How absolute gravimetric measurements and magnetic resonance soundings surveys help to constrain water storage variability: the case of a semiarid, endoreic catchment in Sahelian Southwest Niger

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Advances in methods of observation are essential to ensure a better understanding of the evolution of water resources considering climate changes and human activities. The GHYRAF (Gravity and Hydrology in Africa) project aims to combine geodetic and gravimetric measurements with dense hydrological surveys to better characterize the annual water storage variability in tropical West Africa. In Southwest Niger periodic absolute gravimetric measurements are performed near a temporary pond where rapid infiltration to the unconfined aquifer occurs. In parallel, pond water level, piezometry, and soil water content are regularly measured. As gravity is sensitive both to local and global variations of water mass distribution, the large scale contribution is first removed using either GRACE satellite data or global hydrology models like GLDAS or ECMWF.

The comparison of local water storage variations estimated by gravimetric and hydrological in-situ measurements allows estimating the specific yield of the aquifer to a value ranging between 5 and 7 %. This value is consistent with the 5 to 13 % porosity estimated by Magnetic Resonance Sounding survey. The good agreement between these two independent methods proves the interest in using gravimetric measurements to constrain parameterization of local hydrological modeling. Additional measurements with relative spring gravimeters are scheduled to better characterize spatial heterogeneity in water storage variability.