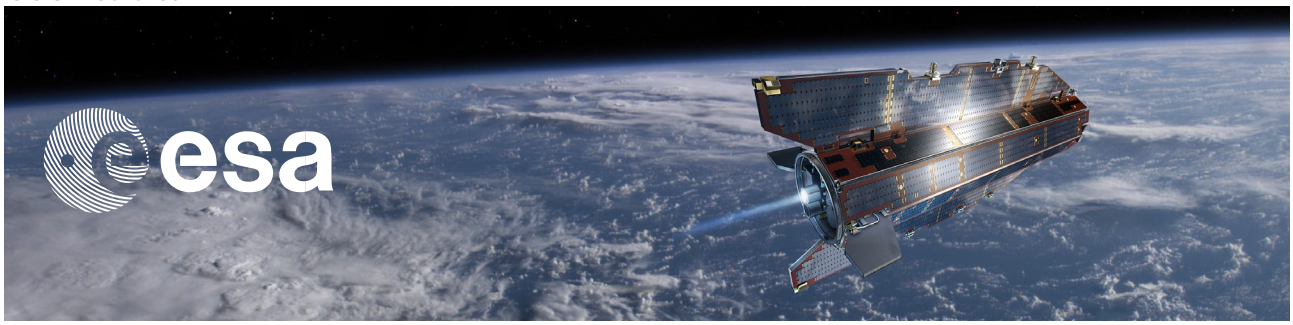

ESA's gravity mission GOCE

The GOCE (Gravity Field and steady-state Ocean Circulation Explorer) mission is dedicated to measuring Earth's gravity field and modelling the geoid (the surface of equal gravitational potential of a hypothetical ocean at rest) with unprecedented accuracy and spatial resolution. Data from this advanced gravity mission will improve our knowledge of ocean circulation, which plays a crucial role in energy exchanges around the globe, sea-level change and Earth-interior processes. GOCE will also help to make significant advances in geodesy and surveying.

Mission Objectives

– to determine gravity-field anomalies with an accuracy of 1 mGal (where 1 mGal = 10^{-5} ms^{-2}).
– to determine the geoid with an accuracy of 1-2 cm.
– to achieve the above at a spatial resolution better than 100 km.

Mission Details

Launch: 2008
Duration: about 20 months, including a 3-month commissioning and calibration phase, followed by science measurement phases adapted to a long-eclipse hibernation period.

Mission Orbit

Orbit: Sun-synchronous, near-circular, dawn-dusk, low-Earth.
Inclination: 96.7°
Measurement altitude: about 250 km
Hibernation altitude: above 270 km

Configuration

GOCE is a slim, octagonal spacecraft approximately 5 m long and 1 m in diameter weighing about 1050 kg. It is a rigid structure with no moving parts - the satellite, system of sensor and control elements form one 'gravity-measuring device'. The cross-section is minimised in the direction of flight to reduce drag. Tail fins act as passive stabilisers.

Payload

– gradiometer; 3 pairs of 3-axis, servo-controlled, capacitive accelerometers (each pair separated by about 0.5 m).
– 12-channel dual-frequency GPS receiver with geodetic quality.
– laser retroreflector enables tracking by ground-based lasers.

Satellite Attitude Control

– 3-axis stabilised
– drag-free and attitude-control system (DFACS) comprising:
  1. actuators – an ion thruster assembly (xenon fuel) and magnetotorquers.
  2. sensors – star trackers, a 3-axis magnetometer, a digital Sun sensor and a coarse Earth and Sun sensor.
– gradiometer

Budgets

Mass: about 1050 kg (including 40 kg xenon fuel).
Power: >1300 W end-of-life (solar-array output power) including a 78 Ah Li-ion battery for energy storage.
Telemetry and Telecommand: S-band (1.2 Mbit/s downlink; 4 kbit/s uplink).

Launch Vehicle

Rockot (converted SS-19), from Plesetsk, Russia.

Flight Operations & Data Products

– the GOCE mission primarily uses the ground station in Kiruna, Sweden to exchange commands and data with the ground. In addition, the mission also makes use of the ground station in Svalbard, Norway.
– the satellite is monitored and controlled by the Flight Operations Segment (FOS) at ESA-ESOC, Darmstadt, Germany via Kiruna.
– level-1b products are generated by the Payload Data Ground Segment (PDGS) at ESA-ESRIN, Frascati, Italy, which also receives the GOCE science data via FOS.
– level-2 products, including gravity-field models and precise GOCE orbits, are generated by the High-level Processing Facility (HPF), which is a European consortium of ten scientific institutes specifically aimed at the complex task of processing GOCE level-1b data.
– the final products are distributed to the global GOCE user community.

Satellite Contractors

Industrial Core Team:
– Thales Alenia Space (Italy) – satellite prime contractor
– EADS Astrium GmbH (Germany) – platform contractor
– Thales Alenia Space (France) – gradiometer
– ONERA (France) – accelerometers & system support
The Core Team leads a consortium of 41 companies distributed over 13 European countries.