GOCE

Gravity as a fundamental force of nature affects many dynamic processes on Earth, such as tectonics of the lithosphere causing earthquake and volcanic eruption, movement of polar ice-sheets, sea-level change and the transportation of water and heat through oceans. A detailed description of the gravity field of the Earth is necessary not only for determining its shape, expressed as the ‘geoid', but also for understanding geodynamic processes and arriving at better insight into the sources and effects of climate change.

On 28th June 1978, Seasat, the first satellite with onboard all-weather synthetic aperture radar (SAR) sensors, was launched to collect data on the dynamic processes of oceans. One result was an improved model of the Earth's gravity field and the geoid at a resolution of 500km. In March 2002, twin German-American GRACE (Gravity Recovery and Climate Experiment) satellites were launched to measure mutual distance differences due to variations in gravity, resulting in a model of the gravity field at 300km resolution. And since 17th March 2009, ESA's Gravity Field and Steady-state Ocean Circulation Explorer (GOCE) has aimed to map global variations in the gravity field with even greater detail and accuracy than ever before. Its most important instrument is the highly sensitive gradiometer which measures variations in gravity at different spots inside the satellite using three pairs of accelerometers.

To ensure that the forces measured originate within the gravity field and not in any other internal or external forces, such as friction in the uppermost part of the atmosphere, the satellite carries no moving components, while its shape has been aerodynamically designed and it is just 5m in length, with a cross-sectional diameter of 115cm. In contrast to other earth-observation satellites, GOCE brushes the top of the atmosphere. This is done intentionally; the further away from Earth, the weaker the gravitational forces and the less detail and accuracy in the measurements. Optimal orbit appears to be around 250km above Earth. Over its lifetime of about twenty months, GOCE will collect data from which the gravity field can be derived with an accuracy of 1mGal, that is one part per million, and the geoid with an accuracy of one to two centimetres, one billion part of the Earth's radius. This example of advanced space technology, introduced by a consortium of 41 companies from thirteen European countries, will not only support understanding of processes occurring inside the Earth and at its surface, but will benefit surveyors in their daily practice by providing them with the resulting enhanced geoid.