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Monitoring and quantifying water storage variations using sensitive ground surface gravimeters

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In this work, we explore to the possibility of accurate ground surface gravity measurements as a means to quantify and monitor local water storage changes. Surface gravity measurements directly reflect the integrated amount of water masses at plot scales (several hundred meters), and so could provide additional information for a better understanding of hydrological processes. A superconducting gravimeter, located on the summit of a hill near Strasbourg (Eastern France), has been equipped with two multi-depth frequency domain reflectometer (FDR) probes. These probes have been monitoring variations of the water content of the soil column, since August 2006. The geometry of the land surface element has also been detailed: a 10cm-resolution local digital elevation model (DEM) has been established using differential GPS. The geometry and heterogeneity of the soil layer have been evaluated using geophysical and geomechanical methods. This collective information enables setting up the hydrological model CaB to calculate water budget and thus evaluate real evapotranspiration and lateral subsurface water fluxes at the scale of the hill. Results show that modelled short term fluctuations of stored water are in good agreement with gravimeter data. For long term variations, other processes could hide the local hydrological contribution. Finally, the modeled hydrological contribution in Strasbourg will enable us to evaluate the utility of more portable but less sensitive instruments, i.e. spring and absolute gravimeters.