

## Estimation of GOCE spacecraft reentry time

### 1. Introduction

The GOCE (Gravity field and steady-state Ocean Circulation Explorer) spacecraft (SC) was launched by the European Space Agency in 2009. The peculiarity of SC exploiting is application of laser measurements for high-accuracy determination of parameters of the orbit (by the International Laser Ranging Service). Spacecraft operation continued up to October 21, 2013, and terminated because of exhausting the fuel store.



ESA site <http://www.esa.int> (November 11, 2013)

Close to 01:00 CET on Monday 11 November, ESA's GOCE satellite reentered Earth's atmosphere on a descending orbit trajectory that extended across Siberia, the western Pacific Ocean, the eastern Indian Ocean and Antarctica. As expected, the satellite destroyed in the upper atmosphere and no damage to property has been reported.

Launched in March 2009, the Gravity field and steady-state Ocean Circulation Explorer – GOCE – has mapped variations in Earth's gravity with unrivalled precision. The result is the most accurate shape of the 'geoid' – a hypothetical global ocean at rest – ever produced, which is being used to understand ocean circulation, sea level, ice dynamics and Earth's interior.

GOCE's innovative ion engine, responsible for keeping the satellite at an incredibly low orbit of about 260 km, together with its accelerometer measurements, have also provided new insight into air density and wind speeds in the upper atmosphere.

On October 21, the mission came to a natural end when it ran out of fuel. Over the past three weeks the satellite has gradually descended.

While most of the 1100 kg satellite destroyed in the atmosphere, an estimated 25% reached Earth's surface. An international campaign involving the Inter-Agency Space Debris Coordination Committee and ESA's Space Debris Office have monitored the reentry.

A signal from GOCE was last acquired at **22:42 GMT** on Sunday as it passed 121km (75 miles) above **Antarctica**. Data from the United States Strategic Command (USSTRATCOM) indicated that reentry occurred a little over one orbit of the Earth later, with the spacecraft beginning to break up at 00:16 GMT on Monday at the altitude of about 80 km.

### Information in Twitter from **Bill Chater** @Cheds23 on November 11

We saw it burn up from the Falklands at about **9.20 pm** last night. Came from the South breaking up into bits. [pic.twitter.com/54DwAiTI0k](http://pic.twitter.com/54DwAiTI0k).

*Note.* Falkland currently UT -3h, so ~21:20 is ~00:20 UT.