



Spatial and temporal distribution of erosion rates in a sample catchment of Central Italy investigated through digital photogrammetric analysis

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Soil erosion is a relevant environmental problem worldwide and represents one of the most significant phenomena of land degradation, frequently responsible for irreversible effects on the "soil resource". This problem is becoming even more important, especially in the Mediterranean area, which is affected by several and mostly severe erosive processes due to the action of surface running water and gravity, favored both by climate conditions and intensive, as well as rapidly changing land use.

Aim of this presentation is to illustrate the results obtained by the application of digital photogrammetric methodologies to evaluate the rate and spatial-temporal development of denudation processes in a selected test area of Central Italy, the Upper Orcia Valley (Tuscany). The test area coincides with a small catchment extending about 4.4 km², highly representative of the typical effects of accelerated slope dynamics that widely affects central Italy. This area is characterized by the widespread outcrop of a clayey substratum, thus experiencing the intensive action of surface running water on slopes, generating the typical badland landforms well-known as "calanchi" and "biancane". There is also diffuse evidence of mass wasting, which is mostly represented by soil creep, solifluction and landslide phenomena.

A digital photogrammetric analysis of landforms was performed on four series of aerial photos which refer to the period 1954–2003, by using a Z-Map digital photogrammetric workstation. In order to obtain the best image orientation (both in terms of internal and external orientation) a DGPS survey was carried out and about 70 ground control points were located. Four high resolution Digital Elevation Models (DTMs with 2x2m pixels) of the test area were extracted from the aerial photographs dating to 1954, 1976, 1990 and 2003, respectively. The estimation of the sediment loss rate was computed by overlaying these DTMs. Moreover, interpretation of air photos allowed producing specific process maps. Comparing these maps, important morphological changes that occurred during the considered period (1954–2003) were observed. In particular, on slopes affected by "calanchi" a headwater retreat was recorded, ranging between 10 and 20 cm a⁻¹. For the whole test area and the period 1954–2003 an average erosion rate of 1.4 cm a⁻¹, with a sediment loss of about 300 t ha⁻¹ a⁻¹, was calculated. These rates are in agreement with those indirectly estimated (Tu index) in previous researches, by using empirical equations derived from the statistical correlation between the values of measured suspended sediment yield at the outlets of several Italian catchments and some geomorphic parameters of the drainage network. The rates obtained for the entire catchment coherently represent averaged values, with respect to the extreme rates measured, in the time-span 1993–2010, at monitoring stations on "calanchi" and "biancane" denudation "hot spots" locally affecting the catchment area. The proposed methodology is a step forward to estimate denudation rates and to better locate and characterize areas affected by active erosive processes. The results can be useful in the planning of erosion control measures and in calibrating regional prediction models.