Copernicus services that will benefit from using gravity:

- Atmosphere Monitoring
- Marine Environment Monitoring
- Emergency Management
- Land Monitoring
- Climate Change

Partners

- German Aerospace Center (DLR), Germany
- Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Germany
- Centre National d'Études Spatiales, France
- University of Bern, Switzerland
- Graz University of Technology, Austria
- Leibniz Universität Hannover, Germany
- HafenCity University Hamburg, Germany
- Université du Luxembourg, Luxembourg
- Géode & Cie, France

Enhancing Europe´s Space Leadership

Satellite Gravimetry - Copernicus meets Newton

Advancing Copernicus services

Environmental information is nowadays of crucial importance. **Observations of mass redistributions constitute a new and unique remote sensing opportunity but are not yet part of the inventory of Copernicus data products**. The European Commission recognized its importance by funding the Horizon2020 project EGSIEM which is taking important steps to convert the raw data into operational products. Satellite gravimetry is thus ready to be a viable component of a modern and efficient Copernicus multi-sensor Earth observing system.

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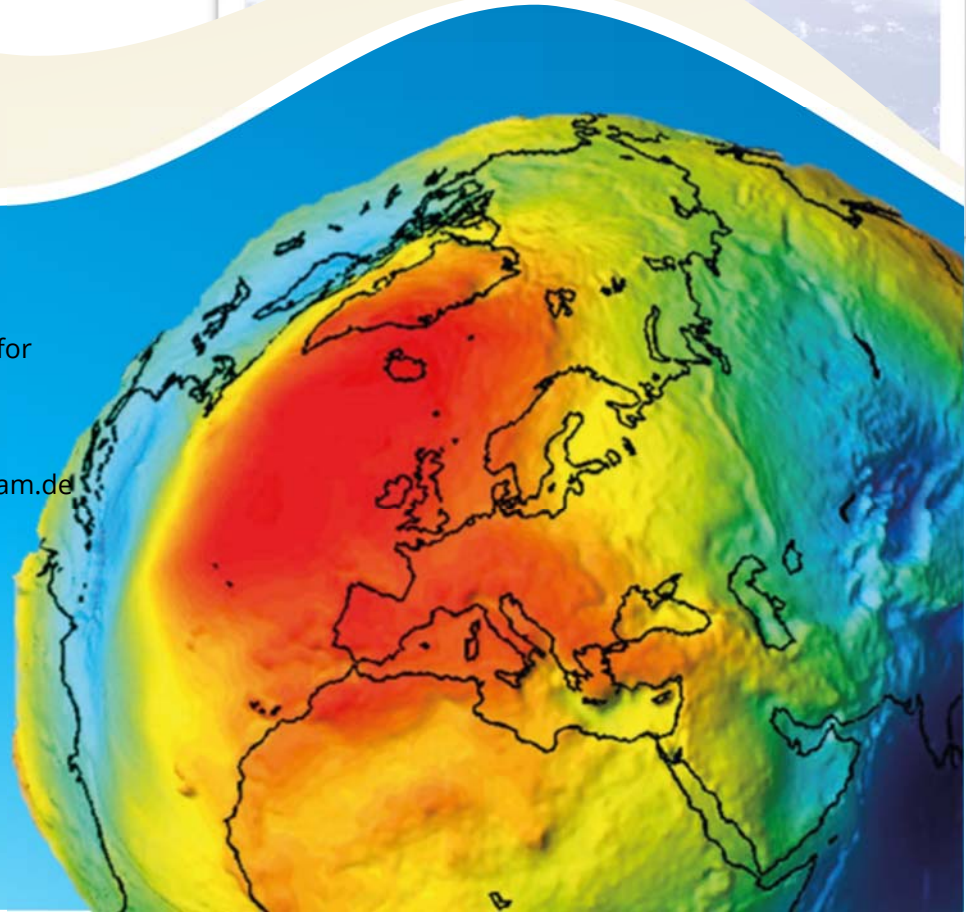


GRACE and its successors are the only satellite missions capable of observing the total water storage variations in the Earth system.

From Newton to Water Resources

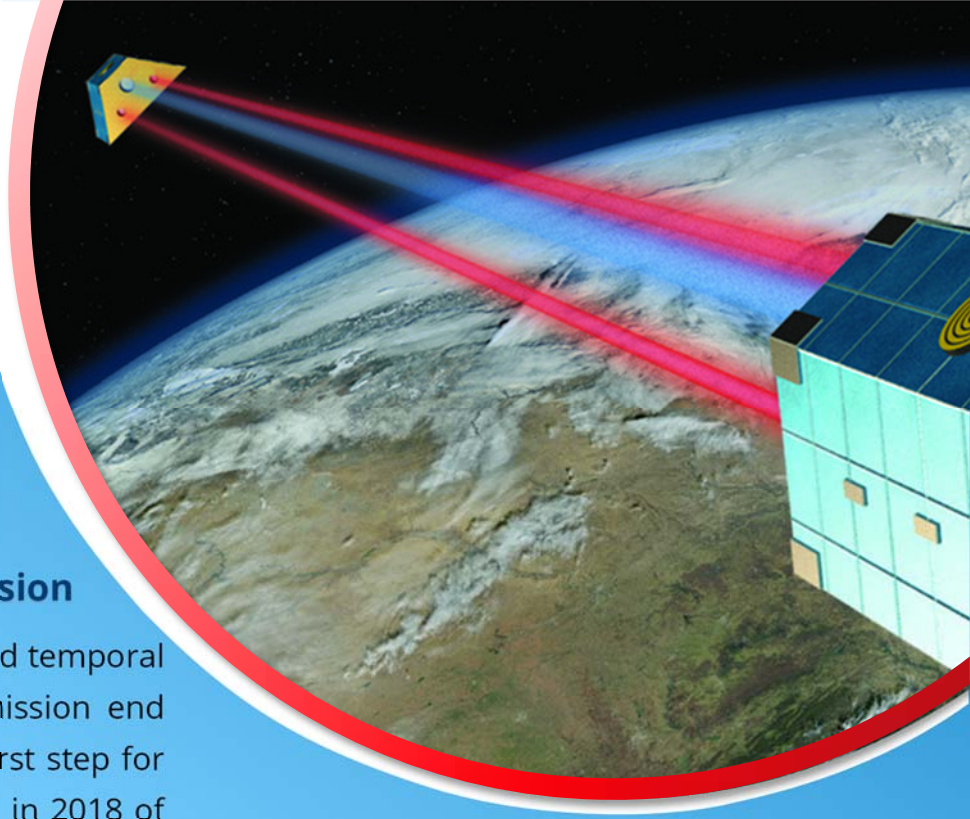
About one-tenth the width of a human hair - with such precision miniscule changes in the distance between two linked satellites can be measured. Regions of slightly stronger gravity (= more mass, e.g. due to more water) affect the distance between the two satellites. Although tiny, these variations contain information of the utmost importance about our planet.

Sir Issac Newton (1643-1727) described the first basic principles of attracting masses. **The US-German satellite mission GRACE (=Gravity Recovery And Climate Experiment) uses these principles to derive the mass distribution of the Earth and more importantly its changes. Changing mass distribution is a measure of water transport within the Earth system reflecting ice melt, water consumption, flooding and drought among others.** It helps to distinguish human-made impacts from natural fluctuations in the water cycle for better resource management and a climate resilient future.

Laser-interferometric Ranging: Ultra-level Precision

GRACE is limited in its spatial and temporal resolution and will reach its mission end after 15 years by mid 2017. A first step for improvement will be the launch in 2018 of the GRACE Follow-On mission with its innovative Laser Ranging Interferometer (LRI) **.**

Similar to any other laser distance measurement systems, laser ranging can be used in space with tremendously high precision. **This next generation system of inter-satellite ranging observes changes in the distance between two satellites with precisions down to a few tenths of a nanometer - about the size of modern chip conductor paths - precise and sensitive enough to detect even tinier variations in the gravity field of the Earth due to changes in the water cycle.**



The Future: Constellation Concepts

International experts from science and stakeholders recognized the uniqueness and benefit of observing gravity changes. But they all demand a higher spatial and temporal resolution to allow for regional and near real-time applications, as well as for long and consistent time-series.

The key is Next Generation Gravity Missions (NGGM) with the LRI on-board but flying in constellations of satellites. The necessary technology is already available, making NGGMs viable candidates for a future Sentinel mission.