

# Blue-Cloud Strategic Roadmap

Unlocking the potential of cloud-based  
Open Science in the marine domain

## Vision & Mission 2030

Action Plan & Policy Recommendations

## Executive Summary

Final deliverable pending approval – Intended as  
supporting material to inform **Blue-Cloud Final Conference**

## Contents

### Blue-Cloud Strategic Roadmap to 2030

- Executive Summary
- Strategic Goals & Action Plan 2026-2030

#### **Blue-Cloud in a snapshot: Materials & infographics for further reference**

- [Blue-Cloud Data Discovery & Access Service and Virtual Research Environment](#)
- Blue -Cloud Virtual Labs:
  - Virtual Lab: [Zoo & Phytoplankton Essential Ocean Variable Products](#)
  - Virtual Lab: [Plankton Genomics](#)
  - Virtual Lab: [Marine Environmental Indicators](#)
  - Virtual Lab: [Aquaculture Monitor](#)
  - Virtual Lab: [Fish, A Matter of Scales](#)
- Applications evolved leveraging Blue-Cloud resources during Blue-Cloud Hackathon:
  - Virtual Lab: [PerfeCt – Performance of Aquaculture under Climate Change](#)
  - Virtual Lab: [Sea Clearly](#)
  - Virtual Lab: [The Wildlife Tracker for Oceans](#)

## Executive Summary

The Blue-Cloud project has piloted a digital platform and services showcasing how web-based Open Science can enhance the **marine knowledge value chain** in support of greater societal objectives, namely those seeking to address Ocean challenges and opportunities associated with the delivery of the **EU Green Deal** and **UN Agenda 2030**. It has proved how providing researchers with **cloud-based analytical tools** and **computing resources**, coupled with access to **marine data** openly available across different, **existing European data services** and **research infrastructures**, can shorten the research-to-innovation cycle, enabling them to harness artificial intelligence (AI) to improve the **transformation of marine data to products**, progress more efficient **modelling** of ocean variables, support **environmental analytical data services**, inspire and accelerate **community-driven innovation** and **collaborate** at a global scale. Blue-Cloud has further showcased the specific applications that these improved capabilities can deliver, advancing solutions towards e.g., monitoring biodiversity; predicting changes in ecosystems; producing marine environmental indicators; or managing fisheries and aquaculture.

### **Blue-Cloud Vision 2030**

*“To contribute to a European cloud-based knowledge system that provides access to a diverse and dynamic portfolio of analytical, prediction & visualisation capabilities underpinned by seamless access to a wealth of FAIR, transdisciplinary Ocean & freshwater observation data, enabling Open Science to deliver knowledge - including hindcast & forecast simulations-, and to drive innovation -notably through artificial intelligence-, science-based policies and public awareness for a safe, healthy and sustainably productive Ocean, in support of the EU Green Deal & UN Agenda 2030”.*

Building on its results and looking ahead (2026-2030), Blue-Cloud’s distinctive and specific contribution to the marine knowledge value chain will be geared at accelerating **marine & freshwater data interoperability** and improving **data modelling** and **Big Data analytics** through collaborative, cloud-based Open Science (**Blue-Cloud’s Mission 2030**). Blue-Cloud will evolve as a key component of Europe’s **FAIR marine digital knowledge ecosystem**, providing a flagship **community of practice** and **incubator** for data analysis and modelling methods in support of applied research of the ocean, European seas, coastal and inland waters. It will contribute to the successful evolution of the (**digital**) **marine knowledge system** required to support the EU Green Deal and the UN Agenda 2030, namely becoming a key **link** in:

- **Making ocean & freshwater digital commons accessible to the wider scientific community via EOSC:** Blue-Cloud will offer its interoperable data framework to bridge the gap with EOSC, supporting the FAIRification of marine & freshwater data and facilitating multidisciplinary innovation at a wider scale.
- **Supporting the development of analytical services and/or Digital Twins that add value to the core European Digital Twin of the Ocean (EU DTO) to inform policy making in the delivery of societal objectives:** Blue-Cloud will leverage its digital ecosystem and community of practice to deliver both user-driven and/or community-driven value at the intersection of the communities enabling the development of environmental (marine & freshwater related) data analytical services and/or digital twins, namely: the **“Observation and Data Collection & Management”** communities, the **“Data Modelling”** communities and the **“e-infrastructures”** that provide cloud storage and computing capabilities.

To achieve its Mission, Blue-Cloud will strive to maximise value to **primary, secondary & tertiary** users:

- **Primary users (marine researchers, computer scientists & software developers):** It will improve its digital platform with user-driven upgrades (more functionalities, more computing power, more federated data); sustain a well-resourced customer support centre (including providing

expertise on the application of artificial intelligence); and nurture community-building by providing users with training opportunities and incentives, aiming at offering access to these resources free-of-charge to researchers.

- **Secondary users** (*EU and (inter)national environmental agencies; marine data & research infrastructures; EOSC; DestinE & EU DTO; Horizon Europe Mission Lighthouses & Blue Parks; Blue Economy SMEs & Industry*): It will continue to evolve its DD&AS with new data repositories from current contributing infrastructures and from new infrastructures to further bridge their gap with EOSC; set up a DTO Task Force to make Blue-Cloud resources easily portable and/or integrated into the future EU DTO; explore collaboration opportunities with other public and/or private initiatives seeking to develop digital twins to support the EU DTO and/or Blue-Economy undertakings, offering them a unique digital ecosystem to co-create, build and test the algorithms and models enabling the data streams and workflows required for their operation, together with an Open Science community of practice that can be leveraged for innovation; and engage with new marine and freshwater research projects and with Horizon Europe “Mission” platforms to identify needs and challenges of marine data users that could be addressed with new methods incubated in Blue-Cloud.
- **Tertiary users** (*policy makers, funders, civil society organisations, citizens*): Blue-Cloud will continue to steer innovation towards supporting strategic EU policy strategies and action (i.e., MSFD, WFD, Biodiversity and “Farm to Fork”) and towards supporting international collaboration around global ocean observing and forecasting capabilities, with special attention to supporting the delivery of the UN Agenda 2030 SDGs 2, 13 and 14. It will closely monitor and engage with developments around the EU Green Deal Data Space (GDSS) to further identify challenges, opportunities and priority action areas where Blue-Cloud could contribute to accelerate progress. It will continue to support the development of user-friendly applications and interfaces that contribute to increasing the flow of citizen science data into the marine knowledge value chain and to bringing ocean science closer to citizens.

**Strategic Goals 2026-2030** and a comprehensive **Action Plan** have been designed to drive future developments towards delivering Blue-Cloud’s Mission 2030, working around **5 strategic paths of action**:

- **Strategic Action Path 1:** Sustain the flow of FAIR & open marine data into Blue-Cloud.
- **Strategic Action Path 2:** Trigger the development of innovative data analytics methods around priority environmental thematic to inspire and guide the Blue-Cloud community towards further evolving applications in support of key policy objectives.
- **Strategic Action Path 3:** (Further) Federate with key marine data, research and e-infrastructures and strategic initiatives (e.g., EOSC, EDITO-Infra) to enhance value to users.
- **Strategic Action Path 4:** (Further) Grow a thriving ocean open science community, leveraging skills, incentives and rewards and promoting wide dissemination of FAIR methods incubated in Blue-Cloud to boost innovation at a wider scale.
- **Strategic Action Path 5:** Connect and align with wider developments and other communities to contribute to a European and a global, international knowledge system in support of the EU Green Deal and the UN Agenda 2030.

Delivering Blue-Cloud’s Mission 2030 will require support from **EU policy and funding frameworks**, which will be needed not only to continue to evolve Blue-Cloud’s efforts, but also to create a thriving context for the successful delivery of its overarching **vision**, which spans well beyond the scope of action of Blue-Cloud. The following table sums up the **roadmap of actions** that Blue-Cloud has laid out to deliver its **Mission 2030**, coupled with **recommendations for policy actions** that are considered critical to realise the full potential of web-based Open Science in the marine domain, paving the way for the successful delivery of the knowledge system required to advance research of Ocean, seas, coastal and inland waters in Europe and beyond.

**Table 1: Summary of Strategic Roadmap & Policy Recommendations**

<b>Strategic Action Path 1 &amp; Policy Recommendations Towards Sustaining the Flow of FAIR and Open marine data in Blue-Cloud's (and other) Open Science environments</b>	
<b>Blue-Cloud Strategic Actions 2026-2030</b>	<b>Policy Recommendations 2030</b>
<p>1.1 Expand Data Discovery &amp; Access Service (DD&amp;AS) with priority EU marine data &amp; research infrastructures.</p> <p>1.2 Expand Data Discovery &amp; Access Service with citizen science repositories.</p> <p>1.3 Expand Data Discovery &amp; Access Service with freshwater repositories.</p> <p>1.4 Enhance DD&amp;AS with additional functionality for sub-setting and extracting data sets, towards feeding and maintaining data lakes with EOVs.</p> <p>1.5 Improve the FAIRness of the federation by optimising machine-to-machine interactions with connected RIs and data repositories.</p>	<p>1. Operationalise funding for trusted EU marine data infrastructures &amp; services to maintain seamless operation and evolution of data services towards meeting future needs e.g., cloud-based data sharing &amp; Open Science.</p> <p>2. Take measures to strongly mandate improved flow of scientific data into EU marine data &amp; research infrastructures and adopt mechanisms to help overcome barriers to data retention for publicly funded research.</p>
<b>Strategic Action Path 2 &amp; Policy Recommendations Towards Triggering Innovative Data Analytics Methods Around Priority Thematics to inspire and guide the community</b>	
<b>Blue-Cloud Action 2026-2030</b>	<b>Policy Recommendations 2030</b>
<p>2.1 Test and develop new digital assets, including workbenches to improve quality control for EOVs.</p> <p>2.2 Continue evolving existing Virtual Labs (e.g., Marine Environmental Indicators VLab) to upscale their current analytical products &amp; services, enhancing their user value and user-friendliness with data inspection and/or visualisation capabilities to support policy objectives.</p> <p>2.3 Develop new analytical services addressing priority policy areas of the EU Green Deal (e.g., biodiversity monitoring, Marine Spatial Planning).</p> <p>2.4 Engage with the private sector to test and develop fit-for-purpose solutions in support of environmental analytical services and/or digital twins servicing Blue Economy applications.</p>	<p>3. Encourage EU initiatives to share outcomes of stakeholder consultation processes towards identifying user needs &amp; requirements for new analytical, modelling and/or visualisation services that could be developed within Blue-Cloud, servicing different communities.</p> <p>4. Capitalise on Blue-Cloud to service the needs of projects building analytical tools &amp; services to support research (e.g., HE projects) and/or to inform policy (e.g., MSFD, WFD, etc).</p> <p>5. Promote free access to data services with data formats and access protocols supporting interoperability worldwide (e.g., OGC, TDWG...), relaxing 3rd party barriers to Open data in the marine domain to enable user-driven innovation and Open Science at a wider scale, while fostering data licensing to support data usage tracking.</p>
<b>Strategic Action Path 3 &amp; Policy Recommendations towards (further) federating marine data, research &amp; e-infrastructures and strategic initiatives to enhance value to users</b>	
<b>Blue-Cloud Action 2026-2030</b>	<b>Policy Recommendations 2030</b>
<p>3.1 Advance further integration with key e-infrastructures (e.g., orchestrating analytical workflows, Single-Sign-On, upscaling computing power).</p> <p>3.2 Further integrate with WEkEO to enable portability of Blue-Cloud assets to EU DTO, DestinE and other relevant environments.</p>	<p>6. Sustain progress towards federation of e-infrastructures to increase EU cloud storage, computing power and GPUs, enabling the research community to tap on EU digital capabilities, resources, and commons to engage in Open Science.</p> <p>7. Encourage key players (EOSC, future EU DTO) to fix protocols and/or rules of compliance that enable</p>

<p>3.3 Setup DTO Task Force to align objectives and contribute digital assets to EU DTO &amp; DestinE.</p> <p>3.4 Connect with communities developing components of EU DTO to offer collaboration &amp; synergies.</p> <p>3.5 Ensure long-term EOSC alignment and integration.</p>	<p>users to easily port their digital assets across e-infrastructures, without being “tied” to them.</p> <p>8. Promote cooperation between public marine data and research infrastructures, e-infrastructures and European, private cloud service providers to bring data and models to their platforms, making them also available in their computing facilities to support wider use, exploitation, dissemination and uptake.</p>
<p><b>Strategic Action Path 4 &amp; Policy Recommendations towards (further) growing a thriving Ocean Open Science community leveraging skills, incentives &amp; rewards and promoting FAIR methods to promote innovation at a wider scale</b></p>	
<p><b>Blue-Cloud Action 2026-2030</b></p>	<p><b>Policy Recommendations 2030</b></p>
<p>4.1 Continuously monitor &amp; deliver the evolving needs of Blue-Cloud’s primary users to offer an excellent service that contributes to consolidate and grow the community.</p> <p>4.2 Set up a support service and a training academy to build FAIR data, AI &amp; Big Data skills amongst researchers, attracting new users.</p> <p>4.3 Set up competitions to invite users to address challenges set forth by secondary users, rewarding ideas with uptake potential.</p> <p>4.4 Expand connections with (Horizon Europe) research project communities.</p> <p>4.5 Set up MoU’s with key EU initiatives to acknowledge methods developed in Blue-Cloud that could be taken-up with a special attribution of “excellence” and/or enticing Terms of Use.</p> <p>4.6 Explore collaboration with commercial platforms offering analysis &amp; visualisation of geospatial datasets (e.g., Google Earth) to promote dissemination of FAIR methods.</p>	<p>9. Include in curricula and support training efforts to build capacity amongst researchers in the use of artificial intelligence, machine learning (ML), and on the application of FAIR practices to analytical methods for wider exploitation, capitalising on Blue-Cloud’s VRE to deliver data camps, courses and training.</p> <p>10. Foster mechanisms that reward research teams that incubate methods and/or services that are taken-up by long term EU initiatives and/or services, including economic rewards linked to their exploitation (e.g., by sharing “exploitation fees” of “freemium” schemes offered to users).</p> <p>11. Establish Terms of Reference for exploitation of digital commons across the EU Green Deal Data Space, promoting open access to such commons (e.g., data, data models, algorithms) and the adoption of an open-source approach to their exploitation if/when obtained and/or developed with public funding.</p>
<p><b>Strategic Action Path 5 &amp; Policy Recommendations towards connecting and aligning with wider communities to contribute to a European and global knowledge system</b></p>	
<p><b>Blue-Cloud Action 2026-2030</b></p>	<p><b>Policy Recommendations 2030</b></p>
<p>5.1 Engage with GDDS Community of Practice.</p> <p>5.2 Engage with HE Lighthouses, Blue-Parks and with EU4Ocean networks to identify community-driven challenges to “interrogating” the Ocean.</p> <p>5.3 Continue collaboration with All-Atlantic Ocean Research Alliance.</p> <p>5.4 Evolve methods into international Ocean Best Practices towards supporting international efforts (GOOS, GEOSS) and UN Decade programs.</p>	<p>12. Support uptake and capitalisation of the results of the community-driven, Open Science efforts delivered by Blue-Cloud into the EU Digital Twin Ocean and other EU and global environmental initiatives, such as the UN Convention on Biological Diversity and the UN Framework Convention on Climate Change.</p>

# Strategic Goals & Action Plan 2026-2030

Blue-Cloud		Strategic Roadmap to 2030		
Action Plan 2026-2030		2023	2026	2030
<b>+FAIR DATA</b>	<b>Strategic Action Path 1:</b> Sustain the flow of <b>FAIR &amp; open marine data</b> into Blue-Cloud	<ul style="list-style-type: none"> <li>1.1 Expand DD&amp;AS with priority EU marine data &amp; research infrastructures</li> <li>1.2 Optimise machine-to-machine interactions with RIs</li> <li>1.3 Enhance for sub-setting &amp; extracting data sets and feeding data lakes for EOVS.</li> <li>1.4 Expand DD&amp;AS with citizen science repositories</li> <li>1.5 Expand DD&amp;AS with freshwater repositories</li> </ul>	<b>KEY ASSETS</b>  <b>An expanded federated DD&amp;AS</b>	<b>KEY ASSETS</b>  <b>A marine &amp; freshwater data space federated into EOOSC</b>
<b>+APPLICATIONS</b>	<b>Strategic Action Path 2:</b> Trigger innovative AI applications & methods around priority thematic to <b>inspire &amp; guide</b> the community	<ul style="list-style-type: none"> <li>2.1 Test and develop new digital assets, including workbenches for EOVS</li> <li>2.2 Evolve existing VLabs to upscale existing analytical products &amp; services to service policy objectives</li> <li>2.3 Test and develop new analytical services addressing priority policy areas of EU Green Deal</li> <li>2.4 Engage with private sector to develop fit-for-purpose analytical services to support digital twins servicing Blue Economy applications</li> </ul>		
<b>+CLOUD &amp; IT</b>	<b>Strategic Action Path 3:</b> (Further) <b>federate</b> (with) blue infrastructures, e-infrastructures & strategic initiatives	<ul style="list-style-type: none"> <li>3.1 Further e-integration: Orchestrating analytical workflows, Single-Sign-On, monitoring &amp; accounting, + computing power</li> <li>3.2 Further integrate with WEKEO</li> <li>3.3 Setup DTO Task Force to align w/ EU DTO &amp; DestinE</li> <li>3.4 Connect with communities developing EU DTO components</li> <li>3.5 Ensure long-term EOOSC alignment and integration</li> </ul>	<b>+ Blue-Cloud VLabs</b>	<b>An incubator of (blue) data analytical methods &amp; services</b>
<b>+COMMUNITY</b>	<b>Strategic Action Path 4:</b> Grow a thriving ocean open science community, leveraging <b>skills, incentives &amp; rewards</b> to boost innovation	<ul style="list-style-type: none"> <li>4.1 Continuously monitor &amp; deliver needs of primary users</li> <li>4.2 Set up a support service and a training academy to build FAIR data, AI &amp; Big Data skills amongst researchers and to attract and service new users</li> <li>4.3 Set up competitions to invite users to innovate solutions to challenges put forward by secondary users</li> <li>4.4 Connect with (Horizon Europe) research project communities to attract new users to Blue-Cloud</li> <li>4.5 Set up MoU's with key EU initiatives (i.e., EU DTO, GDDS) to reward methods developed in Blue-Cloud with attribution of "excellence"; and/or enticing Terms of Use.</li> <li>4.6 Explore opportunities with commercial platforms to promote dissemination of FAIR methods "incubated" in Blue-Cloud</li> </ul>	<b>Workbenches</b>	
<b>+ALLIANCES</b>	<b>Strategic Action Path 5:</b> <b>Connect &amp; align</b> with wider developments and other communities to bring in state-of-the-art and contribute experience	<ul style="list-style-type: none"> <li>5.1 Engage with Green Deal Data Space Community of Practice</li> <li>5.2 Engage with Mission Lighthouses &amp; EU4Ocean networks to identify priorities &amp; challenges when examining the Ocean</li> <li>5.3 Keep collaborating with All-Atlantic Ocean Research Alliance</li> <li>5.4 Evolve methods into international Ocean Best Practices supporting international efforts (GOOS, GEOSS) and UN "Ocean Decade" Programs</li> </ul>	<b>Training Academy</b>	<b>A trusted Community of Practice</b>
			<b>DTO Task Force</b>	<b>A sustainable business model</b>

### Strategic Goals 2026

**SG2026.1.** Blue-Cloud grows its Data Discovery & Access Service with most relevant, priority EU marine data & research infrastructures and with citizen science repositories, while deploying data lakes to showcase potential added value to wider EU services and initiatives (i.e., EU DTO).

**SG2026.2.** Blue-Cloud further demonstrates value of Open Science across current and new research topics, also testing and developing new, (Big Data) analytical workflows that could potentially support or be exploited by other infrastructures and/or EU services and initiatives, inspiring and guiding its community towards EU priority (policy) areas of action.

**SG2026.3.** Blue-Cloud creates an enticing framework of incentives that inspires target users to test and develop their (AI) experiments and/or environmental analytical services in Blue-Cloud, leveraging existing resources and methods to catalyse innovation at a larger scale.

**SG2026.4.** Blue-Cloud further attracts new Open Science practitioners and users to its community.

**SG2026.5.** Blue-Cloud establishes a long-term community dialogue with key stakeholders to enable seamless discovery and exploitation of Blue-Cloud's digital commons, assets and services by users via wider EU (i.e., EOOSC, EU DTO & DestinE, Green Deal Data Space, EOOS) and international (e.g., GEOSS, GOOS) initiatives.

### Strategic Goals 2030

**SG2030.1.** Blue-Cloud consolidates as Europe's flagship cloud-based Open Science community of practice and incubator for innovative marine and freshwater data analysis & modelling methods, contributing to accelerate data interoperability, modelling and Big Data analytics in the marine & freshwater domains.

**SG2030.2.** All relevant EU marine & freshwater data services, Research Infrastructures and initiatives contribute to continuously feed a wealth of FAIR marine & freshwater data into Blue-Cloud, supporting its dynamic user environment and the flow of data into EOOSC.

**SG2030.3.** Blue-Cloud leverages the collective intelligence of its Open Science community to deliver a constant flow of digital assets (methods) that enhance the EU Green Deal Data Space and EU DTO and can be discovered by other research communities via EOOSC. Blue-Cloud's federated approach enables these assets to be portable to other environments for further exploitation, also potentially as services, supporting a wide range of users in transforming data into information, knowledge & innovation.

**SG2030.4.** Blue-Cloud consolidates its position as a key link of the EU marine knowledge value chain, securing a sustainable financial framework for its operation and further development.



# Blue-Cloud

Piloting innovative services for Marine Research & the Blue Economy



[blue-cloud.org](https://blue-cloud.org)



[@BlueCloudEU](https://twitter.com/BlueCloudEU)



[/company/blue-cloud-org/](https://www.linkedin.com/company/blue-cloud-org/)



[/c/BlueCloudorg](https://www.youtube.com/c/BlueCloudorg)



[/communities/bluecloud](https://www.zerodoc.com/communities/bluecloud)

**Lead author:** Seascope Belgium

**Contributing authors & reviewers:** Julia Vera, Kate Larkin, Conor Delaney, Nathalie Tonné, Stefano Cisternino, Jan-Bart Calewaert (Seascope Belgium), Sara Pittonet, Federico Drago (Trust-IT), Dick Schaap (MARIS), Pasquale Pagano (CNR-ISTI), Patricia Cabrera (VLIZ), Massimiliano Drudi (CMCC), Anton Ellenbroek (FAO), Dominique Obaton (Ifremer)

**Graphic design:** Trust-IT

## December 2022

The Blue-Cloud project Consortium would like to thank over 200 respondents who have brought their voice to the different surveys that have shaped the development of the Blue-Cloud Strategic Roadmap to 2030. Also, to the more than 120 participants who joined the Blue-Cloud Hackathon, providing feedback from a user perspective. Finally, our special thanks to the following persons and organisations for bringing their vision, input and guidance into this community effort:

Alessandra Neyts (EATiP) – Blue-Cloud External Stakeholder & Expert Board, Audrey Hasson (GEO Blue Planet - European Office), Bob Jones (EOSC Association), David Bassett (EATiP), David Mills (IMARDIS) – Blue-Cloud External Stakeholder & Expert Board (ESEB), Emilio Campana (CNR), Inga Lips (EuroGOOS), Jaume Piera (CSIC) – Blue-Cloud ESEB, Jay Pearlman (IOC-IODE Ocean Best Practice System), Jean-Noël Druon (EC JRC) – Blue-Cloud ESEB, Karl Presser (Premotec) – Blue-Cloud ESEB, Laurence Delauney (JERICO-RI), Lorinc Meszaros (Deltares), Lucy Scott (UNESCO IOC-IODE), Marc Taconet (FAO), Maria Hood (G7 Future of Seas & Ocean Initiative - European Office), Martin Visbeck (GEOMAR) – Blue-Cloud ESEB, Nicolas Pade (EMBRC), Nicolas Segebarth (European Commission) – Blue-Cloud ESEB, Peter Pissierssens (IOC-IODE) – Blue-Cloud ESEB, Pier Luigi Buttigieg (GEOMAR), Robert Huber (MARUM) – Blue-Cloud ESEB, Rupert Lueck (EMBL) – Blue-Cloud ESEB, Sheila JJ Heymans (European Marine Board) – Blue-Cloud ESEB, Tamsin Vicary (OpenASFA), Tiziana Ferrari (EGI Foundation) – Blue-Cloud ESEB, Toste Tanhua (GEOMAR, EuroSEA) – Blue-Cloud ESEB.



Blue-Cloud has received funding from the European Union's Horizon programme call BG-07-2019-2020, topic: [A] 2019 - Blue Cloud services, Grant Agreement No.862409