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Does GRACE see the water cycle 'intensifying'?

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Several researchers have postulated that, under a changing climate due to anthropogenic forcing, an intensification of the water cycle is already under way (Huntington, 2006). This is usually related to increases in hydrological fluxes such as precipitation (P), evapotranspiration (E), and river discharge (R). It is under debate, however, whether such observed or reconstructed flux changes are real and on what scales. Large-scale increase or decrease of the flux deficit (P-E) would lead to acceleration or deceleration of water storage anomalies possibly visible in GRACE time series, when discharge variability is small or properly accounted for.

We investigate to what extent such accelerations, which are indeed found in maps of global gridded GRACE water storage anomalies, can be explained using output fields derived from global and regional atmospheric (re-)analyses and from hydrological models.

We find this analysis challenging, since the GRACE time series is short and dominated by ENSO-type natural variability. Observed accelerations strongly depend on the analysis time frame, and may be explained to a large percentage by natural variability, thus masking a possible anthropogenically driven intensification of the terrestrial water cycle. This motivates us to apply statistical decomposition techniques in order to identify modes of natural variabilities and to remove them from the GRACE time series prior to the estimation of accelerations.

Huntington T.G. (2006): Evidence for intensification of the global water cycle: Review and synthesis. J. Hydrology, 319:83-95