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Set-up of debris-flow monitoring stations in the Eastern Pyrenees. Preliminary results and first experiences.

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Direct observations of debris flows in the field by monitoring stations are of great importance to improve understandings of triggering, flow behaviour and accumulation of debris flows. Upon the knowledge of the authors, in Europe debris-flow monitoring stations are only situated in the Alps (Italy and Switzerland), while no test site is located in a catchment affected by Mediterranean climate.
In 2005, the first monitoring system was set up by GEOBRUGG IBERICA SA in the Erill catchment, situated in the Axial Pyrenees. A flexible ring net VX160-H4 with load-cells was installed together with a video camera and four geophones. In addition, a meteorological station completed the instrumentation. During 2009, the monitoring of two additional catchments has been set up; Senet in the Axial Pyrenees and Ensija in the Pre-Pyrenees. Four geophones and one ultrasonic device are installed along the torrent in order to determine the flow velocity and flow depth/discharge of the events. As in Erill, a meteorological station completes the devices and measures rainfall and temperature.
The main objective of the three monitoring stations is to get some insights on how the Mediterranean climate influences the critical rainfall for debris-flow initiation. The flow behaviour of debris flows is another major goal, while the Erill test site focuses basically on the effectiveness of flexible ring nets. In addition, the Erill installation also acts as protection for the village located on the fan.
The calibration, installation and analysis during the testing phase showed that a correct implementation of the different sensors is not an easy task and needs knowledge in geophysics, electronics, telecommunications etc. Especially geophones and ultrasonic devices need special attentions. Geophone outputs are strongly affected by the type of underground and the distance to the torrent, while the measures of the ultrasonic sensor clearly depend on the temperature. To simplify the data storage and processing, geophone signals are converted into impulses. This involves definition of a threshold to filter seismic “noise” caused by other processes. An additional difficulty in our test sites is the remoteness, which needs an independent power supply by solar panels and GSM-transmission of the data gathered.
In Senet and Ensija catchment, hyperconcentrated flows have been observed during summer 2009 by field surveys, although these events could not have been clearly detected by the geophones and the ultrasonic device. Thus, only the critical rainfall amount for generating such type of flows could be analysed. These data support the hypothesis that short-lasting and intensive summer storms are common triggering precipitations for hyperconcentrated flows and also for debris flows.
In Erill, three small events with volumes of a few hundreds of cubic-meters have been occurred till now. All of them were stopped by the flexible ring barrier, while the barrier has been self-cleaned by the natural dynamics of the stream. Such events (hyperconcentrated flows) are allegedly exceptional; therefore the flows have been generated as consequence of high intensity rainfall, very common in this area. For this reason it’s thought that the debris flow phenomenon and the trigger conditions should be studied in detail, to achieve the required knowledge to calculate the future impact loads and scenarios.