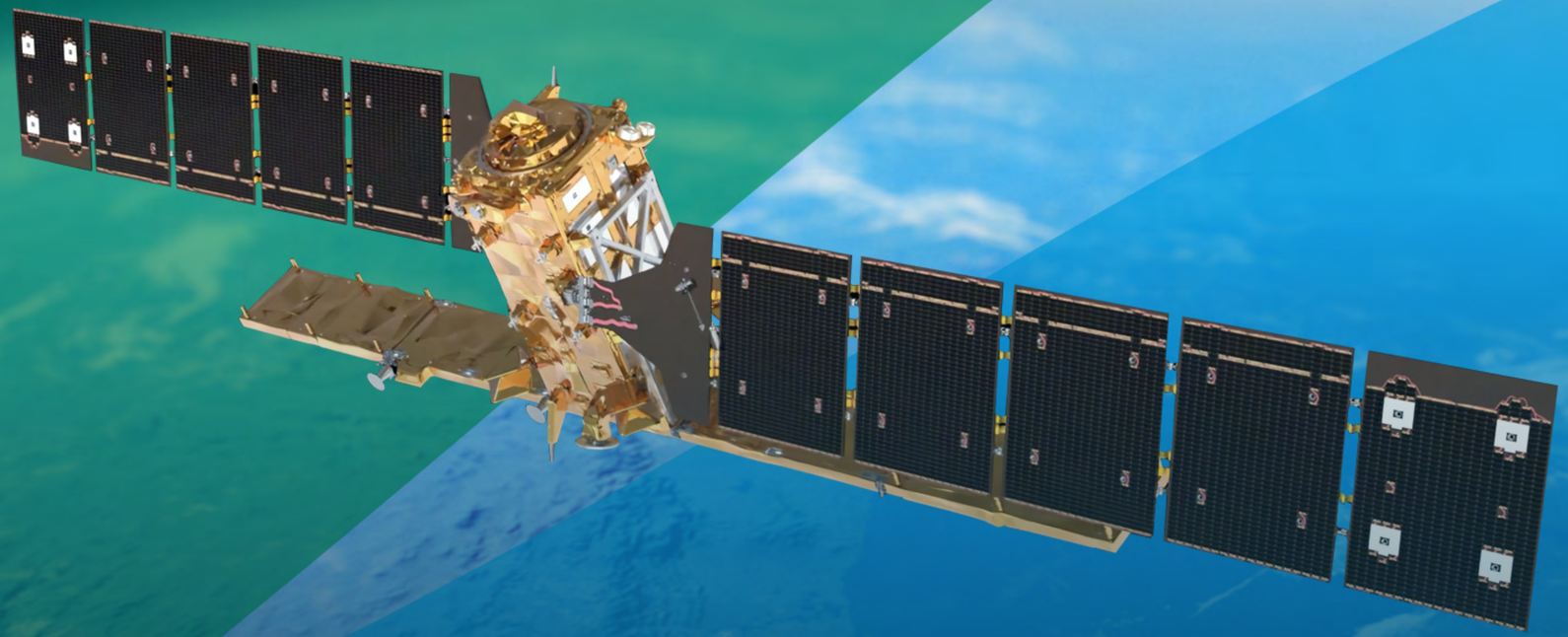
PROGRAMME OF THE EUROPEAN UNION

co-funded with esa



SENTINEL-1

RADAR VISION FOR COPERNICUS

COPERNICUS SENTINEL-1 MISSION

The Copernicus Sentinel-1 satellites each carry an advanced radar instrument that provides an all-weather, day-and-night supply of imagery and information about Earth's land and oceans.

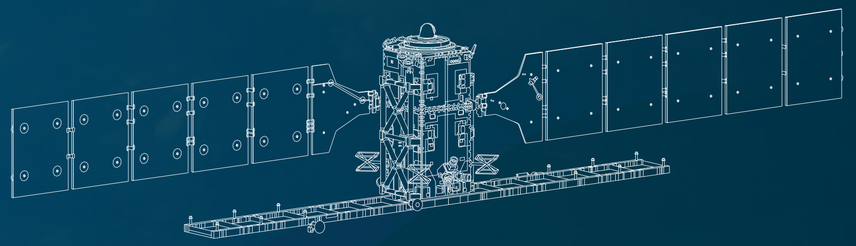
The mission supports enhanced environmental management, land and marine monitoring, disaster response and climate change research and mitigation actions.

Sentinel-1C and -1D introduce new capabilities for detecting and monitoring maritime vessels and their movement, thanks to their integrated Automatic Identification System.

The mission is the result of close collaboration between the European Space Agency (ESA), the European Commission, European industry, service providers and data users.

LAUNCH DATE

Sentinel-1A – 03 April 2014 (on Soyuz from Kourou, French Guiana)
Sentinel-1B – 25 April 2016 (on Soyuz from Kourou, French Guiana)
Sentinel-1C – 05 December 2024 (on Vega-C from Kourou, French Guiana)
Sentinel-1D – 04 November 2025 (on Ariane 6 from Kourou, French Guiana)



SATELLITES IN SERVICE

Sentinel-1 is the first of the series of Copernicus Sentinel satellites, developed by ESA. Copernicus is the Earth observation component of the European Union's Space Programme – the largest and most ambitious environmental monitoring programme in the world.

The data provided by the Sentinel missions form the basis of the operational Copernicus information services, helping to manage the environment, monitor and react to climate change, and safeguard lives. Copernicus data are used worldwide and are available freely and on an open access basis in several data hubs.

Copernicus provides a unified system through which vast amounts of data are fed into a range of thematic information services designed to benefit the environment, the way we live, humanitarian needs and support effective policymaking for a more sustainable future.

Copernicus aims to help us shape the future of our planet and the sustainable use of its resources, for the benefit of all. ESA contributes to the success of Copernicus.

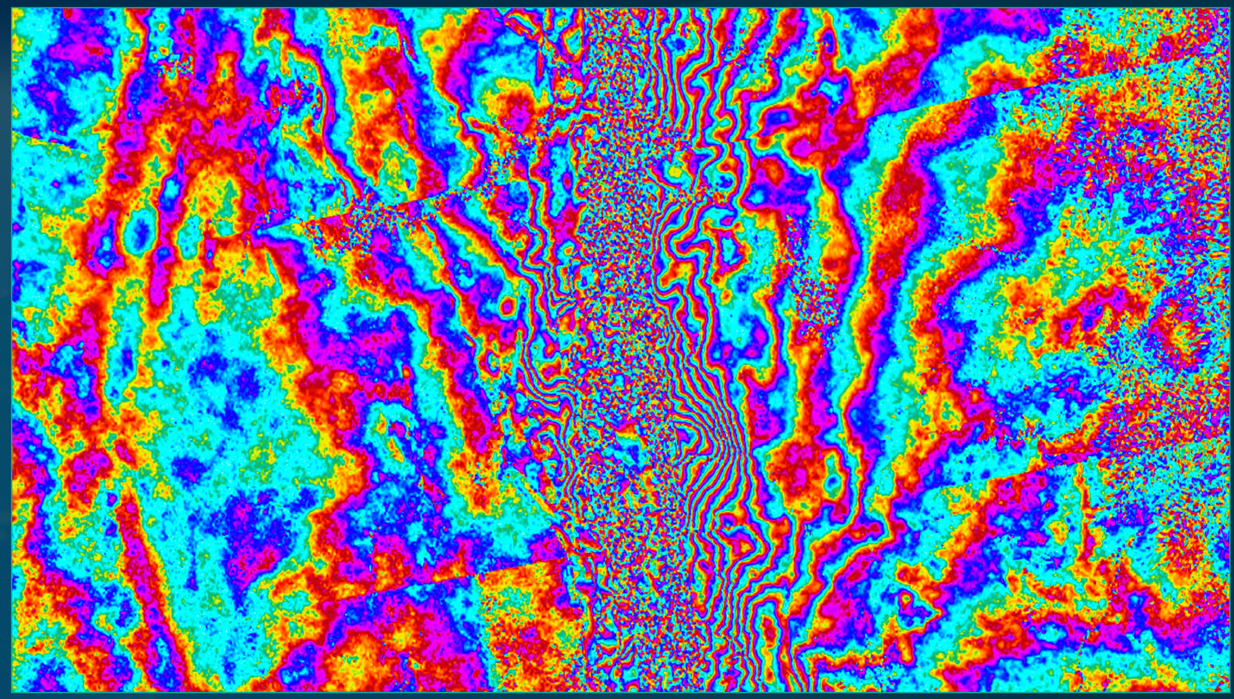
*The suite of **Sentinel missions** are at the heart of the Copernicus Programme.*

SENTINEL-1 OVERVIEW

Copernicus Sentinel-1 is a European Earth observation mission that provides information derived from radar images to support the monitoring of Earth's surfaces. This includes observing sea ice, ships or oil-spills on our oceans, as well as monitoring forests, soil, earthquakes and volcanic activity on land.

The main instrument on board all Sentinel-1 satellites is a 12 m-long advanced synthetic aperture radar, operating in the C-band, which images Earth's surface in darkness and with cloud cover. This is particularly useful for the continuous monitoring of the polar regions and providing imagery to support emergency response during extreme weather conditions.

The mission is based on a constellation of two identical satellites flying in the same orbit 180° apart. Sentinel-1D will substitute Sentinel-1A, which has been in orbit for 11 years. Sentinel-1C replaced Sentinel-1B in May 2025. Sentinel-1B is the first Copernicus satellite deorbited after its cease of operations. The Sentinel-1D satellite will join Sentinel-1C, both of which are equipped with the additional Automatic Identification System instrument.



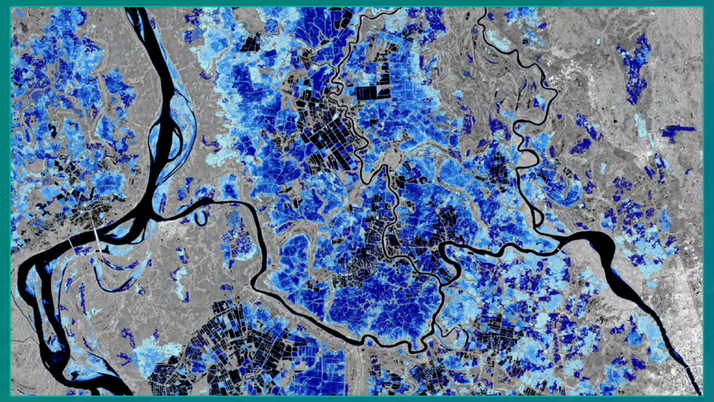
Copernicus Sentinel-1 radar satellites reveal a detailed picture of how the ground shifted during the powerful 2025 earthquake in Myanmar – offering new insights into the mechanics of the tectonic fault and the scale of the seismic rupture.
By using tiny differences in the radar signal phase to detect ground shifts with incredible precision, the image reveals how the land moved during the earthquake.

HOW DOES RADAR VISION WORK?

While the human eye sees just a small fraction of the electromagnetic spectrum, radar technology can see what would otherwise be invisible to us. A radar instrument works by sending out radio waves and creating a map of the 'echoes' created by the wave when it bounces off Earth's surface and back to the satellite.

The instruments on Sentinel-1 satellites use synthetic-aperture radar, or SAR for short. This type of radar instrument is used on a moving object, such as a satellite, to create a high-resolution two-dimensional image or a three-dimensional reconstruction of an object.

Spaceborne SAR offers high-resolution, wide-area imaging and operates reliably regardless of clouds or weather. This makes it suitable for mapping flooded areas or for use in developing disaster resilience, as in this image showing flood frequency in Myanmar.

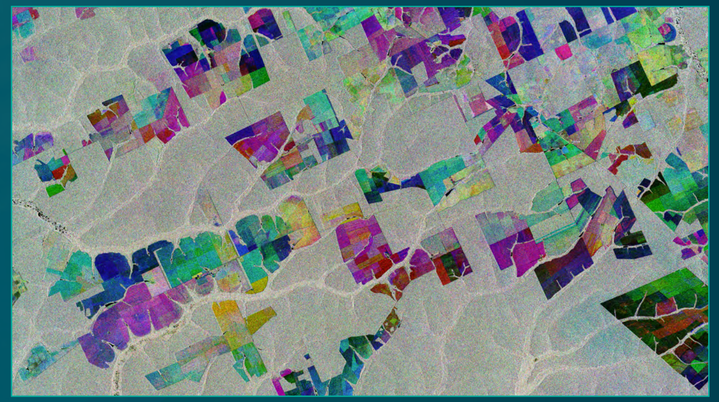


Credit: contains modified Copernicus Sentinel data (2021), processed by LIST

The technique also gathers data about the physical characteristics and roughness of surfaces. These observations can be used to track the paths of oil slicks, as shown in this image of an oil spill near Tobago in 2024.

Credit: contains modified Copernicus Sentinel data (2024), processed by ESA

SAR is also highly effective in providing data on the texture and moisture content of soil. It is used in agricultural monitoring to show the change in crops and land cover over time, as shown in this image of Mato Grosso in Brazil.



Credit: contains modified Copernicus Sentinel data (2015-19), processed by ESA

NEW WAYS TO OBSERVE EARTH

Sentinel-1's radar instrument operates in two main modes: Interferometric Wide Swath, which is the default mode over land, and Wave, which is used over oceans. There is also the potential for operating in two additional modes: Stripmap and Extra Wide Swath.

INTERFEROMETRIC WIDE SWATH MODE

images in three sub-swaths and produces a higher quality and homogeneous image throughout the swath.

- *Resolution*: 5 m x 20 m
- *Swath width*: 250 km

WAVE MODE

can help to determine the direction, wavelength and heights of waves on the open oceans.

- *Resolution*: 5 m x 5 m
- *Swath width*: 20 km x 20 km vignettes every 100 km along the orbit.

STRIPMAP MODE

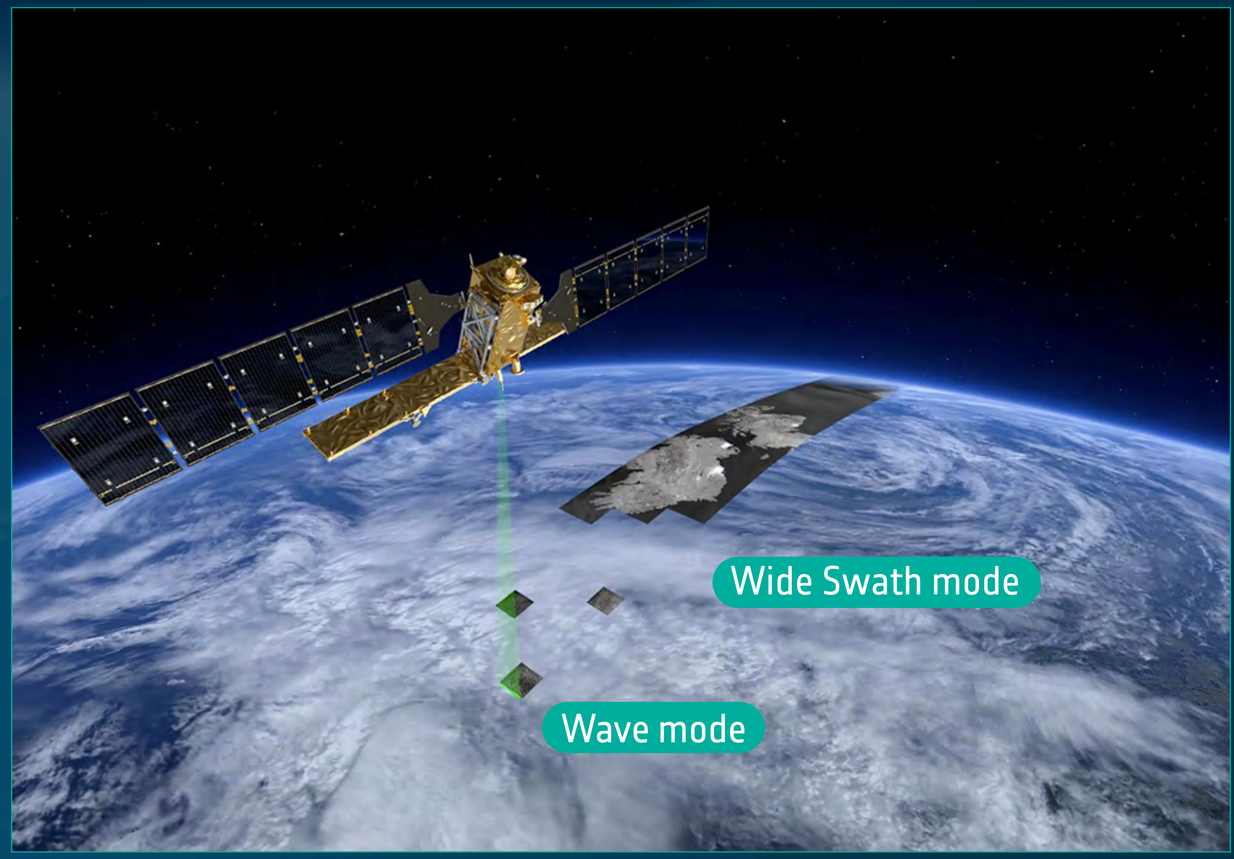
provides a continuity of ERS and Envisat data.

- *Resolution*: 5 m x 5 m
- *Swath width: 80 km*

EXTRA WIDE SWATH

intended for maritime, ice and polar zone operational services.

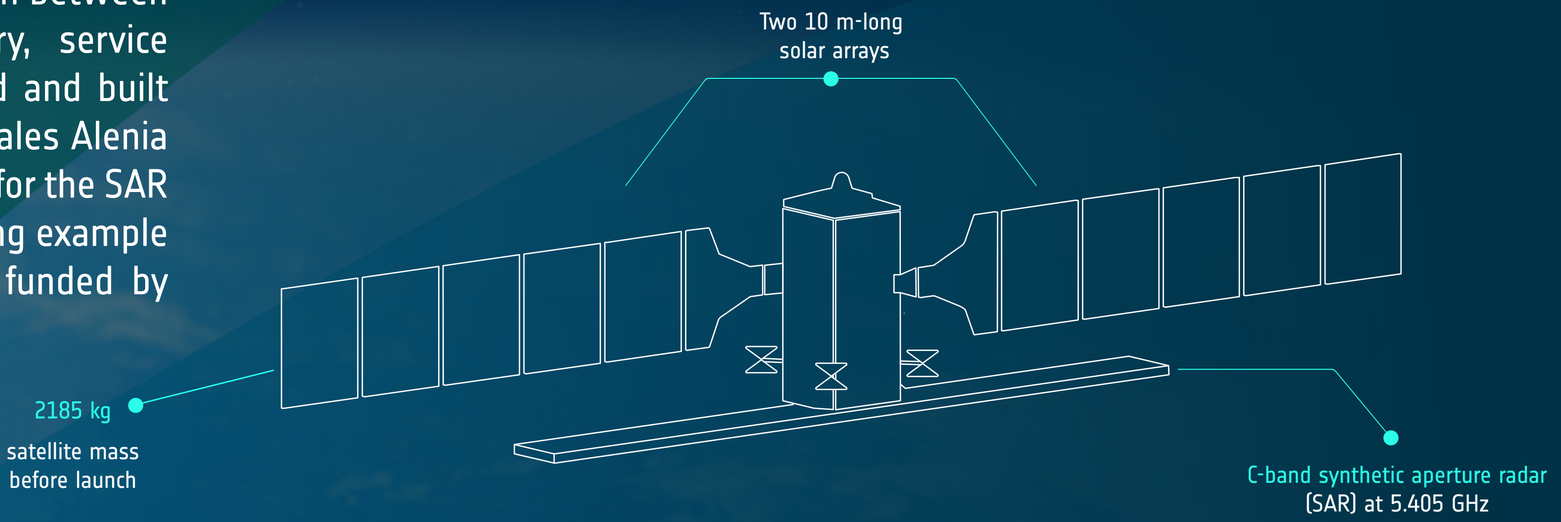
- *Resolution*: 20 m x 40 m
- *Swath width*: 400 km



Interferometric Wide Swath *is a satellite imaging mode that can acquire data over a large distance, covering a strip of land up to 250 km wide with consistent resolution. It is used for applications such as land monitoring and deformation tracking.* ***Wave mode****, on the other hand, is the default mode for acquiring data over open ocean.*

TEAMWORK

Copernicus Sentinel-1 is the result of close collaboration between ESA, the European Commission, European industry, service providers and data users. The mission was designed and built by a consortium of more than 60 companies led by Thales Alenia Space for the spacecraft and Airbus Defence and Space for the SAR instrument. The Sentinel-1 satellites are an outstanding example of Europe's technological excellence. The mission is funded by ESA Member States and the European Union.



OBJECTIVE

- continuous radar mapping of the Earth

ORBIT

- polar, Sun-synchronous, dawn-dusk orbit at altitude of 693 km

LIFETIME

- seven years minimum

FUNDING

- ESA Member States and the European Union

PRIME CONTRACTORS

- Thales Alenia Space for the spacecraft
- Airbus Defence and Space for the SAR payload

DATA ACCESS

- https://dataspace.copernicus.eu/

MEET THE ESA EXPERTS

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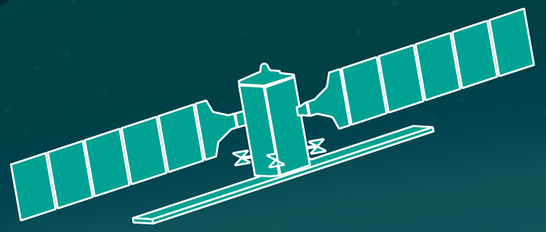
MULTIMEDIA



SENTINEL-1

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THE EUROPEAN SPACE AGENCY

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