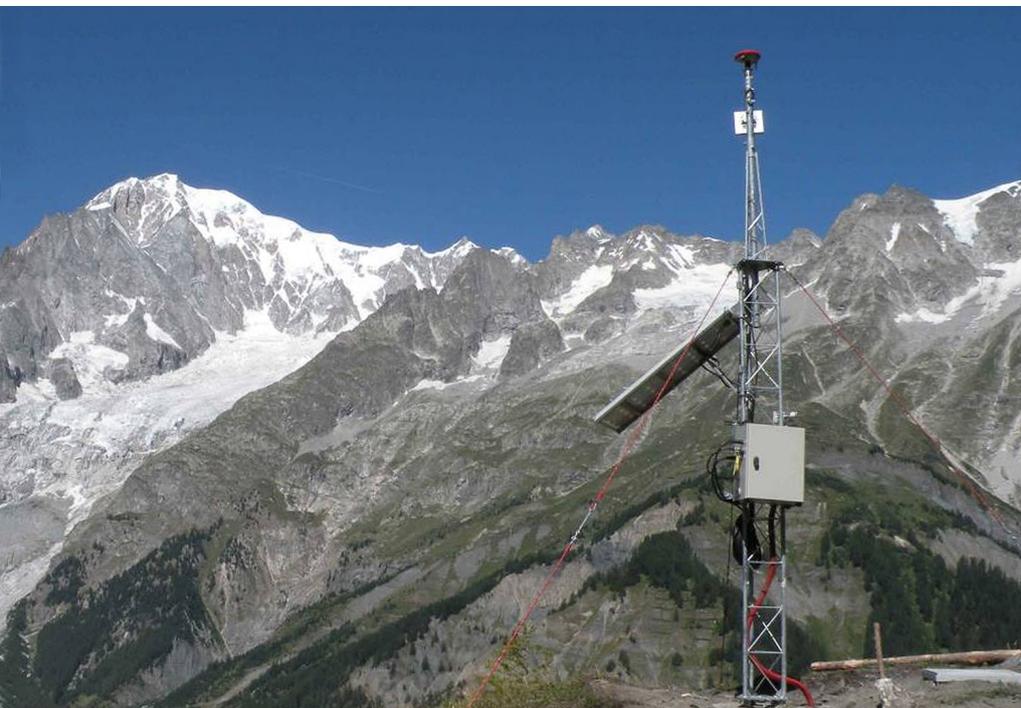


Leica Geosystems **TruStory** Monitoring to Secure an Area With Hydrogeological Instability



■ Scope/Objective

Automatic and continuous monitoring of a mountain slope affected by hydrogeological instability

■ Customer/Institution

The Region of Valle d'Aosta

■ Challenge

Continuous monitoring of any movements in the area for activation of the Civil Protection plan

■ Date

July 2009 - ongoing

■ Location

Valle d'Aosta, Italy



The Aosta Valley (Valle d'Aosta) is a mountainous semi-autonomous region in north-western Italy. It is bordered by Rhône-Alpes, France to the west, Valais, Switzerland to the north and the region of Piedmont to the south and east. With an area of 3,263 km² (1,260 sq mi) and a population of about 130,000, it is the smallest and least densely populated region of Italy. It is an Alpine valley that, with its side valleys, includes the Italian slopes of the Mont Blanc (Monte Bianco), Monte Rosa and the Matterhorn.

Some areas are affected by slope instability called DGPV (Deep-seated Gravitational Slope). The main State Road 26 section accessing the Mont Blanc Tunnel, as well as the districts of Entrev and Palud are influenced.

Since 2000 the Region of Valle d'Aosta and the department for "Inspectorate for public works, soil conservation and water resources - Geological Service" have carried out a series of surveys in order to gain in-depth knowledge on the instability and to understand its dynamics.

As a result, today this area is monitored 24 hours, 7 days a week with a fully automatic and integrated deformation monitoring system. The system combines geodetic and geotechnical instrumentation as well as ground radar measurements.

Based on the surveying results of the last years and the importance of the regions, dedicated monitoring points on the slopes have been selected for automatic deformation monitoring and stability analysis. About 30 monitoring prism and

Project Summary

■ Instruments

Leica TCA2003 Total Station
Leica NIVEL210 Tilt Sensor
Leica GMX902 GG
Leica AS10
Leica GMX901 with communication box
Leica Geosystems Monitoring prisms
Master Unit PC

Software

Leica GeoMoS Monitor
Leica GNSS Spider
SystemAnywhere (data synchronisation & calculations) and Analysis (data view)

Communication

Wireless LAN
GSM/GPRS

Office

Analysis

5 reference prisms are installed. These prisms are measured with a Leica TCA2003 total station every hour. The total station is installed in a stable area with a pillar secured to a rock on site. In addition, a dual axis inclination sensor Leica Nivel210 is installed to verify the stability of the station with an independent sensor. Near to the Leica TCA2003 total station, a separate GMX902 GG receiver with Leica AS10 antenna is installed. Also, several Leica GMX901 have been installed with co-located prisms that record data with 1Hz. The monitoring prisms and the Leica GMX901 are installed over the slope to monitor critical positions.

Commonly for alpine valleys, human access to the monitoring sensors is very limited. All installed equipment requires a reliable and autonomous energy source that guarantees that the equipment works properly. Due to the amount of snow and the reduced solar irradiation during winter months, a combined power supply system was installed for continuous power and recharging



of the buffer battery on site. The power system consists of solar panels and a methanol tank system. A special electronic device controls automatically and intelligently the correct power input to the monitoring equipment between the solar panel and the methanol tank system.

The complete automatic monitoring system is left unattended in the remote environment of the Aosta Valley. The total station and the Leica GMX receivers are managed by Leica GeoMoS and Leica GNSS Spider, which are installed on a master computer (embedded industrial PC), located inside the total station measurement hut. The total station, the Leica GMX902 GG sensor and the Leica Nivel are connected via cable to the master computer and the GMX901 sensors are connected via 5GHz wireless link.

The acquired raw data from Leica GeoMoS and Leica GNSS Spider is downloaded from the monitoring site, with the software called SystemAnywhere, to another dedicated monitoring system computer



■ Benefits

- Study of landslide dynamics
Protecting the safety of the population
- Analysis and study of an efficient integrated approach to multisensor monitoring

located in the headquarters of the customer. This SystemAnywhere retrieves the pure raw data and then automatically computes the total station corrections as orientation, free station, ppm etc. Total station and GNSS baselines are combined and limit checks computed.

In case the three different set limit thresholds are exceeded, the responsible staff member in charge is informed and the required actions are taken to ensure the safety in the Aosta Valley.

As a result, the monitoring system includes two independent geodetic measuring sensors, total station and GNSS data, that increase the reliability of the system. The data is correlated for further evaluation.

This autonomous monitoring system is beneficial for the Aosta Valley, as continuous monitoring data is collected and analysed providing detailed deformation information. In addition, messages are sent to notify the required personnel of exceeded limit levels providing advance warning of possible problems and protecting the safety of the local population.