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Rainfall, evapotranspiration and water storage changes effects on gravity. The case of the superconducting gravimeter in Djougou, Benin,West Africa

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We show the advantages of continuous gravity monitoring for analyzing different processes in the water cycle involved at various time scales. The rapid time scale in the gravity changes (a few hours) involves different contributions: rainfall itself, runoff, screening effect of the gravimeter building and local topography. We present the statistical results of a set of rain events recorded with a superconducting gravimeter (SG) installed since July 2010 in Djougou, northern Benin, within the framework of the GHYRAF (Gravity and Hydrology in Africa) project. The intermediate time scale of gravity changes (a few days) is caused by evapotranspiration and both vertical and horizontal water redistribution. The integrative nature of gravity measurements does not allow to separate these different contributions. However, rates derived from gravity variations are within the range of known values of evapotranspiration, close to the potential evapotranspiration during the wet season of the west-African monsoon. We finally investigate gravity changes at the seasonal time scale caused by water storage changes. We show the rather good agreement between the SG monitoring, repeated absolute gravity (AG) measurements and water storage changes estimated from hydrological monitoring (neutron probe and water table).