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SWA

The Snow Water Analyzer measures the Liquid Water Content (LWC) and the Snow Water Equivalent (SWE)

• Features and advantages

- Recording of the snow parameters
  - Snow water equivalent (SWE)
  - Liquid water content (LWC)
- Sensor integration via RS-485 or
- SDI-12 interface
- Not affected by ice bridging
- No site preparation
- No construction work required
- Maintenance free operation
- No parametrization needed, easy to install
- No antifreeze or other chemicals needed
- Information about SWE of the whole snow pack

• Automatic and continuous measurement

Measuring certain snow parameters can be a challenging task. Therefore several different variables have to be measured to provide reliable information about the whole snow pack. In addition, snow has a considerable variability in space and time. Until now, only punctual measurements for certain values were possible.

The Snow Water Analyzer using constitutes a revolutionary innovation for an automatic, continuous, and most important areal measurement of the parameters Snow Water Equivalent (SWE) and the Liquid Water Content (LWC). Due to the non-contact technology and the software build into the SWA, the significance and reliability of the data about the snow pack's state can be increased substantially.

The SWA enables a modern, up-to-date data recording with a high resolution over time. Moreover, the system helps to reduce the often dangerous and expensive employment of staff in wintry terrain.

• Measuring principle

Measuring snow parameters with GNSS data

The key element of the Snow Water Analyzer is the measurement of the Snow Water Equivalent (SWE) and the Liquid Water Content (LWC) of snow by a new GNSS based solution. Using a two-antenna set-up, installed before the snow season, the local snow parameters can be retrieved in a convenient way SWE (in mm) and LWC (in Vol.%) can be measured several times a day.

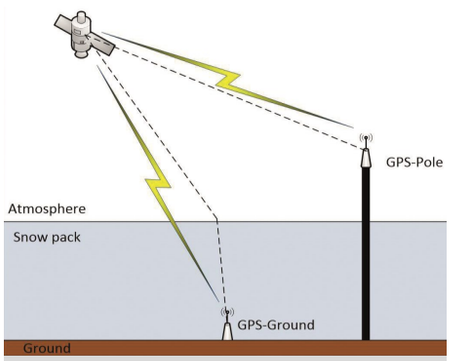

Fig. 1: Measuring principle of the SWA sensor

Measuring LWC

The Liquid Water Content (LWC) is determined by measuring the signal strength and comparing the signal damping to a the reference measurement at the time of installation without snow.

The LWC is causing a damp. The more liquid water in the snow pack, the stronger the damping.

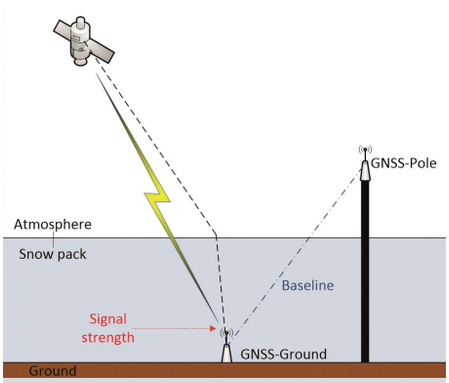

Fig. 2: Measurement of LWC

Measuring SWE

To measure the SWE the system uses two antennas: the one on the ground and one above the snow. The system uses the carrier phase shift between the baseline and the antennas on the ground and the reference above the snow pack. The snow pack and specially the SWE generate a phase shift between the two antennas, which is used to calculate the SWE.

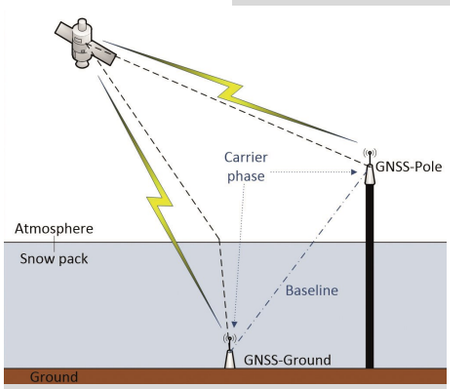

Fig. 3: Measurement of SWE

Easy system assembly

• Installation of the system

The SWA-system can be integrated simply and conveniently into new or existing weather stations. One SWA-sensor antenna is fixed on top of a mast. The second SWA-sensor antenna is attached to a metal plate on the ground. A further core part of the SWA-system is the SWA-analyzer that is integrated in an enclosure. It analyses the GNSS data and transfers the measurement results of the SWE and the LWC to a data logger via an RS-485 or SDI-12 interface.

• Good results despite ice layer

It is a very common situation, that ice layers in the snow pack cause distortions of the measurement values, when measuring the snow water equivalent with a snow pillow or other weighting bases systems.

However, when using the SWA-system ice layers have no influence on the measurements. Hence, a large source of errors can be eliminated.

Fields of application and examples

Water supply and management, hydropower plants, flood prevention authorities	Run-off predictions and expected water quantity during snowmelt
Agriculture, mining	Expected infiltration of melting water into the soil or underground, Run-off and SWE
Hydrology	Point of saturation and snowmelt discharge
Alpine communities, skiing resorts	Liquid water content for risk assessment of wet snow avalanches
Research facilities	Snow water equivalent, contents of liquid water

The SWA-System provides high resolution data of the snow pack parameters snow water equivalent (SWE) and liquid water content (LWC). The most interesting period of the year is during springtime, when the snowmelt begins.

At first a decrease of the snow depth can be noticed, followed by a rise of the liquid water content (yellow line, start of the blue sector). Several days later the snow water equivalent drops (blue line). No more water can be stored in the snow pack and the run-off starts.

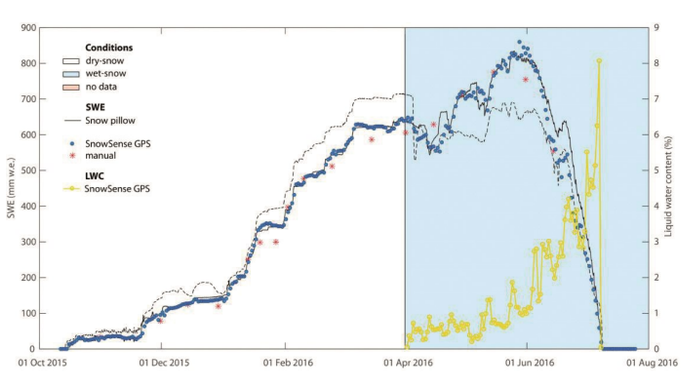

Figure 4: Measuring values of the SWA-system November until July

GENERAL	
Dimensions framework	202 x 112 x 62 mm
Power supply	supply voltage: 5 ... 20VDC
Power consumption	active: 5W (sleep-mode: 0.001W)
Operating temperature	-40... 50°C
SWA-ANTENNAS	
Material	weatherproof, UV resistant antenna
Size	38x38x12mm
Frequencies	L-Band
Number of satellites	32 at 20.200km
Ground plate	160x160x15mm
SWA-ANALYSER	
Inputs	up to two antennas
Measurement cycles	3h measurement time (typically) per cycle 1 - 6 per day for SWE 1 - 6 per day for LWC
Outputs	RS 485 / SDI-12; various ASCII formats
MEASUREMENT RANGE	
Snow depth	up to 6m
SWE (mm of water)	Range: 0 ... 2000 mm H2O (0 ... 100 mm H2O accuracy +/- 10% FS, 100 ... 2000 mm H2O accuracy +/- 5% FS)
Liquid water content accuracy 2% (FS*)	0 ... 15 %
FS*	Accuracy measured in laboratory environment