Agreed	

08/01	JRC	Technical via email: looking for EMODnet report on micro-litter	E-mail	1 day	Resolved	Upload the requested document on the Chemistry portal and send by e-mail	
13/01	Nationalpark und Meeresschutz Schleswig-Holstein	Technical via email: expertise to develop a numbering system for the Joint List of Litter Categories	E-mail	1 day	Resolved	Communication and provide ideas	
16/01	University of Bologna (Italy)	Technical via email: Query for a missing data required for a master thesis.	E-mail	11 days	Resolved	Contacting the author of the data collection (One of EMODnet Chemistry Regional Leaders)	
22/01	JRC	Technical via email: Long time-series (1990-2017) data of dissolved oxygen for the Baltic Sea and Greater Norther Sea	E-mail	3 days	Resolved	Dataset release	
24/01	University of Oldenburg (Germany)	Technical via email: Query for a missing data required for a master thesis.	E-mail	2 days	Resolved	Contacting the author of the data collection (One of EMODnet Chemistry Regional Leaders)	
04/03	EEA	Technical via email: Set a discussion forum for with EMODnet Chemistry, EEA and ICES	E-mail	Hours	Resolved	GitHub project board for EMD Chemistry + ICES -> EEA WISE data flows	
19/03	EMODnet Secretariat	Technical via chat: testing the chat service.	Chat	1 minute	Resolved	Simple response	
03/04/20	HCMR	Technical. A question about the data access page.	Chat	1 minute	Resolved	explanation	

06/04/20	HCMR	Technical. A question about the "Your order" page for the requested data.	Chat	1 minute	Resolved	explanation	
21/04/20	isprambiente.it	Technical: "I am trying to use the beach litter format validator but an error occurs".	Chat	1 minute	Resolved	bug resolved	
18/05/20	4coffshore.net	Technical, web servces: "if it is possible to obtain ad WMS for the whole chemical data".	Chat	1 minute	Resolved	explanation	
01/06/20	4coffshore.net	Technical, contaminants maps.	Chat	2 days	Resolved	explanation	
04/06/20	izvrs.si	Technical, beach litter	Chat	2 minutes	Resolved	explanation	
05/05/20	EMSA, European Maritime Safety Agency	Marine litter annual or seasonal maps	Email	½ day	Resolved	explanation	
19/05/20	EMSA	Marine Litter beach and seafloor data	Video call	Few days	Resolved	explanation	
15/05/20	noaa.gov	Question: Can we download and obtain EDMONET chemistry data to put into the World Ocean Database?	contact form	55 min.	Resolved	Simple response	

7. Meetings/events held/attended & planned

[Organisational meetings/events held/participated (incl. presentations, lectures, trainings, demonstrations, workshops, etc.) by the contractant since the start of the project phase (provide date) and planned in the future. Please add a short description on the meeting as well as the nature and volume of the audience.

When listing a meeting, please indicate whether it was an internal (i.e. within your partnership/lot) or external meeting (i.e. outside your partnership/lot).]

A. Meetings/events organised and attended					
Date	Location	Type event (internal or external meeting, training/workshop)	Indicate if a ppt was given (yes/no + short description)	Meeting attended (A) / organised (O)	Short description and main results (# participants, agreements made, etc.)
02/10/2019	Brussels	Workshop	Yes, joint ppt with Mercator	A	Copernicus Marine for MSFD event organised by Copernicus to listen experience, needs and priorities for MSFD
03/10/2019	Brussels	External meeting	No	A	Listen DG ENV and MS requirements in terms of data for MSFD (WG DIKE)
04/10/2019	Brussels	External meeting	No, oral reporting	A	Report on achievements in marine litter data management and talk about how to improve interaction with EMODnet (TG DATA)
07-11/10/2019	Cascais, Portugal	Congress	Yes, short ppt and poster	A	42nd CIEMS Congress organised by the Mediterranean Science Commission
29-30/10/2019	Rome	Steering committee	Yes	O	Agreement on planned activities for the next period, following project tasks and stakeholders need (EEA mainly).
11-12/11/2019	Sopot, Poland	Workshop	Yes	A	EMODnet Chemistry database and oxygen data quality control presented to the Oxygen Data Platform Scoping workshop
13/11/2019	Virtual meeting	Contaminants in Biota	No, open discussion and agreement on the way forward	O	A virtual meeting dedicated to evaluate the data format to be adopted for contaminants in biota was organised between EMODnet Chemistry and SeaDataCloud experts
05/12/2019	Trieste	External meeting	Yes	A	EMODnet Chemistry presentation for the 8th MONGOOS annual meeting
21-23/1/2020	Venice	Workshop	Yes	A	UN Regional Workshop "The Mediterranean Sea We Need for the Future We Want"

3-6/2/2020	Dresden	Conference	Poster	A	ENVRI week & ENVRI-FAIR annual meeting
12-13/2/2020	Brussels	External meeting	Yes	O	Joint EMODnet Chemistry-CMEMS INSTAC meeting
20/2/2020	Remote	External meeting	No	O	Progress in the alignment of EMODnet and MLW systems to mutually contribute
24/2/2020	Remote	Internal meeting	No, problem solving and agreement on the way forward	O	Video-conference with RL to check status of Eutrophication data products
10/3/2020	Remote	Technical Working Group	Yes	O	EMODnet Chemistry TWG to plan technical developments
11-12/3/2020	Remote	Project Group	Yes	O	EMODnet Chemistry PG to agree and plan activities
05/05/2020	Remote	Regional Coordinators meeting	No, problem solving and agreement on the way forward	O	Video-conference with RL to align on Eutrophication data validation
20/05/2020	Remote	External meeting	Yes	A	EMODnet-CMEMS coordination meeting
20/05/2020	Remote	Regional Coordinators meeting	No, problem solving and agreement on the way forward	O	Video-conference with RL to align on Eutrophication data collection delivery
22/5/2020	Remote	EMODnet Steering Committee	Yes	A	12th EMODnet Steering Committee Meeting
23-24/5/2020	Remote	EMODnet TWG meeting	Yes	A	7th EMODnet TWG Meeting
30/5/2020	Remote	Internal meeting	No	A	MSFD EG Contaminants
04/06/2020	Remote	Regional Coordinators meeting	No, problem solving and agreement on the way forward	O	Video-conference with RL to align on Eutrophication data collection delivery
11-12/6/2020	Remote	External meeting	No	A	MSFD TG ML meeting
15/6/20	Remote	Regional Coordinators and Data Centres meeting	Yes	O	EMODnet Chemistry regional meeting for the North sea area
16/6/20	Remote	Regional Coordinators and Data Centres meeting	Yes	O	EMODnet Chemistry regional meeting for the Mediterranean sea area

17/6/20	Remote	Regional Coordinators and Data Centres meeting	Yes	O	EMODnet Chemistry regional meeting for Baltic and Arctic area
18/6/20	Remote	Regional Coordinators and Data Centres meeting	Yes	O	EMODnet Chemistry regional meeting for the Atlantic region
18/6/20	Remote	External meeting	Yes. Data infrastructure is based on EMODnet Chemistry	A	ADRION HarmoNIA Final event. As appears in a dedicated use case, HarmoNIA uses data from EMODnet Chemistry
18/6/20	Remote	External meeting	Yes. Data infrastructure is based on EMODnet Chemistry	A	ADRION Thematic Cluster on Coastal and Marine Environment management activities. As appears in a dedicated use case, HarmoNIA uses data from EMODnet Chemistry
19/6/20	Remote	Regional Coordinators and Data Centres meeting		O	EMODnet Chemistry regional meeting for the Black sea area
23/6/20	Remote	Regional Coordinators meeting		A	EMODnet reporting and assessment meeting
24/6/20	Remote	External meeting		A	Exclusion WFD PS from MSFD open sea assessment
3/7/20	Remote	External meeting	No ppt but sharing of portfolio draft	A	Bilateral meeting with Mercator Ocean to agree on the way forward in the development of the joint MSFD portfolio
07/09/20	Remote	Webinar	ppt: EU efforts for data harmonisation for policy purposes	A	G20 Marine Litter Workshop, 2020
8/7/20	Remote	External meeting	No ppt, informal communication for common agreement	A	Bilateral meeting organised by EEA to discuss marine Litter data availability for an European marine litter assessment
9/7/20	Remote	Regional Coordinators meeting	No ppt, minutes document with action list is available	O	Video-conference with RL to review the contaminants datasets to be delivered to EEA
10/9/20	Remote	External meeting	No ppt, activity promoted on the Chemistry portal	A	Development of an on-line multiple-choice questionnaire "SDG 14 module" with Mercator Ocean, UNDESA and SULITEST.org

22/9/20	Remote	Webinar	Input for joint overview	A	EMODnet Open Conference
26/09/20	Trieste	Festival	ppt: Trieste Next 2020: Let's get the Sea plastic free	A	Trieste Next - Festival of Scientific Research: raised awareness on marine plastic litter during an underwater clean-up event organized by WWF-Miramare MPA
SUM				O	Total # of meetings organised = 16
SUM				A	Total # of meetings attended = 23

B. Meetings/events planned in the future				
Date	Location	Type event (meeting, training (workshop), etc.)	Meeting to be attended (A) / organised (O)	Short description and main expected outcomes
20-21/10/2020	Remote	EATIP-Copernicus Marine-EMODnet workshop on data for aquaculture	A	To explore opportunities and applications for marine environmental data to support aquaculture sector
12-14/4/21	Amsterdam	International Conference on Marine Data and Information Systems	A	Disseminate EMODnet Chemistry results

8. Communication assets

[List all the relevant communication and dissemination products and assets you have developed since the start of the project phase (provide date) (e.g. brochures, videos, press releases, newsletters, blogs) and are planning to do. At the bottom of the table, provide a total number for every type of communication product you have developed (e.g. total # of press releases, etc.) or provide a summary from the actions on Twitter from (e.g. Twitter Analytics: number of Tweets and followers of Twitter account).]

A. Communication assets				
Date	Communication material	Short description (of the material, title, …) and/or link to the asset	Main results	Name of event at which material was disseminated (if applicable)
02/10/19	Oral presentation	EMODnet Chemistry results for MSFD and the contribution to MSFD portfolio	Agreement on the way forward	Copernicus Marine for MSFD event
04/10/19	Short intervention	EMODnet Chemistry activities as contribution for MSFD (eutrophication, contaminants and marine litter data contribution)	Good agreement on the way forward	TG DATA
04/10/2019	On line communication (section News/Events)	Joint actions: Copernicus and EMODnet Chemistry work together (https://www.emodnet-chemistry.eu/promotion/news)	Keep users and visitors of the Portal up to date with the latest outcomes	
10/2019	On line communication (section Events)	Cascais 2019, CIESM Congress: EMODnet Chemistry use cases (https://www.emodnet-chemistry.eu/promotion/events)	Keep users and visitors of the Portal up to date with the latest initiatives	
07-11/10/2019	Oral & poster presentation	How is EMODnet Chemistry evolving: use cases	Communicate EMODnet results to the Mediterranean community	CIESM 2019 Congress
11-12/11/2019	Oral presentation and further communication	Oxygen Data Platform Scoping workshop, Sopot, Poland	Communicate EMODnet results and possible contribution to the global Oxygen Data Platform	Oxygen Data Platform Scoping workshop
05/12/19	Oral presentation	EMODnet Chemistry was presented at the 8th MONGOOS annual meeting, Trieste, Italy	Outreach	8th MONGOOS meeting
10/01/2020	On line communication (section News/Events)	Data products: marine contaminant maps are now available	Keep users and visitors of the Portal up to date	

		(https://www.emodnet-chemistry.eu/promotion/news)	with the latest products	
20/1/2020	Oral contribution to the discussion	IOC/IODE IWG SODIS	Agreement on the way forward	IOC/IODE IWG SODIS
21-23/1/2020	Oral presentation	Co-convener for WG VI A transparent & accessible Mediterranean Sea	Agreement on the need for a programme for an ocean data and information system conceived as an e-environment of existing data portals where users can discover data, data products, data services, information, information products and services. EMODnet would represent a fundamental piece in the Mediterranean.	UN Regional Workshop "The Mediterranean Sea We Need for the Future We Want"
3-6/2/2020	Poster presentation	EMODnet platform; Communicate EMODnet results to ENVRI-FAIR community. Discuss how to enhance FAIRness for RIs (multiple ERDDAP). EMODnet Chemistry & CMEMS as integrators, ingesting data from RIs and giving feedback on data.	Chemistry	ENVRI-FAIR meeting
12-13/2/2020	Oral presentation and further communication	Joint EMODnet Chemistry-CMEMS INSTAC meeting	To identify datasets of interest to start the collaboration; To share experiences especially in QC procedures; To identify and set up data exchanges	Joint EMODnet Chemistry- CMEMS INSTAC meeting
02/2020	On line communication with roll up (section Events)	Dresden 2020, ENVRI week: EMODnet Chemistry harmonised marine data (https://www.emodnet-chemistry.eu/promotion/events)	Keep users and visitors of the Portal up to date with the latest initiatives	ENVRI week 2020

30/03/2020	On line communication (section News/Events)	Use case: EMODnet Chemistry for EU Marine Litter Baselines (https://www.emodnet-chemistry.eu/promotion/news)	Keep users and visitors of the Portal up to date with the latest achievements	
17-19/3/2020	Oral contribution to the discussion	HarmoNIA workshop	Set synergies with the Interreg HarmoNIA project	HarmoNIA workshop
15/04/2020	On line communication (section Publications)	MIcroplastics: Lessons learned from an intercalibration exercise ((https://www.emodnet-chemistry.eu/promotion/papers)	Keep informed users and visitors of the Portal about the latest publications	
27/3/2020	Oral presentation (held online)	Lesson to the Advanced Master on Blue Growth "Data Management: from data to knowledge for sustainable blue growth"	Dissemination activity on EMODnet Chemistry and on main EU data management initiatives	Advanced Master on Blue Growth (University of Trieste, It – OGS)
5/6/20	Online communication (section News/Events)	Regional leaders' meetings on contaminants, ocean acidification and eutrophication (https://www.emodnet-chemistry.eu/promotion/news)	Keep users and visitors of the Portal up to date with the initiative progress	
15/6/20	Online communication (section News/Events)	One week of regional meetings for EMODnet Chemistry (https://www.emodnet-chemistry.eu/promotion/news)	Raise awareness and spread information	
16/6/20	Online meeting/presentation	EMODnet Chemistry coastal data and products (https://www.emodnet-chemistry.eu/promotion/events)	Assess collaborations across EMODnet themes and between EMODnet and (CMEMS)	EMODnet and CMEMS coastal meeting technical webinar
17/6/20	Online communication with presentation (section News/Events)	EMODnet and CMEMS coastal meeting (https://www.emodnet-chemistry.eu/promotion/events)	Keep users and visitors of the Portal up to date with the initiative progress	EMODnet and CMEMS coastal meeting
23/06/20	On line thematic class/presentation	Virtual class on plastics litter (https://www.emodnet-chemistry.eu/promotion/events)	Raise young people awareness and disseminate information	Junior sailing school 2020, Yacht Club Adriatico (Trieste)
24/06/20	On line communication with presentation (section News/Events)	Yacht Club Adriatico, 2020: virtual OGS class on plastics litter (https://www.emodnet-chemistry.eu/promotion/events)	Keep informed users and visitors of the Portal	
10/07/20	On line communication	Regional leaders' meetings: participants and main topics	Keep users and visitors of the	

	(section News/Events)		Portal up to date with the latest outcomes achieved	
10/07/20	On line communication (section Guidelines)	Guidelines for including information in the CDIs https://www.emodnet-chemistry.eu/about/documents	Keep users and visitors of the Portal up to date with the latest documents released	
17/07/20	On line communication (section News/Events)	EMODnet phase 5: the call for tenders https://www.emodnet-chemistry.eu/promotion/news	Keep informed users and visitors of the Portal about the latest EMODnet call for tender	
06/09/20 08/09/20	On line communications with presentation (section News/Events)	ppt: EU efforts for data harmonisation for policy purposes https://www.emodnet-chemistry.eu/promotion/events	Share and discuss the EU achievements on marine litter data management on a large scale	G20 Workshop on harmonized monitoring and data compilation of marine plastic litter
08/09/20	On line communication (section News/Events)	EMODnet Chemistry Portal: 2020 data availability https://www.emodnet-chemistry.eu/promotion/news	Keep users and visitors of the Portal up to date with 2020 data availabitity	
10/09/20	On line communication (section News/Events)	EMODnet Webinar: 10 years of achievements https://www.emodnet-chemistry.eu/promotion/news	Keep informed users and visitors of the Portal about results achieved by EMODnet	EMODnet Webinar: 10 years of achievements
11/09/2020	On line communication (section News/Events)	SeaDataCloud Workshop: Hi-Tech to High knowledge https://www.emodnet-chemistry.eu/promotion/news	Keep informed users and visitors of the Portal about the relevance of the SDN infrastructure	SeaDataCloud Workshop
11/09/2020	On line communication (section News/Events)	Sulitest Specialized Module on SDG 14 project: kickoff meeting https://www.emodnet-chemistry.eu/promotion/events	Keep informed users and visitors of the Portal about the participation in this awareness and dissemination project	kickoff meeting of the working group of expert for the Sulitest Specialized Module on SDG 14 project
15/09/2020	On line communication (section Publications)	Seasonal and Interannual Trends of Oceanographic Parameters over 40 Years in the Northern Adriatic Sea in Relation to	Keep informed users and visitors of the Portal about the	

		Nutrient Loadings Using the EMODnet Chemistry Data Portal https://www.emodnet-chemistry.eu/promotion/papers	latest publications	
23/09/2020	On line communication with presentation (section News/Events)	ppt: Trieste Next 2020: Let's get the Sea plastic free https://www.emodnet-chemistry.eu/promotion/news	Keep informed users and visitors of the Portal about the activities to raise awareness on ML issues	Trieste Next - Festival of Scientific Research
25/09/2020	On line communication (section Publications)	A European threshold value and assessment method for macro litter on the coastlines https://www.emodnet-chemistry.eu/promotion/papers	Keep informed users and visitors of the Portal about the latest publications	
28/09/2020	On line communication (section Publications)	Heavy Metals in the Adriatic-Ionian Seas: A Case Study to Illustrate the Challenges in Data Management When Dealing With Regional https://www.emodnet-chemistry.eu/promotion/papers	Keep informed users and visitors of the Portal about the latest publications	
30/09/2020	On line communication (section Publications)	Dissolved inorganic nutrients in the western Mediterranean Sea (2004–2017) https://www.emodnet-chemistry.eu/promotion/papers	Keep informed users and visitors of the Portal about the latest publications	
30/09/20	On line communication (section Media)	WWF-MPAMiramare: Trieste Next 2020	Give users and visitors the EMODnet Chemistry press review	

B. Planned communication assets			
Date	Communication material	Short description (of the material, title, ...) and/or link to the asset	Main results expected

[Publications (e.g. peer-reviewed journals, book chapters, conference papers, etc.) that you are aware of using/referring to EMODnet data or data products within since the start of the project phase.]

List of known publications using EMODnet data or data products				
Date	Type and name of journal, conference, …	Publication title	Author(s)	Organisation(s)
01/11/19	Ocean & Coastal Management, 181.	EMODnet marine litter data management at pan-European scale	Maria Eugenia Molina Jacka, Maria del Mar Chaves Montero,François Galgani, Alessandra Giorgetti, Matteo Vinci, Morgan Le Moigne, Alberto Brosich	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Division of Oceanography, Borgo Grotta Gigante, 42/C, 34010, Sgonico, TS, Italy. IFREMER, Laboratoire LER/PAC, Immeuble Agostini, ZI Furiani, 20600, Bastia, France. IFREMER, Service Valorisation de l'Information pour la Gestion Intégrée et la Surveillance, Centre Atlantique, Rue de l'Ile d'Yeu, BP 21105, 44311, Nantes Cedex 03, France.
15/11/19	Ocean Science, 15(6), 1489-1516.	Modelling the marine ecosystem of Iberia–Biscay–Ireland (IBI) European waters for CMEMS operational applications	Elodie Gutknecht, Guillaume Reffray, Alexandre Mignot, Tomasz Dabrowski, and Marcos G. Sotillo	Mercator Ocean, Parc Technologique du Canal, 8–10 rue Hermes, 31520 Ramonville-Saint-Agne, France Marine Institute, Rinville, Oranmore, Co. Galway, H91 R673, Ireland

				Puertos del Estado, Av. Partenón, 10, 28042 Madrid, Spain
05/02/2020	Frontiers in Earth Science	Baltic Sea Operational Oceanography—A Stimulant for Regional Earth System Research	Jun She, H. E. Markus Meier, Miroslaw Darecki, Patrick Gorringe, Vibeke Huess, Tarmo Kouts, Jan Hinrich Reissmann and Laura Tuomi	DMI
13/01/2020	JRC Technical Reports	EU Marine Beach Litter Baselines	Hanke, G., Walvoort, D., Van Loon, W., Addamo, A.M., Brosich, A., del Mar Chaves Montero, M., Molina Jack, M.E., Vinci, M., Giorgetti, A.	EU JRC
10/04/2020		Lessons learned from an intercalibration exercise on the quantification and characterisation of microplastic particles in sediment and water samples https://doi.org/10.1016/j.marpolbul.2020.111097	J.-F.Cadioua, O. Gerignya, Š.Koren, C.Zeric, H.Kaberic, C.Alomard, C.Pantie, M.C.Fossie, A.Adamo, N.Digka, S.Deuderod, M.Concato, A.Carbone, M.Bainie, M.Gallie, F.Galgani	Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer), Zone Portuaire de Bregaillon CS 20 330, La Seyne-sur-Mer 83507, France Institute for Water of the Republic of Slovenia (IWRS), Dunajska cesta 156, SI-1000 Ljubljana, Slovenia Hellenic Centre for Marine Research (HCMR), Institute of Oceanography, 19013 Anavyssos, Attica, Greece Instituto Español de Oceanografía, Centro Oceanográfico de Baleares, Muelle de Poniente s/n, 07015 Palma de Mallorca, Spain

				Department of Physical Sciences, Earth and Environment, University of Siena, Via P.A. Mattioli, 4, 53100 Siena, Italy
13/08/2020	Journal: Water	Seasonal and Interannual Trends of Oceanographic Parameters over 40 Years in the Northern Adriatic Sea in Relation to Nutrient Loadings Using the EMODnet Chemistry Data Portal https://doi.org/10.3390/w12082280	Grilli F.; Accoroni S.; Acri F.; Bernardi Aubry F.; Bergami C.; Cabrini M.; Campanelli A.; Giani M.; Guicciardi S.; Marini M.; Neri F.; Penna A.; Penna P.; Pugnetti A.; Ravaioli M.; Riminucci F.; Ricci F.; Totti C.; Viaroli P.; Cozzi S.	CNR-IRBIM, Università Politecnica delle Marche, Fano Marine Center, FMC, CNR-ISMAR, OGS University of Urbino, Tecnopolo Bologna, University of Parma
31/08/2020	EU Science HUB publications	A European threshold value and assessment method for macro litter on the coastlines https://op.europa.eu/en/publication-detail/-/publication/bbf9b149-f97e-11ea-b44f-01aa75ed71a1/language-en doi:10.2760/54369, JRC121707	Van Loon, W., Hanke, G., Fleet, D., Werner, S., Barry, J., Strand, J., Eriksson, J., Galgani, F., Gräwe, D., Schulz, M., Vlachogianni, T., Press, M., Blidberg, E. and Walvoort, D., 2020.	JRC
01/09/2020	Journal: Marine Pollution Bulletin	Spatio-temporal evaluation of macro, meso and microplastics in surface waters, bottom and beach sediments of two embayments in Niterói, RJ, Brazil https://doi.org/10.1016/j.marpolbul.2020.111537	Rebeca Oliveira Castroa, Melanie Lopes da Silva, Mônica R.C. Marques, Fábio Vieira de Araújo	Federal University Fluminense, State University of Rio de Janeiro

9. Monitoring indicators

[Please refer to the standardised monitoring tool i.e. Matomo to complete the designated excel template on monitoring and progress indicators in annex, and provide a comment or short explanation on numbers and trends in the table below for each indicator when possible/applicable. ***If monitoring was carried out using tools other than Matomo, please indicate clearly.****]*

Comments on the progress indicators in the excel template		
Progress indicator	Means of collecting figures	Comment
1. Current status and coverage of total available thematic data A) Volume and coverage of available data	Database queries done by MARIS.	For CDIs, a lot of quality control activities have been ongoing in this period by Regional Coordinators validating regional data collections for eutrophication and contaminants and providing feedback to data providers for corrections. Moreover, a lot of new data sets have been entered. Due to this, multiple data sets have been deprecated which leads to some decreases in the matrix. However, following new submissions, overall there has been an increase in data.
B) Usage of data since the start of the project phase	Database queries done by MARIS.	The total numbers for the year previous to the reporting period and those for the reporting year have been calculated and compared. For the downloads this gives a moderate increase of circa 13%.
2. Current status and coverage of total number of data products A) Volume and coverage of available data products	Products descriptions. Volume is based on a calculation and P36 mapping.	No new data products.
B) Usage of data products since the start of the project phase	Database queries done by OGS based on metrics sent to the new web service. Map visualisations are based on Matomo events sent by the Map Viewer.	There is a big manual dowloads growth.
3. Organisations supplying/ approached to supply data and data products since the start of the project phase	Database queries done by MARIS.	For CDIs, a lot of quality control activities have been ongoing in this period by data providers, following reports by Regional Coordinators and checks with OCTOPUS

		software. This has resulted in de-activating multiple data sets because of issues. However, overall an increase has been achieved because of new submissions.
4. Online 'Web' interfaces to access or view data	Simple information collating.	No changes in this period.
6. Statistics on information volunteered through download forms	Database queries done by OGS based on metrics sent to the new web service.	Organisation type 'Academia/Research' is higher than 70% except for data products downloading via the catalogoue where it's lower and 'Government/Public administration' arrives to almost 11%.
7. Published use cases	Grafana, based on data from Matomo.	One new use case was published in this period
9.1. Technical monitoring	Grafana, based on monitoring script launched by TRUST-IT	
9.2. Visual Harmonisation score	Report by email from TRUST-IT.	Since data is stored in the USA, we've removed the Google search box
10. Visibility & analytics for web pages	Grafana, based on data from Matomo.	Due to Chemistry portal's complexity, monitoring specific web pages is not representative. We recommend to focus on indicator 11 since it summarises traffic of web sections, and not of individual pages. The decreasing trend from April 2020 is related to non updated metrics following portal restructuring. Only the Marine litter page (which still has the same URL with an extended content) has many visits, with an increasing trend. Matomo metrics in all graphs starts only on 01/01/2020, while this report's period starts on 03/10/2019. Upon comparison to other nodes, metrics should be normalised. As reported to EMODnet Secretariat, due to changes in the portal URLs during the reported period, less relevant pages are monitored, hence their metrics are lower. For example, news and events monitors only the URL https://www.emodnet-chemistry.eu/promotion/news, which is a subsection of promotion without events. Lately a full revision has been done in collaboration with Trust-IT, which will provide better metrics in the future.
11. Visibility & analytics for web sections	Grafana, based on data from Matomo.	As expected, CDI Data Discovery (especially if we add Data) and Products are the most visited web sections.

		Matomo metrics in all graphs starts only on 01/01/2020, while this report's period starts on 03/10/2019. Upon comparison to other nodes, metrics should be normalised. As reported to EMODnet Secretariat, due to changes in the portal URLs during the reported period, less relevant sections are monitored, hence their metrics are lower. For example, 'CDI Data Discovery' should be part of the 'Data' section. Lately a full revision has been done in collaboration with Trust-IT, which will provide the corrected metrics in the future.
12. Average visit duration for web pages	Grafana, based on data from Matomo.	As expected, Data, Products and Marine litter are the most visited web pages. Matomo metrics in all graphs starts only on 01/01/2020, while this report's period starts on 03/10/2019. Upon comparison to other nodes, metrics should be normalised. Lately a full revision has been done in collaboration with Trust-IT, which will provide the corrected metrics in the future.

The monitoring numbers reported as part of the progress monitoring of EMODnet performance are collected through Matomo. In some cases, numbers from other monitoring systems may also be reported (e.g. Awstats, Google Analytics). Each system uses different technical approaches and therefore has its strengths and shortcomings. Therefore, results are indicative and care should be taken with interpreting absolute numbers or comparing results from different tools. It is often more sensible to consider trends over time collected by the same monitoring tool.

10. Recommendations for follow-up actions by the EU

[Give a list of recommendations and suggestions for the EU to consider and take action. Max 1 page.]

EMODnet Chemistry decided, since its pilot phase, to adopt the SeaDataNet infrastructure, standards, tools and services as a basis, taking advantage of all developments undertaken by SeaDataNet with its core network of National Oceanographic Data Centres (NODCs) since the 1980s with the support of a range of EU RTD projects. SeaDataCloud, the EU H2020 project currently driving the further development of the SeaDataNet infrastructure, is officially ending per end October 2020, while it is essential to sustain with appropriate RTD funding its further developments. This for state-of-the-art FAIR standards and services and as an essential link between data observing programmes and networks, both from scientific and governmental monitoring departments, and overarching infrastructures like EMODnet, CMEMS, Blue-Cloud and European Open Science Cloud, being a major aggregator service in the European marine data management landscape.

Extend the scope of the project to neighbouring countries: EMODnet Chemistry already covers some non-EU countries on a voluntary basis. However, in certain areas (e.g. in the Mediterranean) it is of paramount importance to also include neighbouring countries to give a better coverage of the southern areas and strengthen the collaboration with the RSC (UNEP/MAP). Data might not be easily available, and additional financial resources might thus be required.

Organise a meeting with various DGs and agencies of the EU Commission potentially interested in MSFD monitoring data reporting (e.g. DG MARE, DG ENV, EU JRC) to foster synergies and potentially extend the approach set up for beach litter data collection at EU scale to contaminants and eutrophication. Despite the efforts and the discussion within the EU technical groups, MSFD data flow is not always straightforward causing double reporting by EU member states, waste of resources, frustration and, paradoxically, less data availability. Therefore, it might be useful to explore the modus operandi promoted by EU JRC and by the MSFD TG ML and the collaboration strategy between the consolidated systems (RSCs, ICES, EEA).

Request the introduction of the obligation to share data with EMODnet, to safeguard and make available new data to the scientific community. The example of the EU Eurofleets and EU Eurofleets+ projects, where the initiative is implemented at national scale by research vessel operators and making use of EMODnet and SeaDataNet services and mobilising the network of National Oceanographic Data Centres (NODCs) for handling underway and delayed mode scientific data sets as collected during research cruises.

11. Annex: Other documentation attached

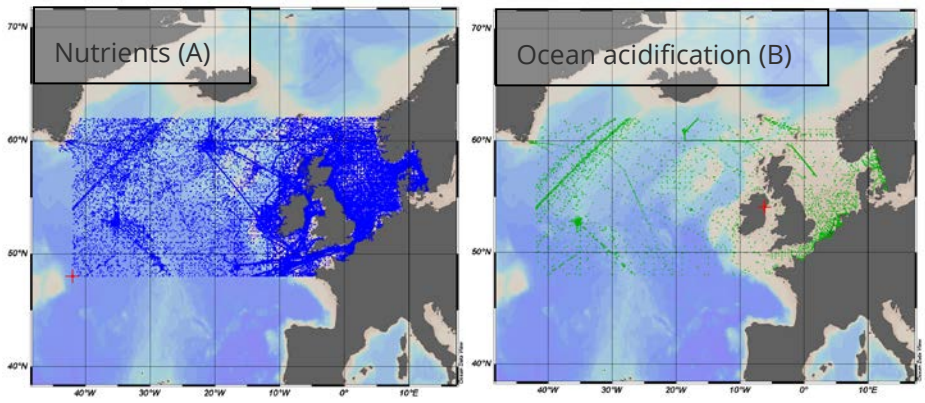
Generating harmonised, aggregated and validated data collections in the North Sea – AU-DCE

In the first year, contribution of AU-DCE to the WP3 for the North Sea activities was focused on aggregation, quality control and validation of data concerning eutrophication and ocean acidification and on harmonization, quality control and validation of data concerning contaminants. The two processes are described individually below.

Eutrophication and ocean acidification data collection

In January, the regional leader for the North Sea received the dataset of harvested data related to eutrophication and ocean acidification as ODV collection AWI, who did the import and aggregation. The dataset boundaries were different from previous EMODnet Chemistry datasets, so direct comparison of the number of CDIs are not possible. The received dataset contained 418664 CDIs for nonrestrictied data, and 25805 restricted dataset for profiles, and 5511 time-series datasets with 303 restricted datasets, indicating 5,8% restricted data only for the North Sea dataset, attributed to 3 originators.

Some exchange of data with Atlantic Ocean, Arctic Ocean and the Baltic Sea was carried out before data validation to further obscure the difference in boundaries compared to earlier EMODnet Chemistry datasets. After enrichment from other Regional leaders, the dataset consisted of 1758667 CDI's. The final dataset treated are shown in figure A and B (nutrients respectively ocean acidification). It contained data originating from 12 CDI partners, with 66 datacenters (including CDI partners) in all.



The data was gathered into profile datasets and the QF marking on the data was evaluated, to establish the percentage of good, bad and unknown quality flags for each parameter before the quality assurance performed by EMODnet was added on top (described below).

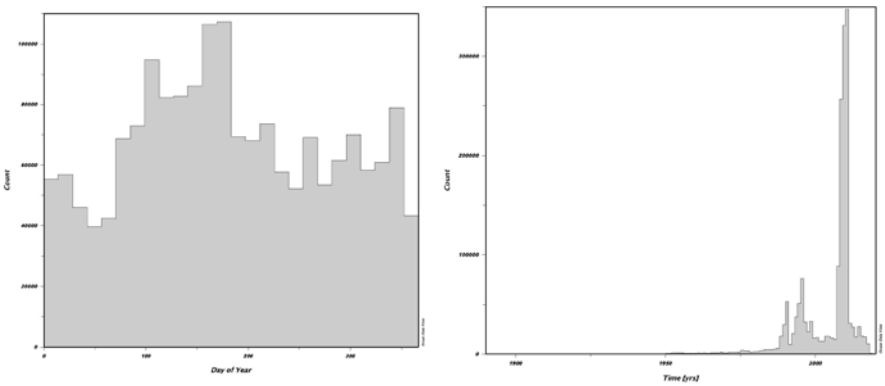


Figure 1. *Nutrients and Ocean acidification data coverage, together with seasonal and between years,*

Quality control

As initial steps in QC, the vertical profiles with only Temperature and Salinity were deleted from collection. No duplicates or on land stations was found.

- For sampling depths > Bot. depth change the QF of Depth [m] to QF=3
- Change the Bot. Depth = -9999 (or similar) to null value
- Change the Bot. Depth > maximum Black Sea depth to null value
- Identify Bot. Depth = 0 (no action, only included in reports to data providers)

For values equal to 0 their flags were changed from QF=0 or QF=1 to QF=6. For values out of range and spikes and negative values QC flags were changed to 3 or 4. Some 136 stations had occurrences of PO4>TP+20% values, and the findings were reported to the 6 partners with violations . The 20% was set as a safety margin to allow for ordinary analytical error on TP and PO4. Where it was clear from profiles either PO4 or TP values wrtr marked with QC flag 3 (mostly TP).

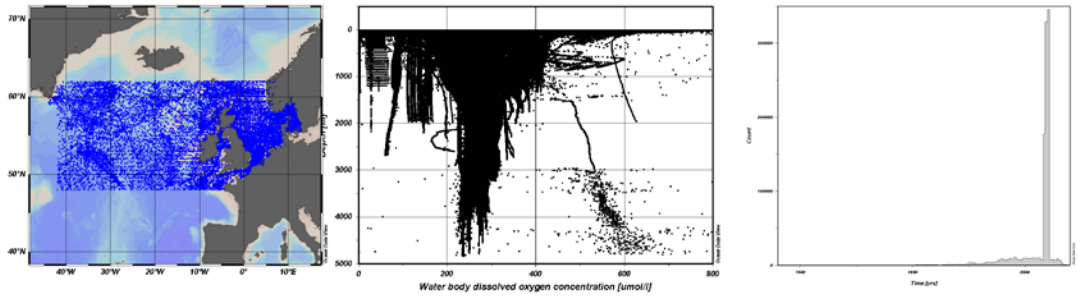
When not present in original data, Water body nitrate plus nitrite was calculated by summing up the Nitrates and Nitrites. Same procedure was applied for Water body dissolved inorganic nitrogen (DIN) which was calculated by summing up the Nitrates, Nitrites and Ammonium. In case all NO2 and NO3 and NH4 were present, cases where (NO2+NO3+NH4)>TN+40% were identified and flagged accordingly. For 26 results, TN was flagged, from 5 different partners.

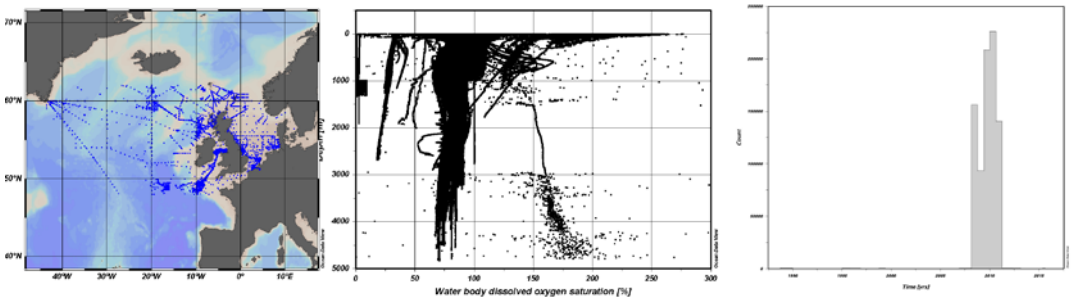
The quality control flags of the North Sea are summarized in table 1 after the additional quality assurance performed by EMODnet. The quality controlled North Sea aggregated data set for eutrophication and ocean acidification contains a total of 74030 vertical profiles with an average of 2 % No Quality Controlled data (QF=0), 95% "Good" flagged data (QF=1, 2, 5, 6, 8) and an average of 3% "Bad" flagged data (QF=3, 4). In **Table 1** are presented the number of total number of vertical profiles (VP), total number of values and total numbers of Good/Bad flagged data per parameters. The spatial, vertical and temporal distributions of selected parameters of the quality controlled eutrophication profile data are illustrated in **Figure 3**.

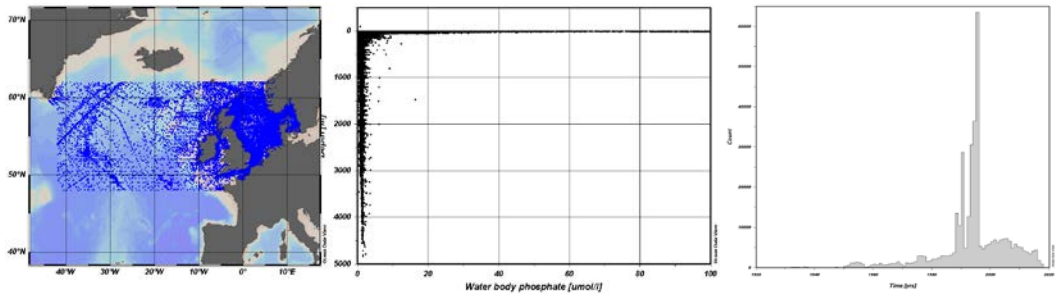
Table 1: *Number of vertical profiles, number and percentage of "No QC", "Good" and "Bad" flagged data in the North Sea data collection*

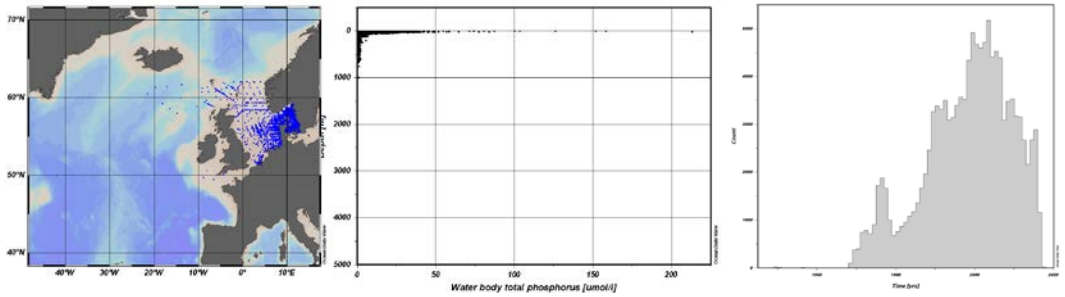
Parameter	No. of VP	Total no. of values	QF=0	%	Good	%	Bad	%
Water body dissolved oxygen concentration [umol/l]	1131804	13199290	12282	0.1%	12807904	97.0%	379104	2.9%
Water body dissolved oxygen saturation [%]	832569	3089210	0	0.0%	2995042	97.0%	94168	3.0%
Water body phosphate [umol/l]	369741	1301816	60796	4.7%	1173496	90.1%	67524	5.2%
Water body total phosphorus [umol/l]	123064	512938	0	0.0%	512913	100.0%	25	0.0%
Water body silicate [umol/l]	276894	925620	60370	6.5%	815205	88.1%	50045	5.4%
Water body nitrate [umol/l]	93246	552457	53125	9.6%	498390	90.2%	942	0.2%
Water body nitrate plus nitrite [umol/l]	235807	365490	8213	2.2%	299636	82.0%	57641	15.8%
Water body dissolved inorganic nitrogen (DIN) [umol/l]	481	496	0	0.0%	496	100.0%	0	0.0%
Water body nitrite [umol/l]	250586	774550	52988	6.8%	660523	85.3%	61039	7.9%
Water body total nitrogen [umol/l]	110354	418367	0	0.0%	418354	100.0%	13	0.0%

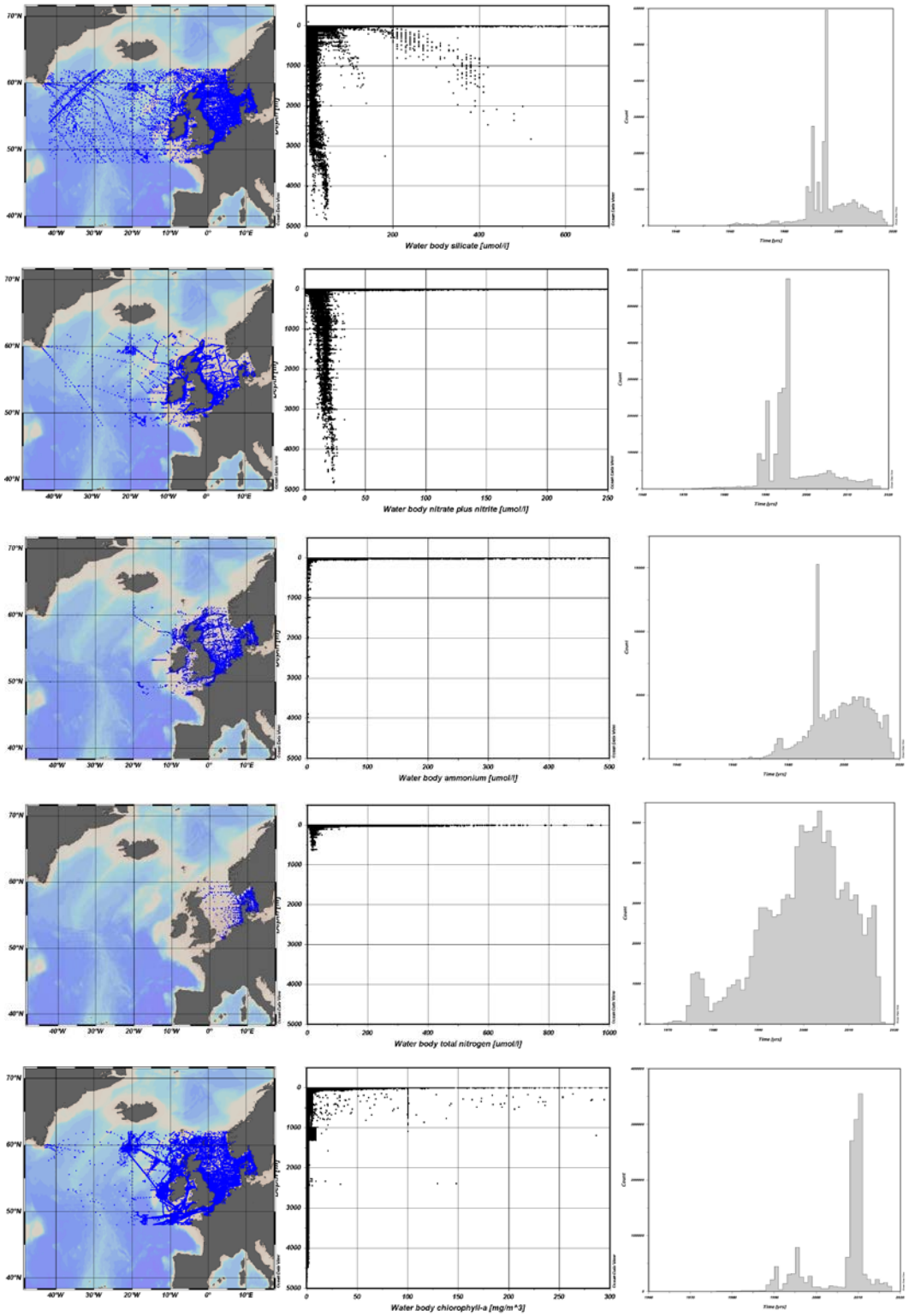
Water body ammonium [umol/l]	143791	601267	365	0.1%	596115	99.1%	4787	0.8%
Chlorophyll-a	1494461	5625199	0	0.0%	5440880	96.7%	184319	3.3%
Water body dissolved inorganic carbon [umol/l]	1023	1038	0	0.0%	1019	98.2%	19	1.8%
Water body pH [pH units]	31564	341319	1	0.0%	341054	99.9%	264	0.1%
Water body total alkalinity [mEquiv/l]	4613	36155	0	0.0%	36131	99.9%	24	0.1%
Average				2.0%		94.9%		3.1%

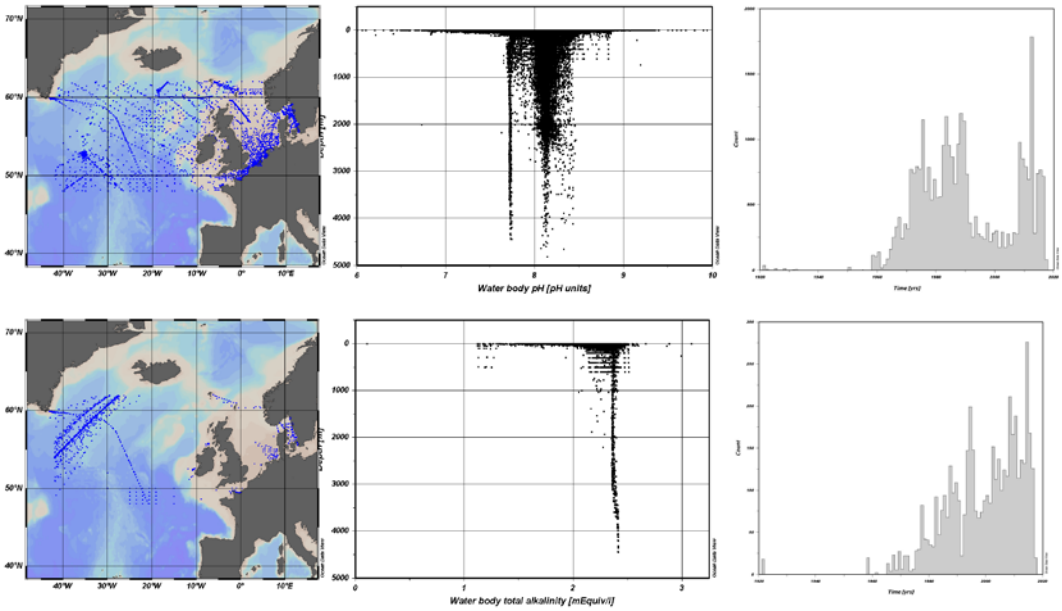









Water body silicate [umol/l]
Water body nitrate plus nitrite [umol/l]
Water body ammonium [umol/l]
Water body total nitrogen [umol/l]
Water body chlorophyll-a [mg/m^3]



Contaminants data collection

The final dataset was made available in may 2020. AU DCE imported the data into ODV. Importing the dataset revealed a problem with the Danish character set, which resulted in 455 errors. Some further 4522 errors and 7634 warnings were recorded during the import, from 4 partners. 23539 datasets were accepted. There were two file sets –"Extra" and ordinaire datasets, which were split into 5 datatypes

-Ocean_Depth_profiles (18336 CDIs with 1006 parameters)

-Sediment (2616 CDIs with 772 parameters)

- Time_series (2017 CDI's with 397 parameters)

- Ocean_minimum_depth_profiles (410 CDI's (Danish) with257 parameters)

- Collection_MinDepBelowBed (164 CDI's (Danish sediments) with 11 parameters)

Some mixtures of biota, water and sediment data in the different datatypes was manually removed, and the two Ocean_minimum_depth_profiles and Collection_MinDepBelowBed was reworked to be included in the Ocean_depth_profiles and sediment datasets.

Quality control

The rinsed dataset for biota, sediment, and water was harmonized, to reduce the number of P01 codes and make the data more accessible for use. For some P01 codes, no actual data was reported (98 "empty parameters" in the biota dataset).

Due to the many different ways to analyse and pre-treat sediments, e.g. both Cd and TBT still after harmonization consists of 5 seperate P01 codes, including different methods and fractions (63 µm/2000µm) analysed. To avoid oversimplification and reporting numbers for the same parameter with different interpretations, this cannot be helped. For some parameters like TOC, which currently are not harmonised, 15 different PO1 codes were found.

A general problem with the dataset was the definition of bottom depth or depth for sediments, which were not reported the same way (sometimes 0, sometimes actual bottom depth, sometimes deeper than

expected at the sampling site). Use of the quality flag for values < detection limit of quantification limit was also problematic, and data with value 0 was changed to QF=6 if not set already.

Results of harmonizing the P01 codes in each matrix is shown in **Table 2** and the distribution of data over the three matrices and contaminants related Parameter groups is summarized in **Table 3.** The spatial and temporal coverage of harmonized contaminants collection per matrix are represented in **Figure 4.**

Table 2: Total number of P01 codes in Contaminants collections in the North Sea. Note that supporting parameters like age, length and weight are not counted as non-harmonized/empty PO1 codes.

Matrix	Total no. of vertical profiles after harmonization	Total no. of P01 codes before harmonization	Total no. of P01 codes after harmonization	Contaminants non-harmonized/empty P01 codes
Water	13501	1006	122	6
Sediment	8529	772	392	73 (+65 supporting parameters)
Biota	24144	159	396	4 (+ 35 supporting parameters)
TOTAL	**34583**	**689**	**328**	**10**

Table 3: Total number of stations (CDIs) for contaminants after harmonization in the North Sea

Parameter group	Water	Sediment	Biota
Total no. of Antifoulants stations	882	644	488
Total no. of Hydrocarbons stations	827	4719	624
Total no. of Heavy Metals stations	10511	2567	596
Total no. of PCBs stations	no data	3972	518
Total no. of Pesticides stations	1054	857	551
Total no. of Radionuclides CDIs	7478	739	no data

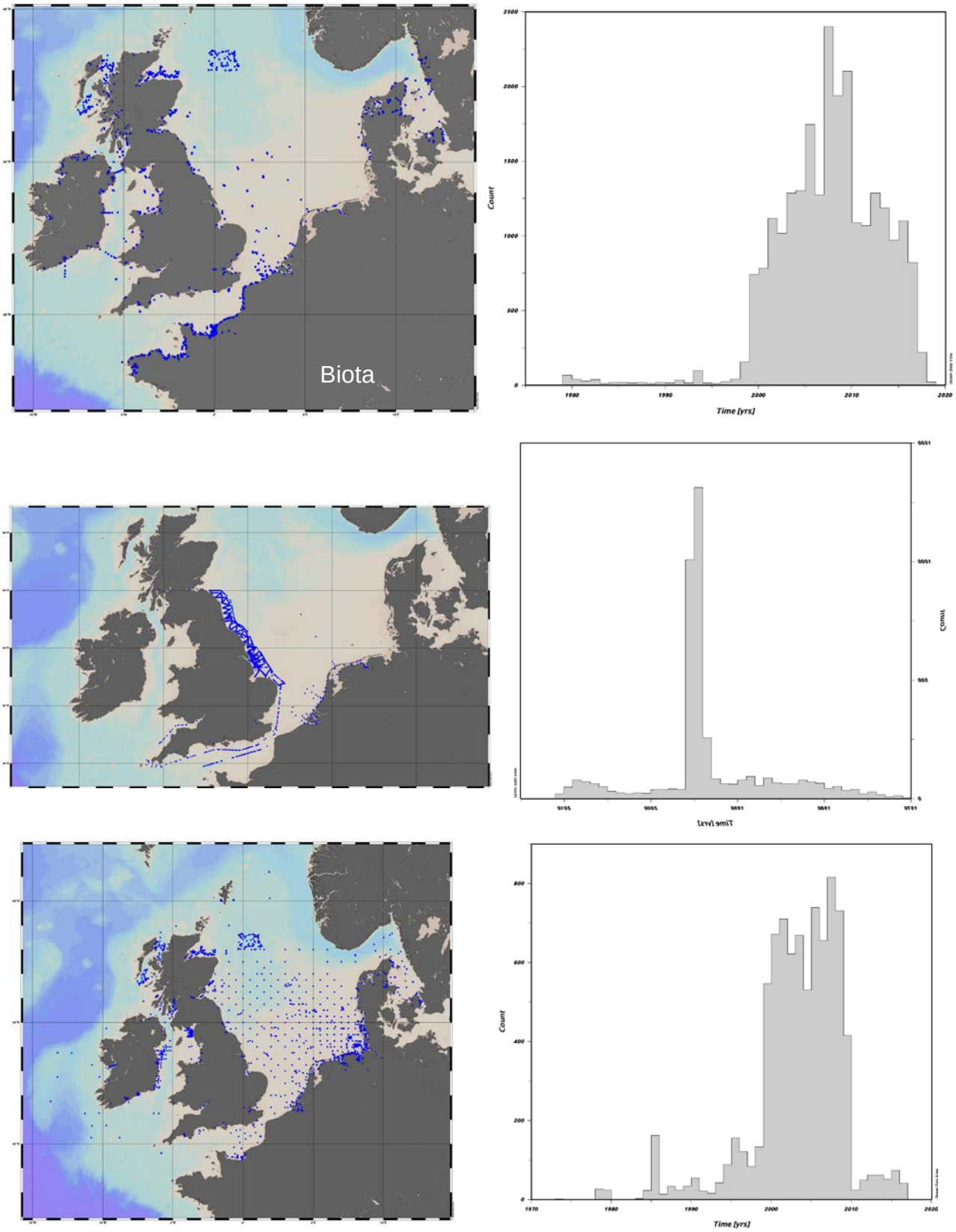


Figure 4: Spatial and temporal data coverage of North Sea harmonized and quality controlled contaminants vertical profiles data

Generating harmonised, aggregated and validated data collections in the Baltic Sea – SMHI

The Baltic Sea dataset for eutrophication and ocean acidification was received in an ODV collection by the regional coordinator in February 2020. Parameters and number of profiles are shown in Table **4**. Profiles with only temperature and salinity included as well as profiles with no metadata were removed before the quality control. Visual quality control was made following the "out of range" boundaries given in the Methodology for data QA/QC and DIVA products. Many out of range values were coastal or fjord data which are known to be high and therefore not flagged. Other out of range values as well as "spikes" were flagged with QF 3. The ratio of inorganic nutrients/total nutrients was checked and where there were larger deviations (ratio>1.15) the suspected parameter was flagged with QF=3. Several data points had a value=0 with QF=1, and these have been given the suggested QF=6. There were also several data points with very small values, close to zero, with QF=1 but as we do not know the limit of detection for all data centres these data points have been left as they are even though several of them might be below detection limit. There are issues with bottom depth in metadata that need to be solved, like bottom depth is sometimes less than the sampling depth in the profile.

In May 2020, the regional coordinator received the Baltic Sea dataset for contaminants as several ODV collections. The number of profiles grouped by P36 is shown in Table **5**. Data was first organised in ODV collections with data for water, sediment and biota. One major task was to identify primary variables for the profiles. The quality control at this stage mainly considered data format and obvious mistakes as negative and zero values.

Profiles and spatial and temporal distribution of a selection of parameters are shown in Table **6**.

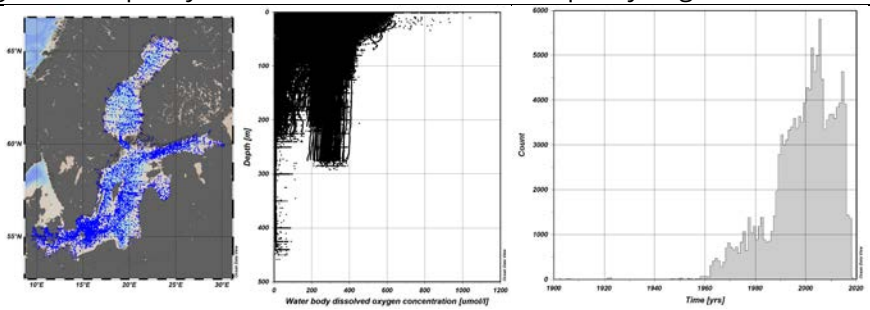
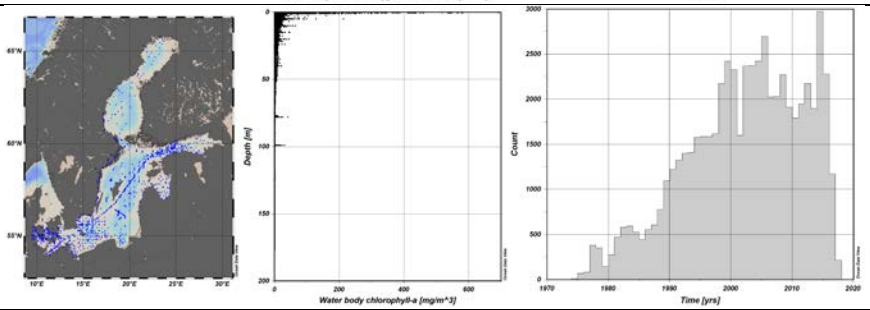
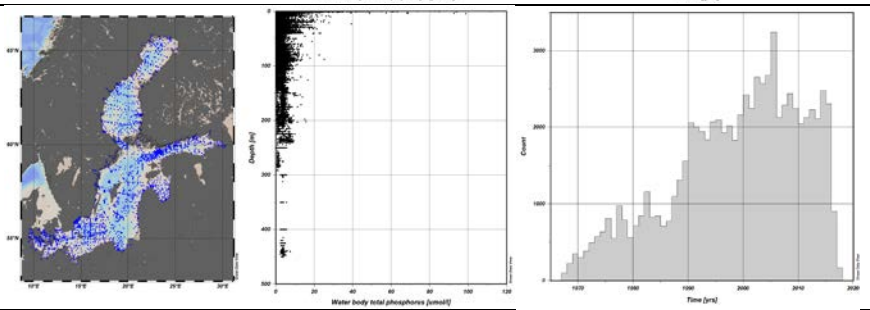
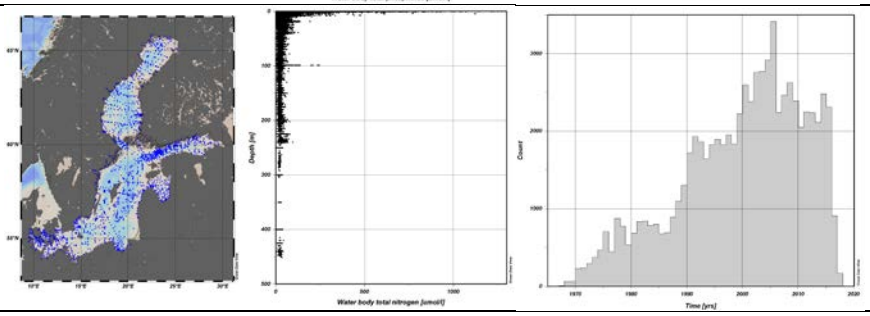
Table **4** Total number of profiles in the eutrophication dataset for the Baltic Sea.

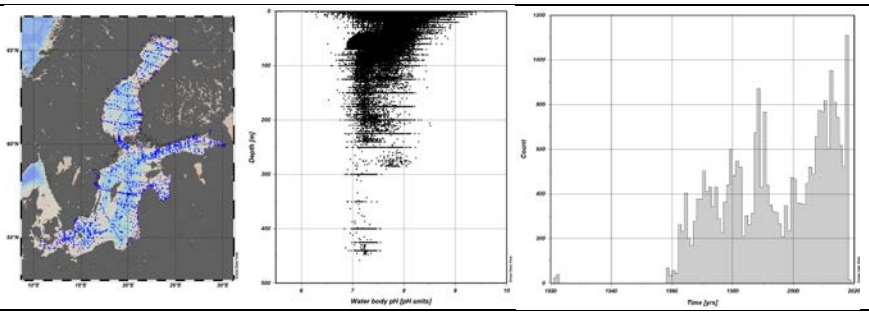
Parameter	Number of profiles
Depth [m] (total number of profiles)	159 935
Water body dissolved oxygen concentration [umol/l]	131 171
Water body chlorophyll-a [mg/m^3]	59 721
Water body phosphate [umol/l]	85 851
Water body total phosphorus [umol/l]	75 836
Water body silicate [umol/l]	65 152
Water body nitrate [umol/l]	34 436
Water body nitrate plus nitrite [umol/l]	46 592
Water body nitrite [umol/l]	37 671
Water body total nitrogen [umol/l]	73 413
Water body ammonium [umol/l]	66 131
Water body pH [pH units]	26 339
Water body total alkalinity [mEquiv/l]	6 887

Table **5** Contaminants in the Baltic Sea in water, sediment and biota grouped by P36.

Parameter group	Water profiles	Sediment profiles	Biota profiles	Biota time series
Hydrocarbons	1149	675	279	21
Heavy metals	407	1344	724	425
PCBs	109	187	316	334
Pesticides	300	98	127	414
Antifoulants	0	128	271	0

Table **6** Spatial and temporal distribution of oxygen, chlorophyll-a, total phosphorus, total nitrogen and pH in the Baltic Sea. Note that the scales for temporal distribution are different for each parameter. Data shown in the figures are quality controlled and marked with quality flag 1 or 2.

Oxygen	
Chlorophyll-a	
Total phosphorus	
Total nitrogen	

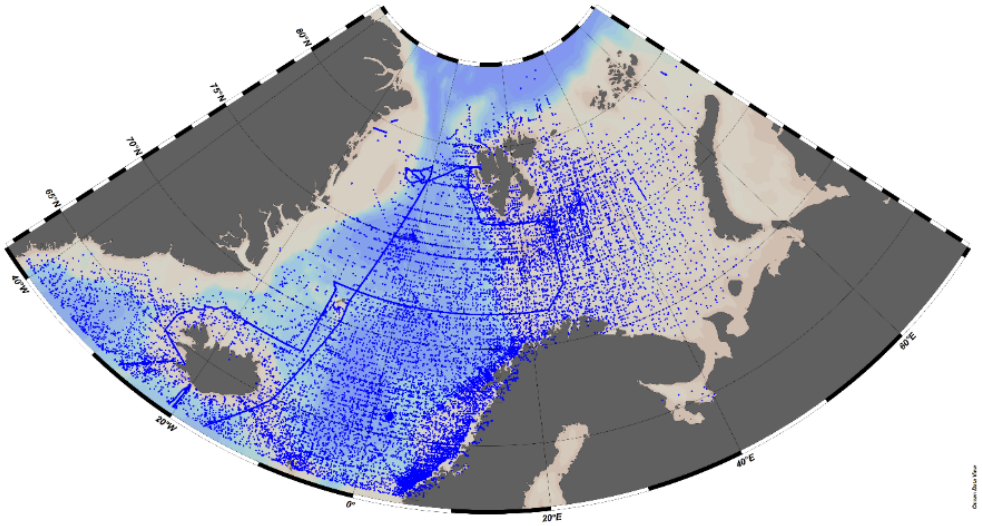
pH	

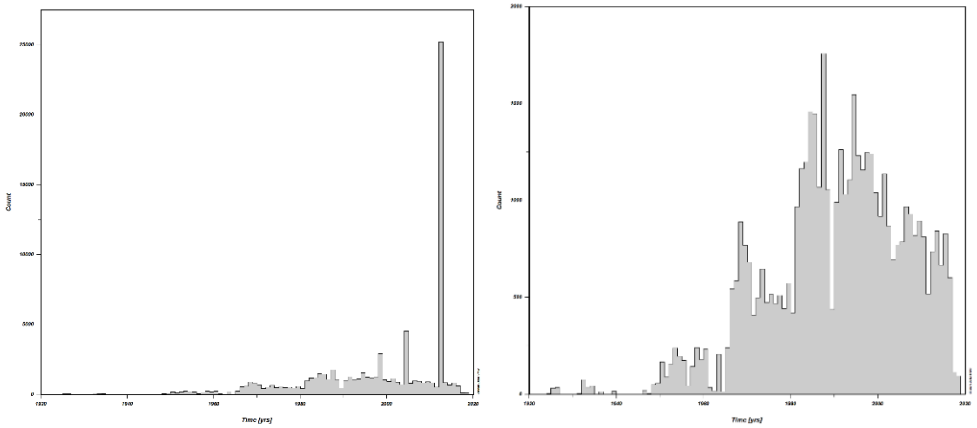
Generating harmonised, aggregated and validated data collections in the Norwegian and Barents Seas – IMR

The Arctic region covers the Norwegian Sea, Barents Sea, Arctic Ocean, Greenland Sea and Icelandic Waters north of 62°N, and between 42°W and 70°E. The southern limit is different from last time, when ICES Ecoregions were used.

Collections of eutrophication and contaminants data have been aggregated/harmonised and validated in 2020. There were no time series data or contaminants in biota in the received data sets.

Eutrophication collection





After deletion of profiles with only temperature and salinity, and Argo profiles that are not validated, the eutrophication collection contains 47 552 CDIs and 77 440 vertical profiles. Almost all the data is unrestricted, only 949 profiles are restricted data.

The spatial coverage of eutrophication data is generally good, with more data along the Norwegian coast, and less in the eastern Barents Sea and along the coast of Greenland.

The temporal coverage is from 1925-2018, where the largest part of the data were collected in the period 1965-2016. The high number of data in 2012 as seen in the time plot to the left is due to ferrybox data. The plot to the right shows annual distribution without ferrybox and glider data.

Quality control of the eutrophication collection

No errors were found in the ODV file format, as the issues from the harvesting in 2018 have been corrected. In the metadata, there were some cases with positions on land, and many default values (0, -9999, 9999, …) in bottom depths.

The data quality is generally good, but some issues were found, particularly in older data. Some examples are:

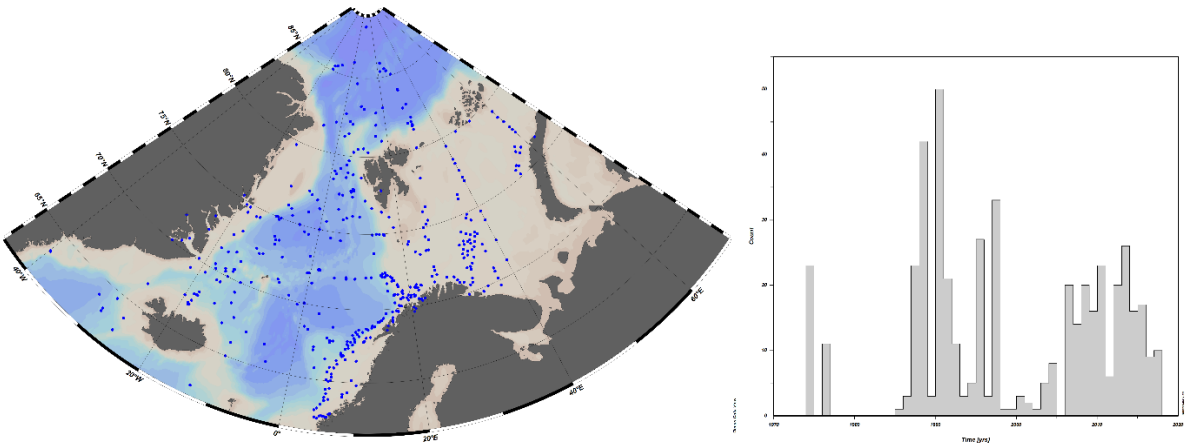
- Default values: -10, -9.98 -> should be empty, with QF = 9
- Negative values: not possible (except for temperature) -> QF = 4
- Zero values: Missing value or below LOD?
- Decimal point errors: Oxygen values 1/10 of normal, and silicate values 10 times higher than normal
- Data with wrong quality flags (QF = 2 used for bad data), or no quality control (QF = 0)
- Profiles with same value for all depths

Table 7 shows the number of vertical profiles, total number of values, and the amount of data flagged as good, bad or no quality control, for each of the parameters in the eutrophication collection after validation. For most parameters, the percentage of good data is above 90%.

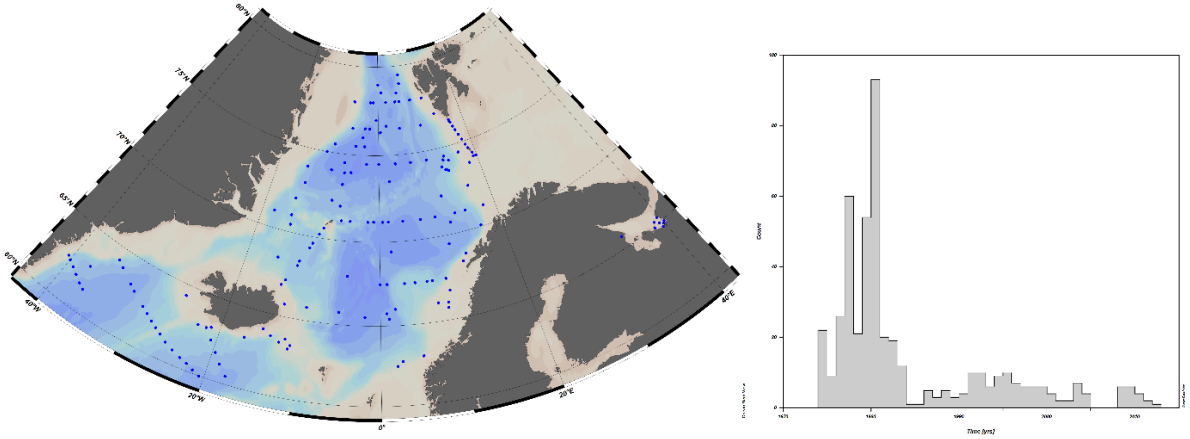
Parameter	No. of profiles	Total no. of values	QF=0	%	Good	%	Bad	%
Water body dissolved oxygen concentration [umol/l]	26 491	926 093	0	0	893 703	96.50	32 390	3.50
Water body dissolved oxygen saturation [%]	1 110	192 596	0	0	159 356	82.74	33 240	17.26
Water body phosphate [umol/l]	40 763	445 098	1 589	0.36	433 396	97.37	10 123	2.37
Water body total phosphorus [umol/l]	60	239	1	0.42	217	87.15	21	8.43
Water body silicate [umol/l]	36 182	405 496	2 976	0.73	387 836	95.65	14 684	3.62
Water body nitrate [umol/l]	29 407	347 744	163	0.05	314 757	90.51	32 824	9.44
Water body nitrate plus nitrite_original [umol/l]	195	2 282	0	0	1 831	80.24	451	19.76
Water body nitrite [umol/l]	29 155	313 463	7 451	2.38	304 958	97.29	1 054	0.33
Water body ammonium [umol/l]	556	1 704	280	16.43	1 421	83.39	3	0.18
Water body pH [pH units]	6 378	34 784	0	0	34 741	99.88	43	0.12
Water body dissolved inorganic carbon [umol/l]	249	249	0	0	248	99.60	1	0.40
Water body total alkalinity [mEquiv/l]	465	2 688	0	0	2 288	85.12	400	14.88
Water body chlorophyll-a [mg/m^3]	43 549	606 172	0	0	554 411	91.46	51 761	8.54
Water body phaeopigments [mg/m^3]	19 821	145 674	0	0	145 019	99.55	655	0.45
Water body nitrate plus nitrite [umol/l]	29 602	350 026	78	0.02	316 407	90.40	33 541	9.60
Water body dissolved inorganic nitrogen [umol/l]	23	217	0	0	71	32.72	146	67.28

Table 7. Number of vertical profiles, total number of data points, and number and percentage of data flagged as "No QC", "Good" and "Bad" in the Arctic eutrophication data collection.

Contaminants in sediment and water



Contaminants data in sediment cover the period 1974-2017, with large variations from year to year in the amount of data. The number of profiles is small (Table 2), but spatial coverage is quite good, with data in most parts of the region.



In the water collection, the number of profiles is also small, and about half of them are located in the White Sea. The rest are spread over most of the region, except in the Barents Sea. The time period covered is 1974-2012, but with little data per year except for the first 10 years.

Quality control of the contaminants collections

In the collection for contaminants in sediment there were some errors in the ODV file format that had to be corrected.

Many profiles had the wrong primary variable - ADEPZZ01 was used instead of COREDIST that is the correct variable for sediment data.

Some sediment profiles had the wrong depth unit, with m instead of cm (confirmed by data provider).

A few ODV files had mixed data from 2 different profiles, and some files had errors in variable names.

After correcting these errors and importing the files to ODV again, units and parameter names were harmonized in both collections. The numbers of harmonized parameters, CDIs and profiles are shown in Table 8.

Collection	Parameters	CDIs (total)	CDIs (restricted)	Profiles
Contaminants in sediment	100	477	0	477
Contaminants in water	26	466	231	466

Table 8. The numbers of harmonized parameters, CDIs and profiles in the contaminants collections.

For many of the parameters there is very little data, in many cases only one measurement. This makes it difficult to do any quality control of the data, and no quality flags were changed, except for some 0 values where the flags were changed from QF = 1 to QF = 6 (below LOD).

Checks for negative values, positions on land, default values in bottom depth and profiles without contaminants data were performed, and no errors were found.

Generating harmonised, aggregated and validated data collections in the N.E Atlantic – IFREMER

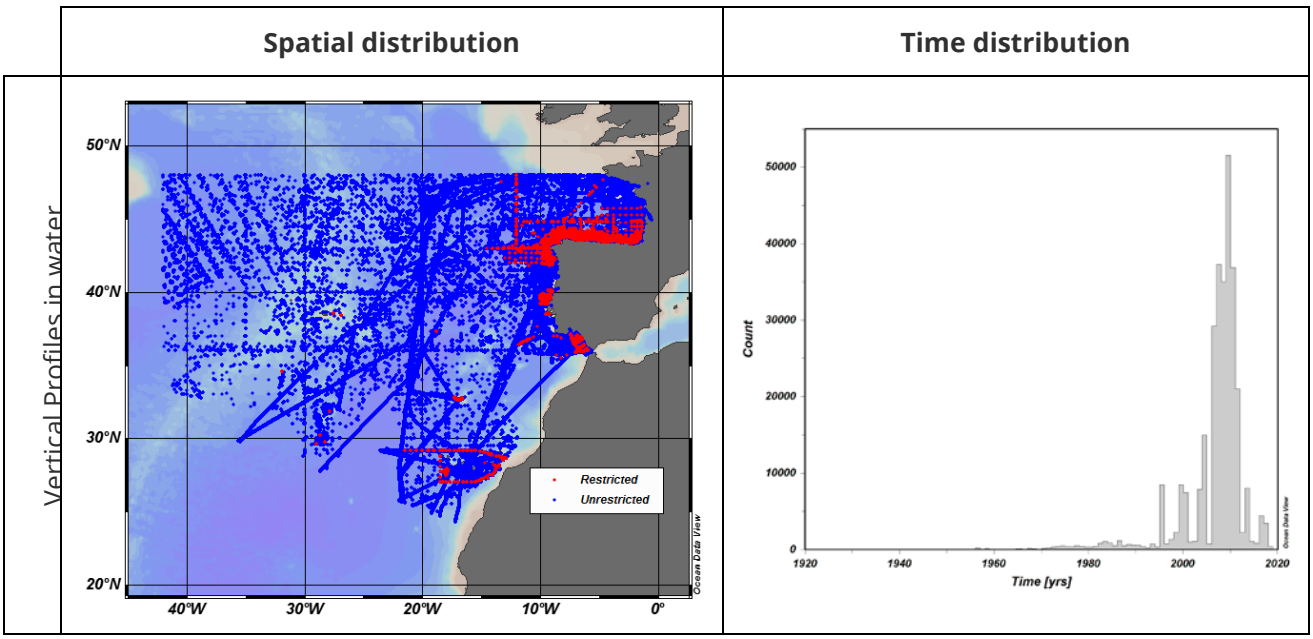
The first year contribution of IFREMER – the regional leader for NE Atlantic was focused on data aggregation, harmonisation and quality control of the first harvesting of the Eutrophication & Ocean Acidification dataset and the Contaminants dataset in spring 2020.

After a new delineation of MSFD regions and internal discussions, it was agreed that the NE Atlantic would extend northward until 48°N as in previous EMODnet Chemistry phases.

Eutrophication & Ocean Acidification dataset description

After file format errors/warnings, duplicates and QC checks, the QCed aggregated NE Atlantic Eutrophication & Ocean acidification dataset extends from 24°N to 48°N and from 42°W to 0°W and contains 35.049 vertical profiles (with 25% of restricted data) and 548 unrestricted time series from 11 CDI-partners.

The spatio-temporal distribution of the QCed aggregated datasets is shown on Figure 5. Vertical profiles spread from the coast to the open sea while time series are mainly concentrated at the French coast with few networks on the Iberian coast. French coastal monitoring stations from WFD and MSFD are indeed submitted into the EMODnet infrastructure as time series. Most of the data were measured between 1970's and 2018 with peaks in 2000's for vertical profiles due to high frequency data from Ferrybox and undulators. The decrease of data in recent years is due to the delay of scientific analysis/validation of chemicals before distribution to the National Data Centers.



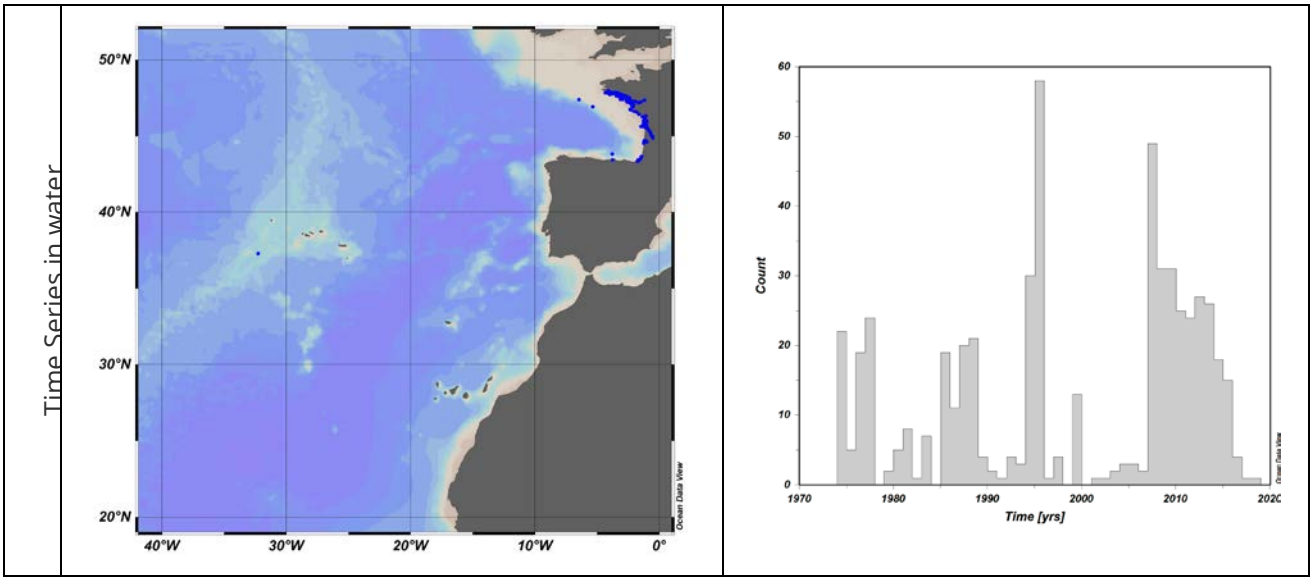


Figure 5 - Spatial (left) and temporal (right) distribution of CDIs/measurements for the vertical profiles (up) and time series (down) in the NE Atlantic Eutrophication & Ocean acidification dataset

Contaminants dataset description

After corrections of format/metadata/inconsistency errors, the NE Atlantic contaminants dataset from 9 CDI-partners results in 3.036 CDIs (with 25% of restricted data) divided into 4 harmonised ODV collections listed in Table 9.

ODV collection	Nb CDIs	Nb harmonised param	Nb total param
harmonized_ocean_depth_profiles.odv	1.766	49	53
harmonized_sediment_depth_profiles.odv	764	85	91
harmonized_Sediment_time_series.odv	268	89	90
harmonized_Biota_time_series.odv	238	180	183

Table 9 – List of the harmonised ODV collections with the number of harmonised parameters and the total number of parameters

The few parameters not harmonised (Table 9) are parameters outside the scope of the project which highlight the huge work done by chemical experts during the previous phases of the project to refine the harmonisation step.

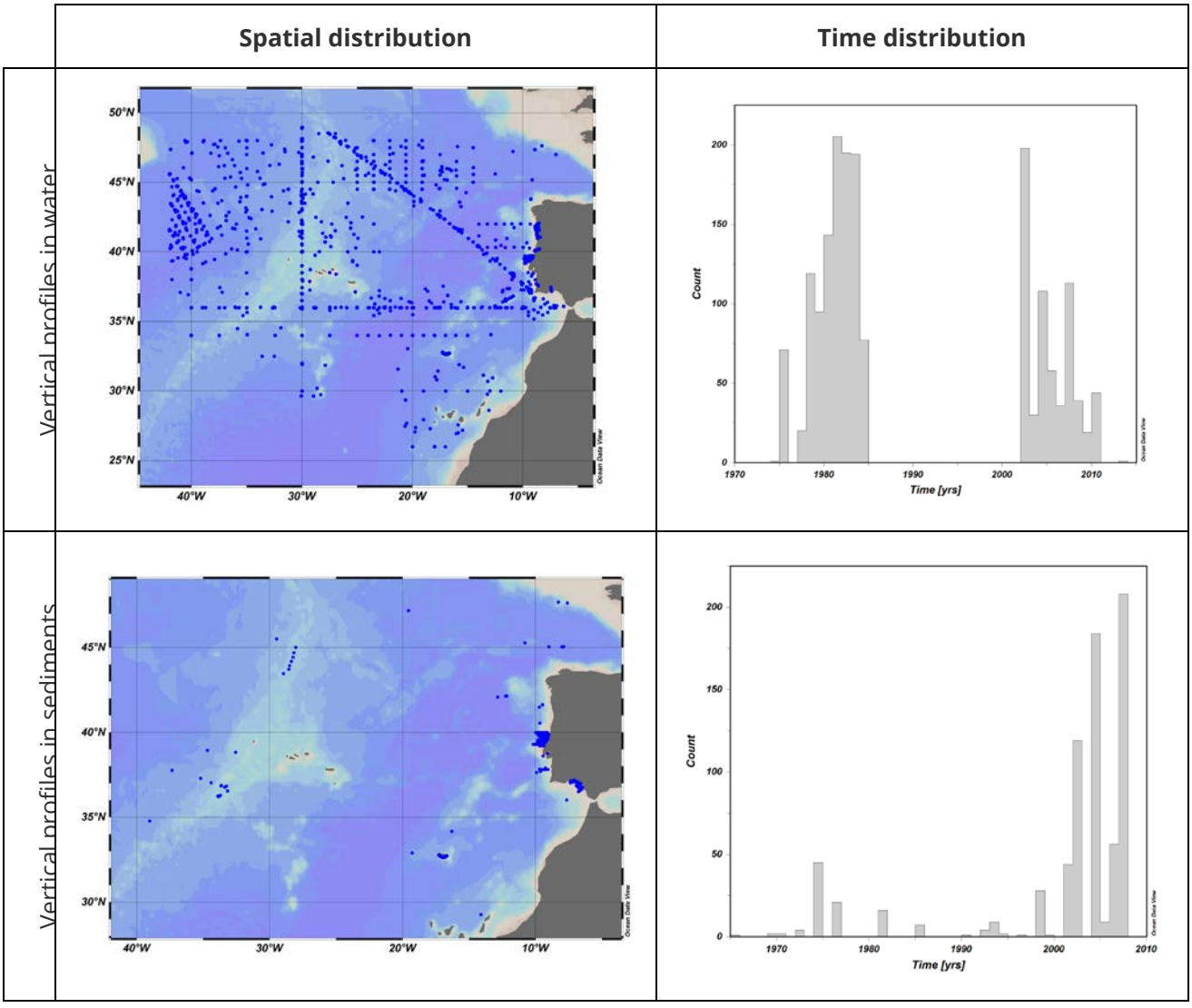
The distribution of CDIs by P36 parameter groups for each harmonised collection is summarized in Table 10 and shows the high number of hydrocarbons in water while antifoulants are mainly measured into sediment and biota.

P36 Parameter group	Water VP	Sediment VP	Sediment TS	Biota TS
Total no. of Antifoulants stations	0	0	63	30

Total no. of Hydrocarbons stations	1043	0	115	172
Total no. of Heavy Metals stations	644	670	176	238
Total no. of PCBs stations	76	94	146	173
Total no. of Pesticides stations	80	94	146	193

Table 10 – number of CDIs per P36 parameter groups for the 4 ODV collections

The spatio-temporal distribution of contaminants is summarized in Figure 6. As with the eutrophication & ocean acidification dataset, timeseries data are concentrated at the coast while vertical profiles cover a larger area to the open sea. First contaminant data appears in the late 1970's with a noticeable increase in the 2000's.



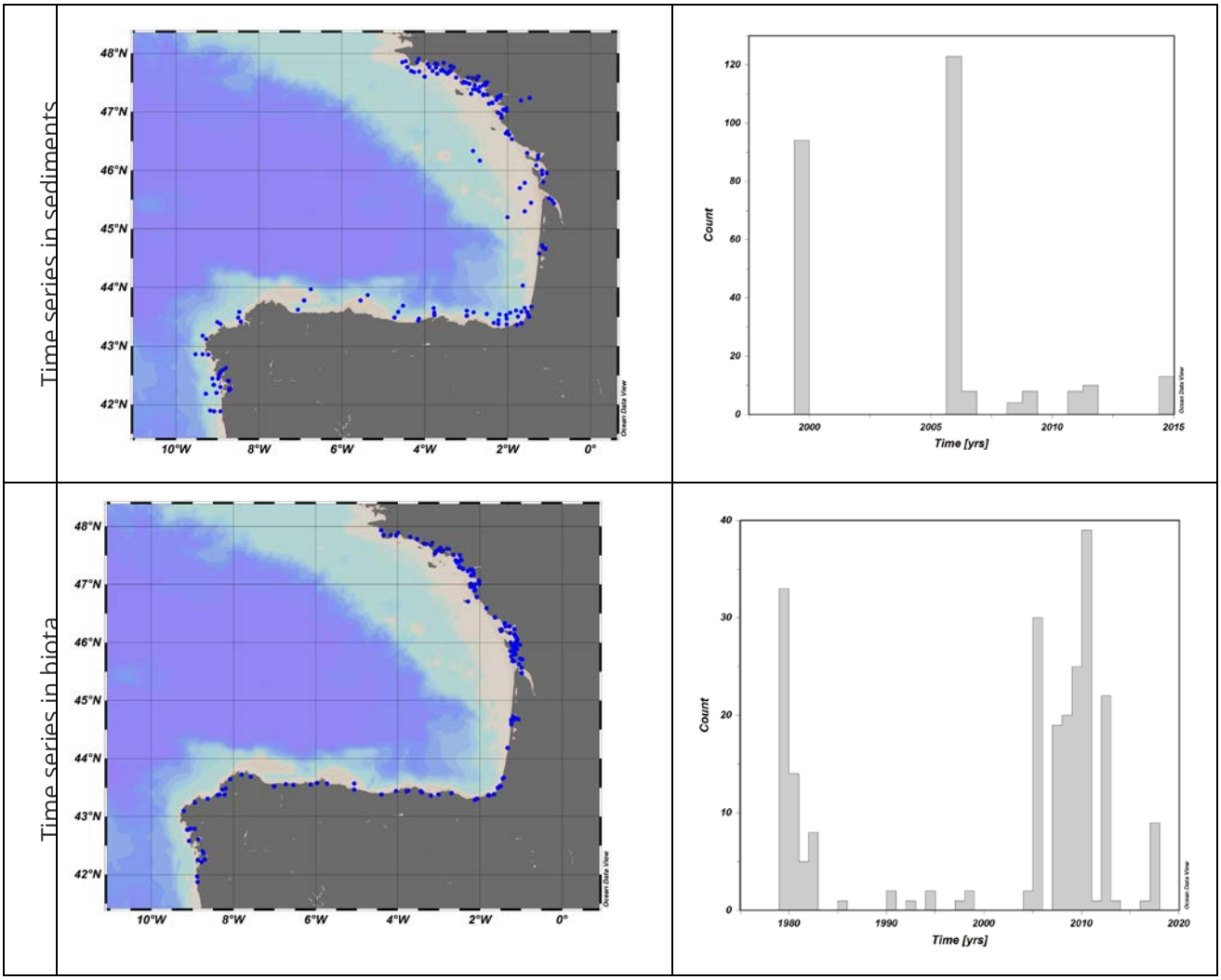


Figure 6 – Spatial (left) and temporal (right) distribution of stations for the 4 data types available in the North East Atlantic Ocean contaminants collection

Quality Control

The latest version of ODV software (5.3.0) and the common project procedure were used for the quality checks of measurements and aggregation/harmonisation at regional scale (https://www.emodnet-chemistry.eu/doi/documents/EMD2chem_QCreport_V8-072015.pdf). The main QC steps were: apply P35 aggregation, check format/file errors (inconsistencies between ODV txt file and CDI, wrong P02 in CDI, wrong primary variable P01 in ODV txt file), check duplicates, check missing values encoding, check broad range, check for nutrients inorganic/total ratio for N and P, checks values under detection limit and zero values.

Thanks to new functionalities of ODV software, additional QC steps of data could be performed: spike detection, and merging of bottle data.

After the joint CMEMS INSITU-TAC/ EMODnet Chemistry meeting on February 2020, broad range checks were refined in some regions for Oxygen and Chlorophyll-a data (https://doi.org/10.13155/54846) and additional QC steps were performed on DM/NRT oxygen ARGO profiles and using oxygen supersaturation.

The number and percentage of Good/Bad data of the QCed aggregated NE Atlantic Eutrophication & Ocean acidification dataset are presented in Table 11. This dataset has more than 90% of good data (QF=1, 2, 5, 6, 7, 8 and Q). Chlorophyll-a and PH data have the worst % of good data because of a higher number of data from uncalibrated instruments.

P35 Parameters	Nb CDIs	Nb values	Good (QF=1,2,5,6,7,8,Q)	% Good	Bad (QF=3,4)	% Bad
Water body dissolved oxygen concentration	24068	8045327	7784947	96.8	260344	3.2
Water body dissolved oxygen saturation	1627	977537	975094	99.8	2443	0.2
Water body phosphate	15804	187134	173103	92.5	7172	3.8
Water body total phosphorus	175	878	865	98.5	13	1.5
Water body silicate	10320	109092	100824	92.4	7456	6.8
Water body nitrate	7209	72669	71120	97.9	1540	2.1
Water body nitrite	8100	48277	47253	97.9	461	1.0
Water body nitrate plus nitrite_origin	2489	32839	32491	98.9	348	1.1
Water body nitrate plus nitrite	9479	87748	85547	97.5	2196	2.5
Water body ammonium	6105	64440	57835	89.8	6605	10.2
Water body dissolved inorganic nitrogen (DIN)	5774	44500	43435	97.6	1065	2.4
Water body urea	284	1045	1036	99.1	9	0.9
Water body total nitrogen	243	609	601	98.7	8	1.3
Water body pH	5633	159855	121503	76.0	38352	24.0
Water body dissolved inorganic carbon	22	389	389	100.0	0	0.0
Water body total alkalinity	415	5144	5037	97.9	107	2.1
Water body chlorophyll-a	11495	2108471	1665098	79.0	443373	21.0
Water body chlorophyll-b	777	3162	3153	99.7	9	0.3
Water body phaeopigments	1181	2814	2803	99.6	11	0.4

Table 11 – Total number of CDIs and measurements and total number and % of Good/bad flagged data per P35 parameter for both vertical profiles and time series collections after QC

Key issues

Key issues were identified and presented to CDI partners during the regional meetings on June 2020 to strengthen the importance of following the updated guidelines (https://www.emodnet-chemistry.eu/doi/documents/Updated-Guidelines-CDI_EMODnetChemistry4_10072020.pdf and https://www.emodnet-chemistry.eu/doi/documents/EMODnetChemistry_Guidelines-ODV_Production_rs_mf.pdf).

In addition to the usual actions of checking consistency of primary variables (P01) with matrix (P02), checking missing values encoding and so on; specific actions were required to some CDI partners to know how to deal with their zero values (are they real values or missing values?), to merge as much as possible bottle data of the same type (inorganic and particulate nutrients for example) in a unique CDI and to check missing values especially for bottom depth (should be empty if unavailable).

The first benefit of these regional meetings is the increase of the feedback from CDI partners to the regional QC reports which should improve the overall quality at source level.

Generating harmonised, aggregated and validated data collections in the Mediterranean – HCMR

During the first year of the project, HCMR WP3 contribution for the Mediterranean Sea was focused on aggregation, quality control and validation of Eutrophication and Ocean acidification data and on harmonization, quality control and validation of contaminants.

Eutrophication and Ocean acidification data collections description

In February 2020, HCMR received from AWI the aggregated Eutrophication and Ocean acidification collections for the Mediterranean Sea as resulted from the harvest conducted by MARIS. The initial data originated from 27 CDI partners from 20 countries and included in total 295,376 vertical profiles (with 19% of restricted data) extended from 1911-2019, and 13,112 time series(with 31% of restricted data) from 1974-2017. After the QC, there was a reduction of 5% at profile data and 24% in time series due to elimination of erroneous CDIs (format errors, wrong or missing metadata, lack of essential for the project needs parameters). Table **12** summarizes the totals, the percentages of the restricted data and the total number of parameters after the completion of the QC. The spatial and temporal distribution of the final QCed aggregated collections are shown in Figure **7**. Western Mediterranean is characterized by a sufficient geographical coverage of vertical profiles except the Tyrrhenian Sea. Significant data gaps are observed at the eastern coasts of Adriatic as well as the southern parts of the Eastern Mediterranean. In the open sea, the spatial coverage is better at the Western Mediterranean and the Adriatic Sea compared to the Eastern basin. The majority of profile data are measured after the '80s with a peak between 2006 and 2016 due to Spanish thermosalinograph data. Time series on the other hand are mainly coastal data. Their majority is concentrated at the Italian and French coasts.

Matrix	Type of data	Nb CDIs	Restricted CDIs (%)	Nb of P01 (*harmonized/non harmonized)	Nb of total P01 before harmonization
Water	Eutrophication & Ocean acidification profiles	280,419	18.5 %	23	
	Eutrophication & Ocean acidification timeseries	9,912	41, 5 %	21	
Biota	Contaminant profiles	89	52.8 %	55*/55	59
	Contaminant timeseries	824	3.0 %	233*/247	395
Sediment	Contaminant profiles	3,019	75.8 %	415*/437	609
	Contaminant timeseries	4,188	2.5 %	275*/280	382
Water	Contaminant profiles	2,555	7.7 %	162*/177	192
	Contaminant timeseries	1,392	0.5 %	146*/163	186

Table 12: Total number of CDIs and parameters (P01) of the final QCed aggregated and harmonized data collections in the Mediterranean Sea.

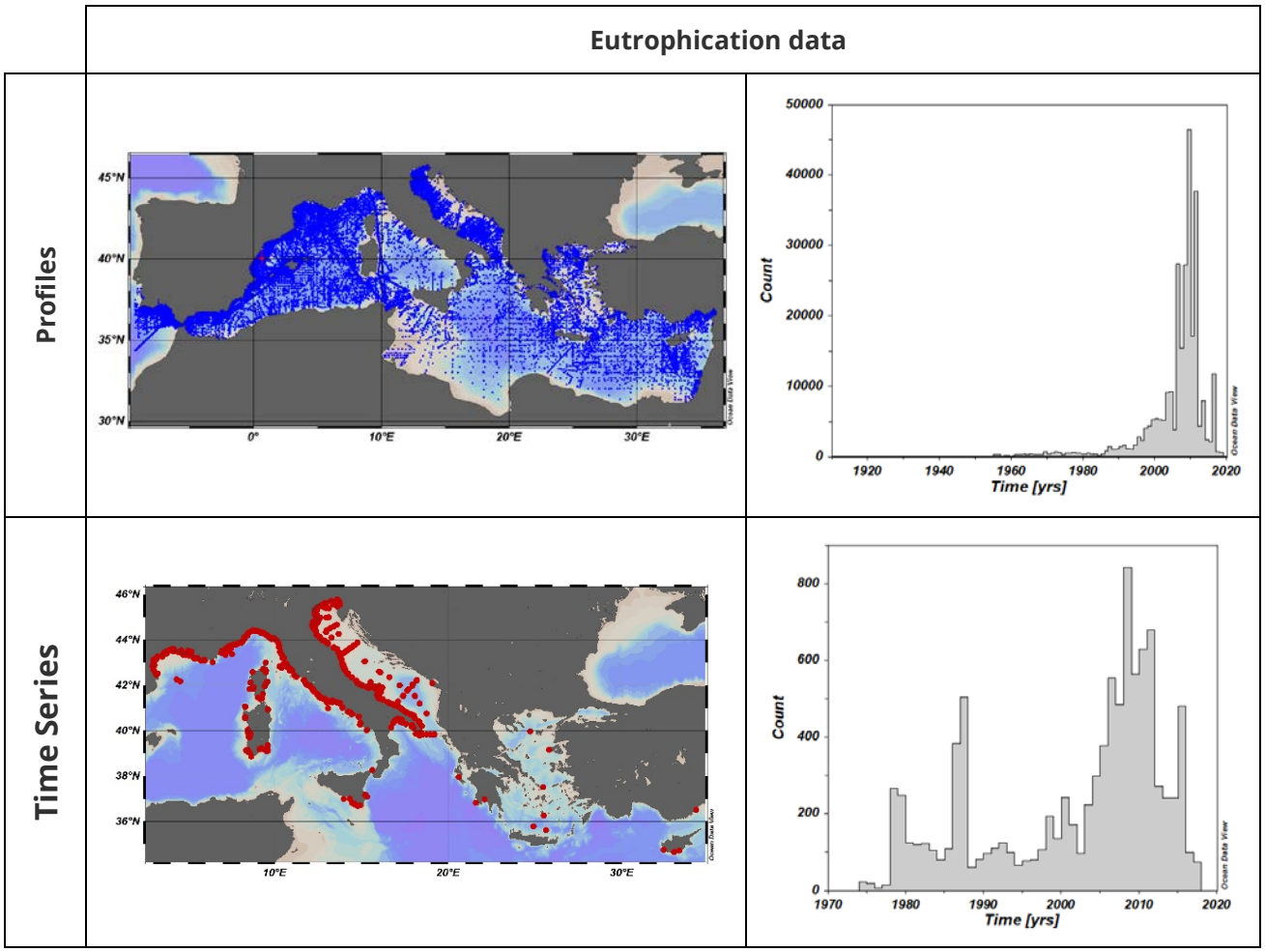


Figure 7: Spatial (left) and temporal (right) distribution for vertical profiles (up) and time series (down) of QCed aggregated Eutrophication & Ocean acidification data in the Mediterranean Sea.

Contaminants data collection description

In May 2020, HCMR received from AWI the contaminants collections for the Mediterranean Sea as resulted from the harvest conducted by MARIS. The initial contaminant data originated from 17 CDI partners from 14 countries and included in total 5,750 profiles (with 45% of restricted data) extended from 1971-2017 and 6,406 timeseries (with 2% of restricted data) from 1979-2018. After the harmonization and the QC, there was a reduction of 1.5% at profile data while the time series remained the same, which means that the quality of the contaminants data has been improved and partners applied the suggested by the regional leader corrections to their data. Table **12** summarizes the total CDIs, the percentages of the restricted data and the number of harmonized, not harmonized and total parameters of the final QCed aggregated and harmonized data collections in the Mediterranean Sea. It can be seen that the majority of the contaminants parameters have been harmonized (1286 from 1359) thanks to the efforts of defining common units and parameters names in the previous phases of the project, while 464 parameters were out of the scope of the project.

The distribution of CDIs by P36 parameter groups for each harmonized collection is shown in Table **13**. Heavy metals in sediment is the majority in the Mediterranean.

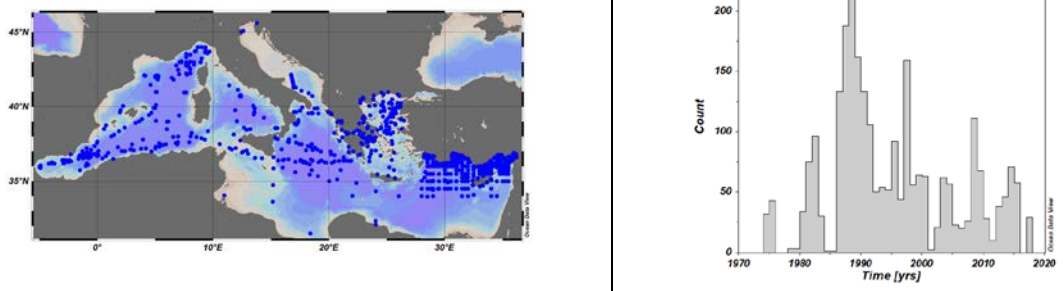
The spatial and temporal distribution of the final harmonized and QCed collections are shown in Figure **8**. Time series are mainly located at coastal areas and are more recent compared to the eutrophication data.

	Profiles			Timeseries			
P36 Parameter Group	**Water**	**Sediment**	**Biota**	**Water**	**Sediment**	**Biota**	**Totals**
Total no. of Antifoulants stations	0	22	36	700	1150	58	**1966**
Total no. of Hydrocarbons stations	1236	332	29	964	3532	367	**6460**
Total no. of Heavy Metals stations	1943	2915	51	1228	3881	726	**10744**
Total no. of PCBs stations	18	268	26	24	1880	256	**2472**
Total no. of Pesticides stations	77	179	24	968	2005	510	**3763**
Totals	**3274**	**3716**	**166**	**3884**	**12448**	**1917**	**25405**

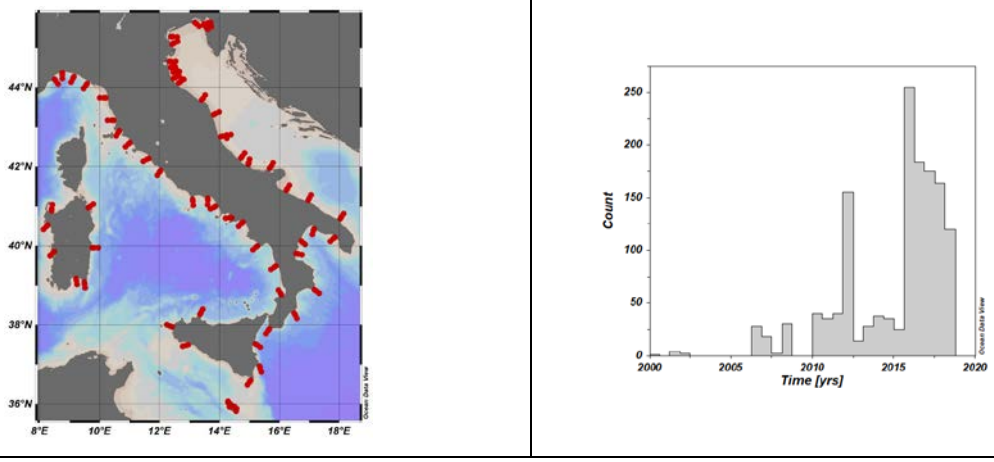
Table 13 Total number of stations (CDIs) per P36 parameter group for the 6 QCed harmonized Contaminants collections in the Mediterranean Sea.

i) Contaminants data in Water

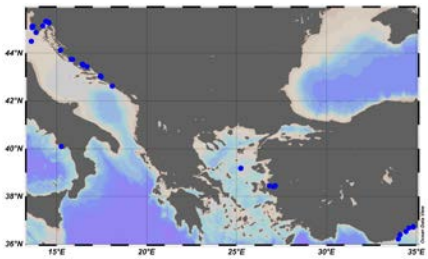
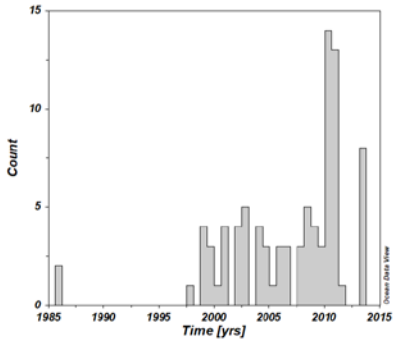
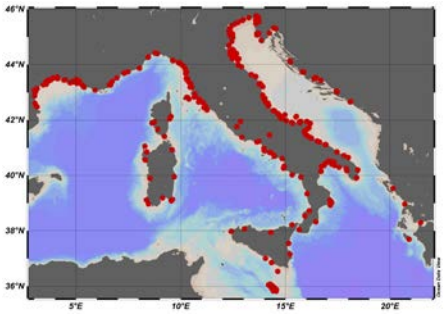
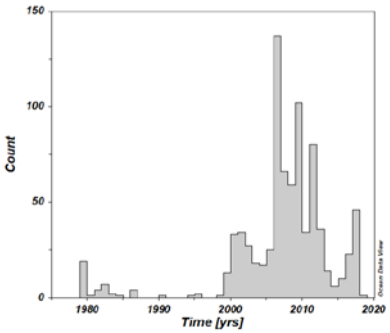
Profiles



Time Series



ii) Contaminants data in Biota

Profiles		
Time Series		

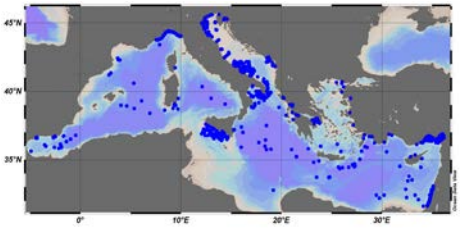
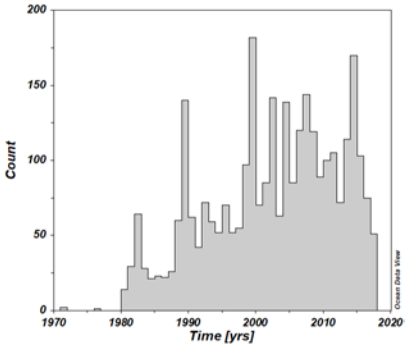
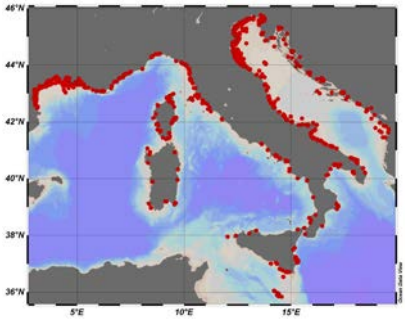
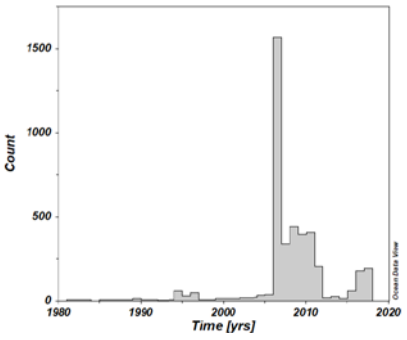
	iii) **Contaminants data in Sediment**	
Profiles		
Time Series		

Figure 8: Spatial (left) and temporal (right) distribution for the 6 data types of QCed harmonized Contaminants collections in the Mediterranean Sea.

Quality control

In both eutrophication and contaminant data collections, around 15,729 CDIs were found with only temperature and salinity and thus excluded from further analysis. Another 1,034 CDIs with eutrophication data had no complete metadata. The regional leaders commonly decided to erase these CDIs from the final collections due to the lack of essential metadata. Furthermore, some French Argo floats (901 CDIs) were also deleted because the real-time oxygen profiles were not adjusted and/or not validated and were considered as wrong.

The split of contaminant data into the three matrices (water, sediment and biota) was not fully automatic using ODV. Additional manual checking was needed because of several mismatches between the parameters (P01) and the matrices (P02) of ODV and CDI files, incorrect primary variables (ADEPZZ01 instead COREDIST), mixed data (sediment and water in the same file. The harmonization of Contaminant data namely the units conversion to preferred target units and grouping of variables with the same P01 code was done after the split of contaminants into the three matrices.

ODV 5.2.1.3 software was used for the data quality control following the common project methodology (http://nodc.ogs.trieste.it/doi/documents/EMD2chem_QCreport_V8-072015.pdf). The applied QC checks for the eutrophication & ocean acidification data are summarized as follows: format checks, broad range control checks to exclude erroneous high values (flags were changed to 3 or 4), negatives and defaults assigned as not null values (flags were changed to 4), QF equal to 0 (flags were changed to 1,2,3,4,6 or remained 0 after consultation with partner), and identification of zero values (flags were changed to 4 or 6). Additional checks for nutrient data were carried out using the ratios NO_2/NO_3, NO_3/NO_2+NO_3 and N/P and the necessary flags corrections were made(flags were changed to 3 or 4). In eutrophication data two parameters, DIN (Water body dissolved inorganic nitrogen) and Nitrate plus Nitrite, were also calculated following the methodology defined within the project. The numbers of corrected measurements per flag in eutrophication data are shown in Table **14**. Around 55% of the total corrected measurements were flagged as "Good" (QF=1, 6) and around 45% as "Bad" data (QF=3, 4). The final collections consists of about 88% "Good" data (QF=1, 2, 5, 6, 8, Q) and of 8% "Bad" data (QF=3,4) (Table **15**). All parameters have high levels of "Good" data except dissolved oxygen saturation. This is because we kept the initial zero data flags (at 72% of the data values) according to the originators suggestions. Furthermore, for six parameters in vertical profiles (DO, Nitrite, Ammonium, Phosphate, Silicate and Aggregated DIN) we kept the initials QF=0 of the zero values because the data originator (EDMO=681) couldn't timely confirm whether these values are below detection limit or are missing data.

For the contaminants, the checks were limited in values with QF=0, and in zero and negative values. The parameters which have undergone changes in their flags were around 6,140 values referring to primary variables (depth and time). These flags were changed from QF=0 to QF=1. In addition, there were more than 1,200 values=0 from different parameters which their flags changed from QF=0 or 1 or 2 to QF = 6 or Q.

Another quality control check concerns the metadata variable bottom depth. There were almost 2,000 CDIs with bottom depths values (included default 9999 values) higher than the maximum reference depth of the Mediterranean (about 5.200 meters). Those values were changed to null. More than 66% of the total CDIs had bottom depth equal to 0 with the largest percentage of them belonging to bathythermographs data. It was decided to leave those values 'as is' for now and correct them at a later stage. A new ODV version (5.3) was developed by AWI to manage the wrong bottom depth values.

The last check that applied to the data (both eutrophication and contaminant data collections) concerns the duplicates. Two different types of duplicates were found in the Mediterranean: a) exact duplicates that were deleted and b) false duplicates that are not deleted because they concern repeat casts, different parameters and/or values in the same station.

Key issues

There is an increase in the number of EMODnet Chemistry data for Mediterranean Sea of improved quality compared to the previous phase of the project. About 50% of the partners corrected their data based on the feedback loop between the partners and the regional leader of the Mediterranean.

During this QC round, the identified errors reported in detail by the regional leader to the partners in order to correct their data sets at their local systems. At the regional online meeting on June 2020 these errors and key issues such as the necessity of correct metadata for correct data harmonization and validation were highlighted to partners. Together with the new project guidelines (updated guidelines (https://www.emodnet-chemistry.eu/doi/documents/Updated-Guidelines-CDI_EMODnetChemistry4_10072020.pdf and https://www.emodnet-chemistry.eu/doi/documents/EMODnetChemistry_Guidelines-ODV_Production_rs_mf.pdf) it is expected that the overall quality of the Mediterranean data will be improved.

The updated ODV tool with additional functionalities such as the spikes tests or the bottom depth updating facilitates considerably the automatic QC checks.

Parameters (P35?)	Profile corrected measurements	QF changed to				Timeseries corrected measurements	QF changed to			
		1	3	4	6		1	3	4	6
DO	1153332	205744	308827	638761	0	2171	1600	2	569	0
DO saturation	1309	1145	163	1	0	1012	0	1012	0	0
NO2	22391	6218	8778	275	7120	1571	1289	217	51	14
NO3	23716	7300	7145	4064	5207	2137	1328	778	25	6
NO2+NO3	2400	1992	13	0	395	244	0	142	1	101
NH4	4535	2141	7	132	2255	1324	1240	20	48	16
PO4	13066	7226	1	84	5755	1363	1264	0	0	99
SiO2	7672	6535	0	0	1137	1938	1262	403	2	271
CHL-a	1162740	600901	320	143731	417788	232	0	0	36	196
CHL-b	429	220	0	0	209	-				
Phaeopigments	2345	2252	0	0	93	-				
Dissolved Inorganic Carbon	314	202	1	111	0	-				
Total Nitrogen	1565	1565	0	0	0	343	204	139	0	0
Total Phosphorus	1048	1033	0	0	15	501	204	210	87	0
pH	51755	50282	1464	9	0	1582	1564	9	9	0
Total Alkalinity	617	616	1	0	0	450	450	0	0	0
Total:	**2449234**	**895372**	**326720**	**787168**	**439974**	**14868**	**10405**	**2932**	**828**	**703**

Table 14: Total number of corrected measurements and changes per flag in the QCed aggregated Eutrophication & Ocean acidification data collections for the Mediterranean Sea.

Parameters	Total Profile measurements	Total Timeseries measurements	Good (QF=1, 2, 5, 6, 8, Q)		Bad (QF=3,4)	
			Profiles	Timeseries	Profiles	Timeseries
DO	10,960,712	593,877	87.86	90.40	12.11	9.60
DO saturation	698,607	77,811	10.07	87.50	17.33	12.50
NO2	138,735	36,572	91.94	95.84	8.04	4.16
NO3	158,699	36,621	90.29	95.34	9.71	4.66
NO2+NO3	45,434	14,673	98.88	96.80	1.12	3.20
NH4	68,633	53,321	98.38	98.18	1.61	1.82
PO4	192,463	55,589	98.21	97.00	1.68	3.00
SiO2	173,469	45,775	99.01	100.00	0.97	0.00
CHL-a	5,417,983	332,251	83.73	79.94	16.27	20.06
Phaeopigments	5,045	-	99.86	-	0.14	-
Dissolved Inorganic Carbon	2,027	-	89.84	-	10.16	-
Total Nitrogen	9,982	8,653	90.12	98.39	9.88	1.61
Total Phosphorus	12,317	33,403	95.75	99.37	4.25	0.63
pH	528,790	386,116	78.88	94.88	21.12	5.12
Total Alkalinity	7,349	7,864	97.93	100.00	2.07	0.00
Aggregated DIN	74,210	39,952	91.88	95.44	8.11	4.56
Average			**87.66**	**94.93**	**7.79**	**5.07**

Table 15: Total number of observations and percentage of "Good" and "Bad" flagged data in the QCed aggregated Eutrophication & Ocean acidification data collections for the Mediterranean Sea.

Generating harmonised, aggregated and validated data collections in the Black Sea - NIMRD

In the first year, contribution of NIMRD to the WP3 for the Black Sea activities was focused on aggregation, quality control and validation of data concerning eutrophication and ocean acidification and on harmonization, quality control and validation of data concerning contaminants.

Eutrophication and ocean acidification data collection

In February 2019 NIMRD, the Regional Leader for the Black Sea, received the harvested data related to eutrophication and acidity as ODV collection, The import and aggregation of the data was done by AWI.

The MSFD Black Sea area (Black Sea and Sea of Azov) ODV collection contained 81992 vertical profiles and 11 time_series. The data originated from 25 CDI-partners from 41 data originators. Out of a total number of the CDIs, 84% were unrestricted while 16% were restricted. The spatial distribution and the data density of the aggregated data sets are shown in **Figure 9** and Temporal distributions of data are shown in **Figure 10**.

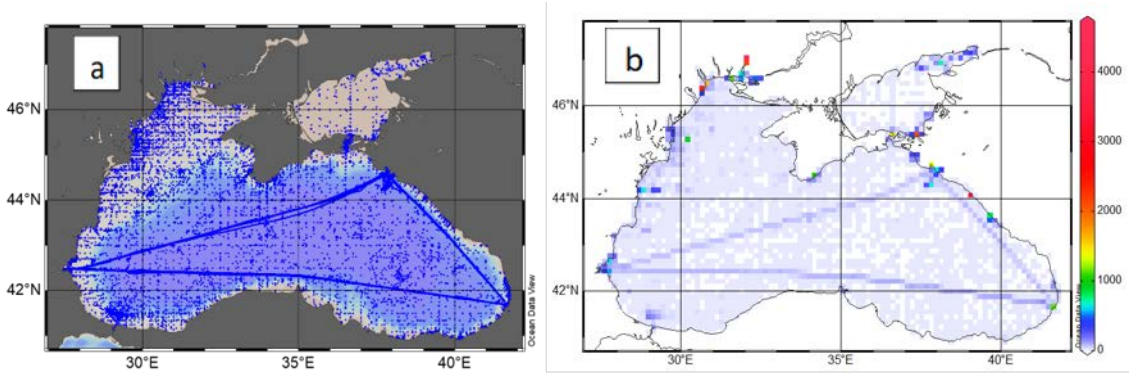


Figure 9. Eutrophication and acidity data collection for the Black Sea):
(a) Data distribution map; (b) Data density map.

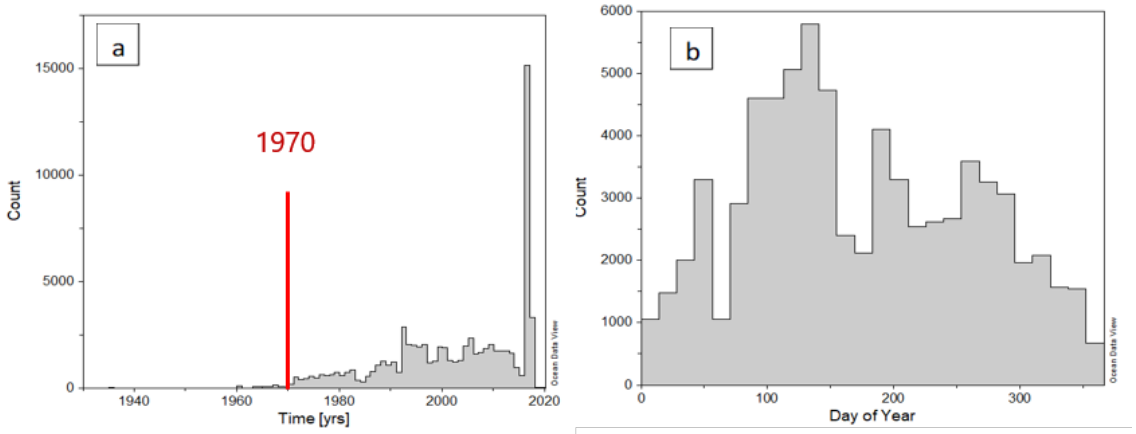


Figure 10. Annual (a) and seasonal (b) data distribution in the Black Sea

The spatial distribution and density maps (Figure 9 a, b) show a good data coverage in the Black Sea basin while in Azov Sea data are sparse. The measurement stations are concentrated along the coastal areas, in special in North-Weastern part of Black sea and in Bosforus and Kerch straits areas.

The temporal distribution of stations (Figure 10 a) shows that the most of the data were obtained between 1970 – 2017 (with only few data in 2018). The very high number of data for the years 2016-2017 is due to ferry-box data (Dissolved Oxygen and Chlorophyll) with high temporal resolution. Most of the observations were performed during spring - summer months (Figure 10 b).

Quality control

As initial steps in QC, the vertical profiles with no data, with only Temperature and Salinity, on land or duplicates were deleted from the collection. Also, French NRT Argo floats/profiles were deleted as they are considered as "wrong" profiles (profiles in Near Real Time (NRT) not adjusted and/or not validated). Then the following checks were applied:

- For sampling depths > Bot. depth change the QF of Depth [m] to QF=3
- Change the Bot. Depth = -9999 (or similar) to null value
- Change the Bot. Depth > maximum Black Sea depth to null value
- Identify Bot. Depth = 0 (no action, only included in reports to data providers)

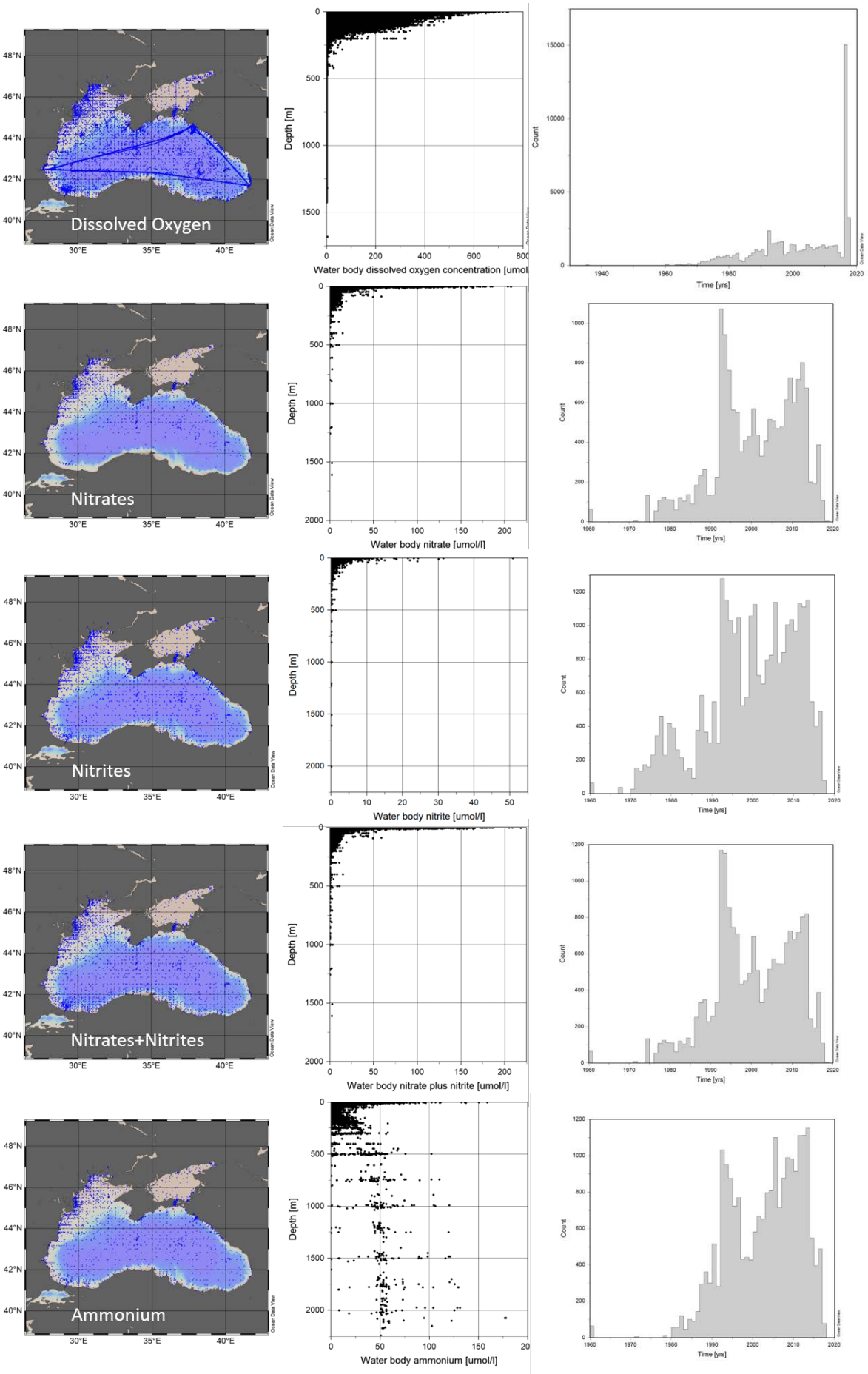
For values equal to 0 their flags were changed from QF=0 or QF=1 to QF=6, except for zero values from EDMO 681, where the quality flag was set to QF=0 (partner couldn't confirm whether values equal to 0 are values below detection or represent missing data (old, historical data, unknown method). For values out of range and spikes and negative values QC flags were changed to 3 or 4. High values (out of range) in the coastal areas or in front of river mouths are known to be high and therefore not flagged as bad. The cases where PO4>TP and N02>N03 where identified and flag accordingly.

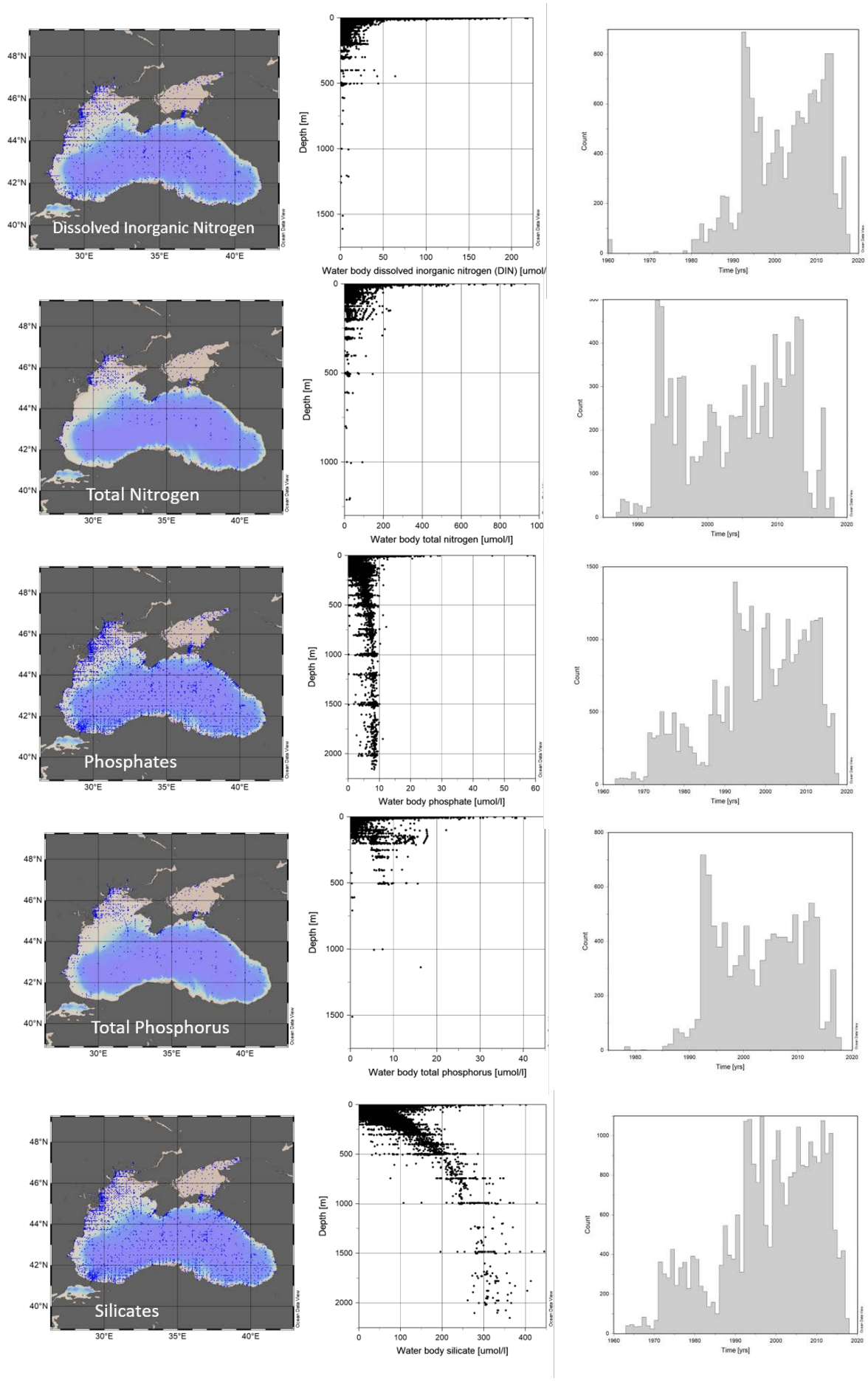
When not present in original data, Water body nitrate plus nitrite was calculated by summing up the Nitrates and Nitrites. Same procedure was applied for Water body dissolved inorganic nitrogen (DIN) which was calculated by summing up the Nitrates, Nitrites and Ammonium. In case all NO2 and NO3 and NH4 were present, cases where (NO2+NO3+NH4)>TN were identified and flag accordingly.

The quality controlled Black Sea aggregated data set for eutrophication and ocean acidification contains a total of 74030 vertical profiles with an average of 1 % No Quality Controlled data (QF=0), 94% "Good" flagged data (QF=1, 2, 5, 6, 8) and an average of 5% "Bad" flagged data (QF=3, 4). In **Table 16** are presented the number of total number of vertical profiles (VP), total number of values and total numbers of Good/Bad flagged data per parameters. The spatial, vertical and temporal distributions per parameter of the quality controlled eutrophication profile data are illustrated in **Figure 11**.

Table 16: Number of vertical profiles and number and percentage of "No QC", "Good" and "Bad" flagged data in the Black Sea data collection

Parameter	No. of VP	Total no. of values	QF=0	%	Good	%	Bad	%
Water body dissolved oxygen concentration [umol/l]	61990	354205	1810	0.51	315737	89.14	36658	10.35
Water body dissolved oxygen saturation [%]	11191	58331	0	0.00	58325	99.99	6	0.01
Water body nitrate [umol/l]	16226	49332	904	1.83	45969	93.18	2459	4.98
Water body nitrate plus nitrite_original [umol/l]	2415	19558	0	0.00	19210	98.22	348	1.78
Water body nitrite [umol/l]	28496	77860	3292	4.23	71971	92.44	2597	3.34
Water body ammonium [umol/l]	22044	54751	935	1.71	53603	97.90	213	0.39
Water body nitrate plus nitrite [umol/l]	18437	67974	1335	1.96	63815	93.88	2824	4.15
Water body dissolved inorganic nitrogen [umol/l]	14803	42630	320	0.75	40365	94.69	1945	4.56
Water body total nitrogen [umol/l]	10131	22690	0	0.00	22104	97.42	586	2.58
Water body phosphate [umol/l]	31481	106504	2613	2.45	102305	96.06	1586	1.49
Water body total phosphorus [umol/l]	10252	23771	12	0.05	22423	94.33	1336	5.62
Water body silicate [umol/l]	27747	85862	190	0.22	85380	99.44	292	0.34
Water body chlorophyll-a [mg/m^3]	20579	26605	0	0.00	24859	93.44	1746	6.56
Water body pH [pH units]	33017	111220	0	0.00	110620	99.46	600	0.54
Water body total alkalinity [mEquiv/l]	12232	29880	0	0.00	27881	93.31	1999	6.69
				1%		94%		5%


Dissolved Oxygen
Water body dissolved oxygen concentration [umol
Depth [m]
Count
Time [yrs]
Nitrates
Water body nitrate [umol/l]
Nitrites
Water body nitrite [umol/l]
Nitrates+Nitrites
Water body nitrate plus nitrite [umol/l]
Ammonium
Water body ammonium [umol/l]


Dissolved Inorganic Nitrogen
Water body dissolved inorganic nitrogen (DIN) [umol/
Total Nitrogen
Water body total nitrogen [umol/l]
Phosphates
Water body phosphate [umol/l]
Total Phosphorus
Water body total phosphorus [umol/l]
Silicates
Water body silicate [umol/l]
Depth [m]
Count
Time [yrs]

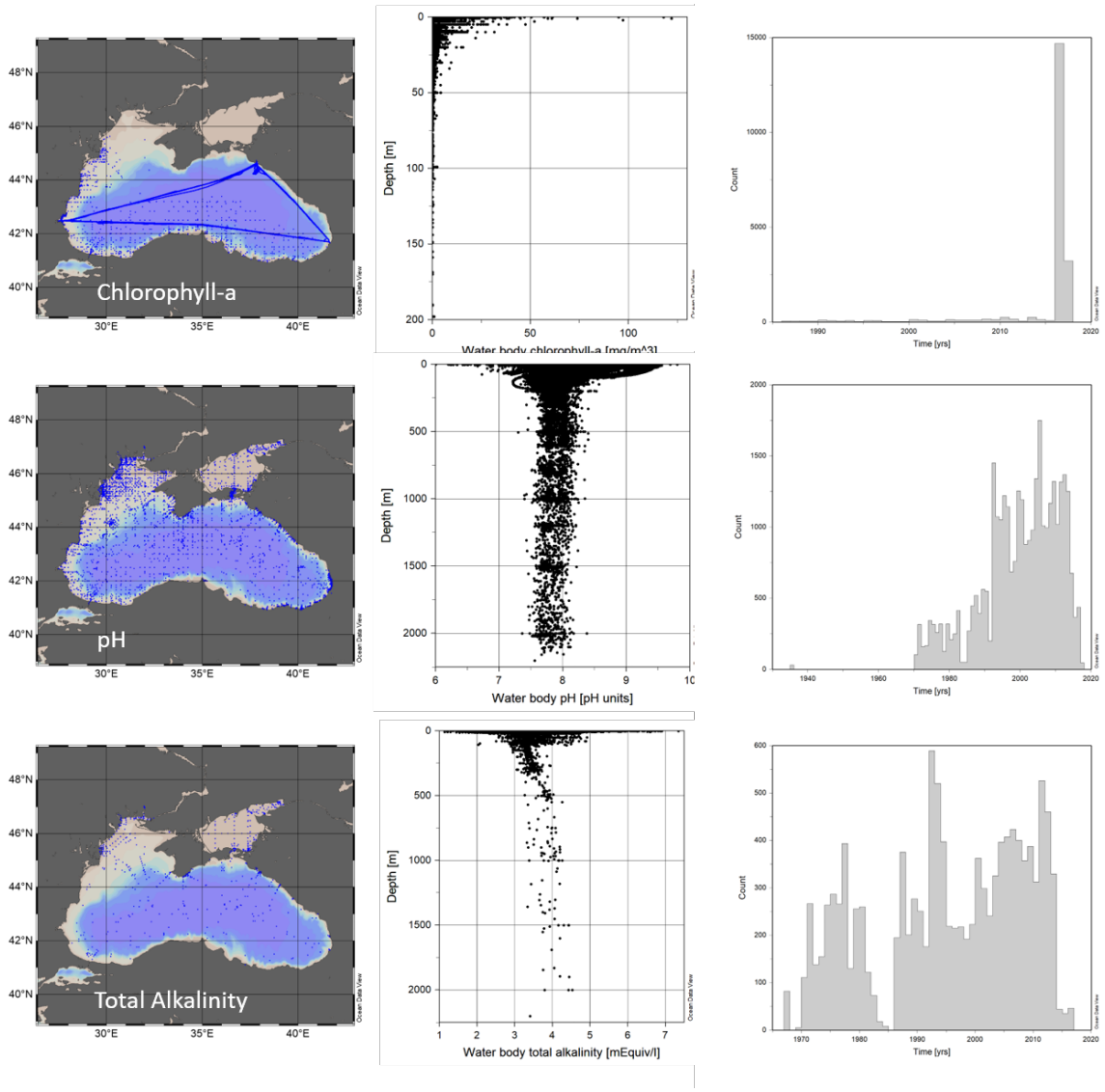


Figure 11. Spatial, vertical and temporal distributions per parameter of the Black Sea quality controlled eutrophication and ocean acidification profile data

Contaminants data collection

The Black Sea MSFD area (Black Sea, Sea of Azov and Sea of Marmara) Contaminants collection in water, sediment and biota, as received by the regional leader for Black Sea (NIMRD) from MARIS in May 2020, contains 34726 files in ODV Spreadsheet format (originated from 13 CDI-Partners distributed over 20 data originators). About 64% of data were unrestricted while about 36% were restricted.

Quality Control

Importing these files in ODV software resulted in 3 collections related to the three matrices: vertical profiles in water, sediment and biota and 12 time series in water (but with very few data).

The QC was done mainly on the data formats (as mismatches between semantic header and header; wrong primary variable (ADEPZZ01 instead of COREDIST for sediment data); mixed water data with sediment data; wrong units for primary variable; wrong P01 and /or P06 codes, mismatches between P02 in metadata and P01/P06 in data, stations with multiple Depth = Bot.Depth or Depth = 0 in sediment profiles, etc).
After the corrections were done, from 34726 files, 34583 were successfully imported and harmonized in ODV, the remaining of 143 being empty files, duplicates or containing both water and sediment parameters. In the latter case new ODV files and CDIs had to be created by the data centres in order to separate P01 codes.
In all harmonized collections:

- All QF=0 (including for depth) changed to QF=1 and then
- For values equal to 0 and QF ≠6 change their flags to QF=6.
- Check for negative values (except for T) >> none found

Because the high number of harmonized P01 codes and the variability of spatial coverage (coastal and open sea waters) the broad range checks on each P01 was not possible.
Initially, before harmonization (contaminants and not contaminants), as well as the harmonized number of P01 codes in each matrix is shown in **Table 17** and the distribution of data over the three matrices and contaminants related Parameter groups is summarized in **Table 18.** The spatial and temporal coverage of harmonized contaminants collection per matrix are represented in **Figure 12.**

Table 17: Total number of P01 codes in Contaminants collections in the Black Sea

Matrix	Total no. of vertical profiles after harmonization	Total no. of P01 codes before harmonization	Total no. of P01 codes after harmonization	Contaminants non-harmonized P01 codes
Water	30370	421	160	6
Sediment	3910	230	130	4
Biota	303	38	38	0
TOTAL	**34583**	**689**	**328**	**10**

Table 18: Total number of stations (CDIs) for contaminants after harmonization in the Black Sea

Parameter group	Water	Sediment	Biota
Total no. of Antifoulants stations	80	no data	no data
Total no. of Hydrocarbons stations	26173	1367	no data
Total no. of Heavy Metals stations	3353	2291	145
Total no. of PCBs stations	971	671	148
Total no. of Pesticides stations	14208	1458	11
Total no. of Radionuclides CDIs	471	64	no data

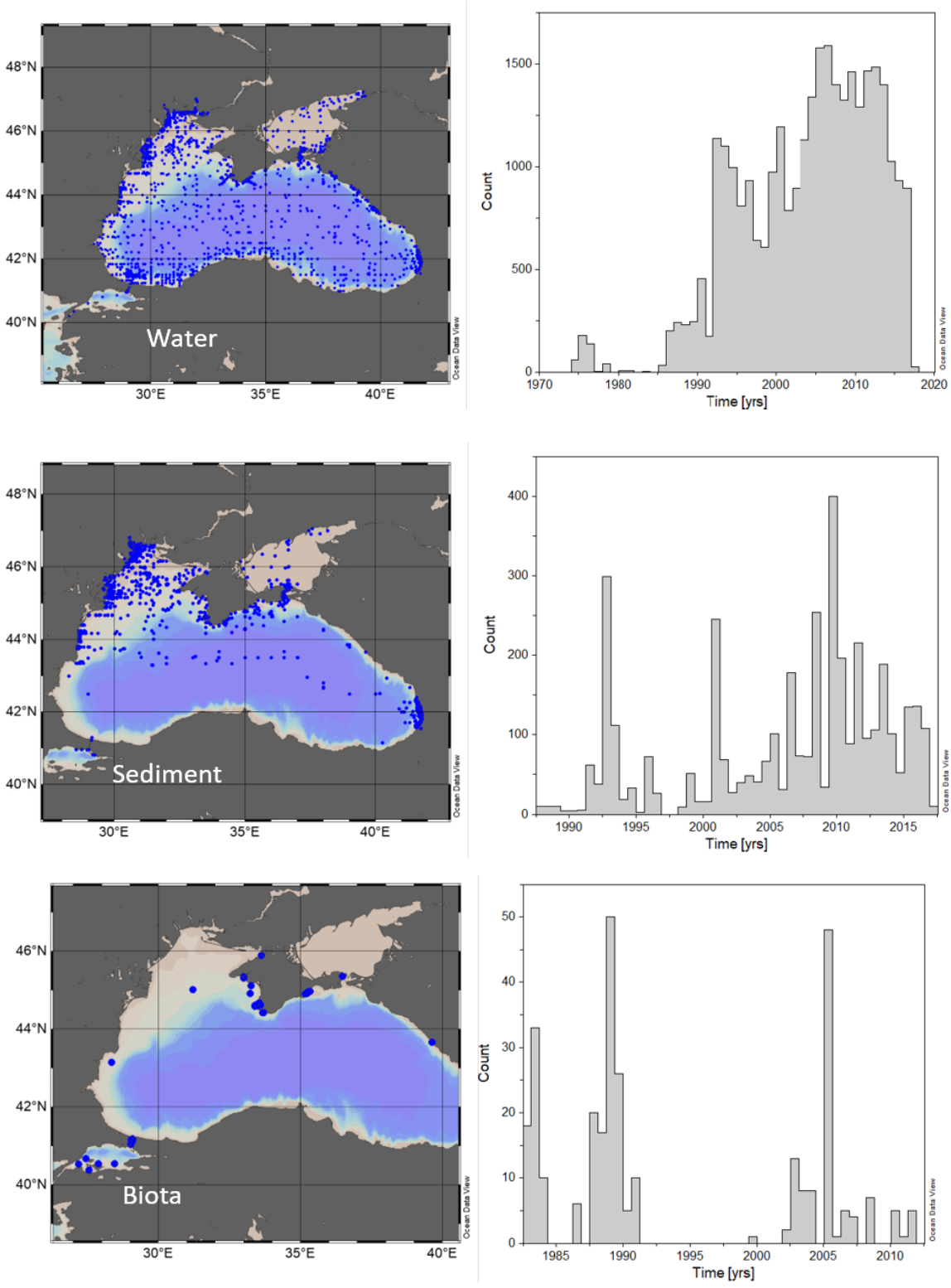


Figure 12: Spatial and temporal data coverage of Black Sea harmonized and quality controlled contaminants vertical profiles data

Key issues

For both collections work has been spent finding and flagging bad and questionable values, but in general the quality of the data has been fairly good. The main issues, and the most time consuming work, has been to handle format errors in the ODV files. Most of these errors have been obvious and actions have been taken to correct them.

All the issues were reported separately to each EDMO for corrections at local servers.

The feedback loop between the Black Sea Regional Leader and the partners during the EMODNET Chemistry Phase III was a very useful and productive activity which improved the quality of the regional pool. Nevertheless, not all the CDIs / ODVs Files were not correctly updated or not updated at all.

As a general comment regarding Eutrophication data collection, oxygen, phosphates and silicate have better spatial coverage than the other parameters, while Chlorophyll-a is not present in Azov Sea (Figure 11).

Black Sea harmonized Contaminants collection includes about 330 harmonized P01 codes (Table 17) with a non-uniform distribution over the years and the spatial coverage not uniform between the three matrices: water data are present over the entire basin while sediment and biota data are mostly located on coastal areas (Figure 12).

12. List of abbreviations and acronyms

CDI, Common Data Index, provides a highly detailed description of the data, answering to the questions: where, when, how and who collected the data, and how to get them. One CDI describes a data series which can be a vertical profile on a fixed location, a time series or a trajectory data set.

CMEMS, the Copernicus Marine Environment Monitoring Service (led by Mercator-Océan).

DeFishGear, Derelict Fishing Gear Management System in the Adiatic Region is the 3-year long project implemented within the framework of the IPA Adriatic Cross-border Cooperation Programme, co-funded by the European Union.

DIN is Dissolved Inorganic Nitrogen.

DIP is Dissolved Inorganic Phosphorus.

DIVA, Data-Interpolating Variational Analysis, is a software tool that allows to spatially interpolate (or analyse) observations on a regular grid in an optimal way.

EDMO is the European Directory fo Marine Environmental Data.

EQS, Environmental Quality Standards.

EQSD, Environmental Quality Standards Directive (Legislative instrument).

GES is Good Environmental Status.

HELCOM Convention = Baltic Marine Environment Protection Commission is the governing body of the Convention on the Protection of the Marine Environment of the Baltic Sea Area, known as the Helsinki Convention.

INSTAC is the In Situ Thematic Assembling Centre of CMEMS in charge of in-situ data delivery.

LOD, Limit Of Detection, means the output signal or concentration value above which it can be affirmed, with a stated level of confidence that a sample is different from a blank sample containing no determinand of interest.

LOQ, Limit Of Quantification, means a stated multiple of the limit of detection at a concentration of the determinand that can reasonably be determined with an acceptable level of accuracy and precision. The limit of quantification can be calculated using an appropriate standard or sample, and may be obtained from the lowest calibration point on the calibration curve, excluding the blank.

MEDITS is the International bottom trawl survey programme in the Mediterranean.

MSFD is the Marine Strategy Framework Directive.

NODC, National Oceanographic Data Centre defined within the International Oceanographic Data Exchange (IODE) System of the UNESCO Intergovernmental Oceanographic Commission (IOC).

Ocean Browser is the EMODnet Chemistry data products viewing and downloading service that allows users to visualize gridded fields on-line. It is based on open standards from the Open Geospatial Consortium (OGC), in particular Web Map Service (WMS) and Web Feature Service (WFS).

ODV, Ocean Data View, is a freely available software package that provides interactive exploration, analysis and visualization of oceanographic and other geo-referenced profiles or sequence data. ODV and NetCDF data file formats are used as mandatory data exchange formats in SeaDataNet/EMODnet Chemistry.

OSPAR Convention is the Convention for the Protection of the Marine Environment of the North-East Atlantic.

P01 = British Oceanographic Data Centre (BODC) Parameter Usage Vocabulary, is one of SeaDataNet Common Vocabularies based upon a semantic model that is the simple concatenation of three 'themes' (what, where/matrix and how/methods) and used to describe individual measured phenomena in ODV data transport format. P01 are narrower terms of P02. At present P01 already contains more than 30.000 concepts.

P02 = SeaDataNet Parameter Discovery Vocabulary, is one of SeaDataNet Common Vocabularies describing fine-grained related groups of measurement phenomena designed to be used in dataset discovery interfaces (namely CDI metadata records).

P35 = EMODnet chemistry lot aggregated parameter names, is one of SeaDataNet Common Vocabularies used to facilitate data aggregation and data labelling (as in products description).

QA/QC = Quality Assurance/Quality Control.

RL = EMODnet Chemistry Regional Leaders as identified in the Technical Proposal (WP3.1).

Robot Harvester is the system used for discovery and gather data from SDN infrastructure of distributed NODCs via the CDI Discovery and Shopping mechanism with an almost full automatic method. It is configured to harvest data on selected sea areas (or MSFD regions) and for specific chemical parameters.

RSC are Regional Sea Conventions.

SC = Steering Committee.

SDN, SeaDataNet is the pan-European infrastructure for ocean & marine data management sponsored within FP7 (grant agreement 283607, 1/10/2011-30/9/2015) linking more than 100 national oceanographic data centres and marine data centres from 35 countries riparian to all European seas.

Sextant products metadata catalogue is the EMODnet Chemistry data products discovery service used for searching Chemistry data products and linking to the viewing service.

TG DATA is the MSFD Common Implementation Strategy Technical Group on Marine Data.

TG ML is the MSFD Common Implementation Strategy Technical Group on Marine Litter.

TN is Total Nitrogen.

TP is Total Phosphorus.

TOC is Total Organic Carbon.

UNEP/MAP is the United Nations Environment Programme, Mediterranean Action Plan for the Barcelona Convention adopted by 16 Mediterranean countries and the European Community.

VRE, Virtual Research Environment.

WPS, Web Processing Services.