

Debris-flow monitoring Matter Valley: Data acquisition for hazard and risk analysis



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Introduction

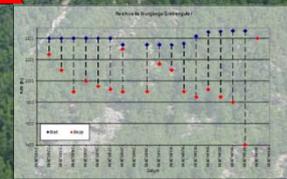
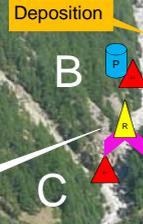
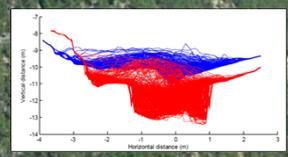
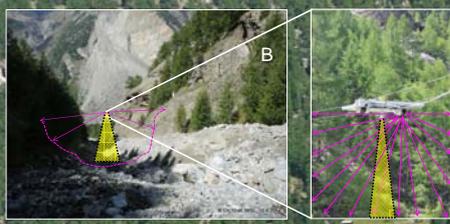
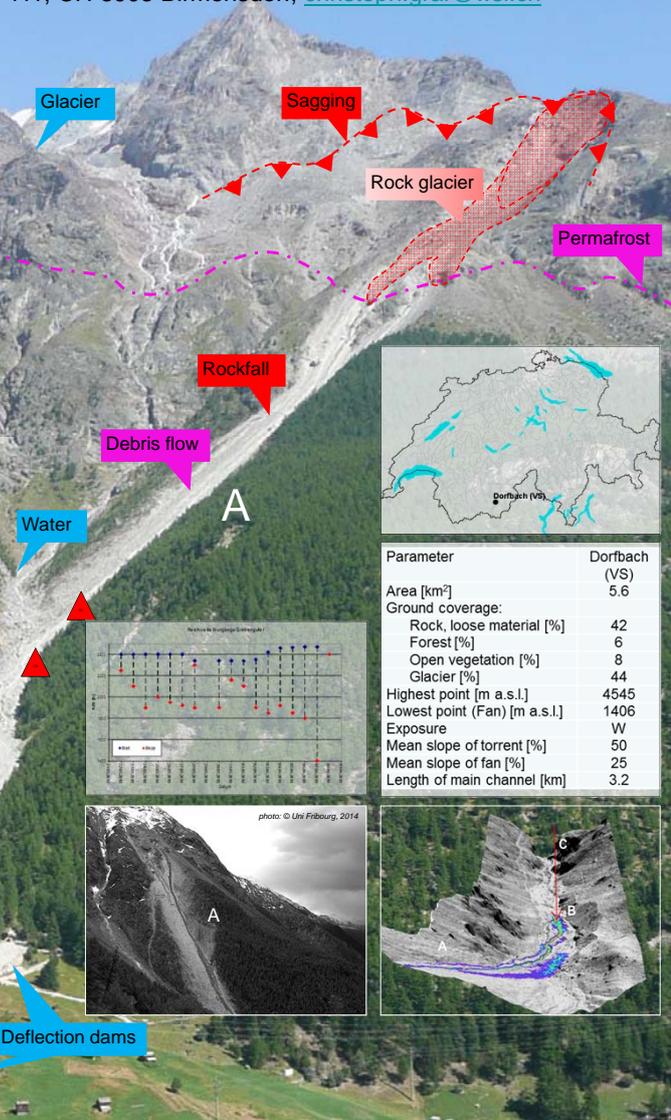
Degradation of permafrost in Alpine environments causes a reduction of the stability of slopes. As a consequence there is more loose material available in the active permafrost layer. It may be transported by erosion into the torrents and intense rainfall may lead to catastrophic events. Settlements and roads in the Alpine valleys are now faced with a persistently changing hazard situation. Recent observations show that thawing permafrost and collapsing fronts of fast-moving rock glaciers lead to instable slopes in the Matter Valley.

Dorfbach

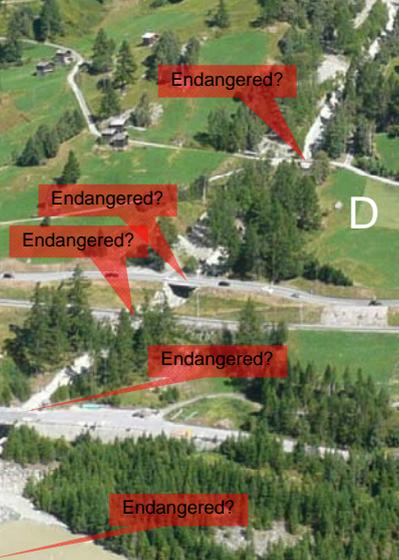
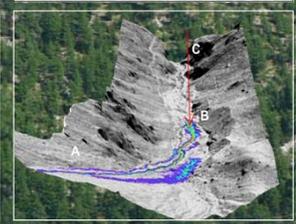
The Dorfbach in Randa is a steep Alpine torrent on the right hand side of the upper Matter Valley in the Swiss Alps. Since 2009 it shows increased debris-flow activity due to a destabilized rock glacier directly linked to the stream. While many small debris flows stop in the transit zone (A - C) and deposit a large amount of debris, bigger events reach the fan (D) and the receiving river (E). Several other steep torrents nearby show similar activity.

Monitoring

In summer 2010 WSL installed an automated debris-flow observation station to monitor the torrent. The station is equipped with geophones (Geospace, DX-20) to trigger the system and to provide information on the propagation of debris-flow fronts. Flow heights are measured by radar (Vega, Vegapuls 68) and profile laser (Sick) devices including a "laser curtain" to acquire flow-surface elevation data. The station is additionally equipped with a video camera (Mobotix, M24M) and rainfall is measured within the catchment. Data is stored locally by Dataloggers (Campbell, CR216X, CR800, CR1000) and transmitted via the radio system by Campbell and by GSM using routers (NetModule).



Parameter	Dorfbach (VS)
Area [km ²]	5.6
Ground coverage:	
Rock, loose material [%]	42
Forest [%]	6
Open vegetation [%]	8
Glacier [%]	44
Highest point [m a.s.l.]	4545
Lowest point (Fan) [m a.s.l.]	1406
Exposure	W
Mean slope of torrent [%]	50
Mean slope of fan [%]	25
Length of main channel [km]	3.2



Debris-flow events
Since 2010, several debris-flow events triggered the observation station (ten's of small events were missed, that stopped further up of the station). Every year, at least two debris flows occurred, reaching the receiving river. A first event peak can be observed typically in June late afternoon triggered by snow melt. A second period starts end of July and ends in autumn. These events are typically triggered by heavy rainfall. Event volumes ranged from 100 m³ to 12'000 m³. More events are expected in the next years.

Literature

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www.wsl.ch/mattertal

www.wsl.ch/ramms

Project «Hazard mapping Mattertal»
WSL was leading an applied research project to survey torrents and to model debris-flow events. The numerical mass movement model RAMMS has been calibrated with the monitoring data and is being used to analyze various hazard scenarios to define zones at risk as a basis for planning of protection measures.