

# EarthCARE

ESA's cloud and aerosol mission



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## MISSION OVERVIEW

The Earth Cloud Aerosol and Radiation Explorer, or [EarthCARE](#), is a groundbreaking satellite mission designed to unravel the mysteries of Earth's [clouds and aerosols](#).

Although it is known that clouds play an extremely important role in atmospheric heating and cooling, they remain one of the biggest uncertainties in our understanding of how the atmosphere drives the climate system. EarthCARE will enhance our understanding of how clouds influence the climate system, providing crucial insights for climate research and environmental science.

With global climate change increasingly affecting our planet, EarthCARE's advanced instruments and technology will provide key data to improve the accuracy of climate models and support numerical weather prediction.

Developed within ESA's Earth Observation [FutureEO programme](#), EarthCARE is the most complex satellite in the series of [Earth Explorer missions](#). EarthCARE is a joint venture between [ESA](#) and [JAXA](#), the Japan Aerospace Exploration Agency.



# EARTH'S RADIATION BUDGET

## HOT OR COLD

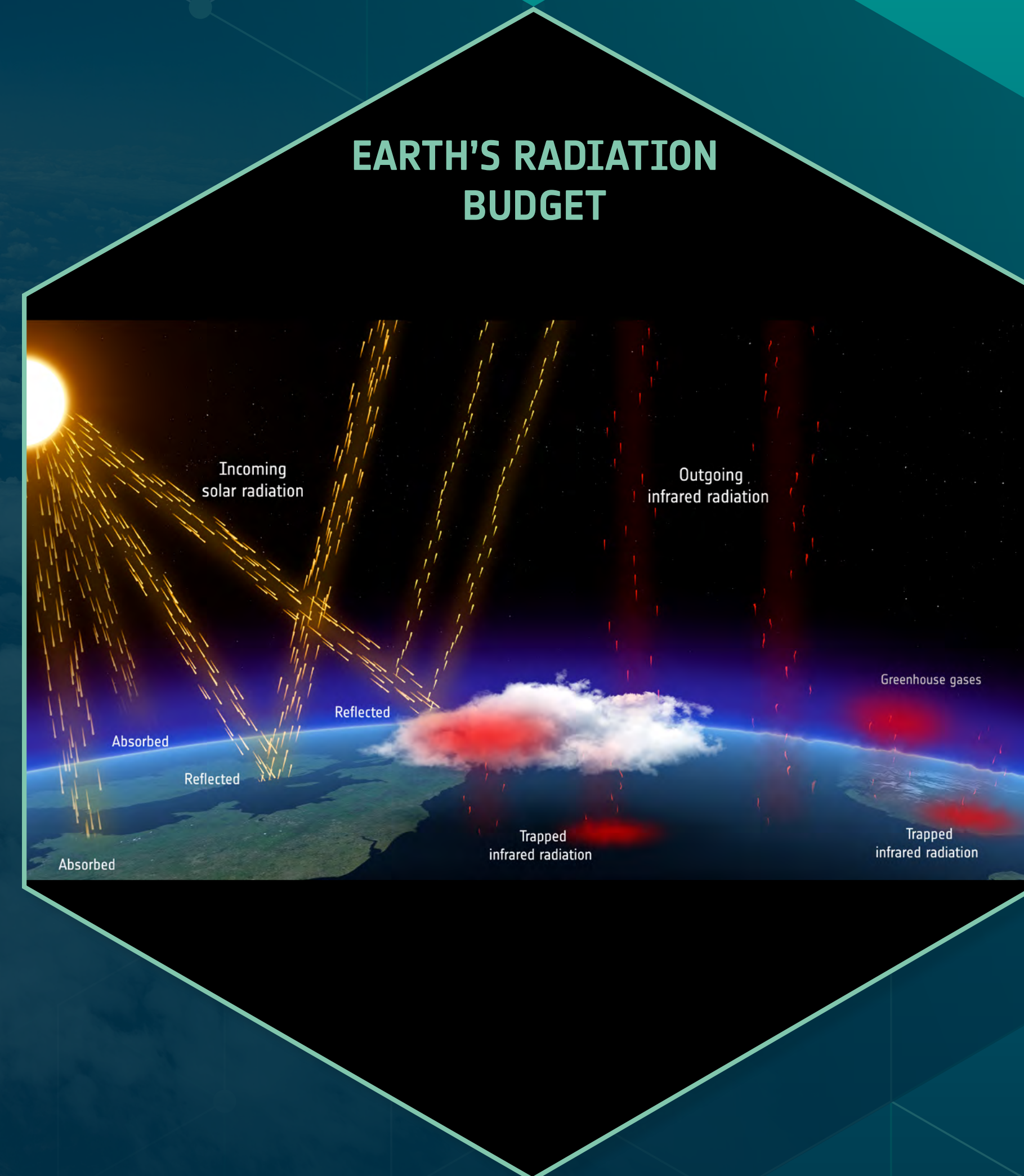
The delicate balance of Earth's radiation budget is a key factor in regulating our climate. Energy in the atmosphere is a balance between incoming radiation from the Sun, which heats Earth, and outgoing thermal radiation, which cools Earth. This balance is crucial as it determines the temperature on our planet and is influenced by various factors.

Clouds and aerosols reflect solar energy back into space while simultaneously trapping outgoing infrared energy, resulting in a net effect of either cooling or heating. Additionally, aerosols impact cloud life cycles and composition, adding complexity to the role of clouds in the climate system.

The limited understanding of clouds and aerosols, and their impact in Earth's radiation budget, remains one of the biggest gaps in understanding the climate system and predicting future changes.

## SOLVING THE MYSTERY

EarthCARE, with its suite of four cutting-edge instruments, provides a comprehensive view of the intricate relationship between clouds, aerosols and radiation. Simultaneously collecting diverse measurements allows scientists to better understand the processes governing the physics and interaction of clouds and aerosols including Earth's radiation balance.





# CLOUDS AND CLIMATE

PRESENT CLIMATE

FUTURE CLIMATE

HIGHER CLOUD  
LOWER CLOUD

High thin clouds **trap outgoing heat** more than they reflect incoming solar energy, warming the atmosphere

More high thin clouds mean more **outgoing heat** is trapped

Low thick clouds reflect **incoming solar energy** more than they trap outgoing heat, cooling the atmosphere

Fewer low thick clouds mean **less solar energy** is reflected back to space

Overall, clouds currently cool the climate system

Cloud distribution is expected to change in the future and amplify climate warming

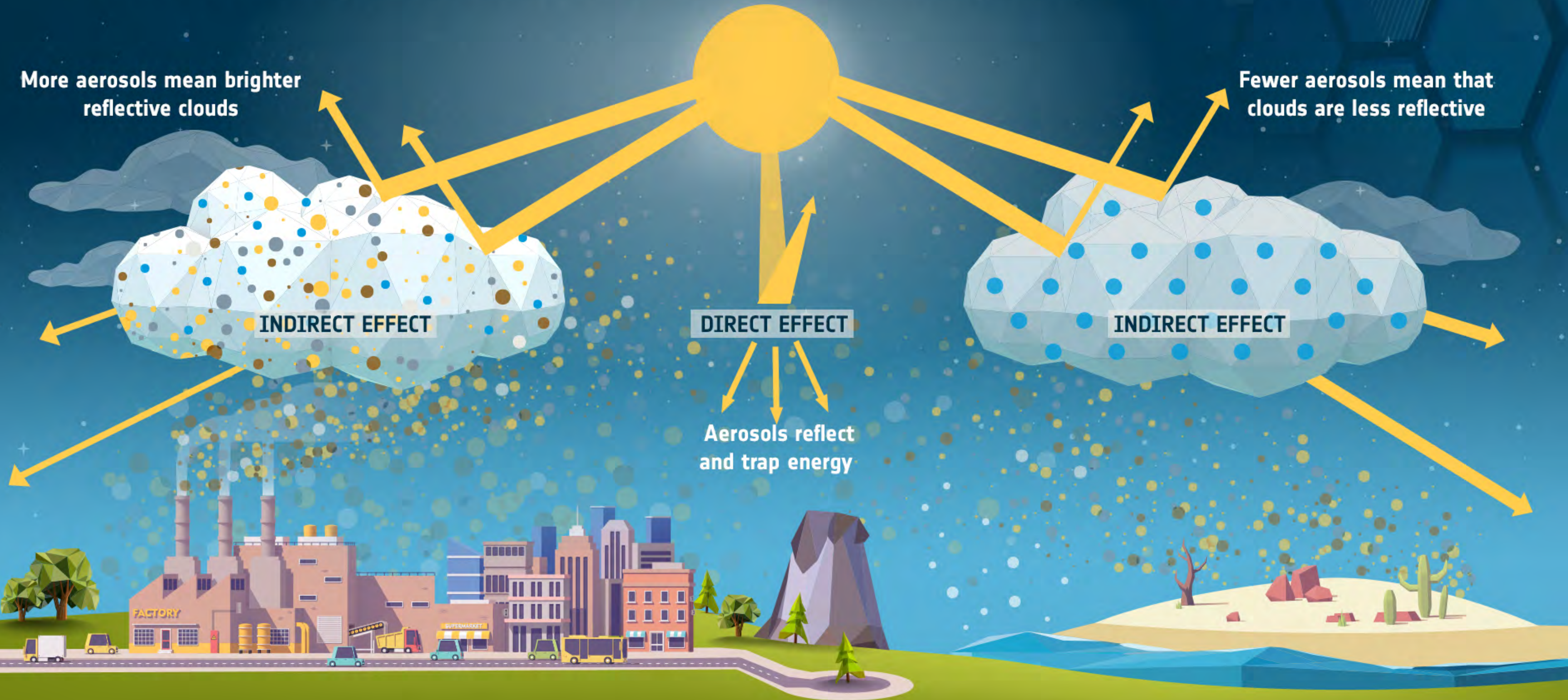


Clouds affect and are affected by climate



# AEROSOLS AND CLIMATE

Aerosols – tiny particles such as dust suspended in the air – affect the climate, either directly by reflecting solar energy back to space and by trapping heat in the atmosphere, or indirectly by influencing how clouds form





4

instruments using synergistic sensing methods

active instruments



passive instruments



Cloud Profiling Radar

Atmospheric Lidar

Broadband Radiometer

Multispectral Imager

**25 days**  
repeat cycle  
(389 orbits)

**17.2 m**  
overall length

**2200 kg**  
weight

**1.7 kW**  
power

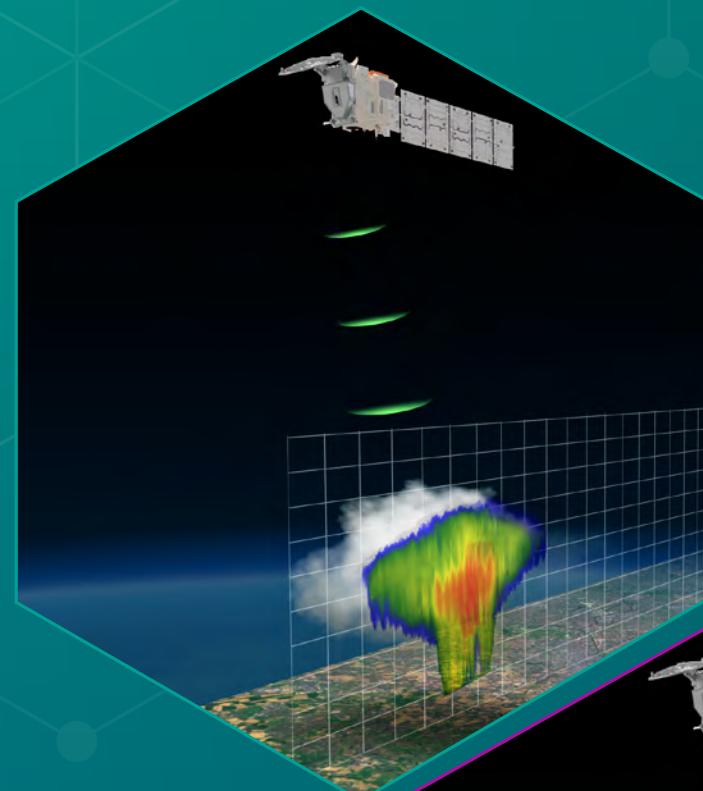
**393 km**  
in a Sun-synchronous orbit

**3 years**  
minimum lifetime

**2** ground stations for science data downlink:  
**KIRUNA (SWEDEN) and INUVIK (CANADA)**

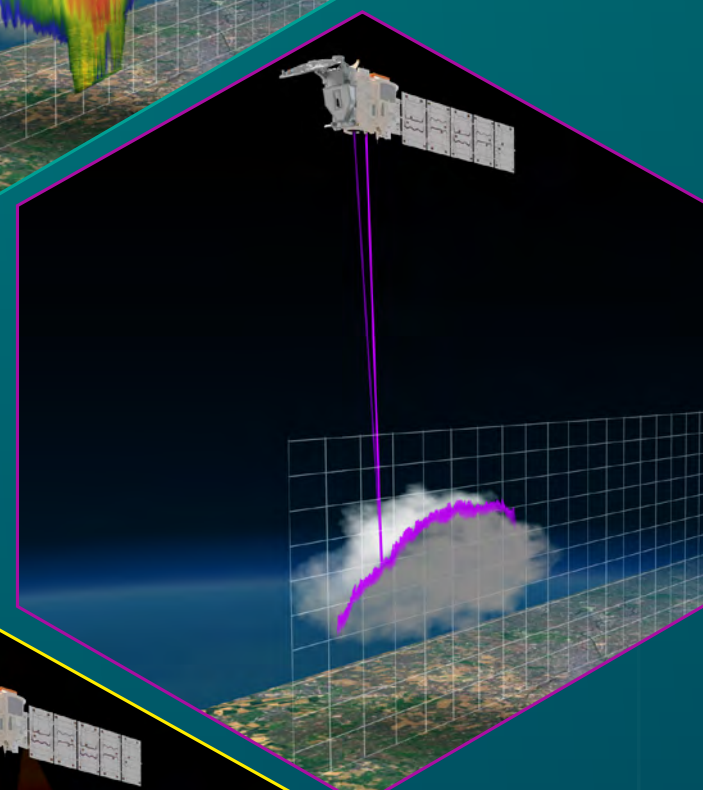
# EarthCARE key facts





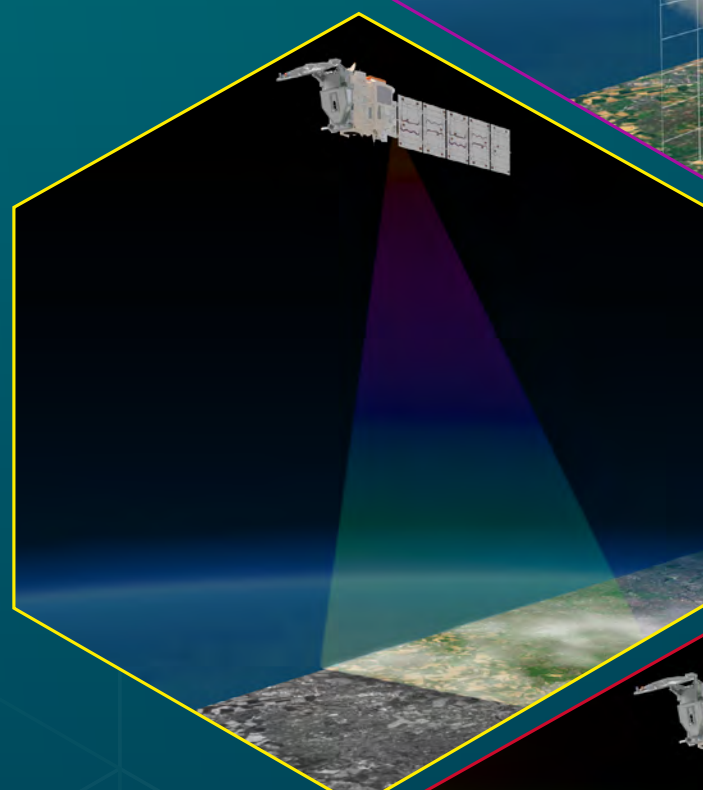
### Cloud Profiling Radar

The cloud profiling radar will provide vertical profiles of cloud water and ice, and detect vertical motion within clouds – providing details on their internal dynamics.



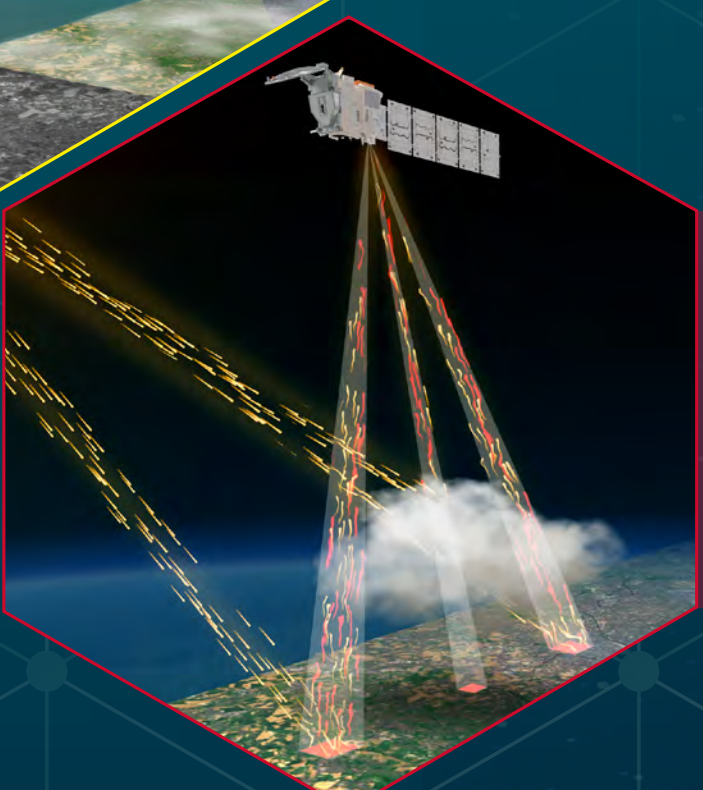
### Atmospheric Lidar

The atmospheric lidar will provide profiles of aerosols in the atmosphere and detect the top of clouds.



### Multispectral Imager

The multispectral imager will provide an overview in multiple wavelengths to set the scene.



### Broadband Radiometer

The broadband radiometer will measure reflected sunlight and heat radiated from Earth.



Cloud Profiling Radar

Atmospheric Lidar

# EARTH CARE INSTRUMENTS

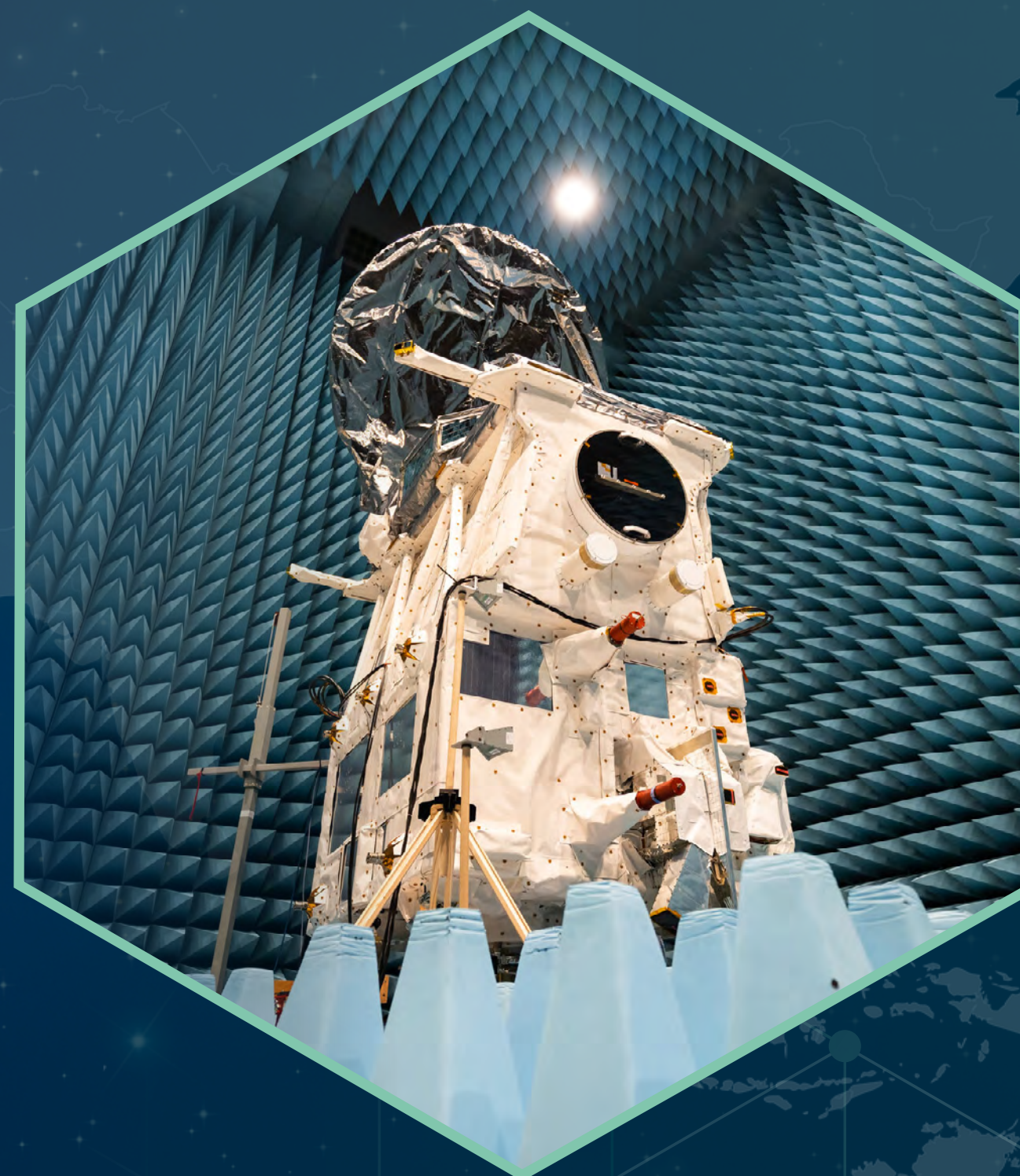
Multispectral Imager

Broadband Radiometer

EarthCARE's instruments work together to provide a holistic view of complex interplay between clouds, aerosols and radiation to yield new insight into the radiation balance against the backdrop of the climate crisis.



# INTERNATIONAL COOPERATION



## THE NETHERLANDS

EarthCARE finds its roots in the Netherlands at ESTEC (European Space Research and Technology Centre) where its team is based. The satellite spent around 12 months at the ESTEC Test Centre – the largest satellite test facility in Europe – where it was rigorously tested.

This 3000 sq m, environmentally-controlled facility hosts test equipment to simulate every aspect of the space environment, from the vacuum and temperature extremes of Earth orbit to the violent noise and vibration of a rocket launch.

EarthCARE's development involved a consortium of over 75 companies across Europe led by prime contractor: Airbus Defence and Space located in Friedrichshafen, Germany.

The UK also played a crucial role building two of the instruments: the Multispectral Imager (led by Surrey Satellite Technology Limited) and the Broadband Radiometer (led by Thales) as well as the base platform. France also made vital contributions in developing the Atmospheric Lidar instrument (Airbus).



# INTERNATIONAL COOPERATION



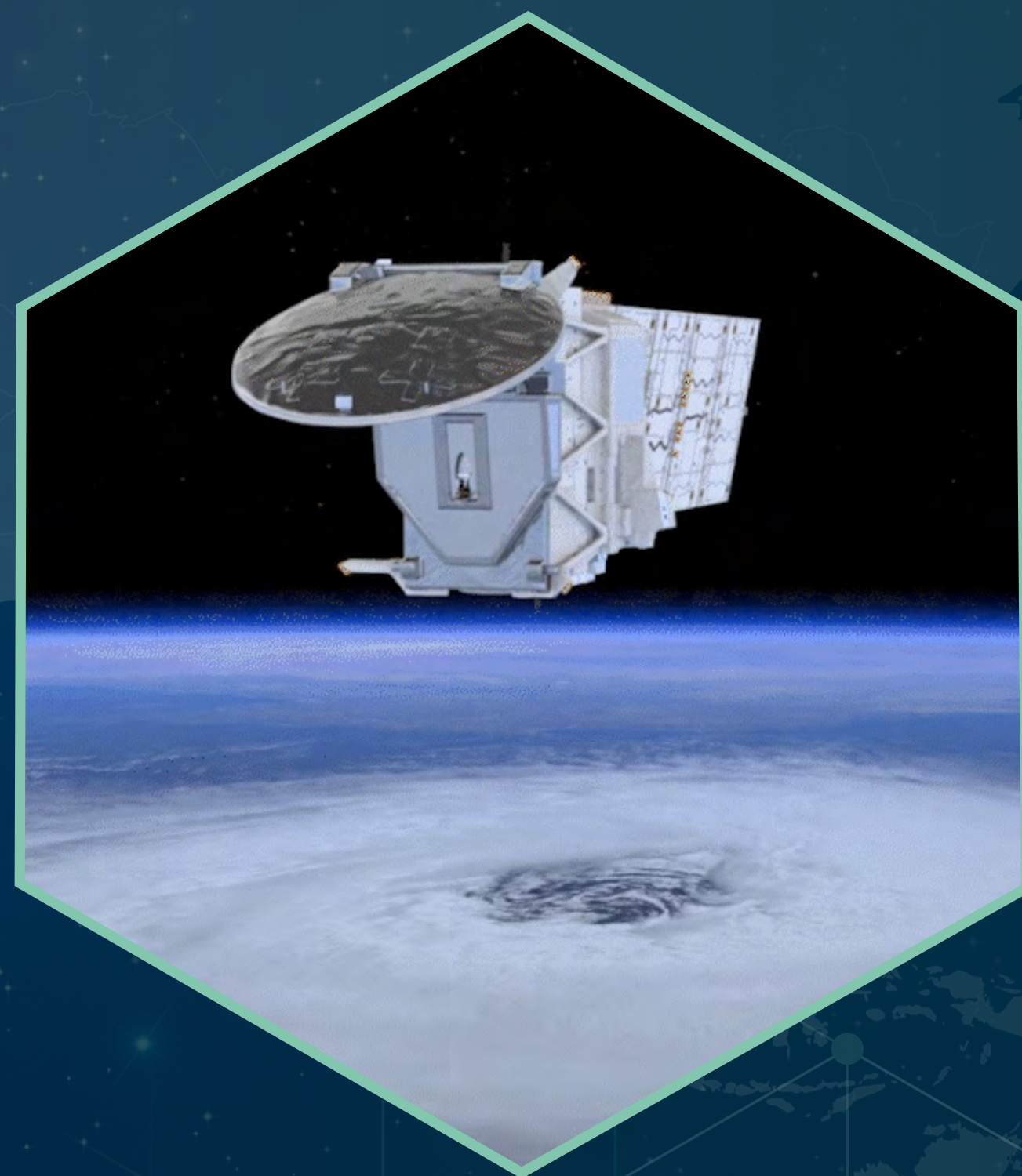
## GERMANY

ESA's European Space Operations Centre (ESOC) in Darmstadt, Germany, is responsible for the satellite operations, the orbit control and on-board software maintenance.

Tracking, telemetry and command signals are sent and received via the S-band ground stations in Kiruna in Sweden, the 'North Pole Satellite Station' in Alaska in the US, and Norway's Troll station in Antarctica.



# INTERNATIONAL COOPERATION



## ITALY

ESA's Centre for Earth Observation in Frascati in Italy is responsible for processing and archiving of the science data. These data are downlinked via X-band to the Kiruna Ground Station in Sweden and to the Inuvik ground station in Canada.

ESA's team in Frascati also handles the exchange of data with the JAXA ground segment and disseminates ESA and JAXA science [data products to ESA's](#) data users.



# INTERNATIONAL COOPERATION



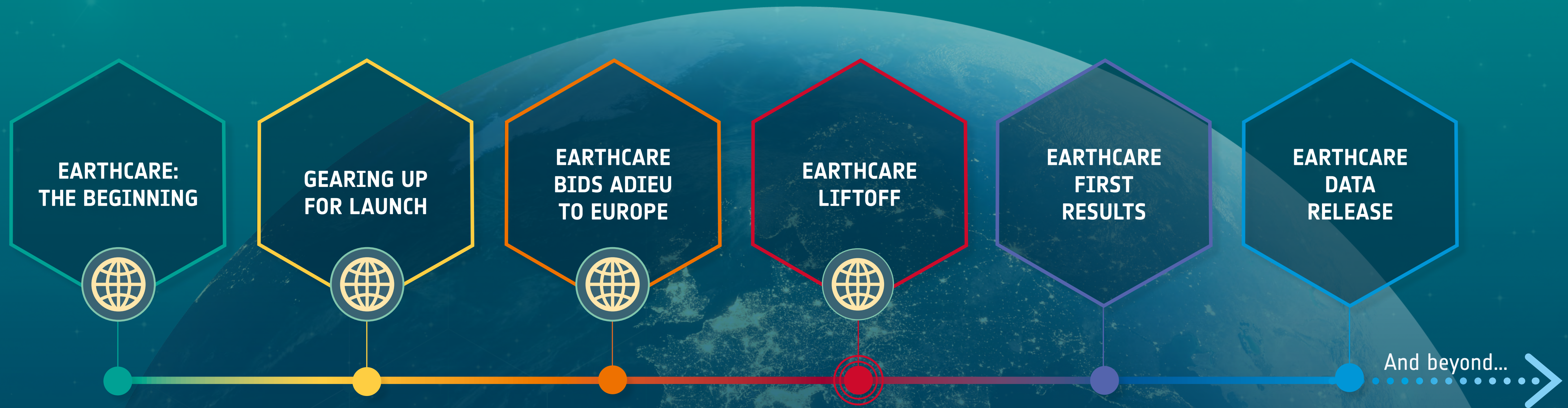
## JAPAN

EarthCARE is a success story made possible by the fruitful collaboration including development, launch and operations between ESA and Japan Aerospace Exploration Agency (JAXA). JAXA has provided the Cloud Profiling Radar instrument, as well as mission science input and instrument-dedicated data processing.

The active involvement of the Japanese scientific community has been instrumental in shaping the mission's goals and the exploitation of its data.



# MISSION MILESTONES



FOLLOW THE LAUNCH LIVE

EARTH-CARE ON SOCIAL MEDIA



#EarthCARE



# MISSION EXPERTS AND SPOKESPEOPLE



**SIMONETTA CHELI**

Director of Earth Observation Programmes

IT, EN, FR, DE

*"EarthCARE was conceived by the science community to respond to challenges associated to the monitoring and mitigation of Earth's radiation budget."*



**DIRK BERNAERTS**

EarthCARE Project Manager and Earth Explorer Missions Programme Manager

NL, EN

*"EarthCARE is a perfect example of cooperation. We have instruments working together to bring one result. We have teams working together in Japan, in Europe, all over the world, working together to get good results."*



**KOTSKA WALLACE**

EarthCARE Mission & Optical Payload Manager

EN

*"The four instruments on EarthCARE will deliver detailed information through the depth of the atmosphere that will allow scientists to improve their models, leading to improved precision in forecasts of global temperature evolution."*



**THORSTEN FEHR**

EarthCARE Mission Scientist and Head of ESA's Atmospheric Section

DE, EN

*"Clouds are fundamental for understanding our climate and it is still one of the biggest unknowns that we have on how the complete climate system works."*



**BJOERN FROMMKNECHT**

EarthCARE Mission Manager

DE, EN, IT

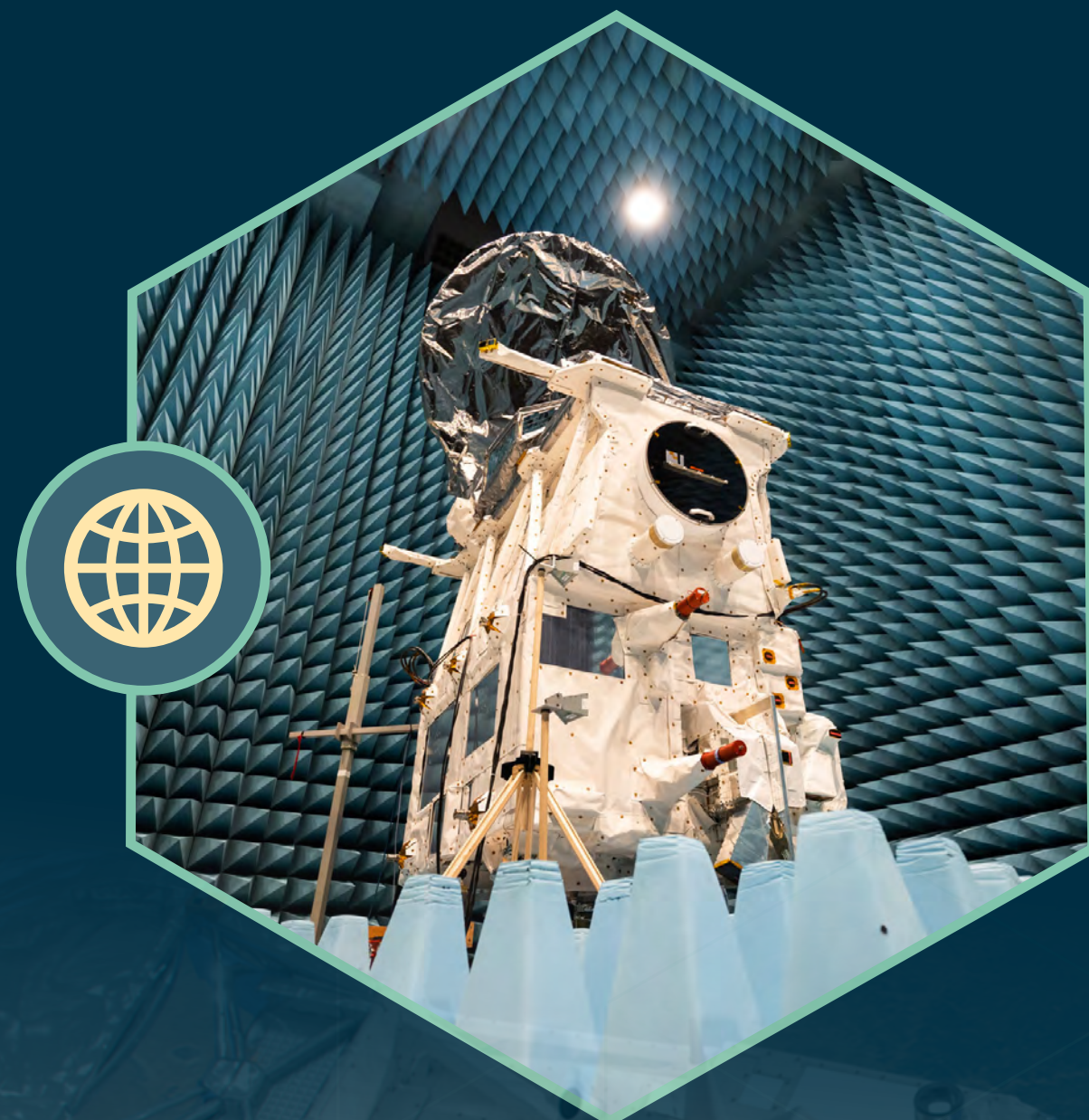
*"A better understanding of the relationship between clouds, aerosols and radiation is a high priority in both climate research and weather prediction."*

**Meet the team behind EarthCARE**

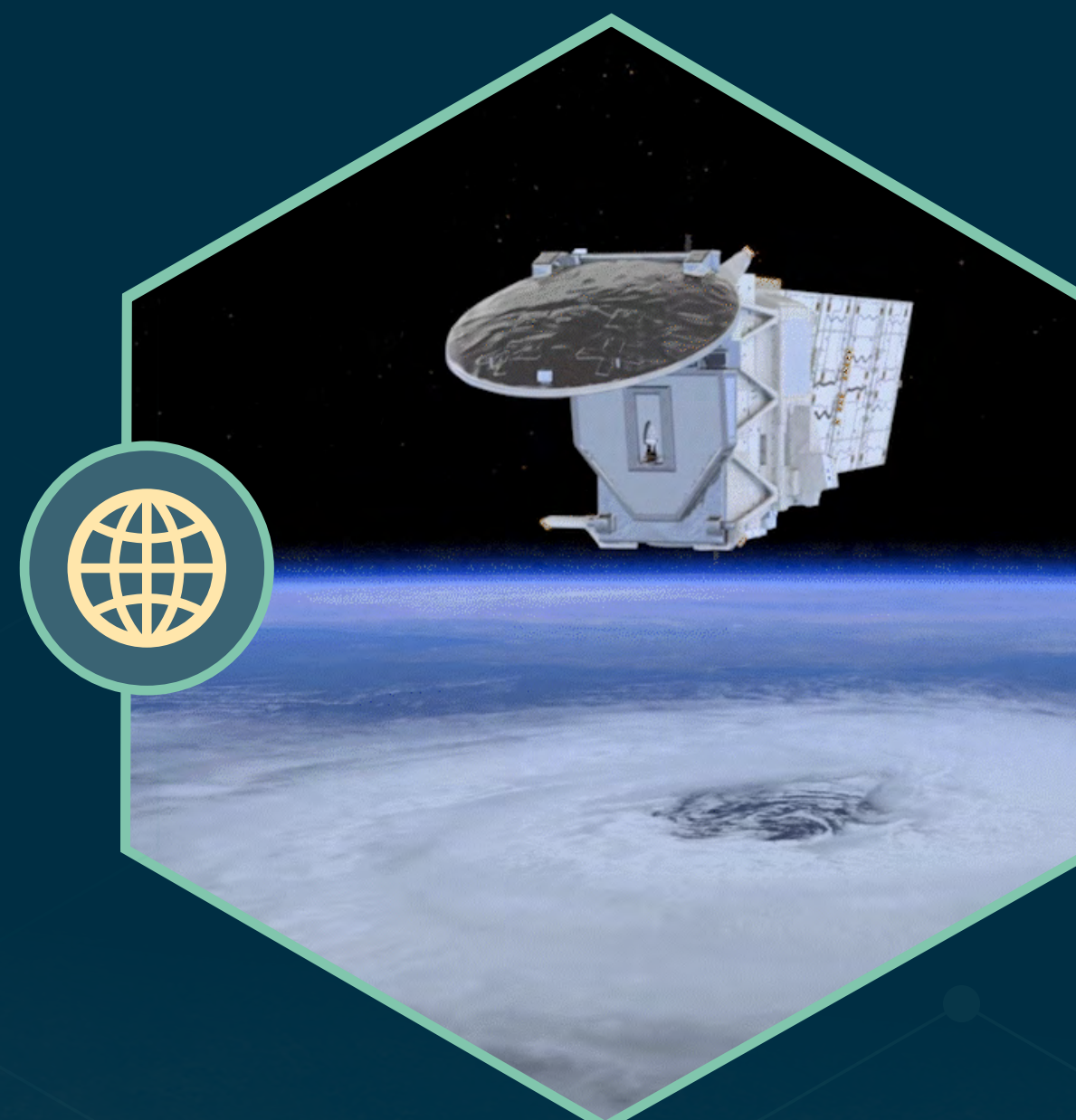
For media interview requests, please contact: [media@esa.int](mailto:media@esa.int)



# MULTIMEDIA



**IMAGES**



**VIDEOS AND ANIMATIONS**



**LAUNCH CAMPAIGN BLOG**

