



# Water - ForCE

Defining the future of Water related services inside of Copernicus, the Earth Observation component of the EU Space Programme

Carmen Cillero, PhD. on behalf of the [Water-ForCE Consortium](#)





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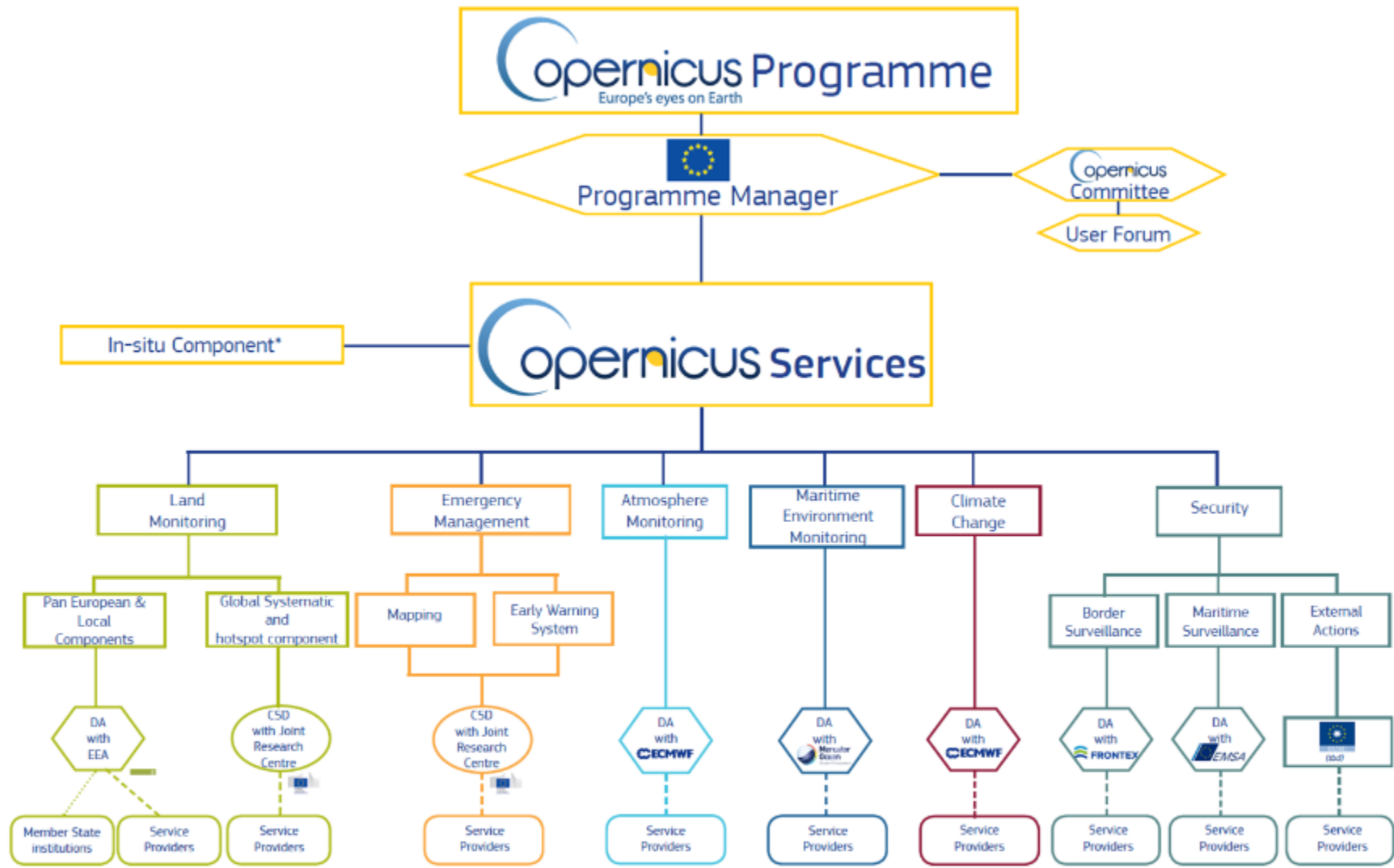
# EU Horizon 2020 Space Programme

**Copernicus evolution:**

**Mission exploitation concept for WATER**

## **Scope:**

The main goal is to analyze current and planned EO space capacities together with innovative processing, modelling and computing techniques to reinforce the existing portfolio offered under Copernicus and to propose an integrated approach for a coherent and consistent inland water monitoring system.

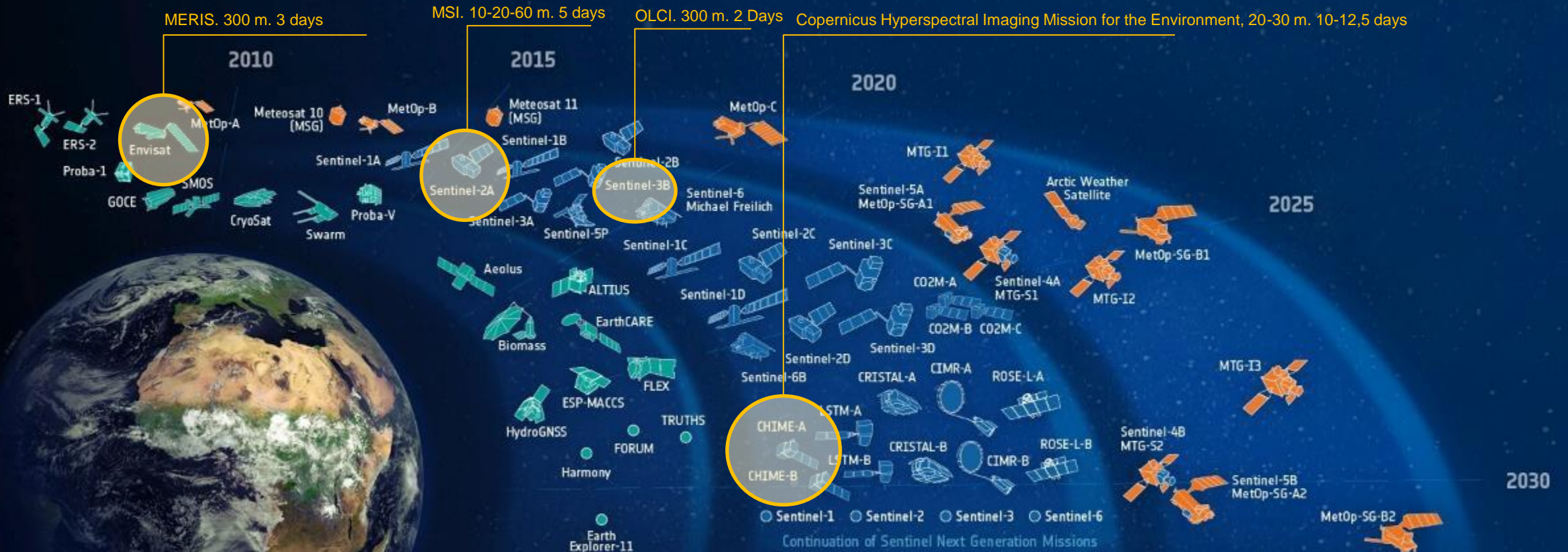


**Legend**

Implementation mode will be defined by:

- Commercial contracts
- ..... Grants
- Copernicus component
- Service Providers
- Joint Management
- Joint Management
- Coordinated by EEA
- Coordinated by Copernicus
- Coordinated by the European Space Agency
- Coordinated by the European Centre for Medium-Range Weather Forecasts
- Coordinated by the European Centre for High-Resolution Weather Forecasts
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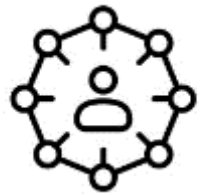
# ESA-DEVELOPED EARTH OBSERVATION MISSIONS



# Water-ForCE approach

Develop Roadmap for  
Copernicus WATER services

# Roadmap



WATER QUALITY SENSOR



# The main outcome: Roadmap for Copernicus Water Services

- Optimal long-term strategy taking into account existing water related products
- List of higher-level biogeochemical products
- Technical requirements for future Copernicus sensors
- Analysis on how Copernicus Water services can support policy development
- Proposal for organizing in situ measurement networks to best validate EO products
- Proposal for defining the relationships between Core Services and Downstream Services
- Recommendations on the evolution of Water Services





WP 7 Dissemination and Communication

WP8 Project Coordination and Management

# Water-ForCE as a workstream inside of

# World Water Quality Alliance





Water-ForCE as a workstream inside of

# World Water Quality Alliance



Maximize benefit

Knowledge exchange

Final impact and relevance of the Roadmap to support the ambitions of the UNEP and WWQA

# Recent workshops

Copernicus water component evolution – policy expert

October 20th and 21st 2021 | Hybrid: Online and Phoenix Copenhagen Hotel



In situ calibration and validation of satellite products of water quality and hydrology

May 17th, 18th and 20th, 2021 | Online



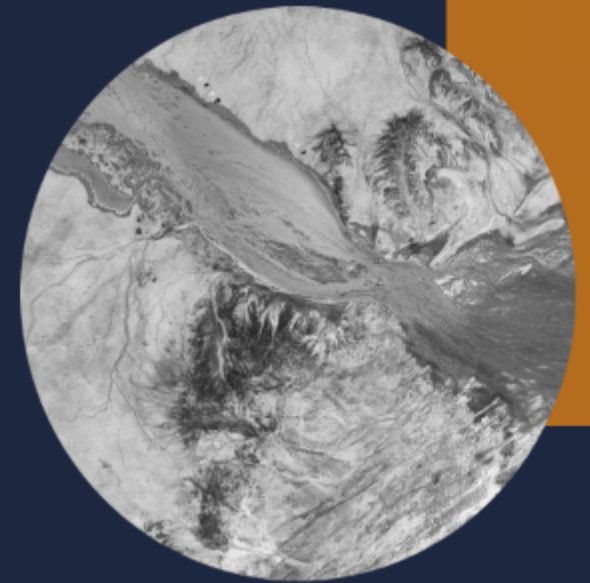
Stakeholder Input on the Evolution of Copernicus Water Services

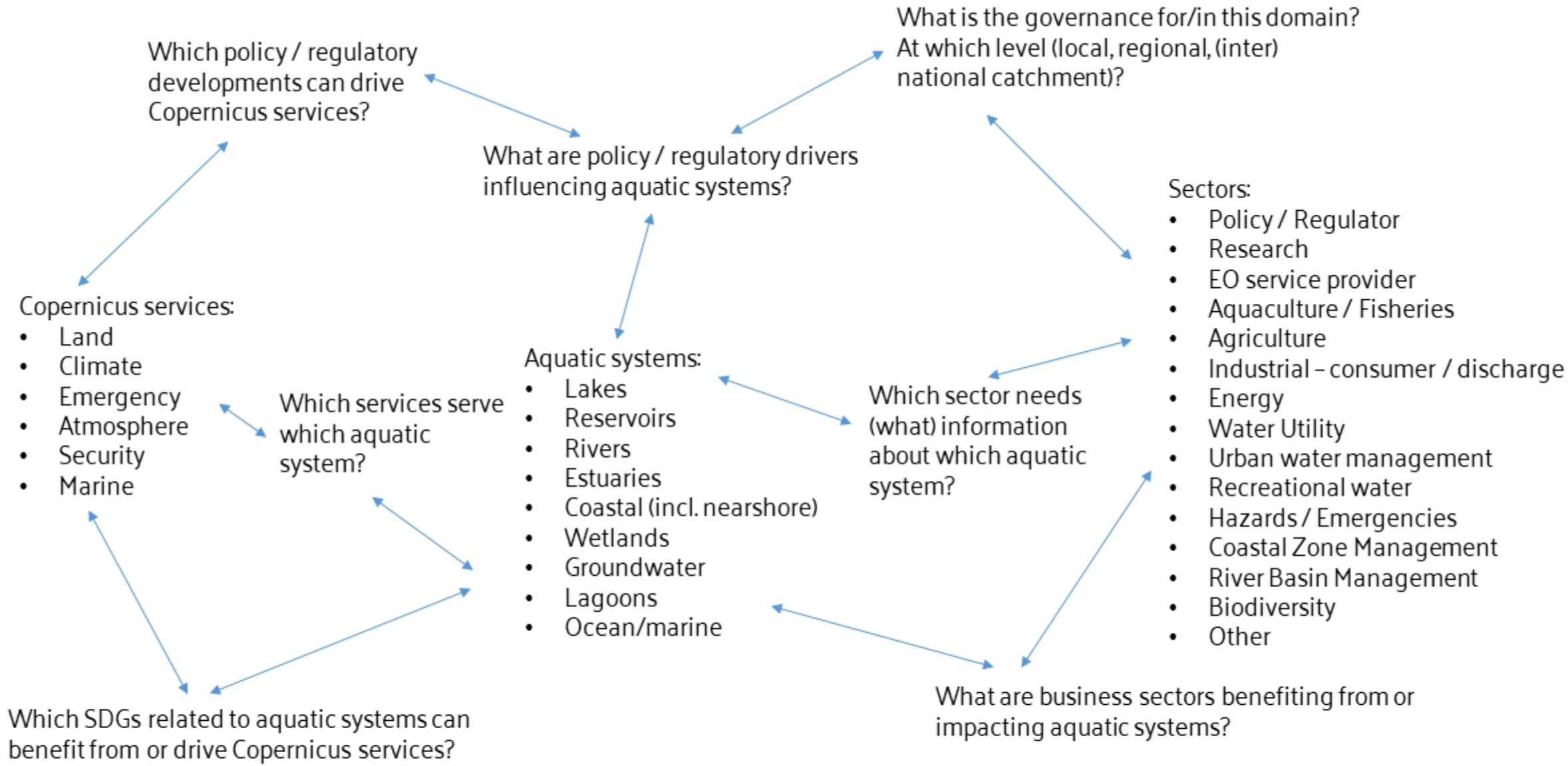
April 20th, 2021 13:00 CEST | Online



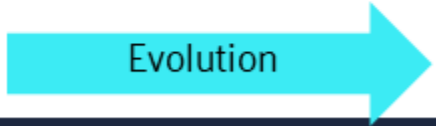
On the use of remote sensing for monitoring and modelling the water cycle

March 15, 2021 09:00 CET | Online



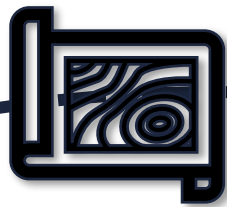


1) What is state of play now? (missions, services, products; desk research + inputs WPs 2-5)



2) What is planned 2021-2027 (e.g. new EEA water quality products)?

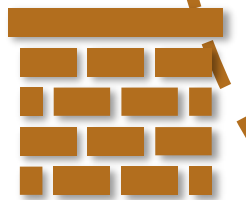
## Product Needs



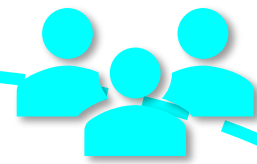
- Increased **resolution**.
- Comprehensive **water quality** indicators.
- **Water quantity** products: flood and drought forecasting.
- Sustainable **agriculture**: water use, soil salinisation, sedimentation, nutrients.
- **Water supply** products

## CAPACITY BUILDING

- **Exclusivity** - Copernicus to expert users.
- **Standardisation** - recommended practices & standards (algorithms, cal/val)
- **Comparability** - Satellite and historical in situ data
- **Confidence** - validation, accuracy, limitations and uncertainties.



## Barriers



## User Needs

- Central **data portal**
- **Training Material**: Data access & use

## OPPORTUNITIES



- Contributions towards **water-related SDGs** and environmental policy.
- **EO and modelling** for water quantity and quality **forecasts**.
- **Combined approach** coupling water quality/quantity data and land use/land use change data could aid **water governance**.

# Water Quality



Lake Water Products (Lake Surface Temp & Lake Water Q)

- **4,200** of medium and large-sized inland water bodies
- 10-day aggregate periods.
- **Averages:** turbidity, TSI & temperature,
- Representative spectrum of lake water-leaving reflectance.



IOPs and Rrs

Products for ecological management:

- Chla concentration
- Sea surface temperature (SST)
- Secchi depth (ZSD)
- Photosynthetically available radiation. (PAR)
- Suspended Particulate Matter (SPM)



Water quality related products derived from satellite observations. :

- Lake surface water temperature (1995 –present)
- Ocean colour daily data (1997 – present)

## Identified bottlenecks

- Harmonization / standardization among different Copernicus Services.
- A centralized portal for easy access to water quality related products from different Copernicus Services
- Data for cal/val of current and future water quality related products.
- Improvement of algorithms for AC
- More spectral bands (and/or better spatial resolution) in satellite sensors.
- Lack of data-awareness with the wider community.
- Higher level water quality products (primary productivity, phycocyanin)

# Water Quality

## Needs and Recommendations from the Expert Panels

- *in situ* water quality experts
- water quality remote sensing experts
- relevant projects

- Data interoperability
- New observation methodologies
- In a range of usage scenarios.

- Higher spatial resolution products, especially for inland aquatic systems.
- **Desirable water quality products:** Dissolved matter composition, Light absorption and scattering properties, Nutrient availability, Particle size distribution, Particulate matter weight or composition, Phycocyanin, Phycoerythrin, Phytoplankton composition, Primary production, Turbidity, Vertical light attenuation or transparency, Water colour indices, Benthic habitats, Microplastics, Dissolved Organic Matter.

## GAPS

- Training for collecting data that can be used for remote sensing calibration and validation
- Common vocabulary between in situ water quality community and remote sensing community
- Funding opportunities for installing spectroradiometers in the existing infrastructures.
- Capacity building for satellite EO data users



# Water Quality

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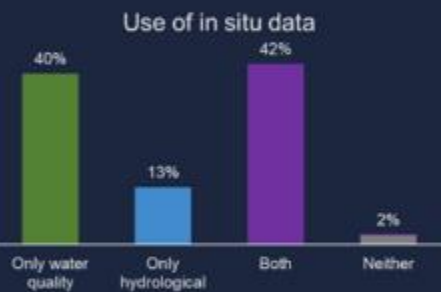
Suggestions for additional Sentinel 2 – MSI spectral bands are:

- A **narrow spectral band around 620 nm** would be needed for the development of cyanobacteria water column-biomass products.
- A **band centered at 470 or 473 nm with 20 nm bandwidth** for the estimation of carotenoids.
- A **810 nm band** as a good indicator of particulate material (if the particular material is phytoplankton (like in most lakes) then the peak height correlating with the Chl-a).
- A narrow spectral band **around 1070 nm** would be needed for the identification of plastic in water (Moshtaghi, 2021).
- **mapping shallow water habitats** and to improve retrieval of substrate type.
- The signal to noise ratio needs to be improved for dark waters. The Feasibility Study for an Aquatic Ecosystem Earth Observing System (CEOS, 2018) recommended for the radiometric sensitivity a noise equivalent radiance difference (NE $\Delta$ L) in the range 0.005 mW m<sup>-2</sup> sr<sup>-1</sup> nm<sup>-1</sup> (optimal) and 0.010 mW m<sup>-2</sup> sr<sup>-1</sup> nm<sup>-1</sup>.
- **Higher temporal resolution** (daily revisit time) to allow monitoring water quality where the dynamics can change rapidly or where cloud cover is frequent.
- Off-nadir viewing angles to avoid **sun glint**.

# In situ monitoring Networks

## Expert response

16 responded on behalf of organisation,  
29 on own behalf.

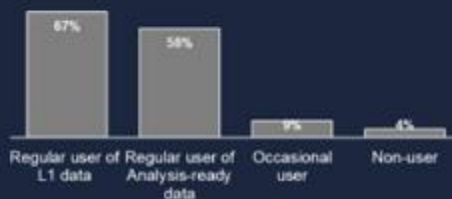


The response is primarily informed by users of hydrology and water quality data, producers and users of satellite data. In situ data collection efforts by responders focus mostly on water quality.

## Collection of in situ data



## Satellite data users



## Water scenarios For Copernicus Exploitation

### Recent uploads

Search Water scenarios For Copernicus Exploitation

December 17, 2021 (1.0) Report Open Access

View

#### Outcomes of the Expert Workshop on in situ calibration and validation of satellite products of water quality and hydrology (H2020 Water-ForCE)

Simis, Stefan; Walker, Peter; Ogashawara, Igor; Cillero, C; Laas, Alo

Part of the Water-ForCE effort is the analysis of synergies between research and monitoring communities operating in situ instruments and platforms to collect water quality and hydrological information, and those working on (satellite) EO. A working group of experts was formed in the first year of t

Updated on December 17, 2021

July 23, 2021 (1.0) Dataset Open Access

View

#### Survey response of the H2020 Water-ForCE expert meeting on In situ calibration and validation of satellite products of water quality and hydrology

Stefan Simis; Nicola Horsburgh; Peter Walker; Igor Ogashawara; Carmen Cillero; Alo Laas;

These slides provide an overview of the expert survey held in advance of the H2020 Water-ForCE workshop. In situ calibration and validation of satellite products of water quality and hydrology which was held as three virtual meeting sessions on 17, 18 and 20th May 2021. Data availability, Acces

Updated on July 23, 2021

More

- Data availability, accessibility, and quality gaps
- Emerging technologies to address current gaps
- Data harmonization and sharing

Water-ForCE Zenodo Community.

[https://zenodo.org/communities/waterforce\\_2020/?page=1&size=20](https://zenodo.org/communities/waterforce_2020/?page=1&size=20)

New upload

Community

## Water - ForCE

### Water scenarios For Copernicus Exploitation

The 'Water scenarios For Copernicus Exploitation' (Water-ForCE) project is a Coordination and Support Action (CSA) responding to the H2020 Space call: 'Copernicus evolution: Mission exploitation concept for WATER', through which it is intended to get a comprehensive understanding of the global water cycle within the scope of Copernicus Services and find the best long-term mission concept to cover current and future, both opportunities and information needs, related to this valuable resource.

To achieve this goal, the Water-ForCE consortium proposed to develop a Roadmap for Copernicus water services. The Roadmap will provide a user and stakeholder driven concept for water services (water quantity, water quality, hydrological parameters, ice, snow, etc.) by assessing the existing and emerging needs, the opportunities presented by the current and future technical capabilities of satellite and in situ sensors, and addressing the current disconnects between remote sensing, in situ observations and modelling communities. Critically, the Roadmap will deliver the clarity required in relation to the needs and expectations of the core Copernicus mission by the public and private sectors and the wider research and business innovation opportunities.



# In situ monitoring Networks

## Needs and Recommendations on Network Interoperability

- Data interoperability
- FAIR principles

- Create a **Standard of Practise** for metadata collection and data storage
- Develop and adopt a **controlled vocabulary**, informed by existing services (NERC vocabulary services, GLEON/NETLAKE common vocabulary, CF conventions, EDMO codes, and ORCID for persons).
- Promote **FAIR principles**.
- **Train individuals** to reach the required data standard
- Develop **tools** to help centralize: 'upload API' & forms/templates, QA/QC
- Provide **platforms to explore and query** in situ and satellite observation data together.
- Pursue the same level of data integration of inland waters as achieved for marine (e.g. SeaDataNet with 100 National Oceanographic Data Centres, 34 European coastal states; physical, chemical, biological, geology, to geophysics and bathymetry)

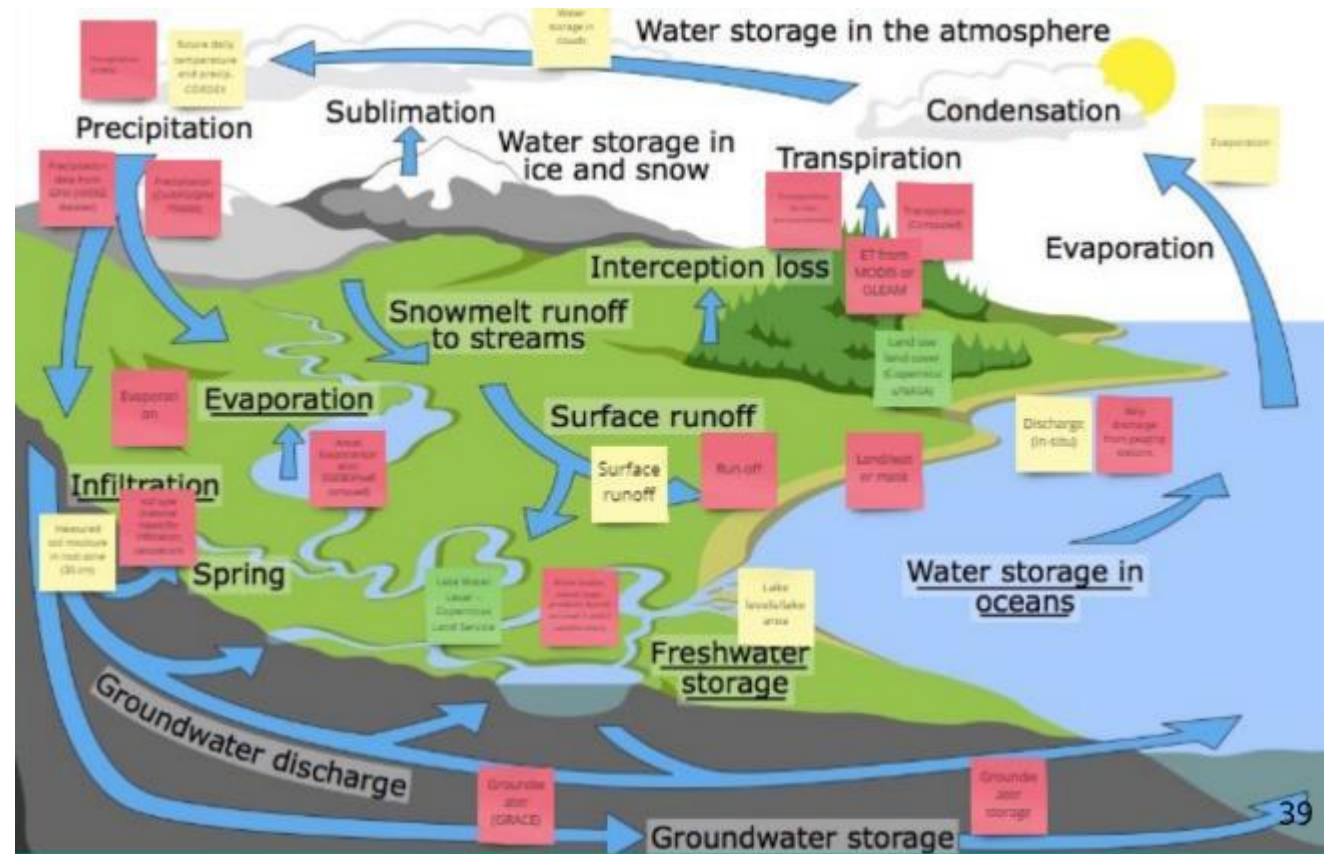
### Advanced data sharing for wider use and impact

- Develop community principles / guidance on data sharing, promoting FAIR principles.
- Data / repositories should be machine searchable (OGC CSW)
- Discourage wild-growth of data hubs, and evidence their value with usage reports.
- Include data purpose (license, sharing) as key search criterion
- Make observation uncertainty traceable through calibration records, protocols.

# Water Quantity & Modelling

## OBJECTIVES OF THE WORKSHOP

- Raise and examine public awareness on Copernicus services, water quantity data products and tools supporting water management and modelling.
- Discuss current availability of data products
- Discuss user needs, data requirements and user wish lists.



# Water Quantity & Modelling

## OUTCOMES

- The **Copernicus services** offer a significant amount of data products and tools free of charge
- There is a low **product awareness** by end users
- There is a demand about more **training material and tutorials**
- Highly **demanded data**: groundwater and soil moisture, evapotranspiration and data for agricultural applications.
- **Data accessibility, metadata and data standards** and information about validation processes is desired.
- Copernicus services offer a significant amount of **toolboxes and viewers**, which are frequently used.

Contribute to the future of Copernicus water component by **joining our International Working Groups** to share your needs and experiences

[www.waterforce.eu](http://www.waterforce.eu)

 @H2020WaterForCE

 WaterForCE



# Water - ForCE



Water-ForCE is a Coordination and Support Action (CSA) that has received funding from European Union's Horizon 2020-research and innovation programme under grant agreement number: 101004186.