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Modelling gully erosion rates across Africa: towards a data-driven and process-oriented model

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In many regions of the world, gully erosion is a dominant land degradation process, threatening available soil and water resources. Understanding and quantifying gully erosion rates and their contribution to catchment sediment yields is not only of fundamental scientific importance, but also necessary for the development of strategies that allow to prevent and mitigate the many negative impacts of gully erosion.
Nonetheless, our ability to simulate and predict this process remains currently very limited, especially at the continental scale. We aim to bridge this gap by developing a first spatially explicit and process-oriented model that simulates average gully erosion rates at the continental scale of Africa, building on recently obtained insights, model concepts and databases.
In a first phase, a model will be developed that can simulate the density of gully heads across Africa using a recently constructed database of mapped gully heads. The database currently consists of 44 000 gully heads in 1680 sites across Africa. The exact location of all gully heads was manually mapped by trained experts, using high resolution aerial photos available in Google Earth. On 48% of these mapped sites, at least 1 gully was detected. Observed gully densities ranged between 0 and 1530 gully heads per km^2 with an average of 22 gully heads per km^2.
Based on this database, a first regression model predicting the amount of gully heads per km^2 already showed promising results. It simulates ~57% of the observed variation in continental gully density, based on topography, rainfall and vegetation cover. By means of these results, we present a first gully density map of Africa. We are currently working on an improved version of this regression model, following a more process-oriented approach that takes into account the threshold dependent character of the gully initiation process.
In a next phase, this gully density model will be coupled to a recently proposed model simulating the expansion rate of individual gully heads. The integration of these two models will result in the very first assessment of gully erosion rates at a continental scale (at decadal timescales).