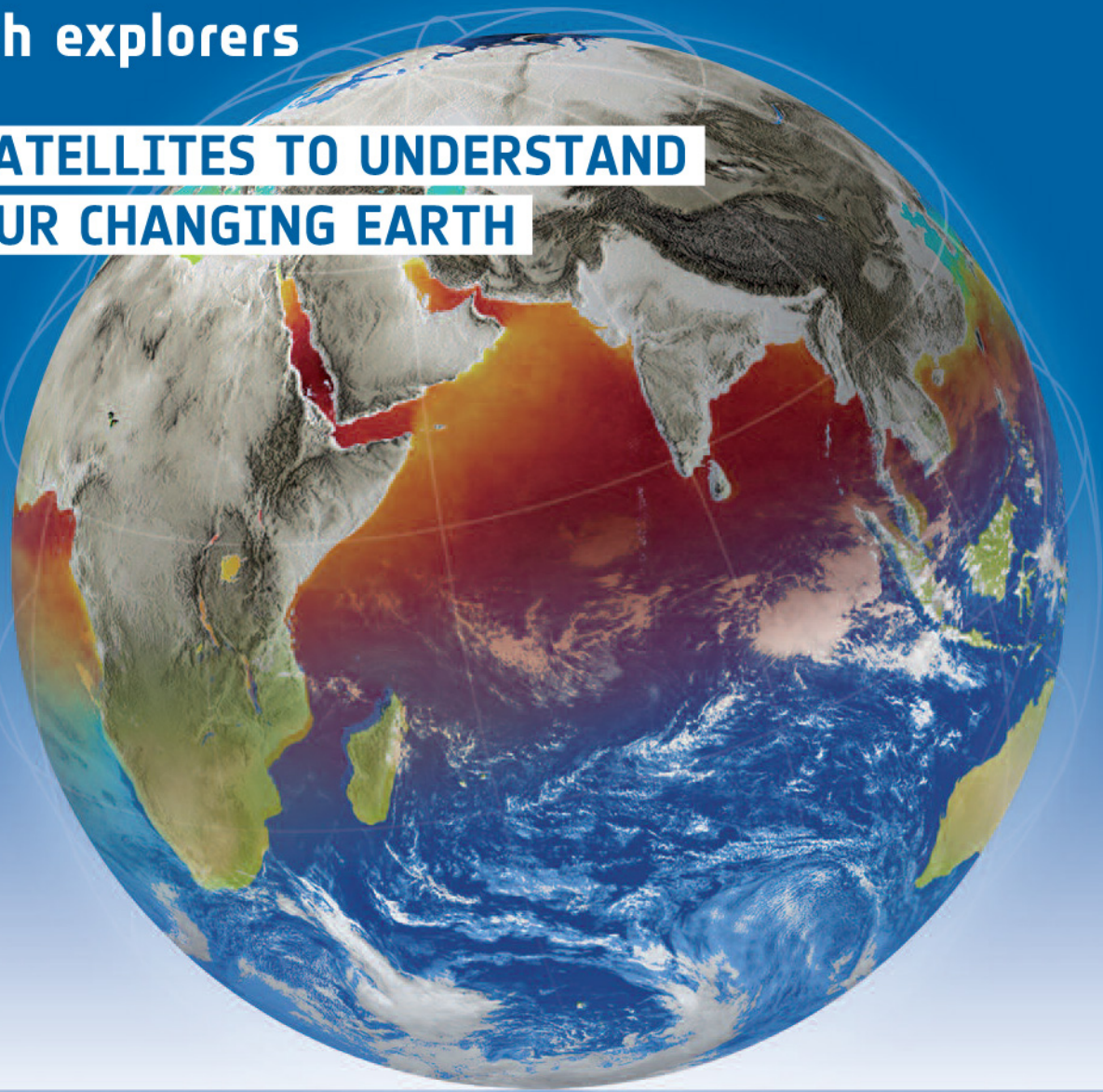
esa

earth explorers

→ SATELLITES TO UNDERSTAND OUR CHANGING EARTH



European Space Agency

A SERIES OF SATELLITES TO UNDERSTAND

→ FOCUSED MISSIONS

Responding to issues raised by the scientific community, ESA's series of Earth Explorers focuses on the atmosphere, biosphere, hydrosphere, cryosphere and Earth's interior. While they gather data on specific areas of scientific interest, the overall emphasis is on learning more about the interactions between these components and how human activity is affecting natural Earth processes.

→ DRIVEN BY SCIENCE

Being proposed by the scientific community and realised through a user-driven selection process ensures that Earth Explorers address the most urgent Earth science questions of our time. Keeping the community involved in the development of this series of missions makes sure that scientific integrity is retained and appropriate data are delivered to improve the understanding of our changing Earth.

→ EUROPEAN INNOVATION

By exploiting Europe's excellence in technological innovation, Earth Explorers demonstrate new ways of observing Earth from space. The cutting-edge technology and novel remote-sensing techniques employed by this family of missions pave the way for the development of future applications of Earth observation data.

"ESA's Earth Explorers further strengthens Europe as a world leader in Earth observation. The data resulting from these missions will boost studies into the environment and climate, removing gaps in our knowledge of the Earth system."

Prof. Johnny Johannessen
Nansen Environmental & Remote Sensing Center

OUR CHANGING EARTH

→ DYNAMIC EARTH

The natural processes that shape our planet's systems are dynamic, complex and highly interdependent. Understanding the intricacies of the Earth system and how human activity is contributing to global change is one of the biggest scientific challenges we face today.

→ EXPLORING OUR DYNAMIC EARTH

Today, the biggest concern for life on Earth is global change, which not only encompasses the consequences of a warming climate, but also the large-scale impact that a growing global population and continued economic growth has on Earth's natural resources and environment.

The vantage point of space provides a window on the world like no other to monitor our changing planet. Access to accurate, timely and uniform satellite data is increasingly important if we are to improve our understanding of the Earth system and develop ever-more sophisticated models to predict how Earth will respond.

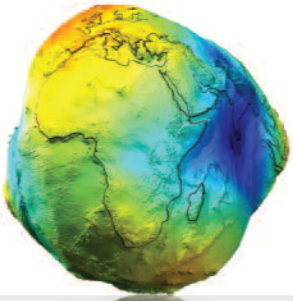
ESA's Earth Explorer missions are developed to fill gaps in our knowledge of how the planet functions. Ultimately, they contribute to equipping decision-makers with the evidence required to take action to protect the environment and adapt to the effects of climate change.

To date, there are three Earth Explorers in orbit, three in development and three candidates undergoing feasibility study.

goce

→ ESA'S GRAVITY MISSION

Gravity is a complex force of nature driving many dynamic Earth processes, but which varies subtly from place to place



GOCE is dedicated to measuring details in Earth's gravity and modelling the 'geoid' – the surface of a hypothetical global ocean at rest – with unprecedented accuracy and spatial resolution. A precise knowledge of the geoid is crucial to advance our understanding of ocean circulation and sea-level change, both of which are influenced by climate. The data from GOCE are also much-needed to improve our knowledge of processes occurring inside Earth.

GOCE employs a state-of-the-art gravity gradiometer incorporating six highly sensitive accelerometers that measure gravity gradients in three dimensions. GOCE is determining gravity field variations with an accuracy of 1 mGal (10^{-5} m/s^2) and the geoid with an accuracy of 1–2 cm, both with a spatial resolution of better than 100 km.

Gravity Field and Steady-State Ocean Circulation Explorer (GOCE)
Looking into the forces that shape our planet

smos

→ ESA'S WATER MISSION

The water cycle is fundamental to life on Earth, but is still relatively poorly understood

SMOS is making global observations of soil moisture over land and salinity over oceans. By consistently mapping these two variables, SMOS will not only advance our understanding of the exchange processes between Earth's surface and atmosphere, but will also help to improve weather and climate models.

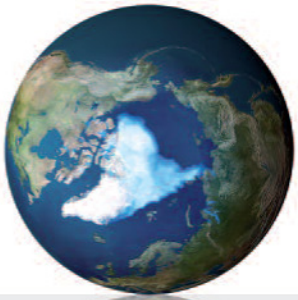
The satellite carries a novel interferometric radiometer operating in the L-band microwave range to capture 'brightness temperature' images. These images are used to derive global maps of soil moisture every three days, achieving an accuracy of 4% at a spatial resolution of about 50 km. Over oceans, SMOS is mapping salinity down to 0.1 practical salinity units (psu, averaged over 10–30 days and in area measuring 200 × 200 km).

Soil Moisture and Ocean Salinity (SMOS)
Improving our understanding of the water cycle

cryosat

→ ESA'S ICE MISSION

Ice plays a crucial role in regulating climate, ocean currents and sea level; the consequences of change are far-reaching



CryoSat-2 is monitoring centimetre-scale changes in the thickness of ice floating in the oceans and in the thickness of the vast ice sheets that blanket Greenland and Antarctica. Together with satellite information on ice extent, these measurements will show how the volume of Earth's ice is changing and lead to a better understanding of the relationship between ice and climate.

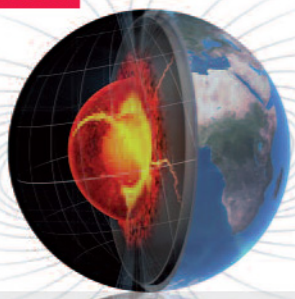
Optimised for measuring icy surfaces, the satellite's high-spatial resolution radar altimeter is the first of its kind. It uses different modes to measure the height of sea ice above the waterline and to target the steeply sloping coastal terrain of ice sheets where the most dramatic changes are happening. Reaching latitudes of 88°, CryoSat-2 provides greater polar coverage than earlier missions.

CryoSat
Detecting variations in the thickness of Earth's ice

swarm

→ ESA'S MAGNETIC FIELD MISSION

The magnetic field that shields Earth from solar winds varies in space and time and now appears to be weakening



Swarm is a constellation of three satellites to measure precisely the magnetic signals that stem from the magnetosphere, ionosphere, Earth's core, mantle, crust and the oceans. This sampling, in both space and time, will lead to an improved understanding of the processes that drive Earth's 'dynamo', which appears to be weakening. Swarm also aims to provide a better insight into Earth's crust and mantle.

The Swarm mission takes advantage of a new generation of magnetometers, enabling measurements to be taken over different regions of Earth simultaneously. GPS receivers, an accelerometer and an electric field instrument will deliver supplementary information to study the interaction of Earth's magnetic field with solar winds, electric currents and radiation, and their effect on the Earth system.

Swarm
Providing insight into Earth's interior and near-Earth environment

adm-aeolus

→ ESA'S WIND MISSION

Since wind greatly influences weather patterns, global profile observations are urgently needed for numerical weather prediction

Aeolus will be the first space mission to acquire profiles of the wind on a global scale. These near-realtime observations will improve the accuracy of numerical weather and climate prediction, advancing our understanding of tropical dynamics and processes relevant to climate variability.

Aeolus carries an innovative Doppler wind lidar to probe the atmosphere and acquire global wind profiles up to an altitude of 30 km. The wind will be measured to an accuracy of 1 m/s in the planetary boundary layer (up to an altitude of 2 km), and 2 m/s in the troposphere and lower stratosphere (up to an altitude of 16 km). By demonstrating new laser technology, Aeolus will pave the way for future operational missions to measure wind.

Atmospheric Dynamics Mission (ADM-Aeolus)
Profiling the wind

earthcare

→ ESA'S CLOUD & AEROSOL MISSION

Clouds and aerosols play an important role in Earth's radiation budget, but these interactions are not completely understood

EarthCARE will advance our understanding of the role that clouds and aerosols play in reflecting incident solar radiation back into space and trapping infrared radiation emitted from Earth's surface. The mission will acquire vertical profiles of clouds and aerosols, as well as the radiances at the top of the atmosphere to improve our understanding of Earth's radiative balance. These observations will lead to more reliable climate predictions and better weather forecasts.

Developed in cooperation with the Japan Aerospace Exploration Agency, EarthCARE carries a high-spectral resolution atmospheric lidar, a radar instrument with Doppler measurement capability to provide cloud profiles, a multispectral imager and a broadband radiometer.

Earth, Clouds, Aerosols and Radiation Explorer (EarthCARE)
Understanding Earth's solar radiation budget

→ LOOKING TO THE FUTURE

The essence of an Earth Explorer mission is to have a bold and singular scientific objective; realising these missions is a continuous process. One of the following mission concepts will be selected as the seventh Earth Explorer:

biomass aims to acquire global measurements of forest biomass to assess terrestrial carbon stocks and fluxes. The mission is envisaged as a novel P-band synthetic aperture polarimetric radar operating at 435 MHz and a 6 MHz bandwidth.

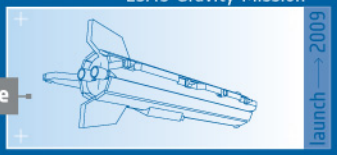
coreh$_2$o aims to fill the gaps in current information on snow cover and glaciers. The mission concept employs dual-frequency synthetic aperture radars operating at 9.6 GHz and 17.2 GHz to deliver information on the amount of water held in snow.

premier aims to advance our understanding of the processes that link trace gases, radiation and chemistry in the upper troposphere and lower stratosphere. The mission concept employs an infrared limb-imaging spectrometer and a millimetre-wave limb sounder.

earth explorers

ESA's Gravity Mission

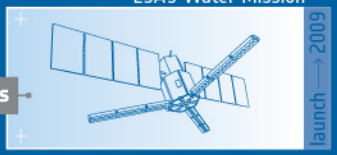
goce



To map Earth's gravity in unprecedented detail with a gravity gradiometer that responds to variations in the gravitational tug of Earth as the satellite travels along its orbital path.

ESA's Water Mission

smos



To map soil moisture and ocean salinity for a better understanding of the water cycle using the novel passive Microwave Imaging Radiometer with Aperture Synthesis (MIRAS).

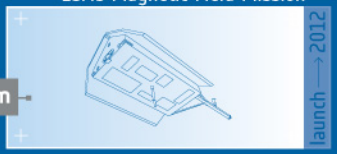
ESA's Ice Mission

cryosat

To determine variations in the thickness of marine ice and ice sheets on land using the Synthetic Aperture Interferometric Radar Altimeter (SIRAL), the first altimeter of its kind.

ESA's Magnetic Field Mission

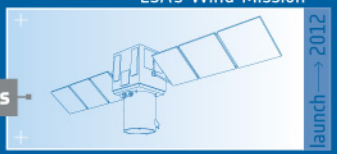
swarm



To map Earth's magnetic field with a trio of satellites that each carries a suite of instruments, including a new generation of magnetometers.

ESA's Wind Mission

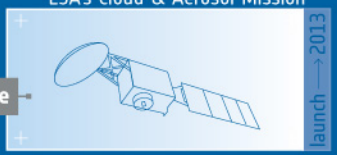
adm-aeolus



To acquire the first wind profiles on a global scale from space by using a novel instrument called Atmospheric Laser Doppler Instrument (ALADIN).

ESA's Cloud & Aerosol Mission

earthcare



To acquire vertical profiles of clouds and aerosols and measurements of radiation with a suite of instruments, including a high-spectral resolution atmospheric lidar and a cloud-profiling radar.

www.esa.int/earthexplorers

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