
News Archive Space 2009

Successful launch for GOCE

17 March 2009

European satellite will investigate Earth's gravity field with unprecedented accuracy



At 15:21 CET on 17 March 2009, the new environmental satellite GOCE (Gravity field and steady-state Ocean Circulation Explorer) was successfully launched into Earth orbit from the Plesetsk Cosmodrome in northern Russia. The Rockot launch vehicle brought the satellite into a near-polar orbit with an inclination of 96.5 degrees at an altitude of 260 kilometres. From this orbit, GOCE will map the Earth's gravity field over a 20-month period, with a level of accuracy never seen before. The expected results will be especially important for oceanography, geophysics and ocean level studies.

Through GOCE, European space exploration will also contribute to the implementation of EU climate and environmental policies. Germany provides 22% of the funding for the European Space Agency's (ESA) Earth Observation Envelope Programme (EOEP) of which the 300 million euro GOCE mission forms part. GOCE is the first in a series of highly specialised satellites that will allow ESA to provide accurate data about processes taking place in the atmosphere, in oceans and on land, which could lead to new insights into global environmental change.

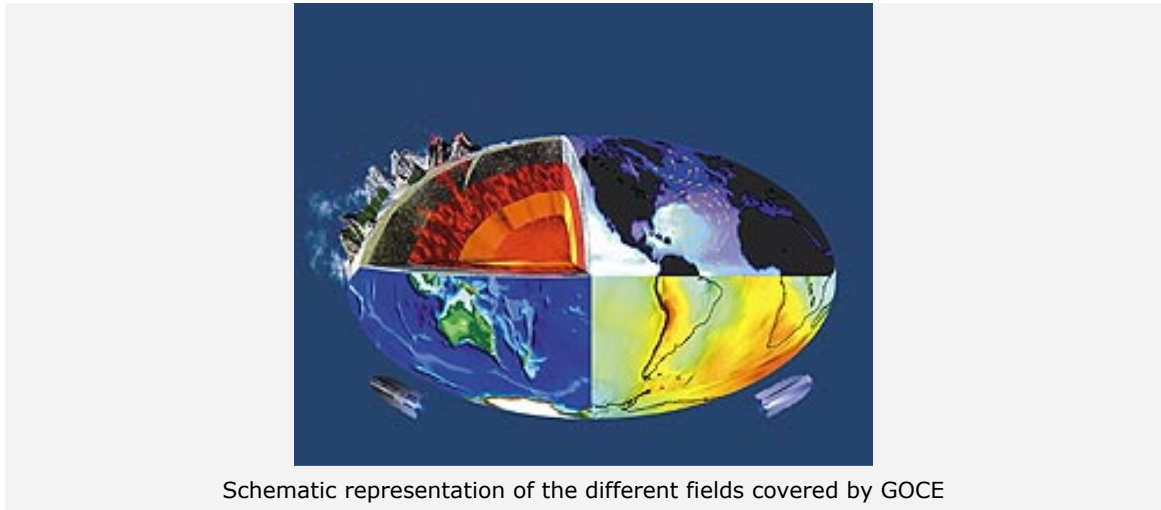


The GOCE satellite in its orbit around the Earth

GOCE has an eye for detail

Gerold Reichle, Executive Board member of the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) and responsible for its Space Agency (Raumfahrt-Management), emphasises the mission's strategic importance: "Seen against the backdrop of massive climate change and the far-reaching impact it could have on the world we live in, GOCE serves to underline the strong commitment of the German and European space sector to long-term climate research. Not only has the space sector played a substantial role in the discovery of global climate change, it also provides the most important instruments used to investigate its effects. This will enable politicians and society as a whole to take the necessary decisions in order to safeguard the basic conditions for human survival."

GOCE will provide environmental researchers with a global, homogenous and accurately detailed picture of the Earth's gravity field, enabling them to establish the surface circulation of the oceans for the first time. Sea level changes around Australia and South America can then, for instance, be compared to those in the North Sea and in the Mediterranean. In this way, oceanographers hope to be able, for example, to answer the question of whether several small circulations have the same effect on heat transport within the global circulation system as a few large ones. Using the data provided by GOCE, it will also be possible to directly derive inch-perfect sea level data from GPS readings.

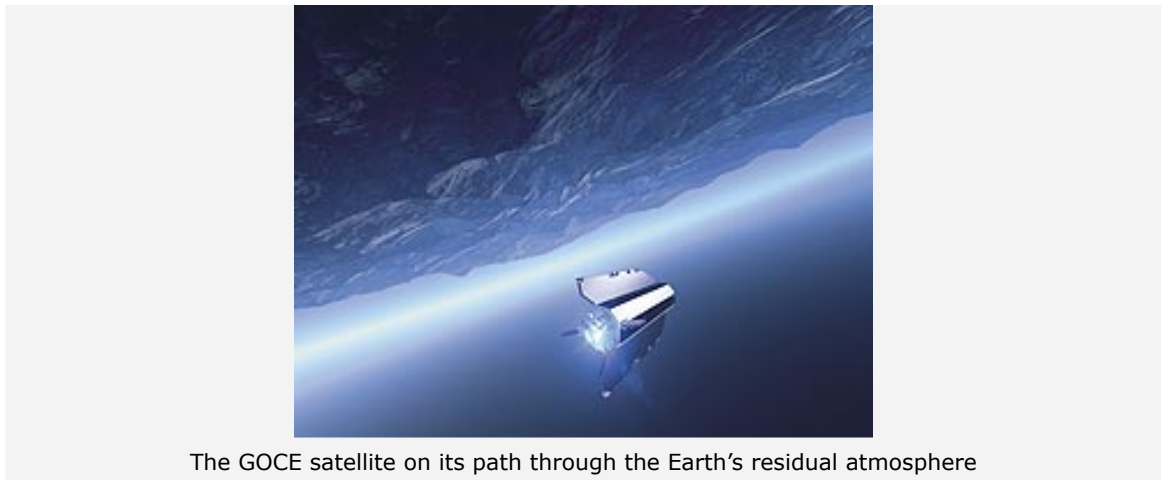


Schematic representation of the different fields covered by GOCE

In the field of geophysics, GOCE's gradiometry promises a glimpse into the Earth's interior. This is expected to significantly enhance our understanding of the Earth's continental and oceanic crust. In addition, GOCE data can be used to determine the topography of the sea floor and the thickness of the polar sea ice, and to reconstruct the density of the large ice sheets.

European Earth science satellite programmes out in front

Speaking about the high-tech equipment on board the latest ESA satellite, Gerold Reichle adds: "GOCE shows how advanced European engineering is. European collaboration has enabled the development of world-class innovative high technologies." The satellite will measure the Earth's gravity field with a spatial resolution of 100 kilometres and record gravity anomalies with a precision of one millionth of the Earth's gravitational pull (10^{-6} g). The geoid will be mapped with an accuracy of one to two centimetres. In order to meet these ambitious goals, GOCE is pushing the limits of what is technically feasible today.



The GOCE satellite on its path through the Earth's residual atmosphere

The closer a satellite is to the Earth, the stronger the gravity signals are. For this reason, GOCE orbits at an altitude of about 260 kilometres, the lowest orbit ever for a scientific satellite. An ion engine known as the Drag-free System will compensate for the drag forces experienced by the satellite due to the residual atmosphere at this low altitude, which would otherwise cause it to lose height quickly. The attitude control system will ensure the instruments are correctly aligned with respect to the Earth.

A GPS receiver on board GOCE allows continuous and inch-perfect determination of the satellite's position. This receiver is primarily used to map out the large-scale structures in the Earth's gravity field. In addition, the satellite is also the first to feature a gravity gradiometer, which is based on the principle of differential acceleration measurement. Equipped with three pairs of such accelerometers, this instrument represents state-of-the-art technology.



GOCE's gravity gradiometer

Forty-one European companies, led by Thales Alenia Space in Italy, have worked together to produce the satellite. EADS Astrium (Friedrichshafen) is the main German contractor for the satellite platform. The magnetic-field-based attitude control elements used to fine-tune the satellite's orientation (by Zarm Technik GmbH) and the solar cells (by RWE Space Solar in Heilbronn) have also been made in Germany. The gradiometer was built at Thales Alenia Space in France and the acceleration sensors by the French firm Onera.

Launch and mission sequence

The launch and mission are just as much a collaborative European effort as the development and construction of the satellite itself. Eurockot, the operating company behind the Rockot launch vehicle, is a German-Russian joint venture between EADS Astrium (51%) and Khruischev Space Center (49%). The rocket lifted off from Plesetsk, 800 kilometres north of Moscow; the launch, separation from the launch vehicle and subsequent flight were monitored by the European Space Operations Center (ESOC).

Raw data will be received and stored at the Command and Data Acquisition Facility (CDAF) in Kiruna, in northern Sweden. Researchers will also monitor the condition of the satellite from here. The Kiruna ground station is optimally located for satellites in a near-polar orbit. The data will be processed and archived at ESA's Earth observation headquarters in Italy and at the decentralised GOCE High-Level Processing Facility (HPF). The German GOCE Project Office (GOCE-Projektbüro), funded by the DLR Space Agency, is located at the Technical University of Munich. The Project Office is headed by Professor Reinhard Rummel, the initiator of the GOCE project. Its function is to co-ordinate the approximately 20 German GOCE user groups and to keep them informed about the mission in order to ensure that German science benefits from it to the greatest extent possible.

GOCE	Technical data
Planned mission duration:	20 months
Orbit altitude:	around 260 kilometres
Orbital period:	90 minutes
Sun-synchronous orbit	

Inclination:	96,5 degrees
Mass:	1100 kilograms
Dimensions:	5 x 1 metres
Xenon propellant:	40 kilograms
Spatial resolution:	100 kilometres
Geoid accuracy:	1-2 centimetres
Mission control:	European Space Operations Centre (ESOC), Darmstadt, Germany
Ground station:	Data download by Kiruna ground station, Sweden
Data processing and archiving:	ESA Earth Observation headquarters (ESRIN), Frascati, Italy

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