Black Sea Checkpoint
Literature Survey

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Author(s):	Nadia Pinardi	CMCC
	Vladislav Lyubartsev	CMCC
	Giuseppe Manzella	CMCC
	Frederique Blanc	CLS
	Atanas Palasov	IO-BAS
	Violeta Slabakova	IO-BAS
	All partners	

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Glossary

2AR	Second Report on the Adequacy of the Global Climate Observing System for Climate
ADCP	Acoustic Doppler current profiler
AG FOMLR	Advisory Group on Environmental Aspects of Management of Fisheries and Other Marine Living Resources
AREG	Adriatic Sea regional model
ASAR	Advanced Synthetic Aperture Radar
ASCII	American Standard Code for Information Interchange
AQUASTAT	FAO's global information system on water and agriculture
ARGO	The broad-scale global array of temperature/salinity profiling floats
BGODC	Bulgarian National Oceanographic Data Centre
BfG	German Federal Institute of Hydrology (Bundesanstalt für Gewässerkunde), Germany
BODC	British Oceanographic Data Centre
BSC	Black Sea Commission
BSERP	Black Sea Ecosystem Recovery Project
BSIS	Black Sea Information System
CAF	Committee of Administration and Finance
CARLIT	Cartography of littoral rocky-shore communities
CAQ	Committee on Aquaculture
CDI	Common Data Index
CDOM	Colored dissolved organic matter
CDS	Catalogue of Data Sources
CFP	Common Fisheries Policy
CFRI	Central Fisheries Research Institute, Trabzon, Turkey
CH	Challenge – Check point application area
Characteristic	Distinguishing feature[1]
CI	Citation
Class	Description of a set of objects that share the same attributes, operations, methods, relationships, and semantics [UML Semantics] NOTE: A class does not always have an associated geometry (e.g. the metadata class).
CLS	Collecte Localisation Satellites (FR)
CLU	CLU s.r.l. (IT)
CMEMS	Copernicus Marine Environment Monitoring Service
CMS	Content management System
CoC	Compliance Committee
Copernicus	European Programme for the establishment of a European capacity for Earth Observation
Coverage:	a feature that has multiple values for each attribute type, where each direct position within the geometric representation of the feature has a single value for each attribute type[2]. Coverage is an abstraction of continuous real world phenomena[3].
COST	Cooperation in Science and Technology
CSR	Cruise Summary Report
CSW	Catalogue Service for Web
CTD	Conductivity, Temperature, Depth
DAC	Data Assembly Center

[1] ISO 9000:2005 Quality management systems. Fundamentals and vocabulary
[2] Quality/FDIS 19123 2005 Geographic information – Schema for coverage geometry and functions
[3] S. Nativi, J.Caron, B.Domenico and L.Bigagli, 2008. Unidata's Common Data model mapping to the ISO 19123 Data Model, Earth Sc. Informatics, Vomule 1,Issue 2, pp 59–78

DAR	Data Adequacy Report
Data	Re-interpretable representation of information in a formalized manner suitable for communication, interpretation, or processing[4]
DCF	Data Collection Framework
DCR	Data Collection Regulation
DCRF	Data Collection Reference Framework
DG-MARE	Directorate-General for Maritime Affairs and Fisheries
DEM	Digital Elevation models
DO	Dissolved oxygen
DPS	Data Product Specification[5]
DQ	Data quality
DTM	Digital Terrain Model
EAFM	Ecosystem-based approach to fisheries management
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecast
ECVs	Essential Climate Variables
EDIOS	European Directory of Oceanographic Observing Systems
EDMED	European Directory of Marine Environmental Data
EDMERP	European Directory of Marine Environmental Research Projects
EDMO	European Directory of Marine Organisations
EEA	European Environmental Agency
EEC	European Economic Community
EEZs	Exclusive Economic Zones
EIONet	European Environment Information and Observation Network
EMBRC	European Marine Biological Resource Centre
EMODnet	European Marine Observation and Data Network
EMSA	European Maritime Safety Agency
EMSO	European Multidisciplinary Seafloor and water-column Observatory
ERIC	European Research Infrastructure Consortium
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
ETC	European Topic Centre
EU	European Union
EUMETNET	European National Meteorological Services
EUNIS	European Nature Information System
EUROGOOS	European Global Ocean Observing System
FAO	Food and Agriculture Organization
Feature	Abstraction of real world phenomena. Discrete world phenomena are conceived as (discrete) features while continuous phenomena are conceived as features that "acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal domain (e.g., grids or images) named coverages[2]
Feature's attribute	Characteristic of a feature
FixO3	Fixed point Open Ocean Observatory network
Fondazione CMCC	Foundation Euro-Mediterranean Center for Climate Change (IT)
GEBCO	General Bathymetric Chart of the Oceans
GEMET	General Multilingual Environmental Thesaurus[6]
GEMS	Global Environment Monitoring System
GES	Good Environmental Status
GEO	Group on Earth Observation
Geoportal	Type of web portal used to find and access geographical information
GEOSS	Global Earth Observation System of Systems

[4] ISO/IEC 2382-1:1993 Information technology – Vocabulary – Part 1: Fundamental terms
[5] ISO 19131:2007/Amd 1:2011 Requirements relating to the inclusion of an application schema and feature catalogue and the treatment of coverages in an application schema
[6] Marine Metadata Interoperability Project - GEMET - GEneral Multilingual Environmental Thesaurus http://marinemetadata.org/references/gemet

GeoTIFF	Public domain metadata standard
GFCM	General Fisheries Commission for the Mediterranean
GIS	Geographic information system
GMES	Global Monitoring for Environment and Security
GOOS	Global Ocean Observing System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GRDC	Global Runoff Data Centre
GTS	Greenwich Time Signal
ICZM	Integrated Coastal Zone Management
IEC	International Electrotechnical Commission
IFR	Institute of Fishing Resources, Varna, Bulgaria
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer (FR)
IHO	International Hydrographic Organization
IMO	International Maritime Organization
IMP	Integrated Maritime Policy
IMS	Middle East Technical University Institute of Marine Sciences (TR)
Information	Knowledge concerning objects, such as facts, events, things, processes, or ideas, including concepts, that within a certain context has a particular meaning[4]
INSPIRE	Infrastructure for Spatial Information in the European Community
IO-BAS	Institute of oceanology, Bulgarian Academy of Sciences (BG)
IOC	Intergovernmental Oceanographic Commission
IPCC	Intergovernmental Panel on Climate Change
IR	Infrared
ISO	International Organization for Standardization
ISO IEC	ISO International Electrotechnical Commission
ISO NP	ISO New Proposal
ISO NP TS	ISO NP Technical Specification
IT	Information Technology
IUU	Illegal, Unreported and Unregulated
JCOMM	Joint WMO-IOC Commission on Marine Meteorology
JECMAP	Joint European Coastal Mapping Programme
JRC	Joint Research Centre
KTU-MSF	Black Sea Technical University, Marine Science Faculty, Trabzon, Turkey
LAT	Lowest Astronomical Tide
LE	Lineage extended
LI	Lineage
LWN	Normalized water leaving radiance
LiDAR	3D laser scanning
MARBOUND	Maritime Boundaries Geodatabase
MD	Metadata
MedSea	Mediterranean Sea
MERCATOR	French center for analysis and forecasting of the global ocean
MPA	Marine protected areas
MRE	Marine renewable energy
MS	Member States
MSFD	Marine Strategy Framework Directive
MSP	Maritime Spatial Planning
MSSD	Mediterranean Strategy for Sustainable Development
MyOcean	Series of projects granted by the European Commission within the GMES Program (Seventh Framework Program)
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NEBS	North-Eastern Black Sea
NetCDF	Network Common Data Form

NeXOS	Next Generation Web-Enabled Sensors for the Monitoring of a Changing Ocean
NGO	Non-governmental organization
NIC	National Ice Center
NOAA	National Oceanic and Atmospheric Administration
NRT	Near Real Time
NKUA	National and Kapodistrian University of Athens (GR)
NIMRD	National Institute for Marine Research and Development "Grigore Antipa"(RO)
NWBS	North-Western Black Sea
Object	Entity with a well-defined boundary and identity that encapsulates state and behaviour [UML Semantics]. NOTE: An object is an instance of a class
ODV	Ocean Data View
OGC	Open Geospatial Consortium
ORION	Joint research and development centre (CY)
OSSE	Observing System Simulation Experiments
OSE	Observing System Experiment
OWF	Offshore Wind Farms
pH	Logarithmic measure of hydrogen ion concentration
P01	BODC Parameter Usage Vocabulary
P02	SeaDataNet Parameter Discovery Vocabulary
P03	SeaDataNet Agreed Parameter Groups
Package	Grouping of a set of classes, relationships, and even other packages with a view to organizing the model into more abstract structures
PNG	Portable network graphics
POMOS	Port Operational Marine Observing System
PR	Pre-eutrophication
PS	Post-eutrophication
PSMSL	Permanent Service for Mean Sea Level
PSU	Practical Salinity Units
QC	Quality Control
QE	Data quality extended
Quality	Degree to which a set of inherent characteristics fulfils requirements[1]
Requirement	Need or expectation that is stated, generally implied or obligatory[1]
RES	Renewable Energy Systems Limited (UK)
RFMO	Regional fisheries management organization
RivDIS	Global River Discharge data set
ROOS	Regional operational system
ROV	Remotely operated underwater vehicle
SAC	Scientific Advisory Committee
SAGE	Systems Approach to Geomorphic Engineering
SAR	Synthetic aperture radar
S-AWS	Ship-borne Automated Weather Stations
SCMR	SC Marine Research SRL (RO)
SeaDataNet/SDN	Pan-European infrastructure to ease the access to marine data measured by the countries bordering the European seas
SeaVoX	Combined SeaDataNet and MarineXML Vocabulary Content Governance Group
SID	Source identifier
SIO-RAS	P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences (RU)
Specification scope	Part of the data content of a product sharing the same specifications
SPLASHCOS	Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf
SRTM	Shuttle Radar Topography Mission
SST	Sea Surface Temperature

SPOT	Commercial high-resolution optical imaging Earth observation satellite system operating from space
STAG	Scientific and technical advisory group
STECF	Technical and Economic Committee for Fisheries
SWH	Significant wave heights
TSU	Ivane Javakhishvili Tbilisi State University (GE)
TAC	Total Allowable Catch
UkrSCES	Ukrainian Scientific Centre of Ecology of the Sea (UA)
UPL	Plymouth University (UK)
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
URL	Uniform Resource Locator
USE CASE	Exemplary literature case related to Challenge Targeted products
USOF	University of Sofia (BG)
UV	Ultraviolet
WISE	Water Information System for Europe
WBS	Western Black Sea
WFD	Water Framework Directive
WGBS	Working Group for the Black Sea
WMO	World Meteorological Organisation
VLIZ	Vlaams Instituut voor de Zee, Belgium
VMS	Vessel Monitoring System
VOS	Voluntary Observing Ships
XML	eXtensible Markup Language
YugNIRO	Southern Research Institute of Sea Fisheries and Oceanography, Kerch (RU)

Executive Summary

The basic aim of the EMODnet Checkpoints is to assess how well the available marine monitoring data in the Black Sea meet the needs of institutional stakeholders and policy makers as well as inform the data providers of the adequacy of their data supply chain. The EMODnet Checkpoint approach consists of assessing the basin-scale monitoring data sets on the basis of the quality of Targeted products done for Challenges defined in the DGMARE Tender, that are: CH1- Windfarm Siting, CH2- Marine Protected Areas, CH3- Oil Platform Leak, CH4- Climate, CH5-Coasts, CH6- Fishery Management, CH7- Fishery Impacts, CH8- Eutrophication, CH9- River Inputs, CH10- Bathymetry, CH11- Alien species.

The Literature Survey (LS) has defined the Black Sea Checkpoint framework for "Data Adequacy" assessment, based upon the ISO and ISPIRE international standards and adapted to the Checkpoint needs. The framework consists of three main components: 1) collection of the metadata information about the input data sets required by the Challenges; 2) definition of the assessment criteria; 3) development of the "adequacy indicators". The LS builds on the vocabulary definition and the methodology developed for the Mediterranean Sea Checkpoint, now followed also by the Atlantic Checkpoint.

The basic terminology for "data" is defined in terms of "characteristics" and the environmental matrix where they are defined. The SeaDataNet common vocabulary is used to provide discovery parameters (so-called P01,P02, P03 throughout the document, http://www.seadatanet.org/Standards-Software/Common-Vocabularies). Using the SeaDataNet standardised sets of terms solves the problem of ambiguities associated with data markup and also enables records to be interpreted by computers. The characteristics are related to air, ice, fresh waters, marine waters, biota/biology, seabed/riverbed monitoring environmental matrices and human activities.

A first list of characteristics needed by the EMODnet Black Sea Challenges has been produced with an overall analysis of the most requested input data sets and the potential data providers. It emerges that 48 different characteristics are needed by all Challenges and over 400 data sets are in principle available. A list of 56 data providers has been identified from International, European, EU Member State plus Russia and USA Institutions and projects.

An overall survey on the Black Sea observational capacities and monitoring systems has been discussed showing that a comprehensive overview of existing monitoring systems exists. It emerges that European Projects contributes to the development of the Black Sea large scale monitoring system while national measurement platforms have been put in place for the territorial waters in the past ten years.

In order to have a first understanding of basin scale monitoring systems adequacy, we analysed several literature Use Cases that described similar products to the Checkpoint Targeted products. The literature Use Cases were chosen on the basis of the fact that they presented and evaluated the quality and availability of the input data sets required for the Use Case.

It was found that the 24 literature Use Cases used data adequacy elements such as: 1) spatial resolution and area coverage; 2) temporal resolution and extent. There is actually only one Use Case that refers to accuracy of the input data set and it is for

the river runoff data. For all 24 Use cases, data availability is generally high except for the accessibility. In a large number of the literature Use Cases the data are completely restricted and/or access to the input data requires specific agreements with the data owners. Thus, the answers to the questions are:

Q1. are there references in literature to goals not achieved because of inadequacy of data (appropriateness)?

A1. Yes, and the main concern is about data coverage in space and time and resolution of the input data sets.

Q2 Is inadequacy due to the reluctance of data-owners to release data, time taken to obtain data, lack of measurements, lack of accuracy or lack of precision (availability)?

A2. Generally, data availability is thought to be high, with some reservations on the accessibility and responsiveness. There is no mention of accuracy except for one Use Case.

Q3. Are there any statements made as to fitness for purpose of data.

A3. The fitness for purpose of data, which in this document we call fitness for use, is related to the previously mentioned appropriateness elements.

1. Introduction

The concept of Sea-Basin checkpoints was introduced by the Marine Knowledge 2020 Communication[7] and clarified by the first two European Sea Basin Checkpoints that started in 2013, the North Sea[8] and Mediterranean Sea Checkpoints[9] (In 2015, four more Checkpoints were added, the Arctic, the Baltic, the Atlantic and the Black Sea).

The basic aim of the Checkpoints is to assess how well the available marine monitoring data met the needs of institutional stakeholders and policy makers, as well as how it informed the data providers of the adequacy of their data supply chain (Fig.1.1).

Institutional stakeholders and policy makers are interested in developing the blue economy and in protecting the marine environment: thus, Checkpoints should develop an assessment framework that considers Use case or "Challenge"products, and evaluates the fitness for use of the monitoring data sets used to build them. The Challenge products shall be related to both "Blue Growth"[10] and the Marine Strategy Framework Directive[11] objectives and they will show how monitoring data are used to achieve innovative and useful products. The quality of the Challenge products will inform on how monitoring data set are "fit for use".

If such an assessment framework can be established, indicators should be developed following international standards (INSPIRE[12] and ISO[13]), showing the gaps and the "adequacy" or "usability" of the input data sets for the Challenges.

Checkpoints are part of a virtual loop where European Sea Basin data collection and assembly activities are evaluated on the basis of the quality of applications identified in Use Cases or Challenges. The Checkpoint assessments, so-called Data Adequacy Reports (DAR), should feedback into the data collection framework, in a circular loop as illustrated by the Fig. 1.2 schematic. In order to achieve this feedback, a "Checkpoint Service" will be developed where information will be presented about the input data sets together with "adequacy" indicators.

[7] European Commission – Maritime Affairs – from seabed mapping to ocean forecasting http://ec.europa.eu/maritimeaffairs/documentation/publications/documents/marine-knowledge-2020-green-paper_en.pdf

[8] EMODnet – North Sea http://www.emodnet.eu/northsea/home,

[9] EMODnet – Mediterranean Sea http://www.emodnet-mediterranean.eu/

[10] European Commission – Maritime Affairs – Blue Growth – Opportunities for marine and maritime sustainable growth, 2012 http://ec.europa.eu/maritimeaffairs/documentation/publications/documents/blue-growth_en.pdf

[11] European Commission – Environment – Our Oceans, Seas and Coasts – Legislation: the Marine Directive, 2012 http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm

[12] INSPIRE Thematic Working Group Coordinate Reference Systems and Geographical Grid Systems. – INSPIRE Technical Guidelines 2013/2014 http://inspire.ec.europa.eu/index.cfm/pageid/2

[13] ISO/TC 211 – Geographic information/Geomatics. http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=54904

Checkpoint activity/Audience	Institutional stakeholders/ Policy makers	Upstream data providers	Intermediate Users	End Users	General audience
General information					Main driver
Data Adequacy Reports: gap indicators	Main Driver				
Data Adequacy Reports: input data adequacy indicators		Main driver			
Checkpoint Service: GIS catalogue			Main driver		
Checkpoint Service: Targeted products				Main driver	

Fig. 1.1 Target audience analysis for different Checkpoint activities such as: General project information, Data Adequacy Reports and Checkpoint Service components

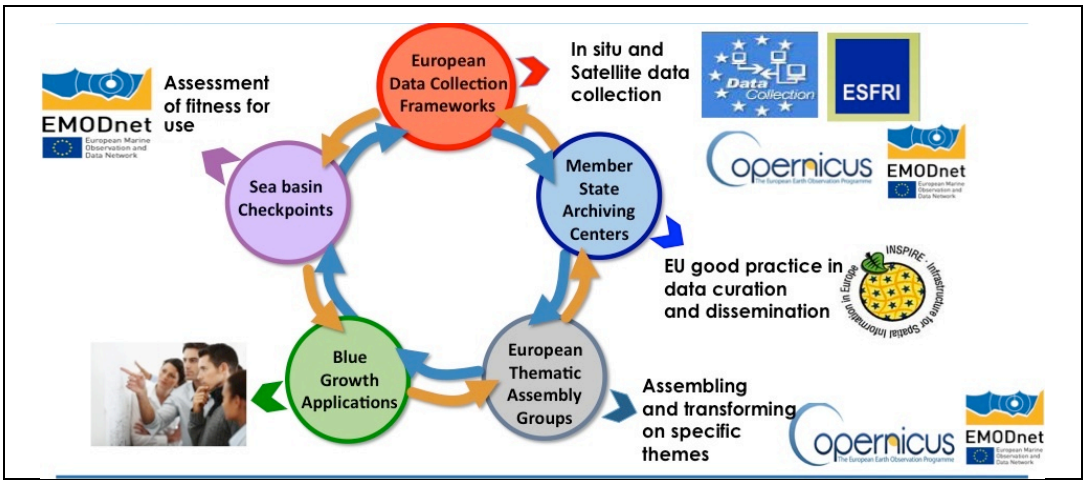

Fig. 1.2 Localization of EMODNET Sea basin Checkpoints in the EU data sharing and production framework

Checkpoint assessments or DAR will be carried out following three basic paradigms:

1) use a science based and expert advice framework that evaluates the *fitness for use* of the monitoring system based upon ISO standards[14]. By the ISO cited *fitness for use* or *usability,* is the ability of a dataset to satisfy an intention other than the one for which it was originally created;

[14] ISO 19157:2013 E Geographic information – Data quality

2) develop metadata and assessment services based on INSPIRE principles[12] that allow to provide meta-information on data and products and the assessment results;

3) Use concepts from EEA Core set of indicators[15] that should prioritize improvements in the quality and coverage of data flows, enhance comparability and certainty of information and assessments; provide a manageable and stable basis for indicator-based assessments of progress against environmental policy priorities.

The EMODnet Black Sea Checkpoint aims to the quality assessment, extracting the synergies between and identifying the gaps of, the present monitoring data sets for the entire Black Sea in view of eleven end-user applications or 'Challenges':

CH1- Windfarm Siting, CH2- Marine Protected Areas, CH3- Oil Platform Leak, CH4- Climate, CH5-Coasts, CH6- Fishery Management, CH7- Fishery Impacts, CH8- Eutrophication, CH9- River Inputs, CH10- Bathymetry, CH11- Alien species.

The specific objective of the Literature Survey is to define the input data sets for the Black Sea Checkpoint Challenges and summarize findings of previous studies of the adequacy of data in the sea basin. By "adequacy of data" we mean "usability" in the ISO nomenclature defined above and the following questions should be answered:

(1) is there an overview of data?

(2) are there references in literature to goals not achieved because of inadequacy of data (e.g. unable to estimate coastal erosion accurately)?

(3) Is inadequacy due to the reluctance of data-owners to release data, time taken to obtain data, lack of measurements, lack of accuracy or lack of precision?

(4) are there any statements made as to fitness for purpose of data– eg., for fish stock or environmental assessments, for spatial planning, for licensing, for coastal protection, for safe navigation.

We have developed the framework for the Black Sea Checkpoint starting from the experience accumulated in the Mediterranean Checkpoint, consolidating and ameliorating the methodology where it was needed. The Atlantic Checkpoint is following the same strategy so that it will be possible to intercompare the assessment results across the three basins. The other Checkpoints have alternative methodologies that hopefully will be harmonized in the second phase of the Checkpoints development.

1.2 The Checkpoint assessment methodology and the Challenges

Several activities will be carried out by the Checkpoints that can be summarized in two main streams:

1) produce Checkpoint information: development of a metadatabase, targeted products and indicators
2) produce Checkpoint results and services: Literature Survey, Data Adequacy Reports and Checkpoint Service

For the development of the metadatabase a new framework has to be set up, with an appropriate nomenclature and vocabulary for input data sets as well as targeted products, quality elements and indicators.

[15] European Environment Agency – EEA core set of indicatos — Guide, 2005. EEA Technical report No 1/2005 — ISSN 1725-2237

1.2.1 Checkpoint vocabulary and methodology

To be consistent with the Marine Strategy Framework Directive[10], the data needed by the Challenges are defined as 'characteristics' belonging to seven, environmental monitoring matrices: Air, Ice, Fresh waters, Marine waters, Biology/Biota, Seabed and Human Activities.

The SeaDataNet common vocabularies are used to classify the characteristics, associate them to the Challenges and to the environmental matrices.

A metadatabase is implemented to organise information on characteristics and challenges products in order to manage the checkpoint information:

1. "what" is available for the Challenges; this includes spatial and temporal coverage and resolution, time extent and resolution, completeness, accuracy; the ISO quality elements that provide this information will be called appropriateness;
2. "How" is it made available; this includes visibility, accessibility and performance; the ISO quality elements[13] that provide this information will be called availability.

Fitness for use is derived from "appropriateness" and "availability" quantitative and qualitative elements. Based on user requirements, ISO19157: 2013(E)[13] provides the quality elements that are useful to classify the "adequacy" of the monitoring data sets.

1.2.2 INSPIRE vs ISO quality elements

Quality indicates the state of completeness, validity, consistency, timeliness and accuracy that makes data appropriate for a specific use. INSPIRE[11] requires the following Data Quality elements:

1. Consistency - Logical, Conceptual, Domain, Temporal, Format;
2. Completeness – Commission, Omission;
3. Accuracy – Positional, Temporal, Thematic, Classification correctness;
4. Lineage;
5. Usability.

The first four quality elements might be characterized as *producer data quality elements* because they are known by the data producer, and are reffered to as the 'classical' quality indicators for the evaluation of spatial data quality. The last one is instead what the Checkpoint aims at, a quantitative estimation of the "adequacy" of the monitoring system to satisfy targeted products requirements.

These INSPIRE[11] quality elements are defined in ISO19157[13] (Figure 1.3), and will be the base for the implementation on indicators to be used to quantify and qualify the elements (e.g. performance, accessibility and usability) of monitoring data for the production of Challenge products.

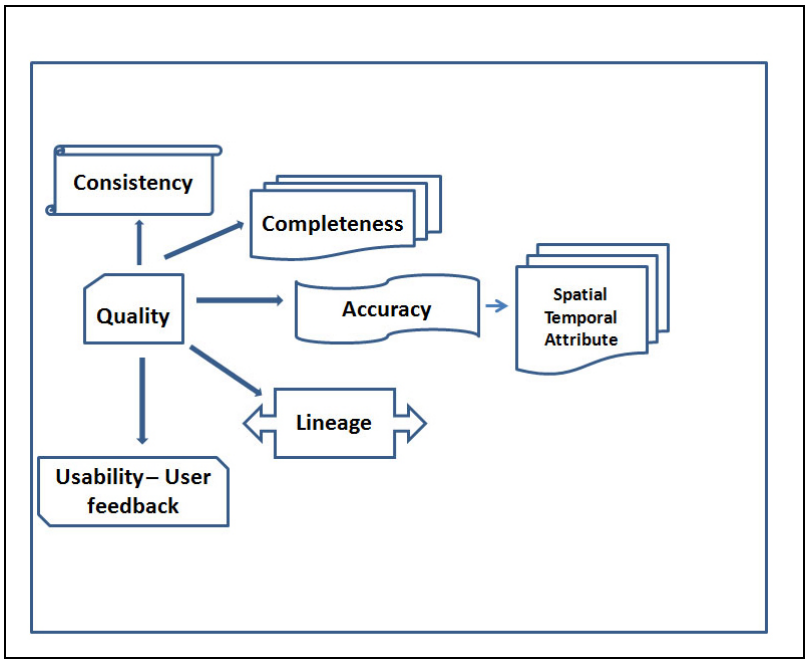

Figure 1.3 The INSPIRE quality elements derived from ISO19157

For the definition of assessment indicators the Black Sea Checkpoint adopts the ISO/IEC 15504 Information Technology - Process Assessment definition[16]: an indicator is an objective attribute of a product that supports the judgement of the performance or capability of an implemented process.

In Checkpoints, the process is the cycle represented in Figure 1.4. Products will be developed from input data sets Checkpoint, a Checkpoint catalogue and metadatabase will associate the quality elements to specific product input data sets, indicators of adequacy will be developed and the assessment produced feedbacking to the input data providers.

[16] ISO/IEC 15504 Information technology – Process assessment. 2012
http://www.iso.org/obp/ui/#iso:std:iso-iec:15504:-5:ed-2:v1:en

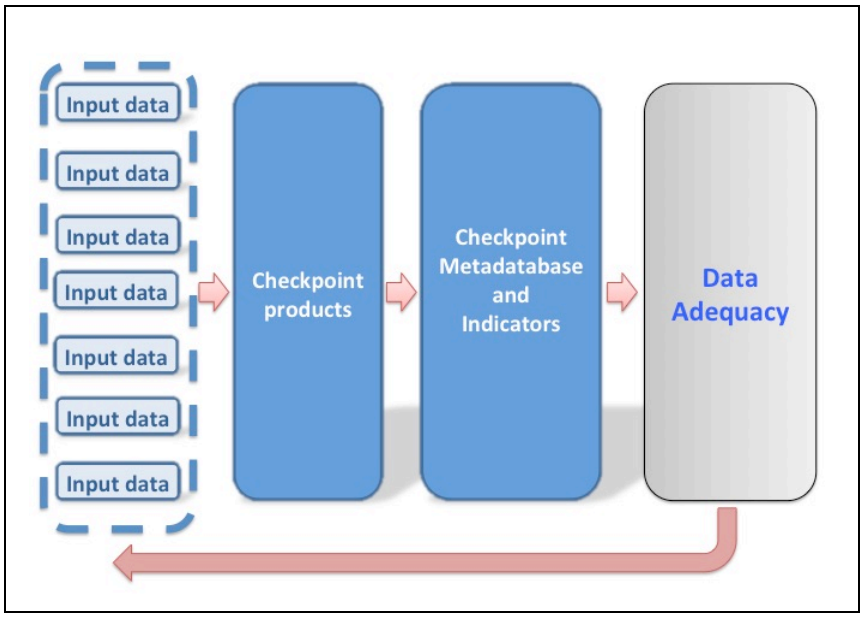

Figure 1.4 The Checkpoint process cycle

1.2.3 Challenge to Targeted products

The eleven Challenges will produce several “Targeted products” (Table 1.1), that will serve as the basis for the assessment of the input data sets adequacy. Each Challenge will have to provide the products listed in the Table in different type of formats as specified by the tender.

At the time of the Literature Survey however, Targeted products have not been produced yet. Thus, the Literature Survey will focus on equivalent Use of Case studies and make an initial assessment reviewing quality elements present in “Use Cases” available from the Literature.

Challenge	Description of Targeted products
CH1- Wind Farm siting	Determine the suitability of sites for development of a wind farm. All aspects should be considered - wind strength, seafloor geology, environmental impact, distance from grid, shipping lanes – even if one of the factors makes this a no-go scenario. The sites to be analysed are: 1. at 20 metre contour where waters of Bulgaria and Romania meet 2. at 50 metre contour at point where Turkish and Bulgarian waters meet 3. at 20 metres contour at point where Turkish and Georgian waters meet
CH2- Marine Protected Areas	Analyze the existing network of marine protected areas (national and international sites, including areas where fisheries is restricted for reasons other than protecting fish stocks), and: 1.categorize them according to the classification used by the International Union for Conservation of Nature; 2. determine whether the network constitute a representative and coherent network as described in article 13 in the Marine Strategy Framework Directive; 3. determine how they are likely to be affected by climate change.
CH3- Oil Platform Leak	The contractor will be informed that there is a leak from an oil platform at a time to be decided by DG-MARE. The contractor will not receive advance warning of the exercise. The contractor will determine the likely trajectory of the slick and the statistical likelihood that sensitive coastal habitats or species or tourist beaches will be affected. The contractor will indicate what information can be provided within 24 CH4and 72 hours
CH4- Climate	Determine: 1. Change in average temperature at surface, 500 metre depth and bottom on a grid, over the past 10 years and 50 years 2. time series of average annual temperature at sea surface and bottom 3. time-series of average annual internal energy of sea 4. average extent of ice coverage over the past 5 years, past 10 years, past 50 years, past 100 years plotted on maps 5. total ice cover in sea (kg) over the past 100 years plotted as time series
CH5- Coasts	Determine: 1. In the coasts of all coastal states, the average annual sea-level rise per stretch of coast (absolute and relative to the land), and for 10, 50 and 100 years. This should be provided in tabular form and as a map layer; 2. In the coasts of all coastal states, average annual sediment balance (mass gained or lost per stretch of coast) for 10, 50 and 100 years. This should be provided in tabular form and as a map layer
CH6- Fisheries management	Produce tables for the whole sea-basin of : 1. mass and number of landings of fish11 by species and year; 2. mass and number of discards and bycatch (of fish, mammals, reptiles and seabirds) by species and year
CH7- Fisheries impact	Produce data layers (gridded), showing the extent of fisheries impact on the sea floor, in particular estimate: 1. area where bottom habitat has been disturbed by bottom trawling (number of disturbances per month); 2. change in level of disturbance over the past ten years; 3. damage to sea floor to both living and non-living components
CH8- Eutrophication	Produce data layers (gridded) showing: 1.Seasonal averages of eutrophication in the basin for past ten years 2.Change in eutrophication over the past ten years (i.e. where eutrophication has reduced and where it has increased)
CH9- River inputs	For each river bordering the sea basin, a time series of annual inputs to sea of: 1. water (mass and average temperature); 2. Sediment; 3. total nitrogen; 4. Phosphates; 5. salmon (both inwards and outwards); 6. eels (both inwards

	and outwards)
CH10- Bathymetry	For the seabasin, produce a digital map of: 1. water depth, 2. uncertainty in water depth Indicate priority areas for surveying for safer navigation taking into account emerging needs.
CH11- Alien species	Provide a table and digital map of alien species in the sea basin. The information should include: 1. species name; 2. family (fish, algae, mammals, sponges etc); 3. year of introduction ; 4. reason for introduction (climate change, ballast water discharge etc); 5. geographical area; 6. impact on ecosystem; 7. impact on economy. Up to ten indicators should be used to determine impacts on ecosystem and economy.

Table 1.1 Targeted product description for each Challenge

1.3 Policy Framework

In the following, we will list the general policy framework that compels the target audience to focus on the EMODnet Checkpoint information and service.

1.3.1 Integrated Maritime Policy

At EU level, the policy framework is provided by the Integrated Maritime Policy (IMP)[17] that seeks to provide a more coherent approach to maritime issues, with increased coordination between different policy areas. Specifically, the framework covers these cross-cutting policies:

- Blue growth
- Marine data and knowledge
- Maritime spatial planning
- Integrated maritime surveillance
- Sea basin strategies

The IMP is complementing, not substituting other ongoing actions. The IMP is the reference policy framework for the EMODnet Checkpoints.

1.3.2 The Black Sea Convention

The Commission on the Protection of the Black Sea Against Pollution[18] (or Black Sea Convention), has the following goals:

- Combating Pollution from land-based sources and maritime transport,
- Achieving sustainable management of marine living resources,
- Pursuing sustainable human development.

The Black Sea Synergy initiative was proposed by the European Commission in Communication to the Parliament and the Council in April 2007[19]. The initiative has

[17] European Commission – Maritime Affairs – Integrated maritime policy http://ec.europa.eu/maritimeaffairs/policy/index_en.htm

[18] The Commission on the Protection of the Black Sea Against Pollution – Convention on the Protection of the Black Sea Against Pollution. 2012 http://www.blacksea-commission.org/_convention-fulltext.asp

produced a number of forward-looking proposals, including the establishment of three sectoral partnerships: environment, transport and energy.

1.3.3 Marine Knowledge

Marine Knowledge 2020[20] launched the flagship EMODnet initiative. Over 20 organisations from the Black Sea littoral states are working together in order to make their marine data more accessible, interoperable and useful to end-users under the framework of EMODNet.

1.3.4 Spatial Planning

In 2014, EU Member States agreed to go beyond single sea-related sectors, and to start developing and implementing coherent processes to plan human uses of their maritime space (maritime spatial planning), and to establish appropriate cross border cooperation. The EU is supporting this process in the Black Sea by launching a dedicated call for proposals for across-border cooperation project between Bulgaria and Romania, which is also open to participation by other, non-EU countries in the sea-basin to ensure consistency of ecosystem based maritime spatial planning across borders.

1.3.5 Cooperation with the General Fisheries Commission for the Mediterranean

The General Fisheries Commission for the Mediterranean (GFCM), to which the EU and its Black Sea Member States are members, established in 2011 a Working Group to facilitate the delivery of advice for fisheries management in the Black Sea, and to promote regional cooperation in the field of fisheries and environmental issues. Together with the GFCM members, Turkey, Bulgaria and Romania, and the non-GFCM cooperating members Ukraine, Russia and Georgia, the EU has actively participated in discussions relating to the state of marine fauna in the Black Sea in 2012 and 2013[21]. GFCM has been invited to participate as an observer in all Scientific, Technical and Economic Committee for Fisheries (STECF), and as Expert Working groups on Black Sea stock assessments. The GFCM is currently working on the establishment of a new data collection scheme, the Data Collection Reference Framework (DCRF). Harmonisation of GFCM requirements with the currently running EU Data Collection Framework (DCF) and national data collection systems is under consideration, and further collaboration towards achieving this goal is anticipated.

1.3.6 The Marine Strategy Framework Directive

The aim of the European Union's ambitious Marine Strategy Framework Directive is to protect more effectively, the marine environment across Europe. The Marine Directive was adopted on 17 June 2008. The Commission produced in 2010 a set of detailed criteria and Good Environmental Status indicators to help Member States implement the Marine Directive[10].

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[19] European Commission – Maritime Affairs – Sea basin strategy: Black Sea
http://ec.europa.eu/maritimeaffairs/policy/sea_basins/black_sea/index_en.htm
[20] European Commission – Maritime Affairs – Marine knowledge 2020
http://ec.europa.eu/maritimeaffairs/policy/marine_knowledge_2020/index_en.htm
[21] GFCM – General Fisheries Commission for the Mediterranean – First GFCM meeting of the *ad hoc* Working Group on the Black Sea
http://gfcmsitestorage.blob.core.windows.net/documents/web/WGBS/2012/docs.html

1.3.7 Coastal Zone Policy

A European Parliament and Council Recommendation, concerning the implementation of Integrated Coastal Zone Management-ICZM in Europe was adopted on 30 May 2002 (2002/413/EC)[22]. It lists eight principles defining the essential characteristics of ICZM. Integration across sectors and levels of governance, as well as a participatory and knowledge-based approach, are hallmarks of ICZM. Based on these principles, the recommendation outlines steps, which the Member States should take to develop national strategies for ICZM. Given the cross-border nature of many coastal processes, coordination and cooperation with neighbouring countries and in a regional sea context are also encouraged.

1.4 Structure of the document

This document is structured around five major parts:

1) The terminology and the framework for input data collection from the project's internal survey, carried out during the first nine months of the project (Section 2);

2) The overall analysis of the internal input data survey that produces a consolidated list of Characteristics needed by the Challenges (Section 3);

3) An overall survey on the Black Sea observational capacities and monitoring systems (Section 4);

4) A survey of relevant Use Cases as a substitute for Challenges in outputs (Section 5);

5) An assessment of data appropriateness, availability and preliminary fitness for use based upon the Use Cases (Section 6).

Section 7 concludes with a synthesis of findings.

[22] European Commission – Environment – Coastal Zone Policy – Recommendation on Integrated Coastal Zone Management http://ec.europa.eu/environment/iczm/rec_imp.htm

2. Terms of reference for the Literature Survey

The methodology with which to carry out the Literature survey for the EMODnet BlackSea Checkpoint was established early in the project, and it is basically the same as the one used in the MedSea Checkpoint. It consisted of two major components:
1) The definition of a common terminology and nomenclature across the different basin monitoring data sets;
2) A framework for information collection, which consisted in an internal project survey to characterize the input data sets in terms of appropriateness, availability and fitness for purpose.
3) A framework for the collection of Use case descriptions, which is common to all Challenges.

These three major methodological components are described in the two sections below.

2.1 Terminology and vocabulary

For the purpose of this project and to avoid confusion with other uses of the terms listed below, the following definitions apply in this literature survey and in the follow-up project activities. These definitions are based on the methodology adopted by the project partners for classifying the existing upstream data of the challenges and to assess their fitness for use.

- **Characteristic**

In this document, a "characteristic" is a distinguishing feature which refers:

- either to a variable derived from the observation, the measurement or the numerical model output of a phenomenon or of an object property in the environment;
- or to the geographical representation of an objecton a map (i.e. a layer such as a protected area, a coastline or wrecks) by a set of vectors (polygon, curve, point), or a raster (a spatial data model that defines space as an array of equally sized cells such as a grid or an image).

Navigation through a large number of characteristics is a daunting task. To help with this, a 3-layer hierarchy of discovery keywords has been used to classify the 'characteristics':

- P01 BODC Parameter Usage Vocabulary – single characteristic name
- P02 SeaDataNet Parameter Discovery Vocabulary – categories of characteristics used for data set discovery metadata (e.g. ISO 19115)
- P03 SeaDataNet Agreed Parameter Groups– grouping the categories of characteristics on the base of general concepts (e.g. biota composition, fish, human activity)

The GEMET thesaurus is also introduced (P022 Vocabulary). The GEneral Multilingual Environmental Thesaurus, has been developed as an indexing, retrieval and control tool for the European Topic Centre on Catalogue of Data Sources (ETC/CDS), and the European Environment Agency (EEA). GEMET is formed by a first point entry with a list of environmental themes. This is followed by further

categorization and finally, a concept definition with links to broader than/narrower than and related terms and also a list of multilingual alternative names.

- **Environmental matrices**

This concept is introduced to avoid ambiguities when using a characteristic such as "temperature" that can be monitored in air or water at the same time. The environmental matrices are the environments where characteristics are measured or computed and they are defined as:

1. Air,
2. Ice
3. Fresh water,
4. Marine water,
5. Biota/Biology,
6. Riverbed/Seabed,
7. Human activities.

Here we use an enlarged meaning for environmental matrices that considers also Human activities as part of the information required by the Challenges to fulfil their mandate.

- **Data**

Data refers to a reinterpretable representation of information in a formalised manner suitable for communication, interpretation or processing[23].

- **Dataset**

A "dataset" is an identifiable collection of data[23]. It can be a time series, a lithological description of a marine sample, a gridded dataset such as a DTM, a hydrodynamic model output, a GIS dataset or a feature layer of a GIS dataset, a data base or a table of values in a publication. A data set can constitute several files (e.g. the set of seismic data files recorded along the same line).

- **Collection of datasets**

A collection of datasets is a set of datasets.

- **Dataset series**

A dataset series is a collection of datasets sharing the same specifications of production. This is the concept in use on the Inspire Geoportal.

- **Input Dataset**

This is the collection of existing data to be input into the Challenges.

2.2 Assessment Criteria

[23] ISO 19115-1:2014 Geographic information – Metadata – Part 1: Fundamentals

The Checkpoint assessment criteria have been elaborated by the MedSea Checkpoint in the past three years, and here, they have been adopted by the Black Sea Checkpoint.
The criteria are focused on two questions which are: "what" is made available to the challenges and "how"? They are derived from the quality principles of the ISO19113 standard[24] for geographic information which concerns 99% of the data needed by the challenges and additional criteria related to services recognized in literature as key elements for the establishment of the fitness for use.

"What" **is also defined as 'appropriateness'** and it includes:

1. ***Spatial extent***
   Box or geographic region bounding the datasets
2. ***Spatial resolution***
   Size of the smallest object that can be resolved on the ground, in a raster dataset, the resolution is limited by the cell size.
3. ***Time extent***
   Time interval represented by the dataset or by the collection.
4. ***Time resolution***
   Size of the smallest interval of time that can be resolved
5. ***Usage***
   Describes the application(s) for which a dataset has been used by the data producer or by other, distinct, data users.
6. ***Completeness*** (ISO19113 quality element[24])
   Degree of absence or of excess of data in a dataset
7. ***Accuracy*** (ISO19113 quality element[24])
   Describes here the thematic accuracy including classification correctness
8. ***Temporal validity*** (ISO19115 quality element[24])
   Time range of validity of the data set produced

"How"**is also referred to as 'availability'** and it refers to:

1. ***Visibility***
   Ability to identify and to get quickly on the appropriate site delivering the desired datasets from existing EU catalogues.
2. ***Accessibility***
   Conditions in which users can obtain data:
   services: manual ordering, discovery, downloading, advanced services
   data policy: restricted, accessible under moratorium, unrestricted
   pricing policy: no charge, at cost, cost charge depends on intented use and category of users
   formats (including semantic conventions)
   interoperability of on-line services[25]
3. ***Performance***
   responsiveness is the timeliness or ability to process a request in a deterministic and acceptable amount of time
   reliability i.e. the ability of the services (to request data), to keep operating over time and to operate correctly and not to fail or report any failure to the service user for compensation.

[24] ISO 19113:2002 Geographic information – Quality principles
[25] OGC® Standards and Supporting Documents http://www.opengeospatial.org/standards

"Data Adequacy" in the context of the Checkpoints has to consider and interconnect two different "fitness" concepts: fitness for purpose of the Targeted products and fitness of the data sets used to produce them (fitness for use).

Within ISO 5127:2001[26] framework, fitness for purpose is understood as, the "totality of a product's characteristics that bear on its ability to satisfy stated and implied needs" and it includes the ease with which a user can obtain data.

Within ISO 9000:2015[27] framework, fitness for use is the degree to which a set of inherent characteristics fulfills users' requirements that in our case, are reffered to asTargeted product requirements.

We will not proceed further with the description on how to arrive at "Data adequacy" from fitness for use and fitness for purpose, because, this is out of the scope of the Literature Survey. Elements of the data adequacy will be given by this initial work but we will not arrive to a full data adequacy assessment here.

2.3 Framework for Input data set information collection

The need to adopt common vocabularies for the classification of required characteristics and their input data sets is an important prerequisite towards data sharing and communication between data providers, data users and other stakeholders especially for projects dealing with a high number of datasets. In particular, the concept of checkpoint requires to group characteristics in accurate, consistent and controlled semantic categories for a better overview of what is needed or available and to make available the common potential synergies among users of the same data sets.

For the purpose of the project, the SeaDataNet classification lists (P01 to P03) initially designed for marine data, have been adopted because they offer:

- Vocabularies governed by Governance Group, which ensures that the vocabulary is consistent with the needs and the practices of the marine community through time;
- Vocabularies which are designed for discovery services;
- The SDN classification offers three different levels of granularity (from the finer to the coarser): the characteristics (SDN parameter list P01), the categories of characteristics (SDN P02 list), and the group of categories (SDN P03 list) allowing to navigate from the more general level of information to the most detailed one;
- the vocabularies and definitions are available on-line[28].

It must be noted that the classification available on web site[29] will be mapped with the SDN classification to be compliant with the Inspire directive when cataloguing the data sets and collections needed by the challenge.

In order to build a metadatabase for the literature survey and later the EMODnet Checkpoint Service, a template has been designed and provided with guidelines to each challenge partner, to collect the upstream data classification elements. This

[26] ISO 5127:2001 Information and documentation – Vocabulary
[27] ISO 9000:2015 Quality management systems – Fundamentals and vocabulary
[28] http://www.seadatanet.org/Standards-Software/Common-Vocabularies
[29] http://www.eionet.europa.eu/gemet/inspire_themes

procedure has been adopted first by the MedSea Checkpoint, and is also being adopted by the Atlantic Checkpoint so that a comprehensive and interoperable framework can be established for these three areas. The template elements are described in details in Annex 1. Here, we overview only the main categories for the six principal elements.

1. Characteristics and categories needed by the challenges using the SeaDataNet classifications:
    - Environmental matrix where characteristics are specified
    - SDN Discovery group code of Parameter (P02 list) for variables;
    - Variable characteristic code from SDN parameter list (P01);
    - Inspire topic category for characteristics (P22 list of SDN)
    - Processing level of characteristics:
    - Production mode:
    - Hierarchy data level:
2. Data sources of these characteristics:
    - Program/Project name
    - Data provider
    - SDN EDMO Identifier
    - Data set identifier
    - Data collection or data set name as given by the provider
    - Catalogue URL
    - Dataset URL
3. Overview
    - Purpose of Characteristics production (provider specification)
    - Production and quality assessment specifications reference
    - Challenge name and Intended use by the Challenge
    - Intended use description (objective, process description, output data)
4. Spatial extent
    - Geographical area code from SDN _C16 list
    - Lat/lon bounding box
    - Horizontal resolution
    - Minimum/maximum depths
    - Vertical resolution
5. Temporal extent
    - Start/end date
    - Time resolution
    - Update time of dataset
6. Availability
    - Visibility of data set:
    - EU Inspire catalogue service:
    - Data delivery mechanisms:
    - Data Policy Visibility:
    - Data policy:
    - Cost basis:
    - Data format(s) and conventions
    - Readiness (information given for distribution format):
    - Responsiveness:
    - Reliability (degree of commitment to provide the service in per cents)

Categories 1, 2 and 3 are required to identify the characteristics and the corresponding datasets or dataset collections needed by the challenges, as well as

to identify the catalogues and documentations of where to find metadata describing the data (URL).

The categories 4, 5 and 6 contain part of the assessment criteria elements (availability and appropriateness as defined in Section 1), for later establishment of the fitness for use indicators.

Partners filling the template have been forced to use specific choices in their answers so that everything can be analyzed in a statistical framework. The specific choices are detailed in Annex 1.

2.4 Framework for Use Case information collection

In order to progress toward an assessment of the "fitness for use" and without having yet Challenge targeted products to work with, we collected detailed descriptions of literature "Use Cases" that utilized several of the main characteristics that will be used also by Checkpoint Challenges. All partners were involved in this Use Case literature information collection.

The word "Use Case" has earned a place in software engineering vernacular over the past 20 years. Originally, Use Cases served as a way to examine whether an IT system design met the real-world conditions for business steps and information flow.

In our study, Use Cases are examples of Targeted Products related to Challenges and documented in the Literature. Each Use Case should document the data sets used to construct the products and mention their quality and adequacy.

A Use Case can be: a project, a product from a project, a scientific paper, a report, etc. We proposed to describe "Use Cases" from literature (normally refereed publications but if not available, grey literature), where products have been developed and the input data used to produce them have been assessed in terms of fitness for use.

For each Use Case and its input data, the literature was analyzed in order to extract some of the data availability and appropriateness elements listed in section 2.1.

Use Case products that are described in the Literature have been scrutinized in order to extract information regarding the reasons why:

- Use Case product goals have not been achieved because of inadequacy of input data used;
- Use Case products are inadequate due to reluctance of data-owners to release data, time taken to obtain data, lack of measurements, lack of accuracy or lack of precision.

3. Identification and classification of characteristics and input data sets for Challenges

Using the framework for information collection explained in section 2.2, the Literature survey identified 48 different characteristic categories (P02), across all Challenges. Table 3.1 and Fig. 3.1 illustrate the number of characteristics classified in terms of characteristics categories (P02), and groups of characteristic categories (P03).

It is interesting to notice that about half of the Challenges, 4,5,6,7 and 10, 11, have listed the need for only few characteristics, while the others have about twice of even three times more. The few characteristics Challenges in fact are related mainly to data assembly, while the many characteristics Challenges have to develop highly value-added products.

The few-characteristics Challenges are: Challenge 4 (Climate) is related only to temperature and sea ice variables and derived quantities, Challenge 5 (Coasts) is related only to sea level and sediment mass balance, Challenge 6(Fishery Management) only to biomass estimates, Challenge 7(Fishery impacts) only to sea bottom impacts of fishing activities, Challenge 10 (Bathymetry) is a data assembly for bathymetry and Challenge 11 (Alien Species) is again a data assembly activity for alien species information.

	Challenges											
	All	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**
Number of input data sets identified	467	49	44	28	115	49	3	6	45	71	33	24
Environmental matrices identified	6	5	4	5	3	3	1	1	3	2	1	1
Numbers of different P03 identified	26	8	9	10	3	3	1	1	5	7	1	1
Numbers of different P02 identified	48	18	14	12	5	3	1	3	10	13	1	3
Numbers of different INSPIRE spatial themes identified (P22)	14	8	6	9	1	3	1	2	2	3	1	1

Table 3.1: Number characteristics, aggregated with the three different vocabularies, as a function of Challenges

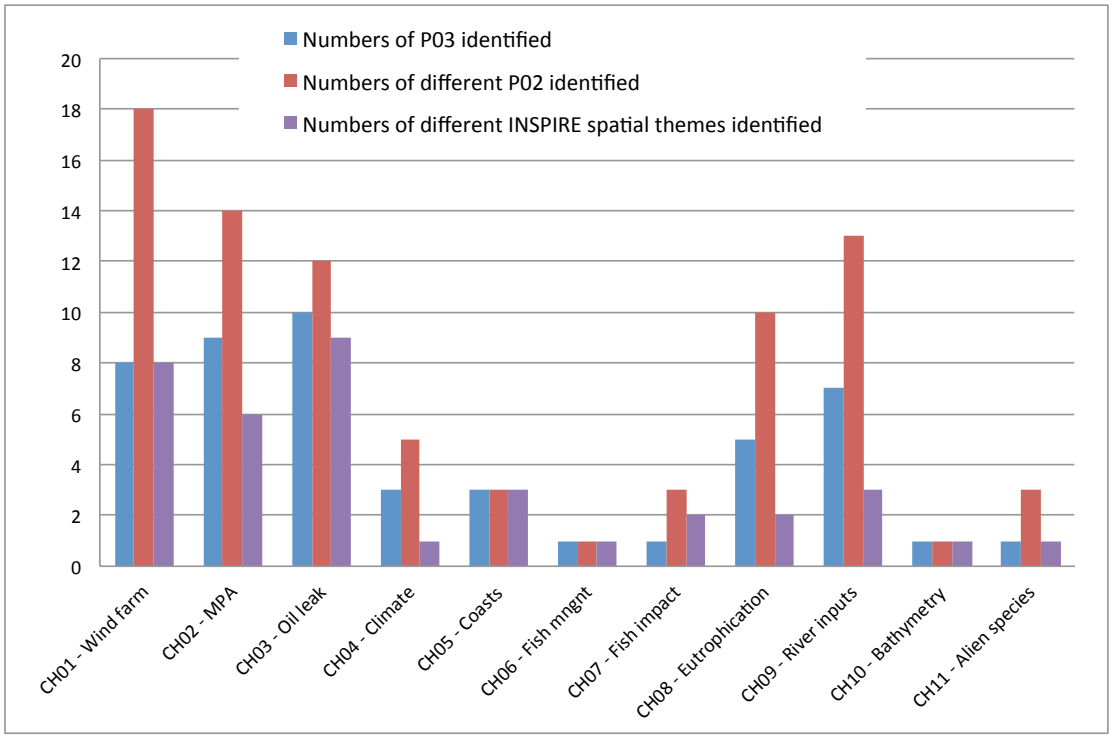

Figure 3.1: Number characteristics P02 and P03 and P22 as a function of Challenges (visual representation of Table 3.1)

It is interesting to note that about half of the Challenges, 4,5,6,7 and 10, 11, have indicated the need for less than 5 characteristic categories, while the others have more than 10. The “few characteristics” Challenges in fact are related mainly to data assembly products while the many characteristics Challenges have to develop highly value-added products such as forecasts of oil spill etc.

The few-characteristics Challenges are: Challenge 4 (Climate), which is related only to temperature and sea ice variables and derived quantities, Challenge 5 (Coasts), is related only to sea level and sediment mass balance, Challenge 6(Fishery Management), only to biomass estimates, Challenge 7(Fishery impacts), only to sea bottom impacts of fishing activities, Challenge 10 (Bathymetry), is a data assembly for bathymetry and Challenge 11 (Alien Species), is again a data assembly activity for alien species information.

Following the information collection methodology, 467 input data sets were indicated as potentially interesting for the 48 characteristics categories on the basis of which the 11 Challenge Targeted products will be produced.

The distribution per Challenge of the number of input data sets is shown in Figure 3.2. It is already evident from this picture that there are at least 20 different datasets that might be used for each challenge except for the two Fishery Challenges. Climate has the largest set of potential input data sets, followed by river inputs and coasts. It should be noted that these are “potential data sets” that might be chosen on the basis of the Challenge Targeted products requirements, still to be defined.Final figures will be available in the first Data Adequacy Report.

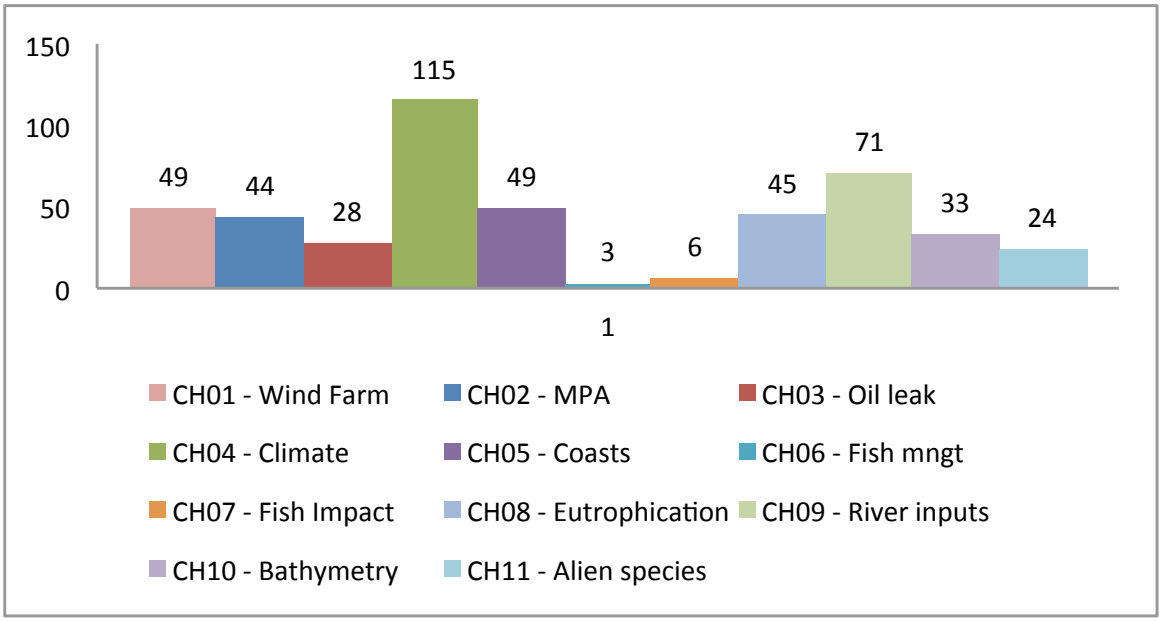

Figure 3.2: Number of input data sets for each challenge (total number is 467)

In the following, each Challenge required "category of characteristics" will be listed and shortly referred to as characteristics.

3.1 Inventory of Challenge characteristic categories

3.1.1 Characteristics for Challenge 1: windfarm siting

Challenge 1 partners have identified 49 input datasets which correspond with 18 categories of characteristics (P02) and 5 environmental matrices as follows:

Air- pressure exerted by the atmosphere, air temperature and density, atmospheric humidity, wind stress and direction

Marine water- temperature of the water column, salinity of the water column, horizontal velocity of the water column (currents), sea level, wave direction, spectral wave data parameters, wave height and period statistics

Riverbed/Seabed- bathymetry and elevation

Biota/Biology- biota abundance, biomass and diversity; birds, mammals and reptiles; positioning, references and data management

Human activities- bio-geographical regions

3.1.2 Characteristics for Challenge 2: protected marine areas

Challenge 2 partners have identified 44 input datasets which correspond with 14 categories of characteristics (P02) and 4 environmental matrices as follows:

Marine water- skin temperature of the water column, temperature of the water column, salinity of the water column, sea level

Riverbed/Seabed- bathymetry and elevation

Biota/biology- bird counts, cetacean abundance, cetacean behavior, chlorophyll pigment concentrations in water bodies, fauna abundance per unit area of the bed, habitat extent, horizontal spatial co-ordinates

Human activities- administrative units, fishery characterization

3.1.3 Characteristics for Challenge 3: oil leak

Challenge 3 partners have identified 28 input datasets which correspond with 12 categories of characteristics and 5 environmental matrices as follows:

Air- wind stress and direction

Marine water- temperature of the water column, horizontal velocity of the water column (currents), wave direction, wave height and period statistics

Riverbed/Seabed- bathymetry and elevation, terrestrial mapping, coastal geomorphology

Biota/biology- habitat extent

Human activities- pollution events, fishery characterization, marine environment leisure usage

3.1.4 Characteristics for Challenge 4: climate

Challenge 4 partners have identified 115 input datasets which correspond with 5 categories of characteristics and 3 environmental matrices as follows:

Ice- snow and ice mass, thickness and extent

Marine water- skin temperature of the water column, temperature of the water column~~,~~

Biota/Biology- phytoplankton generic biomass in water bodies, phytoplankton generic abundance in water bodies,

3.1.5 Characteristics for Challenge 5: coasts

Challenge 5 partners have identified 49 input datasets which correspond with 3 categories of characteristics and 3 environmental matrices as follows:

Fresh water- river flow and discharge

Marine water- sea level

Riverbed/Seabed- coastal geomorphology

3.1.6 Characteristicsfor Challenge 6: fishery management

Challenge 6 partners have identified 3 input datasets which correspond with 1 category of characteristics and 1 environmental matrix as follows:

Human activities- fish and shellfish cash statistics

3.1.7 Characteristics for Challenge 7: fishery impact

Challenge 7 partners have identified 6 input datasets which correspond with 3 categories of characteristics for 1 environmental matrix as follows:

Human activities- fish and shellfish catch statistics, fish biomass in water bodies, fishery characterization

3.1.8 Characteristics for Challenge 8: eutrophication

Challenge 8 partners have identified 45 input datasets which correspond with 10 categories of characteristics and 3 environmental matrices as follows:

Fresh water- particulate total and organic nitrogen concentrations, nitrate concentration parameters in the water column, phosphate concentration parameters in the water column, particulate total and organic phosphorus concentrations in the water column

Marine water- dissolved oxygen parameters in the water column, temperature of the water column,

Biota/Biology- phytoplankton taxonomic surface area in water bodies, phytoplankton generic biomass in water bodies, phytoplankton generic abundance in water bodies, chlorophyll pigment concentrations in water bodies

3.1.9 Characteristics for Challenge 9: river inputs

Challenge 9 partners have identified 71 input datasets which correspond with 13 categories of characteristics and 2 environmental matrices as follows:

Fresh water- particulate total and organic nitrogen concentrations, nitrate concentration parameters in the water column, phosphate concentration parameters in the water column, particulate total and organic phosphorus concentrations in the water column, concentration of suspended particulate material in the water column, temperature of the water column, river flow and discharge

Marine water- nitrate concentration parameters in the water column, nitrite concentration parameters in the water column, phosphate concentration parameters in the water column, particulate total and organic phosphorus concentrations in the water column, temperature of the water column, concentration of suspended particulate material in the water column

3.1.10 Characteristics for Challenge 10: bathymetry

Challenge 10 partners have identified 33 input datasets which correspond with 1 category of characteristics and 1 environmental matrix as follows:

Riverbed/Seabed- bathymetry and elevation

3.1.11 Characteristics for Challenge 11: alien species

Challenge 11 partners have identified 24 input datasets which correspond with 3 categories of characteristics for 1 environmental matrix as follows:

Biota/Biology- zooplankton wet weight biomass, zooplankton taxonomy-related abundance per unit volume of the water column, zooplankton taxonomy-related biomass expressed as carbon per unit volume of the water column

3.2 Challenge characteristics and input data sets

The combination of the environmental matrices and the Seadatanet common vocabulary allows the analysis of the Challenge needs in an easy and comprehensive way.

Table 3.2 lists the group of characteristic categories (P03) in the seven environmental matrices, distinguishing among Challenges.

Environmental matrix	P03 vocabulary used	Number of input datasets using P03	Challenges										
			01	02	03	04	05	06	07	08	09	10	11
Air	**M010/Meteorology**	14	10		4								
Ice	M015/Cryosphere	17				17							
Fresh water	**C005/Carbon, nitrogen and phosphorus**	41								28	13		
Fresh water	G015/Suspended particulate material	2									2		
Fresh water	D025/Water column temperature and salinity	3									3		
Fresh water	**O005/Fluxes**	16					2				14		
Marine water	C005/Carbon, nitrogen and phosphorus	22									22		
Marine water	C015/Dissolved gases	2								2			
Marine water	**D025/Water column temperature and salinity**	134	15	15	1	89				7	7		
Marine water	**D030/Currents**	8	6		2								
Marine water	**D032/Sea level**	51	2	7			42						
Marine water	**D034/Waves**	14	8		6								

Marine Water	G015/Suspended particulate material	10									10		
Riverbed/SeaBed	**G005/Gravity, magnetics and bathymetry**	37		2	2							33	
Riverbed/Seabed	**T001/Terrestrial**	9	2		2		5						
Biota/Biology	B015/Birds, mammals and reptiles	8	2	6									
Biota/Biology	**B030/Phytoplankton and microphytobenthos**	12				9				3			
Marine water	**B035/Pigments**	8		3						5			
Biota/biology	B045/Zooplankton	24											24
Biota/Biology	**B070/Biota abundance, biomass and diversity**	6	3	3									
Biota/biology	**B050/Habitat**	7		2	5								
Biota/biology	Z005/Administration and dimensions	3		3									
Human activities	**Z005/Administration and dimensions**	2	1	1									
Human activities	H001/Anthropogenic contamination	3			3								
Human activities	**H004/Fisheries**	13		2	2			3	6				
Human activities	H005/Human activities	1			1								
		467	**49**	**44**	**28**	**115**	**49**	**3**	**6**	**45**	**71**	**33**	**24**

Table 3.2: Number of input datasets identified per challenge, per environmental matrix and group of characteristic categories (P03)

Today, there are 26 P03 groups of characteristic categories (see Table 3.1), which are identified by challenges. Based on the number of times a characteristic category group is requested, Table 3.2 highlights recurrent needs in terms of groups of characteristic categories. In bold, is the group of characteristic categories used by more than one Challenge. They are:

1. M10/Meteorology;
2. C005/Carbon, nitrogen and phosphorus;
3. O005/Fluxes
4. D025/Water column temperature and salinity;
5. D030/Currents;
6. D032/Sea level;
7. D034/Waves;
8. G005/Gravity, magnetics and bathymetry;
9. T001/Terrestrial
10. B030/Phytoplankton and microphytobenthos;
11. B035/Pigments;
12. B070/Biota abundance, biomass and diversity
13. B050/Habitat;
14. Z005/Administration and dimensions
15. H004/Fisheries.

Furthermore, Fig. 3.3 illustrates the number of P03 groups required by each Challenge. It is clear that Challenge 1, 2, 7 and 8 are the ones requesting the largest

set of characteristic groups, because, they are multi-component products while the others are mainly products out of input data assembly.

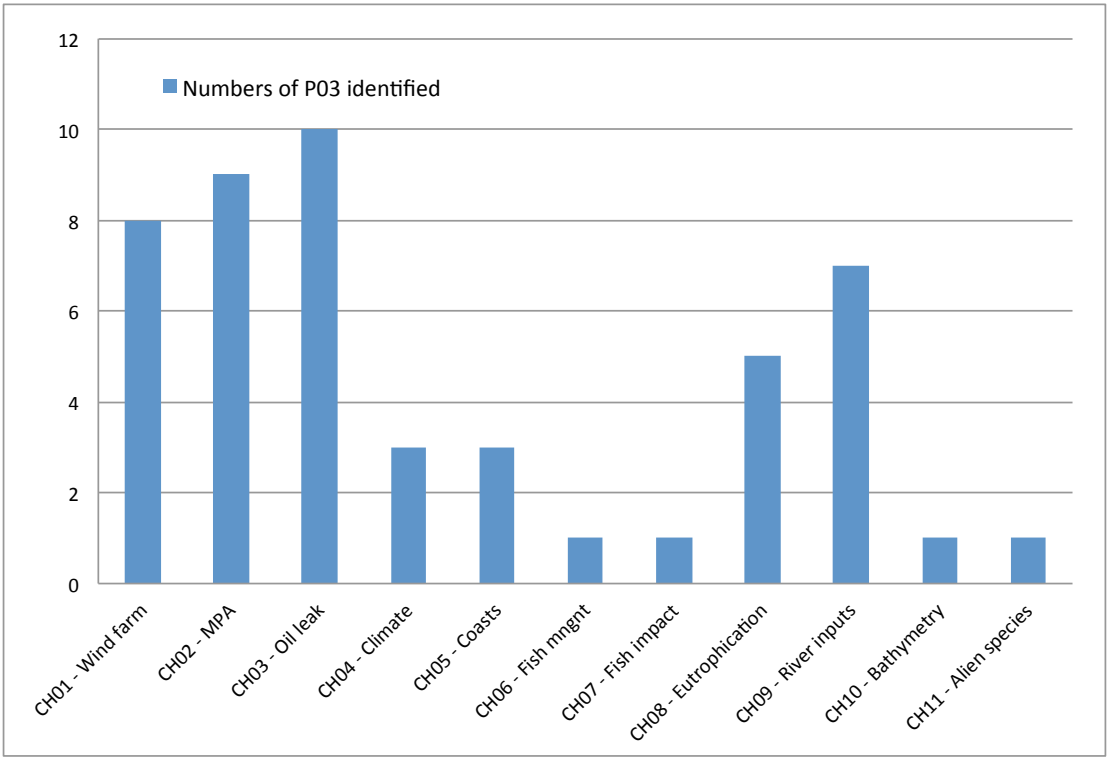

Figure 3.3: Number of group of category of characteristics (P03) as a function of Challenges (visual representation of Table 3.2)

Table 3.3 maps the characteristic category (P02), with the group of characteristics categories (P03), and the P22-INSPIRE categories. The results are that:

- 99% of the upstream data needed by the challenges concern geo-referenced data.
- Less than 5% concern land surfaces, the other being related to the marine environment

P03	P02	P022 (INSPIRE)
M010/Meteorology	CAPH/Pressure (measured variable) exerted by the atmosphere CDTA/Air temperature and density CHUM/Atmospheric humidity EWSB/Wind strength and direction	26/Atmospheric conditions 27/Meteorological geographical features
M015/Cryosphere	CRYS/Snow and ice mass, thickness and extent	NOT FOUND
B015/Birds, mammals and reptiles	BRDA/Bird counts CETA/Cetacean abundance CEBH/Cetacean behaviour	32/Species distribution
B030/Phytoplankton and microphytobenthos	AATX/Phytoplankton taxonomic surface area in water bodies CNTX/Phytoplankton generic biomass in water bodies PNTX/Phytoplankton generic abundance in water bodies	20/Environmental monitoring facilities 28/Oceanographic geographical features

B035/Pigments	CPWC/Chlorophyll pigment concentrations in water bodies	28/Oceanographic geographical features
B045/Zooplankton	GP079/Zooplankton wet weight biomass ZATX/Zooplankton taxonomy-related abundance per unit volume of the water column ZCTC/Zooplankton taxonomy-related biomass expressed as carbon per unit volume of the water column	32/Species distribution
B070/Biota abundance, biomass and diversity	FABD/Fauna abundance per unit area of the bed	32/Species distribution
B050/Habitat	HBEX/Habitat extent	31/Habitats and biotopes
C005/Carbon, nitrogen and phosphorus	NTRA*/Nitrate concentration parameters in the water column NTRI*/Nitrite concentration parameters in the water column NTOT/Particulate total and organic nitrogen concentrations in the water column PHOS*/Phosphate concentration parameters in the water column TPHS*/Particulate total and organic phosphorus concentrations in the water column	20/Environmental monitoring facilities
C015/Dissolved gases	DOXY/Dissolved oxygen parameters in the water column	28/Oceanographic geographical features
D025/Water column temperature and salinity	TEMP/Temperature of the water column PSST/Skin temperature of the water column PSAL/Salinity of the water column	28/Oceanographic geographical features
D030/Currents	RFVL/Horizontal velocity of the water column (currents)	28/Oceanographic geographical features
D032/Sea level	ASLV/Sea level	10/Elevation
D034/Waves	GWDR/Wave direction WVSP/Spectral wave data parameters WVST/Wave height and period statistics	28/Oceanographic geographical features
G005/Gravity, magnetics and bathymetry	MBAN/Bathymetry and Elevation	10/Elevation
G015/Suspended particulate material	TSED*/Concentration of suspended particulate material in the water column	20/Environmental monitoring facilities
O005/Fluxes	RVDS/River flow and discharge	163/Hydrography
T001/Terrestrial	COAS/Terrestrial mapping COGE/Coastal geomorphology	10/Elevation 13/Geology
Z005/Administration and dimensions	ALAT/Horizontal spatial co-ordinates ADUN/Administrative units	158/Protected sites 30/Bio-geographical regions
H001/Anthropogenic contamination	GP001/Pollution events	20/Environmental monitoring facilities
H004/Fisheries	FCST/Fish and shellfish catch statistics FIBM/Fish biomass in water bodies GP087/Fishery characterisation	32/Species distribution 24/Area management /restriction/regulation

		zones and reporting units
H005/Human activities	MLES/Marine environment leisure usage	23/Population distribution - demography

Table 3.4: List of P03, P02 and P22 parameters identified in the input data sets required by the Challenges. (Stars next to names indicate that the P02 is repeated in several environmental matrices. Thet total number of P02 here is 48)

The consolidated list of characteristics identified for Black sea and MedSea Checkpoints are given in Annex 2. Here, we show Fig. 3.4 where the Mediterranean and Black Sea P02 and P03 parameters are compared. There are considerable similarities between the two marginal Seas required characteristics, but also, there are some relevant differences. For example the number of characteristics required by CH1 and CH2 are considerably less and this will require a check of the input data collected for the Literature survey. Overall differences between Black Sea and Med Sea numbers are of the order of 20% that is reasonable if we consider the large data collection exercise done by the project partners.

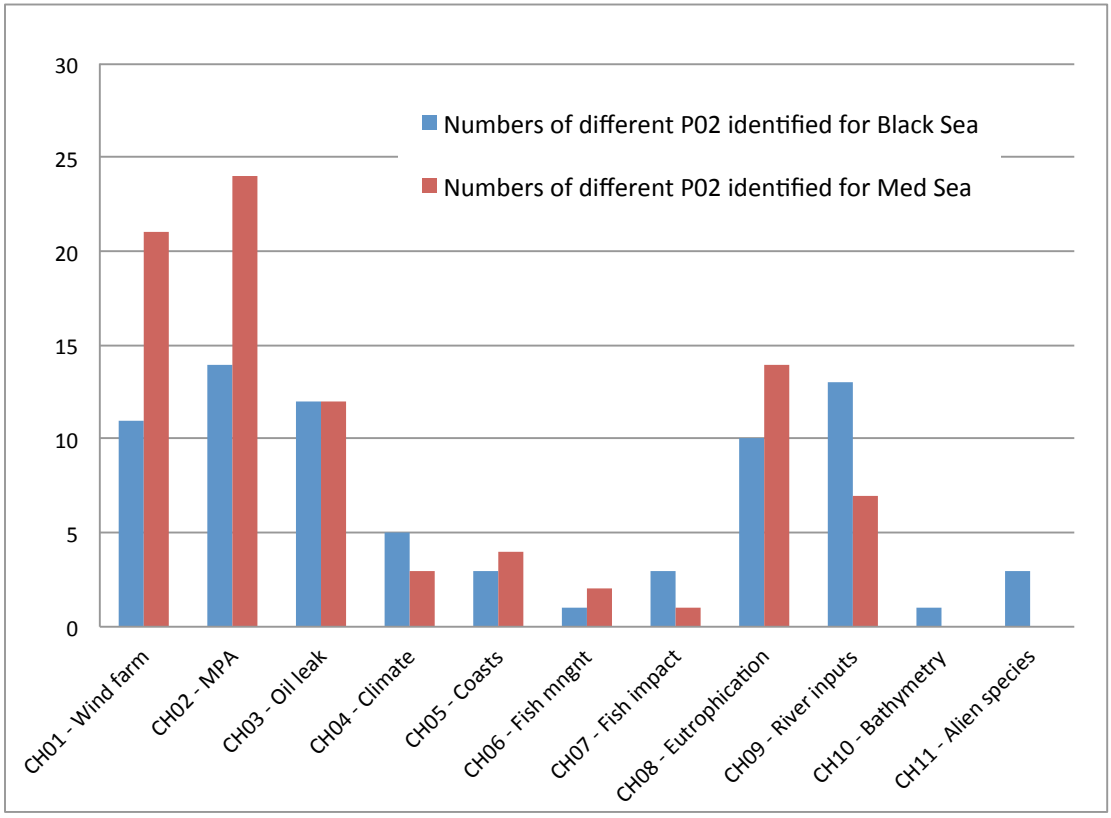

Figure 3.4: Number of different category of as a function of Challenges

Figure 3.5 shows the statistics of input data sets required by each Challenge subdivided among the environmental matrices.

Each challenge has its own spectrum of needs and associated sources of data which is appropriate to its targeted product. Challenge 6 and 7, being referred a very

specific task, that is, fisheries, have only few input data sets from one environmental matrix, i.e., human activity.

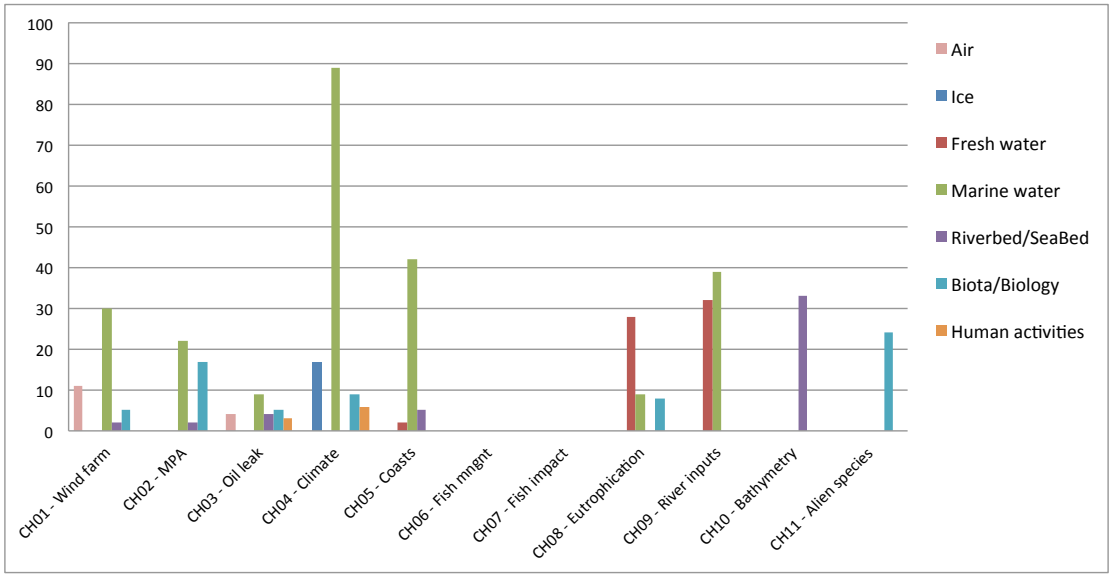

Figure 3.5: Number of input data sets for each challenge (total number is 467)

From another point of view, Figure 3.6 shows the input data sets mapped in the environmental matrices. The marine water, riverbed/seabed, biota/biology and human activity are the main matrices where input data sets are required.

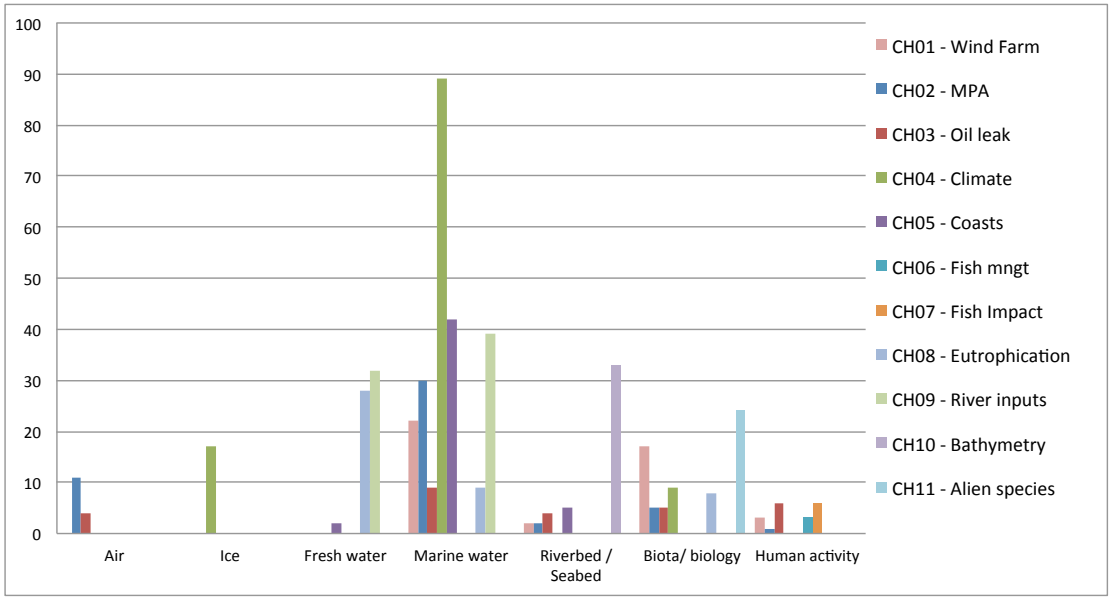

Figure 3.6: Number of input data sets as a function of environmental matrix and Challenges (total number is 467)

The metadata standardization and a common vocabulary offer a powerful solution to identify gaps in basin scale monitoring data sets, and to the definition of common data requirements for applications. This in turn could route intermediate users towards previously unexplored data sources for new applications.

3.3 Data providers

An important result of the survey is the identification of the data sources and datasets needed by the Challenge for each characteristic category.A list of 56 data providers has been identified as INT for International, EU for European, MS for EU Member State plus Russia and USA and projects.

INT	EU	MS	Russia	USA	Projects
5	7	23	5	3	13
GRDC-BFG Aquastat-FAO ARGO PSMSL GEBCO	EMODNET (Chemistry, Physics, Bathymetry and Human activities) CMES (observations and models, global and regional) ECMWF Eurostat Black Sea Commission JRC	Bulgaria (3) France Georgia (3) Germany Greece netherland Romania (7) Turkey (5) UK		NASA NOAA SAGE	MPA management Climate River inputs Oil leak

Table 3.6: Major input data providers identified by Challenge experts

3.3.1 Data centers used by more than 3 challenges

Table 3.6 lists the programme (EDMERP) or organisation (EDMO) potential providers for more than 3 challenges, which challenge refer to them, for what type of characteristics and layer of environmental matrix.The favorite data centers are CMEMS, IO-BAS, EMODNET, EEA, NOOA and NASA.

EDMERP	EDMO	Used by challenge	Environmental matrix	Group of category of characteristic (P03)
Copernicus Marine Environment Monitoring Service	MERCATOR	CH01 - Windfarm CH02 - MPA CH04 - Climate CH05 - Coasts CH08 - Eutro. CH09 - River inputs	Marine Water Biota/biology	B030/Phytoplankton ... B035/Pigments D032/Sea level D030/Currents D034/Waves D025/ Temperature & salinity
	692/IO-BAS BGODC (Institute of Oceanology - Bulgarian National Oceanographic Data Centre)	CH01 - Windfarm CH04 - Climate CH05 - Coasts CH10 - Bathymetry CH11 - Alien ...	Air Marine water Riverbed/Seabed Biota/biology	M010/Meteorology D025/ Temperature & salinity D032/Sea level G005/Gravity and bathymetry B030/Phytoplankton ... B045/Zooplankton

EMODNET Physics	EC DG MARE (European Commission. Directorate-General for Maritime Affairs and Fisheries)	CH01 - Windfarm CH02 - MPA CH04 - Climate CH05 - Coasts	Marine water	D025/ Temperature & salinity D032/Sea level
12055/ EMODNET Bathymetry	EC DG MARE (European Commission. Directorate-General for Maritime Affairs and Fisheries)	CH01 - Windfarm CH02 - MPA CH03 - Oil leak CH10 - Bathymetry	Riverbed/SeaBed	G005/Gravity and bathymetry
	EEA	CH02 - MPA CH08 - Eutro. CH09 - River inputs	Fresh water Marine water Biota/biology	B035/Pigments C005/Carbon, nitrogen, phosphorus
	1433/NOAA (National Oceanic and Atmospheric Administration)	CH02 - MPA CH03 - Oil leak CH04 - Climate	Ice Marine Water Riverbed/Seabed	M015/Cryosphere D025/ temperature and salinity T001/Terrestrial
	US NASA	CH04 - Climate CH08 - Eutro. CH09 - River inputs	Ice Fresh water Marine water Biota/biology	M015/Cryosphere C005/Carbon, nitrogen, phosphorus D025/ temperature and salinity B030/Phytoplankton ... B035/Pigments G015/Suspended particulate material

Table 3.6: List of data centers mentioned as providers of the required input data sets

The full list of programmes and data providers is given in Annex 3.

4. Basin monitoring system overview

Over the last few decades, the Black Sea has been the focus of many international, European and national projects which set the basis and partially implement the basin scale monitoring system. Literature surveys for the existing monitoring systems in the Black Sea have been carried out in the past five years by several European projects and international networks in the Black Sea. They are:

1. PERSEUS[30], pursued a review of ocean observing systems in the Southern European Seas (Mediterranean and Black Sea) and recommended upgrades to serve PERSEUS needs (PERSEUS, 2012);
2. JERICO[31], also produced a report where the Black Sea observing system was partly listed and reviewed (JERICO, 2012);
3. GMES In Situ Coordination (GISC) project[32] delivered a report that evaluated the in situ data requirements and the costs of an European in situ data collection and management system in support of Copernicus (EEA-GISC, 2012);
4. IRIS-SES[33] pursued a review and gap analysis on the existing monitoring programs of MSFD descriptors in the Mediterranean and Black Sea. In the following two sections, we will have a separate overview of the international, European and intergovernmental monitoring programs and projects and the national monitoring systems.
5. Baltic2Black[34] delivers a report that evaluated the usage of automated system for monitoring oceanographic parameters in the Black Sea.

In the following two sections, we will have a separate overview of the international, European and intergovernmental monitoring programs and projects and the national monitoring systems.

4.1 European and international monitoring programs and projects

The major European, Intergovernmental and International data collection/management programs, which are active in the Black Sea are listed in Table 4.1. The majority are pan-European and have the Black sea as one of their activity areas. The choice for the Projects has been to take only the FP7 and Territorial cooperation projects from the periods between, 2007-2016.

[30] http://www.perseus-net.eu/site/content.ph
[31] http://www.jerico-fp7.eu/
[32] http://gisc.ew.eea.europa.eu/
[33] http://iris-ses.eu/
[34] http://www.blacksea-commission.org/_projects_Baltic2Black.asp

№	Name/Web site	Type of initiative	Main range of activities
1	CoCoNet http://www.coconet-fp7.eu	FP7 project	Marine Protected Areas study and integration
2	Copernicus Marine Environment Monitoring Service http://marine.copernicus.eu/	Copernicus service	Monitoring and forecasting of the Black Sea physics and biogeochemical cycles
3	Data Collection Framework for Fisheries http://datacollection.jrc.ec.europa.eu/	JRC and DG-MARE	Fishery data collection and management service
4	EMODNET Data Portals http://www.EMODnet.eu/	DG-MARE consortia for marine data assembling	Historical data assembling and management service
5	Euro-ARGO http://www.euro-argo.eu/	European Research Infrastructure Consortia	ARGO floats acquisition, upgrade and deployment
6	E-SURFMAR http://www.eumetnet.eu/e-surfmar/	EUMETNET Project	EEIG sponsored program for data collection and management
7	GEBCO http://www.gebco.net/	UNESCO-IOC program	Bathymetric data collection, analysis and management
8	GEOSEAS http://www.geo-seas.eu/	European Partnership	e-infrastructure for gelogical and geophysical data
9	GFCM http://www.gfcm.org/gfcm/en	United Nation Contracting Party International agreement	Fisheries conservation and management
10	GRDC http://www.bafg.de/GRDC/EN/01_GRDC/grdc_node.html	WMO hydrological and meteorological center	Repository for world's river discharge data
11	JERICO http://www.jerico-fp7.eu/	FP7 Project	Integrating infrastructure initiative for an European Research Infrastructure network of coastal observatories
12	PERSEUS http://www.perseus-net.eu/site/content.php?locale=1&locale_j=en&sel=1	FP7 Project	Design of a research governance framework for the MSFD
13	SEADATANET-II http://www.seadatanet.org/	FP7 Project	Historical data assembling and management service
14	UP-GRADE BS-SCENE http://www.blackseascene.net/	FP7 Project	e-infrastructure for physical and biochemical data

Table 4.1. European, Intergovernmental and International data collection/management programs active in the Black Sea

4.1.1 CoCoNET

The Project aims at identifying interconnected Marine Protected Areas (MPAs), in the Mediterranean and the Black Seas, shifting from local (single MPA) to regional (Networks of MPAs) and basin (network of networks) scales. Connectivity is assessed by the identification of physical and biological connections that govern patterns of biodiversity distribution. These activities will also individuate areas where Offshore Wind Farms (OWF), can be established, avoiding habitats that are too sensitive, but acting as stepping stones through MPAs. Socio-economic studies will integrate to knowledge-based environmental management, aimed at both environmental protection (MPAs), and clean energy production (OFW). The project will produce the guidelines to design, manage and monitor network of MPAs, and an enriched wind atlas for both the Mediterranean and the Black Seas. Current legislations are crucial to provide guidelines to find legal solutions to problems on the use of maritime space. Pilot projects in the Mediterranean and Black Sea will test in the field the assumptions of theoretical approaches.

Major outputs of the project will be: 1) Wind Atlas of the Mediterranean and Black Sea (Menendez et al., 2014); 2) WebGIS applications on MPAs location and distribution in the Mediterranean and Black Sea; 3) WebGIS applications on habitat mapping and classification in the Mediterranean and Black Sea[35]; 4) WebGIS applications on priority habitats in the Mediterranean and Black Sea[36]; 5) WebGIS applications on threats on MPAs in the Mediterranean and Black Sea[37]; 6) Guidelines to design, manage and monitor network of MPAs[38]; 7) Biodiversity database for the Mediterranean and Black Sea; 8) Impact of offshore wind farms[39] on benthos, plankton, fish, marine mammals, seabirds.

4.1.2 Copernicus Marine Environment Monitoring Service

The Copernicus Marine Environment Monitoring Service is part of the Copernicus Programme which is an EU Programme implemented by the European Commission jointly with the European Space Agency (ESA), and the European Environment Agency (EEA). It is aimed at developing a set of European information services based on satellite Earth Observation and in-situ data. The Copernicus Marine Environment Monitoring Service provides regular and systematic information about the physical state and dynamics of the ocean and the marine ecosystems for the global ocean and the European regional seas. This data covers analysis of the current situation, forecasts of the situation a few days in advance and the provision of retrospective data records (re-analysis). Copernicus Marine Service is composed of 4 Thematic Assembly Centres (Sea Level, Ocean Colour, Temperature – Sea Ice – Wind, In Situ) and 7 Monitoring and Forecasting Centres (Global Ocean, Arctic

[35] Leenhardt et al.: The rise of large-scale marine protected areas: conservation or geopolitics? Ocean Coast. Manag., 85, 112-118. http://wiki.bluelobby.eu/ouvrages/mpa-conservation-or-geopolitics

[36] Mariani, S., M.E. Cefalì, M. Terradas, E. Chappuis, and E. Ballesteros, 2014. Using catenas for GIS-based mapping of NW Mediterranean littoral habitats. Estuarine, Coastal and Shelf Science, 147, 56-67.

[37] Suaria, G. and S. Aliani, 2014. Floating debris in the Mediterranean Sea. Marine Pollution Bulletin, in press.

[38] Levin, N., M. Coll, S. Fraschetti, et al., 2014. Biodiversity data requirements for systematic conservation planning in the Mediterranean Sea. Marine Ecology Progress Series, 508, 261–281.

[39] Bat, L., M. Sezgin, and F. Şahin, 2013. Impacts of OWF installations on fisheries: A Literature Review. Journal of Coastal Life Medicine. 1(3), 241-252.

Ocean, Baltic Sea, Atlantic NWS, Atlantic IBI, Mediterranean Sea, Black Sea) each delivering a set of environmental information products in real time and delayed mode, with a 'click-and-download' system. The main products are described in the Table 4.2.

Copernicus service sub-structure	Main product delivered
Sea Surface Temperature, sea ice and winds Thematic Assembly Center	Satellite SST data production and analysis service
Sea Level Thematic Assembly Center	Satellite Sea Level data production and management service
Ocean Color Thematic Assembly Center	Satellite Chlorophyll, light attenuation within the water column (water clarity) data production and management service
In Situ Thematic Assembly Center	In situ Real Time physical measurements data management service
Black Sea Monitoring and Forecasting Center	Analyses, 10 days forecasts and reanalyses for the physics (sea level, temperature, salinity and currents) and biogeochemical cycles in the whole Black Sea.

Table 4.2 Copernicus products

The products delivered by the Copernicus marine environment monitoring service today are provided free of charge to registered users through an Interactive Catalogue available on the marine.copernicus.eu web portal. These products support marine and maritime applications and related EU policies, e.g. in the fields of: Marine safety; Marine and coastal environment; Marine resources; Weather, seasonal forecasting and climate. The added value of the project is that the Copernicus data policy promotes the access, use and sharing of Copernicus information and data on a full, free and open basis.

4.1.3 Data Collection Framework for Fisheries

Since 2000, an EU framework for the collection and management of fisheries data has been in place. This framework was reviewed in 2008, resulting in the Data Collection Framework (DCF). Under this framework, the Member States (MS) collect, manage and make available a wide range of fisheries data needed for scientific advice. Data are collected on the basis of National Programmes in which the MS indicate which data are collected, how they are collected and the resources allocated for the collection. MS must report annually on the implementation of their National Programmes and the Scientific, Technical and Economic Committee for Fisheries (STECF) must evaluate these Annual Reports. Part of the data collected by the MS is uploaded into databases which are managed by the JRC in response to data calls issued by DG MARE. These data are analysed by experts of the STECF and form the basis for scientific opinions and recommendations formulated in STECF reports. The resulting scientific advices are used to inform the CFP's decision making process. JRC assembles the data, stores them in databases, analyses their quality and coverage and makes them available to the STECF Working Groups (STECF, 2014a, b, c). Once the STECF reports are finalised, the data are disseminated in aggregated form for a target audience of experts for further use in scientific analyses and policy.

In the JRC website, it is possible to find the necessary information and data related to the above described process including:

- latest news in relation to data calls, deadlines, variable definitions, disaggregation levels and uploading procedures;
- National Programs and Annual Reports prepared by the MS;
- access to the uploading facilities and data dissemination platforms for the experts and general public;
- Coverage reports on the data provided by the MS in response to the data calls managed by JRC;
- DCF technical documents, guidelines and legislation.

The Data Collection Framework is strictly linked with the Control Regulation. In particular, the assessment of commercial landings and effort (transversal variables) must be made on the basis of the exhaustive data gathered under the Council Regulation (EEC) No 2847/93, and of the Council Regulation (EC) No 104/2000. For the data not covered by these Regulations, assessment of commercial landings and fishing effort has to be made by sampling and statistical procedures, in such a way that the estimates achieve certain precision of level both for stocks subject to TAC and quota and for stocks not subject to TACs and quotas.

4.1.4 EMODNET Data Portals

The European Marine Observation and Data Network (EMODnet), has the objective to unlock fragmented and hidden marine data resources, and to make these available to individuals and organisations, both public and private, and to facilitate investment in sustainable coastal and offshore activities through improved access to quality-assured, standardised and harmonised marine data. EMODnet is an initiative from the European Commission Directorate-General for Maritime Affairs and Fisheries (DG MARE), as part of its Marine Knowledge 2020 strategy. Presently, there are eight sub-portals in operation that provide access to marine data from the following themes: bathymetry, geology, physics, chemistry, biology, seabed habitats, human activities and coastal mapping. One further portal covering human activities is currently under construction. Through the prototype websites of EMODnet, engineers and scientists can see what data are available for a given sea basin, and download both the original observations and derived data products such as digital terrain models, sediment distributions and marine habitats. At the same time, work is ongoing to help EU countries to optimise their programmes for observing the sea.

4.1.4.1 EMODnet Bathymetry

The overall objective of this Lot is a dedicated portal that will provide access by browsing and downloading to a visitor to the portal, at a harmonised medium resolution Digital Terrain Model (1/8 of minute of arc, approximately 250m of resolution), of all sea basins in European waters and access by discovery and shopping process to the underlying and assembled bathymetric surveys over the European seas held by public and private bodies in an uniform way. The Bathymetry portal was developed by adopting SeaDataNet standards and services. The Lot has resulted in gathering and providing access to metadata and data from more than 10730 bathymetric survey datasets from 24 data centres from 14 countries and originated from more than 114 institutes. Digital Terrain Model (DTM) is based on 3 types of bathymetric data sources:

- Bathymetric surveys, such as LIDAR surveys, single and multibeam echosounder surveys, and even historic leadline soundings. These data sets are most preferred as data source because of their high resolution and of the possibility

to apply the processing specified by the project for the production of the depth and associated statistics.

- Composite data sets from Hydrographic Offices Digital Terrain Models that are maintained for producing their nautical charts, following IHO[40] procedures.
- GEBCO 30" grid, derived from a combination of altimetric data and soundings.

The portal offers access to the following metadata layers delivered with the data source: Minimum cell water depth, maximum cell water depth, average cell water depth, standard deviation of cell water depth, number of values used for interpolation of cell water depth, Source dataset used at each point. The horizontal coordinate reference system is the WGS 84. The depth reference system is the Lowest Astronomical Tide (LAT).

4.1.4.2 EMODnet Geology

The geology portal provides access to data and metadata held by each organisation based on standards developed in the Geo-Seas project, and data products compiled at a scale of 1:250,000 using the standards developed during the early-stage of EMODnet. The data and map products include information on the sea-bed substrate including rate of accumulation of recent sediments; the sea-floor geology and all boundaries and faults that can be represented at the 1:250,000 compilation scale with information on the lithology and age of each geological unit at the seabed; geological events and probabilities and minerals. In addition to sea-bed sediment information, EMODnet Geology also compiles information on the Quaternary geology of the sea floor (sediments deposited during the last approximately 2 million years). Links are being established through common partners with the COST Action SPLASHCOS used to consider drowned paleolandscapes that would be of value to marine archaeologists. SPLASHCOS aims to bring together archaeologists, marine geophysicists, environmental scientists, heritage agencies, and commercial and industrial organizations, which are interested in researching, managing and preserving the archives of archaeological and palaeoclimatic information locked up on the drowned prehistoric landscapes of the European continental shelf, and to disseminate that knowledge to a wider public.

4.1.4.3 EMODnet SeaBed Habitats

The Preparatory action was based on the EUNIS (European Nature Information System) broad scale seabed habitat map project. It was a preliminary attempt at covering a few European marine basins with a broad-scale map representing the upper levels of EUNIS referred to as "physical habitats". Today, the lot has the general objective of the EUSeaMap 2 project, to create a homogeneous seabed habitat map covering all European seas with enhanced validation, and to complement this with the collation of any survey habitat maps available from Member States, their translation into EUNIS, and their storage in an attractive portal designed to meet users' needs fully and effectively. Such a physical habitats map, featuring complete coverage of European seas, will be made available through the former EUSeaMap webGIS offering enhanced capabilities. The broadscale map will be completed locally with detailed maps sourced by the Partners and/or other adjacent countries that have not been made widely available so far. It falls within the brief of this tender to enable Member States to 'plug in' their data, facilitating the publishing of this data with the implementation of bespoke tools.

[40] https://www.iho.int/srv1/index.php?lang=en

4.1.4.4 EMODnet Chemistry

This Portal is connected to the SeaDataNet project. The objectives are:

- gather all measurements of a particular chemical species with their appropriate metadata within a given space and time window
- include the physical conditions under which the measurements were made (from EMODnet physical parameters portal or the GMES marine core service)
- visualise the measurement density in a given time and space window
- visualise a time evolution of a selected group of measurements
- show concentration plots for a given time and space window and also along the coast
- show inflows from rivers of nutrients, the user should be able to select a section of coast, a country or a region (NUTS3) and obtain time series of inflows of parameters expressed as mass or moles per unit time per river (or section of coast)
- calculate spatially distributed data products specifically relevant for Marine Strategy Framework Directive Descriptors 5 (eutrophication), 8 (chemical pollution), and 9 (contaminants in seafood) based on guidance provided by the Marine Strategy Framework Directive Common Implementation Strategy. For eutrophication, it is not necessary to calculate an eutrophication indicator but to provide the relevant data layers concerning water column chemistry that enabled eutrophication to be calculated. In particular, it is necessary to provide spatial and temporal distribution of hypoxia and anoxia in water column and seabed.

4.1.4.5 EMODnet Biology

Marine biodiversity data are essential to measure and study the ecosystem health of maritime basins. These data are often collected with limited spatial and temporal scope and are scattered over different organizations in small datasets for a specific species group or habitat. The aim of this Lot is to assemble individual datasets, and process them into interoperable biological data products for assessing the environmental state of overall ecosystems and complete sea basins.
The main elements of the Lot are:

- to provide access to specified monitoring data from the EMODnet biological data portal, by building on a detailed inventory and gap analysis of existing holdings of biological marine monitoring data that was created during the pilot project.
- to create specific biological data products to illustrate the temporal and geographic variability of occurrences and abundances of marine phytoplankton, zooplankton, macro-algae, angiosperms, fish, reptile, benthos, bird and sea mammal species.

- to seek the harmonisation of differing methodologies and strategies for data management under common protocols, data formats and quality control procedures (by adopting EMODnet and INSPIRE standards), and to ensure that data can be consistently distributed, by making use of relevant, open webservices for user applications including regional data interpretation, environmental assessments and modelling.

- to execute spatial, temporal, and taxonomic queries. The spatial queries will be made possible by entering exact coordinates, by selecting a region on a geographic map or by selecting standardized sea areas; e.g. Exclusive Economic Zone's (EEZs) of European countries from the Maritime Boundaries Geodatabase (MARBOUND, VLIZ), IHO seas or European regional and sub-regional seas, as currently defined by MSFD.

The portal offers access to the following datasets/species groups: Biomass, Abundance, Gridded abundance, phytoplankton, zooplankton, angiosperms, macro-algae, invertebrate bottom fauna, birds, mammals, reptiles, and fish.

4.1.4.6 EMODnet Physics

The Physics preparatory action had the overall objectives to provide access to archived and near real-time data on physical conditions as monitored by fixed stations and Ferrybox lines in European sea basins, and oceans and to determine how well the data meet the needs of users.The existing EMODnet-Physics portal makes layers of physical data and their metadata available for use and contributes towards the definition of an operational European Marine Observation and Data Network (EMODnet). It is based on a strong collaboration between EuroGOOS associates and its regional operational systems (ROOSs), MyOcean and SeaDataNet consortia.The EMODnet Physics portal gives access to two major data streams:

- Near-real-time (NRT: within 24 hours from acquisition) data, collected for operational needs, collected at fixed measuring stations (e.g. moored buoys, rigs/platforms, coastal stations) and by automatic observatories at sea (e.g. profiling floats, drifting buoys, ferrybox, ships of opportunity, research vessels) which are transmitted in near real-time to the shore.

- Archived data derived from further elaboration and validation of the near real time (NRT) data. The access to the first data stream is ensured by the EuroGOOS - ROOSs and the in-situ TAC system; the second data stream is organised through the SeaDataNet infrastructure. The Coriolis infrastructure plays an important role for giving access to the supplementary data from Argo floats (EuroArgo) and glider observations. The portal offers access to the following datasets: Sea water salinity, Sea water temperature, Water currents, Oxygen, Fluorescence, pH, Turbidity, Sea level, Waves, Horizontal wind speed, Wind direction, Atmospheric pressure, Atmospheric pressure hourly tendency, Dew point temperature, Air temperature in dry, Relative humidity, Light irradiance, Daily Ice cover.

4.1.4.7 EMODnet Human Activities

Human Activities is a new Lot not covered in EMODnet Phase I. Its main objective is to disseminate information on the geographical position, spatial extent, and attributes

of a wide array of human activities related to the sea and its bed. Particular attention is given to providing historical time series (when possible), to indicate the temporal variation of activities. Through a single entry portal, it is possible to view, query and download data and metadata from public and private sources all across Europe.
The data is harmonised into interoperable formats that include agreed standards, common baselines or reference conditions; assessments of their accuracy and precision. Users can view, query, and download datasets or subsets of them, via web GIS. Metadata are also available for download.The portal offers access to the following datasets: Aggregate extraction, Commercial shipping, Recreational shipping, Cultural heritage, Dredging, Fisheries zones, Hydrocarbon extraction, Major ports, Marine culture, Ocean energy facilities, Pipelines and cables, Protected areas, Waste disposal (solids, including dredge material, dumped munitions, marine constructions), Wind farms, other forms of area management/designation.

4.1.4.8 EMODnet Coastal Mapping

Coastal Mapping is a recent EMODnet activity, initiated in 2015 at the end of the second EMODnet development phase (Phase II). It was not part of the preparatory action which ran from 2009-2013. EMODnet Coastal Mapping is still in its early development phase. The main objectives of the LOT are to assess the current availability of digital coastal maps in the EU, to disseminate this information by EMODnet, to share experience of coastal mapping in the EU, to develop standards for best practices and to propose how a future Joint European Coastal Mapping Programme (JECMAP) could operate.

4.1.5 EURO ARGO

The main objective of the EURO-ARGO consortium is to organise and consolidate the European contribution and to set up a research infrastructure in support of the global ARGO programme. EURO-ARGO having been endorsed by the European Strategic Forum on Research Infrastructures (ESFRI[41]), the preparatory phase of the project had several objectives to progress towards defining the appropriate legal framework, and to address several critical technical points related to instrumentation and sensors, data management and array design. Capacity building and outreach have also been given due consideration.

The official inauguration of EURO-ARGO ERIC was hosted by the French Permanent Representation in Brussels on the 17th July, 2014. EURO-ARGO is now the European research infrastructure that coordinates the procurement and deployment of about 250 floats per year, monitor these floats and ensure that all the data can be processed and delivered to users (both in real-time and delayed-mode). Some of these floats are deployed in the Black Sea.
EURO-ARGO has its registered office in France for the first 5 years. The Central Infrastructure will coordinate EURO-ARGO activities under arrangements with independent distributed national legal entities and facilities. The EURO-ARGO ERIC governance structure is constituted by the following organs:
-a Council
-a Management Board
-a Programme Manager
-a Scientific and Technical Advisory Group (STAG)

[41] http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri

4.1.6 E-SURFMAR

E-SURFMAR (Surface Marine Operational Service) is a project of EUMETNET[42] that has the main objective of coordinating, optimising and progressively integrating European activities for surface observations over the sea, in support of Numerical Weather Predictions. The main objective of E-SURFMAR is to formulate an optimum overall surface marine network design, to implement it and to regularly revise it according to data user's requirements. The first design study (2004) led to:

- an operational network of about 100 drifting buoys measuring air pressure and sea surface temperature in the North Atlantic and which make their data available in real time onto the Global Telecommunication System of WMO.
- the financial and technical support for the operation of 4 moored buoys as a baseline for the calibration and the validation of satellite-derived wind and wave observations.
- the support of the activities of Voluntary Observing Ships (VOS) in order to better coordinate and harmonise practices. This support includes compensation to participating members for the observations and the communications related to this component.
- both the operation of an increasing fleet of Shipborne Automated Weather Stations (S-AWS), in support of the network design and, in parallel, the automation of the observation aboard ships through the development of such stations.

4.1.7 GEBCO

GEBCO aims at providing the most authoritative publicly-available bathymetry of the world's oceans. It operates under the joint auspices of the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the International Hydrographic Organization (IHO). The regional groups that GEBCO collaborates with are:

1. Intergovernmental Oceanographic Commission (IOC) Regional Mapping Projects;
2. International Hydrographic Organization (IHO) regional coordination work;
3. GEBCO's regional mapping projects;
4. GEBCO/Nippon Foundation Indian Ocean Bathymetric Compilation (IOBC) Project;
5. European Marine Observation and Data Network (EMODnet) Bathymetry.

GEBCO produces a range of bathymetric data sets and products. This includes global gridded bathymetric data sets, which is a global set of digital bathymetric contours; the GEBCO Gazetteer of Undersea Feature Named; the GEBCO Digital Atlas; the GEBCO world map and the IHO-IOC GEBCO Cook Book— a reference manual on how to build bathymetric grids. The GEBCO_08 Grid is a global 30 arc-second grid largely generated by combining quality-controlled ship depth soundings with interpolation between sounding points guided by satellite-derived gravity data. However, GEBCO's global elevation models are generated by the assimilation of heterogeneous data types. In areas where they improve on the existing grid, data sets generated by other methods have been included. Land data are largely based on the Shuttle Radar Topography Mission (SRTM30) gridded digital elevation model. A 'source identifier', SID, grid is also available to download to accompany the GEBCO_08 Grid. This shows which grid cells have been constrained by bathymetry data during the gridding process. It is assumed that all data sources refer to mean sea level. However, in some shallow water areas, the grids include data from sources having a vertical datum other than mean sea level. The grid is available to

[42] http://www.eumetnet.eu/about-us

download from the British Oceanographic Data Centre (BODC). The format is either ASCII or netCDF.

4.1.8 GEO-SEAS

Geo-Seas is an e-infrastructure of 26 marine geological and geophysical data centres, located in 17 European maritime countries. Users are enabled to identify, locate and access pan European, harmonised and federated marine geological and geophysical datasets and to derive data products held by the data centres through a single common data portal[43]. Geo-Seas has expanded the existing SeaDataNet marine and ocean data management infrastructure to handle marine geological and geophysical data, data products and services, creating a joint infrastructure covering both oceanographic and marine geoscientific data.

4.1.9 GFCM

The General Fisheries Commission for the Mediterranean and Black Sea (FAO-GFCM) integrates cooperative efforts by 24 members in seeking to optimize fish harvesting. The terms of reference of the FAO-GFCM have undergone a series of revisions over the last 15 years, searching for a better structure and mode of functioning to accomplish their main purpose. The FAO-GFCM manages the fisheries of the international waters of the Mediterranean, which extend beyond the territorial seas of its Member countries. Unlike most coastal countries in the world, these have not declared Exclusive Economic Zones, and the importance of the FAO-GFCM mechanism stems from this lack of an EEZ extension. The geographical configuration of the Mediterranean is characterized by several linked basins having different ecological/environmental conditions, and harvested by a wide variety of fishing gears, by countries with widely different political, economic conditions and languages. Such complicated situation has hindered a sustainable exploitation of the resources (especially shared) in a common fisheries framework, which is the main purpose of FAO-GFCM. Since its establishment in 1952, FAO-GFCM has been collecting data on fisheries in the different countries of the Mediterranean and Black Sea. Fisheries statistics (e.g. declared catches per species, area and country) are currently available through the GFCM portal[44].

The FAO-GFCM Task 1 concept is an outcome of the transversal Workshop on Stock Assessment and Operational Units (GFCM, 2006), and essentially comprises of a compilation of Operational Units (a group of fishing vessels practicing the same type of fishing operation, targeting the same species or group of species and having a similar economic structure) data into matrices and associated tables, also providing the procedures required for the identification of Operational Units within fishing fleets. At present, GFCM is developing a major revision of its own. Task 1 with the objective of harmonizing the production of fisheries statistics for all the countries around the Mediterranean and Black Seas, but currently, it faces difficulties in gathering this information for several reasons. A review of the different methods and data collection programs in place within GFCM Member Countries is publicly available (GFCM, 2010). In order to fight Illegal, Unreported and Unregulated (IUU) fisheries, GFCM constituted an Authorised vessel list which is available online. This later source of information is comprehensive and accurate for commercial vessels which are longer than 15 meters, but fails to meet its goal for the extensive small scale fleet (<12 m, EC 2005) of the Mediterranean and Black Seas.The technical disaggregation per

[43] http://www.geo-seas.eu
[44] http://www.fao.org/figis/servlet/TabSelector

gear types, fleet segment or operational unit (fleet segment crossed with gear type and targeted species), is an ongoing process initiated within the GFCM Task 1 (GFCM 2007). GFCM requires this type of information annually for the EU Member States and all the other Mediterranean and Black seas countries respectively but it is facing compliance difficulties for obtaining the needed statistics.

4.1.10 GRDC

The Global Runoff Data Centre (GRDC) is an International data centre operating under the auspices of the World Meteorological Organization (WMO), and is internationally manded by the United Nations. Established in 1988 to support the research on global and climate change, and integrated water resources management, the GRDC has been serving for twenty years successfully as a facilitator between the producers of hydrologic data and the international research community. GRDC is a key partner in a number of data collection and data management projects on a global scale. Its primary objective consists in supporting the water and climate related programmes and projects of the United Nations, its specialised agencies and the scientific research community by collecting and disseminating hydrological data across national borders in a long-term perspective.
River discharge is one of the Essential Climate Variables (ECVs), and needs to be systematically observed to characterise the state of the global climate system, its variability and vulnerability. National services are called by the “Second Report on the Adequacy of the Global Climate Observing System for Climate” (2AR) to ensure that their observations and associated metadata, including historical observations, are available at the established international data centres. Against the background of increasing data loads and the wide range of data formats and transfer protocols in use, the standardisation and harmonisation of data became essential to efficient data exchange. The GRDC contributes to the process of developing a metadata profile, which is applicable to the description of hydrologic data and based on the relevant ISO standards.

4.1.11 JERICO

Funded by the European Commission, FP7 Infrastructures, JERICO is an Integrating Activities action contributing to the international and global effort on climate change research (GEOSS), to provide coastal data inputs for operational ocean observing and forecasting, and also to answer the needs of the environmental research and societal communities and has been continued under H2020 as JERICO- NEXT.
The JERICO approach for data management is strongly based on the “use of what exists” through the creation of suitable partnerships with ongoing European data management initiatives for the minimization of duplication of efforts (Fanara et al., 2013). Thus, the JERICO data management framework for delayed-mode data used the SeaDataNet (SDN) infrastructure, while real-time data was being handled through MyOcean (MyO). The JERICO approach is driven by the great importance that MyO and SDN initiatives have had in the last few years, since both systems proved to be robust and successful in the archiving and distribution of marine data, and correspond to a perspective of long-term sustainability for the European marine infrastructures.

In the continuity of JERICO, the objective of JERICO-NEXT consists in strengthening and enlarging a solid and transparent European network in providing operational services for the timely, continuous and sustainable delivery of high quality

environmental data, and information products related to marine environment in European coastal seas. JERICO-NEXT emphasizes that the complexity of the coastal ocean cannot be well understood if interconnection between physics, biogeochemistry and biology is not guaranteed. Such integration requires new technological developments which allows for continuous monitoring of a larger set of parameters. The main objective of the project is to improve and innovate the cooperation in coastal observatories in Europe by implementing the coastal part of a European Ocean Observing System, to cooperate with other European initiatives such as, ESFRI (EURO-ARGO, EMSO, EMBRC), Integrated Infrastructures (FIXO3), OCEAN OF TOMORROW sensors innovation project (SenseNET, NEXOS), the emerging European biological network (EMBRC) and EMODnet to contribute to the provision of services to the research community and the society.

4.1.12 PERSEUS

One of the aims of PERSEUS is to upgrade and expand the present observing capacity in the Mediterranean and Black Sea in responds to policy and science. Capacity building in key Mediterranean and Black sea areas in responds to policy and science. This is specifically addressed by implementing re-locatable multi-platform observatories during periods of several months to address well identified scientific, technological and/or society driven objectives, and gradually develop the local skill to operate such systems.

4.1.13 SEADATANET II

The initiative for developing a Pan-European infrastructure for ocean and marine data management started as Sea-Search project under FP5 (2002 – 2005) with a focus on metadata, and was continued under FP6 (2006 - 2011) as SeaDataNet with a wider focus which includes harmonised access to data. It is continued under FP7 (2011 - 2015) as SeaDataNet. It operated and further developed a Pan-European infrastructure for managing, indexing and providing access to ocean and marine environmental data sets and data products (e.g. physical, chemical, geological, bathymetric and biological properties), and for safeguarding a long term archival and stewardship of these data sets. Data are derived from many different sensors installed on board of research vessels, satellites and in-situ platforms that are part of the various ocean and marine observing systems. Data resources are quality controlled and managed at distributed data centres that are interconnected by SeaDataNet infrastructure and are accessible to users through a central portal. Already, 90 data centres from 35 European countries are connected to the SeaDataNet standards and services for marine data management.

SeaDataNet maintains pan-European discovery services with overviews of marine organisations in Europe, and their engagement in marine research projects, managing large datasets, and data acquisition by research vessels and monitoring programmes for the European seas and global oceans:
•European Directory of Marine Organisations (EDMO)
•European Directory of Marine Environmental Data (EDMED)
•European Directory of Marine Environmental Research Projects (EDMERP)
•Cruise Summary Reports (CSR)
•European Directory of Oceanographic Observing Systems (EDIOS)
•Common Data Index (CDI)

SeaDataNet develops data products and aggregated data sets in five regions: , Mediterranean Sea, Black Sea, Baltic Sea, North Atlantic, and Arctic and North Seas, that can be explored and downloaded by geographical viewing services.SeaDataNet infrastructure is based on the following series of standards and conventions:
•Common metadata standards and XML schemas, based on ISO 19115 / 19139
•Standard data transport formats such as ODV ASCII and NetCDF (CF)
•Common QC methods and quality flag scale
•Common Vocabulary Web services, used to mark up metadata and data, covering a broad spectrum of disciplines. Governed by an international board (SeaVox)
•Unified user interfaces for querying Discovery services
•Use of OGC, ISO, and INSPIRE standard

4.1.14 UP-GRADE BS-SCENE

The UP-GRADE BS-SCENE project is an FP7 EU funded project which ran from 2009-2011, that is building and extending the existing research infrastructure (developed under FP6 project BlackSeaScene 1) with an additional 19 marine environmental institutes/organizations from the 6 Black Sea countries.
The main objectives of the project is to implement FP6 RI SeaDataNet project standards regarding common communication standards, and adapted technologies that ensure the data center's interoperability. Main output was on-line access to in-situ and remote sensing data, meta-data and products. Transnational access activities provides online access to national and international marine environmental and socio-economic data and information services from the data institutes within the Black Sea region. The services include public access to a range of meta-directories, regulated access to the distributed Black Sea datasets, public access to data-viewing services, and regulated access to Black Sea partner's scientific documents, reports and other scientific services.

4.2. Black Sea Member State data collection/ monitoring system

In the Black Sea, there are several collection/monitoring systems in operation or which have been running in the past 10 years. Most of them are nationally operated for different periods and purposes, but none of them has ever been synchronized at the basin level. This monitoring network is partially integrated in the Copernicus Services and in EMODnet data bases.

4.2.1. Coastal stations

- **Bulgarian Port Operational Marine Observing System (POMOS)**

The Port Operational Marine Observing System (POMOS) is a network of distributed sensors and centralized data collection, processing and distribution[45]. The system is designed to allow for the real-time assessment of weather and marine conditions throughout the major Bulgarian ports: Varna, Burgas and Balchik, supporting thereby Maritime administration to secure safety navigation in bays, canals and ports. Real-time information within harbors is obtained using various sensors placed at thirteen strategic locations (Fig. 4.1) to monitor the current state of the environment. The

[45] Palazov et al.: Operational Marine Observing System to Support Safety Port Navigation, Proceedings of the Tenth International Conference on Marine Sciences and Technologies "Black Sea 2010", Varna, Bulgaria, 7–9 October, 2010, 308–312, 2010. http://www.ocean-sci-discuss.net/8/1695/2011/osd-8-1695-2011-print.pdf

most important characteristics for navigation are measured: wind speed and direction, air temperature, relative humidity, atmospheric pressure, visibility, solar radiation, water temperature and salinity, sea level, currents speed and direction, mean wave's parameters. The system consist of: 11 weather stations (3 with extra solar radiation and 4 with extra visibility measurement), 9 water temperature and salinity sensors, 9 sea-level stations, two sea currents and waves stations and two canal currents stations.

Figure 4.1 Location of POMOS measuring stations

All sensors are connected to communication system which provides direct intranet access to the instruments. Every 15 minutes, measured data is transmitted in real-time to the central collecting system, where data is collected, processed and stored in database[46].

- **ECOPORT8- Bourgas prot**

The real-time monitoring systems have been installed in the Bourgas Port, Bulgaria and Constanta Port, Romania under the ECOPORT 8 project.The systems provide real time data for chlorophyll, turbidity, nitrate, oxygen, temperature, salinity, pH, air temperature and pressure, wind speed and direction and humidity[47].

[46] http://www.bgodc.io-bas.bg/ma
[47] http://www.tenecoport.eu/webgis

Figure 4.2 Burgas port- coastal station

- **SHKORPILOVTCI**

Shkorpilovtci is a coastal research base of the Institute of Oceanology, Bulgarian Academy of Sciences, located on the western Black Sea shore about 40 kilometres south from Varna and ten kilometres south from river Kamchia. The base consists of laboratory and 250 m long pier (Fig 4.3). During 1983-1991, the base was used for coastal researches and several experiments were carried out. Nowadays, the base is used mainly for routine observations as well as for case studies. There are several sensors installed such as: weather station, UV radiation and total solar radiation sensors, sea level gauge and sea water temperature sensor.

Figure 4.3 Shorpilovtci pier

- **Mamaia Station**

Mamaia oceanographic real time station is based in Constanta, Romania. It provides data for wind speed and direction, currents speed and direction and six hours average information for water temperature, salinity, oxygen, chlorophyll, and pH[48].

- **Black Sea Automated Sea Level Stations**

Automatic stations of sea level measurements are installed in Constanta (Romania)[49], Katsiveli (Russia), Varna and Burgas (Bulgaria)[50]

4.2.2. Fixed platforms

- **KATCIVELI**

Katciveli is an oceanographic platform situated near the Southern coast of the Crimean settlement Katsiveli, where the Experimental Branch of Marine Hydrophysical Institute is located[51]. The platform is placed at a distance of about 600 m from the coast on the depth 36 m. A number of meteorological and marine parameters are measured at the platform. Meteorological measurements include air

[48] http://www.rmri.ro/Home/Products.MamaiaStation.html
[49] http://www.ioc-sealevelmonitoring.org/map.php
[50] http://www.bgodc.io-bas.bg/sea-level
[51] G. K. Korotaev et al.: Contribution of the Black Sea observing system to ECOOP: Ocean Sci. Discuss., 8, 1695–1722, 2011. doi:10.5194/osd-8-1695-2011. http://www.ocean-sci-discuss.net/8/1695/2011/

temperature, humidity, wind speed and direction. Marine observing component consists of measurements of sea surface temperature, temperature profile of up to 30 m depth, surface waves, low frequency sea level oscillations and currents velocity. Observations are carried out from the beginning of May until the end of October only.

Figure 4.4 Katcively platform

- **GALATA**

GALATA is built on a fixed, unmanned, earth gas production platform, located in western part of the Black Sea on the Bulgarian shelf 26 km east from the city of Varna and its aim is to provide real time oceanographic data. The system collects data with minimum components to maximize the use of existing facilities: weather station, water temperature, conductivity, DO, chlorophyll and ADCP. A SeaPRISM - autonomous above-water radiometer is also installed on the platform that provides continous assessment of the marine and atmospheric products (i.e., LWN and τa(λ) at the 412, 443, 488, 531, 551, 667, 870 and 1020 nm nominal center-wavelengths). The equipment is part of the international ARONEC-OC system[52] and it is operated by JRC scientists[53].

[52] Zibordi et al.: A network for standardized ocean color validation measurements: Eos, Vol. 87, No. 30, 2006. DOI: 10.1029/2006EO300001.
http://onlinelibrary.wiley.com/doi/10.1029/2006EO300001/epdf
[53] http://aeronet.gsfc.nasa.gov/cgi-bin/type_piece_of_map_seaprism_new

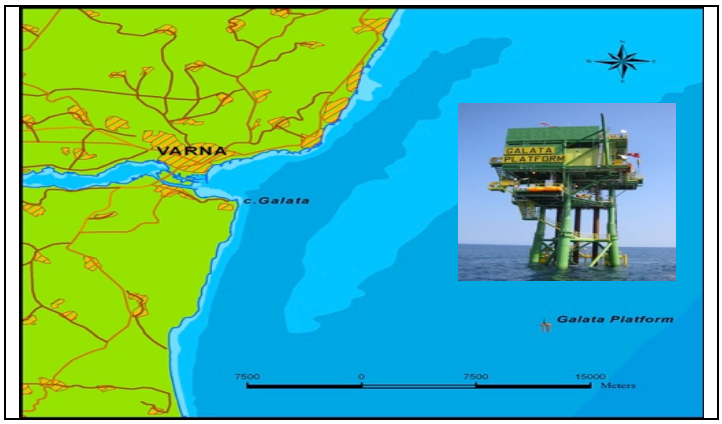

Figure 4.5 Galata platform

- **GLORIA**

Gloria offshore oil platform is located in the north-western part of the Black Sea in front of the Romania coats (50 m depth) (Fig. 4.6). A SeaPRISM - an autonomous above-water radiometer is installed on the platform that provide continous assessment of the marine and atmospheric products (i.e., LWN and τa (λ) at the 412, 443, 488, 531, 551, 667, 870 and 1020 nm nominal center-wavelengths). The equipment is provided by JRC, Ispra and it is part of the international ARONEC-OC system[54].

Figure 4.6 Gloria platform

4.2.3. Moored observatories

- **IMAMO real time oceanographic system**

IMAMO system consists of two Coastal Monitoring Buoys (YSI Integrated Systems & Services, USA) with SmartSub Observatories (Anderaa Data Instruments AS, Norway). The oceanographic instruments are deployed in Varna and Bourgas bays (areas under anthropogenic pressure), where the water depth does not exceed 25 m. The system provides real time data of the major oceanographic (water temperature, salinity, dissolved oxygen, turbidity chlorophylla, CDOM, SWH and currents speed and direction) and meteorological (air temperature, atmospheric pressure, wind

[54] http://aeronet.gsfc.nasa.gov/cgi-bin/type_one_station_aod_v3?site=Gloria&nachal=2&level=1&place_code=10

speed and direction, humidity) parameters. The data are transmitted in real time by GPRS communication[55].

Figure 4.7 Varna surface buoys

- **EUXINUS Black Sea Security System**

The EUXINUS network consists from 4 automatic marine monitoring systems, installed in key points of the Western Black Sea shelf, 3 deployed in water depths around 100 m and one deployed near the shoreline (Mangalia, Romania), close to the Romanian – Bulgarian border. The network provides all the information needed in the process of elaboration and issues off an early-warning notification and assessment of marine environment[56].

4.2.4 FerryBox systems

In the frame of EEA Grand "Marine litter, eutrophication and noise assessment – MARLEN" four Aanderaa versions of Ferrybox named SOOGuard systems have been installed on the two Bulgarian oil tankers (NAVI and AGAMEMNON), a tourist catamaran and Ferry "Drujba". The systems consist of an automated package of conductivity, dissolved oxygen, temperature, turbidity and chlorophyll. Measurements of environmental parameters in the surface water along vessels route are collected and transmitted in near real time[57].

4.2.5 Lagrangian observations (Black Sea Argo floats and drifters)

In total, 30 Argo floats have been operated in the Black Sea since 2002 and have provided more than 3200 CTD profiles. The floats were deployed in the frame of different Black Sea and EU projects and initiatives. The number of active profiles per year significantly increased from 3 in 2002, to 13 in 2013 and 2014 (Palazov et al, 2014). Almost 90 drifting buoys were deployed from 1999 to 2007 in the Black Sea 82 (Fig.17). They are produced by MARLIN-YUG LTD, and they follow common

[55] http://ftpdc.io-bas.bg
[56] http://intranet.geoecomar.ro/rchm/presentation
[57] http://ftpdc.io-bas.bg

standards[58] [Sybrandy et al, 2009]. Drifters have holey sock drogues on the depth 15m, and the system of buoys positioning by ARGOS-2 permits to determine velocity of surface currents. The sensors placed on drifting buoys measure atmospheric pressure and sea surface temperature. The data of drifting buoys are transmitted through GTS to the regional hydrometeorological centres, and are available through the Internet. Drifters with 60 m thermistor chain became a new efficient tool for studying the Black Sea since 2004. Another modification of temperature-profiling drifter was used in the Black Sea in 2009. Three deployed buoys were updated to send the data via IRIDIUM satellite system and to define their locations via GPS receivers. These buoys are permitted to define their locations within 30 mins interval, in any weather condition.

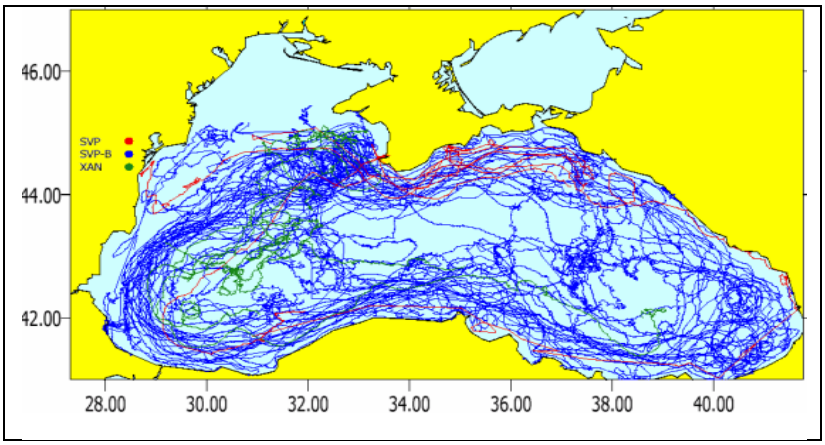

Figure 4.8 Trajectories of the Black Sea drifters

5. Use Cases related to Challenges

In order to have a first understanding of basin scale monitoring systems adequacy, we analysed several literature Use Cases that described similar products to the Checkpoint Targeted products (described in Table 1.1), and evaluated the quality and availability of input data sets. From 42 collected Use Cases, we have selected 24 to be as much as possible relevant for the specific Checkpoint Targeted products. The 24 selected were the ones that contained enough evidence for an initial data adequacy assessment of the input data. The initial list of Use Cases was decided by the single Challenge experts and the final selection was done by the team writing the LS.
Table 5.1 presents links between numbers of literature Use Cases, the characteristic categories involved and the Environmental matrices.

Challenge	Number	Number of characteristics for each Environmental matrix

[58] Sybrandy, A. L., P.P. Niiler, W. Scuba, E. Charpentier, and D. T. Meldrum (2009), Global Drifter Programme – Barometer Drifter Design Reference, 2009: DBCP report 4, Rev. 2.2. Available online at http://www.jcommops.org/doc/DBCP/svpb_design_manual.pdf

	of Use Cases	Air	Ice	Fresh water	Marine water	Biota/ Biology	Riverbed/ Seabed	Human activities
1. Windfarm siting	**1**	6			12	2	2	2
2. Marine Protected Areas	**3**	2			1	5	6	19
3. Oil Platform Leak	**2**	1	1		6	1		2
4. Climate	**3**	4	1		7	2		
5. Coasts	**2**				2		2	
6. Fishery Management	**5**					15		9
7. Fishery Impact	**1**					6		2
8. Eutrophication	**2**	1		1	4	3		2
9. River Inputs	**1**			7				
10. Bathymetry	**2**						2	
11. Alien Species	**2**				3	4		
TOTAL	**24**	14	2	8	35	38	12	36

Table 5.1 Use Cases statistics: number of Use cases by Challenge, number of Use Case characteristics subdivided in environmental matrices

For each Challenge, 1 to 5 Use Cases have been analysed which contain characteristics similar to the one described in Section 3 for the Checkpoint Challenges.

5.1 Use Cases description

The 24 Use cases introduced above are listed in Table 5.2.

ID	Title
CH1.1	MARINA (Marine Renewable Integrated Application Platform)
CH2.1	SINCRON Project "Integrated Management and Awareness Raising System of the Natura 2000 Network in Romania"
CH2.2	COCONET WebGIS Application
CH2.3	MISIS Project "MSFD Guiding Improvements in the Black Sea Integrated Monitoring System"
CH3.1	Modeling the potential oil spill behaviour when operating the off-shore ice-resistant fixed platform "Prirazlomnaya (the Barents Sea)"
CH3.2	Satellite monitoring of oil slicks on the Black Sea surface
CH4.1	Long-term changes in nutrient supply of phytoplankton growth in the Black Sea
CH4.2	MASIE NH (Multisensor Analyzed Sea Ice Extent - Northern Hemisphere)
CH4.3	Decadal variability of temperature and salinity in the Black Sea
CH5.1	Black Sea level trends from tide gauges and satellite altimetry
CH5.2	The lythodynamic processes in the seashore zone of the Black Sea
CH6.1	Fishery Statistical Collections GFCM (Mediterranean and Black Sea) Capture Production
CH6.2	Scientific, Technical and Economic Committee for Fisheries (STECF) – EC
CH6.3	General Fisheries Commission for the Mediterranean (GFCM) - Working Group for the Black Sea
CH6.4	Project Strengthening the Regional Capacity to Support the Sustainable Management of the Black Sea Fisheries (SRCSSMBSF) – 88
CH6.5	FP7 Project MareFrame – Co-creating Ecosystem-based Fisheries Management Solutions
CH7.1	Black Sea Regional Activity Centre for Environmental Aspects of Fisheries and other Marine Living Resources Management (RAC FOMLRM) – Black Sea Commission
CH8.1	State of Environment Report 2001 – 2006/7
CH8.2	Nutrient budgets for European seas: A measure of the effectiveness of nutrient reduction policies
CH9.1	European hydrological predictions for the environment – E-HYPE
CH10.1	Projects BlaSON and BlaSON 2 (Black Sea Over the Neoeuxinian)
CH10.2	Determination of the Black Sea area and coastline length using GIS methods and Landsat-7 satellite images
CH11.1	A basin-wide Black Sea Mnemiopsis leidyi database
CH11.1	Addressing the ecological issue of the invasive species, Special focus on the ctenophore Mnemiopsis leidyi (Agassiz, 1865) in the Black Sea

Table 5.2 Use cases short description

A more detailed description of the content of each Use Case, as deduced from the Literature, deliverable from a project or web site, is given in the following subsections.

5.1.1 Challenge 1: Windfarm Siting

This section describes one Use case for Challenge 1.

ID	Title	Environnmental Matrix of Interest	Related EMODNET challenges

CH1.1	MARINA (Marine Renewable Integrated Application Platform)	Air, Marine Waters	CH-1

Table 5.1.1 Use Cases of CH-1Windfarm Siting

Use case CH1.1: MARINA (Marine Renewable Integrated Application Platform)
The objective of the MARINA Platform project was to establish a set of equitable and transparent criteria for the evaluation of multi-purpose platforms for marine renewable energy (MRE) all focussed on system integration and reducing costs.
One way of reducing costs is to exploit synergies with other technologies. One effective choice is to combine offshore wind with other Marine Renewable Energy (MRE) technologies, primarily wave energy but also ocean and/or tidal currents at sites where these resources are concentrated. If costs can be reduced to a competitive level, the potential for wind farms in deeper waters is huge.These were brought to the level of preliminary engineering designs with estimates for energy output, material sizes and weights, platform dimensions, component specifications and other relevant factors. This allowed the resultant new multi-purpose MRE platform designs, validated by advanced modelling and tank-testing at reduced scale, to be taken to the next stage of development, which is the construction of pilot scale platforms for testing at sea. Recognising the complexity of the challenge, and the significant development risks, MARINA was primarily a research project focused on the longer-term benefits and synergies of integrating deep-water wind and ocean energy.

- Characteristics for CH1.1:
  - ***Air:***
    - Zonal wind component
    - Meridional wind component
    - Air temperature
    - Air pressure
    - Air density
    - Specific humidity of the atmosphere
  - ***Marine waters***
    - Sea level
    - Water temperature
    - Water salinity
    - Water zonal velocity component
    - Water meridional velocity component
    - 2-dimensional wave spectra over frequencies and directions
    - Significant Wave Height
    - Mean wave direction
    - Mean (Energy) wave period
    - Peak wave period
    - Swell wave height
    - Maximum expected wave height

5.1.2 Challenge 2: Marine Protected Areas

This section describes 3 Use cases for Challenge 2: Marine Protected Areas.

ID	Title	Environnmental Matrix of Interest	Related EMODNET challenges
CH2.1	SINCRON Project "Integrated Management and Awareness Raising System of the Natura 2000 Network in Romania"	Air, Marine waters	CH-2
CH2.2	COCONET WebGIS Application	Air, Marine waters,Riverbed/Seabed, Biota/Biology,Human activities	CH-2, CH-1
CH2.3	MISIS Project "MSFD Guiding Improvements in the Black Sea Integrated Monitoring System"	Riverbed/Seabed, Biota/Biology,Human activities	CH-2

Table 5.1.2 Use Cases of CH-2 Marine Protected Areas

Use case CH2.1: SINCRON Project "Integrated Management and Awareness Raising System of the Natura 2000 Network in Romania"

SINCRON is a project aimed at establishing an IT infrastructure for the management and awareness of raising Romania's Natura 2000 network. The solution integrates a powerful Geographic Information System (GIS), combining background satellite data, derived from SPOT satellite high-resolution multispectral images, with very high resolution aerial imagery. These high-resolution images provide the necessary cartographic support for graphical delimitations of habitats and are used to identify relevant natural and man-made elements which have an impact on the protected sites. Structured geospatial information is integrated in the protected sites' management plans and a lot of geographical information is automatically derived from highly accurate GIS data, ensuring the best information available to site administrators, NGOs and stakeholders.

Thanks to SINCRON, national as well as regional environmental protection agencies can share and act in a coordinated manner, on the basis of the same, up-to-date information, online.

- Characteristics for CH2.1:
  - ***Riverbed/Seabed:***
    - Habitats
  - ***Biota/Biology:***
    - Species
  - ***Human Activities:***
    - EU RAMSAR area
    - EU Habitat areas
    - EU Bird protection areas
    - National conservation areas

Use case CH2.2: COCONET WebGIS Application

The COCONET WebGIS is a product of the project "Towards COast to COast NETworks of marine protected areas (from the shore to the high and deep sea) coupled with sea-based wind energy potential" and publishes data stored in the Geodatabases with all information available for the Mediterranean and Black Sea.

The WebGIS system provides access and integration of all types of data and information produced by different partners.

This WebGIS system allows the partners to visualize the Geodatabase architectures, to query and download data, to print a map with a legend. It displays layers stored in the Geodatabase, designed following the INSPIRE UML Schemas that contain:

- **Protected Sites:** protected sites at sea and 15 km inland from the coast. Areas designated or managed within a framework of national, international, Community and Member States' legislation to achieve specific conservation objectives. Each site has its zones of protection, and its characteristics are described in related table, such as, present species, present habitats and regulation. In addiction, they are linked to the webpage or to the established document of the protected site.

- **Offshore Wind Farms:** Existing and planning site for Offshore Wind farms turbines and potential locations based on physical parameters (depth, distance from shore, etc.) or environmental data (habitat presence, marine protected sites, etc.). The geodatabase stores all the information about wind energy and wind speed at 10 and 80 meters. The results about the spatial analysis will be stored here, such as the chart of more suitable areas to install OWF.

- **Habitats and Biotopes:** Geographical areas, lines or points characterized by specific ecological conditions, processes, structure, and functions that physically support the organisms that live there. The gdb includes the habitats' extension and characterization, the sampling elements and the habitat suitability models. The geographical information is completed by no-spatial data about species, sources and cover types.

- **Biodiversity:** The gdb collects information about species occurrences, species distribution, mammals, birds and turtles at sea and about nesting sites at land. The elements are linked to their sampling features (transects, stations and survey areas). Information about taxonomy and sources are stored in related tables.

- **Geology:** The gdb stored geological samples (grabs, boreholes), geological units (lithostratigraphic units, seabed substrate, system tracks, base of Quaternary, etc), geological structures (folds, faults), geomorphologic features (natural and anthropogenic) and geophysical elements.

- **Oceanography:** physical variables (temperature, salinity, currents), biogeochemical variables (chlorophyll, phytoplankton, dissolved oxygen, etc.), and ecoregions, the last one produced in the framework of the CoCoNet project according to physical parameters.

- **Socio-economics:** Units of administration at land, dividing areas where States have and/or exercise jurisdictional rights, for local, regional and national governance, separated by administrative boundaries. The land uses, the land cover, information about socio-economic parameters and stakeholder's positions.

- **Threats:** Natural and anthropogenic activities and impacts: invasive species, outfalls, marine litter, fishing, navigation routes, and so on. The gdb changes in the case of the pilot project areas, where more specific layers have been created.

- **Maritime Units:** Units of administration at sea, dividing areas where States have and/or exercise jurisdictional rights, for local, regional and national governance, separated by administrative boundaries. Here: Exclusive Economic Zones (EEZ), contiguous zones, territorial zones and maritime boundaries.

- **Sea Regions:** Physical conditions of seas divided into regions and sub-regions with common characteristics. A Sea Region (SR) is a 2D geometry of an area or line

with common (physical or chemical) characteristics that is covered by sea. Here, we have: seas, biogeographycal regions (areas of relatively homogeneous ecological conditions with common characteristics) and coastline.

- **Elevation:** Digital Elevation models for land and sea surface. This includes bathymetry, marine contours, and bathymetric surfaces. The DEM of elevation (SRTM 90m Digital Elevation Data) and the bathymetry (EMODNET) are used as base maps in the webgis platform.

- **Connectivity:** The gdb manages data about connectivity, in details: oceanography (currents, trajectories), genetics (species analysis), propagules (source, sink and retainer sites) and beta-diversity (assemblages' similarity and distance decay).

- **Habitat Mapping:** Habitat mapping of the pilot areas according to the CoCoNet classification scheme (Geomorphological layer, Substrate layer, Biological layer). A polygonal map of habitats is produced from indirect methods (e.g. multibeam echosounder) and a linear map from direct methods (ROV dives and CARLIT methodology). Each dataset is linked to the own sampling features (e.g. ROV navigations, stations, transects) described in related tables.

The WebGIS system publishes the data stored in the GDBs using ArcGIS Server 10 software and the Content management System (CMS) called MOKA, provided by Regione Emilia Romagna in cooperation with SEMENDA srl.

- Characteristics for CH2.2:
  - ***Air:***
    - Wind data
  - ***Marine Waters:***
    - Water temperature
  - ***Riverbed/Seabed:***
    - Habitat mapping
    - Geology
  - ***Biota/Biology:***
    - Species
    - Connectivity
  - ***Human Activities:***
    - EU RAMSAR area
    - EU Habitat areas
    - EU Bird protection areas
    - National conservation areas
    - Socio-economics
    - Threats

Use case CH2.3: MISIS Project "MSFD Guiding Improvements in the Black Sea Integrated Monitoring System"

The MISIS Project, "MSFD Guiding Improvements in the Black Sea Integrated Monitoring System" " (DG Env. Project No. 07.020400/2012/616044/SUB/D2). MISIS was financed by the EC as an activity under the EC DG Env. Programme "Preparatory Action – Environmental Monitoring of the Black Sea Basin and a common European framework programme for the development of the Black Sea region/Black Sea and Mediterranean 2011". MISIS is an integral part of the overall ongoing process of harmonization of policies in the Black Sea region in the field of environment protection, taking into consideration relevant European acqua.Purpose of the report is to trace the progress in the beneficiary states toward the marine areas of protection and the Biodiversity and Landscape Conservation Protocol enforcement

and in this context, to specifically review the level of designation in each beneficiary country of MPAs, the management, plans in place, and the effectiveness of their implementation, including legal, policy and technical aspects of planning transboundary areas in the Black Sea for designation as protected.
In order to provide such an overview, specific objectives were settled out, as follows:

- To improve availability and quality of chemical and biological data for integrated assessments of the Black Sea environmental state, including pressures and impact (in line with Annex I and III of the MSFD);

- To increase number and size of protected areas in the Black Sea as well as to increase their degree of protection;

- To enhance stakeholders' participation and public awareness on environmental issues.

- Characteristics of CH2.3:
  - ***Riverbed/Seabed:***
    - Habitats
    - Bathymetry
  - ***Biota/Biology:***
    - Species
    - Biodiversity
  - ***Human Activities:***
    - EU RAMSAR area
    - EU Habitat areas
    - EU Bird protection areas
    - Marine protected areas
    - Monitoring
    - Intercalibration
    - Conservation and protection
    - Management of MPA
    - Tourism

5.1.3 Challenge 3: Oil Platform Leak

This section describes 2 Use cases for Challenge 3: Oil Platform Leak.

ID	Title	Environnmental Matrix of Interest	Related EMODNET challenges
CH3.1	Modeling the potential oil spill behaviour when operating the off-shore ice-resistant fixed platform "Prirazlomnaya (the Barents Sea)"	Air, Marine waters, Human activities	CH-3
CH3.2	Satellite monitoring of oil slicks on the Black Sea surface	Marine waters, Human activities	CH-3

Table 5.1.3 Use Cases of CH-3Oil Platform Leak

Use case CH3.1: Modeling the potential oil spill behaviour when operating the off-shore ice-resistant fixed platform "Prirazlomnaya (the Barents Sea)"

Despite a significant potential for oil reserves in the Black Sea (more than 100 wells), currently, there is not any assessment of emergency response related to the potential oil spills when operating off-shore oil platforms. Thus, we have chosen a use case that summarizes findings of the Greenpeace Russia Project, devoted to the potentials of most severe oil spill scenarios on the first Russian off-shore ice-resistant fixed platform installed in the Barents Sea (Zhuravel et al., 2013). This use case seems to be unique because, it takes into consideration technical characteristics of real oil platform rather than abstract ones. Oil spill scenarios were approved by the oil industry experts in order to reveal the gaps in the oil spill prevention and response plan for the operational area on the Arctic shelf. The Project products consist of oil spill simulations using a Lagrangian model OilMARS v.2 (Oil spill Model for the Arctic seas (Stanovoy et al., 2007, Ovsienko et al., 1999), and stress tests for oil spill emergency response capabilities. Modeling addresses the following accidental oil spill scenarios: (1) oil spill in the event of tanker (crude carrier) accident with the volume of up to 10,000 tons during 5 days; (2) oil spill in the event of the well blowout with the volume of up to 1,500 tons during 3 days; and (3) oil spill in the event of the temporary oil storage damage with the volume of up to 16,000 tons during 5 days. To initiate the oil spill models, two Russian original oceanographic models were used: Arctic Ocean water and ice circulation model (Kulakov et al., 2012, Lebedev et al., 2003), and the regional Barents Sea tidal model (Zilberstein et al., 2007). Analysis of oil spill response operations includes testing the booms, oleophilic skimmers, and oil trawl systems to protect the most important and vulnerable specially protected natural reservations (3 sites) during the ice-free period and the ice season. It was concluded that the most efficient way to deal with massive and long lasting spills under complicated meteorological conditions, include, setting the intercepting booms as close to the source as possible to accumulate the maximum amount of oil (100-120 tons before the spill drifts under the influence of tidal currents) for its rapid collection before the boom's deformation by subsequent maneuvers of the vessels.

The main information gap of the Project seems to be (1) a rather poor visibility, accessibility of the datasets used and (2) lack of international peer-reviewed publications.

- Characteristics of CH3.1:
  - ***Air:***
    - Wind data
  - ***Ice:***
    - Ice cover data
  - ***Marine waters:***
    - Sea temperature and salinity
    - Surface currents including 8 major tidal harmonics
    - Satellite altimetry data for the model assimilation
    - Tide heights for the altimetry data corrections
  - ***Human Activities:***
    - Data on drilling and well production
    - Oil tanker (crude carrier) traffic risk assessment
    - Specially protected natural reservations
    - Response equipment and technologies

Use case CH3.2: Satellite monitoring of oil slicks on the Black Sea surface

This use case (Lavrova and Mityagina, 2013), seems to be an example of best practices of satellite monitoring conducted by the Aerospace Radar Laboratory of Space Research Institute (Moscow, Russia). Apart from the Black Sea, the laboratory is working on monitoring the Baltic, and Caspian seas (Kostianoy et al., 2006, Mityagina et al., 2015).

This paper is dedicated to results from satellite monitoring of the Black Sea waters based on analysis of space images in microwave (SARs installed on ERS-2 and ASARs on Envisat ESA satellites), optical and IR-ranges of EMS. The main reason for our choice of this use case is a generalized Black Sea map of operational oil pollution over 2006–2011. This map allows for identification of the main "hot spots" in the basin. It was discovered that the majority of anthropogenic sea-surface oil pollutions were leaks and discharges of waters containing oil from vessels. Vessel spills concentrate along the main navigation routes, Istanbul–Novorossiysk, Istanbul–Odessa, and Istanbul–Tuapse; and near the large ports of Bulgaria, Turkey, Romania, and Ukraine. The paper discusses a problem of distinguishing the surface films of anthropogenic and natural (biogenic and mineral) origins, and errors arisen from their mixing. In addition, the presence of active mud volcanoes and natural hydrocarbon outflows (methane seeps), influences significantly the SAR images in the Black Sea. Due to obsolete waste-water treatment on the Black Sea coast, the major risk zones in the Russian sector of the Black Sea are regions around the cities of Novorossiysk, Gelendzhik, Tuapse, and Sochi.

The main information gap of the described publication seems to be (1) absence of references to the raw data sources, and (2) poor visibility of the processed satellite radar images represented in the European system of oceanological data SeaDataNet (http://www.seadatanet.org) and poor accessibility in the Upgrade Black Sea Scene international project (http://www.blackseascene.net), in which the authors of this article participated.

The same issue of operational use of space imagery for oil pollution monitoring in the Adriatic basin was discussed in Ferraro et al. (2007) in the framework of AESOP (aerial and satellite surveillance of operational pollution in the Adriatic Sea) Project. AIS-based vessel traffic system was used as a polluter identification tool in the Adriatic. Additionally, sea surface currents from the Adriatic Sea regional model (AREG) (Zavatarelli and Pinardi, 2003), were used for interpretation of SAR images. The structure and contributions of Project partners were described more clearly than in the Black Sea use case, but the sources of raw data and depository of processed data also were not specified.

- Characteristics of CH3.2:
  - ***Marine Waters:***
    - Satellite radar images from ERS-2 and Envisat to detect oil pollution
    - Satellite IR-range and optical data from the MODIS Aqua/Terra, MERIS, and AVHRR NOAA to evaluate SST and the mesoscale dynamics in the radar images interpretation
  - ***Biota/Biology:***
    - Biogenic sea surface films due to chlorophyll life cycles and algal blooms
  - ***Human Activities:***
    - Operational oil pollution of the Black Sea
    - Waste-water leaks

5.1.4 Challenge 4: Climate

This section describes 6 Use cases for Challenge 4: Climate.

ID	Title	Environnmental Matrix of Interest	Related EMODNET challenges
CH4.1	Long-term changes in nutrient supply of phytoplankton growth in the Black Sea	Marine waters, Biota/Biology	CH-4
CH4.2	MASIE NH (Multisensor Analyzed Sea Ice Extent - Northern Hemisphere)	Air, Ice	CH-4
CH4.3	Decadal variability of temperature and salinity in the Black Sea	Air, Marine waters	CH-4

Table 5.1.4 Use Cases of CH-4Climate

Use case CH4.1: Long-term changes in nutrient supply of phytoplankton growth in the Black Sea

In this research, the long-term changes of the total phytoplankton biomass and taxonomic groups were analyzed during the last 40-year period (1969–2008), in the open waters of the Black Sea. The study was based on the Black Sea Database ODBMS prepared in the framework of the NATO SfP-971818 ODBMS Black Sea Project (Ivanov et al., 1998). There are only few similar studies based on the field data of phytoplankton biomass, chlorophyll a or primary production in the deep basin (Yunev et al., 2002; Krivenko, Nesterova et al., 2008; O. & Parkhomenko, 2010).

The special goal of this research is also to trace the long-term dynamics in the supply of nutrients and their ratios in the pycnocline, as well as changes in intensity of the upward flow of nutrients into the euphotic zone and impact of these factors on abundance and the taxonomic structure of phytoplankton. The spatial and temporal resolution of the used data base was not enough for analysis of year-to-year changes. Authors resolved this problem by averaging of data for the decadal periods. Based on changes of the total phytoplankton biomass, three periods were revealed: Pre-eutrophication (PR) in 1969–1983, Eutrophication (EU) in 1984–1995 and Post-eutrophication (PS) in 1996–2008. Averaged depth-integrated phytoplankton biomass increased 6 times from 3.3 g m^{-2} in PR to 19.6 g m^{-2} during EU and decreased down to 10.6 g m^{-2} in PS, what was still 3 times higher than during PR. Similar changes were observed in concentration of inorganic nitrogen (N) both in pycnocline and in the Cold Intermediate layer. Content of inorganic phosphorus (P) has increased significantly on 30% from 0.28 μM during PR to 0.37 μM in PS, while Si sharply decreased from 20 μM in PR to 12.1 μM in PS. The period of EU coincided with the regional cold climatic period, which manifested in the decrease of the winter sea surface temperature (Oguz, T., 2008; Kazmin, A.S., Zatsepin, A.G., 2007).

The used data base provided possibility to analyze changes of the total phytoplankton biomass as well as diatoms and Dinoflagellates, which were similar to the dynamics of N. Their biomasses were highest during EU and decreased after, but remained at a higher level than before the eutrophication. Like P coccolithophorids showed a marked increase over time, which is consistent with their dependence on phosphate concentration. Abundance of Silicoflagellates fell down in 4 times what coincided with decreasing trend in Si. An important prediction was made concerning the growing role of Coccolithophores in the phytoplankton of the open Black Sea.

- Characteristics of CH4.1:
  - ***Marine Waters:***
    - Temperature
    - Nutrients
  - ***Biota/Biology:***
    - Phytoplankton biomass
    - Taxonomic groups

Use case CH4.2: MASIE NH

The Multisensor Analyzed Sea Ice Extent - Northern Hemisphere (MASIE-NH) products, provide measurements of daily sea ice extent and sea ice edge boundary for the Northern Hemisphere. The input data comes from the 1 km and 4 km Interactive Multisensor Snow and Ice Mapping System (IMS), snow and ice product produced by the National Ice Center (NIC). NIC utilizes visible imagery, passive microwave data, and NIC weekly analysis products to create their data product. The MASIE-NH products are distributed in a number of formats including ASCII text, GeoTIFF, PNG, shapefiles, and Google Earth files.The data cover the period since 2006, and will be used to estimate the sea ice extend in the Black Sea over the last 10 years

- Characteristics of CH4.2:
  - ***Air:***
    - Air temperature at 2 m
  - ***Ice:***
    - Snow and ice mass, thickness and extent

Use case CH4.3: Decadal variability of temperature and salinity in the Black Sea

The chosen papers summarized recent research on the Black Sea climate variability performed at Marine climate department of Marine hydrophysical institute (Sevastopol, Ukraine). Decadal temperature and salinity fields at the standard z-levels were calculated from in-situ and satellite datasets, over 195x-2008 by means of optimal interpolation. The upper sea layer (0–50 m) indicated low-frequency quasi-periodic oscillations with a magnitude of 1°C in winter, and 2°C in summer. It was discovered that these oscillations were synchronized with the air temperature oscillations of 60–70 year period. Upper layer salinity showed a negative trend (–0.004 PSU/yr) and 20–30 year oscillations with a magnitude of 0.2 PSU. In pycnocline, both temperature and salinity grew at the rate of 0.002 °C/yr and 0.005 PSU/yr, respectively.

Density fields and geostrophic circulation in the 0–300 dbar layer were obtained from an institutional archive of hydrological data for several decades 195x–199x. Gradual rise of pycnocline depth was indicated in the central cyclonic gyres from 5 m at the top of the pycnocline to 10–15 m at the 100–300 m levels. Geostrophic currents showed some intensification in the 0–50 m layer and reduction in the 200–300 m layer. The connection with the wind vorticity, river runoff, precipitation, and air temperature was analyzed. Strengthening the cyclonic wind vorticity in 196xx and early 197xx may have caused intensification in circulation.

- Characteristics of CH4.3:
  - ***Air:***
    - Long-term time series of air temperature,

- Long-term time series of wind speed at 10-m height
- NAO indices

- ***Marine waters:***
  - Sea water temperature
  - Sea water salinity
  - Sea water density
  - Geostrophic currents calculated by the dynamic method in the 0–300 dbar layer.
  - Kinetic energy of the geostrophic currents.ure

5.1.5 Challenge 5: Coasts

This section describes 2 Use cases for Challenge 5: Coasts.

ID	Title	Environmental Matrix of Interest	Related EMODNET challenges
CH5.1	Black Sea level trends from tide gauges and satellite altimetry	Marine waters	CH-5
CH5.2	The lythodynamic processes in the seashore zone of the Black Sea	Riverbed/Seabed	CH-5

Table 5.1.5 Use Cases of CH-5Coasts

Use case CH5.1: Black Sea level trends from tide gauges and satellite altimetry

Sea level variations are an important signal of global climate change [Kubryakov and Stanichnyi, 2013]. Moreover, vacillations of the sea level strongly influence human activity along the coasts [Boguslavsky et al., 1998]. Long-term variability (more than a century) of the Black Sea level are mainly based on measurements from tide gauges installed at coastal stations [Kubryakov and Stanichnyi, 2013]. Satellite altimetry is operational for nearly three decades and can provide information on mean sea level changes on time scales ranging from ~ 1 month to several years with high spatio-temporal coverage [Cazenave at al., 2002]. The joint analysis of tide-gage and satellite measurements of the sea level variations enables to study the peculiarities of the long-term variability of the sea level in the whole area of the Black Sea, to compute and compare the estimates of its trends by two different measurement methods and to determine the speed of vertical crustal motions [Kubryakov and Stanichnyi, 2013, Cazenave at al., 2002]. Here, we report about one of the latest studies on Black Sea level trends from tide gauges and satellite altimetry [Kubryakov and Stanichnyi, 2013]. In this research work, sea level data which were measured at coastal stations located in Odessa, Sevastopol, Yalta, and Feodosiya in the period of 1993–2005 were used [Goryachkin and Ivanov, 2006]. Satellite altimetry data were obtained in the form of the sea level anomalies along the tracks of Topex/Poseidon and Jason-1 satellites from http://www.aviso.oceanobs.com/ (now available from http://marine.copernicus.eu/).

- Characteristics of CH5.1:
  - ***Marine Waters:***
    - Sea level from tide gauges
    - Sea level from satellite altimetry

Use case CH5.2: The lythodynamic processes in the seashore zone of the Black Sea

For the characterisation of shore processes along Black Sea coastal zones, a case study at Central Kolkhida (Georgia) has been chosen. Here, is located the City of Poti and marine harbors. The seashore zone of the Black Sea in Georgia mainly belongs to accumulative type, where there is a spread of natural sand-stone beaches. The beaches are the natural protective system itself, determining the beach stability. Beaches absorb wave energy, came from the sea, at the expense of their particle mass movement. The overall sum of the components of sediment transport defines the sedimentary balance, which is the main parameter that characterizes the dynamics of the littoral zone. It is computed for each littoral sector by taking into account all sediment inputs into and outputs from the chosen region.

Inputs of sediments are: rivers that flow into the sea, littoral long shore transport from neighbouring beach sectors, onshore transport, eroding cliffs or coastal dunes, or human related activities such as artificial sand nourishment or planned sediment by-passing of certain obstacles. Sediment outputs include transport to neighbouring sectors of the coast by the long shore current or towards the offshore direction. Sediment can also be removed from the dynamic part of the beach system by deposition on the coastal dunes or on prograding coastlines. [Kiknadze, 1991; Kiknadze, 2005].

The above mentioned section of the Georgian seashore zone was formed from the solid runoff, abundantly brought by the River Rioni. River sediments, brought to the sea, under the influence of the sea waves and currents migrate and are distributed on the underwater slope, located along the coast [Zenkovich, 1990].

The coast has been developed to resist strong anthropogenic impacts during the last 150 years. In the second part of the 19th century, the Poti port was built, the moles of which actually divided into two parts the coast of Kolkhida, resulting in independent development of 14-km coast, located southwards from the port, to the River Supsa estuary. The submarine slope of the shore, which is located between Poti and Supsa, from the north, is limited by the Poti submarine canyon head, close to the south mole of the port, and from the south by the submarine canyon, having the same name and located in front of the River Supsa estuary. The heads of both canyons are located near shoreline and the large amount of coast forming sediments flow into the greater depths.

The beach line is very sensitive to artificially initiated human negative impact. In many cases, degradation of the shores is due to the mentioned influences. Damaged shores need protection measures, the correct project decision of which depends on research and study of litho-dynamic processes, ongoing in the coastal zone. Otherwise, the conducted expensive protection measures will not be effective.

- Characteristics of CH5.2:
  - ***Riverbed/Seabed:***
    - Sediment mass balance and coastal erosion
    - Bathymetry, elevation and undersea features

5.1.6 Challenge 6: Fishery Management

This section describes 5 Use cases for Challenge 6: Fishery Management.

ID	Title	Environmental Matrix of Interest	Related EMODNET challenges
CH6.1	Fishery Statistical Collections GFCM (Mediterranean and Black Sea) Capture Production	Biota/Biology,Human activities	CH-6
CH6.2	Scientific, Technical and Economic Committee for Fisheries (STECF) – EC	Biota/Biology,Human activities	CH-6
CH6.3	General Fisheries Commission for the Mediterranean (GFCM) - Working Group for the Black Sea	Biota/Biology,Human activities	CH-6
CH6.4	Project Strengthening the Regional Capacity to Support the Sustainable Management of the Black Sea Fisheries (SRCSSMBSF) – 88	Biota/Biology,Human activities	CH-6
CH6.5	FP7 Project MareFrame – Co-creating Ecosystem-based Fisheries Management Solutions	Biota/Biology,Human activities	CH-6

Table 5.1.6 Use Cases of CH-6 Fishery Management

Use case CH6.1: Fishery Statistical CollectionsGFCM (Mediterranean and Black Sea) Capture Production

This database contains capture production statistics by country or areas, species item, and GFCM statistical division.

Available Formats & Information Products:

- Dataset: GFCM Capture Production (online query)
- Dataset: GFCM Capture Production (FishStatJ)

Typical Usage:

- Analyses and regional studies.

Status

- Data are available from 1970 onwards.

The GFCM (General Fisheries Commission for the Mediterranean) database presents annual statistics (1970 onwards), for capture production (i.e. catches expressed as live weight equivalent of landings) in the Mediterranean and Black Sea region split by:
(i) countries or areas,
(ii) species and
(iii) statistical divisions.

The data exclude production from marine aquaculture practices. The database does not contain statistics for marine mammals, miscellaneous aquatic animal products, and seaweeds.
Data Periodicity: Data are reported yearly and the period used is the calendar year is between (1 January - 31 December).

- Characteristics of CH6.1:
  - ***Biota/Biology:***
    - Species
    - Catches
    - Landings
  - ***Human Activities:***

- Fisheries
- Aquaculture

Use case CH6.2: Scientific, Technical and Economic Committee for Fisheries (STECF) – EC

The implementation of the Common Fishery Policy requires the assistance of highly qualified scientific personnel, particularly in the fields of marine biology, marine ecology, fisheries science, fishing gear technology and fishery economics. For that purpose the Scientific, Technical and Economic Committee for Fisheries (STECF) was established by Commission Decision 93/619/EC, renewed in 2005 by Commission Decision 2005/629/EC, amended by Commission Decision 2010/74/EU and Commission Decision 2012/C 72/06.

The Members of the STECF are nominated by the Commission from highly qualified scientific experts having competence in these fields. The term of a Member of the Committee is 3 years and is renewable. The current STECF Members and reserve list was adopted on 27 October 2010 and can be found on the STECF webpage. Acting in co-operation with officials of the Commission, the Committee may form internal working groups, whose meetings can also be attended by invited experts. The Commission provides the secretariat of the Committee and of the working groups. The STECF may be consulted by the Commission on all problems connected with the provisions governing access to zones and resources of EU fisheries and the regulation of fisheries activities. The opinion of STECF is crucial in the process of setting annual Total Allowable Catches TACs and quotas.The Committee produces an annual report on the situation as regards fisheries resources and on developments in fishing activities. It also reports on the economic implications of the fishery resources situation.

- Characteristics of CH6.2:
  - ***Biota/Biology:***
    - Species
    - Catches
    - Landings
  - ***Human Activities:***
    - Fisheries
    - Aquaculture

Use case CH6.3: General Fisheries Commission for the Mediterranean (GFCM) - Working Group for the Black Sea

The General Fisheries Commission for the Mediterranean (GFCM) is a regional fisheries management organization (RFMO), established under the provisions of Article XIV of the FAO Constitution. The GFCM initially started its activities as a Council in 1952, when the Agreement for its establishment came into force, and became a Commission in 1997.The GFCM implements its policy and activities through its Secretariat, based at its headquarters in Rome, Italy. The Commission holds its regular sessions annually and operates during the intersession by means of its committees: the Scientific Advisory Committee (SAC), the Committee on Aquaculture (CAQ), the Compliance Committee (CoC), the Committee of Administration and Finance (CAF) and their subsidiary bodies, including the ad hoc Working Group for the Black Sea (WGBS).

WGBS was created based on the Resolution of the 35th Session of the GFCM (May 2011), upon proposal of the 13th SAC Session (February 2011). The organizational

and operational backgrounds of BSWG were established at the Black Sea Working Group meeting in Constanta, Romania (January 16-20, 2012). WGBS is a subsidiary body of GFCM, being the SAC subdivision for the Black Sea region and having the status of GFCM technical body for the Black Sea. All activities of the BSWG are in accordance with the general tasks, objectives and procedures of GFCM. The WBSG decisions are advisory, the validation being made by the relevant subsidiary body of GFCM (SAC or CAQ).

- Characteristics of CH6.3:
  - ***Biota/Biology:***
    - Species
    - Catches
    - Landings
  - ***Human Activities:***
    - Fisheries
    - Aquaculture

Use case CH6.4: Project Strengthening the Regional Capacity to Support the Sustainable Management of the Black Sea Fisheries (SRCSSMBSF) – 88

Strengthening the Regional Capacity to Support the Sustainable Management of the Black Sea Fisheries (SRCSSMBSF) - 88 was a project funded by the EC through the Joint Operational Program, "BLACK SEA 2007-2013".
Project duration: November 2011 - November 2013
Priority 2: Sharing resources and competencies for environmental protection and conservation
Measure 2.1: Strengthening the joint knowledge and information base needed to address common challenges in the environmental protection of river and maritime systems
Partnership:

- Institute of Fishing Resources, Varna, Bulgaria (IFR);
- Institute of Oceanography of the Bulgarian Academy of Science, Varna, Bulgaria (IOBAS);
- Southern Research Institute of Sea Fisheries and Oceanography, Kerch, Ukraine (YugNIRO);
- Central Fisheries Research Institute, Trabzon (CFRI);
- Black Sea Technical University, Marine Science Faculty, Trabzon (KTU-MSF);

Overall objective: Cooperation between the Black Sea riparian countries for knowing and rationally managing the marine ecosystem and its resources, carrying out diagnostics of fish stocks status as well as advice on management strategies.
Specific objectives:

- Harmonization of methods and tools to assess the present state of fish stocks by scientific surveys, holistic models;
- Alignment of the common methods for sampling, processing and interpretation data from fisheries and stock assessment using analytic models;

Awareness of the fishery organizations and decision makers from the national fisheries, regarding the need to use the management's strategies, the advice from researches, and the joint-regional stock assessment.

- Characteristics of CH6.4:
  - ***Biota/Biology:***
    - Species

- Catches
- Landings

- ***Human Activities:***
  - Fisheries
  - Aquaculture

Use case CH6.5: FP7 Project MareFrame – Co-creating Ecosystem-based Fisheries Management Solutions

MareFrame is a FP7 EC-funded RTD project, which seeks to remove the barriers preventing more widespread use of the ecosystem-based approach to fisheries management. This entails the development of new tools and technologies, development and extension of ecosystem models and assessment methods, and development of a decision support framework that can highlight alternatives and consequences. Most importantly the removal of barriers depends not only on collaboration with stakeholders in general, but on close integration and co-creation with stakeholders in all development phases, to ensure that ownership lies with them and to increase the chance of acceptance and uptake of the project outcomes.The vision of MareFrame is to significantly increase the use of ecosystem-based approach to fisheries management (EAFM), when providing advice relating to European fish stocks.
Case Study: Black Sea Turbot
Objective: Restoring the Western stock of Black Sea turbot to productive levels through an Ecosystem Approach to Fisheries Management.
Management Problem: The Black Sea turbot (*Psetta maxima maeotica*) is a highly valuable commercial species, which has been subjected to severe decline in recent decades. The main reasons for the decline appears to be overfishing, in particular due to Illegal, Unreported, and Unregulated (IUU) fishing, but the stock development has also been adversely affected by environmental change (including eutrophication and invasive species). Recent assessments of the turbot stock have been based on different assumptions about stock structure, but they have reached similar conclusions, namely that the stock is subjected to highly unstable fishing pressure and is in need of a recovery plan. The case study will benefit from, and ideally contribute to, an ongoing GFCM initiative to develop a management plan for the Black Sea turbot (GFCM, 2014).
The case study is based on the assumption that the western stock of Turbot can be regarded as separate stock, fished by Ukraine, Bulgaria and Romania. Although the evidence in support of this assumption is not conclusive, experts believe that it is more likely that the assumption is a common turbot stock for the whole Black sea, which has been the basis for most stock assessment in the past.
Currently, there is no established agreement on the management of fisheries in the Black Sea. However, the General Fisheries Commission for the Mediterranean is a highly important body for cooperation and coordination with regard to fisheries management. Romania and Bulgaria are members of the GCFM, which has authority to adopt binding measures for its members. Ukraine's is not a full member of GFCM but its affiliation with the Commission has recently been strengthened and formalized as a "Cooperating non-Contracting Party". Bulgaria, Romania and Ukraine participated in an ongoing GFCM initiative to develop a common management plan for Black Sea turbot.
Case study approach: Stakeholders are cooperating with Mareframe as researchers proposed a management plan. The process includes the following steps:

- Identify management problem(s)
- Identify objectives and indicators

- Implement models
- Develop management alternatives
- Evaluate alternatives (decision support)
- Select best alternative
- Draft management proposal

➢ Characteristics of CH6.5:
  - ***Biota/Biology:***
    - Species
    - Catches
    - Landings
  - ***Human Activities:***
    - Fisheries

5.1.7 Challenge 7: Fishery Impact

This section describes one Use case for Challenge 7: Fishery Impact.

ID	Title	Environmental Matrix of Interest	Related EMODNET challenges
CH7.1	Black Sea Regional Activity Centre for Environmental Aspects of Fisheries and other Marine Living Resources Management (RAC FOMLRM) – Black Sea Commission	Biota/Biology,Human activities	CH-7

Table 5.1.7 Use Cases of CH-7 Fishery Impact

Use case CH7.1: Black Sea Regional Activity Centre for Environmental Aspects of Fisheries and other Marine Living Resources Management (RAC FOMLRM) – Black Sea Commission

The Black Sea Regional Activity Centre for Environmental Aspects of Fisheries and other Marine Living Resources Management (RAC FOMLRM) was created in 1994, based on a follow up on the activities of the National Institute for Marine Research and Development "Grigore Antipa" Constanta (Romania) (NIMRD).

RAC FOMLRM, as a subsidiary body of the Black Sea Commission, coordinates and ensures the necessary programmatic support, and practical technical support for the functioning of related Advisory Group of Black Sea Commission in the field of protection, and rehabilitation of marine ecosystem, for conservation and sustainable use of living marine resources.

The Advisory Group on Environmental Aspects of Management of Fisheries and Other Marine Living Resources, provide the Commission with the best possible advice and the technical support for protection and rehabilitation of marine ecosystem in particular for conservation and sustainable use of the marine living resources (Annex I, BS SAP, 1996, amended 2002).

The Advisory Group on Environmental Aspects of Management of Fisheries and Other Marine Living Resources (AG FOMLR), is an integral part of the Black Sea Commission's institutional structure, and constitutes its subsidiary body: The AG

FOMLR is comprised of the national focal points nominated by the members of the Black Sea Commission, as directors of the relevant activity center and they are responsible for the facilitation of links between the Black Sea Commission, the relevant national authorities and the regional and national scientific expertise; the national focal points are also responsible for the accurate and timely delivery of national information to the management of fisheries and other living resources as they deem necessary for the Black Sea Commission.Current responsibilities under the Commission on the Protection of the Black Sea Against Pollution include:

a. Drafting recommendations and policies for the Commission, such as:
    - Legally binding instruments for fisheries;
    - Implementation of ecosystem-based fisheries management;
    - Implementation of FAO Code of Conduct;
    - Strengthening the relationships between fishery sector and environmental authorities (national and regional);
    - Measures for preventing illegal fishing practices;
    - Harmonization of legal and institutional framework (especially enforcement system);
    - Improvement of fisheries management through harmonized methodologies (assessment, indicatory, etc.);
    - Improvement of the aquaculture practices and technologies;
    - Measures to reduce marine mammals' by-catch.
b. Assessment of the efficiency of fisheries management system and impact of existing practices on the marine ecosystem.
c. Drafting of projects for protection and rehabilitation of marine living resources and specific habitats.
d. Ensuring the regular information flow.
e. Other activities required of a regional consulting body with international formation.
f. Reporting of current activities to the Black Sea Commission.

Black Sea Information System (BSIS)

The Black Sea Information System was designed in the framework of the Black Sea Ecosystem Recovery Project (BSERP), for the implementation of the Information Strategy of the Black Sea Commission.

The data flow within BSIS is organized in the following way:

- Advisory Groups or Focal Points in Black Sea countries enter data in standardized format and send or upload it to the Secretariat.
- The Secretariat staff checks and imports received data to central database.
- Output data from central database is available to BSIS users by using the WEB application (BSC data policy should be consulted to get access http://www.blacksea-commission.org/_commission-inf-policy.asp).

- Characteristics of CH7.1:
    - ***Biota/Biology:***
        - Species

- Catches
- Landings

- ***Human Activities:***
  - Fisheries

5.1.8 Challenge 8: Eutrophication

This section describes 2 Use cases for Challenge 8: Eutrophication.

ID	Title	Environmental Matrix of Interest	Related EMODNET challenges
CH8.1	State of Environment Report 2001 – 2006/7	Marine Waters, Biota/Biology	CH-8
CH8.2	Nutrient budgets for European seas: A measure of the effectiveness of nutrient reduction policies	Air, Marine waters,Fresh waters,Riverbed/Seabed, Human activities	CH-8

Table 5.1.8 Use Cases of CH-8 Eutrophication

Use case CH8.1: State of Environment Report 2001 – 2006/7

Structured into 12 Chapters, the report showcases the work of more than 60 prominent scientists dedicated to the Black Sea ecosystem, which have contributed to the State of Environment Report between 2001 - 2006/7 (http://www.blacksea-commission.org/_publ-SOE2009.asp). Despite the fact that this, is the most comprehensive report on the State of Environment of the Black Sea for the periods between 2001-2007, there are some limitations in the systematically collected data and indicators, which makes it difficult to draw a conclusive inference on the real state of the ecosystem of this sea.Chapter 1, within two sub-chapters, presents introductory information on the Black Sea physico-chemical characteristics and geology/history. Chapter 2 deals with one of the most important problems of the Black Sea, the Eutrophication. Chapter 3, which deals with Chemical Pollution, has several subchapters of different pollutant groups. Radioactive pollution is dealt with in Chapter 4. The states of phytoplankton, zooplankton, macrophytobenthos, zoobenthos, are all presented in Chapters 5, 6, 7 and 8, respectively. Fishery is the subject of Chapter 9, and mammals the subject of Chapter 11. Socio-economic pressures and impacts are included in Chapter 11. The overall assessment of the report summarizing all these issues is given in Chapter 12.

- Characteristics of CH8.1:
  - ***Marine Waters:***
    - Concentrations of inorganic nutrients (N, P and SI)
    - Nutrients ratio
    - Concentration of dissolved oxygen
  - ***Biota/Biology:***
    - Chlorophyll a concentrations
    - Phytoplankton – taxonomic composition, algal blooms
    - Macrophytobenthos – species composition, biomass

Use case CH8.2: Nutrient budgets for European seas: A measure of the effectiveness of nutrient reduction policies

Comparative evaluation of the effectiveness of reducing the anthropogenic nutrient inputs to European seas was conducted. Nitrogen(N) and phosphorus(P) budgets were constructed for three different periods (prior to severe eutrophication ~1960s, during severe eutrophication ~1990s and contemporary ~2000–2008) to capture changes in the relative importance of different nutrient sources in four European seas suffering from eutrophication (the Baltic Proper, coastal North Sea, Northern Adriatic and North-Western Black Sea Shelf). The impact of anthropogenic loads on the systems and the effectiveness of environmental policies were estimated by comparing changes in budget across the above specified time slices.

For the Baltic Proper, sedimentary recycling of nutrients was found to play a key role, especially for P.The coastal North Sea as an open dynamic system, demonstrated by dominating the exchanges across lateral boundaries. The Adriatic was found to be P-limited, less fuelled by anthropogenic loads and more by sediment reflux. Rivers were found to be the most important source of N to the NW shelf of the Black Sea. Import from the open Black Sea seemed to be the most important source of P.

The results indicated the intrinsic differences among the seas in sensitivity to nutrient loading. At one end of the spectrum was the Baltic Proper. With hypoxia and cyanobacteria blooms, it is suffering severely from eutrophication despite receiving the smallest anthropogenic loads. Its sensitivity appears to be caused by limited flushing and climatic events that influence vertical mixing. At the other end of the spectrum, the coastal North Sea received some of the heaviest nutrient loads from human activities, but has largely been spared the worst effects of eutrophication as a result of good flushing. Anthropogenic loads are a relatively minor component of this sea's budget. Policy success seemed to be evident for point sources, notably for P in the Baltic and North Seas, but reduction of diffuse sources has been more problematic.

- Characteristics of CH8.2:
  - ***Air***
    - Nitrogen flux from atmosphere to sea surface
  - ***Marine Waters***
    - Nitrogen and phosphorus fluxes across lateral liquid boundaries
  - ***Fresh Waters***
    - Riverine nitrogen and phosphorus inputs
  - ***Riverbed/ Seabed***
    - Nitrogen and phosphorus fluxes across sediments
  - ***Human Activities***
    - Nitrogen and phosphorus fluxes due to agriculture and urbanization and fossil fuel combustion

5.1.9 Challenge 9: River Inputs

This section describes one Use case for Challenge 9: River Inputs.

ID	Title	Environmental Matrix of Interest	Related EMODNET challenges
CH9.1	European hydrological predictions for the environment – E-HYPE	Fresh Waters	CH-9

Table 5.1.9 Use Case of CH-9 River Inputs

Use case CH9.1: European hydrological predictions for the environment – E-HYPE

E-HYPE v2.1 calculates hydrological and nutrient variables.E-HYPE is a model application set up to calculate hydrological variables (e.g.runoff, discharge, snow depth, groundwater level) and nutrient variables (e.g. concentrations and loads) for over 35 000 subbasins (median resolution=215 km2) across all of Europe. The model aims to take into account important processes including both hydrological and anthropogenic impacts for all regions across Europe (e.g. irrigation, hydropower). The model is validated for a wide range of catchment scales, climatic, physiographic and anthropogenic regions. Furthermore, the model is under constant development. The E-HYPE v 2.1 model has been made operational in the SMHI production environment to deliver real-time and forecast hydrological and nutrient data for the entire European coastline. As well as forecasting, the model is used for hindcasting, evaluating nutrient status based on hindcasting, and running of future climate scenarios. (http://hypeweb.smhi.se/europehype/long-term-means/).

- Characteristics of CH9.1:
  - ***Fresh Waters:***
    - River discharge
    - Concentration of nitrate
    - Concentration of phosphate
    - Concentration of total nitrogen
    - Concentration of total phosphorus

5.1.10 Challenge 10: Bathymetry

This section describes 2 Use cases for Challenge 10: Bathymetry.

ID	Title	Environmental Matrix of Interest	Related EMODNET challenges
CH10.1	Projects BlaSON and BlaSON 2 (Black Sea Over the Neoeuxinian)	Riverbed/ Seabed	CH-10
CH10.2	Determination of the Black Sea area and coastline length using GIS methods and Landsat-7 satellite images	Riverbed/ Seabed	CH-10

Table 5.1.10 Use Cases of CH-10 Bathymetry

Use case CH10.1: Projects BlaSON and BlaSON 2 (Black Sea over the Neoeuxinian)

The objectives of the BlaSON and BlaSON 2 projects are to investigate sedimentary records and processes across the NW margin of the Black Sea during the Late Quaternary, in relation with climatic, glacio-eustatic and sea level changes, as well as neotectonism, and to assess the effects of how sandy bodies are deposited on the platform, slope and deep fan of the river Danube. More specifically, the BlaSON cruises provide information on (1) insights into the effect of changes in water, sediment and organic matter inputs related to climate changes in Eurasia (ice cap changes), modifications in exchanges with the Mediterranean during

glacial/interglacial cycles (through the Bosphorus strait) and the neotectonics; (2) comparisons of sedimentation and depositional conditions in this confined sea with those prevailing at basins still linked to the World Ocean. The recently proposed hypothesis of a catastrophic event occurring around 7500 BC, provokes an abrupt opening in the Bosphorus and a rise in the sea level of approximately 150 metres, providing additional, historical interest to the project. Techniques used include very high resolution geophysics, multi-beam bathymetry and acousitc imaging, as well as sedimentary core sampling for sedimentological, bio-stratigraphic, geochemical,magnetic and geotechnical analyses.

- Characteristics of CH10.1:
  - ***Reverbed/Seabed:***
    - DTM of the seabed

Use case CH10.2: Determination of the Black Sea area and coastline length using GIS methods and Landsat-7 satellite images

Quantifying accurate coastline length is important for management applications, such as coastal classification/land cover use, erosion and environmental monitoring. However, due to the dynamic nature of the coastline, measuring its length with high accuracy has turned out to be a difficult research task. By far, different values of the Black Sea coastline length have been determined, and these values ranged between 4020 km and 4500 km. Potential reasons for this could be mostly associated with various data sources and different methods applied. In this context, the study presents recent results for the Black Sea coastline length, which have been obtained during generations of the geo-data base at the IO-BAS. For this purpose, a number of 24 satellite images (Landsat-7), were used. Data processing and analysis were methodologically supported by GIS techniques for precise measurement of the coastline length. In addition, new results for the Black Sea total area were also obtained.

- Characteristics of CH10.2:
  - ***Reverbed/Seabed:***
    - Bathymetric contour of the 0-isobath for the Black Sea basin (contemporary coastline)

5.1.11 Challenge 11: Alien Species

This section describes 2 Use cases for Challenge 11: Alien Species.

ID	Title	Environmental Matrix of Interest	Related EMODNET challenges
CH11.1	A basin-wide Black Sea *Mnemiopsis leidyi* database	Biota/Biology	CH-11
CH11.1	Addressing the ecological issue of the invasive species, Special focus on the ctenophore *Mnemiopsis leidy*i (Agassiz, 1865) in the Black Sea	Marine Waters, Biota/Biology	CH-11

Table 5.1.11 Use Cases of CH-11 Alien Species

Use case CH11.1: A basin-wide Black Sea *Mnemiopsis leidyi* database

A specific marine biological data management tool, the Black Sea Mnemiopsis leidyi database system was created within the European Commission's 6th framework Black Sea SCENE project for the Black Sea region, and was being supported by the Permanent Secretariat of the Black Sea Commission (V.Vladymyrov et al, 2011).

Black Sea SCENE supported the integrated provision of infrastructure related services to the Black Sea region research community. The Black Sea SCENE research infrastructure aims at stimulating scientific cooperation, exchange of knowledge and expertise, and strengthens the regional capacity and performance of marine environmental data & information management, underpins harmonization with European marine data quality control/assessment procedures and adoption of international meta-data standards and data-management practices, providing improved data & information delivery services for the Black Sea region at a European level.

The main tasks of the *M. leidyi* database were:

- to analyze the compatibility of the existing Black Sea *Mnemiopsis leidyi* and *Beroe ovata* datasets;

- to collect all existing *Mnemiopsis leidyi* and *Beroe ovata* data and metadata, to check their quality, and to upload them into the database (quality check is being recently done at the metadata level using the same procedures that are in use for the Black Sea physical and chemical data QC (http://www.ocean.nodc.org.ua/QC.php);

- to discuss and agree on the unified methodology of the *Mnemiopsis leidyi* and *Beroe ovata* sampling, processing, and data formats.

- Characteristics of CH11.1:
  - ***Biota/Biology:***
    - Alien species (*Mnemiopsis leidyi*) abundance and biomass
    - Alien species (*Beroe ovata*) abundance and biomass

Use case CH11.2: Addressing the ecological issue of the invasive species, Special focus on the ctenophore *Mnemiopsis leidy*i (Agassiz, 1865) in the Black Sea

The report addressed the ecological issue of the invasive species. A case study presented was an assessment of distributional mode, long-term dynamics and trends of the invasive ctenophore *Mnemiopsis leidyi* (Agassiz, 1865) in the Black Sea. This species has led to tremendous ecosystem changes and substantial economic losses in the late 1980s-1990s and it has been recognized as a problem of main ecological concern for the sustainable development of the region, together with the high level of anthropogenic forcing on the Black Sea ecosystem.

Data from three Black Sea regions were combined, summarized and information on *M. leidyi* population distribution and occurrence, mesozooplankton pattern and the differences in between the regions was provided. Also, the objective in the study was to analyze short and intermediate term trends of *M. leidyi* distribution faced to the predation by *B. ovata* after 1997, together with long term trends aimed at providing an insight into the those species variability in the Black Sea. The ecosystem's functioning and stability is manipulated by Mnemiopsis; therefore, indicators (measurements) for biodiversity and assessment of ecological health in respect to mesozooplankton were under discussion as well.

The investigated regions were:

(i) North-Eastern Black Sea (NEBS)- no enrichment of nutrients;

(ii) Western Black Sea (WBS)- an area showing direct or indirect effects even if there is not always evidence of nutrient enrichment;

(iii) North-Western Black Sea (NWBS)-a “problem area” regarding eutrophication, mainly due to the Danube influence.

The regional classification- shelf area (< 200 m depths) and open sea or offshore (> 200 m depth) was used with a special focus on the variability of selected parameters (variables) at the sampling stations in the coastal waters.

- Characteristics of CH11.2:
  - ***Marine Waters:***
    - Temperature
    - Salinity
    - Chlorophyll a
  - ***Biota/Biology:***
    - Alien species (*Mnemiopsis leidyi*) abundance
    - Mesozooplankton abundance and biomass

6. Preliminary data adequacy assessment from Use Cases

In this section, we will discuss the expert opinion on the appropriateness and availability of the input data required by the literature Use Cases. The Use Cases have been chosen as an example of usage of input data sets probably similar to the ones that will be used by the Challenges to produce Targeted Products (Table 1.1).

We used the Use Cases to give a first assessment of quality and availability ("data adequacy") of monitoring data sets at the basin level. There are two main criteria used to evaluate "data adequacy": the appropriateness and the availability. Appropriateness and availability elements have been defined in Section 2.1: project experts have extracted from the Literature the discussion about data adequacy if present or interpreted the elements of data adequacy from the documents/webpages/services.

Table 6.1 illustrates the appropriateness and availability of elements extracted by the experts from the different Use Cases.

ID	Title of Use Case	Main appropriateness element discussed in Literature	Availability discussed in Literature
CH1.1	MARINA (Marine Renewable Integrated Application Platform)	Spatial and temporal resolution and area coverage	High except for data policy
CH2.1	SINCRON Project "Integrated Management and Awareness Raising System of the Natura 2000 Network in Romania"	Space resolution and area coverage	High except for accessibility which is partially restricted
CH2.2	COCONET WebGIS Application	Horizontal and vertical space coverage	High
CH2.3	MISIS Project "MSFD Guiding Improvements in the Black Sea Integrated Monitoring System"	Space resolution and area coverage, time extent	High
CH3.1	Modeling the potential oil spill behaviour when operating the off-shore ice-resistant fixed platform "Prirazlomnaya (the Barents Sea)"	Spatial and time resolution of several characteristics	Mixed between poor and high depending on the characteristics
CH3.2	Satellite monitoring of oil slicks on the Black Sea surface	Not clearly specified	Poor
CH4.1	Long-term changes in nutrient supply of phytoplankton growth in the Black Sea	Space and time resolution	Between high and medium
CH4.2	MASIE NH (Multisensor Analyzed Sea Ice Extent - Northern Hemisphere)	Temporal extent and spatial coverage, spatial resolution	High
CH4.3	Decadal variability of temperature and salinity in the Black Sea	Temporal extent and spatial coverage, spatial resolution	Partially high only for most recent data
CH5.1	Black Sea level trends from tide gauges and satellite altimetry	time resolution and extent, area coverage	Low for in situ, high for satellite data
CH5.2	The lythodynamic processes in the seashore zone of the Black Sea	Time and space resolution and extent	High
CH6.1	Fishery Statistical Collections GFCM (Mediterranean and Black Sea) Capture Production	Space (horizontal and vertical) and time resolution	High
CH6.2	Scientific, Technical and Economic Committee for Fisheries (STECF) – EC	Space (horizontal and vertical) and time resolution	High
CH6.3	General Fisheries Commission for the Mediterranean (GFCM) - Working Group for the	Space (horizontal and vertical) and time resolution	High

	Black Sea		
CH6.4	Project Strengthening the Regional Capacity to Support the Sustainable Management of the Black Sea Fisheries (SRCSSMBSF) – 88	Space (horizontal and vertical) and time resolution	High
CH6.5	FP7 Project MareFrame – Co-creating Ecosystem-based Fisheries Management Solutions	Space (horizontal and vertical) and time resolution	High
CH7.1	Black Sea Regional Activity Centre for Environmental Aspects of Fisheries and other Marine Living Resources Management (RAC FOMLRM) – Black Sea Commission	Space (horizontal and vertical) and time resolution	High
CH8.1	State of Environment Report 2001 – 2006/7	Time extent and space coverage	High
CH8.2	Nutrient budgets for European seas: A measure of the effectiveness of nutrient reduction policies	Spatila coverage and time extent	medium
CH9.1	European hydrological predictions for the environment – E-HYPE	Time extent and accuracy of measurement	High
CH10.1	Projects BlaSON and BlaSON 2 (Black Sea Over the Neoeuxinian)	Spatial resolution	Medium
CH10.2	Determination of the Black Sea area and coastline length using GIS methods and Landsat-7 satellite images	Space area coverage	High but not accessible
CH11.1	A basin-wide Black Sea Mnemiopsis leidyi database	Space coverage (horizontal and vertical) and time extent	High but medium accessibility
CH11.1	Addressing the ecological issue of the invasive species, Special focus on the ctenophore Mnemiopsis leidyi (Agassiz, 1865) in the Black Sea	Space coverage (horizontal and vertical) and time resolution	Low

Table 6.1 Synthesis of the appropriateness and availability elements and their quality by the analysis of Literature Use Cases by the project experts

The 24 Use Cases mainly used appropriateness elements referred to as: 1) spatial resolution and area coverage; 2) temporal resolution and extent. There is actually only one Use Case that refers to accuracy and it is for the river runoff data. For all 24 Use cases, data availability is generally high except for the accessibility. In a large number of the literature Use Cases the data are completely restricted and/or access to the input data requires specific agreements with the data owners. Thus, the answers to the questions are:

Q1. are there references in literature to goals not achieved because of inadequacy of data (appropriateness)?

A1. Yes, and the main concern is about data coverage in space and time and resolution of the input data sets.

Q2 Is inadequacy due to the reluctance of data-owners to release data, time taken to obtain data, lack of measurements, lack of accuracy or lack of precision (availability)?

A2. Generally, data availability is thought to be high, with some reservations on the accessibility and responsiveness. There is no mention of accuracy except for one Use Case.

Q3. Are there any statements made as to fitness for purpose of data.

A3. The fitness for purpose of data, which in this document we call fitness for use, is related to the previously mentioned appropriateness elements.

7. Discussion and Conclusions

The Literature Survey contains the basic framework for input data collection in the Black Sea Checkpoint project, a basin overview of the existing monitoring systems and several Use Cases related to the Checkpoint Challenges.

The methodology which was used to carry out the Literature survey is based on three basic elements:

1) the definition of a common terminology and vocabulary for the discovery and analysis of input data sets characteristics for Challenges;

2) the collection of information using an internal project survey that started to characterize the number of thematic input data sets and their data sources;

3) the collection of literature Use case descriptions in substitution of Challenges Targeted Products.

The definition of “common vocabularies” is an important prerequisite to have consistency among the different challenges and interoperability with other information systems. Using standardised sets of terms solves the problem of ambiguities associated with data markup, and enables records to be interpreted by computers. This opens up data sets to a whole world of possibilities for computer aided manipulation, distribution and long term reuse.

This Literature survey has defined its vocabulary, following the SeaDataNet standards and most importantly, has defined the general means to map INSPIRE’s principles into ISO language for spatio-temporal data. The vocabulary and the procedures are the same as the ones used for the Mediterranean Sea Checkpoint and that will be used for the Atlantic Checkpoint. In the near future, this will allow us to have an intercomparison between the monitoring system’s specific structure and gaps in the three basins, browsing the metadata base built with the same SeaDataNet vocabulary.

In this survey, we started the collection of the information about metadata for the input data needs from the Challenges. This initial survey shows for the first time the needed “characteristics categories” and the potential input data sources.

Statistics was computed out of the collected information showing that:

a) 48 characteristics in all seven environmental matrices are thought to be necessary in order to build the Checkpoint Targeted products;

b) over 400 input data sets are described to be potentially usable, many for the same characteristics.

c) The group of characteristics used by more than two Challenges are:

1. M10/Meteorology;
2. C005/Carbon, nitrogen and phosphorus;
3. D025/Water column temperature and salinity;
4. D030/Currents;
5. D032/Sea level;
6. D034/Waves;
7. G005/Gravity, magnetics and bathymetry;
8. B030/Phytoplankton and microphytobenthos;
9. B035/Pigments;
10. B050/Habitat;

11. H004/Fisheries.

The comparison between Black Sea and Med Sea characteristic categories shows that within 20%, there is consistency between the requested groups of categories per Challenge.

A total of 56 input data providers have been identified as International, European, EU Member States, Russia and USA and Projects. In total, they provide about 400 input data sets to be used and selected on the basis of the Targeted product requirements (still to be fully defined).

To advance in the understanding of the monitoring capacity in the Black Sea, an overview of nineteen European, International and Member State programs has been carried out. They partially sample the input data sources required by the Challenges.

In order to progress toward an assessment of the “data adequacy”, 24 “Use Cases” related to Challenge Targeted Products were elucidated from the literature. Use Case products have been analyzed in order to extract information about availability and appropriateness elements.

Among the 24 Use Cases, the main appropriateness elements that experts extracted from the literature were referred to as: 1) spatial resolution and area coverage; 2) temporal resolution and extent. There is actually only one Use Case that refers to accuracy and it is for the river runoff data. For all 24 Use cases, data availability is generally high except for accessibility which sometimes requires specific agreements with the data owners or is completely restricted.

In conclusion, the Literature survey shows that a large amount of input data sets exists at the basin scale level, so that a basin scale overview of the Black Sea monitoring system is available. At this stage, it can only be emphasized that assessments and Literature Surveys should be periodically carried out, because conclusions rapidly become obsolete in a changing marine environment and for the increasing needs of the ‘blue’ economy.

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Annex1: Template used to collect characteristics and input data sets information

The combination of the environmental matrices and the Seadatanet/sextant classification allows for the standardization of the needs expressed by the Challenges and graphical comparisons betweenChallenges in terms of required characteristics. The template used for this standardisation/description is given here.

Folder 1: Introduction

CHALLENGE NUMBER & NAME (M)	Challenge contacts : name, e_mail and phone (M)	Date of last update (YYYY/MM/DD HH:MM:SS) M
Challenge 4: Climate and coastal protection	N.Pinardi, nadia.pinardi@unibo.it, +390514151411	14/10/2015

Upstream data classification elements.

Based on the literature and on iSO quality principles,
a method has been identified **to classify** the upstream data potentially used by the challenges and to establish its fitness for purpose (in the Data Adequacy Report).

Following the MSFD nomenclature, data sets are made out of **'Characteristics' (see Annex III of MSFD)**.
The **characteristics** have been listed in Template-1 and they should be repeated in this Template-2.
A classification methodology is needed to qualify the input data sets for each characteristics. This classification is suggested to be done now by 6 **'elements'**:
1/ Characteristics definition (variable or GIS feature) and category;
2/Data source specification: provider, originating programme and dataset/dataset series;
3/Overview elements : production purpose, known uses, processing level;
4/Spatial coverage;
5/Temporal coverage;
6/Availability;

The classification elements are described in each folder of this Template.

There are 6 folders, please fill all the folder elements with the list of Characteristics required by your challenge and describe the required element parameters.

Folder 2: Characteristics

1/Characteristics definition and category (M=Mandatory, C= conditional, O=optional)							
Unique Identifier (integer number) for the combination : (variable, dataset, intended use) or (geo. feature, dataset, intended use)	**Environmental matrix where characteristics are specified**	**SDN Discovery group code of Parameter (P02) for variables**	**Variable characteristic code**	**Inspire topic category for characteristics**	**Processing level of characteristics**	**Production mode**	**Hierarchy data level**
(M)	Air, Fresh water, Marine Water, River bed /SeaBed, Biota/Biology or Human activities (M)	(http://www.seadatanet.org/Standards-Software/Common-Vocabularies) (M)	SDN parameter list (P01) (http://www.seadatanet.org/Standards-Software/Common-Vocabularies) (C) (if the code does not exist please put an extended description)	Use P22 list of SDN http://seadatanet.maris2.nl/v_bodc_vocab_v2/welcome.asp . For further explanations , see http://inspire.ec.europa.eu/index.cfm/pageid/2/list/7 (C)	A- Observation (raw, QC) B- high level analyzed observational product (L1,L2,L3, L4 for satellite, merged from many datasets, etc.) C- Forecast/Hindcast D- Publication O- Other (M)	1.delayed 2.real-time (M)	1- dataset 2- dataset series 3- non geographic dataset (M)

Folder 3: Data sources

2/Data sources Note : many datasets are missing in the existing catalogues such as the European Directory for Marine Environmental Data (http://www.seadatanet.org/Metadata) or in the catalogue of the Geoportal http://inspire-geoportal.ec.europa.eu/. Please mention if your data set is missing in these catalogues.								
Unique Identifier (integer number)	Programme/ Project name	SDN EDMERP Identifier http://www.seadatanet.org/Metadata/EDMERP-Projects	Data provider	SDN EDMO Identifier http://www.seadatanet.org/Metadata/EDMO-Organisations	Data set identifier	Data collection or data set name as given by the provider	Catalogue URL	Dataset URL
(M)	(C)	(M) (if EDMERP is available please use the same name in Programme/Project name)	(M)	(M) (if EDMO is available please use the same EDMO name in Data Provider)	(M)	(M)		(C)

Folder 4: Overview

3/Overview elements of dataset Please specify the intended use for each characteristics at the moment of production.				
Identifier (M)	Purpose of Characteristics production (provider specification) (M)	Production and quality assessment specifications reference (C)	Challenge name and Intended use by the Challenge (M)	Intended use description (objective, process description, output data) (M)

Folder 5: Spatial coverages

4/Spatial coverage of characteristics									
Identifier (M)	Geographical area code SDN C16 list (C)	Lat S (+/-DD .DDDD) (C)	Lat N (+/-DD .DDDD) (C)	Lon W (+/- DDD.DDDD) (C)	Lon E (+/- DDD.DDDD) (C)	Hor.resolution (unit to be defined) (O)	Min depth (meters > 0 downwards) (O)	Max depth (meters > 0 downwards) (O)	Vert. Resolution (unit to be defined) (O)

Folder 6: Time coverage

5/Time coverage of Characteristics				
Identifier (M)	Start date YYYY/MM/DD HH:MM:SS (C)	End date YYYY/MM/DD HH:MM:SS (C)	Time resolution YYYY/MM/DD HH:MM:SS (O)	Update time of dataset YYYY/MM/DD HH:MM:SS (O)

Folder 7: Availability

6/Availability										
Identifier (M)	**Visibility of data set** 1) Cited in peer reviewed paper or grey literature but no info on how to access; 2) Information retrieved upon specific request to the data source 3) Use of social network, community of practices sharing information, portals of organization where no search is organized by an engine; 4) Use of open search engines, searching by name either the data provider or the characteristics; 5) Search via reference catalogue (e.g. MyOcean, GEOSS Geoportal…)	**EU Inspire catalogue service** 1) Data sets are not referenced in a catalogue or are referenced in a non public catalogue; 2) The datasets are referenced in a public national catalogue, in an internatio nal catalogue service; 3) The datasets provide a full EU Inspire catalogue service (OCG service)	**Data delivery mechanisms** 1) No information was found on data delivery mechanisms; 2) Order form/envoice is requested; 3) On-line downloading services; 4) On-line discovery and downloading services; 5) On-line discovery + downloading + viewing (advanced services) (M)	**Data Policy Visibility** 1) There is no information at all on data policy adopted by data providers; 2) There is information, but details are available only on request; 3) There is detailed information provided to understand data policy (M)	**Data policy** 1) restricted 2) accessible under moratorium 3) unrestricted 4) unknown (M)	**Cost basis** 1) Not or not well documented 2) Commecial cost charge 3) "Distribution charge" "Collection charge" "Free of charge for academic institutions and uses" 4) Open and Free, No charge (M)	**Data format(s) and conventions**	**Readiness** (information given for distribution format) 1) Not or not well documented; 2) Proprietary and not well documented; 3) Not proprietary but content not clearly specified 4) Proprietary but content clearly specifie 5) Not proprietary and content clearly specified (eg autodescriptive eg ODV, NetCDF CF) or at least with appropriate document describing the content (O)	**Responsiveness** 1) No information is found on response time; 2) more than one week for release; 3) less or equal to 1 week, 4) less than few hours (on-line downloading) (M)	**Reliability** (Degree of commitment to provide the service) (O)

Annex2: Consolidated list for Black Sea and Med Sea Checkpoint characteristics

Challenge name	Environmental matrix	P03	P02	P22 (INSPIRE)	BLA	MED
CH01 - Wind Farm	Air	M010/Meteorology	CAPH/Pressure exerted by the atmosphere	26/Atmospheric conditions	2	1
CH01 - Wind Farm	Air	M010/Meteorology	CDTA/Air temperature and density	26/Atmospheric conditions	3	2
CH01 - Wind Farm	Air	M010/Meteorology	CHUM/Atmospheric humidity	26/Atmospheric conditions	2	1
CH01 - Wind Farm	Air	M010/Meteorology	EWSB/Wind strength and direction	27/Meteorological geographical features	3	2
CH01 - Wind Farm	Marine water	D025/Water column temperature and salinity	TEMP/Temperature of the water column	28/Oceanographic geographical features	15	1
CH01 - Wind Farm	Marine water	D025/Water column temperature and salinity	PSAL/Salinity of the water column	28/Oceanographic geographical features	2	1
CH01 - Wind Farm	Marine water	D030/Currents	RFVL/Horizontal velocity of the water column (currents)	28/Oceanographic geographical features	6	2
CH01 - Wind Farm	Marine water	D032/Sea level	ASLV/Sea level	10/Elevation	2	1
CH01 - Wind Farm	Marine water	D034/Waves	GWDR/Wave direction	28/Oceanographic geographical features	1	1
CH01 - Wind Farm	Marine water	D034/Waves	WVSP/Spectral wave data parameters	28/Oceanographic geographical features	2	1
CH01 - Wind Farm	Marine water	D034/Waves	HEAV/Wave Height Estimates	28/Oceanographic geographical features	1	1
CH01 - Wind Farm	Marine water	D034/Waves	WVST/Wave height and period statistics	28/Oceanographic geographical features	5	5
CH01 - Wind Farm	Riverbed/ SeaBed	G005/Gravity, magnetics and bathymetry	MBAN/Bathymetry and Elevation	10/Elevation	2	1
CH01 - Wind Farm	Riverbed/ SeaBed	GSED/Rock and sediment sedimentology	SSTR/Sediment structure	13/Geology		1
CH01 - Wind Farm	Biota/Biology	B015/Birds, mammals and reptiles	GP004/Bird reproduction	32/Species distribution		1
CH01 - Wind Farm	Biota/Biology	B015/Birds, mammals and reptiles	BRDA/Bird counts	32/Species distribution	2	1
CH01 - Wind Farm	Biota/Biology	B015/Birds, mammals and reptiles	GP088/Bird behaviour	32/Species distribution		1
CH01 - Wind Farm	Biota/Biology	B020/Fish	FATX/Fish abundance in water bodies	32/Species distribution	3	1
CH01 - Wind Farm	Biota/Biology	B020/Fish	FREP/Fish reproduction	32/Species distribution		1
CH01 - Wind Farm	Biota/Biology	B070/Biota abundance, biomass and diversity	FABD/Fauna abundance per unit area of the bed	32/Species distribution		3
CH01 - Wind Farm	Human activitiy	Z005/Administration and dimensions	ADUN/Administrative units	32/Species distribution	1	3
CH01 - Wind Farm					**49**	**29**

					BLA	MED
CH02 - MPA	Air	M010/Meteorology	EWSB/Wind strength and direction	27/Meteorological geographical features		2
CH02 - MPA	Marine water	D030/Currents	RFVL/Horizontal velocity of the water column (currents)	28/Oceanographic geographical features		2
CH02 - MPA	Marine water	D032/Sea level	ASLV/Sea level	10/Elevation	7	
CH02 - MPA	Marine water	B035/Pigments	CPWC/Chlorophyll pigment concentrations in water bodies	28/Oceanographic geographical features	3	1
CH02 - MPA	Marine water	D025/Water column temperature and salinity	PSST/Skin temperature of the water column	28/Oceanographic geographical features	3	
CH02 - MPA	Marine water	D025/Water column temperature and salinity	TEMP/Temperature of the water column	28/Oceanographic geographical features	6	3
CH02 - MPA	Marine water	D025/Water column temperature and salinity	PSAL/Salinity of the water column	28/Oceanographic geographical features	6	3
CH02 - MPA	Marine water	C005/Carbon, nitrogen and phosphorus	SAMO/Nutrient fluxes between the bed and the water column	28/Oceanographic geographical features		1
CH02 - MPA	Marine water	C015/Dissolved gases	DOXY/Dissolved oxygen parameters in the water column	28/Oceanographic geographical features		2
CH02 - MPA	Riverbed/Seabed	T001/Terrestrial	MBAN/Bathymetry and Elevation	10/Elevation	2	1
CH02 - MPA	Riverbed/Seabed	T001/Terrestrial	COAS/Terrestrial mapping	10/Elevation		1
CH02 - MPA	Riverbed/Seabed	G045/Rock and sediment lithology and mineralogy	LITH/Lithology	13/Geology		1
CH02 - MPA	Riverbed/Seabed	G060/Sedimentation and erosion processes	BEST/Sediment resuspension	13/Geology		1
CH02 - MPA	Riverbed/Seabed	GSED/Rock and sediment sedimentology	DPEV/Depositional environment	13/Geology		1
CH02 - MPA	Biota/Biology	B015/Birds, mammals and reptiles	GP068/Reptile abundance	32/Species distribution		2
CH02 - MPA	Biota/Biology	B015/Birds, mammals and reptiles	GP088/Bird behaviour	32/Species distribution		1
CH02 - MPA	Biota/biology	B015/Birds, mammals and reptiles	BRDA/Bird counts	32/Species distribution	3	2
CH02 - MPA	Biota/biology	B015/Birds, mammals and reptiles	CETA/Cetacean abundance	32/Species distribution	1	
CH02 - MPA	Biota/biology	B015/Birds, mammals and reptiles	CEBH/Cetacean behaviour	32/Species distribution	2	2
CH02 - MPA	Biota/biology	B015/Birds, mammals and reptiles	FOCA/Seal abundance	32/Species distribution		1
CH02 - MPA	Biota/biology	B070/Biota abundance, biomass and diversity	FABD/Fauna abundance per unit area of the bed	32/Species distribution	3	
CH02 - MPA	Biota/biology	B055/Macroalgae and seagrass	PU02/Macroalgae generic abundance in water bodies	31/Habitats and biotopes		1
CH02 - MPA	Biota/biology	B020/Fish	FATX/Fish abundance in water bodies	32/Species distribution		2
CH02 - MPA	Biota/biology	B050/Habitat	HBEX/Habitat extent	31/Habitats and biotopes	2	20

CH02 - MPA	Marine Water	Z005/Administration and dimensions	ADUN/Administrative units		1	22
CH02 - MPA	Marine Water	Z005/Administration and dimensions	ALAT/Horizontal spatial co-ordinates		3	3
CH02 - MPA	Human activities	H004/Fisheries	GP087/Fishery characterisation	17/Land use	2	
CH02 - MPA					**44**	**75**
					BLA	**MED**
CH03 - Oil leak	Air	M010/Meteorology	EWSB/Wind strength and direction	27/Meteorological geographical features	4	8
CH03 - Oil leak	Marine water	D030/Currents	RFVL/Horizontal velocity of the water column (currents)	28/Oceanographic geographical features	2	14
CH03 - Oil leak	Marine water	D025/Water column temperature and salinity	TEMP/Temperature of the water column	28/Oceanographic geographical features	1	14
CH03 - Oil leak	Marine water	D034/Waves	GWDR/Wave direction	28/Oceanographic geographical features	2	7
CH03 - Oil leak	Marine water	D034/Waves	WVST/Wave height and period statistics	28/Oceanographic geographical features	4	14
CH03 - Oil leak	Riverbed/SeaBed	G005/Gravity, magnetics and bathymetry	MBAN/Bathymetry and Elevation	10/Elevation	2	2
CH03 - Oil leak	Riverbed/SeaBed	T001/Terrestrial	COAS/Terrestrial mapping	10/Elevation	1	1
CH03 - Oil leak	Riverbed/SeaBed	T001/Terrestrial	COGE/Coastal geomorphology	13/Geology	1	1
CH03 - Oil leak	Biota/Biology	B050/Habitat	HBEX/Habitat extent		7	
CH03 - Oil leak	Human activities	H005/Human activities	ADUN/Administrative Units	158/Protected sites		5
CH03 - Oil leak	Human activities	H001/Anthropogenic contamination	GP001/Pollution events	20/Environmental monitoring facilities	3	3
CH03 - Oil leak	Human activities	H004/Fisheries	GP087/Fishery characterisation	24/Area management /restriction/regulation zones and reporting units	2	2
CH03 - Oil leak	Human activities	H005/Human activities	MLES/Marine environment leisure usage	23/Population distribution - demography	1	1
CH03 - Oil leak					**30**	**72**
					BLA	**MED**
CH04 - Climate	Ice	M015/Cryosphere	CRYS/Snow and ice mass, thickness and extent		17	
CH04 - Climate	Marine water	D025/Water column temperature and salinity	TEMP/Temperature of the water column	28/Oceanographic geographical features	83	13
CH04 - Climate	Marine water	D025/Water column temperature and salinity	PSST/Skin temperature of the water column	28/Oceanographic geographical features	6	6
CH04 - Climate	Biota/Biology	B030/Phytoplankton and microphytobenthos	CNTX/Phytoplankton generic biomass in water bodies	28/Oceanographic geographical features	5	
CH04 - Climate	Biota/Biology	B030/Phytoplankton and microphytobenthos	PNTX/Phytoplankton generic abundance in water bodies	28/Oceanographic geographical features	4	
CH04 - Climate	Biota/Biology	B050/Habitat	HBEX/Habitat extent	31/Habitats and biotopes		1

					115 BLA	**20 MED**
CH05 - Coasts	Fresh water	O005/Fluxes	RVDS/River flow and discharge	163/Hydrography	2	
CH05 - Coasts	Marine water	D032/Sea level	ASLV/Sea level	10/Elevation	5	2
CH05 - Coasts	Marine water	D032/Sea level	ASLV/Sea level	10/Elevation	37	6
CH05 - Coasts	Riverbed/SeaBed	G005/Gravity, magnetics and bathymetry	MBAN/Bathymetry and Elevation	10/Elevation		1
CH05 - Coasts	Riverbed/SeaBed	T001/Terrestrial	COGE/Coastal geomorphology	13/Geology	5	2
CH05 - Coasts	Human activities	H002/Construction and structures	MMST/Man-made structures	24/Area management /restriction/regulation zones and reporting units		1
CH05 - Coasts					**49 BLA**	**12 MED**
CH06 - Fish mngt	Human activities	H004/Fisheries	FCST/Fish and shellfish catch statistics	32/Species distribution	1	11
CH06 - Fish mngt	Human activities	H004/Fisheries	FEFF/Fishing effort	32/Species distribution	2	
CH06 - Fish mngt	Human activities	H004/Fisheries	GP080/Fishing by-catch	32/Species distribution		6
CH06 - Fish mngt					**3 BLA**	**17 MED**
CH07 - Fish Impact	Marine water	H004/Fisheries	FIBM/Fish biomass in water bodies	32/Species distribution	1	
CH07 - Fish Impact	Marine water	H004/Fisheries	FCST/Fish and shellfish catch statistics	32/Species distribution	3	
CH07 - Fish Impact	Human activities	H004/Fisheries	GP087/Fishery characterisation	32/Species distribution	2	
CH07 - Fish Impact	Human activities	Z005/Administration and dimensions	ALAT/Horizontal spatial co-ordinates	20/Environmental monitoring facilities		9
CH07 - Fish Impact	Human activities	Z005/Administration and dimensions	ALAT/Horizontal spatial co-ordinates	20/Environmental monitoring facilities		1
CH07 - Fish Impact					**6 BLA**	**10 MED**
CH08 - Eutrophication	Fresh water	C005/Carbon, nitrogen and phosphorus	AMON/Ammonium and ammonia concentration parameters in water bodies	20/Environmental monitoring facilities		1
CH08 - Eutrophication	Fresh water	C005/Carbon, nitrogen and phosphorus	NTOT/Particulate total and organic nitrogen concentrations in the water column	20/Environmental monitoring facilities	2	1
CH08 - Eutrophication	Fresh water	C005/Carbon, nitrogen and phosphorus	TPHS/Particulate total and organic phosphorus concentrations in the water column	20/Environmental monitoring facilities	2	
CH08 - Eutrophication	Marine water	C005/Carbon, nitrogen and phosphorus	NTRA/Nitrate concentration parameters in the water column	20/Environmental monitoring facilities	14	1

CH08 - Eutrophication	Marine water	C005/Carbon, nitrogen and phosphorus	NTRI/Nitrite concentration parameters in the water column	20/Environmental monitoring facilities		1
CH08 - Eutrophication	Marine water	C005/Carbon, nitrogen and phosphorus	PHOS/Phosphate concentration parameters in the water column	20/Environmental monitoring facilities	10	2
CH08 - Eutrophication	Marine water	C015/Dissolved gases	DOXY/Dissolved oxygen parameters in the water column	20/Environmental monitoring facilities	2	
CH08 - Eutrophication	Marine water	D015/Optical properties	ATTN/Transmittance and attenuance of the water column	28/Oceanographic geographical features		6
CH08 - Eutrophication	Marine water	D025/Water column temperature and salinity	TEMP/Temperature of the water column	28/Oceanographic geographical features	7	1
CH08 - Eutrophication	Marine water	D025/Water column temperature and salinity	PSST/Skin temperature of the water column	28/Oceanographic geographical features		3
CH08 - Eutrophication	Marine water	D025/Water column temperature and salinity	PSAL/Salinity of the water column	28/Oceanographic geographical features		3
CH08 - Eutrophication	Marine water	D030/Currents	LRZA/Vertical velocity of the water column (currents)	28/Oceanographic geographical features		1
CH08 - Eutrophication	Marine water	D030/Currents	RFVL/Horizontal velocity of the water column (currents)	28/Oceanographic geographical features		2
CH08 - Eutrophication	Marine water	D032/Sea level	ASLV/Sea level	10/Elevation		1
CH08 - Eutrophication	Marine water	B030/Phytoplankton and microphytobenthos	AATX/Phytoplankton taxonomic surface area in water bodies	20/Environmental monitoring facilities	1	
CH08 - Eutrophication	Marine water	B030/Phytoplankton and microphytobenthos	CNTX/Phytoplankton generic biomass in water bodies	28/Oceanographic geographical features	1	1
CH08 - Eutrophication	Marine water	B030/Phytoplankton and microphytobenthos	PNTX/Phytoplankton generic abundance in water bodies	28/Oceanographic geographical features	1	
CH08 - Eutrophication	Marine water	B035/Pigments	CPWC/Chlorophyll pigment concentrations in water bodies	28/Oceanographic geographical features	5	1
CH08 - Eutrophication					**45 BLA**	**25 MED**
CH09 - River inputs	Fresh water	C005/Carbon, nitrogen and phosphorus	NTOT/Particulate total and organic nitrogen concentrations in the water column	20/Environmental monitoring facilities	3	
CH09 - River inputs	Fresh water	C005/Carbon, nitrogen and phosphorus	NTRA/Nitrate concentration parameters in the water column	20/Environmental monitoring facilities	4	4
CH09 - River inputs	Fresh water	C005/Carbon, nitrogen and phosphorus	PHOS/Phosphate concentration parameters in the water column	20/Environmental monitoring facilities	3	3
CH09 - River inputs	Fresh water	C005/Carbon, nitrogen and phosphorus	TDNT/Dissolved total and organic nitrogen concentrations in the water column	20/Environmental monitoring facilities		4
CH09 - River inputs	Fresh water	C005/Carbon, nitrogen and phosphorus	TDPX/Dissolved total or organic phosphorus concentration in the water column	20/Environmental monitoring facilities		3
CH09 - River inputs	Fresh water	C005/Carbon, nitrogen and phosphorus	TPHS/Particulate total and organic phosphorus concentrations in the water column	20/Environmental monitoring facilities	3	
CH09 - River inputs	Fresh water	O005/Fluxes	RVDS/River flow and discharge	163/Hydrography	14	8

CH09 - River inputs	Fresh water	D025/Water column temperature and salinity	TEMP/Temperature of the water column	28/Oceanographic geographical features	3	
CH09 - River inputs	Fresh water	G015/Suspended particulate material	TSED/Concentration of suspended particulate material in the water column	20/Environmental monitoring facilities	2	9
CH09 - River inputs	Marine Water	C005/Carbon, nitrogen and phosphorus	NTOT/Particulate total and organic nitrogen concentrations in the water column	20/Environmental monitoring facilities	1	
CH09 - River inputs	Marine Water	C005/Carbon, nitrogen and phosphorus	NTRA/Nitrate concentration parameters in the water column	20/Environmental monitoring facilities	11	
CH09 - River inputs	Marine Water	C005/Carbon, nitrogen and phosphorus	TPHS/Particulate total and organic phosphorus concentrations in the water column	20/Environmental monitoring facilities	2	
CH09 - River inputs	Marine Water	C005/Carbon, nitrogen and phosphorus	PHOS/Phosphate concentration parameters in the water column	20/Environmental monitoring facilities	8	
CH09 - River inputs	Marine Water	D025/Water column temperature and salinity	TEMP/Temperature of the water column	28/Oceanographic geographical features	7	
CH09 - River inputs	Marine Water	G015/Suspended particulate material	TSED/Concentration of suspended particulate material in the water column	20/Environmental monitoring facilities	10	
CH09 - River inputs	Biota/Biology	B020/Fish	FATX/Fish abundance in water bodies	32/Species distribution		1
CH09 - River inputs					**71 BLA**	**32 MED**
CH10 - Bathymetry	Riverbed/SeaBed	G005/Gravity, magnetics and bathymetry	MBAN/Bathymetry and Elevation	10/Elevation	33	
CH10 - Bathymetry					**33 BLA**	**0 MED**
CH11 - Alien species	Biota/biology	B045/Zooplankton	GP079/Zooplankton wet weight biomass	32/Species distribution	6	
CH11 - Alien species	Biota/biology	B045/Zooplankton	ZATX/Zooplankton taxonomy-related abundance per unit volume of the water column	32/Species distribution	13	
CH11 - Alien species	Biota/biology	B045/Zooplankton	ZCTC/Zooplankton taxonomy-related biomass expressed as carbon per unit volume of the water column	32/Species distribution	5	
CH11 - Alien species					**24 BLA**	**0 MED**
All challenges					**467**	**296**

Annex3: List of data providers for Challenges

Air
Ice
Marine water
Riverbed/SeaBed
Biota/Biology

Origin	EDMERP	EDMO	Environmental matrix	Group of category of characteristics (P03)
MS	11847 - Mediterranean decision support system for marine safety (MEDESS4MS)	2547/Institute of Accelerating Systems and Applications (IASA-UAT) (Greece)	Air	M010/Meteorology
Project	11974/MARINA FP7 (Marine Renewable Integrated Application Platform)	National and Kapodistrian University of Athens, Department of Physics, Atmospheric Modeling and Weather Forecasting Group	Air Marine water	M010/Meteorology D032/Sea level D030/Currents D034/Waves
MS		Bremen University (DE)	Ice	M015/Cryosphere
RU		State Research Center Planeta (Russia)	Ice	M015/Cryosphere
RU		HMC - ECNM (Russia)	Ice	M015/Cryosphere
INT	GRDC (Global Runoff Data Base) - the world-wide repository of river discharge data and associated metadata	BFG (GE)	Fresh Water	O005/Fluxes

INT	Aquastat global water information system	FAO	Fresh water	G015/Suspended particulate material
EU	12057/EMODNET Chemistry	EC DG MARE (European Commission. Directorate-General for Maritime Affairs and Fisheries)	Fresh water Marine water	C005/Carbon, nitrogen and phosphorus G015/Suspended particulate material
EU		EEA	Fresh water Marine water Biota/biology	B035/Pigments C005/Carbon, nitrogen and phosphorus
MS		DSI - Turkish State Hydraulics	Fresh Water	O005/Fluxes
MS		696/Institute of Marine Sciences, Middle East Technical University (Turkey)	Fresh water Marine water Biota/biology	B020/Fish H004/Fisheries B030/Phytoplankton and microphytobenthos B035/Pigments B045/Zooplankton C005/Carbon, nitrogen and phosphorus C015/Dissolved gases D025/Water column temperature and salinity
RU		727/MHI RAS (Marine Hydrophysical Institute) Russie	Fresh water Marine water	C005/Carbon, nitrogen and phosphorus D032/Sea level
USA	RivDIS global river discharge database	SAGE (US) (Center for Sustainability and the Global Environment)	Fresh Water	O005/Fluxes
Project	3104/CARBOOCEAN IP (GOCE) (Marine carbon sources and sinks assessment)		Fresh water Marine Water	G015/Suspended particulate material C005/Carbon, nitrogen and phosphorus
Project	7613/EURODELTA (European Co-ordination on Mediterranean and Black Sea Prodeltas)		Fresh Water	O005/Fluxes

Project	76643/SESAME (Southern European Seas: Assessing and Modelling Ecosystem Changes)		Fresh Water Biota/biology	O005/Fluxes B020/Fish
Project	12065/PERSEUS		Fresh water Marine Water	C005/Carbon, nitrogen and phosphorus C015/Dissolved gases
INT	10180/ARGO (profiling float)	IFREMER (CORIOLIS)	Marine water	D025/Water column temperature and salinity
INT	8846/PSMSL	46/PSMSL	Marine water	D032/Sea level
EU	Copernicus Marine Environment Monitoring Service	MERCATOR	Marine Water Biota/biology	B030/Phytoplankton and microphytobenthos B035/Pigments D032/Sea level D030/Currents D034/Waves D025/Water column temperature and salinity
EU	EMODNET Physics	EC DG MARE (European Commission. Directorate-General for Maritime Affairs and Fisheries)	Marine water	D025/Water column temperature and salinity D032/Sea level
EU		ECMWF	Marine water	D025/Water column temperature and salinity
EU		2688/JRC - EMIS (Marine Environmental Information System)	Marine Water	G015/Suspended particulate material
MS		692/IO-BAS BGODC (Institute of Oceanology - Bulgarian National Oceanographic Data Centre)	Air Marine water Riverbed/Seabed Biota/biology	M010/Meteorology D025/Water column temperature and salinity D032/Sea level G005/Gravity, magnetics and bathymetry

				B030/Phytoplankton and microphytobenthos B045/Zooplankton
MS		SEAMOD.RO (Romania)	Marine water	D025/Water column temperature and salinity D030/Currents
MS		NIMRD (Romania)	Marine water	D025/Water column temperature and salinity
MS		Turkish National Sea Level Monitoring System (TUDES)	Marine water	D032/Sea level
MS		UK Met Office Hadley Centre	Marine water	D025/Water column temperature and salinity
MS	1330/AVISO (DUACS)	FR – CNES	Marine water	D032/Sea level
RU		SO GOIN State Oceanography (Russia)	Marine water Ice Biota/biology	D025/Water column temperature and salinity M015/Cryosphere B030/Phytoplankton and microphytobenthos
RU		DVS (Russia)	Marine Water	D025/Water column temperature and salinity
USA		1433/NOAA (National Oceanic and Atmospheric Administration)	Ice Marine Water Riverbed/Seabed	M015/Cryosphere D025/Water column temperature and salinity T001/Terrestrial
USA		US NASA	IceFresh water Marine water Biota/biology	M015/Cryosphere C005/Carbon, nitrogen and phosphorus D025/Water column temperature and salinity B030/Phytoplankton and microphytobenthos B035/Pigments G015/Suspended particulate material

Project	10783/UP-GRADE BS-SCENE (Black Sea Scene)	1546/Permanent Secretariat Commission on the Protection of the Black Sea Against Pollution	Marine water Biota/biology	D025/Water column temperature and salinity B045/Zooplankton
Project	Projects	UNEP	Marine water	D025/Water column temperature and salinity
Project	GHRSST (Group for High-Resolution Sea Surface Temperature)		Marine water	D025/Water column temperature and salinity
Project	CLIMATE CHANGE INITIATIVE	ESA	Marine water Biota/biology	D032/Sea level B035/Pigments
INT	GEBCO (General Bathymetric Chart of the Oceans)		Riverbed/SeaBed	G005/Gravity, magnetics and bathymetry
EU	12055/EMODNET Bathymetry	EC DG MARE (European Commission. Directorate-General for Maritime Affairs and Fisheries)	Riverbed/SeaBed	G005/Gravity, magnetics and bathymetry
MS		850/National Institute of Marine Geology and Geoecology (GEOECOMAR) (Romania)	Riverbed/Seabed	G005/Gravity, magnetics and bathymetry
MS		GAMMA Consulted Ltd (Georgia)	Riverbed/SeaBed	T001/Terrestrial
EU		Eurostat	Biota/Biology	B020/Fish H004/Fisheries
MS	12039/NATURA2000	MOEW (Bulgaria) (Ministry of Environment and Water)	Human Activities Biota/Biology	H004/Fisheries Z005/Administration and dimensions B070/Biota abundance, biomass and diversity B050/Habitat
MS		BSPB (Bulgarian Society for Protection of Birds)	Biota/Biology	B015/Birds, mammals and reptiles
MS		APA (Georgia) (Agency of Protected Areas)	Biota/biology	B070/Biota abundance, biomass and diversity

MS		TSU (Georgia) (Ivane Javakhishvili Tbilisi State University)	Biota/biology	B030/Phytoplankton and microphytobenthos
MS		CNDD (Romania) (Centrul National pentru Dezvoltare Durabila)	Biota/biology	B015/Birds, mammals and reptiles
MS	12039/NATURA2000	SIMSHAB (Romania) (Information System for Species and Habitats Monitoring)	Human Activities Biota/Biology	H004/Fisheries B070/Biota abundance, biomass and diversity B050/Habitat
MS	SINCRON NATURA 2000 project	2674/ANPM (Romania) (National Environmental Protection Agency)	Biota/biology	Z005/Administration and dimensions
MS	The Emerald Network (Natura 2000)	Kolkheti National Park (Romania)	Biota/biology	B015/Birds, mammals and reptiles Z005/Administration and dimensions
MS		Sinop University, Fisheries Faculty (Turkey)	Biota/biology	B030/Phytoplankton and microphytobenthos
MS		TurkStat (Turkish Statistical Institute)	Biota/Biology	B020/Fish H004/Fisheries
Project	Bulgarian Citizen project for Green Balkans		Biota/biology	B015/Birds, mammals and reptiles
Project	FAO project TCP/GEO/2904 , SESAME project	190/MEFRI (Georgia) (Marine Ecology and Fisheries Research Institute)	Biota/biology	B015/Birds, mammals and reptiles
Project	11830/SEADATANET2	FR-IFREMER	Biota/biology	B030/Phytoplankton and microphytobenthos
EU		Black Sea Commission (against pollution)	Biota/biology Human Activities	B020/Fish B030/Phytoplankton and microphytobenthos H001/Anthropogenic contamination

Project	11847 - Mediterranean decision support system for marine safety (MEDESS4MS)		Marine Water Riverbed/Seabed Human Activities Biota/biology	D034/Waves T001/Terrestrial H005/Human activity B050/Habitat H004/Fisheries
EU	EMODNET Human Activities	EC DG MARE (European Commission. Directorate-General for Maritime Affairs and Fisheries)	Biota/biologyHuman Activities	B050/Habitat H004/Fisheries
MS	VLIMAR: the VLIZ Marine Gazetteer	422/Flanders Marine Institute (VLIZ)	Human Activities	Z005/Administration and dimensions

Annex4: Use Case detailed appropriateness and availability expert opinion

The Table below lists in details for each Use Case the Appropriateness and data Availability expert opinion.

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
CH1.1	Air	Zonal wind component Meridional wind component Air pressure Air density Specific humidity of the atmosphere Air temperature	Spatial and temporal resolution, area coverage	high visibility	via request to the project partners	high reliability
	Marine water	Sea level Water temperature Water salinity Water zonal velocity component Water meridional velocity component 2-dimensional wave spectra over frequencies and directions Significant Wave Height Mean wave direction Mean (Energy) wave period Peak wave period Swell wave height Maximum expected wave height				
CH2.1	Riverbed/Seabed	Habitats	Space resolution (horizontal and vertical)	high visibility	advanced web service on request, restricted	good responsiveness and reliability

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
	Biota/Biology	Species	Space extent (horizontal and vertical)		to MPA administrators/ custodians	good responsiveness and reliability
	Human Activities	EU RAMSAR area EU Habitat areas EU Bird protection areas National conservation areas	Space extent (horizontal and vertical)	high visibility	advanced web service unrestricted, no charge	good responsiveness and reliability
CH2.2	Air	Wind data	Space (horizontal and vertical) and time extent	high visibility	advanced web service, credentials upon request (after accepting the Data Policy)	good responsiveness and reliability
	Marine water	Water temperature	Space (horizontal and vertical) and time extent	high visibility	advanced web service, credentials upon request (after accepting the Data Policy)	good responsiveness and reliability
	Riverbed/ Seabed	Habitat mapping Geology	Space extent (horizontal and vertical)			
	Biota/ Biology	Species	Space extent (horizontal and vertical)			
	Human Activities	EU RAMSAR area EU Habitat areas EU Bird protection areas National conservation areas Socioeconomics Threats	Space extent (horizontal and vertical)			
CH2.3	Riverbed/Seabed	Habitats Bathymetry	Space resolution (horizontal and vertical)	high visibility	advanced web service unrestricted, no charge	good responsiveness and reliability
	Biota/Biology	Species Biodiversity	Space (horizontal and vertical) and time extent			

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
	Human Activities	EU RAMSAR area EU Habitat areas EU Bird protection areas National conservation areas Sea cables Pipelines Fishery & Aquaculture Zones Tourism	Space extent (horizontal and vertical)			
CH3.1	Air	U and V components of wind speed	Spatial resolution of 2.5˚x2.5˚, temporal resolution of 6 hrs and over 2000–2010	high visibility	free download data from the NCEP/NCAR 40-Year Reanalysis	totally reliable
	Ice	Ice cover data	Arctic Ocean water and ice circulation model at a spatial resolution of 1˚x1˚, temporal resolution of 1 week	high visibility	free download data from the NCEP/NCAR 40-Year Reanalysis	totally reliable
	Marine water	Sea temperature and salinity	Monthly climatology, spatial resolution is not specified	poor	N/A	N/A
		Surface currents	Arctic Ocean water and ice circulation model at a spatial resolution of 1˚x1˚, temporal resolution of 1 week	poor	N/A	N/A
		Satellite altimetry data	Satellites with a high orbit inclination angle: ERS-1, ERS-2	unknown	free download data from the NCEP/NCAR 40-Year Reanalysis	totally reliable

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
		Tide heights	Regional tidal model of the Barents Sea at a spatial resolution of 5x5nm, temporal resolution of 90s	poor	N/A	N/A
	Human activities	Data on drilling and well production	Dataset on 36 wells including 19 production ones	poor	N/A	N/A
		Oil tanker (crude carrier) traffic risk assessment	State-of-the-art approach to marine traffic Risk modelling	poor	N/A	N/A
		Specially protected natural reservations	Two sites were considered in the Barents Sea: Dolgy Island and Gulyaevskie Koshki islands	high visibility	accessible	poor, only in Russian
		Response equipment and technologies	3 salvage vessels equipped by booms and Arctic oleophilic skimmers	high visibility	accessible	poor, only in Russian
CH3.2	Marine water	Satellite radar images from ERS-2 and Envisat to detect oil pollution	High and very high (75 m and 12.5 m) spatial resolution of ASAR images	visible metadata	web data access with registration does not work	N/A
		Satellite IR-range and optical data from the MODIS Aqua/Terra, MERIS, and AVHRR NOAA to evaluate SST and the mesoscale dynamics in the radar images interpretation	Spatial and temporal resolution is not specified	N/A	N/A	N/A
	Biota/ Biology	Biogenic sea surface films due to chlorophyll life cycles and algal blooms	Spatial and temporal resolution is not specified	N/A	N/A	N/A

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
	Human activities	Operational oil pollution of the Black Sea Waste-water leaks	N/A	N/A	N/A	N/A
CH4.1	Marine water	Temperature Nutrients		high visibility	online free search	good responsiveness and good reliability
	Biota/ Biology	Phytoplankton biomass Taxonomic groups	Space (horizontal and vertical) and time resolution	high visibility	online free search	good responsiveness and good reliability
CH4.2	Air	Air temperature at 2 m	Temporal and spatial coverage, spatial resolution	high visibility	advanced web service, unrestricted, no charge	very fast response, totally reliable
	Ice	Snow and ice mass, thickness and extent	Temporal and spatial coverage, spatial resolution	high visibility	advanced web service, unrestricted, no charge	very fast response, totally reliable
CH4.3	Air	Long-term time series of air temperature Long-term time series of wind speed at 10-m height NAO indices	Good basin-scale temporal and spatial coverage	non visible	N/A	N/A
	Marine water	In-situ measurements of sea temperature and salinity	The best frequently and 3D spatial coverage over 1951–1991	non visible	N/A	N/A
		Sea temperature and salinity via ARGO profiles	The best frequently and 3D spatial coverage over 2005–2008	visible	accessible	high performed
		SST via satellite observation	The best frequency and 2D spatial coverage over 1985–2007	non visible	N/A	N/A

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
		Sea water density Geostrophic currents calculated by the dynamic method in the 0–300 dbar layer Kinetic energy of the geostrophic currents	Basin-scale coverage by a regular 5-mile grid (~9.3–9.3km)	non visible	N/A	N/A
CH5.1	Marine water	Sea level from tide gauges	Spatial extent of the instruments network, (number and location of observation stations) and time resolution and extent of tide gauge time series. Completeness and accuracy of the data set.	low visibility	manual ordering, available upon negotiation, format unknown	no responsiveness and reliability
		Sea level from satellite altimetry	Spatial extent of the satellite tracks and time resolution and extent of altimeter sensors.	high visibility	discovery and downloading, unrestricted, format known (NetCDF)	good responsiveness
CH5.2	Riverbed/ Seabed	Sediment mass balance and coastal erosion	Time and space resolution and extent	high visibility	manual ordering, restricted, partly at cost, format known (text, Excel, maps)	good responsiveness
		Bathymetry, elevation and undersea features	Info is available	high visibility	manual ordering, restricted, partly at cost, format known (text, Excel, maps)	good responsiveness
CH6.1	Biota/ Biology	Species Catches Landings	Space (horizontal and vertical) and time	high visibility	online query	good responsiveness

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
	Human activities	Fisheries Aquaculture	resolution			and reliability
CH6.2	Biota/ Biology	Species Catches Landings	Space (horizontal and vertical) and time resolution	high visibility	advanced web search	good responsiveness and reliability
	Human activities	Fisheries Aquaculture				
CH6.3	Biota/ Biology	Species Catches Landings	Space (horizontal and vertical) and time resolution	high visibility	free online download	good responsiveness and reliability
	Human activities	Fisheries Aquaculture				
CH6.4	Biota/ Biology	Species Catches Landings	Space (horizontal and vertical) and time resolution	high visibility	free online download	good responsiveness and reliability
	Human activities	Fisheries Aquaculture				
CH6.5	Biota/ Biology	Species Catches Landings	Space (horizontal and vertical) and time resolution	high visibility	advanced web service on request, restricted to members only	good responsiveness and reliability
	Human activities	Fisheries	Space (horizontal and vertical) and time resolution	high visibility	advanced web service on request, restricted to members only	good responsiveness and reliability
CH7.1	Biota/ Biology	Species Catches Landings	Space (horizontal and vertical) and time resolution	high visibility	advanced web service on request, online access to the BSIS (for registered users only)	good responsiveness and reliability
	Human activities	Fisheries				
CH8.1	Marine water	Concentrations of inorganic nutrients (N, P and Si) Concentration of dissolved oxygen	Time and space extent	high visibility of data and metadata	advanced web service	fast response and reliability

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
		Nutrients ratio	Time and space extent	non visible	N/A	N/A
	Biota/ Biology	Chlorophyll a concentrations Phytoplankton – taxonomic composition, algal blooms	Time and space extent	high visibility of data and metadata	advanced web service	fast response and reliability
		Macrophytobenthos – species composition, biomass	Time and space extent	non visible	N/A	N/A
CH8.2	Air	Nitrogen flux from atmosphere to sea surface	basin/sub-basin scale and long-term data	visible	accessible for Baltic Proper and coastal North Sea; inaccessible for Northern Adriatic and North-Western Black Sea Shelf	well performed for Baltic Proper and coastal North Sea
	Marine water	Nitrogen and phosphorus fluxes across lateral liquid boundaries				
	Fresh water	Riverine nitrogen and phosphorus inputs				
	Riverbed/ Seabed	Nitrogen and phosphorus fluxes across sediments				
	Human activities	Nitrogen and phosphorus fluxes due to agriculture and urbanization and fossil fuel combustion				
CH9.1	Fresh water	River discharge	Accuracy of measurement and time series extension	*GRDC*: medium visibility; *RivDIS database and Global River Discharge Database*:high visibility	GRDC: under User Declaration; RivDIS database: access with registration, no charge; Global River Discharge Database: unrestricted tab-delimited format	GRDC: online service offers immediate access to data RivDIS database and Global River Discharge Database: fast response and reliability

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
		Concentration of nitrate Concentration of phosphate Concentration of total nitrogen Concentration of total phosphorus	Accuracy of measurement and time series extension	Global Environment Monitoring System (GEMS): data difficult to find; EEA's databases and EMODNET Chemistry: high visibility	GEMS: discovery service available but not data for Black Sea; EEA's databases: downloading Access EMODNET Chemistry: accessible but restricted depending on the intended use	Global Environment Monitoring System (GEMS): not applicable; EEA's databases and EMODNET Chemistry: good responsiveness
CH10.1	Riverbed/ Seabed	DTM of the seabed	Appropriate spatial resolution of 8 raster data sets produced: Conclusions are based on sample maps in the relevant publications (however, exact pixel size of the DTM's are unknown)	high visibility	all 8 data sets available for on-line purchase	good enough
CH10.2	Riverbed/ Seabed	Bathymetric contour of the 0-isobath for the Black Sea basin (contemporary coastline)	Most appropriate considering the basin-scale coverage of the shapefile; coastline extracted from Landsat-7 images	high visibility	not distributed online (however, data are at disposal at IO-BAS)	best available when discussing the entire coastline of the Black Sea basin

Use Case	Env. Matrix	Relevant Characteristics	Criteria used for appropriateness	Visibility	Accessibility	Perfomance
CH11.1	Biota/ Biology	Alien species (Mnemiopsis leidyi) abundance and biomass Alien species (Beroe ovata) abundance and biomass	Space (horizontal and vertical) and time extent	high visibility	data policy: accessible under moratorium	good responsiveness and reliability
CH11.2	Marine water	Temperature Salinity	N/A	N/A	N/A	N/A
		Chlorophyll a	Space (horizontal and vertical) and time resolution	high visibility	a format not known	good responsiveness and reliability
	Biota/ Biology	Alien species (Mnemiopsis leidyi) abundance Mesozooplankton abundance and biomass	Space (horizontal and vertical) and time resolution	high visibility	format not known	good responsiveness and reliability