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Lysimeter vs. superconducting gravimeter: Measuring the influence of local water storage changes on temporal gravity observations.

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Temporal gravimeter observations, which are used in geodesy and geophysics to study changes in the Earth's gravity field like tidal or mass transfer effects, are influenced by local water storage change (WSC). This study presents the first comparison of lysimeter measurements with temporal gravimeter observations made by a superconducting gravimeter (SG). Lysimeter measurements in combination with complementary hydrological observations and a rigid hydrological 1D model give the unique opportunity to estimate WSC from the snow down to the groundwater at the field scale. At the Geodetic Observatory Wettzell (Germany), water storage changes in the snow pack, top soil, unsaturated saprolite and fractured aquifer are all important terms for the local water budget. The hydrological influence on SG measurements is estimated by calculating the gravity response of local WSC. We find a high correlation of local WSC and SG residuals on the event and seasonal scale. Lysimeter measurements significantly improve the estimation of WSC on the field scale and consequently provide a better reduction of local hydrological influence on temporal gravimeter measurements. Hence, at temporal gravity observation sites a lysimeter installation is recommended in case that the gravity signal should be reduced from local WSC.