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First gully probability map for Africa at 30m resolution

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Gully erosion is an important process of land degradation that threatens soil and water resources worldwide. However, our ability to simulate and predict this process is still very limited, especially on the continental scale. Nevertheless, such models are essential for the development of appropriate land management strategies, but also to better quantify the role of gully erosion in sediment budgets. One of the main challenges is that patterns of gully erosion depend on regional patterns of controlling factors (e.g., rainfall, lithology, soils), but are also strongly determined by local factors (e.g., topography, vegetation cover, land management). This greatly increases the complexity of potential models and their data requirements. We seek to bridge this gap by developing a robust empirical model capable of predicting gully erosion at high resolution on the scale of Africa with feasible data requirements.

More precisely, we are developing a logistic probability model at 30m resolution for the entire African continent that predicts the likelihood of gully head occurrence by using GIS and spatial data sources that are available on the continental scale. Although empirical in nature, the factors included in this model are consistent with the current process understanding of gully erosion. To calibrate and validate this model, we make use of an extensive database of 44 000 gully heads mapped over 1680 sites, randomly distributed across Africa. The exact location of all gully heads was manually mapped by trained experts, using high resolution optical imagery available in Google Earth. This allows to extract very detailed information at the level of the gully head, such as the local slope and the area draining to the gully.

Our first analyses show that gully occurrences mainly depend on topography (slope and to some extent contributing area), soil characteristics (i.e., mainly silt fraction) and vegetation cover. Combined, these factors already allow for robust and fairly reliable predictions of gully head occurrences (with AUCs of the logistic regression model around 0.7). Better incorporating the role of rainfall and climate will likely result in better predictions which is ongoing work.

Based on these results we present a first gully probability map for Africa at 30m resolution.

Besides providing essential information on gully density hotspots, this offers great potential to couple our gully density model to a gully retreat rate model and to make a first assessment of gully erosion rates at the continental scale of Africa.