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In-filled reservoirs serving as sediment archives to analyse soil organic carbon erosion – A case study from the Karoo rangelands

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Covering about 41 % of the Earth's Land Surface drylands provide a range of ecosystem services for more than one third of the world population. Threatened by climate change and incorrect land use their natural land cover is changing and land degradation is one of their major problems.

The semi-arid rangelands of the Great Karoo region in South Africa are just one example of a region that has experienced a number of environmental changes. After European farmers settled in the late 18th century agricultural activities increased, leading to overgrazing and probably representing a trigger to land degradation. As a consequence of a higher water demand and shifting rainfall patterns many dams and small reservoirs have been constructed to provide drinking water for cattle or to facilitate irrigation during dry periods. High erosion rates lead to a fast filling-up of reservoirs and thereby reduced their storage capacities. Thus, most of the dams are nowadays dry (filled with sediment) or even breached.

In this ongoing project, a combination of analytical methods that include drone imagery, landscape mapping, erosion modelling and sediment analysis have been employed to determine whether land degradation in the Karoo has resulted in the reversion from a net sink of C to a net source of C. Sediment deposits from three silted-up reservoirs were analysed for varying physicochemical parameters, in order to analyse and reconstruct erosional and depositional patterns. A sharp decrease in total carbon content with decreasing depth for two reservoirs suggests that land degradation during and after the post-European settlement most likely triggered erosion of the relatively fertile surface soils, which presumably in-filled the reservoirs. It is assumed that the carbon-rich bottom layers of the dam deposits originate from these eroded surface soils. Low organic Carbon (OC) content in the top layers of the reservoir in-fill, and in the eroded source areas, supports the assumption that the eroded material was transported from the degraded areas down into the reservoir, where it settled. This raises a crucial question of whether the decline of C sinks in degraded rangelands due to exacerbated soil erosion may have had a greater attenuating effect on GHG emissions than modelled scenarios of present emissions suggest. The slight decrease of TOC with increasing depth for the third reservoir might imply differences in geochemical cycling between dried out dams and reservoirs with continuous throughflow.