

Assessing the effects of check dams on sediment dynamics in a debris-flow catchment through SfM technique

Sara Cucchiaro (1), Alberto Beinat (1), Aleix Calsamiglia (2), Marco Cavalli (3), Federico Cazorzi (1), Stefano Crema (3), and Lorenzo Marchi (3)

(1) Department of Agricultural and Environmental Science, University of Udine, Udine, Italy (sara.cucchiaro@uniud.it), (2) Department of Earth Sciences, University of Balearic Islands, Palma de Mallorca, Spain, (3) CNR-IRPI, National Research Council of Italy - Research Institute for Geo-Hydrological Protection, Padova, Italy

The Moscardo Torrent (eastern Italian Alps) is a small rugged catchment (drainage area 4.1 km², range in elevation between 890 and 2043 m) frequently affected by debris flows that deliver large amounts of sediment to the receiving stream, and cause concerns for infrastructures located on the alluvial fan and near the confluence.

Over the last decades, hydraulic control works were implemented in the main channel to limit bed erosion and to stabilize channel banks. Although the objectives of training works have been only partly achieved, check dams and hillslope stabilization works have affected the sediment transfer from hillslopes to the channels and along the main channel.

The effects of hydraulic control works were investigated by means of multi-temporal Structure from Motion (SfM) surveys based on images taken from the ground and UAV. The ground and air based surveys were carried out over a channel reach in which two check dams have recently been built. SfM surveys were taken before and after three debris-flow events (occurred between June and July 2016), allowing the generation of four high-resolution Digital Elevation Models (DEMs).

Geomorphic changes caused by the debris-flow events have been assessed in order to produce the DEM of Differences (DoDs with a 0.2 m spatial resolution) that allowed estimating erosion and deposition volumes in the study area. Furthermore a debris-flow monitoring system has been in operation in the Moscardo Torrent; the analysis of the videos and of the hydrographs recorded by ultrasonic sensors permitted to assess the debris-flow volumes. These estimates were used to characterize the magnitude of events in support of the topographic analysis.

By examining the changing pattern of erosion and deposition over time it was possible to understand the check dams' effects on sediment dynamics. The results show that the new check dams effectively stored sediment transported by the three debris flows. However, once the check dams have been completely filled, they lost their functionality, letting sediment flow downstream along paths drawn accidentally by the torrent control works and by the morphology of debris-flow deposits. Moreover, debris-flow lobes deposited upstream of the check dams could act as sediment sources further increasing downstream debris-flow magnitude.