2024
ANNUAL REPORT

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Director-General's foreword

I see 2024 very much as a year in which EUMETSAT laid the groundwork for the transformative launches, challenges and opportunities of the next two years. But it was also a successful period in its own right, with a number of achievements and milestones to celebrate.

As a satellite operator and data provider driven by the evolving needs of its Member States, EUMETSAT maintains a tight focus on innovation by fostering the development of new spacecraft and cutting-edge instruments with its partners. Throughout 2024, our teams worked assiduously towards the launch of not one but three satellites in 2025: Meteosat Third Generation Sounder 1 (MTG-S1), Metop Second Generation A1 (Metop-SGA1) and Copernicus Sentinel-6B.

With the completion of its commissioning in December, we were thrilled to welcome MTG-I1 into the family of operational Meteosat satellites. As per EUMETSAT tradition, the satellite was renamed Meteosat-12 once fully operational and is now delivering high-value data products to national meteorological services and other users. MTG is one of the most innovative and complex meteorological satellite systems ever built and we fully expect it to have a transformative impact on weather forecasting and the understanding of our climate.

MTG-I1's progress to full operability was hampered by a calibration issue in the Flexible Combined Imager (FCI) – a problem that arose once the satellite was already in orbit. Our commitment to advancing data quality for our customers stood us in good stead however, as we were already developing the Mission Integrated Calibration Monitoring and Inter-Calibration System (MICMICS). With its in-flight calibration toolbox, MICMICS was found to be the optimum solution for ensuring reliable data validation, and I am especially proud of EUMETSAT's hard work and ingenuity, as part of the dedicated task force with ESA and industry, in getting the FCI back on track.

EUMETSAT's key role as a driver for innovation in the weather forecasting arena includes embracing elements of New Space that can improve cost efficiencies and development lead times. Conceived as a standardised constellation of six microsatellites, the EUMETSAT Polar System – Sterna (EPS-Sterna) mission is a salient example of this approach, and in 2024 the EUMETSAT Council approved opening member state voting for the go-ahead of the project. EPS-Sterna's potential for delivering vital observations on atmospheric temperature and humidity was showcased by the precursor Arctic Weather Satellite (AWS), which was launched by the European Space Agency (ESA) in August. We evaluated the AWS's initial data output towards the end of the year and will present the findings to Member States in 2025.

In its multitude of activities and programmes, EUMETSAT casts its net wider than Europe alone. We have a long-term undertaking on collaborating with the African meteorological community, and in December we announced our involvement in the EU-funded project Space for Early Warning in Africa, implemented with the African Union Commission. The project will boost access to Earth observation data for users in Africa, including from Meteosat-12, thereby strengthening resilience to severe weather events.

Our global activities also comprised numerous ongoing or potential collaborations. In North America we reconfirmed our long-term cooperation with the National Oceanic and Atmospheric Administration, met with NASA and continued discussions on support to Canadian Arctic observation missions. Along with several Chinese agencies, meetings with Asian meteorological and space entities involved India, Japan and Korea, and EUMETSAT maintained its pivotal role in the World Meteorological Organization.

Preparing our organisation for the work ahead requires a strong and experienced leadership team. 2024 saw two new members join the EUMETSAT management board, Eleni Katsampani as Director of Administration and Graziano Mori as Director of the Technical and Scientific Support department. As internal appointees, both Eleni and Graziano boast an impressive pedigree of producing outstanding results for EUMETSAT, and I am delighted to be working hand in hand with them.

As our results demonstrate, the entire EUMETSAT management board is backed by highly skilled and committed teams, and, as we move into 2025, I would like to give a heartfelt thank you to our staff for continuing to deliver tangible returns to our Member States, partners and end users.

Phil Evans
Director-General

> MTG is one of the most innovative and complex meteorological satellite systems ever built, and we fully expect it to have a game-changing impact on weather forecasting and the understanding of our climate.

> EUMETSAT's digital transformation is expanding, with multiple new and ongoing initiatives that are empowering the user community with greatly enhanced data access.

Council Chairman's foreword

EUMETSAT's abiding successes are entirely due to the work that our teams do, in collaboration with our partners, to derive value from our operations for the benefit of our Member States. Providing a welcoming environment for that work is a fundamental driver for us all to thrive both as individuals and as an organisation, and so I was particularly pleased to see the new East Building extension open on the EUMETSAT campus in June 2024. With its low-climate-impact design features, the building can now accommodate a further 120 people out of a total workforce of over 630 staff and a similar number of contractors.

Just like our campus, EUMETSAT's digital transformation is expanding, with multiple new and ongoing initiatives that are empowering the user community with greatly enhanced data access. In January 2024, we launched the EUMETSAT User Portal, an all-encompassing catalogue for datasets that revolutionises the way users interface with our data and support services. The User Portal includes among its connected data repositories the European Weather Cloud (EWC), an initiative I discussed in the 2023 Annual Report and which grew substantially throughout 2024. Its total tenancies rose to 150 across 33 countries, demonstrating how this easy-access cloud computing platform and dedicated website have been enthusiastically received in the international meteorological community.

Artificial intelligence (AI) and machine learning (ML) are becoming ever more prevalent in society as a whole, and EUMETSAT has a strategic goal of developing AI and ML-based solutions that are both relevant to our Member States' capabilities and yield efficiency gains in our internal processes. An example of our efforts in this area is our contribution to EUMETNET E-AI, a pan-European project launched in 2024 by the European Meteorological Infrastructure group (EMI) that leverages AI/ML technologies to further enhance Member States' access to our data and drive improvements in user engagement. EUMETNET E-AI also draws on the EWC.

Destination Earth (DestinE), the EU's ambitious Earth-system digital twin initiative, was officially launched for user registration in June 2024. EUMETSAT is responsible for the DestinE Data Lake, and I am happy to report that through attentive project management, Phase I of the Data Lake implementation was completed on schedule and, crucially, within budget. Phase II got underway during the year and focused on, among other tasks, exploiting AI/ML for both a data preparation tool and a series of application demonstrators.

Early November saw two major events on the EUMETSAT calendar. Joint-hosted by EUMETSAT, the Marine User Days forum gathered a diverse group of stakeholders with a vested interest in our oceans. The event covered such topics as the European blue economy and data applications for ship routing, fishing, climate reporting and renewable energy, giving the marine community ample opportunity to discuss their data needs for actionable insight in the sector. Immediately following the Marine User Days, on 7 November we celebrated 10 years since EUMETSAT signed its first Copernicus agreement. We can be justly proud of our contribution to the programme's space component along with ESA, and we look forward to many more years of delivering essential satellite data for the stewardship of our planet.

Paradoxically, I would also like to congratulate our teams on an event that did not happen. In August, EUMETSAT Flight Dynamics reported the risk of a collision between Meteosat-10 and a disused Russian satellite. Through quick thinking and intense collaborative effort, our controllers, analysts and engineers carried out the first-ever collision avoidance manoeuvre for a Meteosat satellite and prevented any risk of impact. This example is indeed a fitting testimony to the expertise and goal-oriented work ethos of the EUMETSAT senior management, staff and contractors, and, on behalf of the EUMETSAT Council, I would like to express my gratitude for their enduring effort and diligence.

Eoin Moran
Council Chairman

Our mission

EUMETSAT's mission, as an intergovernmental organisation, is to establish, maintain and exploit European systems of meteorological satellites, taking into account as far as possible the recommendations of the World Meteorological Organization (WMO). A further objective is to contribute to the operational monitoring of the climate and the detection of global climatic changes.

Our vision

EUMETSAT's vision is to be the leading user-driven operational agency in Europe for Earth observation satellite programmes that fulfil the objectives of its convention. It further aims to be a trusted global partner for those outside Europe who share these objectives. In realising this vision, EUMETSAT's first priority is to fulfil the essential requirements of its Member States in terms of observations, data and support services for operational weather as well as Earth system monitoring and forecasting for climate services. EUMETSAT will do this in the most effective manner, through its own satellite programmes. Our second priority is to establish additional, or shared, capabilities in partnership with the European Union and other satellite operators for the common benefit of EUMETSAT's Member States and partners.

Our core values

Integrity

We act ethically in every professional activity and in accordance with corporate policies.

Excellence

We all strive to ensure excellence and to provide efficient services.

Open-Mindedness

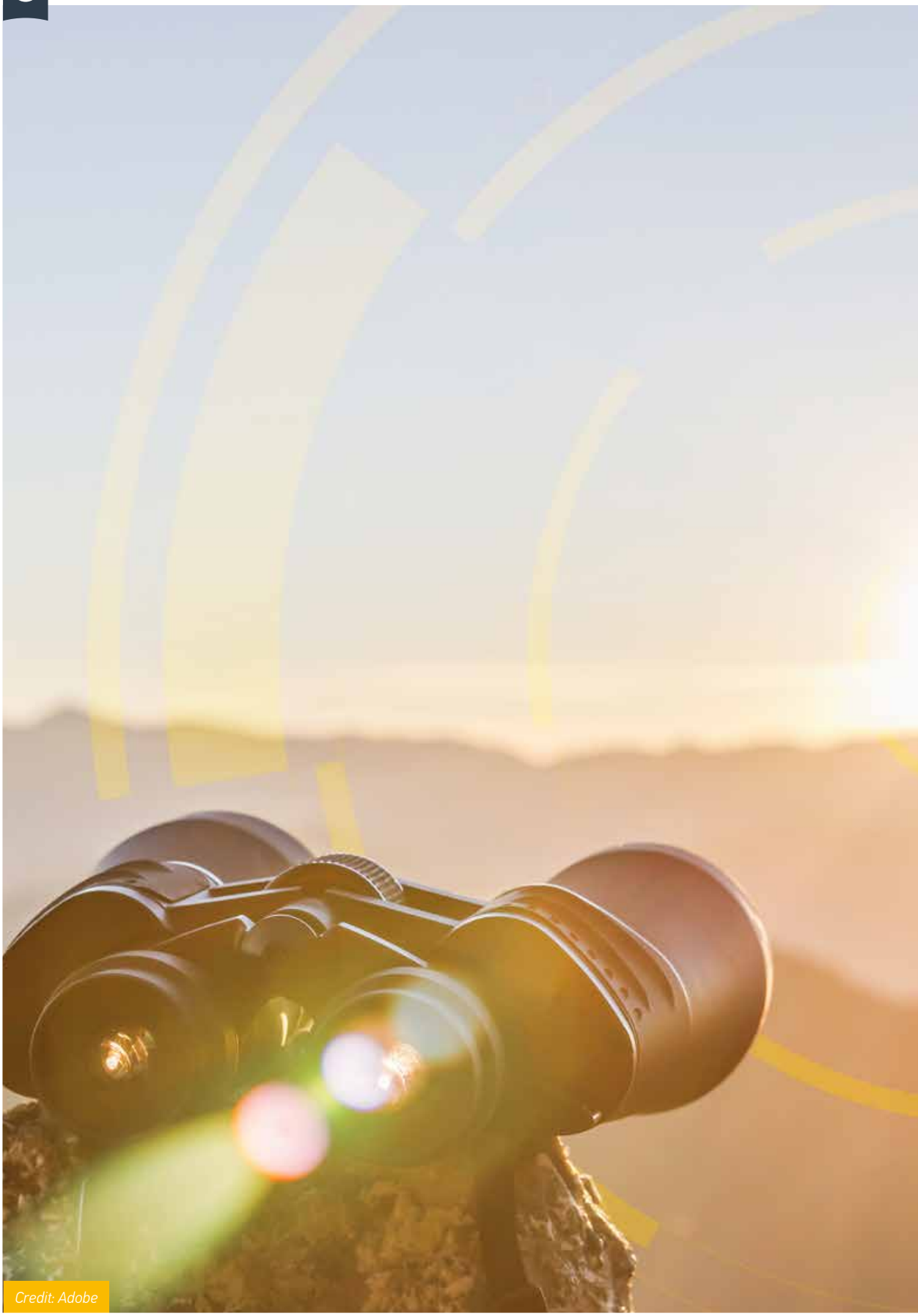
Our openness allows us to anticipate challenges and actively support change.

Collaboration

We collaborate in an environment of mutual respect.

Empowerment

We hire diverse and talented people, empower them, and foster their professional growth.



Credit: Adobe

EUMETSAT's strategic objectives

1. Deploy the new Meteosat Third Generation and EUMETSAT Polar System - Second Generation satellite systems and maximise their benefits to Member States and users
2. Deliver operational services responding to evolving user requirements, based on the continuous infusion of science and cost-effective infrastructures and operations
3. Establish and exploit a federative European Weather Cloud infrastructure in partnership with the ECMWF and European national meteorological and hydrological services
4. Consolidate EUMETSAT's contribution to the realisation of the Vision 2040 of the WMO Integrated Global Observing System and plan future satellite systems
5. As a partner of the Space Strategy for Europe, deliver Copernicus ocean and atmospheric composition monitoring missions and contribute to collaborative research and innovation projects for the common benefit of EUMETSAT and EU Member States
6. Cooperate with other satellite operators and contribute to global partnerships for monitoring weather, climate and greenhouse gases from space to meet additional needs of Member States
7. Expand the user base for EUMETSAT-provided data, products and services
8. Continuously improve management and risk management processes
9. Remain an attractive employer for diverse, skilled, talented and engaged people

Highlights of 2024

January

EUMETSAT User Portal launches

The EUMETSAT User Portal project reached a major milestone with the first release to external users, consolidating satellite data and user support information from several legacy systems into a one-stop shop. As the most recent addition to our online services, the user portal is a major step forward in how our users obtain and access our satellite data and information.

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March

EUMETSAT and China extend cooperation agreement

EUMETSAT and the China Meteorological Administration (CMA) signed a five-year extension to their long-standing cooperation agreement during a meeting in Beijing. The agreement, which first came into effect in 1998, relates to data application, exchange and redistribution. The benefits include access by EUMETSAT data users to observations from the CMA's geostationary and polar-orbiting satellites.

See p 64

May

Agreement facilitates Africa's access to European weather satellite data

The African Union Commission and EUMETSAT signed a memorandum of understanding to strengthen cooperation on Earth observation, building on more than two decades of collaboration within the framework of the European Union-Africa Partnership. The agreement represents another milestone in Africa-Europe cooperation, facilitating access for African environmental and meteorological services to data from EUMETSAT's next-generation satellite systems.

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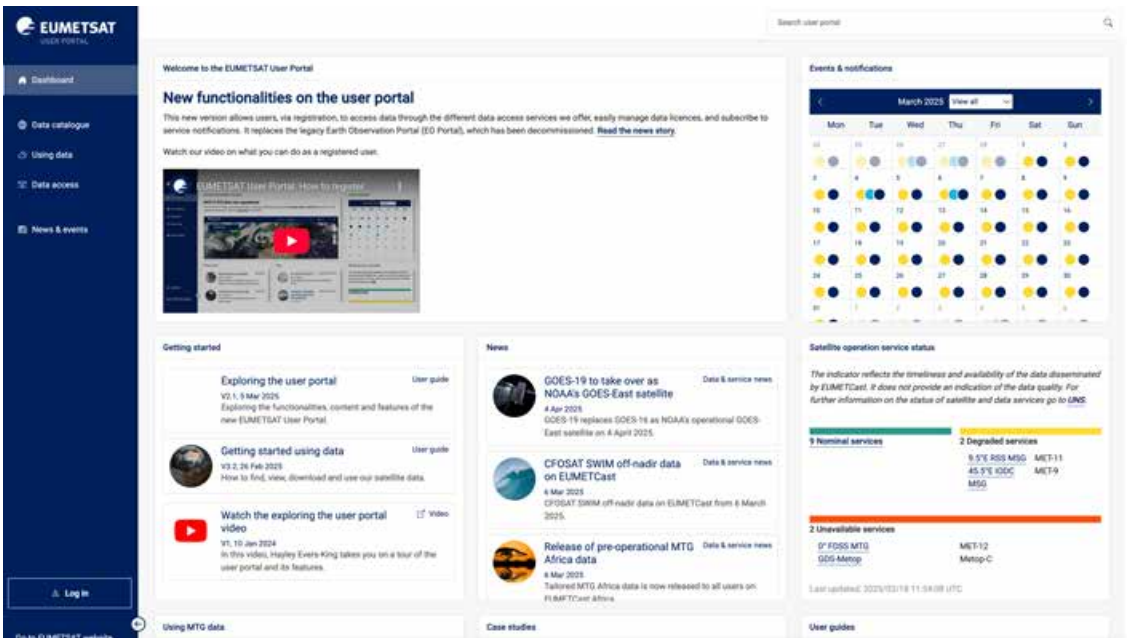

User Portal dashboard

Inaguration of the East Building extension on EUMETSAT campus in June 2024. From left to right: Mayor of Darmstadt Hanno Benz, Head of Department Digital Connectivity at the Federal Ministry for Digital and Transport Gertrud Husch, EUMETSAT Director-General Phil Evans and Hessian State Chancellery, Head of the Office of the Hessian Space Coordinator Sabine Groth

Panel discussion during the launch of the Destination Earth initiative in June 2024. From left to right: moderator Simon Pickard, European Commission Executive Vice-President for a Europe Fit for the Digital Age Margrethe Vestager, ECMWF Director-General Florence Rabier, EUMETSAT Director-General Phil Evans and ESA Head of Mission Management and Ground Segment Department Nicolaus Hanowski.

June

Launching Destination Earth

Destination Earth, a highly accurate digital model of our planet, shows how natural and human activity is likely to affect Earth in the future. Working as part of a collaborative European Commission initiative with the European Centre for Medium-Range Weather Forecasts and the European Space Agency, EUMETSAT's main role is to develop the central Data Lake that provides access to data from a wide variety of sources.

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Credit: ECMWF

Driving effective communication on climate change

The International Weather and Climate Forum at EUMETSAT headquarters in Darmstadt brought together 50 participants from five continents. International weather presenters play an essential role in communicating the issues surrounding global warming to the public. This annual event connects them with journalists and representatives of international organisations in the fields of weather, climate, the environment and Earth observation.

See p 57

Inaugurating an eco-friendly East building extension

When it was founded in 1986, EUMETSAT had just four staff members. Today there are more than 630, with a similar number of contractors. The new €14 million building extension will accommodate 120 members of our growing team. In line with EUMETSAT's goal to reduce its carbon footprint, the building has a 'green roof', solar panels and heat pumps.

EUMETSAT joins Europe-wide AI weather initiative

EUMETSAT's 30-member-state council approved the organisation's involvement in a Europe-wide initiative aiming to enhance the use of artificial intelligence and machine learning in weather and climate applications. EUMETNET is a grouping of 33 European national meteorological and hydrological services that provides a framework for cooperation on meteorological activities, to which EUMETSAT will contribute its expertise in data curation.

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Highlights of 2024

June

EUMETSAT furthers ties with international partners

EUMETSAT's Council approved cooperation agreements fostering international collaboration and the usage of Earth observation data. Two agreements renew and consolidate ties with the US National Oceanic and Atmospheric Administration and the National Research Council Canada. Within Europe, EUMETSAT is strengthening its cooperation with Mercator Ocean International and the European Centre for Medium-Range Weather Forecasts.

See p 64

Opening of the vote for EPS-Sterna

Member States voted on the proposed EUMETSAT Polar System – Sterna programme for a constellation of micro-satellites to observe the crucial weather prediction inputs of atmospheric temperature and humidity. Six low-Earth orbiting micro-satellites would be deployed in 2029, with the mission continuing until 2042.

See p 50

Selection of MTG-S1 launch service

EUMETSAT Member States decided to award a launch service contract to SpaceX to launch the Meteosat Third Generation – Sounder 1 (MTG-S1) satellite on a Falcon 9 rocket in 2025. MTG-S1 will be the first European sounding satellite in a geostationary orbit and will make it possible, for the first time, to observe the full lifecycle of a convective storm from space.

See p 18

R&D call for EWC projects

Research and development (R&D) applications opened for the European Weather Cloud (EWC), leading to 15 approved applications from publicly funded researchers in EUMETSAT Member States. The EWC is a cloud-based collaboration platform for meteorological application development and operations in Europe. R&D projects take the form of scientific or technical studies investigating ways to improve the use of EUMETSAT data or products.

See p 44

July

New Administration Director starts

Eleni Katsampani was appointed Director of Administration. She joined EUMETSAT as Head of Contracts in 2013 and in her new role will oversee the administration of the financial and human resources needed by EUMETSAT, along with providing the organisation with both a regulatory framework and an administrative infrastructure. She took over from Silvia Castañer, who retired after 35 years at EUMETSAT.

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MTG-S1 aces validation tests

The Meteosat Third Generation – Sounder 1 (MTG-S1) system underwent validation tests, with the spacecraft and ground segment both passing with flying colours. The tests aimed to ensure the spacecraft can withstand harsh conditions. It will endure potentially damaging vibrations and acceleration during the launch, followed by temperature fluctuations and intense radiation once in space.

See p 18

Meteosat Third Generation Sounder (MTG-S1) satellite in the anechoic chamber where it was tested for resilience against all types of electromagnetic interference, whether from the rocket or from the satellite itself

August

A successful start for ESA's AWS

The Arctic Weather Satellite (AWS) launched on a Falcon 9 rocket, delivering its first operational data on the humidity and temperature of the atmosphere just one month later. The quality of the AWS data is expected to demonstrate the high strategic value of the proposed EUMETSAT Polar System – Sterna constellation, making it an important factor for the decision-making vote.

See p 50

First MTG-PUMA station installed in Kenya

The first PUMA-2025 receiving station was set up in Nairobi. EUMETSAT's Meteosat satellites are the only Earth observation satellites with a constant view of Africa, and our Meteosat Third Generation (MTG) satellites will provide higher resolution images of the continent more frequently. The MTG data from the new receiving stations will help Kenyan meteorologists to support the sustainable development of local communities and protect lives and livelihoods. PUMA stations were initially established to receive Meteosat Second Generation data within the framework of the Preparation for Use of Meteosat in Africa (PUMA) project.

See p 75

First ever collision avoidance manoeuvre for Meteosat

When the Flight Dynamics experts confirmed that Meteosat-10 was on a near-collision course with a defunct Russian satellite, our Operations team leapt into action. With a minimum miss distance of just 380 metres, a collision avoidance manoeuvre (CAM) was required – the first operational CAM for Meteosat. Hard work and dedication won the day, and a catastrophic encounter was successfully avoided.

See p 26

September

Forum focused on early warning of severe weather in Africa

About 150 meteorologists and scientists from across Africa attended the four-day 16th Africa User Forum, co-organised by EUMETSAT and Meteo Benin. EUMETSAT supports the African Union Commission in setting up European Union-funded PUMA reception stations across the continent. Designed to receive high-resolution data from Meteosat Third Generation satellites, the stations will allow more accurate predictions of severe weather events.

See p 75

EUMETSAT conference gathers European and global weather and climate experts

Around 550 delegates gathered in Würzburg for the annual EUMETSAT Meteorological Satellite Conference, which was co-hosted by the German Meteorological Service, Deutscher Wetterdienst. The conference theme, 'Earth observation value chains for weather, climate and hydrosphere', prompted a multitude of discussions on the latest in the use of satellite data for addressing weather and climate challenges.

See p 57

▲ *Speakers during the opening ceremony of the 2024 EUMETSAT Meteorological Satellite Conference. From left to right: EUMETSAT Director of Programme Preparation and Development Cristian Bank, Deputy Director-General of National Satellite Meteorological Centre China (NSMC) Dr Dongyan Mao, Director, Regional Office for Europe, World Meteorological Organization (WMO) Dr Kornélia Radics, Head of Deutscher Wetterdienst Prof. Dr Sarah Jones, Director for the GOES-R Series Program Office (NOAA) Pam Sullivan, and EUMETSAT Chief Scientist Paolo Ruti*

Highlights of 2024

October

Destination Earth User exchange workshop

At the third Destination Earth User eXchange in Darmstadt, Germany, current and prospective users of the Destination Earth platform learned how to interact with the first two digital twins, or simulations, of the planet. The workshop explored the available visualisation tools and applications in the areas of flood risk management, agriculture, biodiversity, air pollution and renewable energy.

Lightning Imager is good to go

Following very positive feedback on pre-operational data, data from the Lightning Imager (LI) instrument on the first of EUMETSAT's Meteosat Third Generation satellites is now being disseminated for operational use. With four cameras continuously observing lightning activity from space and capturing 1,000 images per second, the LI is the first instrument of its kind covering Europe and Africa.

See p 18

November

Marine User Days

EUMETSAT, the European Commission, the European Space Agency, the European Centre for Medium-Range Weather Forecasts and Mercator Ocean International hosted a two-day event in Lisbon, Portugal for stakeholders with an interest in our oceans. It showcased the range and breadth of uses of marine data from the Copernicus Sentinel satellites to academics, businesspeople and representatives from weather services and the military.

See p 74

Destination Earth user exchange workshop, in Darmstadt in October 2024, brought together a very dynamic group of data users interested in the initiative

December

Celebrating 10 years of the EUMETSAT-Copernicus agreement

On 7 November 2014, EUMETSAT signed its first Copernicus Agreement with the European Commission, marking the start of a groundbreaking European Union-funded partnership. Since then, we have become a key player in Copernicus, working with the European Space Agency to implement the Copernicus space component and delivering critical data to support the marine, atmospheric and climate communities.

Meteosat-12 becomes operational!

The first of EUMETSAT's Meteosat Third Generation (MTG) satellites became fully operational. MTG-Imager 1 also received a new name – Meteosat-12 – to mark the occasion. Its two main instruments, the Flexible Combined Imager and the Lightning Imager, play a crucial role in enabling meteorological services to help protect lives and livelihoods by providing high-resolution, accurate data for predicting severe weather events.

See p 26

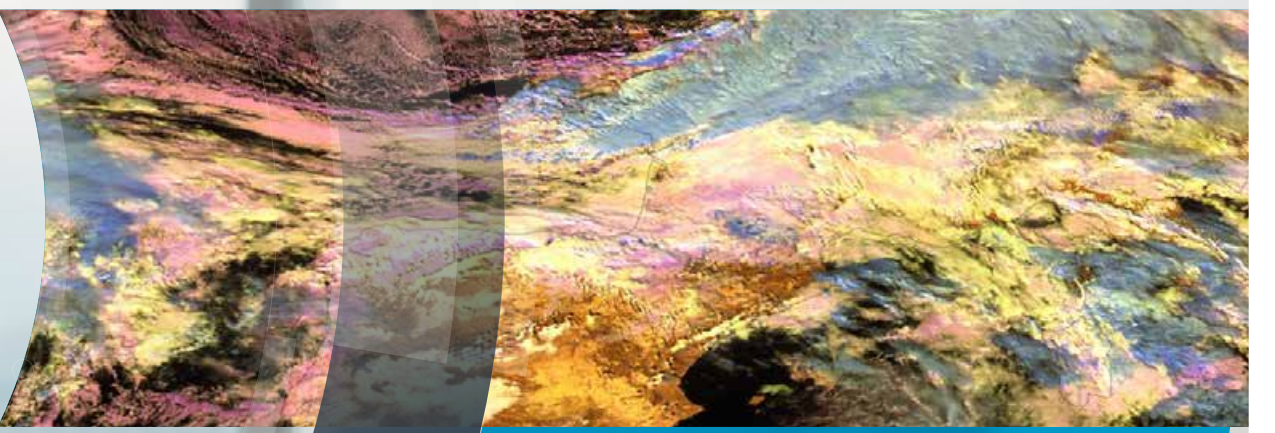
Key leadership updates

In a series of leadership decisions that ensure the stability and continuity of our organisation, our winter Council renewed our Director-General's mandate until 31 December 2029, extended Sean Burns' mandate as Director of Operations and Services to Users until 31 July 2028 and confirmed Graziano Mori as Director of the Technical and Scientific Support Department until 28 February 2027.

See p 81

EUMETSAT Directors. From left to right: Sean Burns, Director of Operations and Services to Users, Cristian Bank, Director of Programme Preparation and Development, Phil Evans, Director-General, Eleni Katsampani, Director of Administration, Graziano Mori, Director of Technical and Scientific Support

Credit: Adobe



1 Deploy the new Meteosat Third Generation and EUMETSAT Polar System - Second Generation satellite systems and maximise their benefits to Member States and users

Providing timely and accurate forecasts of rapidly developing severe weather events is one of the greatest challenges faced by meteorologists. EUMETSAT is helping to protect people and infrastructure by rolling out both Meteosat Third Generation (MTG) and the EUMETSAT Polar System – Second Generation (EPS-SG). Each system employs leading-edge hardware and software to inform rapid forecasting through highly enriched datasets. 2024 saw significant advances not only in the launch readiness of satellites that will take flight in 2025, but also the first MTG satellite to become operational: Meteosat-12.

Meteosat Third Generation

The Meteosat Third Generation (MTG) satellite system is revolutionising how rapidly developing severe storms are forecast by enabling more precise monitoring of the changing atmosphere, land and oceans. It also extends climate records and provides a wide range of essential observations.

The first unit of the MTG system, the MTG-I1 imaging satellite, launched in December 2022. However, in 2024, during the satellite's commissioning phase, the team discovered a calibration issue in the Flexible Combined Imager (FCI), which had automatically gone into safe mode. The assembled task force, involving EUMETSAT, conducted an intensive investigation into the issue, working with industry colleagues under the leadership of the European Space Agency (ESA), and by May were able to resume operations with the imager. While ESA and industry assessed the modifications to be made to future instruments to avoid such problems, EUMETSAT teams concentrated on the calibration of the instrument. Key to the solution was the Mission Integrated Calibration Monitoring and Inter-Calibration System (MICMICS), a multi-mission toolbox that was already under development and that enables calibration through external targets. The team were able to adopt MICMICS for the FCI and get the imager delivering optimum-quality data once again (see p 22).

Commissioning was completed in December 2024, precisely two years after launch, at which point MTG-I1 was named Meteosat-12 in line with the naming sequence of its predecessors. The satellite is now fully operational and is helping to generate timely and accurate weather forecasts through its FCI and Lightning Imager (LI) data products.

Meteosat-12 has enabled the geostationary weather satellite system to become the first to be capable of detecting lightning over Europe, Africa, the Middle East and parts of South America, along with the surrounding waters. This allows weather forecasters to track the full lifecycle of a storm from space, from initial instability in the atmosphere through to lightning strikes within clouds, between clouds, and from clouds to the ground.

EUMETSAT teams worked on preparing the ground segment for the second MTG satellite during 2024. Carrying the Infrared Sounder and the Copernicus Sentinel-4 mission – the Ultraviolet Visible Near-Infrared spectrometer – the MTG Sounder 1 (MTG-S1) satellite will be the first of its kind in Europe in geostationary orbit. In spring and early summer, our teams worked long shifts to test the satellite with the EUMETSAT Control Centre. They witnessed simulations – performed by industry under the supervision of ESA – of the extreme heat and vibrations that the satellite will experience at launch, along with the abrupt swings in temperature and high radiation levels that await in space. In October, ESA gave MTG-S1 a clean bill of health at its qualification and flight acceptance review, and the satellite has now been placed in safe storage in Bremen, Germany, ready for shipping to the launch site in spring 2025. MTG-S1 will be launched on board a SpaceX Falcon-9 rocket in summer 2025.

EUMETSAT teams made good progress during the year on preparing for the operations of the MTG recurrent models. As would be expected, following the FCI anomaly on MTG-I1, the offending components of the flight-model FCIs on MTG-I2, -I3 and -I4 were returned to the supplier for thorough inspection and repair where required. Further testing and integration activities for both the FCI and LI recurrent flight models continued throughout

Meteosat Third Generation Sounder (MTG-S1) satellite ready to go into the thermal vacuum chamber where it remained for three weeks being exposed to extreme temperatures, ranging from –180 °C to +250 °C

Credit: OHB

2024, and midway through the year, the integration of the MTG-I2 satellite with its instruments commenced. MTG-I2 will undergo a comprehensive test programme in 2025 ready for launch in mid-2026 on board an Ariane 6 rocket.

Meanwhile, EUMETSAT teams moved ahead considerably on the MTG ground segment, with the ground stations, mission control and MTG-I1 data processing facilities handed over from the MTG development programme to the Technical and Scientific Support department for maintenance and evolution. In November, EUMETSAT oversaw the successful start of the operational scenario validation campaign of Level 0 and Level 1 data processing and commissioning before the MTG-S1 launch in summer 2025.

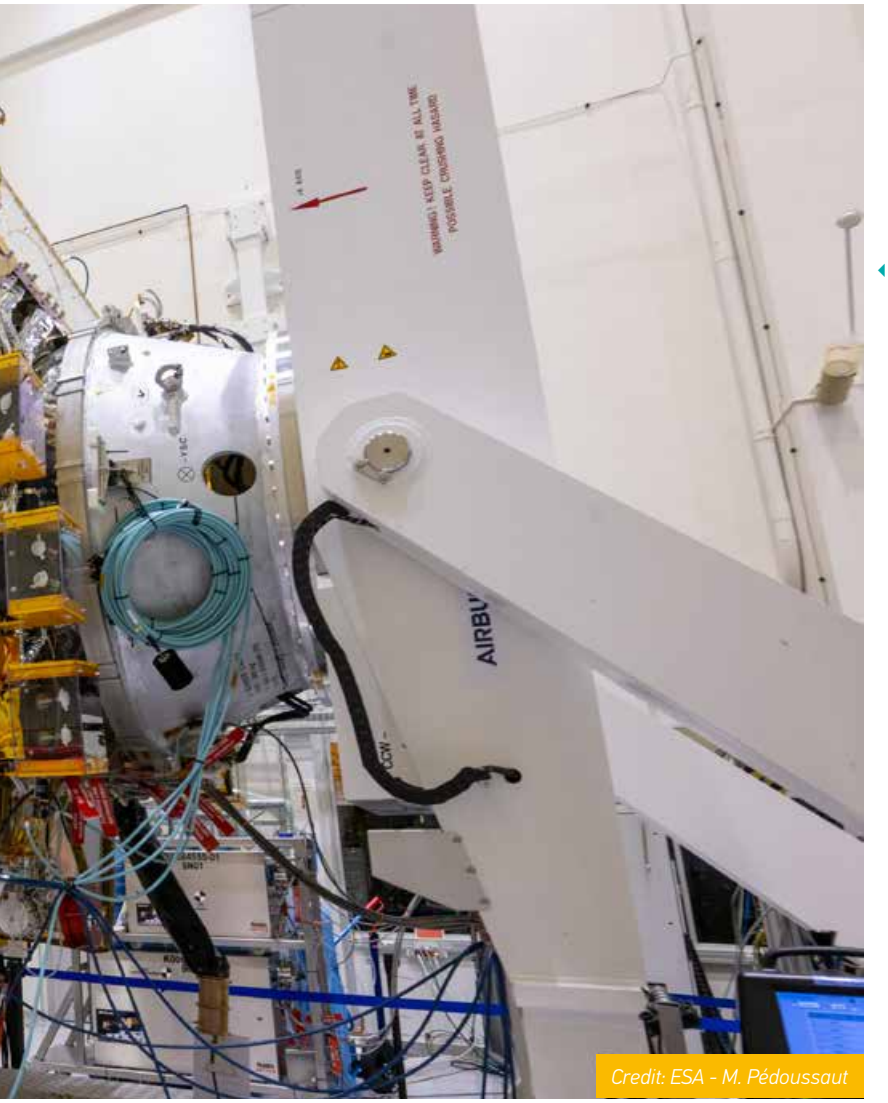
EUMETSAT Polar System – Second Generation (EPS-SG)

The Metop Second Generation (Metop-SG) polar-orbiting satellites of the next generation of EUMETSAT's Polar System will provide a wealth of data relevant for forecasting weather up to 10 days ahead, as well as informing more immediate near-real-time forecasts, building on the strong track record of their predecessors.

In 2024, the EPS-SG teams gave particular focus to increasing the expected performance of the satellite system. Through several measures discussed and implemented with ESA, including best-in-class instrument selection for the series, the teams were able to determine the best satellite configuration for improved collection of the highest quality data during the first seven years of the mission.

The full payload was integrated into the first Metop-SG satellite, Metop-SGA1, during the year, and engineers also identified an opportunity for accelerating the time to instrument operability. The proto-flight model of the Infrared Atmospheric Sounding Interferometer – New Generation (IASI-NG) was replaced with an alternative that had already been built and was undergoing testing. The satellite functioned well in its assembly, integration and test programme and is set to undergo its flight acceptance review in 2025.

Teams working on the sister satellite, Metop-SGB1, also optimised its functionality by identifying an underperforming front-end receiver group component in the Microwave Imager (MWI). Again, an alternative unit to the proto-flight model was identified and used as a replacement, ensuring that the MWI will provide images of the highest possible geophysical-content quality.



The Metop-SGA1 satellite in a horizontal position with its instruments facing downwards at Airbus' facilities in France. The solar panel will be mounted on the front face before the satellite is shipped to the launch site for liftoff in 2025.

The EPS-SG ground segment team worked hard during 2024 to minimise the impact of any potential delays to the building of the supporting ground infrastructure, with particular emphasis on data processing. A temporary ground processing system was set up and tested to ensure it could process all Metop-SGA1 data during its post-launch commissioning phase. The temporary system is expected to be capable of carrying out this task, if needed, not only for Metop-SGA1 but also Metop-SGB1. This back-up system will ensure that the two satellites can start work soon after launch with minimal lead times, allowing time for the consolidation and deployment of the final data processing system during the total operational lifespan of 22 years. The EPS-SG ground segment mission control, a vital component for ensuring the routine and long-term operation of all Metop-SG satellites, was in place by mid-2024.

Both Metop-SGA1 and Metop-SGB1 are due to launch aboard an Ariane 6 rocket under an existing launch service agreement. As the year concluded, discussions were underway between EUMETSAT and Arianespace to bring forward the date of the Metop-SGA1 launch by a few weeks to mid-summer 2025. Metop-SGB1 is scheduled for launch in 2026.

A fix for the Meteosat Third Generation – Imager 1 satellite

A new approach for calibrating an instrument on board the satellite saves the day

On 23 May 2024, the Flexible Combined Imager, one of the instruments on board the Meteosat Third Generation – Imager 1 satellite, resumed delivering data following months of interrupted service. Dr Bojan Bojkov, Head of EUMETSAT's Remote Sensing and Products Division, explains the issue that caused the interruption and reflects on the new calibration system that has been implemented, which enables users to receive the best quality products incorporating observations from the Flexible Combined Imager.

What happened to the Flexible Combined Imager on board the Meteosat Third Generation – Imager 1 (MTG-I1) satellite?

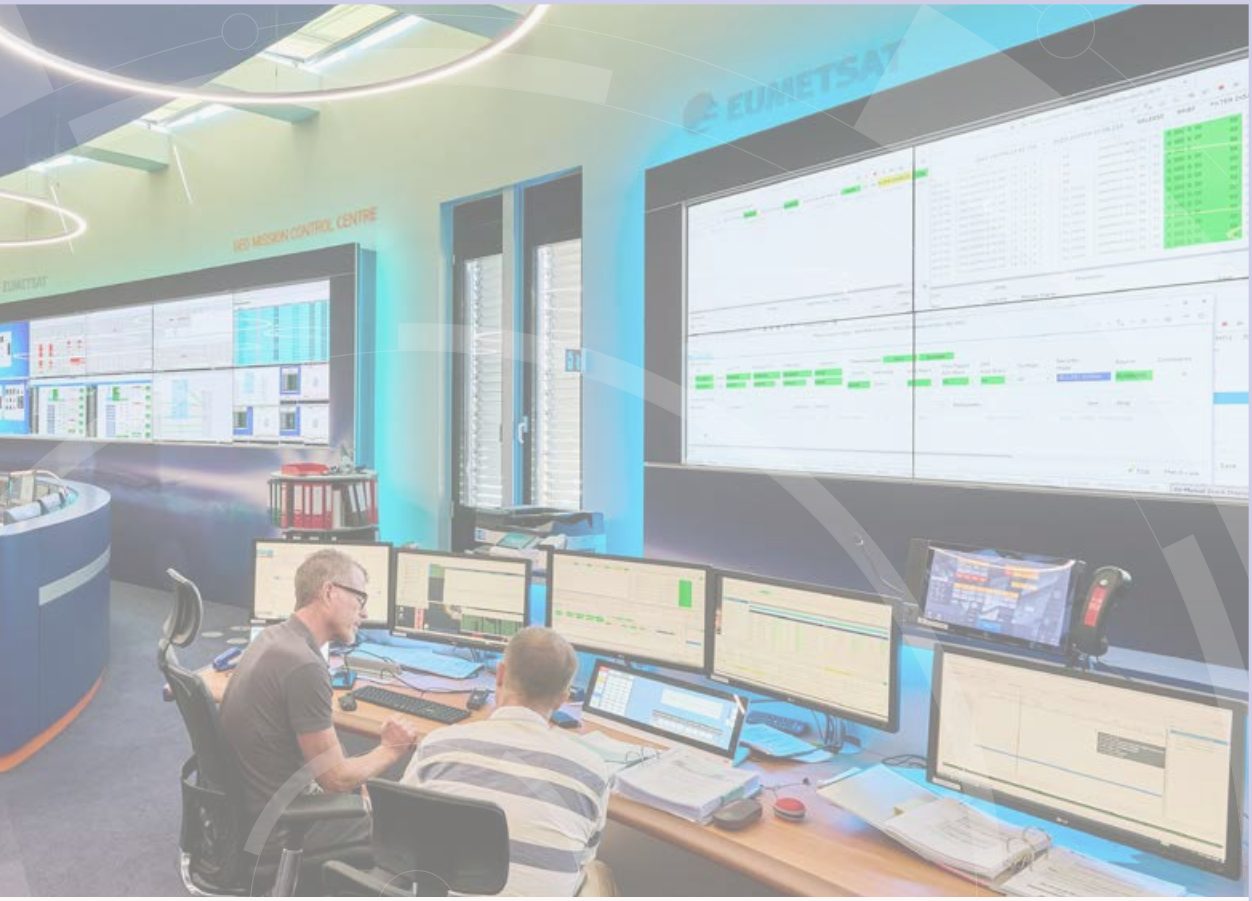
There is an issue with the Flexible Combined Imager (FCI) calibration system, resulting in the unavailability of on board calibration. Because of this, we lost the usual way we calibrate, or monitor the health of, instruments on board. Luckily, we were already developing a new software system for monitoring and calibrating satellite instruments, so we were able to start using this for the Flexible Combined Imager.

If it were functioning properly, how would the calibration and obturation mechanism on the Flexible Combined Imager work?

The calibration and obturation mechanism that we originally planned to use – the part of the system impacted by the malfunction – is like a shutter that blocks the light path or guides the light path to the two reference elements on the satellite. One of them is a black body and the other is a metallic density filter. Both reference elements make it possible to calibrate and monitor the health of a sensor – if you see any drift in your measurements, you know to attribute that not to a real signal the instrument is detecting but rather to the instrument itself slowly changing its response.

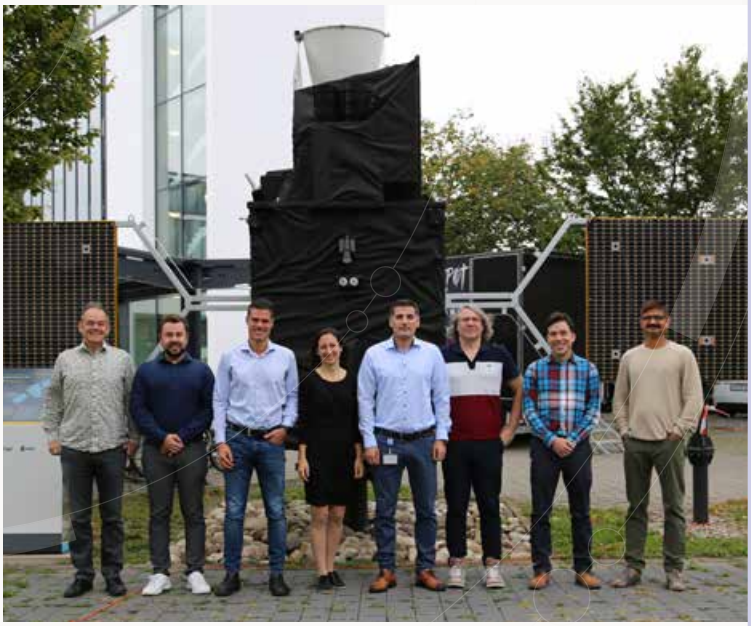
What is the new calibration system and how does it work?

The new system, the Mission Integrated Calibration Monitoring and Inter-Calibration System (MICMICS), is a kind of multi-mission toolbox that makes it possible to access and combine all calibration tools for in-orbit satellites. Since we can't use the reference elements on board the satellite to calibrate the Flexible Combined Imager, we need other ways to calibrate the instrument using natural targets that provide known values. The solution is to use external targets instead.



Why is MICMICS so effective?

I think of MICMICS as a software toolbox. Its strength is that it makes it very easy to put different methods into place and double check or adjust certain instrument parameters. It also allows us to apply certain specifications and see their impact. This enables us to be confident that everything is stable, or if needed, to correct things and improve the calibration so that we can provide better products.

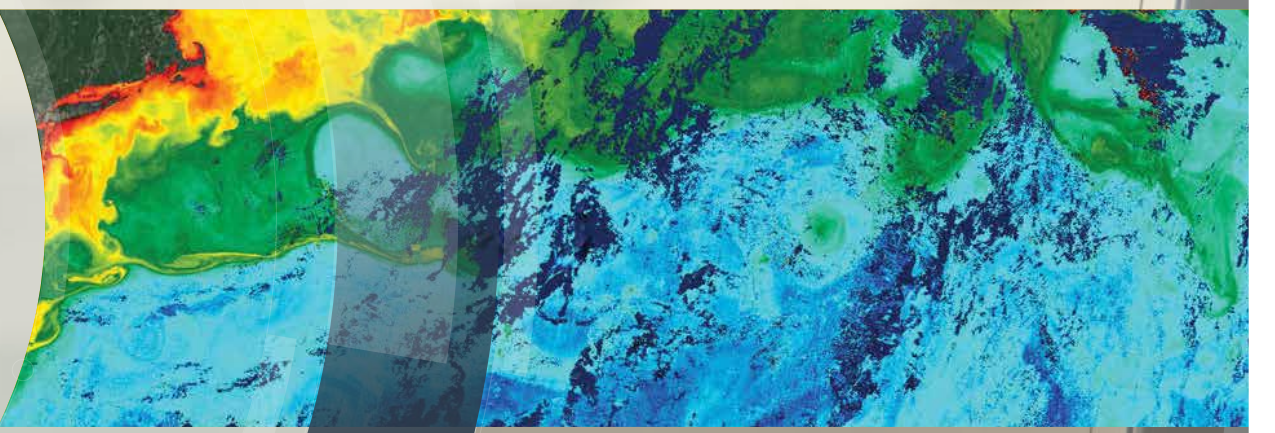


For more information, read the case study on the EUMETSAT website

https://www.eumetsat.int/features/fix-meteosat-third-generation-imager-1-satellite

The team from EUMETSAT that created MICMICS includes (from left) Tim Hewison, Stephan Stock, Alessandro Burini, Janja Avbelj, Ali Mousivand, Christoph Straif, Mounir Lekouara, and Jagjeet Nain. Vincent Debaecker, not pictured, from Telespazio Vega was also involved in the MICMICS calibration for the FCI

Credit: Adobe



2 *Deliver operational services responding to evolving user requirements, based on the continuous infusion of science and cost-effective infrastructures and operations*

Satellite operations

EUMETSAT's operations teams, through their expertise and dedication, ensure the seamless flow of data from our satellites 24 hours a day. The service continuity we deliver is vital for Member States' meteorological and hydrological services to generate precise and timely weather forecasts.

0° longitude

Meteosat-12

Full Disk Scanning Service/ Lightning Imager Service

Became operational on 4 December 2024 and provides the primary Lightning Imager Service and backup Full Earth Scanning service.

0° longitude

Meteosat-10

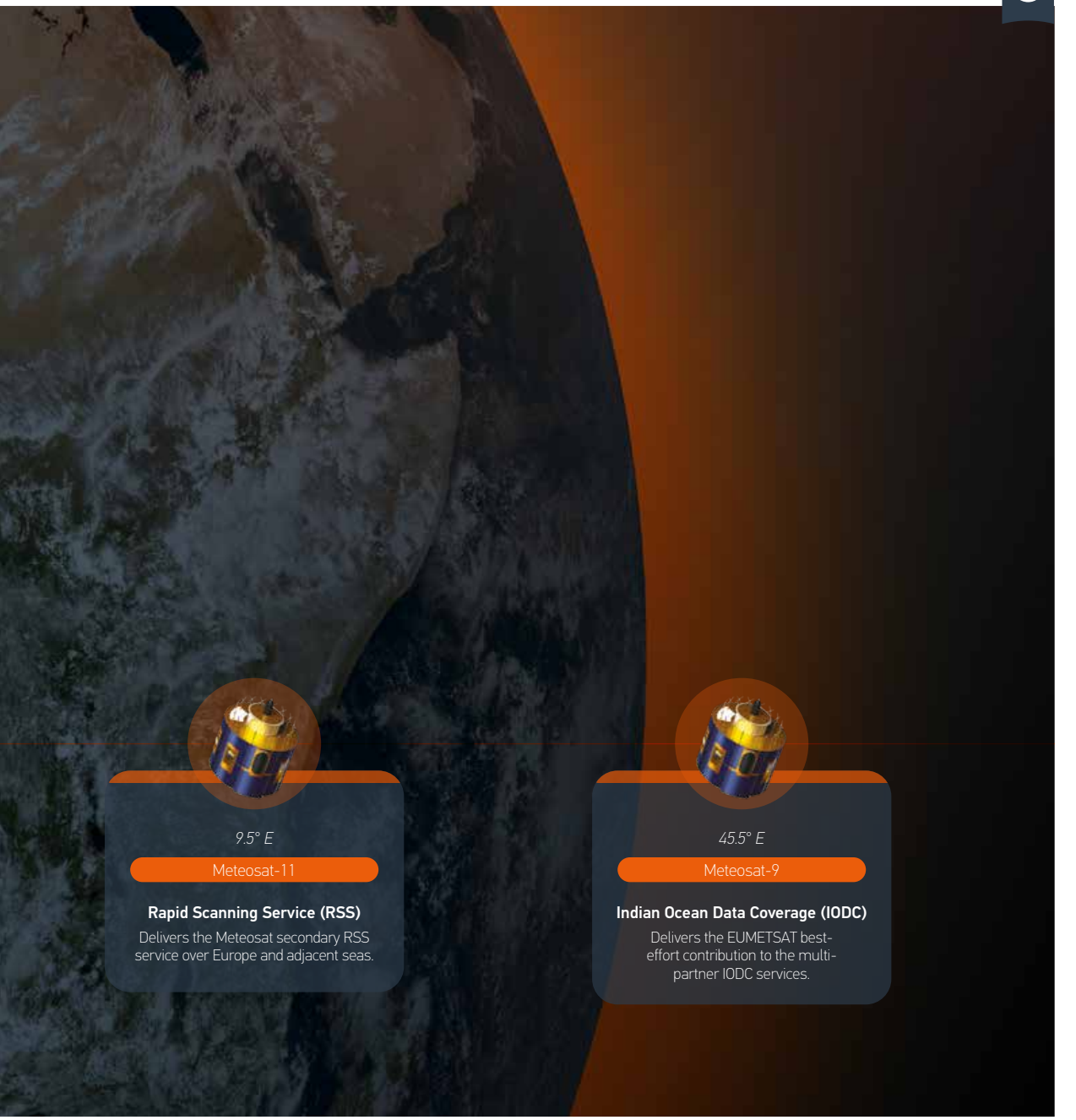
Full Earth Scanning Service

Provides the Meteosat primary full-disc imagery service over the European continent, Africa and parts of the Atlantic and Indian oceans.

Meteosat

Meteosat Third Generation – Imager 1 (MTG-I1) became operational on 4 December 2024 and was renamed Meteosat-12, providing Flexible Combined Imager and Lightning Imager services from 0° longitude in parallel to the prime Full Earth Scanning (FES) mission available from Meteosat-10. Meteosat-9 continued to perform the Indian Ocean data coverage (IODC) FES service from 45.6–45.9°E with very good availability, as did Meteosat-10 at 0° longitude.

A radiation-induced 'safe mode' on 17 August interrupted the prime Meteosat-10 FES mission, which was temporarily transferred to Meteosat-11 within 5 hours until full recovery of Meteosat-10 three days later. The first-ever collision avoidance manoeuvre for an operational Meteosat satellite was also performed on the same date, protecting Meteosat-10 from a high risk of collision with a defunct Russian satellite. Meteosat-11 performed the Rapid Scanning Service (RSS) mission at 9.5°E with availability interrupted only by planned monthly RSS breaks and the temporary support for the Meteosat-10 outage in August.



The in-orbit break-up of Intelsat-33e at 60°E in October 2024 generated a large, energetic debris cloud that rapidly distributed around the geostationary orbit ring, although active monitoring confirmed no significant increase in risk to Meteosat satellites up to the end of 2024.

The 2024 Meteosat Lifetime Review was completed with no significant evolutions compared with the previous review. Aanalysis is ongoing to assess a further extension of Meteosat-9's lifetime to ensure IODC continuity until the start of operational services from MTG-I2, at which point Meteosat-10 may be moved over the Indian Ocean – pending a decision from the EUMETSAT Council.

The Meteosat Second Generation (MSG) ground segment performed nominally, with only one incident in June when a failed network switch led to the MSG mission control system being unable to command the spacecraft for a few hours. This was quickly resolved, with lessons learned to avoid such a failure in the future.

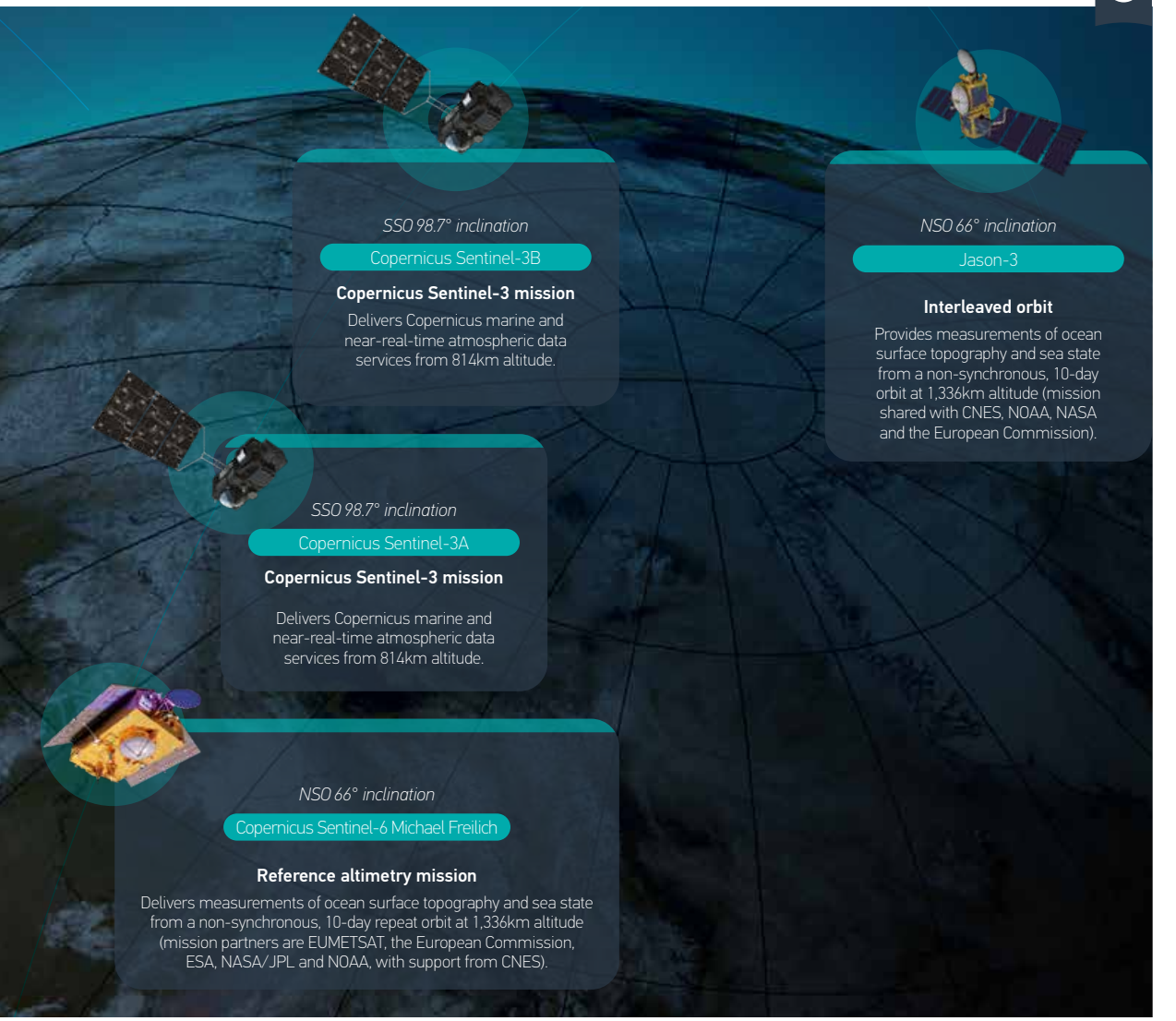
Satellite operations

EUMETSAT Polar System

The EUMETSAT Polar System (EPS) operates dual Metop satellites. Metop-B continued to serve as the primary satellite in 2024, downlinking data twice per orbit at the Svalbard and McMurdo stations to deliver global data to users with the lowest possible latency.

The service availability and operational performance of both Metop-B and Metop-C remained consistently high. Two collision avoidance manoeuvres were carried out in July and October, and at the request of COSPAS-SARSAT, a satellite-aided search and rescue initiative, the Metop-B Search and Rescue Repeater (SARR) was switched off on 20 March to avoid interference with similar payloads on NOAA-19 and Meteor-M2-3. The timetable for re-enabling the SARR was still to be determined at the close of 2024.

The Metop Lifetime Review in May concluded that the satellites were performing well with no significant changes to the overall mission. Metop-B remains the prime satellite due to the inferior performance of Metop-C's microwave instruments. The EPS ground segment performed nominally after updates to several facilities to mitigate obsolescence. An assessment of a further extension of Metop-B's lifetime began in December, to optimise the transition of operational services to Metop Second Generation.



Copernicus Sentinels

Copernicus Sentinel-3 satellite operations continued smoothly in 2024, although collision avoidance manoeuvres were necessary in February, August and September. Service availability was only impacted by planned maintenance activities and minor instrument anomalies that resulted in short duration outages.

Sentinel-3 ground segment operations also ran largely without issue, with the main impacts on the service caused by the late or incomplete delivery of data to EUMETSAT from the ESA-managed core ground station or processing services, together with anomalies with the EUMETSAT Data Store delaying the availability of data.

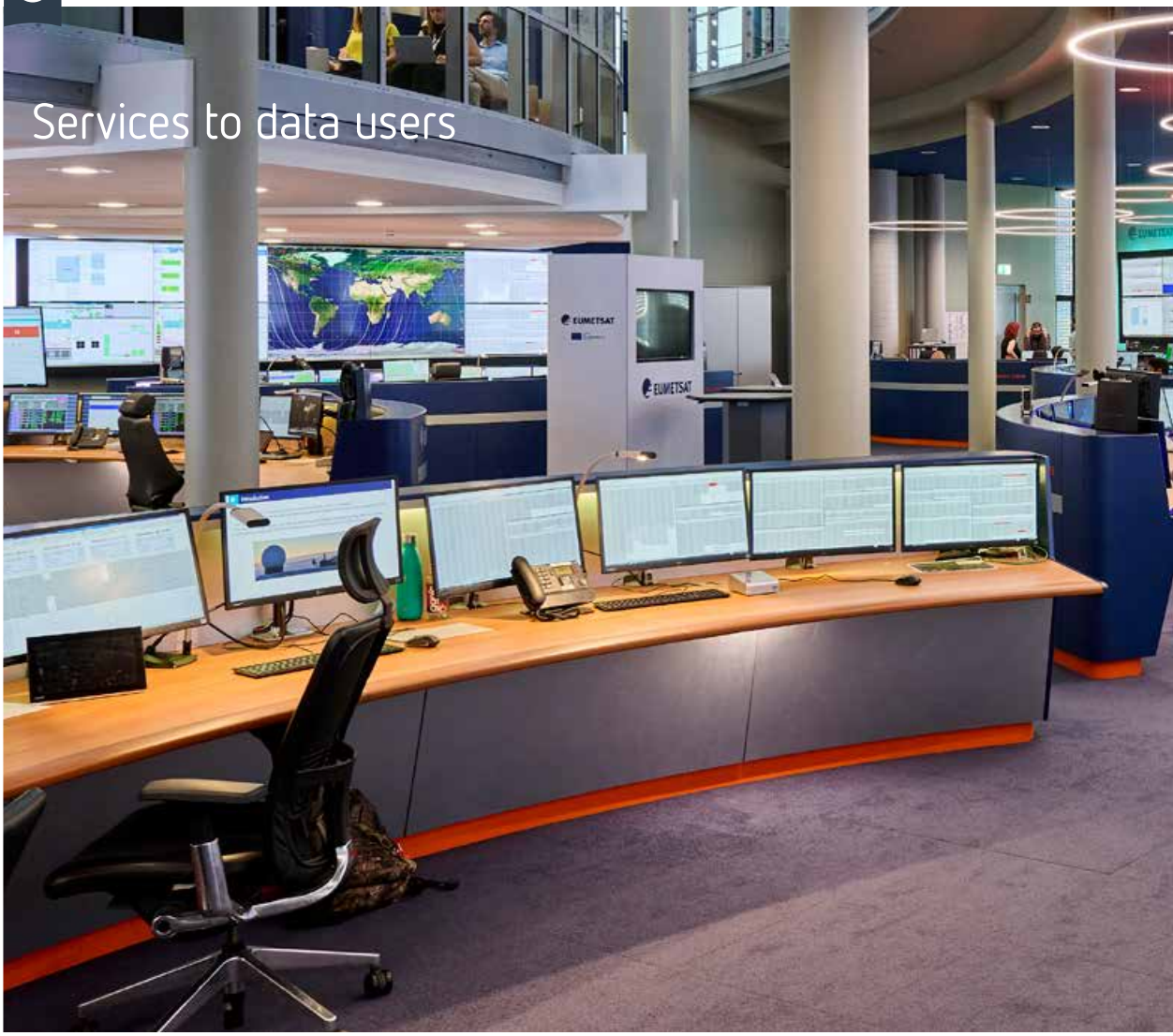
Copernicus Sentinel-6A Michael Freilich satellite operations generally proceeded well, with operational changes successfully mitigating service impacts arising from limitations of the US National Oceanic and Atmospheric Administration Fairbanks ground station antennas. For Copernicus Sentinel-6B, operations preparation activities ramped up during the summer and at the end of the year were on track to be ready for the planned launch in November 2025.

Jason-3

Jason-3 generally performed nominally, except for 4-6 August when the satellite entered reduced mode due to a positioning fault. However, there was no impact on products. A double failure of the Usingen ground stations on 12-13 October led to fewer passes, and continuing issues further reinforced the need for a long-term solution to the obsolescence concerns at the Usingen terminals.

The annual exploitation review meeting, held on 23-25 April, confirmed the intention of the partners to extend mission operations until the end of 2027.

Services to data users



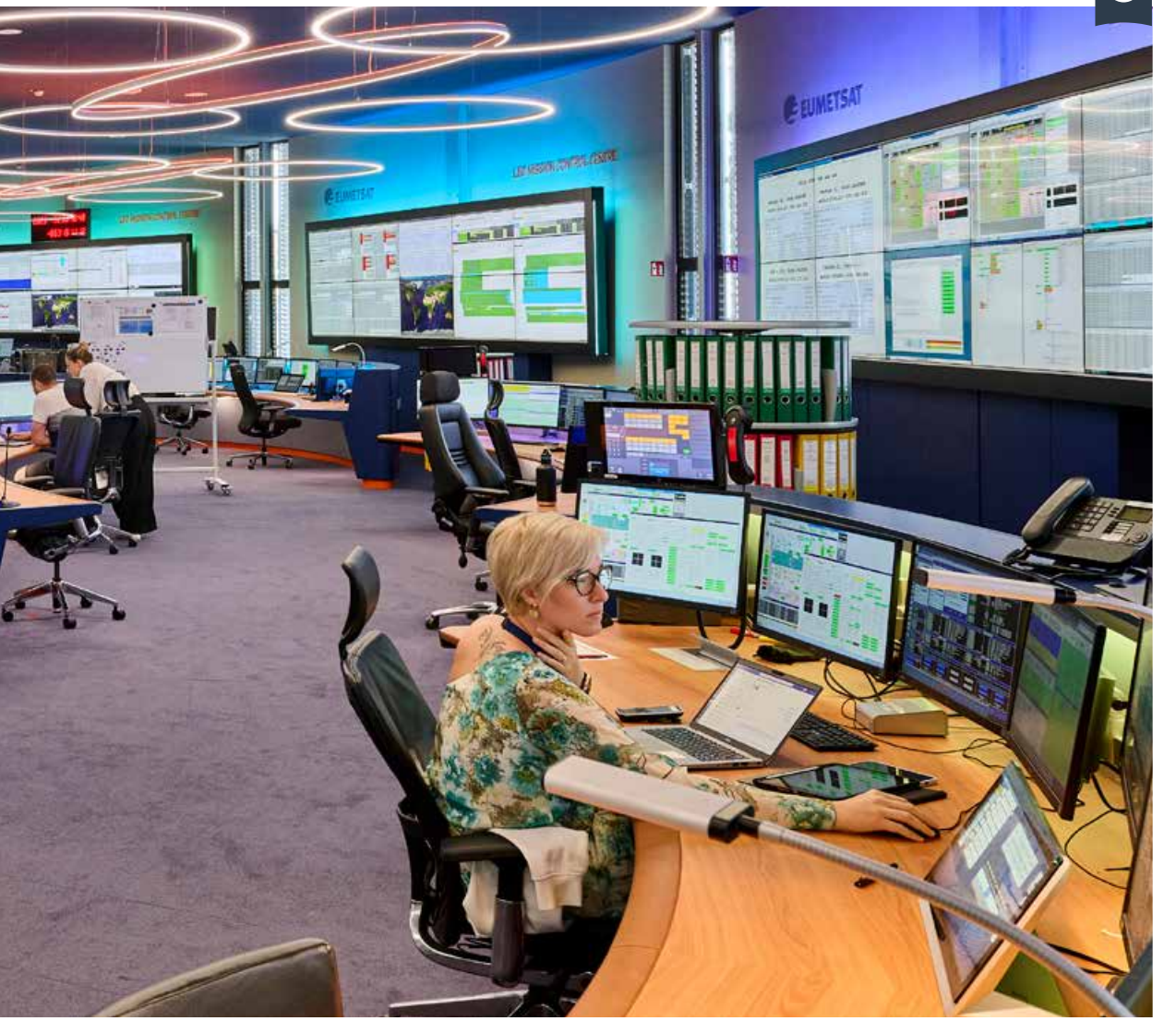
To ensure its Member States and other data users can fully harness the value from EUMETSAT's fleets of satellites, EUMETSAT is committed to ensuring that its data are provided quickly, reliably and efficiently to those who require them and in a way that meets their needs.

EUMETCast 'push' data access service

EUMETCast is EUMETSAT's primary dissemination mechanism for the near real-time delivery of satellite data and products. It delivers a wide range of data through a multi-service 'push' dissemination system, based on multicast technology. EUMETCast serves data through two complimentary delivery systems, EUMETCast Satellite and EUMETCast Terrestrial, providing not only data from EUMETSAT satellites but also products from third parties. At the start of 2024, EUMETSAT upgraded EUMETCast Europe users by migrating from the Eutelsat-10B satellite to Hotbird-13G, resulting in a more resilient service with improved redundancy. The migration went well, and the service ran smoothly throughout 2024.

Online 'pull' data access services

EUMETSAT provides online data access services to customers through its Data Store and EUMETView services, which became operational in 2024.



The Data Store provides access to EUMETSAT data through a web interface and a suite of application programming interfaces (APIs) that incorporate data tailoring capabilities. The Data Access API Client simplifies discovering, searching and downloading the data in the Data Store, giving simple access to all Data Store functions as a Python library and command-line interface. The catalogue of online data steadily increased during 2024, with the addition of Meteosat Third Generation data, new satellite application facility (SAF) data and a range of new climate data records.

EUMETView provides an easy-to-use visualisation of a range of satellite data through a customisable web front end and APIs. Throughout the year, the monthly service availability for online data access services remained well above its 95% target threshold. New MTG visualisation layers such as GEOColour and Cloud Phase were key enhancements introduced in 2024. Cloud Phase is particularly useful for forecasters, as it visualises the microphysical characteristics of clouds.

EUMETSAT also added data on sea ice concentration in the southern hemisphere to the portal, sourced from the EUMETSAT Ocean and Sea Ice SAF, for both blended and interim climate data records.

Towards a new long-term data archive

As more people have switched to using EUMETSAT services and products from the Data Store, the Data Centre has evolved into a deep archive. A long-term data preservation and access management evolution project began in 2024, aiming to achieve efficient and affordable management of, and access to, large volumes of satellite data with an appropriate level of service. By 2027, the project is scheduled to have restructured the current EUMETSAT Data Centre to interact efficiently and seamlessly with the central online data repository, the EUMETSAT Data Lake and its user interface, the Data Store.

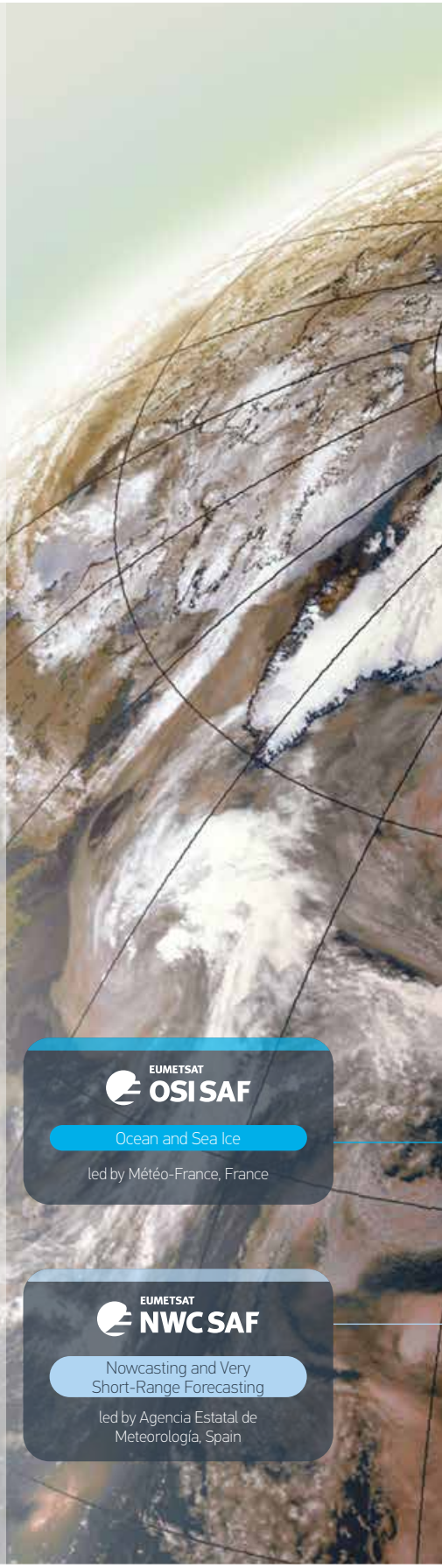
EUMETSAT Satellite Application Facilities

EUMETSAT provides satellite-based data and software products as well as expert support to its user community through eight Satellite Application Facilities (SAFs). Each SAF is a dedicated centre of excellence for processing satellite data, using the specialist knowledge available in EUMETSAT's Member States. This essential network forms an integral part of the distributed EUMETSAT ground segment.

The EUMETSAT SAFs each serve a dedicated user community and application area with their operational data or software products and are organised in consortia consisting of meteorological and hydrological services, research and other operational entities. Each SAF is under the leadership of a "leading entity" (a national meteorological service) and conducts development and operational activities in line with established agreements for a five year phase ("Continuous Development and Operations Phase" – CDOP).

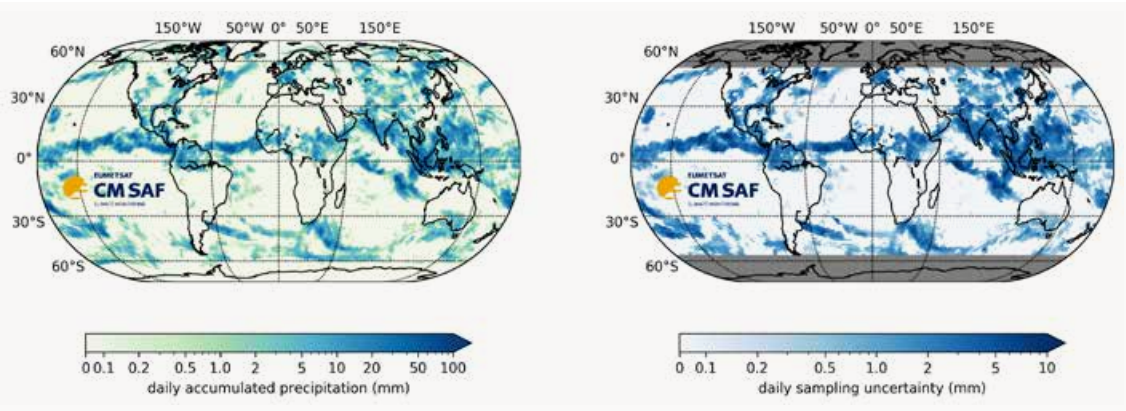
Examples of new and updated product releases for each SAF are given on page 34, while other releases from 2024 are listed in the Appendix.

During 2024, in order to respond to a changing environment, EUMETSAT organised a comprehensive review of the SAF strategy together with Member State representatives. A framework of general principles was drawn up, and the updated strategy will be submitted for approval in 2025. This will support the preparation of the next Continuous Development and Operations Phase (CDOP 5) for which proposals are due by Q4 2025.



EUMETSAT
ROM SAF
Radio Occultation Meteorology
led by the Meteorologiske Institut, Denmark
EUMETSAT
AC SAF
Atmospheric Composition Monitoring
led by the Ilmatieteen laitos, Finland
EUMETSAT
NWP SAF
Numerical Weather Prediction
led by the Met Office, United Kingdom
EUMETSAT
CM SAF
Climate Monitoring
led by Deutscher Wetterdienst, Germany
EUMETSAT
H SAF
Operational Hydrology and Water Management
led by Servizio Meteorologico Aeronautica Militare, Italy
EUMETSAT
LSA SAF
Land Surface Analysis
led by Instituto Portugues do Mar e da Atmosfera, Portugal

EUMETSAT Satellite Application Facilities



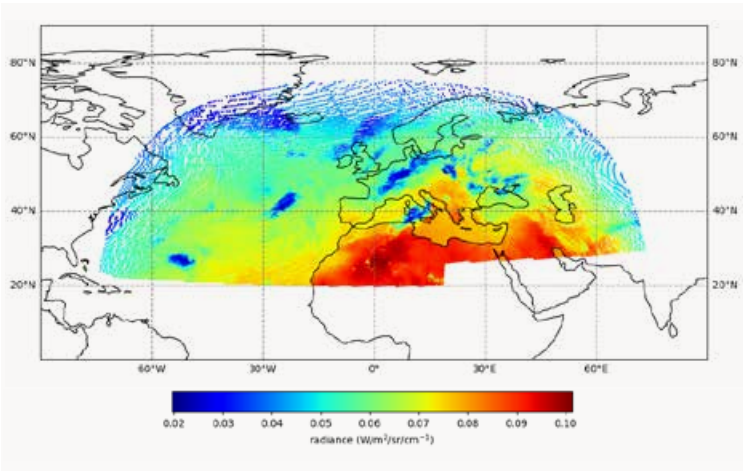
Global map of GIRAFE v1 daily accumulated precipitation on 2021/07/13. Right: Global map of the related daily GIRAFE v1 sampling uncertainty.

The CM SAF released the first edition of a precipitation climate data record (Global Interpolated RAinFall Estimation, GIRAFE version 1) on 12 April. It was generated by combining data from polar orbiting microwave satellite sensors and infrared observations from geostationary weather satellites. The data record covers 20 years from 2002 to 2022.

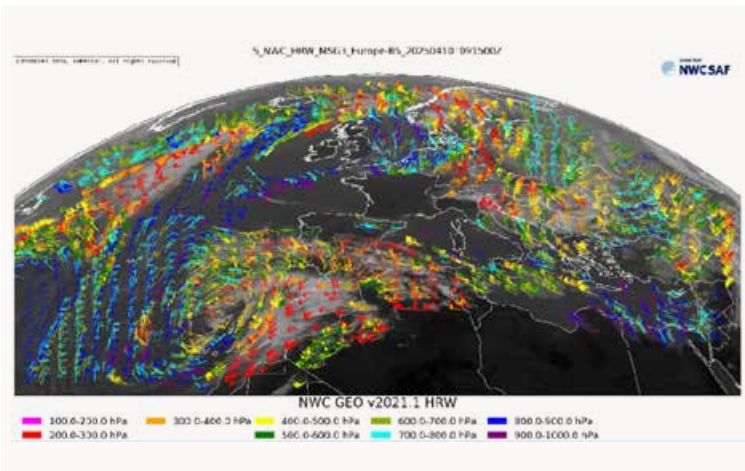
On 19 January, the OSI SAF issued the first release of the RapidScat Level 2 wind record from the International Space Station. Covering the years 2014 to 2016, the records were created using state-of-the-art wind retrieval algorithms.

IRSPP Version 1.3, a pre-processor for the Infrared Sounder (IRS) on MTG satellites, was released by the NWP SAF on 31 October. The software package processes hyperspectral data and supports the IRS pre-launch test data.

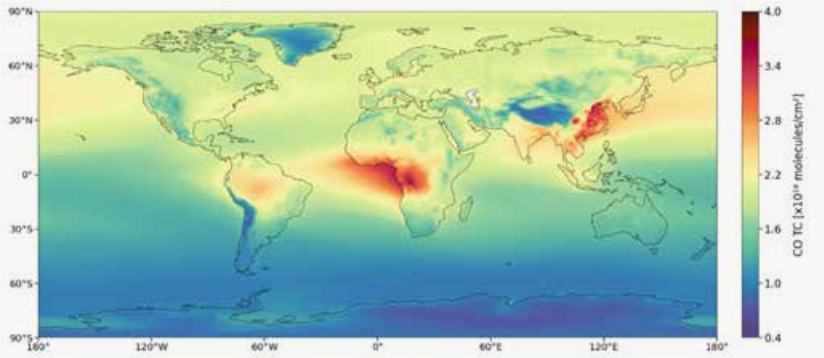
On 18 March, the NWC SAF released a new sub-version of the GEO software package that includes several new options and bug corrections in response to the needs of users. The new features include a configuration for Spinning Enhanced Visible and Infrared Imager Rapid Scan reprocessing, Himawari processing in EHH format and better metadata information in convection and high-resolution wind products.



IRSPP Version 1.3,



NWC SAF high resolution winds



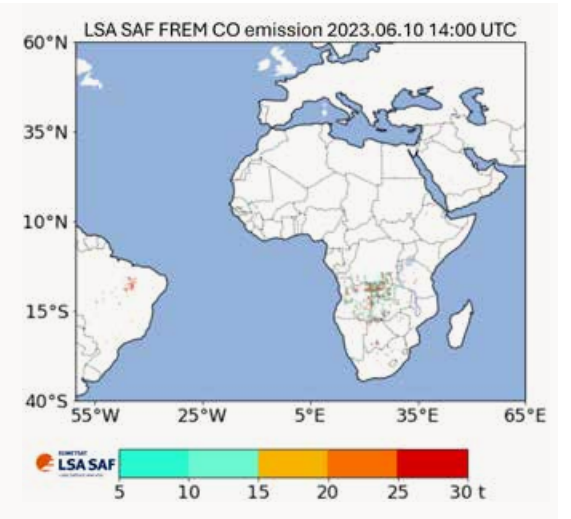
AC SAF IASI CO data record: Mean CO total column concentrations over the period 2008-2022

The LSA SAF issued an operational release of the new Fire Radiative Energy Emission (FREM) product on 12 June. FREM provides daily emissions and emission rates of carbon monoxide, carbon dioxide, methane and nitrous oxide, as well as total and fine particulate matter. The data is available in near-real time and reaches back to 2004.

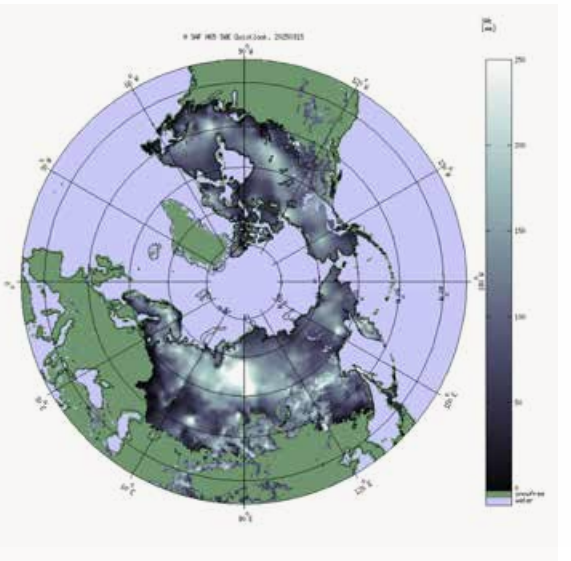
On 20 September, the AC SAF released two new climate data records for carbon monoxide and sulphur dioxide covering the period from July 2007 to December 2023. The data derives from the Infrared Atmospheric Sounding Interferometer on Metop-A and -B.

The ROM SAF released its latest update of the Radio Occultation Processing Package on 11 July. Aside from bug fixes, the release included updates to the library data in BUFR format

On 13 September, the H SAF made available a new version of its snow water equivalent product, which extends the older version to full coverage of the northern hemisphere. This product is based on the Microwave Radiometer on the US Defense Meteorological Satellite Program satellites.



LSA SAF Fire Emission Product (FREM): Total daily accumulated CO emission on 10 June 2023



The new version of the H SAF Snow Water Equivalent (mm)

Climate services

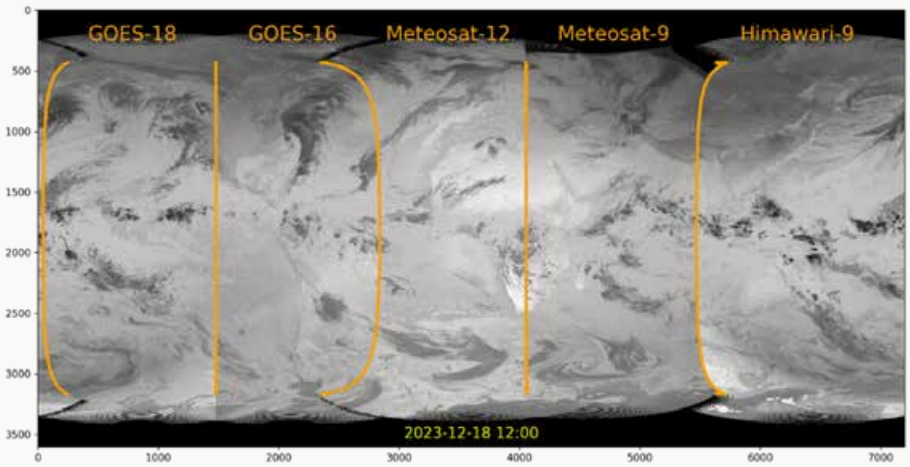
EUMETSAT responds to the climate information needs of its users and wider society by providing high-quality climate data records – a key planning tool in the fight against global warming. These records provide reliable and accurate information over decades, forming the basis for authoritative reports from Member State climate offices, the Copernicus Climate Change Service (C3S), the Intergovernmental Panel on Climate Change and the World Meteorological Organization.

Throughout 2024, EUMETSAT continued to ensure the best use of EUMETSAT data for climate applications, enabling an improved understanding of the Earth system by quantifying climate change variability, extremes and impacts. Teams at EUMETSAT worked to further enhance the systematic and timely delivery of high-value climate data records using satellite observations that now span up to five decades. In 2024, colleagues created new climate data records at EUMETSAT headquarters and within the EUMETSAT Satellite Application Facility network (see the Appendix for a full list).

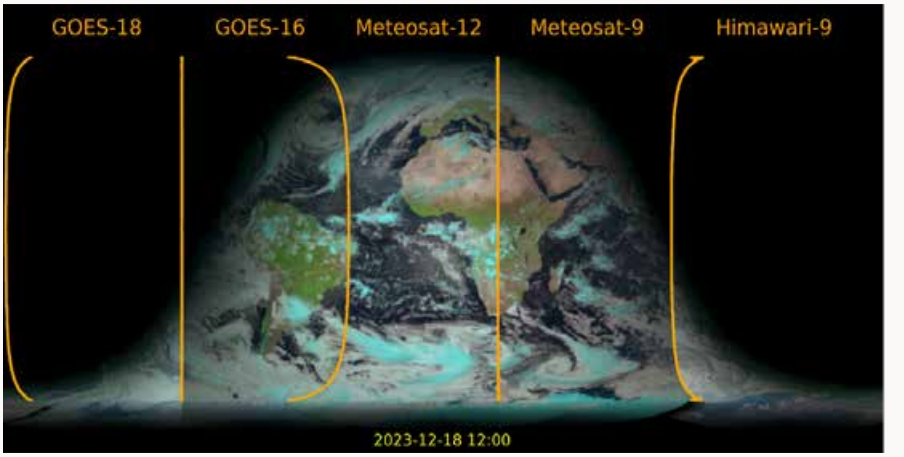
EUMETSAT teams continued to work on data rescue, completing a study on data recently recovered by the US National Oceanic and Atmospheric Administration (NOAA) as part of the bilateral GEO-Ring project to combine historical measurements since the mid-1970s from all geostationary satellites around Earth, providing data every 30 minutes for the whole history. EUMETSAT analysed the data quality for recently rescued data from US satellites and began to integrate the information into the GEO-Ring data record. During 2024, the Indian Meteorological Department began delivering geostationary data that will potentially fill a major data gap over the Indian Ocean in the first half of the 1990s.

Good progress was made on sustaining and speeding up the delivery of extended climate data records by providing information in interim mode. Fast delivery is crucial for responsive climate services and tailoring climate adaptation strategies in Member States.

The plan supporting the C3S reanalysis activities was updated during the year. The EUMETSAT and European Centre for Medium-Range Weather Forecasts teams



Example of GEOring infrared image, based on satellite data for three space agencies: NOAA (GOES-18 and -19), EUMETSAT (Meteostat-8 and -12) and JMA (Himawari-9)



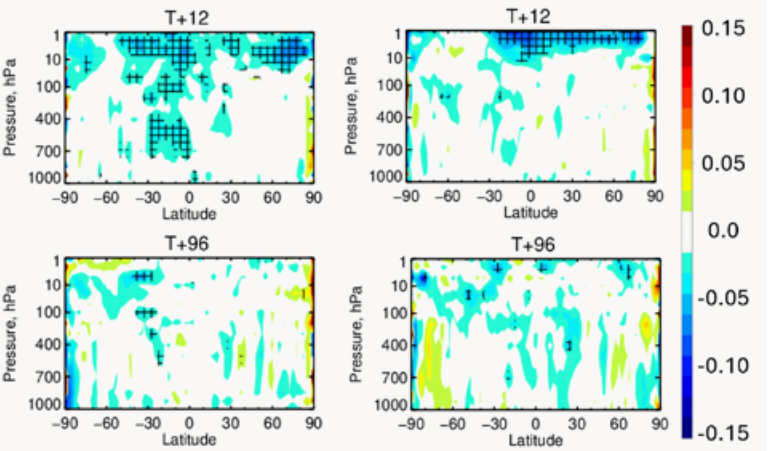
Example of GEOring visible false colour composite image, based on satellite data for three space agencies: NOAA (GOES-18 and -19), EUMETSAT (Meteostat-8 and -12) and JMA (Himawari-9).

developed a plan for the delivery of additional satellite datasets for the 2025 ERA6 reanalysis, including activities to validate the ERA6 results to better understand systematic errors in the reanalysis. In addition, progress was made on analysing the impact of the datasets delivered to the C3S, with encouraging results, as the example of the NOAA High-Resolution Infrared Radiation Sounder data in the figure shows.

EUMETSAT intensified the generation of data records from instruments on board the Copernicus Sentinel-3 and Sentinel-6 satellites, which provide crucial climate system information such as sea level over extended time periods. In 2024, the radiometric quality of the Sentinel-3 Ocean and Land Colour Instrument data was improved, which is a key step towards a new ocean colour record planned for release in 2025.

Climate user engagement continued to develop the climate anomaly and normals service, together with the SAF network and in coordination with the C3S. A release of the service to pilot users is scheduled for 2025 and will include normal and anomaly products from multiple SAFs.

Several climate use cases, explaining how EUMETSAT data records are being used to study climate, were delivered via EUMETSAT's new User Portal, including the effect of global warming on the Indian monsoon and the impact of new maritime sulphur emission legislation on cloudiness over the Atlantic Ocean.



Improved analyses and forecasts in upcoming ERA6 using EUMETSAT reprocessed HIRS data. The Figure shows latitude-height cross sections at different prediction times (12 and 96 hours) showing the change in standard deviation of error for temperature (left) and winds (right) comparing results for new HIRS data vs. HIRS data used in ERA5. Blue (red) areas represent smaller (larger) errors.

Technology infrastructure building

EUMETSAT focuses on secure, reliable data storage and unfailing service provision to its users. As data volumes continue to grow, the need for increased capacity prompts us to plan both our short and medium-term technology infrastructure building (TIB) in order to protect our future service continuity and programme delivery to Member States.

In 2023, EUMETSAT identified several factors that would eventually lead to capacity limitations in its technology infrastructure. These included increased hardware requirements mandated by external suppliers, the data requirements of new programmes such as the Copernicus Anthropogenic Carbon Dioxide Monitoring mission, and the demands of new computational approaches, chiefly artificial intelligence and machine learning.

During 2024, we worked on understanding the approach to resolving this capacity issue. The procurement of offsite data centre capacity was seen as a strategic necessity for the TIB, not least because offsite computing capabilities also offer significant advantages in terms of resilience and the flexibility to easily accommodate future demand increases.

Following the approval by the EUMETSAT Council, a supplier for external capacity was sought, albeit against a backdrop of continuing industry-wide high demand for data centre space, and the new capability is expected to be fully up and running by autumn 2025. In the meantime, internal measures such as reducing programme infrastructure requirements, increased hardware virtualisation and the more efficient use of existing systems will ensure that there is no impact on service delivery, while meticulous planning led by our TIB team will secure a seamless transition for users as the external capacity comes on stream.

EUMETSAT's technical infrastructure building, Darmstadt, Germany

Artificial intelligence and machine learning

EUMETSAT remains at the forefront of artificial intelligence and machine learning (AI/ML) in meteorology, a rapidly changing landscape that has significant implications for modelling, data processing and reporting. Our principal focus is on data curation that ensures satellite data are effectively leveraged for AI/ML development, as such data remain a critical source of information for ML training that will ultimately enable a kilometre-scale view of our planet.

In 2024, EUMETSAT concentrated a good deal of effort in working with Member States on the AI needs of the European meteorological community, largely through the EUMETNET Artificial Intelligence and Machine Learning for Weather, Climate, and Environmental Applications (E-AI) strategic initiative. EUMETNET is a grouping of 33 European national weather services that creates a framework for cooperation on meteorological activities. Set to run for five years, the E-AI programme aims to bolster collaboration among European national meteorological and hydrological services and external partners, focusing on the domains of AI and ML within weather, climate and environmental contexts. EUMETSAT's role in the programme centres around gauging user needs, constructing and maintaining robust training datasets for ML applications, ensuring data access through easy-to-use portals and interfaces, and providing infrastructure that enables Member States to retrain existing ML-derived forecasting models.

The final weeks of 2024 saw the release of the first AI-ready dataset based on Meteosat Spinning Enhanced Visible and Infrared Imager and EUMETNET Operational Programme for Exchange of Weather Radar Information radar products. The first five years of this dataset will be available on the European Weather Cloud (EWC) in January 2025. During 2024, we worked on enhancing the EUMETSAT User Portal and Data Services to improve access to high-value datasets – such as Climate Data Records – for AI/ML applications. This will ultimately include creating a curated catalogue of reprocessed data and exploring AI-assisted discovery tools.

AI is also being integrated into EUMETSAT's internal processes and tools. In 2024, we evaluated the impact of a coding assistant/copilot for software development, an innovation that is expected to yield a 30% gain in efficiency and significant reductions in contract costs. We investigated the potential for data exploration tools that will empower users to query datasets and generate code, enhancing the ability of our engineers and data scientists to work with complex data. More widely across the organisation, future developments are expected to embrace AI-assisted knowledge management to exploit the wealth of information in EUMETSAT document libraries, large-language-model-generated meeting summaries to improve reporting efficiency, and additional AI-powered tools in areas such as operations, training and administrative duties.

Credit: Adobe

Satellite data make flying safer

In April 2024, aviation forecaster Hampus Sellman was setting up for an early shift at the Swedish Meteorological and Hydrological Institute (SMHI) when he received a call from a light aircraft pilot worried about the current weather conditions.

Credit: Adobe

"Medium-range forecasts had predicted cold weather and nearly clear skies, however, when I checked the latest satellite images, I saw it was overcast the whole way," said Sellman, who is based as SMHI's office in Uppsala.

Cloudy, cold conditions pose a serious risk to aviation due to the potential for ice accumulation on aircraft surfaces, which can affect control, performance, and onboard systems. "However, the precise conditions that can ultimately lead to aircraft icing are very hard to predict," Sellman explained. "It's not enough to view weather forecasts, pilots must recognise and react to the conditions in the moment."

Aviation weather experts such as Sellman are trained to interpret a wide range of near-real-time observations made by ground-based radar and sensors on aircraft and meteorological satellites such as EUMETSAT's Meteosat and Metop spacecraft.

"We saw factors such as the temperature, humidity, and cloud droplet size had the potential to cause concentrated ice build-up on the aircraft," he said. "I could see the conditions were bad and advised the pilot he should remain grounded.

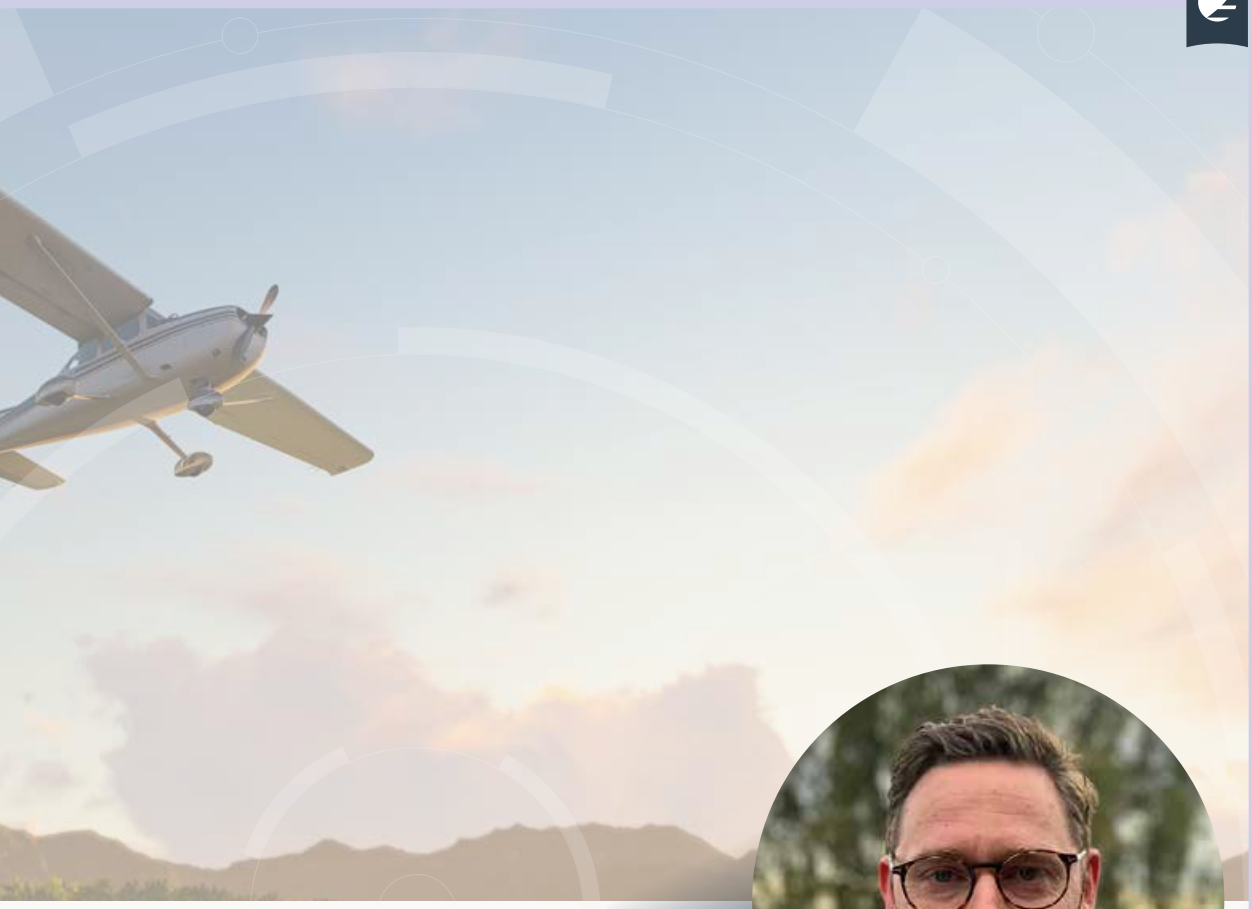
"To predict the development of potentially dangerous conditions, aviation weather specialists must work to extremely tight timescales, just a couple of hours in advance.

"Data products produced using near-real-time satellite observations can help us to characterise air masses, monitor atmospheric motion, observe the distribution of clouds, and track areas of instability."

Improving flight safety

When dangerous conditions such as icing or turbulence are detected in commonly used airspace, Sellman and his team issue warnings for significant meteorological phenomena, known as SIGMETs. Here, he highlighted the potential of new data from EUMETSAT's Meteosat Third Generation programme, which provides observations that can be used to enhance monitoring of lightning activity and cloud microphysics.

"The Lightning Imager will be a tremendous complement to ground-based networks of sensors and allow us to better determine the location and intensity of storms," he explained.



"The improved resolution of data from the Flexible Combined Imager instrument will contribute to us being able to deliver even more detailed and better information to our customers.

"Forecasts and weather warnings help to ensure pilots are going to get from one place to another in a safe way. It can be the difference between life and death for a patient or someone needing rescuing.

"I am proud to play a role in ensuring that they can carry out their activities in safety and with confidence."

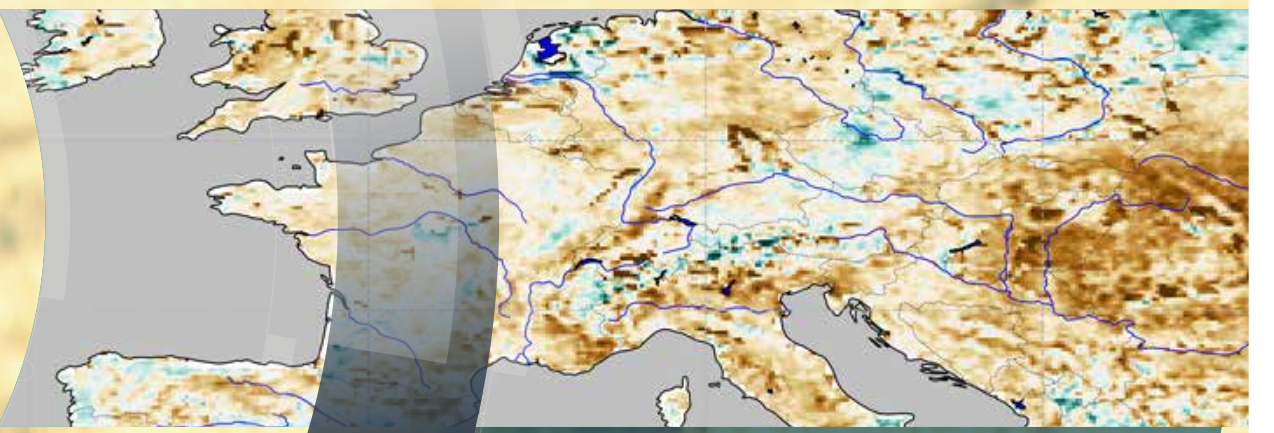
It's very hard to take a picture of lightning with a regular camera, however, this fascination was one of the reasons I became a meteorologist, where observing lightning is a critical part of our work.

Hampus Sellman
Aviation forecaster at the SMHI

For more information, read the case study on the EUMETSAT website

https://www.eumetsat.int/features/satellite-data-flying-safer

Credit: Adobe



3 Establish and exploit a federative European Weather Cloud infrastructure in partnership with the ECMWF and European national meteorological and hydrological services

Key initiatives supported by EUMETSAT in partnership with other organisations ensure the continuing advancement of meteorological and climate applications in Europe, maximising the benefits for all European Meteorological Infrastructure (EMI) entities and the wider meteorological community. These initiatives enhance the capability to support a range of programmes through access to Earth observation data, enhancing artificial intelligence and machine learning capabilities and fostering collaboration. This in turn contributes to the improvement of weather forecasting, environmental monitoring and climate decision making.

European Weather Cloud

The European Weather Cloud (EWC) is a collaboration between EUMETSAT and the European Centre for Medium-Range Weather Forecasts (ECMWF). The platform facilitates the collaborative development of meteorological applications and operations across the EMI.

The EWC's features and ease of use led to a significant expansion in uptake during 2024, with 49 new registrations bringing the total to 150. Fifteen research and development projects via EUMETSAT are now active and a new website launched in late summer, providing improved information on service updates and events, along with example use cases to attract new users. The annual call for EWC R&D projects is now well established and aligned with the ECMWF's process for special projects. The use of EWC resources is also increasingly underpinning the development and operations of EUMETSAT's Satellite Application Facilities.

Member States continue to show interest in using the EWC for time-critical applications. EUMETSAT and the ECMWF conducted a joint study to assess the requirements, and a workshop for Member States in April highlighted the need for improved support for such operations. Key ongoing actions include enhancing the platform's availability, improving system status monitoring, and establishing a round-the-clock contact point for infrastructure-related issues.

The EUMETNET Artificial Intelligence and Machine Learning for Weather, Climate and Environmental Applications initiative uses the EWC for some of its activities.

Future governance of the EWC was discussed during the year. Changes to the Joint Advisory Group's terms of reference were approved to improve governance, such as by better separating policy and technical discussions. The overall reform is aimed at ensuring continued alignment between the two partner organisations operating the EWC.

WEkEO

The Copernicus WEkEO online platform (https://wekeo.copernicus.eu) provides easy, cloud-based access to Copernicus Sentinel satellite data, as well as information derived from the Copernicus Services. WEkEO is the European Union Copernicus Data and Information Access Service for environmental data, virtual processing environments and skilled user support.

By the end of 2024, WEkEO had around 32,000 registered users, gave access to over 93PB of data and released a new feature, the 'EO Canvas'. These serverless functions allow data users to process data directly in the cloud and specifically download the final results. The initial version supports the Sentinel Application Platform software tool and EUMETSAT's data tailoring tools, with plans to add more functions. In addition, a new viewer for visualising and exploring more than 160 Copernicus data layers, including satellite, marine, atmosphere and climate variables, was developed during the year and is scheduled for release in early 2025. Further availability of ECMWF ERA5 data layers was also added and the website was redesigned to be more in line with Copernicus styling.

Future plans include the Observia tool, under development by the European Environment Agency. Observia is an AI project that will enhance WEkEO with a large-language-model-powered chatbot based on Copernicus information from all of the Copernicus Entrusted Entities. The initial release is planned for mid-2025.

Credit: Cineca – Leonardo

Destination Earth

Destination Earth (DestinE) is the European Commission's initiative to build highly accurate digital twins of Earth. EUMETSAT's role in this programme is to build and operate the DestinE Data Lake.

EUMETSAT met all Phase I targets in 2024, with the data lake successfully integrated and ready to accept a first set of users. The phase culminated in June with a formal launch event in Kajaani, Finland. This marked the completion of the core service platform, data lake and first digital twins – on extreme events and climate adaptation.

With a smooth transition into Phase II, DestinE is set to expand through the provision of additional services, advancing AI capabilities and introducing further digital twins, along with maturing the operational capabilities of the overall system. This phase runs until June 2026.

A major milestone for EUMETSAT was achieved with the establishment of the data interface between the Leonardo EuroHPC supercomputer site in Bologna and the data lake, via a dedicated data bridge infrastructure deployed in the same city.

▲ *Destination Earth's codes will run on the European Union's partition of the Leonardo supercomputer, hosted by Cineca in Bologna, Italy, on behalf of the EuroHPC JU and destined to be one of the most powerful in the world.*

Digital Data Services strategy

In December 2024, EUMETSAT initiated a dialogue with its Member States to plan for the update of the EUMETSAT Digital Data Services strategy. The update aims to ensure that EUMETSAT Digital Solutions remain adapted for delivering maximum benefits to Member States in facilitating the access, processing and use of EUMETSAT data.

A digital replica of the Earth

Destination Earth draws on enormous amounts of data to make it possible to better understand how to mitigate the effects of climate change in the future

Credit: Adobe

From increased water scarcity to more frequent wildfires to more extreme heat in many cities, the impacts of climate change are already rippling out across the planet. And as extreme weather events become more frequent, mitigating their effects requires understanding them more deeply. This is exactly what Destination Earth enables people to do. Through the Destination Earth initiative, the European Commission aims to develop digital replicas of the entire Earth system that draws on enormous amounts of data, making it possible to see the multitude of complex ways natural and human activity will likely affect the planet in the future.

"We're looking at replicating what's actually happening across the globe, including the interactions between the atmosphere, land, ocean, people, cities, and agriculture. Destination Earth will allow us to ask 'what if' questions in a more meaningful and more complete way," said Lothar Wolf, EUMETSAT's Head of Digital Solutions and SAF, and Programme Manager for Destination Earth.

"For example, we had a major flood in the Ahr Valley in Germany during the summer of 2021. More than a hundred people died and thousands lost their homes," he continued.

"So now they're rebuilding this valley. And they have a real need to understand how to best plan this so that the buildings are more resilient in the future and increase their overall preparedness for such events. Destination Earth will be able to support in such decision making."

Destination Earth consists of three main components with responsibility divided by the implementing organisations. The European Centre for Medium-Range Weather Forecasts is responsible for the Digital Twins, replicas of the Earth system that can be used for a variety of purposes, including modelling the future environment. EUMETSAT is responsible for the Data Lake, which stores Destination Earth data and enables institutional users to access, interact with, and process them. Finally, the European Space Agency is responsible for the Core Service Platform, through which any users are able to interact with a wide variety of Destination Earth services online.

The launch of Destination Earth in June 2024 is the start of a journey towards the generation of Earth system replicas in the coming years.

By 2030, the goal is to offer decision makers a comprehensive Destination Earth system with the ability to ask "what if" questions.

"I think Destination Earth has the potential to be a game-changing initiative. I'm very proud of our EUMETSAT team for contributing to the foundation of something so impactful," said Wolf.

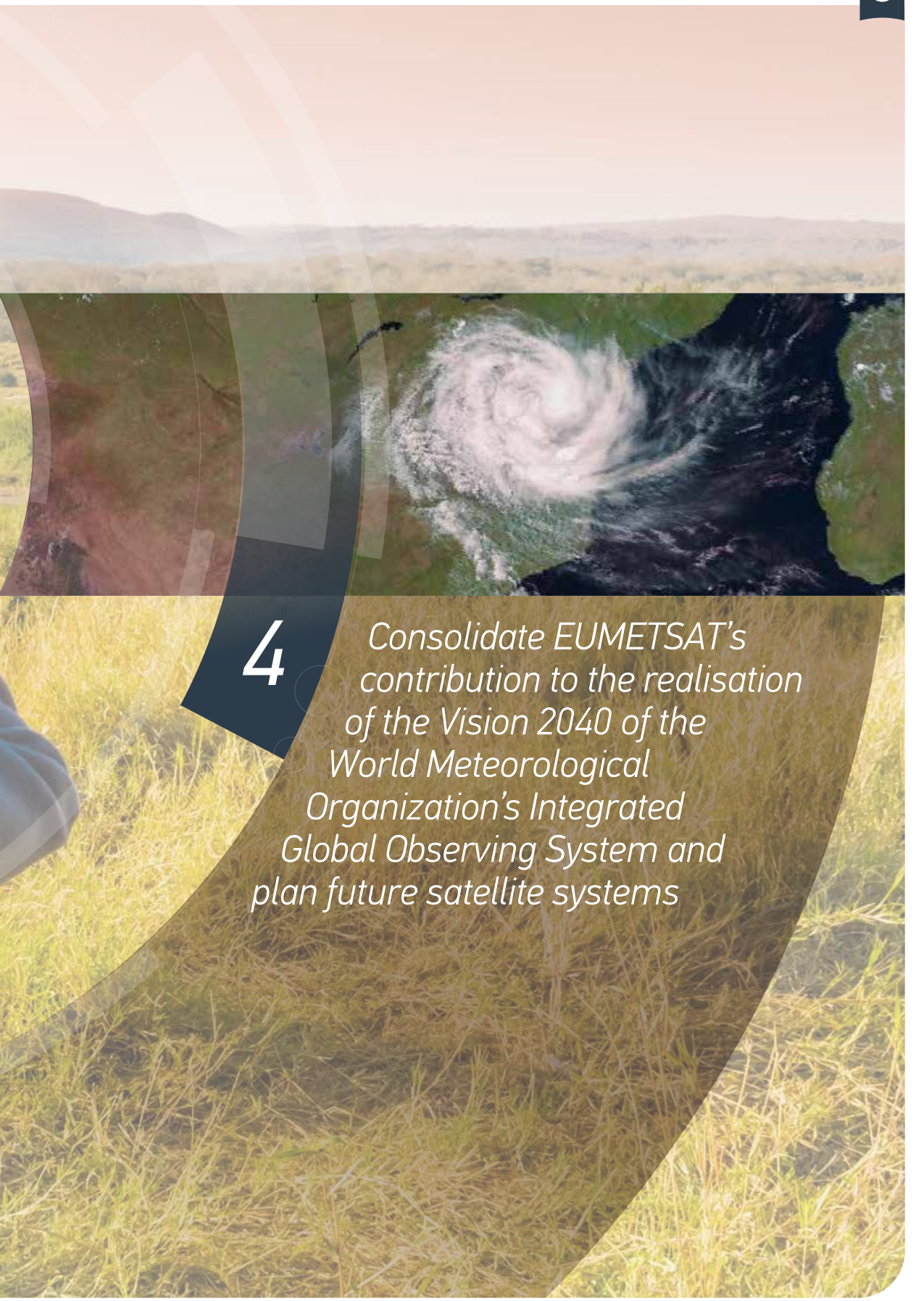
> Destination Earth has the potential to be a game-changing initiative. I'm very proud of our EUMETSAT team for contributing to the foundation of something so impactful.

Lothar Wolf
Head of Digital Solutions and SAF, and Programme Manager for Destination Earth at EUMETSAT

For more information, read the case study on the EUMETSAT website

https://www.eumetsat.int/features/virtual-earth

Credit: Adobe



4 *Consolidate EUMETSAT's contribution to the realisation of the Vision 2040 of the World Meteorological Organization's Integrated Global Observing System and plan future satellite systems*

With the strategic intent of rendering our data more impactful, EUMETSAT is fully committed to aligning with the World Meteorological Organization's integrated global observing system through our many programmes and future missions. Part of the approach involves exploring innovative technologies and commercially-oriented options, such as small satellites and data purchase agreements, enabling a fast, lean procurement ethos to minimise lead times and maximise added value for our Member States.

EUMETSAT Polar System – Sterna

The EUMETSAT Polar System – Sterna (EPS-Sterna) is a potential mission consisting of six micro-satellites to be launched in 2029. It would be the first small satellite constellation operated by EUMETSAT and would run for 13 years, until 2042. Providing vital information on atmospheric temperature and humidity, the mission would appreciably benefit global medium and short-range weather forecasting and enhance very-short-range regional forecasts in high-latitude regions. The programme adopts a New Space approach, focusing on flexible, standardised and cost-effective space system development and marking a sizeable shift towards innovation and efficiency in satellite operations.

During 2024, EPS-Sterna made significant progress, with the successful completion of the System Preliminary Design Review (PDR) bringing Phase B activities to an end. Preparations for the Ground Segment PDR were also advancing, with the review process set to start in early 2025. EUMETSAT's Council unanimously agreed to open the programme for voting by Member States, with a final decision expected by spring 2025.

The precursor Arctic Weather Satellite, developed by the European Space Agency (ESA), launched in August. Its commissioning activities were completed in the following months, and EUMETSAT evaluated its data in late 2024. The findings will be shared with Member States at a workshop in March 2025.

Artist impression of one EPS-Sterna satellite in orbit

Credit: ESA/Mlabspace

EUMETSAT Polar System – Aeolus

The EUMETSAT Polar System – Aeolus (EPS-Aeolus) is a potential mission that would follow up on ESA's Aeolus Earth Explorer, with EUMETSAT operating the Aeolus-2 satellite. The mission would determine wind vectors from the ground to 30-40 km altitude by measuring the Doppler shift of backscattered pulses from an ultraviolet laser.

The EPS-Aeolus Programme Proposal could not be submitted to Council for approval during 2024 as planned, due to cost and timing concerns. The exact impact was still being evaluated as the year ended.

Future EUMETSAT Altimetry programme

To consolidate our involvement in ocean monitoring, altimetry became a mandatory EUMETSAT programme in 2022, with the scope subsequently defined as supporting the continuity of the Copernicus altimetry and topography missions. EUMETSAT presented a concept paper on its vision for a future altimetry programme to delegate bodies in spring 2024, after which the concept, implementation plan and cost breakdown were further refined. EUMETSAT management began working on the details of the programme in late 2024 and plans to submit a draft programme proposal in autumn 2025.

EUMETSAT also carried out a study on the benefits of altimetry for Member States, concluding that this remote sensing technique is indeed advantageous in terms of improving weather forecasting, bolstering integrated coastal zone management and aiding the development of operational hydrology applications. The full results of the study will be presented in March 2025.

Throughout 2024, ESA proceeded with the procurement activities for Copernicus Sentinel-6C and Sentinel-3 Next Generation A and B.

New business models – commercial radio occultation data

After a three-year pilot programme to buy, process and distribute commercial radio occultation (RO) data for use in weather forecast modelling, EUMETSAT signed an initial contract with Spire Global Luxembourg Sarl for these RO data in 2023.

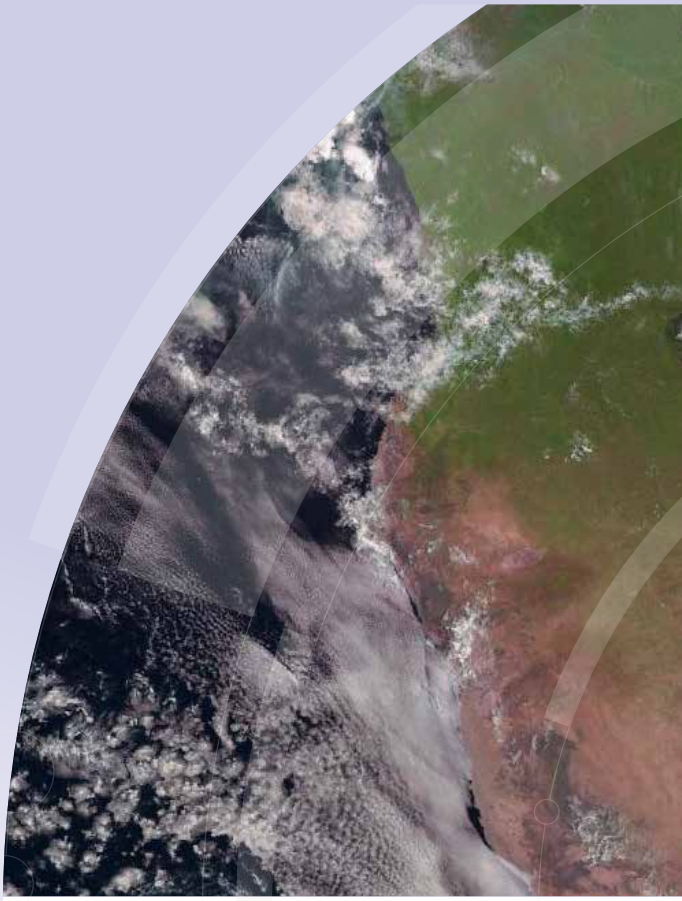
Member States reported that the additional data had been useful and beneficial, leading EUMETSAT to extend its data procurement through a new contract with Spire commencing in August 2024.

Discussions continued during the year on RO data procurement with international partners, particularly the US National Oceanic and Atmospheric Administration (NOAA), the China Meteorological Administration and the China National Space Administration. Strong cooperation allowed EUMETSAT to access commercial RO products from NOAA providers, which are included in the data distributed to Member States. US commercial providers also held discussions with EUMETSAT to understand opportunities for data procurement within the scope of EU's rules, and EUMETSAT obtained microwave sounder commercial data from the US for scientific evaluation.

With our Chinese partner agencies, talks focused on the possibility of China sharing its commercial data with the global community. Our scientific verification of the data revealed potential relevance for users, and we will continue discussions in 2025.

Igniting Africa's satellite data potential

The United Nations has set a goal for every person on Earth to be protected by early warning systems by 2027. Sarah Kimani, a meteorologist and satellite applications trainer at the Kenya Meteorological Department in Nairobi, says access to data from meteorological satellites plays a powerful role in African countries reaching this goal.



"There are a lot of Earth observation data available to Africa, including from EUMETSAT's Meteosat and Metop programmes and the Copernicus Sentinel missions," said Kimani, who chairs the World Meteorological Organization's (WMO) Regional Association I Dissemination Expert Group (RAIDEG). "However, despite the potential to enrich forecasts, specialists often don't harness these datasets as much as they could."

RAIDEG was established by WMO in 2010 in cooperation with EUMETSAT to improve data accessibility and user awareness in the African region, with a special focus on developing opportunities for specialists to acquire and strengthen the skills and knowledge to access, manipulate and interpret satellite data and products.

"One of our top priorities is to demystify the use of satellite data by strengthening forecasters' skills and knowledge through training opportunities and resources developed for the African region by the African Satellite Meteorology Training programme (ASMET)," Kimani said. "If we don't do this, Africa will be left behind."

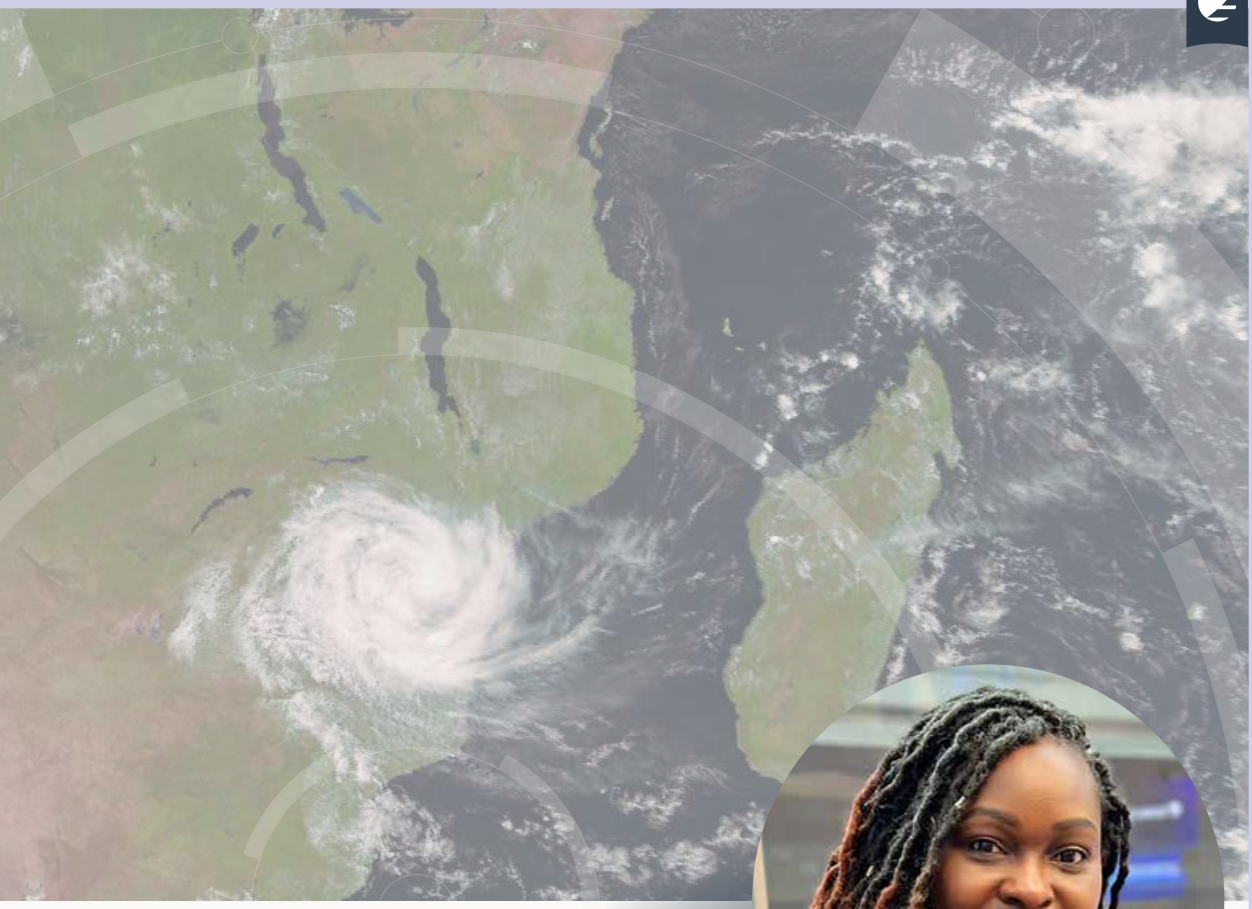
Storm prediction: here and now

A key focus is on data provided by the Meteosat Third Generation (MTG) programme, which has a constant view of Europe and Africa.

"By providing data more regularly and at higher resolution, MTG opens new opportunities for forecasters to warn of imminent hazards and to predict fast developing severe weather such as strong winds, lightning, hail, heavy rain, tropical cyclones, and thunderstorms," Kimani explained.

"This will be particularly valuable in storm-prone regions such as western Kenya, where the interaction between Lake Victoria and East Africa's highlands produce weather that is often characterised by deep convective storms, creating one of the stormiest regions on Earth.

"With these satellite observations, forecasters will be able to see cloud structure more clearly, monitor lightning flashes from space for the first time, and see in finer detail how storms evolve over time.



"MTG also provides high-resolution imagery of low-lying clouds that can support authorities in fog-prone cities limit disruption to roads and airports and help people to better plan daily activities.

"Satellite data products also have huge potential in improving monitoring and management of air pollution and in adapting to and mitigating the impacts of climate change.

"Across Africa, countries are facing many similar issues and challenges: if we talk to each other, we will be better able to solve them. Satellite data products and services can help countries to save lives, properties and infrastructure and improve their economies.

"We have to harness these opportunities."

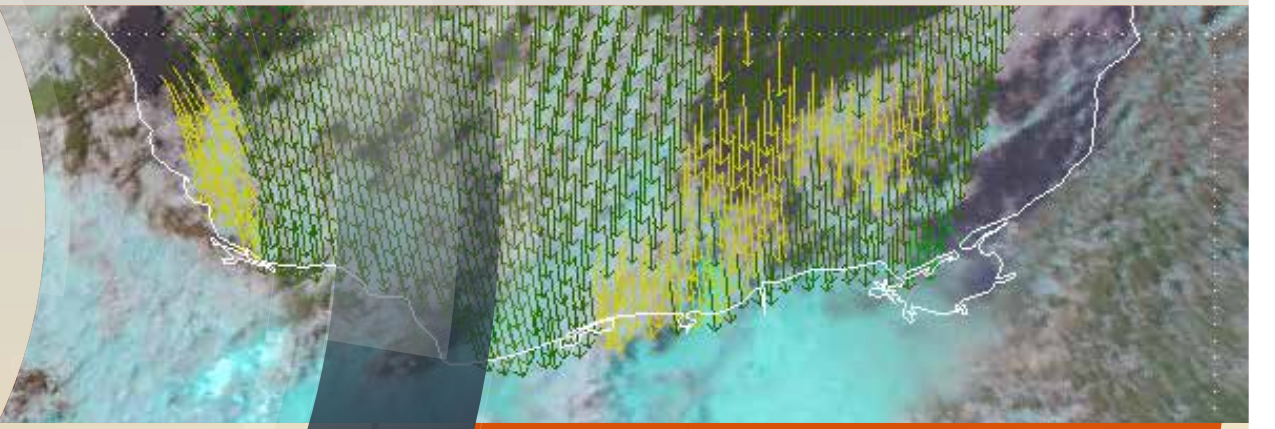
> Satellite data products also have huge potential in improving monitoring and management of air pollution and in adapting to and mitigating the impacts of climate change.

Sarah Kimani
Meteorologist and satellite applications trainer at the Kenya Meteorological Department in Nairobi

For more information, read the case study on the EUMETSAT website

https://www.eumetsat.int/features/igniting-africas-satellite-data-potential

Credit: Adobe



5

As a partner of the Space Strategy for Europe, deliver Copernicus ocean and atmospheric composition monitoring missions and contribute to collaborative research and innovation projects for the common benefit of EUMETSAT and European Union Member States

Space Strategy for Europe

EUMETSAT continues to play a key role in the implementation of the Space Strategy for Europe by strengthening cooperation with EU institutions and expanding international partnerships. Through Horizon Europe and collaborative agreements, EUMETSAT drives innovation, enhances data accessibility and supports the development of future space services, including space weather monitoring.

Collaboration and secondments

The Director-General attended the 16th European Space Conference in Brussels, Belgium, on 23-24 January 2024 and met with European Commission (EC) representatives from the Directorate-General for Communications Networks, Content and Technology (DG CONNECT), the Directorate-General for Climate Action (DG CLIMA) and the Directorate-General for Defence Industry and Space (DG DEFIS) to discuss cooperation with EUMETSAT. He also addressed the European Space Forum in Brussels on 24 June.

DG CLIMA leads the EC's initiatives to combat climate change at an EU and international level. EUMETSAT's Director-General visited the organisation in March to talk about the possibility of formalising a cooperation agreement. The principal advisor to the head of DG CLIMA then visited EUMETSAT on 26 November to discuss the content of a possible cooperation agreement.

EUMETSAT currently supports EC activities with a seconded national expert (SNE) in DG DEFIS. In 2025, this will be increased to three SNEs, with the addition of one in DG CONNECT and another in the Directorate-General for Research and Innovation.

Horizon Europe

Horizon Europe is the EU's research and innovation programme for 2021-2027. With a budget of €95.5 billion, Horizon Europe is focused on addressing climate change, supporting the achievement of the UN's Sustainable Development Goals and enhancing the EU's competitiveness and economic growth.

A Horizon Europe call for proposals on leveraging data from Meteosat Third Generation (MTG) and the EUMETSAT Polar System – Second Generation (EPS-SG) closed in February 2024. The theme of the call was to develop innovative applications based on MTG and EPS-SG products, and of the eight submissions, two were selected for funding: GreenEO and PANORAMA.

The GreenEO project seeks to provide decision-makers with advanced tools to help better manage land use, track pollution and protect biodiversity. Led by the Norwegian Institute for Air Research, the project will centre around the four key areas of cities, farmlands, forests and natural ecosystems. Specialists will integrate satellite data from EUMETSAT's next-generation programmes with digital technologies, climate models and machine learning. Applications will include high-resolution air quality maps, emissions tracking applications, forest fire services and tools to monitor the health of ecosystems.

The PANORAMA project, led by the French National Centre for Scientific Research and the University of Lille, aims to enhance atmospheric monitoring by combining multi-sensor data. The project targets the improvement of Earth observation tools to support climate action, improve warnings of natural disasters and promote sustainable development. By using data from the MTG, EPS-SG and the EU's Copernicus Sentinel missions, PANORAMA's scope is to drive the development of advanced applications, including better models for tracking atmospheric composition, enhanced tools to estimate greenhouse gas emissions and improved weather forecasting.

Networking and outreach activities

EUMETSAT promotes engagement among the European meteorological community by organising an array of events, workshops and training opportunities.

Phil Evans, EUMETSAT Director-General, speaking at a panel discussion on satellites and Earth observation at the 16th European Space Conference in Brussels, Belgium

Space weather

EUMETSAT continued to implement its roadmap on space weather throughout the year, working with international partners to make space weather data operationally available through our tools and platforms. Discussions with the European Space Agency (ESA) took place on the possible role of EUMETSAT as a contributor to the future European operational space weather service, and the first space weather data processing facilities are planned to be implemented as part of the EUMETSAT ground segment.

In September, the five-day EUMETSAT Meteorological Satellite Conference brought together around 550 European and global weather and climate experts to discuss the latest in the application of satellite data. The theme for the 2024 edition of this major annual event, co-hosted by the German Meteorological Service, Deutscher Wetterdienst, was the "Earth observation value chains for weather, climate and the hydrosphere". Topics covered included MTG products in nowcasting applications, upcoming missions, innovations from artificial intelligence, machine learning and cloud-based platforms, assessing climate variability, and data for natural disaster prediction and monitoring.

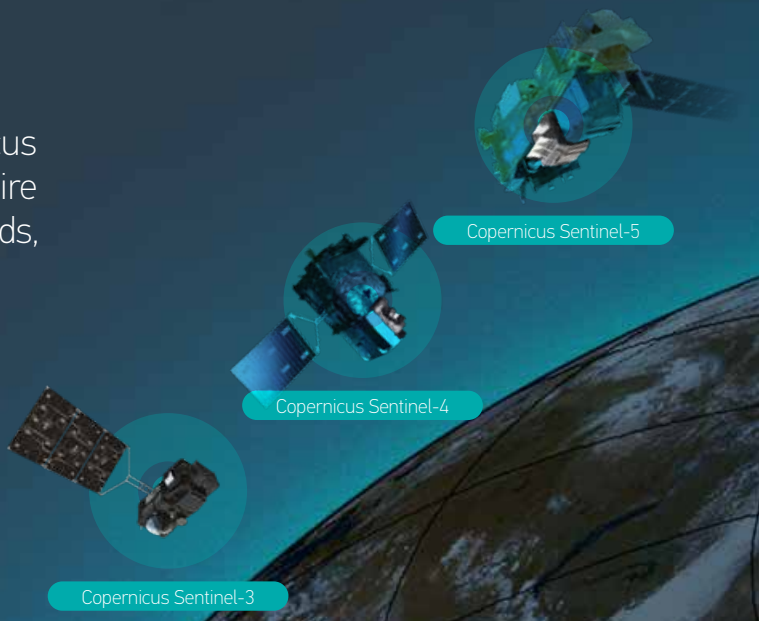
Multiple Copernicus training and user support activities were carried out during 2024, with 117 marine users and around 60 atmospheric data users attending at least one Copernicus-specific training event in the first three months of the year.

Four Ocean Decade webinars were scheduled over 2024-2025. The first webinar was held on 19 June 2024, with 350 registrations, followed by more than 30,000 views on YouTube. The second webinar took place on 10 October and had 380 registrations and more than 60,000 views.

The Marine User Days took place in Lisbon, Portugal, on 5-6 November, while the Future Focus Wildfires User Workshop was held three weeks later in Darmstadt, Germany (see p 74). Other Copernicus outreach events included an advanced training course aiming to support validation and biogeochemical applications of Copernicus Sentinel-3 products for making measurements of in situ ocean colour in May and a WEkEO Hackathon in December.

Copernicus

EUMETSAT is an essential contributor to the EU's Copernicus programme, operating both entire satellites and, from 2025 onwards, instrument missions, delivering data products for the benefit of European Earth observation.



2024 Overview

The UK re-joined the Copernicus component of the EU Space Programme on 1 January 2024, and EUMETSAT procurements executed on behalf of the EC are now also open to UK entities. Thanks to UK contributions to the programme, all high priority candidate missions were able to move forward, and funds became available for the development of the third Copernicus Anthropogenic Carbon Dioxide Monitoring mission (CO2M) unit.

The final report from the 2023 Copernicus User Satisfaction survey, indicating a 92% overall satisfaction rate with EUMETSAT's Copernicus services, was provided to the EC on 24 May.

EUMETSAT supported all Copernicus governance meetings, in particular the Copernicus User Forum meetings and the quarterly EU Space Programme Committee meetings in its Copernicus Configuration. Along with our WEkEO partners, we delivered a presentation on the platform during a Copernicus governance meeting. WEkEO is the EU Copernicus Data and Information Access Service for environmental data, virtual processing environments and skilled user support. WEkEO continued to expand its subscriptions during the year and introduced a number of improvements (see p 44).

Copernicus Sentinel-3

The fifth Copernicus Sentinel-3 Mission Constellation Review (MCR) took place on 26 March 2024 and concluded that both Sentinel-3 satellites were in excellent health and that the mission continues to fulfil the applicable mission requirements. Following successful completion of its operational activation on 28 November, the Sentinel-3 re-engineered ground segment performed very well. Preparations for the launch and commissioning of Sentinel-3C, expected in the third quarter of 2026, continued through the year as planned.

Copernicus Sentinel-4 and Sentinel-5

During 2024, EUMETSAT and the European Space Agency (ESA) jointly invited researchers to propose funded activities aimed at the calibration and validation of Copernicus Sentinel-4 and Sentinel-5. The purpose of the announcement was to facilitate the formation of a joint Sentinel-4 and Sentinel-5 validation team to trigger and coordinate calibration and validation activities. Twenty-three proposals were received and were being assessed as the year came to an end.

Copernicus Sentinel-6

The System Baseline Review for Copernicus Sentinel-6 was completed in March, as well as a design review milestone for the ground segment infrastructure upgrade project, thereby validating the necessary design updates and related implementation plan. A procurement action for Sentinel-6C, the third satellite in the mission, was started during the year by ESA and is expected to conclude in 2025.

Jason-3

The Review of Exploitation meeting, held from 23-25 April 2024, confirmed that the satellite was in good health and no technical barriers were identified that would prevent potentially extending Jason-3 mission operations until the end of 2027. Formal confirmation of the extension is expected in 2025. Obsolescence issues at the Usingen terminals continued to occur, but overall availability nevertheless remained high, due to the two antennas acting as mutual back-ups.

Copernicus CO2M

The Copernicus CO2M System and Operational Ground Segment critical design activities proceeded at the expected pace during 2024, with regular interactions and coordination with ESA. EUMETSAT and ESA co-convened the CO2M Mission Advisory Group throughout the year, with EUMETSAT focusing on ground segment developments and calibration and validation approaches for the CO2M data products. Early access and processing of data from Microcarb, the precursor to CO2M planned for launch by mid-2025, will be essential to these efforts.

CIMR and CRISTAL

ESA and EUMETSAT signed the implementation arrangements for the Copernicus Imaging Microwave Radiometer (CIMR) and the Copernicus Polar Ice and Snow Topography Altimeter (CRISTAL) in 2024. The coordination framework for CIMR was finalised, and a EUMETSAT in-house assessment that defined the operational ground segment driving requirements, development approach and schedule consolidation was ongoing for both missions at the end of December and is set to conclude in early 2025.

European State of the Climate 2023

The 2023 European State of the Climate (ESOTC) report detailed major regional events that defined a year of contrasts in Europe. These included record-breaking temperatures, widespread heat stress, extensive flooding, rapidly shrinking glaciers, extraordinary marine heatwaves, and the largest wildfire ever recorded in the European Union.

The ESOTC report also outlined ways that extreme temperatures, severe weather events, and precipitation patterns have impacted societies, the environment, and human health.

The annual assessment, which was first published in 2017, strongly relies on satellite observations made by EUMETSAT satellites, satellite data products produced and distributed by EUMETSAT's Satellite Application Facility (SAF) network, and satellite data reanalyses.

2023 was the hottest year on record globally. In Europe, the average temperature in 2023 was 2.5°C above pre-industrial levels, by some measures equalling the previous record set in 2020. The three warmest years on record for Europe have all occurred since 2020, and the ten warmest since 2007.

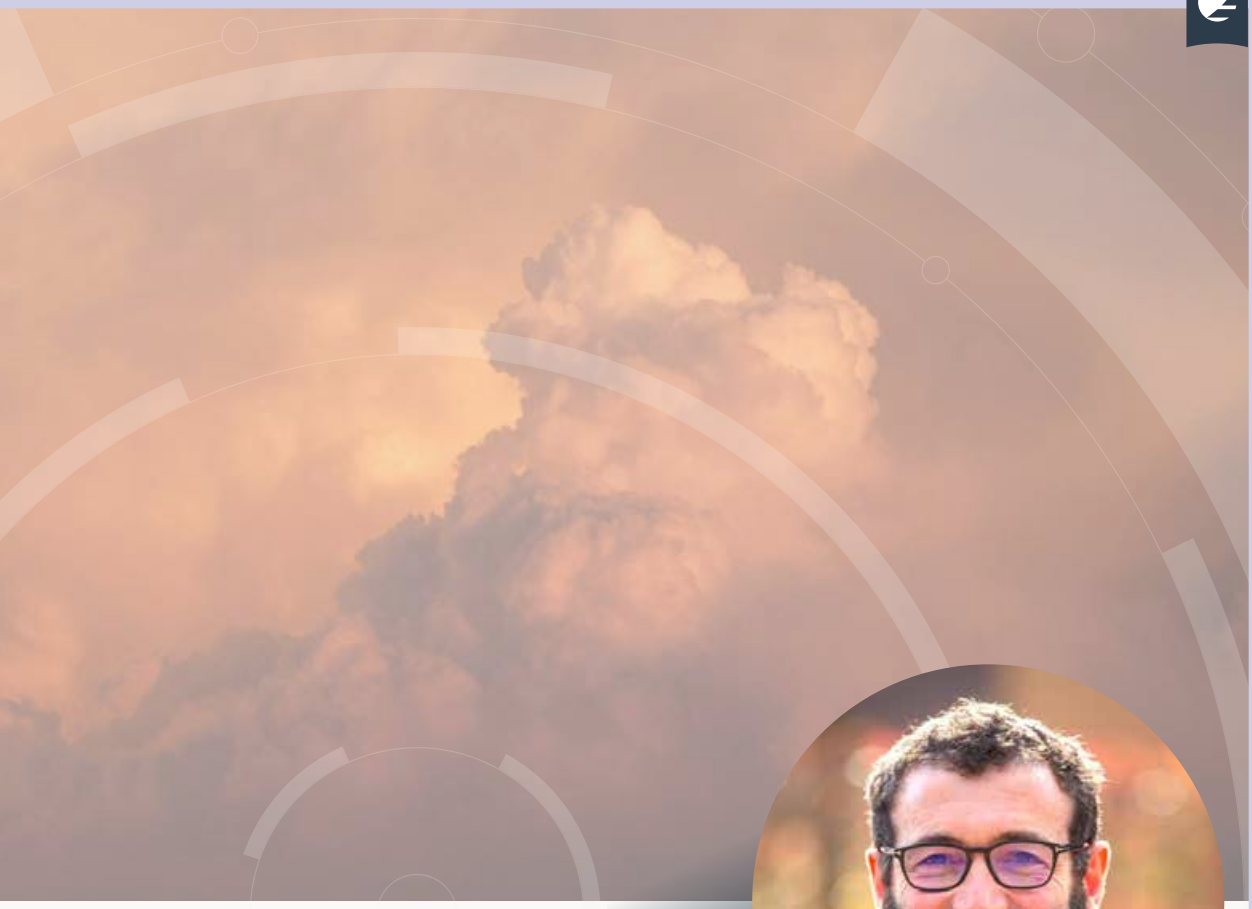
While average river flows across much of the European river network were below average for much of the year, 2023 also saw several severe flood events, with a large number of rivers swelling to record or near-record levels late in the year.

Another phenomenon that took specialists by surprise was record-breaking average sea surface temperatures. Records were broken each month globally from April through to December. And in Europe, across 2023 as a whole, the average sea surface temperature of marine waters was the warmest on record.

"In 2023, across Europe, floods affected around 1.6m people, storms a further 550,000 and wildfires 36,000," said Dr Rebecca Emerton, a scientist working with the European Centre for Medium-Range Weather Forecasts (ECMWF) and the Copernicus Climate Change Service.

"In total, preliminary estimates from the International Disaster Database indicate that economic losses from weather and climate-related events totalled at least 13.4bn Euro, 80% of which was attributed to flooding. At least 63 lives were lost due to storms, 44 to floods, and 44 to wildfires."

Warning that severe weather events will become increasingly likely in future, the report's authors also underscored the need to better understand, for example through better observing and modelling, the Earth's climate system.



"These extreme events have not only strained natural ecosystems, but they also pose severe challenges to agriculture, water resource management, and public health," said Dr Carlo Buontempo, Director of Copernicus Climate Change Service at ECMWF.

"As a society we now have a set of useful tools which can guide our present reaction to emergencies, as well as inform our long-term strategy for climate. Climate data, information and insights have never been as important as they are now."

As a society we now have a set of useful tools which can guide our present reaction to emergencies, as well as inform our long-term strategy for climate

Dr Carlo Buontempo
Director of Copernicus Climate Change Service at ECMWF

For more information, read the case study on the EUMETSAT website

https://www.eumetsat.int/european-state-climate-2023

6

Cooperate with other satellite operators and contribute to global partnerships for monitoring weather, climate and greenhouse gases from space to meet additional needs of Member States

Addressing the global challenges of precise weather forecasting, along with the early detection of severe weather and understanding climate change, are all issues that require international collaboration. EUMETSAT, operating within the framework of the World Meteorological Organization (WMO), engages in global, multilateral and bilateral cooperation agreements focused on sharing resources, exchanging data and advancing scientific knowledge.

CMA	China Meteorological Administration
NSOAS	National Satellite Ocean Application Service (China)
CNES	Centre national d'études spatiales (France)
CNSA	China National Space Administration
ECCC	Environment and Climate Change Canada
EOSDC	Earth Observation and Data Center (China)
ISRO	Indian Space Research Organisation
JMA	Japan Meteorological Agency
KMA	Korea Meteorological Administration
NASA	National Aeronautics and Space Administration (USA)
NESDIS	National Environmental Satellite, Data, and Information Service (NOAA)
NOAA	National Oceanic and Atmospheric Administration (USA)

World Meteorological Organization

EUMETSAT participated in the Consultative Meeting on High-Level Policy on Satellite Matters on 6-7 February. It was the first held in several years, with many members of the Coordination Group for Meteorological Satellites (CGMS) in attendance.

The WMO Core Satellite Data Workshop on 5-7 December identified the core observations for numerical weather prediction (NWP). These are expected to become part of the updated 'Manual on the WMO Integrated Global Observing System', as recommended by the Commission for Observation, Infrastructure and Information Systems (INFCOM).

The WMO INFCOM management meeting in early October approved the updated commission structure, noting that work is still ongoing to consolidate eight commissions into two. The group also commended EUMETSAT's activities associated with VLab, the WIS 2.0 implementation, PUMA and AMSAF (see p 75).

CEOS and GEO

EUMETSAT manages the contract of the Committee on Earth Observation Satellites (CEOS) Executive Officer, a function that is highly appreciated by the CEOS community.

The CEOS plenary took place on 22-24 October in Montreal, Canada. The focus remained very much on climate, particularly the WMO Global Greenhouse Gas Watch, and on biodiversity, with the event culminating in a Montreal Statement on international coordination, data provision and supporting the United Nation's Sustainable Development Goals.

The Group on Earth Observation (GEO) continued to work on the implementation plan for the new GEO post-2025 Strategy 'Earth Intelligence for All'. EUMETSAT will present its potential contribution to the plan during the Delegate Body meeting in 2025.

The newly established EuroGEO Secretariat is keen to engage with agencies such as EUMETSAT. It organised the EuroGEO Workshop in October in Krakow, Poland, and presented the establishment of nine action groups to structure EuroGEO activities in Europe.

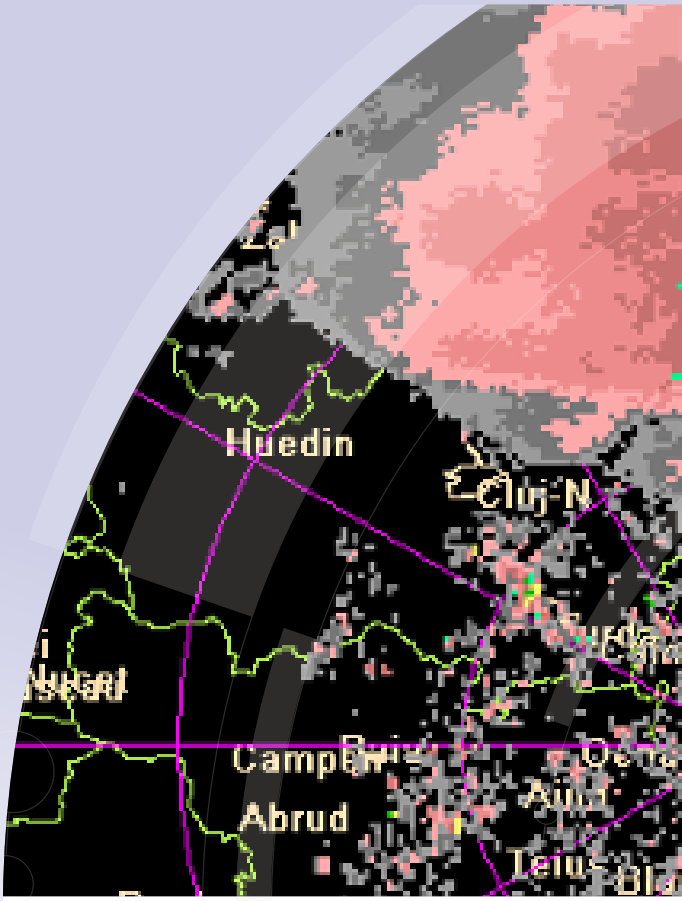
▲ *38th CEOS Plenary Group Photo*

International relationships

International relations were further cemented in 2024 through the signing of a five-year extension to the long-standing cooperation agreement between EUMETSAT and the China Meteorological Administration (CMA). The agreement, which first came into effect in 1998, relates to data application, exchange and redistribution. The benefits include access by EUMETSAT data users to observations from the CMA's geostationary and polar-orbiting satellites. Agreements to renew ties with the US National Oceanic and Atmospheric Administration and the National Research Council Canada were also signed. In the context of international partnerships, EUMETSAT is working with and learning from the experience of the US and China. In this way, EUMETSAT can plan for its future systems in terms of a possible globally coordinated Earth observation architecture which would maximise the benefits from our satellite observations – together with private sector relationships and the integration of scientific advancements.

Tracing echoes in a storm

On 13 July 2023, Raul Cioc, a newly qualified weather forecaster, was preparing for a shift in the forecast room at the Sibiu Meteorological Centre in Romania. Convective activity was predicted in the region and Cioc felt a sense of exhilaration at the thought of applying his skills to tracking the evolution of thunderstorms.



"What I hadn't been expecting was one of the most long-lived supercell thunderstorms of the year in Europe," recalled Cioc, who is a specialist in nowcasting – short-term weather forecasts that depend on the near-real-time data provided by spacecraft such as those in EUMETSAT's Meteosat and Metop programmes.

When the storm reached Romania, it evolved into a weather system known as a "bow echo", where thunderstorm bands are driven by linear wind patterns, with the storm clouds resembling an archer's bow, or a comma, in satellite and radar images.

"These rare formations occur under very specific conditions – including high atmospheric instability and dry air in the mid-atmosphere," Cioc said. "During the evening and night, a cold atmospheric front crossed south-eastern Europe, causing severe convective storms. These storms produced large hail, strong winds, and numerous lightning strikes

"At times it got scary, with wind-driven thunderstorms injuring people and causing significant damage to houses, cars and crops."

However, the situation could have been worse had it not been for orange and red weather warnings issued by the Sibiu Meteorological Centre in coordination with Romania's National Meteorological Administration.

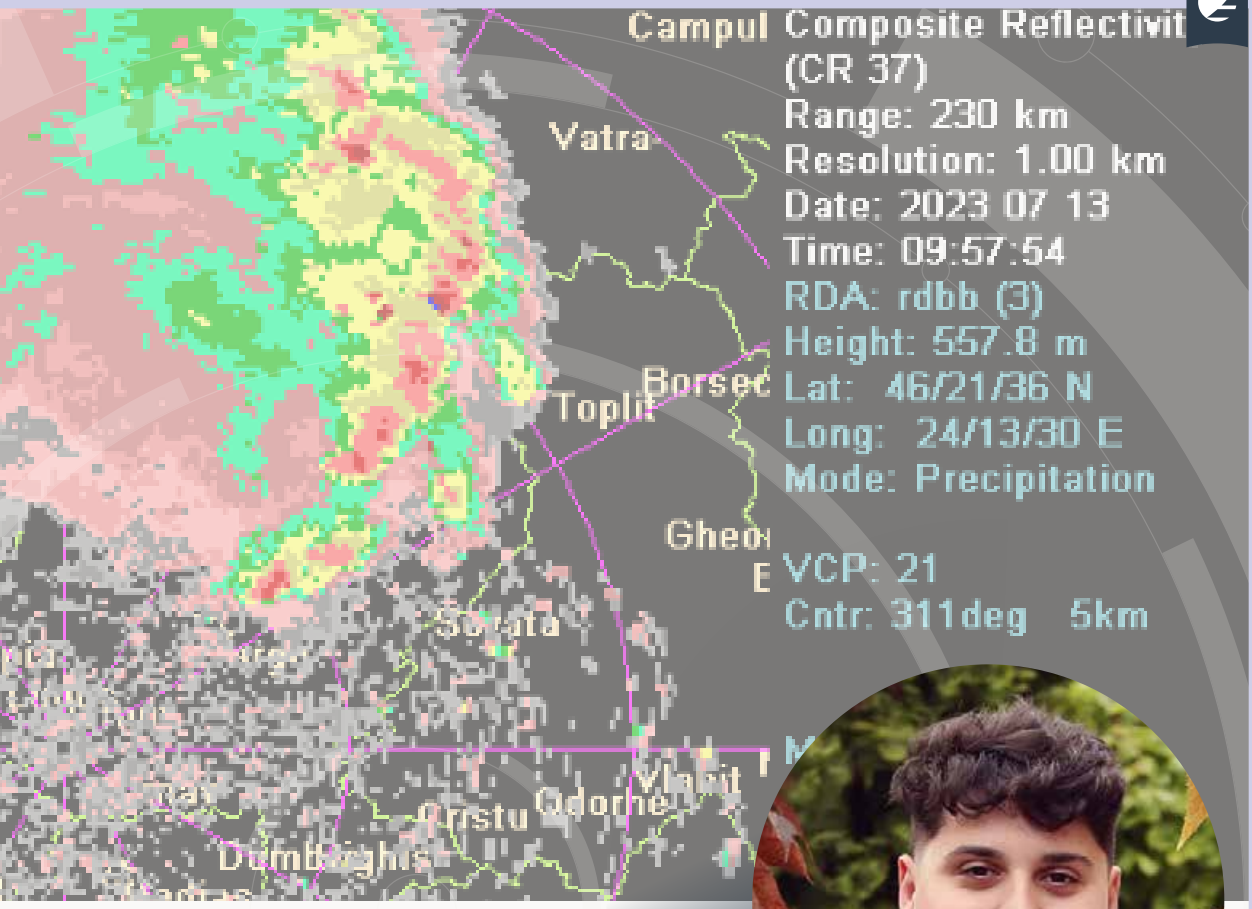
"We identified these dangerous conditions using weather observations from the current moment, including from radar data and near-real-time satellite data," says Cioc. "Nowcasting enables us to predict what the weather will look like in the next minutes and hours and narrow down the uncertainties in weather models."

Judging correctly

Forecasters then use their know-how and experience to interpret what is happening and issue advisories where necessary.

"Here, near-real-time satellite data detailing temperature, precipitation, humidity and cloud coverage at different altitudes play a crucial role in helping meteorologists predict how things might develop," Cioc said.

In June 2024, Cioc visited EUMETSAT's headquarters to take part in a workshop run by specialists from the European Severe Storms Laboratory, which explored the potential of data from next-generation satellite missions to support nowcasting.



"Forecasters from across Europe were tasked with nowcasting severe weather events using data from EUMETSAT's new Meteosat Third Generation programme," he said.

"I was particularly impressed by the new space-based lighting observations provided by the Lighting Imager, which enable meteorologists to detail the extent, form and flash rates of lighting in thunderstorms.

"I became a meteorologist because I was fascinated by the hidden atmospheric conditions that drive the evolution of thunderstorms. Using satellite data, you can see the mesmerising development of overshooting tops and observe their evolution in four dimensions.

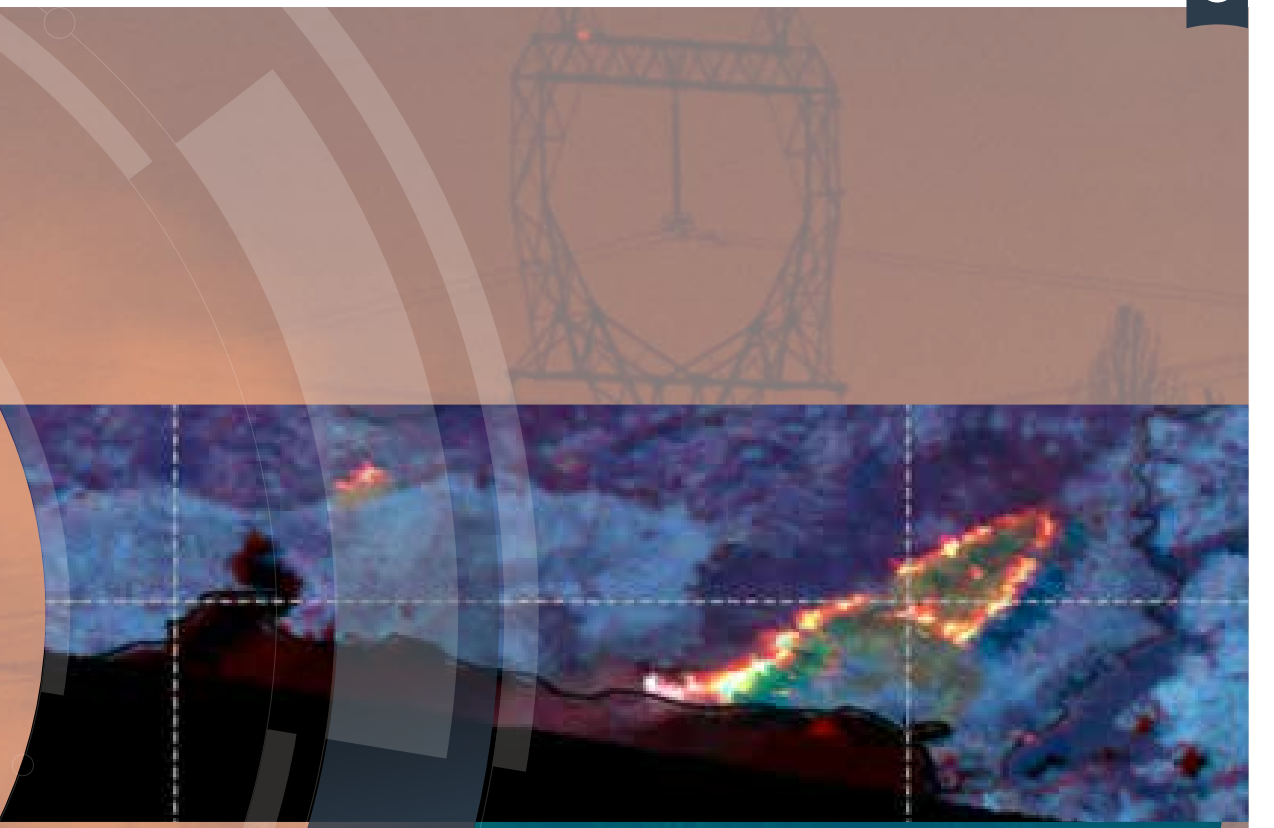
"With the incredible new data from EUMETSAT's next generation missions we will be able to see much more still – it's game changing."

With the incredible new data from EUMETSAT's next generation missions we will be able to see much more still – it's game changing.

Raul Cioc
Weather forecaster at the Sibiu Meteorological Centre

For more information, read the case study on the EUMETSAT website

https://www.eumetsat.int/features/tracing-echoes-storm



7 *Expand the user base for EUMETSAT-provided data, products and services*

EUMETSAT is committed to expanding the use and application of its data, products and services, along with preparing users for the increased wealth of data that will be made available from its next-generation satellite systems.

Launching the EUMETSAT User Portal

Released in January 2024, the EUMETSAT User Portal (https://user.eumetsat.int) is the latest addition to our portfolio of online services, providing a one-stop shop for users of our data. The portal consolidates all user-facing information and support services from several legacy systems into one online platform where users can discover, access and learn how to exploit our data. Upgrades planned for 2025 will further improve its capabilities and the user experience.

Training

EUMETSAT, in collaboration with partners, delivered training to more than 2,300 participants at more than 45 events in 2024. The majority of these focused on the use of Meteosat Third Generation (MTG) data, such as a testbed on the application of MTG data for aviation, and a series of regional courses. Early career scientists attended EUMETSAT's summer and autumn schools, as well as a joint Atmospheric School – organised with the Copernicus Atmosphere Monitoring Service and the European Space Agency – and a marine science training course under the Copernicus programme, the Earth observation component of the European Union's (EU) space programme.

Preparation for next-generation systems

To help Member States maximise the value to be derived from the MTG constellation as it is being deployed, EUMETSAT hosted a train-the-trainers workshop on MTG Lightning Imager (LI) data in February 2024. The gathering brought together LI product and instrument experts, trainers from the European Severe Storms Laboratory (ESSL), EUMETSAT and EUMeTrain, and representatives from the Support to Nowcasting and Very Short Range Forecasting Satellite Application Facility (NWC SAF). Participants analysed early samples of LI group and flash products from summer 2023, exploring their benefit for severe thunderstorm forecasting.

In May, ESSL led a workshop for community experts, exploring the use of the MTG Flexible Combined Imager (FCI) for tracking low-level moisture variability.

To foster the shared development of nowcasting tools using MTG data, we organised a dedicated workshop in January 2024 at EUMETSAT headquarters, with participants from 19 Member State national meteorological and hydrological services (NMHS), the NWC SAF and the World Meteorological Organization (WMO). As a result of the workshop, supported by the EUMETSAT training placement scheme, at least one NMHS that was previously without nowcasting capabilities began developing a tool using open-source code.

A visit to the Italian Aeronautica Militare National Centre for Aerospace Meteorology and Climatology and the Department of Civil Protection included an MTG-focused workshop for 44 national institutions, with more than 140 individuals participating. As in all Member States, there are high expectations for MTG to improve severe weather forecasts and warnings across Italy, and the country already has significant overall uptake capacity and operational readiness in place. Further Member State visits specifically focussed on MTG preparation are planned in 2025.

Short courses on MTG LI and FCI were offered to accompany the trial – and later full release – of pre-operational LI level 2 and FCI level 1c data to the user community, each with around 150-200 online participants. The first simulated MTG Infrared Sounder (IRS) level 2 dataset, published on 27 September 2024 as TD-449, contained six hours of geophysical products describing the atmospheric profile (temperature and humidity) and other parameters that are expected to become available from the IRS.

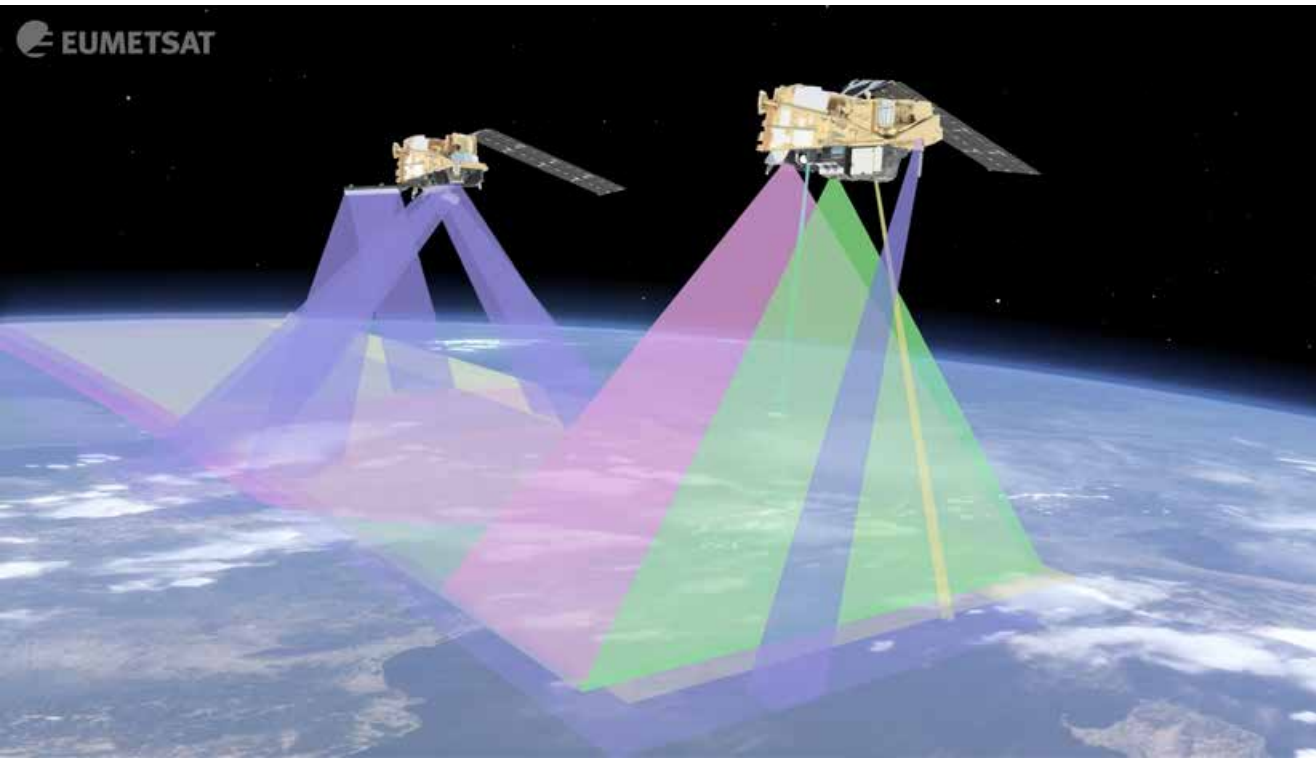
September also saw representatives from the European Centre for Medium-Range Weather Forecasts (ECMWF) and 18 Member States report on technical readiness for accessing and using next-generation satellite data, together with the early uptake of FCI and LI data and training during the Core Numerical Weather Prediction and MTG-UP user group meetings. The groups

expressed considerable appreciation for the much-improved resolution of FCI data and the new RGBs, along with LI products being investigated as an additional information source for thunderstorm forecasting.

Once Meteosat-12 data started to flow operationally, many services commenced internal training for forecasters, supported by EUMETSAT's ongoing learning activities and resources. According to WMO readiness criteria, by the end of 2024 around 80% of Member State NMHSs were fully ready to exploit data from Meteosat-12.

We produced and published video animations on YouTube for the METimage, Infrared Atmospheric Sounding Interferometer – New Generation, Multi-Viewing, Multi-Channel, Multi-Polarisation Imager and Microwave Sounder observation missions on the Metop Second Generation (Metop-SG) satellites, illustrating the principles of the observation technique, the generation of level 1 data and examples of geophysical products. Simulated test datasets were also released that facilitated accelerated user preparation for these instruments, as well as for the Microwave Imager and Scatterometer. With these datasets, users can test ingest into operational processing chains and familiarise themselves with the scientific content of the data, thereby saving time once real data is available.

▾ *A series of video animations illustrating the principles of the observation technique of Metop-SG satellites was published on the EUMETSAT YouTube channel*



User engagement and preparation

In addition to its support and training activities, EUMETSAT undertakes wider user engagement to enable preparation for new mission data and encourage more communities to interact with our data and services.

In November 2024, the EUMETSAT Marine User Days brought together nearly 100 participants from across the diverse marine community. Supported by the European Commission, EUMETSAT, along with other organisations involved in the Copernicus programme (ESA, the ECMWF and Mercator Ocean International) shared their data portfolios and activities and their relevance for oceanography and marine applications. Emphasis was placed on data from across the value chain, including satellite data, derived products, climate data records and their applications. Copernicus-contributing mission data from EUMETSAT's meteorological missions and data from the Ocean and Sea Ice Satellite Application Facility (OSI SAF) broadened the scope, with use cases covering topics from fisheries and aquaculture, climate reporting and policy compliance, through to green shipping, biodiversity assessments and citizen science. The event attracted policymakers, academics, researchers and commercial entity representatives and involved a number of workshops and discussion sessions.

November also saw the Future Focus user workshop on wildfires, held in Darmstadt, Germany. With similar attendance to the Marine User Days, the event showcased recent advances in monitoring fires from space. The primary goal was to strengthen engagement with a broad community of users and service providers, and participants examined how satellite observations feed into the complete wildfire monitoring cycle from early warning to fire management, together with the assessment of fire impacts on ecosystems, air quality and climate.

Marine User Days group photo, Lisbon, Portugal

Supporting Africa

An initiative to provide African meteorologists with state-of-the-art technology to effectively access and apply MTG data reached a significant milestone in August 2024, with the installation of the first in a series of PUMA-2025 receiving stations in Nairobi, Kenya. PUMA stations were established to receive Meteosat Second Generation data within the framework of the Preparation for Use of Meteosat in Africa (PUMA) project. PUMA-2025 stations are specifically designed to receive data from the next-generation of Meteosat geostationary satellites – MTG – and EUMETSAT is supporting the African Union Commission (AUC) in creating a continent-wide network of similar stations within each sub-Saharan national weather and climate service. The installation of the stations, together with training to maximise benefits for meteorologists and enable local maintenance, will deliver higher resolution images of Africa every 10 minutes.

The AUC is deploying the new PUMA-2025 stations as part of the EU-funded Intra-ACP Climate Services and related Applications Programme, an initiative that bolsters the climate information services value chain with not only technical and financial assistance but also infrastructure and capacity building. Installation should be completed by September 2025.

In December 2024, the EUMETSAT Council approved an agreement with the European Commission's Directorate-General for International Partnerships regarding an initiative to enhance the strategic Africa-EU partnership in the field of space.

▲ *Participants of the workshop on the role of Earth observation data for hydrology in Africa taking a tour of the EUMETSAT technical infrastructure building, 21 March 2024*

The 16th EUMETSAT User Forum in Africa took place in September in Cotonou, Benin, following a series of preparatory webinars and workshops. The forum focused on the transition to MTG and the support to Early Warning in Africa and gathered 150 participants from 47 African countries and 15 regional or continental institutions. The discussions also provided an opportunity to make progress on the use of Earth observation for hydrology and greenhouse gas and air quality monitoring – two priorities set out by the African Union Commission.

African stakeholders signed a political statement on the eve of the forum. The Cotonou Declaration calls for the strengthening of African access and use of satellite data to facilitate strategies related to air quality and greenhouse gas monitoring, such as supporting the Paris Agreement Global Stocktake.

The WMO Regional Association I Dissemination Expert Group met in September 2024, just before the User Forum, to check the status of the deployment of the PUMA-2025 stations and initial feedback, as well as to consider various aspects of the African Meteorological Satellite Application Facility and the use of satellite data for the Early Warning for All initiative in Africa.

In the know

Celebrating 20 years of satellite meteorology training

EUMeTrain has become EUMETSAT's largest international training project. Two decades since the project's start, EUMeTrain has been confirmed to continue on for at least another five years, thanks to a freshly renewed agreement between EUMETSAT and GeoSphere Austria, Austria's meteorological service, who leads the project.

Composed of the national meteorological services of Austria, Croatia, Finland, Germany, Portugal, and Hungary, EUMeTrain reaches users worldwide through interactive training sessions, weather briefings, weather forecasting simulators, online training modules, case studies, short guides illuminating different weather features, and more.

"When we run courses, trainers and participants from all over the world attend – not just from Europe but from Africa, Asia, and the Americas, too," said Andreas Wirth, EUMeTrain project manager.

With the first Meteosat Third Generation (MTG) satellite, Meteosat-12, recently having become fully operational, the dedicated members of EUMeTrain have been preparing a wide range of helpful resources to ease forecasters into using the new data.

"EUMeTrain is developing a variety of materials and courses focused on using MTG data," said Dr Natasa Strelec Mahovic, EUMETSAT's Lead Weather Applications Expert who represents EUMETSAT in the EUMeTrain consortium and steering groups.

"When meteorologists forecast the weather, satellite imagery is an important source of data – but it's not the only one.

"EUMeTrain resources focus on showing forecasters how MTG data can be seamlessly included in place of or in addition to data from the previous generation of satellites, Meteosat Second Generation, which is really valuable." Designed with forecasters in mind, two-page Quick Guides have a special place in forecasting rooms across the globe.

"Forecasters actually print out these guides, put them in plastic covers, and keep them on their desk to use as a kind of cheat sheet," she said. And the resources for using MTG data are still continuing to grow.

"From guides on MTG-specific satellite images to training opportunities such as two MTG event weeks planned for 2025 and a meteorology course

focusing on MTG that will be held in 2026, there are a lot of opportunities for forecasters to learn how to best use MTG data," said Strelec Mahovic.

Over the course of its development in the past 20 years, one thing about EUMeTrain has remained constant: the dedication to supporting meteorologists.

"Sometimes, years after I've been one of the trainers at a EUMeTrain session, someone will come up to me and give me positive feedback on a course they attended," said Wirth.

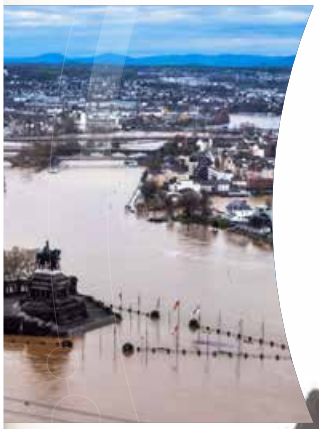
"It makes me happy to have connected with so many people and that these courses are so memorable to them."

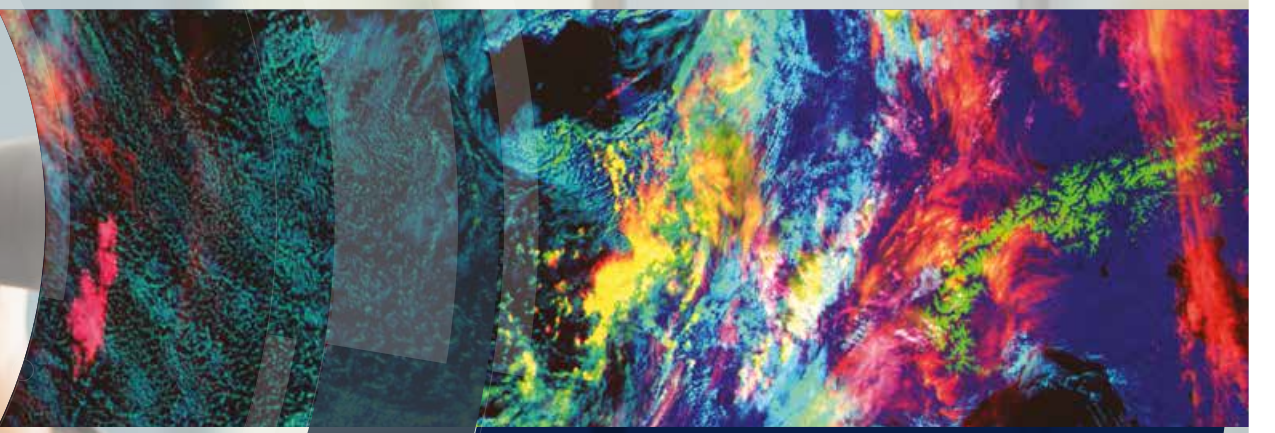
> From guides to training events, there are a lot of opportunities for forecasters to learn how to best use MTG data

Dr Natasa Strelec Mahovic
EUMETSAT's Lead Weather Applications Expert

For more information, read the case study on the EUMETSAT website

https://www.eumetsat.int/features/know





8 *Continuously improve management and risk management processes*

In 2024, we strengthened our management and risk processes, successfully maintaining ISO 9001 certification while streamlining and digitalising our financial, procurement and HR processes to enhance effectiveness across the organisation. Sustainability remained a priority, and we installed new photovoltaic systems and planned future energy-saving initiatives. Key appointments and mandate extensions reinforced our leadership stability, positioning EUMETSAT for continued success in the years ahead.

Quality Management

EUMETSAT's business processes are carried out in conformance with ISO 9001, a globally recognised standard for quality management. In November 2024, we underwent an ISO 9001 surveillance audit by the British Standards Institution and passed with only three minor observations. This followed the ISO 9001 recertification achieved one year earlier.

The auditors noted a number of significant strengths:

- The EUMETSAT Management System (EMS) was stable and well documented.
- All organisational areas were effectively monitored through key performance indicators tracked for all processes.
- Risk management was effective at all levels.
- The strategy was deployed through a complete set of organisational objectives.

In November, the Management Board endorsed a quality management roadmap, which covers the 2025-2028 timeframe and includes seven projects and initiatives to re-evaluate and improve quality management at EUMETSAT as an evolving organisation. An assessment of the EMS will compare its expected outcomes with its actual contributions to the organisation and its users.

Five internal quality audits were executed in 2024, identifying several good practices and opportunities for improvement, with two minor non-conformances and four organisational issues. By year end, actions to address the findings had been identified or were being identified.

Improvement of administrative processes

Following the removal of the financial control function in 2023, we updated the financial and procurement workflows to ensure lean and efficient approval loops with clear accountability for checks and balances.

The EUMETSAT Management Board endorsed a proposal to move away from the current set-up of an invoice workflow to a three-way match workflow (Purchase Order – Goods/Service Receipt – Invoice) that will probably lead to changes to our financial rules. This change is envisaged in 2025-2026 after the conversion of the EUMETSAT SAP ERP system to S/4HANA.

Work progressed on digitalising and automating core HR administrative processes, such as requesting part-time work schedules and parental leave. A talent management system was procured which will further contribute to EUMETSAT's efforts to digitalise human resource processes, such as the annual performance appraisal process, learning and development, and onboarding. Implementation of the new system is expected to commence in 2025.

Reducing EUMETSAT's carbon footprint

Photovoltaic systems were installed on the roof of the East Building as part of its extension project. The systems were being commissioned as the year came to a close.

Further investments in the sustainability of EUMETSAT buildings, leading to energy savings and a reduction in EUMETSAT's corporate carbon footprint, are included in the approved new ceiling of the General Budget 2026-2030. The sustainability measures will be implemented during that period, alongside prioritised activities required to improve occupational health and safety at EUMETSAT Headquarters.

Management Board

The winter Council made a series of leadership decisions that ensure the stability and continuity of our organisation as we move into the busy time ahead, including the renewal of Phil Evans' mandate as EUMETSAT Director-General until 31 December 2029.

Sean Burns' mandate as Director of Operations and Services to Users was extended until 31 July 2028, enabling him to further contribute to the success of our operations.

Graziano Mori was appointed as Director of the Technical and Scientific Support department (TSS) until 28 February 2027, having served as Acting Director of the TSS since September.

Eleni Katsampani was appointed Director of Administration in July 2024, taking over from Silvia Castañer, who retired after 35 years at EUMETSAT. In her new role, Eleni oversees the administration of the financial and human resources needed by EUMETSAT and provides the organisation with both a regulatory framework and an administrative infrastructure.

Seizing the moment

In January 2024, Storm Isha battered Ireland and the UK with wind gusts of almost 150km an hour, driven by a strong jet stream and sharp temperature contrasts over North America.

To anticipate Isha's development over the Atlantic in the days leading up to the storm, forecasters at Met Éireann in Dublin, Ireland, turned to numerical weather prediction models, which are underpinned by satellite data from EUMETSAT's Metop and Meteosat programmes.

However, as Isha approached Ireland's coast, the hard work was just beginning for specialists in the forecast centre who tracked the storm's every move in near real-time.

"By comparing near-real-time satellite and radar images to the model predictions, we could make any necessary adjustments to the forecast," said Linda Hughes, a forecaster at Met Éireann who was on shift as Isha swept over the country.

"Numerical weather prediction models have vastly improved the accuracy of weather forecasts over the past decade. However, because of the multitude of factors involved in these predictions, they also have some limitations.

"That's where short-term forecasting approaches, called nowcasting, come in. Satellite and radar data played a critical role in helping our forecast team assess the situation, identify the position of the storm as it developed, and track it across its lifetime."

Nowcasting also enables teams to have confidence in their decisions.

"Forecasters need to decide under pressure which warnings to issue and when – and then provide briefings on how we think the weather is going to impact people," Hughes said. "Satellite data play a crucial role in supporting these decisions. On days when thunderstorms are predicted, we are eagerly watching the satellite images come in."

Getting the basics right

Hughes is a general forecaster, having previously worked as a specialist in aviation safety, marine forecasts, and shipping routes – all of which she says will benefit from new and enhanced data products that will come from EUMETSAT's next-generation satellite missions.

"Meteosat Third Generation provides the first space-based lightning imaging over Europe, which will be invaluable for pinpointing the early signs of severe thunderstorms and tracking a storm's movement and intensity," she said.

Credit: Beta Bajgart

"In Ireland, we issue thunderstorm warnings if there is frequent or long-lived activity over a region. To have this additional imagery from space will be brilliant.

"On the other hand, higher-resolution data from new Meteosat and Metop programmes will enable forecasters to identify and predict smaller-scale features that can be tricky to identify, such as fog, turbulence, freak waves, adverse currents, ice, and other hazards.

"This will be useful in a wide range of areas that rely on forecasts, including for flood protection, policy making, climate science, and air pollution monitoring.

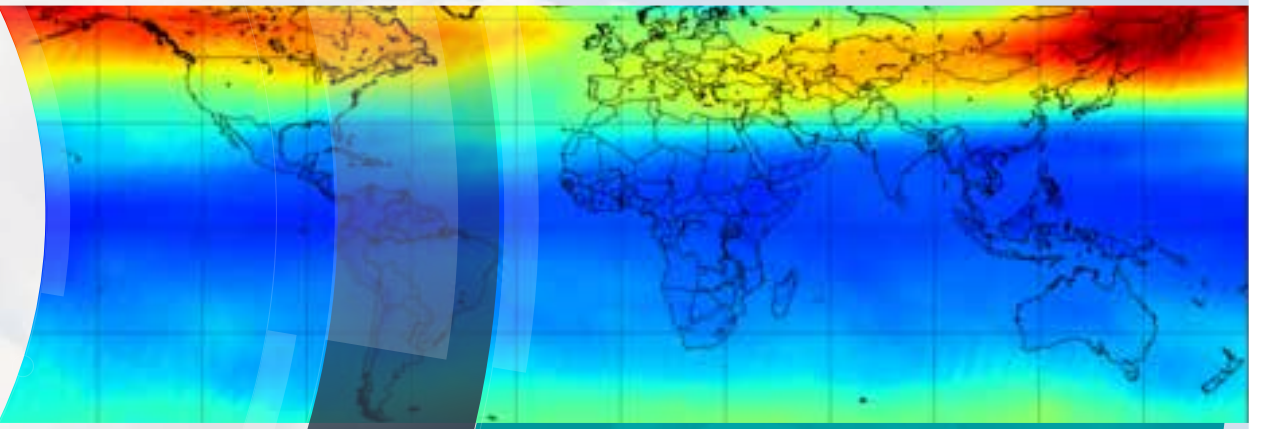
"No matter what we are forecasting, we need to get the basics right. So, it's very exciting to see these new observations, satellite technologies and product innovations, and think about the benefits they are going to have for our work."

> Satellite and radar data played a critical role in helping our forecast team assess the situation, identify the position of the storm as it developed, and track it across its lifetime.

Linda Hughes
a forecaster at Met Éireann

For more information, read the case study on the EUMETSAT website

https://www.eumetsat.int/features/seizing-moment



9

Remain an attractive employer for diverse, skilled, talented and engaged people

EUMETSAT strives to foster a collaborative, dynamic and forward-thinking workplace through people-oriented initiatives and open communication. In 2024, we made significant progress in strengthening our position as an attractive employer, enhancing our performance management system and launching a staff development programme. Our improved intranet, communication survey and new 'Meet the Delegate' event series demonstrate the organisation's efforts to engage and inform our colleagues.

Working at EUMETSAT

EUMETSAT continued to pursue various activities in support of the long-term Human Resources Strategy, which was endorsed by the EUMETSAT Council in 2023. These activities included entering into a partnership with an HR management consulting firm to develop and implement a leadership development programme embracing various levels of the workforce. The organisation also introduced a revised job exchange programme to provide employees with valuable opportunities for professional development.

EUMETSAT has completed the reform of the performance management process for a better balance between assessing the achievement of objectives and behavioural aspects on one hand, with planning a staff member's development on the other. The behavioural aspects assessed are more closely linked to EUMETSAT's core values.

To strengthen accountability and reduce unnecessary bureaucracy, the organisation agreed on a delegation of authority framework for human resources decisions in order to clearly and transparently delegate decisions to more appropriate hierarchical levels. However, at the same time, the framework ensures that all necessary organisational considerations are taken into account and that we keep following due process and overall coherence in the implementation of EUMETSAT's rules and policies.

Work has progressed on analysing the existing workforce composition of staff members and contractors, to ensure that future recruitment focuses on tasks and positions that are critical for EUMETSAT's missions.

LittleOrbiters, the EUMETSAT Childcare Centre – open to our staff members' children from four months old until school age – started operations in early November 2023 and has enjoyed an enthusiastic uptake. Enrolment by the end of 2024 was significantly higher than originally anticipated. EUMETSAT is also reviewing its maternity, paternity and parental leave policies to better reflect our commitment towards a diverse and inclusive workforce and our understanding of the needs of today's families.

We continued to move forward on actions from the 2021 Staff Survey. Ongoing tasks include developing a pilot framework for improving meeting efficiency, procuring career development workshops for staff and reporting officers, and analysing parental and special needs leave benefits across Member States. The next survey is planned for 2025, and the coming year is expected to see work commence on a code of business ethics and conduct for the organisation. During 2024, the EUMETSAT Ethics Officer continued her support to employees and contractors on resolving ethical questions and concerns.

The East Building extension was officially inaugurated on 26 June and received its first occupants in December. The second and third waves of relocation and refurbishment are scheduled for 2025.

The Programme Preparation and Development (PRD) Department implemented its final step of reorganisation in order to proactively address a wider range of topics, including the upcoming transition to a multi-mission ground system, the transition to the next generation of observation systems and instrument technologies in the late 2020s, and new programme

▲ *The new 'Meet the Delegate' event series launched in March and was evaluated very positively by the EUMETSAT community. From top to bottom: Fabio Fontana, MeteoSwiss, Isabel Trigo, Instituto Português do Mar e da Atmosfera and Steven Green, Met Office.*

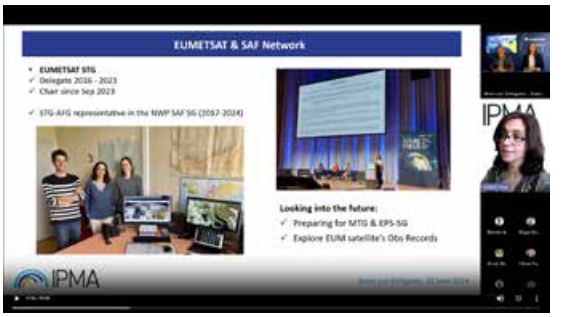
opportunities. The new structure will be in place from January 2025 and will also embrace an extended Project Management Office with harmonised and standardised practices for programme management and control. Three new divisions will be created:

- Altimetry Missions Development, to implement the missions of the Altimetry Programme;
- Small Spacecraft and Constellations, with the EUMETSAT Polar System – Sterna as its first programme;
- New Programmes and Services.

The latter division is a cross-functional unit that hosts, amongst others, Phase B2 of the EUMETSAT Polar System – Aeolus preparatory activities, architectural studies, launch services, space engineering methodologies, and the focal point for future ground segment solutions in the framework of the multi-mission ground system.

Internal communication

EUMETSAT keeps staff and contractors informed on what is happening across the organisation through a multitude of articles, briefings, videos and newsletters. In June, our first internal communication survey resulted in more than 70% of respondents expressing positive views on our overall internal communications activities. The findings were shared with the Management Board and improvements are ongoing. We plan on repeating the survey in 2026.



One of our principal channels for communicating with the workforce is the intranet. The platform underwent a revamp during 2024, including a new homepage, clearer categories, and colour changes for a fresher, brighter look and feel.

The new 'Meet the Delegate' event series, which allows selected representatives from our delegate bodies to share insights into their roles and interact directly with staff, launched in March and was evaluated very positively by the EUMETSAT community. Our first three guests were from Switzerland, Portugal and the United Kingdom and represented respectively the Policy Advisory Committee, the Scientific and Technical Group, and the Administrative and Finance Group.

Behind the data: measuring ocean carbon

Quantifying carbon in the ocean provides crucial information about the oceans' role in climate

Just as water cycles throughout the Earth as clouds give way to rain, rain to ground water, and ground water flows to the sea, so, too, does carbon cycle throughout the planet. Carbon makes life possible, comprising an essential building block of cells and has the power to hinder it, as the greenhouse gas carbon dioxide (CO_2) spurs on climate change.

This is why understanding the changing climate requires understanding the movement of carbon throughout the atmosphere, ocean, and land. Oceanographer and Lead Marine Applications Expert Dr Hayley Evers-King explains how satellite images showing ocean colour can be used to gain insight into where and how much of one form of carbon is in the ocean.

Follow the light

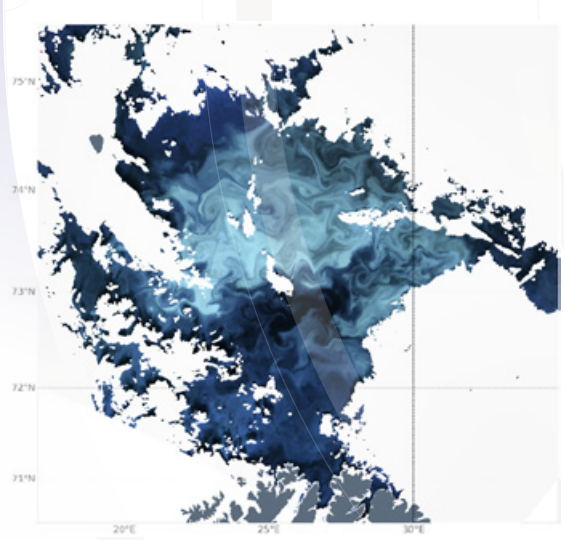
"EUMETSAT-operated satellites measure ocean colour by detecting the light that's reflected at different wavelengths," Evers-King said.

"This variation can tell us about different forms of carbon, including different types produced by phytoplankton, and from river outflows, stirred up sediments, and more.

"In this image, the blue comes from the colour of the ocean water itself, whereas the white comes from the light reflecting off this particular species of phytoplankton called coccolithophores.

"We can track carbon in the ocean when it gets taken up by biological organisms, which coccolithophores do when they use dissolved carbon in the ocean in the form of bicarbonate and carbonate ions to build their calcium carbonate shells.

"From this satellite image we know that there was a coccolithophore bloom in this region of the Barents Sea on 13 July 2022, a normal thing for this time of year. This gives us insight into the location of some of the ocean's carbon at that time."



▲ *A bloom of coccolithophores in the Barents Sea on 13 July 2022 captured by the Ocean and Land Colour Instrument (OLCI) aboard Copernicus Sentinel-3B*

Assigning values

"If we also want find out how much calcium carbonate will be produced and its role in the carbon cycle, we need to turn those measurements of light into concentrations of particulate inorganic carbon (PIC).

"We do this by comparing measurements of known quantities of inorganic carbon in the ocean to measurements of light at those points. Once we know this, we can take light measurements and calculate the corresponding units of PIC in the sea, which is one component of carbon. We can also look at organic forms and those that come from sources beyond phytoplankton.

"Monitoring carbon throughout the Earth system is really important because we can't accurately predict what's going to happen with the climate or say how effective various remediation measures are without keeping track of carbon."

Monitoring carbon throughout the Earth system is really important because we can't accurately predict what's going to happen with the climate or say how effective various remediation measures are without keeping track of carbon.

Dr Hayley Evers-King
Oceanographer and Lead Marine Applications Expert at EUMETSAT

For more information, read the case study on the EUMETSAT website

https://www.eumetsat.int/features/behind-data-measuring-ocean-carbon

Human resources

Staff in post

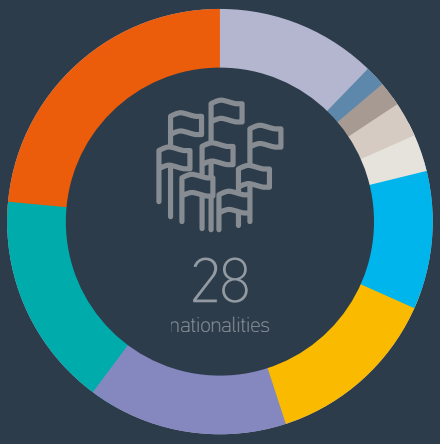
At the end of December 2024 there were 638 staff in post. There were 51 starters and 26 leavers.

Administration | 161

Engineering | 370

Science | 102

Senior management | 5



Staff nationalities

German | 150

Italian | 104

Spanish | 97

British | 85

French | 67

Turkish | 18

Portuguese | 17

Romanian | 12

Irish | 10

Other | 78

Other

Belgian 9, Dutch 9, Polish 8, Finnish 6, Greek 6, Hungarian 5, Swedish 5, Bulgarian 4, Croatian 4, Swiss 4, Austrian 3, Danish 3, Lithuanian 3, Slovakian 3, Norwegian 2, American 1, Czech 1, Estonian 1, Slovenian 1

Recruitment and gender balance

6,454 applications were received for vacancies posted in 2024, of which 32% were from women.

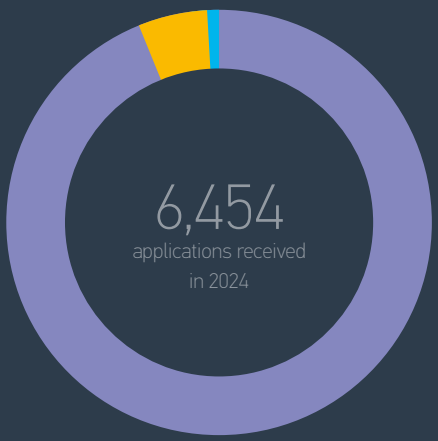
A total of 58 applications were from EUMETSAT staff, with nine successful internal appointments. A further 339 applications were from consultants working with EUMETSAT, with 20 successful appointments.

Recruitment 2024

Staff applications | 58

Consultant applications | 339

External applications | 6,057



% of female candidates 2024

B grade posts

Applications | 58%

Shortlisted | 87%

Suitable | 88%

Appointed | 75%

A1 grade posts

Applications | 23%

Shortlisted | 61%

Suitable | 62%

Appointed | 67%

All grades

Applications | 32%

Shortlisted | 43%

Suitable | 45%

Appointed | 41%

A2-A4 grade posts

Applications | 25%

Shortlisted | 34%

Suitable | 36%

Appointed | 33%

A5-A7 grade posts

Applications | 30%

Shortlisted | 56%

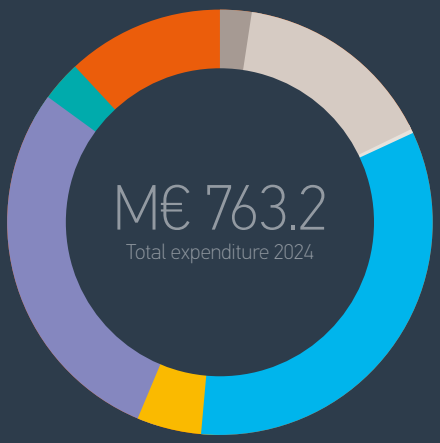
Suitable | 67%

Appointed | 50%

Financial information

The Financial Statements are extracted from the EUMETSAT Annual Accounts 2024 that have been audited by the Spanish Court of Audit (Tribunal De Cuentas) with an unmodified opinion and approved by the 108th Council on 2 July 2024.

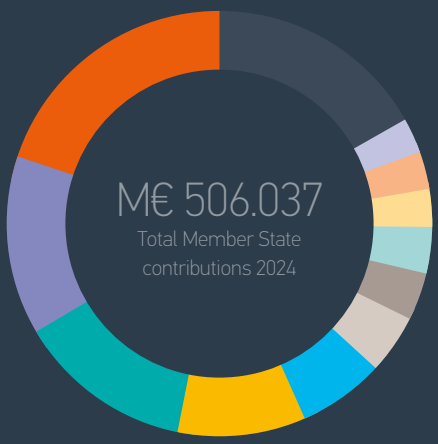
Expenditure budgets 2024



General Budget (GB)	M€ 91
Meteosat Second Generation (MSG)	M€ 23.3
Meteosat Third Generation (MTG)	M€ 219.1
EUMETSAT Polar System (EPS)	M€ 37.4
EPS - Second Generation (EPS-SG)	M€ 254.3
Jason-CS	M€ 2.4
Copernicus 2.0	M€ 111.4
Destination Earth (DestinE)	M€ 24.3
Total	**M€ 763.2**

Member State contributions 2024

	KEUR
Austria	11.045
Belgium	13.480
Bulgaria	1.689
Croatia	1.533
Czechia	5.982
Denmark	9.259
Estonia	790
Finland	6.859
France	68.940
Germany	100.659
Greece	4.885
Hungary	3.953
Iceland	588
Ireland	8.180
Italy	49.399
Latvia	867
Lithuania	1.386
Luxembourg	1.276
Netherlands	22.795
Norway	10.575
Poland	14.496
Portugal	5.753
Romania	6.159
Slovakia	2.631
Slovania	1.353
Spain	33.228
Sweden	14.427
Switzerland	17.840
Türkiye	18.268
United Kingdom	67.742
Total member state contributions	**506.037**



EUMETSAT statement of the financial position

		EUR		EUR
Assets		**31 December 2024**		**31 December 2023**
Current assets				
Cash and cash equivalents		316,817,413.86		316,817,413.86
Receivable from non-exchange transactions		516,668,956.71		523,185,232.47
Receivable contributions	487,058,000.00		506,639,927.27	
Receivable MRM/launch delay contingency	12,800,000.00		0.00	
Receivable VAT/taxes	16,810,956.71		16,545,305.20	
Receivable from exchange transactions		295,494,475.34		320,592,858.23
Accounts receivable	4,157,295.38		6,049,813.82	
Advance payment and accrued income	289,951,203.32		313,049,055.51	
Receivable Interest	1,385,976.64		1,493,988.90	
Other Financial Assets	0.00		0.00	
Other assets		31,590,899.24		27,604,034.27
Assets held for sale		3,583.23		120.00
Non-current assets				
Financial assets		277,550,498.57		243,490,754.82
Other tangible fixed assets		1,138,207.36		984,111.40
Land, heritage assets and buildings		81,512,448.49		75,377,662.12
Technical equipment		225,753,016.39		213,382,690.64
Satellites		3,341,878,898.74		3,343,234,335.45
Intangible assets		97,228,199.15		92,068,879.62
TOTAL ASSETS		**5,196,444,473.42**		**5,156,738,092.88**

Liabilities		**31 December 2024**		**31 December 2023**
Current liabilities				
Payable under non-exchange transactions		677,355,886.83		668,885,686.83
WCF payable	171,702,307.92		146,355,321.33	
Incurred surplus unpaid	18,595,578.91		16,493,365.50	
Deferred contributions	487,058,000.00		506,037,000.00	
Payable under exchange transactions		105,976,060.76		88,193,136.83
Accounts payable	10,648,556.16		23,388,024.14	
Accruals and deferred income	95,327,504.60		64,805,112.69	
Other financial liabilities		55,287,475.49		70,522,423.74
Employee benefits		7,877,361.82		8,002,903.20
Other provisions		53,300.00		53,300.00
Non-current liabilities				
Employee benefits		744,773,082.28		739,915,829.23
Other financial liabilities		592,466.00		147,492.37
TOTAL LIABILITIES		**1,591,915,633.18**		**1,575,720,772.20**

Net Assets		**31 December 2024**		**31 December 2023**
Surpluses/net assets/equity				
Reserves		3,577,622,741.70		3,550,861,886.82
Assets	3,747,514,353.36		3,725,047,799.23	
Budget carry forward	11,769,618.26		13,490,100.06	
Reserve advance payments	280,686,294.68		306,957,259.56	
Employee benefits	-468,119,569.85		-499,198,293.83	
Deferred	5,772,045.25		4,565,021.80	
Net result of the year		26,906,098.54		30,155,433.86
TOTAL NET ASSETS		**3,604,528,840.24**		**3,581,017,320.68**

Financial information

EUMETSAT statement of the financial performance

	EUR 2024	EUR 2023
Operating revenue		
Contributions	643,107,984.41	607,614,292.60
Pension revenue	24,249,403.28	31,854,890.64
Sales revenue	1,454,333.32	1,447,166.66
Other revenue	24,161,492.41	14,782,390.21
Revenue from assets	30,037,277.18	32,524,423.38
Total operating revenue	**723,010,490.60**	688,223,163.49
Operating expenses		
Costs for human resources	257,308,423.48	234,340,497.14
Other operating expenses	18,583,342.26	15,586,522.03
Satellite related costs	177,563,906.31	90,581,117.05
SAF, prospective activities, research fellows	13,912,121.81	10,662,662.35
Depreciation and losses from disposal of assets	229,348,653.55	230,330,522.63
Total operating expenses	**696,716,447.41**	581,501,321.20
NET SURPLUS/DEFICIT FROM OPERATING ACTIVITIES	**26,294,043.19**	106,721,842.29
Financial operations revenue	**9,280,680.47**	6,874,030.93
Financial operations expenses	**13,008.28**	21,582.88
NET SURPLUS/DEFICIT FROM ORDINARY ACTIVITIES	**35,561,715.38**	113,574,290.34
Extraordinary Items		
NET SURPLUS/(DEFICIT) FOR THE PERIOD	**35,561,715.38**	113.574.290,34
Attributable to :		
Incurred Surplus unpaid	**-18,595,578.91**	-16.493.365,50
Net result of the year	**-26,906,098.54**	-30.155.433,86
Result Allocated to Reserves	**9,939,962.07**	-66.925.490,98

EUMETSAT statement of the cash flow

	Eur 2024	eur 2023
Cash flows from operating activities		
Surplus / (deficit) from ordinary activities	26,627,297.65	106,894,590.77
Cash inflows from interest	8,934,417.73	6,679,699.57
Non-cash movements		
Depreciation. net	229,348,532.55	230,119,939.43
(Gains) losses on property. plant and equipment	-30,037,277.18	-32,524,423.38
(Gains) losses on property. plant and equipment	121.00	210,583.20
Receivable contributions	19,581,927.27	-8,584,884.72
Receivable mrm/launch delay	-12,800,000.00	100,000.00
Accrued income/deferred expenditure	-2,461,888.97	758,468.18
Accounts receivable and prepayments	37,653,456.36	-30,051,393.48
Receivable interest	108,012.26	-1,252,050.48
Receivable vat/taxes	-265,651.51	-3,692,649.70
Other assets	-3,986,864.97	-5,413,832.71
Vendor payables	-13,519,261.90	-839,072.22
Staff payables	393,195.59	-43,803.24
Deferred income/accrued expenditure	7,407,196.25	4,488,706.53
Accruals/provisions	23,560,169.29	4,116,962.94
Increase/(decrease) in health insurance and unemployment reserves	-13,946,060.00	37,590,418.11
Other financial liabilities	-15,234,948.25	32,009,989.64
Net cash flow from operating activities	**261,362,373.17**	340,567,248.44
Cash flows from investing activities		
Increase/(decrease) in fixed asset	-221,825,865.47	-220,586,572.72
Increase/(decrease) in financial assets - pension budget	-9,438,270.87	-19,787,288.76
Increase/(decrease) in reserve fund	12,596,070.13	-40,530,271.99
Net cash flow from investing activities	**-218,668,066.21**	-280,904,133.47
Cash flows from financing activities		
Wcf's payable	25,346,986.59	7,197,754.01
Incurred surplus unpaid	2,102,213.41	10,420,032.36
Deferred contribution	-18,979,000.00	13,001,625.00
Advance payments	-10,201,196.76	-9,949,569.67
Surplus previous year(s) to be distributed	-30,155,433.86	-27,672,423.08
Net cash flow from financing activities	**-31,886,430.62**	-7,002,581.38
Net increase/(decrease) in cash and cash equivalents	**10,807,876.34**	52,660,533.59
Cash and cash equivalents at beginning of period	**316,817,413.86**	264,156,880.27
Cash and cash equivalents at end of period	**327,625,290.20**	316,817,413.86

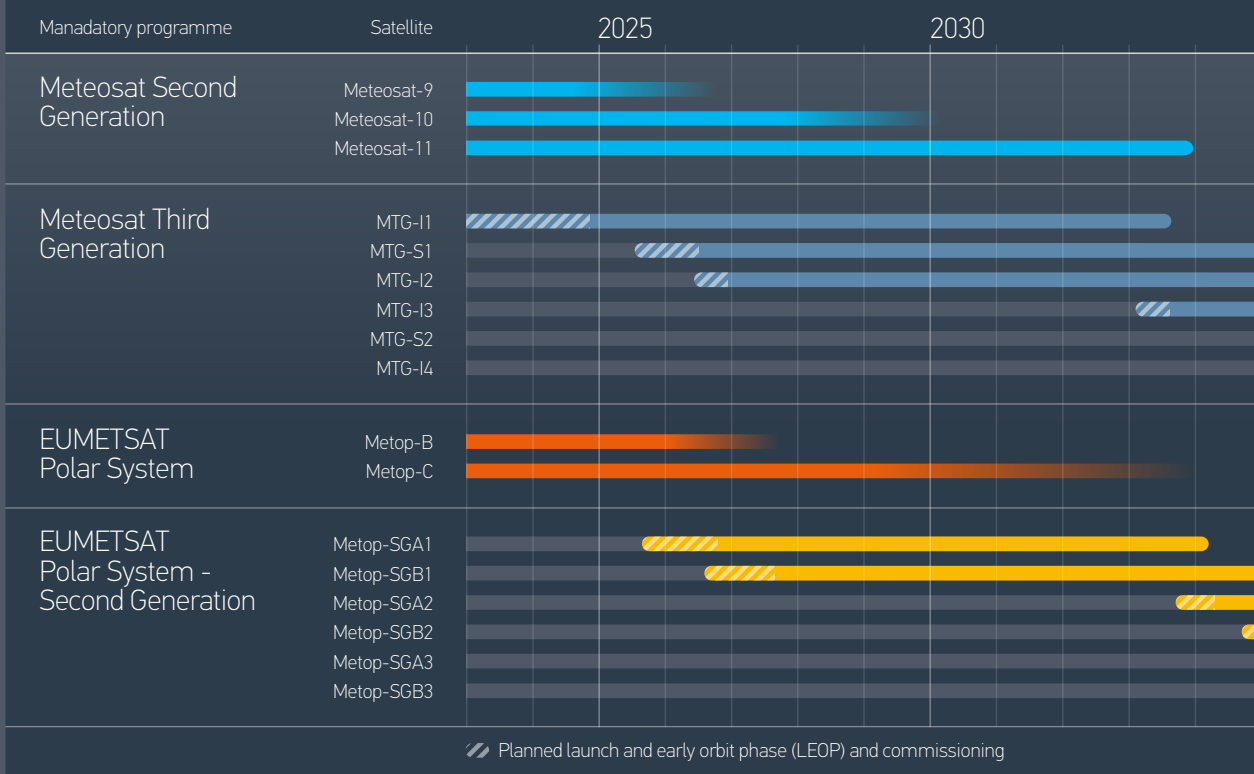
Financial information

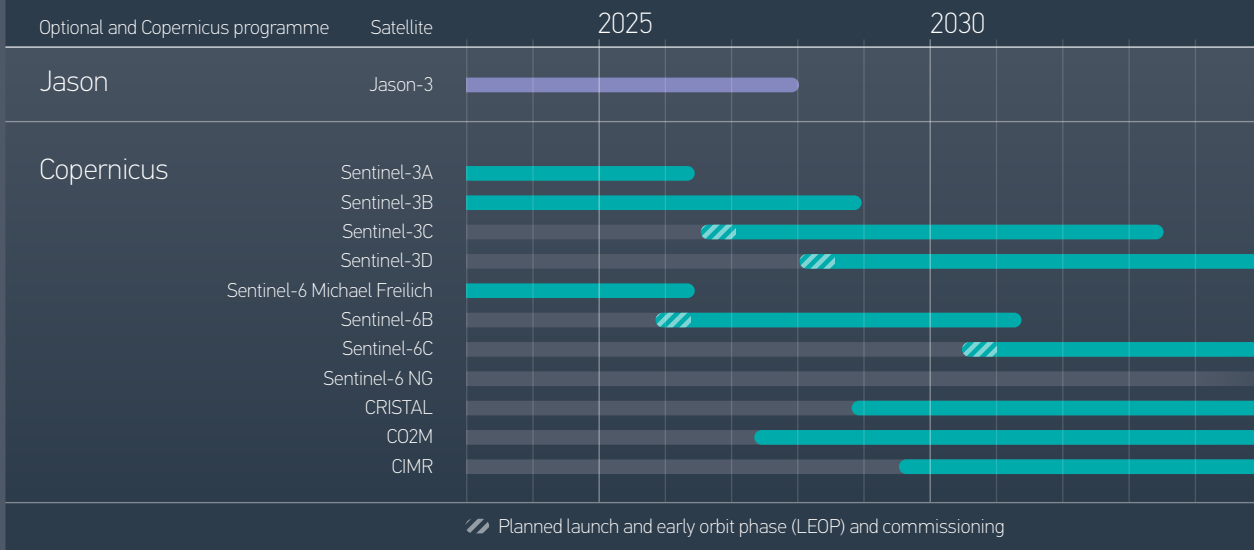
	Asset reserve	Reserve for accrual/ deferral of expenses	Advance payments reserve
Balance at 31 December 2022	**3,702,267,325.76**	**6,178,395.85**	**269,665,498.00**
Net revenue recognised directly in net assets/ equity			
Surplus / (Deficit) for the period	22,780,473.47	-1,613,374.05	37,291,761.56
Total recognised revenue and expense for the period	22,780,473.47	-1,613,374.05	37,291,761.56
Distribution to Member States			0.00
Balance at 31 December 2023	**3,725,047,799.23**	**4,565,021.80**	**306,957,259.56**
Net revenue recognised directly in net assets/ equity	-47,934.97		
Surplus / (Deficit) for the period	22,514,489.10	1,207,023.45	-26,270,964.88
Total recognised revenue and expense for the period	22,466,554.13	1,207,023.45	-26,270,964.88
Distribution to Member States			0.00
Balance at 31 December 2024	**3,747,514,353.36**	**5,772,045.25**	**280,686,294.68**

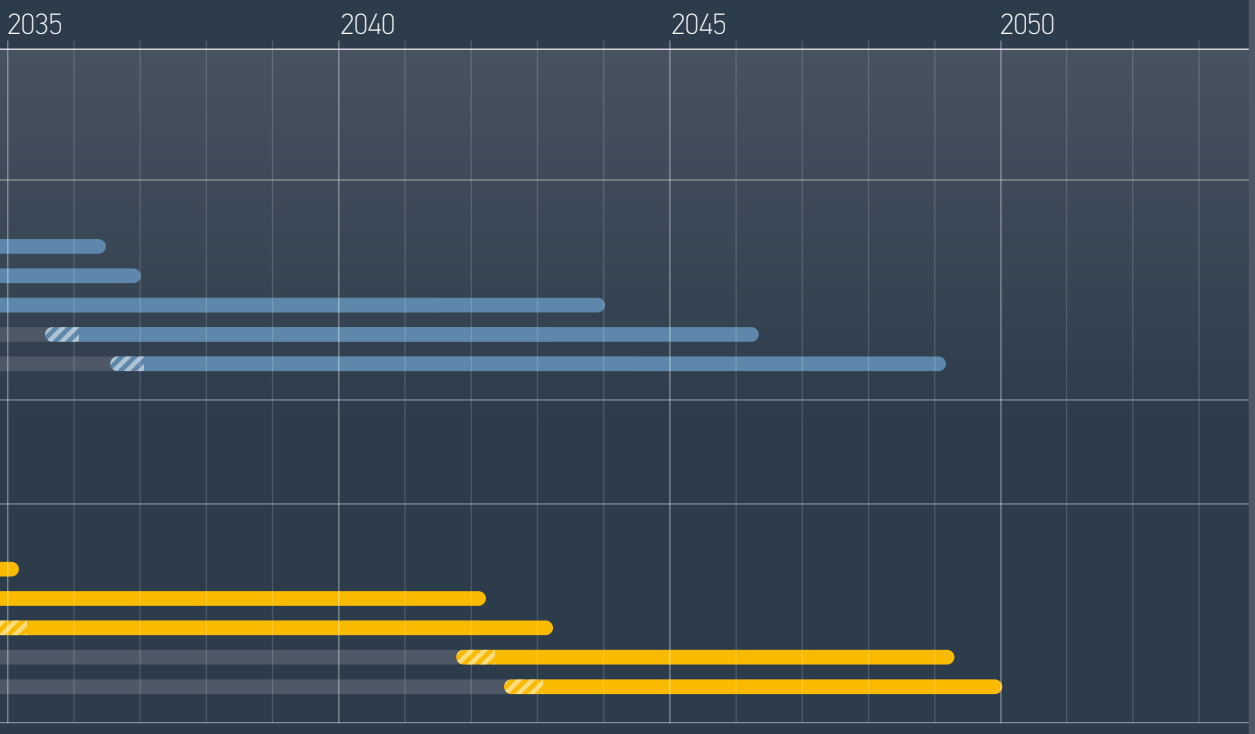
Employee benefits reserve	Budget carry forward	Surplus distributed to member states	Total net assets
-378,818,034.41	**10,264,877.19**	**27,672,423.08**	**3,637,230,485.47**
-103,116,442.50			-103,116,442.50
5,241,407.13	3,225,222.87	46,648,799.36	113,574,290.34
-97,875,035.37	3,225,222.87	46,648,799.36	10,457,847.84
-22,505,224.05	0.00	-44,165,788.58	-66,671,012.63
-499,198,293.83	**13,490,100.06**	**30,155,433.86**	**3,581,017,320.68**
59,808,495.67			59,760,560.70
-5,670,027.94	-1,720,481.80	45,501,677.45	35,561,715.38
54,138,467.73	-1,720,481.80	45,501,677.45	95,322,276.08
-23,059,743.75	0.00	-48,751,012.77	-71,810,756.52
-468,119,569.85	**11,769,618.26**	**26,906,098.54**	**3,604,528,840.24**

Mission planning

31 December 2024



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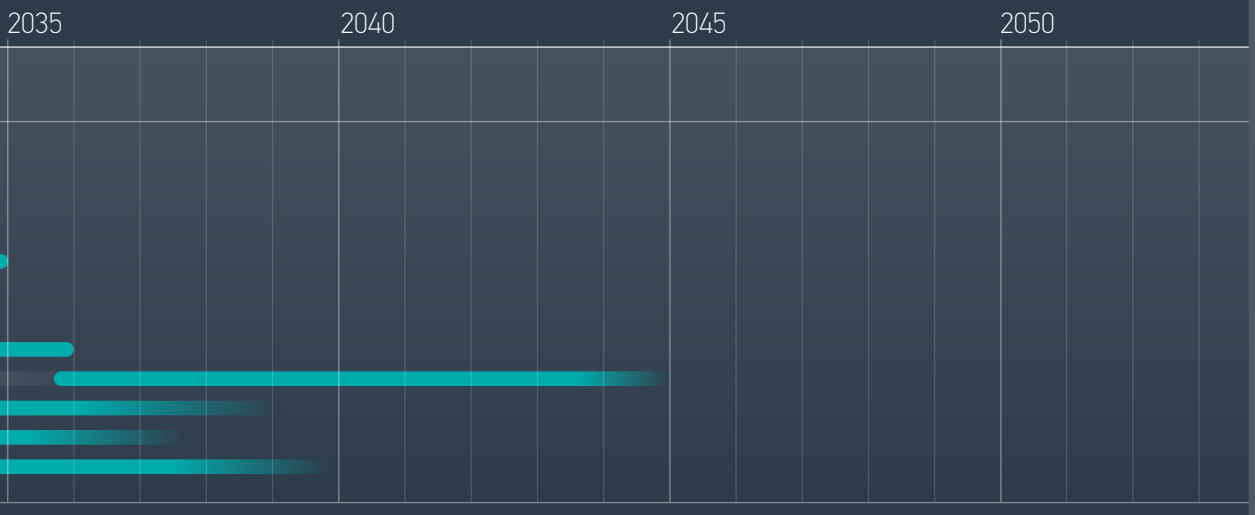
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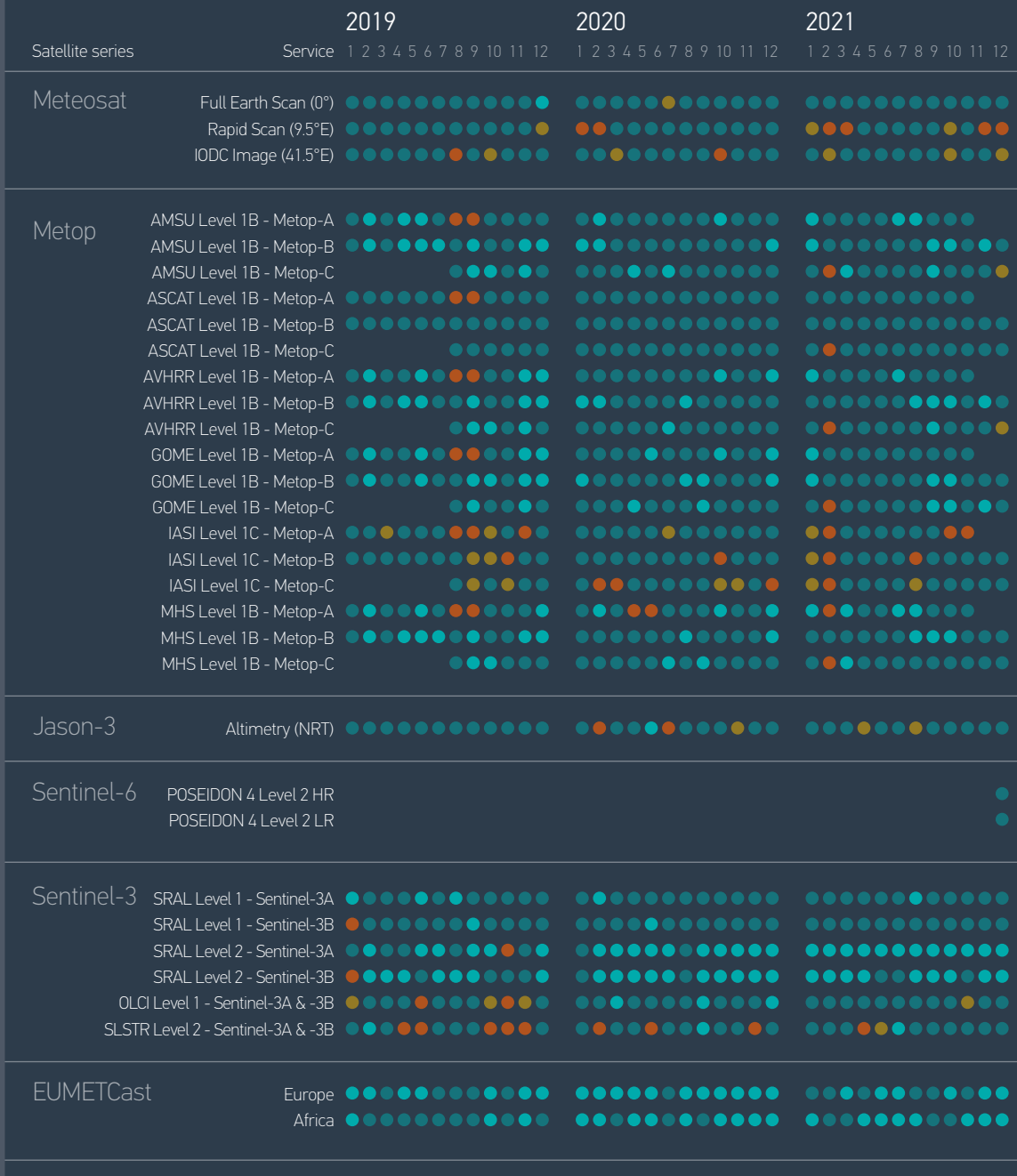
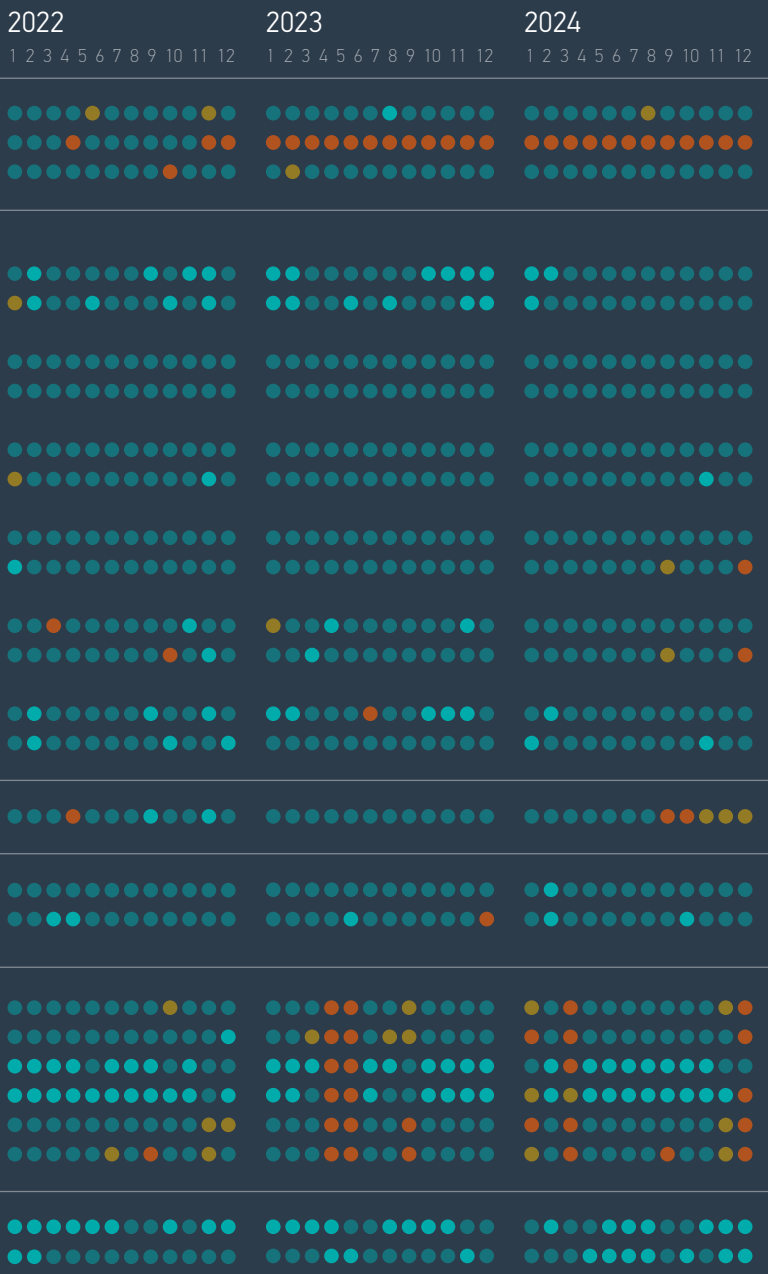
Operational performance



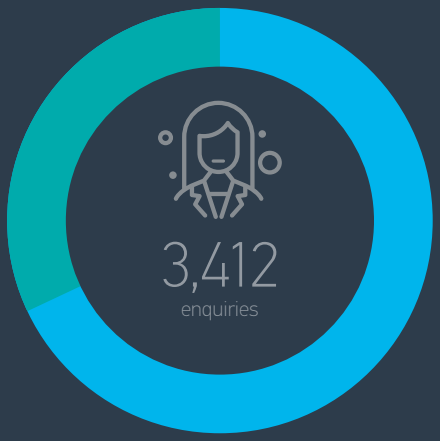
Service availability to users

▲ Above target ● 100% availability ● exceeded target

▼ Below target ● within 1% of reaching target ● more than 1% below target



EUMETSAT user base



User enquiries

3,412 user enquiries were processed in 2024, with 68% from EUMETSAT Member States.

Member States | 2,320

Other | 1,092

EUMETCast

At the end of December 2024, there were 4,961 registered EUMETCast stations exploited by users.

2024 | 4,961

2023 | 5,004

2022 | 4,913

2021 | 4,762

2020 | 4,615

2019 | 4,389

2018 | 4,132

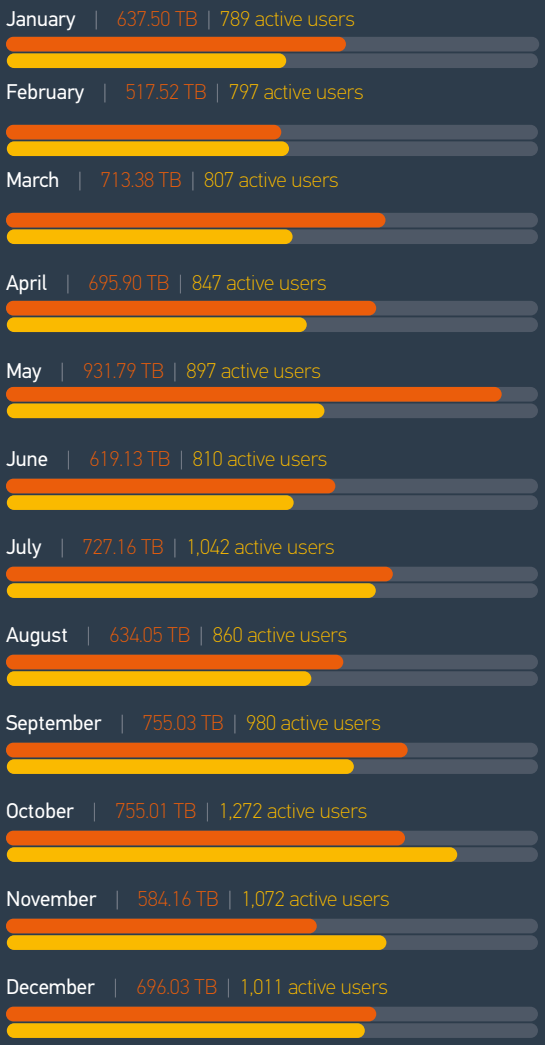
2017 | 4,042

2016 | 3,972

2015 | 4,508

Data store

At the end of 2024, a total volume of 8,266.66 terabytes (TB) were delivered, with an average of 932 unique users per month.



EUMETView

EUMETView attracted on average 3,172 individual users per day. They generated tens of millions of visualisations each month.

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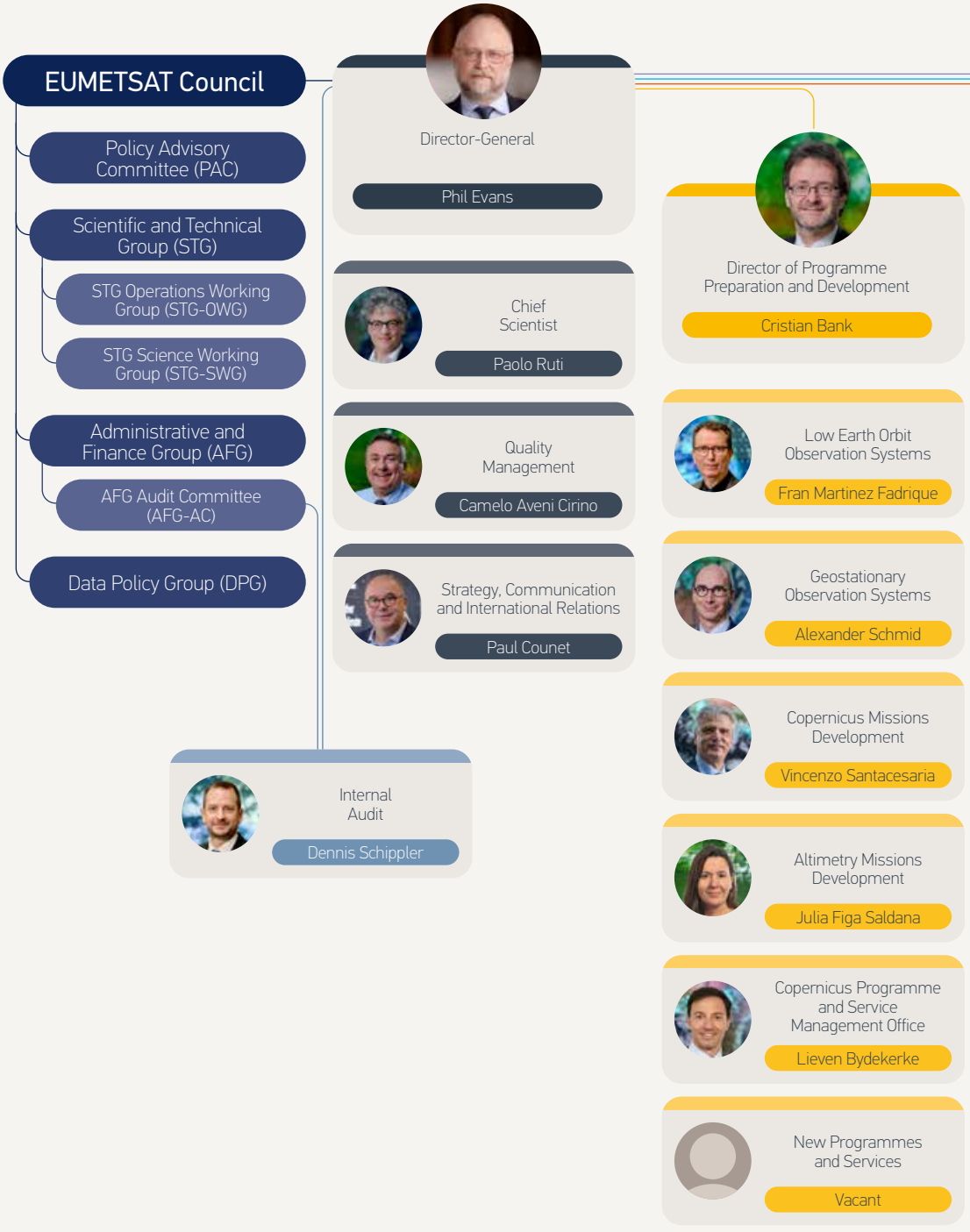
Organisation chart

Official EUMETSAT organigramme
1 January 2025



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Flight Operations

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Contracts

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Mr F. Fontana	Federal Office of Meteorology and Climatology MeteoSwiss

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Mr M. Altinyollar (Interpreter)	Devlet Meteoroloji İşleri Genel Müdürlüğü
Dr Ö. Kurtulus	Devlet Meteoroloji İşleri Genel Müdürlüğü
Ms N. Sogutcuklu	Devlet Meteoroloji İşleri Genel Müdürlüğü

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Mr S. Green	Met Office
Ms S. Jackson	Met Office
Ms Z. McGrail	Met Office
Mr S. Turner	Met Office

Observers

European Centre for Medium-Range Weather Forecasts

European Space Agency

EUMETNET

European Commission

National Oceanic and Atmospheric Administration

World Meteorological Organization

EUMETSAT participation in major events in 2024

16th European Space Conference	Brussels	23-24 January
Integrated Nowcasting Tools: status, collaboration, use of MTG data	Darmstadt	23-25 January
104th AMS Annual Meeting	Baltimore	28 January – 1 February
EUMETSAT AI-ML data foundation: a members' perspective	Darmstadt	19-20 February
6th CGMS WGIII risk assessment workshop,	Darmstadt	21-22 February
Third Workshop of International Cloud Working Group	Darmstadt	26-28 February
GEO-Ring and ISCCP-NG meeting	Darmstadt	29 February – 1 March
Workshop on update of SAF Strategy	Darmstadt	29 February – 1 March
Global Space-Based Intercalibration System annual meeting / Executive Panel meeting	Darmstadt	11-15 March
Workshop: Engaging on use of EO for Hydrology and River Basin Management in Africa	Darmstadt	19-21 March
CEOS SIT-39,	Tokyo	9-11 April
IROWG-ROMEX workshop	Darmstadt	17-19 April
29th International Symposium on Space Flight Dynamics	Darmstadt	22-26 April
CGMS-52 Working Groups	Darmstadt	22-26 April
Space Council under BE EU Presidency	Brussels	23 May
ESPI advisory council and GA	Darmstadt	27-28 May
CGMS-52 Plenary Session	Washington	4-6 June
EURISY General Assembly and Council Meeting	Darmstadt	17-18 June
Media workshop Meteo et Climat	Darmstadt	20-22 June
European Space Forum	Brussels	24 June
EMS Annual Meeting	Barcelona	2-6 September
OSTST conference	Montpellier	2-6 September
16th User Forum in Africa	Cotonou	16-20 September
Meteorological Technology World expo	Vienna	24-26 September
EUMETSAT User Conference	Würzburg	30 September – 4 October
Switch to Space 4	Brussels	2 October
Destination Earth user eXchange	Darmstadt	15-16 October
38th CEOS Plenary	Montreal	22-24 October
Marine User Days	Lisbon	5-6 November
Future Focus: Wildfires User Days	Darmstadt	26-28 November
IASI conference	Nancy	2-6 December
AMSAF Nowcasting Workshop	Darmstadt	10-12 December

Published data records in 2024

SAF and secretariat data records

	DOI
SeaWinds L2 25 km winds data record, release 2	10.15770/EUM_SAF_OSI_0016
SeaWinds L2 50 km winds data record, release 2	10.15770/EUM_SAF_OSI_0017
Oceansat-2 L2 25 km winds data record, release 2	10.15770/EUM_SAF_OSI_0018
Oceansat-2 L2 50 km winds data record, release 2	10.15770/EUM_SAF_OSI_0019
RapidScat L2 25 km winds data record, release 1	10.15770/EUM_SAF_OSI_0020
RapidScat L2 50 km winds data record, release 1	10.15770/EUM_SAF_OSI_0021
Passive microwave upper tropospheric humidity data record - Edition 2	10.5676/EUM_SAF_CM/UTH/V002
Global Interpolated RAinFall Estimation, version 1	10.5676/EUM_SAF_CM/GIRAFE/V001
Cloud Fractional Cover dataset from Meteosat First and Second Generation - Edition 2	10.5676/EUM_SAF_CM/CFC_METEOSAT/V002
Land surface temperature dataset from Meteosat First and Second Generation - Edition 2	10.5676/EUM_SAF_CM/LST_METEOSAT/V002
Surface radiation and fluxes from Meteosat First and Second Generation – Edition 1	10.5676/EUM_SAF_CM/SLF_METEOSAT/V001
10-daily surface albedo data record - Metop	10.15770/EUM_SAF_LSA_0010
Sulphur dioxide climate data record, release 1	10.15770/EUM_SAF_AC_0046
Carbon monoxide profiles climate data record, release 1	10.15770/EUM_SAF_AC_0047

Copernicus Climate Change Service (C3S) data records

	DOI
R1 of SSM/T FDR	10.15770/EUM_SEC_CLM_0085
R1 of SI-1 FDR	10.15770/EUM_SEC_CLM_0086
R2 of HIRS FDR	10.15770/EUM_SEC_CLM_0036

New products released in 2024

OSI SAF: Sea Surface Wind data records from Ku-band scatterometer	19 January 2024
CM SAF Upper Tropospheric Humidity Data Record Release 2	5 February 2024
NWP SAF Cloud and Aerosol Detection Software Version 3.2	27 February 2024
NWC SAF GEO Software Package GEO Version 2021.3	18 March 2024
CM SAF Global Interpolated Rainfall Estimation Data Record	5 April 2024
CM SAF Land Surface Temperature Data Record from Meteosat First and Second Generation – SUMET Edition 2	15 May 2024
CM SAF Cloud Fractional Cover Data Record from Meteosat First and Second Generation - COMET Edition 2	15 May 2024
LSA SAF Fire Radiative Energy Emission Product – FREM	12 June 2024
NWP SAF ATOVS and AVHRR Pre-processing Package (AAPP) version 8.13	18 June 2024
CM SAF Meteosat Surface Radiation and Fluxes Data Record – LANDFLUX Ed. 1	25 June 2024
AC SAF European surface UV radiation (EUV) Offline Product and Data Record	15 June 2024
ROM SAF Software package ROPP version 11.3	11 July 2024
LSA SAF EPS Surface Albedo Data Record	15 July 2024
NWC SAF Polar Platform System software package Version 2021.4	2 September 2024
H SAF Snow Water Equivalent improved version	13 September 2024
AC SAF SO2 and CO data records from IASI	20 September 2024
NWP SAF Pre-processor for MTG IRS (IRSPP Version 1.3)	31 October 2024
OSI SAF Oceansat-3 wind vectors	31 October 2024

Scientific and technical publications 2024

Aguilar Taboada, D. and **J. De Juana Gamo**. "EPS-Sterna and EPS-Aeolus Mission Analysis." *29th Int. Symp. on Space Flight Dynamics (ISSFD) 2024*, Darmstadt, Germany, 2024.

Aminou, D., D. Lamarre, T. Guggenmoser, A. Palacios, P. V. D. Braembussche, J. Champion, P. Blythe, **G. Fowler**, **M. Lekouara**, **J. Grandell**, O. Brize, S. Abdon, R. Schönfeld, R. Feckl and P. Jorba Coloma. "Experiencing Satellite Infrared Sounding Missions Developments for Geostationary Orbit Weather Predictions the Case of Meteosat Third Generation." *2024 IEEE Int. Geoscience and Remote Sensing Symp. (IGARSS)*, Athens, Greece: IEEE, 2024.

Anema, J., K. Boersma, P. Stammes, G. Koren, W. Woodgate, **P. Köhler**, C. Frankenberg, and J. Stol. 2024. "Monitoring the Impact of Forest Changes on Carbon Uptake with Solar-Induced Fluorescence Measurements from GOME-2A and TROPOMI for an Australian and Chinese Case Study." *Biogeosci.* 21, (9): 2297–2311.

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Atwood, E., **T. Jackson**, A. Laurenson, B. Jönsson, E. Spyrakos, D. Jiang, G. Sent, N. Selmes, S. Simis, O. Danne, A. Tyler and S. Groom. 2024 "Framework for Regional to Global Extension of Optical Water Types for Remote Sensing of Optically Complex Transitional Water Bodies." *Remote Sens.* 16 (17): 3267.

Benveniste, J., M. Restano, **S. Dinardo**, C. Buchhaupt, M. Scagliola, M. Passaro, L. Fenoglio-Marc, A. Ambrózio and C. Orrù. "Synthetic Aperture Radar Altimetry Processing on Demand at ESA's Altimetry Virtual Lab." *EGU General Assembly 2024*, Vienna, Austria & online, 2024.

Boynard, A., C. Wespes, J. Hadji-Lazaro, D. Hurtmans, P. Coheur, **M. Doutriaux Boucher**, K. Bowman and C. Clerbaux. "Tropospheric Ozone Global and Regional Distributions and Trends from IASI." *EGU General Assembly 2024*, Vienna, Austria & online, 2024.

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Bozzoli, M., A. Crespi, M. Matiu, B. Majone, L. Giovannini, D. Zardi, Y. Brugnara, **A. Bozzo**, D. Berro, L. Mercalli and G. Bertoldi. 2024. "Long-term Snowfall Trends and Variability in the Alps." *Int. J. Climatol.* 44 (13): 4571-4591.

Cadier, E., B. Courcol, P. Prandi, V. Quet, T. Moreau, C. Maraldi, F. Bignalet-Cazalet, **S. Dinardo**, **C. Martin-Puig** and C. Donlon. 2024. "Assessment of Sentinel-6MF Low Resolution Numerical Retracker over Ocean: Continuity on Reference Orbit and Improvements." *Adv. Space Res.*, November 2024, S0273117724011670.

Cao, Z., Y. Xue, H. Nayak, D. Lettenmaier, C. Frankenberg, **P. Köhler** and Z. Li. 2024. "Understanding Terrestrial Water and Carbon Cycles and Their Interactions Using Integrated SMAP Soil Moisture and OCO-2 SIF Observations and Land Surface Models." *J. Geophys. Res.: Atmos.* 129 (18).

Catania, M., **D. Aguilar Taboada**, **D. Martinez Diez** and **P. Kremmydas**. "Accuracy of Sentinel-3 Operational Orbit Predictions with Increased Solar Activity." *29th Int. Symp. on Space Flight Operations (ISSFD) 2024*. Darmstadt, Germany, 2024.

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Chung, E., S. Kim, B. Sohn, Y. Noh and **V. John**. 2024. "Multi-Decadal Climate Variability and Satellite Biases Have Amplified Model-Observation Discrepancies in Tropical Troposphere Warming Estimates." *Commun. Earth Environ.* 5 (1): 342.

Cimini, D., **V. Barlakas**, F. Carminati, **F. De Angelis**, F. Di Paola, A. Fassò, D. Gallucci, S. Gentile, **T. Hewison**, S. Larosa, F. Madonna, **V. Mattioli**, M. Montopoli, F. Romano, M. Rosoldi, M. Viggiano, **A. Von Engeln** and R. Ricciardelli. 2024. "Anatomy of the Uncertainty of Satellite Vicarious Calibration Using Radiosondes: Concepts and Preliminary Results for Microwave Radiometric Observations." *Bull. Atmos. Sci. Technol.* 5 (1): 9.

Scientific and technical publications 2024

Cotterill, A., E. Nicholson, **C. Hayer** and C. Kilburn. 2024. "Magma Recharge at Manam Volcano, Papua New Guinea, Identified through Thermal and SO2 Satellite Remote Sensing of Open-Vent Emissions." *B. Volcanol.* 86 (11): 87.

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Dubovik, O., P. Litvinov, T. Lapyonok, M. Momoi, A. Lopatin, **B. Fougnie**, S. Remi, R. Checa-Garcia and J. Flemming. "Harmonization of the Assumptions of Atmospheric Aerosol Properties in Climate Models and Remote Sensing Approaches." *EGU General Assembly 2024*, Vienna, Austria & online, 2024.

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Fernández, J., H. Peter, C. Fernández, J. Berzosa, M. Fernández, L. Bao, M. Muñoz, S. Lara, E. Terradillos, P. Femenias, **C. Nogueira Loddo**. 2024. "The Copernicus POD Service." *Adv. Space Res.* S0273117724001984.

Flammini, A., A. Calfapietra, F. Di Pietro, **S. Pessina**, **M. Klinc**, F. Perrella and Kaltenbach. "Meteosat Third Generation (MTG-I1), LEOP Preparation and Challenging Execution: Expect the Unexpected." *29th Int. Symp. on Space Flight Dynamics (ISSFD) 2024*, Darmstadt, Germany, 2024.

Fougnie, B., **M. Vazquez-Navarro**, F. La China, C. Michel, **C. Lee** and L. Landier. "Instrument Polarisation Model for the EPS-SG/3MI Polarimeter: Theoretical Assumption and Adjustment Using on-Ground Measurements." In *Proceedings of SPIE*, 13143: 1314304 San Diego, United States: SPIE, 2024.

Fountoulakis, I., A. Tsekeri, S. Kazadzis, V. Amiridis, A. Nersesian, M. Tsichla, E. Proestakis, A. Gkikas, K. Papachristopouloum, **V. Barlakas**, C. Emde, B. Mayer. 2024. "A Sensitivity Study on Radiative Effects Due to the Parameterization of Dust Optical Properties in Models." *Atmos. Chem. Phys.* 24 (8): 4915–48.

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Published by EUMETSAT - Europe's meteorological satellite organisation.

Produced by the Strategy, Communication and International Relations Division.

For further information about EUMETSAT, its programmes and activities, please contact:

EUMETSAT
Eumetsat Allee 1
64295 Darmstadt
Germany

Tel: +49 6151 807 3660/3770
Email: press@eumetsat.int
Web: www.eumetsat.int

© EUMETSAT, June 2025 EUM.AR.37

ISSN 1013-3410 ISBN 978-92-9110-116-0

EUMETSAT

Eumetsat Allee 1
64295 Darmstadt
Germany

T: +49 6151 807 3660/3770
E: press@eumetsat.int
W: www.eumetsat.int

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EUM AR.37, © EUMETSAT, 2025
ISSN: 1013-3410
ISBN: 978-92-9110-116-0