EGU2020-21326 (SSS2.7): Estimating Badland Denudation With Pin Measurements And High Resolution Digital Elevation Models Derived From UAV Image Analysis

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Background

Badland erosion dynamics are mainly driven by water and render agricultural land unusable by dissecting it. To examine spatial patterns of erosion and deposition in badland areas pin measurements deliver a highly precise point measurement of surface elevation change.

The use of quadrocopter UAV systems appears to be suitable to generate similar data at a larger scale because they easily cover complex terrains.

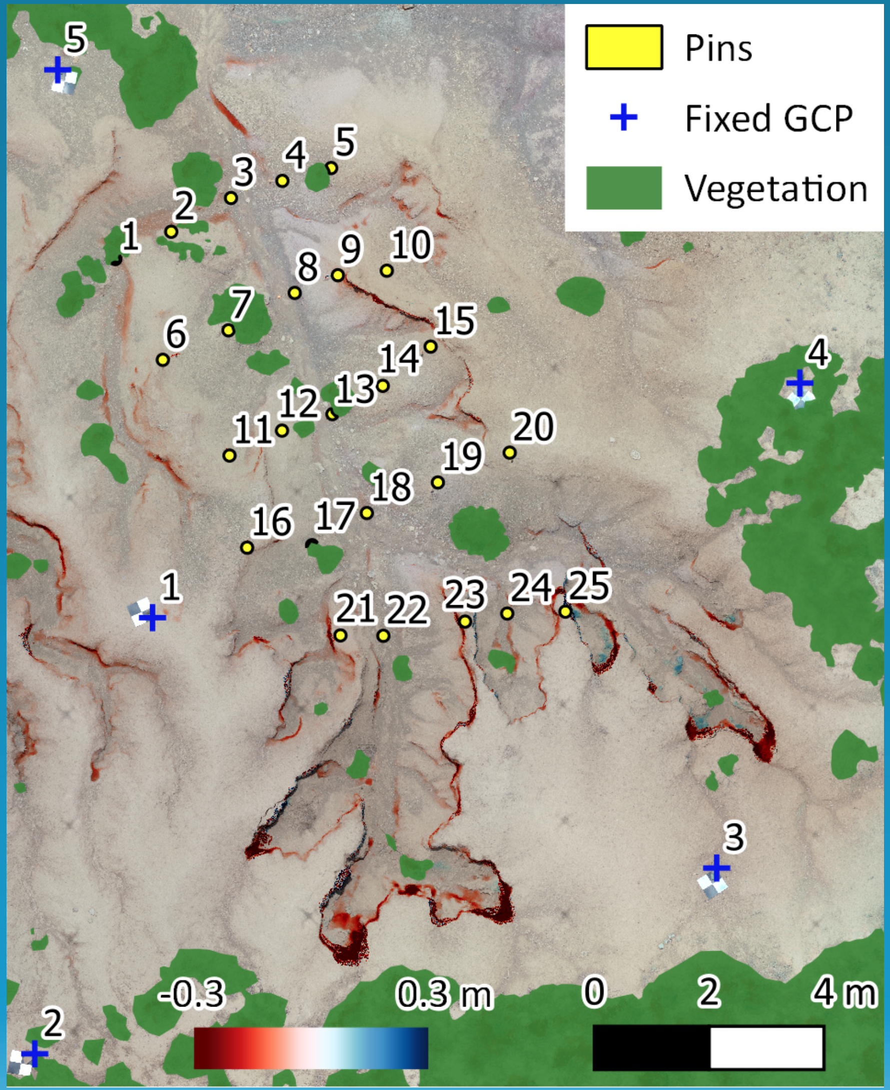
Conventional Mapping TechniQues




	Satellites	**Terrestrial Laser Scanner**	**Erosion Pins/ Sediment Traps**	**UAV (Unmanned Aerial Vehicle)**
+	Regular intervals Long time series available	Fine resolution	Fairly inexpensive	User-specific resolution in time & space Fairly inexpensive
-	Coarse resolution Atmospheric corrections	Time-consuming Expensive Ground-based	Time-consuming Labour intensive Ground-based	**Are UAVs suitable for detecting erosion?**

Aims

- Detect erosion and depostition in badlands with UAVs over a time series from 2017 to 2019.
- Compare the results with conventional pin measurements and discuss the different approaches.



Study Site

- The badland Compassberg 2 is located at the foot of a slope in the Karoo rangelands of South Africa

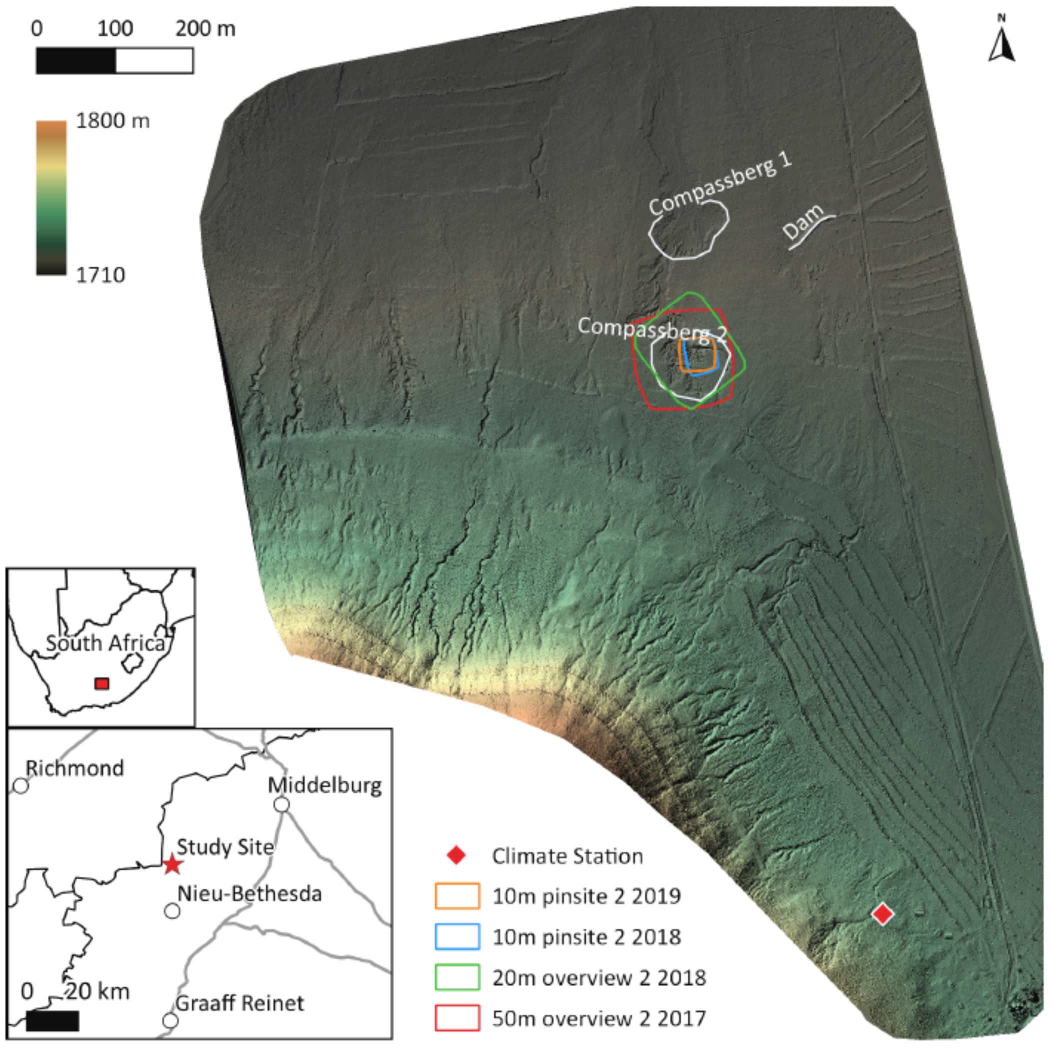


Figure 1 – Hillshaded DSM (Digital Surface Model) "100m Overview 2019" (Table 1) of the study site. All pinsite flights at the badland of interest "Compassberg 2" are marked. Average hight is 1720 m. The two small maps at the lower left corner showing a wide overview of the location of the study site.

Methods

- Fly with the Drone over the badland and create a DSM (Digital Surface Model) from the areal images taken using photogrammetry.
- Subtract the previous year's DSM to get a DoD (DSM of Difference) which represent the material loss or gain.

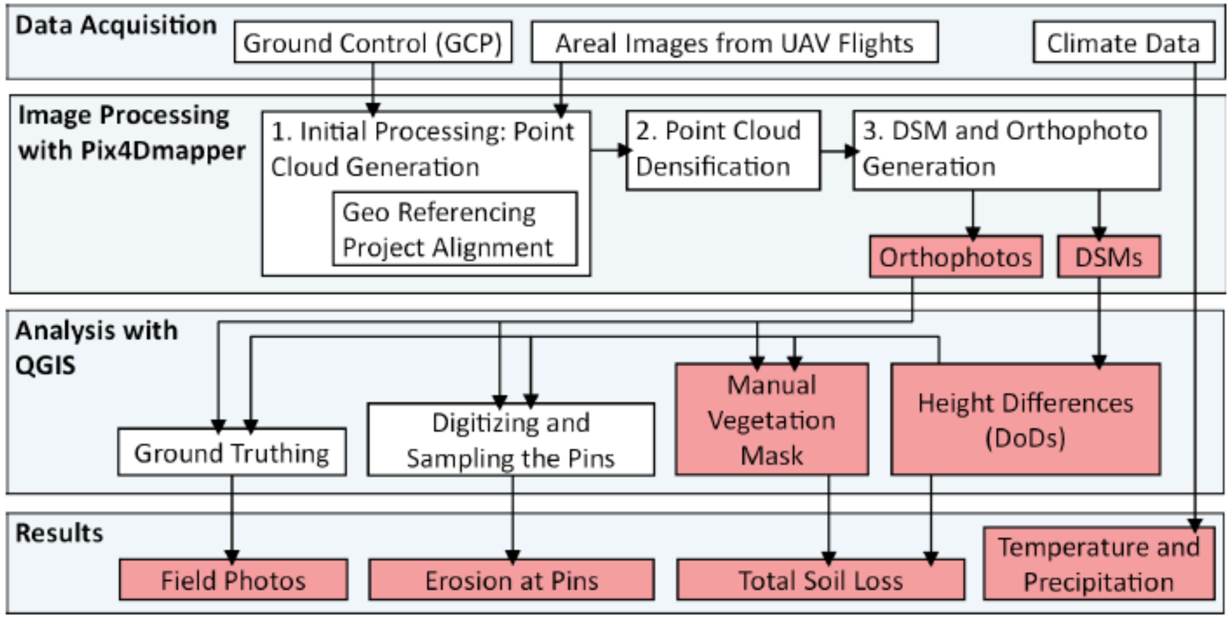


Figure 2 – Schematic workflow from data acquisition in the field, image processing in Pix4Dmapper, analysis in QGIS (Quantum Geographic Information System) and the results. A red background indicates the results and intermediary results.

Groundtruthing

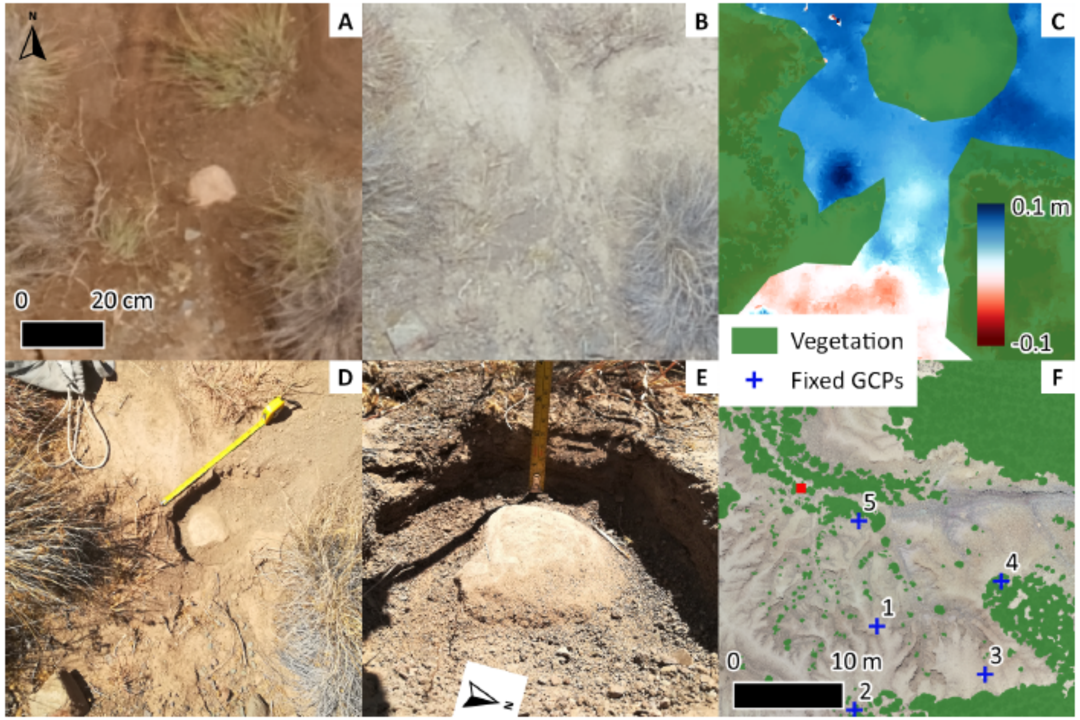


Figure 4 – [A], [B], [C] and [D] show the same outcrop located at the red square in the overview [F]. [A] shows the orthophoto from 2018. [B] shows the orthophoto from 2019. [C] shows the erosion differences from "2019-2018". [D] and [E] are photos taken 2019 in the field showing the excavated rock. [F] is a overview with the orthophoto from 2019.

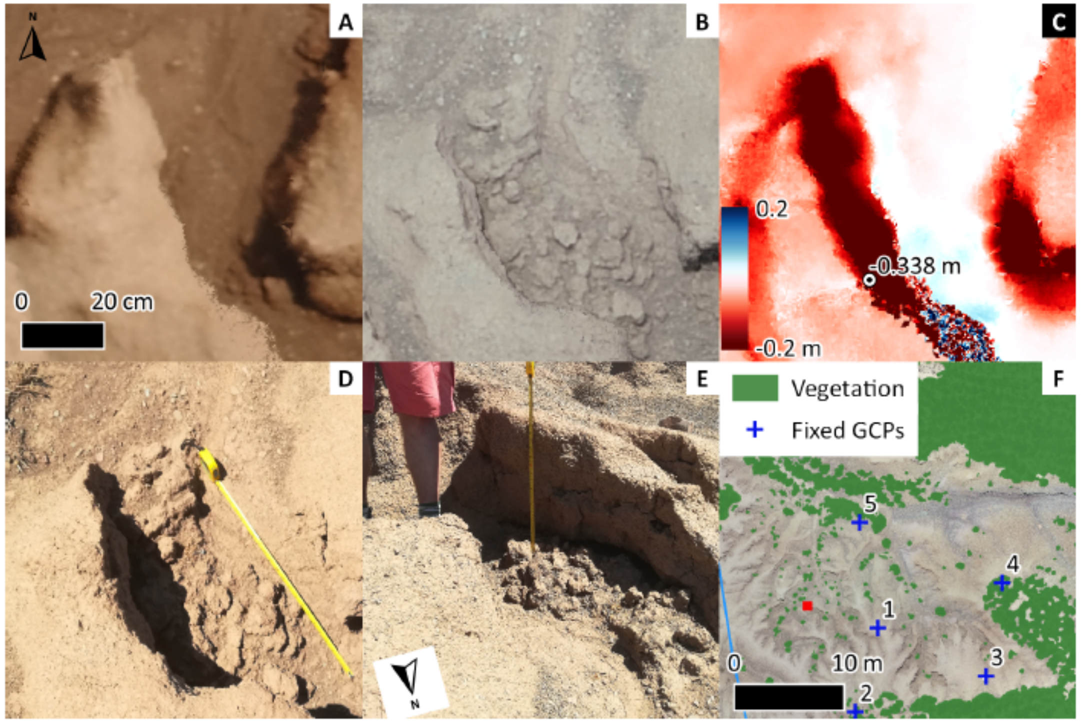
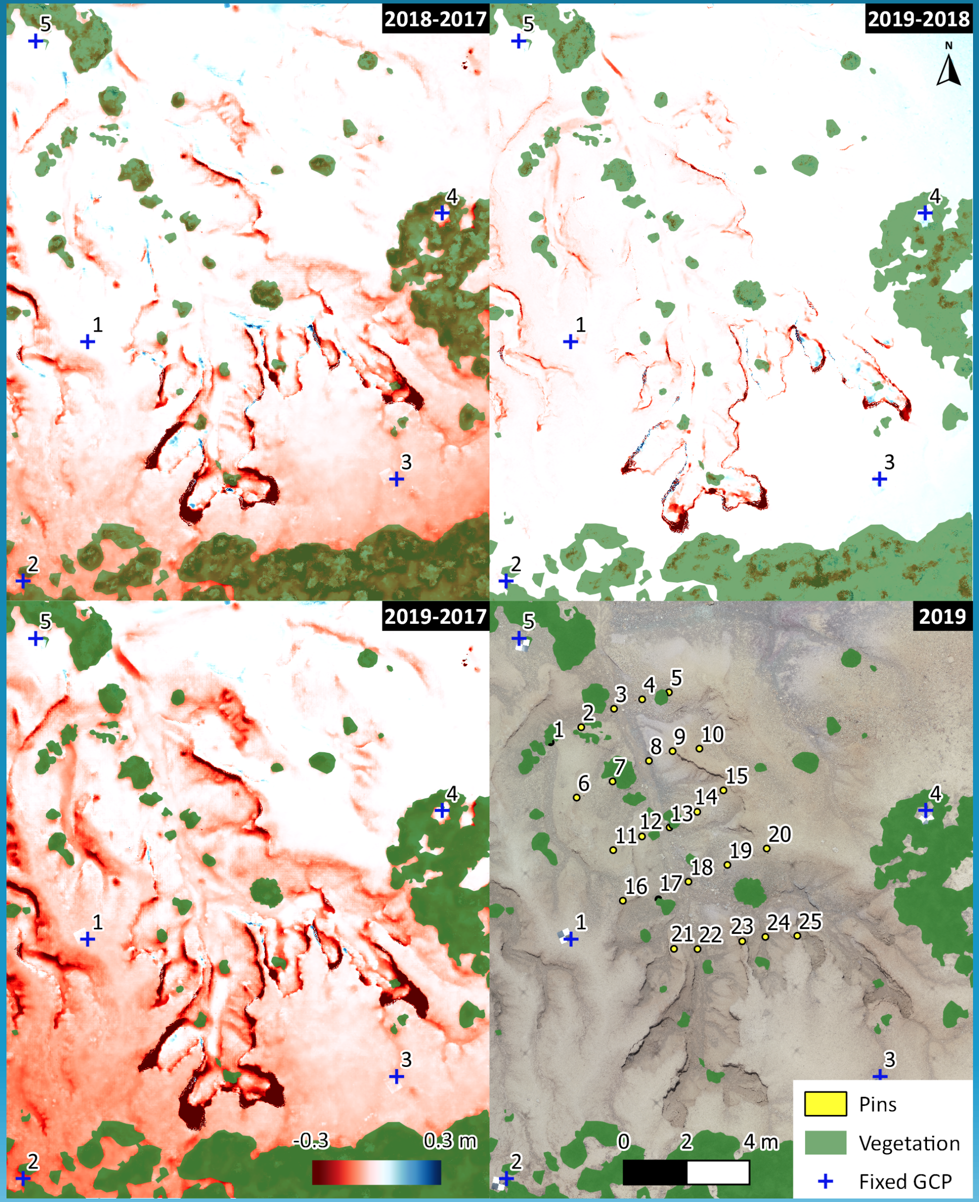


Figure 6 – [A], [B], [C] and [D] show the same outcrop located at the red square in the overview [F]. [A] shows the orthophoto from 2018. [B] shows the orthophoto from 2019. [C] shows the DoD (DSM of Difference) from "2019-2018" with point marking a high difference of -0.338 m. [D] and [E] are photos taken 2019 in the field showing the collapsed wall seen in [A]. [F] is a overview with the orthophoto from 2019.

Results

- Area: 245.87 m^2

Year	Mean DoD (cm)	Total Soil Loss (m^3)	Total Rainfall (mm)	Mean at Pins (cm)
2018-2017	-5.4	-13.4	569	-4.8
2019-2018	-2.6	-6.4	284	-3.9
2019-2017	-8.0	-19.7	853	-8.7



Conclusions

- With UAVs access complex terrain becomes easy.

- Is erosion detectable?
  - Differences in the mm range are hardly detectable.
  - Differences in the cm range are sometimes detectable.
  - Differences in the dm range are easy to detect.

- Annual erosion rates are overestimated.
- Pins still offer fast and reliable results.