EUMETSAT

EPS-Sterna

Facts and figures

Monitoring weather and climate from space



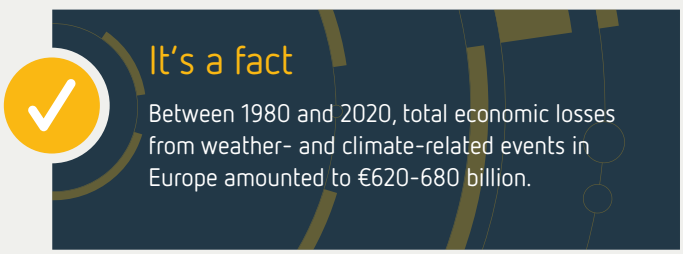
Microsatellites to fill a gap in weather observations

Numerical weather prediction uses computer simulations of the atmosphere to model how the weather will evolve over time. Its accuracy relies, among other data, on the number of microwave sounding observations that are assimilated into models to infer the temperature and humidity of the atmosphere. Such observations currently come mainly from polar-orbiting satellites. It has been shown that more observations are better when it comes to microwave sounding data.

Enter EUMETSAT Polar System – Sterna (EPS-Sterna), a new constellation of microsatellites that will each have a microwave sounder on board. They will improve weather forecasts by providing global measurements of atmospheric temperature and humidity profiles with frequent revisit times, well into the 2040s.

EPS-Sterna will orbit the Earth in a polar orbit. Its state-of-the-art microwave sounder will measure energy reflected off the Earth's surface in the microwave range of frequencies. Because it makes measurements beyond the visible range, it can provide temperature and humidity observations even when it is overcast, raining, or snowing.

Studies undertaken by Météo-France and the European Centre for Medium-Range Weather Forecasting have found that the accuracy of weather forecasts correlates to the quantity of microwave sounding observations assimilated by models. In short, when it comes to microwave sounders, more is always better.



Source: EEA (2022), Economic losses and fatalities from weather and climate-related events in Europe (values adjusted to 2020 Euros)

Advanced and affordable

EPS-Sterna represents a new approach in meteorological satellites. EUMETSAT will fly a constellation of six microsatellites in three different orbital planes ie. two satellites per plane, each carrying an identical instrument. This will enable EUMETSAT to maintain a high level of coverage in a cost-effective way.

Throughout development of EPS-Sterna, EUMETSAT's goal will always be to provide maximum benefit to the users of the data. This will be achieved on the space segment side by capitalising on the development of the EPS-Sterna prototype satellite, the Arctic Weather Satellite (AWS) of the European Space Agency (ESA). On the ground segment side, EUMETSAT will maximise the re-use of existing assets.

European cooperation

EUMETSAT supported ESA in drawing up specifications for its Earth Watch Arctic Weather Satellite instrument (AWS). This ensured that its design fulfilled the requirements of EUMETSAT's users and that it can be reused on the EPS-Sterna mission. EPS-Sterna therefore relies on the AWS development but will be fully funded by EUMETSAT Member States.

EUMETSAT has signed an agreement with ESA for the implementation of this mission in which ESA will procure the satellites on EUMETSAT's behalf. EUMETSAT will be responsible for the EPS-Sterna system, the development and provision of the ground segment, procuring the launch services, performing the launch and early operations phase, operating the satellites and managing the constellation. In addition it will monitor the satellites' health and, most importantly, deliver their data to users.

EUMETSAT Member States approved the EPS-Sterna programme in early 2026.

Expected benefits of EPS-Sterna

EPS-Sterna's new microwave sounders will play a key role in improving numerical weather prediction and nowcasting at a European scale.

Better numerical weather prediction

Meteorologists rely on microwave sounders to provide observational inputs for numerical weather prediction (NWP). They use their knowledge of atmospheric physics and dynamics through computer simulations to predict how the weather will evolve over time.

EPS-Sterna will significantly improve the accuracy of NWP models by providing data globally with unprecedented coverage and revisit time. In addition, the mission will have a large impact over the poles, where geostationary satellites have little visibility and Metop polar-orbiting satellites need longer to achieve global coverage.

The sounders on board each EPS-Sterna satellite will contribute to frequent real-time inputs into NWP models. The expected launch date of the initial constellation of six EPS-Sterna satellites in 2029 will ensure that models will receive necessary data well into the 2040s.

Improved nowcasting from North to South

The Norwegian Meteorological Institute anticipates that some of the benefits will include better thunderstorm warnings, improved data for the fields of aviation, wind power, ski tourism, as well as improved predictions for road safety.

The Italian Civil Protection Department anticipates that observations from EPS-Sterna will substantially improve their ability to monitor precipitation, which is particularly important for extreme weather events such as Mediterranean hurricanes.



Damaged residential buildings in the aftermath of Storm Hans in Valdres, near Oslo, Norway 8 August 2023 (credit: Reuters/Cornelius Poppe)

Satellites and instruments

The initial EPS-Sterna constellation is composed of six satellites in sun-synchronous polar orbits. In only five hours or less, the microwave sounders on these satellites will make observations covering 90% of the globe.

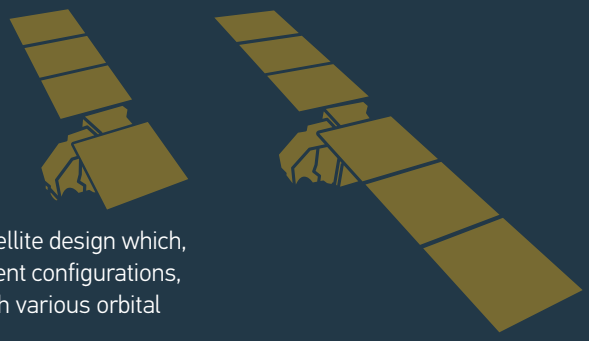
Satellite designs

Payload

- Passive Microwave Radiometer (19 channels)

Number of satellites

- 6 satellites in constellation on 3 planes
- 20 satellites in total (18 plus 2 spares)



EPS-Sterna utilises one satellite design which, thanks to at least two different configurations, can fly in different orbits with various orbital illumination conditions.

Altitude
595 km

Mass in orbit
135kg

Payload mass
30kg

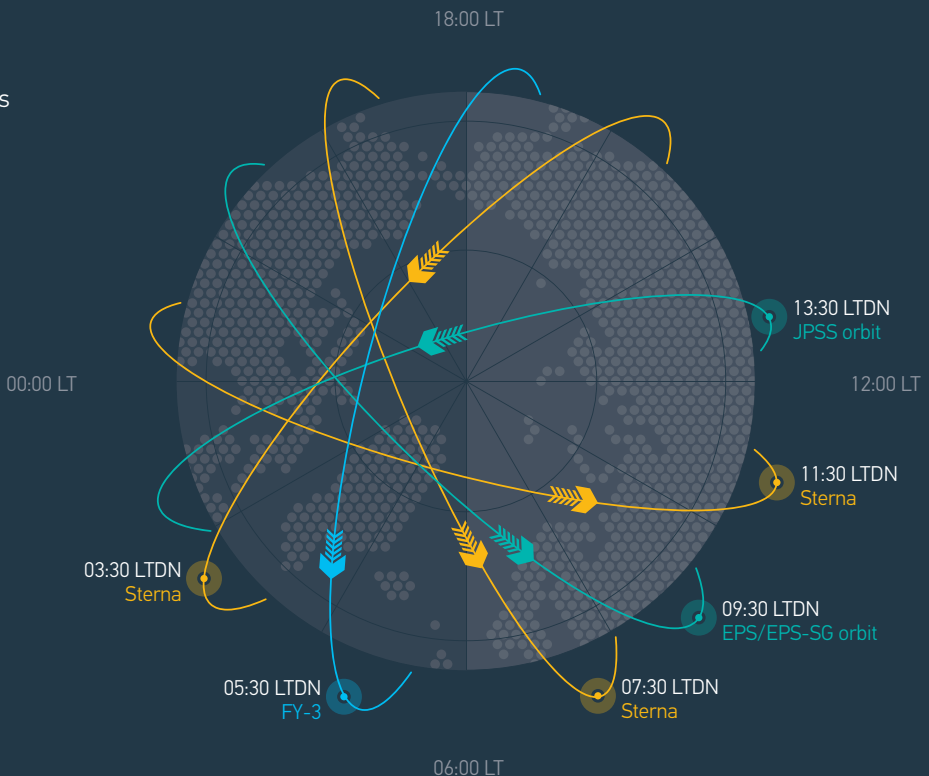
Design lifetime
5 years

Mission duration
13 years

Expected launch date of first satellite
2029

Orbital planes

Sterna will complement the observations from satellites in the EUMETSAT Polar System – Second Generation (EPS-SG), the National Oceanic and Atmospheric Administration's Joint Polar Satellite System (JPSS), and the Chinese FengYun-3 (FY-3) system.



Ground segment and operations

The ground segment consists of the stations and facilities across the globe that connect the satellites to the people who use the data. From the antennas that first receive the data, to the facilities for monitoring and controlling the satellites, processing the data, and more, a fast and reliable ground segment plays a critical role in the success of the EPS-Sterna mission. This is important, as rapid data delivery results in better forecasts. Because the affordability of this mission is a high priority, many existing elements will be reused for the EPS-Sterna ground segment.

To transmit data to the regional network, which covers Europe, northern Africa, the northern Atlantic Ocean, and Greenland, mission data acquisition stations in the following locations will be used: Svalbard, Norway; Kangerlussuaq, Greenland; Lannion, France; Maspalomas, Spain; Athens, Greece; and Punta Arenas, Chile.

Satellite operators based in the Mission Control Centre in Darmstadt will monitor the health of EPS-Sterna satellites, observe their locations, and manoeuvre them remotely via existing telemetry, tracking, and command stations in Svalbard, Norway.

Satellite operators will monitor EPS-Sterna satellites at all times from the Low Earth Orbit Mission Control Centre in Darmstadt, Germany.

The data will be processed and archived at the Data Centre in Darmstadt, Germany.

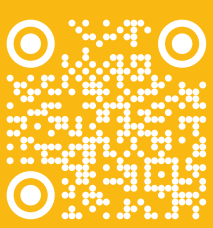
EUMETSAT distributes data directly via its EUMETCast satellite and terrestrial network. The data can also be accessed via EUMETView, a service where satellite data users can visualise the data via EUMETSAT's online data store, with the option to download.



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