

▲ First image of the full Earth disc from Meteosat Third Generation – Imager 1, captured at 11:50 UTC on 18 March 2023 by the Flexible Combined Imager



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## Director-General's foreword

Meteosat Third Generation – Imager 1 (MTG-I1), the first of our next-generation satellites, was in its commissioning phase in 2023. While we continued to work towards the satellite becoming operational and providing its data to our member states, we had an exciting preview of the potential benefits to come.

EUMETSAT made real progress in 2023 on our first organisational objectives: that includes the implementation of our next-generation satellite systems, as well as the development of new concepts for our ground segments and their underpinning information technology in support of operations.

But right across the organisation, we have reformed, or are continuing to reform, how we work and how we deliver our services. From modernising our approach to financial control to preparing for the introduction of a new information management system, from sharpening our focus on cyber security and business continuity to providing a childcare centre for the children of our staff, and from developing new data products to improving how users can access those products, change is impacting all aspects of the organisation.

These changes have proven challenging at times, and have required considerable effort by staff and support from our member states. However, our motivation has been to meet our member states' needs for satellite data and products in the most effective and efficient way.

At the same time, expert and efficient satellite and ground segment operations ensured we maintained a very high level of data availability throughout the year.

The first images from the Flexible Combined Imager (FCI) and Lightning Imager on MTG-I1 were released publicly on 4 May and 3 July, respectively, and generated significant interest in member states and in the media. A first test dissemination of FCI data to member states' national meteorological and hydrological services and EUMETSAT satellite application facilities (SAFs) began on 30 October.

Work progressed on preparations for the first satellites in the EUMETSAT Polar System (EPS) – Second Generation, despite some delays affecting the space and ground segments. A successful satellite system validation test campaign, involving EUMETSAT and Telespazio teams, concluded on 8 December. The launches of the first Metop Second Generation A and B satellites are on track for 2025–2026.

I was pleased to attend the 25<sup>th</sup> anniversary celebrations of the European Union's Copernicus programme in Stockholm, in June. Through our

own meteorological satellite programmes and participation in Copernicus, EUMETSAT ensures data users, including the Copernicus climate, atmosphere and marine services, have the necessary data to monitor and mitigate the impacts of climate change and to assess the emission of greenhouse gases.

In November, EUMETSAT's re-engineered Copernicus Sentinel-3 ground segment became operational. It is now ready for the operation of three of these satellites. A similar update started in October on the ground segment of Sentinel-6. With the launch of Sentinel-6B scheduled for November 2025, a detailed roadmap for its launch and commissioning at system level was established, including the scaling of capability for the operations and exploitation of a second satellite. The availability of mission data was very good.

Work continues apace with the European Space Agency and the European Commission on development of the ground segment for the Copernicus CO<sub>2</sub> Monitoring mission, the Copernicus Polar Ice and Snow Topography Altimeter mission and the Copernicus Imaging and Microwave Radiometer mission.

A study detailing the socio-economic benefits of the proposed EPS-Aeolus and EPS-Sterna missions was presented to the EUMETSAT Council in November 2023. These missions are designed primarily to measure winds, and atmospheric temperature and humidity, respectively. The study found that, together, these missions would generate an estimated €44.2 billion in social and economic benefits for member states over their operational lifetimes, representing a benefit to cost ratio of more than 30 to 1. EUMETSAT will present a formal programme proposal to the council in 2024, with a decision whether or not to proceed to be made in 2025.

Meanwhile, EUMETSAT continues to prepare for the opportunities and challenges ahead. First steps were taken to prepare for the SAFs' next strategic framework and, as part of an effort of the European Meteorological Infrastructure members, EUMETSAT is collaborating on projects to harness the potential of artificial intelligence while enhancing its data services, including through the now-operational European Weather Cloud.

In November, I had great pleasure in officially opening EUMETSAT's childcare centre, LittleOrbiters, together with representatives of the German federal and Hessian state governments and delegate body representatives. The centre, which is testament to EUMETSAT's commitment to remain an attractive employer, will cater for up to 44 children of our staff members.



“

*“Right across the organisation, we have reformed, or are continuing to reform, how we work and how we deliver our services.”*

I take this opportunity to thank EUMETSAT staff members for their continued commitment and hard work, which made the achievements of 2023 possible. I also extend my thanks to the EUMETSAT Council and Chair, Eoin Moran, for their guidance and support.

**Phil Evans**  
Director-General

“

*“The European Weather Cloud will be the foundation for a strong European information technology infrastructure for the meteorological community.”*



## Council Chairman's foreword

While EUMETSAT made progress in 2023 towards its primary strategic objective – the deployment of its next-generation satellite systems – the organisation continued to provide new and more efficient ways to access and work with its data. Through recent and ongoing changes to EUMETSAT's own data services and collaborations with the European Centre for Medium-Range Weather Forecasts (ECMWF) and the European Commission, EUMETSAT enhanced access to meteorological data and products. As the Meteosat Third Generation and EUMETSAT Polar System – Second Generation systems will provide exponentially more data than the current systems, in addition to more crucial data from the Copernicus Sentinels and other missions, the value of this work will become increasingly evident.

An important milestone was reached in September when the joint EUMETSAT-ECMWF initiative, the European Weather Cloud, became operational. The European Weather Cloud will be the foundation for a strong European information technology infrastructure for the meteorological community. This is a community cloud computing platform that makes accessing data easier, improves processing capability and fosters new forms of collaboration among the national meteorological and hydrological services. The platform allows users to access and work with enormous amounts of data directly, without needing to download, process or store them. A call for proposals for research and development projects on the European Weather Cloud resulted in EUMETSAT approving three three-year projects and one fast-track proposal, all from European academic institutions, in 2023.

The EUMETSAT Council approved a proposal in July to establish cooperation agreements with national science and research and development organisations. This type of agreement builds on the long-standing framework of cooperation agreements with space and meteorological satellite agencies. Member states stand to benefit from the extensive Earth observation knowledge in non-meteorological research and development institutions by accessing some of the best scientific expertise in the world. As a result of such agreements, EUMETSAT aims to maximise the benefits to society from its satellite data through the development of enhanced data products for member states.

Collaboration is crucial to meeting the challenges facing the meteorological community, particularly related to the rapid development and impact of artificial intelligence (AI). Machine learning (ML) methods have already demonstrated the ability to produce reliable, short-to-medium range weather forecasts.

EUMETSAT is committed to working with the ECMWF and member states that are actively involved with the European Initiative on Artificial Intelligence in Weather, Climate, and Environment. This initiative focuses on identifying key collaborative activity areas, collaboration mechanisms, and governance structures to lead in developing AI and ML-based knowledge and products.

The council also approved phase two of EUMETSAT's involvement in the European Union's ground-breaking Destination Earth (DestinE) initiative, which aims to build virtual replicas, or digital twins, of Earth systems. EUMETSAT has end-to-end responsibility for the initiative's data lake, reflecting the organisation's significant expertise in data management and services. DestinE will allow greater insights into weather and climate phenomena and their impacts on society.

In December, version 2 of the WEkEO Copernicus data and information access service was launched. WEkEO offers Copernicus Earth observation data for free download, including all data from Sentinel satellites, contributing missions, and the Copernicus services. It features cloud-based hosted processing and allows data users to transform the data and services to meet their specific needs. It is implemented by EUMETSAT, the European Environment Agency, Mercator Ocean International, and the ECMWF. WEkEO 2.0 introduces new services and enhances the platform's architecture.

The importance of these projects is underscored by the unprecedented impact of severe weather on our member states, and beyond, throughout 2023, the hottest year on record. It was a year marked by heat domes, marine heatwaves, wildfires and severe storms, bringing home the impact of our changing climate and the importance of mitigation and adaption measures. EUMETSAT, through its own missions and in collaboration with others, is working to ensure we are prepared for the challenges ahead.

On behalf of the EUMETSAT Council, I extend my thanks to the organisation's management and staff for their hard work and commitment.



**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.*



## 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 2023

## March

### Meteosat-10 takes over full Earth disc scanning

Meteosat-10 moved from 9.5°E to 0° at the start of March to take over the full Earth disc scanning role that had been performed by Meteosat-11. After Meteosat-10 arrived at its new location and successful image acquisition was confirmed, Meteosat-11 moved to 9.5°E to take up Meteosat-10's previous rapid scanning duties. The reason for the swap was because Meteosat-10 was about to reach its qualification limit for the number of rapid scan cycles it should perform, while Meteosat-11 can perform that role for at least five more years. This ensures EUMETSAT continues to reliably provide imagery from geostationary orbit to our member states.

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## May

### Meteosat Third Generation's first image exceeds expectations

The first official images from the first of EUMETSAT's Meteosat Third Generation (MTG) satellites surpassed expectations, revealing features of meteorological phenomena never before seen in such detail from geostationary orbit. EUMETSAT and ESA jointly released the images to the media on 4 May. Comparisons showed the MTG images contained significantly more detail than can be produced by Meteosat Second Generation instruments.

**See p 22-27**

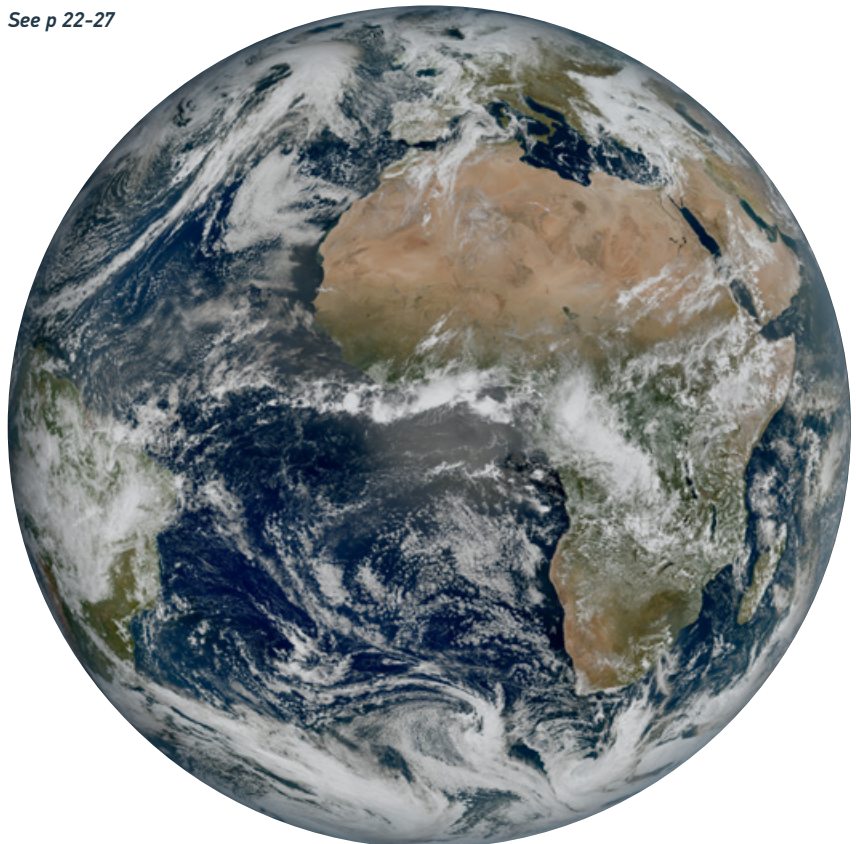
## June

### Copernicus programme celebrates 25<sup>th</sup> anniversary

EUMETSAT's Director-General gave a speech at the 25<sup>th</sup> anniversary celebration for the European Union's Copernicus programme in Stockholm. Copernicus has six operational services providing added-value products from seven Sentinel satellites in orbit and contributing mission data. The Sentinel-4 and -5 instruments on board EUMETSAT's MTG and Metop Second Generation satellites will follow, and six more

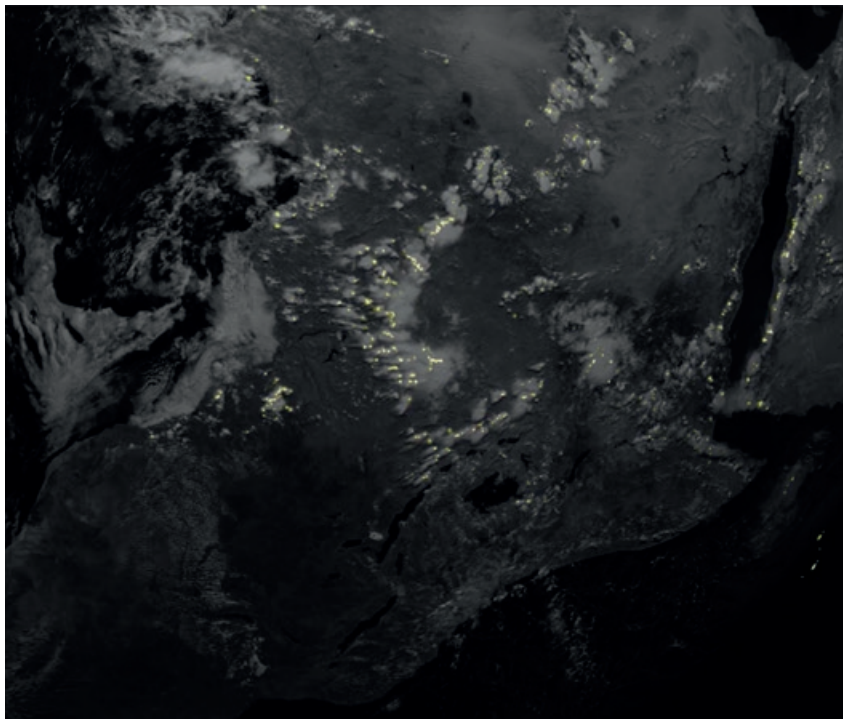
Sentinel expansion missions are planned, with EUMETSAT responsible for the operations of Sentinel-3, -4, -5, and -6, as well as the Copernicus CO2 Monitoring mission satellites. EUMETSAT will also process and disseminate the global products of the Copernicus Imaging Microwave Radiometer and the Copernicus Polar Ice and Snow Topography Altimeter missions.

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► EUMETSAT and ESA jointly released the first image from the Flexible Combined Imager on Meteosat Third Generation – Imager 1 on 4 May. The image was captured at 11:50 UTC on 18 March 2023.

► *Very intense lightning activity occurs continuously in Africa. This image was captured by Meteosat Third Generation – Imager 1’s Lightning Imager at 13:37 UTC on 2 June 2023. The data used for this image were acquired at a lower sensitivity setting of the instrument than will be provided to meteorological services for weather forecasting purposes.*



## July

### Imagery from Europe’s first lightning imager released

The first animations produced from observations from the Lightning Imager on board Meteosat Third Generation – Imager 1 (MTG-I1) were released to the media in July by EUMETSAT, the European Space Agency, and the instrument’s builder, Leonardo. The Lightning Imager continuously detects the light pulses produced by cloud-to-ground, cloud-to-cloud and intracloud lightning flashes and has four cameras covering Europe, Africa, the Middle East, and parts of South America. The cameras will continuously observe lightning activity from space and EUMETSAT will disseminate the data to weather services in its member states and beyond.

[See p 22-27](#)

### Ombudsperson appointed to ensure procurements transparency

The EUMETSAT Council appointed José María Travesí García to a five-year term as EUMETSAT Ombudsperson, and Prof Dr Lesley Jane Smith as his alternate, to adjudicate any complaints about procedural breaches in tendering processes. The appointments will ensure procurements made by EUMETSAT are carried out fairly and transparently. The Ombudsperson will decide on appeals brought by unsuccessful tenderers on the grounds of a procedural breach by EUMETSAT, after a complaint in the first instance to the Director-General.

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### EUMETSAT adopts renewed Climate Service Development Plan

A renewed Climate Service Development Plan, aiming to ensure the best use of data for climate change adaptation and mitigation of severe impacts was approved in July. The Climate Services Development Plan for 2023-2027 lays the groundwork for developing climate data records from EUMETSAT’s past, current, and next-generation satellites. It contains a strengthened focus on user engagement to help enhance the use of these data for a wide range of applications, including assessing the state of the climate, monitoring greenhouse gases, increasing renewable energy use, and mitigating climate risks.

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### Council expands research usage of EUMETSAT data

The EUMETSAT Council adopted a framework for cooperation agreements with science organisations to maximise the benefits to society from the organisation’s satellite data. EUMETSAT has cooperation agreements in place with operational space and meteorological satellite agencies, however the decision will expand collaboration to include research and development, and science entities. EUMETSAT stands to benefit from the extensive Earth observation scientific knowledge in non-meteorological research and development institutions by being able to provide enhanced products to its member states and other users of its data.

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# Highlights of 2023

## August

### **EUMETSAT facilitates CNES/Copernicus WEkEO data access agreement**

EUMETSAT and the French Space Agency (CNES) signed an agreement in August that increases the amount of data available from the WEkEO Copernicus data access platform and provides new sources of information. The signing of the agreement means CNES is now part of the WekEO federation, which provides a platform that pools data and information from Copernicus services and the European Sentinel satellites (wekeo.eu). WekEO is jointly operated by the Copernicus entrusted entities EUMETSAT, the European Centre for Medium-Range Weather Forecasts (ECMWF), the European Environment Agency, and Mercator Ocean International. WEkEO will provide access to about 30 petabytes (pb) of data gathered by satellite missions operated by CNES, giving users free, easy access to no less than 80pb of Earth observation data collected from space.

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## September

### **Big turn-out for EUMETSAT annual conference**

Almost 560 participants attended the 2023 EUMETSAT Meteorological Satellite Conference in Malmö, Sweden, in September, the first fully in-person conference since the Covid-19 pandemic. In addition to the plenaries and roundtable discussions, 291 speakers gave presentations and 187 posters were displayed. A press conference during the event revealed the first animations combining imagery from MTG-11's Flexible Combined Imager and Lightning Imager, demonstrating how the two instruments will work in synergy.

### **European Weather Cloud becomes operational**

The European Weather Cloud, the cloud-based collaboration platform for the development of meteorological applications and operations in Europe, became operational in September. The joint EUMETSAT-ECMWF initiative provides access to online data, functions and services from both organisations. The European Weather Cloud brings together users from different countries and organisations to collaborate, and to share results and resources.

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## October

### **Taking the lead on disaster response**

EUMETSAT and the Canadian Space Agency took up the rotating leadership of the International Charter on Space and Major Disasters, a global group which provides satellite data to support disaster response worldwide. The two organisations will share the 17-member organisation's leadership duties for six months. Representatives from the charter's member agencies met at EUMETSAT headquarters in October.

### **Joining forces to tackle climate change**

EUMETSAT became the 44<sup>th</sup> member of the Space for Climate Observatory, an international initiative to strengthen global efforts to tackle climate change, in October. The French Space Agency leads the observatory's secretariat. EUMETSAT's climate-related satellite data and products will contribute to the observatory's goal to provide decision makers with accurate and relevant information to support resilience and adaptation measures for regions vulnerable to climate change.



## November

### LittleOrbiters childcare centre opens

LittleOrbiters, EUMETSAT's new 44-place childcare centre, opened in November. The opening was attended by Hessian and local dignitaries, as well as members of the EUMETSAT Council. The centre caters for staff members' children aged from four months until they are old enough to start school and is operated by TFK Kitas.

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► Council delegates and local dignitaries explore the new childcare centre

► Participants of the 2023 EUMETSAT Meteorological Satellite Conference in Malmö, Sweden, in September





# Highlights of 2023

## November

### Approval given for continued commercial data procurement

The EUMETSAT Council approved the continued purchase of radio occultation data from Spire Global Luxembourg Sarl in November, after an initial pilot programme demonstrated benefits for weather forecasting accuracy and value for money. The contract was for an initial period of two years, from mid 2024–2026, with three optional one-year extensions. EUMETSAT will continue to monitor the quality of the purchased data, which will be received in near-real time, process them and redistribute them globally.

### Cooperating on global challenges

The EUMETSAT Council gave the go-ahead for new or renewed cooperation agreements to be signed with African, Indian and European organisations to share expertise and promote best use of meteorological satellite data. The benefits of the cooperation agreements would be felt by the citizens of EUMETSAT's 30 member states as well as India and Africa. The agreements with other space, science and meteorological agencies will reaffirm EUMETSAT's commitment to international cooperation on tackling global weather and climate challenges.

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### Council approves next phase of involvement in Destination Earth

The EUMETSAT Council gave the go-ahead for phase two of the organisation's involvement in the European Union's Destination Earth (DestinE) initiative. DestinE aims to build virtual replicas, or digital twins, of Earth systems, allowing greater insight into weather and climate phenomena and their impacts on society. The second phase runs from June 2024 until June 2026. The European Commission has entrusted EUMETSAT, the European Space Agency and the ECMWF with the implementation of DestinE. EUMETSAT is responsible for the initiative's data lake.

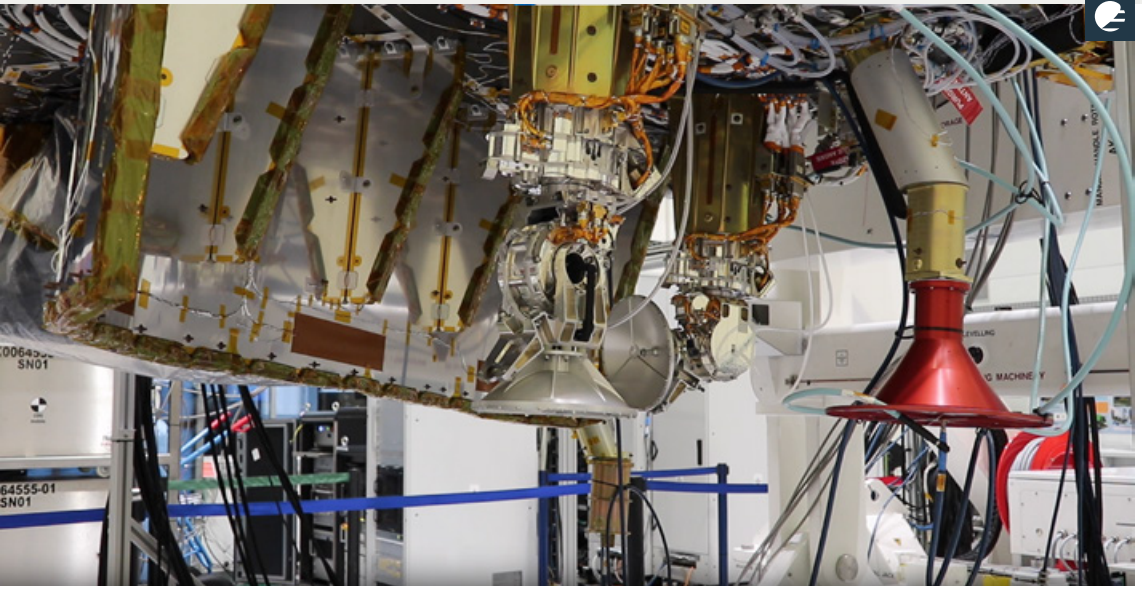
*See p 49*

### Study released on benefits from future satellite missions

The expansion of EUMETSAT's satellite fleet to include programmes measuring atmospheric temperature and humidity, and winds, would create an estimated €44.2 billion in social and economic benefits for member states, according to a study presented to council. The organisation's member states will decide by mid-2025 whether to proceed with the new EUMETSAT Polar System (EPS) programmes – EPS-Sterna and EPS-Aeolus. The study found that, together, the two programmes would have a benefit to cost ratio of more than 33 to 1 over their lifetimes.

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### Re-engineered Sentinel-3 ground segment activated

The new Copernicus Sentinel-3 ground segment at EUMETSAT headquarters was declared fully operational on 28 November. Sentinel-3A and -3B operations were transferred to the new flight operations segment on 14 November; the new payload data processing system was activated on 20 November, and the final communications links with ESA on 28 November. The re-engineering project aligned the ground segment architecture with EUMETSAT's standard ground segment design, fully integrating it with our multi-mission elements and shared computing infrastructure. The new Sentinel-3 ground segment performs the operations of Sentinel-3A and -3B satellites and will support the upcoming -3C and -3D spacecraft, simplifying operations and maintenance.

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◀ The EUMETSAT Council, consisting of delegates from the organisation's 30 member states, meets in Darmstadt, Germany, 28 November 2023

### First business continuity test evacuation carried out

EUMETSAT conducted a business continuity exercise on 7 November, simulating a response to the discovery of a World War II bomb near the premises. The organisation's headquarters was evacuated and fully locked down, with the Operations Evacuation Coordination Centre at the German Meteorological Service premises in Offenbach, and remote mission control centres, activated. The exercise was completed successfully and lessons learnt collected.

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### December

### Satellite system validation test successfully completed

The longest and most complex tests of the Metop-SG satellite system validation test campaign were completed on 8 December. Teams from EUMETSAT and Telespazio commanded the Metop-SGA1 satellite in a closed loop configuration, where the satellite's attitude sensors are stimulated with artificial signals to recreate those of real orbital conditions. The remaining tests in the campaign will be carried out in 2024.


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▶ Metop-SGA1 satellite at Airbus in Toulouse during the test campaign (credit: Airbus)

▼ The Copernicus Sentinel-3 satellites are controlled from the EUMETSAT mission control centre in Darmstadt, Germany







*Deploy the new  
Meteosat Third  
Generation and  
EUMETSAT Polar  
System - Second  
Generation satellite  
systems and  
maximise their  
benefits to member  
states and users*

Meteosat Third Generation

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EUMETSAT Polar System  
- Second Generation

**Page 20**

European launch  
services market

**Page 21**



► *Meteosat Third Generation  
- Sounder 1 being  
successfully integrated  
having passed its first  
functional tests (credit: OHB)*



The Meteosat Third Generation (MTG) and EUMETSAT Polar System – Second Generation (EPS-SG) systems will bring about a new era of monitoring weather and climate from space. These two complex and highly innovative systems offer huge potential for developing new products and applications to enhance weather forecasting and climate monitoring.

### **Meteosat Third Generation – Imager 1**

Meteosat Third Generation – Imager 1 (MTG-I1) was launched on 13 December 2022 and completed its launch and early operations phase 15 days later. Since then, satellite and system commissioning activities, during which the satellite’s instruments are calibrated and the data produced are validated, progressed throughout 2023. The satellite is expected to become fully operational in the first half of 2024.

The first official imagery from the Flexible Combined Imager (FCI) and Lightning Imager (LI) instruments

on MTG-I1 were released to the media on 4 May and 3 July, respectively. Imagery demonstrating the capacities of the instruments working in synergy was released at the EUMETSAT Meteorological Satellite Conference 2023 in Malmö, Sweden, on 11 September. The releases generated significant media interest and coverage throughout member states and around the world.

A keenly awaited first test dissemination of data from the FCI began via EUMETCast on 30 October. These test data were made available to the national meteorological and hydrological services of our member states and the EUMETSAT satellite application facility network.



## Meteosat Third Generation – Sounder 1

The proto-flight model of the Infrared Sounder (IRS) instrument completed its optical vacuum test campaign in July, before being integrated with the Meteosat Third Generation – Sounder 1 (MTG-S1) satellite. Some detector non-linearities of the Copernicus Sentinel-4/ Ultraviolet, Visible Near-infrared spectrometer (UVN) were detected, which will be corrected using on-ground image processing software.

The MTG-S1 satellite integration with the IRS and the Copernicus Sentinel-4/UVN instrument proto-flight models was completed and a system validation test with the EUMETSAT and launch and

early operations phase control centres was held in September. The satellite was then transported to Munich, Germany, for its environmental test campaign in November, with the launch planned for 2025.

The MTG-S1 qualification and flight acceptance review is planned to start in the second quarter of 2024, with the satellite ready for launch at the end of the third quarter.

Production of the recurrent MTG satellites will come to an end. The MTG-I2 platform and FCI flight model 2 instrument are in storage in Cannes, France. MTG-I3, -I4 and -Sounder 2 platforms are in storage in Bremen, Germany. Production of all other recurrent instrument models is progressing.



## EUMETSAT Polar System – Second Generation

Key progress was made in 2023 on the Metop Second Generation (Metop-SG) satellites, despite technical issues in the final integration and testing of some instruments and with the development of the ground segment.

Part one of the Metop-SGA1 satellite assembly, integration and test campaign progressed as planned. The thermal vacuum tests were successfully completed in June, with no major anomalies identified. The start of the second part of the assembly, integration and test campaign depends on the delivery of Copernicus Sentinel-5, Infrared Atmospheric Sounding Interferometer – New Generation and METimage instruments, expected in mid-2024.

The assembly, integration and test campaign for Metop-SGB1 progressed nominally. All platform units were mechanically and electrically integrated and underwent functional testing. The satellite's proto-flight model arrived at Airbus in Toulouse on 12 September for its environmental test campaign. The mechanical test campaign and post-mechanical test solar array deployment were successfully completed.

Journalists were invited to view Metop-SGA1 and -SGB1 in the Airbus Defence and Space cleanroom in Toulouse, France, on 10 November. ESA, EUMETSAT and Airbus briefed journalists on the advances of the next-generation system and its benefits to meteorology and climate monitoring. The event received international media coverage.



◀ *Metop Second Generation B satellite, fully integrated in the clean room at Airbus, Friedrichshafen, Germany (credit: Airbus)*

Development of the ground segment has experienced delays and led to the approval by the EUMETSAT Council in December 2022 of a new procurement approach for the payload data acquisition and processing (PDAP) facility. Under the new approach, EUMETSAT directly procures the evolutions of the product generation facilities and hardware updates needed for the PDAP, while integration of the processing facility is conducted by a joint industry-EUMETSAT team, on EUMETSAT's premises. EUMETSAT continues to consider additional risk mitigation measures.

## European launch services market

During 2023, EUMETSAT continued to carefully assess the European launch services market situation and took action to minimise the impact that delays in the Ariane-6 programme could have on the launches of MTG and Metop-SG satellites contracted with Arianespace.



## First imagery from Meteosat Third Generation instruments

EUMETSAT and the European Space Agency (ESA) released the first images from Meteosat Third Generation – Imager 1 (MTG-I1) to the media on 4 May 2023.

The imagery, captured by the Flexible Combined Imager at 11:50 UTC on 18 March 2023, revealed conditions over Europe, Africa and the Atlantic with an extraordinary level of detail. Much of Northern and Western Europe and Scandinavia were cloaked in clouds, while Italy and the Western Balkans enjoyed relatively clear skies.

Details the imagery contained, such as cloud vortices over the Canary Islands, snow cover on the Alps and sediment in the water along the coast of Italy, were not as clearly visible, or not visible at all, in imagery from the Spinning Enhanced Visible and Infrared Imager on board Meteosat Second Generation satellites.

Crucially for Nordic countries, the image revealed a greater level of detail of cloud structures at high latitudes. This will enable weather forecasters to more accurately monitor the evolution of rapidly developing severe weather in that region.

“This remarkable image gives us great confidence in our expectation that the MTG system will herald a new era in the forecasting of severe weather events,” EUMETSAT Director-General Phil Evans said in a press statement on the day the imagery was released.

The additional detail from the higher resolution imagery, coupled with the fact that images will be produced more frequently, means forecasters will be able to more accurately and rapidly detect and predict severe weather events.

The ground segment infrastructure required to routinely process images was used to produce the first image, as a preview of things to come when the satellite becomes operational in the first half of 2024. Images of the full Earth disc will be produced every 10 minutes when the system is operational.

The imagery and the benefits of the MTG system were widely reported by the media in EUMETSAT’s member states, and beyond.

Similarly, the first animations produced from data from the Lightning Imager on MTG-I1 received widespread coverage in the media when they were released by EUMETSAT, ESA and the instrument’s manufacturer, Leonardo, on 3 July.

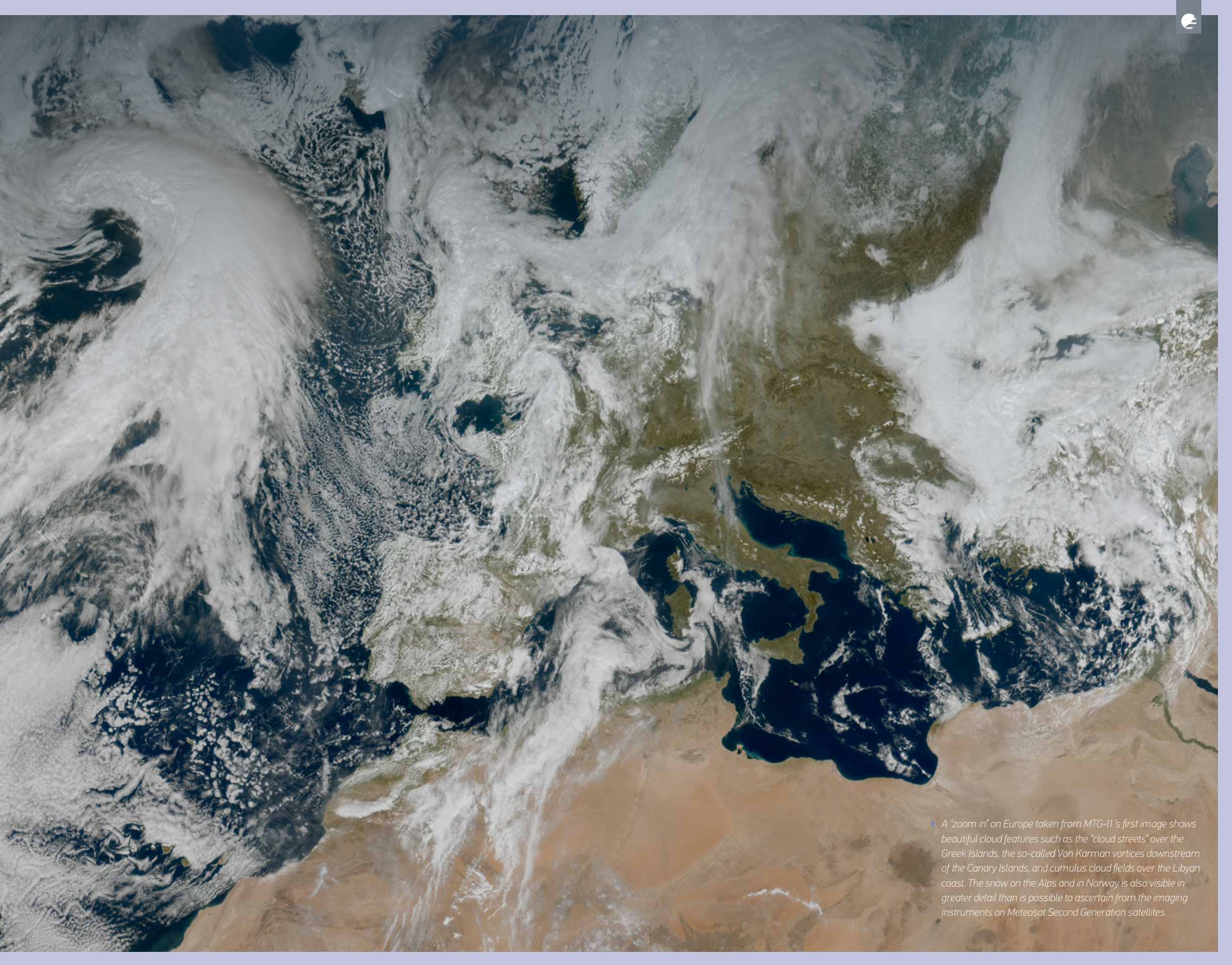
The Lightning Imager continuously detects the light pulses produced by cloud-to-ground, cloud-to-cloud and intracloud lightning flashes.

The instrument has four cameras covering Europe, Africa, the Middle East and parts of South America. EUMETSAT will disseminate the data to weather services in its member states and beyond when MTG-I1 becomes operational. Crucially, EUMETSAT will also deliver the data to weather services in Africa and other regions where lightning detection capability with ground-based observations is limited.

Each of the animations released was a sequence of images created by collecting one minute’s worth of lightning measurements, overlaid on a single image of the Earth from the Lightning Imager.

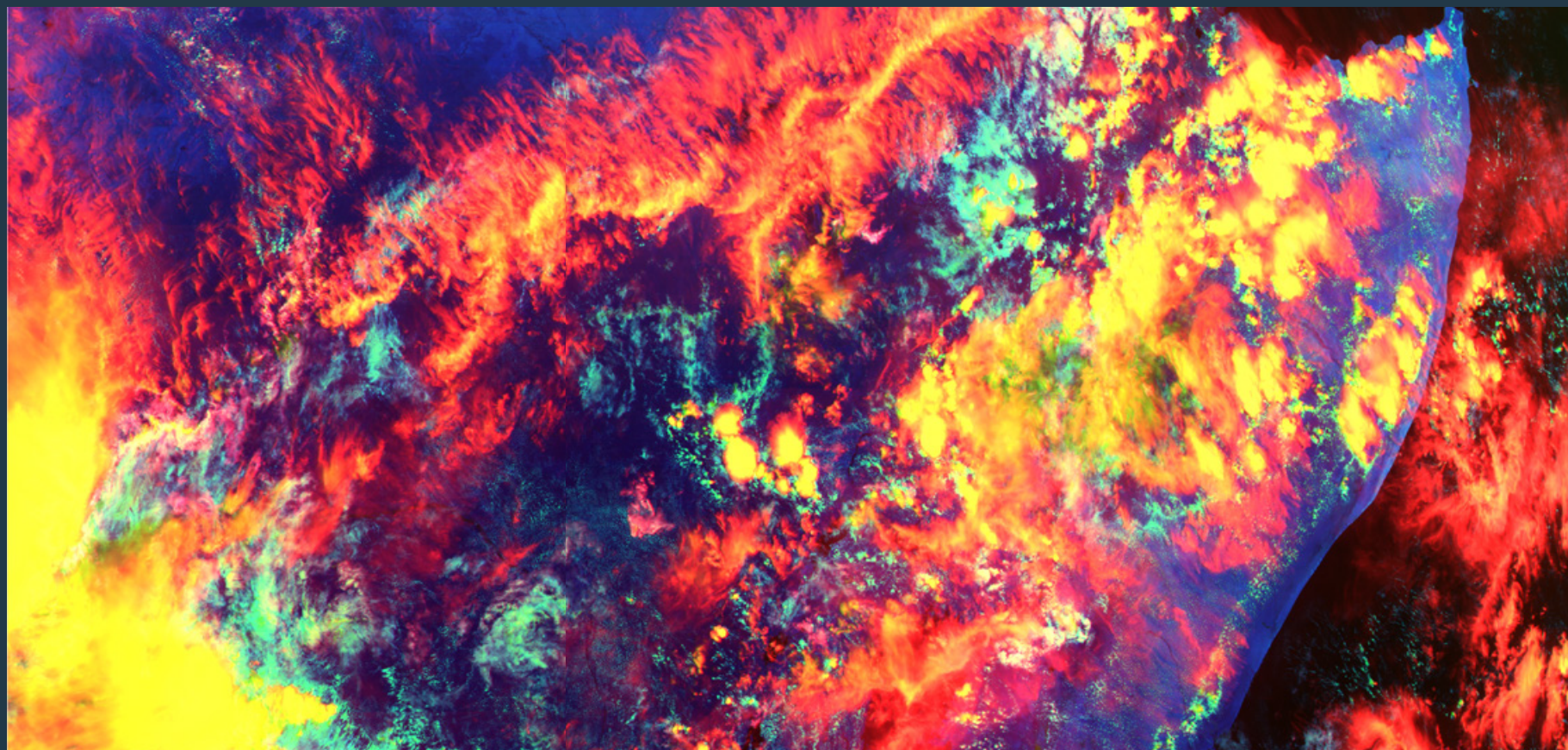
The animations demonstrated the instrument’s ability to accurately and effectively detect lightning activity over the whole area of the cameras’ field of view, which covers 84 percent of the Earth disc.

The data used for the animations were acquired at a lower sensitivity setting of the instrument than will be used for data provided to meteorological services for weather forecasting purposes.

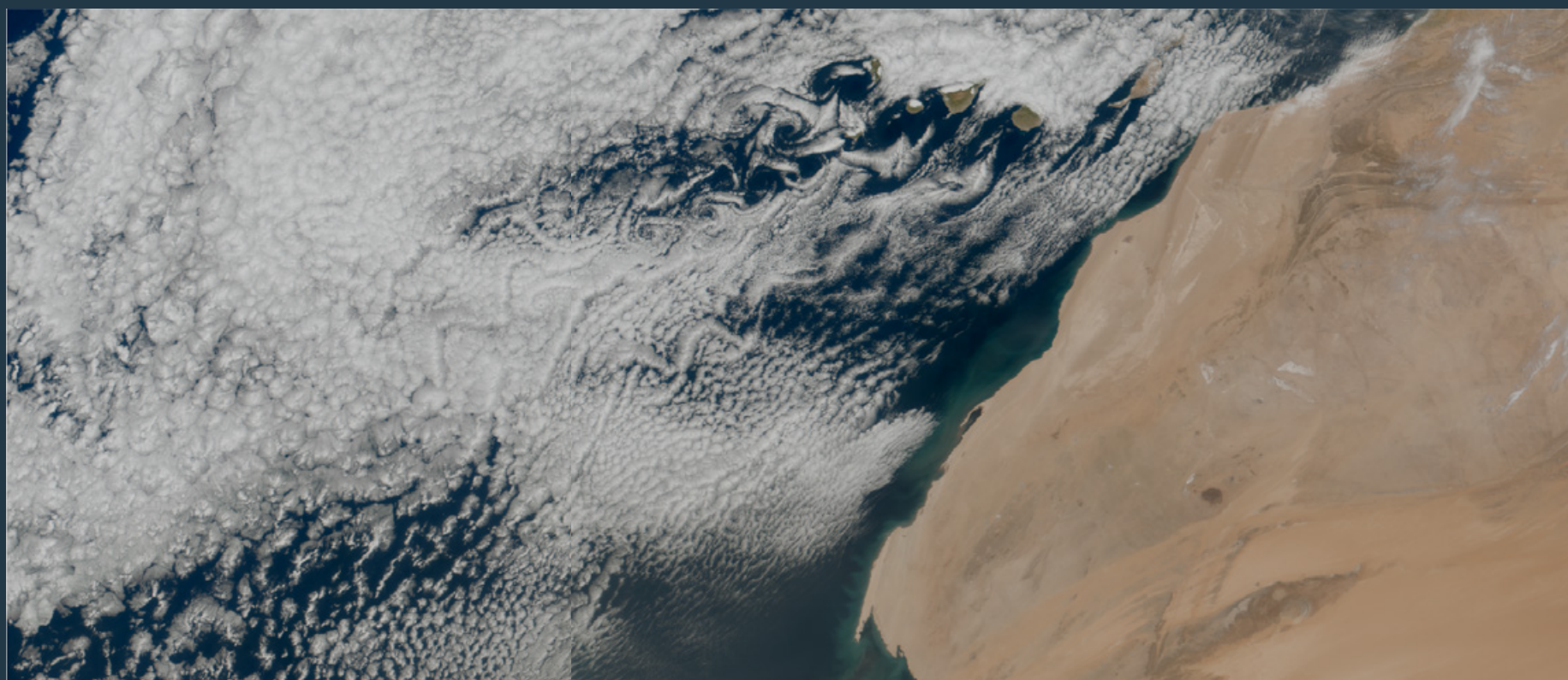


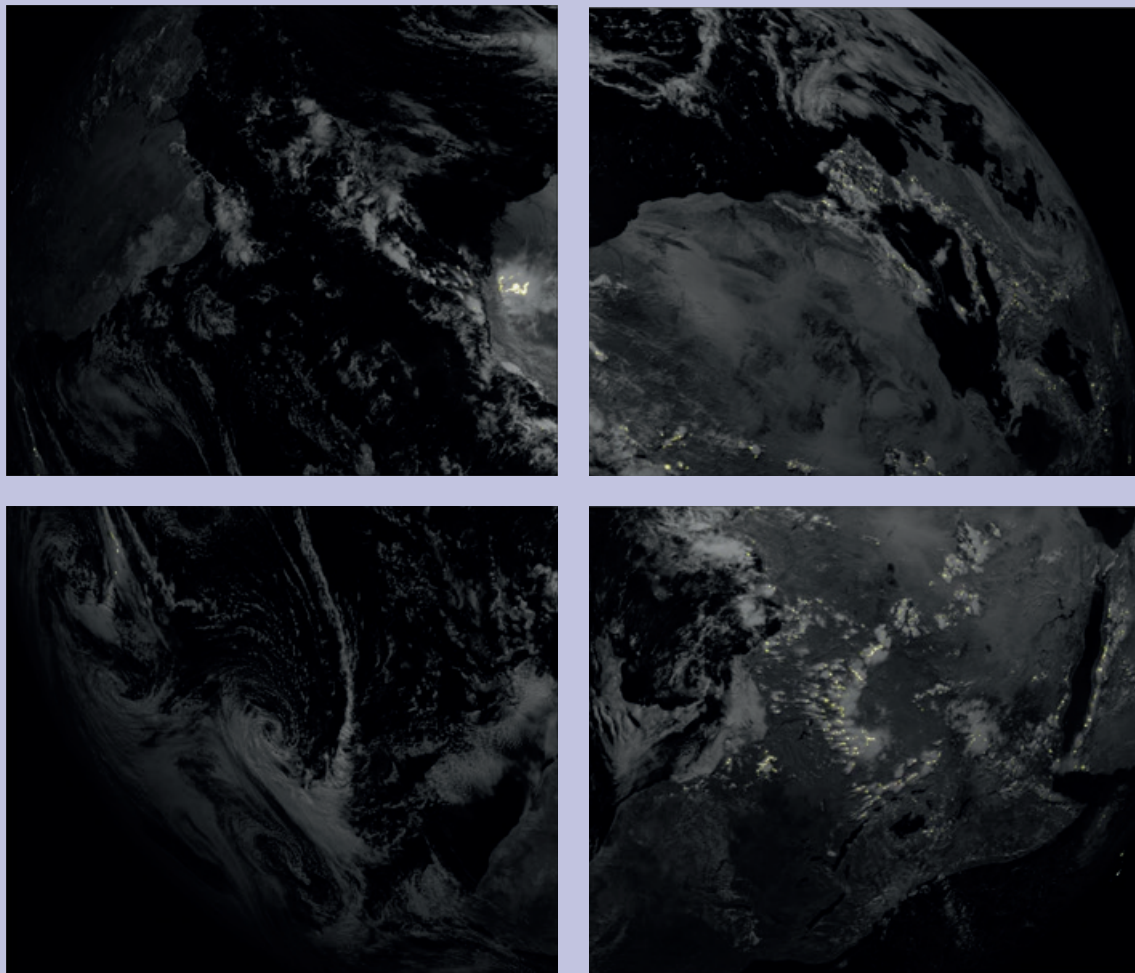
▶ A "zoom in" on Europe taken from MTG-I1's first image shows beautiful cloud features such as the "cloud streets" over the Greek Islands, the so-called Von Karman vortices downstream of the Canary Islands, and cumulus cloud fields over the Libyan coast. The snow on the Alps and in Norway is also visible in greater detail than is possible to ascertain from the imaging instruments on Meteosat Second Generation satellites.

► This Cloud Type RGB image from the Flexible Combined Imager on MTG-I1 shows various cloud types over eastern Africa, clearly differentiating the water clouds (light blue colour) from ice clouds (yellow and red colours). This product is particularly powerful in capturing thin ice clouds (red colours). The image was captured at 11:50 UTC on 18 March 2023.



► This "zoomed in" image beautifully reveals Von Karman vortices, these swirls patterns are formed downstream by the wind flowing over the mountains in the Canary Islands. The FCI instrument shows more cloud detail than is possible imagery from the Meteosat Second Generation satellite's imager. This image was taken at 11:50 UTC on 18 March 2023.





▲ Above is a composite image showing the fields of view of the four cameras of the MTG-I Lightning Imager. The images were taken on 2 and 5 June 2023 by (clockwise from top left) the west, north, east and south cameras. The data used for these images were acquired at a lower sensitivity setting of the instrument than will be provided to meteorological services for weather forecasting purposes.





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

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## Satellite operations

The uninterrupted provision of data from EUMETSAT's satellites, 24 hours a day, every day, is essential for member states' meteorological and hydrological services to provide timely, accurate weather forecasting. Central to this objective is the efficient and expert operation of the organisation's satellite fleets.



### MTG-11

3.4°W

#### Commissioning phase

MTG-11 was successfully launched on 13 December 2022.

## Meteosat

Meteosat Third Generation – Imager 1 (MTG-11) was in its commissioning phase throughout 2023. The MTG-11 satellite in-orbit verification came to an end in December, marking the formal hand-over of the satellite activities from the European Space Agency (ESA) to EUMETSAT.

Between 1 March and 12 April, the missions and orbital positions of Meteosat-10 and -11 were swapped with only a brief interruption to the full-Earth scan service.

Meteosat-10 was moved from 9.5°E to 0° where both satellites shared that slot for 24-hours until, after image acquisition by Meteosat-10 was confirmed, Meteosat-11 was moved to 9.5°E. The reason for the swap was that Meteosat-10 was about to reach its qualification limit for the number of rapid scan cycles it should perform, while Meteosat-11 can perform that task for at least five years. The process involved many EUMETSAT teams and was streamlined as much as possible to minimise the impact on the full-Earth scan service.



### Meteosat-11

*0° longitude*

#### **Rapid Scan Service (RSS)**

Delivers the Meteosat secondary RSS service over Europe and adjacent seas.



### Meteosat-10

*9.5°E*

#### **Full Earth Scan imagery**

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



### Meteosat-9

*45.6-45.9°E*

#### **Indian Ocean data coverage (IODC)**

Delivers the EUMETSAT best-effort contribution to the multi-partner IODC services.

The Geostationary Earth Radiation Budget instrument on Meteosat-10 suffered an anomaly on 13 September which was recovered four days later, just before the instrument underwent a planned switch to safe mode for the sun avoidance season.

Meteosat-9 continued to perform the Indian Ocean data coverage (IODC) service well, with very good availability of data. The satellite is operated between 45.6°E and 45.9°E to mitigate conjunction risk from an adjacent satellite and this has not affected image performance for data users.

The Meteosat Mission Lifetime Review was held in October 2023. The main outcomes included:

- the possibility to extend Meteosat-9's lifetime beyond 2025 until about 2027, providing continuity for the IODC service
- the possibility to extend parallel operations between MTG-I1 (as prime geostationary satellite) and Meteosat-10 into 2026
- Meteosat-11 could continue to provide the rapid scan service until the second or third quarter of 2028, which is compatible with the planned entry into operations of MTG-I2



## Satellite operations

### EUMETSAT Polar System

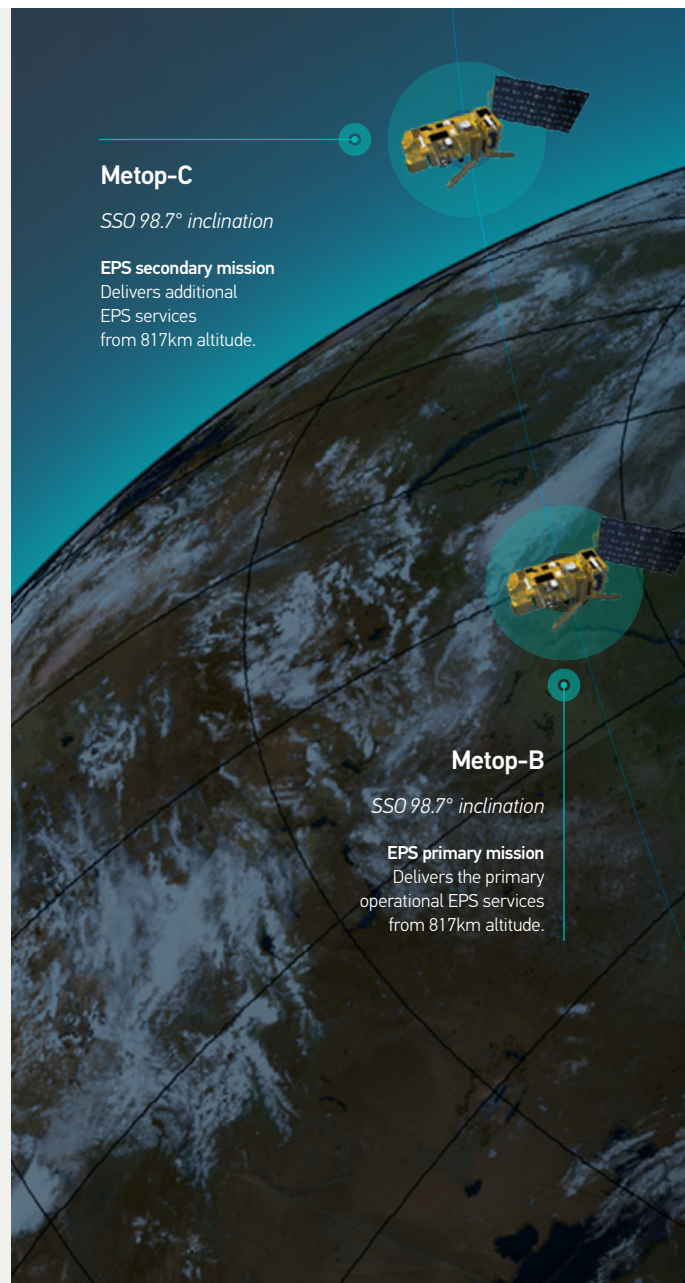
The EUMETSAT Polar System operates a dual-Metop satellite system. Metop-B and -C are likely to achieve operational lifetimes similar to, or better than, the 15 years achieved by the now-decommissioned Metop-A.

Metop-B continued as the primary satellite, downlinking data twice per orbit at Svalbard and McMurdo, the latter through the Antarctic Data Service provided by the US National Oceanic and Atmospheric Administration (NOAA). Metop-B continued to perform well throughout 2023, with some exceptions. The filter wheel on the satellite's High-Resolution Infrared Radiation Sounder, which was successfully restarted in August 2022 after being stalled for two years, stalled again. Automated commanding to free it again resumed. The Advanced Very High Resolution Radiometer instrument's near visible channels began degrading in July. The cause of the anomaly is under investigation. Fortunately, the infrared channels were not impacted.

Metop-C also performed well in 2023. However, an outage of all US instruments for one hour and 54 minutes occurred on 23 August, most likely as a result of a radiation event. One of the satellite's gyroscopes has been marked as failed but sufficient redundancy is in place to continue the mission in case of a further failure. One of the batteries showed indications of cell electrical leakage, triggering preparations to safely disconnect the battery. However, the battery has fluctuated between degraded and near-nominal performance, lifting the need for disconnection in the near term. The battery's performance will continue to be monitored. The partial failure of a platform bus coupler serving the attitude control system sensors and gyroscopes was mitigated by a workaround that was tested during the decommissioning of Metop-A. Nominal lifetime has not been impacted and the single point of failure has been removed.

### Copernicus Sentinels

Copernicus Sentinel-3A and -3B performed well throughout 2023. All routine operations were performed nominally. Although there were four instrument anomalies in February (Sentinel-3B Sea and Land Surface Temperature Radiometer (SLSTR)), August (Sentinel-3A SLSTR and Sentinel-3B SLSTR) and November (Sentinel-3A Ocean and Land Colour Instrument), these accounted for only around 5½ days of data degradation or loss. The payload data ground segment was also generally nominal, apart from an anomaly from 29 April to 5 May, due to a hardware failure which stopped the



#### Metop-C

*SSO 98.7° inclination*

#### EPS secondary mission

Delivers additional EPS services from 817km altitude.

#### Metop-B

*SSO 98.7° inclination*

#### EPS primary mission

Delivers the primary operational EPS services from 817km altitude.

data processing and dissemination functions. A further hardware failure resulted in the late delivery of about 17 hours' worth of data on 30 August, and occasional issues with data being delivered late to EUMETSAT by ESA which impacted the near-real-time key performance indicators. The operational activation of the newly re-engineered ground segment in November has overcome the payload data ground segment's hardware failure risk.

The fourth Sentinel-3 Mission constellation review performed jointly with ESA and covering operations in 2022, took place on 28 March with representatives from the Copernicus services and the European Commission. It concluded that both Sentinel-3 satellites are in excellent health and on track for a long and healthy life beyond the mission lifetime expectations. The mission continues to fulfil its requirements and the needs of users.



### Copernicus Sentinel-3B

*SSO 98.7° inclination*

**Copernicus Sentinel-3 mission**  
Delivers Copernicus marine and near-real-time atmospheric data services from 814km altitude.

### Jason-3

*NSO 66° inclination*

**Interleaved orbit**  
Provides measurements of ocean surface topography and sea state from a non-synchronous, 10-day repeat orbit at 1,336km altitude (mission shared with CNES, NOAA, NASA and the European Commission).

### Copernicus Sentinel-3A

*SSO 98.7° inclination*

**Copernicus Sentinel-3 mission**  
Delivers Copernicus marine and near-real-time atmospheric data services from 814km altitude.

### Copernicus Sentinel-6 Michael Freilich

*NSO 66° inclination*

**Reference altimetry mission**  
Delivers measurements of ocean surface topography and sea state from a non-synchronous, 10-day repeat orbit at 1,336km altitude (mission partners are EUMETSAT, the European Commission, ESA, NASA/ JPL and NOAA, with support from CNES).

Copernicus Sentinel-6 Michael Freilich performed well throughout 2023, with all satellite routine operations, including manoeuvres, performed nominally. The satellite mission availability was very good. The Poseidon-4 high power amplifier continued to be operated on side B, with performance comparable to side A. The instrument is expected to remain able to support altimetry services throughout the satellite's nominal lifetime.

### Jason-3

Jason-3 currently operates in an interleaved orbit with Sentinel-6 Michael Freilich and continues to deliver high-quality altimetry products. Jason-3 flight operations were mostly nominal in 2023, with the spacecraft (operated

by NOAA) and the shared ground segment performing well, resulting in a very high overall availability.

In April, the yearly Jason-3 exploitation review took place with EUMETSAT, the French Space Agency, NOAA, and NASA. The review confirmed Jason-3 was in good health and could be expected to achieve a similar lifetime as its predecessors Jason-1 and Jason-2. Some data losses occurred at the NOAA and Usingen ground stations throughout the year, but did not impact the mission's overall performance. Key performance indicators remained above target.

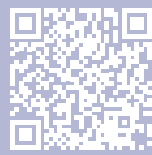




Collision avoidance manoeuvres were carried out four times for Copernicus Sentinel-3B, twice for Metop-C and once each for Metop-B and Copernicus Sentinel-3A. By comparison, three collision avoidance manoeuvres were required in 2022.

In August, two emergency collision avoidance manoeuvres – one for Metop-C and one for Sentinel-3B – were carried out within the space of two days.

On Monday 8 August, EUMETSAT successfully performed a collision avoidance manoeuvre for Metop-C in record time to avoid an unknown object, half an orbit before a potential collision. Just over four hours had passed from receipt of the short notice warning until the manoeuvre was designed, uplinked and executed to the spacecraft.

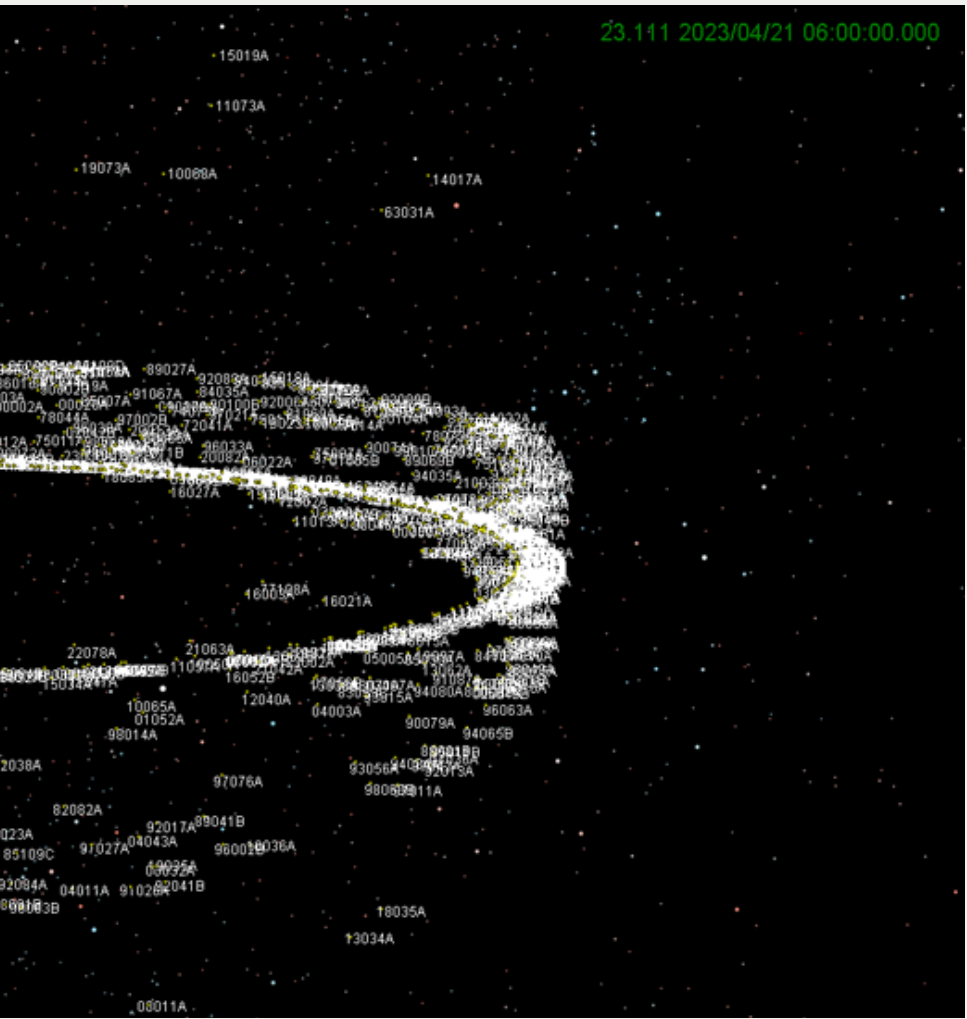


For more information, read the case study on the EUMETSAT website

<https://www.eumetsat.int/features/preventing-space-collisions>

But the record didn't last long.

On 10 August, the flight dynamics team was called on again to design a manoeuvre, this time to ensure Sentinel-3B avoided space debris. In fact, this second manoeuvre was designed and carried out 31 minutes faster than Metop-C's.



◀ The active geostationary satellites population and the more than 2,000 catalogued pieces of space debris within or passing through the geosynchronous region, all labelled by their international designator. In total, there are nearly 27,000 pieces of space debris in orbit – those closer to the earth are not pictured here.

Source: Space-Track geosynchronous catalogue, EUMETSAT visualfocus animation.



## Services to data users

EUMETSAT is committed to ensuring its data are provided to those who require them in a way that meets their needs, that is, quickly, reliably and efficiently. The aim is to ensure member states and other data users reap maximum benefit from EUMETSAT's satellite fleets.

### EUMETCast and other “push” data access services

EUMETCast and ingestion of EUMETSAT's data and products into the World Meteorological Organization's global telecommunication system services were nominal in 2023. EUMETCast services continued to surpass availability requirements with minor issues such as planned maintenance and bad weather having minimal impact.

### Online “pull” data access services

Considerable progress was made in 2023 on the new EUMETSAT user portal, the one-stop-shop for users of EUMETSAT's data products and services, which will become operational in 2024. Via the portal ([user.eumetsat.int](https://user.eumetsat.int)), data users can discover, access, and learn how to exploit satellite data. Users will be able to register for and personalise subscriptions to data via the portal, replacing the existing Earth observation portal. The user portal will be a major enhancement in how people obtain and access EUMETSAT satellite data and information.

The Data Store, Data Tailor and EUMETView online services had monthly availabilities of more than 99.5% for the first half of the year. Some issues arose in the data chains affecting end-to-end timeliness – from sensing to arrival in the Data Store – particularly for Copernicus Sentinel-3 near-real-time products later in the year. Mitigation measures were put in place.

The EUMETSAT Data Access Client offers easy, effective and well-described programmatic methods to download from the Data Store catalogue, including customisations through Data Tailor. It has evolved to become the preferred way for users to access the online data, catering for those with little coding experience, as well as for advanced users.



The latest release of EUMETView included some optimisations in the available layers to create room for new imagery and the ability to save PNG images with transparent backgrounds for no-data pixels. This will allow EUMETView users to combine and overlay saved imagery with other images. Two new products were introduced in the EUMETView service:

- Support to Nowcasting and Very Short Range Forecasting Satellite Application Facility (NWC SAF) rapidly developing thunderstorms
- Ocean and Sea Ice SAF (OSI SAF) sea ice concentration blended climate data record and interim climate data record for the Northern Hemisphere

A new release for the Data Store in May allowed for additional filtering of Copernicus Sentinel-3 data, for example, by searching by orbit, as requested by users. Additional data records were added to the Data Store:

- Advanced Scatterometer (ASCAT) level 1 climate data record release 2 (2007-2014) in three resolutions
- Global Ozone Monitoring Experiment-2 (GOME-2) level 1 fundamental data record release 3, Metop-A and -B (2007-2020)
- Infrared Atmospheric Sounding Interferometer (IASI) all sky temperature and humidity profiles climate data record, Metop-A and -B (2007-2018)

## EUMETSAT Advanced Retransmission Service

The availability of all EUMETSAT Advanced Retransmission Services (EARS) was good throughout 2023. EARS provides data from polar-orbiting satellites from EUMETSAT, NOAA and the China Meteorological Administration with a timeliness to suit the needs of European short-range numerical weather prediction models. The geographical coverage of EARS is primarily over data-sparse sea areas around Europe.

## Archived data services – the Data Centre

Access figures for the Data Centre archive decreased throughout 2023 as intended, as more users switched to the Data Store. The transition will be encouraged by successively hiding products in the Data Centre when they can be downloaded from the Data Store and tailored.

## Helping to mark a milestone

To mark the German Meteorological Service's (DWD) 70<sup>th</sup> anniversary, the German Parliament's subcommittee on traffic and infrastructure held a public hearing on the relevance to society and the economy of the weather service's forecasting and climate monitoring.

Cristian Bank, EUMETSAT's Director of Programme Preparation and Development, was among seven experts invited to participate in two hours of questions from all parties in the parliament on 24 April. Bank addressed questions about the relevance and use of satellite data for weather predictions, the socio-economic benefit of EUMETSAT's satellite systems, access to EUMETSAT data for institutional and commercial users and the improved services expected from Meteosat Third Generation, the EUMETSAT Polar System - Second Generation, and other future programmes.

At the same time, the DWD installed an exhibition at the parliament in Berlin. The exhibition featured contributions from EUMETSAT, showcasing the impact of the organisation's work. The exhibition, which ran from 20 April to 12 May, included models of Meteosat Second and Third Generation satellites.



▲ EUMETSAT Director of Programme Preparation and Development Cristian Bank (front row, second from left) addresses the German parliament on 24 April 2023



## EUMETSAT satellite application facilities

EUMETSAT's satellite application facilities (SAFs) are dedicated centres of excellence for processing satellite data, making use of specialist expertise in our member states. They form an integral part of the distributed EUMETSAT ground segment.

The eight EUMETSAT SAFs provide operational data and software products, each one for a dedicated user community and application area.



**Ocean and Sea Ice (OSI SAF)**  
led by Météo-France, France



**Land Surface Analysis (LSA SAF)**  
led by Instituto Portugues do Mar e da Atmosfera, Portugal



**EUMETSAT**  
**ROM SAF**

Radio Occultation  
Meteorology (ROM SAF)  
led by the Meteorologiske  
Institut, Denmark

**EUMETSAT**  
**AC SAF**

Atmospheric Composition  
Monitoring (AC SAF)  
led by the Ilmatieteen laitos,  
Finland

**EUMETSAT**  
**NWP SAF**

Numerical Weather  
Prediction (NWP SAF)  
led by the Met Office,  
United Kingdom

**EUMETSAT**  
**NWCSAF**

Nowcasting and Very Short-  
Range Forecasting (NWC SAF)  
led by Agencia Estatal de  
Meteorología, Spain

**EUMETSAT**  
**CM SAF**

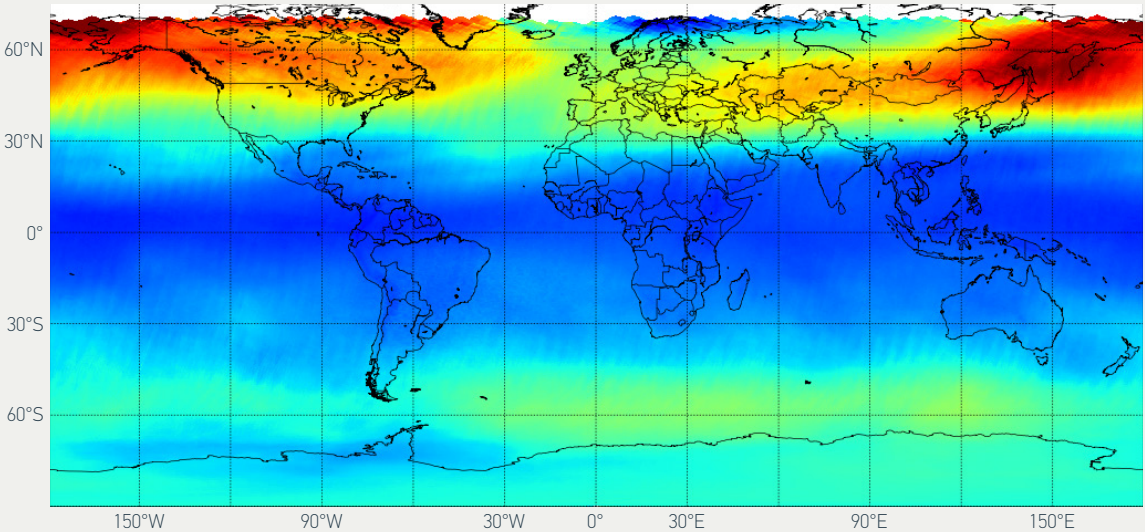
Climate Monitoring (CM SAF)  
led by Deutscher  
Wetterdienst, Germany

**EUMETSAT**  
**H SAF**

Operational Hydrology and  
Water Management (H SAF)  
led by Servizio Meteorologico  
Aeronautica Militare, Italy

## EUMETSAT satellite application facilities

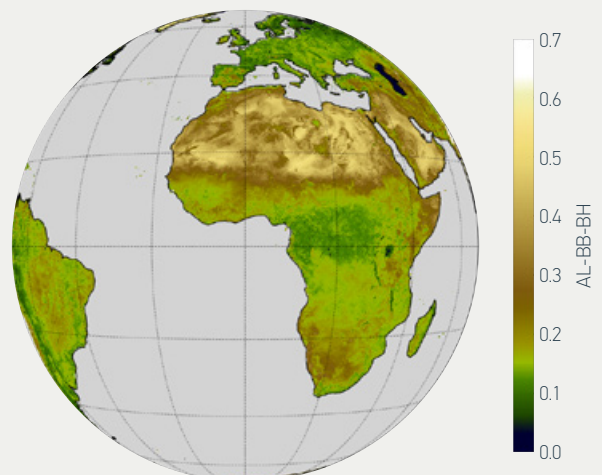
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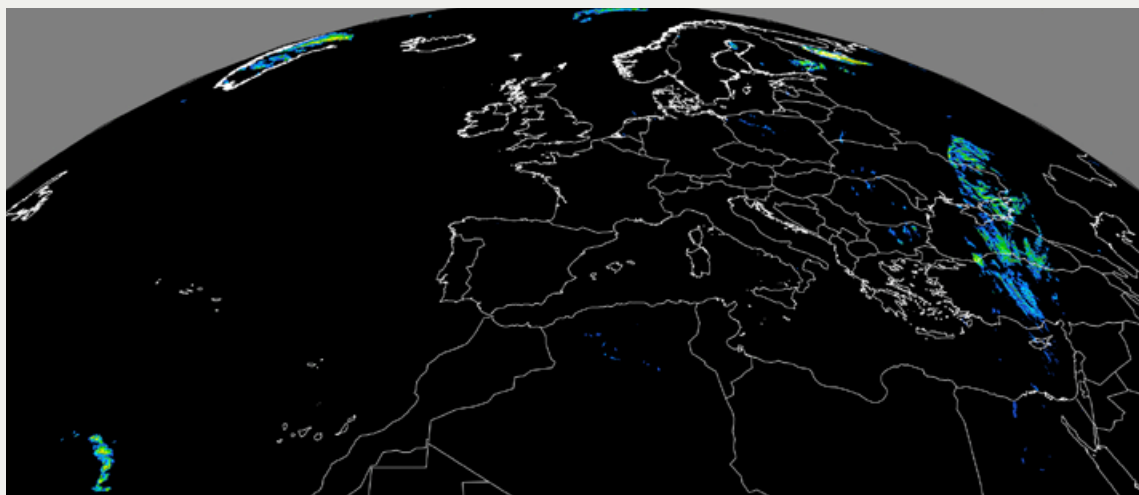


▶ The Atmospheric Composition Monitoring SAF (AC SAF) released an operational service to distribute daily and monthly means of trace gases ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), formaldehyde (HCHO), bromine monoxide (BrO), sulphur dioxide (SO<sub>2</sub>) and water vapour (H<sub>2</sub>O), on 12 April. These products are spatially and temporally aggregated from the operational AC SAF level 2, pixel-based, near-real-time products.

The Atmospheric Composition Monitoring SAF (AC SAF) released an operational service to distribute daily and monthly means of trace gases ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), formaldehyde (HCHO), bromine monoxide (BrO), sulphur dioxide (SO<sub>2</sub>) and water vapour (H<sub>2</sub>O), on 12 April. These products are spatially and temporally aggregated from the operational AC SAF level 2, pixel-based, near-real-time products.

▶ The Land Surface Analysis SAF (LSA SAF) released new versions of the daily and 10-daily surface albedo products based on Meteosat Second Generation Spinning Enhanced Visible and Infrared Imager (SEVIRI) instrument observations. The new products provide enhanced: (i) incorporation of aerosols effects; (ii) SEVIRI bias correction; (iii) updated "SMAC" algorithm coefficients and processing and (iv) updated narrow- to broadband conversion coefficients. The products, released on 20 November, are disseminated in near-real time via EUMETCast.





CCR Convective Rainfall Intensity



▲ The Support to Nowcasting and Very Short-Range Forecasting SAF (NWC SAF) released a new sub-version of the GEO Software Package (version 2021), on 15 June. It includes an extended look-up table for the convective rain rate (CRRPh) module, to capture the complete range of situations in tropical areas. It also included support for European Centre for Medium-Range Weather Forecasts' Grib2 files through the inclusion of an ecCodes library.

▼ The Ocean and Sea Ice SAF (OSI SAF) released upgraded level 2 and level 3 sea ice concentration products from the Special Sensor Microwave – Imager/Sounder and Advanced Microwave Scanning Radiometer-3 microwave instruments, on 25 April. The products are disseminated in near-real time via EUMETCast.

The Climate Monitoring SAF (CM SAF) has provided a data record of water vapour total column content which is based on microwave observations over seas and optical sensors over land. The land data was contributed by the European Space Agency. The record spans July 2002 - December 2017 and was released on 6 February.

The Radio Occultation Meteorology SAF (ROM SAF) started dissemination of level 2 products (refractivity, temperature, humidity and pressure), derived from PlanetiQ data, on 7 September. PlanetiQ data are procured by the National Oceanic and Atmospheric Administration but made available to EUMETSAT under a global licence. These data have "demonstrational" status.

The Numerical Weather Prediction SAF (NWP SAF) released version 3.2 of its Radiance Simulator (RadSim) on 27 July. RadSim v3.2 has been updated to work with the RTTOV v13.2 software and enables new features including the MFASIS-NN (neural network based fast visible/near-infrared cloud solver), the new polarisation treatment in RTTOV-SCATT, and the new SURFEM-Ocean microwave sea surface emissivity model.

Sea Ice Concentration





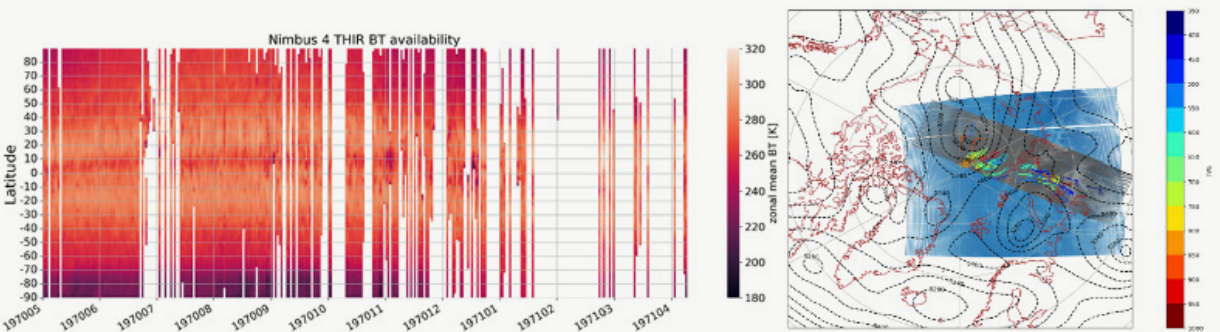
## Climate services

EUMETSAT has enhanced its systematic approach to delivering high-quality climate data records utilising satellite observations that now span more than 45 years. New climate data records were created at EUMETSAT headquarters and by the satellite application facility (SAF) network in 2023.

The EUMETSAT Council approved a renewed Climate Service Development Plan in July. The plan emphasises ensuring the best use of EUMETSAT data for climate applications supporting mitigation of and adaptation to climate change. EUMETSAT's high-quality and long-term climate data records enable an improved understanding of the Earth system, particularly by quantifying climate change in terms of changing variability including extremes and by providing information on the impact of climate change.

The data records play a key role in the fight against climate change as reliable, accurate accounts of changes in the climate over decades. They are relied upon by authoritative reports, such those from the Intergovernmental Panel on Climate Change, as well as annual climate status reports by the Copernicus Climate Change Service and the World Meteorological Organization (WMO).

▼ Figure 1: Coverage of measurements from the THIR instrument infrared window channel in 1970 (left) and derived atmospheric wind vectors on 12 July 1970 over the Arctic Ocean (right)

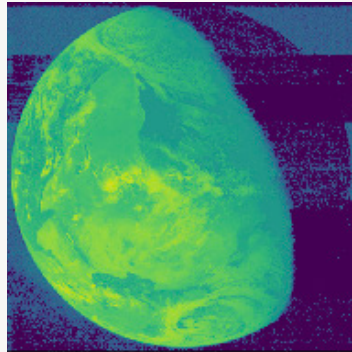
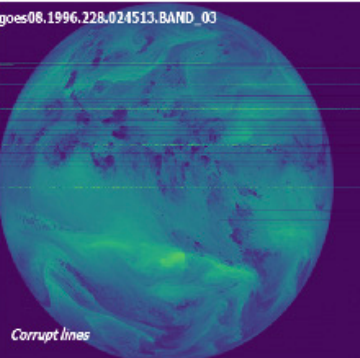
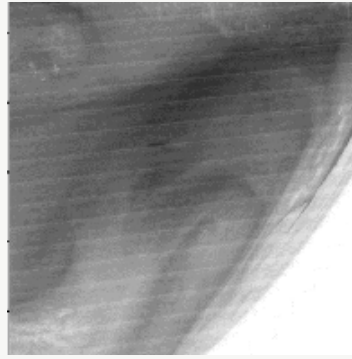
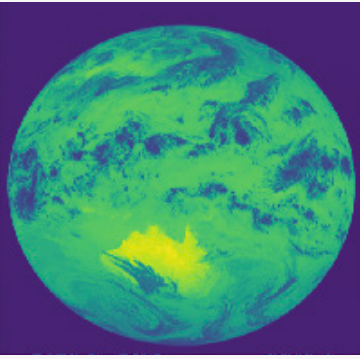


The Climate Service Development Plan 2023 strengthened the focus on user engagement for climate data increasing its utility for climate applications beyond reporting, for example, supporting renewable energy and agriculture applications, monitoring greenhouse gases with the Copernicus CO2 Monitoring mission to support Europe's operational monitoring and verification support capacity to quantify anthropogenic CO2 emissions, and mitigating climate risks.

To foster access to information contained in EUMETSAT climate data records, EUMETSAT and its SAF network have started to develop an online service that will provide climate anomalies for many climate system variables at monthly scale versus the WMO defined climate normal (1991-2020). In the future, the service will be updated with data from the prior month with a timeliness of a few days. This enables the provision of recent information about the status of the climate system to the public. The service will be interoperable with similar services operated by the Copernicus Climate Change Service, implemented by the European Centre for Medium-Range Weather Forecasts (ECMWF), to provide the best from the joint capabilities.

In terms of data records, EUMETSAT has continued its strong support to the Copernicus Climate Change Service by producing more input data sets for the ERA6 reanalysis. Particularly noteworthy is a second release of the High-Resolution Infrared Radiation Sounder (HIRS) data record that consists of all available data from US National Oceanic and Atmospheric Administration (NOAA) and ECMWF archives with a consistent calibration. A trial run with an ERA6-like data assimilation system showed positive impact, particularly in the mid and high troposphere. In addition, a recalibrated and uncertainty characterised radiance data record was delivered from measurements from the Special Sensor Microwave/Temperature microwave sounding instrument for the years 1991-2005.

These data complement data from the Microwave Sounding Unit with spectral channels providing estimates in the stratosphere, which was identified as a weakness



◀ Figure 2: Examples of detected radiometric anomalies in satellite images, GMS-1 over illumination IR on 15 Sep 1979 (upper left), MTSAT-1R moonlight contamination WV on 27 May 2007 (upper right), GOES-8 corrupt line on 16 Aug 1996 (lower left), and Meteosat-1 VIS non-uniform background noise on 16 Dec 1978 (lower right)

prior to the arrival of radio occultation data in the ECMWF Reanalysis v5 (ERA5). It is expected that these data will provide significant improvements for ERA6. In addition, the feasibility of deriving atmospheric motion vectors from measurements of the Temperature-Humidity Infrared Radiometer (THIR) instrument with data for the year 1970 was demonstrated (Figure 1).

EUMETSAT started a project with NOAA to produce a consistent radiance data record for all measurements taken from geostationary orbit by EUMETSAT, NOAA and the Japan Meteorological Agency at a temporal sampling of 30 minutes and a spatial sampling of about 4km, starting in the late 1970s. This project involves data rescue activities for early GOES satellite data, rigid quality control by detecting all radiometric anomalies, recalibration and cross-calibration of all sensors, and mapping to a common grid. In 2023, EUMETSAT completed the radiometric anomalies for NOAA satellites from GOES-8 onwards and to the Himawari-8 and -9 satellites (Figure 2). These data will be extremely useful for creating consistent Global Climate Observing System essential climate variable data records and to enable consistent tracking of tropical cyclones and mesoscale convective clusters around Earth. All of this will be particularly impactful in supporting the improvement of emerging climate models operating at kilometre scale with spatial resolution like measurements from geostationary orbit.

Data records completed and released in 2023:

- Advanced Very High Resolution Radiometer global area coverage radiance data record from 1979 to present
- Meteosat First Generation radiances with full image characterisation (anomalies) and derived all sky radiance products (1981-2007)
- Cross-calibration coefficients for the entire time series of Meteosat Second Generation instruments' data since 2004
- Consolidated HIRS data record unifying NOAA archives and ECMWF data holdings for all instruments (1978-2022)
- Special Sensor Microwave/Temperature data record providing recalibrated and uncertainty characterised microwave temperature sounding data (1991-2005)
- Spinning Enhanced Visible and Infrared Imager (SEVIRI) rapid scan service data record with recalibrated radiances with 5-minute time resolution (2008-2021)
- Meteor SI-1 (Spectrometer/Interferometer-1) data record of about 4,000 infrared spectra from the German Democratic Republic spectrometer/interferometer flown on Russian Meteor satellites (1977 and 1979)

EUMETSAT started to implement the new, five-year rolling Copernicus Reprocessing Plan in 2023. Complete reprocessing was performed for all altimeter data on the Copernicus Sentinel-3 and Sentinel-6 Michael Freilich satellites. For the Copernicus Atmosphere Monitoring Service (CAMS), a Sentinel-3 Sea and Land Surface Temperature Radiometer aerosol optical depth data record has been created to be used in the CAMS reanalysis planned for 2024.



## Aiming for the Moon – to accurately monitor the Earth

When it comes to monitoring our changing climate, small signals detected by satellite instruments can have large implications.

So, ensuring the accuracy of measurements of these signals is crucial.

On 4-8 December, scientists from around the globe took part in a meeting hosted by EUMETSAT to discuss progress on this challenge.

The meeting shared knowledge and expertise in the field of lunar calibration, that is, using satellite instruments' observations of the Moon to determine the accuracy of observations of the Earth's systems.

### Using the Moon to calibrate satellite instruments

Unlike the Earth, the Moon has several advantages that make it a very powerful calibration target for satellite instruments.

Firstly, the Moon has properties that make it an exceptionally stable target over time; secondly, it has no atmosphere and there is no impact from human activity to influence sensors' observations, EUMETSAT radiometric calibration expert Dr Sébastien Wagner said.

The lunar cycle is also well known. Combining this knowledge and the extreme stability of the Moon surface allows scientists to establish numerical models to simulate very accurately the lunar brightness at any point in time. In return, those simulations can serve as references for comparisons with lunar measurements from an instrument in space.

"When an instrument has the possibility to observe the Moon on a regular basis, it offers a unique opportunity to very accurately assess the instrument's calibration and temporal stability, which is essential for Earth observation missions," Wagner said.

"We want to work also on defining intercalibration algorithms that can allow us to tie all of the instruments that we have to a common reference, using the Moon."

To achieve those goals, the scientists are working to define new and more accurate models that would simulate what a satellite's instrument should see when it targets the moon to determine the accuracy of the instrument.

To do so, they need to "characterise" the Moon's brightness over time, by getting as many independent and accurate measurements of it as possible.

"The only limitation comes from the models and the measurements that are used to infer those models," Wagner said.

"We are trying to get as many measurements as possible to calibrate the models. Measurements that are traceable. Once you have the models, you can apply them to your instruments."

It is hoped this work will reduce the uncertainties of instruments' measurements and reference data.



*“We want to work also on defining intercalibration algorithms that can allow us to tie all of the instruments that we have to a common reference, using the Moon.”*

**Dr Sébastien Wagner**  
Radiometric calibration expert  
EUMETSAT

▼ *A complete view of the Moon, taken by the Flexible Combined Imager on Meteosat Third Generation – Imager 1, on 1 September 2023 at 10:50 UTC*

### Reducing uncertainty

The “why” of this international effort goes back to the original point about the need for confidence in the accuracy of satellite data used for climate and weather monitoring.

Satellites’ instruments can degrade over time and scientists who use their data need to know whether they are seeing results of a change in what an instrument is measuring, or a change in an instrument’s accuracy.

Improving the lunar models to serve as references against which satellite instruments can be calibrated will help determine the accuracy of those instruments’ observations of the Earth system.



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

<https://www.eumetsat.int/aiming-moon-accurately-monitor-earth>





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

New horizons

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European Weather Cloud

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WEkEO

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## New horizons

Meteorology and climate science continue to experience a period of rapid change related to developments, applications and impacts of artificial intelligence (AI). Machine learning (ML) methods have proven capable of producing reliable short-to-medium range forecasts.

Several national meteorological and hydrological services recognise that advancements in ML are set to transform operational workflows, particularly in numerical weather prediction and other services. There is a shared understanding of EUMETSAT's crucial role in the various aspects of data curation.

The application of AI and ML technologies is not limited to prediction tools, but will also extend to other areas relevant to EUMETSAT, including:

- remote sensing image fusions, an effective method for merging multiple satellite data sources into a single, more interpretable product (virtual instruments);
- automatic feature search and extraction, using reinforcement learning, to analyse various satellite data, producing advanced information levels;
- expanding existing physically based processors and algorithms to create a unified platform for development and testing;
- applying large language models to various components of the EUMETSAT value chain, including operations, data exploration and access and cloud management.

The EUMETNET General Assembly has adopted a strategic initiative called "Artificial Intelligence and Machine Learning for Weather, Climate and Environmental Applications" (E-AI) that will rely substantially on EUMETSAT's expertise in data curation.



▲ Credit: AI generated using Adobe Firefly

It is structured around three modules:

- Data curation to enhance the value of observations, gridded observational datasets, model fields, and further datasets by making them AI-ready. This module is expected to receive substantial contributions from a EUMETSAT project that is currently under development and aims for activities in data curation, management and exploitation, as well as in training and capacity building and infrastructure support.
- Analysis, modelling and post-processing, including retrieval and estimation products, nowcasting, data assimilation and modelling, uncertainty estimation, and post-processing. The objective is to enhance capabilities to use AI/ML approaches in modelling. This module includes the European Centre for Medium-Range Weather Forecasts' member states' pilot programme.
- A products and services module to enhance the use of AI/ML in the development of products and services.

The implementation of this initiative will start in 2024, after the EUMETSAT Council has validated the involvement of the organisation.

## European Weather Cloud

The European Weather Cloud (EWC) is a joint initiative of EUMETSAT and the European Centre for Medium-Range Weather Forecasts (ECMWF). It is the cloud-based collaboration platform for the development and operations of meteorological applications in Europe and is enabling the digital transformation of Europe's meteorological infrastructure. The EWC is dedicated to supporting the national meteorological and hydrological services in EUMETSAT's and the ECMWF's member states in fulfilling their official duties to protect life and property from impending meteorological hazards. The platform became operational on 26 September 2023. The fifth EWC user workshop was held the same day and was attended by about 130 participants, confirming interest among the user community. By the end of 2023, the EWC hosted 100 tenancies from member states.

EUMETSAT launched its first research and development call for the EWC in August 2022 and the second in April 2023. Five projects were approved in May 2023. Four more projects, all from European academic institutions, were approved after a second call for submissions. The research and development calls will be repeated annually, every spring.

## WEkEO

The European Union's (EU) Copernicus programme aims to provide integrated access to its data and information. To achieve this, EUMETSAT, together with the European Centre for Medium-Range Weather Forecasts (ECMWF), the European Environment Agency and Mercator Ocean International – the entities entrusted with implementing the Copernicus atmosphere, climate, land, and marine monitoring services – have established the WEkEO Data and Information Access Service. WEkEO ([wekeo.eu](http://wekeo.eu)) provides easy and transparent access to data from the Copernicus Sentinel satellites operated by EUMETSAT and the European Space Agency, and data from the Copernicus services, and offers hosted processing capabilities close to the data sources.

EUMETSAT and the French Space Agency (CNES) signed an agreement in August 2023 that increases the amount of data available from WEkEO and provides new sources of information. CNES is now part of the WEkEO federation.

The WEkEO 2.0 contract was kicked-off in June, with the new system launched in December. It features new services and an enhanced architecture which enables greater optimisation of, resources, elasticity and scalability. The WEkEO data offer has been extended with the ECMWF's ERA5 variables and data from EUMETSAT's own meteorological satellites.

Following the signature of a federation agreement with CNES, data from the Satellite pour l'Observation de la Terre (SPOT) World Heritage Catalogue was also added to the WEkEO catalogue. The service had more than 15,000 registered users at the end of 2023 and provides easy access to no less than 80pb of Earth observation data collected from space.

The partners held a WEkEO hackathon in June, attracting 78 participants in 24 teams from five continents.

## Destination Earth

The European Union's Destination Earth initiative (DestinE) will create digital twins of the planet, modelling the entire Earth system. EUMETSAT has responsibility for the multi-cloud data lake underpinning DestinE, including its design, establishment and testing, as well as its operations, and the provision of an online inventory. The European Centre for Medium-Range Weather Forecasts (ECMWF) and the European Space Agency (ESA) are the other two agencies selected by the European Commission for the implementation of the initiative. ESA is responsible for DestinE's core service platform and the ECMWF for the digital twins driving the weather and climate modelling.

A milestone was reached in October with the acceptance of the minimum viable service of the DestinE data lake, establishing the first version of the data lake services and distributed infrastructure. This version was ready for integration with the ECMWF's digital twins and ESA's core service platform.

At a meeting between EUMETSAT's Director-General and the European Commission's Directorate-General for Communications Networks, Content and Technology in November, agreement was reached to further consider how developments in artificial intelligence and machine learning could be used for the implementation of DestinE.

In December, the EUMETSAT Council approved phase two of the organisation's involvement in DestinE. The second phase, which begins in June 2024 and lasts until June 2026, will build on previous achievements, and will focus on engagement, meeting users' needs, and bringing the data lake services to a 24/7 operational level.

EUMETSAT will also work with the ECMWF and ESA to provide outreach, training and capacity building activities to foster the user uptake of DestinE. Other key activities planned for phase two include extending the DestinE data portfolio, maturing the artificial intelligence and machine learning preparedness of its big data processing framework, and helping to harmonise and standardise data services and their application processing interfaces, where appropriate.



# Portrait of a lake's death

Just a decade ago, Laguna de Aculeo – a 12km<sup>2</sup> lake hugging the edge of the Chilean Andes – was a popular tourist attraction. It was a vital habitat for wildlife such as birds, fish, and amphibians, and a crucial water source for local communities. But in May 2018, after several years of alarming decline, Laguna de Aculeo inexplicably dried up. The lake's demise has become a symbol of Chile's changing environment. The country is experiencing warming at twice the global average.

## Widespread concern

Diana Zambelloni, an Italian architect based in Switzerland, was studying in Santiago as part of an Erasmus+ exchange programme when the story of the lake's disappearance made national and international headlines.

"Many people were very distressed about the disappearance of Laguna de Aculeo," said Zambelloni.

"Despite the event coinciding with a major drought, the reasons for its demise were not well understood."

## The project

Zambelloni wanted to apply her technical skills to shine light on the lake's desertification. And when her friends Carlos Vivar Ríos, a bioinformatician and data scientist, and Colas Droin, a computational physicist, invited her to explore ideas for a Copernicus Jupyter Notebook competition run by WEkEO, the Copernicus data and information service, the team decided to develop a data-driven approach.

Their project, called "Portrait of a Lake's Death", impressed judges with its depth, narrative, and replicability. It was selected as the winner of the competition, organised by the WEkEO partners EUMETSAT, the European Centre for Medium-Range Weather Forecasts, Mercator Ocean International, and the European Environment Agency.

"Earth observation data is a unique source of information, and can be combined with other social, economic, or environmental datasets to provide insights into environmental change and its causes," Zambelloni said.

The Jupyter Notebook Competition by WEkEO aimed to develop a community-driven resource of notebooks for Earth observation using Copernicus data. Amongst the 36 entries were projects focused on observations of water pollution, glacier decline, and solar energy.



*"We hope that our project will inspire people in the Earth observation community and beyond to help answer outstanding questions."*

**Carlos Vivar Ríos**

Open-Research Data Engineer  
Swiss Data Science Centre

"Copernicus Sentinel-2 satellites are a powerful resource that provide high resolution Earth images in 13 spectral bands, including visible, near-infrared, and short-wave infrared, taken at regular intervals," Vivar Ríos, who works as a freelance consultant in Lausanne, said.

"We developed a script that segmented the area of Laguna de Aculeo in images taken by the satellite during the period 2016-2022. The multiple datasets enabled us to account for aspects such as seasonal ups and downs in the water level and to track the evolution of the lake over time, right up to the moment when it dried out entirely."

In their Jupyter notebook, the team outlined the approaches that they took to compile data and segment and measure the total lake area in the images.



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

<https://www.eumetsat.int/features/portrait-lakes-death>

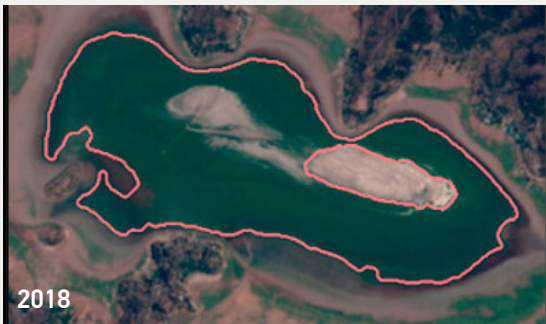


The narrative of the document provides reasoning behind preprocessing decisions and the steps the team took to make best use of the data available.

“We hope that our project will inspire people in the Earth observation community and beyond to help answer outstanding questions,” Ríos said. “These include technical challenges but also important research problems: what roles have agricultural practices and urbanisation played in the lake’s disappearance? Is the same thing happening to other water bodies nearby? What are the contributions of drought and climate change?”



2017



2018



2019

► The team used Copernicus Sentinel-2 data to profile the loss of the lake over a seven-year period



2020





*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*

EUMETSAT Polar  
System - Sterna

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EUMETSAT Polar  
System - Aeolus

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## EUMETSAT Polar System – Sterna

The EUMETSAT Polar System – Sterna (EPS-Sterna) mission would provide atmospheric temperature and humidity profiles. The mission would significantly benefit medium and short-range weather forecasting globally, as well as enhancing very-short-range forecasting regionally at high latitudes. The EPS-Sterna mission would be a constellation of small satellites, based on the Arctic Weather Satellite developed by the European Space Agency (ESA). It would be the first small satellite constellation operated by EUMETSAT.

The preliminary phase of activities of the potential EPS-Sterna mission closed in January 2023, with the preliminary requirement review. The second phase is well advanced, having held a successful system requirement review in December 2023. The ground segment requirement review is expected in the first or second quarter of 2024 and the system preliminary design review at the end of 2024 or beginning of 2025.

ESA reported nominal progress on all activities linked to the prototype, the Arctic Weather Satellite. The satellite has been integrated and the environmental testing began in November 2023. The launch of the prototype is expected in June–July 2024 and will be followed by a one-year in-orbit demonstration. EUMETSAT will be responsible for distributing the prototype data to users.

▼ *Artist's impression of EPS-Sterna (left) and EPS-Aeolus (right)*

## EUMETSAT Polar System – Aeolus

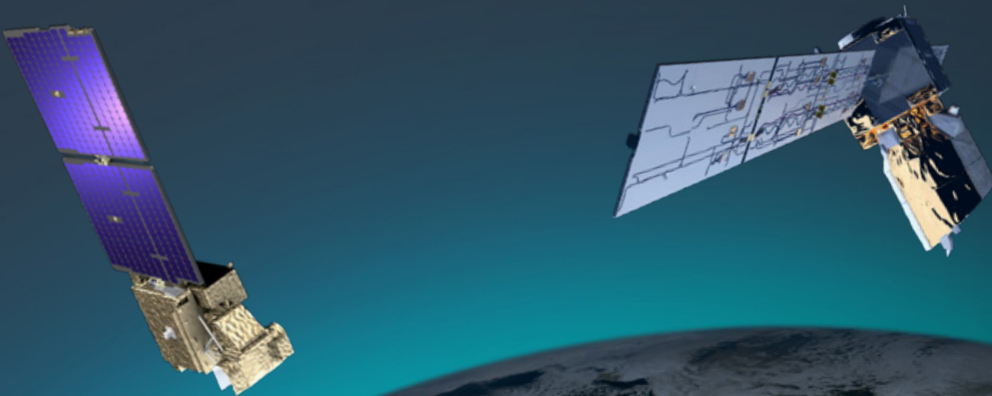
EUMETSAT Polar System – Aeolus (EPS-Aeolus) would allow wind vectors from the ground to 30–40km altitude to be determined by measuring the Doppler shift of signal backscattered by the pulses from an ultraviolet laser. The mission would be the successor to the European Space Agency's (ESA) Aeolus Earth Explorer. EUMETSAT would operate the Aeolus-2 satellite, whose development was approved by ESA's ministerial council in November 2022, and EUMETSAT plans to procure a recurrent satellite to ensure at least 10 years of observations.

The first preliminary phase of development concluded in October 2023, following a successful preliminary requirements review. The next phase began immediately, with the objective of completing the system requirements review about 12 months later.

ESA continued to report nominal progress on all technology pre-development, space segment and instrument activities, and remains on track to complete an interim space segment review during the first half of 2024. This review will confirm the capability of the spacecraft to carry a radio occultation "piggy-back" instrument.

### Decision making process

The results of a socio-economic benefits study for the EPS-Sterna and EPS-Aeolus programmes were presented to the EUMETSAT Council in November 2023 (see p55). The programmes will be presented to member states and opened for a vote in June 2024. A decision on whether to proceed with the programme is expected by mid-2025 latest.



# Study examines the potential benefits of new satellite programmes

The expansion of EUMETSAT's satellite fleet to include programmes measuring atmospheric temperature and humidity, and winds, would create an estimated €44.2 billion in social and economic benefits for the organisation's member states, according to a new study.

The study, carried out for EUMETSAT, found the adoption of two new, low-Earth-orbiting satellite missions would produce significant socio-economic benefits through improved decision making made possible by better informed weather and climate services.

Our member states will decide by mid-2025 whether to proceed with the new programmes – EPS-Sterna and EPS-Aeolus.

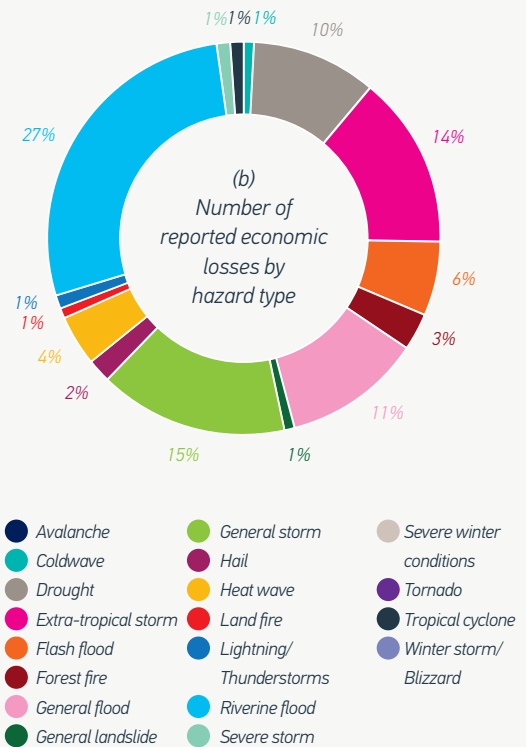
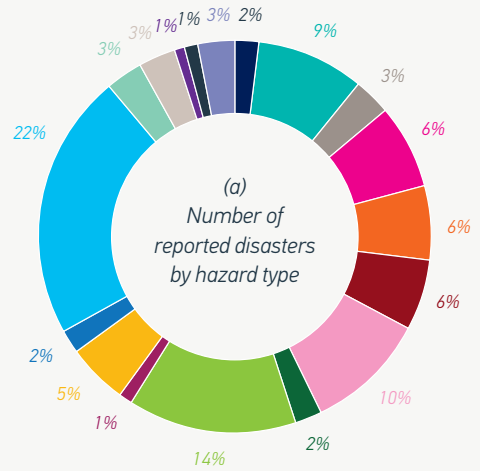
"We commissioned the study into the benefits versus the costs of the programmes to assist our member states to determine the potential return on their investment, should the council decide to approve the new missions," EUMETSAT Director-General Phil Evans said.

"The study estimated the benefits from EPS-Sterna at €32.7 billion and from EPS-Aeolus at €13.6 billion, over their expected operational lifetimes. This represents benefit to cost ratios of 51 to 1 and 20 to 1, respectively.

"Together, these two programmes would generate benefits conservatively estimated at €44.2 billion, with a benefit to cost ratio of more than 33 to 1, over their lifetimes.

"These estimates are considered conservative because they did not take into account future evolutions in weather and climate services, such as through greater use of artificial intelligence and machine learning."

The study does not attempt to quantify the value of the programmes for climate monitoring or for lives potentially saved, and does not address the value for security or defence-related applications.



▲ Distribution of (a) number of disasters and (b) economic losses by hazard in Europe (1970–2019). (Source: WMO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (2021))



For more information, read the full report on the EUMETSAT website

<https://www.eumetsat.int/media/51704>





*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

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Copernicus

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Altimetry programme

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## Space Strategy for Europe

EUMETSAT's Director-General contributed to roundtable discussions at the European Space Conference in Brussels on 24-25 January. It was an opportunity to report on recent developments at EUMETSAT and to meet with industry and European Union (EU) space leaders. Shortly after, bilateral meetings were held with the Directors-General for Defence, Industry and Space (DEFIS) and International Partnerships to review cooperation on the EU's Copernicus programme and on Africa. Cooperation on space weather also was discussed with DG DEFIS.

The Director-General discussed the continuation of research and development themes related to data from the Meteosat Third Generation and EUMETSAT Polar System – Second Generation systems with the Director-General of DG Research and Innovation. In parallel, EUMETSAT has provided contributions to the strategic research and innovation agenda, which will be used as a basis to prepare future Horizon Europe calls.

The continuation of Destination Earth (DestinE) was the focus of discussions with the Director-General for Communications Networks, Content and Technology (DG Connect). One important aspect for DG Connect was the need to integrate artificial intelligence (AI) and machine learning (ML) technologies into the next phase of DestinE. DG Connect held a dedicated meeting on the topic on 9 November, involving EUMETSAT, the European Space Agency (ESA) and the European Centre for Medium-Range Weather Forecasts (ECMWF), the three entities implementing DestinE. The European Commission has an ambitious agenda on AI/ML, which will be reflected in priorities for programmes such as Horizon Europe, Copernicus and DestinE.

EUMETSAT's Director-General participated in the ESA Council at ministerial level and in the informal joint European Union-ESA ministerial meeting in Seville on 6-7 November, during the Space Summit. The priorities discussed were support for the EU's Green Deal, and space transportation and exploration. The Director-General delivered a statement on EUMETSAT's role in Europe, the contributions that it can make and also the importance of Europe maintaining leadership on Earth observation technologies which will help in preparing future meteorological programmes. In relation to the EU's Green Deal, ESA invited partners to join its Zero Debris Charter initiative, which might be considered by EUMETSAT in 2024. A discussion on the availability of launchers also called for more aggregation of European institutional demand in future, reaffirming the need to have European priority for such launches.



### European space strategy for security and defence

In March, the European Commission and the High Representative of the Union for Foreign Affairs and Security, Josep Borrell Fontelles, presented a joint communication on European space strategy for security and defence. The strategy implements the EU Strategic Compass adopted in March 2022, which defined space, together with cyber security and oceans, as contested strategic domains, the security of which must be ensured. EUMETSAT held a follow-up discussion with the European Commission to assess the possible impact on EUMETSAT and, in particular, its Copernicus activities. Regular communication is held with member states on this issue.

### International relationships supporting European initiatives

EUMETSAT is committed to maintaining international partnerships to tackle global challenges for the benefit of its member states. It does this through bilateral and multilateral meetings and as part of European collaborations.

In January, EUMETSAT reported on its cooperation with the Japan Meteorological Agency and Japan Aerospace Exploration Agency at the EU-Japan Space Dialogue.

EUMETSAT took part in the 12<sup>th</sup> US-EU Space Dialogue on civil use of space which took place in Brussels in June. EUMETSAT and the US National Oceanic and Atmospheric Administration reported on the status of their cooperation, which is unique. EUMETSAT also contributed to discussion in the Copernicus Coordination Group on greenhouse gas monitoring.



▲ EUMETSAT Director-General Phil Evans (back row, centre) spoke about the importance of Europe maintaining leadership on Earth observation technologies at the second Space Summit, held in Seville, Spain on 6-7 November 2023 (Credit: ESA)

EUMETSAT contributed to the first Europe-Africa Space Dialogue held by the African Union Commission and the European Commission in October in Dakar, Senegal. In cooperation with the African Union Commission, EUMETSAT reported on the status of the transition to Meteosat Third Generation (MTG) in Africa and its expected contribution to strengthening weather and climate services in Africa.

Following a visit by the Director-General of the European Space Policy Institute (ESPI) in August, EUMETSAT participated in the 20<sup>th</sup> anniversary celebrations of the institute in September, and its first extraordinary general assembly. EUMETSAT will host ESPI's spring general assembly in Darmstadt in 2024.

EUMETSAT participated in a series of events organised with the Network of European Regions Using Space Technologies, the most important of which was a lunch debate hosted in the European Parliament, where the role of EUMETSAT in Copernicus was discussed. In Brussels in November, EUMETSAT attended a session organised by the network and the Hessian Government, during which the first MTG results were presented to members of the European Parliament and member states' representatives.

## Collaborative research and innovation projects

A collaboration agreement between EUMETSAT and the European Commission's Joint Research Centre (JRC) will be renewed for five years, focusing on cooperation on activities related to climate and developing countries, after receiving approval from the EUMETSAT Council in November. Research and development actions relating to EUMETSAT's next-generation satellite programmes also are covered by the agreement. For EUMETSAT and its member states, a particular benefit of the agreement will be continuation of access to JRC scientific knowledge supporting EUMETSAT's missions in the provision of satellite data for meteorology, weather and climate monitoring.

## Space weather

In September, EUMETSAT met with the management team of the ESA Operations Centre to discuss evolutions of ground segments and space weather cooperation. The European Space Policy Institute interviewed EUMETSAT's Director-General for its study on the future of space weather governance, a study funded by ESA under an arrangement with the European Commission. As a result of the study, several governance schemes for space weather activities in Europe will be proposed and possibly funded by the EU as part of the budget post-2027. EUMETSAT plans to play an operational role this governance scheme.



# Copernicus



EUMETSAT co-organised a series of webinars to bring Earth observation data visualisers, journalists and researchers together to share their ideas and experiences working with Earth observation data for storytelling. The Visualising Copernicus Earth Observation Data webinars, held between 16 May and 20 June, attracted more than 1,500 participants, including representatives from The Financial Times, Der Spiegel, Le Monde, and CNN. Its outcomes will be published on the EUMETSAT website as a good practice guide that will serve as a reference. The series was funded by the Copernicus Programme and organised by EUMETSAT in partnership with the European Centre for Medium-Range Weather Forecasts, Mercator Ocean International and the European Environment Agency.

Communications were held with Mercator Ocean International and the ECMWF to ensure the EUMETSAT Copernicus services portfolio remains aligned with the evolutions taking place in the Copernicus marine, atmosphere and climate services.

## Copernicus Sentinel-3

The re-engineered Copernicus Sentinel-3 ground segment became operational at the end of 2023, a major milestone in the preparations for the launch of Sentinel-3C. The re-engineering project removed hardware and software obsolescence and expanded its capacity to process data from a third satellite.

EUMETSAT and the European Space Agency (ESA) held their fourth yearly Sentinel-3 mission constellation review on 28 March, concluding Sentinel-3A and -3B are in excellent health and are likely to be able to continue operations beyond their expected mission lifetimes. The Sentinel-3 Joint Steering Group met the next day. Topics discussed included the approach for the tandem phase

following the launch of Sentinel-3C and the configuration of the potential in-orbit standby. The group also agreed that lunar calibration activities performed throughout 2023 should continue and become a routine activity from 2024.

## Copernicus Sentinel-4

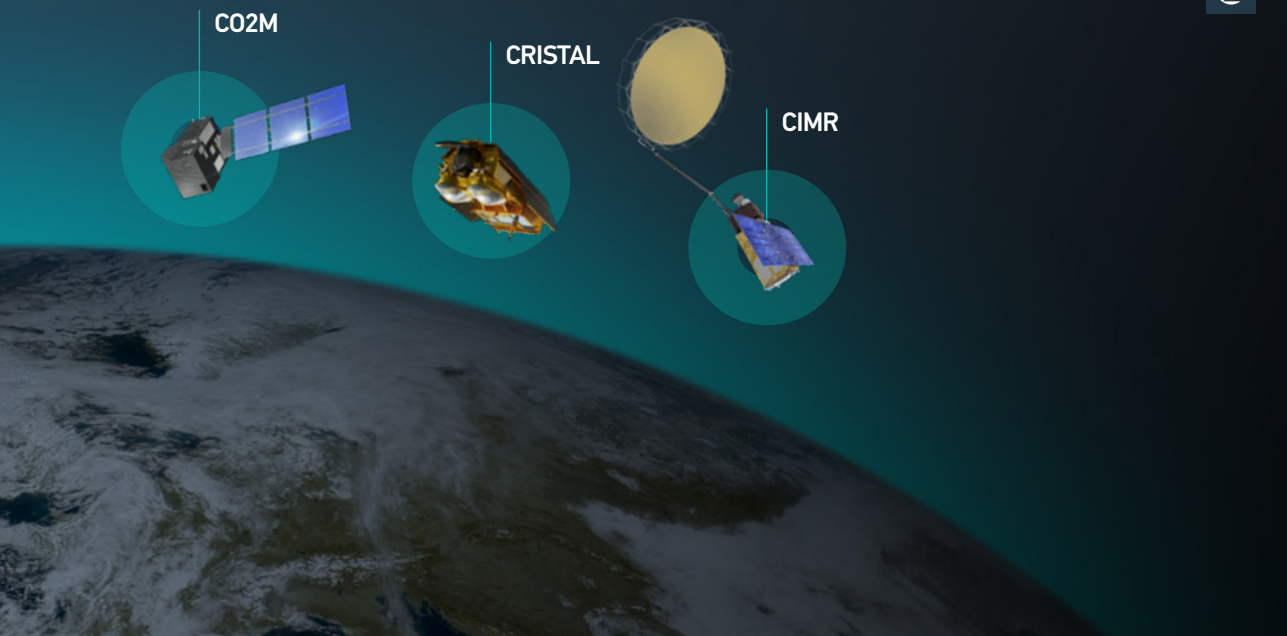
Copernicus Sentinel-4 is an Ultraviolet Visible Near-infrared (UVN) spectrometer instrument to be carried on EUMETSAT's Meteosat Third Generation – Sounder (MTG-S) satellites. The instrument has been integrated with the MTG-S1 satellite. See p19.

## Copernicus Sentinel-5

The Copernicus Sentinel-5 or Ultraviolet Visible Near-infrared and Short Wave Infrared Sounder instrument will be part of the Metop Second Generation A1 payload. Implementation of a temporary ground processing system at EUMETSAT to support the instrument's commissioning phase proceeded nominally in 2023. A first version of Sentinel-5 test data was released to users in January.

## Copernicus Sentinel-6

With the support of European and United States partners, EUMETSAT continues operating and exploiting the data from the first satellite of the Sentinel-6 mission, Sentinel-6 Michael Freilich. A second recurrent satellite, Sentinel-6B, remains on track for a November 2025 launch from Vandenberg Air Force Base in California. The satellite has been in storage since 2022 and ESA successfully carried out its first annual activation in October 2023. EUMETSAT and the partners have carried out an assessment of the ground segment's capacity to identify any necessary updates required to support the Sentinel-6 Michael Freilich and Sentinel-6B cross-



calibration tandem flight and the subsequent dual satellite operations. The assessment covered the capacity of the ground station services in Europe and the United States and will be jointly evaluated in early 2024, in order to give the go-ahead to the required operations build-up in preparation for the launch of Sentinel-6B.

## Future Copernicus missions

EUMETSAT develops the operational ground segment for the future Copernicus CO2 Monitoring mission (CO2M), and will operate the satellite and process and disseminate the mission data. Copernicus CO2M will provide inputs into the global stocktake of carbon emissions through the monitoring and verification support system being put in place by the Copernicus Atmosphere Monitoring Service. Milestones for this mission achieved in 2023 included:

- the ground segment preliminary design review was successfully completed in February;
- the mission control and operation subsystem and mission data processing subsystem successfully completed a design key point in June;
- integration of EUMETSAT operations preparations team members with representatives at ESA's European Space Operations Centre started in October;
- scientific activities progressed at the expected pace and a new scientific support service related to the ground-based CO2 observation network kicked off in August;
- EUMETSAT and ESA co-convened the Copernicus CO2M Mission Advisory Group, particularly addressing the calibration and validation approaches for the mission data products.

EUMETSAT will contribute to the Copernicus Polar Ice and Snow Topography Altimeter (CRISTAL) mission with the deployment and operations of global ocean altimetry product processing and data access services.

EUMETSAT will also contribute to the Copernicus Imaging Microwave Radiometer (CIMR) mission with the deployment and operations of the data processing chains for the generation and the dissemination of global secondary level 2 products. It will do this to support weather applications in synergy with other relevant missions operated by EUMETSAT.

Negotiation of the draft CRISTAL and CIMR implementing arrangements by EUMETSAT and ESA began in 2023. A study into the specification of CRISTAL level 1 and level 2 global ocean processing and products started in June. Also, a study related to the development of CIMR synergistic global ocean and atmospheric products was procured.

## Altimetry programme

The scope of EUMETSAT's future altimetry system was refined in 2023 to support the continuity of the Copernicus Sentinel-6 high precision altimetry reference mission and that of the Copernicus Sentinel-3 topography mission.

At the end of 2022, EUMETSAT's council decided to recategorise the organisation's altimetry programme from "optional" to "mandatory". The decision consolidates EUMETSAT's involvement in ocean and climate monitoring.

Procurement activities for Copernicus Sentinel-6C are expected to begin in early 2024 and the expected launch remains in 2030.

In relation to the continuation of the Copernicus Sentinel-3 topography mission, EUMETSAT held a successful mission definition key point in 2023. Elements of a programme proposal are expected to be presented to EUMETSAT's delegate bodies in 2024 and a draft programme proposal in 2025. The launch dates for the Copernicus Sentinel-3 Next Generation Topography A and B satellites remain in 2033 and 2035 respectively.



# The emissions missions

Ammonia from fertilisers and livestock plays a central role in the cycle of air pollution, which contributes to the deaths of millions of people around the world every year.

Yet when researchers from the Université libre de Bruxelles, Belgium, studied a decade’s worth of global ammonia emissions data from EUMETSAT’s Metop polar-orbiting satellites, they found that two-thirds of hotspots were previously unknown.

“While ammonia only stays in the air for a few hours, when it combines with other polluting gases it can generate dangerous particulate matter that can persist for several days and travel long distances,” Dr Rosemary Munro, EUMETSAT’s Polar System Programme Scientist, said.

Data from Metop’s Infrared Atmospheric Sounding Interferometer (IASI) was used for the 2018 study.

“Using these data, specialists estimated the vertical density of ammonia around the world,” Munro said. “The study demonstrated how time-series satellite data can be used to pinpoint the origins of emissions, understand how levels fluctuate, and help attribute pollution to specific sources or environmental events.”

## Improving emissions monitoring

The focus of meteorological satellite programmes is being expanded to zoom in on not just the quantities and concentrations of emissions in the atmosphere, but – like with the ammonia study – also their sources.

One example is the Copernicus CO2 Monitoring mission (CO2M), a low-Earth orbit programme that will track carbon dioxide emissions. EUMETSAT will operate the mission’s spacecraft, due to launch in the mid-2020s, and process and disseminate the data.

Copernicus CO2M instruments will take detailed measurements of carbon emissions and enable specialists to differentiate between human-produced sources of carbon dioxide and those emitted by natural processes.

“The data will also contribute to a bigger picture,” Munro said. “For example, the mission will also deliver data on other greenhouse gases such as methane, the pollutant nitrogen dioxide and aerosols. This is important because often the same processes



*“Metop-SG instruments will enable more detailed observations of a large range of gases relevant to climate and air quality applications.”*

**Dr Rosemary Munro**

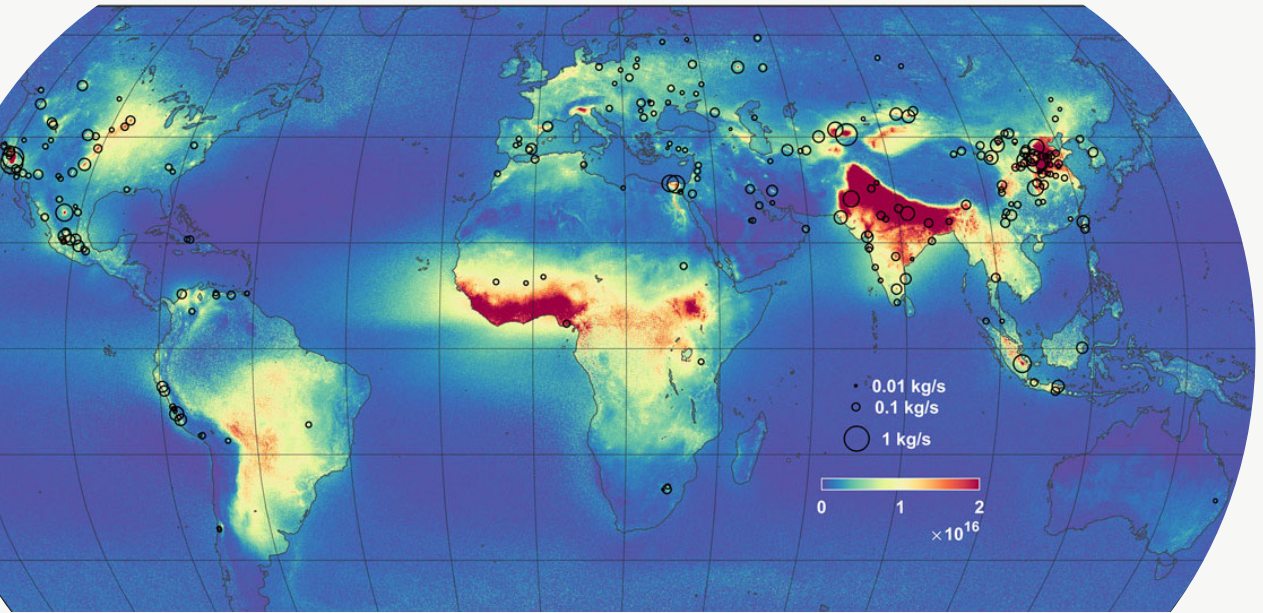
EPS-SG Programme Scientist  
EUMETSAT

that cause carbon emissions also release other species of greenhouse gases and/or air pollution.

“For example, atmospheric ammonia is not just a noxious gas in itself – large quantities of carbon dioxide are emitted when ammonia is produced and the substance can also be broken down by bacteria in the soil, generating vast quantities of nitrous oxide as a by-product.

“Meteorological satellite data can help to quickly identify if measures to reduce emissions are working, or if they might inadvertently have side effects that impact human health and the environment.”





## Next-generation coverage

Due to launch in the mid-2020s, EUMETSAT's Metop Second Generation spacecraft will help track and trace emissions from a low-Earth polar orbit.

"Metop-SG instruments will enable more detailed observations of a large range of gases relevant to climate and air quality applications, such as carbon monoxide, methane, ammonia, and stratospheric ozone," Munro said.

Next-generation geostationary satellites will also contribute to emissions monitoring, providing frequent observations always focused on the same part of the Earth.

Meteosat Third Generation sounder satellites will carry the Copernicus Sentinel-4 instrument.

"This will be the first instrument in geostationary orbit over Europe to provide air quality measurements of aerosols and trace gases such as ozone, nitrogen oxides, sulphur dioxide, and formaldehyde," Munro said.

The combination of new polar-orbiting and geostationary programmes will provide data helpful for assessing emissions reduction strategies and tracking the long-range transport of emissions.

For more information about emissions-monitoring missions, visit [www.eumetsat.int/news/features](http://www.eumetsat.int/news/features)

▲ A 2018 study of ammonia molecules carried out using almost a decade of IASI satellite measurements revealed previously unknown ammonia hotspots. Hotspots are identified with black circles. (Credit: Martin Van Damme and Lieven Clarisse / ULB)



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

<https://www.eumetsat.int/features/emission-missions>





*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*

Global cooperation

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World Meteorological Organization

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The need for accurate weather forecasts, early warnings of severe weather events and understanding of Earth's changing climate are global challenges that require global cooperation to address. Through a framework established by the World Meteorological Organization, EUMETSAT maintains global, multilateral and bilateral cooperation agreements focusing on sharing of infrastructures and data and scientific exchange.

#### Canada

Environment and Climate Change Canada gave a presentation on the Arctic Observatory Mission to the Science Working Group of EUMETSAT's Scientific and Technical Group on 5 September. Regular bilateral meetings about this mission took place in 2023 to assess possible cooperation with Europe through EUMETSAT.

EUMETSAT's Director-General met with the Canadian Space Agency's Director-General for Earth Observations in a bilateral meeting during the CEOS Plenary.

#### United States

EUMETSAT and the National Oceanic and Atmospheric Administration (NOAA) had their annual high-level working group meeting in Washington on 16-17 February.

During the Global Space Conference on Climate Change in Oslo on 23 May, the Director-General met with the NOAA administrator.

EUMETSAT's Director-General had bilateral meetings with the NOAA National Environmental Satellite Data, and Information Service Assistant Administrator Dr Steve Volz during the plenaries of the Coordination Group for Meteorological Satellites and the Committee on Earth Observation Satellites in June and November to prepare for a high-level working group meeting in early 2024.

EUMETSAT attended NOAA's briefing for international partners on the 2024 budget on 7 June.

The NASA representative in Europe visited EUMETSAT on 16 October.

EUMETSAT's Director-General met with the NASA Earth Science Division Director Dr Karen St Germain on 7 June and held a bilateral meeting during the CEOS plenary to discuss cooperation with NASA on science.

#### France

The French Space Agency's Chief Operating Officer visited EUMETSAT headquarters on 21 October for the Director-General's signing of the Charter of the Space for Climate Observatory.

### Federation of Bosnia and Herzegovina

EUMETSAT and the Federal Hydrometeorological Institute of the Federation of Bosnia and Herzegovina co-hosted an Information Day for national meteorological and hydrological services (NMHS) in the Western Balkans region in Sarajevo on 18-19 April.

### Georgia

EUMETSAT and the National Environmental Agency of Georgia co-hosted an Information Day for NMHS in the Eastern Europe, Caucasus and Central Asia region in Tbilisi on 27-28 April.

### South Africa

The Group on Earth Observation held its GEO Week 2023 and ministerial meeting in Cape Town, South Africa, on 6-10 November.

### India

A five-year renewal of the cooperation agreement with the Indian Space Research Organisation was approved by the EUMETSAT Council in July.

### China

The new China Meteorological Administration (CMA) Administrator, Zhenlin Chen, visited EUMETSAT on 30 May, his first official overseas visit after his appointment. He was accompanied by a delegation including the Director-General of the CMA's National Satellite Meteorological Centre, Dr Jinsong Wang.

A five-year extension of the cooperation agreement with the CMA was approved by the EUMETSAT Council in July.

A delegation from the China National Space Administration visited EUMETSAT on 29 September.

### Thailand

Thailand's Geo-Informatics and Space Technology Development Agency hosted the Committee on Earth Observation Satellites plenary on 15-16 November.

### Japan

The Japan Meteorological Agency and the Japan Aerospace Exploration Agency hosted the Coordination Group for Meteorological Satellite's 51<sup>st</sup> plenary on 26-28 June and EUMETSAT held bilateral meetings with both agencies.



## World Meteorological Organization

The World Meteorological Organization (WMO) Congress-19 on 22 May-2 June approved its coordinated global greenhouse gas monitoring watch and Early Warning for All initiatives.

EUMETSAT hosted a small event on its contributions to Africa, Meteosat Third Generation (MTG) and the African Meteorological Satellite Application Facility during the congress. EUMETSAT also delivered a statement on behalf of the Coordination Group for Meteorological Satellites on the importance of satellite observations in support of the WMO Integrated Global Observing System Vision 2040. Footage of the launch of MTG-Imager 1 was shown at the event and posters of the satellite's first image were presented to attendees.

EUMETSAT responded to the WMO's call for contributions to its Early Warnings for All initiative by providing a list of our satellite products and applications that help to monitor and forecast six priority hazards. Early Warnings for All is an initiative designed to ensure that everyone on Earth is protected from hazardous weather, water or climate events through life-saving early warning systems by the end of 2027.

▲ *Phil Evans, EUMETSAT Director-General, speaking at the WMO Congress-19 in Geneva, 24 May 2023 (credit: WMO)*

EUMETSAT participated in the WMO workshop, "Observations within the Global Greenhouse Gas Watch", on 3-5 October. EUMETSAT presented a paper on ground-based remote-sensing carbon data processing for the validation and monitoring of the Copernicus CO<sub>2</sub> Monitoring mission (CO<sub>2</sub>M) products. The presentation also highlighted the importance of ground-based remote sensing greenhouse gas measurements for the needs of current, and in particular, future space-based greenhouse gas monitoring infrastructure.

The WMO submitted a letter of support to EUMETSAT for the potential EUMETSAT Polar System (EPS) – Aeolus and EPS-Sterna missions.

EUMETSAT also participated in the 18<sup>th</sup> WMO Regional Association 1 (WMO RA-I) session in Addis Ababa, Ethiopia, in February. MTG and the African Meteorological Satellite Application Facility are included in the WMO RA-I priorities. See p75

## Cutting through the noise

In preparation for processing data from Himawari-10, Japan's first satellite carrying a hyperspectral infrared sounder, Shin Koyamatsu is spending a year at EUMETSAT learning from its wealth of infrared sounder data and the techniques used to process them.

Koyamatsu found his way toward investigating weather phenomena through an interest in puzzles.

A high school physics class ignited his passion for piecing together various scientific laws, which he likened to putting together a puzzle. This interest only strengthened in college, where he studied astronomy out of a desire to combine various observations in order to clarify phenomena in the universe.

Now, as a visiting scientist from the Japan Meteorological Agency, Koyamatsu is turning his attention toward yet another complex puzzle – analysing data from hyperspectral infrared sounders.

These satellite instruments, which measure features of the atmosphere such as temperature and humidity, collect an abundance of data points numbering in the thousands. And while the quantity of data is incredibly beneficial, unfortunately, amid the useful data lurks a profusion of meaningless information.

Koyamatsu came to EUMETSAT in March 2023 and began work sifting out the noise from the signal in infrared sounder data using a technique known as principal component analysis. This powerful statistical technique makes it possible to compress the data, making the total volume smaller, and also capture their large patterns.

"The volume of data from infrared sounders is enormous, so it is very important to know what information to extract from it," he said. "How we visualise the data is also important because what we see completely changes depending on which aspects of the data we cut out. I am learning more about it every day, as handling huge amounts of data requires a lot of ingenuity."



For more information, read the full report on the EUMETSAT website

<https://www.eumetsat.int/features/cutting-through-noise>



▲ Visiting Scientist Shin Koyamatsu applies a hefty dose of ingenuity to filter out the noise from the signal in infrared sounder data

Koyamatsu is grateful for the opportunity to do this work at EUMETSAT, which has been operating the Infrared Atmospheric Sounding Instrument on polar-orbiting Metop satellites since 2006. Being able to draw on the extensive experience at EUMETSAT in processing this type of data, as well as the expertise being currently built in preparation for the upcoming launch of the first Meteosat Third Generation – Sounder, which will carry an infrared sounder, has been helpful.

"I think EUMETSAT is the best place for my work because it has a great deal of knowledge about infrared sounder operation, data processing, and other related issues," he said.

When Koyamatsu concludes his work at EUMETSAT in March 2024, he will leave equipped with knowledge he can use as the Japan Meteorological Agency prepares to launch Himawari-10, its first satellite that will carry a hyperspectral infrared sounder.





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

Training

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Preparation for next-generation systems

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Supporting non-member states in Europe and Central Asia

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Supporting Africa

**Page 75**



In conjunction with partners, EUMETSAT strives to enhance the uptake of our data products and services, and their applications. We engage with the users of our data and services through training and support, a helpdesk reachable at ops@eumetsat.int, dedicated workshops, capacity building initiatives, and by gathering, analysing and responding to feedback. Preparation for our next-generation satellite systems forms an integral part of our engagement.

## Training

EUMETSAT conducted more than 130 training courses for more than 3,000 participants in 2023, with a strong focus on preparation for using data from next-generation satellites.

A severe storm testbed, held in partnership with the European Severe Storms Laboratory, and an aviation testbed, run in partnership with the Finnish Meteorological Institute, were well attended. The test beds used proxy data and some real images from Meteosat Third Generation – Imager-1 (MTG-I1) in training for forecasters. Participants showed a high level of interest in the satellite's Flexible Combined Imager (FCI) and Lightning Imager data and applications and expected improvements the mission will bring. Severe convective storms testbeds were greatly appreciated, with 60 participants trained in 2023 and six more testbeds planned for 2024.

In a series of workshops, product and instrument experts, senior forecasters and trainers investigated the value of early FCI data for low-level moisture detection and cloud top feature identification for better forecasting and tracking of convective storms. To prepare for MTG level 1 data operational use, experts from EUMETSAT and member states met with forecasters and trainers from the US National Weather Service to learn about their experience in introducing GOES Geostationary Lightning Mapper data into operational forecasting.

Regional training courses are run in partnership with the national meteorological and hydrological services of a



particular region and cover the full role of the forecaster. For example, the Nordic Meteorological Competency (NOMEK) training course for Nordic countries, which also included participants from the Baltic States and Ireland, incorporated elements of warning improvement. These elements were presented by the hosts, the Swedish Meteorological and Hydrological Institute. The event demonstrated the cross-country knowledge sharing that is possible in the co-created regional courses.

## Preparation for next-generation systems

In preparation for the deployment of the MTG and EUMETSAT Polar System – Second Generation (EPS-SG) systems, EUMETSAT held user days in 2022 which revealed emerging themes for research and development that need addressing to unlock the potential of the new missions. In 2023, member states were invited to provide feedback on how to shape the R&D agenda in Europe in support of EUMETSAT mission data utilisation and to translate the R&D priorities identified earlier into national R&D contexts. R&D in support of EUMETSAT



data utilisation remains an essential prerequisite for the research-to-operations transition and ultimate uptake of new data by users, especially given the novelty of many of the missions, such as the Lightning Imager, the Infrared Sounder, the Multi-Viewing, Multi-Channel, Multi-Polarisation Imager and the Ice Cloud Imager.

Online and in-person meetings on national meteorological and hydrological services' preparedness for the new mission were held in Romania, Bulgaria, Slovakia, Greece, and Lithuania in preparation for the use of MTG data.

A new open-source version of the Satellite Information Familiarization Tool (SIFT) – a data visualisation tool tailored for MTG's FCI and Lightning Imager – was developed in collaboration with the University of Wisconsin – Madison's Space Science and Engineering Centre and was released on github. A short course on the tool was held in May and attended by more than 150 participants. A full set of EPS-SG test data, and of MTG FCI atmospheric motion vectors and all sky radiance test data, in binary universal form for the representation of meteorological data (BUFR) format, was made available

▲ *EUMETSAT staff and data users confer during a user days event held in preparation for the deployment of the organisation's next-generation satellite systems*

to users in March and May 2023. A complete six-hour cycle of simulated MTG Infrared Sounder level 1b test data in principal components was released in December.

To enhance user preparation activities with manufacturers of EUMETCast reception stations and visualisation software, two dedicated webinars took place in November. They covered the upcoming release of the first MTG-I1 data and later transition into operations, and preparation activities for the reception and processing of local mission data from EPS-SG. The first special dissemination to member states' national meteorological and hydrological services, via EUMETCast, of early, near-real-time FCI level 1c data began at the end of October.



## Supporting non-member states in Europe and Central Asia

EUMETSAT held its biennial information days for the Western Balkans and for the Eastern Europe, Caucasus and Central Asia region (World Meteorological Organization Regional Association VI), in April. The meetings aim to strengthen the capacity of national meteorological and hydrological services (NMHS) in the regions that are not EUMETSAT member states to use EUMETSAT's data.

Forty representatives of NMHS in the Western Balkans region attended the first of the information days, which was co-organised by the Federal Hydrometeorological Institute of the Federation of Bosnia and Herzegovina and held in Sarajevo. The second event, for Eastern Europe, the Caucasus and Central Asia, and held in Tbilisi, attracted a similar number. The focus of discussions was data access and training. EUMETSAT and the NMHS

▲ *About 40 representatives from national meteorological and hydrological services in the Western Balkans region attended an information event in Sarajevo in April*

discussed the transition to Meteosat Third Generation and the need to upgrade the Data Access for Western Balkan and Eastern European Countries (DAWBEE) EUMETCast reception stations used in the regions to allow visualisation and use of the new MTG data. Based on the discussions, EUMETSAT is assessing options to design a DAWBEE-MTG station based on existing tools and experience in EUMETSAT member states.

EUMETSAT, together with the World Meteorological Organization and the European Commission, will continue to investigate potential resources to support expanding the use of EUMETSAT data in the regions.

## Supporting Africa

Africa is continuously in the field of view of EUMETSAT's Meteosat satellites. Therefore, the data and imagery the satellites provide are crucial for weather forecasting across the African continent and for supporting climate and environmental monitoring. EUMETSAT's cooperation with African agencies, meteorologists and climate experts began more than 20 years ago.

The World Meteorological Organization (WMO) Regional Association-I (WMO RA-I) session took place in Addis Ababa, Ethiopia, in February 2023. EUMETSAT, in cooperation key stakeholders, held a side event to inform participants about the Meteosat Third Generation (MTG) system and the status of activities designed to ease the transition to MTG in Africa.

MTG and the African Meteorological Satellite Application Facility were also among the WMO RA-I strategic priorities for 2024 -2027, specifically: "Enhancing capacities of members to prepare for the products from the Meteosat Third Generation satellite under the umbrella of the African Ministerial Conference on Meteorology (AMCOMET) and in partnership with the African Union Commission (AUC) and EUMETSAT through increasing support to the Africa Meteorological Satellite Applications Facility (AMSAT) and enhancing facilities for polar-orbiting satellite data reception".

The WMO and the AMCOMET secretariat consulted EUMETSAT during the drafting of an implementation plan for the Integrated Africa Strategy on Meteorology, which underlines the transition to MTG in Africa as a priority.

The WMO RA-I Dissemination Expert Group (RAIDEG) met virtually in May, and in person in September, with a focus on nowcasting and access to and use of numerical weather prediction model outputs through EUMETCast. Representatives from the Global Production Centre (the European Centre for Medium-Range Weather Forecasts (ECMWF), Météo France and the Met Office) also participated. The participants also discussed the MTG transition schedule for the MTG Full Disc 0° service and the deployment of new PUMA stations procured under the European Union (EU)-funded Intra-ACP Climate Services and Related Applications (ClimSA) programme.

The AUC and EUMETSAT signed an agreement in 2022 to formalise their cooperation under the ClimSA programme. The Organisation of African, Caribbean and Pacific States and the EU initiated ClimSA to improve climate services. The AUC coordinates its implementation in Africa.

As part of the ClimSA programme, the AUC published a tender package in 2023 for the procurement of new PUMA-MTG stations and climate stations for each sub-Saharan national meteorological and hydrological service and regional centres. The stations will rely on EUMETCast-Africa and the internet to facilitate access to and use of MTG and global climate data in Africa. The stations will be installed by the end of 2025.

EUMETSAT is currently supporting the AUC in establishing a training plan for use of the new PUMA-MTG stations, in cooperation with the WMO Centres of Excellence for training in satellite meteorology in Africa. A first train the trainers session on MTG was held in Kenya in November.

In April, EUMETSAT held a webinar on Earth observation for air pollution monitoring in Africa, in cooperation with the AUC. A second webinar, on Earth observation and hydrology in Africa, was held in August in cooperation with African users and EUMETSAT's Support to Operational Hydrology and Water Management and Land Surface Analysis satellite application facilities.

A workshop was held in Brussels in March with representatives from the European Commission's Directorates-General for International Partnerships and Defence Industry and Space, the Joint Research Centre, the AUC, AMCOMET, the African Centre of Meteorological Applications for Development (ACMAD) and regional centres, the WMO and the ECMWF to identify activities within a future EU-funded programme that would support the use of MTG data in Africa. The programme would also support the use of ECMWF model outputs and Copernicus early warning products for systems in Africa. In November, the European Commission confirmed the availability of funds to support this programme over the coming years.

As part of its contribution to the Global Monitoring for Environment and Security and Africa programme, EUMETSAT supported training activities with the two African consortia implementing the marine and coastal monitoring services in Africa.



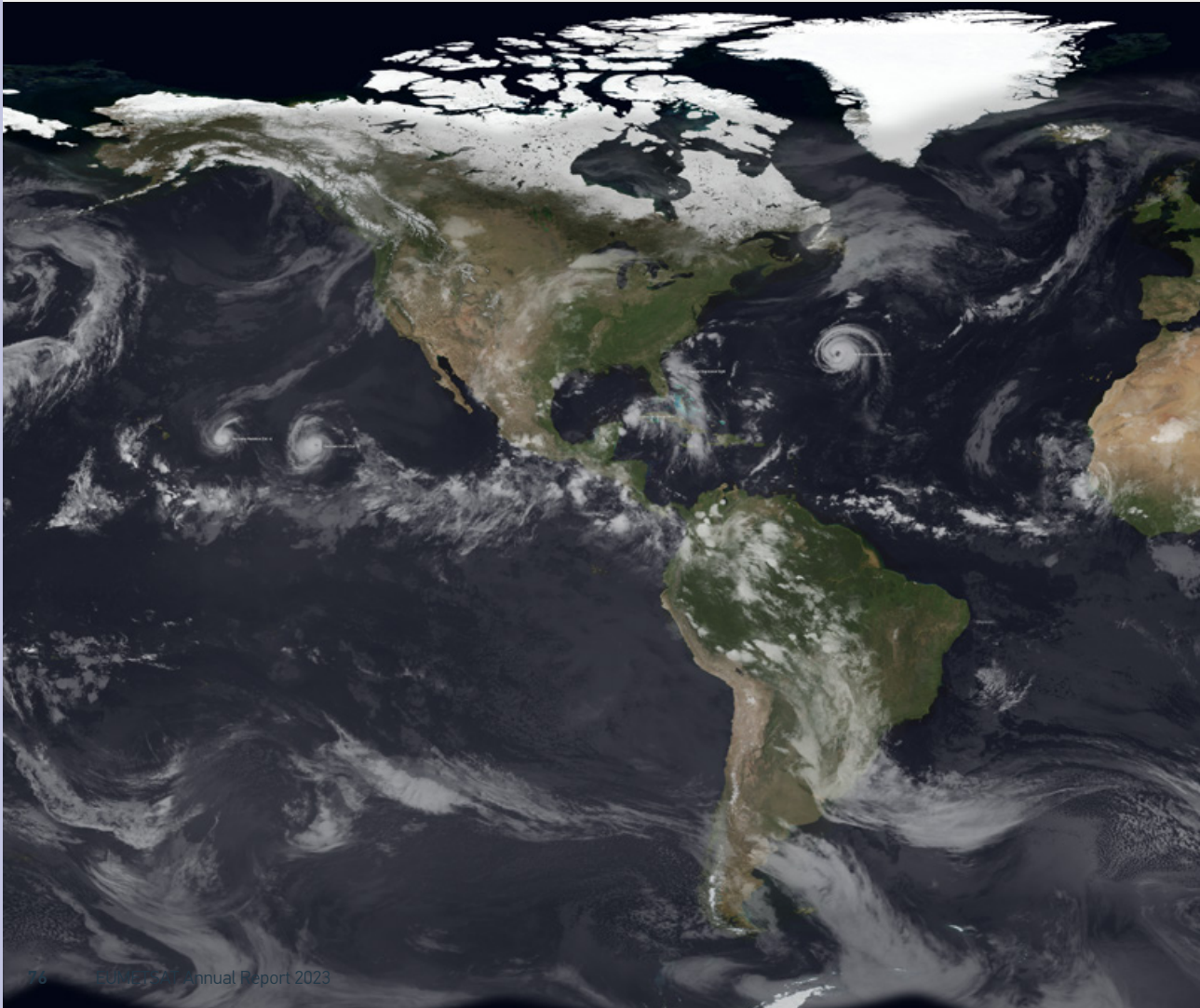
## EUMETSAT moves to expand research usage of its satellite data

EUMETSAT will establish cooperation agreements with national science and research and development organisations to ensure the best use is made of data from its next-generation satellites. The agreements will access the best scientific expertise in the world, with benefits for EUMETSAT's member states.

The organisation has cooperation agreements in place with operational space and meteorological satellite agencies but will expand its collaboration to include science and research and development entities.

EUMETSAT stands to benefit from the extensive Earth observation scientific knowledge in non-meteorological research and development institutions by being able to provide enhanced products to its member states and other users of its data.

"In a time of more frequent extreme weather events due to our changing climate, it is crucial we derive the most benefit from the extraordinary amount of data our new satellite systems will soon be delivering," EUMETSAT Director-General Phil Evans said.





*“Through these agreements, we aim to maximise the benefits to society from the data our satellites produce.”*

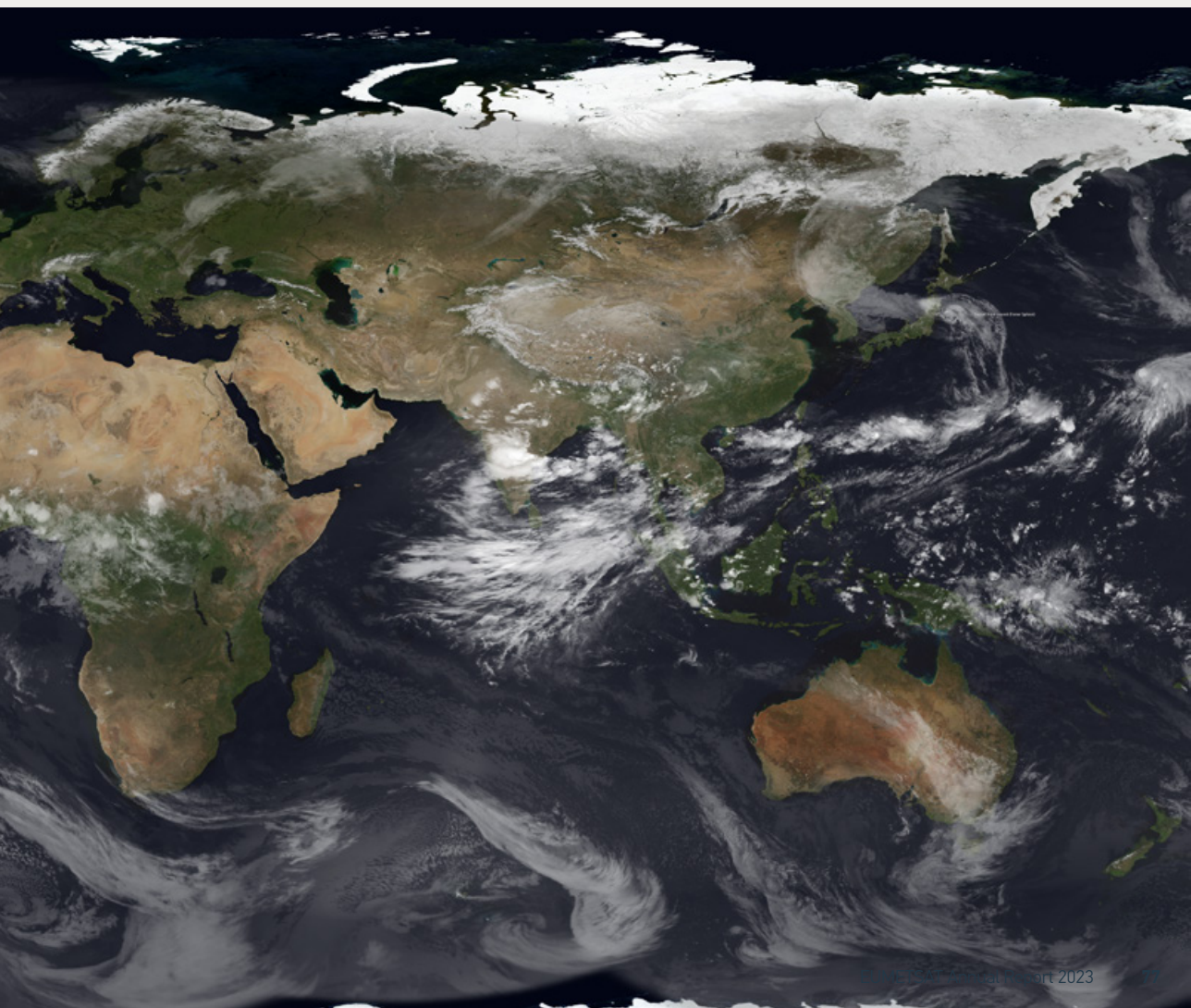
**Phil Evans**  
Director-General  
EUMETSAT

“The EUMETSAT Council’s decision to adopt a framework for cooperation agreements with science organisations will help us achieve this objective by reinforcing the international and scientific network of expertise on which we rely.

“Through these agreements, we aim to maximise the benefits to society from the data our satellites produce.”

The framework will benefit the work undertaken at the national science institutions, at EUMETSAT headquarters and at the organisation’s network of satellite application facilities.

Evans said the council’s decision would ensure the data EUMETSAT disseminates can help to protect communities and boost economies.







*Continuously improve  
management and  
risk management  
processes*

Quality management

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Internal control framework

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EUMETSAT Ombudsperson

**Page 80**

Business continuity exercise

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◀ José María Travesí García,  
EUMETSAT Ombudsperson

## Quality management

EUMETSAT successfully passed an ISO 9001 recertification audit in November. The ISO 9001 certificate is a globally recognised standard for quality management. The audit was conducted by the British Standards Institution.

Among the strengths noted by the auditors were:

- full integration of the EUMETSAT Management System into the organisation and awareness at all organisational levels and the setting of organisational objectives and follow-up with clear reporting of achievements provided to all interested parties with definite overflow to all organisational levels;
- clearly described and deployed multi-layer management review with detailed inputs from all process pilots;
- tender evaluation boards' excellent evaluation process with clear weighting and tightly controlled recommendations;
- the key performance indicators of spacecraft safety and service to users were exceptional, with a very low level of open items quickly detected and dealt with, while flight controls planning and execution was exceptional, with risk mitigation, detailed shift handovers, logging, reaction planning and control.

The following were among the opportunities for improvement identified by the auditors:

- supplemental key performance indicators targeting process efficiency;
- simplification of improvement planning and a structured approach to better track and communicate progress of improvement initiatives and projects;
- use of a customer satisfaction survey, or equivalent, where relevant for new responses from the user feedback team in relation to issue resolution and its use to drive improvement.

## Internal control framework

EUMETSAT discontinued its financial control function on 1 July and transitioned to a modern and more cost-efficient system of internal controls for which management is fully accountable, supported by a strong internal audit function.

## EUMETSAT Ombudsperson

The EUMETSAT Council at its July meeting appointed an ombudsperson and an alternate to adjudicate any complaints about procedural breaches in open tendering processes to ensure the organisation's procurements are carried out fairly and transparently. The appointments will give member states increased confidence that EUMETSAT uses its funding properly and follows transparent, fair procurement processes.

The ombudsperson will decide on appeals brought forward by unsuccessful tenderers on the grounds of a procedural breach by EUMETSAT, after a complaint in the first instance to the Director-General.

Following the appointments, a procurement review procedure entered into force in October. The updated chapter of the EUMETSAT procurement procedures on the open competitive tender procedure, as well as the updated general tender conditions, were published on EUMITS. Tenderers now have visibility of each step of the open, competitive procedure.

## Update of expenditure-related processes

All internal expenditure-related approval workflows have been reviewed with the aim of better clarifying responsibilities, preserving necessary checks and balances, and empowering middle management.



## Business continuity exercise

EUMETSAT conducted exercises throughout the year, culminating in an annual evacuation exercise on 7 November, to test the continuity of its operations during disruptive events that prevent access to headquarters. The aim was to assess communication flows and to rehearse the ability to evacuate the premises in a controlled manner.

The business continuity exercise simulated a response to authorities discovering a World War II bomb near EUMETSAT headquarters.

The exercise was an opportunity to activate the Operations Evacuation Coordination Centre (OECC) at the German Meteorological Service in Offenbach, as well as remote mission control centres.

Major exercises included a combined information security management system-business continuity management system paper exercise in the summer, and an operational activation across all programmes in the spring.

▲ *Business continuity team after completing the evacuation exercise on 7 November 2023*

Communication was tested across all levels and channels, including operations and the Management Board and between the controller teams in Madrid, Fucino, the OECC, and the Mission Control Centre in Darmstadt.

EUMETSAT's headquarters was subjected to a complete lockdown for the first time, starting with the evacuation of all those on site from 11:30 onwards. It culminated at 16:00 with remaining security personnel and controllers briefly leaving the campus.

At 17:00, an SMS message was sent to mark the end of the exercise.

The exercise was considered a success. Lessons learnt are being compiled.



# Reducing EUMETSAT's carbon footprint

The results of a study into EUMETSAT's corporate carbon footprint were presented to its council in November. The method applied for the independent audit was based on the greenhouse gas protocol corporate accounting standards and ISO 14064-1. The reporting year was 2021, while 2019 (the last year before the Covid-19 pandemic) was selected as the base year.

## Evaluation

The biggest step in reducing CO<sub>2</sub>e emissions was taken in 2019 with the decision to obtain electricity from 100% renewable providers. Prior to that, many energy efficiency measures had been adopted in the Technical Infrastructure Building, leading to a Certified Energy Efficient Datacentre Award certification at gold level.

The pandemic led to a reduction of about 1,100 tonnes of CO<sub>2</sub>e through reduced business travel. EUMETSAT aims to keep travel at 20-30% lower than pre-pandemic levels.

Other measures to reduce the corporate carbon footprint include the provision of a subsidised public transport pass, support for cyclists, and the installation of e-charging points on campus.

The most significant omissions within the scope of the study were the satellite manufacturing and launch footprints.

Rough figures obtained from Arianespace show a full lifecycle CO<sub>2</sub>e footprint of around 10,000 tonnes of CO<sub>2</sub>e for a EUMETSAT launch. This will dominate the organisation's overall footprint in launch years.

The following emissions sources were identified:



### Scope 1

All direct greenhouse gas emissions caused by sources a company owns or has control over. Combustion of natural gas and liquefied petroleum gas for heat production, combustion of diesel in vehicles and petrol for gardening tools, as well as diesel and heating oil for electricity production.



### Scope 2

All indirect greenhouse gas emissions caused by the company's consumption or purchased electricity, heat, steam and cooling. Consumption of purchased certified green electricity and district heat.



### Scope 3

All other indirect greenhouse gas emissions caused within the upstream and downstream value chain. Purchased goods and services (office supplies, food for canteen, water), generated waste, business travel and employee commuting.

## Next steps

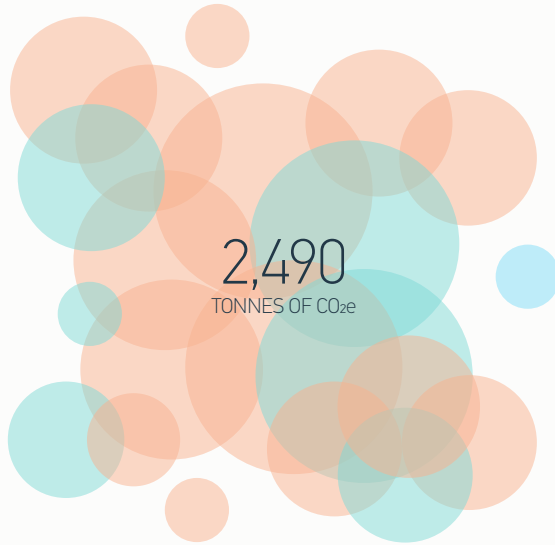
As more than 50% of EUMETSAT's carbon footprint in 2021 was generated by heating costs, measures to improve efficiency and insulation at headquarters have been investigated.

Pressure to minimise travel emissions will be maintained. When there is a better understanding of scope 3 emissions – in particular more precise estimates of manufacturing and launch footprints – the carbon audit will be repeated with those elements included in the scopes.

**CO<sub>2</sub>e** is "carbon dioxide equivalent", a measurement of the total greenhouse gases emitted, expressed in terms of the equivalent measurement of carbon dioxide.

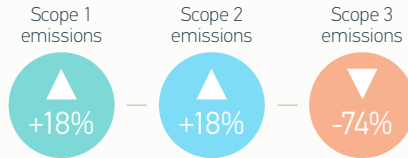
# Results

2019

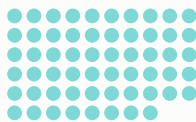


In 2019, EUMETSAT emitted 2,490 tonnes of CO<sub>2</sub>e and in 2021 1,236 tonnes of CO<sub>2</sub>e, reflecting a total decrease of 50%.

2021



Scope 1 and 2 emissions each increased by 18%, scope 3 emissions reduced by 74%.



The biggest decrease in emissions stemmed from fewer international flights and hotel stays as a result of the pandemic in 2020-2021.

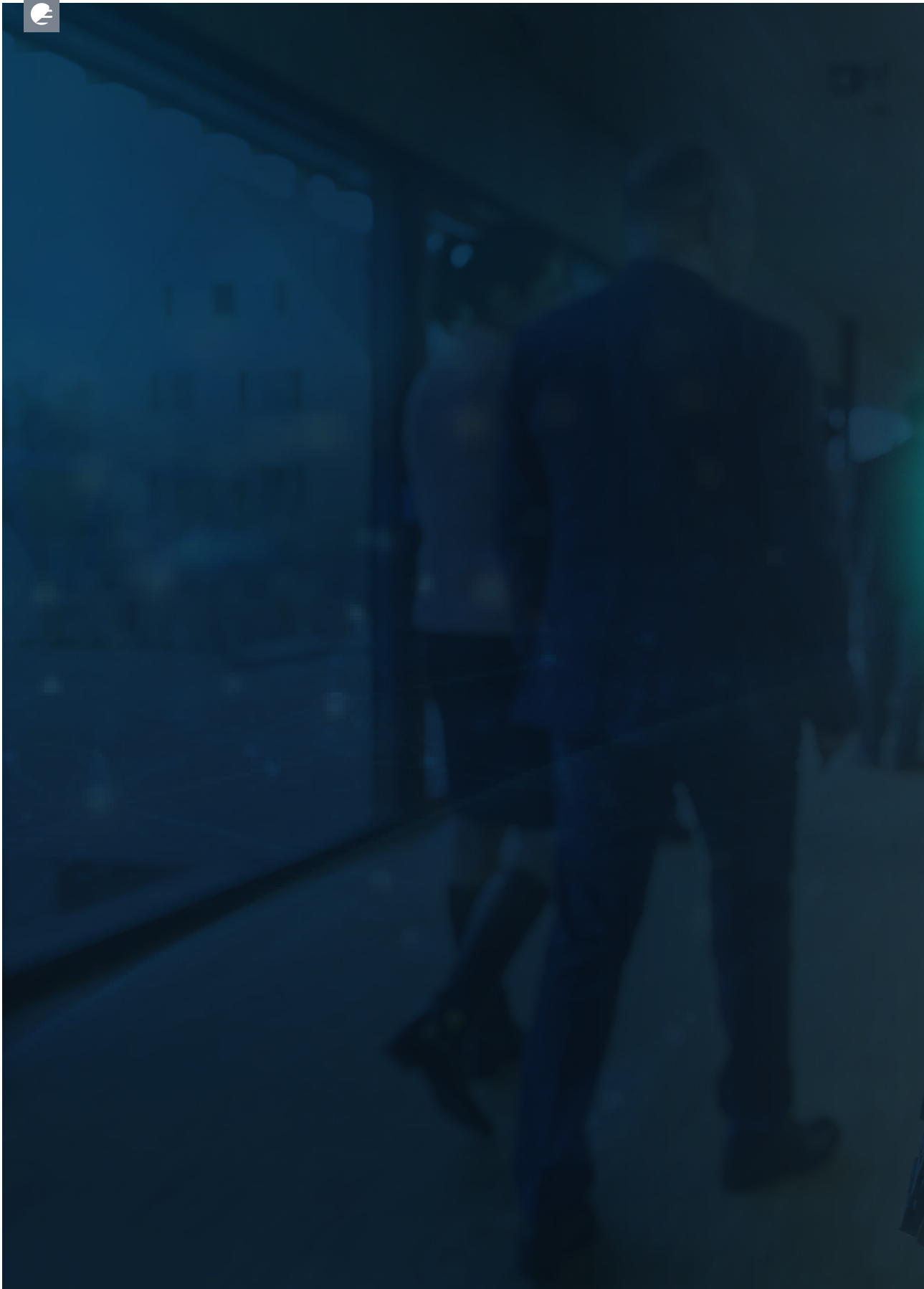
Scope 1 emission sources represented 58% of total greenhouse emissions in 2021 and were dominated by heat production (96%).



Scope 2 emissions contributed about 2% to the total carbon footprint in 2021 and were caused entirely by the consumption of district heat for the EUMETSAT East Building. EUMETSAT purchases electricity produced only via hydro power plants, which counts as zero emissions.



Scope 3 emissions accounted for about 40% of the corporate carbon footprint in 2021. Within this category, 46% was attributed to purchased goods and services, and 21% resulted from business travel. Employee commuting contributed 17%.





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

Working at EUMETSAT

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Work-life balance

**Page 86**

Childcare centre opens

**Page 86**

Staff survey

**Page 86**

Communication and engagement

**Page 87**



## Working at EUMETSAT

A revised long-term human resources policy was adopted and endorsed by the EUMETSAT Council in 2023. Its five policy goals are:

- developing staff to increase the agility, versatility and resilience of the workforce and build a strong bench of future managers and technical leaders;
- instilling a meritocracy by delegating decisions to appropriate levels, holding people accountable and managing performance appropriately;
- maintaining the competitiveness of remuneration packages and increasing non-monetary attractiveness;
- deploying diverse talent the most efficient and effective way, considering longer-term capability and strategic competencies needs;
- fostering a culture aligned with EUMETSAT's core values.

Reforms to the performance management process have been undertaken to ensure more balance between assessing achievement of objectives and behavioural aspects and planning a staff member's development. The assessed behavioural aspects will be closely linked to EUMETSAT's core values, in the form of a behavioural competency framework against which staff will be assessed, as well as a more transparent and better structured approach for managing performance. The changes, which come into effect in 2024, will allow for the swifter addressing of underperformance while still ensuring that staff have sufficient time and opportunity to recover from low performance. Performance assessments conducted in early 2025 will follow the new process.

A code of business ethics and conduct will be developed and the "Speak Up" toolkit improved with a designated communication and training campaign. As part of the process, an anonymous online survey will be conducted to identify relevant areas of particular concern to EUMETSAT staff. Workshops will be held to review areas of concern and agree on specific remedies.

### Focusing on staff members' health and safety

EUMETSAT continued to develop its health and safety policy in 2023. The organisation provided training throughout the year to foster the health and safety culture, including:

- monthly health and safety induction training for new starters and refresher training;
- two induction training sessions for safety representatives;
- four evacuation coordinator induction training sessions;
- four evacuation coordinator refresher sessions;
- one forklift recertification training.

Stress, diet and mindfulness were top of the agenda for the popular Health Day held on 9 November at EUMETSAT. More than 100 staff members had a "stress portrait" prepared, while others booked in for massages, coordination and eye checks and other services. Presentations on mindfulness and home office organisation also were popular. The HR division has organised another Health Day in 2024, due to the popularity of the 2023 event.

### Extension of the East Building

By mid-October 2023, work on the concrete-steel skeleton was completed. The inauguration of the building is planned for June 2024.

### Work-life balance

A revised teleworking policy was implemented in October, granting staff more flexibility than the previous policy. The number of allowed teleworking days away from the duty station was increased from 12 to 24 per year and the teleworking period was expanded to a fortnight. The teleworking policy maintains the principle that business needs always take priority over teleworking requests and depends on trust and good communication between staff and their reporting line.

### Childcare centre opens

The "LittleOrbiters" childcare centre opened on 8 November. The enrolment process started in February 2023 and 22 children were enrolled to start in 2023, with nine more enrolled to start in the first quarter of 2024.

Prof Dr-Ing Hans Moser from the Federal Ministry for Digital and Transport, Mr Uwe Becker from the State of Hesse's Chancellery and Mr Björn Hörnle from TfK Kitas joined the EUMETSAT Director-General and heads of delegations at the opening ceremony.

The childcare centre will cater for EUMETSAT staff members' children aged from four months until they are old enough to start school. It is operated by TfK Kitas.

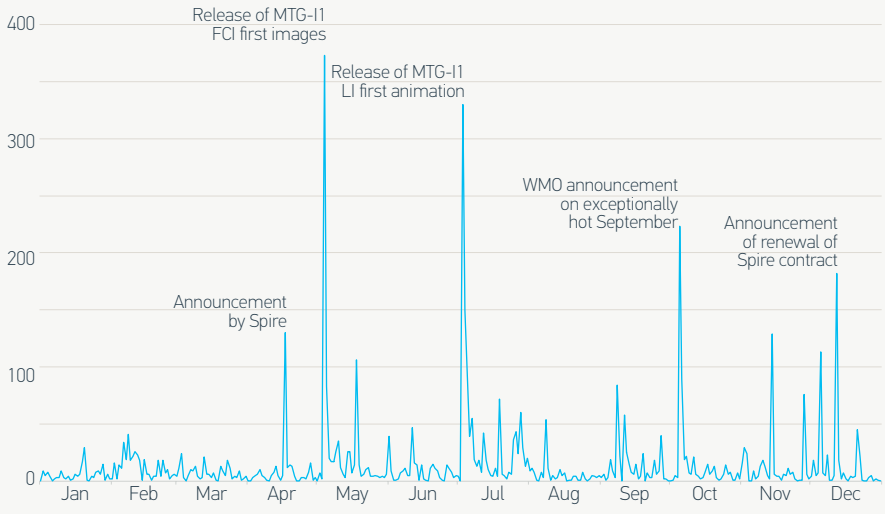
### Staff survey

EUMETSAT finalised its consolidation of action plans arising from the cross-organisational working groups formed to address the most pronounced corporate level issues identified in the 2021 staff survey. The consolidation took longer than planned, as the initial set of actions had to be prioritised based on strategic alignment and assessments of effort and benefits to ensure feasibility of the final action plan. The action plan focuses on issues identified in the areas of efficiency and bureaucracy; people and career development; and diversity, inclusion and workload. The final action plan, with 18 corporate level actions, was communicated to staff at a dedicated staff assembly in June.



# Communication and engagement

## Media exposure

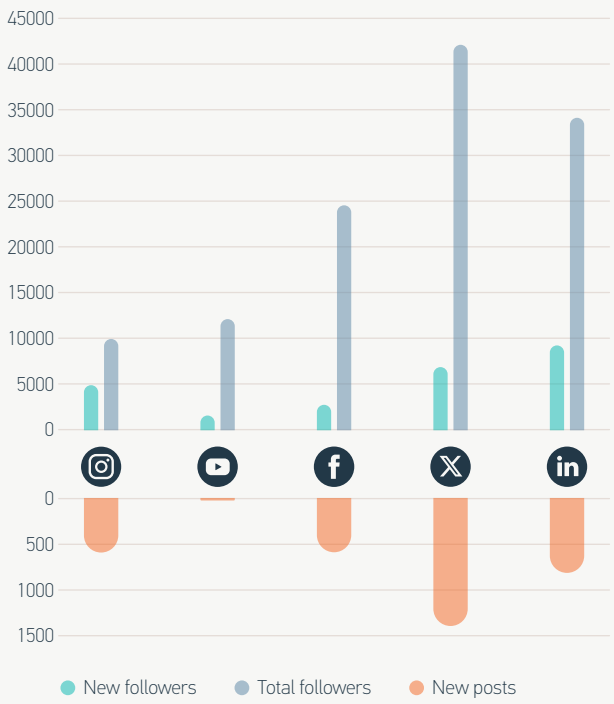


5,291  
Total media hits



14  
Press releases published

## Social media



## Internal communication



381  
Intranet top stories



15  
General briefings



5  
Staff assemblies



9  
Internal outreach events

## Website



146,841  
Average number of visitors per month



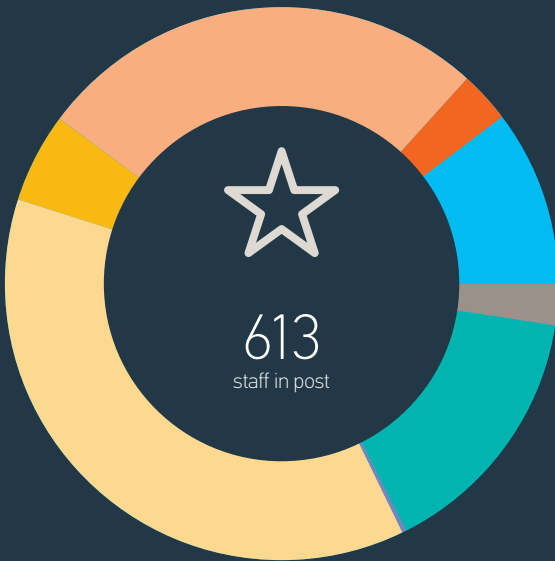
22  
Feature articles published



# Human resources

## Staff in post

At the end of December 2023, there were 613 staff in post. There were 40 starters and 17 leavers.



## Staff nationalities



Administration	<span style="color: #00AEEF;">●</span>	152
Engineering	<span style="color: #FFC000;">●</span>	361
Science	<span style="color: #808080;">●</span>	95
Senior management	<span style="color: #00AEEF;">●</span>	5

German	<span style="color: #FF8C00;">●</span>	22.68%
Italian	<span style="color: #00AEEF;">●</span>	17.13%
British	<span style="color: #808080;">●</span>	13.87%
Spanish	<span style="color: #FFC000;">●</span>	13.87%
French	<span style="color: #00AEEF;">●</span>	11.09%
Portuguese	<span style="color: #808080;">●</span>	2.94%
Turkish	<span style="color: #808080;">●</span>	2.61%
Romanian	<span style="color: #00AEEF;">●</span>	1.79%
Irish	<span style="color: #FF8C00;">●</span>	1.63%
Other	<span style="color: #FFC000;">●</span>	11.40%

*(Belgian 1.47%, Dutch 1.31%, Polish 1.14%, Finnish 0.98%, Greek 0.98%, Hungarian 0.82%, Swedish 0.82%, Bulgarian 0.65%, Croatian 0.65%, Swiss 0.65%, Austrian 0.49%, Danish 0.49%, Lithuanian 0.49%, Slovakian 0.49%, Norwegian 0.33%, American 0.16%, Czech 0.16%, Estonian 0.16%, Slovenian 0.16%)*

## Recruitment and gender balance

4,620 applications were received for vacancies posted in 2023, of which 30.3% were from women.

A total of 54 applications were from EUMETSAT staff, with nine successful internal appointments. A further 321 applications were from consultants working with EUMETSAT, with 13 successful appointments.

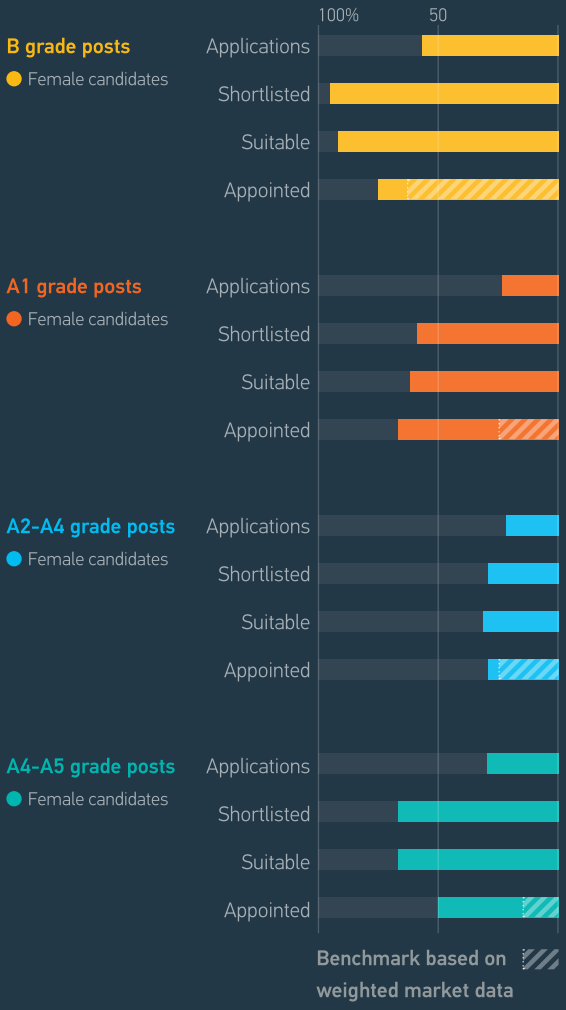
### Recruitment 2023



Staff applications	●	1.17%
Consultant applications	●	6.95%
External applications	●	91.88%



### % of female candidates 2023



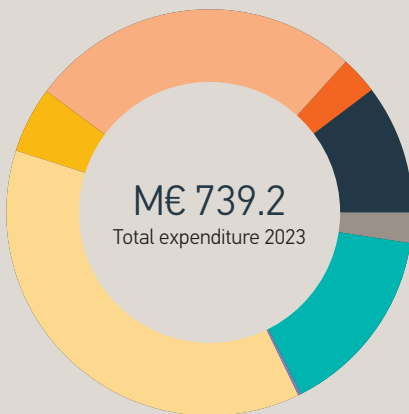


## Financial information

The financial statements are extracted from the EUMETSAT annual accounts 2023 that have been audited by the Spanish Court of Audit (Tribunal De Cuentas) with an unmodified opinion and approved by the 105<sup>th</sup> Council on 26-27 June 2024.

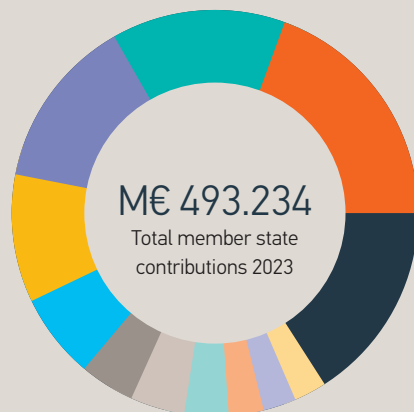
### Expenditure budgets 2023

		MEUR
General Budget (GB)	●	76.2
Meteosat Second Generation (MSG)	●	22.2
Meteosat Third Generation (MTG)	●	196
EUMETSAT Polar System (EPS)	●	38.8
EPS - Second Generation (EPS-SG)	●	274.4
Jason-CS	●	1.8
Copernicus 2.0	●	111.9
Destination Earth (DestinE)	●	17.9
<b>Total expenditure</b>		<b>739.2</b>



### Member state contributions 2023

		KEUR
Austria	●	10,643
Belgium	●	12,916
Bulgaria	●	1,469
Croatia	●	1,398
Czechia	●	5,245
Denmark	●	8,616
Estonia	●	670
Finland	●	6,518
France	●	67,574
Germany	●	95,786
Greece	●	5,180
Hungary	●	3,461
Iceland	●	532
Ireland	●	6,826
Italy	●	50,207
Latvia	●	770
Lithuania	●	1,168
Luxembourg	●	1,055
Netherlands	●	21,356
Norway	●	10,589
Poland	●	12,769
Portugal	●	5,496
Romania	●	5,270
Slovakia	●	2,394
Slovenia	●	1,213
Spain	●	33,389
Sweden	●	13,789
Switzerland	●	17,278
Türkiye	●	21,517
United Kingdom	●	68,140
<b>Total member state contributions</b>		<b>493,234</b>



## EUMETSAT statement of the financial position

	EUR	EUR
	31 December 2023	31 December 2022
<b>Assets</b>		
<b>Current assets</b>		
Cash and cash equivalents	316,817,413.86	264,156,880.27
Receivable from non-exchange transactions	316,817,413.86	264,156,880.27
Receivable contributions	506,639,927.27	498,055,042.55
Receivable MRM/launch delay contingency	0,00	100,000.00
Receivable VAT/taxes	16,545,305.20	12,852,655.50
Receivable from exchange transactions	320,592,858.23	280,098,312.78
Accounts receivable	6,049,813.82	3,368,953.44
Advance payment and accrued income	313,049,055.51	276,487,420.92
Other assets	27,604,034.27	22,190,201.56
Assets held for sale	120.00	239.20
<b>Non-current assets</b>		
Financial assets	243,490,754.82	205,394,657.82
Other tangible fixed assets	984,111.40	1,286,756.27
Land, heritage assets and buildings	75,377,662.12	71,533,979.71
Technical equipment	213,382,690.64	194,051,350.88
Satellites	3,343,234,335.45	3,343,963,880.01
Intangible assets	92,068,879.62	91,431,119.69
<b>TOTAL ASSETS</b>	<b>5,156,738,092.88</b>	<b>4,985,115,076.24</b>
<b>Liabilities</b>		
<b>Current liabilities</b>		
Payable under non-exchange transactions	668,885,686.83	638,266,275.46
WCF payable	146,355,321.33	139,157,567.32
Incurred surplus unpaid	16,493,365.50	6,073,333.14
Deferred contributions	506,037,000.00	493,035,375.00
Payable under exchange transactions	88,193,136.83	80,695,143.75
Accounts payable	23,388,024.14	24,398,209.16
Accruals and deferred income	64,805,112.69	56,296,934.59
Other financial liabilities	70,522,423.74	38,512,434.10
Employee benefits	8,002,903.20	7,447,222.09
Other provisions	53,300.00	53,300.00
<b>Non-current liabilities</b>		
Employee benefits	739,915,829.23	582,860,214.37
Other financial liabilities	147,492.37	50,001.00
<b>TOTAL LIABILITIES</b>	<b>1,575,720,772.20</b>	<b>1,347,884,590.77</b>
<b>Net Assets</b>		
Surpluses/net assets/equity		
Reserves	3,550,861,886.82	3,609,558,062.39
Assets	3,725,047,799.23	3,702,267,325.76
Budget carry forward	13,490,100.06	10,264,877.19
Reserve advance payments	306,957,259.56	269,665,498.00
Employee benefits	-499,198,293.83	-378,818,034.41
Deferred	4,565,021.80	6,178,395.85
Net result of the year	30,155,433.86	27,672,423.08
<b>TOTAL NET ASSETS</b>	<b>3,581,017,320.68</b>	<b>3,637,230,485.47</b>



# Financial information

## EUMETSAT statement of the financial performance

	EUR 2023	EUR 2022
<b>Operating revenue</b>		
Contributions	607,614,292.60	549,511,858.59
Pension revenue	31,854,890.64	6,794,620.97
Sales revenue	1,447,166.66	1,345,500.00
Other revenue	14,782,390.21	17,060,079.89
Revenue from assets	32,524,423.38	519,535,443.07
<b>Total operating revenue</b>	<b>688,223,163.49</b>	<b>1,094,247,502.52</b>
<b>Operating expenses</b>		
Costs for human resources	234,340,497.14	262,977,354.09
Other operating expenses	15,586,522.03	15,621,356.48
Satellite related costs	90,581,117.05	66,018,531.13
SAF, prospective activities, research fellows	10,662,662.35	14,042,794.41
Depreciation and losses from disposal of assets	230,330,522.63	162,165,329.71
<b>Total operating expenses</b>	<b>581,501,321.20</b>	<b>520,825,365.82</b>
<b>NET SURPLUS/DEFICIT FROM OPERATING ACTIVITIES</b>	<b>106,721,842.29</b>	<b>573,422,136.70</b>
<b>Financial operations revenue</b>	<b>6,874,030.93</b>	<b>558,651.72</b>
<b>Financial operations expenses</b>	<b>21,582.88</b>	<b>846,727.08</b>
<b>NET SURPLUS/DEFICIT FROM ORDINARY ACTIVITIES</b>	<b>113,574,290.34</b>	<b>573,134,061.34</b>
<b>Extraordinary Items</b>		
<b>NET SURPLUS/(DEFICIT) FOR THE PERIOD</b>	<b>113,574,290,34</b>	<b>573,134,061,34</b>
<b>Attributable to :</b>		
<b>Incurred Surplus unpaid</b>	<b>-16.493.365,50</b>	<b>-6.073.333,14</b>
<b>Net result of the year</b>	<b>-30.155.433,86</b>	<b>-27.672.423,08</b>
<b>Result Allocated to Reserves</b>	<b>-66.925.490,98</b>	<b>-539.388.305,12</b>

## EUMETSAT statement of the cash flow

	EUR 2023	EUR 2022
<b>Cash flows from operating activities</b>		
Surplus / (Deficit) from ordinary activities	106,894,590.77	573,538,293.38
Cash inflows from interest	6,679,699.57	426,809.39
Cash outflows from interest	0.00	-831,041.43
<b>Non-cash movements</b>		
Depreciation, net	230,119,939.43	162,165,206.71
(Gains) losses on property, plant and equipment	-32,524,423.38	-519,535,443.07
(Gains) losses on property, plant and equipment	210,583.20	123.00
Receivable contributions	-8,584,884.72	-8,067,655.42
Receivable MRM/launch delay	100,000.00	32,200,000.00
Accrued income/deferred expenditure	758,468.18	-1,036,556.93
Accounts receivable and prepayments	-30,051,393.48	42,267,171.31
Receivable interest	-1,252,050.48	-232,948.75
Receivable VAT/taxes	-3,692,649.70	15,684,759.58
Other assets	-5,413,832.71	9,682,799.52
Vendor payables	-839,072.22	12,753,344.45
Staff payables	-43,803.24	1,205,323.01
Deferred income/accrued expenditure	4,488,706.53	-9,650,667.45
Accruals/provisions	4,116,962.94	-12,208,368.44
Increase/ (decrease) in health insurance and unemployment reserves	37,590,418.11	-102,736,622.29
Other financial liabilities	32,009,989.64	8,132,939.93
<b>Net cash flow from operating activities</b>	<b>340,567,248.44</b>	<b>203,757,466.50</b>
<b>Cash flows from investing activities</b>		
Increase/(decrease) in fixed asset	-220,586,572.72	-301,289,254.90
Increase/(decrease) in financial assets - pension budget	-19,787,288.76	48,449,234.08
Increase/(decrease) in reserve fund	-40,530,271.99	116,616,871.72
<b>Net cash flow from investing activities</b>	<b>-280,904,133.47</b>	<b>-136,223,149.10</b>
<b>Cash flows from financing activities</b>		
WCF's payable	7,197,754.01	-2,763,522.59
Incurred surplus unpaid	10,420,032.36	493,361.45
Deferred contribution	13,001,625.00	6,778,375.00
Advance payments	-9,949,569.67	2,851,205.25
Surplus previous year(s) to be distributed	-27,672,423.08	-24,834,836.39
<b>Net cash flow from financing activities</b>	<b>-7,002,581.38</b>	<b>-17,475,417.28</b>
<b>Net increase/(decrease) in cash and cash equivalents</b>	<b>52,660,533.59</b>	<b>50,058,900.12</b>
<b>Cash and cash equivalents at beginning of period</b>	<b>264,156,880.27</b>	<b>214,097,980.15</b>
<b>Cash and cash equivalents at end of period</b>	<b>316,817,413.86</b>	<b>264,156,880.27</b>

# Financial information

## EUMETSAT statement of the changes in net assets

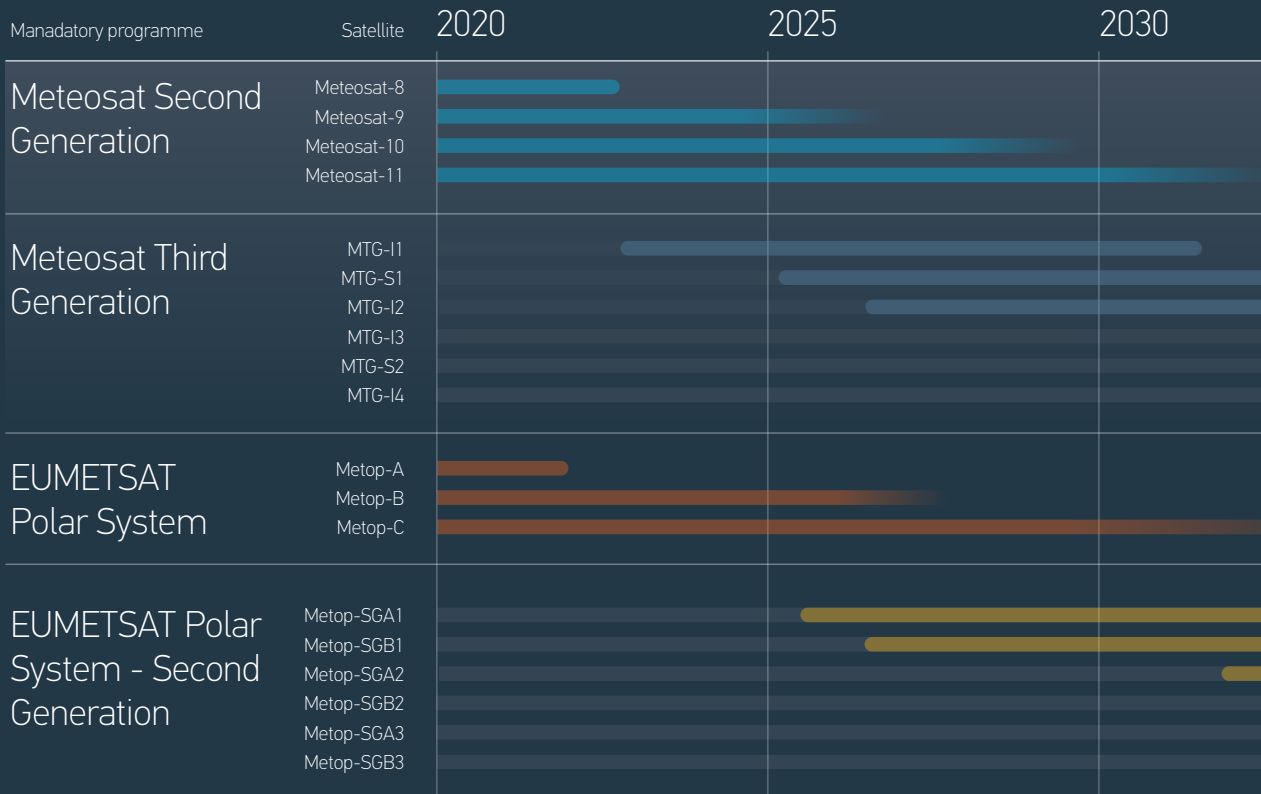
	Asset reserve	Reserve for accrual/ deferral of expenses	Advance payments reserve
<b>Balance at 31 December 2021</b>	<b>3,043,607,957.50</b>	<b>4,971,938.15</b>	<b>316,425,825.55</b>
Net revenue recognised directly in net assets/ equity			
Surplus / (Deficit) for the period	658,659,368.26	1,206,457.70	-46.760.327,55
Total recognised revenue and expense for the period	658,659,368.26	1,206,457.70	-46.760.327,55
Distribution to Member States			0,00
<b>Balance at 31 December 2022</b>	<b>3.702.267.325,76</b>	<b>6.178.395,85</b>	<b>269.665.498,00</b>
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
<b>Balance at 31 December 2023</b>	<b>3.725.047.799,23</b>	<b>4.565.021,80</b>	<b>306.957.259,56</b>

<b>Employee benefits reserve</b>	<b>Available-for-sale reserve</b>	<b>Budget carry forward</b>	<b>Surplus distributed to member states</b>	<b>Total net assets</b>
<b>-704.056.914,10</b>	<b>33.642.077,07</b>	<b>18.665.281,76</b>	<b>24.834.836,39</b>	<b>2.704.448.925,25</b>
390.634.001,23	-33.642.077,07			390.634.001,23
-64.107.728,42		-8.400.404,57	33.745.756,22	574.343.121,64
327.735.333,11	-33.642.077,07	-8.400.404,57	33.745.756,22	966.186.183,17
-2.496.453,42		0,00	-30.908.169,53	-33.404.622,95
<b>-378.818.034,41</b>	<b>0,00</b>	<b>10.264.877,19</b>	<b>27.672.423,08</b>	<b>3.637.230.485,47</b>
-103.116.442,50	0,00			-103.116.442,50
5.241.407,13		3.225.222,87	46.648.799,36	113.574.290,34
-97.875.035,37	0,00	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
<b>-499.198.293,83</b>	<b>0,00</b>	<b>13.490.100,06</b>	<b>30.155.433,86</b>	<b>3.581.017.320,68</b>

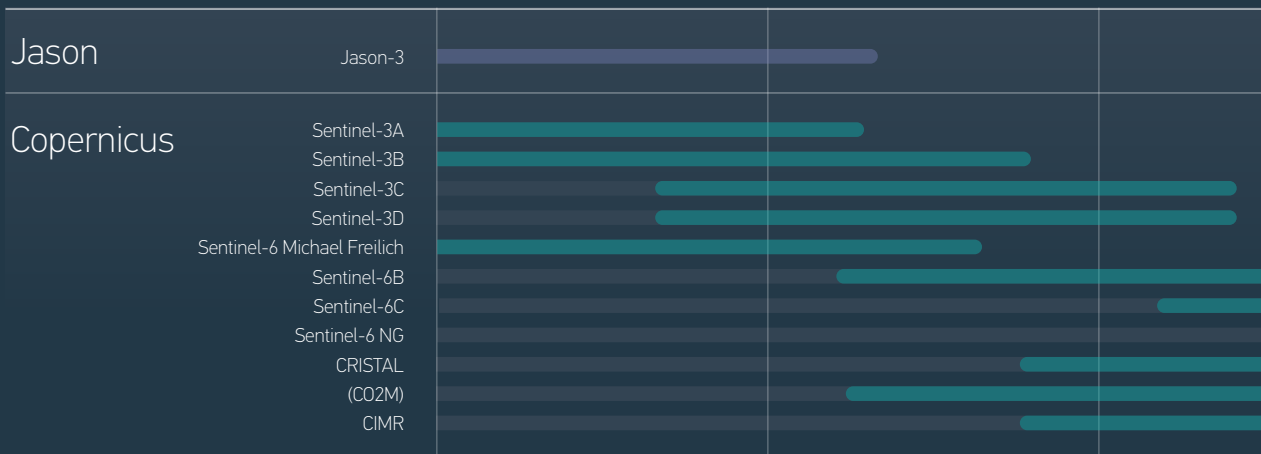


# Mission planning

31 December 2023



## Optional and Copernicus programme









# Service availability to users

▲ Above target    ● 100% availability    ● exceeded target  
 ▼ Below target    ● within 1% of reaching target    ● more than 1% below target

## 2021

1 2 3 4 5 6 7 8 9 10 11 12

## 2022

1 2 3 4 5 6 7 8 9 10 11 12

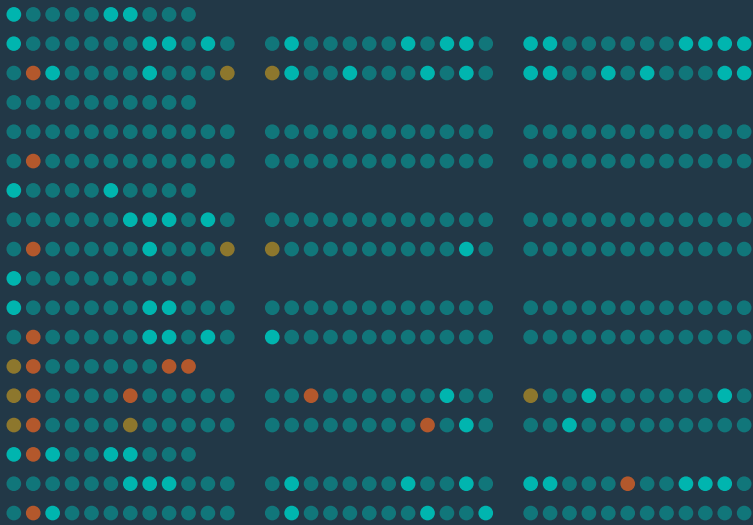
## 2023

1 2 3 4 5 6 7 8 9 10 11 12

Why were some services below target?

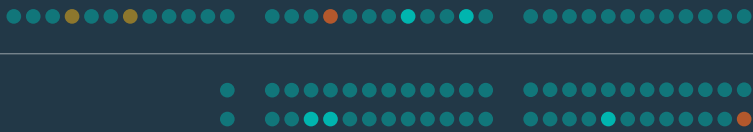


Rapid scan, expected due to the monthly rapid scanning break of two days per month. IODC, expected outages.



Metop-B IASI, extended IASI calibration.

Metop-B MHS, instrument level anomaly followed by investigation tests.



POSEIDON 4 L2 LR, ground segment maintenance



Major failure of the Sentinel-3 PDGS hardware.





# EUMETSAT user base

## Number of user enquiries in 2023

3,227 user enquiries were processed in 2023, with 67% from EUMETSAT member states.



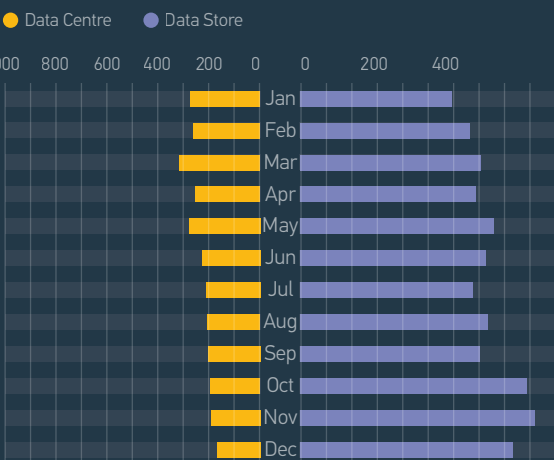
## Number of EUMETCast stations and users on 31 December 2023

At the end of December 2023, there were 5,004 registered EUMETCast stations exploited by 3,417 registered users.

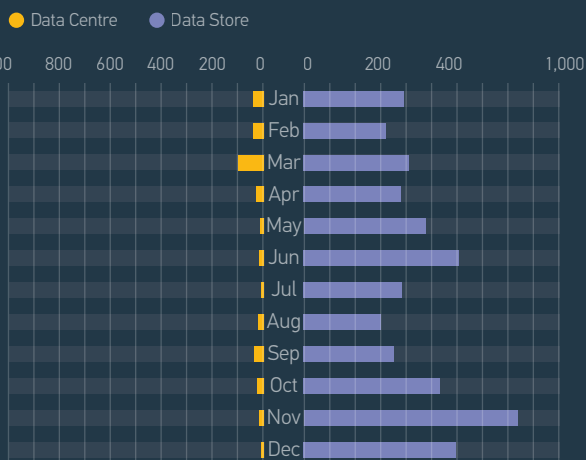


## Data Centre and Data Store users and orders in 2023

Unique active users in 2023



Total delivery volume in terabytes (TB) in 2023



# EUMETSAT delegate body chairs 2023

## EUMETSAT Council



*Chair*

**Mr E. Moran**  
*Met Éireann*



*Vice-Chair*

**Ms M. Thyrring**  
*Danish Meteorological Institute*

## Policy Advisory Committee (PAC)



*Chair*

*from 1 September 2023*  
**Mr P. Rottiers**  
*Belgian Space Policy  
Office (BELSPO)*



*Vice-Chair*

*from 1 September 2023*  
**Dr D. Biron**  
*Italian Air Force*



*Chair*

*until 31 August 2023*  
**Mr F. Fontana**  
*MeteoSwiss*



*Vice-Chair*

*until 31 August 2023*  
**Mr P. Rottiers**  
*Belgian Space Policy  
Office (BELSPO)*

## Scientific and Technical Group (STG)



*Chair*

*from 1 September 2023*  
**Dr I. Trigo**  
*Instituto Português do  
Mar e da Atmosfera*



*Vice-Chair*

*from 1 September 2023*  
**Lt. Col. I. Matsangouras**  
*Hellenic National  
Meteorological Service*



*Chair*

*until 31 August 2023*  
**Mr M. Manso Rejón**  
*Agencia Estatal de  
Meteorología (AEMet)*



*Vice-Chair*

*until 31 August 2023*  
**Dr I. Trigo**  
*Instituto Português do  
Mar e da Atmosfera*

## STG Operations Working Group (STG-OWG)



*Chair*

**Mr S. Keogh**  
*Met Office*



*Vice-Chair*

**Mr P. de Valk**  
*Koninklijk Nederlands  
Meteorologisch Instituut*

## STG Science Working Group (STG-SWG)



*Chair*

**Dr P. Francis**  
*Met Office*



*Vice-Chair*

**Dr K. Lauritsen**  
*Danish Meteorological Institute*

## Administration and Finance Group (AFG)



*Chair*

**Mr S. Green**  
*Met Office*



*Vice-Chair*

**Ms J. Prendergast**  
*Met Éireann*

## AFG Audit Committee (AFG-AC)



*Chair*

**Mr S. Green**  
*Met Office*

## Data Policy Group (DPG)



*Chair*

**Mr V. Rak**  
*Slovenský  
hydrometeorologický ústav*



*Vice-Chair*

**Mr S. Ulatowski**  
*Instytut Meteorologii i  
Gospodarki Wodnej Państwowy  
Instytut Badawczy*



# Organisation chart

1 January 2024

## EUMETSAT Council

*Policy Advisory Committee (PAC)*

*Scientific and Technical Group (STG)*

*STG Operations Working Group (STG-OWG)*

*STG Science Working Group (STG-SWG)*

*Administration and Finance Group (AFG)*

*AFG Audit Committee (AFG-AC)*

*Data Policy Group (DPG)*



**Director-General**

*Phil Evans*



**Chief Scientist**

*Paolo Ruti*



**Quality Management**

*Camelo Aveni Cirino*



**Strategy, Communication and International Relations**

*Paul Counet*



**Programme Preparation and Development**

*Cristian Bank*



**Mandatory LEO Programmes**

*Fran Martinez Fadrique*



**Mandatory GEO Programmes**

*Alexander Schmid*



**Copernicus Missions Development**

*Vincenzo Santacesaria*



**Internal Audit**

*Dennis Schippler*



**Operations and Services to Users**  
Sean Burns



**Administration**  
Silvia Castañer



**Technical and Scientific Support**  
Frédéric Pradelles



**Flight Operations**  
Gareth Williams



**Contracts**  
Eleni Katsampani



**Process Assurance and Management Support**  
Andrea Duflaut



**Real Time Services and System Operations**  
Jenny Rourke



**Finance**  
Per Collin



**Information and Communication Technology**  
Okan Gumrah



**User Support and Climate Services**  
Joachim Saalmueller



**General Services**  
Bernd Kaufmann



**Satellite System Ground Segments**  
Arnaud Carlier



**Copernicus Programme and Service Management Office**  
Lieven Bydekerke



**Human Resources**  
Raffael Clerici



**Infrastructure for IT and Data**  
Andy Phelps



**Legal Affairs**  
Mechtild Lauth



**Digital Solutions and SAF**  
Lothar Wolf



**Remote Sensing and Products**  
Bojan Bajkov

# EUMETSAT Council delegates and advisors

## Austria



<b>Mr A. Schaffhauser</b>	GeoSphere Austria
<b>Dr G. Wotawa</b>	GeoSphere Austria
<b>Mr L. Berset</b>	FFG-ALR

## Belgium



<b>Dr D. Gellens</b>	Koninklijk Meteorologisch Instituut
<b>Mr P. Rottiers</b>	Belgian Science Policy Office (BELSPO)

## Bulgaria



<b>Prof. Dr. T. Marinova</b>	National Institute of Meteorology and Hydrology
<b>Prof. Dr. I. Gospodinov</b>	National Institute of Meteorology and Hydrology
<b>Prof. Dr. C. Georgiev</b>	National Institute of Meteorology and Hydrology

## Croatia



<b>Dr B. Ivancan-Picek</b>	Državni hidrometeorološki zavod
<b>Mr I. Guettler</b>	Državni hidrometeorološki zavod

## Czechia



<b>Mag. M. Rieder</b>	Český hydrometeorologický ústav
<b>Dr J. Stastka</b>	Český hydrometeorologický ústav
<b>Ms D. Bachmanová</b>	Ministerstvo životního prostředí
<b>Mr K. Dědič</b>	Ministerstvo životního prostředí

## Denmark



<b>Ms M. Thyrring</b>	Danmarks Meteorologiske Institut
<b>Mr T. Kjellberg Christensen</b>	Danmarks Meteorologiske Institut
<b>Ms C. Munksgaard</b>	Danmarks Meteorologiske Institut

## Estonia



<b>Mr T. Ala</b>	Estonian Environment Agency
<b>Ms K. Rosin</b>	Estonian Environment Agency

## Finland



<b>Prof Jussi Kaurola</b>	Finnisches Meteorologisches Institut
<b>Mr A.-M. Harri</b>	Finnisches Meteorologisches Institut
<b>Mr J. Pulliainen</b>	Finnisches Meteorologisches Institut

## France



<b>Mr A. Soulan</b>	Météo France
<b>Ms A. Magnouloux</b>	Météo France
<b>Ms M. Chiricao</b>	Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation
<b>Ms Z. Mokadem</b>	Centre National d'Etudes Spatiales

## Germany



<b>Prof. Dr S. Jones</b>	Deutscher Wetterdienst
<b>Prof G. Adrian</b>	Deutscher Wetterdienst
<b>Mr M. Rohn</b>	Deutscher Wetterdienst
<b>Dr G. Seuffert</b>	Bundesministerium für Verkehr und digitale Infrastruktur
<b>Dr M. Uphoff</b>	Bundesministerium für Verkehr und digitale Infrastruktur
<b>Mr T. Ruwwe</b>	Deutsches Zentrum für Luft- und Raumfahrt

## Greece



<b>Brig. Gen. S. Barsakis</b>	Hellenic National Meteorological Service
<b>Maj. Gen. D. Sideridis</b>	Hellenic National Meteorological Service
<b>Brig. Gen. K. Kasapas</b>	Hellenic National Meteorological Service
<b>Lt. Col I. Matsangouras</b>	Hellenic National Meteorological Service
<b>Mr T. Theodoridis</b>	Hellenic National Meteorological Service

## Hungary



<b>Mr G. G. Szanka</b>	Országos Meteorológiai Szolgálat
<b>Dr K. Radics</b>	Országos Meteorológiai Szolgálat
<b>Mr R. Tóth</b>	Országos Meteorológiai Szolgálat
<b>Dr M. Diószeghy</b>	Országos Meteorológiai Szolgálat
<b>Dr E. Lábó-Szapponas</b>	Országos Meteorológiai Szolgálat

## Iceland



<b>Dr A. Snorrason</b>	Veðurstofa Íslands
<b>Mr I. Kristinnsson</b>	Veðurstofa Íslands

## Ireland



<b>Mr E. Moran</b>	Met Éireann
<b>Ms J. Prendergast</b>	Met Éireann
<b>Dr N. Fitzpatrick</b>	Met Éireann
<b>Ms S. O'Reilly</b>	Met Éireann

## Italy



<b>Brig. Gen. L. Baione</b>	Aeronautica Militare
<b>Lt. Col. D. Biron</b>	Aeronautica Militare
<b>Mr A. Raspanti</b>	Aeronautica Militare
<b>Ms S. Puca</b>	Dipartimento della Protezione Civile
<b>Dr F. Battazza</b>	Agenzia Spaziale Italiana
<b>Ms P. Sacco</b>	Agenzia Spaziale Italiana

## Latvia



<b>Mr E. Zarins</b>	Latvijas Vides ģeoloģijas un meteoroloģijas centrs
<b>Mr A. Viksna</b>	Latvijas Vides ģeoloģijas un meteoroloģijas centrs

## Lithuania



<b>Ms V. Raliene</b>	Lietuvos hidrometeorologijos tarnyba
<b>Mr K. Šetkus</b>	Lietuvos hidrometeorologijos tarnyba

## Luxembourg



<b>Ms M. Reckwerth</b>	MeteoLux, Administration de la navigation aérienne
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## Netherlands



<b>Prof. Dr M. van Aalst</b>	Koninklijk Nederlands Meteorologisch Instituut
<b>Prof. G. Van der Steenhoven</b>	Koninklijk Nederlands Meteorologisch Instituut
<b>Dr P. Stammes</b>	Koninklijk Nederlands Meteorologisch Instituut
<b>Mr G. Verver</b>	Koninklijk Nederlands Meteorologisch Instituut

## Norway



<b>Mr R. Skålin</b>	Meteorologisk institutt
<b>Mr L. A. Breivik</b>	Meteorologisk institutt
<b>Dr J. Tradowski</b>	Meteorologisk institutt

## Poland



<b>Dr J. Karp</b>	Instytut Meteorologii i Gospodarki Wodnej Państwowy Instytut Badawczy (IMGW)
<b>Dr A. Rutkowski</b>	IMGW
<b>Mr J. Trzosowski</b>	IMGW

## Portugal



<b>Prof. J. A. Guerreiro da Silva</b>	Instituto Portugues do Mar e da Atmosfera
<b>Mr J. M. A. de Miranda</b>	Instituto Portugues do Mar e da Atmosfera
<b>Mr R. Deus</b>	Instituto Portugues do Mar e da Atmosfera
<b>Ms I. Trigo</b>	Instituto Portugues do Mar e da Atmosfera

## Romania



<b>Ms E. Mateescu</b>	Administrația Națională de Meteorologie
<b>Mr C. Ostrovneanu</b>	Administrația Națională de Meteorologie
<b>Dr G. Stancalie</b>	Administrația Națională de Meteorologie

## Slovakia



<b>Dr M. Benko</b>	Slovenský hydrometeorologický ústav
<b>Mr V. Rak</b>	Slovenský hydrometeorologický ústav

## Slovenia



<b>Mr J. Knez</b>	Agencija Republika Slovenija za okolje
<b>Mr J. Jerman</b>	Agencija Republika Slovenija za okolje
<b>Mr G. Sluga</b>	Agencija Republika Slovenija za okolje

## Spain



<b>Mr M.-Á. López González</b>	Agencia Estatal de Meteorología
<b>Mr F. Belda Esplugues</b>	Agencia Estatal de Meteorología
<b>Ms A. Grande Royo-Villanova</b>	Agencia Estatal de Meteorología
<b>Mr M. Manso Rejon</b>	Agencia Estatal de Meteorología

## Sweden



<b>Mr H. Wirtén</b>	Sveriges meteorologiska och hydrologiska institut
<b>Ms B. Aarhus Andrae</b>	Sveriges meteorologiska och hydrologiska institut
<b>Mr S. Nilsson</b>	Sveriges meteorologiska och hydrologiska institut
<b>Ms E. Strandberg</b>	Sveriges meteorologiska och hydrologiska institut

## Switzerland



<b>Prof. Dr C. Appenzeller</b>	Federal Office of Meteorology and Climatology MeteoSwiss
<b>Mr F. Fontana</b>	Federal Office of Meteorology and Climatology MeteoSwiss
<b>Mr M. Keller</b>	Federal Office of Meteorology and Climatology MeteoSwiss

## Türkiye



<b>Mr V. Mutlu Coskun</b>	Devlet Meteoroloji İşleri Genel Müdürlüğü
<b>Mr Y. Yagan</b>	Devlet Meteoroloji İşleri Genel Müdürlüğü
<b>Mr M. Altinyollar (Interpreter)</b>	Devlet Meteoroloji İşleri Genel Müdürlüğü
<b>Mr C. Kaplan</b>	Devlet Meteoroloji İşleri Genel Müdürlüğü
<b>Ms N. Sogutcuclu</b>	Devlet Meteoroloji İşleri Genel Müdürlüğü

## United Kingdom



<b>Mr S. Brown</b>	Met Office
<b>Mr S. Green</b>	Met Office
<b>Ms I. Harrison-Roberts</b>	Met Office
<b>Ms S. Jackson</b>	Met Office
<b>Mr S. Turner</b>	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 2023

<b>33<sup>rd</sup> EUMETSAT - ESA bilateral Meeting</b>	Darmstadt	19 January
<b>European Space Conference</b>	Brussels	24 January
<b>Meeting with UKMO, UKSA and BIS</b>	London	26-27 January
<b>EUMETSAT-ESOC Bilateral Meeting</b>	Darmstadt	4 February
<b>Future Possibilities - EUMETSAT/NOAA Environmental Architecture to Meet Users Needs</b>	Darmstadt	9-10 February
<b>ESA Earth Observation Programme Board Meeting</b>	Frascati	14-15 February
<b>NOAA - EUMETSAT HLWG meeting</b>	Washington	16-17 November
<b>Fifth CGMS Risk Assessment Workshop</b>	virtual	21-23 February
<b>76<sup>th</sup> WMO Executive Council</b>	Geneva	27 February - 3 March
<b>CGMS future direction 2022 and sixth task team meeting</b>	Darmstadt	15-16 March
<b>CEOS SIT-38 meeting</b>	Frascati	28-30 March
<b>CGMS future direction 2022 and project: second high level meeting</b>	virtual	29 March
<b>MTG AMSAF Workshop</b>	Brussels	30-31 March
<b>EUMETSAT Information Days for Western Balkan Countries</b>	Sarajevo	18-19 April
<b>EPS-Sterna and EPS-Aeolus Impact Assessment Workshop</b>	Darmstadt	19-20 April
<b>Webinar on air quality monitoring in Africa</b>	virtual	20 April
<b>Second CGMS WGIV cloud expert workshop</b>	Darmstadt	21-22 April
<b>CGMS-51 WG Meetings</b>	Darmstadt	24-28 April
<b>EUMETSAT Information Days for Eastern Europe, Caucasian and Central Asian</b>	Tbilisi	27-28 April
<b>ECMWF-EUMETSAT Bilateral Meeting,</b>	Reading	3 May
<b>11<sup>th</sup> European Conference on Severe Storms</b>	Bucharest	8-11 May
<b>Global Space Conference On Climate Change</b>	Oslo	23-25 May
<b>19<sup>th</sup> WMO Congress meeting</b>	Geneva	22 May - 2 June
<b>ESA Earth Observation Programme Board Meeting</b>	Frascati	30-31 May
<b>Hessen in Space exhibition</b>	Frankfurt	1 June
<b>Copernicus Joint PB-EO / CPC and 25<sup>th</sup> anniversary event</b>	Stockholm	7-8 June
<b>Third International Operational Satellite Oceanography Symposium</b>	Busan	12-15 June
<b>CGMS-51 plenary session</b>	Tokyo	26-28 June
<b>55<sup>th</sup> GEO High level Working Group meeting</b>	virtual	10 July
<b>Webinar on Earth Observation for Hydrology in Africa</b>	virtual	24 August
<b>EUMETSAT Meteorological Satellite Conference</b>	Malmö	11-15 September
<b>RA I Dissemination Expert Group (RAIDEG) meeting</b>	Darmstadt	26-27 September
<b>WMO workshop on Observations within the Global Greenhouse Gas Watch</b>	virtual	3 October
<b>Meteorological Technology World Expo</b>	Geneva	3-5 October
<b>Forum Meteo Climat</b>	Paris	6-7 October
<b>50<sup>th</sup> Meeting of the International Charter Space &amp; Major Disasters</b>	Darmstadt	16-20 October
<b>EU Space Week</b>	Seville	6-10 November
<b>International Cooperative for Aerosol Prediction (ICAP) 13<sup>th</sup> working group</b>	Darmstadt	8-10 November
<b>CEOS Plenary, Chiang Rai</b>	Thailand	13-17 November
<b>Copernicus Ocean Colour System Vicarious Calibration Information Day</b>	Darmstadt	8 November
<b>WMO core satellite data workshop</b>	Geneva	4-7 December
<b>Eighth Sentinel-3 Validation Team meeting,</b>	Darmstadt	5-7 December
<b>Fourth Joint GSICS/IVOS Lunar Calibration Workshop</b>	Darmstadt	4-7 December

# Data records released in 2023

## Datasets released in 2023

	DOI
Cloud, albedo and surface radiation dataset R3	10.5676/EUM_SAF_CM/CLARA_AVHRR/V003
Surface Solar Radiation Data Set R3	10.5676/EUM_SAF_CM/SARAH/V003
Total column-water vapour	10.5676/EUM_SAF_CM/COMBI/V001
RapidScat L2 50 km winds data record, release 1	10.15770/EUM_SAF_OSI_0021
R2 of HIRS FDR	10.15770/EUM_SEC_CLM_0036
R1 of SSM/T FDR	10.15770/EUM_SEC_CLM_0065
R1 of SI-1 FDR	10.15770/EUM_SEC_CLM_0086
R1 - MSG SEVIRI FCDR (rapid scan)	10.15770/EUM_SEC_CLM_0098
R1 - AVHRR GAC Level 1c FDR	10.15770/EUM_SEC_CLM_0060
R2 - MFG/MSG 0° FCDR IR/WV/VIS	10.15770/EUM_SEC_CLM_0057
R2 - MFG IODC-57° FCDR IR/WV/VIS	10.15770/EUM_SEC_CLM_0058
R2 - MFG IODC-63° FCDR IR/WV/VIS	10.15770/EUM_SEC_CLM_0059
R1 - MFG IODC-57° Atmospheric Motion Vectors	10.15770/EUM_SEC_CLM_0021
R1 - MFG IODC-63° Atmospheric Motion Vectors	10.15770/EUM_SEC_CLM_0022
R1 - MSG IODC-41° Atmospheric Motion Vectors	10.15770/EUM_SEC_CLM_0054

## Reprocessed datasets released in 2023

	DOI
SRAL Level 1B (version BC005) - Sentinel-3 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0088)
SRAL Level 2 Altimetry Global (version BC005) - Sentinel-3 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0089)
SRAL Level 1B Stack Echoes (version BC005) - Sentinel-3 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0090)
SRAL Level 1A Unpacked L0 Complex Echoes (version BC005) - Sentinel-3 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0091)
Advanced Microwave Radiometer Level 2 Products (baseline version F08) - Sentinel-6 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0092)
Poseidon-4 Altimetry Level 1A High Resolution (baseline version F08) - Sentinel-6 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0093)
Poseidon-4 Altimetry Level 1B High Resolution (baseline version F08) - Sentinel-6 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0094)
Poseidon-4 Altimetry Level 1B Low Resolution (baseline version F08) - Sentinel-6 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0095)
Poseidon-4 Altimetry Level 2 High Resolution (baseline version F08) - Sentinel-6 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0096)
Poseidon-4 Altimetry Level 2 Low Resolution (baseline version F08) - Sentinel-6 - Reprocessed	(doi: 10.15770/EUM_SEC_CLM_0097)

## New products released in 2023

CM SAF: Total column water vapour climate data record	6 February 2023
AC SAF: Level 3 trace gases GOME-2	21 April 2023
OSI SAF: Improved NRT Sea Ice Concentration products	25 April 2023
CM SAF: CLARA A3 Cloud Data Record	27 April 2023
CM SAF: SARA-3 Surface Radiation Data Record	5 May 2023
NWC SAF: GEO Software Package GEO Version 2021.2	15 June 2023
NWP SAF: Radiance Simulator (RadSim) Version 3.2	27 July 2023
AC SAF: Ammonia (NH <sub>3</sub> ) from IASI	21 September 2023
NWP SAF: ATOVS and AVHRR Pre-processing Package version 8.12	5 October 2023
OSI SAF: HY-2D Surface Wind Vectors (pre-operational)	9 November 2023
LSA SAF: Surface Albedo from MSG SEVIRI version 2	20 November 2023

## Scientific and technical publications 2023

Agar, P., **S. Roohi**, B. Voosoghi, A. Amini, and D. Poreh. 2023. 'Sea Surface Height Estimation from Improved Modified, and Decontaminated Sub-Waveform Retracking Methods over Coastal Areas'. *Remote Sens.* 15, no. 3: 804.

Aminou, D., [...] **D. Innorta**, **G. Fowler**, **M. Lekouara**, **A. Burini**, **B. Viticchie**, **J. Grandell** et al. 'Meteosat Third Generation (MTG) Satellites Series Overall Status: The Launch and in-Orbit Characterisation of the First Imagery Mission of MTG'. In *Proceedings of SPIE*, 12729:1272905. Amsterdam, Netherlands, 2023.

**Arriazu, P.**, **E. Trollope**, **C. Vera**, **J. De Juana Gamo**, **E. Kwiatkowska**, **S. Wagner**, and **D. Montero**. 'Lunar Observations in Copernicus Sentinel-3: Implementing a New Operation into a Flying Mission'. *17<sup>th</sup> Int. Conf. on Space Operations (SpaceOps 2023)*, Dubai, United Arab Emirates, 2023.

**August, T.** 2023 'Operational Sounding of Thermodynamic Variables in the Atmosphere'. In *Satellites for Atmospheric Sciences 2: Meteorology, Climate and Atmospheric Composition*, edited by T. Phulpin, 9–29. Hoboken, United States: Wiley.

**August, T.**, T. Wagner, **L. Spezzi**, **T. Hultberg**, and **M. Crapeau**. 'Operational Water-Vapour Products at EUMETSAT, Latest Evaluation in Pre-Convective Situations and Future Plans'. *11<sup>th</sup> Europ. Conf. on Severe Storms*, Bucharest, Romania, 2023.

**Bach, N.**, **F. Roveda**, and **E. Bouchez**. 'Meteosat Third Generation (MTG) Ground Segment and Technical Challenges to Integrate It'. *17<sup>th</sup> Int. Conf. on Space Operations (SpaceOps 2023)*, Dubai, United Arab Emirates, 2023.

**Barbieux, K.**, and **R. Borde**. 2023. 'An Investigation of the Reasons behind the Biases in the Tropical and Extratropical Atmospheric Motion Vectors Derived from EUMETSAT Low Earth Orbit Satellite Data'. *Remote Sens. Lett.* 14, no. 6: 620–30.

**Bassi, E.**, **J. Miller**, **D. Coppens**, **B. Theodore**, O. Vandermarcq, L. LeBarbier, M. Faillot, and J. Ansart. 'IASI Instrument: End of Life Activities and Technology Tests'. *17<sup>th</sup> Int. Conf. on Space Operations (SpaceOps 2023)*, Dubai, United Arab Emirates, 2023.

Bertzosa, J., C. Fernández Martín, M. Matuszak, M. Fernández Usón, J. Fernández Sánchez, **C. Nogueira Loddó**, P. Femenias, H. Peter, and U. Meyer. 'Reprocessing of Copernicus Sentinel POD Solutions with COST-G Geopotential Models'. *2023 EGU General Assembly*, Vienna, Austria & online, 2023.

**Bojinski, S.**, D. Blaauboer, X. Calbet, E. De Coning, F. Debie, T. Montmerle, **V. Nietosvaara**, K. Norman, L. Bañón Peregrín, F. Schmid, N. Strelec Mahović, and K. Wapler. 2023. 'Towards Nowcasting in Europe in 2030'. *Meteorol. Appl.* 30, no. 4: e2124.

Names in **bold** indicate EUMETSAT authors

- Borde, R.**, and J. Pailleux. 2023. 'Wind Observations'. In *Satellites for Atmospheric Sciences 2: Meteorology, Climate and Atmospheric Composition*, edited by T. Phulpin, 31–45. Hoboken, United States: Wiley.
- Bourgeois, Q., A. Tetzlaff, R. Stöckli, N. Christen, **J. Viju**, W. Moutier, N. Clerbaux, F. Gellens-Meulenberghs, J. Trentmann, and I. Trigo. 'Concept and Validation of a Meteosat Based Dataset for Surface Radiative Balance'. *2023 EGU General Assembly*, Vienna, Austria & online, 2023.
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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](mailto:press@eumetsat.int)

**Web:** [www.eumetsat.int](http://www.eumetsat.int)



Eumetsat Allee 1  
64295 Darmstadt  
Germany

T: +49 6151 807 3660/3770

E: [press@eumetsat.int](mailto:press@eumetsat.int)

W: [www.eumetsat.int](http://www.eumetsat.int)



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EUM AR.36, © EUMETSAT, 2024

ISSN: 1013-3410

ISBN: 978-92-9110-114-6