ISSN 2599-8293

European Commission

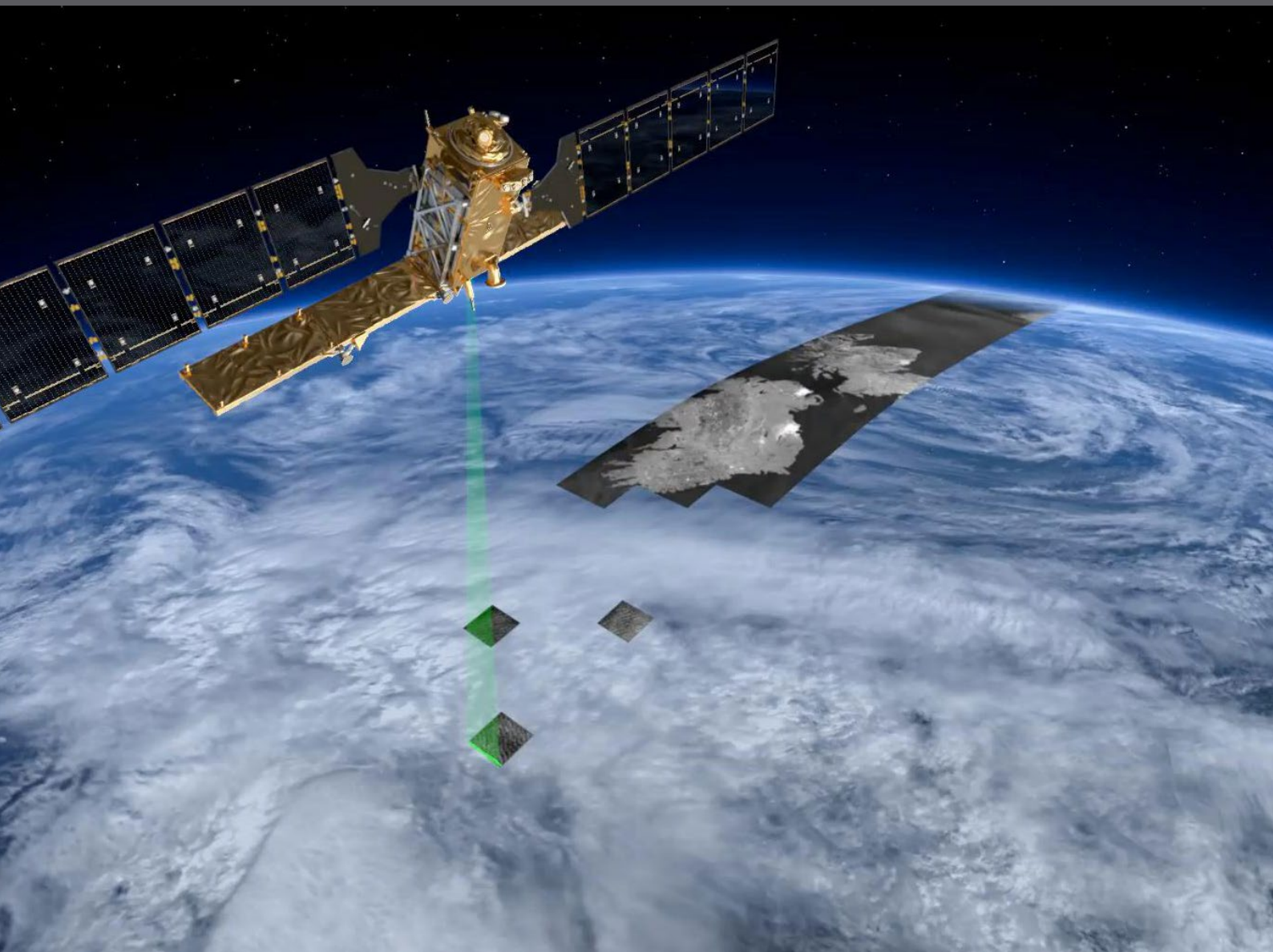
Research and Innovation

CORDIS Results Pack on Earth Observation Technologies

From Sensor to Service: Next-Generation Earth Observation Systems

A thematic collection of innovative EU-funded research results

November 2026



Contents

3
Europe's space data services join the federation

5
Lightweight AI detects marine litter from space

7
Rapid infrastructure monitoring through Earth observation

9
A centralised platform to boost access to Earth observation data

11
Tackling bottlenecks in Earth observation data delivery

13
Computing at the edge of space to accelerate EO insights

15
A space-based observatory to monitor climate emissions

17
Orbital processing helps small satellites deliver big data

Editorial

The explosive growth in the number of satellites in orbit, twinned with developments in big data and AI technologies, offer unprecedented capabilities and opportunities for Europe's space services ecosystem. This CORDIS Results Pack highlights eight EU-funded research and innovation projects that are delivering technologies and platforms to accelerate Europe's leadership and competitiveness in this fast-growing sector.

The Earth observation (EO) market has been evolving into a more commercialised sector, with businesses leveraging the vast amounts of data generated by EO satellites to create value-added services. These cover a wide range of applications across different areas, including precision agriculture, land management, disaster response, climate research and weather forecasting, emissions tracking, maritime surveillance, critical infrastructure monitoring, and much more.

It is crucial to position Europe as a leader in EO, and bolster the competitiveness of its research and industrial community, including SMEs and start-ups. This entails leveraging new technologies, improving system efficiency and cost-effectiveness, supporting environmental goals, and enhancing the broader space sector's prowess. In pursuit of these objectives, the European Union is funding pioneering research and innovation activities in key areas.

They include the development of highly flexible and interoperable end-to-end EO systems, notably technology demonstration, and validation in representative environments and real-world use cases.

In addition, the development and maturation of key technologies essential for high-performance EO is crucial. This includes new observation payloads, enhanced autonomy of EO systems, and advanced data management through edge computing, on-board image processing, AI integration, data fusion and advanced processing units. Support is also being offered to enhance flexibility and affordability for businesses working in the sector. This flexibility will allow for a more effective response to evolving market needs, improving system availability and latency, while ensuring high-quality end-user experiences. Low-cost solutions at technology level support rapid development and testing processes, shortening development and production cycles, and increasing cost-efficiency.

On the ground, EU funding is driving the development of advanced solutions for secure, scalable and resilient multi-mission ground segments that are able to meet growing data demands and adapt efficiently to complex scenarios.

The eight projects included in this publication have each contributed successes to the achievement of these objectives, bolstering the competitiveness of the European space sector.

Funded under Horizon Europe and managed by the European Health and Digital Executive Agency (HaDEA), the projects' ambitious developments and demonstrations have pushed the boundaries of European capabilities in addressing global commercial EO challenges and markets.

In doing so, this R&I portfolio has paved the way for a longer-term strategy designed in the context of the co-programmed European Partnership for Globally Competitive Space Systems (GCSS). This partnership is further driving the digitalisation of commercial space solutions, including collaborative and synergetic solutions for EO and satellite communication missions.

Together, this work is helping to secure a competitive and innovation-driven EO ecosystem that delivers value for Europe's citizens, industry and the global market.

Europe's space data services join the federation

A complex and fractured service layer is limiting the potential benefit of Earth observation satellites. The EU-funded DOMINO-E project aims to make high-quality satellite data more accessible, affordable and collaborative.



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From their high vantage point, satellites can gather information on a range of phenomena over time, including land use, air and water quality, surface temperatures, crop health, wildfire progression, the extent of floodwaters, and much more.

Yet much of the potential of Earth observation (EO) goes unfulfilled. "Data often doesn't reach the right people at the right time, and only benefits a small circle of expert users," says Jean-François Vinuesa, future programs manager at Airbus Defence and Space in France.

"Our ambition is to improve the current fragmented and proprietary EO landscape, opening it to boutique developers and end users such as municipal authorities," explains

Vinuesa. "Open data-driven EO services could boost European competitiveness, and shared standards will enable governments to develop interoperable EO-based missions, while retaining data governance or localisation rules."

An interconnected, federated EO system

Building on the DOMINO-X project, which developed modular and interoperable components for the Earth-based half of satellite services, the DOMINO-E project set out to build a federation layer that offers users seamless access to imagery from multiple missions and providers.

The consortium of seven European partners, led by Airbus Defence and Space, designed, built and validated three further proof of concept 'dominoes' to support the growth of space data products and services.

Open data-driven EO services could boost European competitiveness.

The Coverage Service, developed with ONERA and Capgemini, manages and optimises data requests from users across a federation of EO missions. The Mission Booking Service developed with Polish SME ITTI provides a standardised interface for scheduling and managing satellite resources. And the Virtual Assistant Service built with Latvian SME Tilde helps to identify the user's needs and retrieve the most appropriate imagery. Communications were led by Oikoplus.

Architecture developed with a route to market in mind

The Coverage Service was tested with a complex request for a large-area, partitioned image of southern France, including coordinated tasks across mission chains – requiring different satellites, operators and infrastructures – and optimised for capacity visibility and user constraints.

The Mission Booking Service was successful in automatically scheduling satellite-to-ground station contact, accommodating factors such as orbital windows, bandwidth availability and user priorities.

Lastly, the Virtual Assistant Service translated plain language descriptions of the desired region by non-experts into image previews. "We confirmed that federated planning is faster, with fewer redundant satellite or mission acquisitions," adds Vinuesa. "A federation approach could redefine the EO sector from being about satellite quantity to how quickly observations become insights."

Building a standards-based marketplace

The work supports a new EO marketplace, characterised by dynamically evolving roles and services, from hosting to workflows and user experience. "Our Ground-Stations-as-a-Service model in particular could spearhead a pay-as-you-go market," explains Vinuesa, "lowering entry costs for SMEs that are well placed to introduce innovative commercial servicAIGes."

With the project concluded, the consortium is currently seeking partners to expand its efforts – especially ground-station operators, mission planners and analytics developers. Further work is being delivered through sister projects DOMINO-A, which extended the DOMINO concept to radar constellations, and the EU-funded MESEO project, which aims to deliver a flexible, scalable and secure end-to-end system for processing satellite data.

PROJECT
DOMINO-E – Earth Observation Multi-mission federation layer

COORDINATED BY
Airbus Defence and Space in France

FUNDED UNDER
Horizon Europe – Digital, Industry and Space

CORDIS FACTSHEET
cordis.europa.eu/project/id/101082230

PROJECT WEBSITE
domino-e.eu

Lightweight AI detects marine litter from space

Earth observation satellites are capturing more data than ever, but using it requires passing through congested downlink channels. The EU-funded Edge SpAIce project moves this analysis into orbit, helping to deliver insights quickly and efficiently.



© M. Jurzyk/stock.adobe.com

The number of satellites in orbit is growing faster than the bandwidth available to download this data. To remedy this, Edge SpAIce set out to develop and demonstrate artificial intelligence (AI) capable of analysing Earth observation (EO) imagery on board a satellite, limiting downloads to the most valuable data.

The team chose the identification of marine litter as a test case. But according to project coordinator Pauline Audenino, senior project director at Agenium Space in France, the underlying technology has much broader applications.

In the aftermath of an emergency, for example, useful information can be identified while the satellite is still in orbit, rather than waiting for imagery to be sent to Earth for analysis: "A satellite goes over a disaster area and promptly provides images of changes – what has been destroyed, or not."

A satellite goes over a disaster area and promptly provides images of changes.

The project brought together four partners with very different expertise. The National Technical University of Athens (NTUA) developed and trained the AI models, while project coordinator Agenium Space worked on making these models small enough to run on board a satellite. CERN provided the open-source technology needed to adapt the models to specialist computing hardware, and EnduroSat supplied satellite imagery and led the in-orbit validation.

Shrinking AI for space constraints

NTUA developed a deep neural network (DNN) using labelled satellite imagery. The model was trained to recognise marine litter, distinguishing this from the many other features seen in ocean imagery.

The team at Agenium Space managed to reduce this neural network (containing more than 9 million parameters) to 1 % of its original size. Despite the dramatic reduction, the lightweight model could still accurately identify marine litter while avoiding false positives.

With the complete on-board detection package reduced to around one megabyte in size, it was uploaded and run on the BALKAN 1 for a successful end-to-end demonstration of image acquisition followed immediately by on-board processing.

Building European space capabilities

"The other objective, only on ground, was to use a sovereign European board," says Audenino. NanoXplore is currently Europe's only manufacturer of space-grade field-programmable gate array (FPGAs) – reconfigurable hardware chips that form the backbone of satellite computers. But running AI on this hardware also requires suitable software.

Edge SpAIce extended CERN's open-source HLS4ML framework to support the technology, successfully running a small neural network on NanoXplore's NG-Ultra chip in ground tests.

Aside from technical results, the consortium has shared its work through publications and international conferences, while select partners have submitted applications for a new Horizon Europe project, ALMAGEST, to further develop Edge SpAIce's work.

For now, the project has shown that DNNs don't have to remain on the ground. Giving satellites more autonomy to interpret what they see could help EO systems respond faster to crises, delivering tangible benefits on the ground.

PROJECT
Edge SpAIce – Unleashing AI potential to foster space accessibility and novel Earth Observation services creation

COORDINATED BY
Agenium Space in France

FUNDED UNDER
Horizon Europe – Digital, Industry and Space

CORDIS FACTSHEET
cordis.europa.eu/project/id/101135358

PROJECT WEBSITE
edgespaice.eu

Rapid infrastructure monitoring through Earth observation

Faults can occur anywhere along the millions of kilometres of roads, railways and power lines in Europe. The EU-funded IIMEO project offers a platform for continuous, automated monitoring of this critical infrastructure.



© Julien Baumann/OHB Digital Connect GmbH

The efficient and reliable delivery of services such as energy, communications and transport is essential to Europe's security and economy. Yet monitoring the integrity of infrastructure that may stretch across hundreds or even thousands of kilometres – such as power lines, railways and roads – remains a challenge.

Satellite technology offers a means to provide the continuous, wide-coverage monitoring desired, and this data could also act as a valuable resource to support innovation in the downstream market. However, progress has been limited by the complexity, time needed to deliver usable data, and operational effectiveness of satellites at night and in adverse conditions.

These were some of the challenges that the IIMEO project sought to address. "We wanted to develop an automated system that detects infrastructure malfunctions across large areas and in near real time, regardless of local weather and lighting conditions," explains Felix Wenk, a systems engineer at project host OHB Digital Connect in Germany.

The project team also wanted to make it easy for end users to request observations for specific areas. "We used railway operators as a pilot use case – if a track is blocked, it will hold up all traffic," says Wenk. "At the same time, we also wanted to ensure that the technology could be applicable to other end-use cases."

A multispectrum view from above

The IIMEO system combines three elements – a satellite module, on-ground platform and user services. For the satellite, the project team combined cameras with synthetic aperture radar, allowing observations to be made during the day or night, and through cloud cover. On-board image processing and algorithms were developed to combine information from both sources, automatically detecting anomalies and reporting this information to the relevant authorities in a quick and functional way.

The on-ground platform we developed could also potentially be used for other Earth observation projects, and not just for infrastructure.

The prototype equipment was put through airborne trials on a small aircraft that flew along the route of the Küstenbahn Ostfriesland in northern Germany. Using a museum railway that operates infrequent tourist services, the team was permitted to place temporary obstacles on the tracks to simulate potential disruptions.

In the study, rail operators sent observation requests from an on-ground platform which were passed to the airborne satellite. Data visualisations of the track section were then returned, and presented as a digital map.

Delivering fast and accurate monitoring

The successful test demonstrated that combining camera and radar technology with automated on-board processing can offer fast and accurate monitoring, with the team aiming to have results delivered within one hour of a request. Next steps include expanding the technology to other use cases, such as roads.

"The on-ground platform we developed could also potentially be used for other Earth observation projects, and not just for infrastructure," adds Andreas Weihusen, also a systems engineer at OHB. Wenk says the on-board image processing technology developed in IIMEO has already been used by another project that required geo-referenced images from an airplane.

Moving forward, IIMEO has shown that Earth observation technologies can enable the continuous monitoring of infrastructure on a large scale. This will enable operational efficiencies for end users, and boost the satellite-as-a-service business model in Europe. Weihusen envisions a future where a large system integrator could supply a satellite constellation, with SMEs integrating corresponding monitoring and data analysis technologies.

PROJECT
IIMEO – Instantaneous Infrastructure Monitoring by Earth Observation

COORDINATED BY
OHB Digital Connect in Germany

FUNDED UNDER
Horizon Europe – Digital, Industry and Space

CORDIS FACTSHEET
cordis.europa.eu/project/id/101082410

PROJECT WEBSITE
ohb-theo.de/iimeo-project

A centralised platform to boost access to Earth observation data

The global space data industry is booming, but accessing and combining datasets remains complex. The EU-funded LEONSEGS project built a service that searches and synthesises multiple sources, providing a unified, automated European Ground Segment.



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Satellite imagery and Earth observation (EO) data has huge potential to support a range of sectors, from agriculture to disaster relief. But its impact and commercial potential are limited by a fragmented ecosystem of different formats and interfaces, which users must stitch together themselves.

"Accessing and exploiting all this information can be complex and time-consuming, especially for users without strong technical expertise," says Álvaro Núñez Martínez, a satellite engineer at Spanish IT services firm GMV Aerospace and Defence.

The LEONSEGS project was launched to address this issue. "Our aim was to bring together different satellite data providers, ground segment services and processing capabilities into a single federated platform," explains Núñez, who acted as the project's technical lead. "Having a unified, automated and interoperable platform would simplify access to EO data, and support both service providers and end users."

Intelligent semantic search capabilities

The project team built a centralised, user-friendly data processing platform capable of requesting, integrating and making sense of information from various EO providers. This platform is structured around two main components.

The first is the Multi-mission Operations Control and Processing Service (MOCPS). This manages data from different satellite-related operations, carrying out automated activities such as requesting and processing specific data from a range of users, and downloading the information.

The second component is the Automated Multi-mission Earth Observation Service (AMEOS), which performs intelligent searches across internal and external catalogues, retrieves the most suitable images, and generates final EO products.

"This semantic search engine helps users find the most relevant imagery not only through traditional metadata, but also through more contextual and meaning-based queries," notes Núñez. "All together, these components allow users to request data or services without needing to interact manually with multiple systems."

Trials in vineyards and agricultural fields

The project's approach was validated through real demonstrations on vineyards in Spain's Ribera del Duero region, and agricultural fields in Lower Austria. These pilots involved retrieving historical imagery and requesting very high-resolution data from external providers.

"We successfully integrated multiple EO data providers into a single federated ecosystem, and validated the semantic search engine," remarks Núñez. "We also demonstrated the automated workflows covering satellite tasking, data retrieval, processing and product generation."

The LEONSEGS platform was able to produce agricultural indicators such as crop vigour, biomass, chlorophyll content and moisture levels using data from different missions and sensors.

Crop health, irrigation needs and drought conditions

The project team believe that the platform can benefit a wide range of end users. Farmers, vineyard owners and agronomists can use the generated products to monitor crop health, irrigation needs or vegetation conditions. Public agencies can benefit from improved tools for drought monitoring, land-use assessment or environmental surveillance.

"Private commercial space operators can also use the platform to access ground-segment-as-a-service capabilities without having to build their own full infrastructure," adds Núñez.



These components allow users to request data or services without needing to interact manually with multiple systems.

The objective now is to continue expanding the federation of EO data providers, integrate additional satellites and catalogues, and further improve the semantic retrieval and automation capabilities. "The longer-term goal is to evolve from a validated prototype towards a fully operational ecosystem capable of supporting real missions and commercial services, while enabling easier access to high-quality EO products for a broad range of users," says Núñez.

PROJECT
LEONSEGS – Large Earth Observation New Space Ecosystem Ground Segment

COORDINATED BY
GMV Aerospace and Defence in Spain

FUNDED UNDER
Horizon Europe – Digital, Industry and Space

CORDIS FACTSHEET
cordis.europa.eu/project/id/101082493

PROJECT WEBSITE
leonsegs.eu

Tackling bottlenecks in Earth observation data delivery

High demand for space-based data services can slow response times, frustrating users. The EU-funded MESEO project optimises data delivery with on-board and ground-based processing, and by coordinating requests to provide the data in the most appropriate form.



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Satellites offer huge amounts of data that can serve environmental monitoring, defence and security, logistics, food production, insurance, and many other sectors. But delivering this to end users poses a challenge.

"Earth observation missions are generating increasing amounts of data, while users expect information to be available much faster," notes Paloma Fonseca, a software architect at GMV Aerospace and Defence in Spain. "One of the main challenges is to deliver timely information without overwhelming

communication networks or compromising interoperability between different systems."

Distributed and interoperable EO ecosystems

Reducing the response time required to deliver information to users is a major challenge, as is the ability to add value to the available data by combining information from different missions, while maintaining security and data sovereignty.

The MESEO project was launched to meet demand for faster and more responsive Earth observation (EO) services, and to better integrate data from different sources. This will also open new commercial opportunities for EO providers in delivering more usable and accurate information.

The project set out to develop a more distributed and interoperable EO ecosystem. A key aim was to reduce unnecessary data transfers, and to achieve data processing as close to the data gathering technology as possible.

For this, enhanced on-board processing functions, including artificial intelligence-based image analysis, were developed for satellites. "Processing information closer to where data are generated allows only the most relevant data to be transmitted," explains Fonseca.

Methane emissions monitoring and crop classification

At the core of the MESEO framework is the EO Coordination Centre. This digital platform orchestrates distributed processing functions across satellites, ground infrastructures and external data providers. Targeted and timely data is then delivered to users, such as farmers or emergency services, accessible on a standardised computer interface. In addition to the EO Coordination Centre, common interfaces and security mechanisms were developed to ensure interoperability among different EO systems.

Processing information closer to where data are generated allows only the most relevant data to be transmitted.

To demonstrate its capabilities, two relevant use cases were selected to validate the end-to-end processing chain and demonstrate how individual components operate together within the MESEO framework.

The first was methane emissions monitoring, where improvements would allow environmental agencies to process methane emissions data more rapidly, supporting more responsive climate monitoring and regulatory activities.

The second was crop classification, enabling agricultural authorities to generate crop maps over large areas to support environmental monitoring, food security and policymaking.

"For methane emission detection, newly acquired images are compared with previously stored images to identify methane emissions," adds Fonseca. "For crop classification, large-scale processing of archived multitemporal satellite imagery is carried out."

Environmental agencies and commercial service providers

The team is confident that the project, due for completion at the end of November 2026, will bring benefits to a range of EO users including public authorities, environmental agencies, research organisations, EO operators, and commercial service providers.

"Although demonstrated through two representative use cases, the MESEO framework has been designed as a flexible foundation that can support many additional Earth observation services," says Fonseca. "New processing capabilities and services can be integrated through the same standardised interfaces, enabling the ecosystem to evolve as future missions and user needs emerge."

In the meantime, the next phase of MESEO focuses on further developing individual components, and supporting their adoption through additional validation, dissemination and collaboration with industrial and institutional stakeholders.

PROJECT
MESEO – Multi-Mission Efficient and Secure High Capacity End-to-End EO

COORDINATED BY
GMV Aerospace and Defence in Spain

FUNDED UNDER
Horizon Europe – Digital, Industry and Space

CORDIS FACTSHEET
cordis.europa.eu/project/id/101135067

PROJECT WEBSITE
meseoproject.eu

Computing at the edge of space to accelerate EO insights

Long data delivery times are holding back the potential of Earth observation data. A new platform by the EU-funded ORCHIDE project offers autonomous, secure, in-orbit data processing.



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Able to capture high-definition scans of air, land and sea across a range of visible and electromagnetic spectra, Earth observation (EO) satellites collect a lot of data. While this has the potential to help monitor wildfires, track weather, manage agriculture, and much more, the desired insights lie buried in huge amounts of raw data.

"Before EO data can be processed, it needs to be sent from the satellite in space back down to the ground, which can take hours," explains Adèle Hankache, microservices and cloud-native architect specialist at Thales Alenia Space in France.

This transmission latency creates bottlenecks that drive up competition for download bandwidth and limit our ability to make use of satellite data. This is where the ORCHIDE project comes in.

Leveraging an approach known as space edge computing, the project – a consortium of four partners across France, Poland and Romania – set out to relieve the EO bottleneck by processing data on board satellites as it is acquired.

"By processing data directly in space, we can reduce the amount of data being transmitted to Earth and improve response times for time-critical applications while also strengthening Europe's technological autonomy and competitiveness in the space sector," says Hankache, the project's coordinator.

Lightweight, secure, unikernel design

At the heart of the project is an artificial intelligence-enabled on-board orchestration platform for the autonomous, secure and energy-efficient in-orbit processing of data. The system is unikernel-based, supporting the lightweight operating systems that are increasingly common as satellites shift to multipurpose, software-defined devices.

"Because our platform is software- and hardware-agnostic, it operates independently of underlying technologies and is thus compatible across heterogeneous edge and space platforms," notes Hankache.

Our platform makes satellite systems and services more efficient and responsive.

On the ground, developers use the project's software development kit (SDK), a suite of diagnostic and application tools, to develop, package and prepare their applications for execution on board satellites. These tools can also be shared through an app marketplace.

The project developed a simulation environment that allows the on-board system and end-user applications to be tested and validated before deployment, reducing development risks and further facilitating the adoption of space edge computing technologies.

More efficient and responsive EO services

From maritime surveillance to cloud and fire detection, once deployed, the orchestration platform can support any use case packaged and prepared with its SDK.

Safe-and-secure-by-design, the ORCHIDE platform dynamically manages services, on-board resources and task priorities. Raw image data is processed while still on the satellite, and only meaningful results sent to ground, drastically improving the speed at which insights can be delivered.

"Our platform makes satellite systems and services more efficient and responsive – which is particularly important for environmental monitoring and emergency response missions where time is of the essence," concludes Hankache.

The ORCHIDE project concluded in May 2026. Since then, new partners have joined the consortium to further develop the project's key results under the EU-funded ORION project.

PROJECT
ORCHIDE – Orchestration of Reliable Computing on Heterogeneous Infrastructures Deployed at the Edge

COORDINATED BY
Thales Alenia Space in France

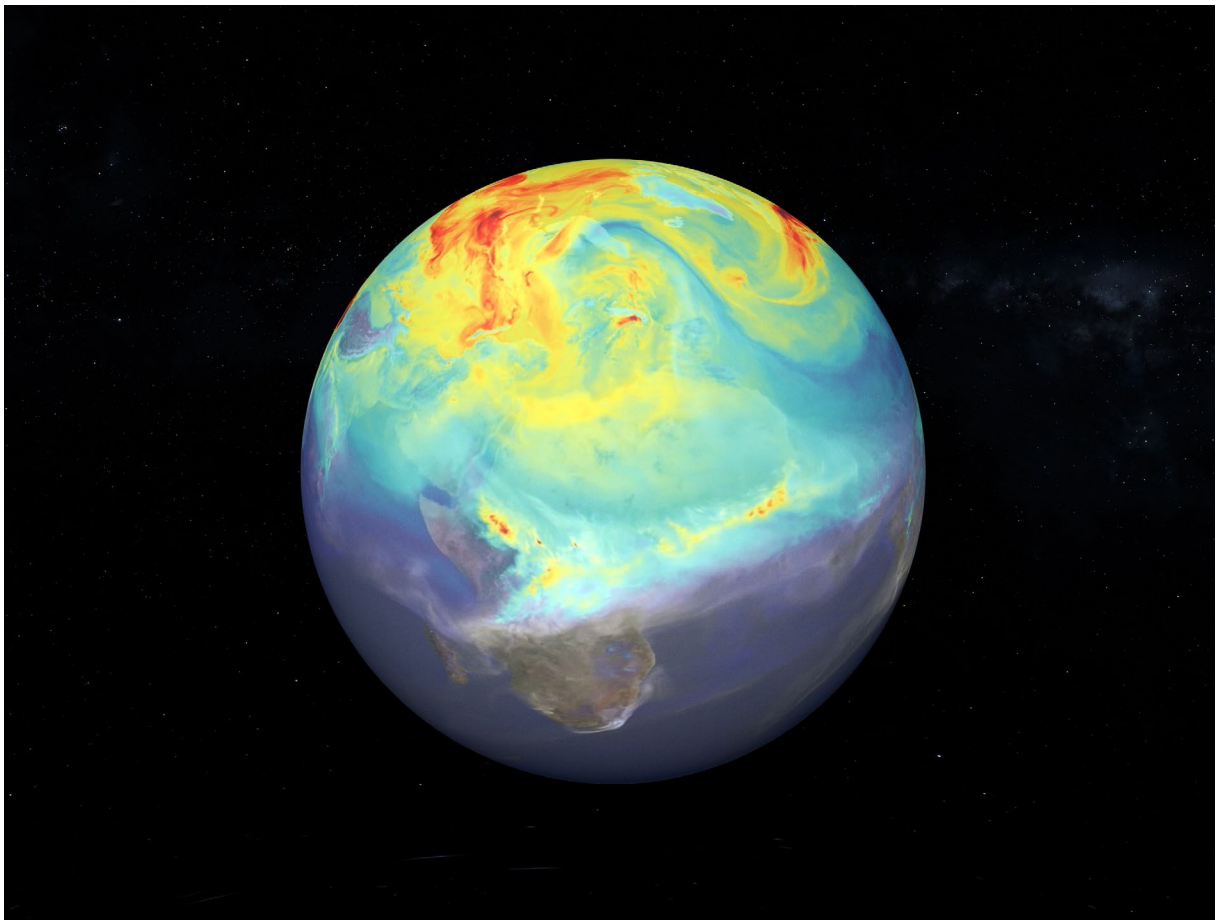
FUNDED UNDER
Horizon Europe – Digital, Industry and Space

CORDIS FACTSHEET
cordis.europa.eu/project/id/101135595

PROJECT WEBSITE
orchide-project.eu

A space-based observatory to monitor climate emissions

Using miniature sensors on board a constellation of small satellites, the EU-funded SCARBOn project can help Europe to better monitor – and mitigate – the greenhouse gas emissions driving climate change.



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The European Union is making Earth observation (EO) data a key tool in its fight against climate change.

The SCARBOn project is making this possible. A consortium of 10 European partners coordinated by Airbus Defence and Space in France is working to design a constellation of small satellites that can track carbon dioxide (CO_2) and methane (CH_4) emissions in the Earth's atmosphere.

"Meeting our climate objectives requires the accurate and permanent tracking of anthropogenic greenhouse gas emissions, and the ability to evaluate reduction efforts, both of which can be done via space observations," explains Céline Belloc, project manager at Airbus. "SCARBOn is dedicated to advancing the space-based monitoring of anthropogenic greenhouse gas emissions, providing bi-daily recurrence and accurate observations of both CO_2 and CH_4 emissions."

A shrinking sensor to monitor a growing problem

The SCARBOn satellite concept is built on NanoCarb, a cutting-edge miniaturised spectrometer, both developed by the predecessor project SCARBO, which also developed a complementary aerosol sensor called SPEXone.

Designed specifically to monitor CO_2 and CH_4 emissions, the NanoCarb prototype has been upgraded, manufactured and characterised under SCARBOn, with noted improvements to its interferometric core and thermal behaviour.

SCARBOn is a key contributor to not only Europe's climate objectives, but also the EU's global leadership in Earth observation systems.

The team is now preparing to run the sensor through airborne trials, assessing its ability to detect plumes of CO_2.

The NanoCarb sensors are the key component in a scalable and affordable small satellite constellation, the architecture of which is currently under development. This process includes deciding everything from payload design to ground segment operations, data retrieval strategies and deployment options.

"SCARBOn has progressed from individual technological developments towards a coherent, scalable satellite mission concept," says Belloc. Once operational, the constellation will provide high frequency and high spatial resolution observations to complement existing EO systems such as Copernicus.

Boosting the EU's leadership in Earth observation systems

With the project concluding in April 2027, the project consortium will further develop the NanoCarb sensors towards space flight model manufacturing. This will be followed by environmental and qualification testing, along with the continued development of on-board and on-ground data processing capabilities to enable the efficient and timely handling of the measurements.

A further task will be ensuring the system's interoperability with existing and future EO missions, such as integrating SCARBOn data with other emissions observations.

The data will be available to scientists, policymakers and other users, improving our ability to understand emission trends, assess mitigation measures, and strengthen the transparency of emissions reporting.

By advancing innovative and miniaturised sensor technology, as well as the scalable small-satellite constellation concept, the SCARBOn project is paving the way towards an improved space-based greenhouse gas monitoring solution.

The constellation will aid the implementation and monitoring of EU climate policies such as the European Green Deal, and support the EU's contribution to the Paris Agreement.

Belloc concludes: "SCARBOn is a key contributor to not only Europe's climate objectives, but also the EU's global leadership in Earth observation systems."

PROJECT
SCARBOn – SCARBO next step - Space CARBon Observatory's solution to improve monitoring of GHG emissions and help establishing reliable data for emission trends forecasts

COORDINATED BY
Airbus Defence and Space in France

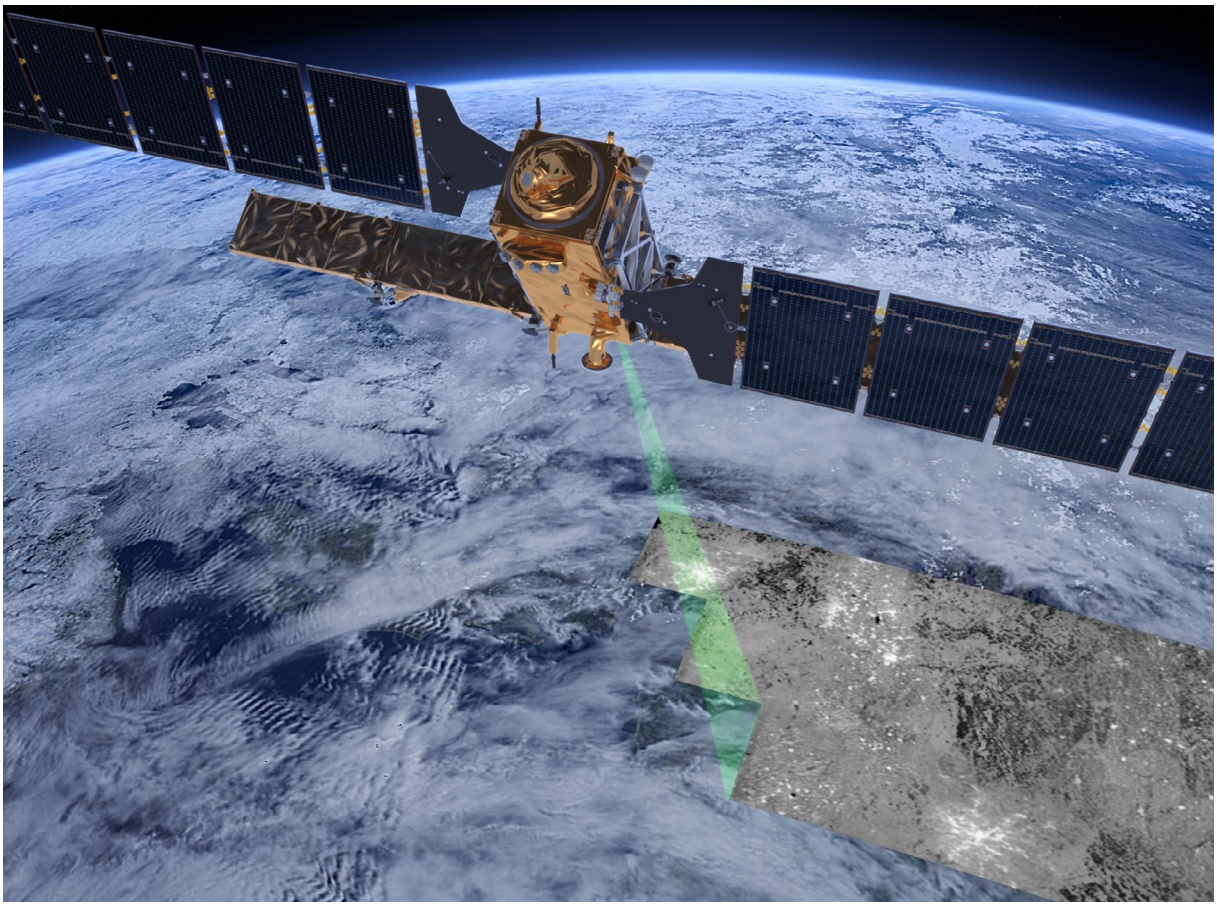
FUNDED UNDER
Horizon Europe – Digital, Industry and Space

CORDIS FACTSHEET
cordis.europa.eu/project/id/101135301

PROJECT WEBSITE
scarbon-project.eu

Orbital processing helps small satellites deliver big data

Satellites can gather huge amounts of data – and slow downloads. By shifting data processing into orbit, the EU-funded SOPHOS project is shrinking file sizes and accelerating the growth of space data services.



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As the number of satellites orbiting and observing our planet continues to grow, so too does the amount of data they generate. Getting this data back to the ground, however, is a challenge.

The downlink from satellite to Earth acts as a bottleneck, due to limitations in radio frequency bandwidth. There are a limited number of ground stations available to receive data, and where they do exist, they are only able to connect with satellites as they pass overhead.

Cost is also a major issue, as installing a new ground station is prohibitively expensive for small-satellite missions, throttling the growth of the space services ecosystem.

Shrinking files, expanding coverage

SOPHOS technologies are already in orbit on several missions.

One solution is to reduce the amount of data to download. "The idea behind SOPHOS is to enable more processing directly in space," explains Maike Taddiken, project manager at DSI Aerospace and SOPHOS project coordinator.

Through SOPHOS, a consortium of European industrial and academic partners led by DSI Aerospace designed and developed new technologies that perform data compression and image formation on board satellites, using a high-performance processing module, optimised algorithms and reliable data storage.

"The system reduces the transmission data volume, making far more efficient use of the limited downlink capacity," adds Taddiken. This is especially valuable for data-intensive applications such as synthetic aperture radar (SAR), a high-resolution Earth observation (EO) technique that can generate massive amounts of raw data.

By miniaturising high-performance hardware modules and optimising SAR processing algorithms for use on satellites (where computing and battery power may be tightly constrained), the technology relieves some of the downlink capacity pressure. This allows the most pertinent data to be delivered in less time.

"This is particularly relevant for the growing commercial small-satellite sector, as well as for applications such as damage assessment and disaster response coordination," notes Taddiken.

Launching new hardware and software

The hardware and software advances developed by SOPHOS were tested in a ground-based demonstrator built by the project.

For hardware, SOPHOS focused on two key satellite modules. The Payload Processing Module (PPM) was worked on by partner Unibap, and a newly developed radiation-tolerant Mass Memory Module (MMM) was developed by DSI Aerospace. High-speed Ethernet routing allows images and data to be processed online or offline, or replayed raw to the ground segment.

Taddiken says that both modules were developed to fit SmallSat form factors, a type of satellite that is increasingly popular for commercial missions and constellations.

In supporting work, SOPHOS consortium partners DLR Microwaves and Radar Institute also developed new algorithms for SAR image formation and raw data compression, which were further optimised to increase the performance and data throughput for the system by researchers at the University of Lübeck in Germany. SOPHOS partner TELETEL in Greece developed easily deployable Electrical Ground Support Equipment (EGSE) used for prelaunch operations.

Boosting Europe's capabilities in Earth observation

By increasing the bandwidth of our connections to orbital observatories, SOPHOS aims to strengthen Europe's competitiveness in space-based EO. The project's off-the-shelf technology offers a scalable solution that could be adapted for future low Earth orbit missions.

The project, which concluded in early 2026, is already making an impact. "SOPHOS technologies are already in orbit on several missions, while development will continue on the project's outcomes by the partners, both individually and in different collaborations," says Taddiken.

PROJECT
SOPHOS – Smart on-board processing for earth observation systems

COORDINATED BY
DSI Aerospace in Germany

FUNDED UNDER
Horizon Europe – Digital, Industry and Space

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cordis.europa.eu/project/id/101082745

PROJECT WEBSITE
n/a

CORDIS Results Pack

Available online in 6 language versions: cordis.europa.eu/article/id/467887

Published
on behalf of the European Commission by CORDIS at the
Publications Office of the European Union
L-2985 Luxembourg
LUXEMBOURG

cordis@publications.europa.eu

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Print	ISBN 978-92-78-45248-3	ISSN 2599-8285	doi:10.2830/7936060	OA-01-26-067-EN-C
PDF	ISBN 978-92-78-45247-6	ISSN 2599-8293	doi:10.2830/5310147	OA-01-26-067-EN-N

Luxembourg: Publications Office of the European Union, 2026
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