In-filled reservoir serving as sediment archive to analyse soil organic carbon erosion – Taking a closer look at the Karoo rangelands

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Background

Even though rangelands account for two thirds of the agricultural productive land nutrient cycling and consequences of erosion processes, especially on strongly degraded areas, are underexplored. Work undertaken in the upland areas of the Great Karoo region of South Africa has established a link between land degradation and overgrazing which began when European farmers settled (approx. 200 years ago) [e.g. 1,2].

As a result of agricultural intensification many dams and reservoirs have been constructed to provide drinking water for cattle or to facilitate irrigation during dry periods. Nowadays most of the dams are filled with sediment and many have breached, revealing sediment archives that can be used to analyse land use changes during the last ca. 100 years.

Fig. 1. View on the breach of Dam53 (front) surrounded by rangelands within the great Karoo, South Africa.

What are the aims?

- Reconstructing the history of the infilled reservoir with a focus on Carbon deposition
- Estimating the amount of potentially stored and lost Carbon
- Assessing the extent of areas of erosion and deposition

Approach

Two profiles from sediment deposits from the in-filled reservoir and a total of 15 sediment cores were taken within the former reservoir area. Sediment samples are analysed for various physicochemical parameters. Analysis results are used to align the sediment cores with the dam profiles and furthermore reconstruct the filling of the reservoir as well as improving the Carbon stock calculations.

Drone imagery was taken over the dam catchment and processed with pix4d. A high-resolution elevation model (resolution ~3cm) was created that serves as a base for detailed erosion modelling.

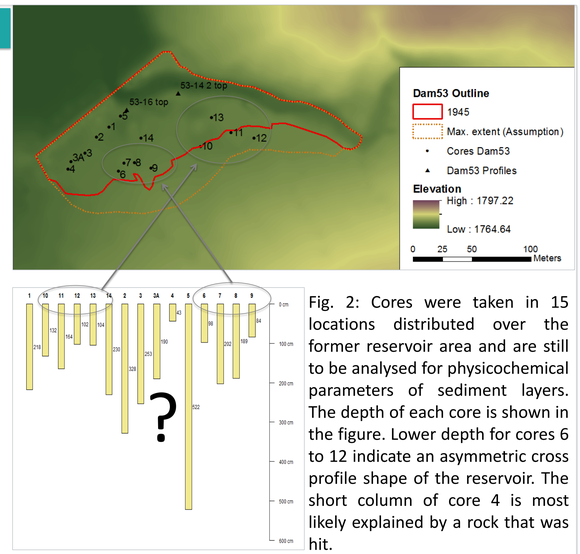

Fig. 2: Cores were taken in 15 locations distributed over the former reservoir area and are still to be analysed for physicochemical parameters of sediment layers. The depth of each core is shown in the figure. Lower depth for cores 6 to 12 indicate an asymmetric cross profile shape of the reservoir. The short column of core 4 is most likely explained by a rock that was hit.

Preliminary Results

Preliminary results from sediment deposits show that organic Carbon content is decreasing towards the surface, while median particle size is relatively stable throughout all layers (Figure 3). This suggests that **land degradation led to accelerated erosion of comparatively fertile surface material**. Younger Organic Carbon inputs into the reservoir declined, most likely because the Carbon-rich surface material already has been in eroded in earlier years.

A first estimation revealed that an amount of ca. **262-367 t of Carbon** is potentially stored in the reservoir.

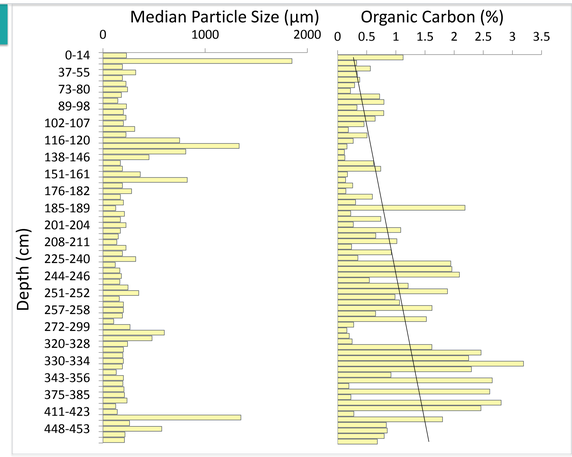

Fig. 3: With the exception of notable peaks, which presumably indicate large storm eventsmedian , particle size (left) shows little variation with depth. This contrasts with C-content (right), which decreases notably towards the surface.

Outlook

Further data analysis of the soil cores will help to reconstruct the history of filling of the reservoir and refine the Carbon stock calculations. Additionally, the data serves for an estimation of how much Carbon was lost in total from the catchment, maybe answering the question, if past soil erosion and deposition had a greater diminishing effect on GHG emissions than present scenarios suggest.

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