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Research and Innovation Action

Delivering Advanced Predictive Tools from Medium to Seasonal Range for Water Dependent Industries Exploiting the Cross-Cutting Potential of EO and Hydro-Ecological Modelling

Meeting report

Australian End Users Workshop: HABs Early warning tools

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1. Introduction

PrimeWater is a Horizon2020 funded research project that generates information on the effects of upstream changes on future water quality and quantity. Building on advanced Earth-Observation data products, integration with additional data sources and diagnostic modelling tools, public and private sector decisions for water resources management are provided with better and actionable information.

Within PrimeWater, the co-development strategy was used. This aimed to bring together various perspectives of stakeholders in the design, development and implementation of end-products which are adopting Earth Observation (EO)-based systems in Integrated Water Resources Management (IWRM).

To facilitate co-development, a dynamic group of international panel of users of EO downstream services (Multi User Panel, MUP) convened three times during the duration of the project. The MUP, involving the scientific community, purveyors and users, acted as a platform for user engagement, co-generation of EO services for water quality, and mutual learning.

The purpose of the MUP meetings was to provide expert feedback on the EO-enabled services developed or extended in the context of the project and participate in the co-generation process itself, through a mutually beneficial dialog. The MUP supported the consolidation of users' requirements into the system design, followed by an industry evaluation of the end product. At the same time, the MUP participants function as a project ambassador, facilitating the project's outreach to international markets and the exploitation of the project outputs.

Additionally, local MUP meetings were organised in Italy and Australia to discuss the local case studies.

This report summarised the results of the discussion following the local *Australian End-Users Workshop: HABs Early warning tools.*

2. The Australia MUP

The *Australian End-Users Workshop: HABs Early warning tools* took place on 20 April 2023 in a hybrid format.

Many inland water bodies in Australia and around the globe often experience algae blooms that can impede public health since many of them supply household needs for towns and landholders. In Australia, water from reservoirs is mainly used for stock needs, irrigation, recreation, flood mitigation, and hydroelectricity, demonstrating the significant socioeconomic impact that water quality outbreaks might incur. Lake Hume and Melbourne Water are the case studies where the PrimeWater consortium explored the predictability of algal blooms – in terms of timing, extent, and intensity employing both process-based and data-driven, machine learning models.

This workshop intended to initiate a discussion on short to medium-term water quality forecasts into an early warning service for HAB outbreaks. The main objectives of the workshops are:

- To inform local/regional end users of the findings of the PrimeWater and demonstrate operational forecasting service for inland freshwater
- To discuss how forecast-based early warning services for HAB can improve risk management operations

In particular, the discussion was conducted using the collaborative tool GroupMap available to those both in person and online. This focused on barriers, risks, benefits and opportunities of the PrimeWater tools.

2.1 Participants of Australian workshop

A list of organizations which joined the event is presented in Table 1.

Table 1 Participants of Australian workshop

Sector	Participants
Utility/End Users	• Goulburn-Murray Water • Hornsby Shire Council • Hunter Water • Murray-Darling Basin Authority • NASA • North East Water • South East Water • WaterNSW
Universities and Research Institutes	• Monash University • Acharya N G Ranga Agricultural University • The University of Sydney • Water Research Australia

	• DES – Department of Science, Information Technology, Innovation and Arts • Diponegoro University • Helmholtz-Zentrum für Umweltforschung (UFZ)
PrimeWater project partners:	• CSIRO • EMVIS • SatDek • Melbourne Water • International Water Association

2.2 Summary of discussion

The barriers to the implementation of the project's product were mostly linked to financial constraints, technology implementation and data availability, capacity development and end users perceptions. These barriers are then connected to the perceived risks (unreliability of data, costs and community understanding). More information is available in Table 2.

Participants of the session also identified benefits and opportunities connected to the implementation of the product. PrimeWater can provide confident forecasting and monitoring of threats to water quality based on spatial distribution. The involvement of the public was also seen as an opportunity as Citizen Science can be integrated into the development of the products (**Error! Reference source not found.**Table 3). The information developed within the project can be used for informed decision making at policy level.

Table 2 Key barriers and risks identified by local end users

Category	Sub-category	Description
Barriers	Finance	• Funding sources and long-term sustainability of the technology
	Technology implementation	• Cybersecurity issues • Installing on recreational waterways (approvals for installation, theft or vandalism risks) • Many moving parts, e.g. impact of satellite network issues
	Capacity development	• Capability within utilities to interpret and integrate the use of tools • Need to tailor the technology to different institutions
	End users perception	• Long lead time - technology transfer from research to operational implementation. • End users could perceive this as another long expensive project with *uncertain* outcomes • Lack of trust in the system
	Data availability	• Insufficient (historic) data to calibrate/validate a specific case study • Monitored area too limited and restrictive • Challenges of acquiring appropriate imagery for smaller waterbodies • For some applications we also need information on algal bloom toxicity. Further work required in this area to determine the drivers of cyanotoxin production • Complexity clouds understanding
Risks	Unreliability	• Closure of water bodies based purely on EO data (which may be unreliable) • Loss in trust in case of false negatives of HAB bloom forecasts • Not verifying the model outputs on an ongoing basis and putting too much trust in the tech and algorithm • Economic loss due to false positive closures • Data loss

	Costs	• Need to specify if only a free trial is available or if the service is completely free.
	Community understanding	• What is the community understanding of confidence intervals – need capacity development • What information is provided (do they just want an index?) or is required?

Table 3 Key benefits and opportunities identified by local end users

Category	Description
Benefits	• Compile data from different data sources and integration into added value for utility • Inform operational management of water bodies of HABs events (e.g., harvest water during periods of better water quality, reduce algal loading of reservoirs & reduce water treatment costs; inform use of in-reservoir interventions - destratification systems, chemical dosing etc) • Potential for early intervention in drinking water catchments & avoided water treatment costs • Prepare and ensure treatment capability thanks to forecasting window and undertake more targeted grab sampling and algal cell counts • Minimise or even avoid major water quality extreme events • Highlight areas of water quality problems to better focus sampling strategies • Improved confidence of the status of the waterway with improved visibility • More comprehensive (spatially & temporally) datasets that can be used for planning purposes (e.g., designing water treatment plants; desal plants) • OH&S Risk reduction - Reduce requirement to send people into field. • Planning and policy benefits • Reduced use of facilities with subsequent carbon footprint reduction and personnel risk reduction • Spatial resolution improvement

	• Visualisation of products for communities as well as water management agencies • Digital transformation strategies – Improving the current to monitoring (manually) which is a very backwards approach when compared to other IoT processes and advances. Net-based provides ready access anywhere/anytime
Opportunities	• Confident forecasting of threats to water quality • EO or model events to trigger in situ monitoring/sampling campaigns • Financial/commercial opportunity - mostly free to everyone • Global initiative - case study for working together to help solve emerging issue • Improved warnings based on spatial distribution • Informed WQ decision in areas where currently no information is available • Integration of Participatory (Citizen) Science into the PrimeWater program • Live data for the public access (can become a benefit) • Monitoring for unknown and illegal discharges from agriculture and industries through having a view of all estuaries and rivers • More efficient chemical usage in water treatment plants • Optimised *in situ* site selection and long-term validation data set acquisition • Public interest • Integration with regulatory frameworks

3. Conclusion

PrimeWater project has raised increased awareness on how to assist end users for their operation needs by using EO based water quality early warning tools developed within the project. Even though there is a need for developing trust and long-term confidence in PrimeWater products, many end users are keen to try the products developed by the Project and include them into their innovation strategy. In particular, end users expressed they will try EMVIS products in parallel to their ongoing methodologies.

During the exploitation phase of the PrimeWater project, the results of this discussion will be implemented in the follow up actions when engaging local stakeholders.

PrimeWater

EMVIS S.A. | National Research Council of Italy | Swedish Meteorological and Hydrological Institute | EOMAP GmbH & Co.KG | International Water Association | Burgundy School of Business | Ente Acque della Sardegna | US Environmental Protection Agency | Commonwealth Scientific and Industrial Research Organization | Melbourne Water | SatDek

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