CryoSat – ESA's Ice Mission

Earth Explorer series continued

CryoSat is one of ESA's Earth Explorer missions, which are developed in direct response to issues identified by the scientific community. They aim to improve our understanding of how the Earth system works and the impact human activity is having on natural Earth processes.

CryoSat will be the third Earth Explorer in orbit, following on from GOCE (launched in March 2009) and SMOS (launched in November 2009). CryoSat was originally set to be ESA's first Earth Explorer; however, the satellite was lost as a result of a failure in the timing of the launch sequence in October 2005. Just three and a half years after the decision to rebuild was taken, the CryoSat-2 satellite, which carries a number of design improvements, was ready for launch.

The importance of ice

Ice plays an important role regulating global climate:

- Because it is white, ice reflects a large proportion of incident solar radiation. If ice cover diminishes, less sunlight is reflected away from the surface and the atmosphere absorbs more heat. This leads to a positive feedback loop where the ice melts further and in turn reflects less and less sunlight.

- Sea ice insulates large areas of the ocean from warm air in the summer and prevents heat loss in the winter. It therefore plays an important role in energy exchange processes and sea-water temperature, which in turn affect ocean-circulation patterns and climate.

- The formation and melting of ice affect the salinity, and therefore density, of the surface waters of the ocean. Density plays an important role in ocean-circulation patterns such as the Gulf Stream. Diminishing Arctic sea-ice is likely to have an affect on this important current.

- Ice on land impacts sea level. A reduction in the polar ice sheets will lead to a rise in sea level.

To determine changes in land- and sea-ice thickness

CryoSat will deliver data to accurately determine the rate of change in the thickness of the polar ice sheets and floating sea-ice. CryoSat is capable of detecting changes as little as 1 cm per year.

Record lows in the extent of summer Arctic sea ice demonstrate that environmental changes are occurring in the polar regions. While ice extent is already mapped from space by satellites such as Envisat, to understand more about how climate change is affecting these sensitive regions, there is an urgent need to also determine how the thickness of the ice is changing.

Data from the CryoSat will lead to a better understanding of how the volume of ice on Earth is changing and in turn a better appreciation of how ice and climate are linked.

Innovative technology

CryoSat carries the first all-weather microwave radar altimeter optimised for determining changes in the elevation of both the floating sea-ice, which can be up to a couple of metres thick, as well as the polar ice sheets, which in Antarctica can be up to five kilometres thick. CryoSat's SAR Interferometric Radar Altimeter (SIRAL) exploits synthetic aperture processing to detect narrow leads between ice floes to act as a reference for the freeboard and its two radar antennas help to accurately measure the changes at the edges of land-ice fields.

Facts and figures

- Launch: 8 April 2010
- Launcher: Russian/Ukrainian Dnepr, based on SS-18 intercontinental ballistic missile
- Launch provider: International Space Company Kosmotras
- Launch site: Baikonur Cosmodrome, Kazakhstan
- Mission control: ESA's European Satellite Operations Centre (ESOC) in Darmstadt, Germany via ESA's ground station in Kiruna, Sweden
- Data processing: Science data download to Kiruna ground station. Data is distributed directly to the users from Kiruna. Distribution is managed by ESA-ESRIN in Frascati, Italy
- Orbit: Mean altitude of 717 km and 92° inclination; low-Earth, polar, non-Sun-synchronous
- Nominal life: 3 years (plus 6 months commissioning)
- Instruments: SAR Interferometric Radar Altimeter (SIRAL), supported by Doppler Orbit and Radio Positioning Integration by Satellite (DORIS) and Laser Retro-Reflector (LRR) for precision orbit determination
- Satellite mass: 720 kg at launch, including 37 kg of fuel
- Satellite dimensions: 4.6 × 2.4 × 2.2 m
- Power: 2 × GaAs body-mounted solar arrays each delivering 850 W, 78 AH Li-ion battery
- Satellite Prime Contractor: Astrium GmbH

For further information:
ESA Media Relations Office
Tel: +33 1 5369 7299
Fax: +33 1 5369 7690
E-mail: media@esa.int

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