An open surface Water Quality Emergency Monitoring Service (WQeMS) for the water utilities' industry leveraging on the Copernicus products and services. Target is an optimized use of resources by gaining access to frequently acquired, wide covering and locally accurate water-status information.

Newsletter IV

Copernicus Services Evolution

Ioannis Manakos, project coordinator
(on behalf of the consortium)

This project has received funding from the European Union's Horizon 2020
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Contents

Highlight:

7 July 2022: WQeMS Information Day for the local stakeholders and involved bodies in Thessaloniki-Greece, organized by EYATH & CERTH. Local involved bodies, PPC, GOEB, AUTH and EKBY, as well as special guests from EYDAP, EDEYA, DEYA, & the consortium "Intrakat - Goliopoulos".

Editorial

Dear Reader,

we kindly welcome you to get acquainted with a Copernicus Service Evolution project within the Research and Innovation Action program of the H2020 framework. Being part of the cluster of projects for Space Research by the European Commission our working team is honoured to inform you about the Copernicus Assisted Lake Water Quality Emergency Monitoring Service (WQeMS).

In this issue, you may enjoy interesting articles about the evolution of WQeMS service components, their results in the pilot areas and the benefits offered for the user/end user.

Follow us at our social media accounts and visit our website for more information: https://wqems.eu/.

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WQeMS Services Evolution

The following WQeMS core services can be used to provide added value support to Decision Support Systems of the water utilities:

1. Water quality features changes;

2. Bloom Events Detection;

3. Extreme events detection;

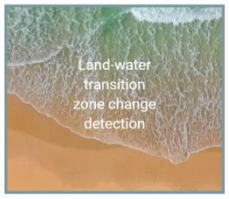
4. Land-water transition zone change detection;

5. Alerting through reporting and crowdsourcing;

6. Capacity building through the provision of training material and tools.

In the previous volume (Newsletter 3) the services were presented, which are directly related with increment of substances dissolution/ concentration in the water (1., 2., 3.) and their scope.

In this volume we are presenting the evolution of the rest service components (4., 5., 6.), their results in the pilot areas and the benefits deriving for the users (e.g. water utilities) and the end users (e.g. citizens).



Land-water transition zone change detection

Service description:

Water level fluctuations influence the presence and concentration of solid material and substances in the water. In case the water is flooding additional land areas, pollutants or other substances can potentially be introduced in the water reservoirs, requiring immediate assessment and follow-up actions. In case water retreats, because of over-abstraction or evaporation, the concentration of dissolved substances may increase possibly over certain limits. Moreover, a great decrease in water level can have an impact on the inflow or speed of water in the water utilities infrastructure. For the aforementioned reasons, it is beneficial for the water utilities to be able to detect, map and investigate all these incidents. This will further support the decision-making process regarding the water quality monitoring.

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The Land Water Transition Zone Change Detection (LWTZCD) service exploits earth observation data from the Copernicus mission (Sentinel-2 and Sentinel-1), to capture the variabilities in land/ water cover in open surface water reservoirs. ONDA DIAS provider and computation resources will be exploited for the access to the satellite data and the execution of the processing chains.

Relevant pilot use cases are provided by the open surface water reservoirs of Polyphytos in Greece and Giaretta in Italy. Leveraging the WaterMask [1] and Hydroperiod modules, developed in the Horizon 2020 ECOPOTENTIAL project, the LWTZCD service will provide maps with a spatial resolution of 10m, which indicate (i) the transition zones from land to water and vice versa for two instances in time, and (ii) the total number of inundation days per pixel through a given time. The user will be able to submit a request for a specific product through the WQeMS platform.

To enhance the temporal frequency, two modes will be offered at each case: One which uses information solely generated by multispectral data (e.g. Sentinel-2), and a second which uses a fusion approach [2] based on multispectral and Synthetic Aperture Radar (SAR) data (e.g. Sentinel-2 and Sentinel-1). Especially, for the hydroperiod estimation an adequate number of available products (e.g. every 15 days) is required to achieve an acceptable accuracy. Thus, in case of periods with persistent cloud cover, the lack of optical data makes the use of the Radar ones necessary.

Service results:

To validate the inundation maps for the Polyphytos pilot use case, Google Earth Images were used as reference layers (in combination with the bathymetry map, EYATH observations, and spot wise Very High Resolution imagery {<1m^2}). Their acquisition date coincides with the ones of Sentinel-2. In total, 10 different layers were utilized for the products

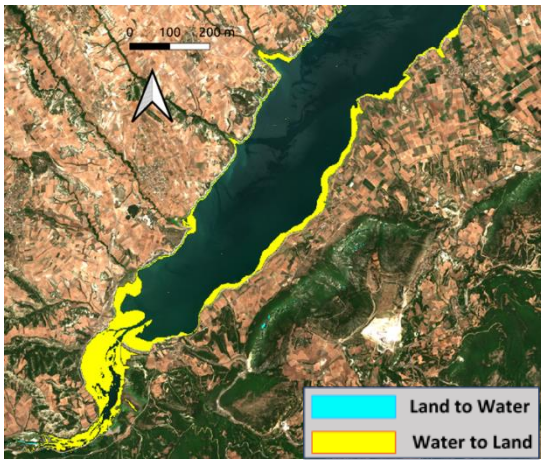

Figure 1: Rymnio Region in Polyphytos. Transition zone between 07-07-2021 and 31-08-2021.

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validation. An overall accuracy of ≥ 98% was achieved. To detect the variabilities in the water extent for two instances in time, inundation maps are generated for each date. For example, in Figure 1 and 2, the land/ cover transition is presented between the dates 07-07-2021 and 31-08-2021, and 21-10-2017 and 05-12-2017, respectively. Precisely, the areas

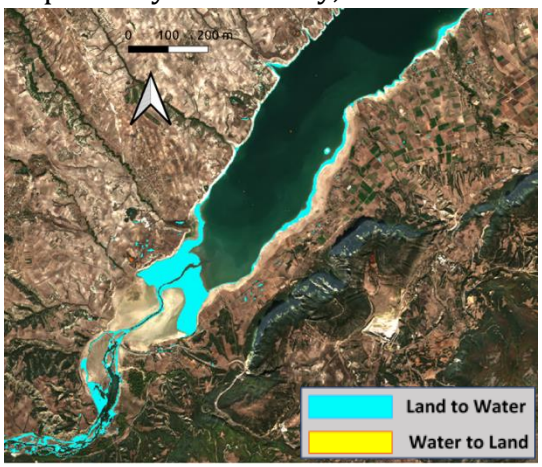

Figure 2: Rymnio Region in Polyphytos. Transition zone between 21-10-2017 and 05-12-2017.

where water has retreated are depicted with yellow color, whereas the flooded areas are highlighted with light blue color.

Gain for the user:

Evaporation, over-utilization from the primary and secondary sectors, or flooding over new areas may affect considerably water quality and quantity. The LWTZCD service facilitates evidence-based monitoring for temporal and spatial impacts. Water utilities will benefit from a frequent and wide area covering (water reservoirs' system) registration of the water extent (indirectly linked with the water volume) to capture seasonal changes and adapt exploitation and management measures.

Alerting module (Reporting & Crowdsourcing)

Service description:

WQeMS aims to explore the utilization of the widely used social media to obtain crowdsourced data that are relevant to water quality. Thus, enhance awareness with a novel source of information. To this end, WQeMS provides three related service components:

- First, the Social Media Crawler establishes an open connection to Twitter and collects in real time tweets

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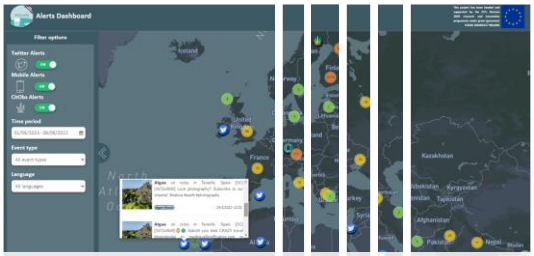
based on user-defined keywords and certain accounts.

- Secondly, the Crowdsourcing Android Mobile App offers an intuitive way for its users to report water-related issues. They can fill in a simple form to define the description and the location of the water issue and possibly attach/take an associated photo.

- Finally, the Alerting Module monitors the posts collected by the Social Media Crawler and the complaints submitted by the Crowdsourcing Mobile App and produces alerts, when a significant number of tweets/complaints accumulates in a certain time range and in a specific geographic region.

Service results:

The Alerting Module comes along with the Alerts Dashboard, a friendly Web interface that visualizes the generated crowdsourced alerts on a map and offers filtering capabilities.

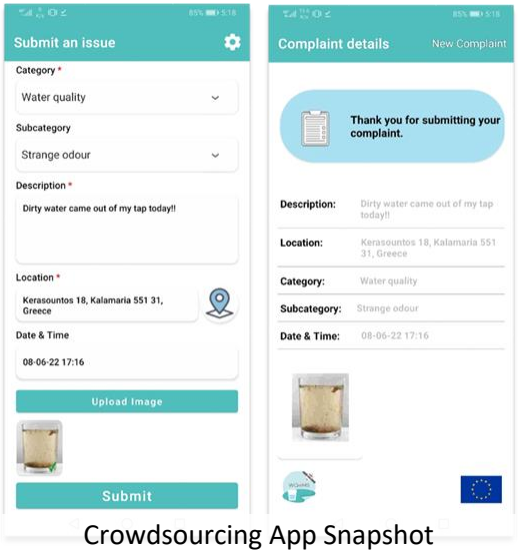


Alerts Dashboard Snapshot

Gain for the user:

With the utilization of WQeMS's Alerting Module the water utility operators will be provided with timely, crowdsourced alerts of potential water issues that need to be investigated. If they already take into consideration the social media as a complementary information source to their traditional means, the Social Media Crawler will save them time (automatic retrieval of relevant posts instead of manual search) and offer better coverage (every single tweet that matches the search criteria is collected).

WQeMS' Crowdsourcing Mobile App enables the direct communication between water utilities and citizens. It facilitates citizens to post water-related reports/ complaints through their smartphone and water utilities to efficiently receive and handle them.



Crowdsourcing App Snapshot

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Instead of a possibly lengthy conversation on the phone, the water operator will instantly have the complete necessary details as posted via the app. Thus, the water company will save human resources (operators that have to answer the calls) and, at the same time, improve its image, since they will facilitate water consumers to submit their reports/ complaints.

Overall, the adoption of the Alerting Module opens a new channel of incoming information that enhances the situational awareness related to water quality issues. Human sensing is already a game changer in natural disaster management and its value can be transferred to a different domain, such as water safety and security. As society evolves and social media are an integral part of it, water utilities should also evolve and consider them as a tool for the benefit of their operation and customers.

User training

Service description:

The innovation process starts and ends with the users' involvement, the expression of their needs and subsequently the validation of the developed technologies within the identified business/use-cases. The systematic increment of understanding about the WQeMS services is of vital importance in the project's innovation process. The objective is for water professionals and water utilities to acquire the necessary skills and competencies related to the operation and content interpretation of the developed WQeMS services. At the same time, the correct and sustainable operation of the WQeMS platform will facilitate the long-term benefit to the water consumers, who will enjoy the basic right for high water quality.

Service results:

As part of the user training process, in May 2022 we have released an online survey aiming to collect feedback from the end-users and stakeholders of the WQeMS services about their potential training needs.

The survey can be accessed at: https://phoebeinnovations.com/survey/start/wqems-project-wqems-training-needs-users-survey-6 and will remain open until end of September 2022.

The survey targets professionals and organizations working with inland water, e.g., water utilities, water operators, regional/national water development authorities, policy makers, water-related emergency

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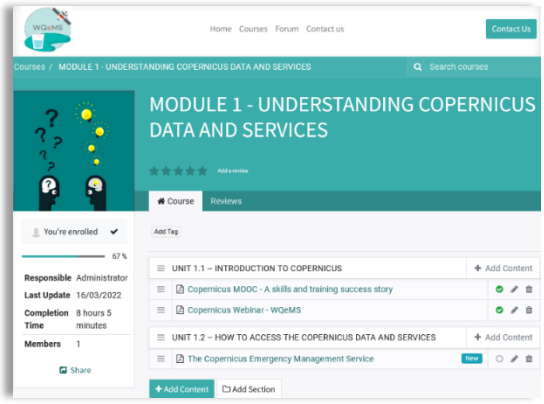
response units, etc. The analysis and consideration of the received feedback will facilitate the creation of appropriate and useful training material, towards the effective adoption of the WQeMS services.

Gain for the user:

At its completion, the User Training task will produce:

- A Training Curriculum, with clear indication of skills/competences to be pursued and a collection of learning objects (textual, videos, gaming tools, etc.) to facilitate the delivery of the training.
- A Training Handbook, to act as a guide for the training and transferring of knowledge to the WQeMS users and stakeholders.
- An eLearning environment to host the learning material and facilitate the access to it



Participation in Conferences:

1) International Geoscience and Remote Sensing Symposium (IGARSS) 2022, 21st of July, in Malaysia, with an oral presentation: 'A temporal deep convolutional neural network model on sentinel-1 image time series for pixel-wise flood classification". Session TH1.O2 "Change Detection and Multi-Temporal Analysis'. Prepared by K. Vlachos, A. Moumtzidou, I. Gialampoukidis, S. Vrochidis, I. Kompatsiaris, (CERTH).
2) SIL 100, 36th Congress of the International Society of Limnology, 7-10 August 2002. WQeMS was presented in 2 oral presentations for the session 'The next 100 years of inland water sensing – combining remote sensing, in situ data and modelling': a) 'Techniques and applications for Cyanobacteria and Phytoplankton monitoring at high spatio-temporal resolution using multiple satellite sensors' by K. Schenk (EOMAP) and b) 'Digital applications to access and integrate operational freshwater monitoring from space at highest spatio-temporal scale' by T. Heege, K. Schenk, M. Siegmann (EOMAP).

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