From in-situ gravitation to water storage. A case study: Westerbork, the Netherlands

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Hydrological models are generally calibrated on discharge data alone, since direct observation of other integrated stocks and fluxes are often lacking. Although, these models can have a good performance, they may not do so for the right reasons, meaning that other processes of the water balance are not being modeled correctly. Gravity observations may form an additional source of information that we can use to constrain hydrological models. Water stored, through its mass, influences the gravity field. By measuring the gravity field, it should be possible to obtain information on the water stored in different compartments of a catchment.

Recently, much research has been initiated on using gravity information for hydrological modeling. An example is the satellite mission GRACE (Gravity Recovery and Climate Experiment). However, uncertainty of GRACE data is still large, particularly at the smaller scales.

In Westerbork, at the location of the Radio Observatory, in the north-east of the Netherlands changes in gravity are measured with in situ gravitation equipment. Furthermore, rainfall, forest floor interception, soil moisture, and ground water are directly observed. After correcting the gravity data for several processes, like air pressure, ocean and earth tides, a fluctuating signal remains. We show that the fluctuations can be related to the hydrological processes of surface and subsurface storage.