JPI OCEANS ACTIONS – CONCEPT SHEET

Title joint action: Science for Good Environmental Status

SRIA strategic area: Interdisciplinary Research for Good Environmental Status
Lead countries: Belgium, Italy, Malta
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Supporting countries: Expression of interest from DE, EE, ES, FR, GR, NO
Required resources: TBD

BACKGROUND – STATE OF PLAY

The Marine Strategy Framework Directive (MSFD) is the current regulatory European Union framework that promotes actions for environmental assessments, defines environmental targets and sets programs of monitoring and measures, with the overall objective of maintaining or restoring a good environmental status (GES) of European Seas and their resources. The MSFD came into force in 2008 with the goal of achieving the GES by 2020. This interval represents the timeframe of the Directive and encompasses the time necessary for its implementation at national levels and six-year assessment cycles. The initial assessment and the Member States reports on the environmental status carried in the first implementation cycle have shown a range of complexity and difficulty in the implementation of the Directive. The results showed the necessity to significantly improve the quality and coherence/consistence of the determination of good environmental status by the Member States. Furthermore, the Commission recognized that criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment should be based on the best available science and additional scientific improvement and that technical progress is needed and should be used when available.

JPI Oceans has already addressed the challenges by Member States in fulfilling the requirements of many directives, for instance through the pilot action “Intercalibration for the EU Water Framework directive”, where the support of research jointly funded by the participating countries has provided impacting clues for solutions at policy level. Other JPI Oceans’ actions are already framed in the context of monitoring and assessment and of fostering Good Environmental Status (GES), e.g. Munitions in the Sea or Ecological Aspects of Microplastics.

In all this context, it is anticipated that the JPI Oceans process can improve coordination and have a role in sharing best practice among Member States.

RATIONALE

Effective linkages are needed between emerging knowledge, innovative approaches and techniques in marine science and its practical understanding, and possible uses within the MSFD context. This means that criteria, including threshold values, methodological standards, and proper representation of the MSFD descriptors, should be periodically reviewed and amended in the light of scientific and technical progress. The efficient mechanisms for such revisions should also be built and strengthened, including development of new and innovative observational schemes and techniques, available for Member States. This will lead to a better consistency in the determination of the GES of different marine regions in the European Seas.
In such a context science can contribute revising or introducing criteria, apply risk-based approach,

and provide rigorous definitions to sharpen and refine/specify the concept of thresholds and, in turn, of the Good Environmental Status (GES). Science has also the responsibility to foster data harmonization and interoperability, as well as integrations among MSFD Descriptors.
MSFD is a relatively new European directive, but now after more than ten years of its driven initiatives, it is timely to provide a refreshed perspective. This will be based on the activities sketched below contributing to fulfil the implementation of the MSFD and the policy message that lies in it, and will mainly focus on the questions that science will address, in order to **make the assessing process effective and efficient.**
The proposed action will then be articulated in three main lines of activities: i) Knowledge sharing towards the determination of GES, through a series of workshops; ii) Joint integrated monitoring approaches, that will take advantage of all state of the art techniques and existing infrastructures; and iii) Test beds and augmented observatories, that will introduce new infrastructure for near real time monitoring at sea. The three activities are described in more detail in the following section 'Expected Impact'.

A- SCIENCE RELATED TO GES DETERMINATION

The determination of the GES is based on the values of ocean variables associated to different ecosystem components, which are specified in the criteria of descriptors. These variables and related indicators should be relatively simple to measure and communicate, allowing a better common understanding across disciplines and a better information transfer, giving policy makers a clearer picture of changes and trends in the ocean system. However, resolving temporal and spatial variability, as well as environmental feedbacks, in the marine realm remains particularly difficult, because of their naturally highly complex and non-linear dynamics. This also implies that determination of statistically robust trends requires long-term time-series datasets, whereas indicators may also show differed and delayed response to anthropogenic pressures and changes in environmental hydrological, climatic, and ecological conditions.
This makes the setting of threshold values, even through EU and regional cooperation, a scientifically challenging task, also because this should be done in relation to reference conditions, set at appropriate geographical scales, and should reflect the different biotic and abiotic characteristics and natural ecosystem dynamics. In addition, the same concept of threshold, which implies knowledge of regime shifts and tipping points in ecosystem responses, is difficult to identify without relevant knowledge of the physical, biological, and biogeochemical dynamics of the system.

As a consequence, indicators seem to be far from having been identified and the scientific bases for the definition of thresholds, as required by the recent Second Commission Decision, appear highly challenging.
The strategies in monitoring and data interpretations and reporting should be better suited to answer the key questions implicitly raised by the general descriptors of the MSFD. This implies that an improved MSFD approach should take into account a clever exploitation of additional tools, new technologies, sensors and variables, advanced use of computational methods to map and model environmental changes and impacts, including better interoperability and coupling between modelling and observational data.

B- SUPPORT TO POLICY AND GOVERNANCE

National implementation of the MSFD is subject to fragmentation. In order to fulfil the MSFD requirements along the science - policy interface and the ecosystem approach, scientific syntheses of

key ecosystem datasets need to be improved, towards a better understanding of the determination of GES in the European Seas. However, despite the wealth of scientific information produced across Europe, much of this knowledge is currently not in a form that can be readily used by policy makers and many stakeholders, and it is often overlooked even by the scientific community. Furthermore, the need for the indicators of change, knowledge of pressures and their impacts should be linked to social and economic state-of-the-art indicators. Understanding and integrating environmental information with societal and economic developments and goals is also more and more essential for an effective policy of sustainable resource use.

The research support to policy and governance should thus set efficient and effective science-based information and tools, ensuring that the capacity of marine ecosystems to respond to human-induced changes is not compromised.

The contributions from the different national responsible authorities and the European bodies, including JPI Oceans, should lead a transformation of the governance and effective coordination among different member states, with the aim of improving coordination, assuring better allocation of resources, avoiding duplications and promoting rationalization of common interpretations via a knowledge-based analysis i.e. «Science for Good Environmental Status».

C- DATA COLLECTION

Data, at national and EU level, appear sparse and heterogeneous in terms of targeted variables, quality, sampling methodologies and strategy, etc. This implies difficulties in providing usable data sets for interoperability, comparability or harmonization, and for calibration and validation activities. Indeed, a harmonised strategy is often lacking, due to what is available and/or feasible, based on national capacities.
Moreover, complexity cannot be approached by addressing the status of the system as the sum of single parts: data alone will never be enough to fully represent the spatial and temporal variability of the system. A categorization and a process-based context of data collection is therefore needed, in terms of fitness for purpose, protocols, and quality control, in the light of a synergic use of data along with modelling and remote sensing analyses. Although there are already good practices in management of measurements for different datasets, the scientific community calls for a better understanding of the “landscape” of the available in situ products, useful for the MSFD descriptors as for example for the support of those model outputs and satellite algorithms that are able to capture, synoptically, the state of the ecosystem. By enhancing this synergy, MSFD descriptors can be closely linked to their scientific meaning. The integration of Earth Observations, in situ, and modelling will be to achieve the goal of defining “trajectories” along state variables, thus analysing the ecosystem as a whole, space and time wise. Data collection, including inter-calibration of data and data management, usually underestimated, should focus on the dynamics of the ecosystem, within the contexts of an integrated observing system. JPI Oceans can promote the sharing and merging of data, addressing the problem of harmonization, as well as the main issue of data heterogeneity and assessment.

EXPECTED IMPACT

Different joint research activities can support the MSFD, aimed at increasing the efficiency and effectiveness of its implementation. Three main types of activities are identified.

1- KNOWLEDGE SHARING

A series of scientific MSFD European workshops will be organized for sharing new knowledge and its practical understanding, conceptual approaches, identification of needs and clues, as a structured

learning process to support “the official Task Groups”, the Marine Strategy Competence Centre and, in general, the entire community working and addressing the MSFD. This will also set possible platforms (i.e., EU policy lab, knowledge hub, blue-bridge virtual research environments, etc) and adapt the implementation of the MSFD to the different needs, for a better determination of GES. This will also contribute to structure a dialogue between different experts and facilitate the transformation from a silos approach (still disciplinary) to a true ecosystemic approach, aiming at building rules of correspondence between different communities. The IPCC model will be exemplary for building up a permanent panel for assessing science related to the determination of good environment status.
A steering committee will be in charge to identify and support the organization of specific meetings with a concept of science driven discussions about crucial aspects of the Directive.
This process of circulation of knowledge and ideas will result in background and reflection documents about gaps and needs that are behind those questions that are set by the Policy Makers. The documentation will support decision makers to proceed in launching joint actions or revisions in implementing the MSFD.
The MSFD European workshops will also represent the “knowledge environment” where priorities and specific activities focused on approaches at joint integrated observations (described in the following two paragraphs) will be identified and set up, creating a scientific ‘fil rouge’ and comprehensive conceptual support for this JPI Oceans action.

2- JOINT INTEGRATED MONITORING APPROACHES

The proposed integrated monitoring approaches should include shared, trans-disciplinary monitoring platforms and expertise. This has to be linked to specific activities such as interdisciplinary workshops, integrated methodologies, development of technologies for monitoring relationships of biological (e.g., omics), biogeochemical, and physical processes, in order to support a common approach, synergies, and complementarity of efforts. This would also help to assist member state groups to implement monitoring programmes, according to adopted strategies, and to promote common systems, by transferring knowledge and methods, in practice, by direct hands-on joint actions at national level. The scope of all this is to achieve harmonized, wide-regional, innovative, cost-efficient, and effective assessment schemes of the GES, in particular, from the synergy of modelling, satellite, and in situ products.

This will include the examination of opportunities for joint actions, leading to the renewed approach to the common assessments of procedures, by taking into account: monitoring objectives, parameters, indicators, sampling techniques and strategies, analysis methods, calibrations, data management and reporting, reduction of costs, identification of central fundings. Testing interoperability of data (for a number of case study), in order to integrate information towards meaningful results, will identify feasible, efficient, and effective implementation approaches at national level. Specific indicators and common protocols will be selected and used as benchmark for future interventions. In this context, mounting of integrated, joint monitoring actions, for instance, organised on shared multi-party and cross-disciplinary teams on board of European research vessels, will be also evaluated. Other options for joint actions could also envisage the support and direct involvement of the MSFD Task Group in the organisation and conduction of national scale monitoring campaigns in collaboration with national entities, leading to transfer of common practices and methodologies through a hands-on approach. These innovative surveys are therefore envisioned as a downstream activity of what results from the synergic analysis of model (physical and biogeochemical) outputs, remote sensing products, and available in situ measurements, in order to test hypotheses and collect crucial data that may emerge from gap analyses.
Additionally, to meet evolving ocean observation needs for MSFD, the role of joint, integrated observation approaches as a part of the wider European Ocean Observing System (EOOS) will be

taken into account. In this context an integration of European research oceanographic fleet for conducting periodic MSFD-oriented surveys may create appropriate framework toward better collaboration and interoperability of MS, within emerging areas of activity, sharing the methodological advancements and coherent approaches. Continuous feedback with the Marine Copernicus community will also result crucial, in comparing CMEMS Ocean Monitoring Indicators (OMIs), as well as with the EMODnet organizations, which may help, for instance, in filling emerging gaps in marine data availability.

Finally, an interesting win-win situation should be highlighted whereby ocean observations for environmental management, for monitoring the health of the marine ecosystem, and for marine safety and surveillance would (i) use common platforms, and (ii) serve to also feed the research and economic sectors for added value generation and societal benefits. This means that the same infrastructure for data collection and generation proposed here would be available for use and re-use by multiple users at no additional cost. In an evolving knowledge-based society, access to high quality data, modelling and satellite observations, blended into smart technologies, are key ingredients to support sustainable blue growth, especially in the coastal areas where many essential economic activities are occurring at the national scale.

3- TOWARDS AUGMENTED OBSERVATORIES

Augmented observatories should be conceived as integrated observation, monitoring and experimentation infrastructures. Key elements will be the requirement of being autonomous and automated, provide multidisciplinary measurements, obtain a high-resolution data collection and a real or near-real time link with the base station on the mainland. Furthermore, the observatory ideally allows a multi-platform, adaptive sampling strategy.

Key to the success will be the synopticity and co-localisation of the observations. Essentially, the approaches should aim at multivariable time series that are collected simultaneously at the same location or within a limited region. Furthermore, sampling will be unavoidable, and a multiplatform adaptive sampling strategy should be developed. This can be accomplished experimenting with changing sampling rates and/or sampling scales or by integrating autonomous mobile platforms such as gliders and AUVs. The latter can complement the strength of a permanent observing infrastructure. Such observatories will generate massive amounts of data covering multiple variables. Data processing and assessment will need to be adapted in relation to this. Algorithms will need to be developed that are able to handle the diversity of data and these will essentially be more focussed on the observation of patterns and their changes, rather than the analysis of single data series. Adapted statistics will need to be tested and developed alongside. The latter should be supported by quality assurance and quality control procedures that allow quantifying the measurement uncertainty of the different sensors. This also means that the challenge of continuous maintenance, calibration and intercalibration needs to be tackled. Finally, the observations need the be linked to hydrodynamical models, not only to allow model testing and correction but also in relation to understanding what is happening in the environment.

These new approaches and a harmonised view on specific and crucial indicators, will provide an unprecedented opportunity for understanding the marine ecosystem. Setting-up test beds that handle different aspects of the tasks and are conceived within the broader strategy of the ultimate augmented observatory is the way forward. The ultimate goal is to provide science-based novel approaches allowing the implementation of MSFD and that more adequately describe the marine ecosystem and changes therein.

4- PAVING THE PATH TO AN INTEGRATIVE APPROACH OF THE USE OF THE SEA

Mankind aims to perform in the next decades a step change in the use of the marine ecosystems, yet aware that the still limited knowledge in their functioning may hamper long-term exploitation of their resources. The MSFD is one of the initiatives taken so far for the exploitation of the sea with some precaution in order to prevent irreversible changes, as it has occurred, in several cases, on land and to possibly revert or mitigate changes already caused by its human use. The MSFD is in fact part of a much wider set of EU policies which include the Blue Growth Strategy, the Maritime Spatial Planning Directive, the Common Fishery Policy, and others. Our joint initiative aims at improving the implementation of MSFD in a more integrative way towards a sustainable use of the sea.

All this is challenging and requires a long-term perspective and international coordination that a JPI Oceans Action can facilitate.

RELATED INITIATIVES

JPI Oceans - Knowledge Hub on 'Integrated Assessment of effects of New Pollutants'
JPI Oceans action - Munitions in the Sea
JPI Oceans action- Ecological Aspects of Microplastics
Marine Strategy Framework Directive – EU Competence Centre
BlueMed Initiative for blur jobs and growth in the Mediterannean.
Eurofleets Plus program(s) 2019 – 2023
EOOS European Oceans Observing System 2018 – 2022
EuroGOOS /GEOSS
Regional Sea Conventions: HELCOM, OSPAR, Barcelona Convention
Related EU Directives and policies : WFD, Habitats, Birds, CFP.
ICES Working Group on Integrating Surveys for the Ecosystem Approach (WGISUR)
Approx. 60 EU funded projects since 2009 (FP7, H2020, Interreg, DGENV) (~120 M€) related directly or indirectly to the MSFD implementation.

RISKS

Lack of involvement: some countries might act only partially, for lack of efficient communication with relevant stakeholders or reduced capacity, not following a truly integrated and cooperative effort.
Lack of interdisciplinary coordination and of shared marine data: non-integrated modeling or adoption of common vocabulary between experts can represent inefficient approaches to the challenge.
Lack of an implementation mechanism: a clear and shared harmonization plan in terms of methods, approaches and timelines is crucial for implementing a solid, process-based integrated, augmented observing system, which should be able to tackle MSFD descriptors (and the integration of them) in a synergic and cross-disciplinary way.
Lack of specific investments/funding: collecting data and running experiments could be expensive and may require the availability of marine infrastructures and ship time, also from stakeholders not involved in the JPI Oceans process.

IMPLEMENTATION OPTIONS – TOOLS

Research and innovation:

Institutional and/or structural funds from single countries. Joint calls to EU funding scheme. ERA-NET Cofund initiatives, INTERREG.

Connectivity: Establishing knowledge hubs and networks of experts.

Capacity building: training, mobility of human resources, accessing/sharing marine infrastructures, procedures/agreements for transnational access and sharing of infrastructures, access to data;

Supporting actions: through workshops, reviews, impact assessments, test cases. This can be scaled in several contexts (supranational: UN, OPCW, NATO; Europe: EU, OSCE, European Council; National: ministers of environment, fishery etc., regional authorities), including existing accessing and sharing marine infrastructures (national ships, national coastal observatories), procedures and agreements for transnational access and sharing data.