



## **Repairing filtering induced damage to the GRACE time-series at catchment scale**

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The gravity field products from Gravity Recovery And Climate Experiment (GRACE) satellites are usable only after filtering. Filtering suppresses noise, but also changes the signal. There are methods to minimize the signal change, and most of them depend on a hydrological model to compute leakage, scale factor or bias for improving the time-series signal. Using a model to suppress the uncertainty introduced by filtering is not without problems of its own, because it brings in the uncertainty in the model, that varies spatially and temporally. We provide a mathematical relation between leakage, true signal and filtered signal. We find that not only the amplitude but also the phase of the total water storage time-series is affected due to filtering. For certain catchments the phase change can be equivalent to a shift of half a month or nearly a month. We propose a data driven approach to negate the effects of filtering on catchment scale signal. We demonstrate our method in a closed loop simulation environment and compare it to other widely used approaches for 24 catchments. The method proposed is independent of the filter type and works exceptionally well for catchments above the filter resolution. We apply our approach to GRACE products and discuss its limitations.