

Operational ECology

Ecosystem forecast products to enhance marine GMES applications

DG SPACE

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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

Content

Purpose and Scope 4

Relevance to Policy..... 4

The Downstream Services 4

 Introduction..... 4

 The processing system 5

 The portal 6

Outlook..... 7

Purpose and Scope

The purpose of this document is to present and list the work that has been done in order to fulfil the user requirements for a Downstream Service built upon the OPEC core products. This Downstream Service is an extension of the **Water Quality Service System (WAQSS)**, which has been operated by Brockmann Consult GmbH since 2006.

In order to identify user requirements, a survey of end users of the WAQSS was conducted. Its results have been compiled in the document [D6.1](#), the Report on Downstream user requirements. Based on this report, basically two lines of work has been conducted: first, the WAQSS processing chains have been migrated to the cluster-based Calvalus¹ system, and second, the OPEC data portal has been adapted and put into place for WAQSS users. Both of these tasks are described below.

Note that the actual deliverable is the upgraded Downstream Service, while this document serves as a short overview of the work that has been done.

Relevance to Policy

A common set of descriptors, with associated indicators to assess the Good Environmental Status (GES) for the Marine Strategy Framework Directive (MSFD), and Essential Climate Variables (ECVs) have been defined across the four OPEC regions (North East 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.

The Downstream Services

This section provides an overview of the background of the downstream services, and it describes the technical implementation of these services.

Introduction

The primary goal of OPEC is to improve the quality of operational services for biogeochemical and ecological parameters and hence our ability to project the future status of European marine ecosystems by delivering a suite of error quantified indicators which describe changes in ecosystem function suitable for implementation in operational centres, such as chlorophyll concentration, total suspended matter, or salinity.

The GMES Marine Core Service (MCS) is intentionally serving large institutional users and intermediate users (i.e. service providers) only. The service to regional, national and local monitoring agencies, industry and other market segments, as well as the public with their very specific user requirements is performed within the GMES Downstream Services, which are currently developed and consolidated in a number of EU and ESA/GSE funded initiatives. One of them is the MARCOAST

¹ 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

Network of Marine Service Providers (<http://gmes-marcoast.com>) which delivers satellite-based services in the field of marine and coastal applications. The MARCOAST project focused on a sustainable service market, based on real user demands and implemented by fostering commercial activities driven and controlled by end users. Furthermore, in different FP7 Downstream projects, dedicated services for e.g. inland waters (Freshmon; <http://www.freshmon.eu/>), for high biomass algal blooms predictions (CoBiOS; <http://www.cobios.eu/>), or the development of forecasting capabilities to warn of impending harmful algal blooms (HABs) (Asimuth; <http://www.asimuth.eu>) are developed. 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.

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.

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 add 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. In order to serve the users with tailored products, the following steps need to be performed:

- 1) Acquire the data from NASA servers and make it available to the processing system
- 2) Acquire auxiliary data from NASA servers
- 3) Create a spatial subset of the satellite data
- 4) Run a number of scientific algorithms that are part of the NASA SeaDAS software for retrieving water leaving reflectance and in water constituents such as chlorophyll concentration
- 5) Create quick looks (for later Quality Control)
- 6) Aggregate the output of step 4) in order to create daily, weekly, and monthly products
- 7) Stage the data, i.e. make it available to the users via FTP

Until now, these steps have been implemented by Python scripts on a virtual machine running at Brockmann Consult. These scripts form what is known by users as ‘the WAQSS’. However, the service is cumbersome to maintain, and lacks performance.

The solution for both of these drawbacks is to move the service to Brockmann Consult’s Calvalus service, a massively parallel processing system. This migration has been one of the two key challenges undertaken in work package 6.

As a result, the system has been completely migrated. All steps listed above have been migrated from Python scripts into Calvalus tasks, and the production of user-tailored data is up and running. For example, applying all the steps listed above to a month of global MODIS data (about 4000 data products worth) takes less than 2.5 hours now due to the massive parallelisation. See Figure 1 for an

example of how operators can monitor the state of the processing – here, a full month of MODIS data (June 2013) is being processed.

Job Overview			
Job Name:	WAQSS MODIS L2 2013-06		
State:	RUNNING		
Uberized:	false		
Started:	Thu Sep 25 16:30:02 CEST 2014		
Elapsed:	1hrs, 8mins, 25sec		

ApplicationMaster			
Attempt Number	Start Time	Node	Logs
1	Thu Sep 25 16:29:59 CEST 2014	node43.bc.local:8042	logs

Task Type	Progress	Total	Pending	Running	Complete
Map	<input type="text" value="3507"/>	3507	294	217	2996
Reduce	<input type="text" value="0"/>	0	0	0	0

Attempt Type	New	Running	Failed	Killed	Successful
Maps	294	217	0	0	2996
Reduces	0	0	0	0	0

Figure 1 – Screenshot of Calvalus portal

Additionally, a few more steps have been added in order to increase the value of the data for the users. For example, files that have been corrupted during download from NASA servers are now sorted out and re-downloaded automatically, which increases the data coverage as well as the general quality. Thus, the management of the processing itself as well as the monitoring of the processing has been transferred to a much more user friendly system.

An important step newly created is the collocation of OPEC data products and satellite data products: now, the WAQSS systematically downloads OPEC data from the OPEC data portal (<http://portal.marineopec.eu/>), 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, sub-setting or, generally, tailoring the data themselves.

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 (www.portal.marineopec.eu) has been developed by PML Applications and is described in D6.3. This data portal serves exactly the tasks described above, tailored for users of the OPEC modelled data. Additionally, it has been identified as an ideal basis for a solution for delivering the user requirements described in the above paragraph. Consequently, the PML Applications 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. It should be noted that the version of the portal used in the WAQSS differs from the final version reported in D6.3. This is due to further develop of the OPEC portal user experience after the milestone for transference of the code to start development of the WAQSS was complete.

In order to fulfil the user requirements, we added some functionality to the portal, and did some tailoring. Examples:

- 1) The original portal already allowed creating plots on a user-specified rectangular area for a user-specified time range. This functionality has been extended, so that users now can also draw circles and arbitrary polygons, and even upload ESRI shapefiles in order to apply a far more specific and advanced selection of regions.
- 2) The original portal already featured a basic interface to OpenID in order to allow users to log in and save their state of work. This feature has been extended in the way that it is now possible to limit data access, and even portal actions to specific user groups. For example, guest users are not allowed to upload shapefiles, or to view daily WAQSS data.
- 3) The look-and-feel of the original portal has been adapted, so that the WAQSS portal resembles the original WAQSS webpage at <http://www.waqss.de>.

The portal has been set up, and can be visited at <http://portal.waqss.de>. Note that access to data is user-restricted, so without logging in, no WAQSS data are available. For handling user accounts, a dedicated LDAP-server has been set up. User accounts for WAQSS users have been created. See Figure 2 on the next page for a screenshot of the WAQSS portal.

As of writing of this document, the portal is up and running, and is subsequently being filled with data. Currently, the first month of daily aggregated MODIS data is available in the portal, and later months will be added systematically. Likewise, the 2013 chlorophyll data created by PML for the NE Atlantic REA (WP3) has been made available within the portal, and more variables and years will follow subsequently.

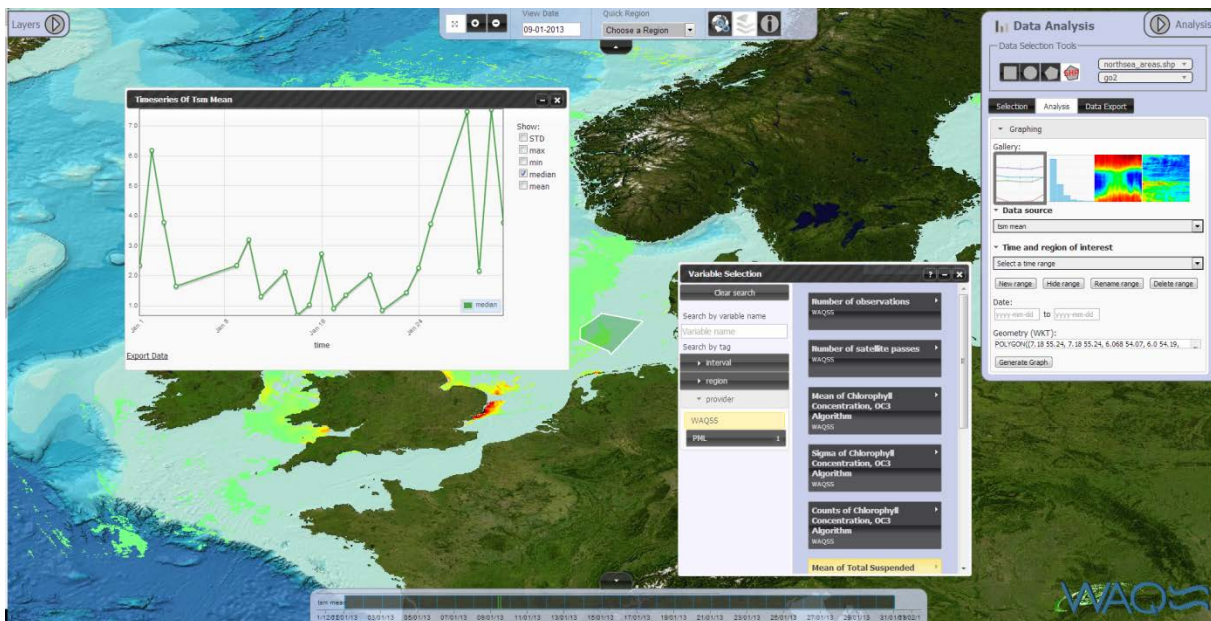


Figure 2 – The WAQSS portal

Outlook

At the time of writing this document, there are still some minor outstanding tasks in the backend of the WAQSS. The data is fine, and it is already possible to perform the complete processing chain, starting at a raw MODIS satellite data product and ending at, for example, a time series plot within the portal. However, not all processing steps already run in an automated fashion; the most important of these steps is the data staging step, which copies the final products from the processing

system to the portal server. In order to render the service operational, these remaining steps need to be automated, which will be completed by November 2014.

Nevertheless, since data is already available, both the data products output by WAQSS and the portal will be made available to core users. These users will be asked for their experiences using the service and the data, and, if feasible, user wishes will be incorporated. Lastly, the user feedback will be collected and compiled in Deliverable D6.4, the report on service delivery.