

# DEBRIS FLOW ALARM SYSTEM SPREITGRABEN



GEORADAR



LEVEL MEASUREMENT



ALERTING

Outgoing debris flows at the Spreitgraben are detected at an early stage by a sophisticated monitoring system. If the Grimsel Pass road is endangered, the system automatically closes the road and sends out an alarm.



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Title Page: Spreitgraben – the channel is approximately 50 m wide and 30 m deep.

Figure 1: The system consists of several sub systems combining event detection and alerting control. Located at different sites within the terrain, the sub systems and are redundantly connected through radio (left). Laserscanner (right).

## SITUATION

Thawing permafrost was held responsible for several rock fall events that initiated in the north face of the Ritzlihorn (3263 m asl) in the Bernese Oberland in 2009. Up until 2011, large debris flows followed every summer after those events, depositing several 100'000 m<sup>3</sup> of debris in the Aare River, causing significant aggradation. The debris flows have eroded a deep channel into the landscape and repeatedly threaten the road acting as only access to the local village as well as a major mountain pass named Grimsel. The main transit gas pipeline connecting Northern Europe and Italy was even relocated to the opposite side of the valley due to the debris flow hazard.

## SOLUTION

Geopraevent installed a comprehensive monitoring system for road security including automatic road closure and local authority alert. Additionally, all data is continuously recorded in order to improve the understanding of the physical processes causing the debris flows. The monitoring system consists of the following components:

- Several trigger lines spanned across the channel
- Two radar gauges to estimate flow height and debris flow magnitude



Figure 2: Radar measurements are used to detect movements in the rupture zone of the debris flow.

- Two laser profile scanners that permanently examine the channel profile
- A Doppler radar for detection of movements in the starting zone of the debris flows
- Four webcams with live-access and infrared flood lights that allow day and night alarm verification

The online data portal combines all components and illustrates their data with around the clock access for authorized users.

The different measurement devices converge into one system that is itself linked to the a set of alert equipment. In case a critical threshold is exceeded, the system detects an event and triggers an alarm. The alarm sets off different alert mechanisms, such as automatic road closure by means of traffic lights, alarm lights and horns as well as text messages to local authorities.



Figure 3: Several traffic light automatically close the road in case of an event. Further information on the closure reason is displayed for the waiting motorists.