Summary
Water-ForCE

Project Identification	
Project Full Title	Water Scenarios for Copernicus Exploitation
Project Acronym	Water-ForCE
Grant Agreement	101004186
Starting date	01.01.2021
Duration	36 months

Table of Contents

Water-ForCE is a CSA that has received funding form the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101004186.

1 Introduction and Objectives

It is widely recognized that inland waters play a crucial role in human health and well-being as an increasingly important source of drinking water and food (irrigation, fisheries, and aquaculture), recreation, and tourism. They provide diverse habitats, support high levels of biodiversity and vital ecosystems services and play a crucial role in the global carbon and nutrient cycles. Moreover, lakes and reservoirs integrate and archive information from the entire watershed and thus act as sentinels and records of environmental change. Despite their importance, many inland waterbodies are under severe anthropogenic pressures resulting in eutrophication, inorganic pollution, acidification, invasive species, extraction of upstream water, and climate change. Of the 117 million lakes on Earth a tiny fraction (0.0001%) is monitored regularly or systematically. This poor representation of a globally significant ecosystem impedes our understanding and ability to manage these waterbodies in the face of these multiple interacting pressures that are compounded still further by the effects of climate change including extreme events, especially in the most data-scarce regions of our planet. Furthermore, inland waters, including rivers, lakes, reservoirs, estuaries and deltas connect three quarters of the Earth's terrestrial surface with the oceans. This connectivity has been brought into sharp focus by the impact of emerging pollutants, plastics and microplastics on marine ecosystems. Earth Observation (EO) has a critical role in characterising this connectivity of the continuum of water to fully understand the impacts of society and climate on the ecosystem services provided by inland, transitional and marine environments to target effective mitigation measures.

Data products related to the water and hydrological parameters are being developed and examples can be found across all six Copernicus Services. However, the development of these data products tends to be undertaken in isolation of each other and in response to specific challenges without consideration of the global perspective, understanding or better representation of the water cycle from regional to global scales. In order to avoid duplication between the six Services, to Improve the understanding of the water cycle and to provide better services to wide user community The European Commission had a call for the Coordination and Support Action projects: "Copernicus evolution: Mission exploitation concept for WATER". The expectation from the call is that the successful project consortium will provide the best long-term mission concept for water.

Water-ForCE is a CSA that has received funding form the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101004186.

The overarching objective of the Water-ForCE project is:
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.

Water-ForCE will bring together experts on water quality and quantity, in policy, research, engineering and service sectors. This will include the relevant Copernicus Services (Atmosphere, Marine, Land, Climate Change, Security, Energy) and Networks (Copernicus Academy and Copernicus Relays), ESA, H2020 projects and international organizations as well as public and private research organizations. By working with these communities, Water-ForCE will deliver:

- A Roadmap for the water component of future Copernicus services defining which is the most optimal long-term strategy that takes into account that existing water related products are split and distributed across the six Copernicus Services.

- The technical requirements for future Copernicus missions to fulfil better inland and coastal water related needs (e.g. optimal configuration of Sentinel-2E and onward, CHIME hyperspectral sensor etc).

- An enlarged service portfolio, containing higher level biogeochemical products, improved performance of the current products and products that integrate across water quality and water quantity.

- The closer cooperation between remote sensing, *in situ* and modelling communities in order to build an optimal network that provides necessary information about inland and coastal waters to policy makers, managers, researchers and general public.

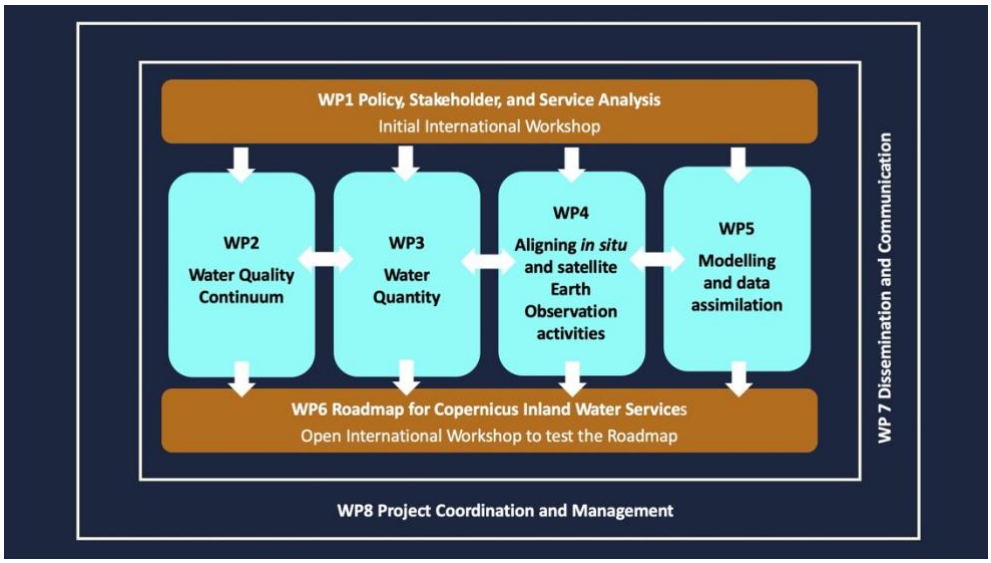
Water-ForCE is a CSA that has received funding form the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101004186.

2 Water-ForCE Concept and Impact

2.1 Concept

The Copernicus Inland Water Services Roadmap, proposed by the Water-ForCE, will be tested in an open international workshop in 2023 with potential users and stakeholders encompassing the Space Industry, Business and Policy sectors, Intergovernmental agencies and NGOs before the final version will be delivered. The roadmap will include all different aspects of the WATER services starting from the EU directives where the Services can or should be used and ending with proposed technical requirements for the next generation of Copernicus sensors and a framework that will structure future research and innovation that will minimise duplication and maximise the opportunity in the production of WATER products provided by Copernicus Services and the resulting value chain.

In order to achieve this, we developed a **work concept that consist of four overarching WPs and four technical WPs.** The first overarching **WP1** will analyse current and future policies, end-users needs, innovation needs, need for supporting water related SDG's, etc. The WP1 will organise an open international workshop in 2021 that will synthesise the initial findings of the WP1 and provide direction to the technical WP's (WP2-5).



The technical WPs are: Water quality continuum (WP2), Water quantity (WP3), Aligning *in situ* and satellite Earth observation activities (WP4) and modelling

Water-ForCE is a CSA that has received funding form the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101004186.

and data assimilation (WP5). Each of the technical WPs will build an international open working group, that will analyse the current and future Copernicus services from their specific perspective. This will include organising at least one thematic workshop, regular electronic meetings, and trainings (at different levels from PhD students to policy makers) within each of the technical WPs (2-5). The working groups will coordinate their activities as much as possible to support cross-topic discussions. Each of the technical WPs will produce their recommendations for the Roadmap.

The second overarching WP **(WP6)** will summarise the findings of each technical WP and produce the first draft of the Roadmap. WP6 will organise an open international workshop in 2023 where the first draft of the Roadmap will be reviewed and discussed. After that the WP6 will provide a consensus Roadmap, as the final outcome of the Water-ForCE project, to relevant bodies like the European Commission, ESA, EEA, JRC, national space agencies, national monitoring and regulatory agencies, research communities and industry.

2.2 Impact

WP1 (Policy, Stakeholder, and Service Analysis) will identify key users within the different public domains and business sectors and evaluate whether operational services can meet policy goals, operational requirements and innovation opportunities. Policymakers will be engaged in a knowledge synthesis exercise to identify policy-defined information needs, define the indicators for monitoring and reporting and assess the uptake of satellite EO-based services and barriers to successful implementation (including industrial policy and innovation).

WP2 (Water Quality Continuum) will analyse what new water quality related Copernicus products are feasible with current Copernicus sensors and what kind of improvements will be needed in next generation sensors to make them more suitable for inland (and coastal) water quality monitoring. This WP will address the monitoring and reporting current needs and future opportunities (including higher level water quality-related remote sensing products) for the coverage of EU policies related to water quality and water management.

WP3 (Water Quantity) will evaluate the current possibilities that satellite based EO services can bring to improve current coverage of EU policies regarding water quantity and also explore future possibilities. A state-of-the-art gap analysis and recommendation on Copernicus and other services supporting water management focused in flood, drought, water allocation, SDG6 and water accounting will be performed. Special attention will be given on data representing

Water-ForCE is a CSA that has received funding form the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101004186.

human interactions and interventions (dam operations, irrigations, etc.). It will define how models using remote sensing data can improve adaptive decision making and policy implementation and technical requirements for future needs.

In **WP4 (Aligning *in situ* and satellite Earth Observation activities)**, **innovative combinations** of existing ***in situ* sensors** will be reviewed to assess the possibility of developing **higher level biogeochemical products** for water monitoring and management. The need in improving *in situ* networks for water quality and water quantity monitoring to provide validation data for Copernicus space component and input for modelling activities will be analysed.

WP5 (Modelling and data assimilation) will be fed by knowledge acquired in WP1 to WP4 to identify the potential for **future use of different satellite EO data in modelling of water resources** for support of decision makers towards **adaptive management** of **water resources** and **policy implementation**. Current issues in Copernicus hindcast/forecast capabilities will be identified, and a range of future ways of using services will be defined. Available satellite EO data will be evaluated on how monitoring and modelling of water bodies dynamics is currently done and where they can be improved. A guide how models should be adapted to use existing Copernicus data will be explored, including the use of Artificial Intelligence (AI). Finally, the findings will be integrated to demonstrate the value of **satellite EO-enhanced models** for **policy and decision making**.

Finally, the **WP6** (Roadmap for Copernicus Inland Water Services) will combine all the previous effort and present them in an organized way to defining opportunities (including those yet to be identified or realised) for co-development with industry (including space sector), business and policy sectors. The Roadmap will deliver a **framework to support the capacity building needs that will ensure a consistent water observation strategy that meets the needs of policy and industry**.

Water-ForCE is a CSA that has received funding form the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101004186.