The Entrepreneurial University.

Technische Universität München

News Release

Munich, 31 March 2011

Precise model of the global gravitational field from data gathered by ESA's GOCE satellite

Earth's gravity revealed in unprecedented detail

After just two years in orbit, ESA's GOCE satellite has gathered enough data to map Earth's gravity with unrivalled precision. In a project coordinated by researchers from Technische Universitaet Muenchen (TUM), scientists have now produced the most accurate model of the global gravitational field ever produced to further our understanding of how Earth works. It was unveiled today at the Fourth International GOCE User Workshop at TUM.

This model, known as the 'geoid', represents the surface of an imaginary global ocean dictated only by gravity in the absence of tides and currents. It is by no means the same everywhere. Places where the gravitational pull is weak are visualised as troughs, while areas where the force of gravity is strong appear as peaks.

The geoid provides oceanographers with essential reference data for their measurements: scientists can work out ocean circulation, for example, on the basis of differences between the idealised ocean – that which would be expected if it were shaped only by gravity – and the actual sea level. Given that ocean circulation, sea-level change and ice dynamics are all affected by climate change, knowledge of them is crucial for the study of the phenomenon.

Furthermore, the gravity data from GOCE are helping to develop a deeper knowledge of the processes that cause earthquakes, such as the event that recently devastated Japan. Because gravitation is directly correlated with the distribution of mass in the Earth's interior, the data can contribute to a better understanding of dynamics in Earth’s crust and of how earthquakes are formed.

Surveying should also profit enormously from the GOCE data. There are currently more than 20 different height systems based on different sea levels in Europe alone. In the future, it will be easy to compare the heights of the Earth's surface on different continents using the exact geoid reference planes. Through coordination with measurements from satellite navigation systems (such as GPS), it will be possible to make such data available with centimeter accuracy to every user. This will make it much simpler to plan the construction of roads, tunnels, and bridges.

Professor Reiner Rummel from Technische Universitaet Muenchen said, "We see a continuous stream of excellent GOCE gradiometry data coming in. With each new two-month cycle, our GOCE gravity field model is getting better and better.

Now the time has come to use GOCE data for science and applications. I am particularly excited about the first oceanographic results. They show that GOCE will give us dynamic topography and circulation patterns of the oceans in unprecedented quality and resolution. I am confident that these results will help improve our understanding of the dynamics of world oceans."

Technische Universitaet Muenchen Corporate Communications Center 80290 Muenchen www.tum.de

Dr. Ulrich Marsch	Head of Corporate Communications	+49.89.289.22779	marsch@zv.tum.de
Patrick Regan	International Public Relations	+49.89.289.22743	regan@zv.tum.de

TUM scientist Reiner Rummel is one of the initiators of GOCE and the Chairman of the European GOCE Gravity Consortium. This group of ten European institutes from seven countries analyses the data that the satellite sends back. It is coordinated by Professor Roland Pail's Institute for Astronomical and Physical Geodesy at Technische Universitaet Muenchen. The project is supported by the Institute for Advanced Study, an organisation which makes it possible for outstanding scientists to work on long-term research projects at TUM.

The GOCE (Gravity field and steady-state Ocean Circulation Explorer) satellite was launched in March 2009 and has now collected more than 12 months' worth of gravity data.

Volker Liebig, Director of ESA's Earth Observation Programmes said, "Benefiting from a period of exceptional low solar activity, GOCE has been able to stay in low orbit and achieve coverage six weeks ahead of schedule. This also means that we have enough fuel to continue measuring gravity until the end of 2012, thereby doubling the life of the mission and adding even more precision to the GOCE geoid."

GOCE has achieved many firsts in Earth observation. Its gradiometer – six highly sensitive accelerometers measuring gravity in 3D – is the first in space. It orbits at the lowest altitude of any observation satellite to gather the best data on Earth's gravity. The design of this sleek one-tonne satellite is unique. In addition, GOCE uses an innovative ion engine that generates tiny forces to compensate for any drag the satellite experiences as it orbits through the remnants of Earth's atmosphere.

Professor Liebig added, "You could say that, at its early conception, GOCE was more like science fiction. GOCE has now clearly demonstrated that it is a state-of-the-art mission." Rune Floberghagen, ESA's GOCE Mission Manager, noted, "This is a highly significant step for the mission. We now look forward to the coming months, when additional data will add to the accuracy of the GOCE geoid, further benefiting our data users."

Please direct any inquiries to:
Prof. Roland Pail
Technische Universitaet Muenchen
Institute for Astronomical and Physical Geodesy
Tel.: +49 89 289 23190
Fax: +49 89 289 23178
E-mail: pail@bv.tum.de

Download pictures and animation:
http://www.esa.int/SPECIALS/GOCE/SEM1AK6UPLG_1.html#subhead2

Video on GOCE:
http://www.youtube.com/user/TUMuenchen1#p/u/12/7sBaSJHSpww