Aims and Objectives

The monitoring of sediment transport in the Manival Torrent and its catchment (Chartreuse mountain range, France) began in spring 2009 with a sediment budget approach. The objective is to identify the sources of erosion, the transport pathways, and the possible sinks for sediments generated in the catchment. The methods used include airborne LiDAR for 3D mapping of the catchment, ground LiDAR for the source area, and terrestrial laser scanning in the torrent channel. The data collected provide insights into the sediment transport processes and the potential impacts on the landscape.

Methods

Airborne LiDAR and terrestrial laser scanning are used to monitor erosion and deposition in the source area, the torrent channel, and sediment traps. The airborne LiDAR was surveyed in June 2009 with 2 points/m², while the terrestrial laser scanning was performed in August 2009 with 0.5 points/m². The LiDAR data are processed to calculate the volume of sediments transported throughout the catchment and its torrent channel.

Sediment Transport Events

Throughout the summer 2009, several convective storms with medium rainfall intensities did not produce any significant sediment transport events. At the end of summer, a debris flow occurred induced by a high rainfall event with a maximum intensity of 1200 mm/hr. Following the debris flow event, two floods occurred induced by low-intensity, long-duration rainfall events in autumn.

Discussion and Conclusion

Recent studies reveal the significance of sediment availability, recharge, and connection to the catchment channels for debris flow occurrences (Coï et al. 2008, Schlunegger et al. 2009). The presented results indicate that the debris flow is a scouring process in the catchment where bedload transport is a process that replenishes the entrained areas. Despite erosion activity in the source area during the high-intensity rainfall, sediment was stored in the source area with high-hydrometric channel coupling. This suggests a potential for sediment storage in the source area during high-intensity rainfall events.

Study Site

The catchment is 3.6 km² (200 m relief) and the torrent channel is 200 m long. The torrent is characterized by a steep gradient of 20%. Debris flows or hyperconcentrated flows occur almost every year in the torrent channel.

Limestone and Jurassic Marls

Hydrometeorological Processes:

- Debris flow: the channel in the source area experienced deposition of sediment coming from hillslopes. These deposits had short transport distances, for example, the talus slope failure in a disconnected gully.
- Flood: before the flood, the channel in the source area experienced erosion (total volume not currently able to be measured). Activity can be observed in the LiDAR data which can identify where the source of material came from seen in the catchment map.
- Flood: after the flood, at least 750 m³ of sediment entered the main channel from the source area depositing where entrainment occurred during the debris flow.

Source Area

Debris Flow: the channel in the source area experienced deposition of sediment coming from hillslopes. These deposits had short transport distances, for example, the talus slope failure in a disconnected gully during the debris flow. Sediment coming from talus slope failures were deposited within a hundred metres downstream which did not reach the torrent channel.

Main Torrent Channel

Debris Flow: the initiation occurred in the channel at the main confluence of the source area. The volume grew 0 m³ to 1.873 m³ for 600 m downstream with 1.873 m³ deposited in the sediment trap.

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