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*Original Citation:*

*Availability:*

This version is available at: 11577/3348245.7 since: 2020-09-04T02:36:06Z

*Publisher:*

*Published version:*

DOI: 10.5194/egusphere-egu2020-3516

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## Analyzing topographic changes through LiDAR and SfM techniques: assessing the deposition-erosion patterns and estimation of debris-flow volume in the eastern Italian Alps

Xuwei Chen<sup>1,2</sup>, Sara Cucchiaro<sup>1</sup>, Martino Bernard<sup>1</sup>, Luca Mauri<sup>1</sup>, Jianping Chen<sup>2</sup>, Paolo Tarolli<sup>1</sup>, and Carlo Gregoretti<sup>1</sup>

<sup>1</sup>University of Padova, Land, Environment, Agriculture and Forestry, Italy (viviansias@163.com; paolo.tarolli@unipd.it; carlo.gregoretti@unipd.it)

<sup>2</sup>China University of Geosciences, Beijing, School of Earth Sciences and Resources, China (3s@cugb.edu.cn)

On 4 August 2015, a very high intensity storm, 31.5 mm in 20 min (94.5 mm/h), hit the massif of Mount Antelao on the Venetian Dolomites (eastern Italian Alps) triggering stony debris flow characterized by high magnitude. It routed along the Ru Secco Creek and progressively reached the resort area and the village of San Vito di Cadore, causing fatalities and damages. The aim of the present research is the study of this debris-flow event by means of pre and post-event topographic data derived by LiDAR (Light Detection and Ranging) and Structure-from-Motion (SfM) photogrammetry technique associated to its occurrence. This study analyzes the Digital Terrain Models (DTMs) derived from LiDAR survey carried out in July 2015 and UAV-SfM data obtained in September 2019. The most important step to compare these multi-temporal surveys was the co-registration process, fundamental to guarantee the coherence among the two different surveys. The post-event SfM-DTM of the area routed by debris flow subtracted to the pre-event LiDAR-DTM, provided a DoD (DTM of Difference) that was useful to assess the deposition-erosion patterns and estimate debris-flow volume. Multi-temporal topographical data are important to analyze the phenomenon and its characteristics. This allowed us to more in depth analyzed the debris-flow effects and provide valuable information for the planning of risk prevention measures.

**How to cite:** Chen, X., Cucchiaro, S., Bernard, M., Mauri, L., Chen, J., Tarolli, P., and Gregoretti, C.: Analyzing topographic changes through LiDAR and SfM techniques: assessing the deposition-erosion patterns and estimation of debris-flow volume in the eastern Italian Alps, EGU General Assembly 2020, Online, 4–8 May 2020, EGU2020-3516, <https://doi.org/10.5194/egusphere-egu2020-3516>, 2020