Integration of semi-automatic detection and sediment connectivity assessment for the characterization of sediment source areas in mountain catchments

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Identifying areas that are directly delivering sediment to the channel network or to a catchment outlet is of great importance for a sound sediment dynamic characterization and for assessing sediment budget.

We present an integration of remote sensing analysis techniques to characterize the effective sediment contributing area that is the sub-portion of the catchment in which sediment is effectively routed towards the catchment outlet.

A semi-automatic mapping of active sediment source areas is carried out via image analysis techniques. To this purpose, satellite multispectral images and aerial orthophotos are considered for the analysis. Several algorithms for features extraction are applied and the maps obtained are compared with an expert-based sediment source mapping derived from photointerpretation and field surveys. The image-based analysis is additionally integrated with a topography-driven filtering procedure. Thanks to the availability of High-Resolution, LiDAR-derived Digital Terrain Models, it is possible to work at a fine scale and to compute morphometric parameters (e.g., slope, roughness, curvature) suitable for refining the image analysis. In particular, information on local topography was integrated with the image-based analysis to discriminate between rocky outcrops and sediment sources, thus improving the overall consistency of the procedure.

The sediment source areas are then combined with the output of a connectivity assessment. A topography-based index of sediment connectivity is computed for the analyzed areas in order to better estimate the effective sediment contributing area and to obtain a ranking of the source areas in the studied catchments.

The study methods have been applied in catchments of the Eastern Italian Alps where a detailed census of sediment source areas is available. The comparison of the results of image analysis with expert-based sediment sources mapping shows a satisfactory agreement between the two approaches. Furthermore, the integration with sediment connectivity maps permitted a first fast assessment of effectively connected sediment source areas. This valuable information could enable land managers to focus on the most active geomorphic paths at catchment\regional scale.