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Assimilation of Gravity Data into a Soil Moisture and Groundwater Column Model

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Gravity has the potential to become a new source of important remote sensing data for catchment-scale hydrological modelling. Monitoring changes in the Earths gravity field through time is expected to give information on the change in terrestrial water storage (soil moisture, groundwater, etc.) over that time period. However, the usefulness of this data has not yet been demonstrated. Specifically, the ability to accurately disaggregate the vertical (and spatial) distribution of terrestrial water storage change information contained in gravity measurements at the soil surface has not been explored.

Through a series of synthetic twin studies, we demonstrate the potential for gravity data to constrain a land surface model through data assimilation, and thus yield more accurate predictions of soil moisture profile distribution for a single point. This pilot study uses a simple soil column model that describes the temporal variation of soil moisture (in three layers: near-surface, root zone and vadose zone) and groundwater for a single point in the landscape. The study demonstrates the ability of data assimilation to retrieve the correct vertical distribution of water content in a soil profile. Additionally the accuracy requirement for gravity observations is assessed.

Keywords: Data assimilation; gravity; soil moisture; groundwater; one dimensional; synthetic study.