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Spaceborne gravimetry: a novel tool for continental-scale storage change monitoring

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In recent years several spaceborne geodetic sensors, designed for altogether different purposes, have established themselves as valuable hydrological monitoring tools. Radar satellite altimetry, originally aiming at oceanography and geodesy, has demonstrated its potential to act as virtual lake and river gauges. Future altimetry technology will be able to overcome the current limitations of spatial and temporal resolution. The ubiquity of Global Navigation Satellite Systems (GNSS) also provides a wealth of information on several components of the hydrological cycle. GNSS-based atmospheric sounding operationally monitors tropospheric water vapour content; GNSS-network deformation reflects amongst others hydrological loading effects; and GNSS-reflectometry aims to measure both water-level heights and soil moisture.

The satellite mission GRACE has established a fundamentally new remote sensing tool for hydrological applications. Measuring changes in the Earth's gravitational field from space, it is able to monitor mass changes, due to the global hydrological cycle. Although the spatial resolution may not be satisfactory for such purposes yet, the mission strongly constrains the hydrological cycle at continental scales. The current success has set in motion a number of proposals and ideas for future missions.

This contribution discusses the strengths and weaknesses of the various geodetic sensors for hydrological purposes in terms of spatial resolution, time resolution and accuracy. Also the distinction between geometric observables (height, volume) as opposed to gravitational observables (mass) is underlined. In particular the exciting utility of future spaceborne gravimeters is discussed. Current developments are rapid, though. Thus, a 30-year visionary horizon for future developments and applications is challenging, but intriguing.