

Germany

Federal Agency for Cartography and Geodesy

Keeping an eye on Germany's water resources with a high-precision network of sensors

"In the last 20 years, the water balance in Germany has not always been easy. Droughts like those in 2003 and 2018 not only caused problems for the groundwater level, but also for natural water storage as a whole. The lack of availability of the elementary resource water not only leads to considerable damage to nature and its ecosystems, but also has a significant impact on agriculture, forestry and other sectors. A large part of the reservoir for the vital element of water is located below the Earth's surface and cannot be seen with the naked eye. In combination with satellite data and hydrological models, the extended gravimeter network in Germany will help to make reliable statements even about regional changes in water resources."

Professor Paul Becker
President, Federal Agency for
Cartography and Geodesy

High-precision instruments for measuring changes in gravity are being used alongside satellite data and hydrological models to monitor Germany's water resources.

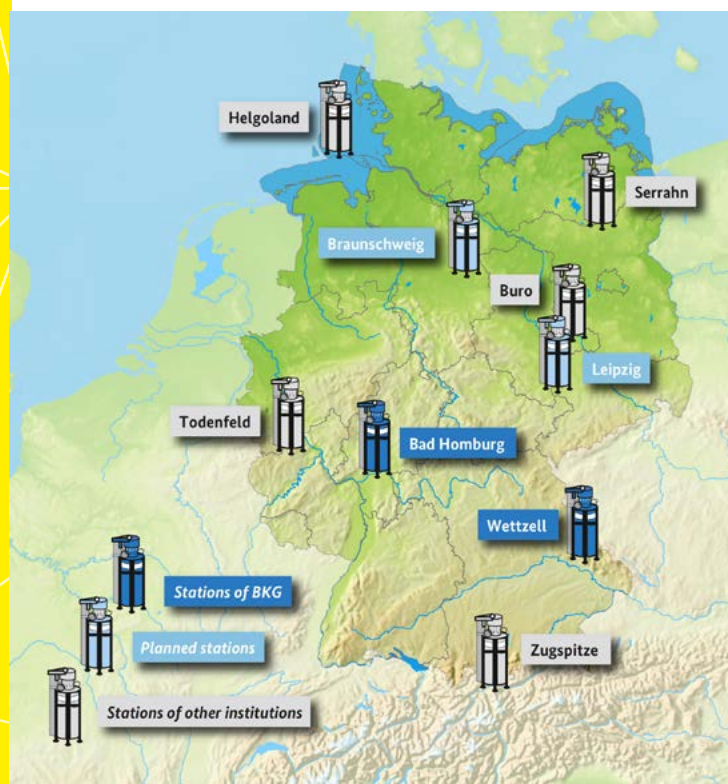
The Federal Agency for Cartography and Geodesy (BKG), together with partner institutions such as the GFZ Helmholtz Centre for Geosciences, is implementing a network of high-precision superconducting gravimeters. These measure the acceleration of gravity and its changes over time, that are influenced by terrestrial water storage changes, like groundwater or soil moisture.

For more than two decades, these small changes have been successfully monitored from space by the satellite missions of the Gravity Recovery and Climate Experiment (GRACE). The new network, which comprises the most stable and precise terrestrial gravity sensors, complements the data of large-scale features provided by GRACE with locally sensed and temporal highly resolved measurements.

Regional hydrological models that describe the water flux on the Earth's surface and into the ground are validated by comparing simulated and measured gravity variations. This bridges the gap in resolution between local terrestrial and global space-based gravity signals.

BKG's existing gravimeter stations in Wettzell and Bad Homburg, as well as those of GFZ in Helgoland, Mount Zugspitze, and Northern Germany, are being extended to build the permanent gravimeter observation network. The first steps have already been achieved with a new site in Leipzig-Holzhausen set up by BKG in partnership with Germany's National Weather Service. In addition, a new field installation by GFZ next to the Middle Elbe is also close to operation.

The gravimeter network in Germany



Superconducting gravimeter GWR OSG



Benefits

- Provides - based on terrestrial measurements - independent validation of variations in total water storage monitored using satellite data (GRACE).
- Enables detailed conclusions on water storage changes to be derived using a combination of high-precision gravimeters, regional hydrological models and satellite data.
- Uses the latest technology to record hydrological signals for the localisation of changes in water supplies.
- Applies the latest research findings to take a closer look at the changes in water storage.
- Demonstrates how BKG and its partner institutions are pooling resources to establish a gravimeter network for Germany that it could not have maintained alone.
- Delivers relevant and knowledge-based information about the changes in water storage for decision-makers and the public.