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## **Open Earth Observation and federative-type systems as a basis for innovation, competitiveness, permanent monitoring of the European environment and green transition**

The Open-Earth-Monitor Cyberinfrastructure project (OEMC) was funded under the HORIZON EUROPE (HORIZON-CL6-2021-GOVERNANCE-01-16) call and is focused on speeding up uptake of EO data for monitoring purposes, demonstrated through almost 30 use-cases (duly registered via the GeoKnowledge Hub), and helping users of EO data make their workflows more FAIR (Findable, Accessible, Interoperable and Reusable), specifically to support the objectives of the [European Green Deal](#), the [EU Climate Adaptation Strategy](#), the [European Data Strategy](#) and the [UN Sustainable Development Goals](#). After three years of the OEMC project, a list of key summary recommendations and conclusions is provided.

### **SCOPE**

This policy brief was produced by the OEMC project Executive Board and represents the views and opinions of the authors. It aims to support decision-makers, especially within European and international organizations, looking for guidelines on: how to use open EO data to support new businesses, especially Small and Medium Enterprises (SME's), which cyberinfrastructure and data and software choices to follow, and what are the current bottlenecks of upscaling open EO projects such as Copernicus Sentinel. The document also aims to answer practical, real-world questions, such as: what AI technology can and cannot do to speed up land restoration and the green transition? And, how can civil society contribute to the European Commission's efforts on funding EO research projects?

### **BACKGROUNDS**

**Open Earth Observation is a foundation of data-driven governance. EO-based monitoring might soon become the basis of environmental accounting.** Thanks to the Copernicus Sentinels, today the whole planet is scanned at a spatial resolution of 10 m, and the revisit time on each point is every 5–6 days. Open Earth Observation data are at the core of **a reliable, timely and robust information system for decision-making and carbon accounting.** The costs of developing and maintaining Earth Observation (EO) missions such as **Copernicus**

**Sentinel satellites** are minor compared to the potential losses in goods and human lives due to poor planning and poor forecasting. The economic benefits of Copernicus are forecasted to generate **10 to 20 times** the programme's total investment over the long term<sup>1</sup>.

**In Europe, the Copernicus Data Space Ecosystem<sup>2</sup> (CDSE) provides a fully-fledged infrastructure and a fully-operational platform — everyone is invited.** The initiative, funded and established by the European Union, is now a comprehensive platform for solving critical problems in data access, processing, and availability, while hosting nearly 100 petabytes of data and providing tools that support AI and machine learning workflows. The platform is open to researchers, policymakers, and businesses, providing seamless integration and scalable compute resources. The OEMC project has now added a [bimonthly 30 m Landsat](#) data set to CDSE (in addition to Sentinel-1 and Sentinel-2 data), covering 1997–2024, so that users can also analyse EO data prior to 2016.

Considering the benefits of open EO data and considering the total costs of ESA missions such as Copernicus Sentinel (especially in terms of costs per capita per year), there is still room to increase investments into EO missions due to the significant imbalance between investments into the ESA's space segment and investments into the exploitation and uptake of open EO data.

## CHALLENGES AND RECOMMENDATIONS FOR EARTH OBSERVATION DATA IN AN AI CONTEXT

- **The fast-emerging AI technology will likely boost the use of EO data in the coming years, but there are still a lot of open challenges.** The recent AlphaEarth<sup>3</sup> (Google Earth embeddings) are the first complete, consistent, and ready-to-use open (distributed under a CC-BY license) EO global coverage 10 m-resolution annual products (2017–2024) currently available. Embeddings have the potential to revolutionise the use of EO, but many issues remain unresolved, including interpretability and the potential loss of information. AI technology and further fusion of AI technology and EO / remote sensing will result in a revolution of applications and will cut down costs of processing data significantly. Some new application areas post 2026 are even difficult to predict as technology is evolving rapidly.
- **Europe is a strong partner with the USA; however, the EU's cloud-dependence on the USA questions the sovereignty of many private and business entities:** A small number of US companies (Microsoft Azure, Amazon Web Services, Meta, OpenAI and Google) dominate 70–80% of the European market for cloud services<sup>4</sup>. European organizations should prioritize using, extending and improving their own infrastructures in order to achieve **at least 50% of cloud sovereignty**. **Self-hosting data using open-source solutions such as Nextcloud<sup>5</sup>, Ceph<sup>6</sup> and similar are among the most viable options.**

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<sup>1</sup> <https://www.copernicus.eu/en/what-are-tangible-benefits-copernicus>

<sup>2</sup> <https://dataspace.copernicus.eu/>

<sup>3</sup> <https://deepmind.google/discover/blog/alphaearth-foundations-helps-map-our-planet-in-unprecedented-detail/>

<sup>4</sup> <https://www.clingendael.org/publication/netherlands-and-eu-prioritising-cloud-sovereignty>

<sup>5</sup> <https://nextcloud.com/>

<sup>6</sup> <https://ceph.io/en/>

- **Today's high interest in establishing robust monitoring mechanisms and infrastructures to track every pixel, every tree, every water stream, every soil (pedon) both at national, continental and global scales** contemplates four key aspects: (I) Single baselines (*i.e.* the reference, year 0); (II) changes need to be registered using immutable, decentralized infrastructures to avoid any misuse or manipulation (*e.g.* using block-chain solutions); (III) Uncertainty of estimates/metrics needs to be assigned and communicated clearly to users; (IV) infrastructure and production of data should have free, fast and simple access to data including via mobile phones so that citizens can see a return of their contributions.
- **The key role of in-situ measurements in validating satellite data should be recognised and brought to the attention of the public.** Without “*ground truth*”, researchers could not have usable EO datasets. Also, *in-situ* measurements are powerful tools *in their own right*, useful for characterising an area, an ecosystem, or a biome from many different perspectives.

## CITIZEN SCIENCE, CROWD-SOURCING AND EARTH OBSERVATION EFFORTS

- Citizen-science initiatives and data need to play a more prominent role in environmental monitoring: There is a significant opportunity to include citizens and their networks for monitoring environmental resources. It is crucial that NGOs, voluntary organisations, and individual citizens get fully involved and become a dominant source of up-to-date, high-quality information on the status of the environment.
- Systems that are entirely reliant on government agencies and long-term funding are often inefficient, and there is no guarantee that they will continue after the programme finishes. Self-organized communities of volunteers, enthusiasts, and not-for-profit organisations should lead innovation and foster tangible, real-world impact.
- Landowners and land managers who help reduce land degradation, *i.e.* help restore ecosystems and their functions, should be rewarded either through national schemes, tax reduction schemes and/or subsidies. There is a clear consensus among the OEMC project partners that champions of land & ecosystem restoration need to be celebrated and rewarded for their work. The best way to speed up the restoration of ecosystems is to motivate all landowners/land managers to recognise the tangible benefits of doing it fast and doing it right. The [Restor.eco](#) infrastructure (a partner/stakeholder of the OEMC consortium) demonstrates that landowners are indeed excited about being validated and listed on a public portal.

## A SUMMARY OF THE ACTION PLAN FOR THE FUTURE

The three main technical challenges that require urgent improvements for the full exploitation of Earth Observation (EO) data are: [1] making EO data more Analysis-Ready (ARD), Decision-Ready, Decision-Relevant (DRD) and/or Forensic-Ready-Data (FRD), [2] testing and implementing new, more efficient data formats (*e.g.*, Cloud-Optimized formats, multi-array binary formats like

XDGGS), [3] helping European researchers develop and extend their own GeoAI solutions / transforming core Copernicus service outputs into specific policy-ready indicators.

ESA and the European Union could significantly increase investments to make EO data more usable, boosting exploitation and supporting the growth of start-ups and Small & Medium Enterprises (SMEs) that can bring this data to a diversity of users, most importantly to farmers, spatial planners, forest managers, and similar. Over the last decade about €3.2 billion for period 2014–2021 and €5.4 billion for period 2021–2027 were invested for the Copernicus programme<sup>7</sup> (about €3 per EU citizen per year; total costs of ESA is about €14 per citizen per year) so why not spend an additional 10–15% of that amount on supporting open development communities that can boost usability of EO data?

Emerging EO companies are rapidly prototyping solutions. Traditional development cycles are becoming too slow for today's dynamic market demands. Open source plays a key role here. Keeping EO data open and using open-source solutions as the basis for the back-end are critical to ensuring the sustainability and reproducibility of environmental and climate action efforts across the policy landscape. The OEMC project will conclude with a final closing conference in Barcelona in October 2026: <https://earthmonitor.org/global-workshop-2026/>.

## SUGGESTED CITATION FOR THE FULL REPORT

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<sup>7</sup> [https://www.esa.int/Applications/Observing\\_the\\_Earth/Copernicus/New\\_financial\\_resources\\_for\\_Copernicus\\_space\\_component](https://www.esa.int/Applications/Observing_the_Earth/Copernicus/New_financial_resources_for_Copernicus_space_component)