

# Structure-from-Motion as a method to quantify erosion volumes and to identify sediment sources in eroding rills

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## Introduction

One particular problem in the study of rill erosion is the lack of information about sediment sources. So far, the sediment sources can only be identified by observation during the event or the experiment. Furthermore, only large and clear visible changes are considered and observations do not allow the quantification of erosion rates. A solution to this problem can be provided by 3D-modeling using the **Structure-from-Motion** (SfM) technique.

## Data



Photo 1 & 2: Erosion rill in the vineyard with a small alluvial fan

Table 1: Characteristics of the rill

Length	Average Width	Average Depth	Average Slope Angle
28 m	0,59 m	0,11 m	28°



Photo 3 & 4: To reduce erosion, stones were laid into the rill by workers

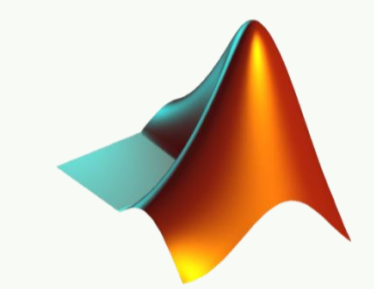
## Method

### Used Camera



Canon Legria HF G30	
Recording Format:	MP4
Sensor Type:	1/2.84-Type-CMOS (HD CMOS PRO)
Resolution (effective Video):	2.91 MP
Focal Length:	3.67 – 73.4mm
Image Processor:	DIGIC DV 4
Image Stabilizier	Optical Image Stabilizier Dynamic

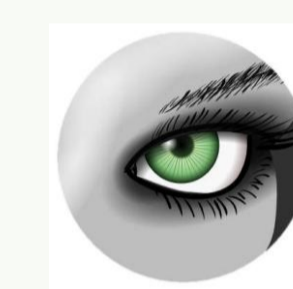
### Used Software



MATLAB



VisualSfM



MeshLab

### Hand-held camera

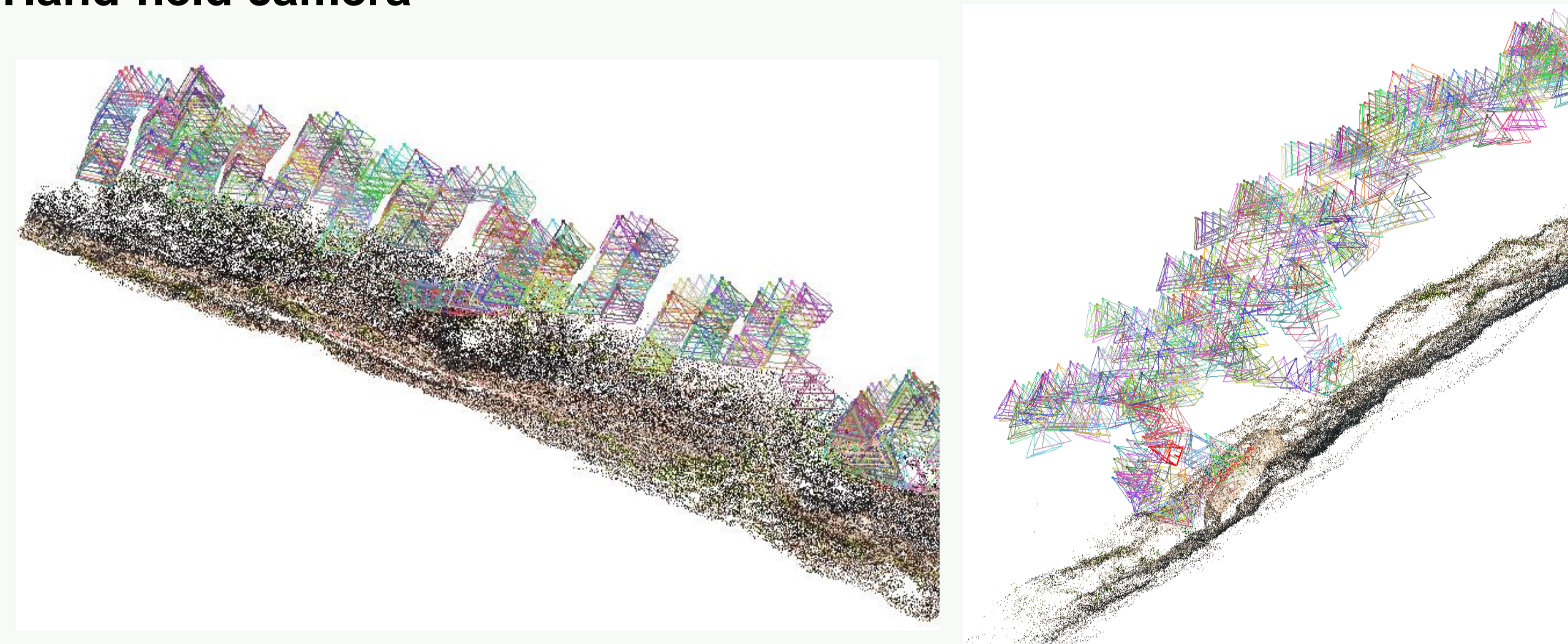


Fig. 1: Camera Positions

## Results

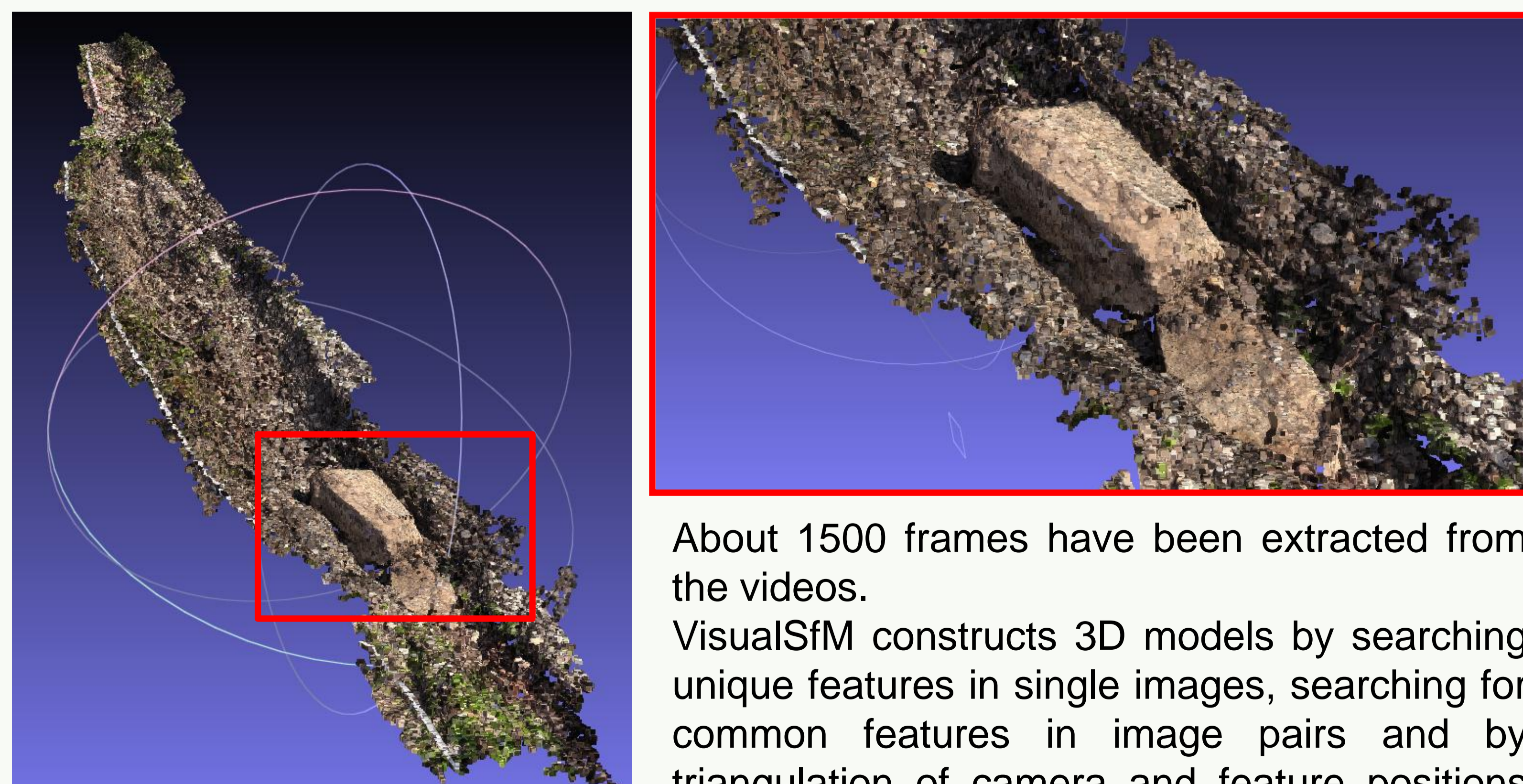


Fig. 2: 3D-Model of the rill

About 1500 frames have been extracted from the videos. VisualSfM constructs 3D models by searching unique features in single images, searching for common features in image pairs and by triangulation of camera and feature positions using these pairs.

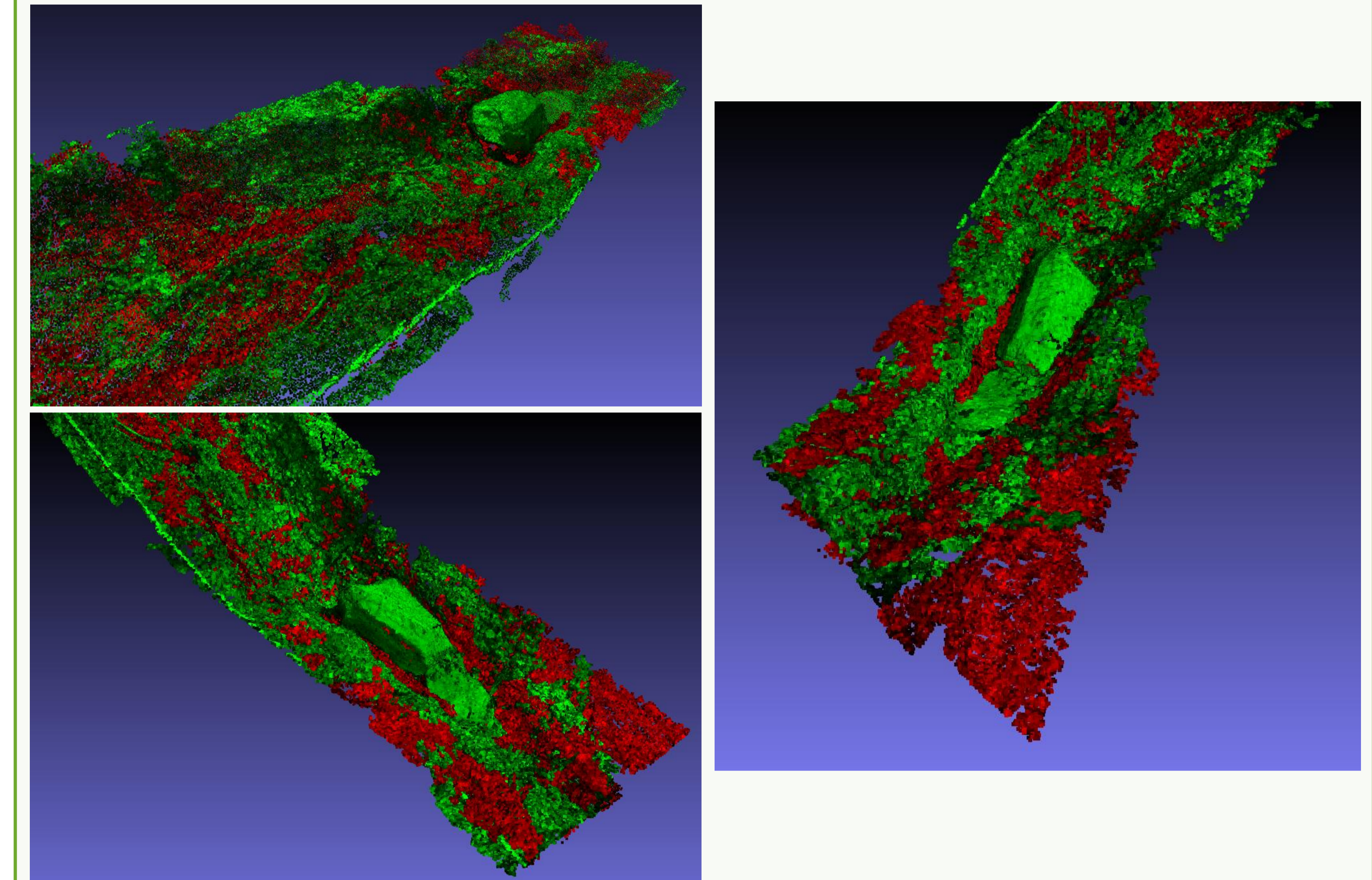


Fig. 3: Difference calculation by the superimposition of two models before and after stone placement (Red: areas of erosion; Green: areas of accumulation)

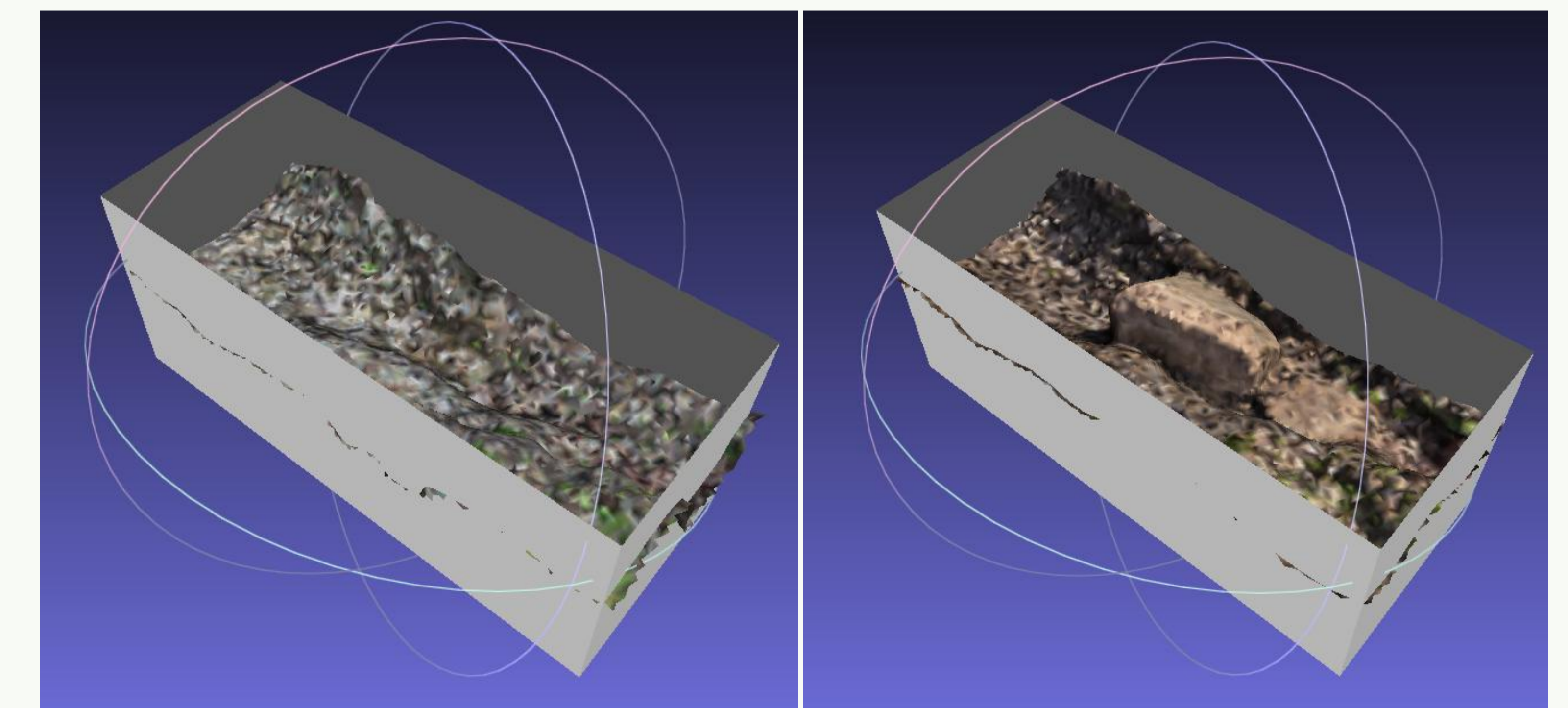


Fig. 4: Volumetric Surface Model

## Conclusion

- Volume deviations between 3D models and reference volumes do not exceed 10%.
- The noise of the 3D models in the worst dimension (z-axis) does not exceed the pixel spacing times 4-5.
- The advantages of recording with a video camera lie in a short recording time and nevertheless a high number of different camera positions, whereby the indispensable overlap of the individual images is ensured.

