Science Briefing

Eyes on Water: Space, Science and European Resilience

Science for Diplomacy

Welcome

Wifi: CH-Mission-BRU
Password: @MiBXL_Love_Sw!ss

SwissCore

eawag aquatic research

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Mission of Switzerland to the European Union

Science Briefing

Welcome and introduction

Laurin Reding

SwissCore

SwissCore

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Confederaziun svizra

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Science Briefing

Swiss contributions to research, innovation and science diplomacy

Thomas Meier

Mission of Switzerland to the EU

SwissCore

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Science Briefing

Science and technology for ecological insight and international water cooperation

Christian Stamm

Eawag

SwissCore

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eawag
aquatic research
Water is at the center
of global challenges

eawag aquatic research

Research and Impact Institute

- Globally leading institute for aquatic research
- Developing innovative and sustainable solutions for preserving water as a vital resource for humans and the environment.
- System integrated research
- Trans- and interdisciplinary approaches

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Confederazione Svizzera
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Federal Department of Economic Affairs, Education and Research
EAER

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ETH-RAT

ETH zürich EPFL PSI Empa WSL

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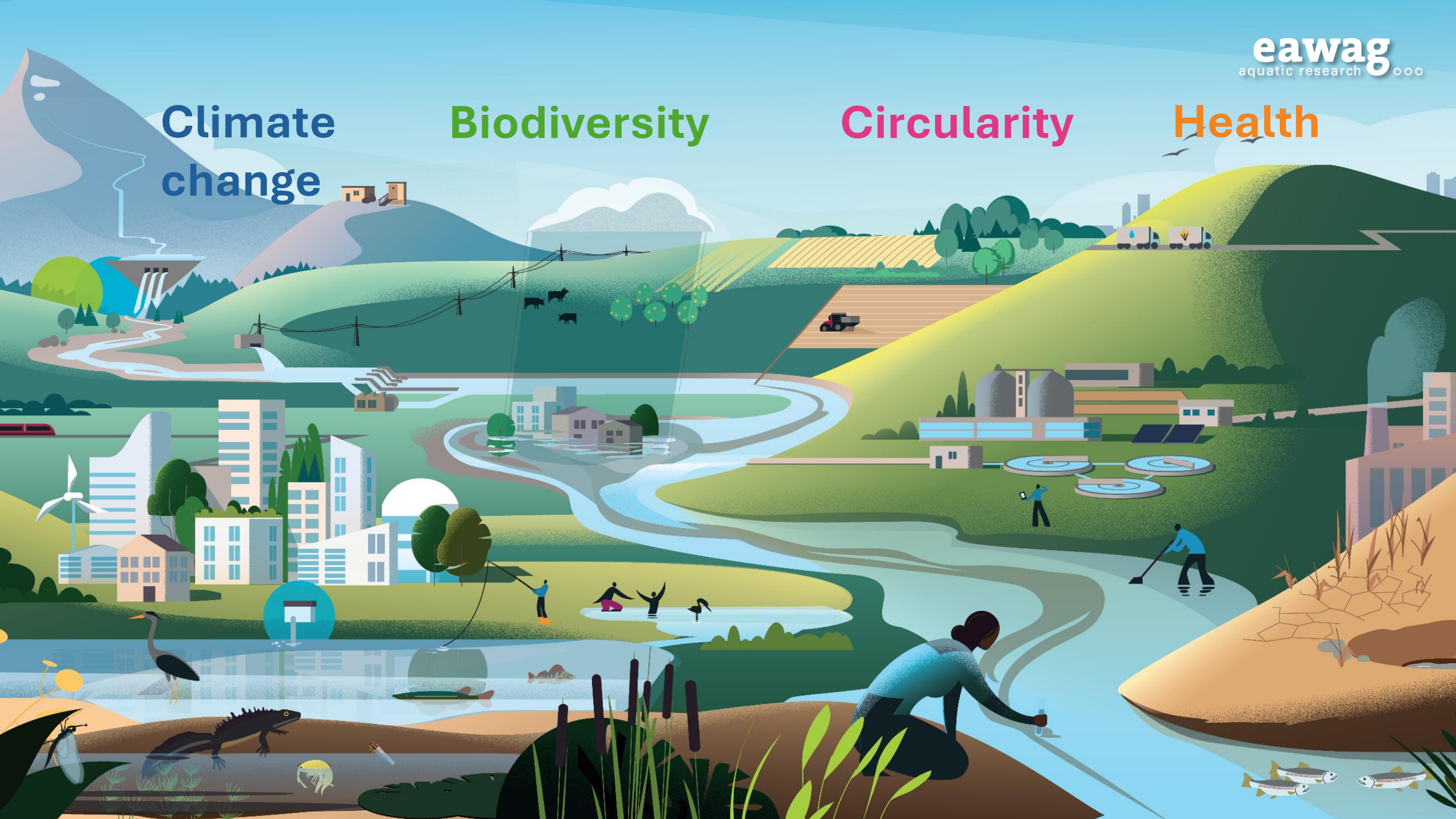
Climate change

Biodiversity

Circularity

Health



Technologies for micropollutant removal

Technology development for robust drinking water provision

Wastewater based epidemiology - From science to application. Translation into policy and national task

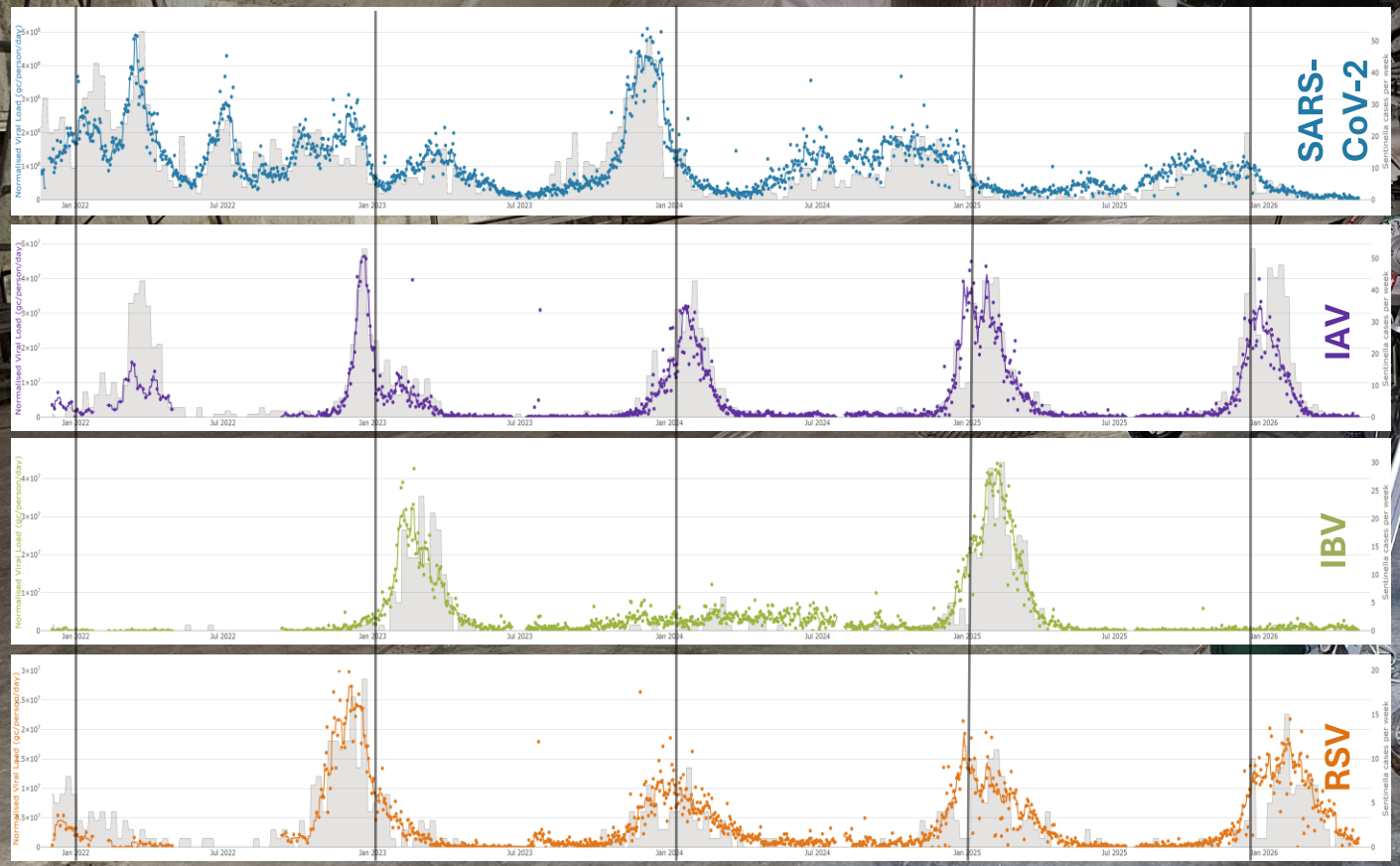
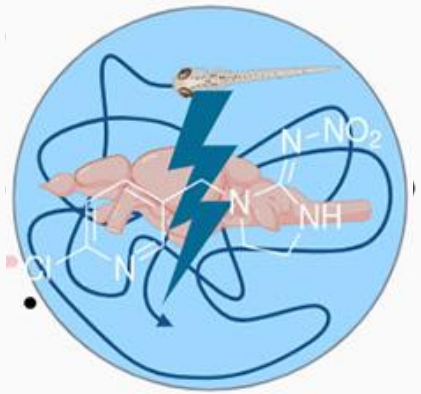


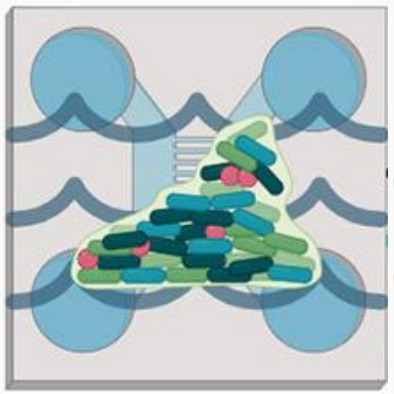
Image: Christoph Ort, https://wise.ethz.ch

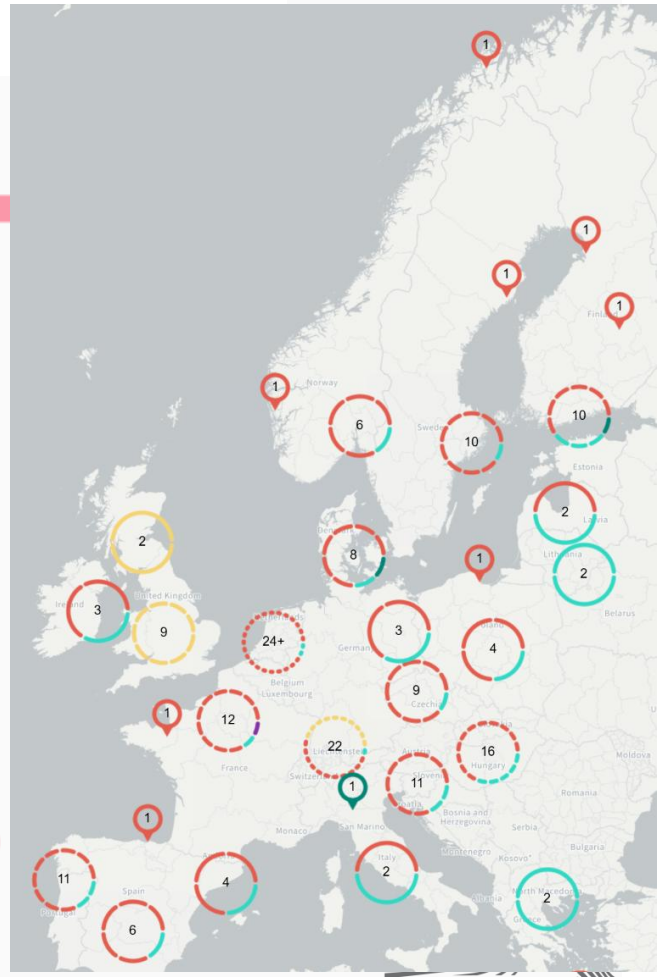
International collaboration & data sharing

Image: salmoncomeback.org

European Partnership for the Assessment of Risks from Chemicals (PARC)







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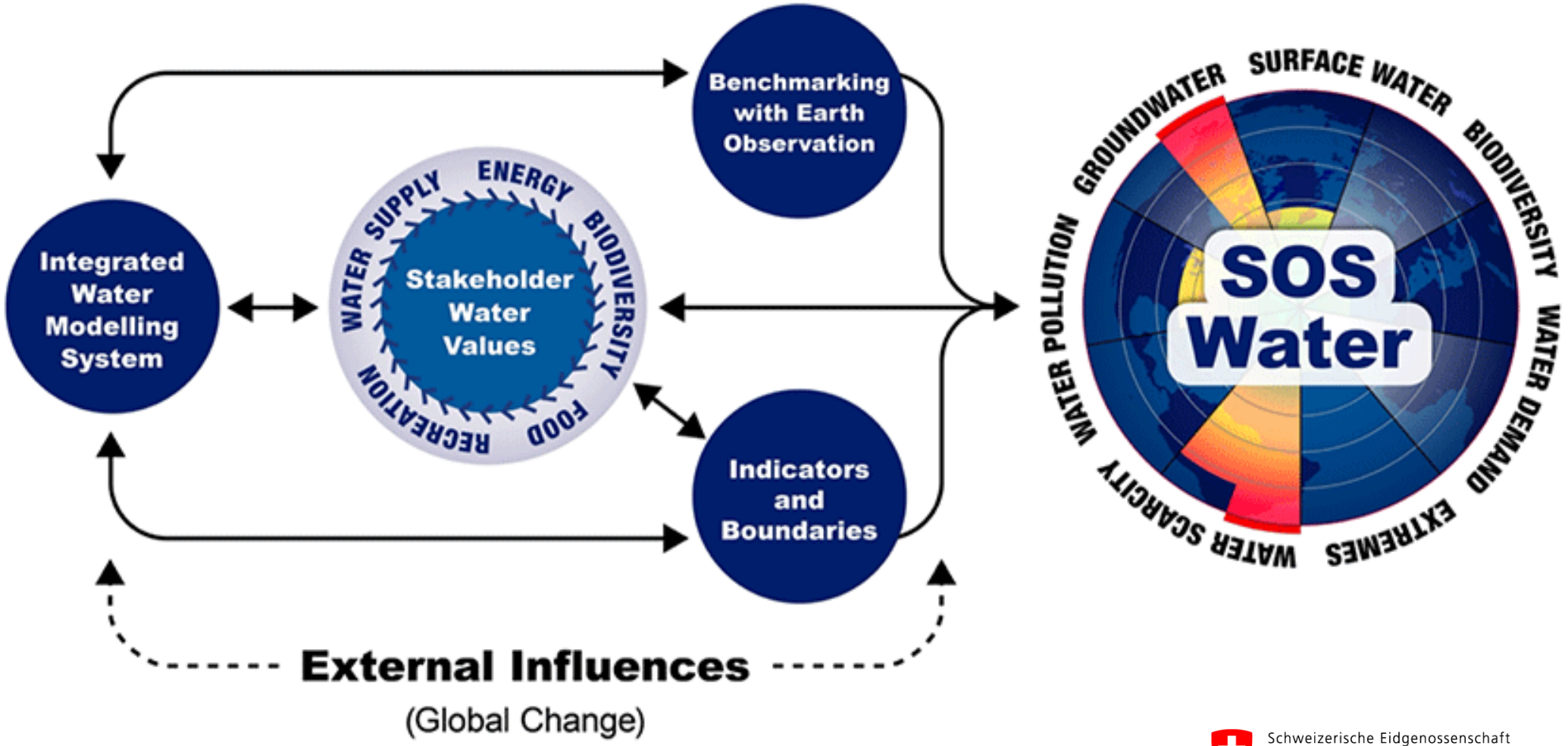
European Commission

Space: No longterm missions without closed cycles

Image: Artist's view of a moon base, European Space Agency, P. Carril

Safe Operating Space in water management



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European Commission

Tritium (^{3}H) in groundwater, IAEA database

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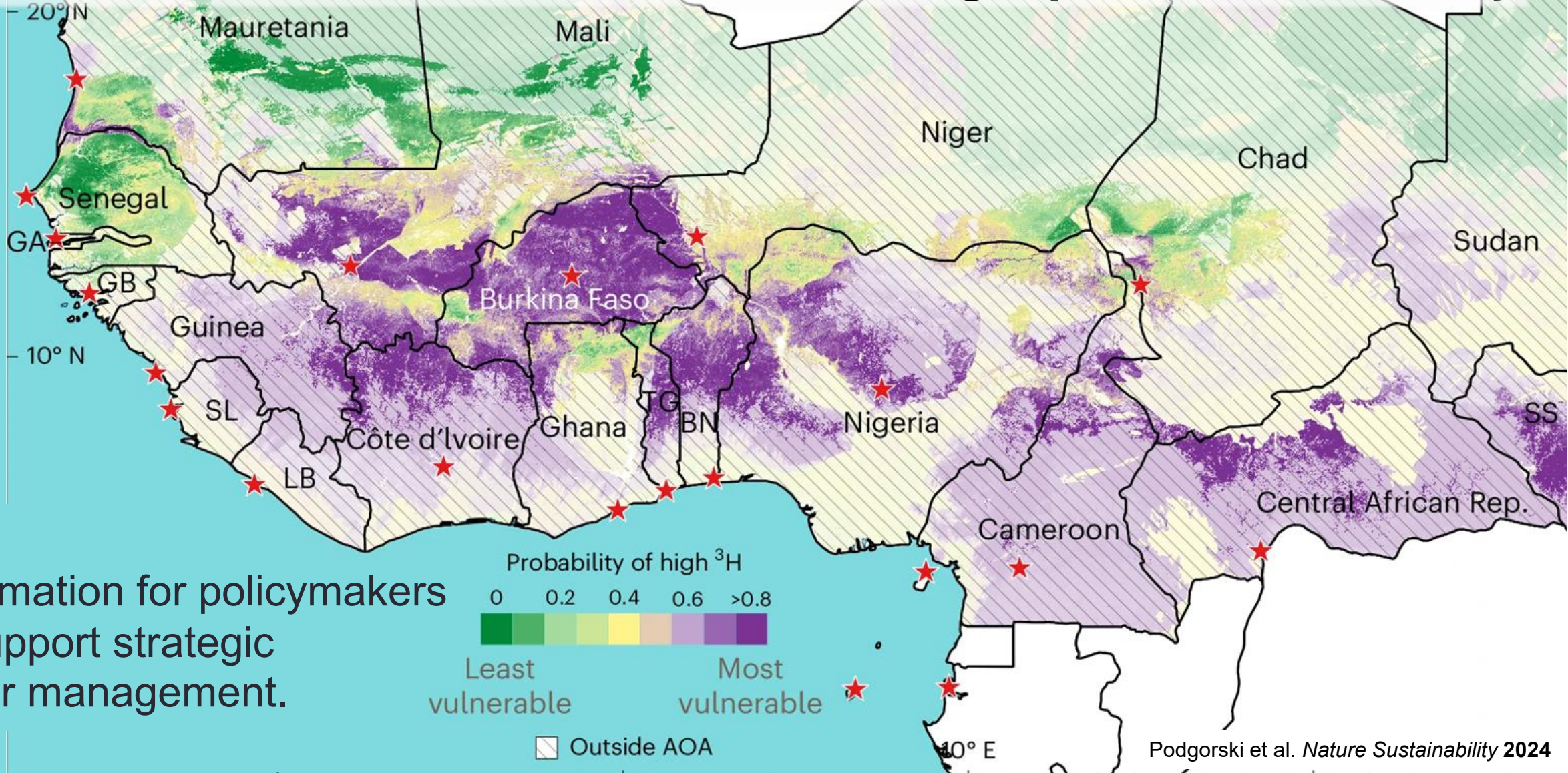
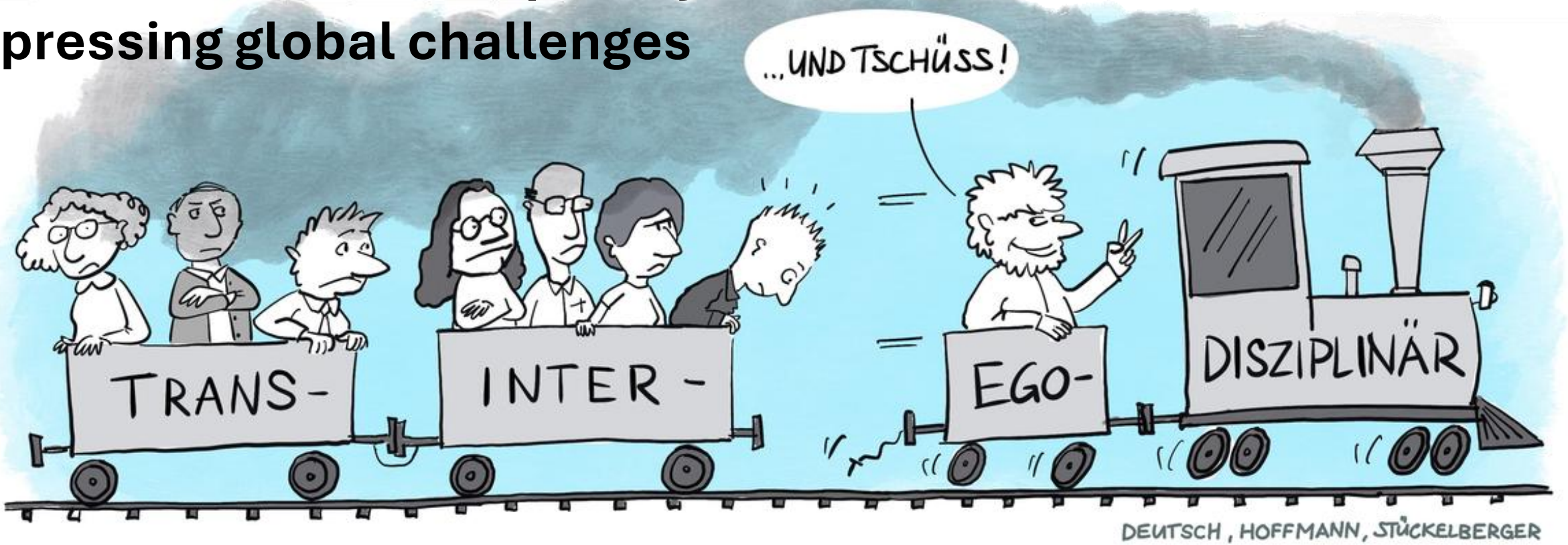
In collaboration with IAEA – Understanding aquifer vulnerability



Information for policymakers to support strategic water management.

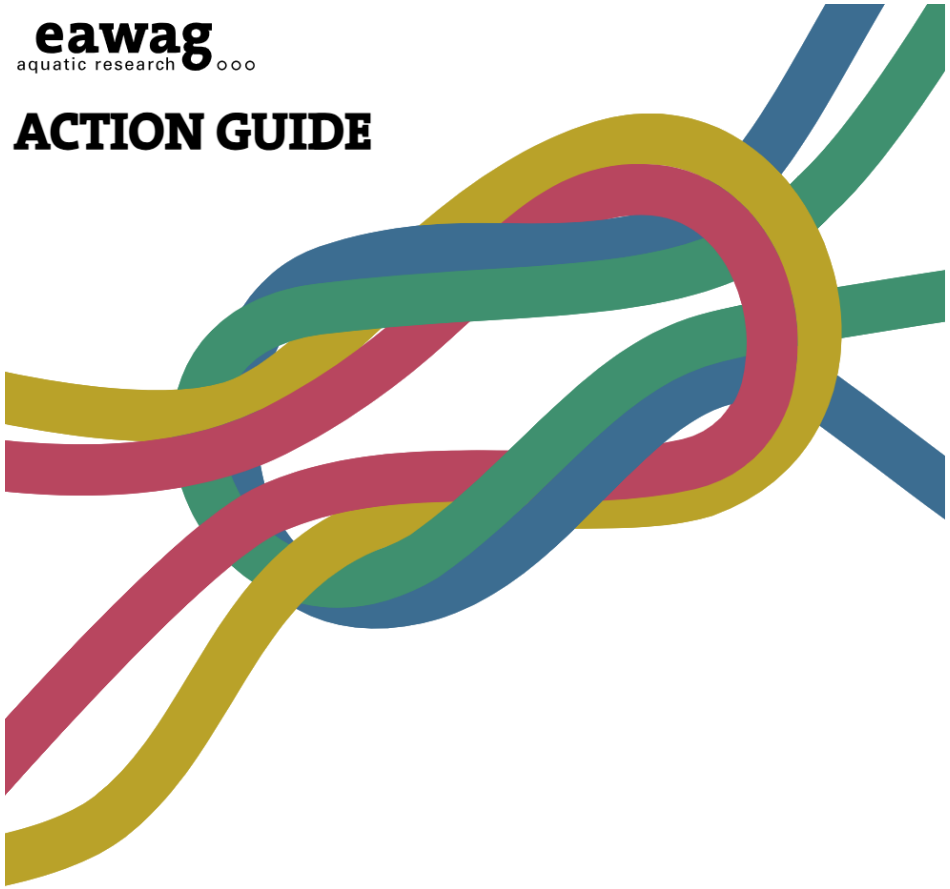
Podgorski et al. *Nature Sustainability* **2024**

Inter- and transdisciplinary research to meet societal pressing global challenges



KOPPELN SIE SICH MIT IHRER EIGENEN FORSCHUNG AB
UND MACHEN SIE SICH AUS DEM STAUB

Inter- and transdisciplinary research to meet societal pressing global challenges



Sustainability Science (2025) 20:95–115
https://doi.org/10.1007/s11625-024-01585-4

ORIGINAL ARTICLE

Herding cats: integrative leadership strategies in inter- and transdisciplinary research programs

Lisa Deutsch[1,2] · Astrid Björnsen[3] · Andreas M. Fischer[4] · Angela Michiko Hama[4] · Niklaus E. Zimmermann[3,5] · Christian Zurbrügg[1,6] · Sabine Hoffmann[1,7]

Received: 1 December 2023 / Accepted: 1 October 2024 / Published online: 24 October 2024

Abstract
This paper focuses on the critical role of integrative leadership in inter- and transdisciplinary (ITD) research programs. ITD programs have become one of academia's responses to address contemporary sustainability challenges. Fulfilling the

Advancing solutions for future water challenges

Interdisciplinary breadth

Innovation depth

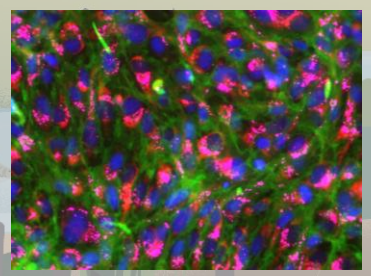


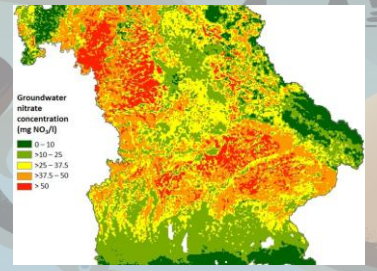
Water solutions



Technological implementation



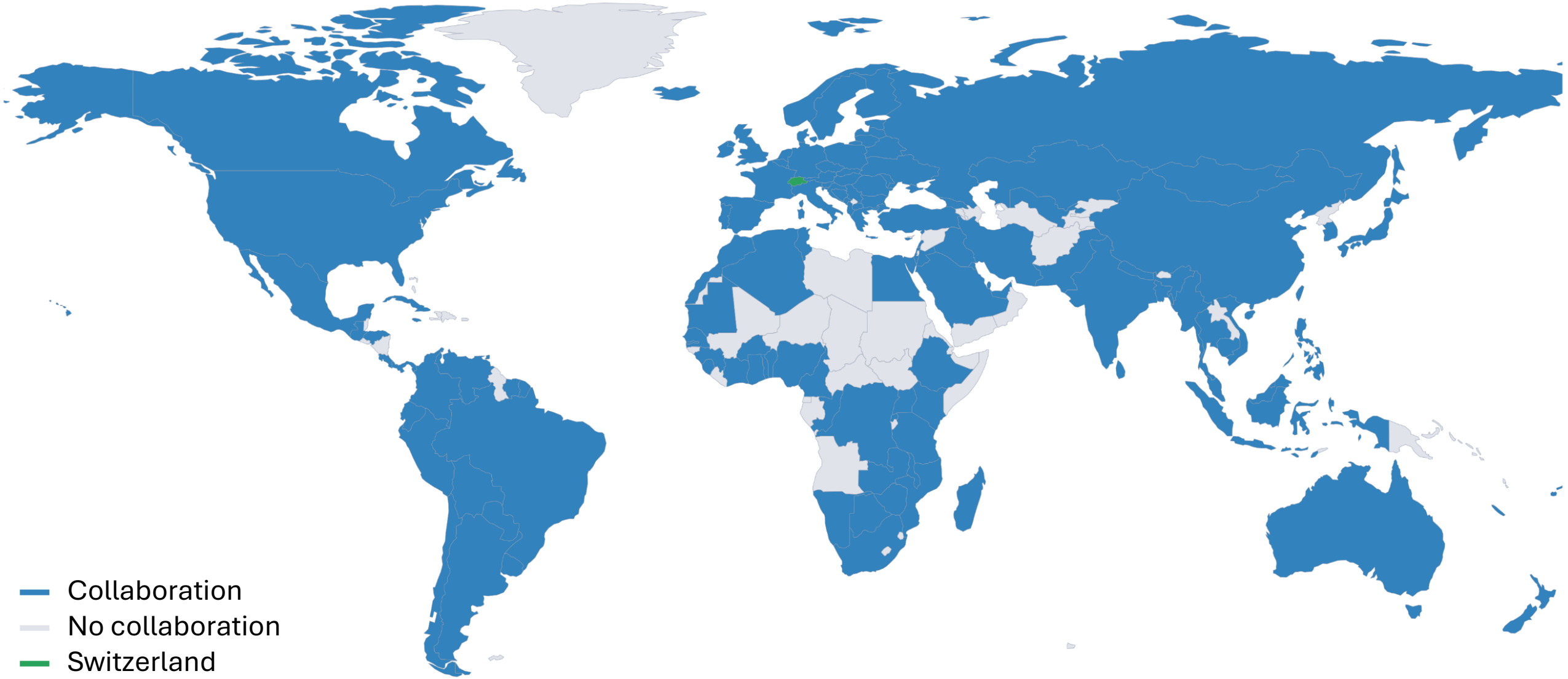




Fundamental research

Natural sciences, engineering and social sciences focused on water

Global collaborations for sustainable impact



Our mandate and mission:

Advancing science for creating impact

Strong partnerships are key to solving real-world challenges

- Advancing science
- Co-creating and transferring knowledge to practice, policy and diplomacy

→ Looking forward to this exchange and discussion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aquatic research
Thank you for your attention!

Science Briefing

From space to water:
Earth observation for sustainable water management

Marc Paganini

European Space Agency

SwissCore

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Confédération suisse
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Mission of Switzerland to the European Union

EUROPEAN SPACE AGENCY
ELEVATING THE FUTURE OF EUROPE IN SPACE

THROUGH EUROPEAN COOPERATION
AND WITH INTERNATIONAL PARTNERS

23 MEMBER STATES

4 associate members
1 cooperating state

6500 ESA WORKFORCE

IMPLEMENTS
60%
OF THE EUROPEAN SPACE BUDGET

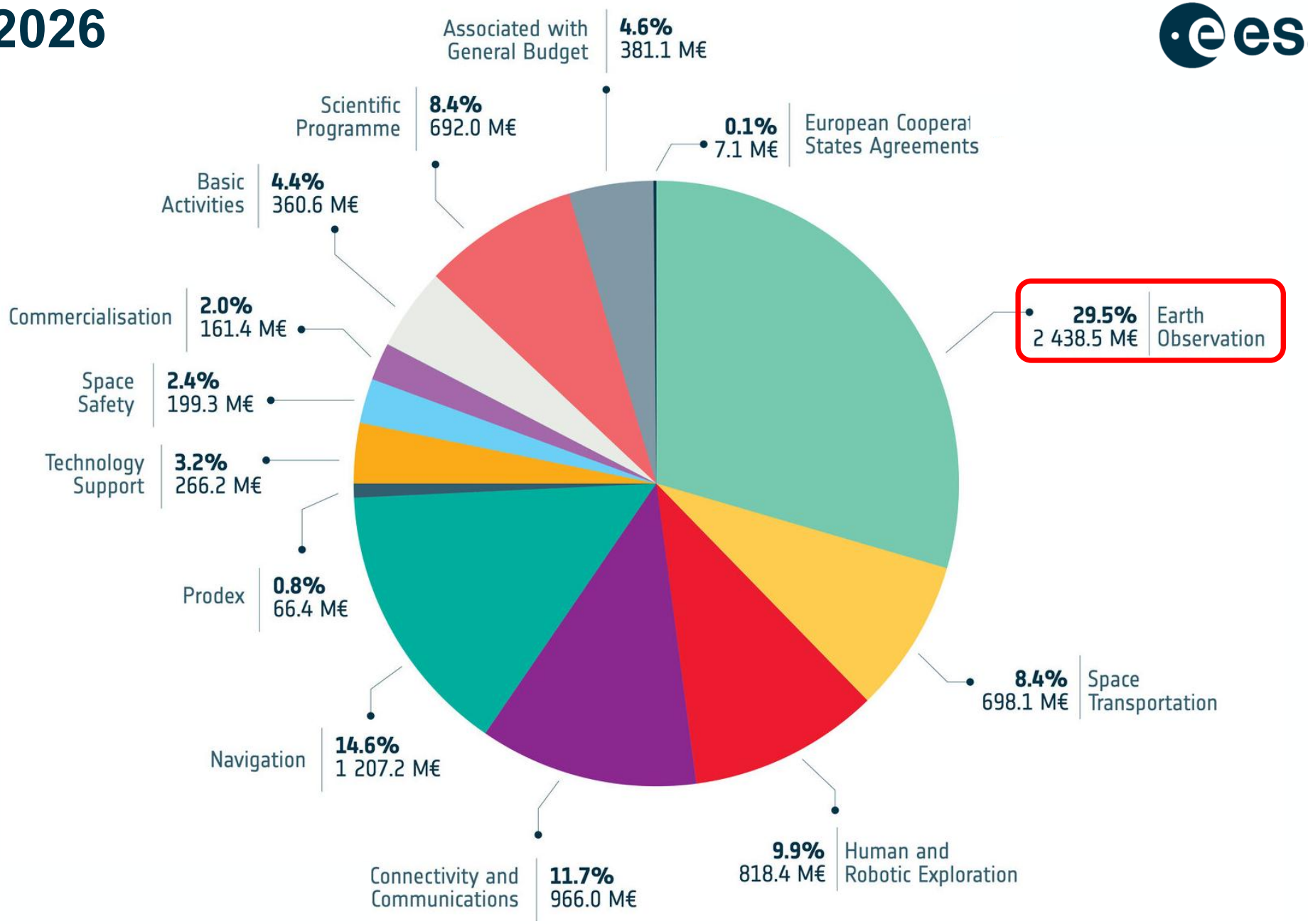
150+
missions delivered
30+
missions upcoming

2026 BUDGET
€8.26B

€15
per European

→ THE EUROPEAN SPACE AGENCY

ESA Budget for 2026

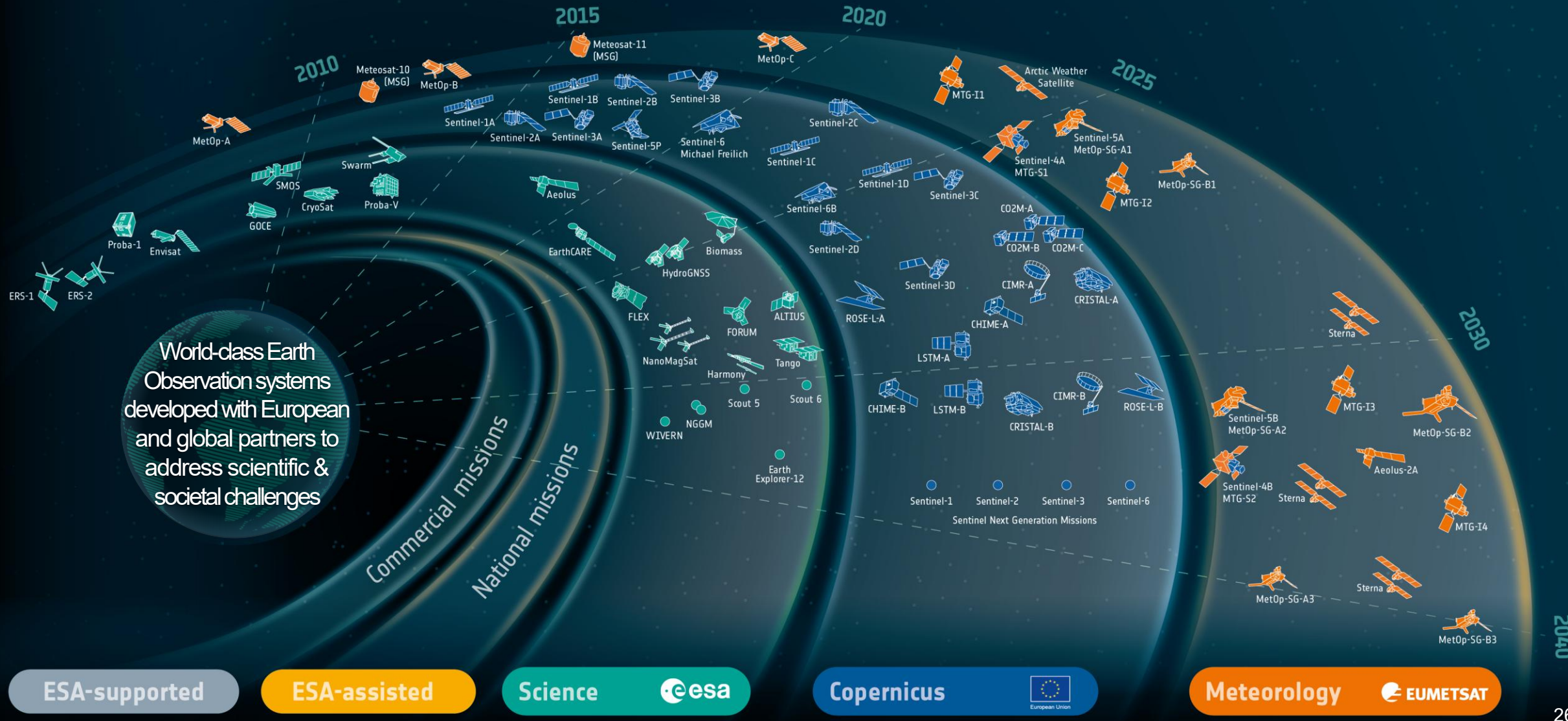


TOTAL
8.26 B€

* Includes activities implemented for other institutional partners

ESA's Earth Observation Missions

Satellites**: Heritage **08** / Operational **24** / Developing **38** / Preparing **39** / Total **109



ESA Earth Observation Programmes at CMIN25

FUTURE EO

Continuing to deliver world class Earth Observation systems and earth science

COPERNICUS

Continuing and enhancing our eyes on Europe and the World

ERS-EO

Responding to resilience & security challenges

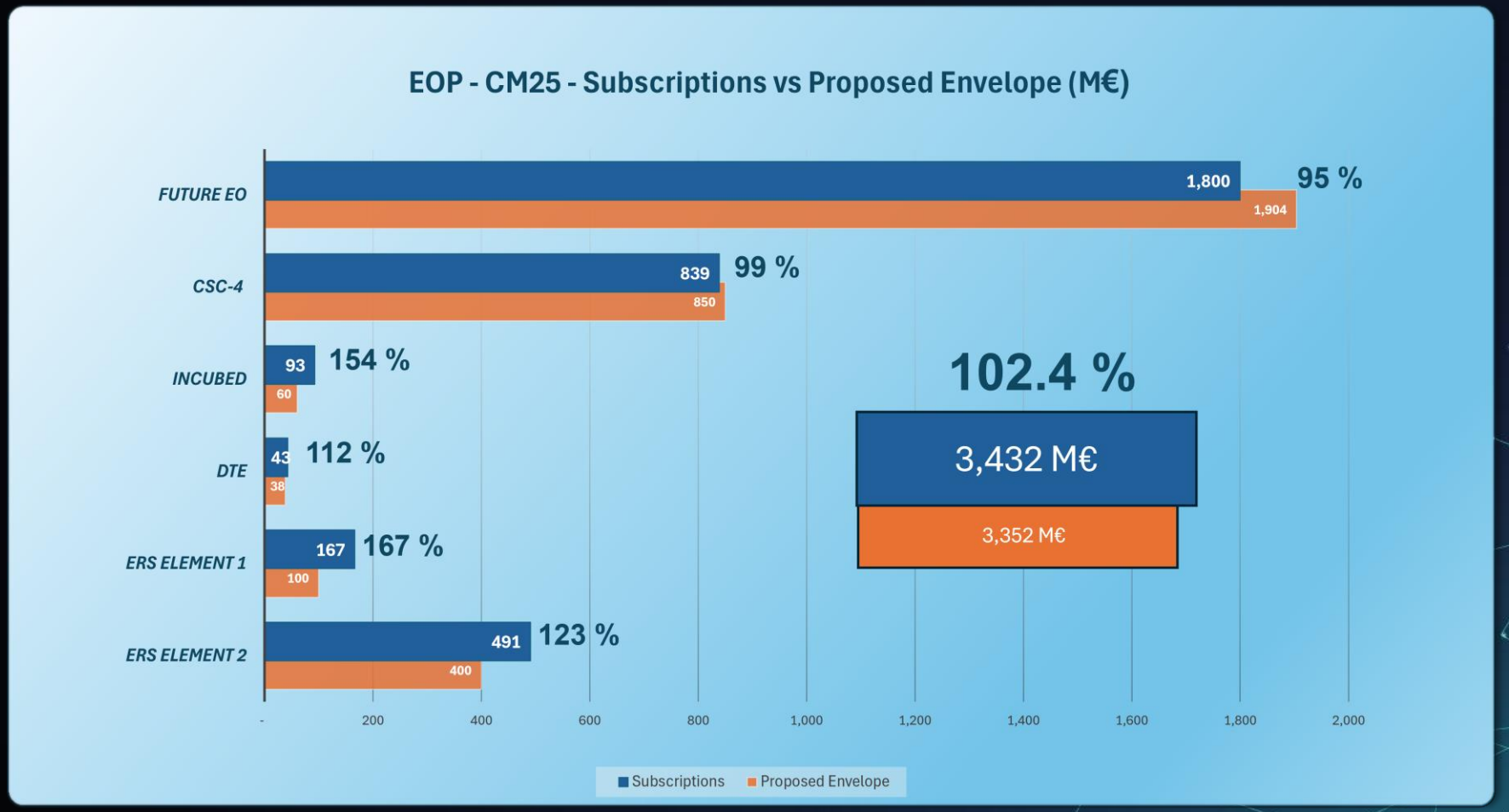
INCUBED

Supporting industrial innovation

DIGITAL TWIN EARTH

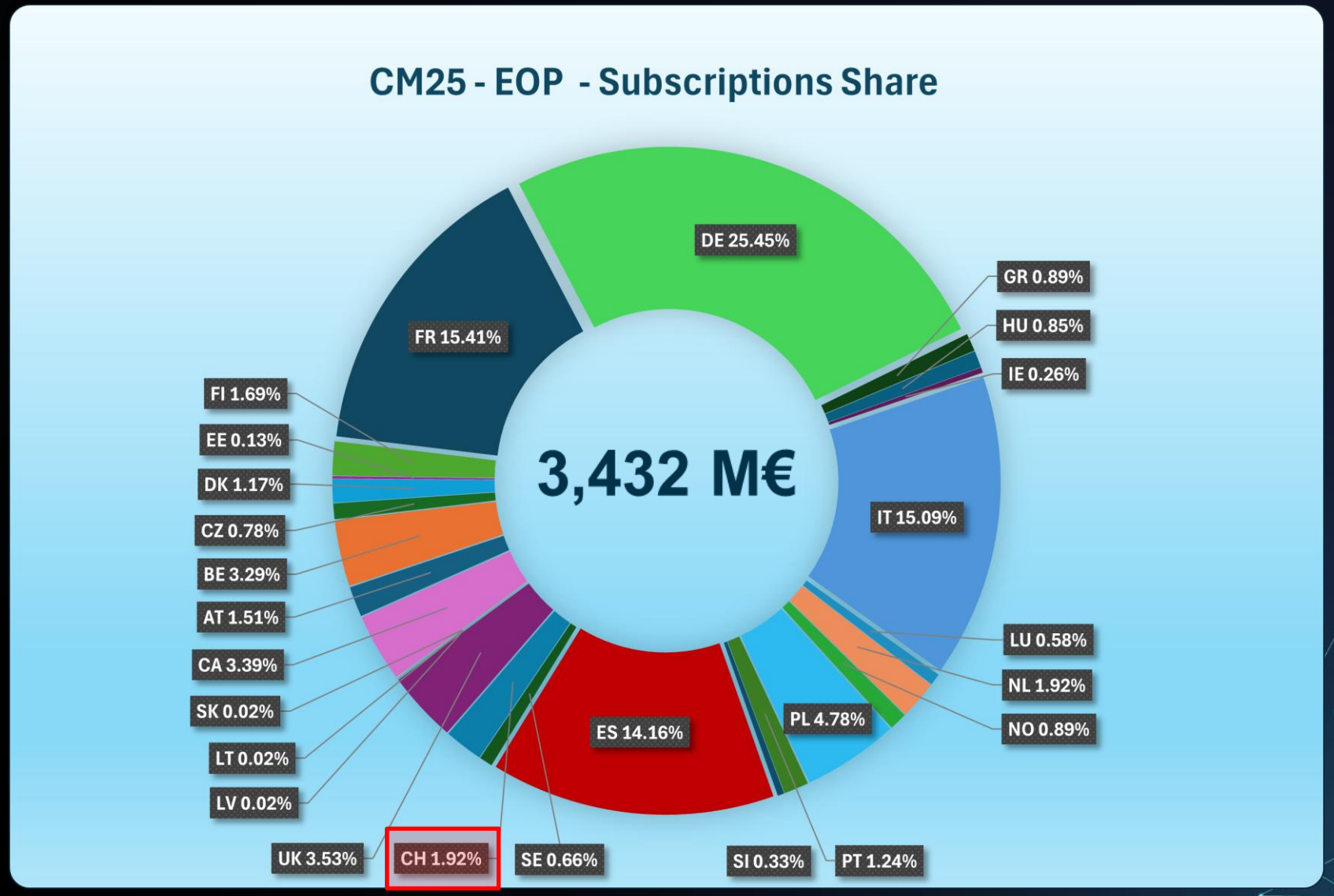
Enhancing understanding, characterisation & modelling of the Earth

CM25 Outcome for ESA Earth Observation Programmes



Positive results for Earth Observation: 3.4B€ subscribed to EOP programmes, guaranteeing continuity of current EO programmes and allowing the start of new activities

CM25 Outcome for ESA Earth Observation Programmes



26 countries contribute to ESA CM25 EO programmes

FutureEO: Mission Preparation, Development & Earth Action

esa

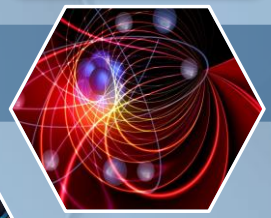
World-class science benefitting society

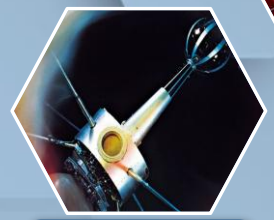
FUTURE EO

Mission preparation activities

Campaigns

Mission definition

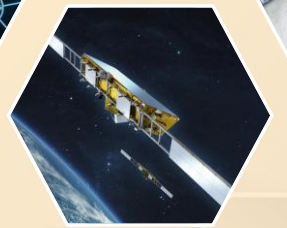




Mission development & mgmt. activities

Scout 2nd Cycle

WIVERN (2030s)



EARTH ACTION

Defining our priorities along the following verticals:

1. Earth System and Climate Science

2. Enabling Policies

Transversal Elements Supporting All FutureEO Activities:

A. Industrial Strategy & Competitiveness

B. Disruptive Innovation & Digital Enablement

C. Knowledge Exchange & Capacity Building

D. Partners & Cooperation

Earth Observation for Sustainable Water Resource Management

- Policy Applications on Water Resources and Freshwater Ecosystems
- Hydrology Science
- Climate and ECVs
- Sentinel User Preparation (SUP)
- Global Development Assistance

SDG Target 6.6: Protect and Restore Water-Related Ecosystems

WorldWater

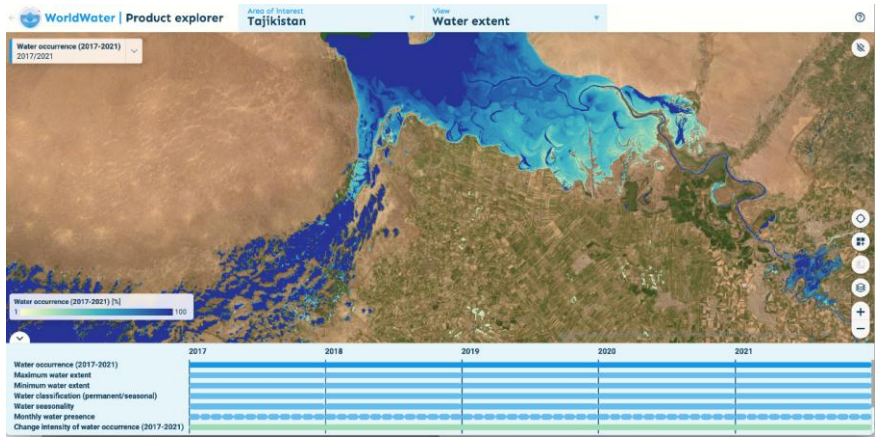
EO-based solutions for monitoring of the dynamics of surface waters

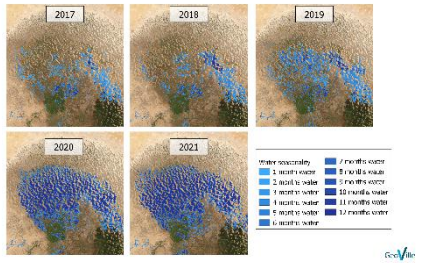
6 CLEAN WATER AND SANITATION

SDG Indicator 6.6.1 Change in the extent of water-related ecosystems over time

EO-based solutions for National Wetland Inventories

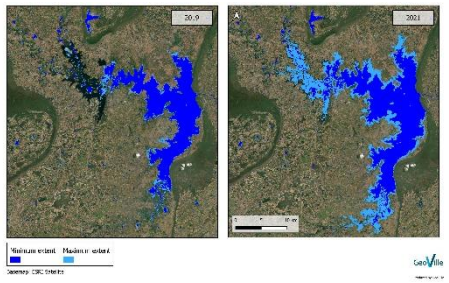
EO4WI WETLAND INVENTORIES



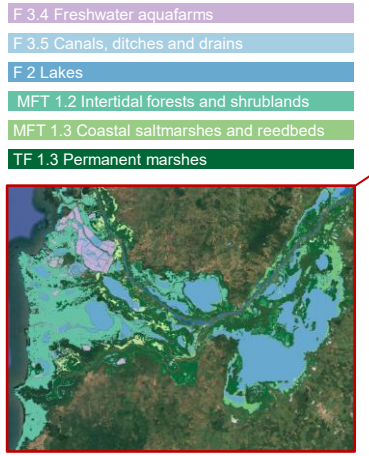


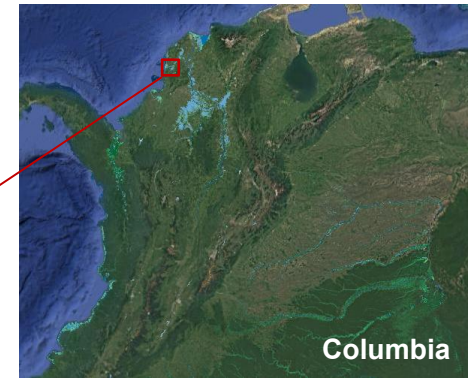
Water frequency,
Niger, Diffa, Northern Lake Chad

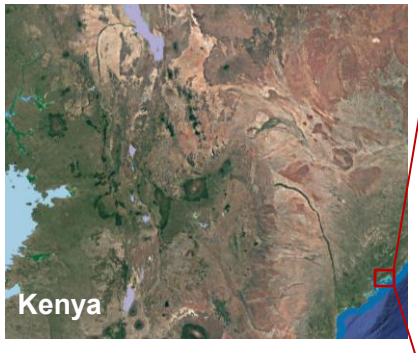
Surface Water Min-Max extent,
Thailand, Ubolratana reservoir

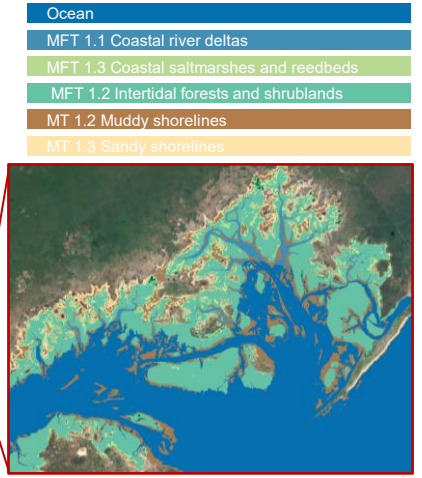


Support
UNEP and Ramsar Secretariat
(custodians of SDG Indicator 6.6.1
on changes over time
in water-related ecosystems)
for the development of monitoring
guidelines, datasets, and tools
to **advance the use of**
Earth Observation
for the monitoring, assessment and
management of water-related
ecosystems.









WorldWater: Advanced Surface Water Dynamics

WorldWater

Empower national and regional stakeholders with EO data and tools
to better monitor their water resources and report on the global water agenda.

https://worldwater.earth

New advanced algorithms.
for the monitoring of the intra-annual and inter-annual variations of surface waters, in extent and volume.

Surface Water Dynamics from Space: A Round Robin Intercomparison of Using Optical and SAR High-Resolution Satellite Observations for Regional Surface Water Detection

by Christian Tottrup [1,*], Daniel Druce [1], Rasmus Probst Meyer [1], Mads Christensen [1], Michael Riffler [2], Bjoern Dulleck [2], Philipp Rastner [2], Katerina Jupova [3], Tomas Sokoup [3], Arjen Haag [4,5], Mauricio C. R. Cordeiro [6], Jean-Michel Martinez [6], Jonas Franke [7], Maximilian Schwarz [8], Victoria Vanthof [9], Suxia Liu [10,11], Haowei Zhou [10,11], David Marzi [12], Rudiyanto Rudiyanto [13], Mark Thompson [14], + Show full author list

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3 Gisat s.r.o., 170 00 Praha, Czech Republic
4 Deltares, 2629 HV Delft, The Netherlands
5 SERVIR-Mekong, Bangkok 10400, Thailand
6 Géosciences Environnement Toulouse (GET), Unité Mixte de Recherche 5563, IRD/CNRS/Université, 31400 Toulouse, France
7 Remote Sensing Solutions GmbH, 81673 München, Germany
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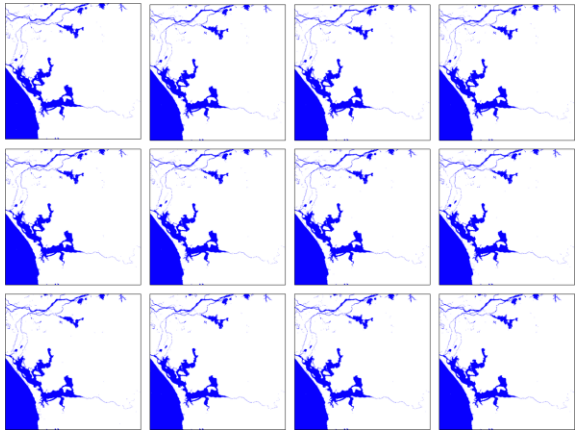
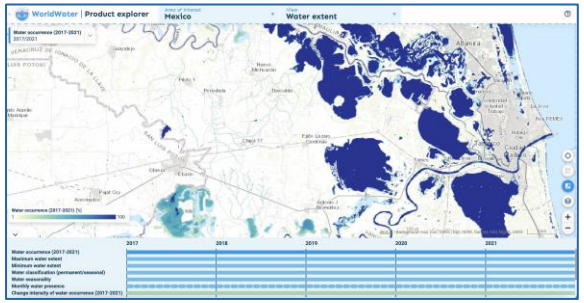
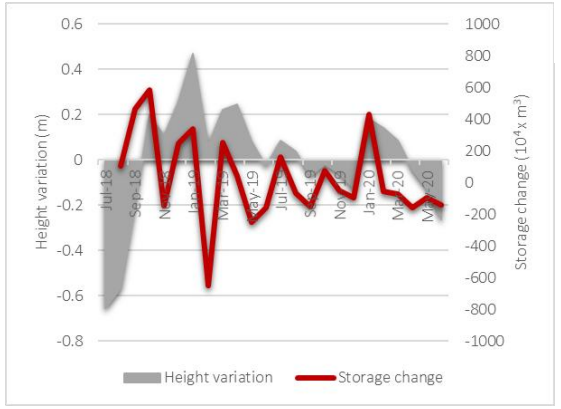
10 Key Laboratory of Water Cycle and Related Land Surface Processes, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China

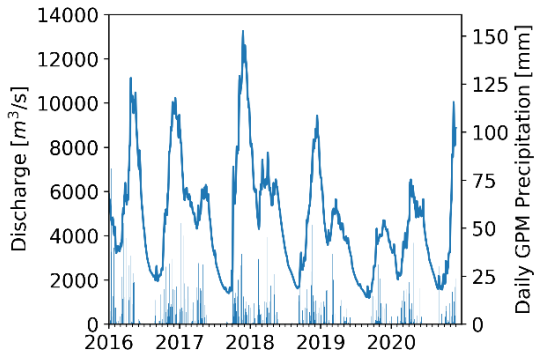


Changes in Surface Water Extent
Monthly water occurrences

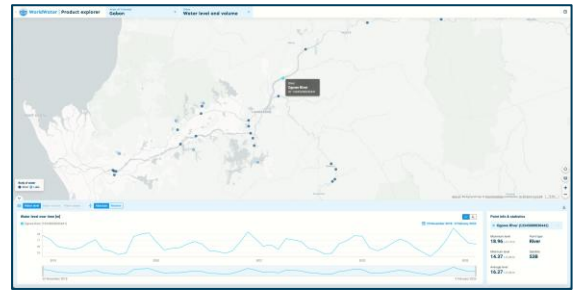




Changes in Lake Water Storage
Surface water level variations



Changes in River Discharge
Hydrological modelling

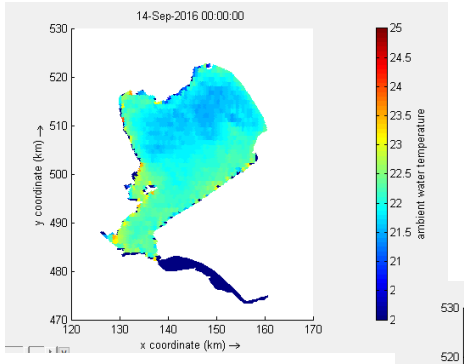


→ THE EUROPEAN SPACE AGENCY

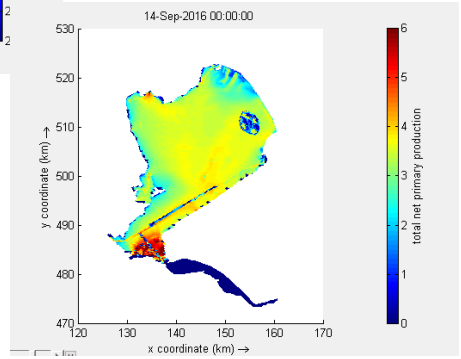
Freshwater Biodiversity Pilots

http://www.biomondo.info

Pilot 1 – Pollution
Lake Eutrophication

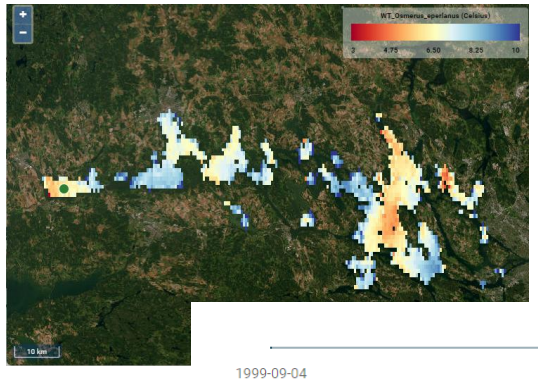


EO-based Lake Surface Water Temperature (LSWT)

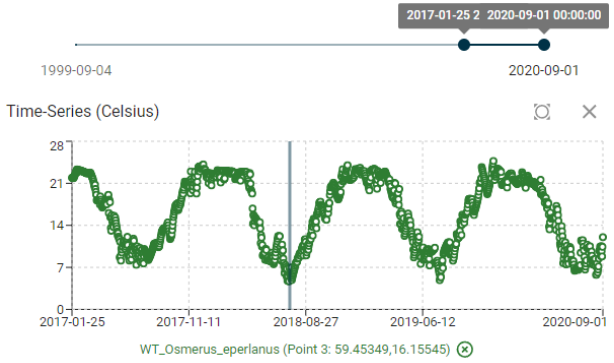


Modelled Primary Productivity

Pilot 2 – Climate Change
Lake Surface Temperature

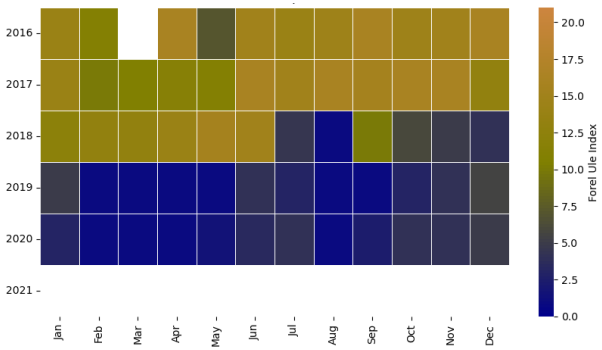


European smelt Warming tolerance
2018-07-19

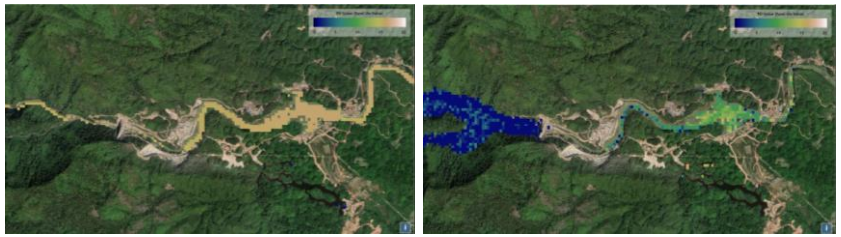


EO-based time series of smelt warming tolerance

Pilot 3 – Land Use Change
Connectivity



Reduced sediment transport affecting downstream delta of Nam Giep dam (Mekong basin)



Impact of water pollution on freshwater habitats in shallow lakes

Impact of water temperature increase on freshwater fish diversity

Impact of dams on river connectivity, sediment transport and freshwater biodiversity

ESA 2026 Invitation to Tender on Earth Action “Enabling Policies”: *“Sustainable Water Resources and Wetland Ecosystems Management”*

Single procurement with 4 separate contracts to develop scalable EO-based solutions for:

- **River Connectivity** 1 MEUR, 30 months.

  Monitor river connectivity and flow alterations, quantify impacts on river hydrology and aquatic ecosystems, and identify restoration opportunities.

- **Inland Water Pollution** 1 MEUR, 30 months.

  Detection-attribution framework to monitor freshwater quality and link water pollution to the sources and drivers of pollution across rivers and lakes.

- **Drought Risk Monitoring** 1 MEUR, 30 months.

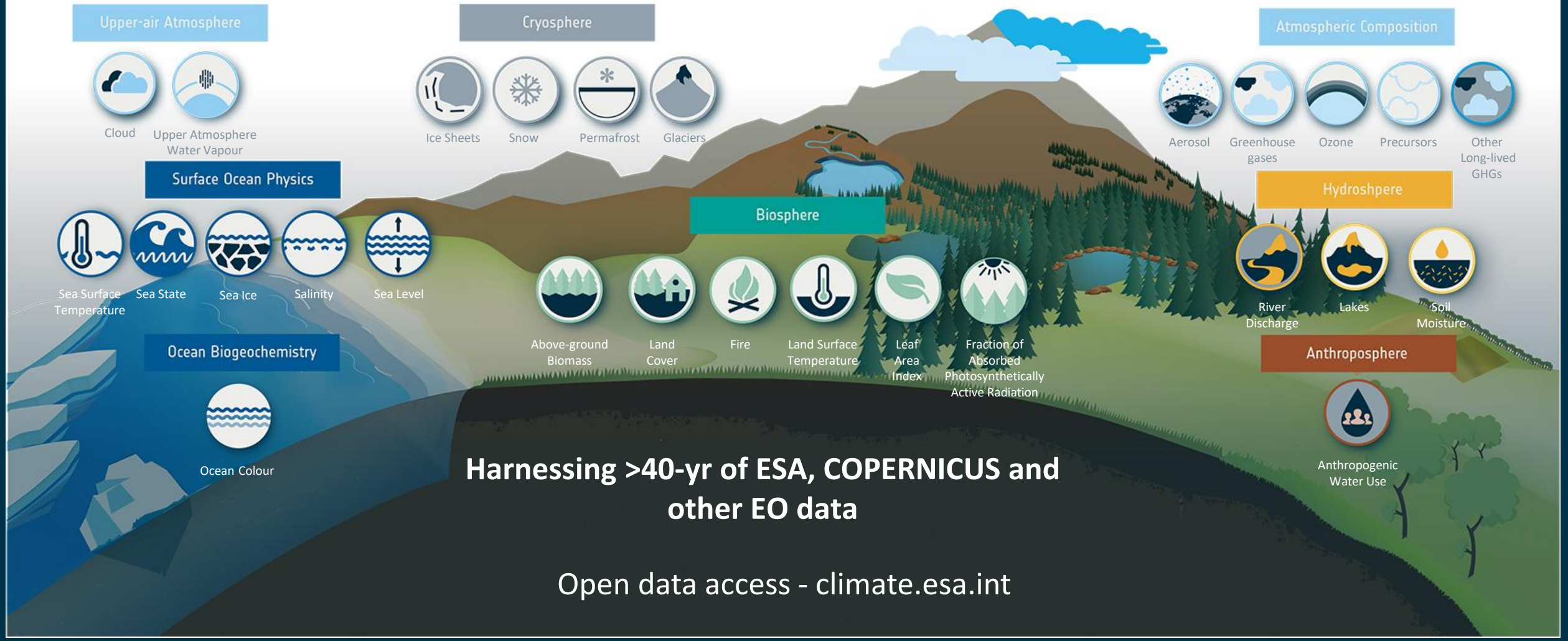
  Drought risk monitoring framework to detect, characterise, and track drought conditions across river basins, supporting climate-resilient water management.

- **Essential Wetland Variables for Wetland Condition** 1.8 MEUR, 30 months.

  Essential Wetland Variables (EWW) framework to assess wetland condition and support conservation and restoration efforts.

ESA's Climate Change Initiative (CCI)

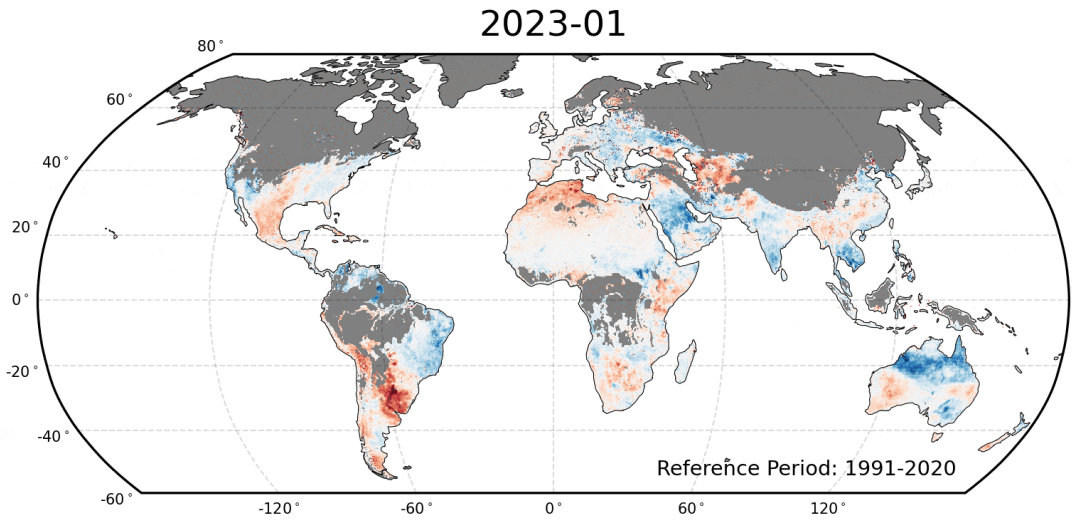
GCOS defined **55** Essential Climate Variables | **36** benefit from space observations
27 generated by ESA Climate Change Initiative | ~20 transferred to operational climate services



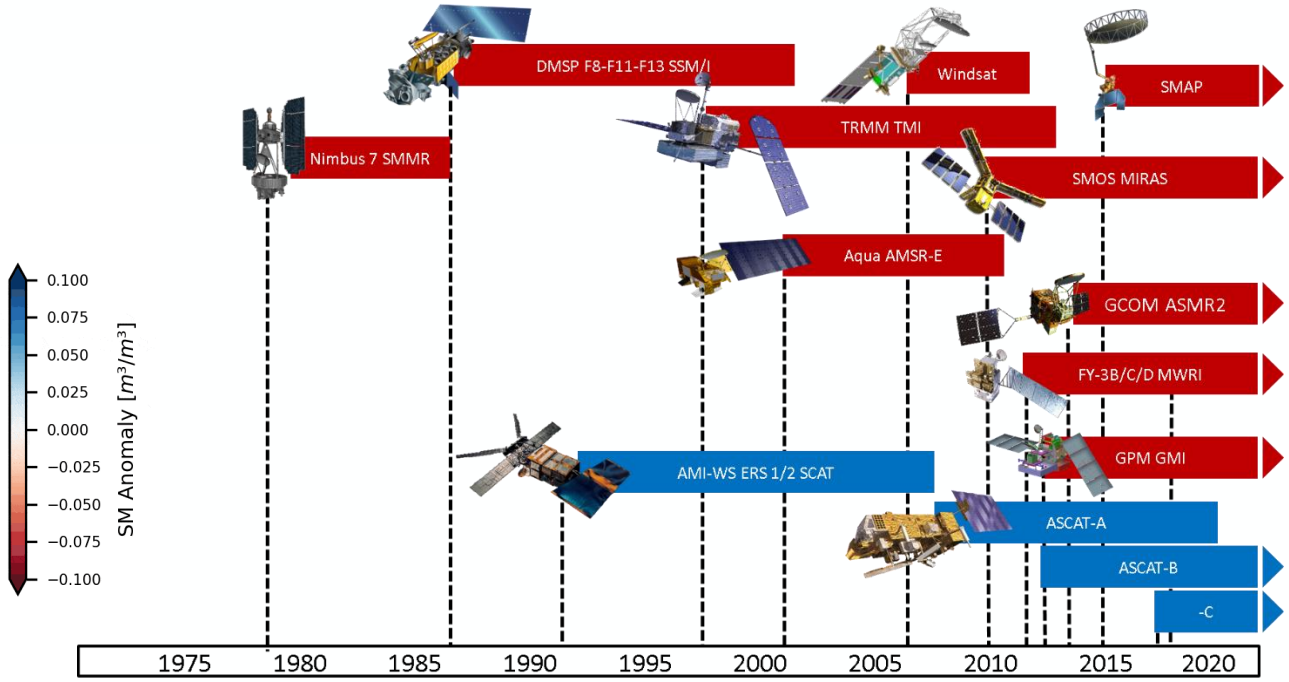
ESA'S CCI: SOIL MOISTURE ECV

- Annually algorithmically updated global climate data record of soil moisture spanning > 40-yr
- 3 separate soil moisture products derived from active, passive and combined (active + passive) sensors
- 14 public releases to date

https://climate.esa.int/en/projects/soil-moisture/



Soil moisture anomalies for the year 2023 derived from the ESA CCI COMBINED v09.0 product



ESA CCI soil moisture v09.1 products utilize 5 active and 12 passive microwave sensors

V09.1 (1979-2023), already available at:

https://climate.esa.int/en/projects/soil-moisture/

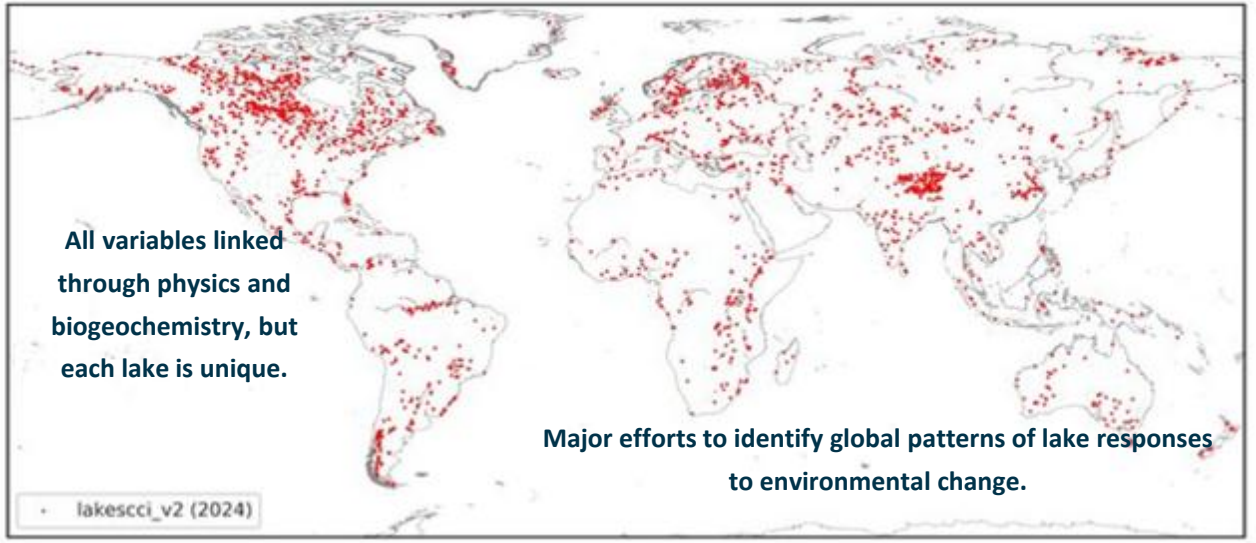
Now generated operationally via C3S

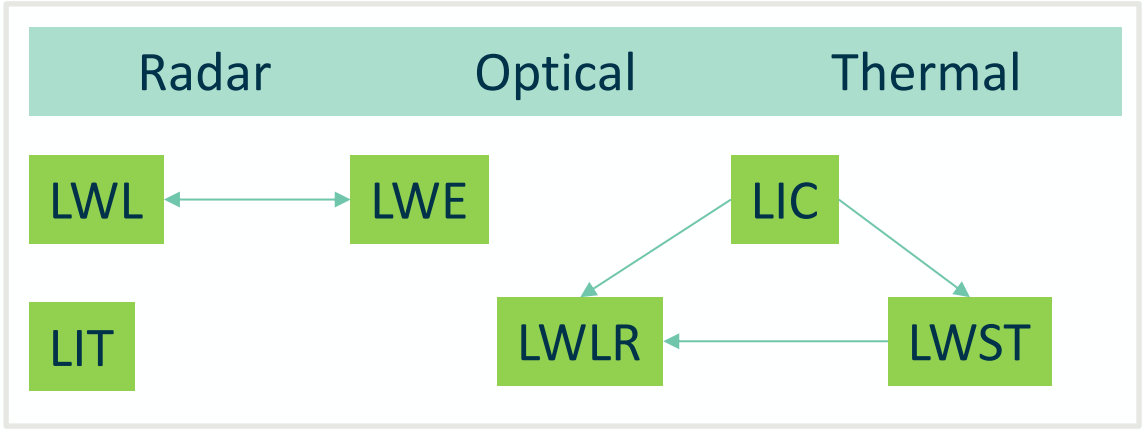
ESA'S CCI: Lakes ECV

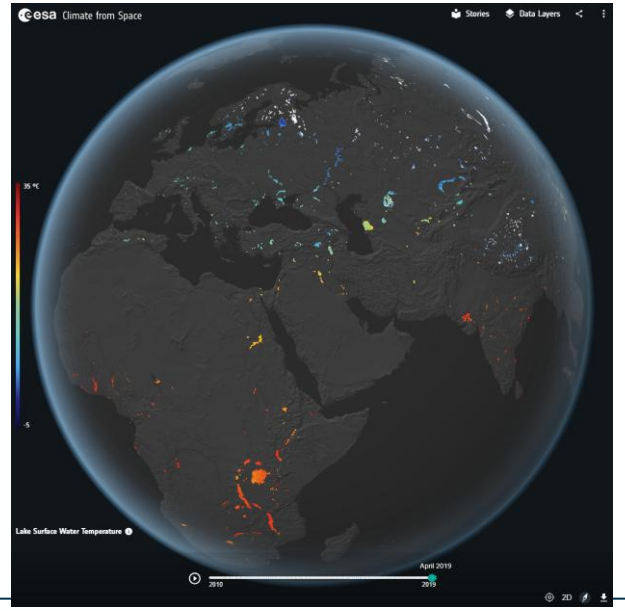
The Lakes ECV includes **six thematic variables**

- **L**ake **W**ater **E**xtent & **L**ake **W**ater **L**evel (coupled)
- **L**ake **I**ce **C**over
- **L**ake **S**urface **W**ater **T**emperature
- **L**ake **W**ater-**L**eaving **R**eflectance
- **L**ake **I**ce **T**hickness (developed in 2021)

It will also include Lake Water volume changes in the future (already available in Hydroweb for ~200 large lakes)







Carrea L., Cretaux J-F., Liu X., et al., Satellite-derived multivariate world-wide lake physical variable timeseries for climate studies, *Nature Sci Data* **10**, 30 (2023). https://doi.org/10.1038/s41597-022-01889-z

Climate Activities under Earth Action: Evolution of the Essential Climate Variables (ECV) framework

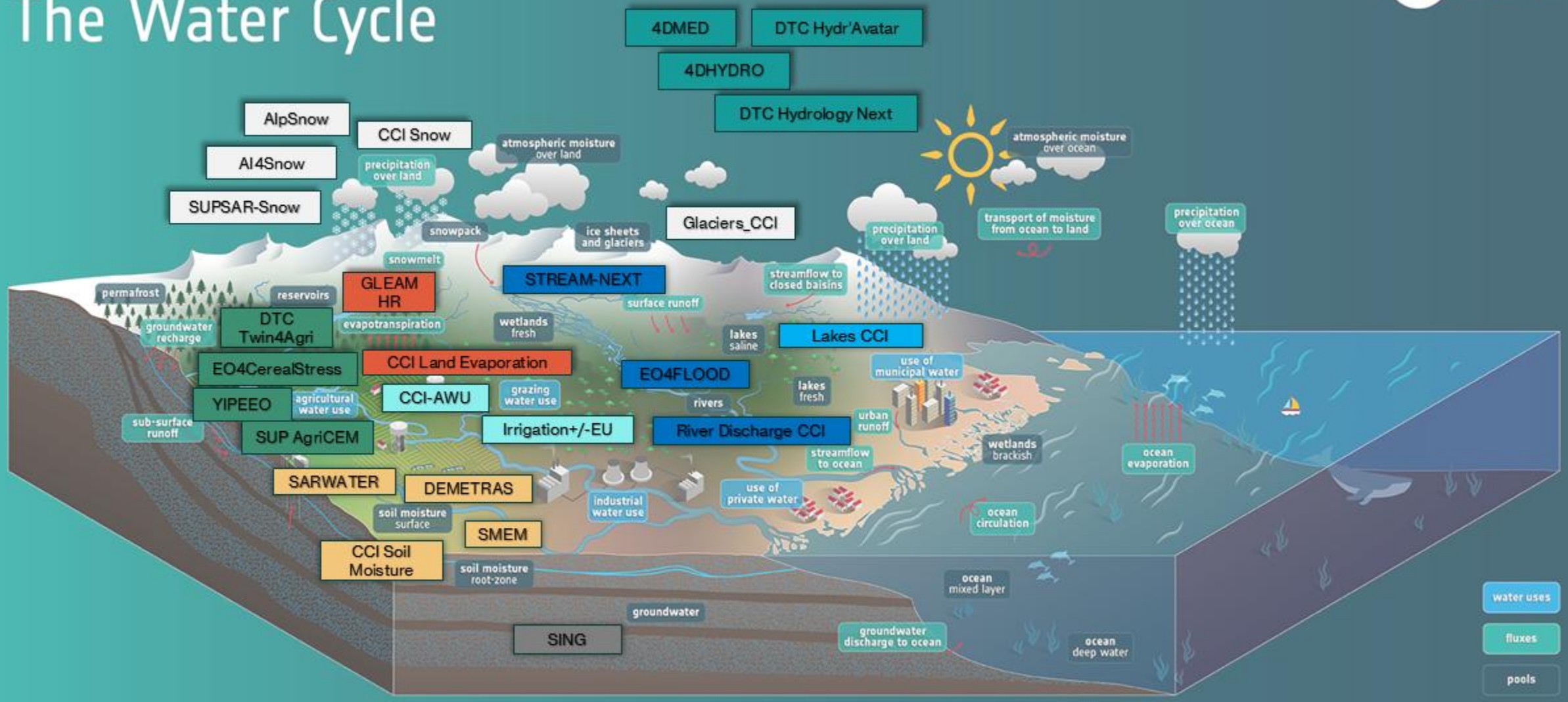
Thematic area	ECVs covered (Projects)
Land and biosphere	▪ Above-ground Biomass Carbon Stocks & Change ▪ Soil Moisture ▪ Land Cover, Land Cover Change & Vegetation ▪ Fire ▪ Lakes & River Discharge
Cryosphere	▪ Ice Sheets ▪ Snow & Glaciers ▪ Permafrost ▪ Sea Ice
Ocean and coastal areas	▪ Sea Level & Sea State (including SLBC) ▪ Sea Surface Salinity ▪ Ocean Colour & Productivity ▪ Ocean-Air Carbon Fluxes & Ocean carbon storage
Atmosphere	▪ Clouds, Aerosols, Radiation budget ▪ Ozone, Water vapour, Precursors ▪ Greenhouse gases (CO_2, CH_4, N_2O, F-gases)
Cross-sphere	▪ Surface Temperatures (Land, Sea, Ice)

- Develop & validate algorithms responding to GCOS ECV requirements, QA4EO quality assessed, to generate extended multi-sensor data records
- Requirements consultation & consolidation with international scientific user communities
- Backward extension & gap-filling of ECVs, & generation of their related Climate Impact Driver indices for climate science & services
- Development of processing & reprocessing data systems for transfer to operational climate services
- Strengthen climate modelling community links (CMIP, CORDEX)
- Involvement in intercomparison or assessment initiatives
- Demonstrate ECV product value in climate science and climate service case studies

40M EUR

Tender Issue Planned:	3rd Quarter 2026
Intended Start Date:	1st January 2027
Estimated Contract Duration:	3 Years

ESA Earth System Science activities in Hydrology



DTC - Hydr'Avatar

Develop an innovative digital twin platform for hydrology at a continental and regional/basin scale

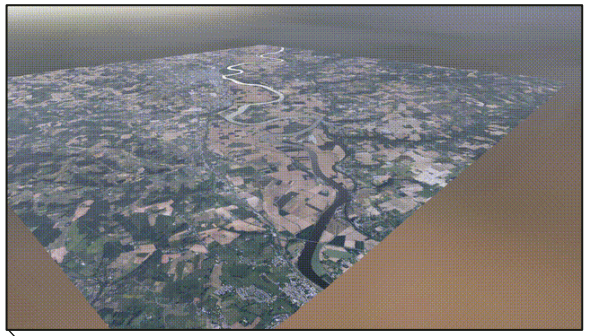
HYDR'AVATAR: EO-Driven Digital Twin for High-Resolution Hydrology: Monitoring, Modelling, and Decision Support under Climate Change.

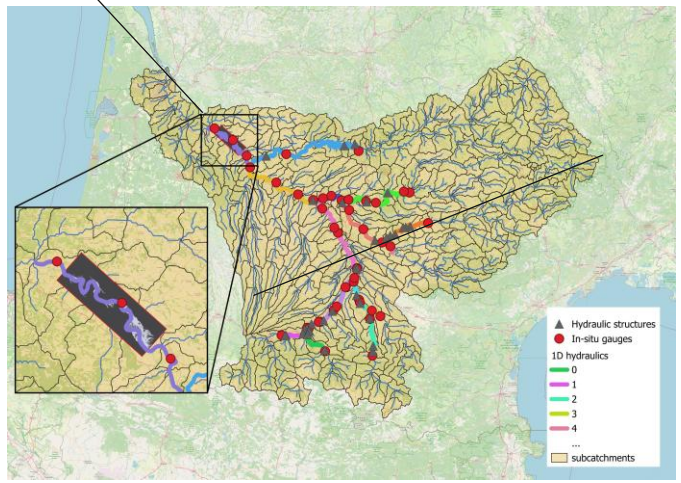
The overarching objectives of Hydr'Avatar are:

- Advance scientific and technical challenges related to improved hydrological prediction with EO data
- Provide end-users and stakeholders with advanced tools and foster their integration in the construction process
- Deliver a high-level and versatile end-to-end approach for EO data fusion and hydrological-hydraulic (H&H) modelling illustrated with numerical representations over selected river

- Improved/automatic hydraulic model construction with EO datasets
- Reinforced hydrological-hydraulic (H&H) coupling strategy and model parameters regionalization
- Multi-scale datasets inference and construction

- Pre-processing & modelling chains under deployment
- V0 of Hydr'Avatar platform deployed on cloud infrastructure, V1 under construction
- Model runs & datasets being transitioned to platform





H/H coupled modelling setup in the Garonne River basin

ESA 2026 ITTs on Earth Action “Earth System Science” under ”Water Cycle & Hydrology”

Towards a global assessment of anthropogenic impacts on the water cycle:

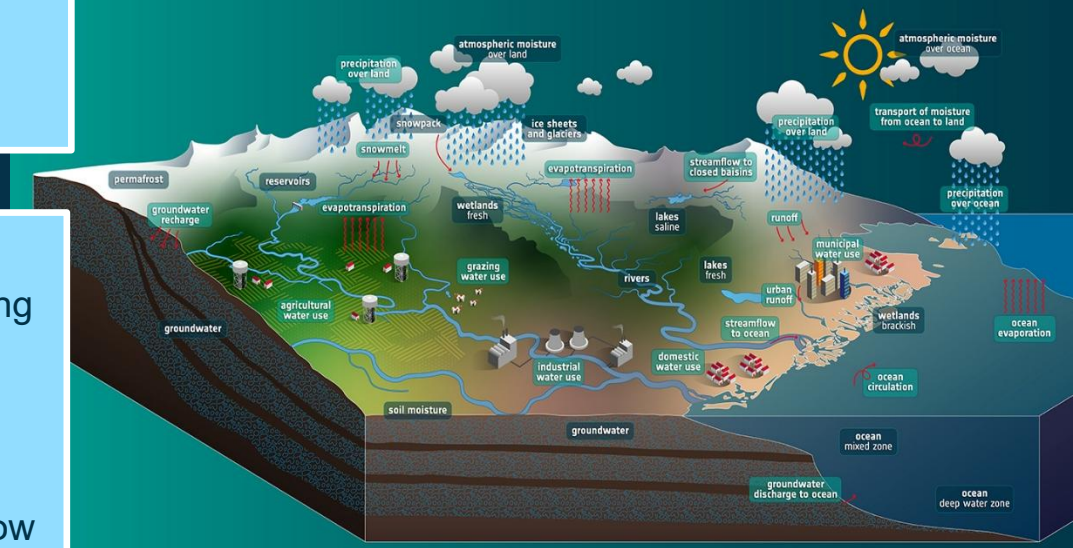
Advancing the understanding of how human activities alter the terrestrial water cycle by exploiting the full diversity of EO data to quantify and attribute changes in surface and groundwater storage, as well as water fluxes, and to evaluate the sustainability of observed trends at High resolutions. Key processes processes includes dams and reservoirs, land-cover change, water abstraction, irrigation, and other infrastructure interact to influence water availability, storage dynamics, and the partitioning of precipitation into evapotranspiration, runoff, and recharge in natural ecosystems.

Overall budget: 1 MEUR

SimulEarth Hydrology - Data driven Hyper-Resolution Hydrology:

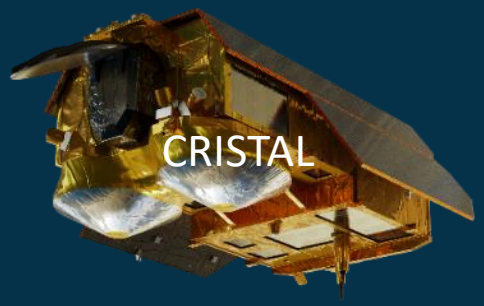
Advancing towards a novel data-driven (AI based, hybrid, physically informed) modelling system capable of reconstructing, simulating and predicting the hydrological cycle by jointly estimating a coherent, consistent, and uncertainty-aware suite of hydrological variables at a targeted spatial resolution of 1 km. The system shall be based on advanced EO data (low- and high-level products), rigorous uncertainty propagation, ensuring consistency across precipitation, evapotranspiration, soil moisture, runoff, snow water equivalent, water-body storage changes, groundwater variations, discharge, and human water use. The system and data shall be open to the community.

Overall budget: 1 MEUR



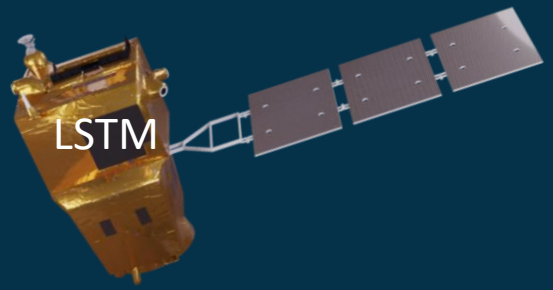
Sentinel Users Preparation (SUP) Initiative

Activity in collaborative synergy with the EC



WHAT

SUP is a preparatory initiative for the use of Copernicus Expansion/NG data with a multi-mission approach.

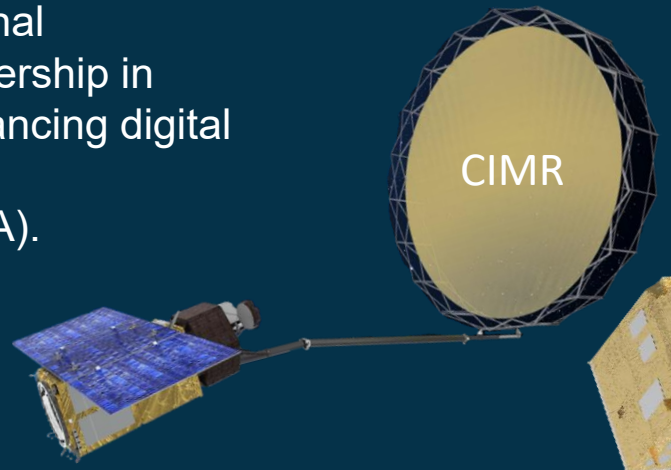


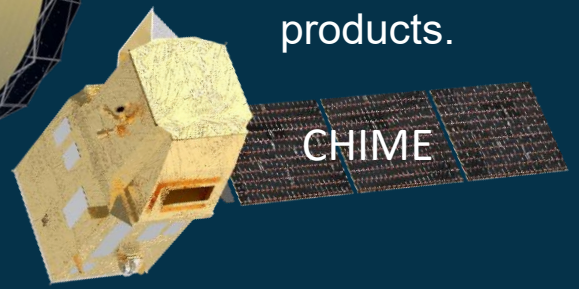
WHY

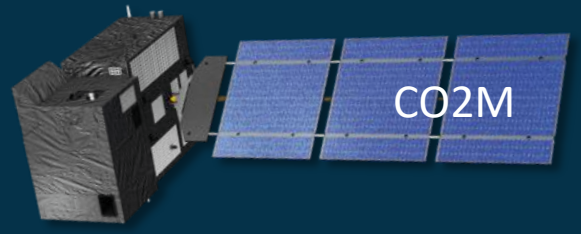
Facilitating the integration of Copernicus Expansion/NG datasets into operational workflows, reinforcing European leadership in competitive space domains, and advancing digital commercialisation
(ref. EARSC workshop 2021 with ESA).

HOW

- Over 22 workshops with stakeholders.
- Build the necessary expertise in the various science and application domains and sectors (academia, value adding companies) to prepare future downstream services.
- Ensure readiness for rapid uptake by users and stakeholders of derived information products.







EFFECTS

- Readiness of science and downstream analytics to address societal/environmental challenges.
- Act as ‘de-risking’ factor and incentive for growth to maximise return-on-investment.

ANACONDA- Co-creating new water quality and biodiversity management products from Sentinel expansion mission data

Objectives:

O1. Develop innovative methodologies and applications to monitor **inland water quality** and **wetland ecosystem health** using Sentinel Expansion missions (**CHIME, LSTM, ROSE-L**), in combination with current Sentinel data and local in-situ observations.

O2. Demonstrate the **innovative applications and methodologies** across multiple use cases and for a range of end-users and stakeholders.

O3. Build experience, technical capacity, and **user readiness for future Sentinel Expansion missions** through close collaboration with end-users and stakeholders.

Pilot sites:

- Danube Delta (Romania)
- Forth Estuary Catchment (Scotland)
- Volkerak-Zoommeer (Netherlands)

Kick-off: **Nov 2024**

Duration: **24 months**

52°impact

UNIVERSITY of STIRLING

Deltares
Enabling Delta Life

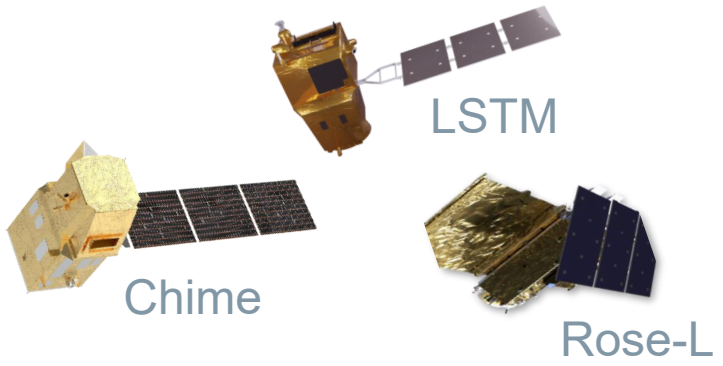
25 years GeoEcoMar® Home page

Early Adopters

Rezervatia Biosferei - Delta Dunarii - Tulcea- ROMANIA

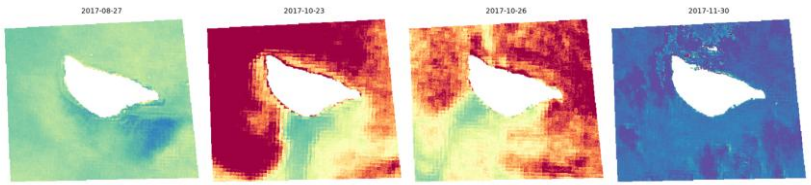
Scottish Water
Trusted to serve Scotland

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu



High Priority applications:

- Water Quality monitoring
- Algal bloom monitoring and forecasting
- Wetland dynamics and ecosystem health



Chlorophyll-a maps output over the course of an algal bloom event in 2017

Water Resources
KO Feb'23

Clean Energy
KO Dec'22

Transport & Infrastructure
KO Jan'24

Agriculture
KO Sep'22

Forest Management
KO Sep'24

Marine Env. & Blue Economy
KO Jun'22

Public Health
KO Sep'24

Urban Sustainability
KO Feb'22

- **75** countries (*05/25)
- **109** IFI projects
- **172** EO products

Fragility, Conflict & Security
KO Jan'22

Climate Resilience
KO Dec'21

Disaster Resilience
KO Sep'21

Climate Adaptation & Finance
KO Apr'25

GDA AID

Agile EO Information Development

From **Piloting** to **Mainstreaming**

GDA AID Water Resources

GDA mission: Accelerate impact through satellite Earth Observation in international development

GDA AID Water Resources (2023-2025): Sustainable Water Resources Management, including monitoring of water quality, flood management, groundwater assessment, drought impact analysis, water infrastructure safety and other water-related topics

EOMAP, Brockmann Consult, GeoVille, gisat, gmv, gruner, UFZ


WATER RESOURCES
Supporting Georgia to improve climate resilient water management for agriculture


WATER RESOURCES
How innovation can resolve conflict in the Sahel


WATER RESOURCES
Tracking surface water dynamics for agricultural resilience in Timor-Leste


WATER RESOURCES
Balancing Water Demand: EO Support of Mexico's Integrated Water Management


WATER RESOURCES
Building a Resilient Future: Tackling Floods, Droughts, and Water Scarcity in Pakistan


WATER RESOURCES
Battling pollution threats of Africa's largest freshwater lake


WATER RESOURCES
GDA AID Water Resources in support of combating water scarcity in Botswana

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Jan Marco Müller

European Commission

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Thank you

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