Influence of a windstorm-affected area on the transmission of a mountain basin's sediment fluxes

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Abstract

Climate change in Alpine areas is altering the rainfall regimes, increasing the magnitude/frequencies of extreme events, and affecting the sediment dynamics at the scale of both the basin and the river network. However, understanding the responses of sediment transport processes to climate change is still a challenging task as all disturbances are intertwined and each has a different reaction time [1]. This work was carried out in the Rio Cordon basin (Dolomites, Italy) and aimed at monitoring and analyzing the suspended and bedload transport processes (Figure 1A) during five flood events (July 2021-June 2022) in two cross-sections, upstream (CSA) and downstream (CSB) a windstorm-affected area, respectively. In October a windstorm produced changes in the channel morphological configuration such as channel widening, avulsions and lateral erosions. Water discharge (*Q*), water maximum discharge (Q_{peak}) and suspended sediment load (*SSL*) were retrieved from two multiparameter sonde (OTT Hydrolab MS5 and Hydrolab HL4) (Figure 1B). To do so, specific rating curves relating water level - Q and NTU - g l^{-1} were established (more details in [2]). As far as the bedload (*BL*) is concerned, two Bunte bedload traps [3] were installed to determine the transport rate during each event, using the critical *Q* for initiation of *BL* motion equal to 0.44 m^3 s^{-1} [4] (Figure 1C). Then, the total load (*TL*) was computed combining *SSL* and *BL*.

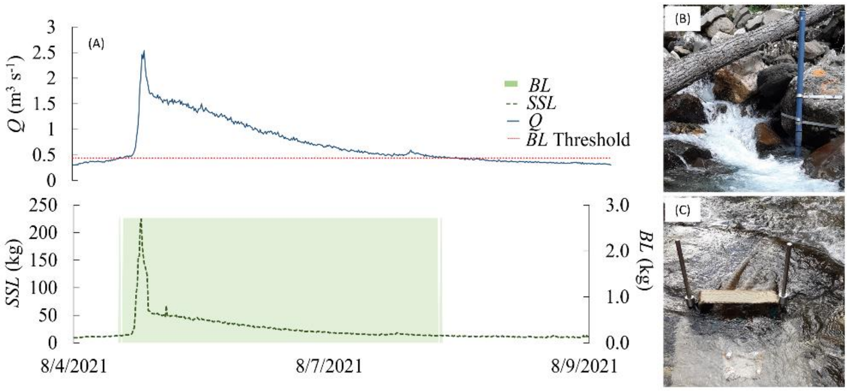

Figure.1 (A) *Q* (blue line), *SSL* (green dotted line) and *BL* (green area) experienced by the Rio Cordon during the Event 4 (EV_4) at CSB, as way of example. The red dotted line indicates the *Q* for initiation of *BL* motion. (B) Multiparameter sonde and (C) Bunte trap used to measure the *SSL* and *BL*, respectively.

Results show different behaviors between *SSL* and *BL* processes (Table 1). On the one hand, *SSL* was consistently higher in CSB compared to CSA, except for the event 1. On the other hand, *BL* was always higher in CSA rather than in CSB. Also, for both cross-sections, the *SSL* fractions (SSL_f) ranging between 0.85 and 1.00 always exceeded those of *BL* (BL_f) that ranged between 0.15 and 0.02. Overall, this suggests that the windstorm-affected area may still be (i) an active source of suspended sediment due to the ready-available fine sediment and bare soil of the eroded banks but also (ii) a spot that promotes bedload deposition due to the ongoing process of morphological stabilization and the post-event wider active channel. Further monitoring and analysis are needed to better understand and compare the data with the pre-windstorm condition.

Table 1. Summary of the parameter measured during the five flood events recorded between July 2021 and June 2022

Cross-section	Event	Q_{peak}	*SSL (t)*	*BL (t)*	*TL*	SSL_f	BL_f
CSA	EV_1	0.62	86.10	5.07	91.17	0.94	0.06
CSB		0.80	78.26	2.20	80.45	0.97	0.03
CSA	EV_2	0.63	73.07	7.52	80.59	0.91	0.09
CSB		0.76	89.28	3.24	92.52	0.96	0.04
CSA	EV_3	0.76	6.70	0.30	7.00	0.96	0.04
CSB		1.04	8.35	0.16	8.51	0.98	0.02
CSA	EV_4	1.8	93.72	16.14	109.86	0.85	0.15
CSB		2.54	123.02	8.67	131.69	0.93	0.06
CSA	EV_5	1.02	168.41	2.24	170.65	0.99	0.10
CSB		1.71	353.58	0.77	354.35	1.00	1.00

Keywords: Mountain basin; Flood events; Sediment transport; Suspended sediment load; Bedload

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