

## AVALANCHE RADAR



Automatic avalanche detection with radar technology in all-weather and at any time of the day. Real-time detection with alarm option for automatic traffic control.



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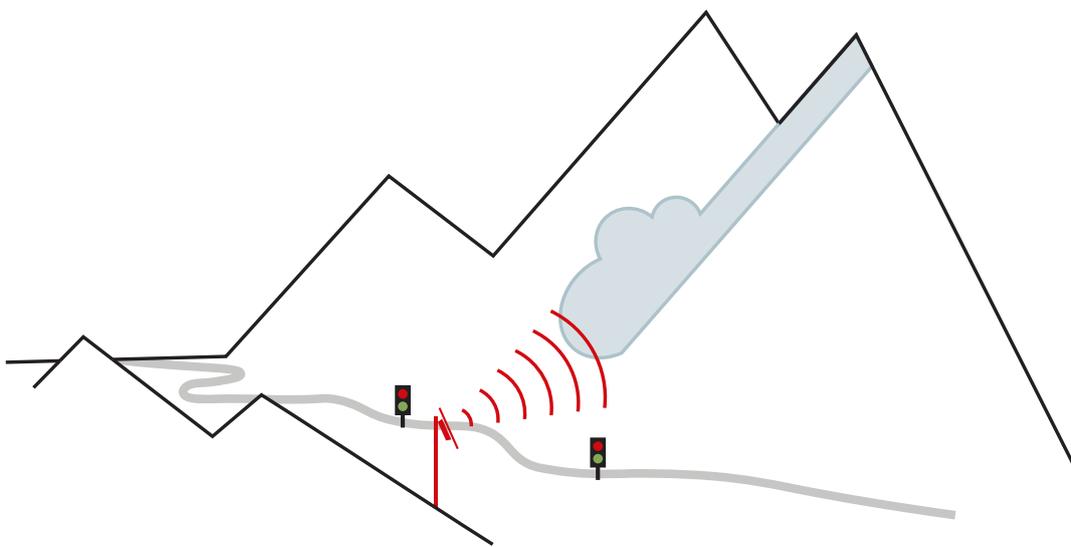


Figure 1: The avalanche radar monitors avalanche-prone slopes from the opposite valley side. It continuously scans the slope for avalanches independent of weather or time of day. Detected avalanches are tracked and illustrated on the online data portal. If linked to an alarm system, roads are automatically closed within seconds.

## OVERVIEW

The avalanche radar is a device for automatic detection and tracking of avalanches. The radar permanently scans the targeted slope for avalanche release. Once the radar detects an avalanche, it tracks the avalanche's path and size. Avalanche characteristics are transmitted to Geopraevent's online data portal and the avalanche is shown on an area map. Integrated cameras record videos of the event. Additionally, remote camera access is available via the online data portal, allowing for convenient and quick inspection of the area. The avalanche radar can be linked to an alarm system enabling automatic traffic control measures, for example road closures.

## WHY RADAR TECHNOLOGY?

Radar is particularly suitable for the detection of avalanches and has several advantages over other technologies, particularly the ability to work in all-weather and at any time. Radar sees through snow and fog day and night. In addition, radar operates at distance and thus permits large areas to be monitored without the need to install instruments in dangerous zones (such as geophones). With a maximum range of 5 km, slopes of up to 10 km<sup>2</sup> can be monitored with a single radar.

Given that the measuring device is installed at safe distance (usually the counterside of the slope), the avalanche radar is not affected by avalanches. Along with avalanche detection, radar technology can track and assess the size of an avalanche. This ability enables the triggering of a real-time alarm system, e.g. road control measures (traffic lights, gates), if the distance between detection and alarm system location is sufficient.



All-weather



day/night



in real-time



## RADAR POSITION PARAMETERS

In order to guarantee the area of interest is visible by the radar (and to maximize the scannable area), careful selection of the radar location is vital. Initially, potential radar positions are simulated by using a digital terrain model. Appropriate radar locations are then assessed by simulating the radar's view and range from the proposed positions (Figure 2). Along with the view criteria, the position must consider electricity and communication availability. If required, alternatives for electrical power supply and communication can be provided (e.g. fuel cells, solar power or radio).

Further crucial radar parameters are the horizontal ( $\alpha$ ) and vertical ( $\beta$ ) antenna opening angles. Figure 3 illustrates how the combination of these angles outlines the radar's view. The horizontal angle (max.  $90^\circ$ ) defines the width of the visible area, whereas the vertical angle (usually around  $20^\circ$ ) sets the area's height. These settings are location-specific and can be adjusted as required.

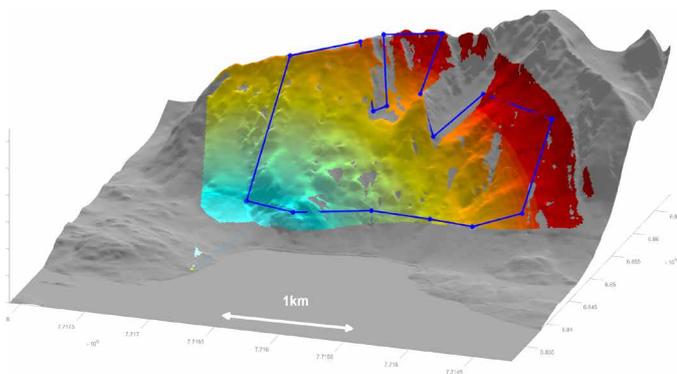


Figure 2: Simulation of the radar's view from a given location. The scale represents distance in metres (red = 3000 m).

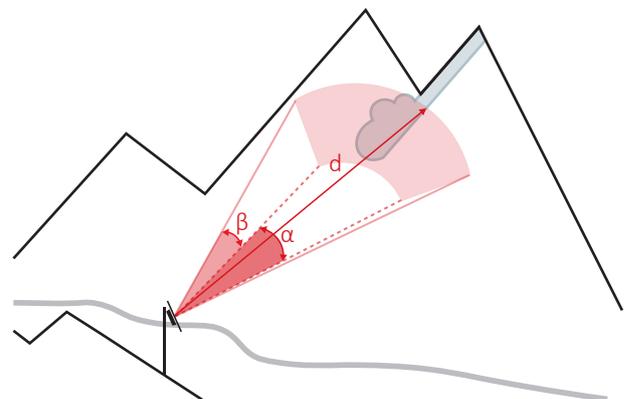


Figure 3: Important parameters: horizontal radar angle ( $\alpha$ ), vertical radar angle ( $\beta$ ) and distance ( $d$ ).

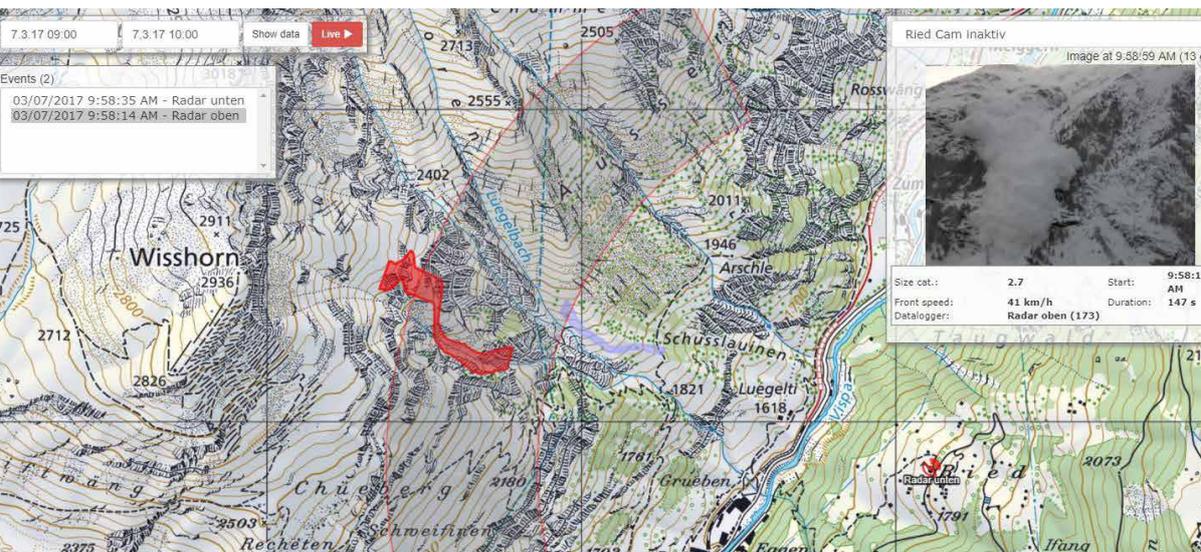


Figure 4: Area map with a detected avalanche, tracks and characteristics. The camera can also be controlled remotely via the online data portal.

## COMPREHENSIVE SOLUTIONS

Avalanche radar solutions come as a complete system and include electricity and communication options as required. Important parts of the system are designed in a redundant way, particularly if it is installed as an alarm system.

### ONLINE DATA PORTAL

Our online data portal combines station data of all measurement devices (radar, cameras, traffic lights etc). Authorized personnel can access the online data portal 24/7 with a personal login. The data portal shows information on the detected avalanches including tracks and characteristics, along with event videos automatically recorded by integrated cameras (Figure 4). Additionally, the online data portal provides access to all cameras connected to the system for live inspection of the area at risk.

### CAMERAS

A PTZ-camera (Pan-Tilt-Zoom) installed on the radar mast observes the slope and automatically records the detected avalanches. In the case of an alarm system, additional cameras are mounted in the area at risk (e.g. on the barriers or traffic lights) for automatic event recording and remote inspection at any time (e.g. after an avalanche).

### SERVICE

The online data portal is permanently serviced and updated by the Geopraevent team in Switzerland. We constantly monitor the condition of all our stations and respond where required. The intervention time depends on customer requirements (min 6 h, max 1 week).

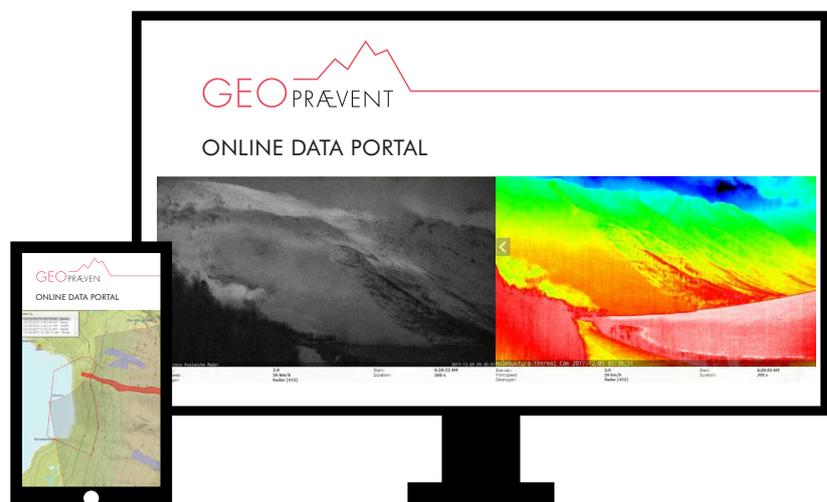
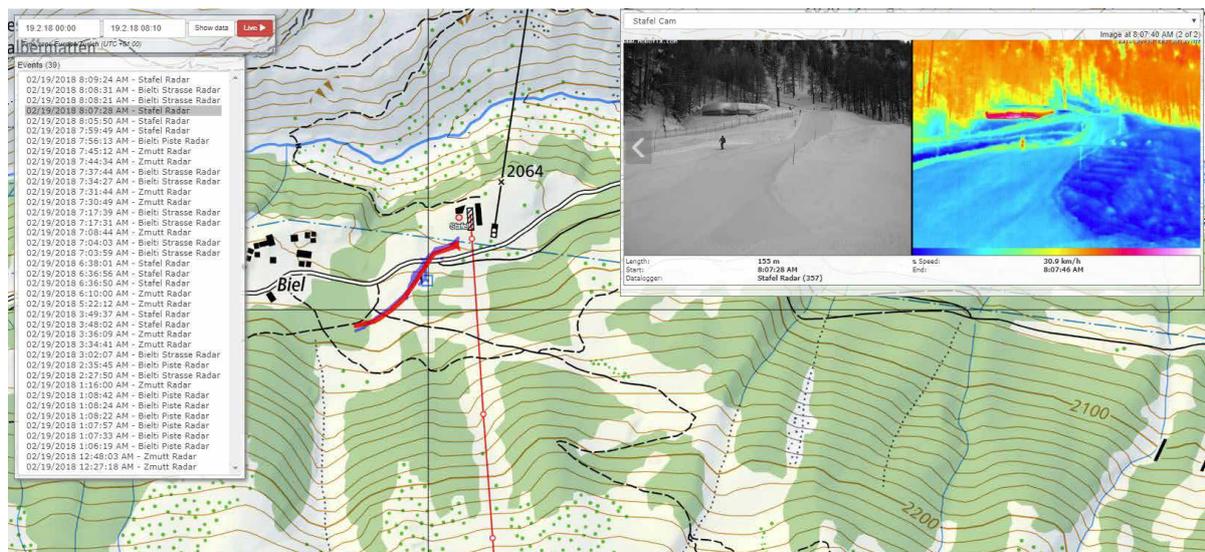


Figure 5: The people detection radar identifies moving objects and tracks them on the area map.



## ADDITIONAL OPTIONS

The avalanche radar can be combined with various additional options. In the following, a number of such options are described. However, this list is not exclusive and we are always happy to discuss other or further customer requirements and solutions.

### PEOPLE DETECTION RADAR

The people detection radar is a convenient add-on to the avalanche radar system, particularly if avalanche control work is carried out. This type of radar detects moving people, vehicles or other objects within a range of 1500 m and tracks them in real-time. The people detection radar also operates in all-weather and at any time of the day (Figure 5).

### ALARM SYSTEM

Another common add-on to the avalanche radar is the alarm system. Often used for safety management of roads or railways, the alarm system is used to automatically close road sections at risk by means of traffic lights or barriers. In addition, emergency managers or authorities are informed by text messages, emails or calls (Figure 6).

### ANTI SNOW SYSTEM

Certain snow conditions (heavy and wet snowfall) can cause temporary snow accumulations on the radar antenna. Whereas the radar sees through snowfall without any problems, it suffers from significant range loss under snow accumulations. The specially designed anti-snow system removes potential accumulations and ensures maximum radar range at all times.

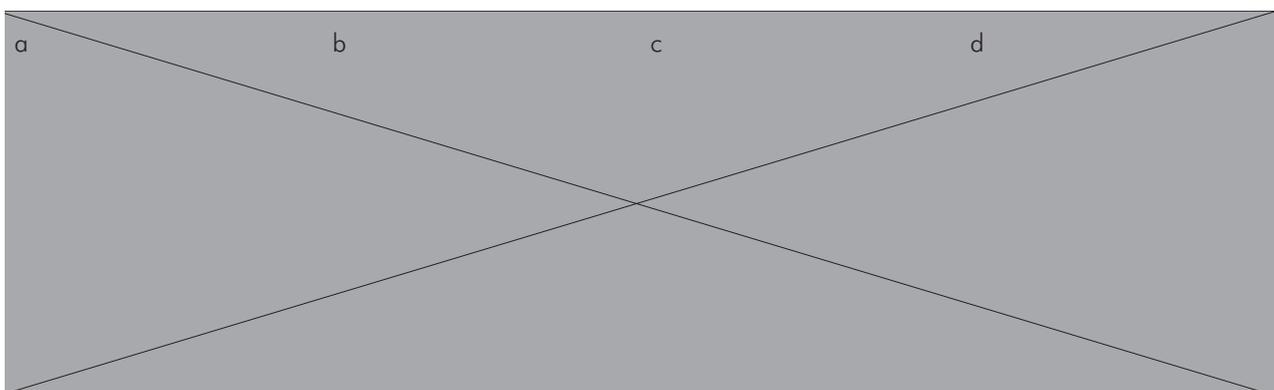


Figure 6: AVALANCHE ALARM SYSTEM: The avalanche radar continuously scans the slope (a) and detects a starting avalanche with potential to reach the road (b). The radar automatically triggers the alarm system for automatic road control (e.g. traffic lights, barriers, alarm sirens) and informs emergency managers (c). The road can be reopened automatically or manually. Cameras record the event and allow for remote viewing of the situation (d).



## REFERENCE PROJECTS

To date, Geopraevent has operated 20 avalanche radar systems internationally that have detected more than 2500 avalanches since 2014. The following customer projects provide insights into the application of our avalanche radar technology.

Please find more information and reference projects on [www.geopraevent.com](http://www.geopraevent.com).

### ZERMATT, SWITZERLAND

The famous tourist resort is situated at the end of a steep valley that is prone to avalanches. The only access road was frequently closed as a precaution. The installation of the avalanche radar including alarm system for automatic road control reduced the closure time of the road and acts as important tool for avalanche control work.

Read more: [Avalanche Radar Zermatt](#)

### HOLMBUKTURA, NORWAY

Holmbuktura bay is a notoriously avalanche-prone area located at a fjord in northern Norway. Seaside villages are only accessible by the road along the bay. Since 2017, a long-range avalanche radar has monitors the large slope from the side of the bay. The radar covers the entire area and has detected avalanches in a distance of more than 3.3 km.

Read more: [Avalanche radar Holmbuktura](#)

### RIGOPIANO, ITALY

On 18 January 2017, a large avalanche hit a hotel in Italy's Rigopiano and buried 40 people inside. Severe weather conditions aggravated the search and rescue operation and endangered emergency teams on site. 28 hours after receiving the request call, Geopraevent was on site and set up the avalanche radar to monitor the area for further avalanches.

Read more: [Avalanche alarm system Rigopiano](#)



## TECHNICAL DATA AVALANCHE RADAR

**Range:** 600 m to 5 km  
**Coverage:** 0.3 km<sup>2</sup> to 10 km<sup>2</sup>  
**Frequency:** 10 - 10.6 GHz  
**Bandwidth:** 10 - 50 MHz  
**Antenna opening angle:** 15° - 90°  
**Weight (without mast):** approx. 50 kg  
**Power consumption:** approx. 50 W

**Power supply:** grid power, solar panel, fuel cell  
**Software:** avalanche-detection-algorithm, online data portal  
**Integration:** online data portal, smartphone, tablet  
**Alarm:** automatic alert option, other alarm-functions  
**Installation:** quick, few hours



# ALARM AND MONITORING SYSTEMS FOR NATURAL HAZARDS

Geopraevent provides alarm and monitoring solutions for a wide range of natural hazards. We either monitor the hazard zone to measure precursors of an event or we detect the event itself and automatically trigger alarms. Geopraevent also provides technology to detect people in the hazard zone (e.g. prior to avalanche blastings).



ROCKFALL



FLOODS



GLACIERS



LANDSLIDES



GLACIAL LAKES



AVALANCHES



DEBRIS FLOWS



SAFETY NETS



PEOPLE

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