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WEBINAR INFORMATION

- This webinar will be **recorded and made available "on-demand"** on the IWA website.
- Following the webinar, you will be sent a **post-webinar email** with the on-demand recording, presentation slides, and other information.

- **'Chat' box**: please use this for general requests and for interactive activities.
- **'Q&A' box**: please use this to send questions to the panelists.

  (We will answer these during the discussions)

Please Note: *Attendees' microphones are muted. We cannot respond to 'Raise Hand'.*

PANELISTS

Dr Erin Urquhart
PACE Applications Coordinator at NASA GSFC, USA

Steven Greb
Researcher at University of Wisconsin-Madison, Director of GEO AquaWatch, USA

Apostolos Tzimas,
Managing Director at EMVIS Consultant Engineers, PrimeWater project leader, Greece

Maria Dessena,
Geologist at ENAS, Italy

Blake Schaeffer,
Research Scientist at US Environmental Protection Agency (EPA), USA

AGENDA

- Welcome, housekeeping rules and panelists introduction
  Dr Erin Urquhart
- The GEO AquaWatch initiative - Building Confidence in EO Water Quality Data
  Steven Greb
- New approaches from PrimeWater being developed to connect EO to end users
  Apostolos Tzimas
- Case study: EO in practice, the point of view of a water utility
  Maria Antonietta Dessena
- Use of EO in practice for water management
  Blake Schaeffer
- Panel discussion with questions from audience
- Closing remarks

The GEO AquaWatch initiative

Building Confidence in EO Water Quality Data

STEVEN GREB

UNIVERSITY OF WISCONSIN-MADISON

GROUP ON EARTH OBSERVATIONS

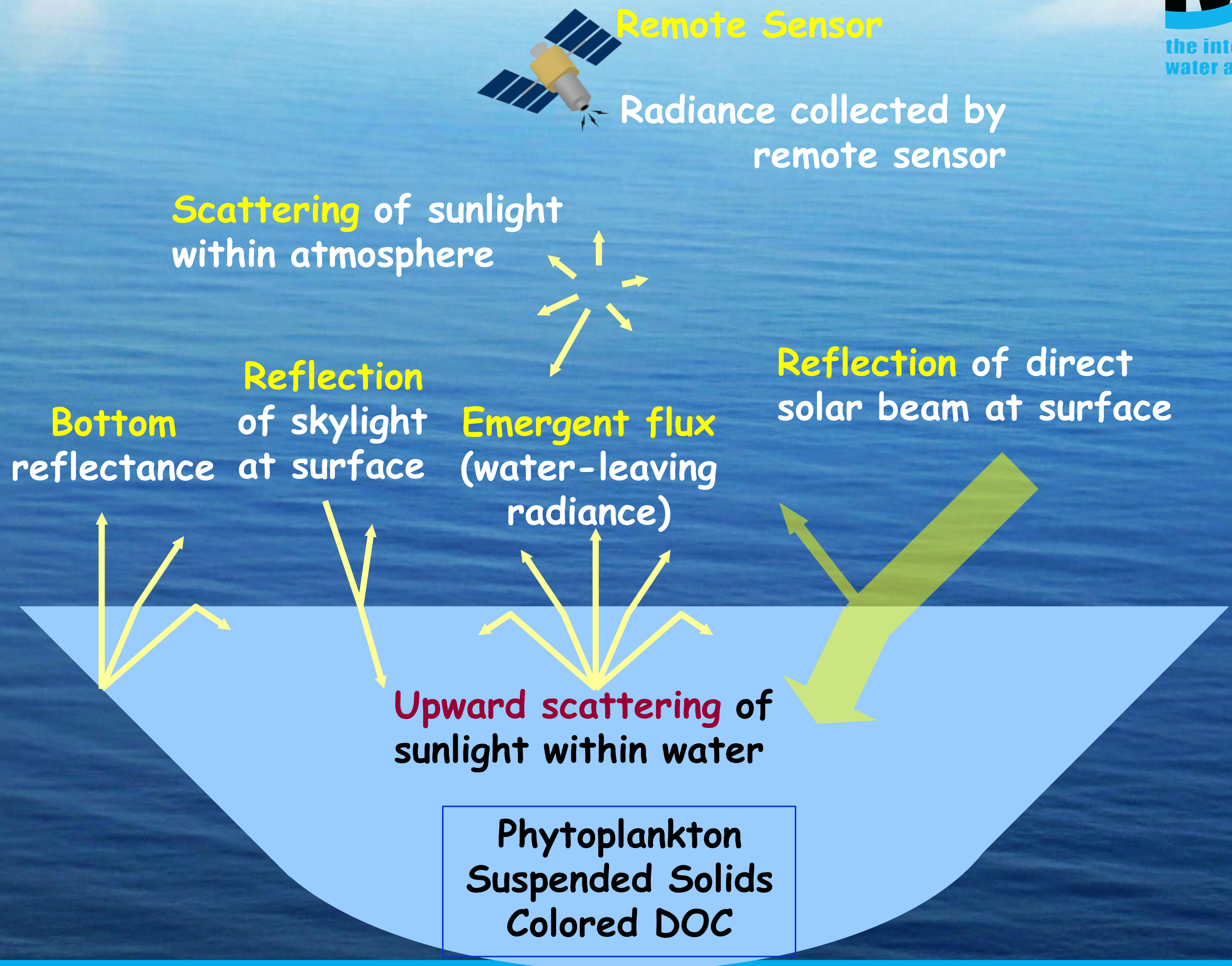
AQUA WATCH

AquaWatch

The GEO Water Quality Community of Practice

AquaWatch aims to develop and build the global capacity and utility of Earth Observation-derived water quality data, products and information to support water resources management and decision making.

REMOTE SENSING OF FRESHWATERS



Credit:New York Times

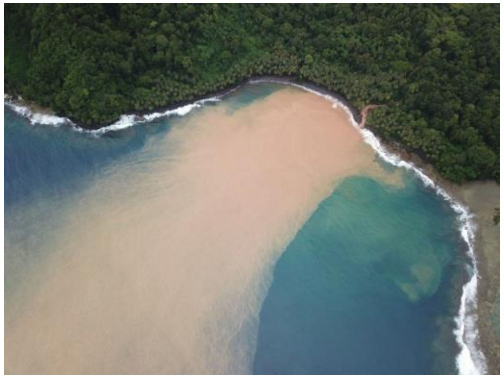
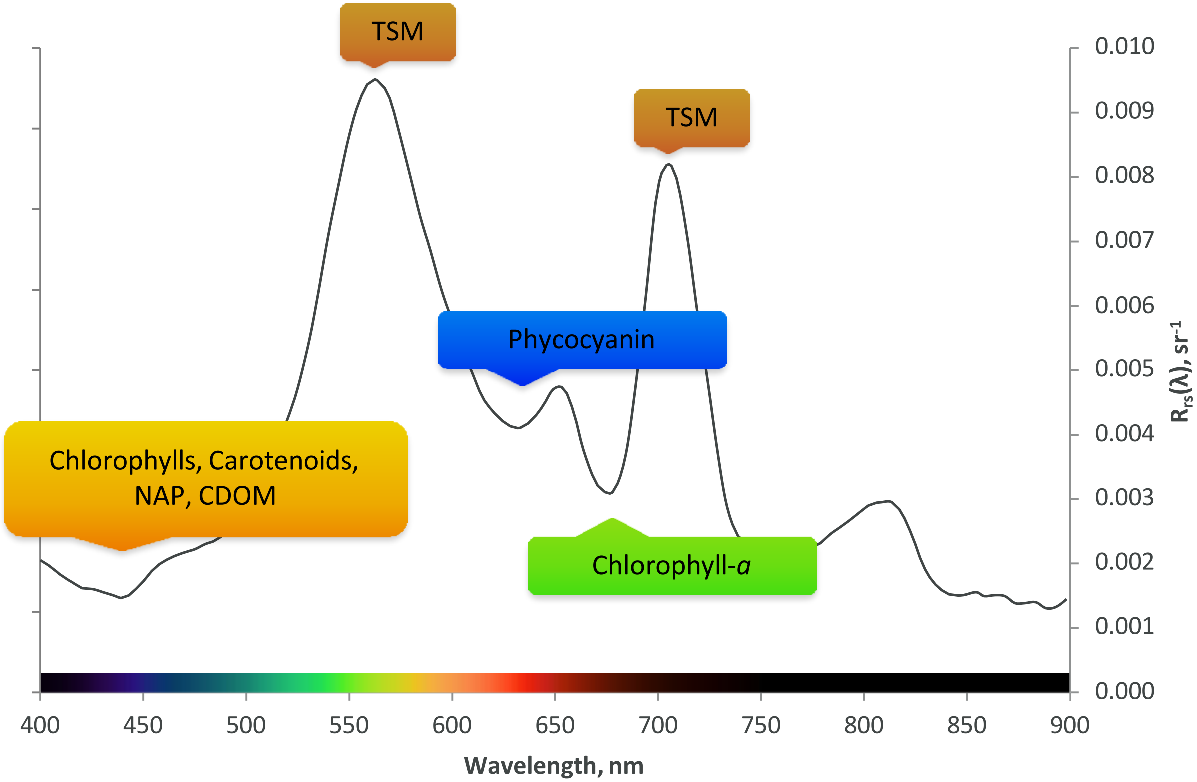


Image by Wade Fairley/WCS

Photo by Steve Rohrs



COMPARISON OF EARTH OBSERVATION SENSORS SUITABLE FOR WATER QUALITY ASSESSMENT WITH PUBLIC ACCESS DATA POLICY

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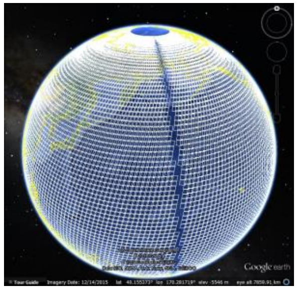
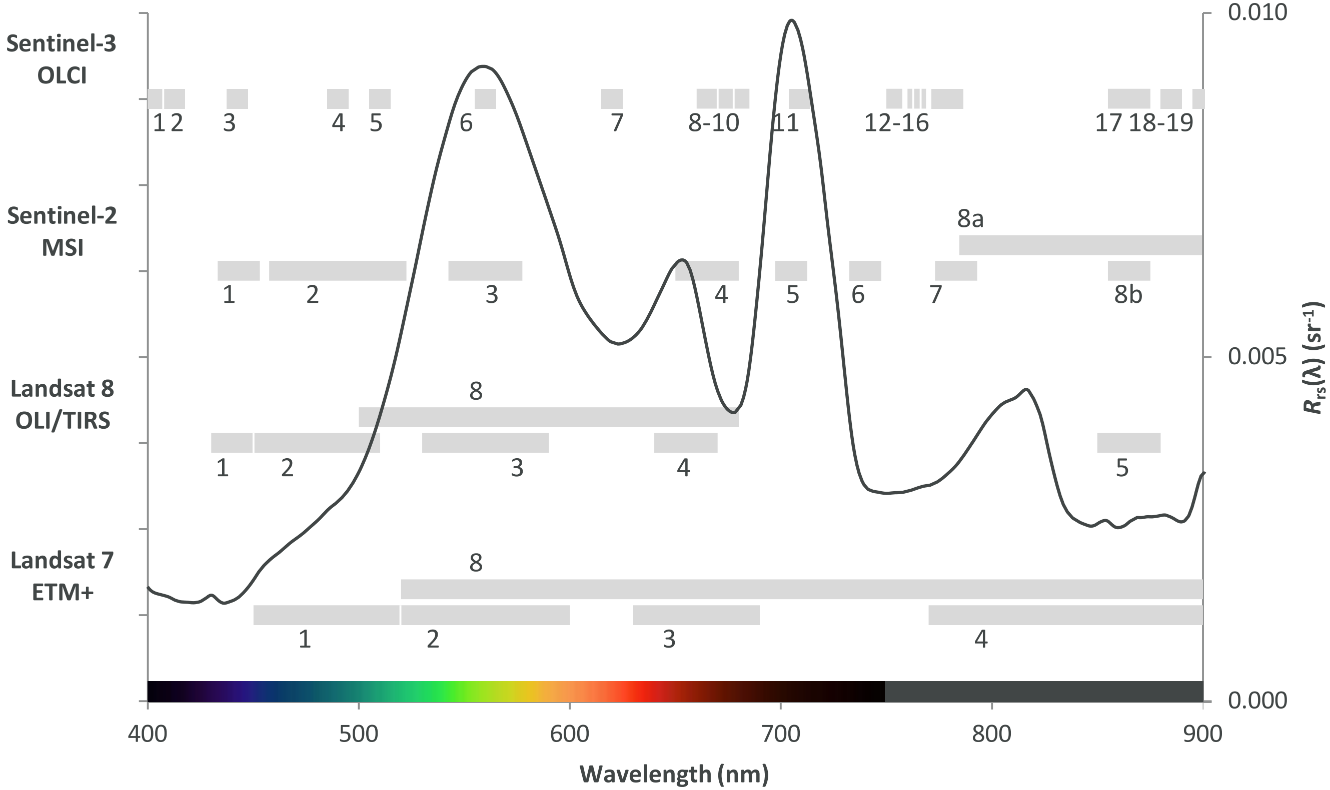
Credit : ESA/Pierre Carril



Google Earth Image



ADVANTAGES AND DISADVANTAGES

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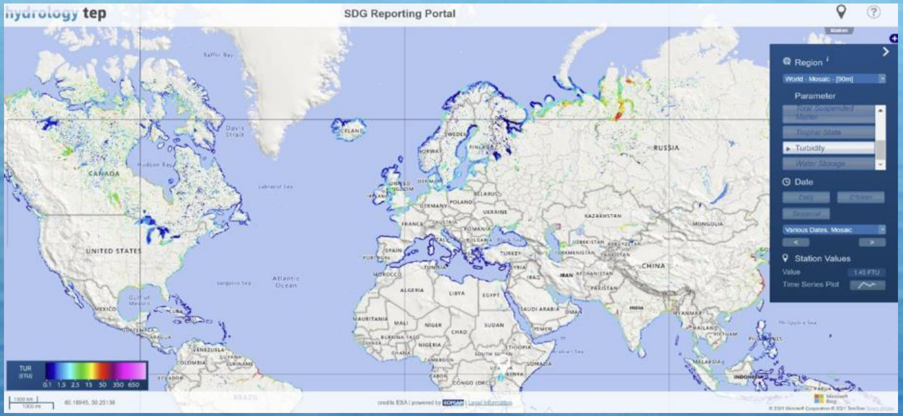
Advantages of the remote sensing of water quality

- Water quality data with a high spatial and temporal resolution for multiple water bodies at a time
- Affordable
- Historical data for studies of trends in water quality
- Near real-time data for current information
- Accuracy continuing to improve

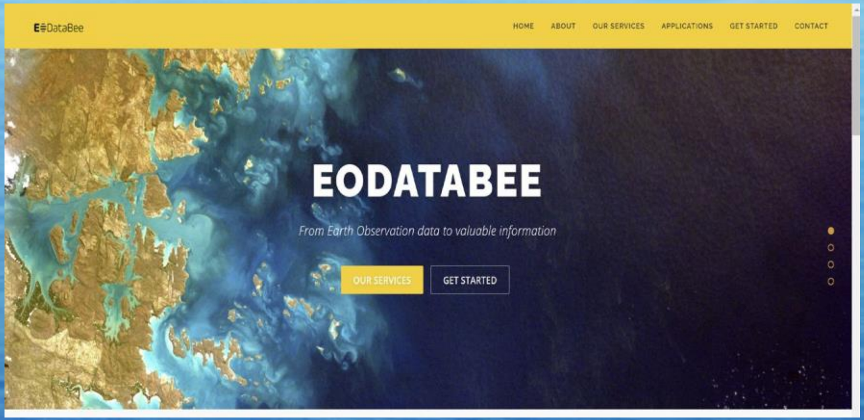
Disadvantages of the remote sensing of water quality

- Optically complex conditions found in lakes
- Potential interference from the lake bottom in shallow lakes
- Clouds!
- Dynamic changes in water quality
- Limited number of water quality parameters
- Calibration and validation of models typically requires the collection of ground truth data

Examples of Current Data and Product Sources

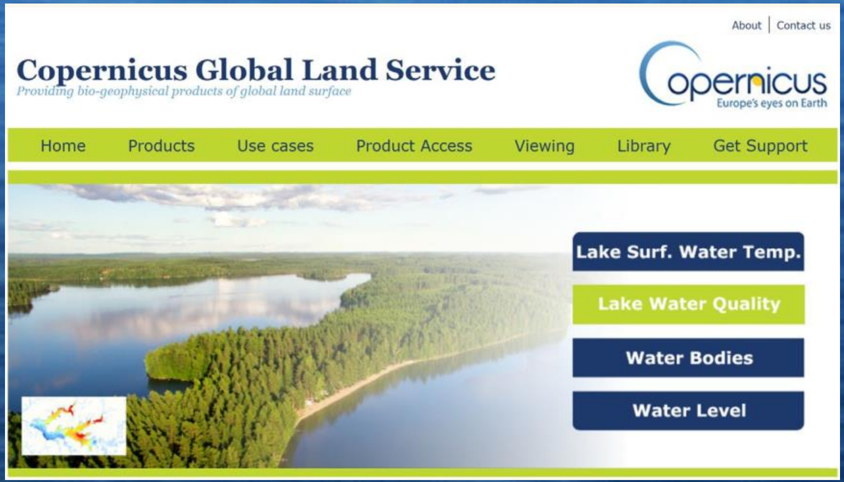


http://sdg6-hydrology-tep.eu/



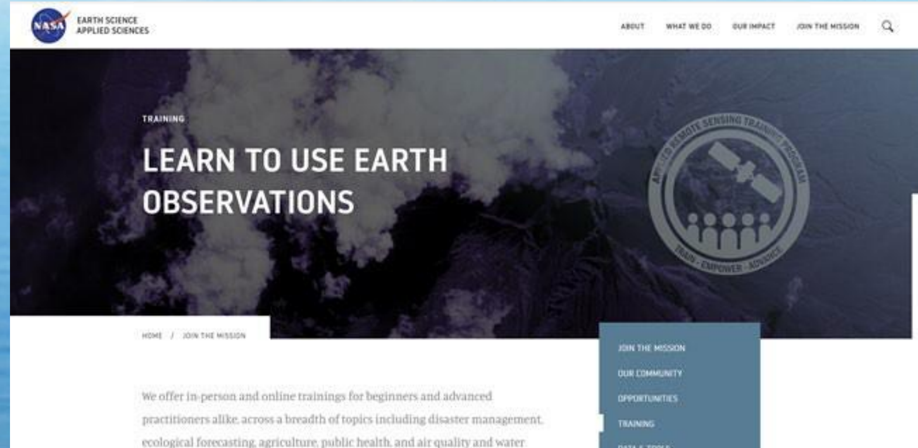
https://eodatabee.eu/

https://search.earthdata.nasa.gov/search



https://land.copernicus.eu/

Training Resources



https://appliedsciences.nasa.gov/what-we-do/capacity-building/arset

https://www.copernicus.eu/en/opportunities/education/copernicus-academy

Contact Information

If interested in joining a working group or getting involved in AquaWatch, please contact the AquaWatch Secretariat (Merrie-Beth Neely) at info@geoaquawatch.org

Or contact Steven Greb, AquaWatch Director at the University of Wisconsin at srgreb@geoaquawatch.org

New approaches from PrimeWater being developed to connect EO to end users

APOSTOLOS TZIMAS

EMVIS MANAGING DIRECTOR

PRIMEWATER PROJECT COORDINATOR

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PRIMEWATER IN A GLANCE

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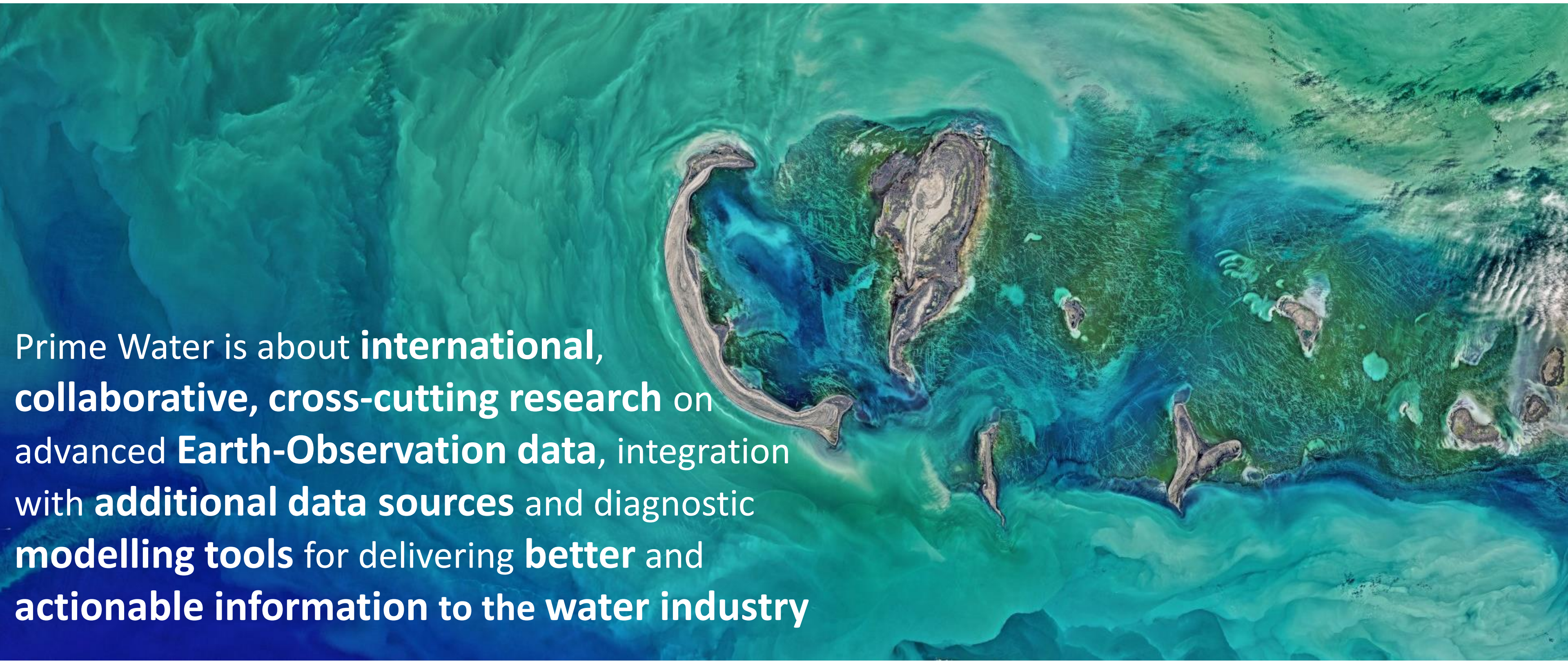


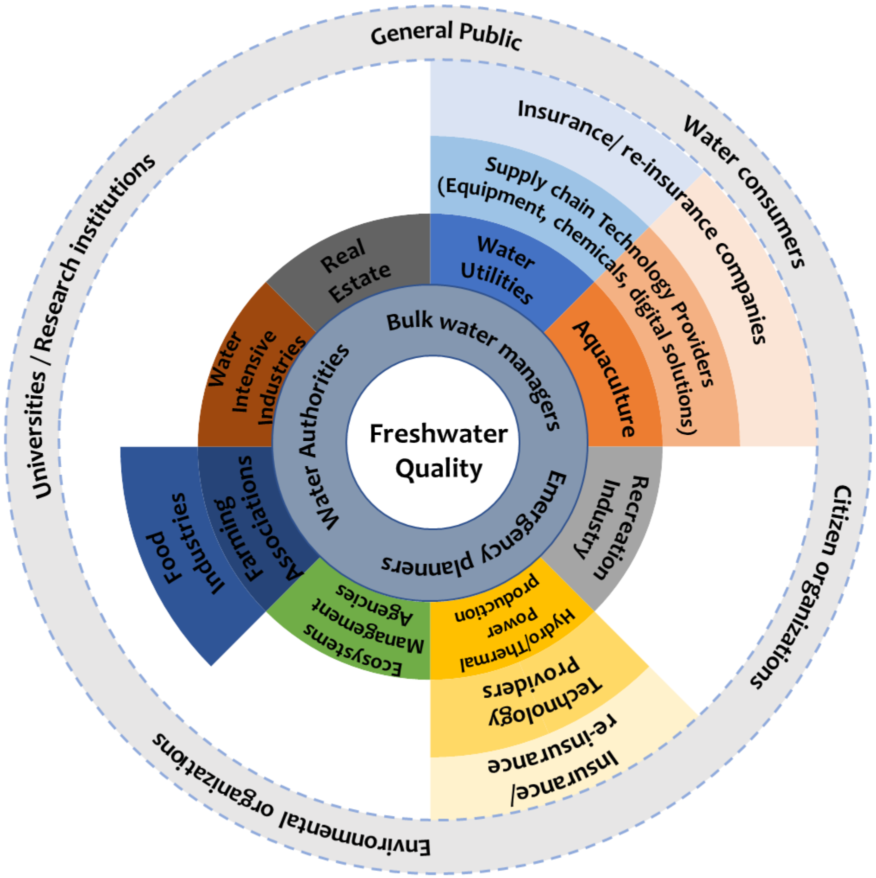
Prime Water is about **international**, **collaborative, cross-cutting research** on advanced **Earth-Observation data**, integration with **additional data sources** and diagnostic **modelling tools** for delivering **better** and **actionable information to the water industry**

WATER QUALITY HAZARDS EXPOSURE AND VULNERABILITY REDUCTION

Proactive management of water related risks

What is the rational for acting as early as possible

What is the optimum lead time in decision making



Develop reliable, predictive and prescriptive services for Water Quality Hazards exposure and vulnerability reduction in the Water Sector

- Water Quality Forecasts as a Service
- Forecasts based Early Warning System for Algae Bloom
- Predictive Reservoir Water Management (e.g Blending among interconnected reservoirs)
- Water Abstraction Optimization based on forecasted Water Quality

Demonstrate EO potential for supporting local-scale operations in the water industry

Cross-cutting research and integration with hydroecological models for generating skilled Water Quality forecasts

The rational for being proactive

COST OF INACTION AND OPPORTUNITIES

Predictive management of a utility's risks

Risk management is critical in proactively determining and mitigating issues. Mitigating risks in a planned manner is less expensive than reacting to a major system failure

Blending source water

5-50 K $US for 20 Ha
Algaecide Flocculants application

40-50 K $US per devise
Water circulation (aeration or mixing)

Increased treatment costs and efforts

10 £/d per Supply
OFWAT Guaranteed Standards Scheme , 2017

1.0 - 4.0 M $US
Lake Erie, 2009, 2014

30-40 K $AUD
Murray River, 2010-11

3000 $ US
Increased treatment cost for removing microcystis

2.0B CNY (300 M $US) 21 M people for 4d
Songhuajiang River Pollution Accident, 2005 China

Water supply disruption

$0.5M US 11 M People affected
Lake Erie, 2009

$US 200 K/Month
Toledo spending on carbon

$400,000 2.5 M people for 2d
Boston, 2010 – Main Break

…Not to mention Tourism, Fisheries, Aquaculture, Property values, Livestock , Public Health

THE OPTIMUM LEAD TIME IN DECISION MAKING

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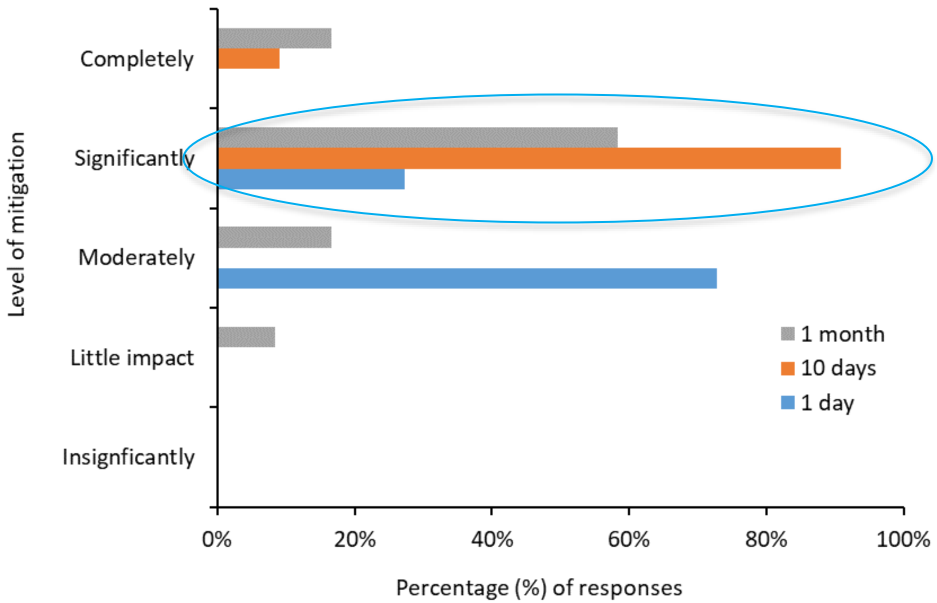
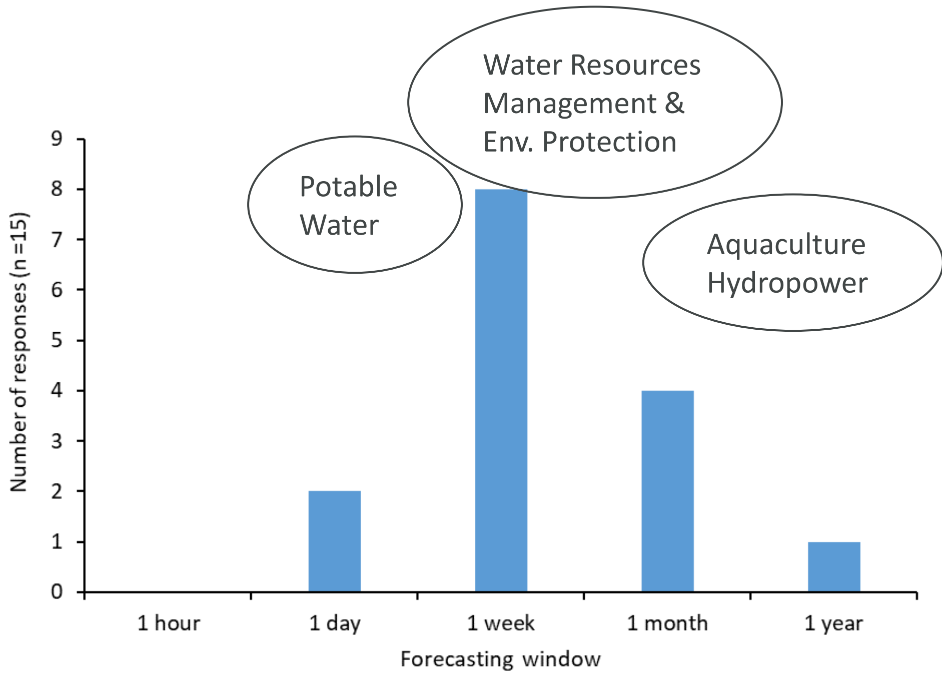


Extent that an Action Plan, when forecasting services are available can mitigate water related issues



Preferred optimum forecasting window across sectors

Results from PrimeWater 1st Multi-User Panel Workshop
(21 participants, 15 responses)

DELIVERING HIGH RELIABILITY WATER QUALITY FORECASTS FOR THE WATER INDUSTRY

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Hydrological Modelling.

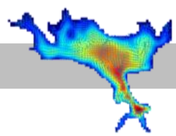
Attributes: **River discharges** in upstream catchments, **Diffuse loads** (e.g. sediments, nitrogen, phosphorus).

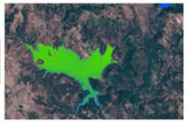
Earth Observations.

Satellite imagery: **Sentinel 2A/B** and **Landsat 7/8**, **PRISMA)**
Attributes: **Turbidity**, **chlorophyll-a,** surface water **temperature**,.

Data Assimilation.

Automatic real-time **assimilation of EO** to **improve forecasting skill**, (Ensemble Kalman Filter, 4dVAR, Weighted Average).





Hydrodynamic Modelling.

Attributes: **Velocity field** and **circulation pattern** of the reservoir.

Operational Forecast production.

PrimeWater service line **integrates** operationally multiple scientific components & produces **short term forecasts** (up to 10 days) of **hydrological and ecological parameters** of the reservoir,

Water Quality Modelling.

Attributes: **Algae growth**, **nutrients, sediments and dissolved oxygen.**

Machine Learning Models.

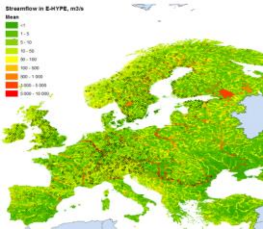
Machine Learning algorithms (random Forests, Gaussian Process Regression, Quantile regression forests) are used for **Water Quality predictions**, **assessment of prediction uncertainty** and systematic **errors correction** in forecasting systems,
Data used: **Satellite imagery**, **in situ monitoring** data, **meteorological** and **hydrological** forecasts

…for generating real time, short to medium range water quantity and quality forecasts for reservoirs.

THE SCIENCE BEHIND THE SERVICES

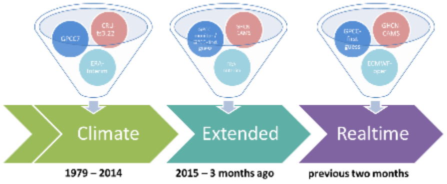
Advancing the skill of hydrological forecasting

Continental and global hydrological forecasting



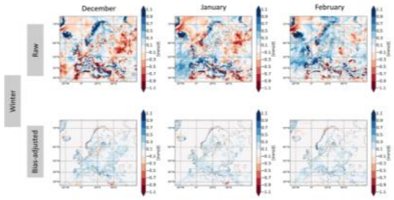
E-HYPE model & WW-HYPE
Semi-distributed, process based model. Uses ECMWF meteorological forcing and provides 10-days forecasts of:
• Daily river discharges • Sediment and Nutrient (N, P) loads

Meteorological forcing



SMHI's operational global forcing dataset
• 0.5 degrees resolution
• 3-hrs frequency for 'Climate' and 'Extended'
• 6-hrs frequency for 'Realtime'

Bias adjustment



SMHI's operational global forcing dataset
• Bias of SEAS5 precip. vs HydroGFD • Bias-adjustment based on quantile-quantile mapping approach

THE SCIENCE BEHIND THE SERVICES

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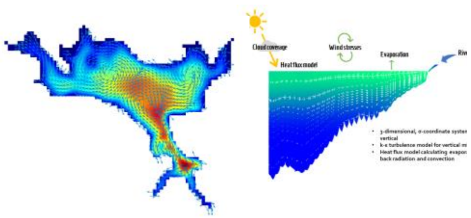
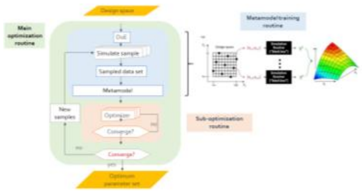
Advancing the skill of process-based WQ forecasting

Operational coupled Hydrodynamic and Water Quality forecasting



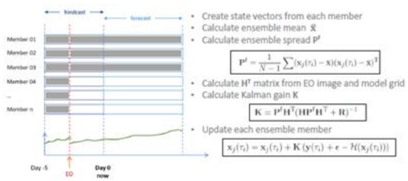
Capture the motion of water and calculate the forces acting on it using **Delft3D-FLOW**.
• water velocities • mixing and turbulence • water temperature and densities. **Delft3D-WAQ** uses 50 ecological processes and 16 state variables to capture the dynamics of:
• algae populations • dissolved nutrients • particulate matter • dissolved oxygen

Efficient calibration



Metamodeling approach to replicate the response of high fidelity models with reduced computational effort

Improve forecasting skill through Sequential and Variational Data Assimilation techniques



Automatic real-time assimilation of EO and in-situ monitoring to correct initialization state of ecological modelling and improve forecasting skill,
Benchmarking various techniques (Ensemble Kalman Filter, 4dVAR) in terms of skill improvement and computational effort.

Uncertainty estimation

Quantify uncertainty using ensemble modelling

THE SCIENCE BEHIND THE SERVICES

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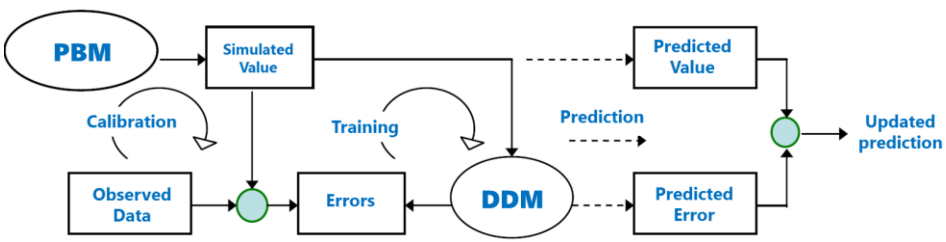
Advance the skill of process-based models through a model fusion approach

An error-correcting framework

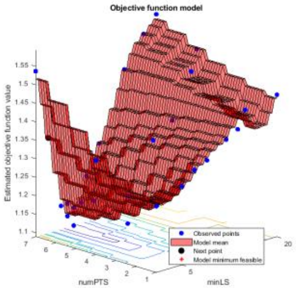
Systematic errors might contain useful information

- Train data-driven algorithms to recover some of the missing information and correct process-based predictions



Exploiting the wealth of satellite-derived data

Development of credible data-driven models



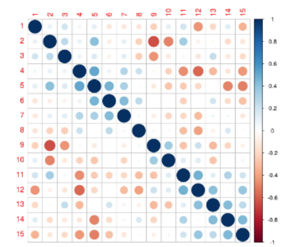
Training Random Forests and Gaussian Process Regression using …

- EO-derived water quality
- Meteorological forecasting
- Hydrological forecasting

Assessment of prediction uncertainty

Go beyond the conditional mean and give information about the spread of the predictions using …

- Quantile regression forests



Assessment of predictor importance

Uncover interaction effects among variables

FROM SCIENCE TO OPERATIONAL SERVICES FOR THE WATER INDUSTRY

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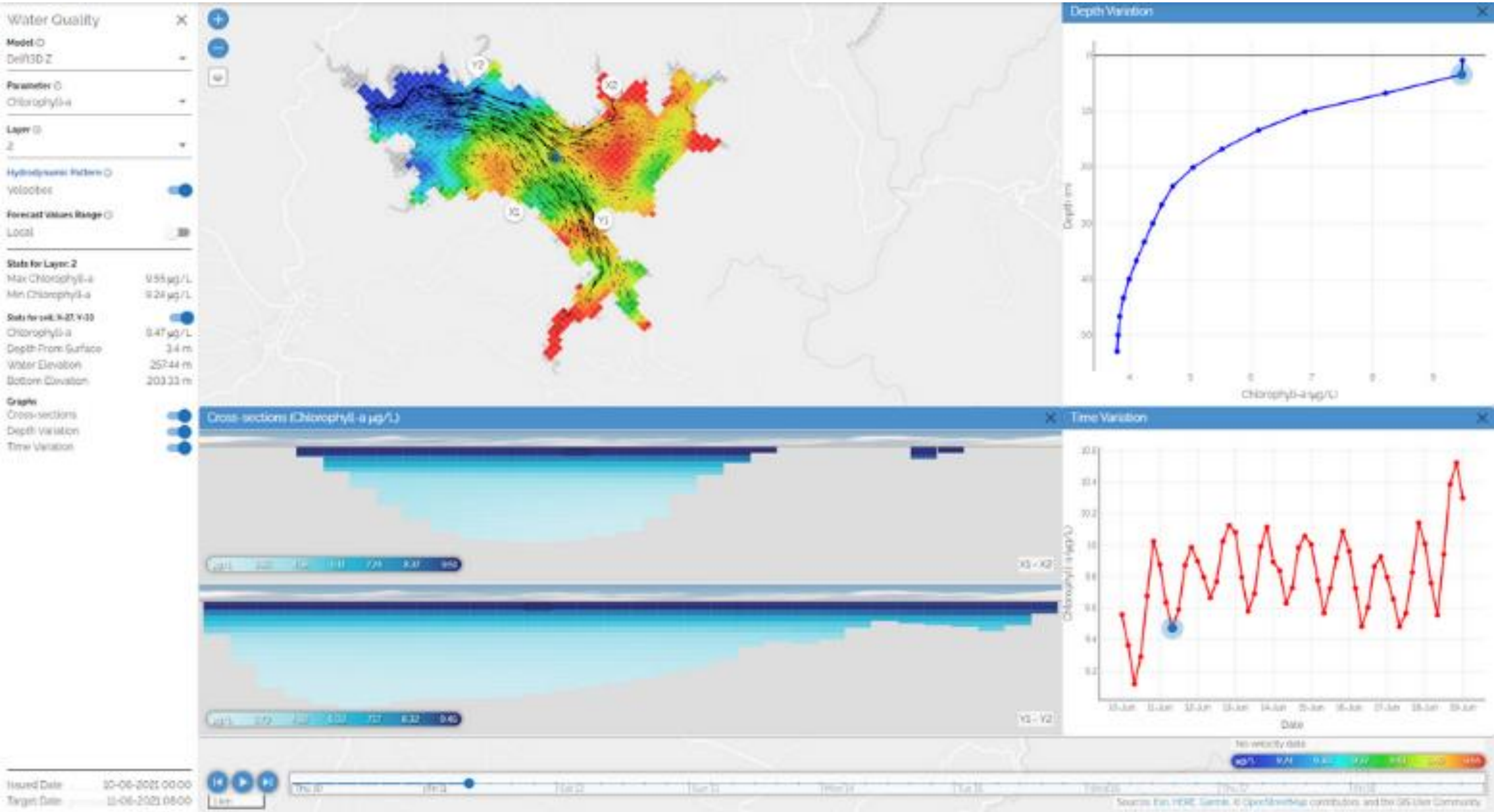
Water Quality Forecasts as a Service



FROM SCIENCE TO OPERATIONAL SERVICES FOR THE WATER INDUSTRY

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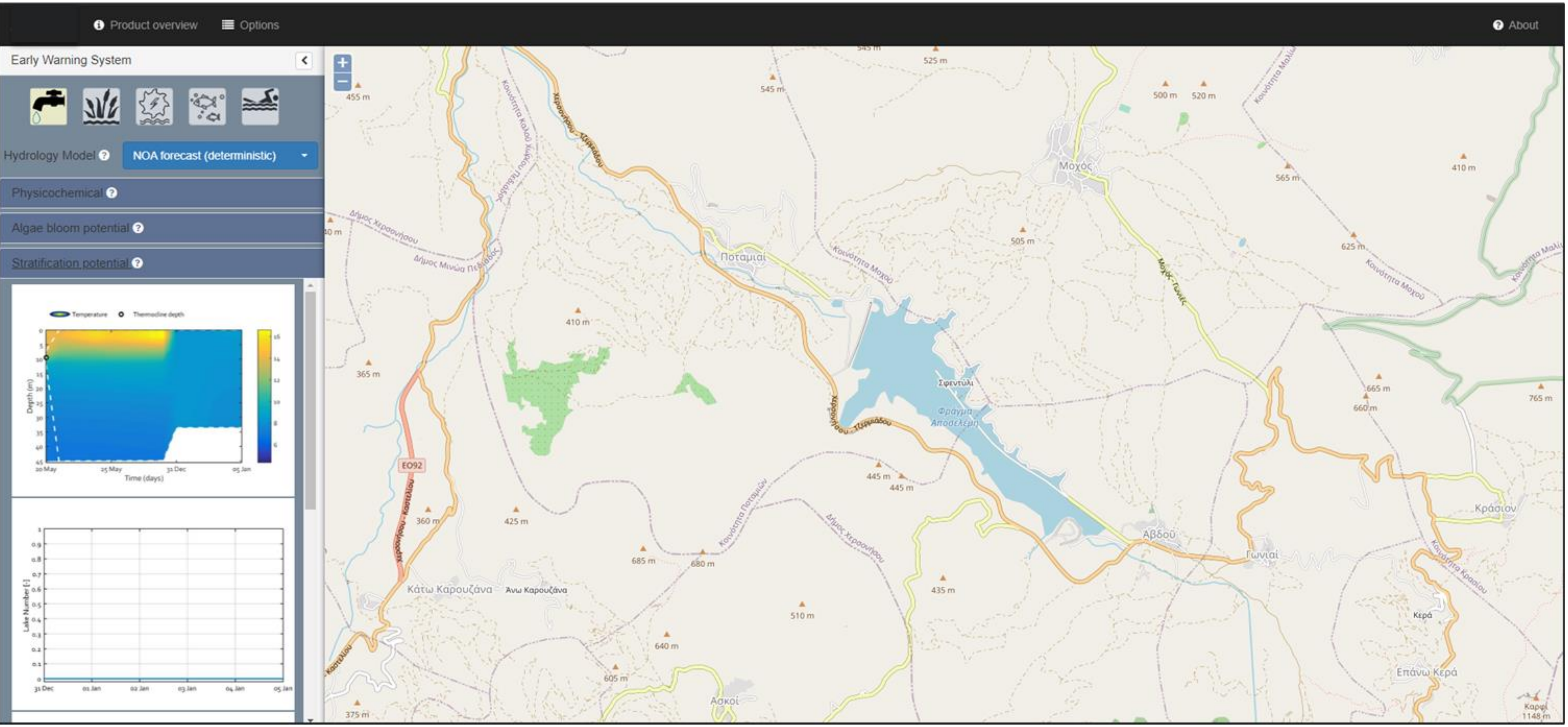
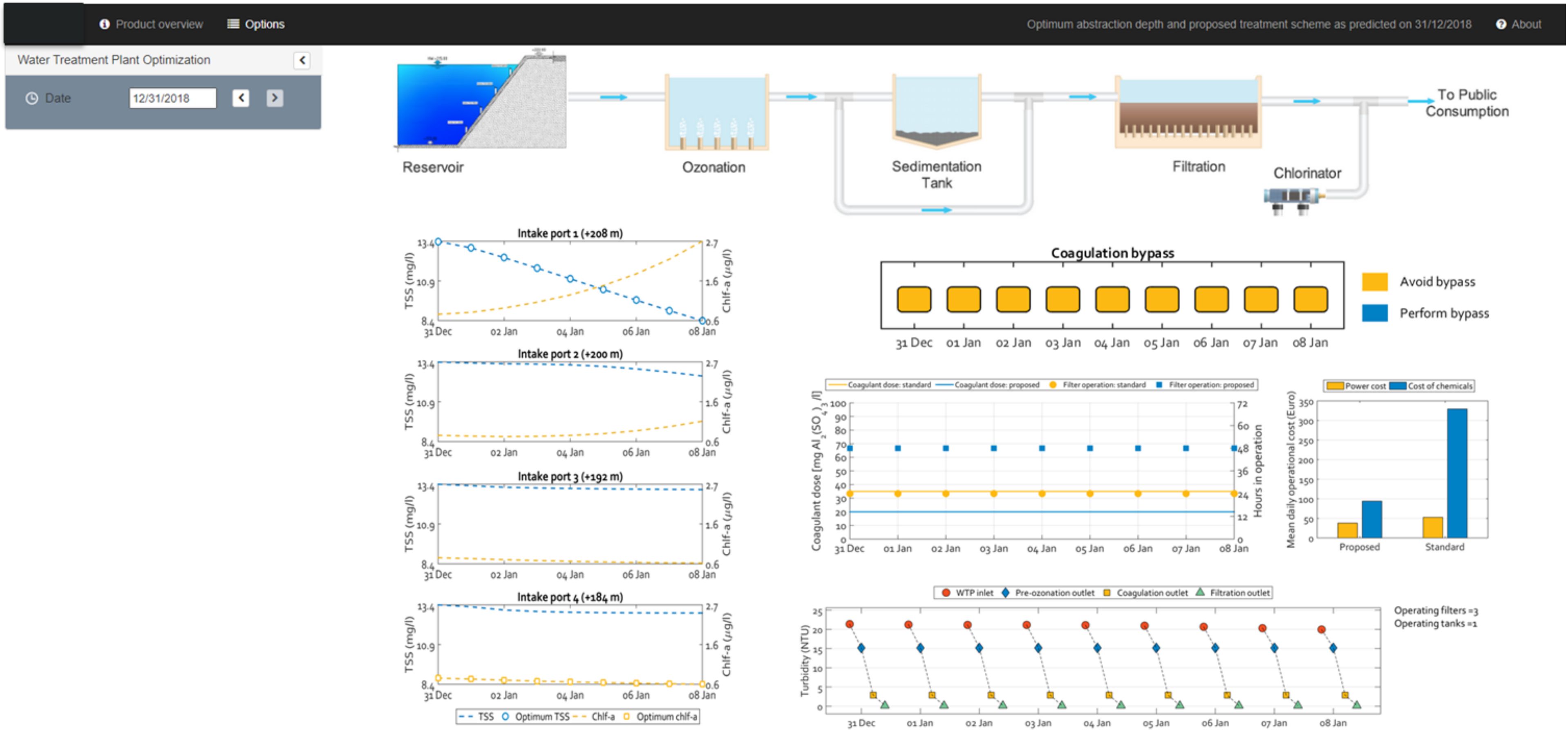
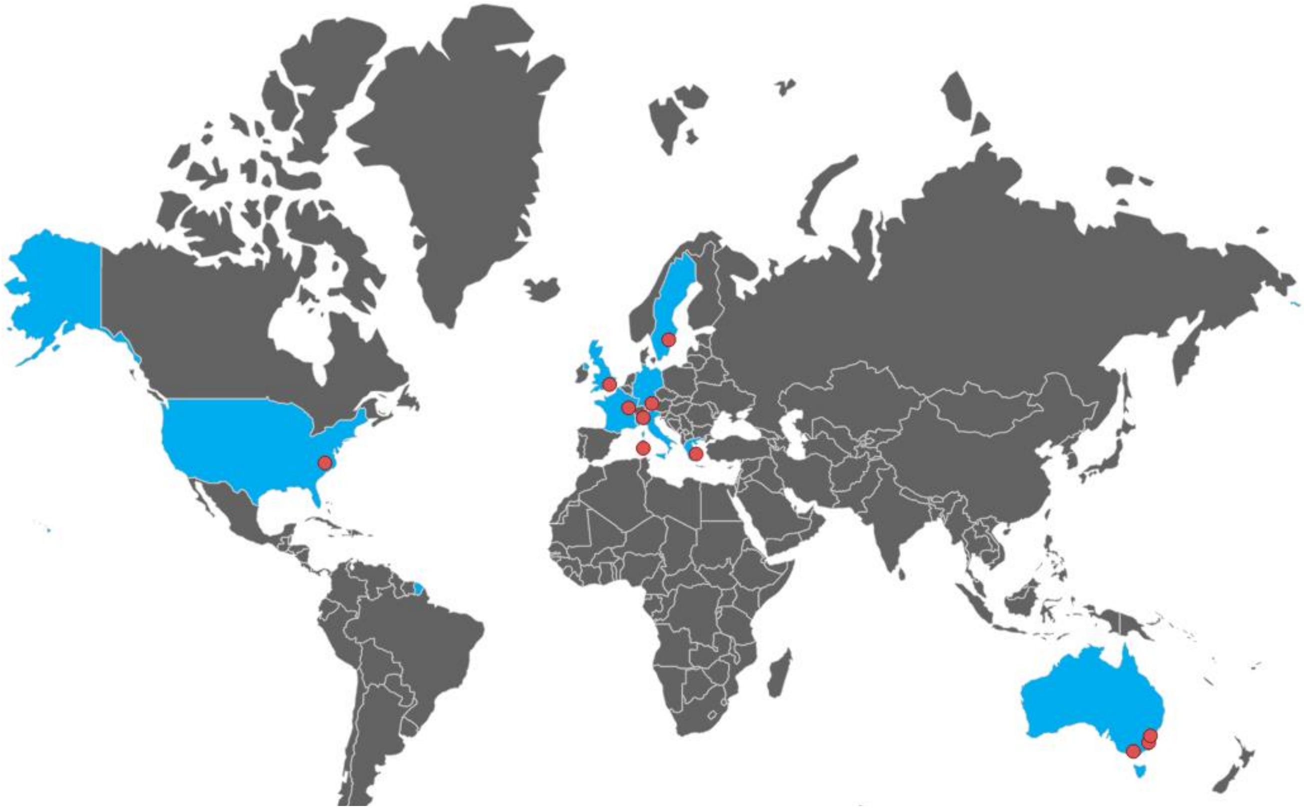
Forecasts based Early Warning System for Algae Bloom



Water Abstraction Optimization for a Potable Water Treatment Plant based on forecasted Water Quality



MEET OUR TEAM



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 Pty Ltd

The project has received funding from the European Union's Horizon H2020 Research and Innovation Programme under Grant Agreement No 870497

European Commission

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Case study: EO in practice, the point of view of a water utility

MARIA ANTONIETTA DESSENA

ENAS – REGIONAL WATER BODIES

ENAS Sardegna

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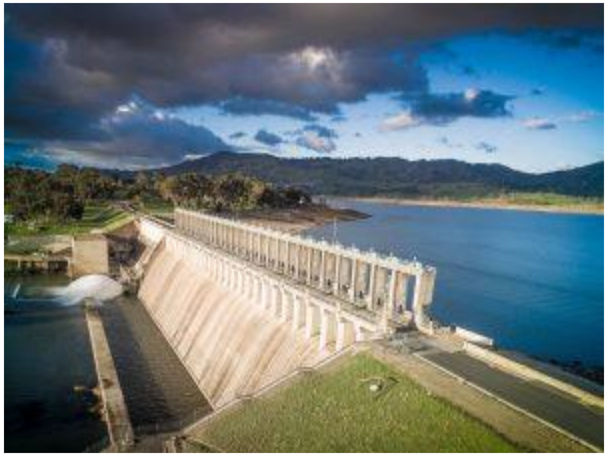
CASE STUDIES

Lake Harsha
Ohio, US

Lake Hume
New South Wales/Victoria, AU



Melbourne Western Treatment Plant
Victoria, AU

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LAKE MULARGIA
SARDINIA, IT

Mulargia Reservoir is one of the PrimeWater case studies.

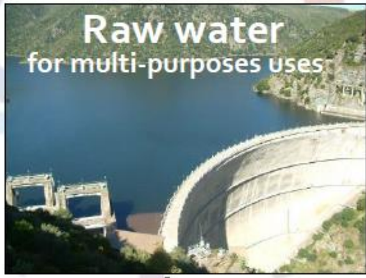
Here, research is taking place to explore **multiplatform optical data for assessing water quality**.

In Mulargia Reservoir, PrimeWater aims to **assess the predictability of algae blooms** – in terms of timing, extent, and intensity – for time scales spanning from several days to a few weeks ahead employing both process-based and data-driven models. PrimeWater will further evaluate the limits of those modelling approaches in terms of their sources of uncertainty and forecast horizons.

ENAS - Ente Acque della Sardegna: The Mission

ENAS Sardegna

According to the allocations, yearly established by
the Regional Sardinian Water Authority for each reservoir, ENAS supplies **raw water**:



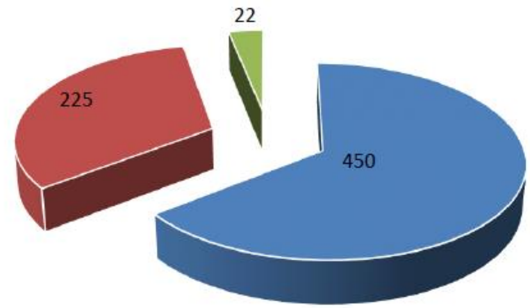
Industrial uses: 22 Mmc

Agriculture uses: 450 Mmc

Civil uses: 225 Mmc

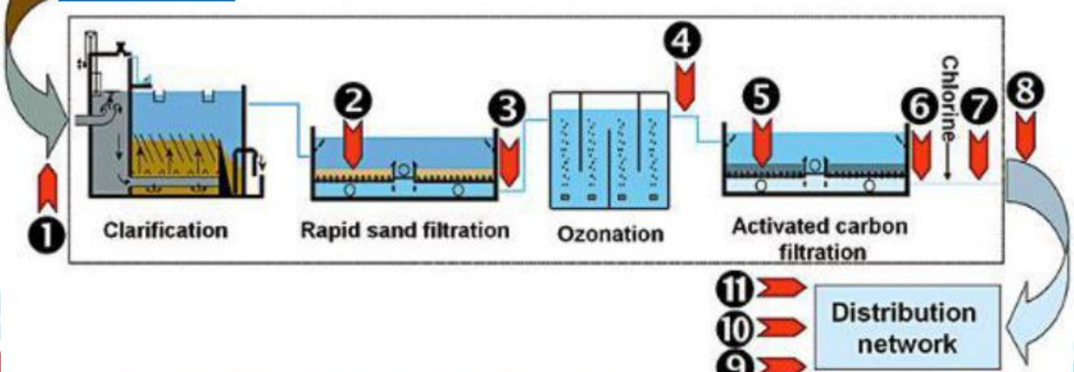
ABBANOA abba de Sardigna — Integrated water service operator

YEARLY WATER VOLUMES DISTRIBUTED



697 Mmc

Raw water

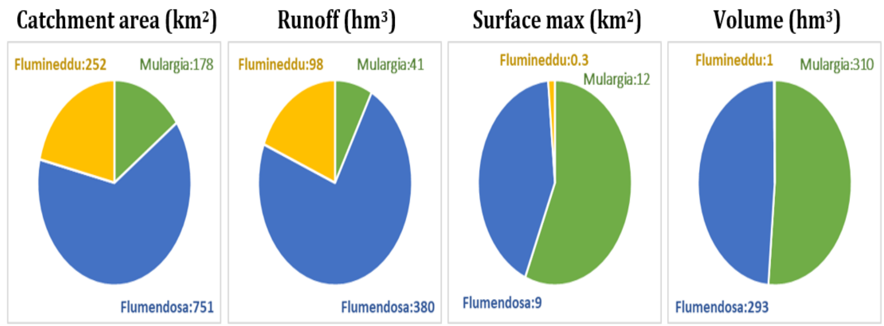


Potable water

THE RATIONAL FOR WATER BLENDING AMONG INTERCONNECTED RESERVOIRS

Problem definition

Dam height	99 m
Reservoir area	12 km^2
Capacity	310 hm^3
Upstream catchment area	178 km^2
Rainfall	600 mm/year



1) Inflow from river basin of Mulargia
2) Flumendosa tunnel transferring water from Flumendosa reservoir to Mulargia
3) Pumping station Basso Flumendosa transferring water to the entrance of Mulargia
4) Ecological outflow from Mulargia reservoir to downstream water body
5) Water abstraction for civil, agriculture and industrial uses
6) Automated monitoring station inside Mulargia
7) Automated monitoring station inside Flumendosa

- Mulargia & Flumendosa formulate a complex water system
- Bringing water from Flumendosa is not only a quantitative matter but also a way to improve water quality
- Currently water blending is performed empirically based on weather forecasting
- The correlation between action (blending water from an alternative source) and result (improving water quality) is not always obvious
- 9-days forecasting capacity of PrimeWater allows for preventive actions at early stage

INTRODUCTION

Defining the framework for evaluating the skill of the produced forecasts and warnings:

The end-users perspective

Co-design

Co-creation

Co-evaluation

Preparation
Elicitation
Analysis
Specification
Development & Testing
Validation

Operational services definition for the Mulargia Reservoir

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Problem | **Solution** | Impact

Problem	Solution	Impact
EO based water quality monitoring services		
Reservoirs monitoring is time and resource intensive.	A single daily measure of physical, chemical, and biological contaminants	Previous day detection of source water contamination and ability to evaluate effectiveness of protective strategies
Operational Forecasting services for Water Quality in Rivers & Lakes		
Responding to contamination events may be more costly than being prepared to avoid contamination events.	Up to 10-days in advance forecast of daily measures of physical, chemical, and biological contaminants and indices in a 3D grid	Early warning of impeding contamination and ability to evaluate effectiveness of protective strategies
Water Blending among interconnected reservoirs		
Managing interconnected reservoirs under Water Quality stress is a complex and multi-parametric problem which requires advanced tools.	Dynamically assess the effectiveness of various water transfer scenarios in terms of volume, timing and duration 10 d in advance through scenario-based forecasting tool for WQ characteristics and schedule proactively of water transfers between reservoirs.	Mitigate the evolution of algae blooms

QUESTIONS OF USERS

As a user, I would like to know the skill of forecasts for <*parameter or indicator*> during <*time period of interest*> at <*point of interest*> because it is critical for <*operation/action*>.

- ***Parameters***: *Define the most critical forecasted parameter (or indicator) that you would like to validate against your in-situ measurements.*
- ***When***: *Is there a specific time period when a skillful forecast would make difference for your operations (e.g. during a specific season or month, throughout the year).*
- ***Where***: *Validation will be performed against monitoring datasets collected by the floating station in Mulargia. Is there a specific point of interest (e.g. at surface, at a specific depth) or is the entire water column that matters?*

Main forecasted parameters and indicators to assess HABs

	Parameter	unit	Time resolution	Spatial resolution
Upstream catchments	River discharges entering reservoir	[m3/d]	Daily time step- 10 days ahead	Catchment level
	Nitrogen, Phosphorus and Sediment loads entering reservoir	[kg/d]		
	Temperature of water entering reservoir	[ºC]		
Reservoir	Chlorophyll (green algae, cyanobacteria, diatoms) inside the reservoir	[mg/L]	Hourly time step - 1 week ahead	100x100 m^2 grid cell, 15 vertical layers (aggregation in larger areas available)
	Suspended sediments inside reservoir	[mg/L]		
	Nitrogen (NO3, NH4), Phosphorus (PO4) inside reservoir	[mg/L]		
	Water temperatures inside reservoir	[ºC]		
	Dissolved oxygen	[mg/L]		
	Velocities	[vectors]		

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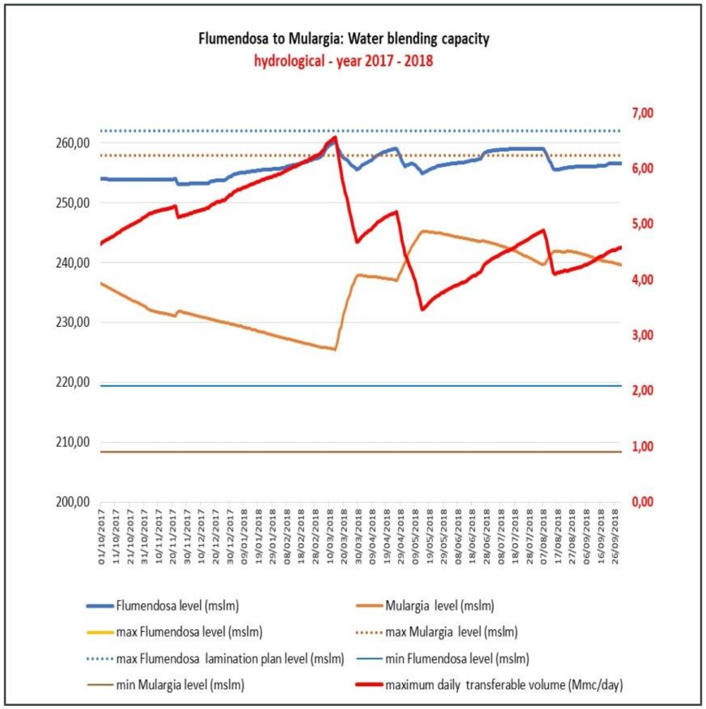
Define specific indicators for targeted concerns or operations

Indicator Type	Category	Assessment based on
Intensification of algae bloom	Increase /No change or Rate of increase	Localized change in chlorophyll levels
Evenness of phytoplankton community	According to Pielou' s evenness index	Calculated based on forecasted values of a different member community
Reservoir stratification tendency	Depth of the thermocline, Lake number, Wedderburn number Schmidt stability	Capture change of circulation pattern in the reservoir

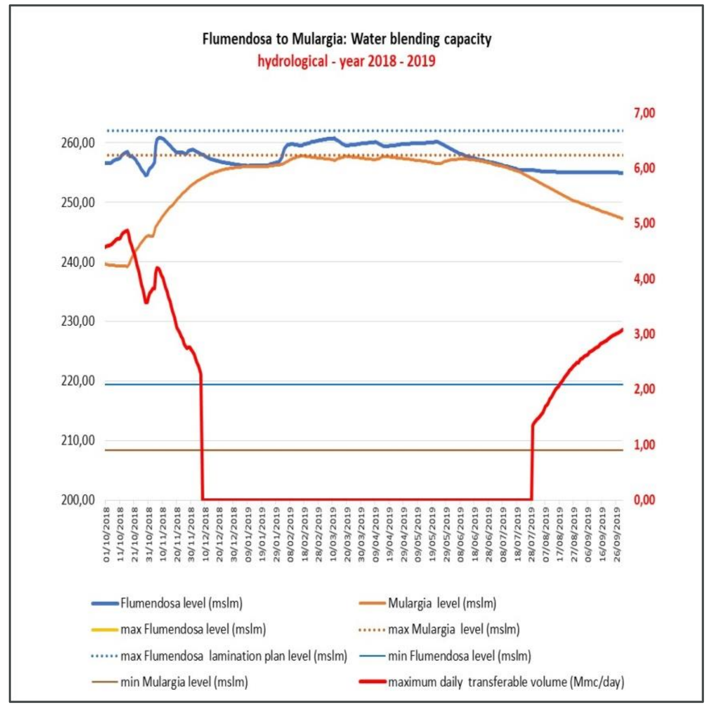
THE RATIONAL FOR WATER BLENDING AMONG INTERCONNECTED RESERVOIRS

Problem definition

1. Flumendosa - Mulargia water blending is dependent on the **amount of water that can be transferred**;
2. The **transferable water volume** is related to the Flumendosa and Mulargia water level.
3. Maximum **transferable water volume: 6.5 Mmc/day**



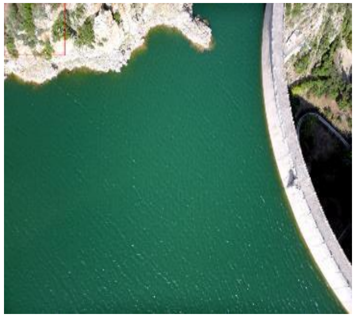
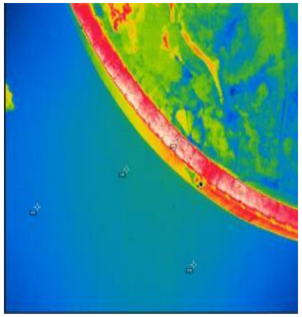
Drought season:
Water blending scenarios can be established all over the hydrological year



Standard season:
Water blending scenarios can be established in the following periods: October-December and July-September

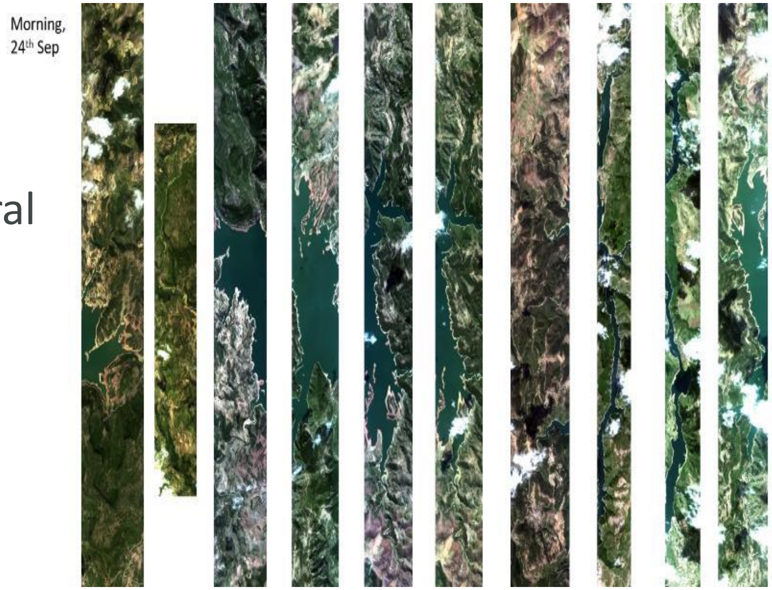
Water blending scenarios should be congruent to the current management of the reservoirs

ANALYSIS - MULTIPLATFORM EXPERIMENTS: 22-25 SEPT 2020 (BY CNR-IREA/EO ELABORATIONS)

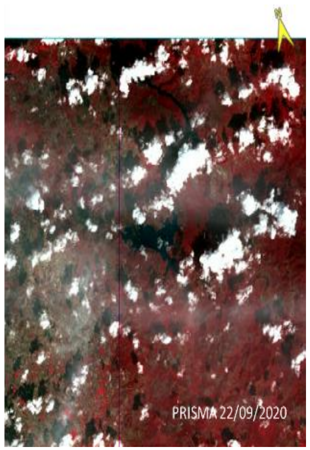
UAV Multispectral and Thermal acquisition

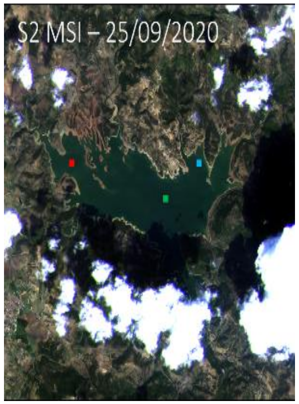
Airborne Hyperspectral acquisition



In situ Field campaign

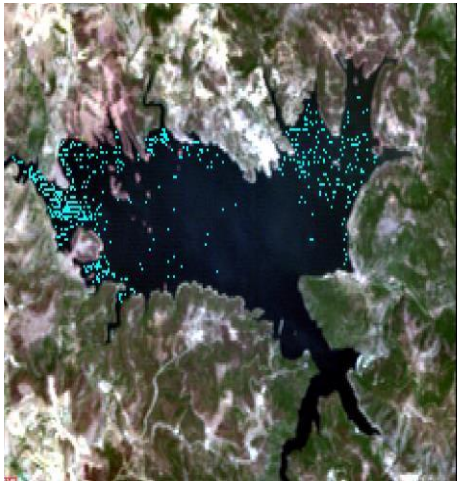
Different Satellite acquisition



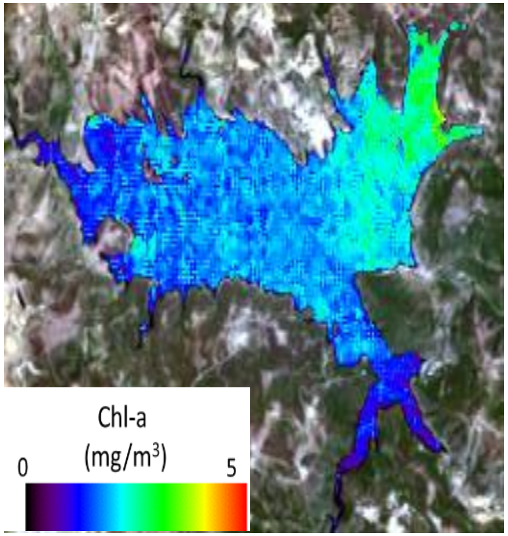


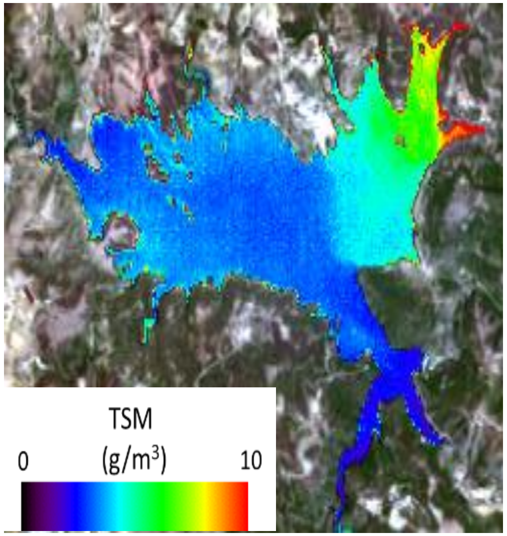
RESULTS - HYPERSPECTRAL ON MULARGIA RESERVOIR (BY CNR-IREA/EO ELABORATIONS)

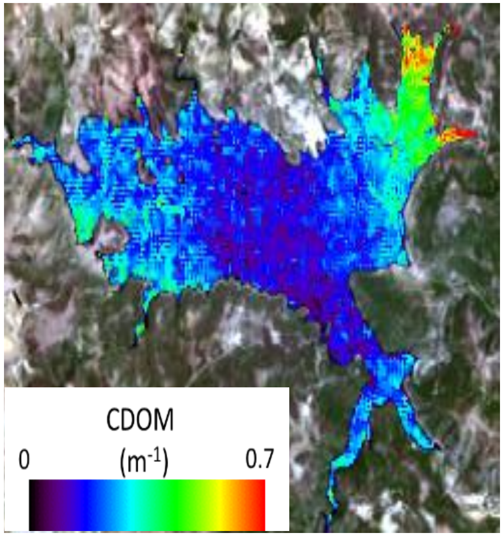
PRISMA
(8/7/2020)



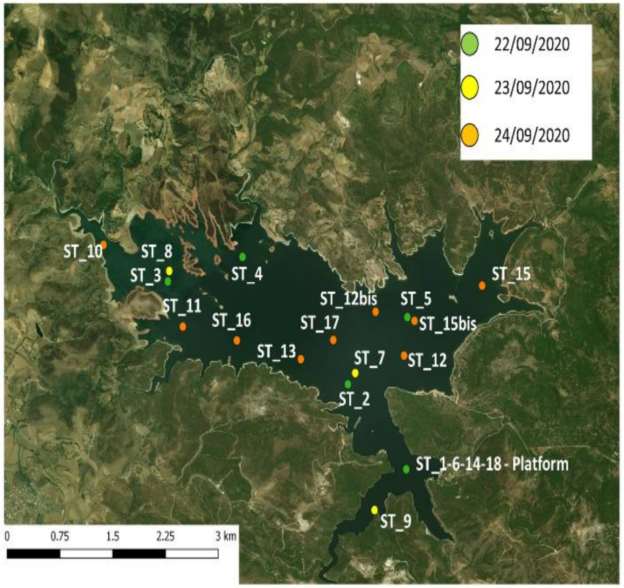
Pixel with spectral signature characterized by cyanobacteria with phycocyanin pigment

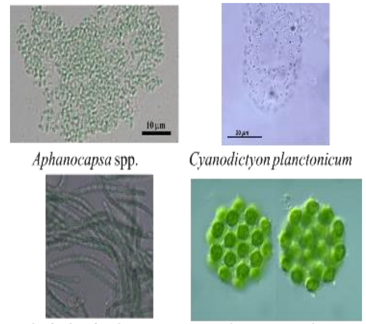






RESULTS - IN SITU DATA 22-25 SEPT 2020 (BY CNR-IREA/EO ELABORATIONS)





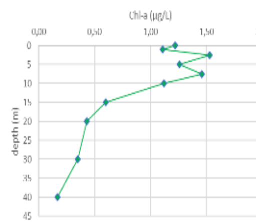
Aphanocapsa spp.

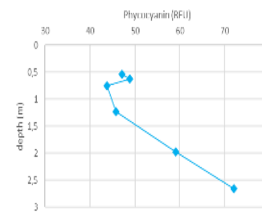
Cyanodictyon planctonicum

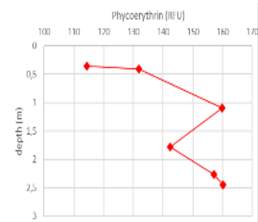
Planktolyngbya limnetica

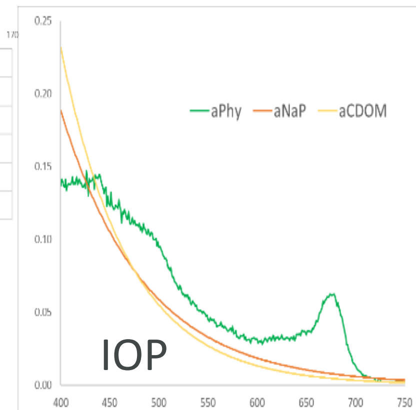
Coelastrum reticulatum

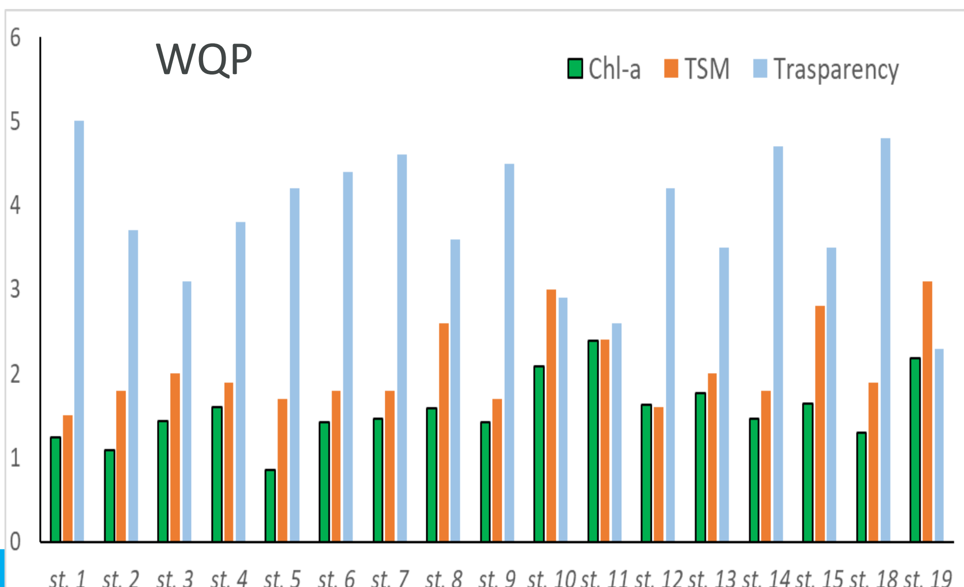
Parameter	UM	Depth											
		0 m	1 m	2,5 m	5 m	7,5 m	10 m	15 m	20 m	30 m	40 m	50 m	64 m
Temperature	°C	25.2	24.9	24.8	24.7	24.3	23.4	16.8	14.5	13.9	12.6	12.2	12.1
pH	pH	8.55	8.56	8.54	8.55	8.34	7.69	7.01	6.91	6.88	6.85	6.76	6.77
Conductivity	µS cm^{-1}	315	311	311	311	311	309	282	274	267	275	272	276
Turbidity	NTU	2.8	2.0	2.3	2.4	2.5	2.6	3.3	3.2	3.6	5.8	6.2	7.9
Alcalinity	meq l^{-1}	2.26	2.08	2.16	2.16	2.12	2.18	2.14	1.90	1.96	1.96	1.88	2.08
Oxygen	mg l^{-1}	8.5	8.5	8.5	8.4	7.3	3.9	1.2	2.1	1.9	1.7	0.3	0.1
Ossigeno	% satur.ne	106	105	105	104	89	47	12	21	19	17	3	1
Phosphorus	mg P m^{-3}	NR	NR	NR	NR	NR	NR	NR	2	3	4	8	9
Total phosphorus	mg P m^{-3}	10	13	10	9	11	8	7	8	11	12	14	20
NO3	mg N m^{-3}	tracce	NR	NR	78	8	44	258	408	506	482	505	498
NO2	mg N m^{-3}	NR	NR	NR	NR	NR	1.0	tracce	tracce	NR	NR	NR	tracce
NH3 Nitrogen	mg N m^{-3}	NR	tracce	NR	tracce	NR	7	NR	NR	NR	NR	11	11
Total Nitrogen	mg N m^{-3}	358	368	370	364	378	342	490	654	763	717	741	810
Silica	mg Si l^{-1}	0.08	0.06	0.06	0.07	0.07	0.13	0.52	1.20	1.47	1.47	2.01	2.17



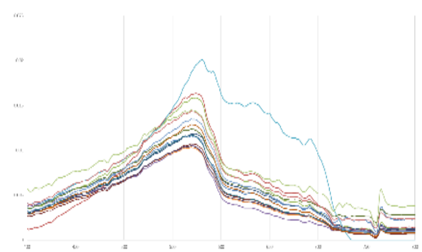


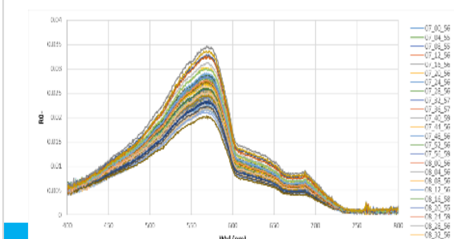


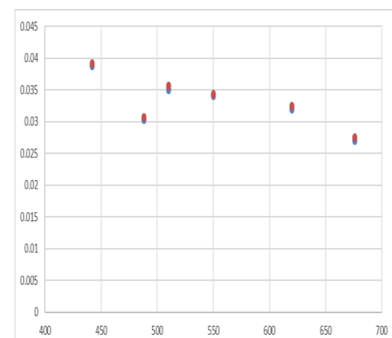




Reflectance







Preparation

Elicitation

Analysis

Specification

Development & Testing

Validation

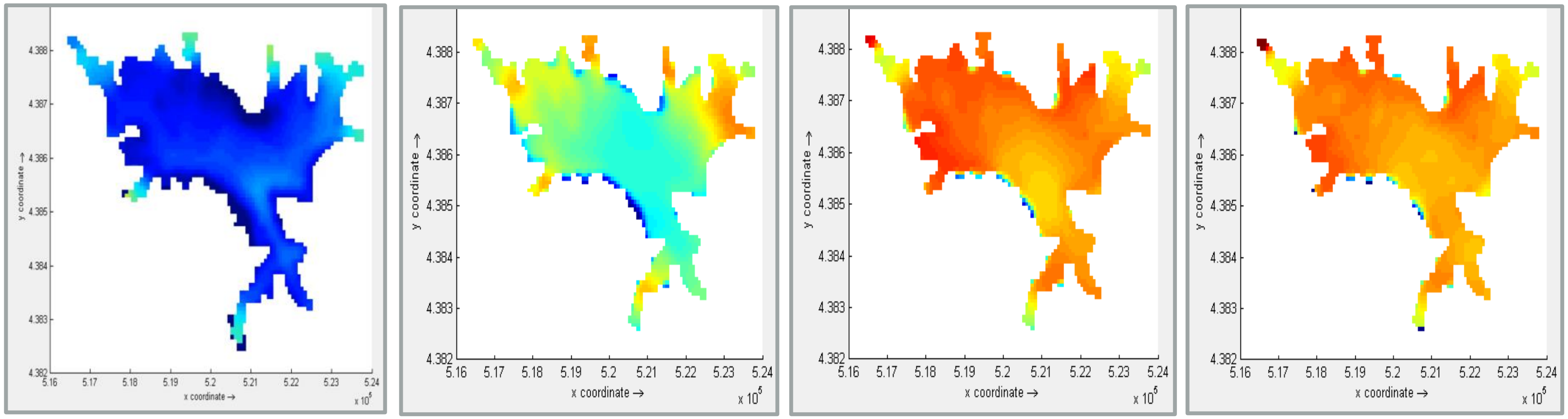
ELABORATIONS - THE RATIONAL FOR WATER BLENDING AMONG INTERCONNECTED RESERVOIRS

Using PrimeWater for optimizing water quality in Mulargia Reservoir

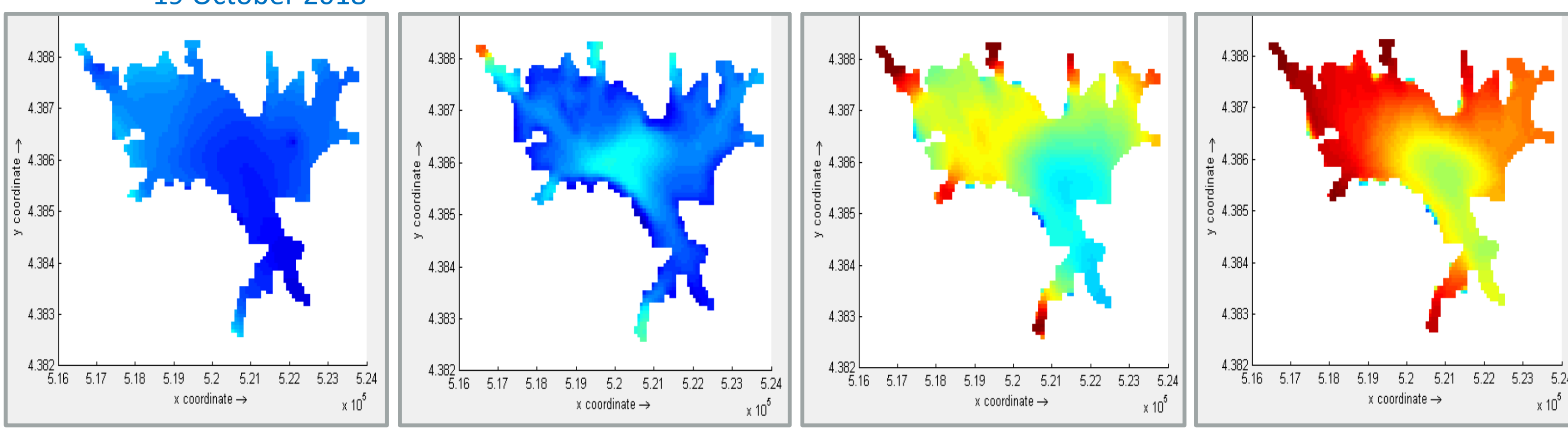
the international water association

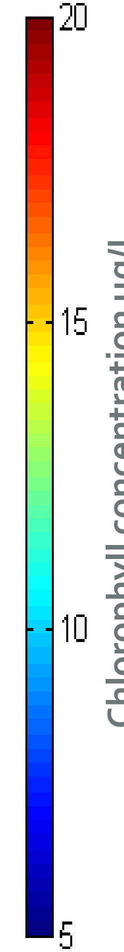
Algae bloom evolution during autumn 2018 & summer 2017

Day 0 **3d forecast** **6d forecast** **9d forecast**



10 October 2018 13 October 2018 16 October 2018 19 October 2018



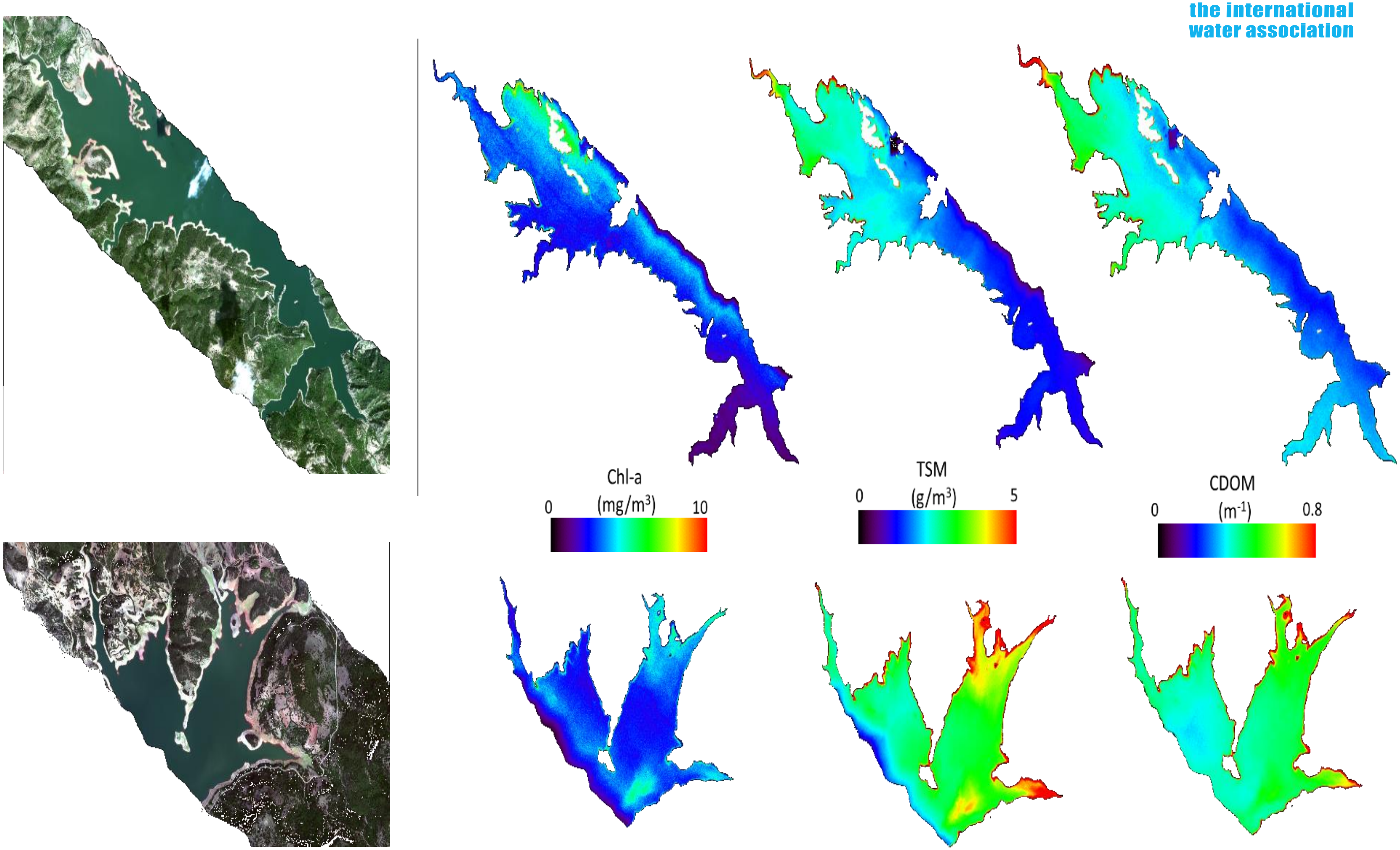


17 July 2017 20 July 2017 23 July 2017 26 July 2017

Could these algae blooms have been avoided?

AIRBORNE RESULTS (BY CNR-IREA/EO ELABORATIONS)

the international water association



Preparation
Elicitation
Analysis
Specification
Development & Testing
Validation

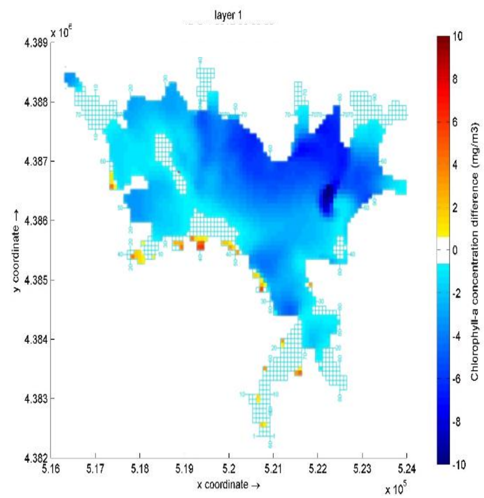
WATER BLENDING AMONG INTERCONNECTED RESERVOIRS

Preventing the evolution of an algae bloom by combining different sources of water

the international water association

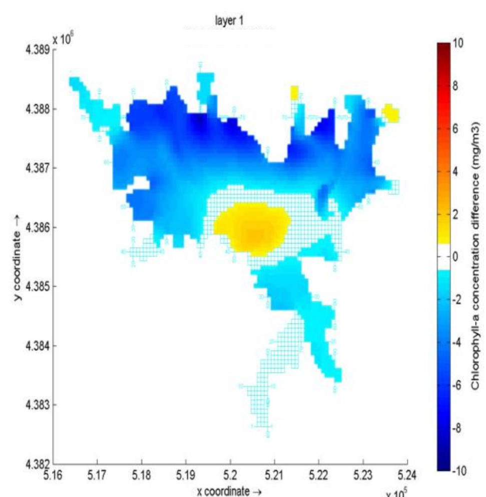
Investigate if transferring 40 hm3 of water from Flumendosa can reduce chl-a concentrations

Differences in chlorophyll a concentrations between the scenario of Flumendosa contribution and the reference scenario at day +9 (19 Oct 2018) for the top layer.



- ❑ Water elevation in Mulargia increases by almost 3 meters
- ❑ Additional water from Flumendosa reduces chl-a values by up to 10 µg/L.
- ❑ Higher reduction is observed near the area of the Flumendosa tunnel entrance and the north part of the reservoir.
- ❑ Smaller differences are observed in the reservoir perimeter due to nutrient fluxes from upstream rivers

Differences in chlorophyll a concentrations between the scenario of Flumendosa contribution and the reference scenario at day +9 (26 Jul 2017) for the top layer.

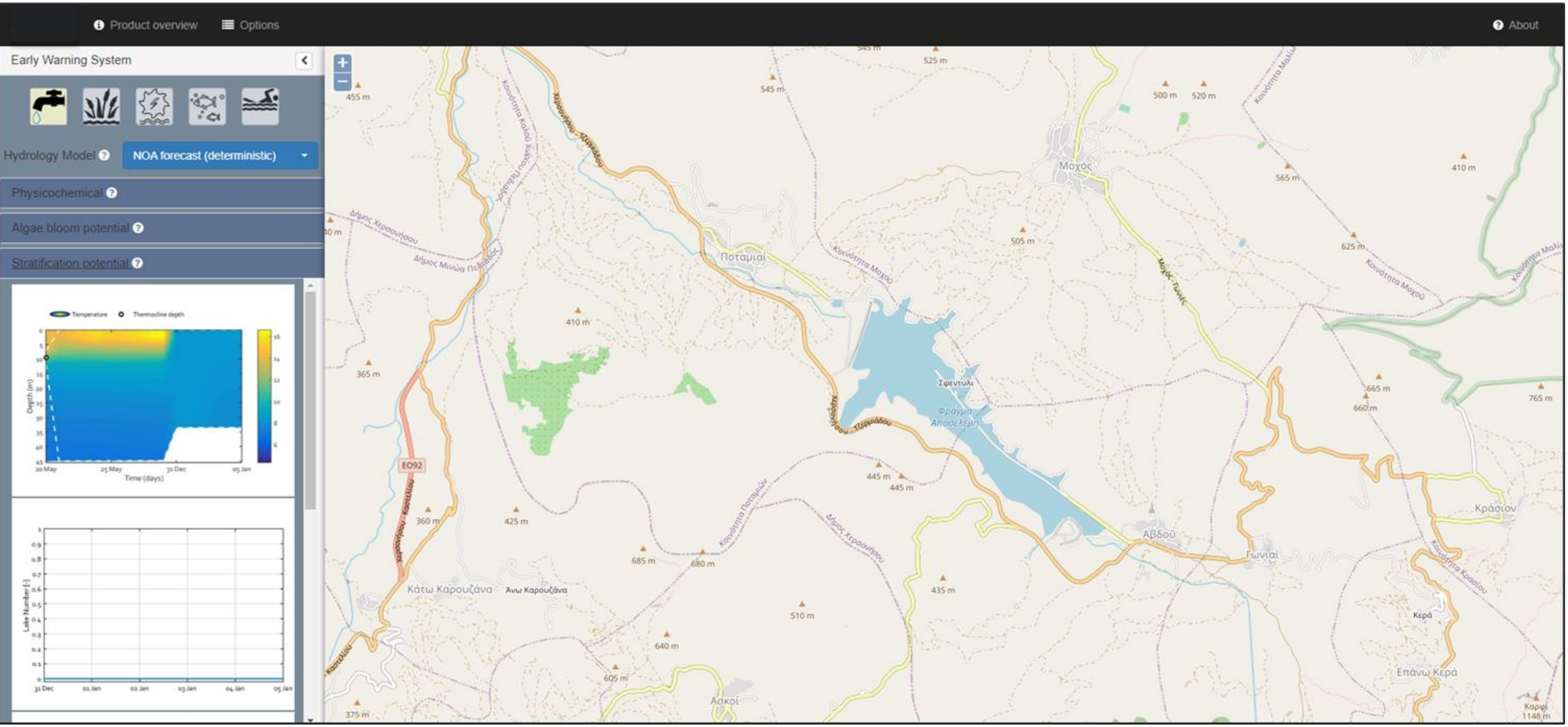


- ❑ Water elevation in Mulargia increases by almost 3 meters
- ❑ Chlorophyll reduction is also dictated by the hydrodynamic conditions
- ❑ Additional water from Flumendosa reduces chl-a values by up to 6 µg/L in the north part but increases chl-a in the center of the reservoir.

Why did the reservoir not respond in the same manner?

- ❑ the different water quality characteristics of Flumendosa at that time of the year
- ❑ the hydrodynamic pattern which breaks the thermal stratification and releases nutrients to the upper layers.

OPERATIONAL SERVICE OFFERS TO END USER BY PRIMEWATER PLATFORM



the international water association

THANK YOU

Grazie

Use of EO in practice for water management

BLAKE SCHAEFFER

US EPA

inspiring change

IWA & SATELLITE WATER QUALITY

the international water association

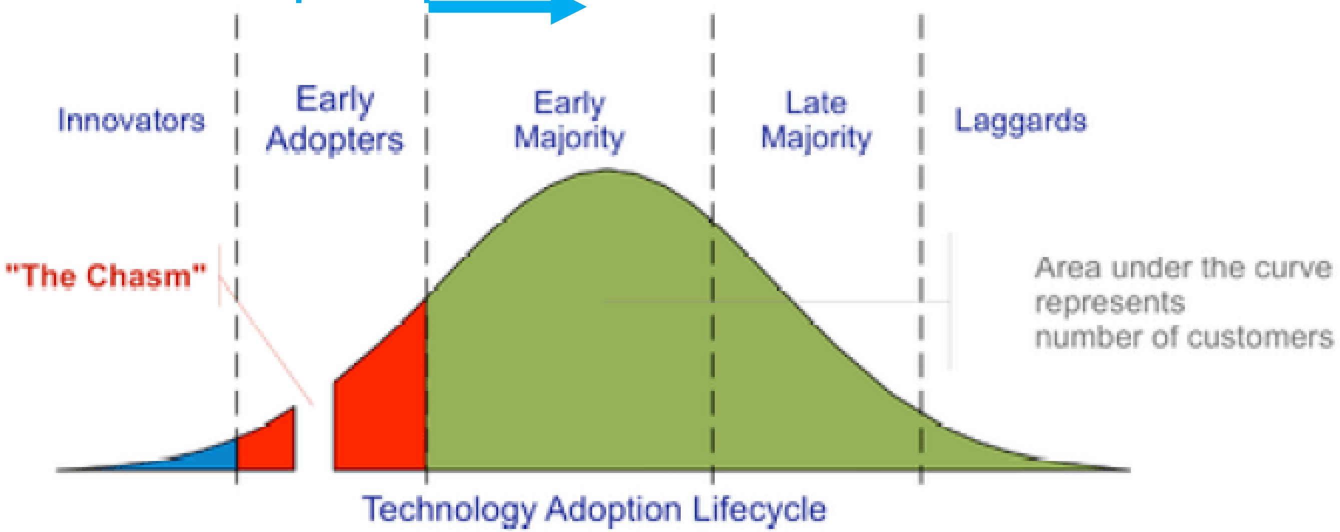
- **IWA 2019 Strategic Plan**
  - "scarcity into abundance."
  - "utilities…improve efficiency, enhanced services and credibility."
  - "universally applicable, easily accessible, and locally adaptable."
- **Satellite Water Quality Concepts**
  - Discrete temperature measures >11,000 U.S. lakes…satellite temperature >170,000 lakes (Schaeffer et al., 2018).
  - Annual potential avoided costs increasing the availability of remotely sensed chlorophyll-a values…range between \$5.7 and \$316 million (Papenfus et al., 2020).
  - Better targeting of sampling and providing additional spatial and temporal context (Schaeffer et al., 2013).

IWA & SATELLITE WATER QUALITY

IWA "…**bridging the chasm** between research and practice..."

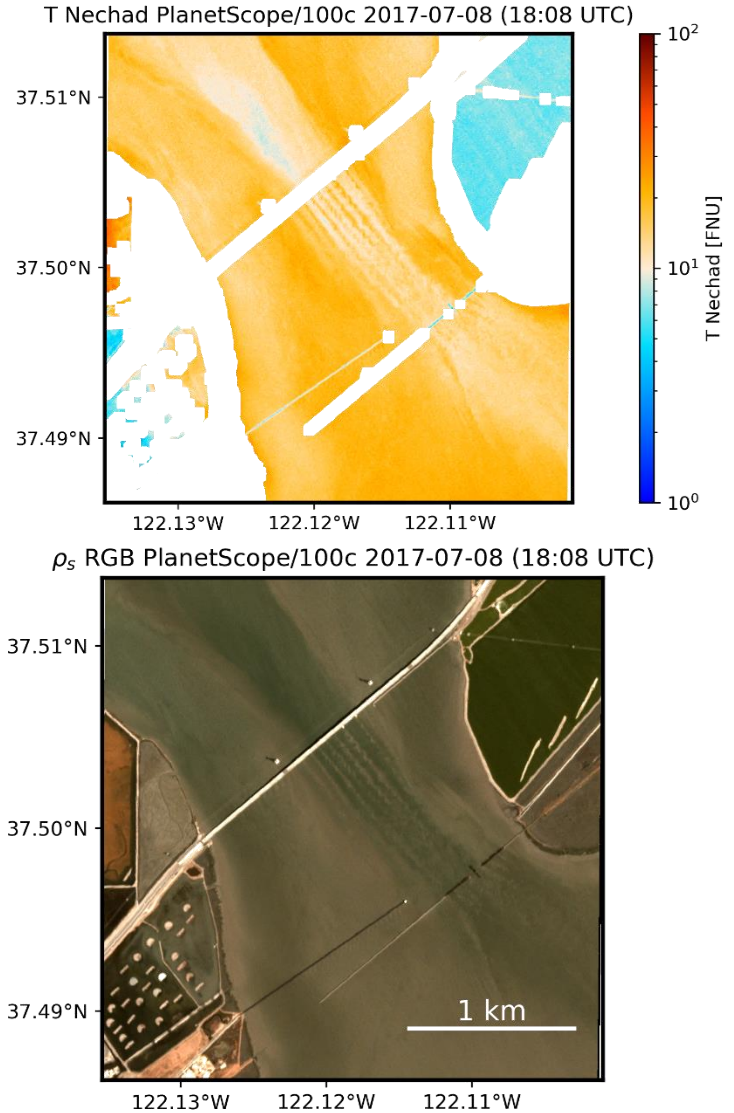
Satellite
Water Quality
Monitoring

Satellite
Water Quality

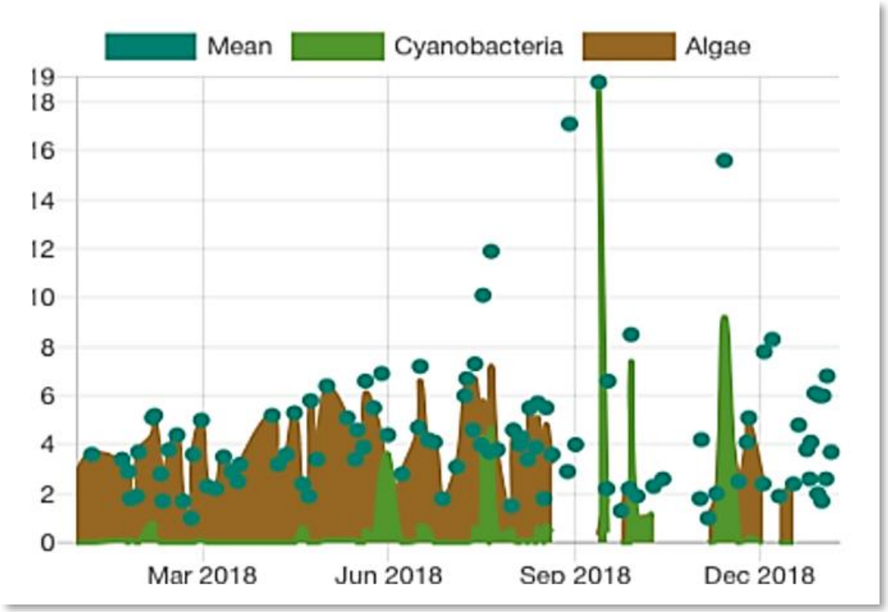


Source: strategiesforinfluence.com
G. Moore "Crossing the Chasm"

EARLY ADOPTERS

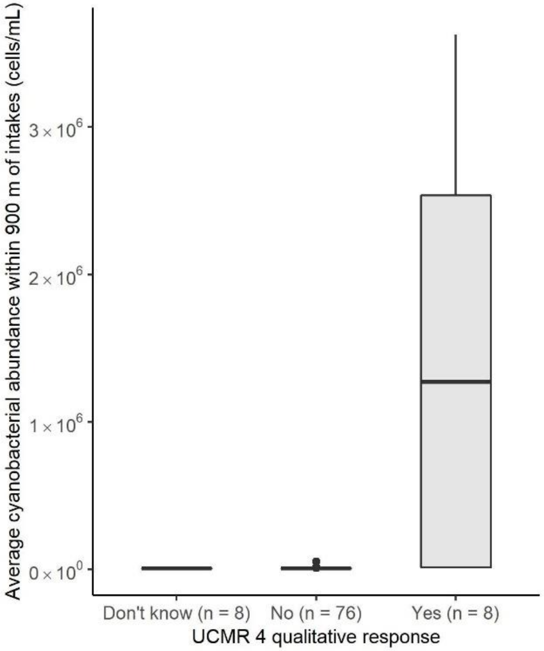


Source: qvanhellemont@naturalsciences.be



Source: mark@cyanolakes.com
cyanolakes.com

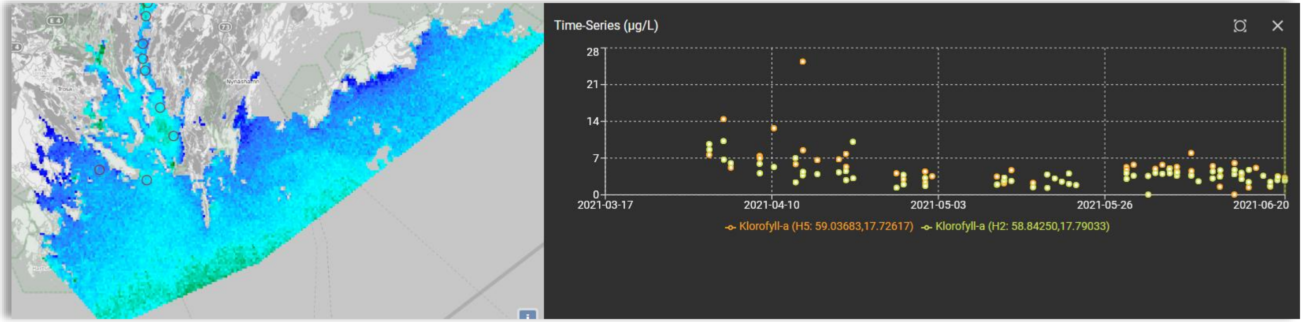
EARLY ADOPTERS



CYAN CYANOBACTERIA ASSESSMENT NETWORK

Source: schaeffer.blake@epa.gov

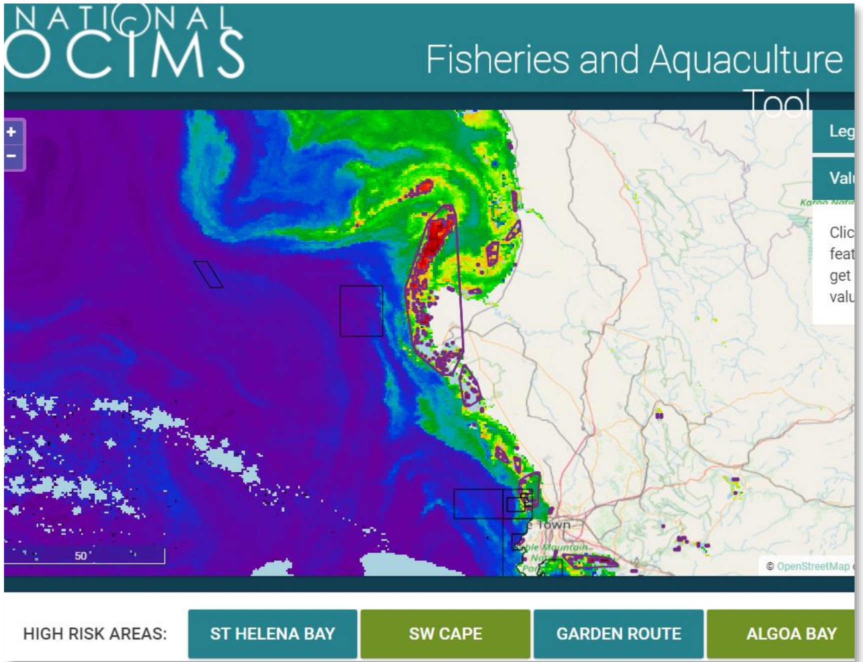
epa.gov/cyanoproject



Source: kerstin.stelzer@brockmann-consult.de

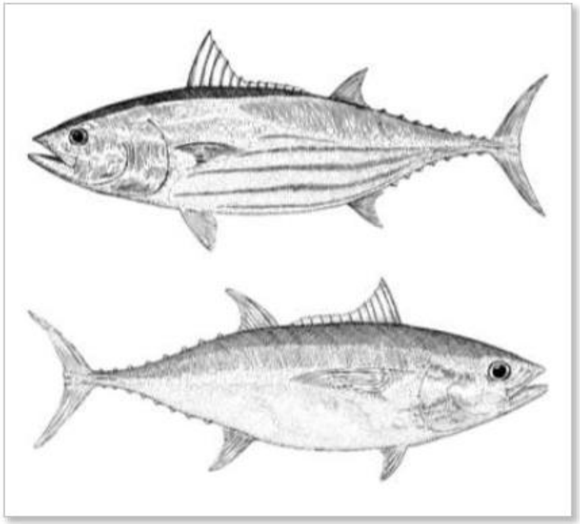
cyanoalert.com

EARLY ADOPTERS



Source: MSmith2@csir.co.za
ocims.gov.za/hab/app/

Annual Stock Assessment and Fishery Evaluation Report for U.S. Pacific Island Pelagic Fisheries Ecosystem Plan
2019



Source: ryan.rykaczewski@noaa.gov

EARLY MAJORITY

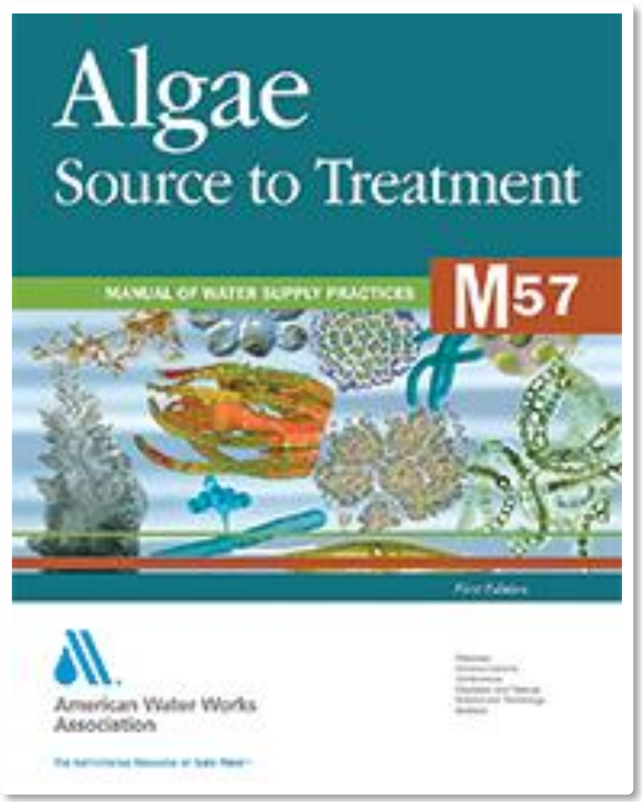
IWA's "Sustainable Development Goals (SDGs) for water require a rapid and transformational new approach based on inclusive governance."

MONITORING FOR SDG INDICATOR 14.1.1: Coastal Eutrophication

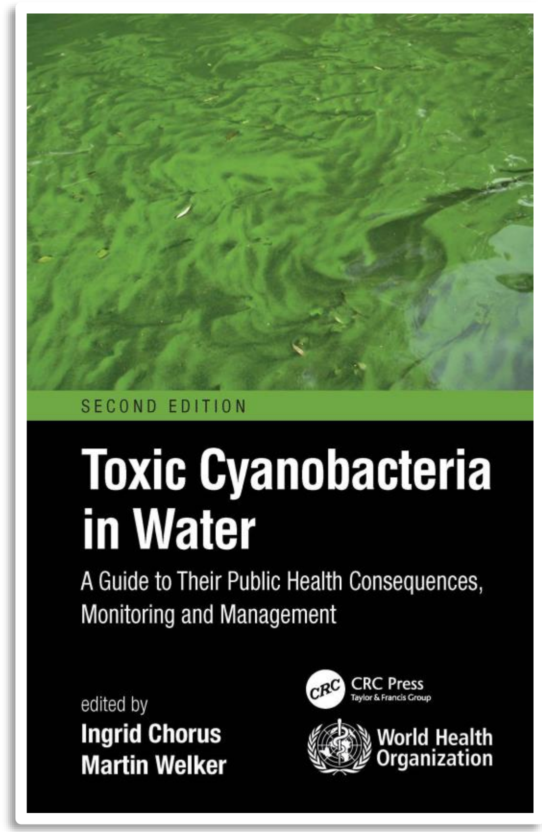
Source: chlorophyll-esrioceans.hub.arcgis.com/

sdg661.app/home

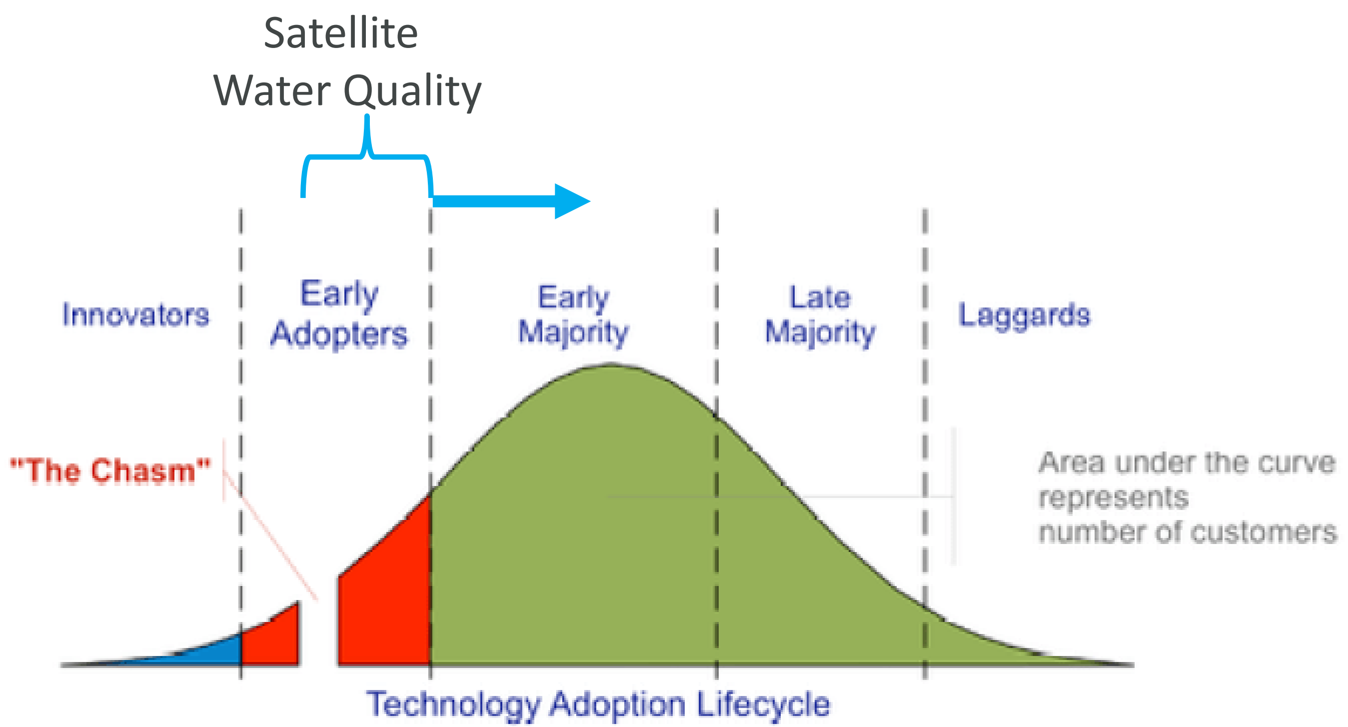
EARLY MAJORITY



Strategies for Preventing and Managing Harmful Cyanobacterial Blooms (HCBs)
AVAILABLE NOW!



IWA & SATELLITE WATER QUALITY



Source: strategiesforinfluence.com
G. Moore "Crossing the Chasm"

Q&A DISCUSSION

Dr Erin Urquhart
PACE Applications Coordinator at NASA GSFC, USA

Steven Greb
Researcher at University of Wisconsin-Madison, Director of GEO AquaWatch, USA

Apostolos Tzimas,
Managing Director at EMVIS Consultant Engineers, PrimeWater project leader, Greece

Maria Dessena,
Geologist at ENAS, Italy

Blake Schaeffer,
Research Scientist at US Environmental Protection Agency (EPA), USA

UPCOMING! EARTH OBSERVATION FOR WATER MANAGEMENT GROUP

The IWA Digital Water Programme will soon launch the **Earth Observation for Water Management Group**.

MAIN OBJECTIVES

- Provide a platform for different end-users to share approaches on the application of EO, in situ data sets, citizens science, modelling and data assimilation techniques for water management.

- Enable linkages between cross cutting scientific communities and end-users to attain a better understanding of EO.

- Identify gaps and how these can be addressed in the understanding and use of EO technology in managing water.

More info will be shared in the post-webinar email!

the international water association

GET-TOGETHER

the international water association

YOUNG WATER PROFESSIONALS

Next Generation Water Action: Turning Challenges into Opportunities

Wednesday, 28 July 2021 13:00 BST

https://iwa-network.org/learn/ywp-get-together-next-generation-water-action-turning-challenges-into-opportunities/

Join our network of water professionals!

IWA brings professionals from many disciplines together to accelerate the science, innovation and practice that can make a difference in addressing water challenges.

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