

Improvement of process identification and discharge measurement by the combination of different sensors

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The Lattenbach is a very active torrent located in a geologic fault zone in the western part of Austria with a catchment area of 5,3 km², feeding the river Sanna, which is a tributary of the river Inn. The highest elevation in the watershed is around 2900 m above sea level (asl), the confluence with the river Sanna at 840 m asl. Both, the village Grins in the middle reach of the torrent and the village Pians at the outlet of the catchment, are affected by the hydrologic and geomorphic processes within the watershed.

Aside from the 'regular' flood events with bedload transport in spring and summer, the torrent produced five debris flows and three debris flow-like events within the last years (16/08/15, 09/08/15, 26/08/12, 10/07/10, 01/09/08, 20/06/07, 30/08/07 and 22/08/05, respectively).

Due to the frequent debris flow and debris flood events the torrent is monitored by the Institute of Mountain Risk Engineering since several years. The parameters that are currently measured during an event includes meteorological data (rainfall, temperature, etc.) in the upper part of the catchment (station Dawinalpe) and run-off data from the middle and lower reach of the torrent at the villages Grins and Pians.

In the last years the monitoring equipment has been improved:

Since July 2013 a first version of a warning system based on a combination of infrasound and seismic data is installed at the monitoring station closed to Grins. This system is build up on a minimum of one seismic and one infrasound sensor which are co-located and a microcontroller which runs a detection algorithm to detect debris flows with high accuracy in real time directly on-site. The detection algorithm is based on an analyses of the evolution in time of the frequency content of the infrasound and seismic signals produced by a mass movement and has already been tested at several test sites in Austria, Italy and Switzerland.

Further a high frequency pulse Doppler Radar has been installed which provides the opportunity to measure the surface velocity of a debris flow. Together with a recently installed 2D-Laser Scanner this setup provides the possibility to get a very precise approximation for the discharge. Therefore the cross sectional wetted area is multiplied with the mean surface velocity of the related range gate within a time step of one second.

This method has already been successfully applied to a debris flow which took place on the 09.08.2015. It was a medium sized event with two surges and a peak discharge of 64 m³/s. The average velocity measured by the high frequency Radar ranges from 0,7 to 4,3 m/s and the cross sectional wetted area measured by the 2D Laser was up to 18,6 m². The total debris flow volume over the measurement time of one hour was calculated to ~16.000 m³.