

EMODnet MedSea Checkpoint Data Adequacy Report

EMODnet

European Marine
Observation and
Data Network



MedSea Checkpoint

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GROWTH AND INNOVATION IN OCEAN ECONOMY – GAPS AND PRIORITIES IN SEA BASIN OBSERVATION AND DATA

EMODnet MedSea CheckPoint *DRAFT* **Second Data Adequacy Report**

Total number of pages: 62

A project funded by:

**EUROPEAN COMMISSION, DIRECTORATE-GENERAL FOR MARITIME AFFAIRS AND FISHERIES,
MARITIME POLICY ATLANTIC, OUTERMOST REGIONS AND ARCTIC**



Workpackage	11	11.4 Draft of the Second Data Adequacy Report
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Glossary

AIS: Automatic Identification System
BODC: British Oceanographic Data Centre
CFP: Common Fisheries Policy
CH: Challenge
Chl: Chlorophyll
CLS: Collecte Localisation Satellites (FR)
CLU: CLU s.r.l. (IT)
CMCC: Euro-Mediterranean Centre for Climate Change (IT)
CMEMS: Copernicus Marine Environment Monitoring Service
CNR: National Research Council (IT)
CNR-ISAC: CNR Institute of Atmospheric Sciences and Climate
CNR-ISMAR: CNR Institute of Marine Sciences (IT)
CoConet: Towards COast to COast NETworks of marine protected areas
Copernicus: European Programme for the establishment of a European capacity for Earth Observation
CSW: Catalogue Service for Web
CYCOFOS: Cyprus Coastal Ocean Forecasting and Observing System
CZCS: Coastal Zone Colour Scanner
DAC: Data Assembly Center
DAR: Data Adequacy Report
DCR: Data Collection Regulation
DCF: Data Collection Framework
DG-MARE: Directorate-General for Maritime Affairs and Fisheries
DIN: Dissolved Inorganic Nitrogen
DO: Dissolved Oxygen
DPS: Data Product Specification
EC: European Commission
ECMWF: European Centre for Medium-Range Weather Forecast
ECV: Essential Climate Variables
EDF-EN: EDF Energies Nouvelles (FR)
EDMED: European Directory of Marine Environmental Data
EEA: European Environmental Agency
EEC: European Economic Community
EEZs: Exclusive Economic Zones
EIONet: European Environment Information and Observation Network
EMODnet: European Marine Observation and Data Network
EMSA: European Maritime Safety Agency
ESA: European Space Agency
ESIF: Energy Saving In Fisheries
ETA: Estimated Time of Arrival
ETP: Endangered Threatened Protected species
EU: European Union
EUMETNET: European National Meteorological Services
EU MS : EU Member State
EUNIS: European Nature Information System
EUROGOOS: European Global Ocean Observing System

FAO: Food and Agriculture Organization
FEM: Association de Préfiguration de l'IEED France Energies Marines (FR)
FP7: Seventh Framework Programme
GEBCO: General Bathymetric Chart of the Oceans
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
GFCM: General Fisheries Commission of the Mediterranean and Black Sea
GIS: Geographic information system
GMES: Global Monitoring for Environment and Security
GOOS: Global Ocean Observing System
GPS: Global Positioning System
GSA: FAO-GFCM Geographical Subarea
GT: Gross Tonnage
HCMR: Hellenic Centre for Marine Research (GR)
HO: Hydrostatic Office
ICES: International Council for the Exploration of the Sea
ICCAT: International Commission for the Conservation of Atlantic Tunas
ICZM: Integrated Coastal Zone Management
IEO: Instituto Español de Oceanografía
IFREMER: Institut Français de Recherche pour l'Exploitation de la Mer (FR)
IH-Cantabria: Fundación Instituto de Hidráulica Ambiental de Cantabria (ES)
IHO: International Hydrographic Organization
IMEDEA: Mediterranean Advanced Studies Institute
IMO: International Maritime Organization
INGV: National Institute of Geophysics and Volcanology (IT)
INSPIRE: Infrastructure for Spatial Information in the European Community
IOC: Intergovernmental Oceanographic Commission
IPCC: Intergovernmental Panel on Climate Change
IRIS: Integrated Regional monitoring Implementation Strategy in the South European Seas
ISCOMAR: Isleña Marítima de Contenedores
ISO: International Organization for Standardization
ISO/IEC: ISO and International Electrotechnical Commission
ISO/IEC JTC: ISO/IEC Joint Technical Committee
ISO NP: ISO New Proposal
ISO NP TS: ISO NP Technical Specification
ISPRA: Italian National Protection Agency
JCOMM: Joint WMO-IOC Commission on Marine Meteorology
JRC: Joint Research Centre
LOA: Length OverAll
MAP: Mediterranean Action Plan
MERIS: MEdium Resolution Imaging Spectrometer
MODIS: Moderate Resolution Imaging Spectroradiometer
MPA - Marine Protected Areas
MS: Member States
MSFD: Marine Strategy Framework Directive
MSP: Maritime Spatial Planning

MSSD: Mediterranean Strategy for Sustainable Development
NRT: Near Real Time
NKUA: National and Kapodistrian University of Athens
NMEA: National Marine Electronics Association
OCEANS-CAT: OCEANS Catalonia International SL (ES)
OPL: Oil Platform Leak
OOCS: Operational Observatory of the Catalan Sea
OSSE: Observing System Simulation Experiments
OSE: Observing System Experiment
OTB: Bottom Otter Trawl
P01: BODC Parameter Usage Vocabulary
P02: SeaDataNet Parameter Discovery Vocabulary
P03: SeaDataNet Agreed Parameter Groups
SeaWiFS: Sea-viewing Wide Field-of-view Sensor
SFTP - SSH File Transfer Protocol
SHOM: Service hydrographique et océanographique de la marine
SMOS: Soil Moisture and Ocean Salinity
SOCIB: Balearic Islands Coastal Observing and Forecasting System (ES)
SOG: Speed Over Ground
SPAMI: Specially Protected Areas of Mediterranean Importance.
SSH: Secure Shell
SST: Sea Surface Temperature
TBB: Beam Trawl
TP: Total Phosphorous
TPD: Targeted Product Description
TRIX: Trophic Index
UCY: University of Cyprus (CY)
UN: United Nations
UNCLOS: United Nations Convention on the Law of the Sea
UNEP: United Nations Environment Programme
UNESDO: United Nations Educational, Scientific and Cultural Organization
VHF: Very High Frequency
VLIZ: Flanders Marine Institute
VMS: Vessel Monitoring System
WISE: Water Information System for Europe
WFD: Water Framework Directive
WGS84: World Geodetic System 1984
WMO: World Meteorological Organisation
WMOP: SOCIB Western Mediterranean Sea Operational forecasting system
VMS: Vessel Monitoring System
WWF: World Wildlife Fund

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Executive Summary

This second Mediterranean Data Adequacy Report (DAR) is completing the development of concepts and methodologies initiated in the Literature Review and in the first Data Adequacy Report. The aim of this DAR is to document the reliability and utility of the existing monitoring system at the sea basin level and to identify the gaps, prioritizing them.

This DAR documents the final methodology used in the MedSea Checkpoint project based upon ISO and INSPIRE principles for the development of indicators. The indicators are constructed directly on the Checkpoint metadatabase, containing information on the upstream data providers. For each Challenge, Checkpoint Information on What, Why, Where, When, How data have been used to develop targeted products is given and statistically analysed.

The metadatabase contains 266 data set descriptors, which identify and assess potentially usable information for the construction of the Challenge products. It must be underlined that only 90 of the 266 data set descriptors have been used for the realization of the Challenge products.

The assessment methodology is providing quantitative and qualitative information on **How** the input data sets are made available to Challenges (Availability Indicators) and **What** is the quality of the monitoring data for the Challenge products (Appropriateness Indicators). The assessment methodology has been based on four elements:

1. the Data Product Specification,
2. the collection of information on Input Data needed for these products,
3. the realization of Targeted Data Products (TDP - requested by the call) using the Input Data
4. the development of indicators to assess the Input Data and the adequacy of products obtained from them with respect to DPS.

Indicators values have been grouped in three colour codes in order to increase the readability of the results. Results are presented first for the availability and appropriateness indicators separately and then in a combined way.

From the combined availability and appropriateness indicators analysis, the emerging gaps for the monitoring system at the basin scales, in view of the 7 prescribed Challenges, are:

1) sediment mass balance monitoring data, the targeted product could not be realized, data are only available in the literature and after the last EUROSION project, terminated in 2004, no INSPIRE catalogue and database was constructed from the data collected.

2) the fishery management data, such as fish catch and by-catch, are totally inadequate to cover the required targeted products needs from all the indicators point of view. The key inadequate quality attributes for this monitoring are: visibility, EU INSPIRE catalogue, data policy visibility, readiness, data delivery and data policy, horizontal and temporal coverage, temporal validity. Another major point is the scarcity of the data collected in 2 years search.

3) the habitat extent input data sets, such as Posidonia oceanica, Coralligenous and Maerl habitats, seabed sensible habitats, are totally inadequate in terms of Data Policy and Responsiveness, Vertical and horizontal coverage, temporal and horizontal resolution.

4) the wave height, period, direction and spectral parameters input data sets are totally inadequate because of negative scores for visibility, INSPIRE Catalogue, Data Policy, Pricing, responsiveness, temporal coverage, horizontal and temporal resolution.

Recommendations and actions are also suggested to try to remove these gaps in the short to medium term time range.

1. Introduction

The DGMARE tender “Gaps and priorities in Sea Basin Observation and Data” asked for:

”determining gaps in data and observation systems and priorities for an observation system that supports the delivery of sustainable growth and innovation. The objective is to support the deployment of a marine observation infrastructure that offers the most effective support to the blue economy. The cost effectiveness, reliability and utility of the existing monitoring infrastructure will be assessed by developing products based on these data and determining whether the products are meeting the needs of industry and public authorities.”

General
aim of the
assessment

The concept of a Data Adequacy Report (DAR) was then formulated i.e.:

“the DAR is an annual report providing an annual view of the monitoring effort in the sea basin.”

The DAR
concept

All the European sea basins, including the Arctic, Atlantic, Baltic, Black Sea, Mediterranean and North Sea, are now developing the framework for the DAR and this report is concerned with the Mediterranean Sea assessment.

In the past three years a Literature Survey¹ and a first DAR² have been released.. The second DAR is completing the assessment allowing the final gap analysis and suggesting the improvements.

The Med
Sea
reports

1.1 The Challenge Targeted products

The monitoring system assessment done in the DAR is quite an innovative concept because it is done by analysing the “fitness for use” or “adequacy” of input data sets in order to create specific products for seven Challenges, that are: CH1- Windfarm Siting, CH2- Marine Protected Areas, CH3- Oil Platform Leak, CH4- Climate and Coastal Protection, CH5- Fisheries Management, CH6- Marine Environment, CH7- River Inputs.

DGMARE defined the following specific challenge products:

Tender
Challenge
products

- CH1-Windfarm siting
 - Suitability of sites for wind farm development
- CH2-Marine Protected Areas
 - Representativeness and coherency of existing European network of marine protected areas (national and international sites) as described in article 13 in the Marine Strategy Framework Directive.
- CH3-Oil Platform leak

¹ <https://webgate.ec.europa.eu/maritimeforum/node/3646>

² <http://www.emodnet-mediterranean.eu/wp-content/uploads/2015/06/D11.2-revised-V11.pdf>

- Likely trajectory of a leak from an oil platform and the statistical likelihood that sensitive coastal habitats or species or tourist beaches will be affected within 24 hours and after 72 hours.
- CH4-Climate and Coastal Protection
 - Spatial data layers for the following parameters for the past 10 years, the past 50 years and the past 100 years
 - average annual change in temperature at surface, midwater and sea-bottom
 - average annual sea-level rise at the coast (absolute and relative to the land)
 - sediment mass balance at the coast
 - Time plots for the following parameters for the whole sea basin
 - average annual sea temperature over sea-basin at surface, mid-water column and bottom.
 - average annual changes in internal energy of sea
- CH5-Fisheries Management
 - tables for the whole sea-basin of mass and number of landings of fish by species and year
 - mass and number of discards and bycatch (of fish, mammals, reptiles and seabirds) by species and year
 - data layers (gridded) showing the extent of fisheries impact on the sea floor
 - area where bottom habitat has been disturbed by bottom trawling (number of disturbances per month)
 - change in level of disturbance over past ten years
- CH6-Marine Environment
 - data layers (gridded) showing
 - Seasonal averages of eutrophication in the basin for past ten years
 - Change in eutrophication over past ten years (i.e. where eutrophication has reduced and where it has increased)
- CH7-River inputs
 - for each river bordering the sea basin, the country where it enter the sea and a time series of annual inputs from rivers of
 - water
 - sediment
 - total nitrogen
 - phosphates
 - eels
 - monthly averages, maxima and minima for these parameters over the past ten years

Tender
Challenge
products

Tender
Challenge
products

These specifications have been transformed by each Challenge into “Targeted Products” with well-defined input datasets. A metadata archive has been developed where quality elements have been defined and assigned to both the

targeted products and the input datasets. The assessment is done on the basis of indicators extracted from the metadatabase or calculated from the metadatabase information. This assessment framework is described in the next section.

1.2 The assessment framework

The Mediterranean Sea Checkpoint developed a completely new framework to carry out the data adequacy assessment. This framework is based upon three methodological pillars:

- 1) use of the ISO principles for the methodological development and the metadata definition;
- 2) design of a metadatabase containing the information about the input data sets, the Targeted products and the quality indicators;
- 3) definition of indicators for the objective assessment of the data adequacy following INSPIRE rules.

The overall working scheme of the Mediterranean Checkpoint is shown in Figure 1.1.

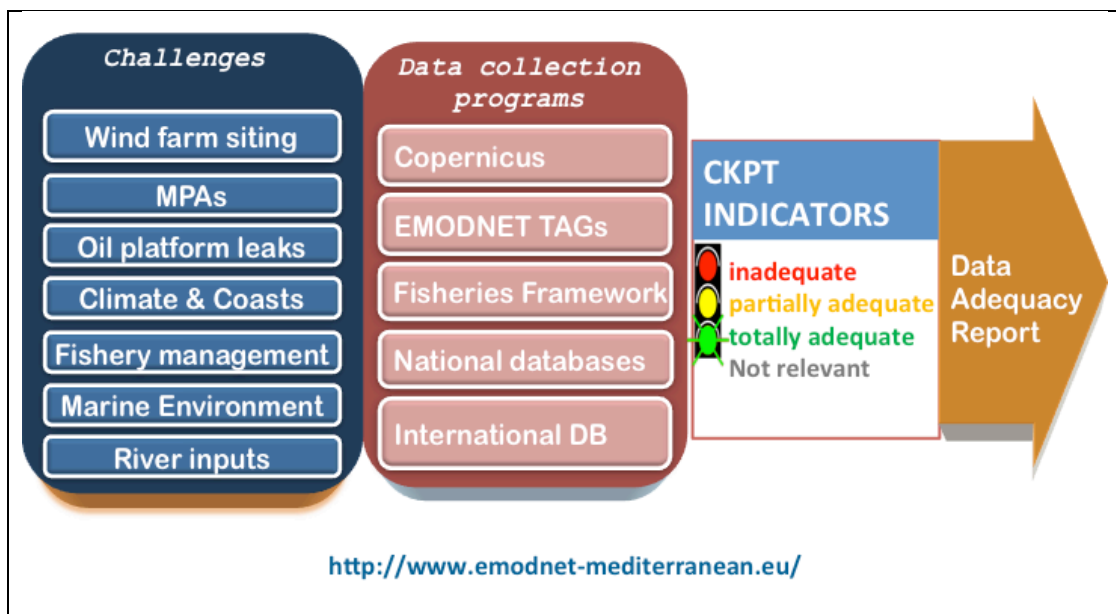


Figure 1.1 The Mediterranean Checkpoint Framework from tender challenges products, to input data sets, services and assessment

1.3 Structure of the document

The report is subdivided into nine sections:

- 1) the first is the general introduction;
- 2) the second describes the ISO and INSPIRE methodological framework used in the Checkpoint;
- 3) the third describes the assessment indicators;
- 4) the fourth analyses the input data sets presently stored in the Checkpoint metadatabase;
- 5) the fifth analyses the input data sets in terms of availability indicators;
- 6) the sixth analyses the input data sets in terms of appropriateness indicators;
- 7) the seventh analyses the Targeted product quality;
- 8) the eight extracts the gaps from the combined analysis of the two indicators;
- 9) the ninth concludes with recommendations.

Five Annexes compose this second DAR. They contain the statistical analysis of the input data sets in the metadatabase (Annex 1), the indicator definition (Annex 2), the statistical analysis of indicators (Annex 3 and 4) and the expert opinions on the Challenge products and gaps (Annex 5).

2. The methodological framework

The Mediterranean Sea Checkpoint has developed an objective assessment methodology for the basin scale monitoring system. The latter is composed of “input data sets” that are used by the Challenges to derive products. The general framework has been provided by the “Methodology to assess and communicate the economic benefits of consensus-based standards”³ developed by ISO.

2.1 Key definitions

Vocabulary
definitions

The definition of key vocabulary terminology has an important role in the Mediterranean Sea Checkpoint assessment framework. These semantic aspects are mainly based on ISO standard definitions.

- **Characteristic:** A distinguishing feature which refers to:
 - a variable derived from the observation or the measurement;
 - a numerical model output of a phenomenon
 - an object property in the environment
 - a geographical representation of an object on a map (i.e. a layer such as a protected area, a coastline or wrecks) by a set of vectors (polygon, curve, point)
 - a raster (a spatial data model that defines space as an array of equally sized cells such as a grid or an image).
- **Environmental matrices:** The environments where characteristics are measured or computed:
 - Air,
 - Fresh water, Marine water,
 - Biota/Biology,
 - Riverbed/Seabed,
 - Human activities.
- **Data:** reinterpretable representation of information in a formalised manner suitable for communication, interpretation or processing (ISO 19115)
- **Dataset:** an identifiable collection of data (ISO 19115). It can be a time series, a lithological description of a marine sample, a gridded dataset such as a DTM, an 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 be constituted of several files (e.g. the set of seismic data files recorded along the same line).
- **Input Dataset:** The collection of existing data to be input to the Challenges
- **Assessment criteria:** The criteria are focused on two questions : “what” and ‘how’ is made available to the challenges. Appropriateness (what) and availability (how) indicators have been defined using ISO 19113 and ISO 19157 standards.

³ Assessing economic benefits of consensus-based standards – The ISO methodology.
<http://www.iso.org/iso/home/standards/benefitsofstandards/benefits-detail.htm?emid=6>

- **Data adequacy:** can be defined as the fitness for use of the data for a particular user or for a variety of users. Since different applications require different properties associated with the data itself, ‘adequacy’ should be defined objectively using standardized nomenclature and methods. In an EC Report⁴ adequacy was defined as an assessment of the reported information to meet the objectives of the Marine Strategy Framework Directive (MSFD) and its technical requirements listed in MSFD Articles 8, 9 and 10⁵. The CheckPoint adequacy is close to this definition but focused on several Challenges. In other words adequacy is here intended as ‘sufficient to satisfy a requirement or meet a need’⁶. From this definition, ‘adequacy’ relates to meeting both requirements as well as needs and is normally applied within the framework of an ISO 9001 based Quality Management System.

2.2 The ISO rules adopted for the assessment

Table 2.1 overviews the ISO standards used for definitions, services and assessment criteria of the Mediterranean Checkpoint.

Assessment standards

Table 2.1 ISO standards for Checkpoint methodology

Standards used for key definitions	Standards used for the Med Checkpoint Services	Standards used for assessment criteria
<p>ISO9000: The ISO 9000 family addresses various aspects of quality management. The standards provide guidance and tools for companies and organizations who want to ensure that their products and services consistently meet customer’s requirements, and that quality is consistently improved.</p> <p>ISO9001: sets out the requirements of a quality management system.</p> <p>ISO19113: establishes the</p>	<p>ISO19115: defines the schema required for describing geographic information and services by means of metadata. It provides information about the identification, the extent, the quality, the spatial and temporal aspects, the content, the spatial reference, the portrayal, distribution, and other properties of digital geographic data and services.</p> <p>ISO 19156:2011 defines a conceptual schema for observations, and for features involved in sampling when making observations. These provide models for the</p>	<p>ISO8601: is the international standard covering the exchange of ‘date’ and ‘time’ so as to avoid misinterpretation of numeric representation of them.</p> <p>ISO9004: focuses on how to make a quality management system more efficient and effective.</p> <p>ISO19108: defines concepts for describing temporal characteristics of geographic information. It depends upon existing information technology standards for the interchange of temporal information.</p> <p>ISO19157: establishes the principles for describing the</p>

ISO rules for metadata

⁴ The first phase of implementation of the Marine Strategy Framework Directive (2008/56/EC) - The European Commission’s assessment and guidance. CELEX_52014SC0049_EN_TXT

⁵ Adequacy does not necessarily mean, for instance, that if the defined data is adequate, this automatically means that the quality of the marine waters is acceptable

⁶ Random House Unabridged Dictionary, Random House Inc, 2006

<p>principles for describing the quality of geographic data and specifies components for reporting quality information. It also provides an approach to organizing information about data quality. This standard has been revised by ISO19157.</p> <p>ISO19131: help in the creation of data product specifications, so that they are easily understood and fit for their intended purpose.</p>	<p>exchange of information describing observation acts and their results, both within and between different scientific and technical communities.</p> <p>ISO19119: identifies and defines the architecture patterns for service interfaces used for geographic information, defines its relationship to the Open Systems Environment model, presents a geographic services taxonomy and a list of example geographic services placed in the services taxonomy.</p>	<p>quality of geographic data (components for describing data quality; components and content structure of a register for data quality measures; general procedures for evaluating the quality of geographic data; principles for reporting data quality). It also defines a set of data quality measures for use in evaluating and reporting data quality.</p> <p>ISO25010: is a quality in use model composed of characteristics and sub-characteristics that relate to the outcome of interaction when a product is used in a particular context of use. The model is applicable to both computer systems and software products.</p>
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The ISO based methodology provides a set of standards that measure in an objective way the 'data adequacy'. The assessment is based on appropriate quality information, which include:

1. per-product quality (ISO quality elements);
2. input data set quality information (quantified values through indicators);
3. reputation of data (expert knowledge on the input data set);
4. community assessments of data relevance and usability within the application domain (expert opinion).

These elements require the definition of 'ideal product specifications' (called Data Product Specifications) that must be compared with the products obtained from existing input data (the Targeted Products). ISO19157:2013(E) quality elements are used to provide a statistical indication of the Targeted Products quality with respect to the Product Specifications and also provide a quantitative estimation of the extent to which data sets or data set series can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. In other words, ISO 19157 standards contain elements for assessing 'how' and 'how much' data meets requirements in order to enhance user satisfaction.

The Mediterranean Check Point ISO9004 base concepts (Figure 2.1) allow a quality management approach with self-assessment as a tool to review the checkpoint results. This 'self-assessment' has been based on the internal review of deliverables and on the comparison between 'objective assessments' based on indicators and expert opinion. In the Figure 2.1 the

t

Quality management approach

ISO schema is showing the processes important for the Checkpoints:

- continually monitor and regularly analyse the organization's environment, including its customers' needs and expectations, the competitive situation, new technologies, political changes, economic forecasts, or sociological factors
- identify and determine the needs and expectations of other interested parties
- assess its current process capabilities and resources,
- identify future resource and technology needs,
- identify the outputs necessary to meet the needs and expectations of the interested parties.

These processes should be established in a timely manner, with any necessary plans and resources being provided to support them.

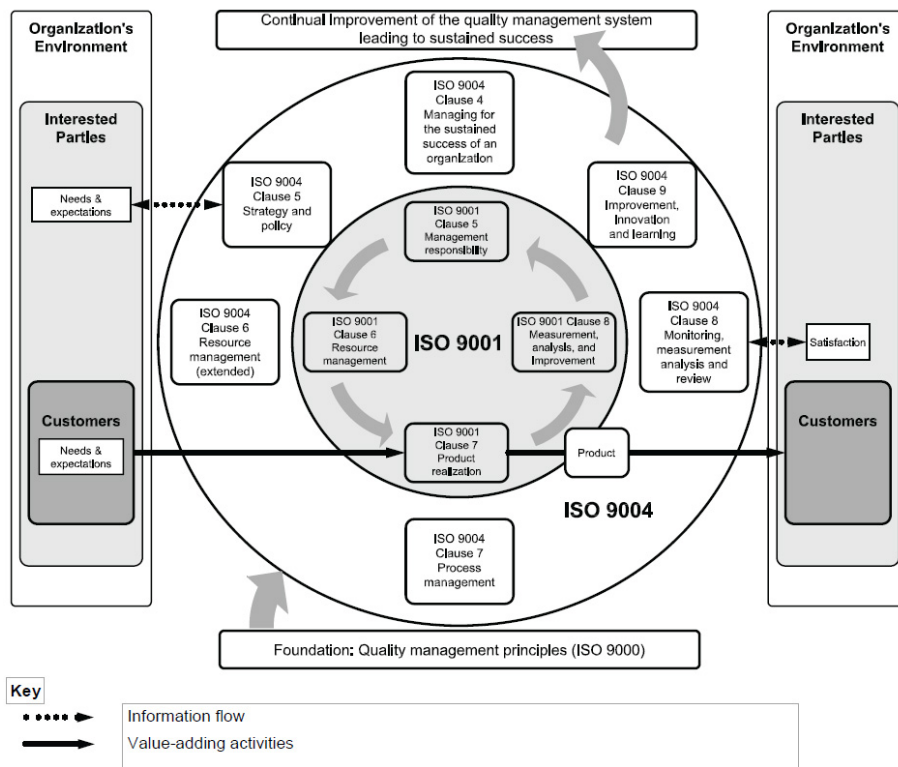


Figure 2.1 ISO9004 extended model of a process-based quality management

2.3 CheckPoint assessment methodology

The ISO based quality elements and assessment methodology allows to assess the quality of challenges' products and existing service delivery to stakeholders by:

The
Checkpoint
methodology

- Benchmarking their level of quality
- Identify their strengths and weaknesses
- Identify opportunities for either improvements or innovation, or both.

The Med Checkpoint assessment methodology has been based on four

elements:

1. the Data Product Specification,
2. the collection of information on Input Data needed for these products,
3. the realization of Targeted Data Products (TDP - requested by the call) using the Input Data
4. the development of indicators to assess Input Data and the adequacy of products obtained from them with respect to DPS.

2.3.1 Data Product Specifications

A Data Product Specification (DPS) is a detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to- and used by- another party (ISO19131:2007). It is a precise technical description of the data product in terms of the requirements that it will or may fulfil. The data product specification only defines how the dataset should be and provide the basis for the assessment of the Upstream Data sets supplied to- and used by- the challenges for the Targeted Data Products (TDP).

The Data Product Specification

2.3.2 Targeted data Products

The values of data increases when they are transformed in sophisticated Data Products (e.g. by means of analysis, models, etc.). Targeted Data Products can assist stakeholders with their specific decisions.

The Targeted Data Product

2.3.3 Upstream data sets

The initial effort of the Mediterranean Checkpoint was the collection of information related to input data sets potentially required by the Challenges. The selection of input data sets was derived from expert specifications of data needs for Challenge products required by the tender and listed in §1. The content of the Checkpoint metadatabase is then strongly linked to the specific Challenges chosen by the DGMARE call for tender and the expert opinion. Additional consultations in the challenge communities of practices have helped to finalise the list of data providers and data sets.

The Upstream Data sets

Challenges have collected information on providers selecting the 'best copies' of data sets, i.e. the ones with the highest level of quality and trying to avoid duplications. However, the same 'best data sets' could have been uploaded in the Med Checkpoint metadatabase by different challenges. To reduce these problems, the metadatabase has been checked by each challenge leader and successively by 'auditors' not working in the Challenges.

2.4 INSPIRE rules adopted for service

It has been noted that nearly all the characteristics that are populating the Mediterranean Checkpoint metadatabase are composed by spatial data. In general, the INSPIRE Directive is asking for spatial data service types, and the INSPIRE Metadata Regulation 1205/2008/EC mandates the use of (among others) a Discovery Service, View Service, Download Service, Transformation Service, Invoke Spatial Service.

The technical specification⁷ provided by INSPIRE working groups are herewith listed.

- Service to access to information: The INSPIRE Rule for accessing information are part of the ISO19115 On-line resource and INSPIRE Implementing Rules for Metadata B 1.4 – Resource Locator. The Resource Locator is the ‘navigation section’ of a metadata record which point users to the location (URL) where the data can be downloaded, or to where additional information about the resource may be provided. Setting up the correct resource locators is important for the connection between the data and the services that provide access to them or for providing additional information concerning the resource. If a linkage for data is available, the Resource Locator shall be a valid URL providing one of the following:
 - a link to a web with further instructions
 - a link to a service capabilities document
 - a link to a client application that directly accesses the service
- Service to link datasets: In addition to the Resource Locator, it should be considered also the link of services to the relevant datasets, and this is the metadata element called Coupled Resources and referenced in B 1.6 of the Implementing Rules.
- Classification of characteristics: A correct categorisation of characteristics is very important to help users to search and find the resources they are looking for (Topic category, B 2.1). For the purpose of the project, the SeaDataNet classification lists have been adopted for the following reasons:
 - the vocabularies are governed by a Governance Group ensuring the vocabulary is consistent with the needs and the practices of the marine community through time;
 - they are designed for discovery services;
 - the SDN classification hierarchy offers three different levels of granularity : the variables (SDN parameter list P01), the categories or characteristics (SDN P02 list) and the group of categories or group of characteristics (SDN P03 list) allowing to navigate from the more general level of information to the most detailed one.
- INSPIRE Network Service: The INSPIRE Implementing Rules requires also to specify if the discovery, view, download, transformation, invoke and other services are ‘INSPIRE Network Services’ (Spatial service type B 2.2).
- Conditions for access and use of spatial data sets and services, and where

⁷INSPIRE metadata implementing rules: technical guidelines based on EN ISO 19115 and EN ISO 19119.

applicable, corresponding fees as required by Article 5(2)(b) and Article 11(2)(f) of INSPIRE Directive 2007/2/EC. These are part of B 8.1 Implementing Rules: Restrictions on the access and use of a resource or metadata. It is recommended to have in the metadata descriptions of terms and conditions, including where applicable, the corresponding fees or a link (URL) where these terms and conditions are described.

- The INSPIRE Implementing Rules defines the metadata concepts for limitations on public access in part B 8.2 that applies to access constraints to assure the protection of privacy or intellectual property, and any special restrictions or limitations on obtaining the resource. In relation to constraints classes, there may be three scenarios according to the INSPIRE rules:
 - There may be no limitation on public access;
 - There may be only a classification property when expressing a security constraint;
 - There may be one or more instances of the access constraints property, possibly associated with one or more instances of other restrictions property (i.e, Legal Constraints).

The INSPIRE needs and requirements have been translated partly in terms of indicators and they have been used to construct the Checkpoint service.

3. Assessment Indicators

The assessment criteria have subdivided into two 'Territories' that need to be evaluated in terms of Challenge requirements. The term "territory" refers to a domain of assessment and we have chosen two categories:

Assessment Territories

Territory 1: Availability How the input data sets are made available to Challenges
Territory 2: Appropriateness What is the quality of the monitoring data for the Challenge products

Table 3.1 The two territories of the assessment

3.1 Territory 1: Availability

'Availability' measures the extent to which datasets are ready for use and are obtainable. The eight availability indicators are:

Eight availability indicators

Definitions	Name of Availability indicators
Visibility Indicators	
Easily found	AV-VI-1
EU Inspire Catalogue service	AV-VI-2
Accessibility Indicators	
Policy visibility	AV-AC-1
Delivery	AV-AC-2
Data Policy	AV-AC-3
Pricing	AV-AC-4
Readiness	AV-AC-5
Performance Indicator	
Responsiveness	AV-PE-1

Table 3.1.1 Availability indicators nomenclature

The availability indicators (AV) provide an understanding of the readiness and service performance of the infrastructure providing access to data. The availability indicators are subdivided into three categories:

- Visibility (VI), i.e. the possibility of identifying and quickly accessing the appropriate site for the required data sets;
- Accessibility (AC) i.e. the possibility, for non expert users, to understand the retrieval model status;
- Performance (PE) i.e. the ability of a system to keep operating over time and to meet real time operational conditions. This is related to service performance.

3.1.1 Visibility indicators

"Visibility" is the ability to identify and quickly access the appropriate site delivering the desired data sets. In other words it is the ability for all users, including non-experts, to perform data sourcing through an EU Inspire

catalogue. Two indicators have been defined for the visibility element, i.e.:

Visibility indicator

AV-VI-1 Easily found	Can the data sets or series of data sets be found easily?
AV-VI-2 EU Inspire catalogue service	Is the dataset referenced by a EU catalogue service or other bodies (private or public, national or international non EU services ⁸)

Table 3.1.2 Visibility indicator meaning

By referring to the INSPIRE Directive, this AV-VI-1 indicator provides information on visibility of data in catalogues. The AV-VI-2 indicator informs users whether the characteristic can be searched for by a catalogue service, such as EMODnet Thematic Portals, Copernicus core services, EEA services, DG MARE services, INSPIRE Geoportal, etc. Both indicators are identified as part of the INSPIRE Metadata Implementing Rules B 1.4 and the technical guidelines are based on EN ISO 19115 and EN ISO 19119.

3.1.2 Accessibility indicators

‘Accessibility’ is the ability of all users, including non-experts, to understand the retrieval model status and its appropriateness. ISO 19115 provides a general mechanism for documenting different categories of constraints applicable to the resource (or its metadata). The constraints could be legal and/or security constraints.

Accessibility indicators

The INSPIRE Implementing Rules defines the metadata concepts for limitations on public access in part B 8.2 that apply to access constraints in order to ensure the protection of privacy or intellectual property, and any special restrictions or limitations on obtaining the resource. In relation to constraint classes, there may be three scenarios according to the INSPIRE rules:

- There might be no limitation on public access;
- There might be only a classification property when expressing a security constraint;
- There might be one or more instances of the access constraints property, possibly associated with one or more instances of other restrictions property (e.g., Legal Constraints).

There are five indicators devised for accessibility:

AV-AC-1 Policy visibility	Visibility on data policy adopted by data providers.
AV-AC-2	Data delivery mechanisms, i.e. the

⁸ The non EU services are advanced services, but not following the guidelines defined in INSPIRE and its technical annexes.

Delivery	services available to the user to access data
AV-AC-3 Data Policy	Data policy
AV-AC-4 Pricing	Cost basis / price policy
AV-AC-5 Readiness	Format for use

Table 3.1.3 Accessibility indicator meaning

In the framework of the “blue growth” and for the specific indicator on Data policy, the exact meaning of ‘open’ has not been established. Among the many definitions of ‘open’, one or more of these can be adopted:

- Accessible to all; unrestricted to participants
- Free from limitations, boundaries, or restrictions
- Usable by registered users

The indicator will classify all of these under the same score value.

3.1.3 Performance indicators

The performance indicators indicate the ability of a system to keep operating over time and to meet real time operational conditions. It is related to service performance. Only one indicator is defined for performance:

Performance indicator

AV-PE-1 Responsiveness	How responsive is the delivery service for the available data?
---------------------------	--

Table 3.1.4 Performance indicator meaning

3.1.4 Availability indicators evaluation scale

Indicators provide both an overview of the situation at a high level of aggregation as well as detailed information about trends and links. The difficult task is to find an appropriate balance between simplification and completeness and offer, at the same time, an assessment of the input data sets without directly accessing all the metadata. The Checkpoint has defined 4-6 possible values for the different availability indicators and has defined a “color scale” evaluation that is described in Annex 3, Table A3.0.

Availability indicators scale

In synthesis the meaning of the color scale is:

Red: urgent actions are required to provide datasets and services fitting for use – totally inadequate

Yellow: limited actions are required to provide datasets and services fitting for use – partly adequate

Green: actions and services are fit for use and should be maintained – fully adequate

3.2 Territory 2: Appropriateness

Appropriateness indicators are constructed by comparing the DPS (Data

Product Specification) Quality Elements against the TDP (Targeted Data Product) and UD (Upstream Data) quality elements. The concept is illustrated in Fig. 3.2.1

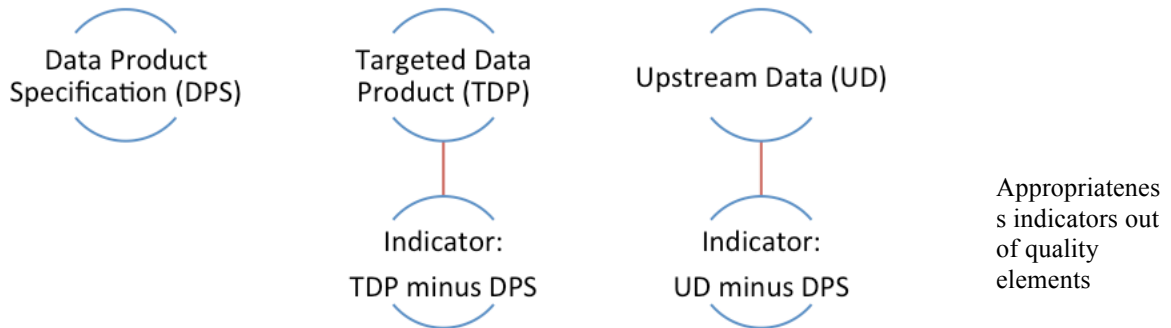


Figure 3.2.1 High level scheme for the appropriateness indicators: Quality Elements are decided for DPS and reproduced for TDP and UD so that a “difference” (TDP minus DPS or UD minus DPS) can be calculated and this gives indicator values.

In a generic assessment process the first step is the assessment of the appropriateness of TDP vs the product specification. In Checkpoint we add the assessment also of the UD with respect to product specification since we are interested to extract information about the quality of the monitoring system that provides input data to the products. The details of the calculations are given in Annex 2.

3.2.1 Quality elements for appropriateness

‘Appropriateness’ is providing indications on the inherent properties of the products and the input data sets used in the products. The quality elements are specified in ISO19157 standards. The relevant Appropriateness quantitative elements chosen for the Checkpoint are listed in Table 3.2.1.

Definitions	Name of Appropriateness Quality Elements
Completeness	
Horizontal Spatial Coverage	AP-1-1
Vertical Spatial Coverage	AP-1-2
Temporal Coverage	AP-1-3
Consistency	
Number of Characteristics	AP-2-1
Accuracy	
Horizontal Resolution	AP-3-1
Vertical Resolution	AP-3-2
Temporal Resolution	AP-3-3
Thematic Accuracy	AP-3-4
Temporal Quality	

Quality Elements for appropriateness indicators

Table 3.2.1 Appropriateness quality elements nomenclature

In the Mediterranean Checkpoint, appropriateness is measuring how input data sets are fit for the challenges. The appropriateness quality elements, definitions, measures, units and calculation of the fitness for use are given in Annex 2 and are herewith shortly presented.

3.2.1.1 Completeness quality elements

‘Completeness’ is the amount or extent to which something is covered or data are absent from a data set. In the case of the check points the completeness applies to both spatial and temporal coverage. Three indicators have been defined as ‘coverage’.

#-AP-1.1 Horizontal Spatial Coverage	Horizontal coverage extent of product (eg : surface of the Mediterranean Sea)
#-AP-1.2 Vertical Spatial Coverage	Vertical coverage extent of product
#-AP-1.3 Temporal Coverage	Temporal coverage extent of product

Completeness
quality
elements

Table 3.2.2 Completeness quality elements meaning. The # is replaced in the metadatabase with DPS, TDP and UD as appropriate.

3.2.1.2 Consistency quality elements

‘Consistency’ is the adherence to rules of the conceptual schema and measures the uniformity among the parts of the Data Product Specification and Targeted Data Product. This quality element is only applicable to DPS and TDP.

#-AP-2.1 Number of Characteristics	Number of Characteristics in product
---------------------------------------	--------------------------------------

Table 3.2.3 Consistency quality element meaning. The # is replaced in the metadatabase with DPS and TDP as appropriate.

Consistency
quality
elements

3.2.1.3 Accuracy quality elements

‘Accuracy’ is the comparison of classes assigned to features or their attributes to universe of discourse or the extent to which a given measurement agrees with the standard value for that measurement. Three indicators on ‘spatial and temporal resolution’ and one indicator on ‘thematic accuracy’ have been used.

#-AP-3.1 Horizontal Resolution	Horizontal mesh size or equivalent value for the given scale of product (eg 50m for 1/50 000)
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#-AP-3.2 Vertical Resolution	Average vertical sampling and description of specific vertical sampling schema	Accuracy quality elements
#-AP-3.3 Temporal Resolution	Temporal sampling interval of product	
#-AP-3.4 Thematic Accuracy	Percentage error of the product and description of error concept for the product	

Table 3.2.4 Accuracy quality elements meaning. The # is replaced in the metadatabase with DPS, TDP and UD as appropriate.

3.2.1.4 Temporal Quality element

‘Temporal quality’ is the validity of data with respect to time. This provide an indication on how old is the last update of the input data set and an indirect information on how much can be assumed valid the product.

#-AP-4.1 Temporal Validity	Max elapsed time between last input data records update and product creation date
-------------------------------	---

Table 3.2.5 Temporal quality element meaning. The # is replaced in the metadatabase with DPS, TDP and UD as appropriate.

3.2.2 Appropriateness indicator definitions

The basic idea of appropriateness indicators is that they are related to “errors” in the Quality Elements just defined. Appropriateness corresponds then to “low” errors in the specific quality element.

Temporal Quality elements

“Errors” for quality elements are defined as the differences between what has been realized and what was “expected” or “required”. DPS includes the requirements or expectations while TDP and UD are the actual products and input data sets used respectively.

The nine appropriateness indicators for Targeted Data Products are described in Table 3.2.6.

Appropriateness errors for indicators

QE number	Indicator name	Definition of indicator	Units
1	TDP.APE.1.1	Percentage to which the extent of the horizontal spatial coverage of TPD is compliant with the DPS extent in km**2	Percentage
2	TDP.APE.1.2	Percentage to which the extent of the vertical spatial coverage of TPD is compliant with the DPS extent in metres.	Percentage

Targeted products

3	TDP.APE.1.3	Percentage to which the extent of the temporal coverage of TPD is compliant with the DPS extent in days.	Percentage	indicators
4	TDP.APE.2.1	Percentage of Completeness/Incompleteness of the number of characteristics with respect to the list in DPS	Percentage	
5	TDP.APE.3.1	Percentage to which the product averaged horizontal mesh size or horizontal scale is compliant with the DPS averaged mesh size or horizontal scale	Percentage	
6	TDP.APE.3.2	Percentage to which the product averaged vertical mesh size or vertical scale is compliant with the DPS averaged mesh size or vertical scale	Percentage	
7	TDP.APE.3.3	Percentage to which the product temporal sampling interval is compliant with the one defined in DPS (percentage to be extracted from text of AP.3.3 measure)	Percentage	
8	TDP.APE.3.4	Compliance with the value domain of the accuracy defined in DPS	Percentage	
9	TDP.APE.4.1	Percentage to which the elapsed time of the product is compliant with the max elapsed time specified in DPS.	Percentage	

Table 3.2.6 Appropriateness indicators meaning for Targeted Data Products. The indicators that are based on calculation of “errors” for the different quality elements and they are explained in details in Annex 2.

Moreover the same type of indicators have been evaluated for the input data sets to the TDP and they are called UD indicators. The eight appropriateness indicators for Upstream Data are described in Table 3.2.7.

QE number	Indicator name	Definition of indicator	Units
1	UD.APE.1.1	Percentage to which the extent of the horizontal spatial coverage of UD is compliant with the DPS extent in km**2	Percentage
2	UD.APE.1.2	Percentage to which the extent of the vertical spatial coverage of UD is compliant with the DPS extent in metres.	Percentage

Upstream Data indicators

3	UD.APE.1.3	Percentage to which the extent of the temporal coverage of TPD is compliant with the DPS extent in days.	Percentage
5	UD.APE.3.1	Percentage to which the product averaged horizontal mesh size or horizontal scale is compliant with the DPS averaged mesh size or horizontal scale	Percentage
6	UD.APE.3.2	Percentage to which the product averaged vertical mesh size or vertical scale is compliant with the DPS averaged mesh size or vertical scale	Percentage
7	UD.APE.3.3	Percentage to which the product temporal sampling interval is compliant with the one defined in DPS (percentage to be extracted from text of AP.3.3 measure)	Percentage
8	UD.APE.3.4	Compliance with the value domain of the accuracy defined in DPS	Percentage
9	UD.APE.4.1	Percentage to which the elapsed time of the product is compliant with the max elapsed time specified in DPS.	Percentage

Table 3.2.7 Appropriateness indicators meaning for Upstream Data. The indicators that are based on calculation of “errors” for the different quality elements and they are explained in details in Annex 2.

3.2.3 Appropriateness indicators evaluation scale

In the case of appropriateness, it is less immediate than for availability to provide a simple characterization of the indicators at a high level of aggregation. At present we have made some simplifying assumptions, allowing a non-expert to easily assess the appropriateness indicators without looking at the metadata and reports.

Appropriateness indicator scale

Appropriateness indicator values for both TDP and UD can have negative or positive values. The former score is an “under-fitting score, representing lower than expected quality elements for the Targeted product or the Upstream data while the latter is an “over-fitting” score. Both the under-fitting and over-fitting scores have been saturated at $\pm 100\%$.

In order to associate a range of indicator values to a synthetic indicator score it is necessary to establish “thresholds” for the values. It was decided that products with ‘errors’ within -10% and +10% with respect to DPS are ‘appropriate’ or at least partly adequate. Values smaller than -10% are under-fitting and not adequate while values large than +10% are over-fitting or totally adequate, no need for further development.

For a certain indicator value range, a color is associated with the following meaning:

- **Red:** the TDP or UD have errors between -100% and -10% and urgent actions are required to provide datasets fit for use by the Challenges – not adequate
- **Yellow:** the TDP or UD have errors between -10% and +10% and can be considered quite appropriate and monitoring data are fit for use and should be maintained but also improved – partly adequate
- **Green:** the TDP or UD have errors between +10% and +100% and there is an 'over – offer', no need for further development – totally adequate

4. Analysis of the input data sets metadatabase

In the Mediterranean CheckPoint metadatabase there are 266 data sets descriptions that are distributed among the seven challenges, described by 47 P02 characteristic categories, 16 INSPIRE themes (over 34), 6 environmental matrices and 23 P03 group of characteristics. All the statistical information is provided in Annex 1. In the Table 4.1 a synthesis is displayed.

MedSea
metadatabase
contents

These data sets are potentially usable by the Challenge partners to generate their products. As we will see later, only 90 of these will be actually used by the Challenges.

Table 4.1 The number of input datasets by Challenge and the environmental matrices, P02, P03 and P22 characteristics by Challenge. (P02, P03, P22 numbers do not match with the overall “Numbers of different P02, P03 and P22 identified” because the same characteristic is requested by more than one Challenge).

	Challenge							
	Ch1 Windfarm siting	Ch2 Marine protected areas	Ch3 Oil platform leaks	Ch4 Climate and coastal protection	Ch5 Fisheries mgmt	Ch6 Marine env.	Ch7 River inputs	ALL
Number of input data sets identified	38	75	66	9	18	20	40	266
Environmental matrices identified	5	5	5	2	3	1	2	6
Numbers of different P03 identified	12	18	9	3	4	4	5	23
Numbers of different P02 identified	27	19	11	3	5	6	7	47
Numbers of different INSPIRE spatial themes identified (P22)	9	11	7	2	4	1	2	16

Statistical
analysis of
contents

The histogram of Fig. 4.2 illustrates the results of Table 4.1 making evident the larger number of P02, P03 and P22 categories potentially required by the first three Challenges with respect to the others.

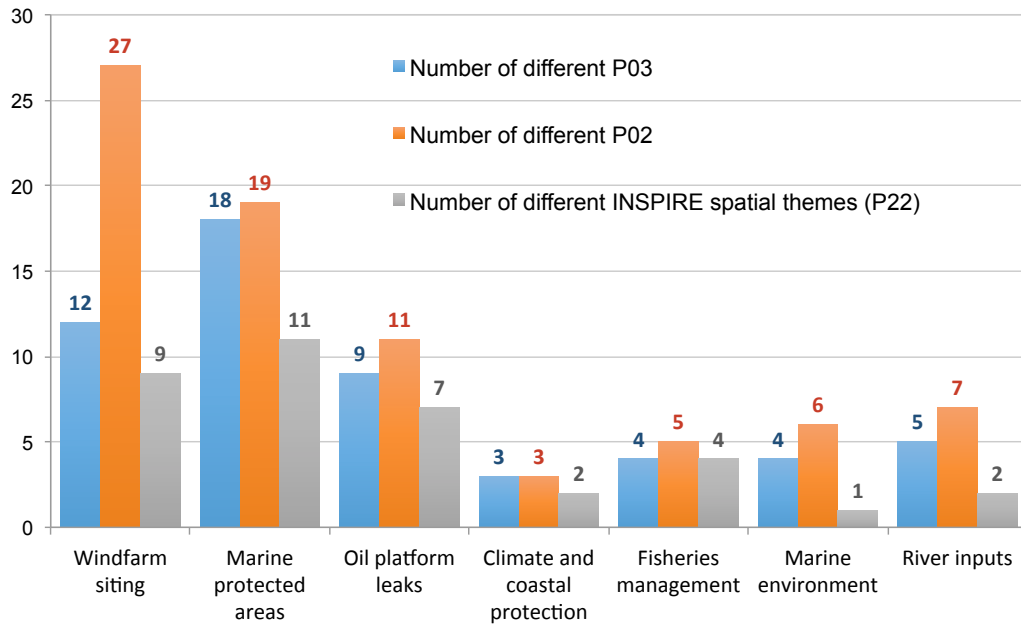


Figure 4.2: Number of characteristic categories identified by P02, P03 and P22 as a function of Challenges

The different number of input data sets potentially usable by the Challenges to generate their products is described in Figure 4.3 where it is evident that Wind Farm Siting, MPAs, Oil Platform Leaks and River inputs request more data sets than the others.

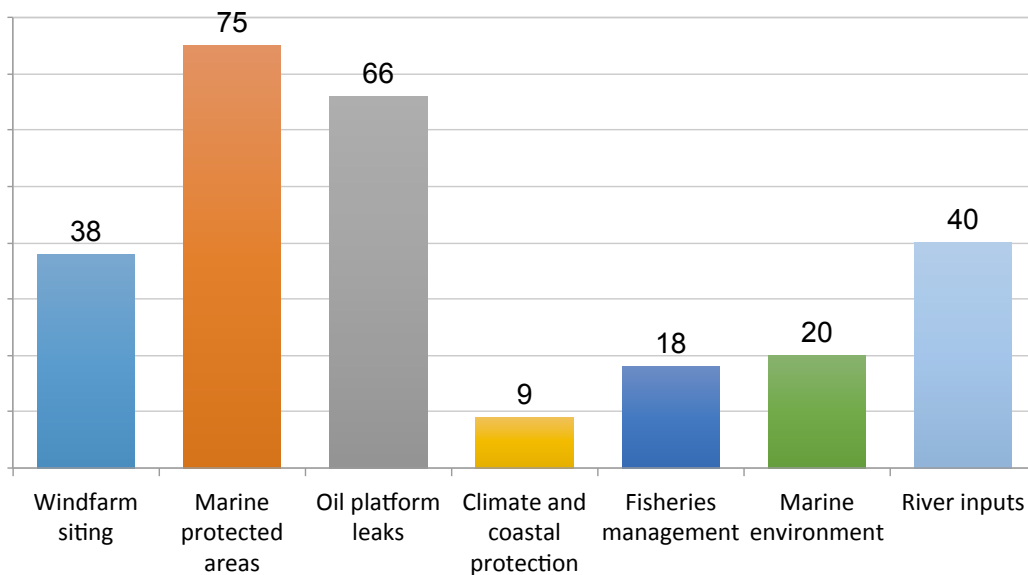


Figure 4.3 Number of input data sets for each Challenge

5. Analysis of the monitoring system by availability indicators

The availability indicators, described in Section 3, have been used here to carry out the first part of the monitoring system assessment . The indicators for the 266 input data sets, inserted in the metadatabase and potentially required by the Challenges, have been analysed by means of a distribution histograms of the scores.

Monitoring system adequacy with availability indicators

5.1 Analysis of indicators across Challenges

In order to provide a visual indication of the input data availability, a colored table for each indicator has been produced as a function of Challenges. This assessment is done on the entire metadatabase constructed for all Challenges, and not only on the one referring only to the input data sets used for the products. The data sources selected for each Challenge and for each P02 characteristics could be more than one, and can have different availability indicators.

5.1.1. AV-VI-1: Easily Found

Table 5.1: Scores for the AV-VI-1 ‘Easily found’ indicator as a function of Challenges for all input data sets. The last column indicates the score across all challenges

Indicator name	Meaningful (Symbol)	Achievable & Realistic (Choice)	Ch.	Ch.	Ch.	Ch.	Ch.	Ch.	Ch.		
			1	2	3	4	5	6	7		
AV-VI-1 Easily found	Low visibility	Choice 1: Red <i>"Cited in peer reviewed paper or grey literature but no info on how to access"</i>	2	0	3	0	9	0	0	14	Easily found
		Choice 2 : Red <i>"Information retrieved upon specific request to the data source "</i>	30	0	6	0	7	0	3	46	
	Medium visibility	Choice 3: Yellow <i>"Use of social network, community of practices sharing information, portals of organization where no search is organized by an engine"</i>	0	0	0	0	0	0	0	0	
	High visibility	Choice 4: Green <i>"Use of open search engines, searching by name either the data provider or the characteristics"</i>	1	25	52	5	2	19	15	119	
		Choice 5: Green <i>"Search via reference catalogue (e.g. Copernicus, GEOSS Geoportal...)"</i>	5	50	5	4	0	1	22	87	
Total			38	75	66	9	18	20	40	266	

For all Challenges more than the 77% of the input data sets can be ‘easily

found', however Ch. 1 and Ch. 5 have most of the input data sets non 'easily found'.

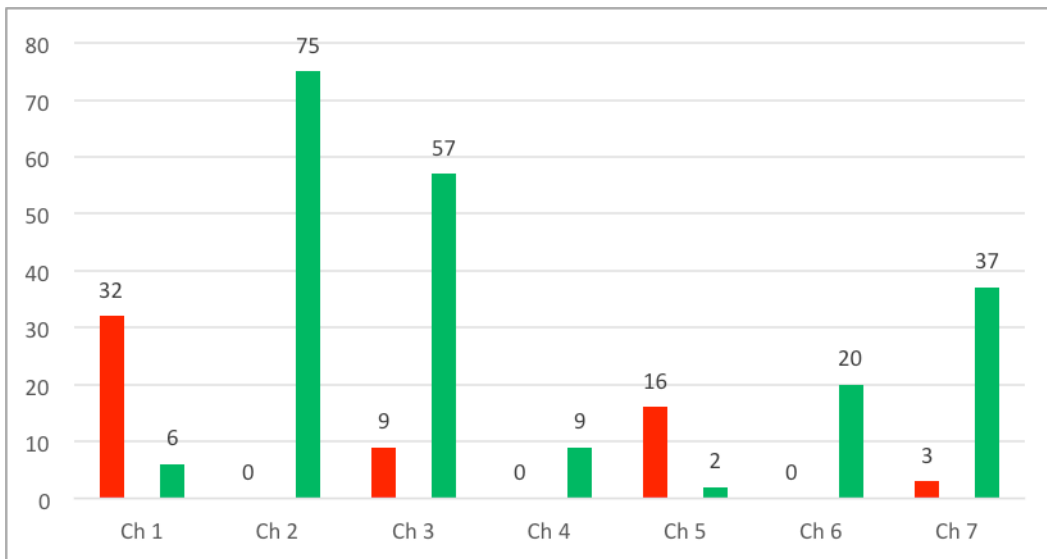


Figure 5.1: AV-VI-1 'Easily found' indicator across all Challenges

5.1.2 AV-VI-2: EU INSPIRE catalogue service

Table 5.2: Scores for the AV-VI-2 'EU INNSPIRE catalogue service' indicator as a function of Challenges for all input data sets. The last column indicates the score across all challenges

Indicator name	Meaningful (Symbol)	Achievable & Realistic (Choice)	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7	
AV-VI-2 EU Inspire catalogue service	Inadequate	Choice 1: Red "Data sets are not referenced in a catalogue or are referenced in a non public catalogue"	19	4	27	6	15	0	0	69
	Partially adequate	Choice 2: Yellow "The datasets are referenced in a public national catalogue, in an international catalogue service "	19	9	33	1	0	16	13	20
	Totally adequate	Choice 3: Green "The datasets provide a full EU Inspire catalogue service "	0	61	6	2	3	3	27	177
	unknown							1		
			38	75	66	9	18	20	40	266

EU INSPIRE catalogue

For all Challenges there are more than 38% of INSPIRE compliant catalogue services, but there is also a significant amount (about 27%) of data not referenced or in no-public catalogues. Also in this indicator the worst cases are in Ch. 1 and Ch. 5.

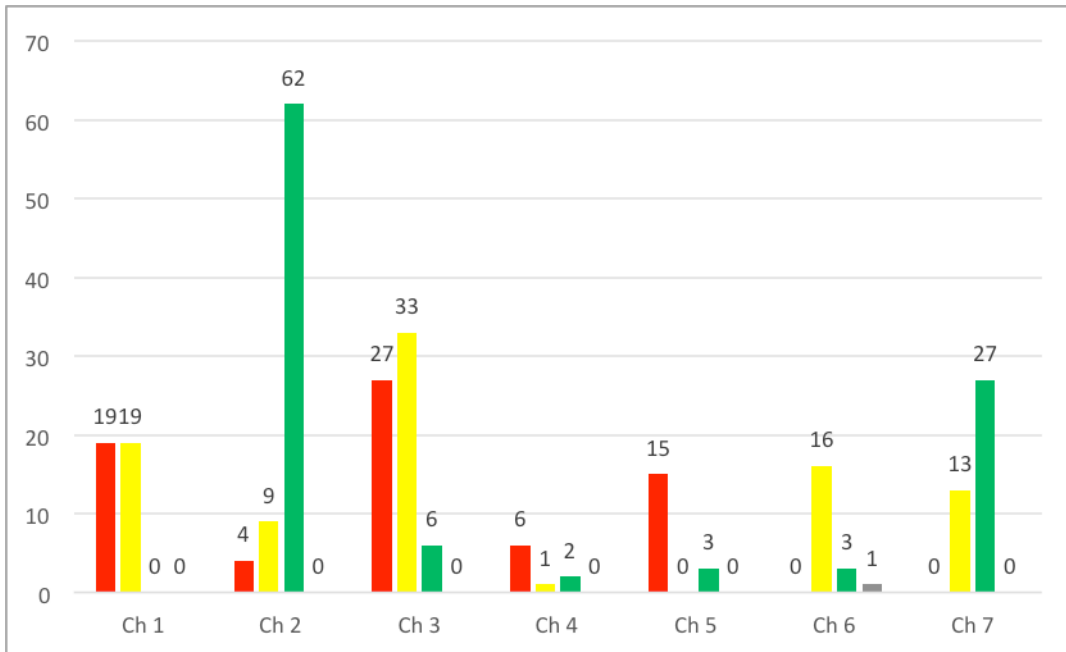


Figure 5.2: AV-VI-2 'EU INSPIRE catalogue service' indicator across all Challenges

5.1.3 Policy visibility

Table 5.3: Scores for the AV-AC-1 'Policy visibility' indicator as a function of Challenges for all input data sets. The last column indicates the score across all challenges

Indicator name	Meaningful (Symbol)	Achievable & Realistic (Choice)	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7	
AV-AC-1 Policy visibility	Low transparency	Choice 1: Red "There is no information at all on data policy adopted by data providers"	11	3	47	0	4	1	0	66
	Medium transparency	Choice 2: Yellow "There is information, but details are available only on request"	19	10	4	0	7	1	2	43
	High transparency	Choice 3: Green "There is detailed information provided to understand data policy"	8	62	15	9	7	18	38	157
			38	75	66	9	18	20	40	266

Policy visibility

For all Challenges there are more than 50% of input data sets with visible policy, red are about 19% and yellow about 30%. For this indicator the worst situation is in Challenge 3.

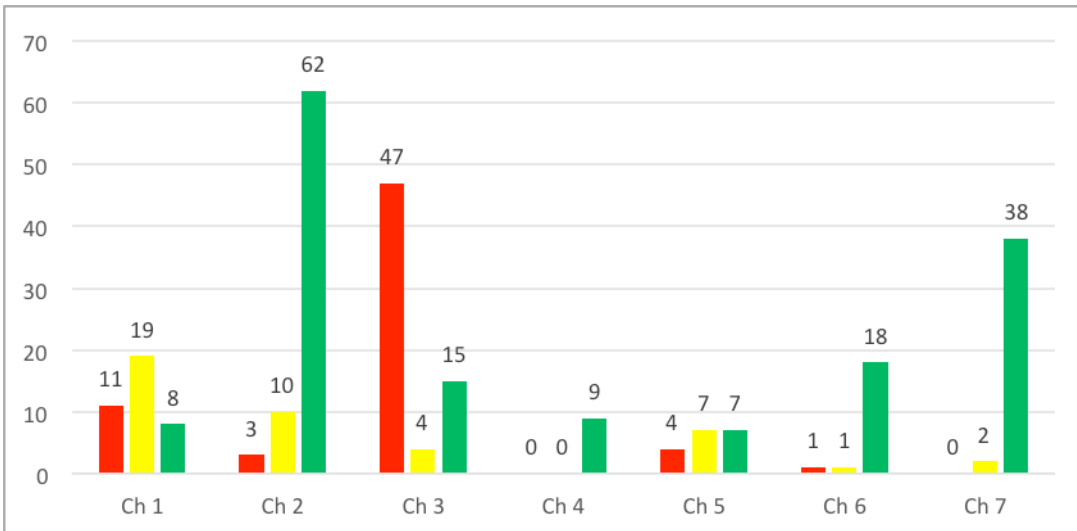


Figure 5.3: AV-AC-1 'Policy visibility' indicator across all Challenges

5.1.4 Delivery mechanism

Table 5.4: Scores for the AV-AC-2 'Delivery mechanism' indicator as a function of Challenges for all input data sets. The last column indicates the score across all challenges

Indicator name	Meaningful (Symbol)	Achievable & Realistic (Choice)	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7	
AV-AC-2 Delivery mechanism	No information	Choice 1: Red "No information was found on data delivery mechanisms"	0	0	16	0	1	0	0	17
	Manual	Choice 2: Red "Order form/invoice is requested"	20	24	6	0	15	0	0	65
	Partial Inspire function	Choice 3: Yellow "Online downloading services "	1	1	4	1	1	1	40	49
	Full Inspire function	Choice 4: Green "Online discovery and downloading services"	2	35	3	7				47
		Choice 5: Green "Online discovery + downloading + viewing services"	15	14	37	1	2	19		88
			38	75	66	9	18	20	40	266

Delivery mechanism

For the delivery mechanism the green values are about 50%, a very significant amount of input data sets have a red indicator (more than 30%) and also the yellow is quite high (about 18%).

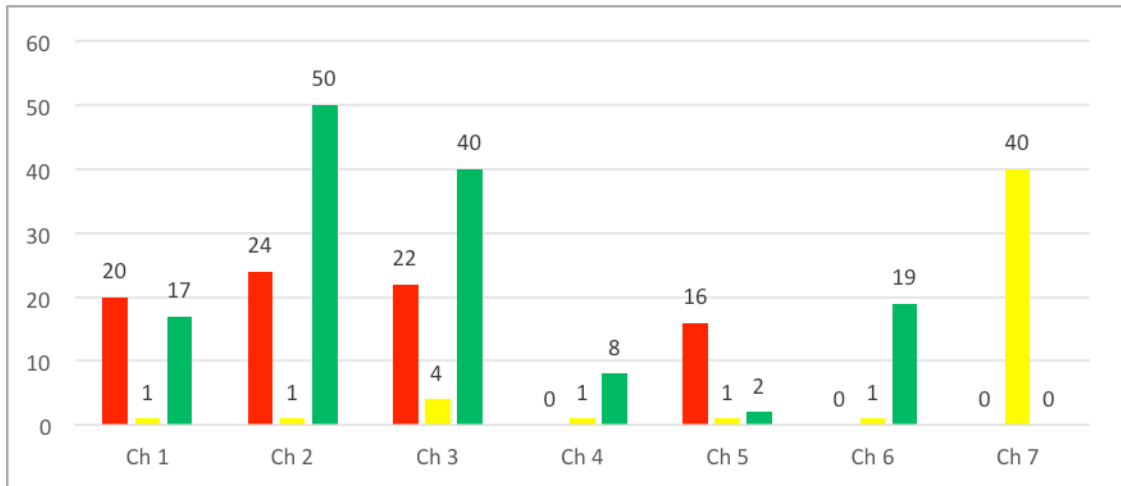


Figure 5.4: AV-AC-2 'Delivery mechanism' indicator across all Challenges

5.1.5 Data Policy

Table 5.5: Scores for the AV-AC-3 'Data policy' indicator as a function of Challenges for all input data sets. The last column indicates the score across all challenges

Indicator name	Meaningful (Symbol)	Achievable & Realistic (Choice)	Ch.	Ch.	Ch.	Ch.	Ch.	Ch.	Ch.	
			1	2	3	4	5	6	7	
AV-AC-3		Choice 1: Red "Not or not well documented"	0	0	19	0	0	0	0	19
Data policy	No documents									
	Restricted	Choice 2: Red "Restricted"	4	22	0	2	2	0	0	30
	Partially restricted	Choice 3: Yellow "Accessible under moratorium"	19	4	27	0	12	2	0	64
	Unrestricted	Choice 4: Green "Unrestricted"	15	49	20	7	4	18	40	153
			38	75	66	9	18	20	40	266

Data policy

Data policy is still a problem. Only the 57% of input data sets are unrestricted, a 24% will be made open after the use by data collectors and 18% is not documented.

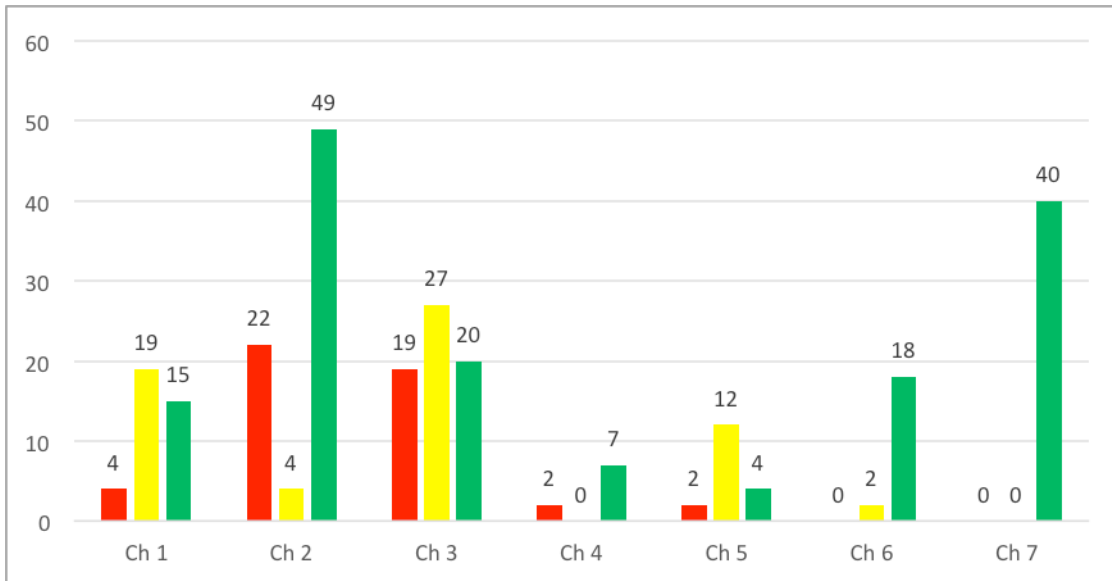


Figure 5.5: AV-AC-3 'Data policy' indicator across all Challenges

5.1.6 Pricing

Indicator name	Meaningful (Symbol)	Achievable & Realistic (Choice)	Ch.	Ch.	Ch.	Ch.	Ch.	Ch.	Ch.	Pricing
			1	2	3	4	5	6	7	
AV-AC-4 Pricing	Not documented	Choice 1: Red "Not or not well documented"	3	2	22	0	1	0	0	28
		Choice 2: Red "Commercial cost charge"	3	0	0	0	0	0	0	3
	Cost Charge	Choice 3: Yellow "Distribution charge" "Collection charge"	18				1			19
		"Free of charge for academic institutions and uses"			1		1			3
	Free	Choice 4: Green "Open and Free, No charge"	14	73	43	9	15	20	40	212
			38	75	66	9	18	20	40	266

Table 5.6: Scores for the AV-AC-4 'Pricing' indicator as a function of Challenges for all input data sets. The last column indicates the score across all challenges

Pricing indicator is quite good for all Challenges, since about 81% of input data sets is free. Reds in Ch. 1 and Ch. 3 must be noted as well as the yellow in Ch. 1 again.

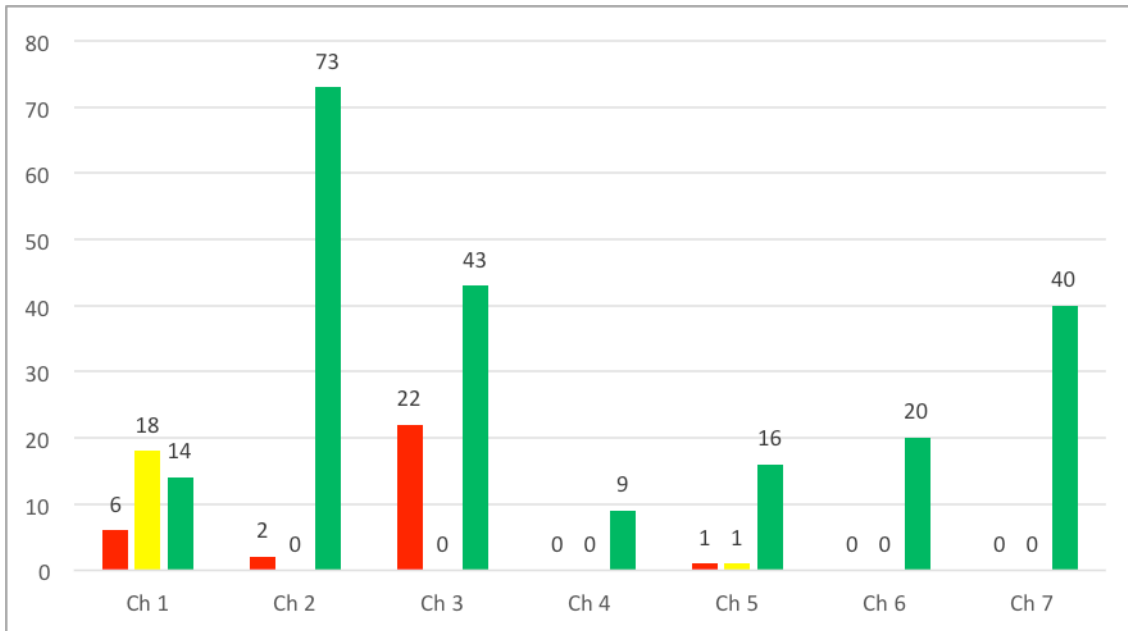


Figure 5.6: AV-AC-6 'Pricing' indicator across all Challenges

5.1.7 Readiness

Table 5.7: Scores for the AV-AC-5 'Readiness' indicator as a function of Challenges for all input data sets. The last column indicates the score across all challenges

Indicator name	Meaningful (Symbol)	Achievable & Realistic (Choice)	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7		
AV-AC-5 Readiness	No document	Choice 1: Red "Not or not well documented"	4	4	11	0	7	0	0	26	Readiness indicator
	Not ready to be consumed	Choice 2: Red "Proprietary and not well documented "	0	0	0	0	1	0	0	1	
		Choice 3: Red "Not proprietary but content not clearly specified "	5	1	1	0	0	0	1	8	
	Can be processed to be consumed	Choice 4: Yellow "Proprietary but content clearly specified "	1	2	0	0	2	0	1	6	
	Ready to be consumed	Choice 5: Green "Not proprietary and content clearly specified (eg auto-descriptive eg ODV, NetCDF CF) or at least with appropriate document describing the content."	28	68	54	9	8	20	38	225	
			38	75	66	9	18	20	40	266	

Also Readiness indicator is quite good for all Ch.s, since about 84% of input data sets is ready to be consumed. Reds in Ch. 1 and Ch. 3 must be noted again, as well as in Ch. 2 and 5.

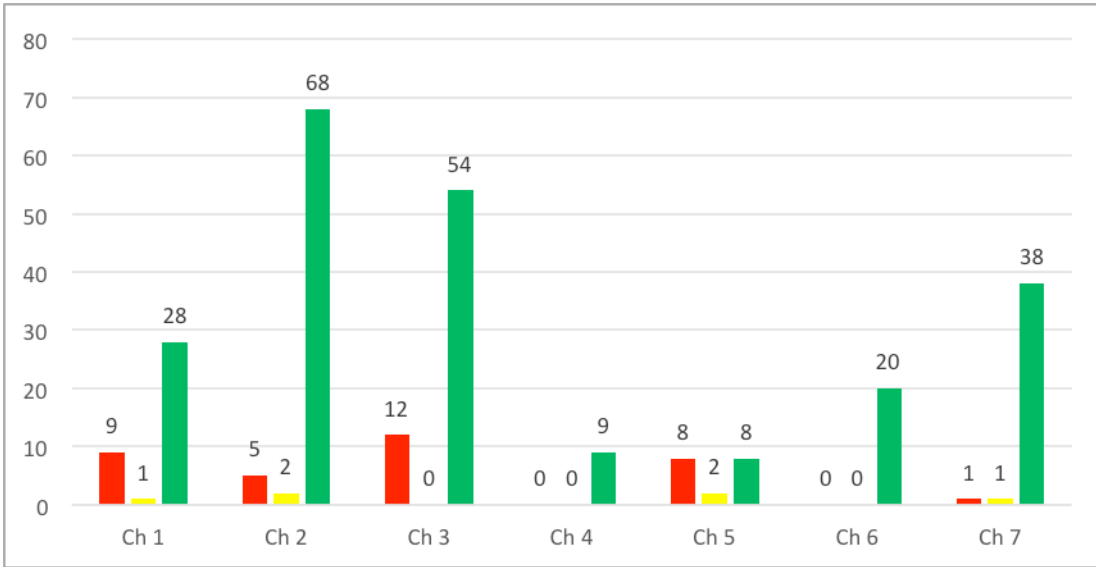


Figure 5.7: AV-CE-5 'Readiness' indicator across all Challenges

5.1.8 Responsiveness

Table 5.8: Scores for the AV-PE-1 'Responsiveness' indicator as a function of Challenges for all input data sets. The last column indicates the score across all challenges

Responsiveness

Indicator name	Meaningful (Symbol)	Achievable & Realistic (Choice)	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7	
AV-PE-1 Responsiveness	Low response	Choice 1: Red "No information is found on response time"	1	31	17	0	1	0	0	50
	Medium response	Choice 2: Red "More than 1 week for release"	0	0	0	0	5	0	0	5
		Choice 3: Yellow "Less or equal to 1 week for release"	21	0	1	0	0	0	36	57
	High response	Choice 4: Green Online downloading (i.e. a few hours or less) for release	14	44	48	9	2	19	4	141
		unknown	2	0	0	0	10	1	0	
			38	75	66	9	18	20	40	266

Responsiveness is presenting significant problems. For all Challenges about the 53% of the input data sets are in high responsive systems, but red and yellow indicators (respectively 20.6% and 21%) together are of the same order of the green ones.

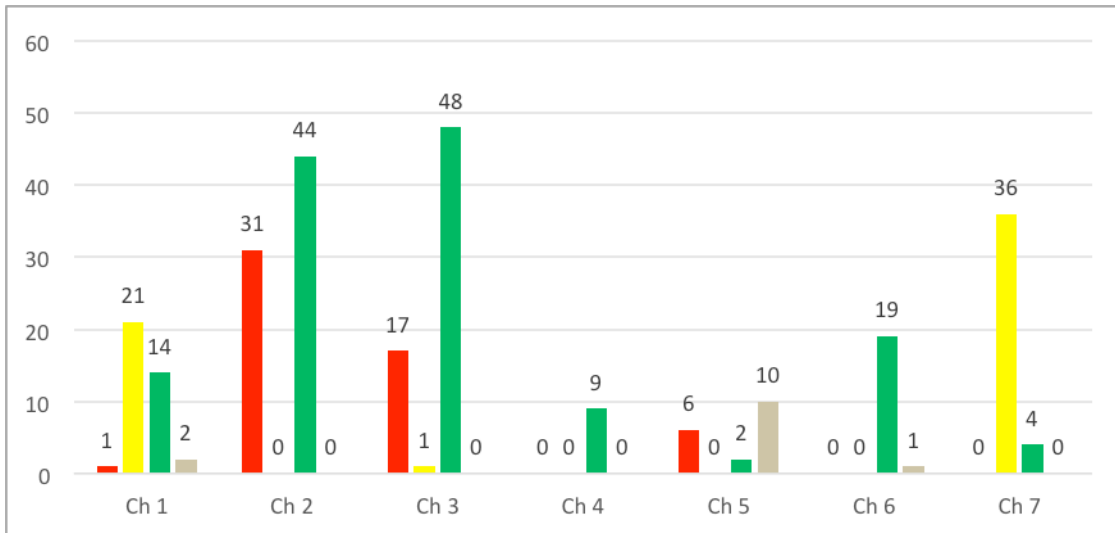


Figure 5.8: AV-PE-1 'Responsiveness' indicator across all Challenges

5.2 Analysis of adequacy of monitoring characteristics by availability

P02 characteristics category	# of data sets	Easily found	INSPIRE catalog service	Visibility of Data policy	Data delivery	Data policy	Pricing	Readiness	Responsiveness
1. Sedimentary structure	1	Green	Yellow	Green	Green	Red	Red	Red	Yellow
2. Spectral wave data parameters	1	Red	Red	Green	Yellow	Yellow	Red	Green	Red
3. Wave direction	8	Green	Red	Red	Green	Yellow	Red	Green	Green
4. Wave height and period statistics	19	Green	Red	Red	Green	Yellow	Green	Green	Green
5. Pollution events	1	Red	Red	Red	Yellow	Red	Red	Red	Red
6. Bird reproduction	1	Red	Yellow	Green	Green	Green	Green	Red	Green
7. Fauna abundance per unit area of the bed	4	Red	Yellow	Red	Green	Green	Green	Green	Green
8. Fish abundance in water bodies	3	Red	Yellow	Red	Green	Green	Green	Green	Green
9. Fish behaviour	1	Green	Green	Green	Yellow	Red	Green	Green	Red
10. Fish reproduction	1	Red	Yellow	Red	Green	Green	Green	Green	Green
11. Habitat extent	17	Green	Green	Green	Yellow	Red	Green	Green	Red
12. Fish and shellfish catch statistics	6	Red	Red	Green	Yellow	Yellow	Green	Red	Green
13. Fishing by-catch	1	Red	Red	Green	Yellow	Yellow	Green	Red	Yellow
14. Horizontal platform movement	8	Red	Red	Yellow	Yellow	Yellow	Green	Green	Red
15. Marine archaeology	1	Red	Yellow	Green	Green	Red	Red	Yellow	Green
16. Marine environment leisure usage	2	Red	Yellow	Red	Yellow	Yellow	Green	Green	Yellow
17. Air pressure	1	Red	Red	Yellow	Yellow	Yellow	Yellow	Green	Yellow
18. Air temperature	1	Red	Red	Yellow	Yellow	Yellow	Yellow	Green	Yellow
19. Atmospheric humidity	1	Red	Red	Yellow	Yellow	Yellow	Yellow	Green	Yellow

Table 5.2.1 Characteristics that scored at least 2 red indicators for availability

In order to assess the monitoring system at the basin scale on the basis of “availability” we need to organise the information across challenges, ordering in terms of P02 characteristic categories for the various indicators.

Adequacy
for
availability

Table A3.1 and A3.2 lists all the indicator information for the 266 data sets. We have extracted the monitoring Characteristics that have at least two red color availability indicators. The results are presented in Table 5.2.1

In conclusion adequacy for availability is low (at least two red indicators over 8) for 19 categories of monitoring data at the basin scale. Sub-dividing them into “themes” they are:

The 19
inadequate
characteristics

- 1) for geology: sedimentary structure data is totally inadequate in terms of Data Policy, Pricing and Readiness and quite inadequate for INSPIRE Catalogue and responsiveness;
- 2) for physics: wave data (spectra, wave height and direction) is totally inadequate for the visibility, the EU Catalogue and the Data Policy visibility;
- 3) for chemistry: pollutants in the water column (oil) are totally inadequate for almost all the availability indicators (7 over 8);
- 4) for biology: sea birds and fish characteristics (abundance, reproduction, behaviour) are totally inadequate for visibility, INSPIRE Catalogue and Data Policy Visibility;
- 5) for habitat: habitat extent is totally inadequate for Data Policy, Data delivery and and responsiveness
- 6) for human activities: fish catch and by-catch, horizontal platform movement (maritime traffic), marine archaeology, marine environment leisure usage are totally inadequate for visibility, INSPIRE catalogue, and readiness.
- 7) for others: atmospheric conditions in general are totally and partly inadequate.

These results are also summarized in Table 5.2.2 where the availability indicator scores are now summed considering all the input data sets without distinguishing the P02 characteristics.

The results that above 60% of the input data sets contributing to the monitoring of the Mediterranean Sea are totally and partly inadequate of the data set for the INSPIRE Catalogue. Moreover above 40% of the input data sets contributing to the monitoring of the Mediterranean Sea are partly and totally inadequate for Policy Visibility, Delivery mechanism, Data Policy and Responsiveness.

60% of
input data
do not have
an adequate
INSPIRE
Portal
service

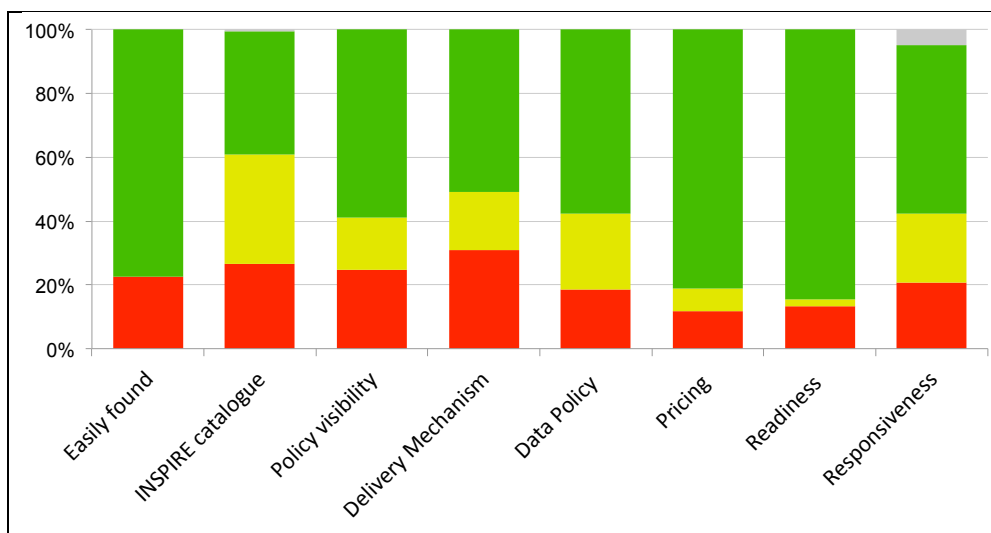


Table 5.2.2 Availability indicators scores in percentage over the total number of input data sets (266) present in the metadatabase.

5.3 Analysis of availability indicators for Copernicus and EMODnet services

A special analysis has been carried out specifically for the Copernicus and EMODnet Portals data sets. This is reported in Table 5.3.1.

Results indicate that CMEMS has a weak Data policy visibility especially for sea level products.

EMODnet Portals instead have:

- 1) not completely structured in a user-friendly EU-INSPIRE web portals
- 2) the Habitat Portal data fails on most of the availability scores

Table 5.3.1 Copernicus and EMODnet Portals availability indicator scores

Data set provider: Copernicus Marine environment monitoring service

PO2 characteristics	Easily found		INSPIRE catalogue		Visibility of Data policy		Data delivery		Data policy		Pricing		Readiness		Responsive ness	
Chlorophyll pigment concentrations in water bodies		4		4		4		4	1	3		4		4		4
Dissolved oxygen parameters in the water column		2		2		2		2		2		2		2		2
Horizontal velocity of the water column (currents)		4		4		4		4		4		4		4		4
Nutrient fluxes between the bed and the water column		2		2		2		2		2		2		2		2
Salinity of the water column		2		2		2		2		2		2		2		2

Temperature of the water column			2			2			2			2			2			2			2			2			2			2			
Sea level			2			2			2			2			2			2			2			2			2			2			2

Data set provider: EMODnet

PO2 characteristics	Easily found			INSPIRE catalogue			Visibility of Data policy			Data delivery			Data policy			Pricing			Readiness			Responsive ness		
Bathymetry and Elevation			3		1	2			3			3		1	2			3			3			3
Depositional environment			3			3			3			3			3			3			3			1
Dissolved oxygen parameters in the water column			1		1				1			1			1			1			1			1
Habitat characterisation			2		1	1	1		1		1	1	1		1	1		1			2	1		1
Light extinction and diffusion coefficients			2			2			2			2			2			2			2			2
Nitrate concentration parameters in the water column			1		1				1			1			1			1			1			1
Phosphate concentration parameters in the water column			1	1					1			1			1			1			1			1

6. Analysis of monitoring system by appropriateness indicators

The appropriateness indicators, described in Section 3 and Annex 2, have been used to define the adequacy of the monitoring system for the different quality elements that compose the appropriateness territory. Here we discuss the results of the statistical analysis of the indicators for the input data sets used in the Challenge products.

Monitoring system adequacy with appropriateness indicators

6.1 Analysis of appropriateness indicators across products

Using the Appropriateness indicators defined in Annex 2 for the Upstream data we can extract the characteristics that have negative appropriateness indicator values, i.e. they do not comply with the specifications given for the targeted product.

Only 90 of the potential 266 data sets, which cover only 29 of the P02 characteristic categories, are used in the analysis. Statistics is becoming a problem and results could be noisier than the assessment via availability indicators. Table 6.1 shows the scores across all Challenge products and their upstream data.

Only 90 data sets for appropriateness indicators

Table 6.1 Upstream data sets appropriateness indicators as a function of P02 across all Challenges

List of P02 Characteristics related to input data sets	Horizontal Coverage UD.APE.1.1	Vertical Coverage UD.APE.1.2	Temporal Coverage UD.APE.1.3	Horizontal Resolution UD.APE.3.1	Vertical Resolution UD.APE.3.2	Temporal Resolution UD.APE.3.3	Thematic Accuracy UD.APE.3.4	Temporal Validity UD.APE.4.1
Administrative units	1 1 1	9 2 1 1N A	6 5 1N A	6 1 4 2N A	2 1 10N A	2 11N A	3 1 0	7 4 1 1N A
Air pressure	1	1	1	1	1	1	1	1
Bathymetry and elevation	3 3	2 4N A	2 4N A	2 4	1 5NA	6NA	3 3	1 4 1N A
Birds count	1	1N A	1	1	1NA	1NA	1	1
Chlorophyll pigment concentrations in water bodies	4	4	1 3	4	4	4	4	4
Coastal geomorphology	3	3	3	3	3	3	3	3
Concentration of suspended particulate material in the water column	2	2	2	2	2	2	2	2
Dissolved oxygen parameters in	8	8	8	8	8	8	8	8

the water column																						
Dissolved total and organic nitrogen concentrations in the water column		2	2		1	1		2	2	2	2	2		2	2							
Dissolved total or organic phosphorus concentration in the water column	1	2	3		1	1	1	3	3	3	3	3		3	3							
Fish abundance in water bodies	1		1		1			1	1	1	1	1		1	1							
Fish and shellfish catch statistics	4	2	6		3	3		6	6	6	6	6		6	4	2						
Fishing by-catch	1		1		1			1	1	1	1	1		1	1							
Habitat characterisation		2	2		1	2	1N A	4				4NA		2	2	4						
Habitat extent	1	5	3	2	1		4	2	4	2	2	1NA	1	4	1NA	6	2	3	1			
Horizontal platform movement	9	4	1	9	3		1	2	4	7	2		6	1	0	1	1	5	9	3	4	
Horizontal velocity of the water column (currents)		1	1		2		2	1	3				2	1			3		1	2		
Light extinction and diffusion coefficients		1			1		1			1		1NA					1		1	1		
Lithology	1	9	3	1	6		8	2	9	1		6	1	3		1	0		1	0	4	6
Man-made structures		1				1N A			1	1		1NA				1NA			1	1	1	
Nitrate concentration parameters in the water column	9		9				1	8	8	1		9				9		9	1	8		
Phosphate concentration parameters in the water column	6		6					6	6			6				6		6	6	6		
River flow and discharge	6	2	8				7	1			7					7		7	7	7		
Salinity of the water column	4		4					4	4			4				4		4	4	4		
Sea level	2	1	2	0			1	4	9	7	4	2	0	1	2	8		1	2	8	1	3
Temperature of the water column	3	2	3	1			2	8	1	0	3	2	0	2	2	6		2	7	6	7	2
Wave direction					1		1		1			1		1		1		1	1	1	1	
Wave height and period statistics		1	4			1N A	2	1	4		2		4	1NA	4	1		4	1	5		
Wind speed and direction		2	2				2			2					1			1	1	2		
Wind strength and direction		3	1	2			3	3	6	2		1	7	3	4	1		6	2	7	1	

We first note that some characteristic categories use only less than 5 data sets for the analysis and this makes the results uncertain from a statistical point of view.

We can filter the statistics in Table 6.1 by taking only the P02 where at least

two dominant red scores are present among all indicators. These characteristics are now listed in Table 6.2.

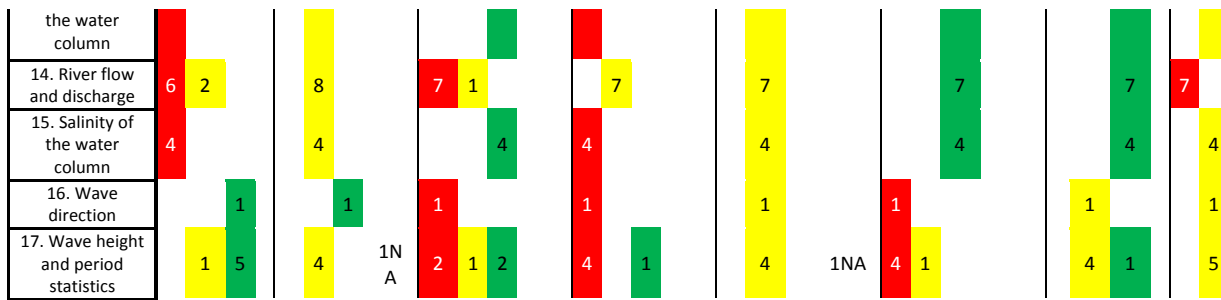
Over a total of 29 P02 characteristics used in the Challenge products, 17 (Table 6.2) are not adequate at the scale of the Mediterranean Sea monitoring. The most frequent quality elements that score “not adequate” are: Dominant monitoring system inadequacy

- 1) horizontal coverage;
- 2) temporal coverage;
- 3) horizontal resolution;
- 4) temporal validity.

Thus in conclusion about 17 P02 characteristics emerge as not adequate from the point of view of appropriateness.

Table 6.2 Upstream data sets appropriateness indicators as a function of P02 across all Challenges only for the characteristics that have more than two prevailing red indicators in Table 6.1

List of P02 Characteristics related to input data sets	Horizontal Coverage UD.APE.1.1	Vertical Coverage UD.APE.1.2	Temporal Coverage UD.APE.1.3	Horizontal Resolution UD.APE.3.1	Vertical Resolution UD.APE.3.2	Temporal Resolution UD.APE.3.3	Thematic Accuracy UD.APE.3.4	Temporal Validity UD.APE.4.1
1. Administrative units	1 1 1	9 2 1 1N A	6 5 1N A	6 1 4 2N A	2 1 10N A	2 11N A	3 1 0	7 4 1 1N A
2. Coastal geomorphology	3	3	3	3	3	3	3	3
3. Dissolved oxygen parameters in the water column	8	8	8	8	8	8	8	8
4. Dissolved total or organic phosphorus concentration in the water column	1 2	3	1 1 1	3	3	3	3	3
5. Fish abundance in water bodies	1	1	1	1	1	1	1	1
6. Fish and shellfish catch statistics	4 2	6	3 3	6	6	6	6	4 2
7. Fishing by-catch	1	1	1	1	1	1	1	1
8. Habitat extent	1 5	3 2 1	4 2	4 2	1 2 2 1NA	1 4 1NA	6	2 3 1
9. Horizontal platform movement	9 4	1 9 3	1 1 2	4 7 2	3 1 0	6 1 0	1 1 5	9 3 4
10. Horizontal velocity of the water column (currents)	1 2	1 2	2 1	3	3	2 1	3	1 2
11. Lithology	1 9	3 1 6	8 2	9 1	6 1 3	1 0	1 0	4 6
12. Nitrate concentration parameters in the water column	9	9	1 8	8 1	9	9	9	1 8
13. Phosphate concentration parameters in	6	6	6	6	6	6	6	6



6.2 Analysis of appropriateness indicators for Copernicus and EMODnet services

In this section we analyse the EMODnet and Copernicus service input data used in the Challenge products. Most common negative values are for the horizontal/vertical coverage and resolution indicators meaning that products are still too coarse to be satisfactory for the Challenge products and that coverage is still low, especially for the EMODnet datasets.

Table 6.3 P02 characteristics used by the Challenge products from EMODnet portals and most common indicator with negative score

P02 Characteristic	Emodnet Portal	Used in:	Negative value Indicators
Administrative units	Habitats	MEDSEA_CH3_PRODUCT_2_3	
Bathymetry and Elevation	Bathymetry	MEDSEA_CH2_PRODUCT_6, MEDSEA_CH3_PRODUCT_2_2	Temporal coverage,
Dissolved oxygen parameters in the water column	EMODnet Chemistry	MEDSEA_CH6_Product_4	Horizontal Coverage Horizontal Resolution
Habitat characterisation	Seabed habitats	MEDSEA_CH3_PRODUCT_2_4	
Light extinction and diffusion coefficients	Seabed habitats	MEDSEA_CH2_PRODUCT_5	Temporal coverage,
Lithology	Seabed habitats	MEDSEA_CH5_Product_7, MEDSEA_CH5_Product_8, MEDSEA_CH5_Product_9, MEDSEA_CH5_Product_10	Vertical Coverage Temporal Coverage Horizontal Resolution Vertical Resolution
Nitrate concentration parameters in the water column	EMODnet Chemistry	MEDSEA_CH6_Product_5	Horizontal Coverage Horizontal Resolution
Phosphate concentration parameters in the water column	EMODnet Chemistry	MEDSEA_CH6_Product_6	Horizontal Coverage Horizontal Resolution

Table 6.3 P02 characteristics used by the Challenge products from Copernicus service and most common indicator with negative score

P02 Characteristic	Used in:	Negative value Indicators
Chlorophyll pigment concentrations in water bodies	MEDSEA_CH6_Product_2, MEDSEA_CH6_Product_3, MEDSEA_CH6_Product_4,	
Horizontal velocity of the water column (currents)	MEDSEA_CH2_PRODUCT_4, MEDSEA_CH3_PRODUCT_2_7	Vertical Coverage, Horizontal Resolution, Temporal Validity
Sea level	MEDSEA_CH4_PRODUCT_4_1, MEDSEA_CH4_PRODUCT_4_2, MEDSEA_CH4_PRODUCT_4_3, MEDSEA_CH4_PRODUCT_4_4, MEDSEA_CH4_PRODUCT_5_1, MEDSEA_CH4_PRODUCT_11_1, MEDSEA_CH4_PRODUCT_11_2, MEDSEA_CH4_PRODUCT_11_3, MEDSEA_CH4_PRODUCT_11_4, MEDSEA_CH4_PRODUCT_12_1,	Horizontal Resolution
Temperature of the water column	MEDSEA_CH3_PRODUCT_2_6, MEDSEA_CH4_PRODUCT_2_1, MEDSEA_CH4_PRODUCT_2_2, MEDSEA_CH4_PRODUCT_2_3, MEDSEA_CH4_PRODUCT_3_1, MEDSEA_CH4_PRODUCT_9_1, MEDSEA_CH4_PRODUCT_9_2, MEDSEA_CH4_PRODUCT_9_3, MEDSEA_CH4_PRODUCT_10_1, MEDSEA_CH4_PRODUCT_10_2	Horizontal Resolution

7. Analysis of Challenge targeted products quality

In this section we will analyse and discuss the appropriateness indicators for 79 Challenge Targeted Product components (out of 45 products).

7.1 Evaluation of Targeted Products from appropriateness indicators

As for the availability indicators we will display here the scores for each indicators across all Challenges products.

The picture emerging from the TDP appropriateness indicators, shown in Fig. 7.1 is that:

Targeted product evaluation by indicators

- 1) most of the products have consistent quality with respect to the DPS requirements;
- 2) the largest TDP errors are linked to **inadequate horizontal coverage and resolution and to temporal validity**.

7.2 Evaluation of Targeted Products from expert opinion

The objective of this internal project survey is to provide an expert evaluation of the “fitness for purpose” of the Targeted Products. The coordinator asked the challenges teams to answer to the following points:

Targeted product evaluation by expert opinion

1. Assign an overall product quality score with respect to scope (fitness for purpose) and explain why according to the scale in Table 7.2.1.
2. Explain what is (are) the most important characteristic(s) for the Targeted Product quality (if all characteristics are important please say so);
3. Explain what is (are) the quality element(s) (see Annex 1) of the most important characteristic(s) that affects the Targeted Product quality;
4. Explain the limitations on the quality of Targeted products due to the input data set used;
5. Explain which characteristics “fails the most” to meet the scope of the Targeted Product;
6. Provide an expert judgement to describe for each Targeted Product the most important gaps in the input data sets.

SCORE	MEANING
1	EXCELLENT → it meets completely the scope of the Targeted Product
2	VERY GOOD → it meets more than 70% of the scope of the Targeted Product
3	GOOD → it meets less than 50% of the scope of the Targeted Product
4	SUFFICIENT → it does not really meet the scope but it is a starting point
5	INADEQUATE → it does not really fulfil the scope, not usable

Table 7.2.1 Targeted Products quality scores and their meaning.

The detailed answers to these questions are documented in Annex 5. Table

7.2.2 summarizes the quality scores given by the project experts. The Targeted products with lowest “fitness for purpose” are:

1. Challenge 5 (fishery management) products encountered the largest problems since of the data are not available at appropriate time.
2. Challenge 7 (river inputs) produced a low accuracy product since the quality of the input data is low.
3. Challenge 4 reported a lack of information on the sediment mass balance and gaps on the sea level data which do not allow to compute long time series directly from measurements so that only reconstructed time series are possible.
4. Challenge 2 faced the issue of assessing MPA connectivity at the whole basin scale where some crucial data sets are missing, i.e. larval behavior and spawning time. Furthermore the Challenge products are not based on a sound methodology yet. The assessment of MPA network representativeness is still an open research issue.

Challenge products problems

TP	CH1	CH2	CH3	CH4	CH5	CH6	CH7
1	1	2	3	2	3	2	2
2	1	1	2	3	4	2	2
3	1	3		1	5	4	2
4		4		3	4	4	2
5		3		1	4		5 2
6		4		4	3		2
7				5	4		5 2
8				2	4		2
9				3			4
10				1			
11				3			
12				4			
13				1			

Table 7.2.2 Summary of the quality scores associated to each Targeted Products according to the expert’s evaluations.

Thus in conclusion the monitoring system of the Mediterranean does not make possible to have “fit for purpose” products for at least six of seven Challenge products.

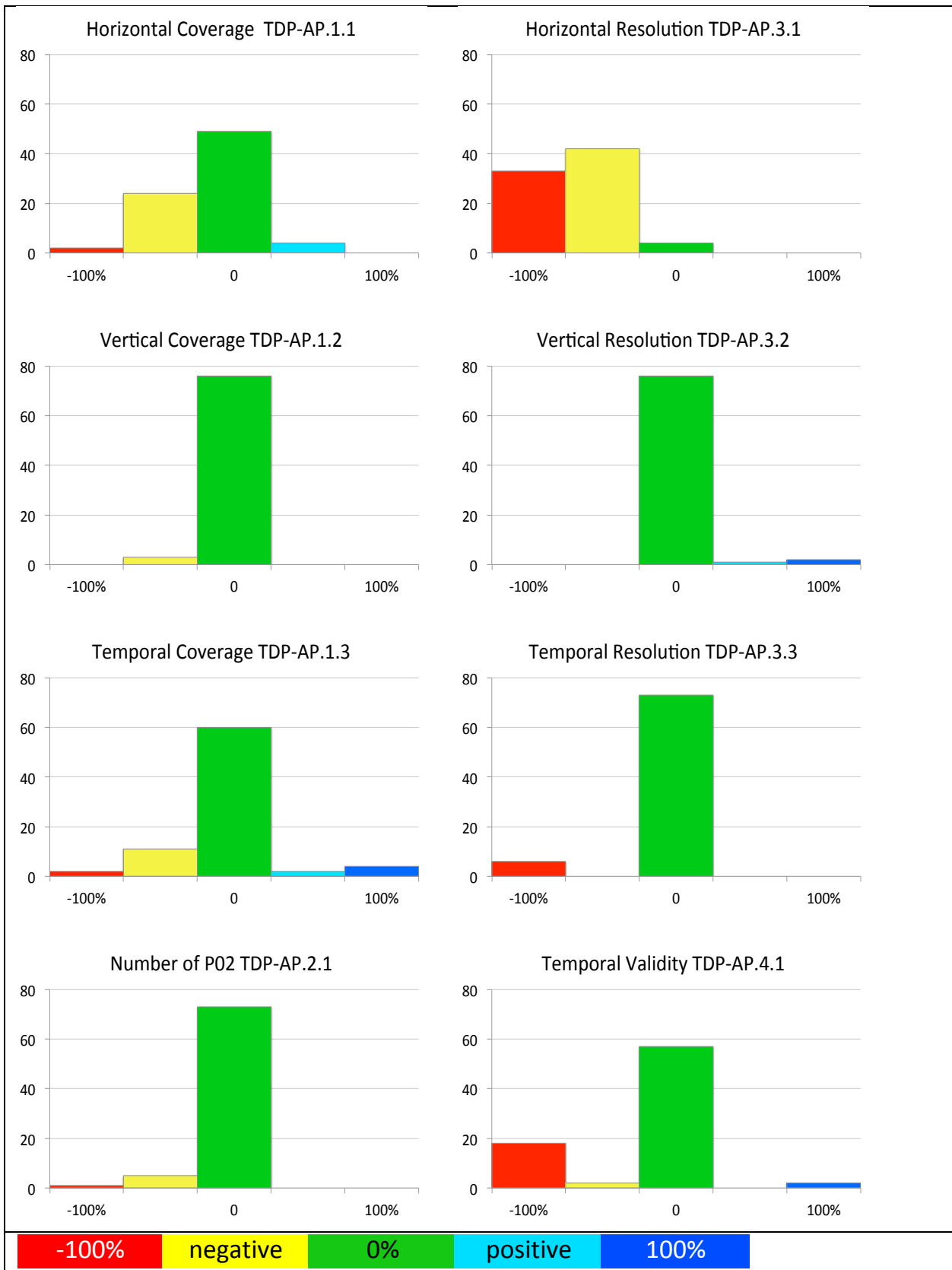


Figure 7.1: TDP appropriateness indicator score distributions (79 products).

8. Key gaps based on all indicators and expert opinions

Gaps of the monitoring system for the Mediterranean Sea are emerging from all the previous analyses and here we will try to make a synthesis of the findings from a combination of the availability and appropriateness indicators. Such a combination has been called in Annex 2 the “Fitness for Use” indicator and we devised also a mathematical formula for it.

Methodology to define monitoring gaps

Unfortunately the FU indicator described in Annex 2 does not give rise to reasonable values probably because of the limited numbers of input data sets available that do not allow to compute a standard deviation of the error. As shown in Table 6.1, we have 29 different characteristics for 90 input data sets, i.e. about 3 data sets per characteristics. Thus it is impossible to have a combined FU indicator calculated with sufficient statistics.

In order to distil the gaps from a combination of the two indicator territories, we made an inter-comparison between the inadequate P02 characteristic categories for the availability (see Table 5.2.1) and appropriateness indicators (see Table 6.2). The comparison is shown in Table 8.1

Table 8.1 The most inadequate P02 characteristics for the availability and appropriateness indicators. Colors indicate common variables across the indicator territories

Not adequate for availability indicators	Not adequate for appropriateness indicators
1. Sedimentary structure	1. Administrative units
2. Spectral wave data parameters	2. Coastal geomorphology
3. Wave direction	3. Dissolved oxygen parameters in the water column
4. Wave height and period statistics	4. Dissolved total or organic phosphorus concentration in the water column
5. Pollution events	5. Fish abundance in water bodies
6. Bird reproduction	6. Fish and shellfish catch statistics
7. Fauna abundance per unit area of the bed	7. Fishing by-catch
8. Fish abundance in water bodies	8. Habitat extent
9. Fish behaviour	9. Horizontal platform movement
10. Fish reproduction	10. Horizontal velocity of the water column (currents)
11. Habitat extent	11. Lithology
12. Fish and shellfish catch statistics	12. Nitrate concentration parameters in the water column
13. Fishing by-catch	13. Phosphate concentration parameters in the water column
14. Horizontal platform movement	14. River flow and discharge
15. Marine archaeology	15. Salinity of the water column
16. Marine environment leisure usage	16. Wave direction
17. Air pressure	17. Wave height and period statistics
18. Air temperature	
19. Atmospheric humidity	

The result of this comparison is that 6 monitoring characteristics have low to very low scores for both availability and appropriateness. They are:

- 1) **the fishery data, such fish catch and by-catch, fish abundance in the water column** are at the top of the list for their inadequate availability and appropriateness indicators. The key **inadequate** quality attributes for this monitoring are: **visibility, EU INSPIRE catalogue, data policy visibility, readiness, data delivery and data policy, horizontal and temporal coverage, temporal validity.**

A synthesis of the indicators this monitoring characteristics is given in Table 8.2

P02 Characteristics related to input data sets	Horizontal Coverage			Vertical Coverage			Temporal Coverage			Horizontal Resolution			Vertical Resolution			Temporal Resolution			Thematic Accuracy			Temporal Validity		
Fish abundance in water bodies	1				1		1				1			1				1			1	1		
Fish and shellfish catch statistics	4	2		6			3	3			6			6				6			6	4	2	
Fishing by-catch	1				1		1			1				1				1			1		1	
	Easily found			INSPIRE catalogue			Visibility of Data policy			Data delivery			Data policy			Pricing			Readiness			Responsiveness		
Fish abundance in water bodies	2		1		2	1	2		1			3			3			3			3		1	2
Fish and shellfish catch statistics	6			6			2		4		4	2		6		6			6				6	
Fishing by-catch	1			1					1	1				1		1			1				1	

Table 8.2 Availability and appropriateness indicators for the P02 fishery management characteristics. The numbers in the cells corresponds to the number of data sets and the number of challenges that have used them in the evaluation.

It is to be noted that for the entire Mediterranean Sea only 6 data sets were available for fish catch statistics while only 1 data set is present for fishing by-catch.

These input data sets were used in Challenge 2 and 5 products.

- 2) **the habitat extent** characterization (posidonia oceanica, Coralligenous and Maerl habitats, seabed sensible habitats) input data sets are also totally inadequate in terms of **Data Policy and Responsiveness, Vertical and horizontal coverage, temporal and horizontal resolution.**

A synthesis of the indicators this monitoring characteristics is given in Table 8.3

P02 Characteristics related to input data sets	Horizontal Coverage			Vertical Coverage			Temporal Coverage			Horizontal Resolution			Vertical Resolution			Temporal Resolution			Thematic Accuracy			Temporal Validity		
Habitat extent	1	5		3	2	1	4	2		4	2		1	2	2	1	4				6	2	3	1
	Easily found			INSPIRE catalogue			Visibility of Data policy			Data delivery			Data policy			Pricing			Readiness			Responsiveness		
Habitat extent	1		16	2	1	14		6	11		12	5	10	1	6			17	1	16		11		

Table 8.3 Availability and appropriateness indicators for the P02 habitat extent characteristics. The numbers in the cells corresponds to the number of data sets and the number of challenges that have used them in the evaluation.

These input data sets were used in Challenge 2 and 5 products.

- 3) **the wave height, period, direction and spectral parameters** input data sets are totally inadequate because of negative scores for **visibility, INSPIRE Catalogue, Data Policy, Pricing, responsiveness, temporal coverage, horizontal and temporal resolution**

A synthesis of the indicators this monitoring characteristics is given in Table 8.4

P02 Characteristics related to input data sets	Horizontal Coverage			Vertical Coverage			Temporal Coverage			Horizontal Resolution			Vertical Resolution			Temporal Resolution			Thematic Accuracy			Temporal Validity		
Wave direction			1			1	1			1			1			1				1			1	
Wave height and period statistics		1	5		4		2	1	2	4		1		4		4	1			4	1		5	
	Easily found			INSPIRE catalogue			Visibility of Data policy			Data delivery			Data policy			Pricing			Readiness			Responsiveness		
Wave direction	2		6	5	3		5	3		5	3		2	2	4	2	2	4	1	6	1	4	1	3
Wave height and period statistics	7		11	15	3		9	3		9	7	2	4	6	8	4	6	8	7	7	4	6	8	4

Table 8.4 Availability and appropriateness indicators for the P02 wind waves characteristics. The numbers in the cells corresponds to the number of data sets and the number of challenges that have used them in the evaluation.

These input data sets are used in Challenge 3.

8.1 Expert opinion on sediment mass balance inadequate monitoring

The only product in the Mediterranean Sea Checkpoint that was not realizable was the Challenge 4 product:

“Spatial data layers for the sediment mass balance at the coast for the past 10 years, the past 50 years and the past 100 years”

The project expert group of Challenge 4 discussed the inadequacy of the input data sets that might have been used to realize the products if existing. The discussion is done by answering 6 questions (see Section 7.2) and here we report such discussion for the specific sediment mass balance product.

- 1) Question: Assign an overall product quality score with respect to scope (fitness for purpose) and explain why according to the scale in **Error! Reference source not found.7.2.1.**

As a result of the Checkpoint investigations, there is a lack of valid data on sediment mass-balance or coastal erosion-accretion at a basin level. The EUROSION dataset (that ended in 2004) provides a qualitative estimation of sediment mass balance coded as stable, eroded, or accreted, without being specific on time extent, methods and approaches used. Other available data from EMODnet Portal, Geology Portal or from the European Atlas of the Seas provide data (i.e. sediment type, deep-sea water bathymetries) that do not fulfil the minimum requirements for a sediment mass balance assessment and therefore **the overall product quality score is inadequate**, despite the challenge have explored the existence of alternative data sources and datasets described in the report entitled “D5.3.5.1 Sediment Mass Balance Data Assessment in the Mediterranean”.

- 2) Explain what is (are) the most important characteristic(s) for the Targeted Product quality (if all characteristics are important please say so);

There are no usable characteristics for generating this product.

- 3) Explain what is (are) the quality element(s) of the most important characteristic(s) that affects the Targeted Product quality

To justify why we did not constructed the requested product, two approaches were addressed: (1) a specific survey to the national agencies dealing with coastal protection and (2) a scientific literature survey. In both cases the resulting datasets incorporates doubts about the quality of the exploitable characteristics.

- 4) Explain the limitations on the quality of Targeted products due to the input data set used;

The main limitations of the resulting products relate to the type and nature of available data. Firstly, the specific surveys identified (i.e. surveys originated from national agencies or scientific literature) a plethora of data sources that would be appropriate for the Tender request. However, in most cases this data is not visible, neither easily available. Additional analyses and supplementary effort would be needed to locate and access them, and determine their usefulness and value to address the Tender purposes or the potential use for non-expert users. The data from specific surveys indicate that in relation to spatial layers of sediment mass balance, adequate resolution can be obtained for only 10% of Mediterranean NUTS3 regions. Only 4 regions have adequate temporal resolution. We have discarded local studies that can provide time series at a specific location, but not at the scale requested by the tender. Secondly, the scientific literature survey carried out shows that despite the existence of numerous studies in the Mediterranean, they are usually local and with an incoherent frequency. In addition, very different methods are used and as a consequence, it

is very difficult to use and compare the resulting data. Additionally, there is some concern on the representativeness of the locations surveyed for being used as NUTS3 regional indicators.

5) Explain which characteristics “fails the most” to meet the scope of the Targeted Product;

Regarding to the limitations of this products, both the scientific literature survey and the specific surveys showed a persistent difference on the amount of data and its quality between countries and between the northern and southern coasts of the Mediterranean.

The literature survey done for the sediment mass balance data is available at the project web site:

<http://www.emodnet-mediterranean.eu/portfolio/climate-coastal-protection/>

for the product called MEDSEA_CH4_Product_7 .

9. Conclusions

This document describes the findings of the EMODnet Checkpoint investigation for the assessment of the basin scale monitoring system data adequacy in the Mediterranean Sea.

Assessment of monitoring systems has been undertaken in the past for the Global Ocean Observing System (GOOS; <http://www.goosocean.org/>) and the European Seas (EuroGOOS, <http://eurogoos.eu/>) and it has started for basin-scale systems (TPOS, <http://tpos2020.org/first-report/>, AtlantOS, <https://www.atlantos-h2020.eu/>). However all these approaches are connected to intermediate users, i.e., ocean analysis and forecasting centres that produce more elaborated but still basic information about the ocean state, from physics to biochemistry. However an approach that tries to assess the upstream observing system by the quality of the end-user products is missing, desirable and timely.

On the impetus of the EMODnet activities in Europe, DGMARE started an ambitious program, the EMODnet Checkpoint network, that, on the basis of the existing monitoring capabilities evaluates the quality of targeted products to define the monitoring “data adequacy” at the level of the European sub-basins, from the Arctic to the Black Sea, through the Mediterranean Sea among others.

The Mediterranean Sea EMODnet Checkpoint project started at the end of 2013, together with the North Sea basin, and it developed a strategy for such an assessment. The work was undertaken following two basic principles:

- 1) use ISO standards to define the quality elements of the assessment;
- 2) use INSPIRE principles to make available intermediate and final results of the assessment.

Both principles guided the development of a system infrastructure that uses a well-defined vocabulary and a consistent metadata framework that can be used by multiple stakeholders (see Fig. 10.1). The Checkpoint Service has the main aim to produce reports, the so-called “Data Adequacy Reports”, and this report is one of them, in particular the final one for the Mediterranean Sea. Hopefully in the future the reporting will be done regularly, with a report coming out yearly or bi-yearly (see recommendations).

The information system infrastructure build in the EMODnet Mediterranean Sea Checkpoint is based upon three major pillars:

- 1) a structured metadatabase containing information about: a) input data sets from the monitoring system; b) targeted products description and outputs, all in a standardized way;
- 2) a set of monitoring assessment indicators developed with ISO standards;
- 3) a dashboard for computation of indicator or product statistics from the information collected in the metadatabase.

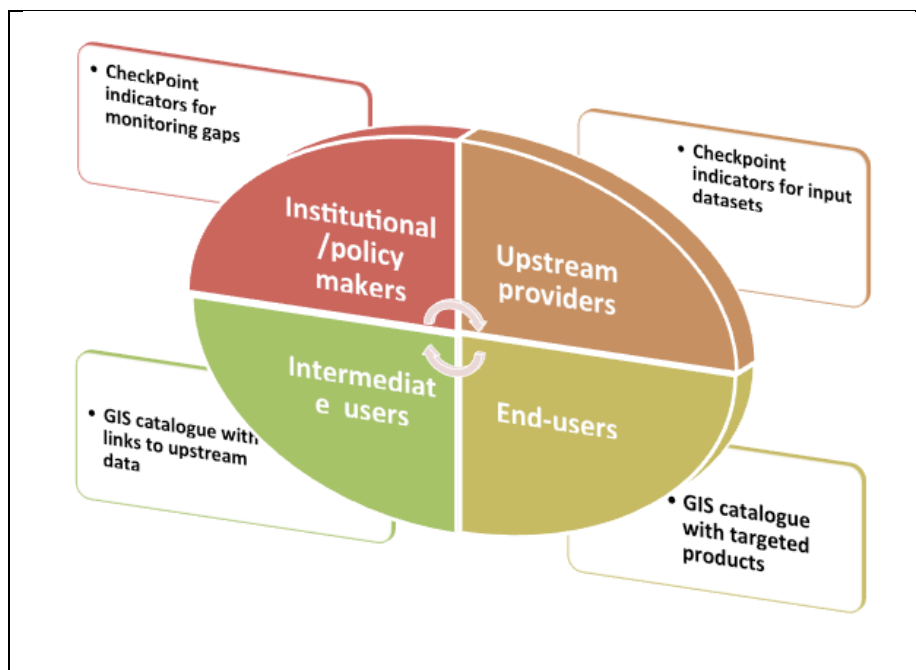


Fig. 10.1 The Checkpoint stakeholders and the relationship to Checkpoint services

In the Mediterranean Sea information was collected for 266 input data sets, covering 47 different characteristics categories, 45 different Targeted products to satisfy 7 Challenges needs: CH1- Wind Farm siting, CH2- Marine Protected Areas, CH3- Oil spill platform Leaks, CH4- Climate and coastal protection, CH5- Fishery management, CH6- Marine Environment, CH7- River inputs.

The final metadatabase is available here: <http://www.emodnet-mediterranean.eu/browser/> where all the information about input data sets can be accessed.

The Targeted data products are instead available from each Challenge web page: <http://www.emodnet-mediterranean.eu/challenges/>

and a visualization service is available with the Sextant GIS Portal technology.

The dashboard is still under final revisions and will be ready soon here: <http://www.emodnet-mediterranean.eu/checkpoint-dashboard-new/>

To summarize, the results presented in this DAR are:

- 1) a detailed analysis of input data sets both as a function of Challenges and different characteristic categories (Annex 1 and Section 4 of this report).
- 2) a detailed analysis of indicators for input data sets from the two territories, the availability and the appropriateness (Annex 3 and 4 and Sections 5 and 6);
- 3) a detailed analysis of the quality of the Targeted products via indicators and expert opinion (Annex 5 and Section 7)
- 4) an analysis of basin monitoring gaps based upon indicators and expert opinions.

10.1 The monitoring system gaps

We first analyse the gaps separately for the availability and the appropriateness indicators, after we combine the two and we arrive to the common minimum denominator, i.e. the basic monitoring system gaps from the point of view of the Challenge products.

From the availability indicators of the 266 input data sets, we found that data adequacy is low for 19 categories of monitoring data at the basin scale. Sub-dividing them into “themes” these not adequate characteristics are:

- 1) for geology: sedimentary structure data is totally inadequate in terms of Data Policy, Pricing and Readiness and partly inadequate for INSPIRE Catalogue and responsiveness;
- 2) for physics: wave data (spectra, wave height and direction) is totally inadequate for the visibility, the EU Catalogue and the Data Policy visibility;
- 3) for chemistry: pollutants in the water column (oil) are totally inadequate for almost all the availability indicators (7 over 8);
- 4) for biology: sea birds and fish characteristics (abundance, reproduction, behaviour) are totally inadequate for visibility, INSPIRE Catalogue and Data Policy Visibility;
- 5) for habitat: habitat extent is totally inadequate for Data Policy, Data delivery and and responsiveness;
- 6) for human activities: fish catch and by-catch, horizontal platform movement (maritime traffic), marine archaeology, marine environment leisure usage are totally inadequate for visibility, INSPIRE catalogue, and readiness.
- 7) for others: atmospheric conditions in general are totally and partly inadequate.

These results are also summarized in Table 5.2.2 where the availability indicator scores are now summed up considering all the input data sets without distinguishing the P02 characteristics. The results show that above 60% of the input data sets contributing to the monitoring of the Mediterranean Sea for the seven Challenges are totally and partly **inadequate for the INSPIRE Catalogue indicator**. Moreover above 40% of the input data sets contributing to the monitoring of the Mediterranean Sea are partly and totally **inadequate for Policy Visibility, Delivery mechanism, Data Policy and Responsiveness**.

Using now the appropriateness indicators, over a total of 29 P02 characteristics used in the Challenge products, 17 (Table 6.2) are not adequate at the Mediterranean Sea basin scale. The most frequent quality elements that score “not adequate” are:

- 1) horizontal coverage;
- 2) temporal coverage;
- 3) horizontal resolution;
- 4) temporal validity.

From the combined availability and appropriateness point of view, the emerging gaps for the monitoring system at the basin scales, in view of the 7 prescribed Challenges, are:

5) sediment mass balance monitoring data, the targeted product could not be done, data are only available in the literature and after the last EUROSION project, terminated in 2004, no INSPIRE catalogue and database was constructed from the data collected.

6) the fishery management data, such as fish catch and by-catch, are totally inadequate to cover the required targeted products needs from all the indicators point of view. The key inadequate quality attributes for this monitoring are: visibility, EU INSPIRE catalogue, data policy visibility, readiness, data delivery and data policy, horizontal and temporal coverage, temporal validity. Another major point is the scarcity of the data collected in 2 years search.

7) the habitat extent input data sets, such as Posidonia oceanica, Coralligenous and Maerl habitats, seabed sensible habitats, are totally inadequate in terms of Data Policy and Responsiveness, Vertical and horizontal coverage, temporal and horizontal resolution.

8) the wave height, period, direction and spectral parameters input data sets are totally inadequate because of negative scores for visibility, INSPIRE Catalogue, Data Policy, Pricing, responsiveness, temporal coverage, horizontal and temporal resolution.

From the different expert opinions it emerges that many data sets that would be necessary and that are available are not yet ready to be “ingested” into the Challenge products because the data sets do not have an appropriate format. This does not emerge completely from the indicators because people have avoided from the beginning to list input data sets, which they did not understand how to use.

From this picture we suggest recommendations and actions to be undertaken to fill the gaps.

10.2 Recommendations and actions

We have ten recommendations:

Recommendation 1: (urgent action) include or develop new EMODnet like Portals for sediment mass balance and fishery data. Probably there is a need for a separate portal for a) fishery, b) hydrology and river loading.

Recommendation 2: (urgent action) improve the habitat and the wave data set availability from the existing EMODnet portals in close connection with Copernicus Marine Service and the satellite community.

Recommendation 3: develop a new scheme for monitoring the sediment mass balance on the basis of satellite multi- or hyper- spectral sensors that will monitor river inputs and connect it to coastal morphodynamics modelling and predictions.

Recommendation 4: develop INSPIRE compliant transformation services connected to the EMODnet Portals, in particular investigate what stakeholders needs and have Challenges use the same data set in a multidisciplinary setting.

Recommendation 5: “operationalize” the data collection for sediment and fishery data sets, since most of the negative appropriateness scores arise from “temporal validity”. Data sets should be continuously updated and maintained and this can be done only with an operational service providing periodic upgrades.

Recommendation 6: Connect EMODnet Portals to EU projects to act as a repository of all data collected by H2020 and future research programs.

Recommendation 7: Increase the EU INSPIRE fully compliant Portal system especially for the EMODnet and CMEMS services.

Recommendation 8: make partnerships with the atmospheric analysis and forecasting community that from many years has developed a global infrastructure for data sharing.

Recommendation 9: Multiple formats and service mechanisms for the same input data set should be encouraged in order to have a multidisciplinary community to uptake the products.

Recommendation 10: Further develop the monitoring assessment framework developed in the Checkpoint as an authoritative network service to assess periodically the monitoring systems at the 6 European marine basin scales. This will allow for an increase of the statistical database, achieve the credibility of the indicator analysis, consider upgrades of the system and how they work in concert with other components.

Possible actions in the short to medium time range (2017-2020):

Action 1: develop a new data access system for fishery data that will be research based and that will harmonize the data collection protocols and data analysis systems.

Action 2: develop a new strategy and implementation plan for a monitoring and data access system for hydrology and sediment load at the coasts. Such system should be based upon a basic satellite observing system for the rivers and coastal areas coupled to an in situ advanced monitoring/calibration/validation observational network and a morphodynamics modelling system.

Action 3: enlarge the activities of the Habitat and Physics EMODnet Portals in terms of: 1) new data collection programs with open and free data policy; 2) assembly of wave data

from in situ, satellite and new instruments together with the atmospheric community.

Action 4: Produce multiple format products and more value added products (“easier to ingest”) from EMODnet Portals as well as Copernicus service

Action 5: form a Checkpoint steering committee that will distil the Checkpoint infrastructure that should emerge as a service that will go hand-in-hand with the EMODnet Portals and the CMEMS future developments.

Action 6: provide a user consultation Forum for the choice of Challenge products, the requirements for the products and the significant range of values for the indicators