

## 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 uses the EU’s Copernicus (before: GMES) as a framework and feeds 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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## 1. Purpose and Scope

OPEC has to undertake R&D to improve the quality of operational services for biogeochemical and ecological parameters. OPEC has adopted the Copernicus (previously GMES) core service model (figure 1).

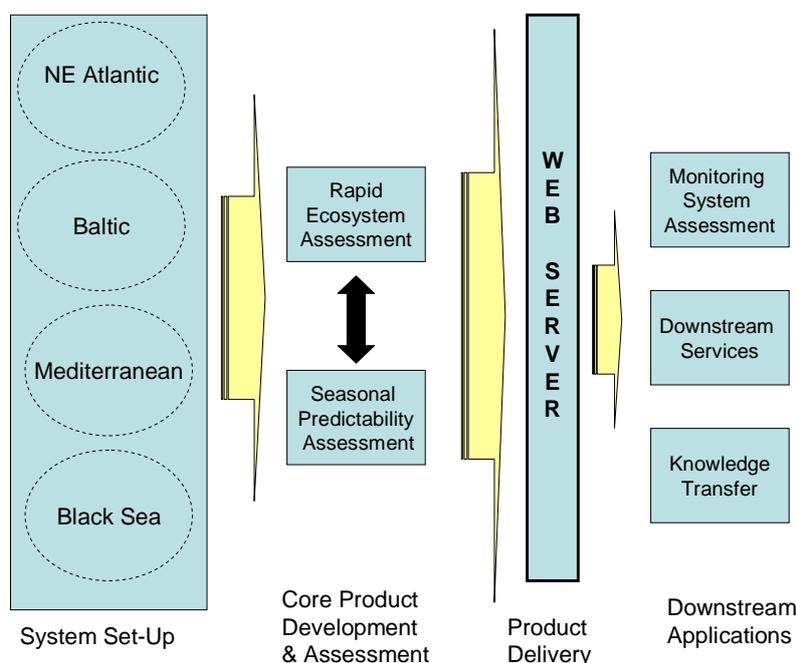


Figure 1. The GMES core service model as applied to OPEC.

OPEC has advanced existing best-practice in ecosystem modelling making use of state of the art coupled end to end models, biochemical data assimilation, optimizing model performance by improving key parameterisations, and the assessment of model skill and predictability through:

- Establishing a core model system for each region and assess model skill for key indicators:
- Demonstrating a capability for Rapid Environment Assessment (REA) of ecosystem variables:
- Exploring timescales of predictability of key ecosystem variables:
- Assessing current ecological monitoring systems and the data needs for a GMES ecological service:
- Data Delivery, Downstream services and Knowledge Transfer

In WP6 OPEC has developed a webbased GIS server which offers open and free access to data and dissemination of research-based knowledge, expertise and skills from the project to the users. The Marine Service is intentionally serving large institutional users and intermediate users (i.e. service providers) only. Consequently there is a gap between MSC and regional, national and local monitoring agencies, industry and other market segments, as well as the public. A European group of Service Providers are taking up the MCS products, amending them and delivering end-user tailored services for water quality (MARCOAST network of Marine Service Providers [<http://gmes-marcoast.com/>]), which delivers satellite-based services in the field of marine and coastal applications. MARCOAST is focussed on a sustainable service market, based on real user demands and implemented by fostering commercial activities driven and controlled by end users.

The MARCOAST services are composed of the following 3 service lines:

- Water Quality Monitoring services including 14 individual service chains which are operated by 14 service providers.
- Water Quality Indicators services including 5 individual service chains which are operated by 5 service providers.
- Ocean Colour data service operated by a unique service provider.

Today, users of water quality parameters are foremost the European and national monitoring agencies. Industries operating in coastal waters, such as aquaculture or oil industry, are also concerned by water quality and some are regular users of water quality information. Brockmann Consult is member of the MARCOAST network and is offering its services through WAQSS, the Water Quality Service System [www.waqss.de]. In OPEC we have built on this work to add new services and products based on the developed indicators from models, and through amending the WAQSS system with processing and distribution capabilities.

The purpose of this document is to present a report on the user services Brockmann Consult GmbH has established within work package 6 of the OPEC project. The work has been completed in order to fulfil the user requirements for a Downstream Service built upon the OPEC core products has been described in document D6.2, "Updated WAQSS". That Downstream Service is an extension of the **Water Quality Service System (WAQSS)**, which is operated by Brockmann Consult GmbH since 2006 in the vicinity of German national waters in both the Baltic and North Seas.

Two strands of work have been conducted: first, the WAQSS processing chains have been migrated to the cluster-based Calvalus<sup>1</sup> system, and second, the OPEC data portal has been adapted, tailored, and put into place for WAQSS users. Both of these tasks have been described in detail in D6.2.

This document deals with the actual usage of the services. After a short description of the downstream services offered by WAQSS in section 3, section 4 describes the provided data. The key section of this document is section 5, which deals with the user feedback on the services. Note that for privacy reasons we have kept the individual users anonymous, but assigned each of them a type.

## 2. Relevance to Policy

A common set of descriptors, with associated indicators to assess the Good Ecological Status (GES) for the Marine Strategy Framework Directive (MSFD), and Essential Climate Variables (ECVs) have been defined across the four OPEC regions (Atlantic, Baltic Sea, Mediterranean Sea and Black Sea). These descriptors are the OPEC target variables. OPEC emphasises the assessment of predictability of these key indicators. The downstream service is dedicated to tailor the core OPEC products to the user requirements so that the products can be easily picked up by the users and integrated into their running systems.

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<sup>1</sup> Full-mission EO cal/val, processing and exploitation services; N. Fomferra, M. Bottcher, M. Zuhlke, C. Brockmann, E. Kwiatkowska; DOI: 10.1109/IGARSS.2012.6352418 In proceeding of: Geoscience and Remote Sensing Symposium (IGARSS), 2012 IEEE International

### 3. The Downstream Services

This section provides a brief overview of the downstream services. Detailed information is to be found in the document [D6.2](#).

The WAQSS System developed within the MARCOAST framework by Brockmann Consult is used as a use case for the OPEC services to provide OPEC products as tailored Downstream Service products to the users. OPEC is adding new products based on indicators developed from models, and the WAQSS system is amended with processing and distribution capabilities.

#### 3.1 The processing system

The purpose of the WAQSS system is to turn raw satellite data into user-tailored regional and temporal subsets, performing specific temporal and spatial aggregations of selected water constituents, and to make these products available to end users in a near-real time manner. This task is tackled with a processing chain, consisting of a set of discrete steps that translates the raw data into information and thus adds value to the data.

Since the demise of ENVISAT in April 2012, the NRT service provided via the WAQSS System is based on the NASA MODIS AQUA instrument.

An important step newly created is the collocation of OPEC data products and satellite data products: now, the WAQSS systematically downloads OPEC data, tailors it according to user wishes in terms of spatial and variable subsets and provides it alongside the satellite data. This allows users to work with both kinds of data simultaneously without having to remove obstacles, such as care for collocation, subsetting or, generally, tailoring the data themselves.

#### 3.2 The portal

The second main challenge in work package 6 is to make the data available to users in a graphical way, so that users are able to easily view data, compare it to other data, and even create statistical plots.

Within the OPEC work package 6, a browser-based data portal has been developed by PML Applications. This data portal serves exactly the tasks described above, tailored for users of OPEC modelled data. Additionally, it has been identified as an ideal basis for a solution for the user requirements described in the above paragraph. Consequently, the portal has been adapted by Brockmann Consult, and is used to allow WAQSS users to interactively work with both the WAQSS satellite data and the OPEC modelled data in the same environment. Figure 2 shows a screenshot of the adapted WAQSS Portal.

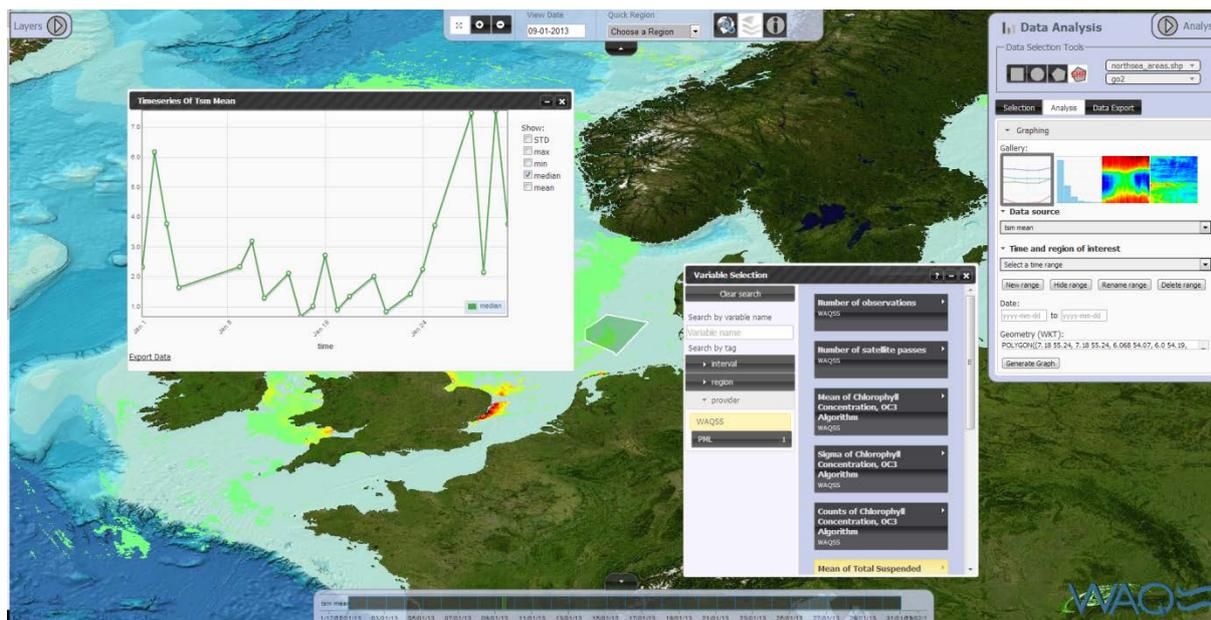


Figure 2 – The WAQSS portal

## 4. Service Data

This section describes the data being served by the WAQS system and the data portal.

### 4.1 Types of data

#### 4.1.1 MODIS

The bulk of the data available via WAQSS has been processed on the basis of MODIS data. The NASA Oceancolour website<sup>2</sup> hosts 5-minute snippets of MODIS satellite data, which are downloaded systematically into the Calvalus system, and processed afterwards. The processing chain is already described in D6.2 in detail; basically, subsets of the L1-data are created, processed to level 2, enriched with special variables, and finally processed to level 3.

##### 4.1.1.1 Resolution

The L3-data has a geographical resolution of 1.2 km/pixel, and three temporal resolutions:

- 1) Monthly means that aggregate all L2 data between the first and the last day of a month
- 2) Weekly means for each day  $d$  that aggregate all L2 data between  $d$  and  $d - 6$ .
- 3) Daily means for each day that aggregate all L2 data of that day.

<sup>2</sup> <http://oceandata.sci.gsfc.nasa.gov/MODISA/L1/>

#### 4.1.1.2 Variables

The L3-data contains the following variables:

Name	Description
<b>num_obs</b>	The number of observations incorporated within the pixel.
<b>num_passes</b>	The number of satellite passes.
<b>CHL_{mean,sigma,counts}</b>	The mean, sigma, and counts of <b>Chlorophyll Concentration</b> within the aggregated L2 data, computed using the OC3 Algorithm.
<b>TSM_{mean,sigma,counts}</b>	The mean, sigma, and counts of <b>Total Suspended Matter</b> within the aggregated L2 data.
<b>SST2_{mean,sigma,counts}</b>	The mean, sigma, and counts of <b>Sea Surface Temperature</b> within the aggregated L2 data.
<b>Kd_490_{mean,sigma,counts}</b>	The mean, sigma, and counts of the <b>Diffuse attenuation coefficient at 490 nm</b> within the aggregated L2 data, computed using the KD2 algorithm.
<b>KdPAR2_{mean,sigma,counts}</b>	The mean, sigma, and counts of the <b>Diffuse attenuation coefficient</b> within the aggregated L2 data.
<b>PAR2_{mean,sigma,counts}</b>	The mean, sigma, and counts of the <b>Photosynthetically Active Radiation</b> within the aggregated L2 data.

#### 4.1.1.3 Projection

All MODIS data is projected onto a geographic lat/lon grid based on the WGS84 datum. The data is computed within the following rectangle, which covers the North and the Baltic Sea:

Minimum Longitude: -15.00°

Minimum Latitude: 47.00°

Maximum Longitude: 31.00°

Maximum Latitude: 66.00°

#### 4.1.2 OPEC

Modelled data that has been created within the OPEC project has been made available via the WAQS system. Thus, users are enabled to work seamlessly with modelled data and satellite-based data within the same environment.

A mechanism has been put into place that systematically downloads, reformats, and stages the data so that always the latest data is made available to users. At the time of writing, the considered data covers the North East Atlantic (in particular, the North Sea), and has been created by PML. In the future, the same mechanism may be put into place for data covering the Baltic Sea, created by DMI.

#### 4.1.2.1.Resolution

The modelled data has a spatial resolution of ~10 km/pixel, and a monthly temporal resolution.

#### Variables

The modelled data contains the following variables:

Name	Description
<b>Chl</b>	Monthly mean of <b>Chlorophyll-a</b> .
<b>Pc</b>	Monthly mean of <b>Phytoplankton C</b> .
<b>netPP</b>	Monthly mean of <b>Net Primary Production</b> .
<b>DIP</b>	Monthly mean of <b>Phosphate</b> .
<b>euphDepth</b>	Monthly mean of <b>Euphotic Depth</b> .
<b>O2</b>	Monthly mean of <b>Oxygen</b> .
<b>Zc</b>	Monthly mean of <b>Zooplankton C</b> .
<b>S</b>	Monthly mean of <b>Salinity</b> .
<b>DIN</b>	Monthly mean of <b>Nitrate</b> .

#### Projection

All modelled data is projected onto a geographic lat/lon grid based on the WGS84 datum. The data is computed within the following rectangle, covering the North East Atlantic Sea:

Minimum Longitude: -15.00°

Minimum Latitude: 47.00°

Maximum Longitude: 13.00°

Maximum Latitude: 64.89°

#### **4.1.3 Future: MERIS archive**

Before the demise of ENVISAT in 2012, WAQSS has been based on MERIS data. Thus, a data archive has been established and PNG images are made available for visual inspection to the users, starting in January 2006 and ending early April 2012. At the time of writing, it is planned to make available these data via the new WAQSS as well, in particular via the portal. However, since the archive does not contain geophysical data, but merely RGB images, a concept has to be carved out how to best present the data.

#### 4.1.3.1 Resolution

The MERIS archive data has a spatial resolution of  $\sim 3.2$  km/pixel, and a running weekly temporal resolution (for each day  $d$  all base data is aggregated between  $d$  and  $d - 6$ ).

#### 4.1.3.2 Variables

The MERIS-based data contains the following variables:

Name	Description
<b>Chl</b>	Weekly mean of <b>Chlorophyll-a</b> .
<b>SST</b>	Weekly mean of <b>Sea Surface Temperature</b> .
<b>TRN</b>	Weekly mean of <b>Water Transparency</b> .
<b>TSM</b>	Weekly mean of <b>Total Suspended Matter</b> .
<b>YS</b>	Weekly mean of <b>Yellow Substance</b> .

#### 4.1.3.3. Projection

The MERIS-based data is projected onto a geographic lat/lon grid based on the WGS84 datum. There are two data sets, the first of which covering the North East Atlantic Sea:

Minimum Longitude:  $-5.00^\circ$

Minimum Latitude:  $49.00^\circ$

Maximum Longitude:  $13.00^\circ$

Maximum Latitude:  $63.00^\circ$

The second data set covers the Baltic Sea:

Minimum Longitude:  $9.00^\circ$

Minimum Latitude:  $53.00^\circ$

Maximum Longitude:  $31.00^\circ$

Maximum Latitude:  $66.00^\circ$

## **4.2 Amount of data**

As of writing of this document, the data archive available via the WAQSS-portal contains the following data:

#### 4.2.1 MODIS data

MODIS data is available for the years 2008, 2012, and 2013 in daily, monthly, and weekly aggregations.

The overall data consumption of this dataset sums up to about 110 GB of data, stored as compressed NetCDF. See the table below for a more detailed breakdown. Note: the large amount of variation is caused by different amounts of data for different years, e.g. in case that a certain month has many cloudy days, only few days will be considered, causing the amount of data to be small. This effect has no influence on the amount of uncompressed data. Further note that the high need of disk space for weekly aggregated files is caused by the number of files (one for each day) with a relatively high number of observations, compared to the daily aggregations.

	1 year of...	
	Compressed NetCDF-data (GB)	Uncompressed NetCDF-data (GB)
<i>daily aggregated</i>	~ 8	200
<i>weekly aggregated</i>	~ 30	200
<i>monthly aggregated</i>	~ 1.4	6.7

#### 4.2.2 Model Data

The model data generated and provided by PML are available as monthly aggregates for the years 2008, 2012, 2013, and 2014.

Due to the relatively coarse spatial resolution, and, most importantly, to the monthly aggregation of data, the modelled data amounts to ~ 8 Megabytes a year. Note that this value is constant, because modelled value does not contain any fill values, as opposed to satellite data.

### 4.3 Performance

As shortly mentioned in section 1, and elaborated in D6.2, processing takes place on the massively parallel Calvalus system.

A year of MODIS is processed from L1A data to L2 data within roughly 4 hours. At least in theory there is room for optimisation, because a great deal of time is spent deciding if the data intersects the desired region, and the bulk of data is not considered for the actual L2 processing. Processing all three types of L3 data from L2 data takes roughly a day of processing time (for one year of data).

Due to the small amount of data, the receiving, tailoring, and staging of OPEC data takes no considerable amount of time, it is done within the magnitude of a few minutes.

## 5. User Feedback

This is the key section of this document, as it contains the actual feedback of users. It is structured as follows: In subsection 5.1, the two different user profiles are briefly outlined. Subsection 5.2

describes the method of how BC has collected user feedback, and, finally, subsection 5.3 compiles the actual user feedback.

## 5.1 User profiles

### 5.1.1 *Institutional well-equipped users and developers*

This class of user is generally interested in the technology behind the product, and capable of both developing techniques and performing scientific analysis on the acquired data. Typically these institutions have national obligations of service provision or such services are an important part of their operations. In turn these users are often themselves service providers; the products they request have therefore to fit in to their running services and systems in order to ensure interoperation. These users are both Core Service as well as Downstream Service Users.

### 5.1.2 *Baseline end users*

This group is rather more interested in using the systems and services than developing them. Typically the baseline end users can integrate the service products to their operations. This means that the users require very specific products dedicated to their running systems. Product integration and use is only possible if the products fulfil their requirements and serve the requested interfaces. These users are typically Downstream Service Users. These are mainly scientists and individual users.

## 5.2 Mode of collecting user feedback

The user feedback has been gathered by creating a dedicated document, which consists of two main parts:

- 1) a step-by-step guide on how to use the data portal
- 2) questions about the services

This document has been sent to all of the users described in the last section, together with dedicated user accounts for the portal. See Annex A for the document.

Find below a list of the blocks of questions that have been asked in the document:

### **Data**

**Please provide a rating of the types of data: Does it cover your needs? What chances or problems do you see by combining satellite and model data in one portal? Are you content with the selection of variables? What do you think of the data quality?**

### **Resolutions**

**Please provide a rating of the resolutions: Do they meet your expectation, or do you need coarser or finer resolutions in spatial or temporal dimension?**

**Graphing**

**The portal offers the capabilities to create four different kinds of plots: Time series, Histogram, Hovmoller (lat/lon). Please provide a rating of these graphing capabilities: Do you miss any plot types? Do you need additional functionality within the plots?**

**Daily work**

**Please describe how you can imagine to use the portal and the data within it in your daily work. In particular, please describe what would block you from using it.**

**Wishes**

**If there are any additional wishes you have, or functionalities you miss, please describe them here.**

**Bugs / Anomalies / Ambiguities**

**Every software has bugs. Have you experienced any when you tried the portal? Additionally, have you found any anomalies within the data?**

**5.3 Feedback**

This section compiles the user feedback from the different partners.

**5.3.1 User A**

This user is an institutional well-equipped user and developer as described in section 5.1.1.

**5.3.1.1 Data**

*The variable selection is ok, although it would be helpful to know a bit more about the quality of the state variables that come from the model but are not in the MODIS data set. It is good to have two different data sets combined to see where they differ and where they correspond, however for my work it would be great if I could combined these two data sets with my own data.*

**5.3.1.2 Resolutions**

*The resolution for MODIS is fine, model data could be on weekly and daily bases.*

**5.3.1.3 Graphing**

*The Plot types are fine, but units are missing either at the y –axis for timeseries plots or at the x-axis for histogram plots. I have not checked the other plots.*

#### 5.3.1.4 Daily work

*I would not use it on a daily base because I cannot quickly compare my own model data with the provided datasets.*

#### 5.3.1.5 Wishes

*I did not succeed in plotting model and satellite data in the same time series plot, although this would be a helpful feature.*

#### 5.3.1.6 Bugs / Anomalies / Ambiguities

*n/a*

### **5.3.2 User B**

This user is a representative of the group of institutional well-equipped user and developers, as described in section 5.1.1.

#### 5.3.2.1 Data

*n/a*

#### 5.3.2.2 Resolutions

*For the Wadden Sea area the different temporal resolutions (monthly, weekly, daily) are convenient, but the spatial resolution is much too coarse (10-30 m/pixel (or better) would be suitable).*

#### 5.3.2.3 Graphing

*I am missing an option to export the graphs.*

#### 5.3.2.4 Daily work

*Maps with classification of tidal flats at different times of the year (particularly with respect to vegetation) could be very useful. Thus it would be very interesting to compare the areas of specific habitats (e.g. mussel beds or seagrass meadows) over the years. A functionality to “play” through all data sets (see below) would be very helpful to illustrate changes. A too coarse resolution would definitely limit the usefulness.*

#### 5.3.2.5 Wishes

*It would be nice to have:*

- *a function where you could automatically “play” through all the available data (the system automatically moves from one time period to the next); maybe with a possibility of saving/exporting such small “videos”.*
- *an option to export the displayed data in an image format.*
- *an option to browse through the layers alphabetically.*

#### 5.3.2.6 Bugs / Anomalies / Ambiguities

*When the Data Layer window is set to “Base Layer” it is not possible to see the “hourglass” (=system is working) when choosing another time period and sometimes it is difficult to know when the new layer has been displayed fully.*

*The graph windows appear to have a fixed size. When a graph is larger scroll bars appear but it is not possible to increase the size of the window to fully display the graph.*

*Trying to create a histogram of SST2 caused the screen to freeze. The “hourglass” was still active, but generation of the graph could not be stopped (not even by logging out).*

### **5.3.3 User C**

This user is a baseline end user, according to section 5.1.2

#### 5.3.3.1 Data

*MODIS-based water constituents could be of interest for surveys and data/information collection in the open Baltic. The resolution in the coastal zone is too coarse for most applications. My experience in the OC3 algorithm is limited and validation of the algorithm would be needed (or summarized from literature) before the data could be of use for Swedish end users. There are no model-based data in BS, but the combination is appealing. Modelled results are in general more (too) homogeneous, but could help in understanding the general trends in a specific area. RS data could either be a very good representation of the general trend, if a sufficient amount of cloud free/valid data is available, or sometimes too heterogeneous (“good weather weighted” etc) if too few observations is registered per month. The combination of Remote Sensing (RS) and modelled data is helpful in the interpretation of the data and identification of extremes and outliers. The “quality” of the RS data (monthly) is in general related to the number of observations. Too few observations most likely create the noisy pattern, which usually affects the perceived quality.*

*As an “expert user” I would like to have a general overview of the processing chain of the RS data as well as a brief description to the modelled data, such as input, time step, forcing parameters etc, either as a short text in help or links to relevant documents. I know RS data, but to me modelled data would be useless without information about production and included variables.*

#### 5.3.3.2 Resolutions

*As mentioned above the resolution in the coastal zone is too coarse for most applications, but useful for open Baltic Sea. Regarding the temporal resolution, there will always be user specific requests that go beyond the calendar, but in general monthly/weekly/daily data is very good! Monthly OPEC*

*data sounds reasonable, but depends on the estimated accuracy of the model and the input data on which the results are based.*

#### 5.3.3.3 Graphing

*I can't think of any more plot types at the moment, but it is always useful to be able to plot more than one variable at the time, but not necessary as you proved the possibility to export data too. But yes, OC3 chlorophyll plotted together with modelled chlorophyll would be nice.*

*Is there an alternative naming convention? When working in the "Data analysis" I did not remember if "CHL mean" was modelled or RS and vice versa. This is a very small problem, but it would make the analysis and export smoother if there are products of the same type from two sources.*

#### 5.3.3.4 Daily work

*I would most likely find the portal very useful in my daily work in order to gain general knowledge about data availability, general trends and identification of extreme situations like bloom events and other outliers. Adding MERIS data would increase the usefulness. As a visualisation tool I think it fulfils its task.*

#### 5.3.3.5 Wishes

*I wanted to look at Chl mean and Num Obs at the same time and switching between these changed the view area, so I had to scroll in all the time. I would have preferred to keep the view, while exploring different products in the chosen ROI.*

*I would prefer coloured pixels even if they are out of range with respect to the legend. Black means "no data" to me.*

*Regarding data export, I obviously needed additional information on how to open the exported data.*

#### 5.3.3.6 Bugs / Anomalies / Ambiguities

1. *See above regarding shift of zoom level.*
2. *See above regarding max colour = black.*

### **5.3.4 User D**

This user is a baseline end user as described in section 5.1.2.

#### 5.3.4.1 Data

*The quality can hardly be assessed in terms of a validation.*

*The quality in terms of performance is quite good. I realized that, after a new date is chosen using the time slider, the new dataset is "built" behind the old one. When the dataset is loaded completely, the old one - overlaying the new one - will disappear. I would appreciate the new built in front of the old one to watch changes more distinctly.*

#### 5.3.4.2 Resolutions

*A coarser resolution makes sense, if e. g. official regions like water framework directive regions can be considered. Do I understand correctly, that these can be uploaded as a shapefile and then provide a basis to calculate regional means for a certain date as well as for a time period? This sounds great and should be used as a showcase example for presentations to users!*

#### 5.3.4.3 Graphing

*My favourite plots are:*

1. *TS plot*
2. *Histogram plot*
3. *"Hovmoller" plot using lat or lon instead of the time as an axis*

*A useful plot type could show differences in order to compare changes between layers. Maybe this function should be included as a "Calculated layer" rather than shown in a separate layer.*

#### 5.3.4.4 Daily work

*Calculate regional and temporal statistics for my areas of interest.*

#### 5.3.4.5 Wishes

- *See plot functions above*
- *Animations showing the changes over time*
- *Plots along a transect*

#### Additional comments regarding usability

*The portal should start up with the variable window closed as long as a login is required.*

1. *I would prefer a combobox providing all available parameter/variables.*
2. *If the textbox is empty, all results should be listed, i. e. the search result is not limited at all.*
3. *Ecosystem element: Should all CHL datasets have the same element, i. e. Phytoplankton? At the moment it only refers to "Chlorophyll-a, month mean, PML".*
4. *Interval: Not sure whether we should exclude Baltic Sea from North Atlantic. At the moment the selection of North Atlantic covers the Baltic datasets as well.*
5. *Source: I would group the sources by Model and EO first/only. Selecting no element within this search category results in the same search result like selection of all elements, which is not intuitive. Maybe, this behavior makes sense, if you understand the search elements rather as filters than as elements, which you select (e. g. by a checkbox). Please check all other categories regarding the suitability of this behavior. I am not sure, whether there is one solution that suits all categories.*
6. *General: Does the order of selected items play any role? If not, I would recommend to retain the initial order.*

7. *Scalebar: to open the scalebar window I hide a layer and activate it again. This method seems a bit odd, especially since the map zooms to full extent afterwards.*

## 6. Summary and outlook

The overall impression is that the users in general are quite keen to work with the data, although there are very diverse requirements in terms of spatial and temporal resolutions. The data can, of course, not serve all requests equally, so a compromise has been found. Regarding the visualisation portal, the users seem quite happy, which is proven by the number of wishes they have and the pretty positive feedback in the “Daily Work”-chapters. Nevertheless, a number of bugs and incommodities have been identified and reported.

The users have a number of wishes, most prominently they want to have a playback function for time series in order to improve the visual experience, and generally export functions. Anyway, export of the data is a delicate matter and needs to be tuned thoroughly in order to not allow general export of specially processed data.

In the future, we plan to further fill the data archive by legacy MODIS data and legacy MERIS data. Additionally, we may add more variables created in the OPEC project. Minor look-and-feel updates will be done, and, if resources allow, maybe we will add the timeseries playback function because it has been asked for multiple times.

## 7. Annex I – User Feedback Template

### Introduction

#### 7.1.1 WAQSS

The Water Quality Service System (WAQSS) is a bespoke downstream service product developed in 2006 by Brockmann Consult (BC) in order to provide value-added and tailored satellite data to users.

#### 7.1.2 OPEC

The OPEC project (Operational Ecology) helps developing and evaluating 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 focusses on four European regional seas (North-East Atlantic, Baltic, Mediterranean and Black Seas) and plans to implement a prototype ecological Marine Forecast System, which includes hydrodynamics, lower and higher trophic levels (plankton to fish) and biological data assimilation.

#### 7.1.3 WAQSS within the OPEC project

A key challenge within the OPEC project has been to extend the WAQS system to include model data allowing access to two important data sources. The goal is to combine modelled and satellite data within the same work environment in a transparent and easy manner, in order to provide added value to those working with these data.

Within the context of the OPEC project, an open source GIS data portal has been created. This data portal has been adopted and customized by BC in order to include the satellite products made available to users through the WAQSS system. Thus, a working environment providing access to satellite and model-based data has been put in place.

## 8. Scope

The overall goals of this document are to present the WAQSS data portal to WAQSS users, and to provide a template for user feedback.

In section 3, some guidelines are provided on how to use the portal. Section 0 provides a short list of future changes BC plans to the portal and its data content. Section 5 finally contains the template for creating user feedback.

## 9. How to use the portal

This section provides a short overview on the main use cases that can be performed with the data portal, in a typical step-by-step manner. While the first 9 steps are visible for the public, the steps 10 – 16 are only possible for authorized users and respective login.

<p><b>1</b> Visit <a href="http://portal.waqss.de">portal.waqss.de</a> with your browser</p>	<p><b>You see disclaimer and Acknowledgement information. Please read.</b></p>
<p><b>2</b> Close the disclaimer overlay window.</p>	<p>You see a world map, and an opened overlay window with the caption „Variable Selection“.</p>
<p><b>3</b> Login: click the button on the top bar showing a person, and in the window that opens, click the „Log in “. Log in with the credentials sent to you via e-mail, and click „Continue“. Click again on the person-logo on the top in order to make the overlay disappear.</p>	<p>You are logged in now; this means you have access to restricted data and restricted analyse methods.</p>
<p><b>4</b> Take a look at the „Variable Selection“-window: its left hand side has been filled with a number of available tags, which indicates that you now have access to variables.</p>	
<p><b>5</b> Open the region category by clicking on the „region“-button.</p>	<p>Those regions are listed that contain accessible data: Baltic Sea and North Atlantic.</p>
<p><b>6</b> Click on the „N. Atlantic“-button.</p>	<p>The accessible variables in the North Sea area are listed on the right.</p>
<p><b>11</b> Open the „interval“ dropdown, and choose „monthly“.</p>	<p>The list of variables on the right hand side narrows down to monthly aggregated variables available in the North Sea.</p>
<p><b>12</b> Enter “chlorophyll” in the text box at the top of the left hand side panel.</p>	<p>While typing, the list of variables on the right hand side narrows down to monthly aggregated variables available in the North Sea that match the name you are entering. There should now be three variables left: Mean, Sigma, and Counts of Chlorophyll.</p>
<p><b>13</b> Select the „Mean of Chlorophyll ...“-button.</p>	<p>The map zooms to the North Sea and shows the Chlorophyll distribution at the date indicated by the “View Date” at the top of the map.</p>
<p><b>14</b></p>	<p>Note: all selected parameters and selections are highlighted in yellow. If you want to de-</p>

		select an option, click it again.
<b>15</b>	Choose a different view date: either you click inside the time range bar at the bottom, or use the „View Date“-field at the top.	The chlorophyll data on the map changes accordingly.
<b>16</b>	Choose a different base layer: at the upper left, the overlay window „Data Layers“ should be open. If not, open it with a click on „Layers“. Choose „Base Layer“, and change the value in the drop down from „GEBCO“ to „Metacarta Basic“	The base layer changes.
<b>17</b>	Control the visibility of the layers: On the upper left, click „Models“, and uncheck the “CHL_mean” checkbox.	The chlorophyll data layer disappears.
<b>18</b>	Check the checkbox again to make the layer visible again.	The chlorophyll data layer re-appears.
<b>19</b>	Start with analysing your data: Close the scalebar and the „Variable Selection“-windows in order to see the full screen. Open the analysis-panel by clicking on „Analysis“ at the top right.	The „Data Analysis“-panel is shown.
<b>20</b>	Create a time series plot: choose the leftmost plot type, and choose „CHL_mean“ as data source. Then create a new time range by clicking on the „New range“-button and draw the range on the time bar at the bottom. Finally, select a region by drawing a geometry onto the map by using the buttons at the top of the „Data Analysis“-panel. Then click „Generate Graph“.	After a short computation time, a time series graph is shown.
<b>21</b>	Analysing your own regions by uploading a shapefile: Click on the „SHP“-button on the top of the „Data Analysis“-Panel. The dropdown to the right, displaying „No shapefile“, is activated. Click it and choose „Upload ESRI shapefile“. Choose a shapefile and upload all files that belong to it at once (mark not only the .shp file, but also the .dbf, prj., ...). Select the uploaded shapefile from the upper drop down, and select a region from the lower one.	The shape of the chosen region is painted on the map.
<b>22</b>	Create a histogram for the selected region: Switch to the „Histogram“ plot type, and click „Generate Graph“.	A histogram plot is shown for the chosen region, data source and time range.

## 10. Outlook

Although the portal can be considered operational, there is still room for improvements. Find below a short list of issues we will address in the future:

- Incorporate the user feedback
- Add more data, for example add processed MODIS data in NRT

- Add possibility to draw transects
- Add the possibility to use an empty base layer
- Improve the overall usability

Additionally, BC plans to make available the MERIS-WAQSS archive via the portal. The data within the archive are available as images only, in difference to the MODIS-based data and the OPEC-model data. This implies specific changes within the portal code.

## 11. User Feedback Template

**The portal contains two types of data:**

- MODIS-based water constituents
- Model-based data generated in the OPEC project

**Please provide a rating of the types of data: Does it cover your needs? What chances or problems do you see by combining satellite and model data in one portal? Are you content with the selection of variables? What do you think of the data quality?**

*<Please provide an estimation of the data quality according to the questions above>*

**The data is provided in multiple temporal and spatial resolutions:**

- MODIS-based data: monthly/weekly/daily means, ~ 1.2 km/pixel
- OPEC data: monthly, ~ 10 km/pixel

**Please provide a rating of the resolutions: Does it meet your expectation, or do you need coarser or finer resolutions in spatial or temporal dimension?**

*<Please insert here your rating of the offered resolutions according to the questions above>*

**The portal offers the capabilities to create four different kinds of plots: Time series, Histogram, Hovmoller (lat/lon). Please provide a rating of these graphing capabilities: Do you miss any plot types? Do you need additional functionality within the plots?**

*<Please insert here your rating of the offered graphing capabilities according to the questions above>*

**Please describe how you can imagine to use the portal and the data within it in your daily work. In particular, please describe what would block you from using it.**

*<Please insert here your description of how you would use the portal and its data >*

**If there are any additional wishes you have, or functionalities you miss, please describe them here.**

*<Please insert here your additional wishes and missing functionalities>*

**Every software has bugs. Have you experienced any when you tried the portal? Additionally, have you found any anomalies within the data?**

*<Please insert here any bugs and data anomalies you have experienced>*