



## Operational Ecology

Ecosystem forecast products to enhance marine GMES applications

DG SPACE

Collaborative Project - small or medium-scale focused research project

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## OPEC Overview

“OPEC provides an enhanced capability to predict indicators of good environmental status in European regional Seas“

The OPEC project (Operational Ecology) will help develop and evaluate ecosystem forecast tools to help assess and manage the risks posed by human activities on the marine environment, thus improving the ability to predict the “health” of European marine ecosystems. The programme will focus on four European regional seas (North-East Atlantic, Baltic, Mediterranean and Black Seas) and plans to implement a prototype ecological Marine Forecast System, which will include hydrodynamics, lower and higher trophic levels (plankton to fish) and biological data assimilation.

Products and services generated by OPEC will provide tools and information for environmental managers, policymakers and other related industries, laying the foundations for the next generation of operational ecological products and identification of knowledge / data gaps.

OPEC will use the EU’s [Global Monitoring for Environment and Security Marine Service](#) as a framework and feed directly into the research and development of innovative global monitoring products or applications. This in turn will advise policies such as the European Marine Strategy Framework Directive and Common Fisheries Policy, as well as the continued monitoring of climate change and assessments of mitigation and adaptation strategies.

[www.marineopec.eu](http://www.marineopec.eu)

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## Executive Summary

The OPEC User Advisory group was initially formed with two key aims in mind. Firstly to provide strategic advice and feedback to the project consortium to ensure that products and outputs developed were relevant and met the needs of the user community. Secondly to support the dissemination of OPEC knowledge and outputs to the stakeholder community outside of Copernicus (previously the GMES) Marine Core Service so as to maximise the impact of the project and help ensure continued development in the long term ensuring a future legacy for Operational Ecology (OE). We found limited success in engaging with a small pre-defined group of users and so adopted a more broad approach. By engaging with a wide range of people from the potential operational ecology user community the project has been able to maximise its impact on future developments within this community and ensured outputs and products were tailored to meet the needs of a wide user base.

## Relevance to Policy

Ecosystem models have a key role to play in the development of the evidence base that underpins future policy and regulation. It is not possible to answer complex policy or regulatory questions or assess the impact of management measures without considering dynamic ecosystem feedbacks and responses to external pressures, which can only be achieved using models. Despite this need, the use of ecosystem models in policy and regulation is often limited as modellers are isolated from the decision makers that need model-derived products. The lack of dialogue between communities means that there is limited understanding of how models can be applied to policy and regulatory questions, a lack of confidence in model-derived products, no visibility of models or access to model-derived products, and no assurance of quality, robustness and transparency of models.

Effective outreach involves two-way communication with the user community (including scientists, policy makers, managers and other stakeholders) as well as the public at large. The main objective in this task is to develop a strategy for engaging with stakeholders outside of the GMES Marine Service (e.g. ICES, OSPAR, Plan Bleu, and Black Sea Commission). OPEC was a proof of concept project which undertook research to enhance operational ecology to develop innovative products to help assess and understand the ecology of European regional seas. In order for these products to be fit for purpose and identify points for the future development it was vital to engage with the potential users of the data products.

Challenges for the uptake of ecosystem models include: producing the right information, building confidence in models, visibility of and access to model products, and the need for targeted development of ecosystem modelling capability. The link to social and economic systems is central to delivering the maximum benefit from ecosystem models with systems dynamics and ecosystem services providing potential solutions, but there is need to further develop methods to link biological, social and economic systems.

## 1. Introduction

The Operational Ecology (OPEC) Project was launched in 2012. Co-ordinated by Plymouth Marine Laboratory, OPEC has developed and evaluated ecosystem forecast tools to help assess and manage the risks posed by human activities on the marine environment, in order to improve the ability to predict the “health” of European marine ecosystems. In support of environmental assessment and ecosystem-based management, Operational Ecology (OE) reconstructs past history and aims to predict the future status of the marine environment and ecosystem. It is applications-focussed, delivering regular quality ensure information products in support of management and decision making via information that is relevant and in a form which can be easily accessed and used.

Using the Marine Core Service as a framework, OPEC implemented a prototype regional ecological Marine Forecast System in four European Regions (NE Atlantic, Baltic, Mediterranean and Black Seas), which include hydrodynamics, lower (plankton) and higher trophic (e.g. fish) and biological data assimilation. Data products produced during this project were intended to provide information in support of the implementation of policies such as the European Marine Strategy Framework Directive and Common Fisheries Policy, as well as the continued monitoring of climate change and assessments of mitigation and adaptation strategies.

OPEC has delivered ‘new products’ in terms of rapid environmental assessments as well as hindcasts of the recent past for use in environmental management. By assessing the potential spatial and temporal scales of predictability of seasonal forecasts appropriate to both lower and higher trophic levels OPEC has also laid the foundations for the next generation of operational ecological products.

An OPEC User Advisory Group was formed to facilitate the development of user relevant and applicable products.

## 2. Objectives of the User Advisory Group

The aim of the OPEC UAG was to provide user input throughout the project, focusing on applicable data products for use in the broad management community. The group was intended to meet approximately once a year to provide feedback and advice, with key strategic objectives to act as facilitators of knowledge transfer/exchange through:

- a) Advising on the development and delivery of operational ecology products.
- b) Advising and assisting in the dissemination efforts of OPEC knowledge and outputs to potential users (e.g. managers, policymakers, regulators, etc.).
- c) Sharing information about other work in progress or about policy and practice development, thus providing a context for OPEC.
- d) Using their own networks to publicise the project’s outputs.

### 3. Establishment and Membership User Advisory Group

The establishment of the UAG was considered from the outset of the project as it was clear that feedback given both in the early and final stages of the project would be most relevant.

Membership of the OPEC UAG was initially by invitation, with members selected by the Knowledge Exchange group or recommended by project partners. Once appointed members were asked to consider other possible members that they thought would make a useful addition to the group. It was intended that membership to the group would be fluid, with new members invited/ consulted as required throughout the project.

#### 3.1 Forming the initial group

Based on previous experience we had expected positive feedback and interest in joining the user group for this innovative and applications focused project. However the feedback we received was that with the growing strain on resources, particularly people's time, limitations had been put in place in terms of travel and participation in such groups. It appeared that project User Groups had become so prolific that many of the key people we approached were already sitting on several user groups and were no longer permitted by their organizations to join new groups, especially for small projects. Many of those unable to join the group expressed interest in the project itself and were keen to provide informal feedback as needed but could not officially join the group.

Following this initial experience, WP6 decided to continue with the formation of a project User Group but to recognize that relying solely on this group may not be the most strategic or effective way to gather the advice and feedback required. As the project progressed and products were being developed WP6 planned to seek feedback through a range of methods.

#### 3.2 Members of the UAG

The UAG membership at the close of the project was as follows:

- [Black Sea Commission](#): Prof Halil Ibrahim Sur
- [Marine Board - European Science Foundation](#): Dr Kate Larkin
- [International Council for the Exploration of the Sea](#): Dr Manuel Barange
- [Lamans s.a. Management Services](#), Greece: Dr George Triantaphyllidis
- [Met Office, UK](#). Dr Rosa M. Barciela Fernandez

#### 3.3 Confidentiality

UAG members acted in a personal capacity and not as representatives of their organisations, their role in the project was an in an advisory capacity and as such they did not have management responsibility for the project or its finances.

#### 3.4 Expenses

Any expenses incurred by UAG members would be reimbursed to the members.

## 4. Communications

The OPEC UAG membership was broad and geographically spread, as a result the most efficient mode of communication was through electronic communication and documents available on the project website.

Although invited, no members of the UAG were able to join the first or final Annual Science meetings, as a result the main form of communication with the group was electronic through email and telephone conversations.

## 5. Alternate methods of User engagement

To supplement the feedback from the User Group, WP6 engaged and encouraged partners to engage in an ad hoc manner at meetings taking the opportunity to have face to face conversations with potential users, this approach was found to be the most effective way of getting useful feedback and advice.

The Marine OPEC Data Portal was the main tool for delivery of the OPEC products and so there was a heavy focus on user engagement during the development of the portal to ensure it was not only fit for purpose but delivered a highly quality product and user experience that would live on beyond the OPEC project.

### 5.1 Face to face engagement

We found that one of the most successful ways to promote the project and get really targeted helpful feedback was to talk to potential user groups directly. This was achieved in a variety of ways outline below but includes: participation in workshops, private conversations, individual demonstrations and general informal discussions.

Examples include:

- Our Black Sea partner (METU), regularly met with the Black Sea Commission and so could easily discuss OPEC products and demonstrate the OPEC data portal, comments were then feedback to WP6 and WP7.
- Following an invitation from a User Group member (Marine Board), the WP7 leader attended a Stakeholder Engagement workshop in Brussels, where they were able to gather useful information about general needs and of European Stakeholders along with examples of best practice in user engagement. The workshop included scientists, policy makers, environmental managers, NGOs and representatives from industry. Along with gathering general information on user needs the workshop provided an excellent opportunity to demonstrate and discuss the portal and gather additional contacts who later provided feedback to the project on final products. Discussions on what improvements could be made and how data should be presented were feedback to the development team.
- The project coordinator met with the Head of the Marine and Fisheries Evidence Team at Defra (Department for Environment, Food and Rural Affairs, UK) to discuss the OPEC

project and received positive feedback. In relation to the data portal the features which allow users to subset and download data were particularly valued. Defra are keen for evidence which will help to determine baselines for the MSFD and are keen to explore the potential of model data. In addition the monitoring system assessment work developed by WP4 was presented. Defra have a pressing policy need to evaluate the effectiveness of current UK environmental monitoring and are keen to hold further discussions on the application of these methods in monitoring system assessment and design.

- One of the portal developers spoke with a mussel farmer who had used the portal without any assistance and successfully created plots of historical Temp/CHL. He was using these to match up with his yield records to help establish parameters for decision making on the farm.
- In the final weeks of the project the Marine OPEC Data Portal was demonstrated to a User Group (which included amongst others representatives from ICES, Marine Management Organisation, Marine Scotland, Seabed Users Group, Scottish Natural Heritage) who provided useful feedback on how the data was categorized and some linguistic issues that may cause confusion for potential users. This was really helpful and precipitated some changes to how the data was labelled, to add clarity from the user perspective.

These examples show how direct consultation with a broad range of people has really helped to deliver products that are user relevant and fit for purpose.

**Table 1. Additional examples of engagement with user groups that resulted in useful feedback:**

OPEC Partner	User/Stakeholder	Comments	Date
DMI	EUROMARINE Web Service workshop	Good idea, usability needs to be improved, discuss on how to link up online services in the future.	May 2013
DMI	MyOcean Annual Meeting	Innovative product - could see the potential.	April 2013
Cefas	ICES: Operational Oceanographic Products for Fisheries and Environment (WGOOFE) working group	Interesting product which fill a gap, but still in developmental stages, keen to see the final outcome	December 2013
PML Applications	Blog was written about the development of the data portal and the technical problems encountered	Feedback came from a wider range of respondents showing an interest in the software used to providing advice on how to fix certain bugs	January 2014

WP7 Leader	The STAGES and DEVOTES Stakeholder Consultation Workshop (“Building a Science-Policy Interface to Support MSFD Implementation”)	Participation in this workshop not only provided insight into stakeholders needs which was feedback into the project, but also allowed for the portal to be informally demonstrated to a number of potential users including the Marine Board, OSPAR and ICES. Discussions on what improvements could be made and how data should be presented, these were feedback to the development team.	February 2014
PML	MSCC/MASTS Ecosystem Modelling Workshop. Participants included: UK government policy leads and regional agencies responsible for environmental management	The workshop brought together 23 organisations across England, Wales, Scotland and Northern Ireland to set the agenda for the future of UK marine ecosystem modelling, through building a shared understanding and improve communication. A roadmap was developed which reflects the outputs from the workshop and generated a set of actions that will take the UK towards the delivery of its vision for ecosystem modelling.	May 2014
PML	AMEMR Conference	Useful feedback from the modelling community on improvements to how the data was displayed and accessed	June 2014
PML Applications	Kiost (Korean Institute of Ocean Science and Technology)	Impressed with the usability of the data portal, could easily access data. Thought the multi plot was a real bonus.	November 2014

Such ad hoc engagement activities not only provided useful advice but also helped to ensure the promotion of the project and its outputs across a broad range of user communities.

## 5.2 Electronic engagement

The other main avenue for engagement, in particular to get feedback on the web-based portal, was through electronic communication. The portal went through 3 main feedback

rounds. Different respondents were targeted depending on the feedback sought; in the early stages the focus was on usability of the portal and so people from a diverse range of backgrounds were included. In later stages it was important to refine the data products themselves and so potential users of the portal were engaged.

Data Portal User feedback rounds:

- ✓ Round 1 June – December 2013: Portal was tested and feedback provided from: OPEC User Group member, Web developers, Science communication professionals and a scientist.
- ✓ Round 2 Service Users – July-August 2013: Data centre managers and members of the OPEC User Group.
- ✓ Round 3 – September-October 2014: User Advisory Group and Scientists.

This method of user engagement allowed feedback to be sought quickly and targeted as appropriate, allowing the development team to continually refine and tailor the portal to the specific needs to the users.

The full comments and the response of the portal development team to those comments are available in Appendix 1. As the rounds of feedback progressed and the portal user interface was improved, comments focused less on problems with usability and more on the data products themselves. Web development is an ongoing process and comments on the user interface and minor bugs continued throughout, these provide vital in terms of producing a portal that was both accessible and enjoyable to use.

Following the first round of user feedback it was clear that there were significant problems with the user interface. This was a vital point to fix. A consultant UX web designer was bought in (March 2014) to provide an updated design, with the goal of greatly improving the user experience and ensuring that the portal could be used to its full potential.

As a result Round 2 of engagement received much more positive feedback and allowed for continued development of the data products themselves during the final months. The remaining user engagement focused on ensuring the data products provided met the user's needs. Some of the many developments made in response to user comments include:

- Option to draw an irregular shaped polygon to define a specific area of interest
- Displaying indicators across multiple regions as the same time
- Multi indicator plots
- Provisions of extensive metadata to support the transparency and accountability of the data
- Add depth information to the plots

Please see Appendix 1 for the full tables of comments and response to those comments.

## 6. Linking models to policy

Implementing ecosystem-based management requires sufficient understanding to support the assessment of impacts on whole ecosystems over long periods of time. The funding needed for data collection is considerable but limited, so it is important to examine new cost-effective ways of obtaining and processing data. Ecosystem models are central to delivering current and future policy requirements including: predicting the effects of competing management options, assessing potential impacts across the whole ecosystem, testing the sensitivity of socio-ecological indicators, optimising monitoring programmes, understanding the application of theoretical concepts like Maximum Sustainable Yield (MSY), developing ecosystem service flows, and providing an assessment of the risk associated with management measures.

The potential for quick wins in the policy and regulatory environment were explored as part of the MSCC/MASTS ecosystem modelling workshop (Table 1). However, there were still concerns expressed by both stakeholders and modellers about the translation of policy needs to tractable modelling questions. More work is required on each of these quick win topic areas to identify where work is already being done that will deliver these aims and, if not, exactly how this might be taken forward. This should focus on attributing drivers of change, integration of models and monitoring to maximise the efficiency and utility of those programmes, assessing MSFD indicators and interactions between descriptors, and cost-benefit of legislation (Table 1).

**Table 2: Potential for use of ecosystem models in addressing policy needs in terms of quick wins, multi-model *ensembles* (in italics), and gaps that cannot currently be addressed.**

Theme	Quick Wins	Gaps
<b>Environmental change and climate adaptation</b>	<ul style="list-style-type: none"> <li>• <i>Regional scale climate impacts and their value</i></li> <li>• <i>Attributing change in ecosystems to environmental drivers and the systems response</i></li> <li>• <i>Impacts of shelf-seas biogeochemistry on ecosystem state</i></li> </ul>	<ul style="list-style-type: none"> <li>• Introductions and impacts of non-native species</li> <li>• Animal and human disease</li> <li>• Local effects of pressures</li> <li>• Impacts of ocean acidification</li> <li>• Impacts on the land-sea transition zone</li> <li>• Impacts of geo-engineering</li> <li>• Impacts of offshore structures</li> </ul>
<b>Natural variability and monitoring</b>	<ul style="list-style-type: none"> <li>• <i>Distinguishing between different indicators.</i></li> <li>• <i>Quantifying uncertainty</i></li> <li>• Integration of models with monitoring to increase efficiency</li> <li>• Identifying current system state</li> </ul>	<ul style="list-style-type: none"> <li>• None identified</li> </ul>
<b>Management measures, goods and services</b>	<ul style="list-style-type: none"> <li>• <i>Efficient programme of measure for achieving GES</i></li> <li>• Impacts of landing obligations on MSY through food webs interactions</li> <li>• <i>Management strategies for achieving MSY in a mixed fishery</i></li> <li>• <i>Effects of fishery management on food webs</i></li> </ul>	<ul style="list-style-type: none"> <li>• Assessing networks of MPAs in terms of connectivity, achieving management objectives and socio-economics.</li> <li>• Cumulative effects</li> <li>• Risk of decline of endangered species from CFP reform</li> <li>• Coupling between ecosystem services and benefits in socio-</li> </ul>

	<ul style="list-style-type: none"> <li>• <i>Cost-benefit of implementation of legislation (e.g. MSFD, CFP, WFD)</i></li> <li>• <i>Marginal costs / values of changes in ecosystem services</i></li> <li>• <i>Links between ecosystem function and services</i></li> </ul>	ecological systems
<b>Good Environmental Status, state and pressure</b>	<ul style="list-style-type: none"> <li>• <i>Sensitivity of indicators to management measures and identification of better indicators</i></li> <li>• <i>Effects of pollution on the marine environment</i></li> <li>• <i>Interdependencies between MSFD descriptors</i></li> </ul>	<ul style="list-style-type: none"> <li>• Impacts of population dispersants</li> <li>• Interdependencies between different descriptors within MSFD</li> <li>• Model interoperability – modular approaches</li> </ul>

## 7. User engagement leading to a policy impact

Advancements in the Baltic modelling system were presented to the ICES working group on Baltic Fish Stock Assessment, by extending the standard model used for eastern Baltic cod with knowledge gained in OPEC, scientist were able to make probable links that oxygen depletion actually resulted in lower recruitment than anticipated. This original finding was well received by the working group and will be used in innovating predictions for cod population dynamics and vital rates in ecosystem assessments and management. Engagement with this particularly group of users resulted in a clear impact on policy and management as a result of advances made through the OPEC project.

## 8. Legacy of OPEC data delivery service

The Marine OPEC Data portal provides open access to the key data products developed during this project. PML will continue to upload new data as it become available onto the OPEC Data portal, and partners (DMI, METU, HCMR and OGS) have expressed interest in doing the same.

Communication about the portal and how it can be used has proved successful in encouraging other EU funded projects to adopt the same service for their data delivery. As a result the great efforts in making sure this was a good quality, fit for purpose delivery service have paid off and the portal will live on past the OPEC project, with continued development and enhanced new tools.

At the time of writing the portal has been taken by the following EU funded projects:

- ✓ EarthServer (<http://www.earthserver.eu>)
- ✓ Earth2Observer <https://wci.earth2observe.eu/portal/>
- ✓ Ocean Colour CCI (<http://earthserver.pml.ac.uk/map/>)
- ✓ Aqua Users (<http://portal.aqua-users.eu> – demo only currently)

## 8. Summary and lessons learnt

OPEC was funded to develop prototypes for the first generation of operational ecology data products and most importantly deliver them to appropriate user groups. The aim of this deliverable and task was to form a User Advisory Group to provide feedback on the OPEC project. As shown by the summary of our experience, reliance on a small group of individuals to provide the much needed broad range of feedback was not appropriate for this particular project. Great gains and useful feedback was sought by taking a more open and broad approach to engaging with users. By using different methods be it face to face meetings, demonstrations at workshops or electronic communications we were able to get the range of advice and feedback that was needed to really refine the project data products and ensure they were delivered in to a high standard in a way that would ensure the long term legacy of the project. By encouraging all partners to get involved with User engagement the OPEC project has increased its impact and influence on the growing field of Operational Ecology.

## Appendix 1. User feedback and actions taken during development of the OPEC Marine Data Portal

### Feedback Round 1

Comments on Data portal provided between June – December 2013

Feedback from 3 different groups: **Scientists with experience in presenting extensive complicated data sets (provided October 2013)**, **Service User (provided December 2013)**, **Web developers and Science Communicators (provided June 2013)**,

	Comment/Feedback	Action
Overall impressions	Concept is self-explanatory from the OPEC website, and the layout of the portal is very inviting and makes me want to play with and export data. Simplistic layout reminiscent of HELCOM so can capitalize on their user group with minimal education on how to use.	
	Seems quicker and more aesthetic than other data portals I've used.	
Walkthrough	When loading up the site, I get the walkthrough introduction, saying welcome to OPEC, please report bugs to PML. I press the cross to close this, am asked if I want to see this walkthrough again next time, and wonder if that was meant to have been the walkthrough. Only after a bit of playing around do I get this screen back up and realise there's a small arrow button to move to the next screen. This button could be made more obvious (e.g. bigger, not grey on black).	Walkthrough is being redesigned and a video is being created to make this more visual and obvious.
	Essential concept, great to see it but needs improvement	Being redeveloped
Layer selection	Confused labelling in variable/layer selection panel e.g. . I imagine some people would come to the site looking for temperature data for the North Sea, click on "temperature", assume there's only data available for the Mediterranean, and leave. I would prefer variables to be sorted with standardised names, not just whatever things happen to be called in the original model output file. Clicking on the arrows next to variable names doesn't seem to show more details as promised.	Variables have been relabelled with common names and the variable selection panel has been developed into groups. At present: Type, Region, MSFD descriptor, data provider.  Following further user discussions additional selection groups can be easily added.
	I think the variable listings could be better handled. It seems variables are listed for each region and have different names e.g. temperature, Temp, temp, tem depending on the provider. Also the exact nature of the data doesn't seem to be presented anywhere obvious e.g. is it SST from satellite or observations taken at 1m depth. Perhaps theses could be included as sub options e.g. a single temperature option then the ability to select a particular providers product with some metadata e.g. PML SST	This has been addressed through the new layer selection panel
	It isn't obvious which variables come from which models, or whether there are three models	This will be considered

	providing information or 30.	
	- Selecting "Juvenile_Cod_0_2__0_40cm_", a box covers the North Sea, and the date bar implies data's available continuously from 1991 to 2010, but there doesn't seem to be any data available to plot. Likewise with various other variables	Date selection panel will be restricted so that only dates with data are visible. The timeline will be the primary way to view which dates have available data.
	One improvement could be that once a region and period are selected the variable list could be automatically modified to only show available data.	This has been achieved through redesigning and grouping the variable selection list
	The combination of the "Layers Selection" and "Data Layers" panels is not immediately intuitive, and takes some time to figure out.	This issue will be considered during the new layout design, seeking further feedback on how best to develop this
	It may be beneficial to consider that the politically important users OPEC is trying to attract (managers, policy makers, non-academic users) are probably as basic users as myself seeking more the "visualization service" than "download data service", and will have limited patience to navigate the two panels	Future developments are focused on the user experience to ensure outputs can be achieved in a few simple clicks. Help videos will provided user with further information if they wish to delve further into the portal
Menus panels	Too many distributed panels makes it a confusing to look at. delay in completion of a rapid visualization loop diffuses the "wow factor" that the portal is capable of producing during the first experience	
	Suggestion: group panels if possible, keep the map visible at all times, allow user to see the effect of each menu click and manipulation to augment the experience and shorten the learning time. There is a need and place for the portal to be sophisticated and rich in services and settings for the mature and seasoned user, however for the novice this can be intimidating and discouraging.  If there is a way to structure the experience so that the portal is simple to use at first (e.g. allow a novice who has never seen the portal to visualize a layer for their regional sea <i>in less than 7 seconds</i> ), but progressively offers complexity of manipulation as the user learns about the richness of visualization layers and settings.	Developers are considering this in next design to simplify user experience and ensure a rapid output. A focus group will be held to seek further suggestions on how best to achieve this.
	Date select shows all dates with no clear indication of where data is available for, had to scroll through each month, frustrating. Needs to be clear at the beginning what data is actually available so you don't waste time looking for data that doesn't exist	The date selector has been replaced with time line to select data period

	Arrows either side of the bottom time line are cumbersome	Timeline redesign to be simpler to use
	Direction for layer panel to Data panel is not clear. If you generate layers and then have to go click data to find the data. This is not obvious.	Video walkthrough will provide a basic intro to use the website.
	Labelling of variables feels entirely impenetrable	Variable names have been changed to more common names.
Map tool	The "zoom to area" tool zooms in too much	This has been fixed
	Having a prominent scale bar (and control over this) for the data plotted on the map would be useful.	Scale bar is currently available but not immediately obvious this will be addressed in next design
	When the selected regions go colour eg. Green. What does this mean?	Appropriate scales have been added to each data set to a suitable colour range appears, users can then alter the scale bar according to how they want the data visualised
Target audiences	Imagine three target audience segments: 1) novice visualisation user, 2) advanced user with some GIS knowledge able to manipulate and cross layers 3) a data user, using the visualizations to pinpoint specific data sources and download for external analysis and use. Portal currently focuses on 3, need to work more on restructure menus and experience so that they learn through the experience while getting to 3	The aim of the redesign will be to make it easy for the basic user to create something and for the more advanced user to be able to manipulate it as they wish.
Clicks	Reduce clicks as much as possible. Suggestions: "Data Analysis" panel, DATE range selection: once month/year selected, auto-accept and remove the DONE button;	Done. Further reductions continue as the portal develops.
	- View date/Quick Region Panel: reduce the calendar panel date options only to where data is available; scanning through a list of grey dates is ambiguous.	View date will be removed altogether and the time line used to select date ranges.
Data analysis	Useful concept, would love to test fully, but persistent server error (screen capture below) prevented me from choosing a period range and fully exploring the graph properties.	Bugs have been removed and server errors are now massively reduced. There are also plans for developing more advanced error handling that will alert the developers whenever there is an error.
	It would be great if multiple parameters can be displayed/compared for a period of interest, rather than plot one at a time/export one at a time.	The graph generation tool is being further developed and this feature will be included, part of the redesign will be working out how to extend the current graphing capabilities without making it confusing to the user.

	It would also be useful if at this stage, the architecture allows space for future development so that observational data for the chosen layer and period can also be displayed as an optional layer on top of the model output graph. Comparison like this is useful visually, but also will allow for more complex development in future projects (e.g. complex statistical comparisons between the model output and data, target maps, Taylor diagrams etc).	Further functionality is being added to mapping service to included comparison across variables.
	Unable to download the data files as lack the correct programs to download netcdf... files. Some indication of what programs you need on your computer to use the portal would be helpful. How do people know if they are going to be able to download the data	Data will also be made available to download in excel spreadsheets for those with different software availability.
	Graphical outputs – would be useful to have a title of what you are seeing, particularly the region.	This has been added, details of data provider will also be added in next development stage
	In terms of plotting the data, this works quickly and neatly. More control over plots would be nice, but that's something that can be developed over time.	Plots will be developed in 2014
	I haven't been able to download any data, perhaps this is not up and running yet but the data export section within the Data analysis tool seems straight forward.	Bugs have been removed so this now works
Additional comments	CONGRATULATIONS to the developers! I imagine this is NOT an easy job! I do love the portal, but it would make me very sad if its potential suffers the same fate as so many e-infrastructure projects, where users simply run away due to lack of ergonomics and user friendliness.	
	For more efficient use of time and more complete feedback, it would be useful to organize a 10-15 min demo by the developers via webconference to showcase the full potential and current feature to a group of testers. After that I am sure I would be more confident to play it with, and give you more comprehensive feedback and suggestions.	This has been done several times now, developers are now keen for feedback from new users to ensure the interface is self-explanatory and easy to use.
	Overall, it seems like a good tool with a lot of potential that just needs tidying up and developing a bit. There's a bit more of a learning curve than there needs to be, but making the variable selection, overview and availability more obvious to the non-specialist would help with this.	
	Perhaps an FAQ could be added to the help section, and perhaps some introductory explanatory text, explaining what functionality exists, and an overview of data sources.	A walkthrough in the form of a video clip is being developed to provide further explanation on what the portal can provide
	Having a wide range of data available through a single portal is useful.	
	Would be useful to be provided with easy access to product metadata	Limited metadata currently available, more is being added as development continues
	A clear all/back to the clean map button would be really useful	Will be added in next development stage
Additional features?	3d data and the ability to produce point profiles and vertical sections.	There is currently a basic way to view 3D data, in the same dropdown menu as the

		scalebar. This is something that we plan to make far more obvious and easier to use. We also hope to be able to produce plots with all of the dimensions as we work on the graphing tools
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### Feedback Round 2 - July/August 2014

In this round the majority of feedback was obtained from Service Users, with only limited consultation with scientists.

#### Data Centre Managers, Service Users, Scientists

Respondent	Portal functions	Comment	Action
British Oceanographic Data Centre (BODC)	User interface	On the main page, the addition of links to latest versions of browsers and instructions for enabling Javascript might be helpful if they are targeting a wide range of users, who may not be particularly IT savvy	Information about optimal browsers is provided but not direct links as developers this was too prescriptive.
		There doesn't seem to be an 'OK' button to click once the indicator has been chosen. When the indicators have been selected it isn't clear if what has been selected is being processed.	This has been addressed by changes to the User Interface
		I've been using the 'rubbish bin' icon to navigate back to the main indicator page, but I'm not sure if this could be made a little more intuitive	Changes made to improve this
Marine Management Organisation (MMO)		The tool is not particularly intuitive to use, particularly the scale and analysis functions. You don't get much in the way of a description of the values you're playing around with. This may be a result of our slightly outdated browser (IE9) but if not then it needs to be more intuitive with better support or help functions.	Whilst this is a browser related issue, significant changes have been made to the scale feature, make it more intuitive and most notably visible at all times for each indicator.
Met Office UK		There is no indication when the website is processing something e.g. changing the scale bar – it looks like nothing is happening but if you wait long enough it does adjust, could do with some icon to show that a process is underway	A spinning circle has been added so users a process is happening.
ICES (OPEC UAG)		I am not sure about the "popular indicators". It has a feel of amazon "people buying this were interested in this" statement.	These have been removed
		The most irritating feature of the site is that there is no BACK button that takes you back one step and allows you to continue changing some but not all the parameters selected in the previous iteration. The only option I can	This is a problem that has not easy technical solution and is a result of the architecture of the site and how it accesses the datasets. Potential UI changes

		see is using the IE back button, which brings you back to the first page (“launch the portal”), as which point you may lose customers already. A good option (but not easy) is to have the runs as pop up windows. The same problem arises if you Export data.	include locking the back button, providing local storage states. This is under investigation. A button allowing people to return to their previous map selection has been added.
ICES	Launch page	First page after launching the page lists 4 potential plots. This is confusing because one does not know whether these are all the maps one can produce and if not why are they specifically listed. May need some explanation to ensure users are not confused. Personally, I prefer a list of generic variables one could potentially explore, rather than a specific map.	Comments potentially related to a bug in the system that has been fixed. However there is ongoing discussion as to the need and benefit of these worked examples. Seeking further feedback on this.
BODC	Mapping tool	the Map Tools tab and its contents are misaligned which for some reason is more disorientating than a few millimetres should cause	Fixed
		There also seems to be quite a bit of white space in the Map tools tab which bulks out the interface unnecessarily	Boxes resized
		There seem to be issues with different layers in different regions disagreeing with one another. Having added temperature and oxygen and then attempting to switch from the Black Sea to the North Atlantic, it would only display the Black Sea data unless the layer is deleted and re-added. There also doesn't seem to be the ability to view data from more than one region for the same parameter.	UI changes have been implemented to address this. Can now view indicators across multiply regions
		Under the scale section it's not immediately clear what the text fields actually refer to given their positions, although they are the min and max for the colour bar (labels would help	Scale bar has been reworked to make it more interactive and responsive to user manipulation.
ICES		There are no units in the maps, and while one can get them by exploring the scale function it would be better if it appears by default.	This has been addressed b clear metadata available for each indicator and data output.
		I tried to save the picture (or use a COPY windows option) and in both cases only part of the picture was copied, not the entire map. Also the legend was not copied (as it is not part of the map. I suggest that any map has a legend that comes with it if one exports the figure. This applies as well to the data of the map (present at the bottom of the map, but not exported).	Graph feature has been entirely redesigned and these issues should be addressed within those changes.
BODC	Graphs	Creation of graphs can be a smooth process, and the output well	The option to view 2 indicators at a time has been

		presented, although I couldn't figure out if there was meant to be a way to produce graphs that made use of more than one type of data – which may well be a future development but would seem to be quite a handy tool for such a portal	added to the graph feature. For this version of the data portal that is the maximum that can technically be added.
BODC	Website stability	The website crashed a couple of times whilst trying to create or return from a graph page – although whether that was a problem with the site or local to my browser I don't know	Stability has been improved.
BODC	Toolbars	there is a tab named 'MSFD' – what does this mean? I think I know what it means, but I'm not sure everyone who uses the portal will. Could be explained somewhere in the portal	Has been relabelled 'EU MSFD Descriptors' to be clearer. Space limitations prevent the acronym from being fully expressed.
ICES	Scale bar	I played with the scale in the Ch1a map without success. I saw little change when editing the max min scale, or resetting it. Maybe I am not doing it right. Not sure what the 'add indicators' button does at this stage. It adds a 'line' in the map tools, and in the time but what does the map show as there is only one map?	Spinning loading icon has been added, and UI changes implement to make the indicator selection more obvious. Seeking further feedback or recent changes.
Met Office (OPEC UAG)		I could not find the scale bar – can it be made more obvious or permanently visible? There are no numbers of the scale bar	Has been made permanently visible.
BODC	Functions	Is there an animation option which can show the indicators you have chosen across time spans? Does the user have to manually change the time on the date/time bar at the bottom of the page or can it be set to run from one specific date to another	Not available in this version of the portal but is a feature planned for future development phases.
		The search tab doesn't seem to notify the user if an indicator that has been searched for does not exist. It takes the user back to the map instead. Maybe it would be useful to have a popup which states that the indicator which has been searched for isn't available.	UI changes implemented to address this.
MMO		The data download function does not appear to work.	Fixed
ICES	Understanding the data	many project sites that allow users to extract maps, but those not directly involved in the project often feel unsure about the nature of the extracted map and its interpretation. There is no easy solution to this unless each map comes with an email address of the originator, and an offer to contact the originator to answer any questions the user may have	Full metadata has been attached to each indicator including: <ul style="list-style-type: none"> <li>• Regional summary</li> <li>• Indicator explanation</li> <li>• Models used</li> <li>• Simulation period</li> <li>• Contact person</li> </ul>

			<ul style="list-style-type: none"> <li>Link to full explanation of model system used, rational behind it and skill assessment</li> </ul>
Scientist		What am I looking at? It is not clear what data I am actually looking at, especially for fisheries – what is the unit?	Units have been clearly added for all indicators.
		 what does this icon mean?	This icon had been removed as the scale bar (which it represented) is now permanently visible.
		 unclear what this icon means	This icon has been replaced with a labelled button called 'draw a polygon'
Cefas		As above – was not sure what the dotted box meant	As above
Met Office		Is it possible to select point time series from appropriate locations to compare model data with?	This is being investigated maybe not be possible for this version of the data portal.
Met Office		Would it be possible to select line transects?	Investigating
Cefas		Line transects would be really useful	Investigating
Scientist		The maps are quite blocky, is it possible to smooth the appearance at all?	This is a result of model resolution and cannot be fixed without compromising the data integrity.
MMO		Can't seem to find any metadata relating to the content. This makes it very difficult (bordering on impossible) to interpret and understand the data you're looking at.	This has been addressed, as explained in previously.
		You don't get a sense of the values behind the data (either for individual cells or on the whole).	This has been addressed, as explained in previously.
ICES	General	Great start, and the data is clearly useful and usable, but the whole experience needs to be more intuitive and flexible.	
BODC	Other	These are just a few things I picked up on. Other than that I found the portal to be very useful and pretty user friendly.	

**Feedback round 3 – September/October 2014**

In this final round of feedback comments were sought from both **Service Users** and **Scientists** in order to sure the content was both relevant and scientifically sound before the portal was officially launched.

Respondent	Portal function	Comment	Action
European Marine Board (OPEC UAG)	User interface	The portal provides a useful interface with options to create maps by ecosystem indicator, regional seas and MSFD Descriptor. I can also see stakeholders using the tool for sharing plots and maps.	NA
		The descriptor name in some cases is slightly different from the official MSFD descriptor name which could be confusing for stakeholders? Eutrophication and Food Webs are listed exactly as the MSFD Descriptor Name. But the other three have subtle differences and I suggest using the exact wording of the MSFD Descriptor to be absolutely clear e.g. for MSFD stakeholders. e.g. Biodiversity (Descriptor is Biological Diversity); Fisheries (Descriptor is Commercial Fisheries); Hydrography (Hydrographical Conditions).	Names changes have been implemented
		Once a polygon is drawn it will never go away. This is irritating and confusing	Added button when user hovers over polygon which allows deletion
Focus group of Scientists		It was unclear that additional variables can be added to a graph	Continued changes to User Interface to address this
		Provide away to remove the bounding box	Added button when user hovers over polygon which allows deletion
		When you click on an indicator that is only available for one region, it goes straight to the map, does not actually tell you that only one region is available	This was a deliberate act to reduce the number of steps users had to take, we are currently investigating other approaches
		Zoom feature is not clear	Accessible through pressing shift whilst clicking, investigating ways to make this clearer
		Accidentally pressed Export button when trying to add a new indicator to plot. How to add multiple variables to plots is	Relabelled button to 'Download netCDF'

		not clear.	
MMO	Bugs	There seemed to be a glitch when I tried to plot zooplankton for the Mediterranean. A map was created but it seemed to plot monthly phytoplankton, i.e. state a different variable at the top of the map than the variable I selected.	Could not replicate, will continue to investigate
Focus group of Scientists	Data	Depth information would be useful	Base layer map with explicit depth contours added. Depth information has been added to the axis of each graph.
		What does the 'mean' refer to? is it a mean of the area, or the bbox or the mean of the time in that area.	Improved metadata/information available with graph
		Phytoplankton is listed under the Zooplankton dropdown menu	Change to collective 'Plankton' drop down which will include the various types of plankton
		When you look at indicators with REA and hindcast your not sure what data your	Information has been added to tell which time periods are hindcast and which are REA
		Would be useful to save the plots you have made	This feature is now available
		Can cvs files be made available to download for people who cannot open netCDF files	A full range of file options are now available including CVS
MMO		The categorisation of the data is not always logical, it may do to a modeller but not a user, e.g. seabirds under the fish category. More details advice was provide on which indicators should be in which category	Indicators were added and removed from categories as advised.
European Marine Board		Layer Elevation: All depth options are presented for each variable. But maybe these should be customised to show what data are available for each parameter e.g. For phytoplankton options currently span 0m to -2000m!	Only depths for which there is data available are presented.  Name change to Depth to be less ambiguous.
European Marine Board	Metadata	I suggest more information should be presented up-front on	Full meta data and supporting

		how model-derived data is produced. It is very important for decision-makers to know the potential uncertainties/ranges of data and have all available data for a certain variable.	documentation has been provided, including details of the model system used and an assessment of their skill.
		Good graph app but currently this may be most useful to scientists who understand the variables/data formats. For wider users I suggest more information could be presented up-front on how different variables can be used (i.e. before you create a map). e.g. Phytoplankton: You can select from many options; chlorophyll, primary production etc. Maybe some stakeholders will need more explanation on the differences and also the use of these datasets?	A short description of each variable has been provided.  At the moment the portal just provides, consideration being given to providing further information on how to use the different data sets.
		MSFD Descriptors e.g. Eutrophication you can choose from 16 variables – many people will be unclear what the benefit of plotting e.g. Mixed Layer Depth is for Eutrophication	Each Descriptor has been reconsidered with several being removed from Eutrophication including temp, pH and pCO <sub>2</sub> . Mixed layer depth was left as following discussions with the scientists they thought it could be useful in determining eutrophication events.
Focus group of Scientists		Show the validation data under the model data under the slide out	Links to full description of skill assessment added
Focus group of Scientists		People don't know what low, medium and high mean in terms of confidence	Smiley faces have been added to give an immediate indication along with explanation as to how this confidence is derived
European Marine Board		Sometimes it then asks you to 'select a data provider' e.g. OGS, HCMR. This is potentially confusing to an external user a) may not be familiar with oceanographic institutions b) even if they know the organizations, how should people choose which dataset to plot? If a choice is given, there could be information on the length of time-series/ depths etc. or the models used up-front before you make the selection?	An 'information' icon is provided which tells about the different forcing used, a key difference between the regional models. Developers will look at making this more prominent. <i>Depth and time-series are the same for the different providers.</i>

Focus group of Scientists		Out of range data is shown in black	Requires a back-end upgrade which will be carried out in due course
European Marine Board	Graphs	Single variable, multiple regions. For example options to overlay Net PP from Atlantic and Biscay on the same graph so it is easier to assess averages/thresholds/trends across European seas, particularly neighbouring regions.	This feature is available, changes to UI will hopefully make this feature more prominent and easier to use.
European Marine Board		Plotting multiple depths for a single region and variable could also be useful?	As above
Focus group of Scientists		The use of bottom graph not clear	Add a label to indicate it allows users to zoom into the main graph
European Marine Board	Other comments	As I understand, the portal allows users to make custom plots of model simulated ecosystem data for European regional seas? This is very useful.	
European Marine Board		Is there a way / future plan to interface this portal with <i>in situ</i> observational data e.g. Emodnet portals, Copernicus Marine Core Service?	This function is currently being developed but may not be ready by the conclusion of OPEC, however the portal will continue after the project with such features being added
European Marine Board		Interesting developments – are there plans for longer-term maintenance/updates to this post-OPEC?	Yes the portal will be maintained with data from project partners following the close of the project. The portal has also been taken up by other EU funded projects and so the extensive software development undertaken by OPEC developers will continue to be used and taken forward.