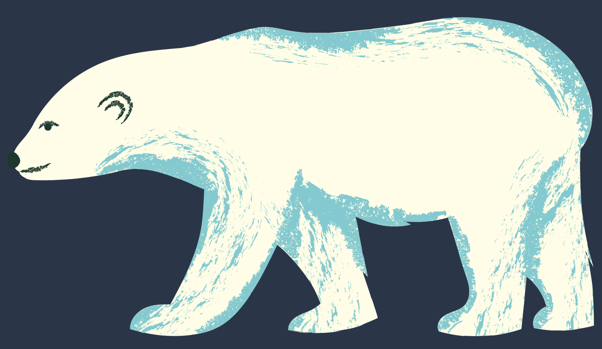
CRYOSAT-2



A MISSION FOR POLAR ICE MONITORING

TOPIC ID: 16

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SENSOR DESCRIPTION [1]

ESA's CryoSat mission is dedicated to **measuring and monitoring polar sea ice and ice sheets** covering Greenland and Antarctica. It is collecting ice volume and extent data to validate predictions of **ice melt driven by global warming**. CryoSat-2 was launched on the 8th April 2010 from Baikonur Cosmodrome in Kazakhstan.

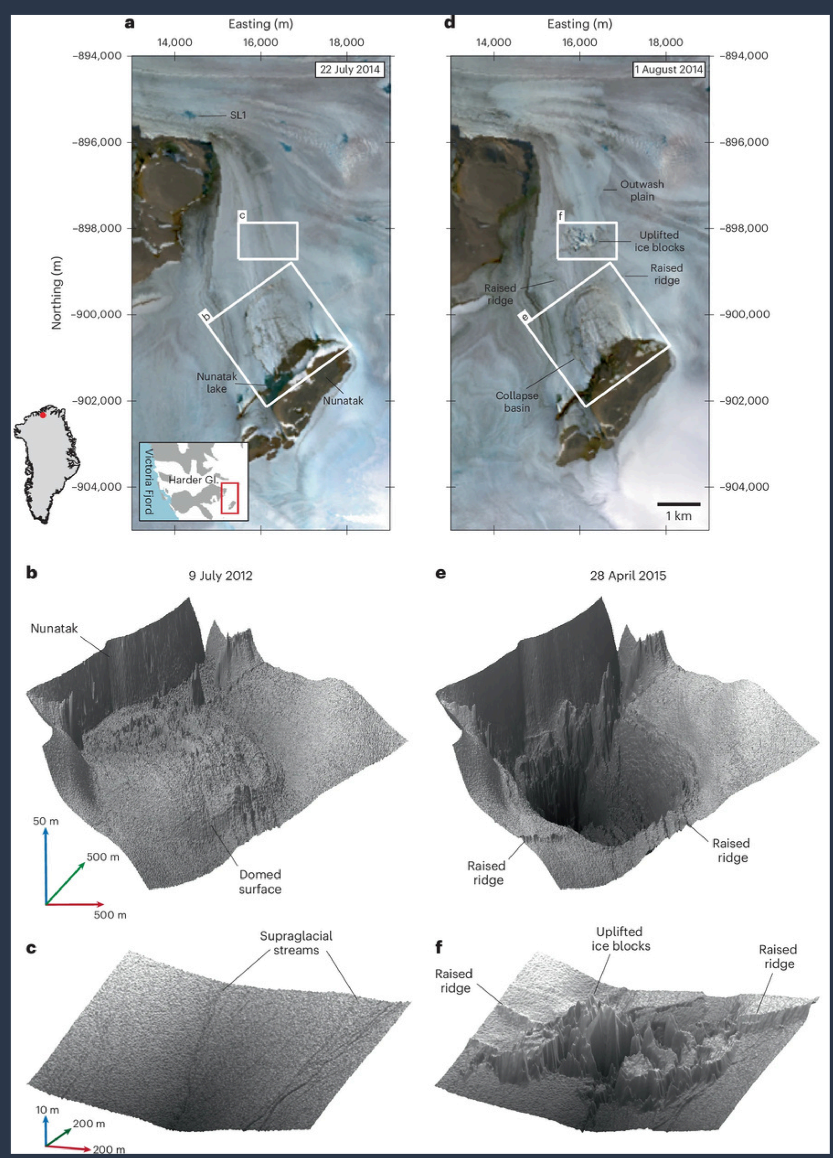
The satellite travels on a **low Earth, polar, non-Sun-synchronous orbit**, on a 92° inclination and a mean altitude of 719 km. Its measurement accuracy for ice thickness is 2 to 5 cm in Arctic Ocean and 2 mm in Antarctic Ocean.

CryoSat-2's instruments are a **Synthetic Aperture Interferometric Radar Altimeter** *(SIRAL)*, supported by a **Doppler Orbit and Radio Positioning Integration by Satellite** *(DORIS)*, which determines the satellite's orbital position, and a **Laser Retro-Reflector** *(LRR)* for precision orbit determination. An **S-band helix** antenna on the satellite's underside receives ground commands and downlinks status data. Beside it, an **X-band antenna** transmits the satellite's data when aligned with the Kiruna ground station in Sweden.

EXAMPLE [3]

Outburst of a subglacial flood from the surface of the Greenland Ice Sheet

A 2025 Nature Geoscience publication led by Jade Bowling et al. is one of the scientific reports of CryoSat. In their study, CryoSat data are used to observe the outburst of a related subglacial flood onto the surface of the Greenland Ice Sheet. By combining CryoSat's altimeter data with satellite observations and 3D models, the scientists mapped the aftermath of the flood, revealing previously unknown ice sheet hydrology processes crucial to future sea level rise predictions and evaluation of climate change effects on polar environments.



Observations of subglacial lake drainage and surface outburst.

APPLICATIONS [2]

Cryosat-2's mission is to monitor:

- **Dynamics and thickness** of the marine sea ice on polar ocean
- **Variation of the thickness** of the Antartica and Greenland ice sheets.
- **Sea level variations**

Its data helps track rates of **thinning, melting and volume change** in the polar ice caps, which is essential in the context of climate change.

WHY IT FITS APPLICATION [4]

- **SAR / SAR Interferometric** (SARIn) modes provide high spatial resolution and the ability to distinguish surfaces (ice, thin ice, open water) near ice sheet margins and sea-ice edges.
- **High-latitude coverage**
- **Continuous dataset** since ~2010 and further extend of this dataset expected in the future (monitoring of climate change)
- **Freeboard measurement** (ice elevation above sea level) → then ice thickness of floating sea ice can be deduced

CHALLENGES

- **Surface roughness** : rough ice surfaces scatter radar signals, making retracking more complex and potentially biased [5]
- **Snow cover effects** : snow depth and density alter radar penetration and signal timing. Converting freeboard to thickness requires snow/ice/water density assumptions, which introduce uncertainty [6]
- **Melt ponds in summer** : radar backscatter from melt ponds can resemble open water or slushy ice, making summer retrievals uncertain [4]

https://www.esa.int/Applications/Observing_the_Earth/FutureEO/CryoSat [1]
https://esamultimedia.esa.int/multimedia/publications/BR199_LR.pdf [2]
https://www.nature.com/articles/s41561-025-01746-9 [3]
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