

Evolution of farm terraces in the upper Sacos River catchment (Alacant) and the effects on soil conservation



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The catchment, at the north of the province of Alacant; is an area with elevations ranging from 320 m to 540 m in a tectonic depression of the Prebetic mountains system. Covers an extension of 0.44 km², mostly occupied by agricultural terraces. It has been divided into 5 sub-catchment in order to analyze soil erosion by terrace wall collapses and its relationship with hydrological connectivity.

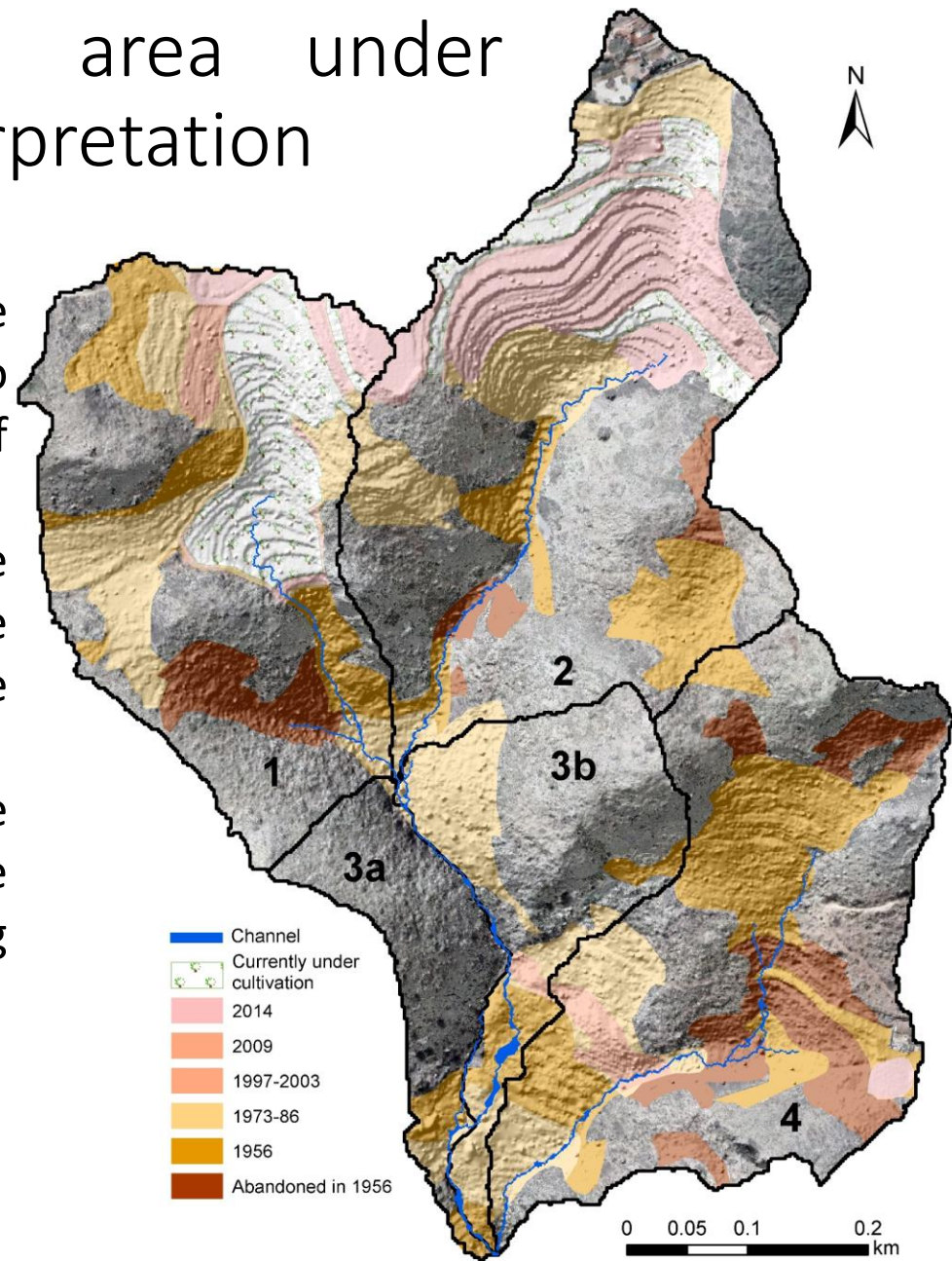


Historical evolution of the area under cultivation based on photointerpretation

The abandonment of agricultural activity and the non-maintenance of the terrace-walls leads to the degradation of these structures by means of erosion processes.

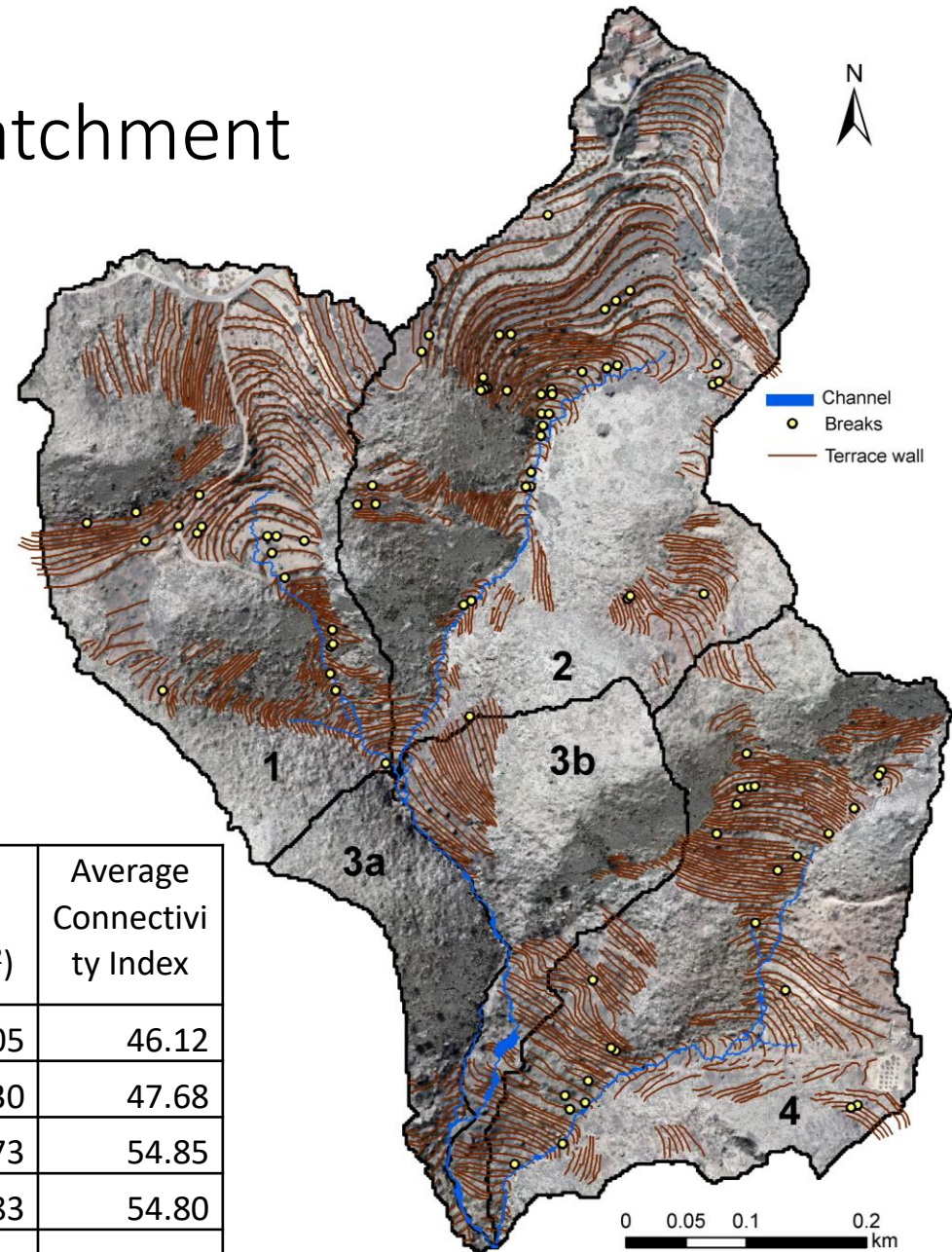
In 1956 (first available aerial images) there were already abandoned areas. The amount of the coloured areas would correspond to the maximum of land occupation.

There has been an abandonment of 85% of the terraces that were active in 1956 when the abandoned terraces represented 3.19 ha, rising to 20.3 ha today.



Wall characterisation by sub-catchment

The semi-automatic method of terrace mapping developed by Arnau et al. (2018) has allowed the estimation of the lengths and heights of the total number of walls in the study area.

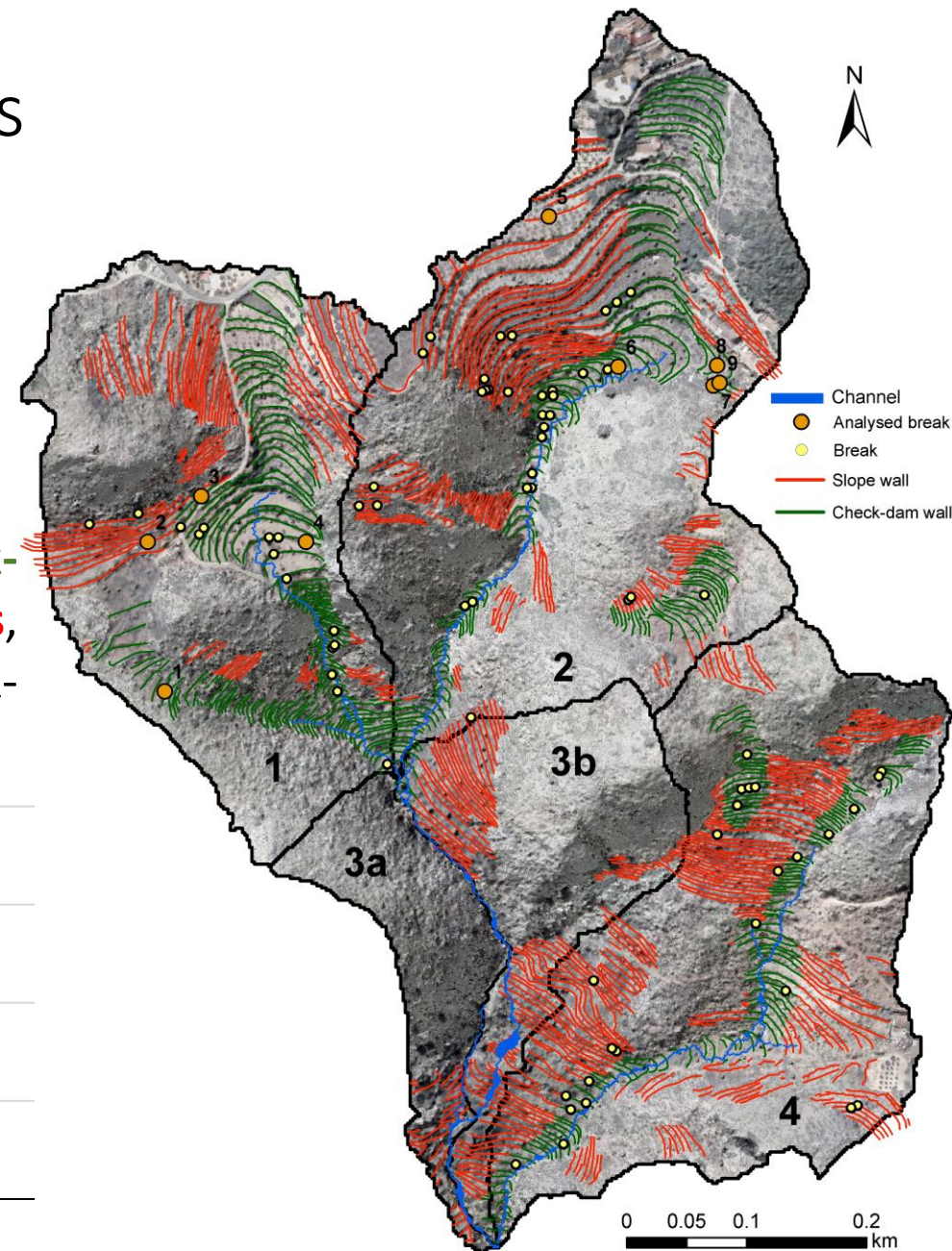
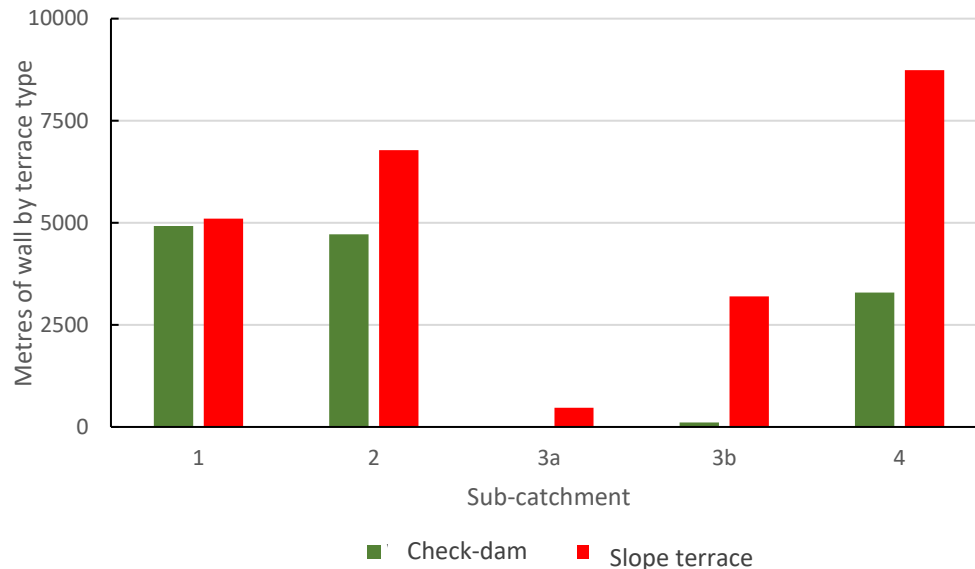


Sub-catchment	Surface (km ²)	Total wall length (m)	Wall height (m)			Wall density (km km ⁻²)	Average Connectivity Index
			Min	Max	Average		
1	0.11	9873.20	0.00	4.99	0.83	91.05	46.12
2	0.15	11488.01	0.00	5.66	0.95	76.30	47.68
3a	0.03	482.04	0.27	4.29	0.91	18.73	54.85
3b	0.04	3297.11	0.00	5.27	0.89	73.83	54.80
4	0.11	12019.69	0.00	5.10	0.92	105.60	52.88
Amount	0.44	37305.39					

Terrace types and implications

The breaks have been located by photointerpretation and further field work, and 9 of the 82 have been measured, using photogrammetry techniques, for their subsequent analysis.

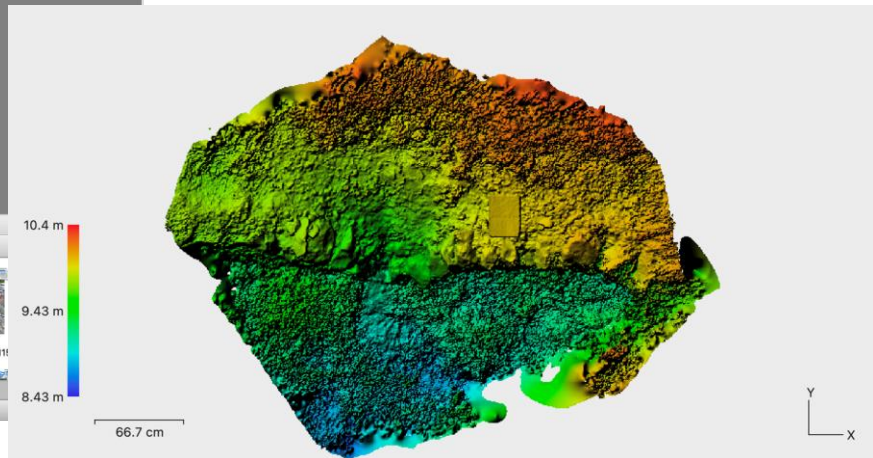
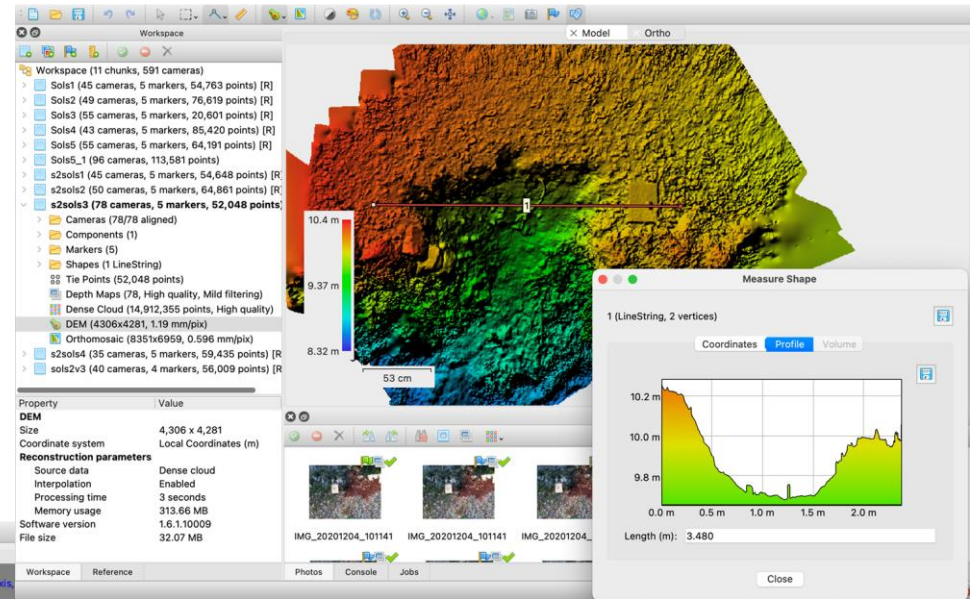
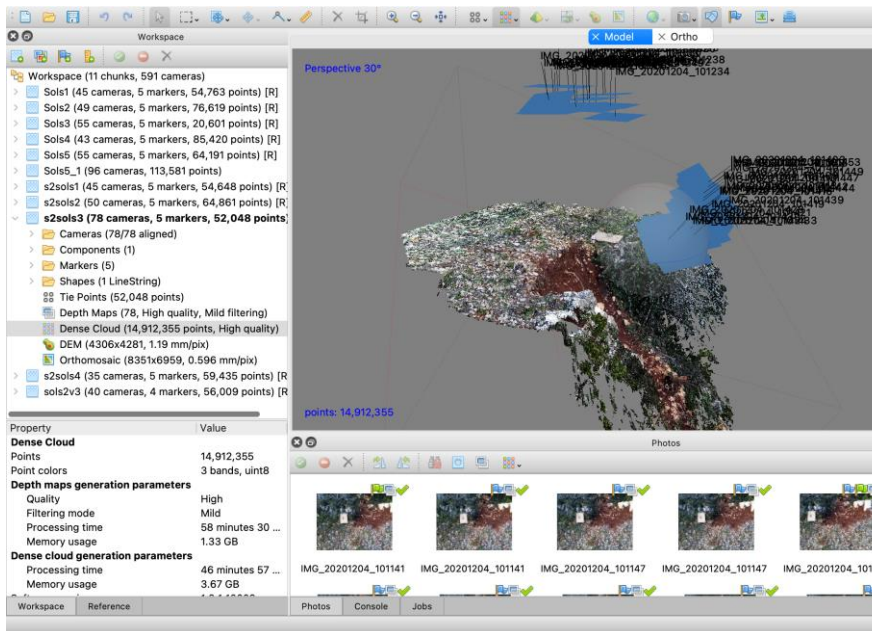
68% of the breaks located affect to the **check-dam terraces** while 32% to the **slope terraces**, despite these represent the 75%, while check-dam terraces are the 25% of the total wall length



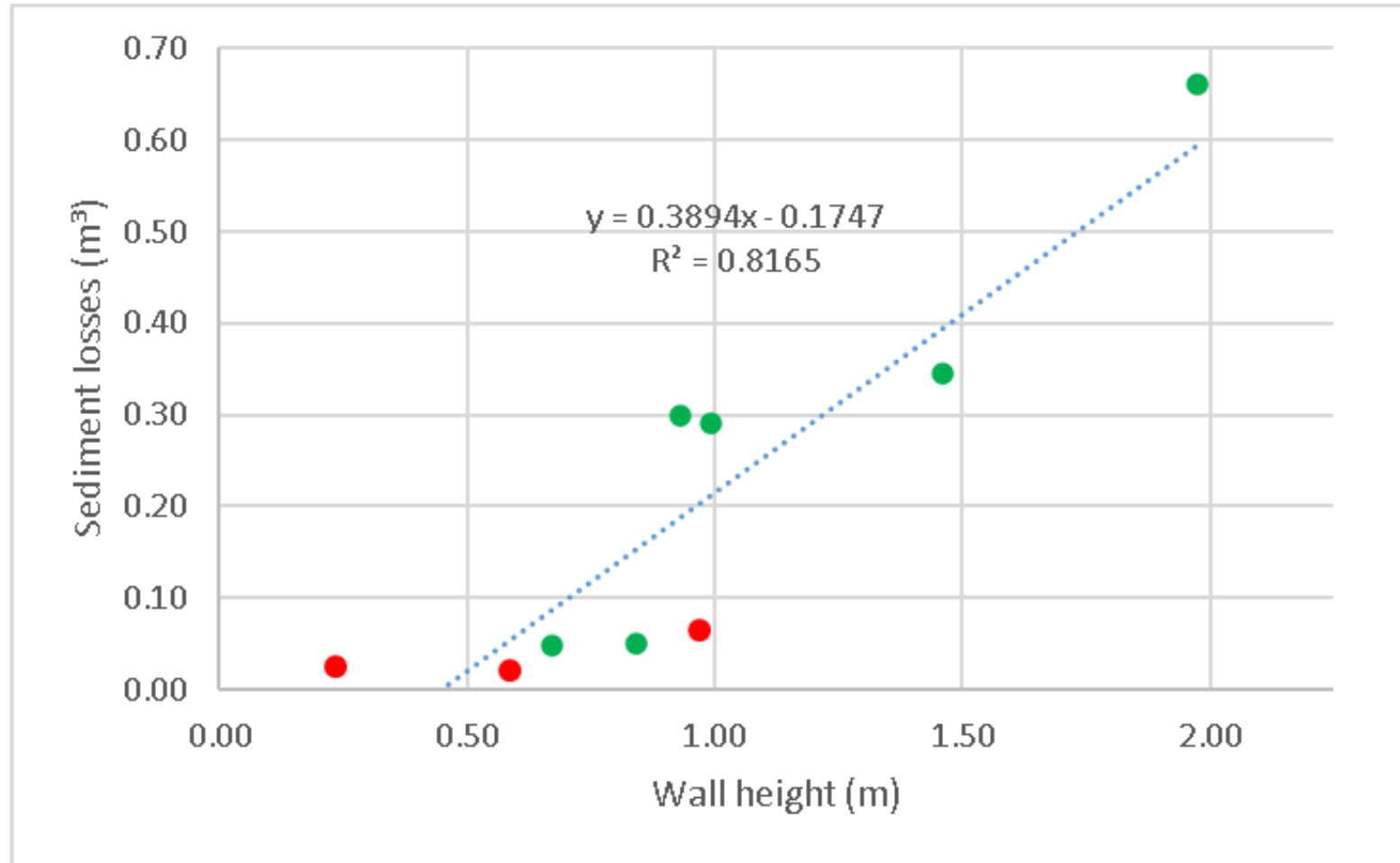
Break analysis and photogrammetry

The volume eroded at the sampled breaks has been obtained from 3D reconstruction by means of the SfM-MVS (Structure from Motion, Multiview Stereo) photogrammetry technique processed in Metashape Pro v1.7 with the fieldwork photos.

A DEM and an orthoimage for each photographed break were obtained in order to obtain the sediment yield volumes.



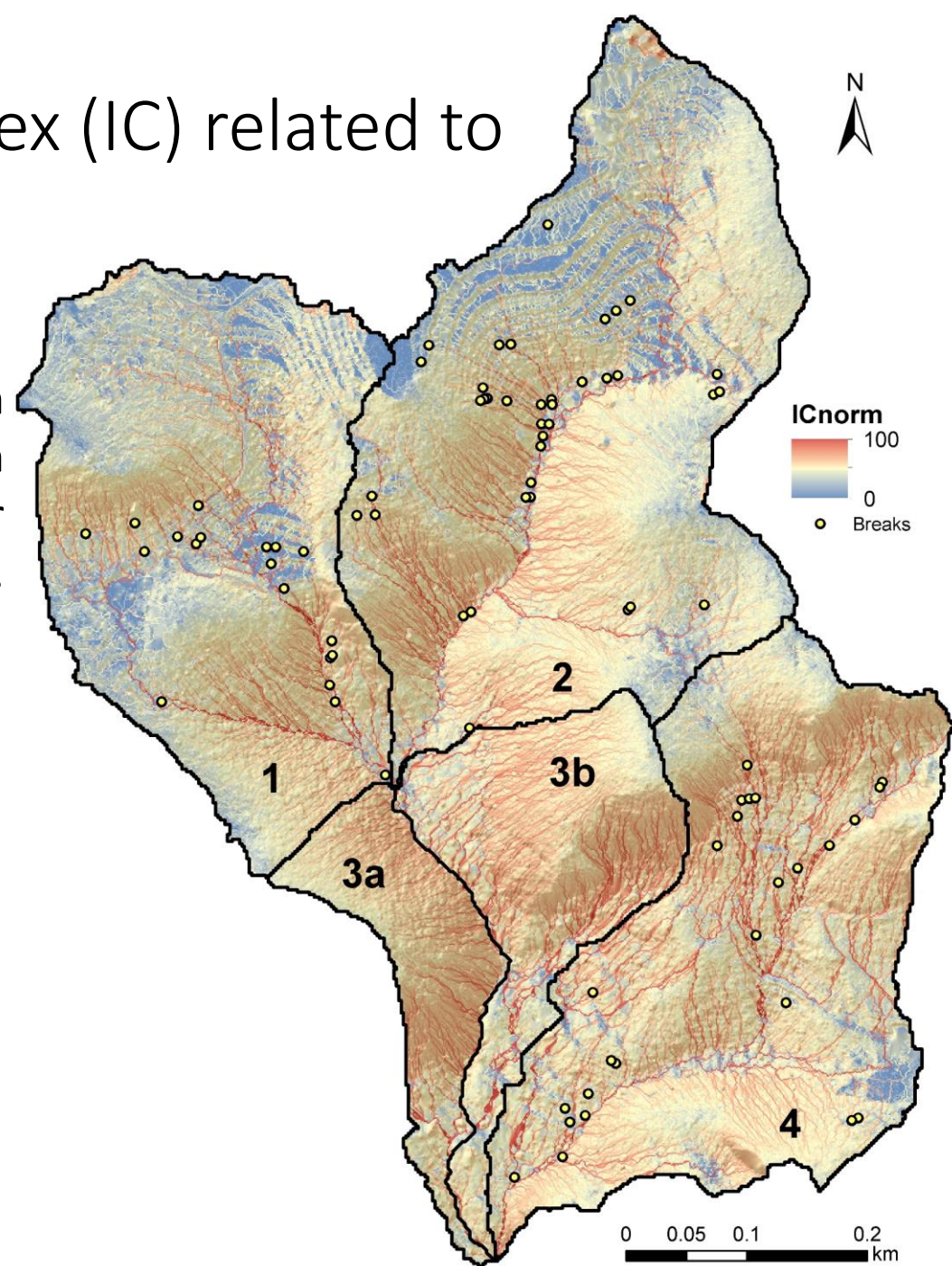
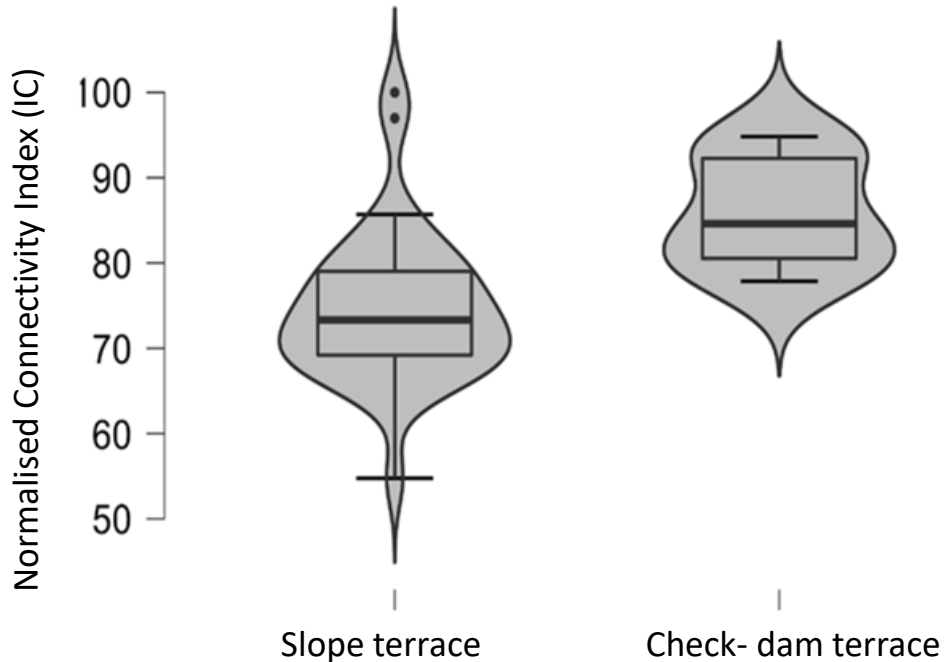
Sediment yields delivered from the measured collapses



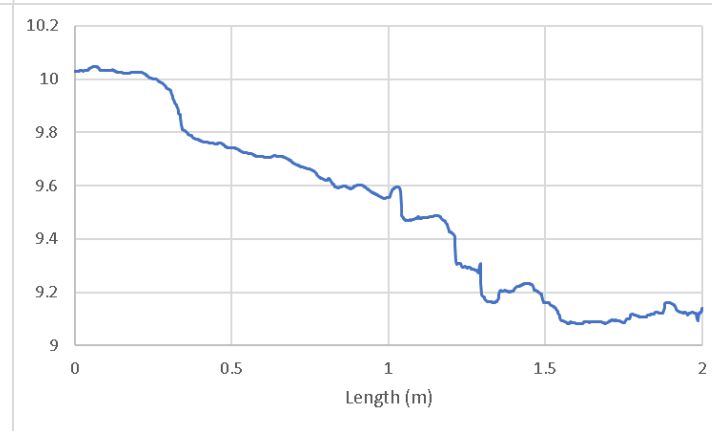
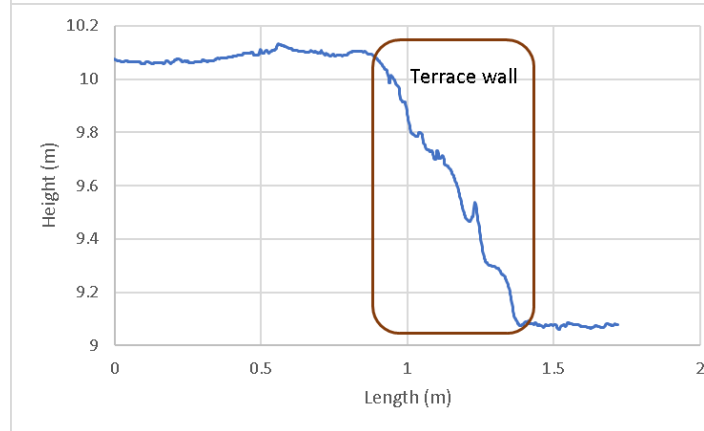
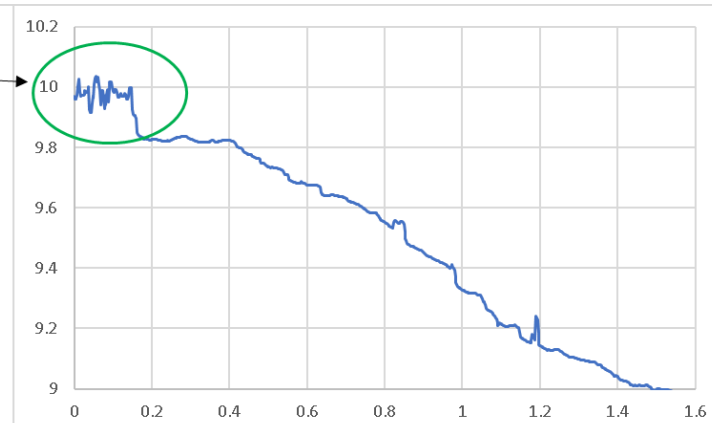
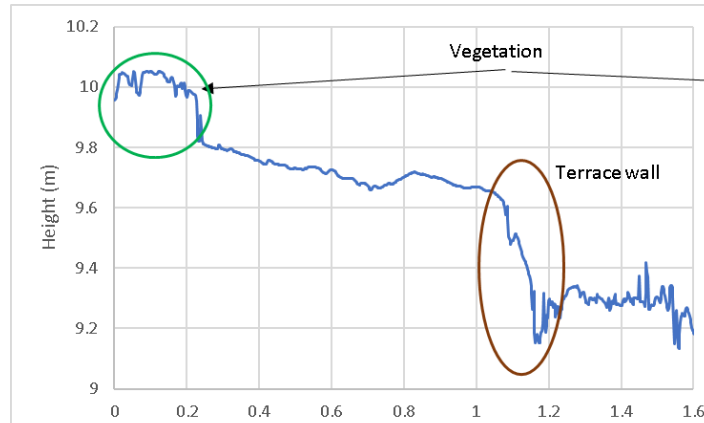
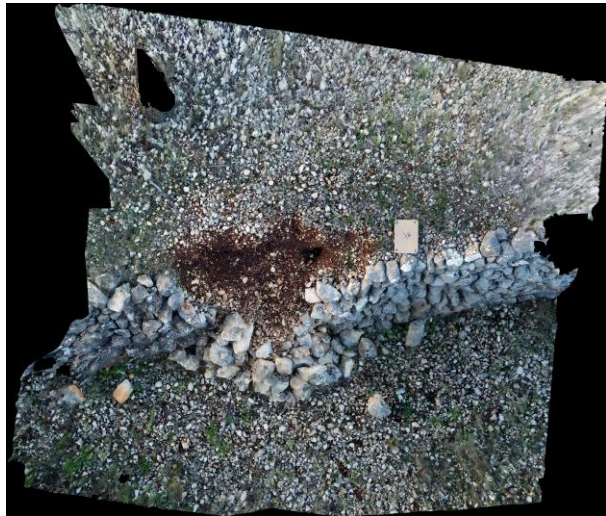
9 breaks have been analyzed with an average amount of soil removed per break of 0.12 m^3 for **slope terraces** and 0.24 m^3 for **check-dam terraces**. Extrapolating the trend line by considering the walls' height (to 82 breaks), **5.83 m^3** and **9.95 m^3** of soil removed was estimated, totaling 15.78 m^3 with an average wall height of 0.93 m.

Normalized connectivity index (IC) related to breaks

The IC illustrates higher connectivity on talwegs; i.e., 85.98, compared to 74.57 on the slope terraces, involving a higher number of breaks in the check-dam terraces, 56 vs. 26.



Geomorphological consequences



Before the wall collapse

After the wall collapse

A change in the longitudinal section was observed after the wall collapse, with a slope adjustment, no longer retaining sediments and interrupting surface runoff.

Conclusions



- The SfM-MVS (Structure from Motion, Multiview Stereo) photogrammetry technique is a remarkable tool for detecting and quantifying erosion processes.
- The link between IC and terrace type is evident, being in the check-dam terraces where a higher erosive activity occurs.
- A loss of $7.28 \text{ t ha}^{-1} \text{ yr}^{-1}$ was triggered by wall collapses, higher than an erosion rate of $1 \text{ t ha}^{-1} \text{ yr}^{-1}$, considered the "sustainable" limit that can occur in a system in the form of sediment loss.
- The need for establishing urgent conservation strategies for these soils as they may lead to new watercourses, no longer functioning as terraces.