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Flood monitoring and early-warning with satellite gravimetry

The wetness conditions of a river basin, besides rainfall characteristics, are important factors for the amount of runoff that is generated, eventually leading to a flood event. Satellite gravimetry with GRACE and its successor mission GRACE Follow-On (GRACE-FO) allows for retrieving terrestrial water storage (TWS) anomalies by measuring temporal variations of the Earth's gravity field. This opens the possibility of estimating the wetness conditions before and during flood events. However, its use in flood monitoring and flood warning applications so far has largely been limited by the insufficient temporal and spatial resolution. The goal of this project in collaboration with ETH Zürich and the University of Bern and Braunschweig is to improve the monitoring and forecasting of flood events by using TWS anomalies derived from GRACE/GRACE-FO with daily resolution and spatially downscaled to a resolution of 50 km globally.

This study will explore if and up to which regional scales (< 100,000 km²) the high-resolution GRACE-based TWS anomalies can provide useful information for flood monitoring and flood forecasting. To this end, information on flood events on a global scale since 2002 gathered in the Dartmouth Flood Observatory (DFO) and from other sources, and hydro-meteorological data that may be explanatory factors for the generation of flood events besides TWS will be collected, such as river discharge, precipitation, snow or soil moisture. It will be assessed on the global scale whether during the flood events exceptionally high TWS can be observed, and which types of floods and for which hydro-climatological regions the GRACE/-FO-based data are particularly useful. For early-warning purposes, a gravity-based wetness index as an indicator of flood potential will be developed and evaluated at the global scale. In collaboration with the project partners, the index will also be incorporated and assessed in a machine-learning-based flood forecasting approach and in an operational flood modelling system for small river basins in Lower Saxony, Germany.

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