

Automatic snow and weather stations in the Swiss Alps

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In the last few years automatic snow and weather stations have become an important tool for practitioners dealing with alpine hazards in the Swiss Alps. By now more than 150 of our automatic snow and wind measurement stations for avalanche warning (cf. figure 1), 15 alarm stations for different alpine hazards and scientific stations on glaciers provide important data for warning, protection and scientific research. These stations are operated autonomously throughout the year. They run under high alpine environmental conditions with a minimum of maintenance. The understanding of the physically correct way of measuring is as important for obtaining good and reliable data as is an optimal design of the stations. This includes the data acquisition, energy supply and communication subsystems as well as the mechanical structure. Furthermore, the wide range of available sensors and the use of specifically developed measurement systems offer interesting solutions for automatic stations on glaciers.



fig. 1: automatic snow station for avalanche warning (Simplon 2420 m.a.s.l.)

Most of our stations are based on dataloggers from Campbell Scientific³. With these devices, virtually every type of sensor signal can be logged with high resolution and quality. Additionally they offer a wide range of programming features and are completely controllable and programmable from a remote location.

Measurements

The standard meteorological parameters like windspeed and direction, air temperature and humidity or atmospheric pressure are measured on most automatic stations. Parameters like snow depth, infrared surface

temperature, short wave radiation, snow and ground temperature, snow wetness and density or snowdrift characterize the properties of the snowpack. Moreover, radiation or energy flux balances, water pressure and level measurements, drilled temperature profiles, dislocation measurements, extensometers or TDRs can be logged without any problem.

Camera system for observations on glaciers

Our autonomous camera system has been specifically developed for operation under harsh ambient conditions. Due to its high-resolution digital camera it is well suited for detailed observation of slow movements like the opening of crevasses. The images can be stored in the

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camera system or transmitted by a data link. The solar power supply and the rugged, double-walled metallic housing allow a maintenance-free autonomous operation even under high alpine environmental conditions. Figure 2 shows an image of the Trift glacier in the Swiss Alps taken with an automatic camera.

Distributed measurements

The use of a simpler type of datalogger with spread spectrum radios allows flexible configuration of sub-networks composed of a data concentrator and distributed sensors. Thanks to this technology it is possible to link the data from distributed measurement points without having to connect them by cable but all the same at low costs.

Power supply and communication

In most cases our automatic weather stations have to run completely autonomously and with high reliability throughout the year. For this reason they are optimized for low power consumption and equipped with a solar power supply.

Measured data can be stored in the extendable internal memory of the station and read out manually. Of course data transfer over a radio, GSM or satellite link is possible as well. Additionally complete control and programming from a remote location can be achieved using a communication link.

Mechanical construction

For our normal stations we use a standard 6.5m steel pylon, which is mounted on three anchors. For smaller pylons up to 5m and subjected to a maximum torque of 3kNm we developed a special anchor system. This construction is particularly suitable for the use on ice-

and rock-glaciers because it is very flexible yet economical. The three arms of the anchor system can be adjusted to the shape of the terrain and can either be fixed to the surface or buried into the ground. Furthermore the anchor system can be mounted on any supporting platform. Thanks to the simple installation it can easily be removed and readjusted.

Well adapted and cost-effective solutions

The needs and circumstances for scientific measurement systems vary widely from case to case. So there is no need for standard solutions. We like to attack the challenge to find the optimal solution for your measurement problems making the most effective use of the available resources.



fig. 2: picture of the Triftgletscher taken by an automatic camera system