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Exploring historical gully dynamics in an agricultural setting in Mediterranean climate

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Gully erosion is a significant degradation process affecting land (on-site effects) and water resources (off-site effects) in regions exhibiting a Mediterranean climate. Climate change projections suggest lower mean annual rainfall and higher intensity rainfall events, which could amplify gully erosion processes during the 21st century. Analysing gully erosion over extended periods is essential to understanding better and predicting future gully perturbations and degradation. However, few studies monitor gully evolution on such temporal scales. We analyse long-term (1938-2023) gully morpho-dynamics in a Mediterranean catchment to estimate the impact of climate and land use drivers thereon.

The Sandspruit catchment in the Western Cape of South Africa exhibits a distinct Mediterranean climate. Natural vegetation is sparse, interspersed only between extensive agricultural fields mainly used for dryland agriculture. Four gully networks were analysed using aerial imagery and climate data. Gully changes and land use activities were mapped from the sequential aerial imagery. Climatic variability during the study period was assessed in terms of mean annual rainfall, rainfall intensity derivatives, and the El Niño–Southern Oscillation cycles (ENSO) to identify significant trends and association with gully evolution.

Preliminary results show that human activity is the primary influence on gully evolution. Agricultural intensification increased erosion up to 1938, whereafter mitigation efforts reduced gully sizes up to five times in 29 years. In subsequent years, contraction and expansion were observed. However, contemporary gully erosion since 1999 shows active growth. The increase in activity could be due to a reduction in the efficiency of the ageing mitigation measures but may also be caused by a changing climate. Rainy Day Normal, a rainfall intensity proxy based on mean annual rainfall, shows no distinct trend. However, ENSO cycles coupled with the timing of high-intensity events may play a critical role.