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Application of hydrological models to detect hydrological effects on gravity variation

S. Hasan (1), J. Boll (2), P.A. Troch (1) and C. Kroner (3)

(1) Hydrology and Quantitative Water Management, Wageningen University, The Netherlands (shaakeel.hasan@wur.nl), (2) Department of Biological and Agricultural Engineering, University of Idaho, USA, (3) Institute of GeoSciences, Friedrich-Schiller-University, Jena, Germany

A superconducting gravimeter observes the temporal variations in the Earth's gravity field near Moxa, Germany since 1999. Earth tides, polar motion and barometric pressure variations are some of the well-known and quantified causes for temporal variation of gravity, while the variations caused by hydrological processes (interception, infiltration, surface runoff and subsurface redistribution) are still less known.

In a previous study (Hasan et al., J. Hydrometeorol., accepted) we applied time series analysis and distributed hydrological modeling techniques to understand the effect of the hydrological processes on observed gravity residuals. In this study we extend the distributed soil moisture routing model by accounting for the saturated water storage using hillslope-storage Boussinesq model. The distributed model provides storage change in soil moisture, snow and vegetation, and the hillslope-storage Boussinesq model provides change in saturated water storage to model temporal gravity variation.

To further explore the spatio-temporal dynamics of the relevant hydrological processes and their relation to observed gravity residuals we analyze different water storage components and their effects on gravity in different time scales.