ASSISTING FIRST RESPONDERS IN WATER-BORNE HAZARDS IN NORTHERN GREECE THROUGH PATHOCERT SOLUTIONS

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ABSTRACT

As water is a valuable and indispensable ingredient of life, drinking water's safety is extremely important both for ensuring consumers' health and for the proper functioning of the ecosystem. The implementation of new technologies aiming to ensure that water quality and monitoring in water utilities lies in compliance with current EU and national standards, prove very promising for enhancing risk assessment processes and management of water supply systems. The overall objective of the PathoCERT project is to strengthen the coordination capability of the first responders in handling waterborne pathogen contamination events, allowing the rapid and accurate detection of pathogens, improving their situational awareness and their ability to control and mitigate emergency situations involving waterborne pathogens. The developed methodologies involve the processing of a vast amount of data of different sources; PathoSAT collects data and images from satellites, analyse them to identify water contaminations and their extent and relays them to PathoCERT's platform. PathoTWEET analyses data and photos from social media to assess the occurrence, severity and extent of water contamination events. To align PathoCERT's various components with the needs of the first responders, three Community of Practice (CoP) meetings were organized, where the scenarios are formed based on the usability of the presented technologies.

Keywords: PathoSAT, PathoTWEET, water-borne hazards, satellite view, citizen observations, Chlorophyll-a

1. INTRODUCTION

In Greece, emergency management on earthquakes, floods, fires and industrial accidents, is organized in a top-down approach. Preventive activities include risk assessments as well as communication of these risks and strategies. Preparedness activities revolve around conducting trainings and emergency drills as well as developing the operating procedures. In the response stage, all relevant actors are coordinated and the set plans are implemented. The recovery stage focuses on set of actions aiming at restoring affected sites to the status quo prior to the emergency event. This top-down planning is further complemented by regional and local organizations plans and strategies. The Greek scenario underpinning the pilot activities is located in Thessaloniki and the implementers are the Hellenic Rescue Team (HRT) and the Thessaloniki Water Supply & Sewerage Co S.A. (EYATH), with the support of the Centre for Research and Technology Hellas (CERTH) that is delivering state-of-the-art research in Artificial Intelligence. The Greek scenario and pilot activities focus on the management of contamination incidents, due to severe flooding phenomena that occur in the open flow river channel that transports water to the

Thessaloniki Drinking Water Treatment Plan, as well as in the delta of Axios river where Search and Rescue activities must take place. The performance and impact of the developed tools for pathogen monitoring, threat assessment and incident management will be studied. Accordingly, CERTH's PathoSAT and PathoTWEET technologies will be tested, while the stakeholder engagement and has already started offering continuous feedback to the technology providers through the Communities of Practice (CoP).

2. COMMUNITY OF PRACTICE TO SUPPORT FIRST RESPONDER TEAMS

A set of three CoP meetings have been organized in Thessaloniki thus far: one in June 2021, one in January 2022 and one in June 2022. Due to the increasing number of COVID-19 cases in Greece the first two meetings were held online to comply with health regulations and ensure the well-being of the participants. The external stakeholders covered a wide range of expertise and responsibilities with deep knowledge on the existing protocols, measures and emergency plans. Organizations such as Regional Civil Protection Departments, Public and Municipal Authorities, Research Centers, Universities, First Responders and Water operators create a complete set of experts to support the methodology for collecting requirements and feedback from first responder teams.

2.1 Communities of Practice for user interaction with technology providers and stakeholders

The key objectives of the first CoP meeting in Thessaloniki were to introduce the PathoCERT project, its objectives and technologies as well as the CoP approach and the related engagement activities to be undertaken. In addition, stakeholders were able to discuss and exchange on the role and responsibility of each organization in the management of the incidents described in two pilot exercise scenarios. In the first exercise scenario, polluted water from Axios river overflows due to flooding, to the water transportation channel towards the Thessaloniki Water Treatment Plant posing a potential risk to the safety of drinking water. In the second exercise-scenario, also due to a flooding event, two photographers are missing in the area of the Axios river basin and delta (including also the wider sea area). Specifically, the discussion was structured around four key questions:

- What actions do you take today when an incident occurs per exercise-scenario?
- What information is available today when one of these exercise-scenario incidents occurred?
- What information is missing today when one of these exercise-scenario incidents occurred?
- What technologies and tools do you think are needed to tackle both exercise-scenarios?

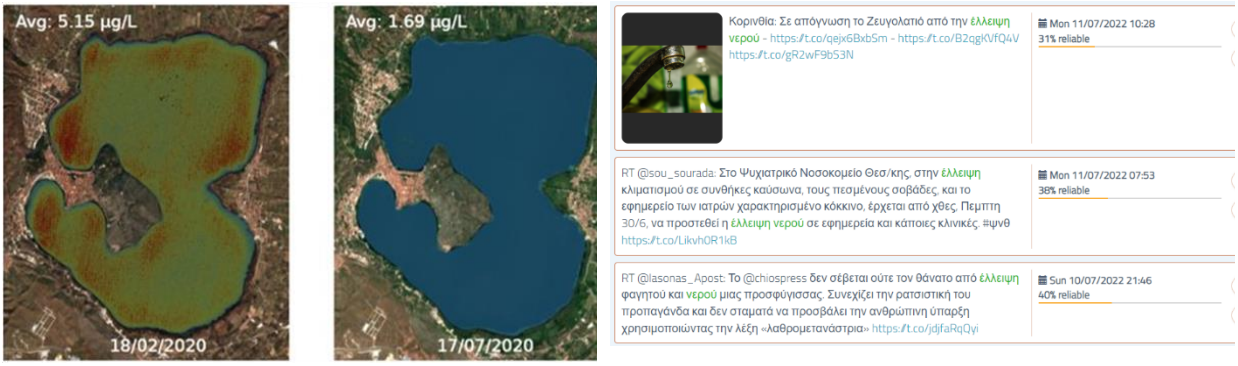
These guiding questions allowed for the collection of stakeholders' requirements and needs regarding the collaboration and coordination procedures when managing an emergency or disaster incident, but also the collection of an initial dataset regarding the relevance and ease of use of the PathoCERT technologies in the exercise-scenarios developed. Following up on the discussions of the first CoP meeting, the aim of this second online CoP in January 2022 was to look more closely at some of the technologies that will be tested in the Thessaloniki exercise-scenarios and gather the stakeholders' inputs. The key aspects where the interaction with the stakeholders focused were the advantages and disadvantages of each technology, the potential interest in using the technology, and the applicability of each technology in the different stages of the exercise-scenarios.

2.2 Overview of the technologies that contribute to the Greek Community of Practice

2.2.1 Support to first responders

First responders can be exposed to waterborne pathogens when they are responding to an emergency. The PathoCERT project's goal is to enhance the protection of first responders from these waterborne pathogen contaminations and augment their ability to react to dangers. This is achieved through

developing technologies, services and governance mechanisms that enable the fast and accurate detection of waterborne pathogens as well as improve the communication between different emergency management actors. To this direction, two technologies namely PathoSAT and PathoTWEET are able to provide insights, events and valuable information to first responders during an operation in a timely manner.



(a) **(b)**

Figure 1. PathoSAT and PathoTWEET functionalities: (**a**) Visualization of estimated levels of chlorophyll concentration in water as a heatmap to assess the severity level before a search and rescue scenario; (**b**) A set of tweets that need to be automatically assessed with AI algorithms in terms of their reliability and relevance, with location estimation from raw text when geospatial information is missing from a Twitter post.

PathoSAT monitors the formation of algal blooms on surface water using satellite images. Algal blooms can be poisonous for human and animals via skin contact, or via consumption. Through PathoSAT, the First responders have open access to recent satellite information and thus can obtain the most recent information on the quality of the water and avoid exposure to infected waters. The outcome of PathoSAT is visualised on the map of a GIS system, as it is shown in Figure 1(a). The development of the AI algorithm that is able to quantify the severity level through algal bloom estimation is based on previous historical events that were used for training Deep Learning models [1, 2]. PathoTWEET collects information from citizens, as it is shown in Figure 1(b), aiming to reduce noise, identify relevant tweets with useful text description or mobile photos from the field.

2.2.2 Support to water utility operators

The technological tools are expected to be combined with the legacy systems of EYATH SA and to provide necessary data for an integrated risk assessment and an in-depth study to highlight the vulnerabilities in water safety and security. There is a high expectation that a series of appropriate mitigation measures and actions will be defined (concerning water resources monitoring methods, communication procedures amongst the first responders, information-harvesting methods to exploit social media etc.). This systematic approach will bring out the general rules and procedures to be integrated into a framework of a solid standardized methodology. Moreover, EYATH SA is currently in the process of developing its Water Safety Plan (WSP), in accordance with the recently revised Drinking water directive (Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption [3, 4]) with a holistic Risk Based approach within the whole water system it manages.

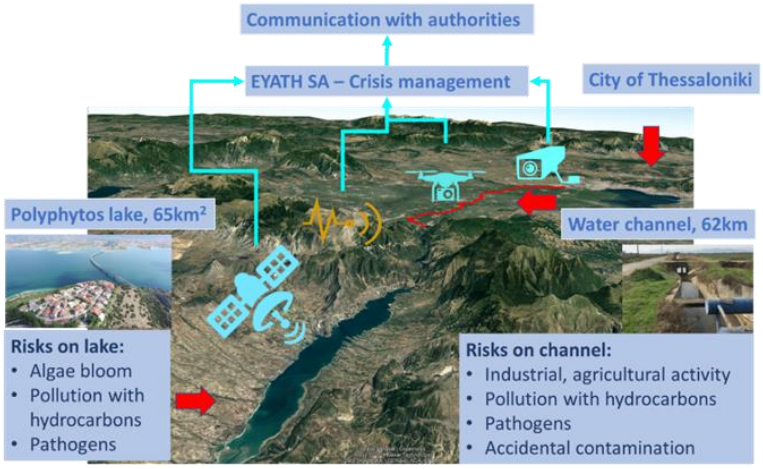


Figure 1. Description of the case study for EYATH SA indicating the potential risks and the forecasted tools to be used in order to mitigate the risks (i.e. satellite images, network of sensors, drones-UAVs and cameras)

3. CONCLUSION AND FUTURE STEPS

During the first two rounds of CoPs in Thessaloniki, the organizers have collected a significant amount of feedback with respect to challenges and needs as well as on expectations in terms of usage for the presented and discussed technologies. As a next step, stakeholders and the CoP organisers have identified the need to engage more directly with the respective technology developers in order to specify and clarify technical aspects. These specifications will then allow for a more detailed review of the exercise-scenarios and targeted adjustments to the technologies of interest. Furthermore, since not all the PathoCERT technologies have been fully discussed with local actors, similar exercise will be repeated in the upcoming CoP meetings. Finally, the Greek stakeholders will also further define the roles and responsibilities of the various actors involved in the emergency management system in order to define a common and detailed framework of their operational coordination, in connection to the PathoCERT technologies.

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REFERENCES

1. Ha, N. T. T., Thao, N. T. P., Koike, K., & Nhuan, M. T. (2017). Selecting the best band ratio to estimate chlorophyll-a concentration in a tropical freshwater lake using sentinel 2A images from a case study of Lake Ba Be (Northern Vietnam). ISPRS International Journal of Geo-Information, 6(9), 290.
2. Pahlevan, N., Smith, B., Schalles, J., Binding, C., Cao, Z., Ma, R., ... & Stumpf, R. (2020). Seamless retrievals of chlorophyll-a from Sentinel-2 (MSI) and Sentinel-3 (OLCI) in inland and coastal waters: A machine-learning approach. *Remote Sensing of Environment*, *240*, 111604.
3. European Commission, "European Civil Protection and Humanitarian Aid Operations," 2019. [Online]. Available: https://ec.europa.eu/echo/what/civil-protection/nationaldisaster-management-system/greece_de. [Accessed February 2022].
4. European Commission, "Greece Civil protection," n.d.. [Online]. Available: https://portal.cor.europa.eu/divisionpowers/Pages/Greece-Civil-protection.aspx. [Accessed February 2022].