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Carbon Erosion in the Great Karoo Region of South Africa

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Work undertaken in the seasonally arid upland areas of the Great Karoo region of South Africa has established a link between land degradation and overgrazing which began in the second half of the 18th century when European farmers first settled the area. Ongoing land use change and shifting rainfall patterns resulted in the development of badlands on foot slopes of upland areas, and gully systems on valley bottoms. As a consequence of agricultural intensification and overgrazing, accompanied by a higher water demand, many small reservoirs were constructed, most of which are now in-filled with sediment. The deposited material serves as an environmental archive by which land use change over the last 100 years can be analysed, but with a particular focus on erosion and deposition of soil-associated carbon (C). It is assumed that erosion caused an initial flush of carbon rich soil which was subsequently buried and stored off-site. Despite this assumption, however the net-effect of erosion on carbon dioxide emissions is still unknown. In this project, preliminary results are presented from an investigation to determine whether land degradation in the Karoo has resulted in a shift from a net sink of C to a net source of C. Firstly, a high resolution digital elevation model was generated and erosion modelling was then employed to create an erosion risk map showing areas most prone to erosion. Information from the model output then served as the basis for ground-truthing and on-site erosion mapping. Secondly, sediment deposits from silted reservoirs were analysed for varying physicochemical parameters, in order to reconstruct spatial patterns of erosion and deposition. Analysis of total carbon (TC) content revealed a sharp decrease with decreasing depth. This provisionally suggests that land degradation during and after post-European settlement probably led to accelerated erosion of the relatively fertile surface soils. This presumably resulted in the rapid in-filling of many reservoirs with carbon-rich surface material seen today. The decline of C sinks in degraded rangelands here and possibly elsewhere raises the question whether past soil erosion may have had a greater attenuating effect on GHG emissions than modeled scenarios of present emissions suggest.