EUMETSAT Polar System – Second Generation

Introducing the EUMETSAT Polar System - Second Generation and its Metop Second Generation satellites

Monitoring weather and climate from space

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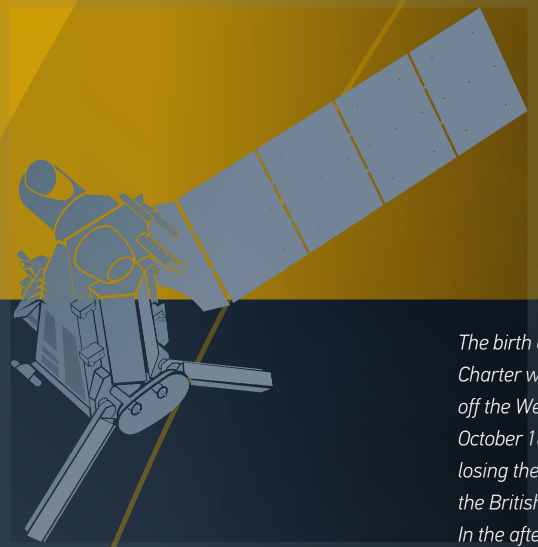
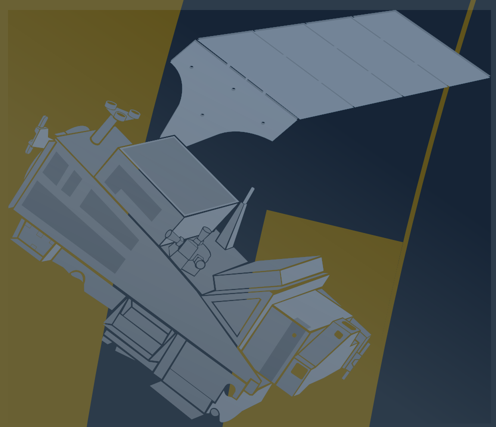
Data from first-generation Metop satellites have been the single biggest contributor to the accuracy of European weather forecasts between 12 hours and 10 days in advance[1]. With more and higher-resolution data, introducing the EUMETSAT Polar System – Second Generation (EPS-SG) and its Metop Second Generation (Metop-SG) satellites: monitoring weather, climate and the environment from space like never before.

1 Joo, S et al (2013) The Impact of Metop and Other Satellite Data within the Met Office Global NWP System Using an Adjoint-Based Sensitivity Method, The Monthly Weather Review, 141:10





The birth of weather forecasting: the Royal Charter was destroyed in a massive storm off the Welsh coast on the night of 25 October 1859, with all 450 people on board losing their lives. A further 800 people across the British Isles died during the catastrophe. In the aftermath a storm warning system emerged, inspired by reports and charts that proved that the storm could have been predicted. Today, storm warnings save lives and livelihoods the world over, with meteorological satellite data underpinning modern warning services.

The EUMETSAT Polar System – Second Generation and its Metop Second Generation satellites

Accurate weather forecasts contribute tens of billions of euros in value to the economies of EUMETSAT's member states. Weather-sensitive sectors such as transport, agriculture, energy, and tourism, rely on accurate forecasts that require global observations from low-Earth orbiting satellite systems.

The EUMETSAT Polar System – Second Generation (EPS-SG) programme and its Metop Second Generation (Metop-SG) satellites will bring global observations of weather, climate and the environment from polar orbit to a new standard from the mid-2020s.

EPS-SG consists of three pairs of Metop-SG satellites operating in a sun-synchronous polar orbit at an altitude of 823-848km. The programme extends the legacy of Metop observations to at least 2040 and will provide invaluable data for numerical weather prediction, nowcasting, climate monitoring, and a multitude of other essential services and applications.

The system features a comprehensive ground segment equipped with the facilities required to control the satellites, acquire, process, and archive the data, and deliver products to users worldwide.

EPS-SG brings together European partners, including the French Space Agency (CNES), which provides the Infrared Atmospheric Sounding Interferometer – New Generation, and the German Aerospace Center (DLR), which provides the METimage instrument.

EPS-SG also brings together the European Union's Copernicus Earth observation programme, with Metop-SG hosting the Copernicus Sentinel-5 instrument, which will measure trace gases in the atmosphere and support air quality monitoring and forecasting.

The EPS-SG programme is the European contribution to the Joint Polar System, a shared system between EUMETSAT and the United States' National Oceanographic and Atmospheric Administration (NOAA). In addition to joint operations of EUMETSAT's Metop series and NOAA's Joint Polar Satellite System, the agencies share global data from these polar-orbiting satellites. Other operators, including from China with their FenYung-3 series of satellites, complement this system to fulfil the requirements of the World Meteorological Organization's Vision 2040 for the Integrated Global Observing System.

Metop-SG satellites are developed in cooperation between EUMETSAT, the European Space Agency, CNES, DLR and a consortium of European industries. EUMETSAT defines the overall system and user requirements, develops the ground systems, procures the launch services, operates the satellites and makes the data available to users. It also provides users with operational data and software products through eight satellite application facilities, each with dedicated user communities and application areas.

EUMETSAT Polar System – Second Generation impacts

“Disaster risk reduction is unfeasible without good early warning systems and good meteorological and hydrological services. The transition to clean energy is only possible if we have good systems in place to measure and forecast wind, sun and rain. These global agendas and objectives require the strengthening of meteorological and hydrological services.”

Professor Celeste Saulo
Secretary-General, World Meteorological Organization

From predicting extreme weather events and nowcasting to climate monitoring, EPS-SG will support a wide range of critical applications.

More and higher-resolution data

A fleet of remarkable instruments on board Metop-SG satellites will provide high-resolution observations of temperature, humidity, precipitation, clouds, fog, winds, sea ice extent and thickness, ocean currents and surface winds, aerosols, pollution, greenhouse gas emissions, volcanic dust, vegetation states, soil moisture, wildfires, radiation budgets, and many other parameters.

Critical observations for forecasts

Datasets provided by EPS-SG will be invaluable for numerical weather prediction, continuing the leading role that Metop satellites play in ensuring the accuracy of regional and global weather forecasts. New and enhanced capabilities will further improve forecasts up to 10 days ahead across Europe and the world.

Severe weather prediction

EPS-SG data will substantially enhance nowcasting applications, very short-range forecasts that can enable specialists to spot tell-tale signs of early storm development and other high impact weather events. Datasets from these remarkable polar-orbiting satellites will be particularly beneficial at higher latitudes.

A multitude of other applications and services

The EPS-SG programme will support a huge range of other applications, including climate monitoring, atmospheric composition monitoring and forecasting, ocean state forecasting, hydrology, land surface analyses, and space weather monitoring.

It’s a fact

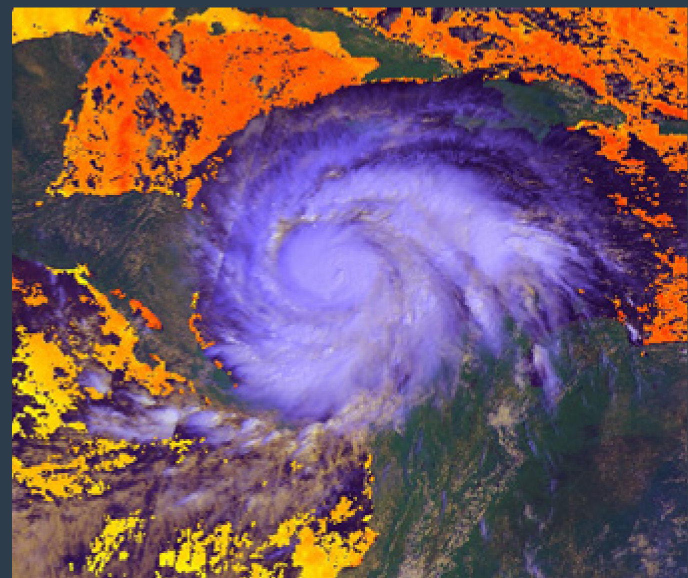
User consultations will continue across the lifetime of the EPS-SG programme, including in innovative product development led by the EUMETSAT Satellite Application Facilities (see page 19).

Europe’s most advanced low-Earth orbit meteorological satellite system

When the first Metop satellite was launched on 19 October 2006, it ignited a revolution in weather forecasting. National meteorological and hydrological institutes in Europe suddenly had access to a ready supply of high-resolution data from state-of-the-art instruments in low-Earth polar orbit to complement data provided by EUMETSAT’s long-running geostationary Meteosat programme.

Studies show that Metop data reduce forecast errors more than any other satellite mission – accounting for around 25% of the total global forecast error reduction across all data sources[1].

Metop Second Generation series satellites are expected to continue Metop’s role as the single most important source of meteorological observations for forecasts 12 hours to 10 days ahead. They also add a suite of new capabilities, supported by enhanced or new instruments, some of which have never been flown on operational satellites before.



Observations made by instruments on board Metop satellites enable specialists to detail parameters such as sea surface temperatures and cloud cover – critical for accurately tracking severe storms and hurricanes. Metop Second Generation satellites will continue and, in many cases, enhance these observations.

It is predicted that the EUMETSAT Polar System – Second Generation programme’s benefits to Europe will exceed 63 billion euros over its lifetime, with a benefit-cost ratio of at least 20:1[2]. These data will help to save lives, protect livelihoods, and support services that improve the wellbeing of people across Europe and beyond.

Combining strengths of polar-orbiting and geostationary satellites

Located some 36,000km above the equator, EUMETSAT’s Meteosat satellites are ideally positioned to monitor Europe and Africa for nowcasting and short-term weather prediction. These satellites provide continuous observations from the same viewpoint, enabling timely tracking of rapidly evolving weather events.

However, their fixed position means that some parts of the Earth are always out of sight. By orbiting pole-to-pole at a height of 800km, Metop satellites go a long way towards filling in missing pieces of the overall global picture. Because polar-orbiting satellites pass by much closer to Earth than geostationary spacecraft, they can make more detailed observations of parameters such as cloud cover, fire emissions, ocean colour, and sea ice extent.

It is this complementarity between geostationary and polar-orbiting satellites that is key to EUMETSAT’s contribution to supporting national meteorological and hydrological services in providing accurate weather forecasts.

It’s a fact

The EUMETSAT Polar System – Second Generation will deliver unprecedented observations of precipitation, aerosols and ice clouds thanks to three new instruments: the Microwave Imager, the Multi-Viewing, Multi-Channel, Multi-Polarisation Imager, and the Ice Cloud Imager.

1 Joo, S et al (2013) The Impact of Metop and Other Satellite Data within the Met Office Global NWP System Using an Adjoint-Based Sensitivity Method, The Monthly Weather Review, 141:10
2 EUMETSAT (2014) The Case for EPS/Metop Second Generation: Cost Benefit Analysis: Full Report

The future in focus

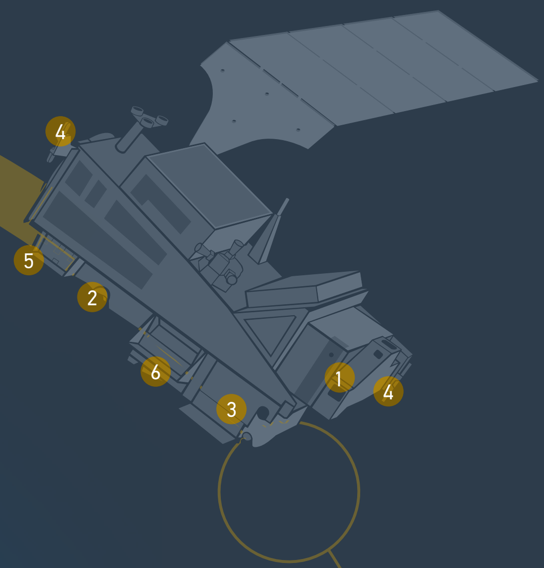
The EUMETSAT Polar System – Second Generation and its Metop Second Generation satellites is one of the most complex and innovative low-Earth orbit meteorological satellite systems ever built.

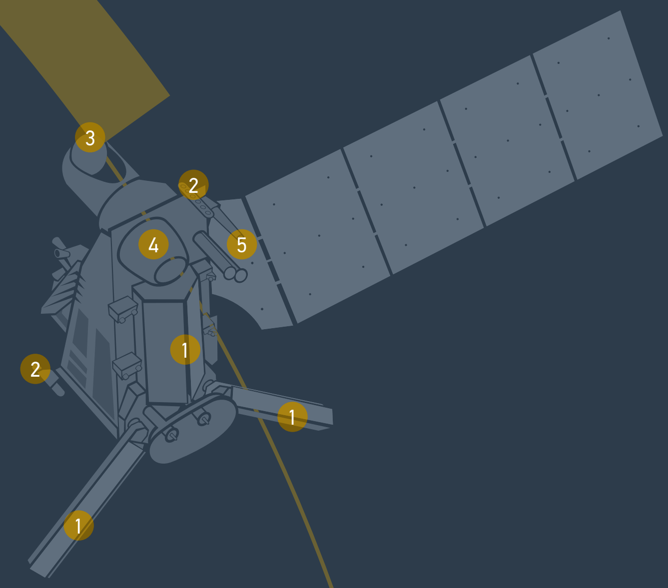
The system consists of two satellites working in tandem, each endowed with different suites of complementary instruments.

Metop-SGA satellites host six instruments, covering a range of environmental parameters such as atmospheric temperature and humidity profiles, and providing detailed data on the composition of the atmosphere and land applications.

Metop-SGB satellites host four instruments, providing data on winds, precipitation and clouds, as well as the Argos data collection platform.

Three successive pairs of Metop-SGA and Metop-SGB spacecraft will be deployed, enabling full operational coverage for more than two decades, beginning in the mid-2020s.





Metop Second Generation A instruments

1. **Infrared Atmospheric Sounding Interferometer – New Generation**
   A passive infrared sounder that will measure parameters such as temperature and humidity profiles, clouds, greenhouse gases, aerosols, and trace gases in the Earth's atmosphere.
2. **Microwave Sounder**
   A total power microwave sounder that will deliver calibrated and geolocated atmospheric temperature and water vapour sounding data under all weather conditions.
3. **Visible and Infrared Imager (METimage)**
   A multi-spectral optical and short wave infrared imager that will provide observations of the Earth's outgoing radiation for meteorological and climate applications.
4. **Radio Occultation Sounder**
   An atmospheric sounder that will provide temperature and humidity profiles in all weather conditions with high accuracy and provide ionospheric measurements for space weather applications.
5. **Multi-Viewing, Multi-Channel, Multi-Polarisation Imager** NEW INSTRUMENT
   An optical imager with a wide field of view, whose objectives are to provide atmospheric aerosol and cloud imagery for climate monitoring, air quality forecasts and numerical weather prediction.
6. **Copernicus Sentinel-5/Ultraviolet, Visible, Near-Infrared and Short Wave Infrared Sounder**
   An ultraviolet visible near-infrared shortwave spectrometer, valuable for monitoring gas concentrations and air quality of the atmosphere.

Metop Second Generation B instruments

1. **Scatterometer**
   A real aperture pulsed imaging radar that will provide measurements relevant for measuring sea surface roughness, which correlates closely with wind speed and direction over the ocean, and soil moisture.
2. **Radio Occultation Sounder (see satellite A)**
3. **Microwave Imager** NEW INSTRUMENT
   A microwave imager that will provide data on precipitation, temperature, cloud, water vapour, sea ice, and snow cover.
4. **Ice Cloud Imager** WORLD FIRST
   A short microwave imager that will enrich global observations of ice clouds, such as cirriform clouds.
5. **Argos-4**
   The satellite element of an advanced data collection system dedicated to oceanography and wildlife.

It's a fact

The design lifetime of both Metop-SGA and Metop-SGB satellites is 7.5 years. As there will be three sets of this pair of satellites, the total mission lifetime will exceed 20 years.

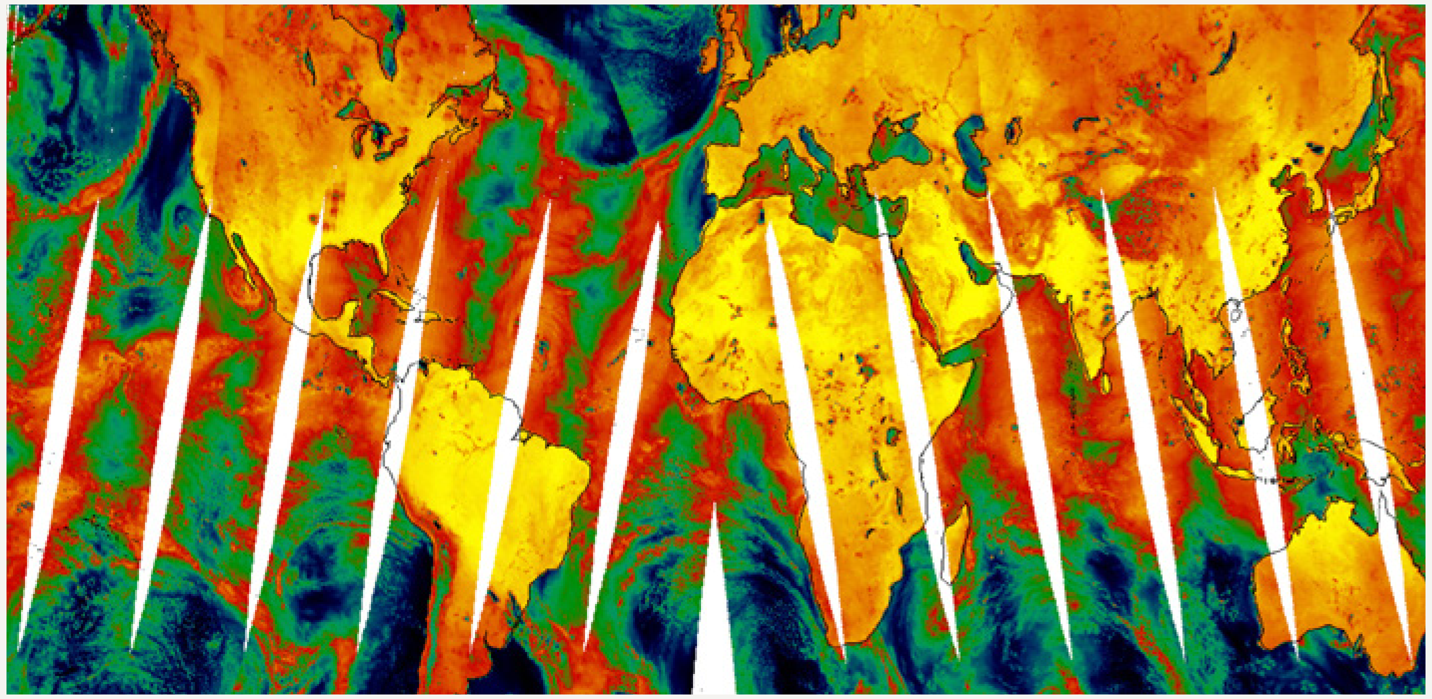
More accurate numerical weather prediction

"The data provided by Metop-SG satellites will support improvements in forecasting in general. The better we characterise the initial conditions, the more robust our computer simulations become, and the better we will be able to predict how things will develop in the future. People, businesses and authorities can use this information to plan, schedule, and lead better lives; everyone makes use of these meteorological reports in some way."

Dr Nadia Fourrie
Deputy Director of the French National Centre for Meteorological Research

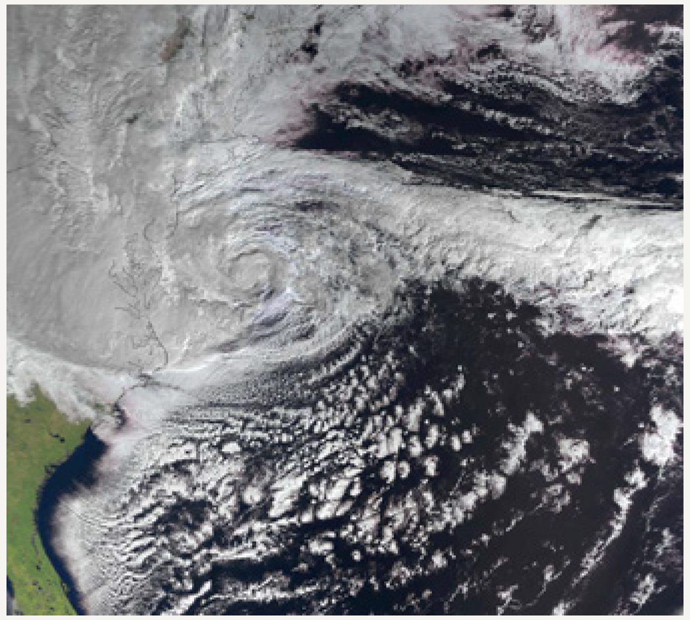
Numerical weather prediction models provide the foundation of accurate weather services. With substantial input from Metop series satellites, four-day forecasts are now as accurate as one-day forecasts were three decades ago. Data provided by Metop Second Generation (Metop-SG) spacecraft will continue and enhance datasets processed by advanced computers and provide input into global and regional weather models. This will enable forecasters to provide more detailed weather predictions and earlier warnings of severe weather events.

Hurricane Sandy devastated communities in areas such as Far Rockaway in New York City



The Microwave Sounder instrument on board Metop-SGA satellites will improve the accuracy of weather forecasting by providing data relevant for observing atmospheric temperature and water vapour in clear and cloudy conditions

Hurricane Sandy, as seen by the Advanced Very High Resolution Radiometer on board the EUMETSAT Polar System's Metop-A satellite at 14.16 UTC on 29 October 2012. Credit: EUMETSAT



Numerical weather prediction begins with an analysis of the state of the atmosphere, which relies on bringing together many different measurements taken by instruments from the ground, sea, air and space. With sweeping views over the Earth, meteorological satellite data provide the largest contribution.

Metop-SG will provide a broad range of continuous, high-resolution observations essential for operational numerical weather prediction carried out by national meteorological and hydrological institutes and will play a major role in its continuous improvement.

"By using different measurement techniques and technology, meteorological satellites provide diverse measurements of many essential parameters such as air temperature, humidity, wind, surface temperature, vegetation, snow and ice cover, and even concentrations of trace gases and aerosols," says Dr Christina Kopken-Watts, Head of the Data Assimilation Section at the German Weather Service (DWD).

"The use of these data significantly benefits many areas of our work and enables us to create a wide range of customer products. More than 85 percent of the data used for global modelling at the DWD now comes from satellites. The quantity of these data and their importance to forecasting will continue to grow, particularly with the advent of new generations of satellites.

"EUMETSAT plays a very important role for us as it develops and operates satellite systems that are essential for weather forecasting and also distributes data acquired by other international satellites to European weather services.

"When satellite data are excluded, many extreme events such as storms in Germany or tropical cyclones cannot be well predicted or are only predicted much closer to the event. The forecast improvements achieved using satellite data thus have direct benefits for all end users and, in many cases, they facilitate earlier warnings."

More precise nowcasting

"Data from Metop-SG satellites will be crucial for nowcasting severe blizzards, for instance those caused by sea-effect snowstorms. These observations can help to reduce societal impacts, accidents on the roads, and enable aviation and shipping to operate more safely and efficiently."

Adam Dybbroe
Research Lead at the Swedish Meteorological and Hydrological Institute

The increasing impact of severe weather over Europe necessitates improved very short-range forecasts up to six hours ahead, called nowcasts. Nowcasts are critical for issuing warnings for extreme events whose scale and consequences can sometimes be impossible to predict using longer-range forecasting models. Metop Second Generation (Metop-SG) satellites will make crucial contributions to nowcasting from a polar orbit, observations that will be especially impactful at higher latitudes where data from geostationary spacecraft can be sparse or non-existent.

Data from polar-orbiting satellites provide critical information for warning systems that prepare citizens for extreme weather and other dangerous phenomena. In 2016, Iceland launched its first colour-coded weather warning system, which classifies severe weather and storms according to their strength using four colours – green, yellow, orange, and red.

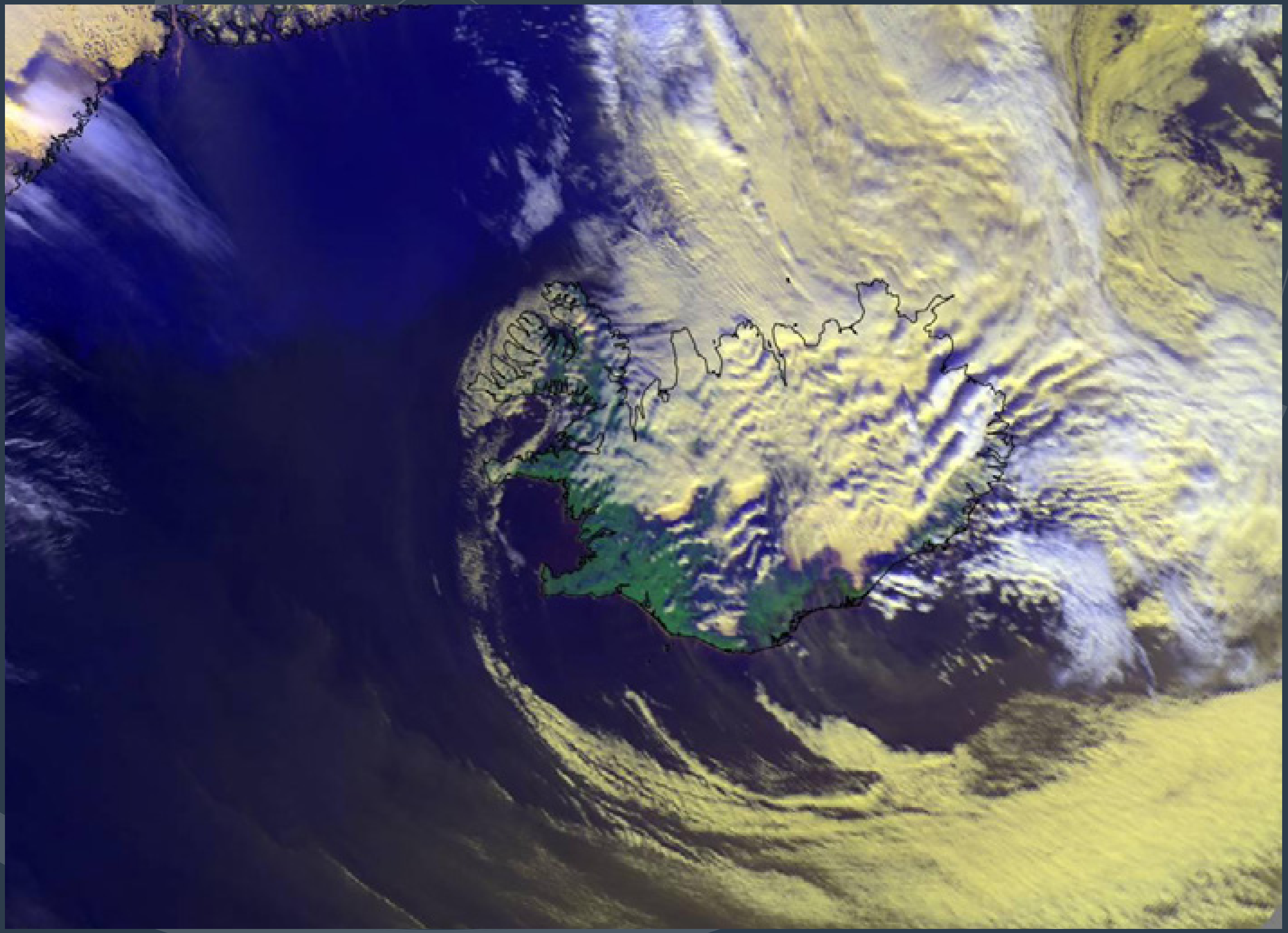
"Underpinning these warnings is data provided by polar-orbiting satellites such as the Metop series of satellites, which pass directly overhead and provide fine-grained data from above," explains Dr Elín Björk Jónasdóttir, who heads up the forecasting team at the Icelandic Meteorological Office.

"We rely heavily on polar-orbiting satellites and the better resolution data provided by Metop-SG satellite instruments will be particularly valuable for nowcasting storms and improving monitoring capabilities, such as the effects of volcanic eruptions and the extent of sea ice.

"People associate Iceland with the cold, but in most of our warnings the common denominator is winds, which are often a major factor in storms, blizzard conditions, and avalanches.

"The data, products and services provided by EUMETSAT in the infrared, near-infrared and visible spectrums are critical to our day-to-day operations. Continuing and enhancing the regular and reliable flow of these vital data is a reason why the EPS-SG programme is so important."

Elín Björk Jónasdóttir
Head of Weather Services at the Icelandic Meteorological Office



Hazard warnings are guided by meteorological satellite data that can reveal when dangerous conditions may be developing. This includes observations of volcanic ash in the atmosphere provided by instruments on board Metop polar-orbiting satellites. Credit: Image courtesy of Icelandic Meteorological Office

More comprehensive air quality monitoring

> "The sense of urgency for ambitious climate action has never been higher, while measures to reduce emissions can also produce major benefits for human health. In synergy with other Metop-SG instruments, the Copernicus Sentinel-5 mission will map carbon dioxide, water vapour, volcanic ash, dust, ozone, and a multitude of trace gases that affect air quality. All these measurements will contribute to furthering our understanding of chemical processes occurring in the atmosphere and how they are linked to our health and climate."

Dr Vincent-Henri Peuch
Director of the European Centre for Medium-Range Weather Forecasts' engagement with the European Union

Air pollution and climate change are closely related. Metop Second Generation (Metop-SG) series satellites will enable specialists to monitor greenhouse gases and trace gases in the atmosphere like never before.

Measures to reduce emissions are critical for improving human health, with air pollution estimated to be responsible for the premature deaths of around seven million people globally every year[1]. And often the same processes that cause air pollution also release greenhouse gases, which contribute to climate change by affecting the amount of incoming sunlight that is reflected or absorbed by the atmosphere.

"Metop-SG 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," says Dr Rosemary Munro, EUMETSAT's Polar System Programme Scientist.

"The mission will also allow specialists to look at phenomena such as aerosols in new ways – including particulate matter produced during combustion processes and volcanic ash.

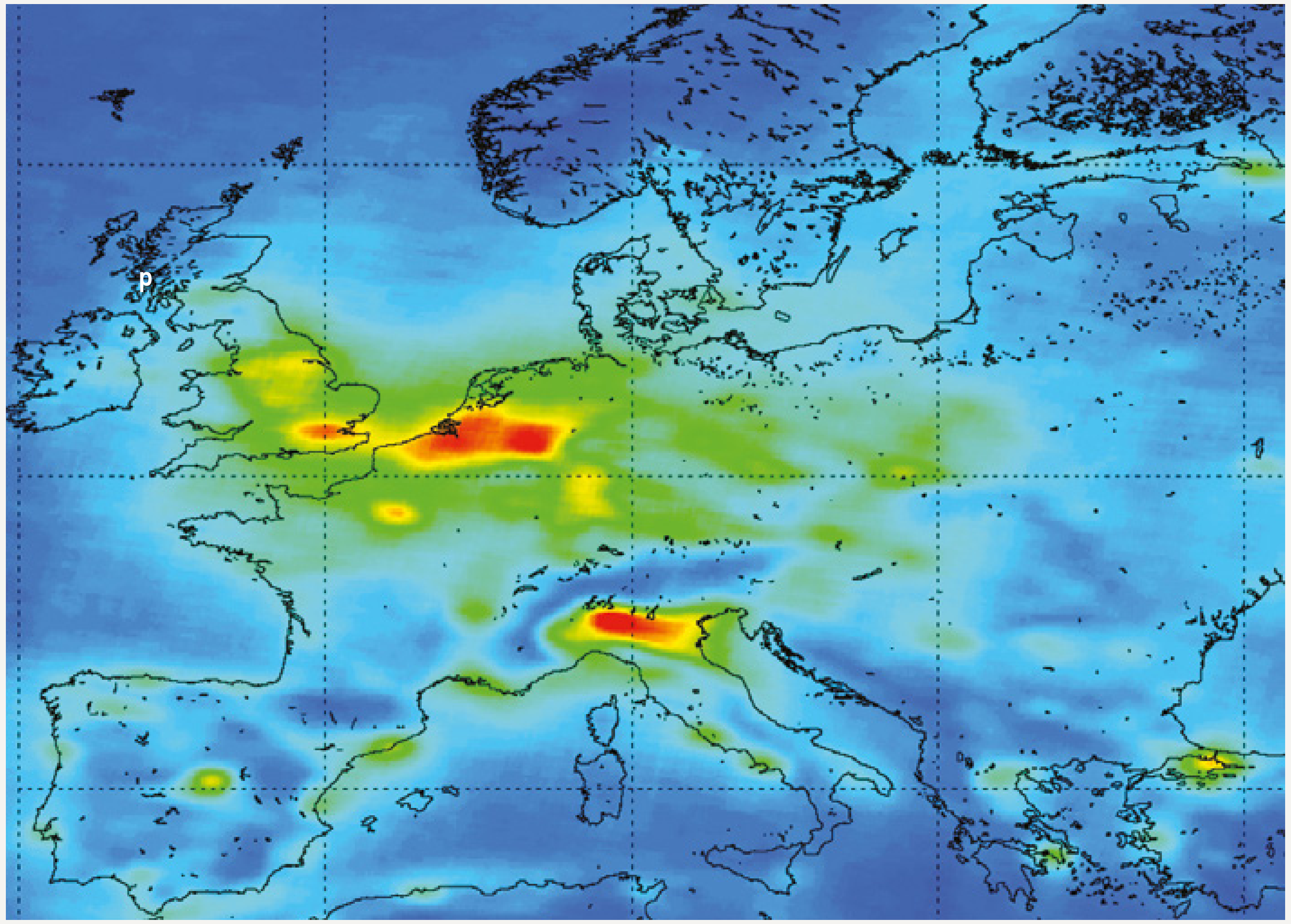
"Another major benefit of these observations is that they will help to improve climate models. For example, there is still a lot that we don't know about the effects that aerosols have on incoming and outgoing radiation at the top of the atmosphere, which determines their heating or cooling impacts on the Earth.

"Data provided by the mission will also support specialists in characterising the absorption structures of gases in finer detail, presenting the possibility to observe a wider range of pollutants, for example from wildfires, which will benefit air quality predictions.

"The combination of new polar-orbiting and geostationary programmes will provide diverse datasets that can help assess emission reduction strategies and track the long-range transport of emissions.

"Knowledge is power, and by bringing countries, people, and expertise together, meteorological satellite data can help shine a light on climate change, air pollution and their effects and gives countries the opportunity to develop informed policies to mitigate impacts."

Often the same processes that cause carbon emissions also release other species of greenhouse gases and/or air pollution



Observations made by the Global Ozone Monitoring Experiment–2 instrument on Metop satellites enable specialists to quantify harmful emissions such as nitrogen dioxide. 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.

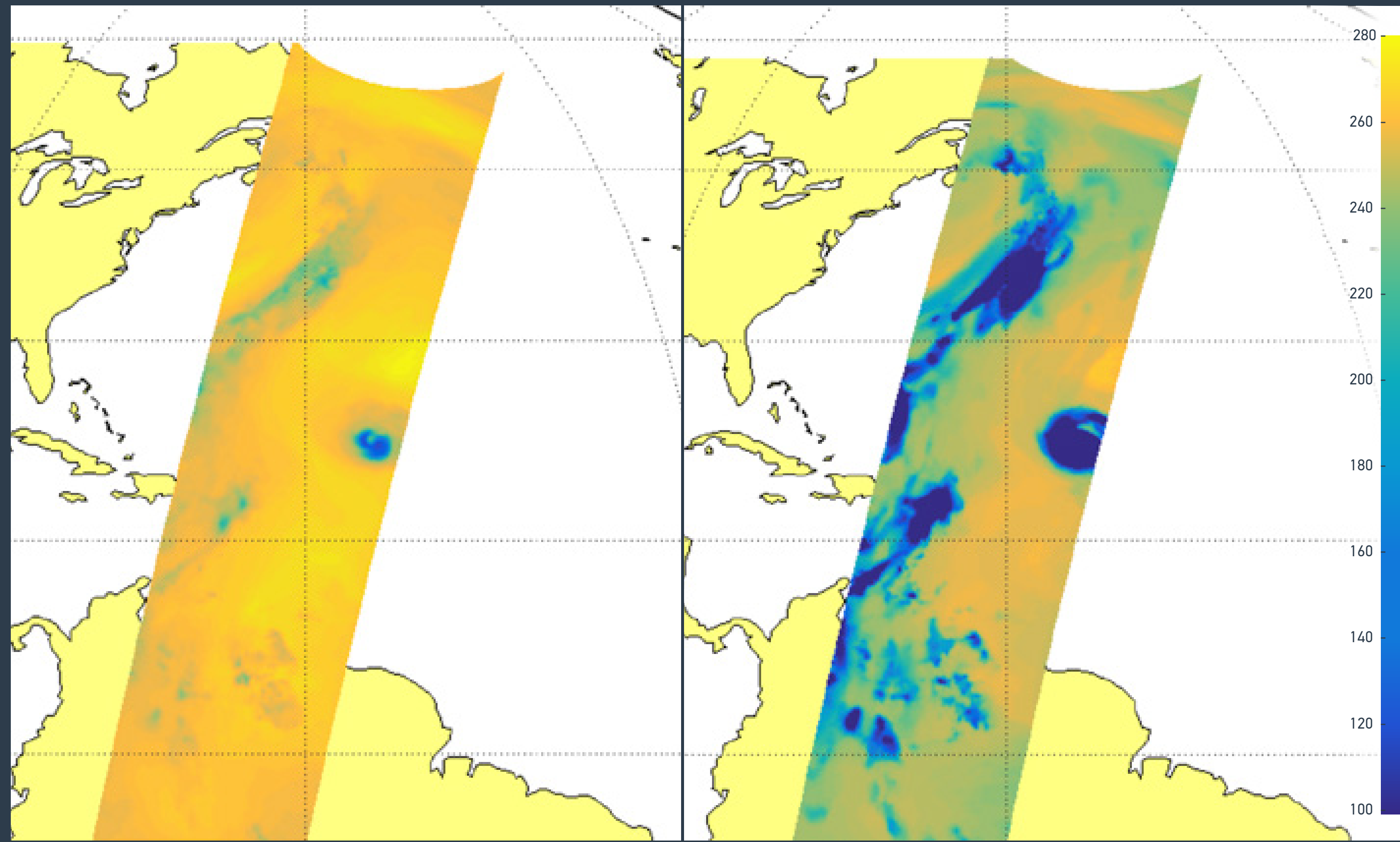
1 World Health Organization's Global Health Observatory

Unprecedented observations of ice clouds

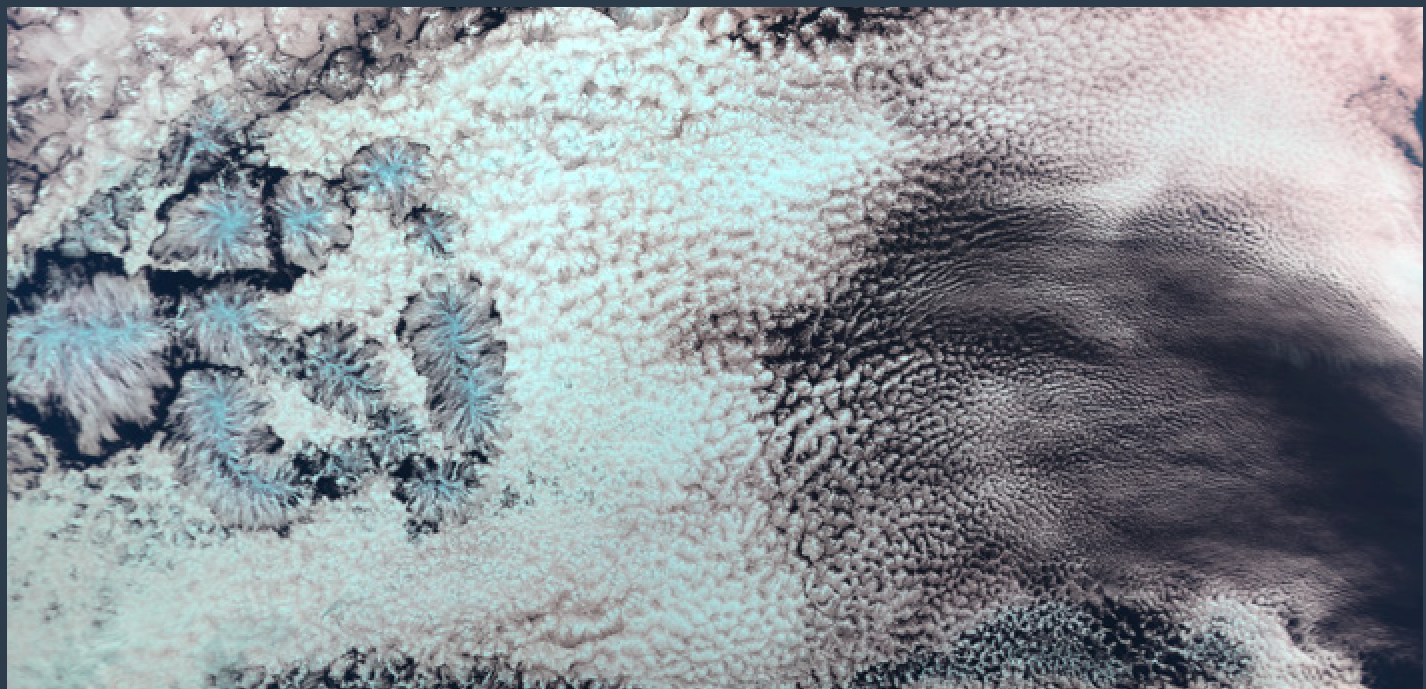
"If we want to forecast weather we have to understand clouds. If we want to model the climate system we have to understand clouds. And if we want to predict the availability of water resources, we have to understand clouds."

Professor Petteri Taalas
Director General, Finnish Meteorological Institute and former Secretary-General, World Meteorological Organization

Clouds come in wildly different shapes, sizes, amounts, and types. Another important variable is whether they are composed of water droplets, ice, or a mix of the two. This diversity affects how clouds contribute to and respond to a warming climate. Because of the high variability in size, shape and orientation of ice crystals, ice clouds are some of the largest unknowns in numerical weather prediction and climate models. Using data provided by Metop Second Generation's new Ice Cloud Imager, specialists will be able to tackle that uncertainty in models.



The Ice Cloud Imager establishes the first operational ice-cloud imaging mission to support weather forecasting, hydrology, water management and climate monitoring. It will provide cloud ice content, vertical humidity profiles and gross profiles of snowfall, as well as snowfall rate at the surface.



Ice clouds typically begin to form at altitudes of around 5.5km above temperate regions and 6.5km above the tropics and can extend all the way up into the furthest reaches of the troposphere.

Developing high in the troposphere where temperatures are far below freezing, ice clouds are formed of ice crystals rather than water droplets and can come in many guises, including wispy cirrus clouds and the tops of the dark cumulonimbus anvils associated with thunderstorms.

"Satellite-based radiometers selectively observe microwave frequencies in the atmosphere to obtain ice-cloud measurements," says Dr Vasileios Barlakas, who completed a EUMETSAT fellowship at Chalmers University of Technology in Gothenburg, Sweden. "However, existing microwave sensors cannot detect small ice crystals due to the insensitivity of their operational frequencies."

"What's particularly exciting about the Ice Cloud Imager is that it will operate in both millimetre and submillimetre frequencies and will therefore be sensitive to both large and small ice crystals. This innovative instrument will provide insights into ice crystals at various atmospheric levels and make it possible to quantify ice concentrations. Such invaluable data not only deepen our comprehension of ice clouds but also play a pivotal role in refining climate and weather models."

Dr Vinia Mattioli, a remote sensing scientist who, like Barlakas, works on the Ice Cloud Imager at EUMETSAT, says that ice clouds cover more than a third of the Earth's surface, thus playing a pivotal role in regulating the planet's climate.

"Depending on their characteristics and altitude, ice clouds can have warming or cooling effect on Earth," she says. "The Ice Cloud Imager will enhance our understanding of ice cloud microphysics, allowing for more precise representation in weather and climate models. Therefore, the data will be invaluable for climate monitoring, numerical weather prediction, and nowcasting applications."

Better observations of oceans and sea ice

"Starting in December 1972 with the Electrically Scanning Microwave Radiometer aboard NASA's Nimbus 5 spacecraft, polar-orbiting satellites have helped build a more detailed picture of sea ice cover by providing daily measurements throughout the year over both hemispheres. It's not just the ice extent we are interested in, but the thickness, age, and drift of sea ice, as well. EUMETSAT's Metop-SG satellites will soon take the baton, continuing these measurements and monitoring sea ice from space. This will ensure a continuation of meteorological observations from polar orbit for at least the next two decades."

Dr Rasmus Tonboe
Sea Ice and Remote Sensing Scientist,
Technical University of Denmark

Continuous observations of the oceans are crucial for numerical weather prediction, climate monitoring, ocean state forecasts, and to support everyday activities such as ship routing. Metop Second Generation (Metop-SG) series satellites will provide invaluable data for improving these key services.

Data provided by Metop-SG spacecraft will feed into critical services including the long-term monitoring of ice cover and charting the extent of sea ice to guide safe shipping. Dr Jekaterina Služenikina, Chief Specialist in the Estonian Environment Agency's Data Management and Monitoring Department, says countries in Northern Europe are working closely together to prepare for the data bounties from Metop-SG satellites and make the observations accessible to users as fast as possible.

"Countries in Northern Europe face similar challenges, including the need to provide environmental services like icing or blizzard forecasts and sea ice charting," she says. "One effective way we tackle the challenges of producing these services is through the joint development of software and applications that enable specialists to access the right meteorological products quickly and effectively for operational work.

"In Estonia, ice charting began in the mid-1940s, based mainly on ground-based ice observations and information exchange from ports, maritime transport, and aviation. Later, satellite data became essential for analysis of daily ice conditions and is widely used today in combination with measurements from radars and high-resolution optical instruments.

"Integrating these datasets enables us to provide ice charting at the level of detail and scale required by diverse users, including marine transport, ice breakers, emergency responders, fisherfolk, scientific researchers and the public.

"One of the biggest opportunities lies in the use of new satellite data with improved horizontal resolution and measurement frequency. Metop-SG series satellites will substantially increase the spatial and temporal resolution of many parameters essential for making forecasts.

"These datasets will enable continuation and in many cases improvements of key services as well as observations essential for accurate weather forecasting – including short-range severe weather predictions, medium-range forecasts, and long-term climate monitoring.

"Climate change means that the chances of severe weather conditions are increasing, not only in winter but throughout the year. It's critical to have this space-based data, which can help protect property and save lives."

Dr Jekaterina Služenikina
Chief Specialist in the Estonian Environment Agency's
Data Management and Monitoring Department

The METimage instrument on board Metop-SGA satellites will enable specialists to continue long-term monitoring of environmental changes such as melting sea ice, as pictured here in the Beaufort Sea by NASA's Moderate Resolution Imaging Spectroradiometer. Credit: Modis/NASA.

Enhancing climate science and services

“Long time-series satellite data such as those provided by Metop series satellites and their Metop-SG successors are an essential resource for climate monitoring, including for global reanalyses. We need to further increase the use of Metop and other satellite data for climate science and services to help inform policies and actions to limit the potentially massive negative effects of climate change on nature and humanity.”

Dr Jörg Schulz
Head of Climate Services at EUMETSAT

As Europe reels from some of its hottest, driest periods on record, satellite data are helping experts to understand the impacts of extreme heat, and to identify conditions conducive to droughts, floods, and wildfires. Precipitation, soil moisture, solar radiation, and related data that will be provided by instruments on board Metop Second Generation satellites will make critical contributions to these efforts.

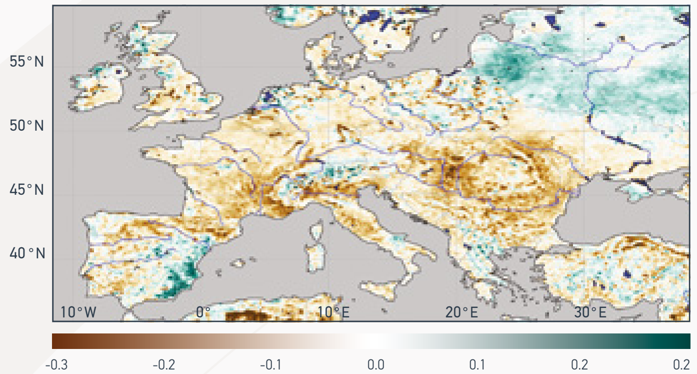
In winter 2021-22, northern Italy saw some of its driest conditions in nearly a decade. In the Italian Alps, there was some of the lowest snowfall in the past quarter century. Temperatures were far above average; some of the water retained in glaciers melted away early, in part due to the lack of snow cover. The record low precipitation led to serious drought conditions.

“On top of this, the Po Valley was still suffering from the effects of drought in previous years,” recalls Dr Luca Brocca, Director of Research at the Italian National Research Council in Perugia. “By the end of February 2022, the Po’s water levels were like those expected in August. When the heatwaves hit in summer, it was a recipe for disaster.

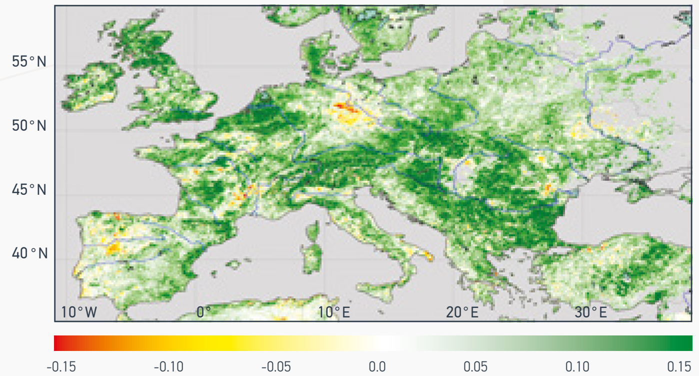
“The years-long drought issues affecting northern Italy are raising pressing questions on a range of topics, including water management and other climate change adaptation strategies. It’s a major challenge to really understand all the factors in play.

“Metop-SG satellites will enable us to see things not possible from the ground – from the effects of weather and climate, to the human impacts on the landscape and water cycle. For example, precipitation, soil moisture, and solar radiation data will be increasingly important for predicting and managing drought conditions.

“Combining these polar-orbiting observations with data from geostationary missions such as Meteosat Third Generation will enable us to better understand the causes and effects of droughts and potentially provide better flood predictions. This is essential as the impacts of climate change impact landscapes and increase the likelihood and severity of severe weather events across Italy and Europe.”



Anomaly of Monthly Soil Wetness Index (28cm-100cm below the surface), compared the period 2006-2020. Product: Root Zone Soil Wetness. Credit: EUMETSAT H SAF



Anomaly of Fraction of Absorbed Photosynthetic Active Radiation (fAPAR) for June, July, and August 2022, compared to the period 2006-2020. Product: fAPAR. Credit: EUMETSAT LSA SAF

Water levels on Italy’s Po River were extraordinarily low in 2022

Users' needs come first

EUMETSAT is a user-driven international organisation that operates spacecraft that provide a wide array of data used for monitoring the weather, climate, and the environment.

National meteorological and hydrological institutes use data collected by EUMETSAT's operational activities to improve essential public services such as weather forecasts. These activities help to keep societies moving, economies running, and can save lives and livelihoods.

"This is the main driver for EPS-SG and why systems requirements have been defined guided by the needs, expertise, and contributions of our member states," says Dr Sreerekha Thonipparambil, EPS-SG User Preparation Project Manager at EUMETSAT.

"EUMETSAT is now preparing users such as specialists from national meteorological and hydrological institutes, policymakers, and climate scientists, so that they can absorb the data from EPS-SG as early as possible once the operational data come in. This is a cross-organisational effort providing information to the users prior to the launch and continuing through the routine operations phase."

It's a fact

Metop-SG satellites are the first European satellites designed for controlled re-entry at the end of their life in orbit, as part of an international effort to reduce space debris.

User preparation initiatives include:

- providing users with pre-launch test data
- providing science support, training and information through:
  - webpages
  - webinars
  - workshops
  - user days
  - conferences
  - data access support

Specialists from across Europe and beyond convened in Darmstadt, Germany in spring 2022 for a User Days event on EUMETSAT's next-generation satellite programmes, including EPS-SG

Collaboration and cooperation at its heart

The EUMETSAT Polar System – Second Generation (EPS-SG) represents a new chapter in an established European success story that has resulted in Europe being a world leader in satellite meteorology.

European industrial collaboration

The EPS-SG programme brings together teams from EUMETSAT, the European Space Agency, the European Commission's Copernicus Programme, the French National Centre for Space Studies, the German Space Agency, a European industrial consortium led by Airbus Defence and Space, and many other contributors. The programme will also form half of the European-United States' Joint Polar System, combining the benefits of leading satellite programmes on both sides of the Atlantic.

"Through the EPS-SG programme we are bringing international teams together to develop some of the most technically advanced meteorological instruments ever made, and pushing technological and physical limits," says Fran Martinez Fadrique, EPS-SG Programme Manager.

"EUMETSAT has undertaken extensive user consultation with specialists in member states and national meteorological and hydrological services and the European Centre for Medium-Range Weather Forecasts, with initial user engagement on EPS-SG beginning in the mid-2000s.

"Since then, user consultation has been continuous and iterative through dialogue, user conferences and workshops, and dedicated studies. This enables us to understand what users need and want, and ensure the programme delivers. This will continue across the lifetime of the programme, for instance through the innovative data product development led by international teams in EUMETSAT's Satellite Application Facilities.

"I am immensely proud of what's been achieved so far by teams at EUMETSAT and our cooperation partners. We look forward to the next stages of the programme with great anticipation and excitement."

It's a fact

With Airbus as prime contractor, more than 110 companies in 17 European countries are involved in building the Metop-SG satellites.

What happens on the ground

In addition to Metop Second Generation (Metop-SG) spacecraft, the other main component of the EUMETSAT Polar System – Second Generation (EPS-SG) is a comprehensive ground segment that EUMETSAT uses to control the satellites, acquire, process and archive data and products, and deliver those data and products to users worldwide.

Telemetry, tracking and command
Svalbard, Norway
Ground segment elements are linked to the satellites via the S-band for telemetry and telecommand.

EUMETSAT Mission control
• Darmstadt Germany
• Madrid, Spain (backup)

Flight control teams working 24/7 monitor the status of the satellites and the instruments. They also command the satellites to adjust their flight path and adjust the satellite configuration and instruments accordingly.

Measurements are processed into weather and climate data products, archived, and made available to users worldwide.

User community
Worldwide

EUMETSAT Mission Control
Darmstadt, Germany
Madrid, Spain (backup)

At the control centre, the data packets received from both stations are consolidated to ensure that the data streams are complete with no gaps. This enables EUMETSAT to continue to uphold its commitment to provide users with nearly continuous data, while making it possible for Metop-SG satellites to deliver a significantly higher volume of data than ever before.

The teams working in the backup control centre in Madrid monitor the status and command the satellites during any contingencies which may arise in the EUMETSAT Mission Control.

Mission data acquisition
Svalbard, Norway
Azores, Portugal
Direct broadcast stations network, Europe
McMurdo Station, Antarctica (in conjunction with the US National Oceanic and Atmospheric Administration)

Ground segment elements are linked via Ka-band, a radio frequency band that enables high-bandwidth communication for science data acquisition. The ground segment is also linked to the satellites in X-band, to allow geographically distributed direct data acquisition.

EUMETSAT is committed to ensuring the continuous delivery of data from its satellites. Specialised payload data and acquisition infrastructure located at multiple geographically distributed sites ensures the continuous delivery of data provided by Metop-SG satellites, covering global and regional missions.

It's a fact

Studies show that EPS-SG will generate an estimated socio-economic return of 20:1 on EUMETSAT's member states' investment through substantially improved weather predictions, which are worth €61 billion to economies of European Union member states.

The people who make it happen

The whole of EUMETSAT has been involved in ensuring the success of the EUMETSAT Polar System – Second Generation programme.

"People in EUMETSAT member states will experience the tangible benefits of data provided by the EUMETSAT Polar System – Second Generation (EPS-SG) in the coming years. These impacts will be further enhanced by EUMETSAT's continued investment in the translation of satellite data into products and services for improved weather forecasting and climate and environmental monitoring. None of the achievements made would have been possible without the talent and dedication of specialists from many teams across EUMETSAT, who are the central components of the organisation's successes."

Dr Rosemary Munro
EPS-SG Programme Scientist