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Estimation of mass loss due to soil erosion in the Loess Plateau in China: A comparison of the erosion model RUSLE, multi-temporal DEMs and GRACE satellite gravimetry.

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A comparison of the erosion model RUSLE, multi-temporal DEMs and GRACE
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The ongoing redistribution of masses on Earth is driven by various factors. The time-variable mass distribution maps into the observations of the gravity field satellite mission GRACE (Gravity Recovery and Climate Experiment). Since its launch in 2002, GRACE is providing a unique data source for the quantification of spatio-temporal variations of mass on global scale.

After the reduction of atmospheric signals in the course of the GRACE data processing observed mass changes over the continents primarily reflect hydrological mass redistributions. They are caused by effects like water level changes, glacier melting or river runoff. Minor effects arise from non-hydrological mass changes like forest fires or soil erosion. In this paper we focus on the latter and study possible contributions of soil erosion to the signals observed by GRACE. An ideal test side for soil erosion is the Loess Plateau in China which is characterised by a huge amount of soil erosion. Its spatial extent is approximately 580.000 km2 which is clearly resolvable by GRACE.

In the first step of our study we determine the mass change of the eroded soil on various temporal scales from different data sources: One method is to estimate the soil loss by subtracting two multi-temporal DEMs (digital elevation model) from each other. The volume change will be correlated with soil data and results in a proxy of the corresponding mass change. A second, more sophisticated approach is the erosion model RUSLE (Revised Universal Soil Loss Equation). It is constrained by different input data such as rainfall (R), soil erodibility (K), slope length and steepness (LS), cropping and management system (C) as well as erosion control practices (P). The used data is a combination of in-situ data (R, C, P), maps (K), remote sensing data (C) and a DEM (LS). The result of the RUSLE model is the annual soil loss (A) expressed in tons per km2. The results of both approaches will be compared to each other and also be contrasted to sediment data of rivers in the Loess Plateau.

In the second step of our study we investigate if these modelled variations are strong enough to be identified in the observations of GRACE. For the analysis of the GRACE data we apply different algorithms based on global and regional mathematical base functions. Hydrological mass variations are reduced from the observations on the basis of the atmospheric-terrestrial water balance within the catchment of the Yellow River. A discussion on the detectability of signatures of soil erosion in the residual GRACE signal concludes the contribution.