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STRESS TESTING THE EU MONITORING CAPACITY FOR THE BLUE ECONOMY

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Abstract

An EMODnet activity has started in 2013 to assess how well the European marine monitoring data meets the requirements of a sustainable blue economy. The activity is done by six European Sea Basin Checkpoints listed in the EMODnet central web page: <http://www.emodnet.eu/checkpoints>.

Checkpoints should develop an assessment framework that considers "Use Cases" or "Challenges" to evaluate the fitness for use of input monitoring data sets. The Challenge products are related to both Blue Growth¹ and the Marine Strategy Framework Directive² objectives. The idea is that the quality of the Challenge products will inform stakeholders on how monitoring data set are "fit for use".

The Checkpoint assessment framework developed for the Mediterranean Sea is implemented through a "Service" composed of: 1) a GIS metadatabase with information about upstream data sources for Challenge products and availability indicators; 2) a Web GIS product display, encompassing links to the upstream data sources; 3) a tool to evaluate and display the statistics of assessment indicators. User requirements are recorded in the product catalogue (Data Product Specifications), which can be viewed for corrective actions.

The same assessment framework is now being applied to the Atlantic and the Black Sea thus producing in the near future the first large basin scale assessment of input monitoring data set adequacy for applications.

Keywords: EMODnet, Checkpoint assessment, Challenge products, Mediterranean Sea

¹ European Commission – Maritime Affairs – Blue Growth – Opportunities for marine and maritime sustainable growth, 2012 http://ec.europa.eu/maritimeaffairs/documentation/publications/documents/bluegrowth_en.pdf

² European Commission – Environment – Our Oceans, Seas and Coasts – Legislation: the Marine Directive, 2012 http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm

1. Introduction

The objective of the EMODnet Checkpoint initiative is to assess how monitoring meets the needs of public and private users by generating Challenge products that are related to societal needs. The main stakeholder of the Checkpoint initiative is the European Marine Observation and Data Network (EMODnet), that is, a network of marine organisations supported by the EU's Integrated Maritime Policy.

The required Challenge outputs for the Mediterranean Sea have been defined by EMODnet and they are listed in Table 1.

Table I. CheckPoint Mediterranean Sea Challenges required outputs.

CHALLENGE	INFORMATION PRODUCT TO BE DELIVERED (REQUESTED BY STAKEHOLDER)
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	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 <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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-Rivers	For each river bordering the sea basin, the country where it enter the sea and a time series of annual inputs from rivers of <ul style="list-style-type: none"> • water • sediment • total nitrogen • phosphates • eels Monthly averages, maxima and minima for these parameters over the past ten years

An assessment of the marine environmental monitoring capacity, based upon final products generated with observations and model data, has never been attempted before in the world, so the Mediterranean Sea Checkpoint developed an entirely new methodology at the same time implementing it for the required outputs of Table 1.

In Section 2 we will describe the Checkpoint methodology and in Section 3 we will overview the final Checkpoint assessment and the gap analysis.

2. The checkpoint methodology and service

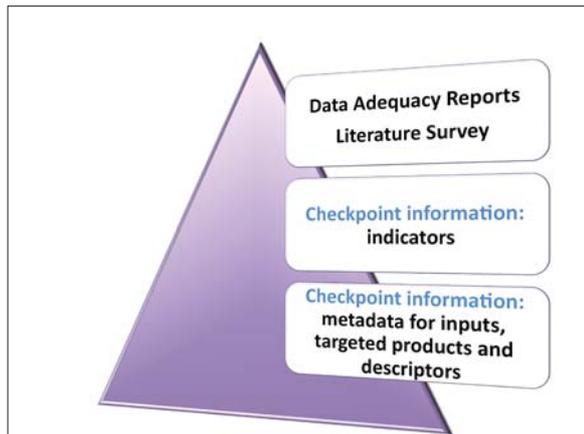


Fig. 1. The Checkpoint methodology.

The Checkpoint assessment framework is based upon three major pillars:

1. Use of the ISO principles for the methodological development and the metadata definition of input data sets (the monitoring data sets as required in the Data Product Specification);
2. Design of the metadatabase containing the information about the input (upstream) 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 ISO principles used to describe the input data sets can be found in the open access EMODnet MedSea Checkpoint browser, available here: <http://www.emodnet-mediterranean.eu/browser/>. All input data sets for the Challenges are described and catalogued following the SeaDataNet vocabulary for "Characteristics", i.e. an attribute of a distinguishing feature that refers: either to a variable derived from the observations, the measurement or the numerical model output of a phenomenon or of an object in the environment, or to the geographical representation of an object on a map by a set of vectors (polygon, curve, point) eg "coastline".

Each input data set is then classified in terms of which characteristics it refers to, the spatial and temporal structure of the data set, the environmental matrix it belongs, the data producer and the original use of the data set. The assessment framework followed two main paths:

1. An expert opinion on the quality of the Challenge Targeted products and their related input data set adequacy;
2. A set of "indicators" that classify the "fitness for use" of the input data sets and the "fitness for purpose" of the targeted products.

For the indicator path, two assessment were chosen: the first, so-called "Availability territory" answers the question of "how the input data sets are made available to Challenges, while the second, so-called "Appropriateness territory" answers the question "What is the quality of the monitoring data for the Challenge products". Eight indicators have been chosen for each territory, listed in Table 2.

Indicators provide both an overview of the situation as well as information about trends, if continuously updated, at a high level of aggregation. 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.

Table II. Availability and Appropriateness indicators nomenclature.

AVAILABILITY TERRITORY	APPROPRIATENESS TERRITORY
Definitions	Definitions
Visibility Indicators	Completeness (ISO) Indicators
Easily found	Horizontal Spatial Coverage
EU Inspire Catalogue service	Vertical Spatial Coverage
Accessibility Indicators	Temporal Coverage
Policy visibility	Accuracy (ISO) Indicators
Delivery	Horizontal Resolution
Data Policy	Vertical Resolution
Pricing	Temporal Resolution
Readiness	Thematic Accuracy
Performance Indicator	Temporal Quality (ISO) Indicator
Responsiveness	Temporal Validity

For the Availability indicators the Checkpoint has defined 4-6 possible values of each indicators to be chosen by the project experts, according to the information on the input data they succeeded to collect and according to the conditions of access they experienced. The appropriateness indicators (Fig.2) are “errors” defined as the difference between the required monitoring input data set (DPS) and the actual Upstream Data used (UD).

For each indicators we defined a “color scale” with the following meaning:

- 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

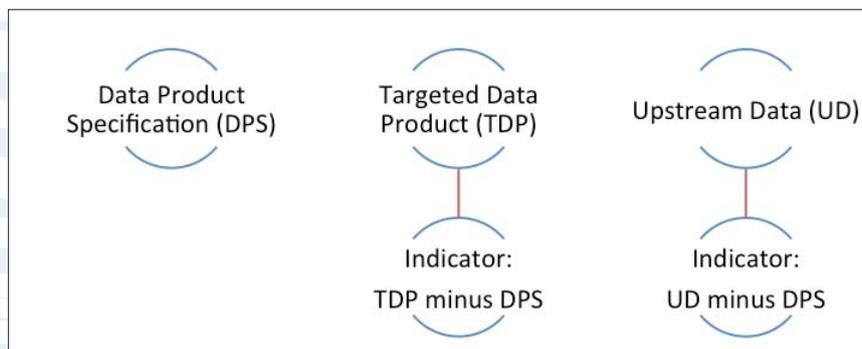


Fig. 2. High level scheme for the appropriateness indicators: Quality Elements are decided for DPS and reproduced for TDP and UD so that a “difference” (TDP minus DPS or UD minus DPS) can be calculated and this gives indicator values.

Following INSPIRE rules, all the input data sets, the upstream data sets and the Targeted products have been displayed in a Web Portal available to everybody for discovery: <http://www.emodnet-mediterranean.eu/>. In this Portal a Checkpoint Service has been defined and implemented: <http://www.emodnet-mediterranean.eu/checkpoint-service/>. Each Challenge has a proper page (<http://www.emodnet-mediterranean.eu/challenges/>) where the input data sets and the Products that make use of them, are listed and displayed. Links give access to the product specifications (DPS) and the full description of the assessment results both for the targeted product and for the input data sets, allowing end-users and data providers to directly access the results.

3. The monitoring assessment and the Gap Analysis

The Checkpoint metadatabase contains 266 input dataset descriptors, which identify and assess potentially usable information for the construction of the Targeted Products. 45 Targeted Products have been generated following the stakeholder requests. Only 90 over the 266 input dataset, spanning 29 different characteristics, have been used for the realization of the 45 Targeted Products.

This means that only approximately 3 data sets per characteristics can be used to determine the “fitness for use” of the monitoring system for each characteristic. Statistical validity of the results is somewhat low and thus the project decided to find the key gaps or the most important monitoring inadequacy by selecting the characteristics that scored lowest indicator values (red) for both availability and appropriateness. If statistics will be larger in the future we could most likely use a better combination of the indicators.

The final assessment results for the Mediterranean Sea (Pinardi *et al.*, 2017) and for all the Challenges point out that:

1. Sediment mass balance data are not available at the basin scale and products cannot be constructed at the basin scale level;
2. Fishery data sets are inadequate for the following key quality attributes: visibility, INSPIRE catalogue, data policy visibility, readiness, data delivery and data policy, horizontal and temporal coverage, temporal validity;
3. The biological habitat extent characterization (Posidonia oceanica, Coralligenous and Maerl habitats, seabed sensitive habitats) input data sets are also inadequate in terms of Data Policy and Responsiveness, Vertical and horizontal coverage, temporal and horizontal resolution.
4. The wave height, period and direction input data sets are inadequate in terms of visibility, INSPIRE Catalogue, Data Policy, Pricing, responsiveness, temporal coverage, horizontal and temporal resolution.
5. The Platform movement characteristics, i.e. maritime traffic data sets, are inadequate in terms of visibility, INSPIRE Catalogue, responsiveness, horizontal and temporal coverage, temporal validity.

The methodology developed for this assessment is now being applied to the Atlantic and the Black Sea basins thus producing in the near future the first large basin scale assessment of input monitoring data set adequacy for societal applications.

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