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Toward an operational use of debris-flow monitoring stations

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The detection and the characterization of both debris flows and their occurrence conditions using monitoring stations was increasingly developed during the last two decades. The devices operate with various types of sensors and techniques, and in particular rain gauge, ground vibration sensors, flow stage sensors or video cameras. In case of debris-flow detection, such sensors make it possible to estimate the peak flow depth, the mean flow velocity, the flow discharge and the transported volume. These flow characteristics as well as the occurrence frequency are quantitative information relevant for hazard assessment. The multiplication of instrumented debris-flow prone sites could improve the evaluation of regional influences which affect, for instance, the occurrence conditions used in regional early-warning system. However, because debris-flow monitoring stations have to operate in harsh conditions and require both, strong maintenance and time-consuming post-processing, their use in operational context is still limited.

A key element of the post-processing relies on the seismic signal from geophones. Indeed, such a signal is used for the recognition of the flow process involved and for estimating the surge velocity. Because very high frequency recording is not suitable for such monitoring stations, the seismic signal has to be conditioned while maintaining flow signature. We developed an electronic interface for analogically processing the raw signal, similarly to the so-called amplitude method: it allows us to preserve the signal energy while degrading the temporal resolution. For dealing with the continuum of sediment processes, from bedload transport to debris flow, but also with the sensor sensitivity to vibration source distance, the system has been adapted. A better characterization of the sediment transport process is expected. It should improve the automatic classification of rainfall events responsible for large, small and no flow occurrence.

Finally, the advent of new sites equipped with monitoring stations should benefit from past experience. Thus, (i) the use of environmental stations with low power consumption, (ii) the development of remote monitoring web interface which allows the operator to be reactive on maintenance and field visit, (iii) the application of event mode for optimizing data storage, and (iv) the development of semi-automatic tool for assisting the post-processing facilitate the system integration and promote new installations.