



# MONITORING SOLUTIONS FOR NATURAL HAZARDS

# WHAT DO WE DO?

Rockfall, landslides, debris flows, floods, avalanches and glacier lake outbursts threaten infrastructure and its users. In such situations, electronic monitoring systems can complement or even replace structural measures. Often at lower cost and with a smaller environmental impact.

Geoprevent has been the leader for many years in monitoring natural hazards. Together we design, develop, install and operate monitoring systems for:



## ROCKFALL

- Detection of rockfall in real time with automatic alerts
- Identification of unstable zones
- Monitoring of slightest rock displacements



## LANDSLIDE

- Detection of landslides in real time with automatic alerts
- Automatic images of the event
- Rain measurement with notification in case of torrential rainfall



## AVALANCHE

- Detection of avalanches in real time with automatic alerts
- Images/videos of the event
- Tracking/mapping of avalanches

## CORE COMPETENCES



## DATA ANALYSIS

- Password-protected online data platform
- Cloud-processing of the measurement data
- User access via PC, tablet or smartphone



## ENERGY SUPPLY

- Autonomous energy supply everywhere
- Energy-efficient system design
- Multiple power sources for redundancy in critical systems



## COMMUNICATION

- Reliable communication systems for data and alarm transmission
- Simultaneous use of various communication channels to guarantee redundancy

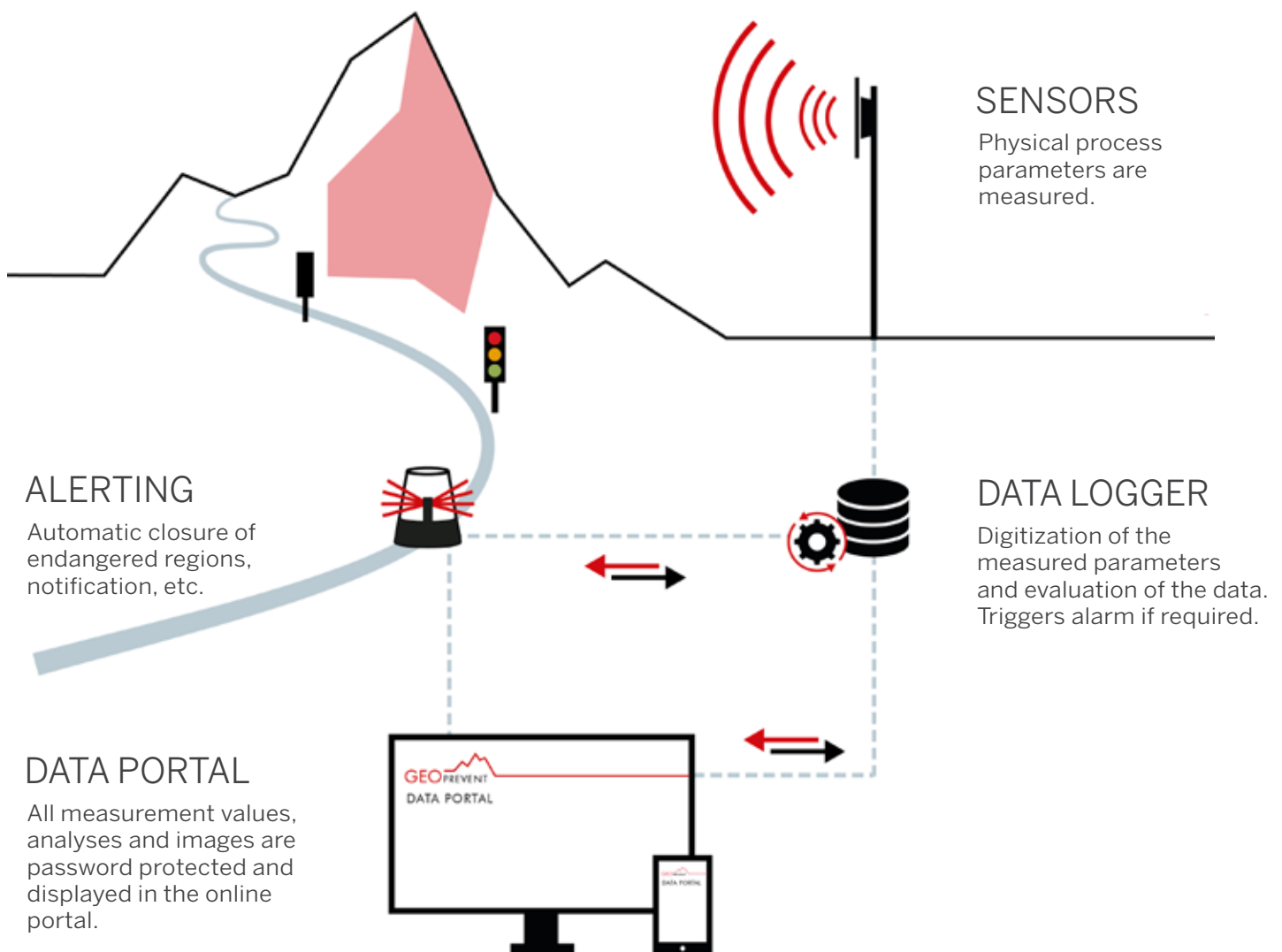


# MAKING THE INVISIBLE VISIBLE

In the electronic monitoring of natural hazards, we distinguish between two different systems:

**Warning systems** identify precursors to events. These enable measures to be taken in good time (e.g. closures, evacuations).

**Alarm systems** recognize the event itself. Alerts take place in real time so immediate protection can be guaranteed.



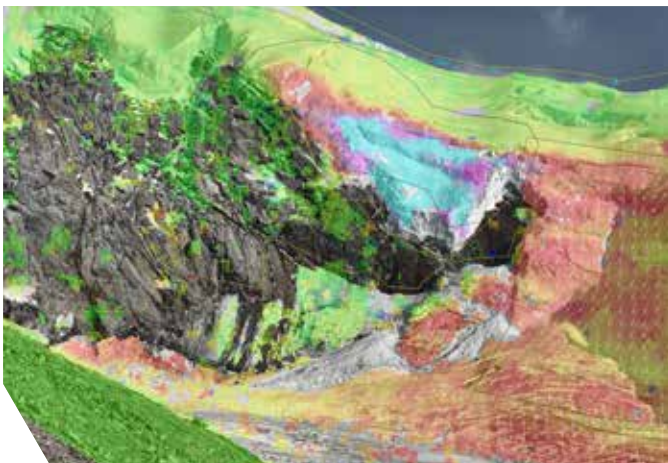
**A monitoring unit is a system solution and consists of various components. In order that the individual components can stand up to harsh environmental conditions, we implement several redundancy levels and carry out rigorous system tests.**

# WHAT SOLUTIONS ARE THERE?

## WARNING SYSTEM

## ALARM SYSTEM

<b>FUNCTION</b>	Signs of an upcoming event are detected measured	Automatic detection of the event itself
<b>ACTIONS</b>	Interpretation of the measured data by experts, possible actions are triggered "manually" e.g. evacuation	Instant, automated actions such as closures of roads, railways and evacuation e.g. of buildings
<b>WARNING TIME</b>	Hours - weeks	Seconds - minutes
<b>APPLICATIONS</b>	Processes that develop slowly and continuously such as rock mass movements or landslides	Spontaneously triggered processes or those that build up rapidly such as avalanches or mudslides
<b>MEASUREMENT PARAMETERS</b>	Deformation, precipitation, snow depth, flow height, temperature, activity (e.g. rockfall, avalanches), vibration	Deformation, velocity, pressure, flow depth, flow height, vibration
<b>APPLIED SYSTEMS</b>	<ul style="list-style-type: none"> <li>• Interferometric georadar</li> <li>• DEFOX® - deformation camera</li> </ul>	<ul style="list-style-type: none"> <li>• AVYX® - avalanche radar</li> <li>• ROCYX® - rockfall radar</li> </ul>
<b>EXAMPLES</b>	<ul style="list-style-type: none"> <li>• Permanent rock monitoring at Pizzo Cengalo, Bondo (Switzerland)</li> <li>• Landslide monitoring at Moosfluh, Aletsch region (Switzerland)</li> </ul>	<ul style="list-style-type: none"> <li>• Avalanche radar with automatic road closure, Holmbuktura (Norway)</li> <li>• Rockfall radar with automated road closure, Brienz (Switzerland)</li> </ul>



**DEFOX® - WARNING SYSTEM**

Glacier deformation measuring at Weissmies (Switzerland)



**AVYX® - ALARM SYSTEM**

Automated road closure in case of an avalanche at Zermatt (Switzerland)

# OUR SYSTEMS



## DEFOX®

**The deformation camera is a cost-efficient, wide-area solution for long-term monitoring of instabilities in rock and ice. The fully automated deformation analysis enables easy and fast detection of displacements.**

- Fully automated selection and analysis of high-resolution images with proprietary algorithms
- Long range and large coverage area
- Deformation rate time series of defined areas
- Flexible analysis interval for deformation analysis e.g. daily or weekly



## ROCYX®

**Automatic real-time detection of rockfall for monitoring rockfall activity or for immediate alerting e.g. road closure. The rockfall radar can be used to complement structural measures or as a stand-alone solution.**

- Reliable, real-time detection of falling boulders
- All-weather functionality (fog, rain, snowfall)
- Wide-area coverage
- Automatic closure and reopening of traffic routes
- Rockfall tracking and mapping in online data portal with password-protected user access at any time
- Automatic notification



## GEORADAR

**Wide-area monitoring for critical rock or glacier instabilities with sub-mm displacement accuracy. The interferometric georadar operates permanently in any weather at any time of the day. It enables early detection of imminent slope failures.**

- Permanent monitoring of instabilities in rock and ice
- High availability due to all-weather functionality (fog, rain, snowfall)
- Long-distance and wide-area coverage
- Deformation analysis of fast and slow movements (up to mm per months/years) with proprietary algorithms
- Early detection of slope failure, estimation of collapse time possible



## AVYX®

**Reliable, real-time detection and tracking of avalanches in all visibility conditions. AVYX® radar continuously scans the target slope for starting avalanches. As soon as an avalanche is detected the system automatically alerts e.g. via road closure and traffic lights.**

- Real-time detection of avalanches in starting zone
- All-weather functionality (fog, rain, snowfall)
- Long-distance and wide-area coverage
- Automatic closure and reopening of traffic routes
- Avalanche tracking and mapping in online data portal for password-protected user access at any time
- Automatic notification

# SAFETY MEETS ADDED VALUE

Besides providing real-time alerts, a monitoring system offers economic benefits with particular regard to the availability of infrastructure. Monitoring measures can make a decisive contribution to safeguarding housing, traffic routes, tourist destinations or industrial sites.

## PERMANENT INFORMATION

- Online data portal, automatic notifications
- Monitoring of instabilities possible in the millimeter range
- Event detection in all visibility conditions with tracking and mapping

## WIDE RANGE MONITORING

- Ideal supplement to structural measures for monitoring large, infrequent events
- Low landscape impact through remote monitoring

## UNDERSTANDING PROCESSES

Monitoring supplies valuable process information such as:

- Location of unstable zones, estimate of volume
- Movement speed/direction
- Event frequency, mapping, event images/videos, and many more

## MINIMIZING CLOSURES

- Traffic routes are closed automatically only in the case of an event
- Automatic re-opening: If the event does not reach the traffic route the closure is reversed

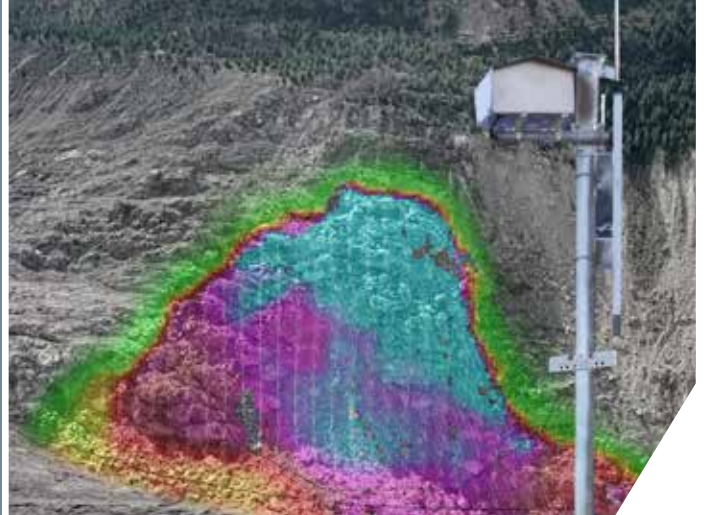
## INVEST IN SAFETY

- Cost-effective solution to increase safety
- Low maintenance costs
- Cost-efficiency through shortened closure times e.g. of transport routes or infrastructure

# WORLDWIDE APPLICATION – SOME REFERENCES

## LANDSLIDE MONITORING, MOOSFLUH, SWITZERLAND

- The **DEFOX® optical deformation camera** monitors the unstable slope from a safe distance
- **Sophisticated algorithms** automatically measure the velocity and time of the deformation
- **Automatic notification** of key personnel when deformation threshold is exceeded



## DEBRIS FLOW MONITORING, MT. KAZBEK, CAUCASUS

- **Level radars with webcam:** Detects a debris flow event and automatically closes the waiting area for traffic at the Georgian-Russian border
- **Webcam** for glacier monitoring
- **Trigger lines:** Redundancy to level radars; in the case of an event, they are pulled out; also, automatic road closure







## AVALANCHE ALARM SYSTEM, HOLMBUKTURA, NORWAY

- The **AVYX® avalanche radar** observes several avalanche tracks with a range of up to 4 km
- **PTZ-camera** (pan-tilt-zoom): It records avalanches automatically or if required provides a situation overview at any time
- **Thermal imaging camera**
- **Automatic closure** at risk and reopening of road sections





-  Headquarter & production facilities
-  Subsidiaries
-  Sales offices
-  Partners

EN.200630



Your local GeobruGG specialist:  
[www.geobruGG.com/contacts](http://www.geobruGG.com/contacts)

**GeobruGG AG**  
Aachstrasse 11 | 8590 Romanshorn | Switzerland  
[www.geobruGG.com](http://www.geobruGG.com)

**A BRUGG GROUP COMPANY**