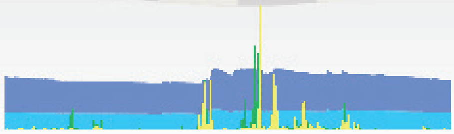
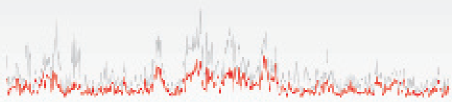
FLOWCAPT

remote automatic snow & weather monitoring





Joint Technologies

ISAW
Outdoor Environmental Monitoring
www.isaw.ch

IAV
engineering spirit
www.iav.ch

SENSALPIN

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FlowCapt Technical Specifications

ABOUT SNOWDRIFT MONITORING

The quality of local avalanche warning can be highly improved by the availability of automatically measured data from sites near potential avalanche release zones. Since avalanche risk cannot be measured directly, data characterizing meteorological conditions and snow cover properties are as important as information about processes highly relevant for avalanche formation – and snowdrift for sure is one of the most important of these processes.

The transport of snow – eroded from the snow cover or blown snowfall – by the wind may have a huge influence on the distribution and the cohesiveness of the snow cover in an alpine topography. Therefore snowdrift monitoring is very important mainly for the prediction of slab avalanches.

Since snowdrift may occur over very large areas it is crucial to carefully choose a well adquate site for snowdrift monitoring. Anyway direct measures of snowdrift from a dedicated site have to be set in relation to mass transport over large areas – which is only possible with long-term experience combining measured data with field observations.

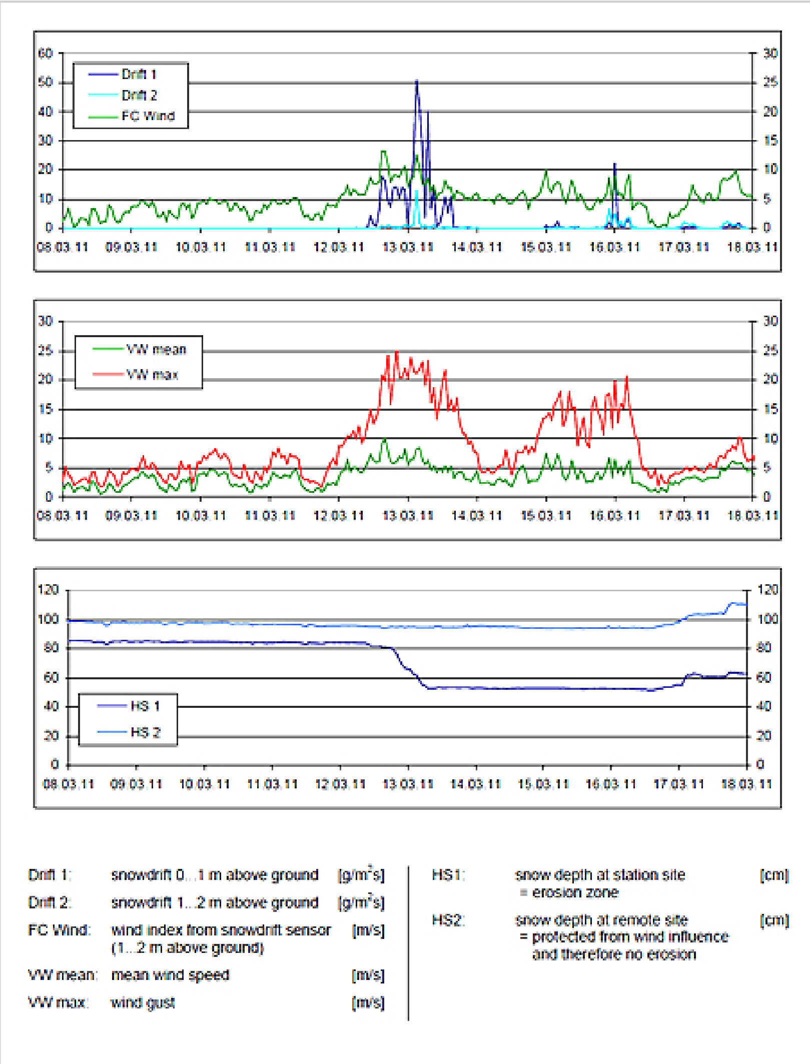
The importance of knowing snowdrift by direct measurements for daily avalanche forecasting and associated practical operational planning such as artificial release or road opening decisions has been widely agreed by all experts including security professionals and road regulators.

MEASURING SNOWDRIFT: FLOWCAPT

The phenomenon of snowdrift mainly depends on wind speed and the erodibility of the surface of the snow cover. Often wind speed and snow cover properties are measured in order to estimate the potential snow drift. The uncertainness of this estimation can be avoided using the only available sensor allowing a direct and autonomous measurement of snowdrift: **FlowCapt**.

The monolithic vibro-acoustic instrument furnishes a snow drift and wind speed index providing good qualitative and quantitative information about intensity and duration of snowdrift periods. Provided that it is installed at a well adquate site an index of mass transport over a larger area with similar wind field and exposition of erosion zones can be derived from data measured with FlowCapt sensors.

In combination with a good knowledge of the topography and with detailed field observations long-term experience using FlowCapt data allows a high level of reliability in the regional avalanche risk due to strong snowdrift periods.



FLOWCAPT STATION & FLOWCAPT SENSOR

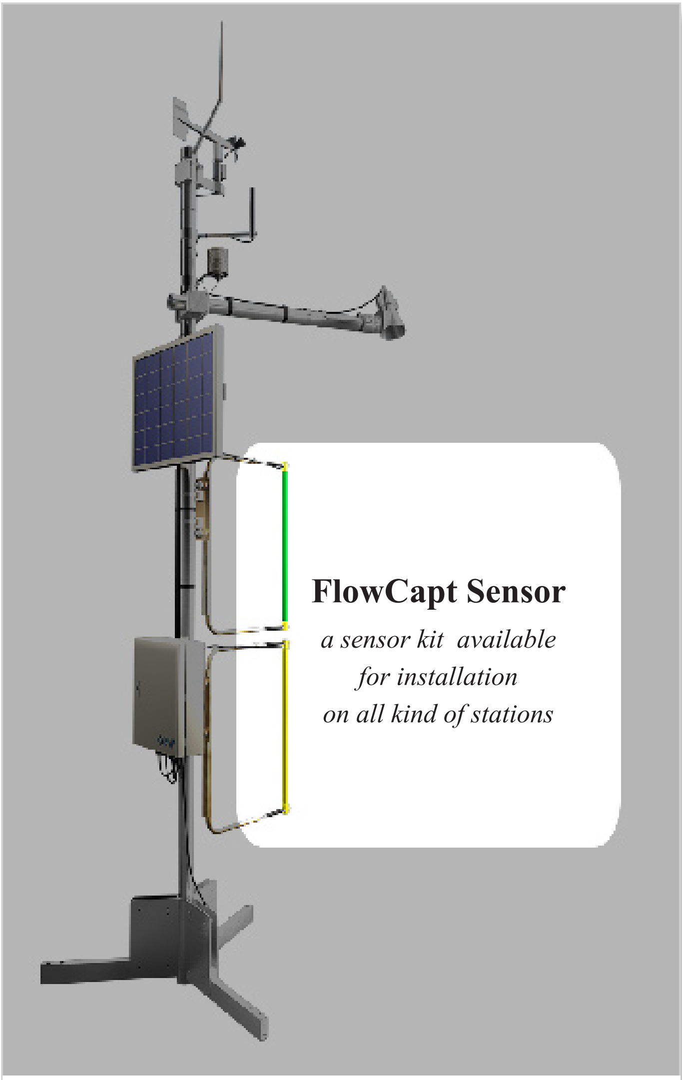
Depending on our customers needs we can furnish FlowCapt as a full automated snowdrift monitoring solution ("**FlowCapt Station**"), or as a snowdrift sensor to be interfaced to other materials ("**FlowCapt Sensor**").

FlowCapt Station

Our integrated snowdrift monitoring solution has been originally developed in early 90's joining our acoustic snowdrift sensor (www.flowcapt.ch) with the automatic and autonomous nivo-meteorological measurement stations from AlpuG (www.alpug.ch).

The modular and easy-to-install design as well as the complete autonomy due to the solar supply and the flexible communication options allow our integrated snowdrift monitoring stations to be installed at virtually any possible site and to fulfill all special needs. The FlowCapt snowdrift measurements are supplemented by the measurement of additional meteorological parameters – typically wind speed and direction, snow depth or temperature and humidity of the air, with several other sensors available as options.

The continuously measured data are stored locally and periodically transferred to local user interfaces as well as to the sophisticated and well known www.isaw.ch website according to the end-users needs. Installation and start of operation can be done by our personnel as well as by local users based on our detailled instructions. Remote access to local data acquisition servers allows us to follow the operation of the station as well as to support the users of our stations.



FlowCapt Station*
* Typical configuration example

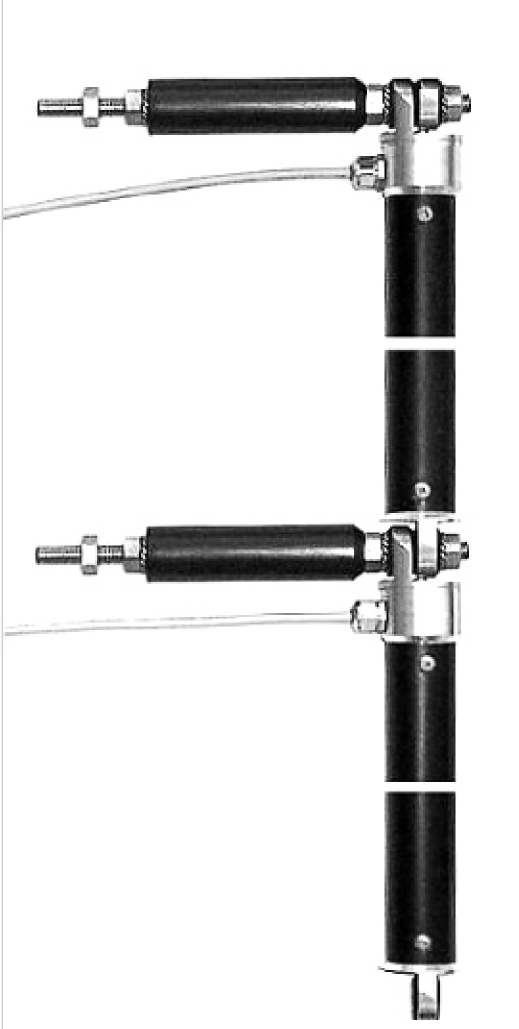
FlowCapt Sensor

FlowCapt is a monolithic acoustic snowdrift sensor furnishing an index of local snowdrift and wind speed. Its technical properties make it possible to integrate it to many common data loggers including solar powered, autonomous measurement systems.

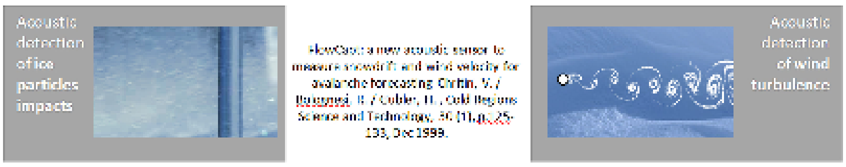
The sensor has to be powered with 8 – 20 V DC featuring a very low power consumption of less than 2mA avarage. The measured values are available or over a 0 – 1 V analog interface or an RS232 or SDI-12 serial interface. Using the serial interface mean, maximal and minimal values over a user-selectable period of time are available additional to actual values of the snowdrift and wind speed.

BRIEF HISTORY

Original FlowCapt Sensor
(1993 version)



The FlowCapt gauge has been developed in the early 90's by Chritin, Gubler & Melly. The goal was to provide a simple and reliable instrument able to provide automatically and continuously a significant snowdrift index from remote sites.The sensor is based on the principle of vibro-acoustics : when exposed to snowdrift the impact of solid particles (ice grains) drifted by the wind, together with the wind itself (air friction), excite vibrations of the sensing tube which can be detected measuring the acoustic pressure inside the sensor's body. Due to its design, materials and electrical filtering, the sensor very efficiently discriminates wind from snowdrift.



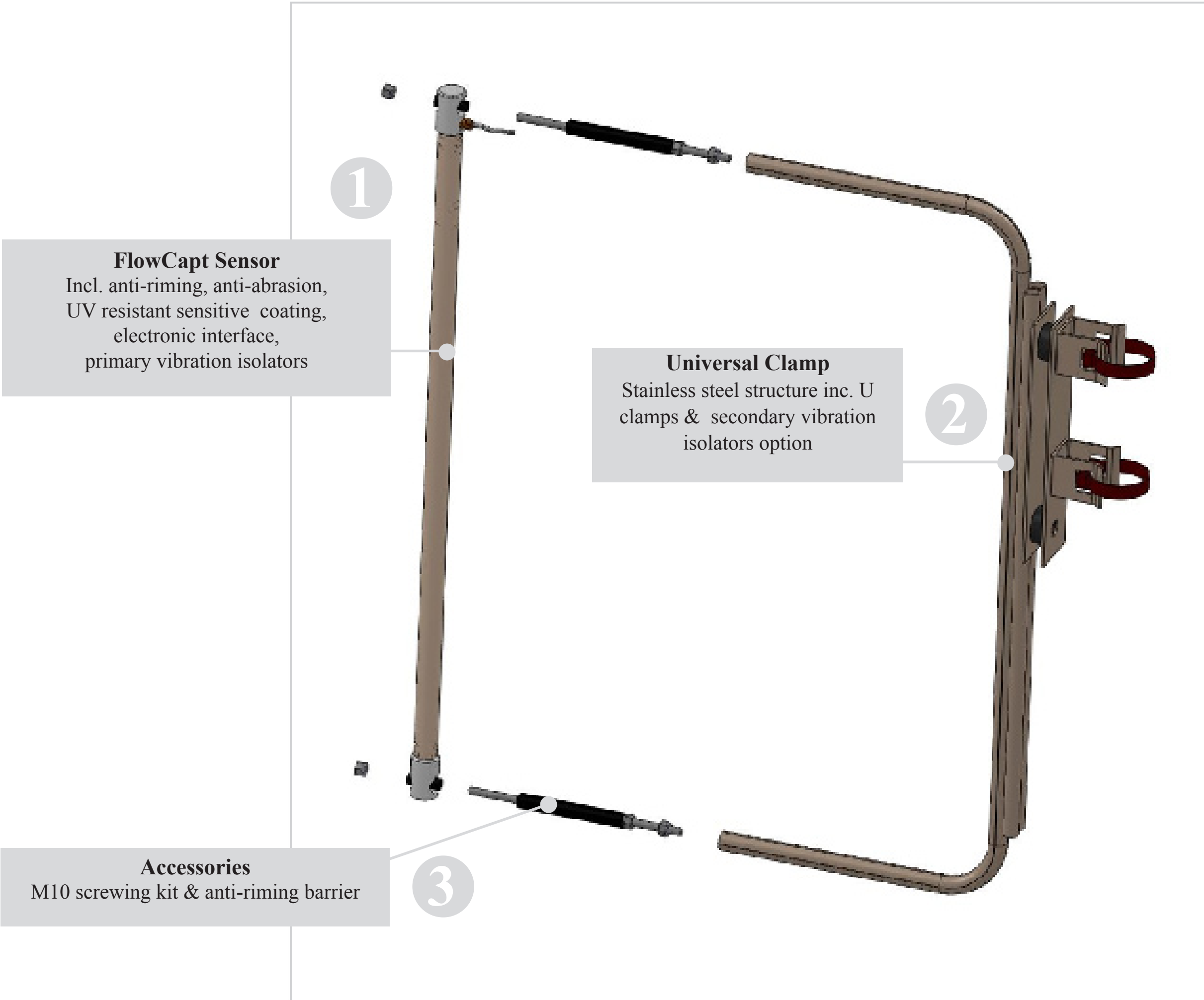
Since the sensor delivers two independent output signals proportional to the wind velocity and to the momentum of the flux of solid particles respectively, the gauge was called an anemo-driftometer. The monolithic sensor features a very low power consumption, analog or serial data interface and long-term stability. It has been patented by IAV Acoustics & Vibration Engineering (www.iav.ch) company for industrial integration. After several years of extensive testing under harsh ambient conditions it has been integrated in a dedicated weather station in order to allow autonomous remote operation. The concept of this integrated solution includes solar power supply, radio or GSM/GPRS data transmission and additional nivo-meteorological measurements and has proven its reliability under harshest climatic and topographical ambient conditions all over the world.

Manual measurement of snowdrift

In the past snowdrift was measured using manual driftometers. These instruments such as Bolognesi's model catch snow particles blown into a collector through a tube by the combined effects of filter and pressure drop. Weighing the collector directly gives a snowdrift index. This simple gauge makes quantitative snow drift assessments possible, but it requires the presence of a human observer at the site. Where manual measurements are not possible, snow drift has to be estimated indirectly from other parameters, with significantly lower reliability.

6 FlowCapt Sensor

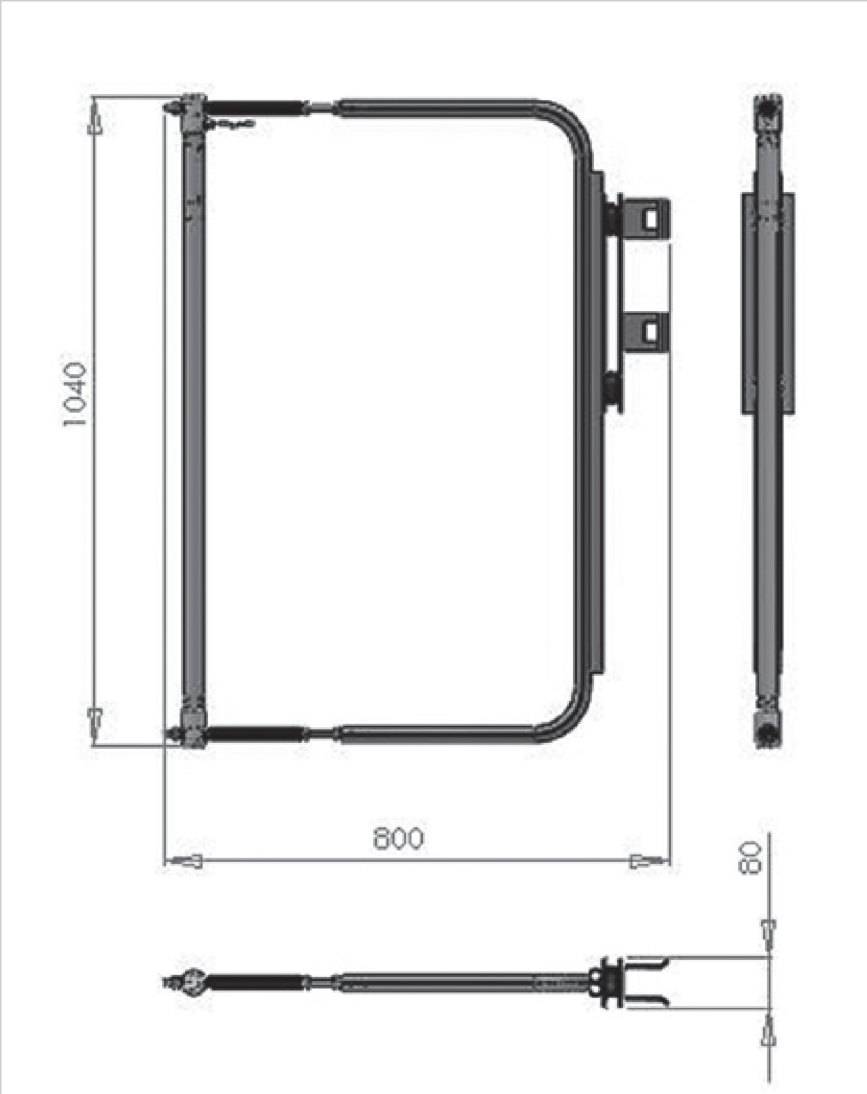
FLOWCAPT SENSOR KIT FURNITURE



The FlowCapt Sensor is furnished with all necessary items allowing to integrate it to any meteorological station:

1. 1m effective length FlowCapt Sensor with 1m length sensor cable and extension cable up to 20m
2. Universal Clamp allowing to mount the sensor onto a vertical tube with a diameter of 80mm (other diameters on request)
3. Mounting accessories
4. Manuals for mounting and data interfacing

OVERALL DIMENSIONS



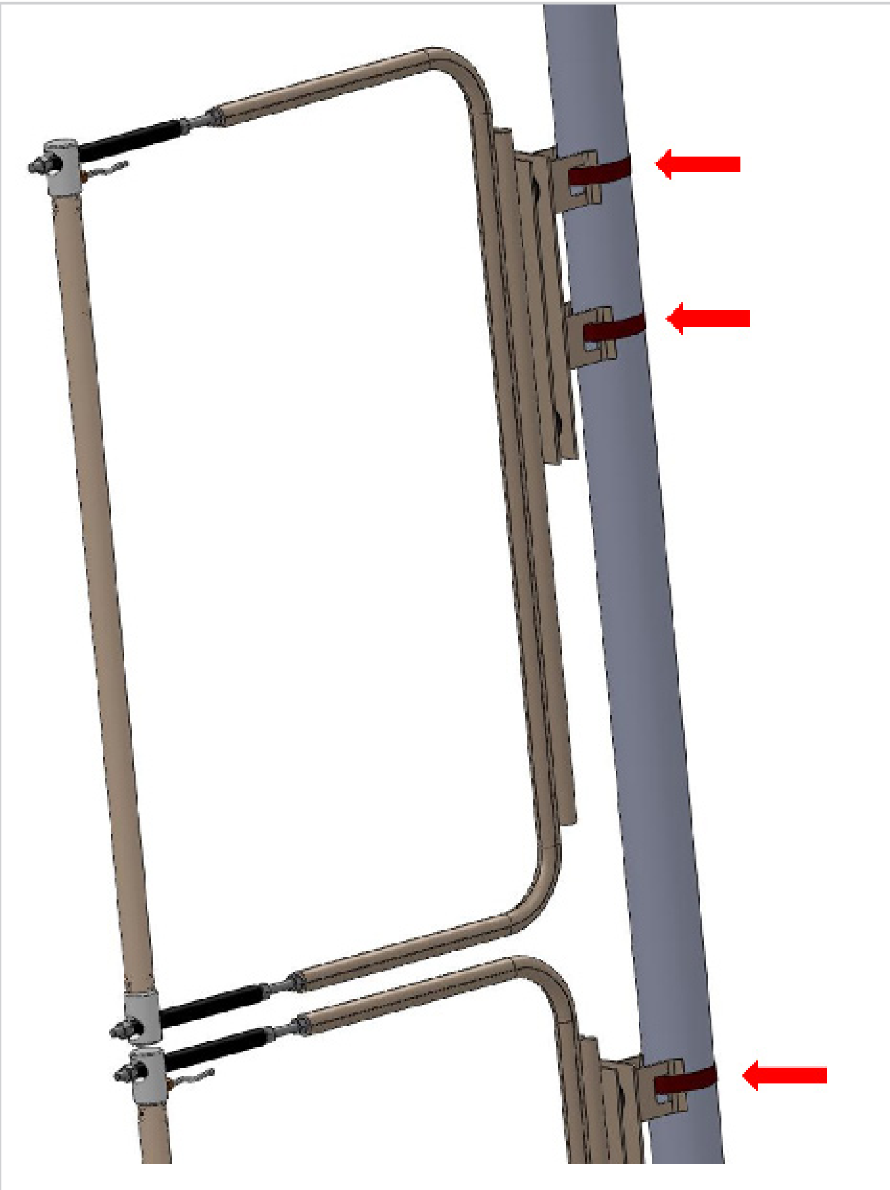
Mounted Dimensions :

H x L x W = 1040 x 800 x 80 mm
Indicative Total Weight = 4 kg
Standard Cable length = 2.5 m
(Extension Cord up to 20 m)

Packing Information :

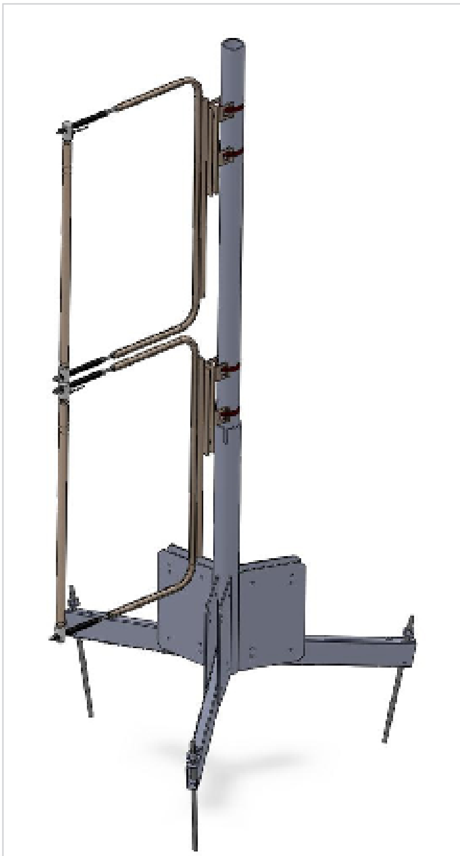
No Wood Packing CardBox
1100 x 500 x 100mm, 5Kg Net Weight

CLAMPING THE SENSOR ON A MAST



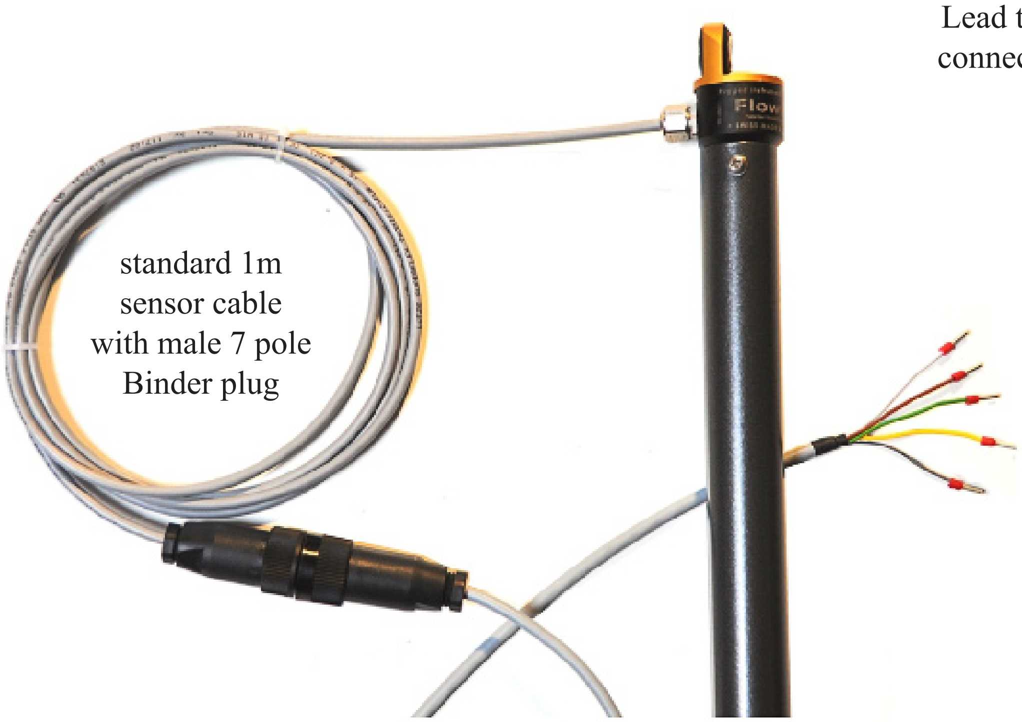
Clamping

Standard collars are fitting to pylons with an outer diameter of 80mm. Collars for other tube diameters are available on request.



WIRING OF THE SENSOR

Lead terminals for direct connection to data logger



1 /White
11..20 VDC
Sensor Power Supply

2/Brown
GND Sensor Power
& Signals Ground

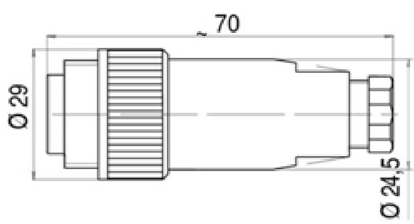
3/Yellow
Snow Drift Signal

4/Green
Wind Speed Signal

5/ Grey
Sensor Test Trigger

extension cable with female Binder plug - length up to 20m

Binder Serie 692/693/6+PE Connectors



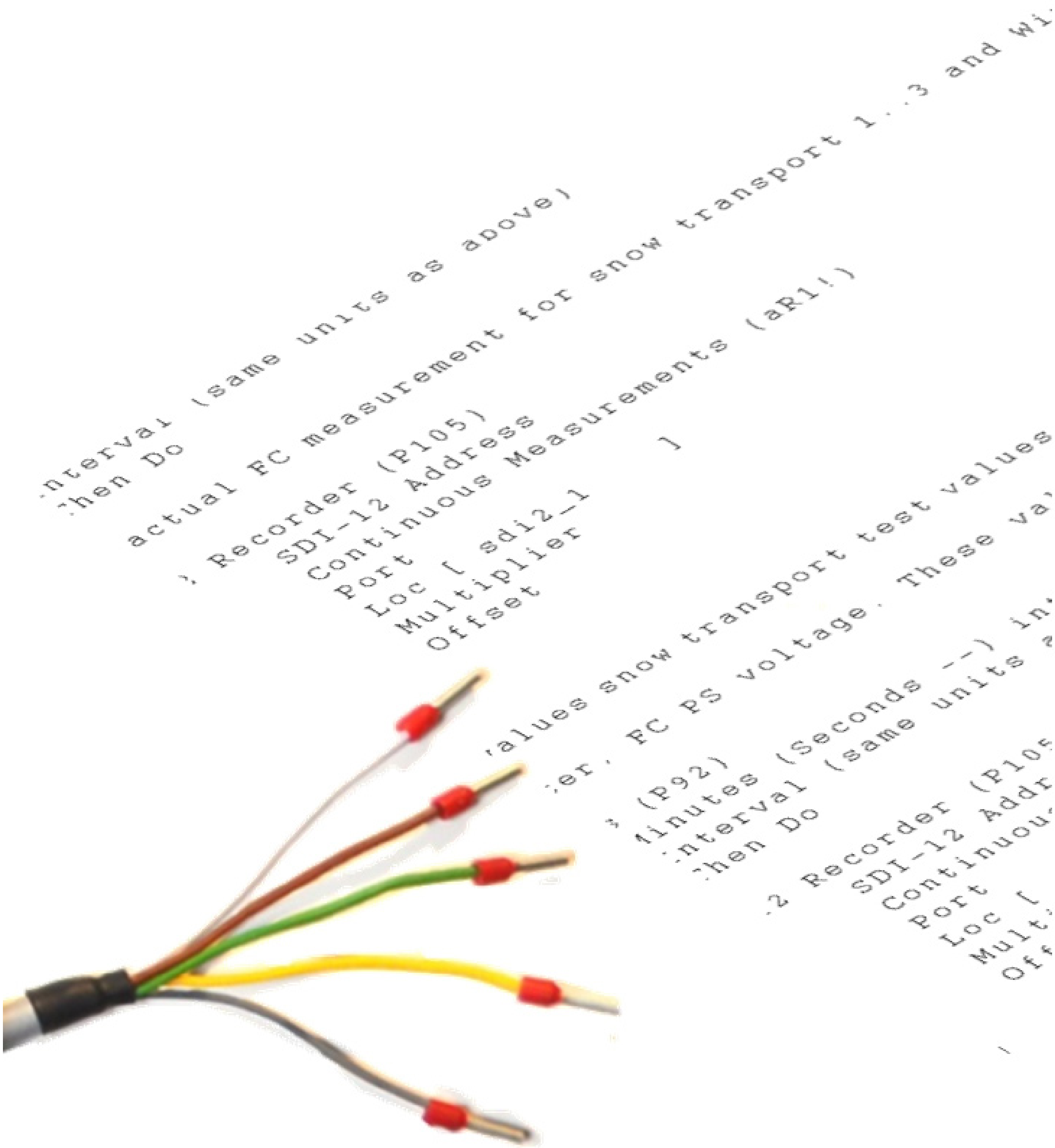
INTERFACING TO AN EXTERNAL DATA LOGGER

Description

The integrated electronics of the FlowCapt Sensor furnishes instantaneous snowdrift and wind speed signals picked up by the the integrated acoustic transducers converted to two linearized analog voltage output signals.

Additionally the instantaneous values as well as a mean, maximal and minimal value over a user-defined period of time are available over a serial RS232 or SDI-12 interface. A sensor self test can be triggered and it's result queried over the serial interface as well.

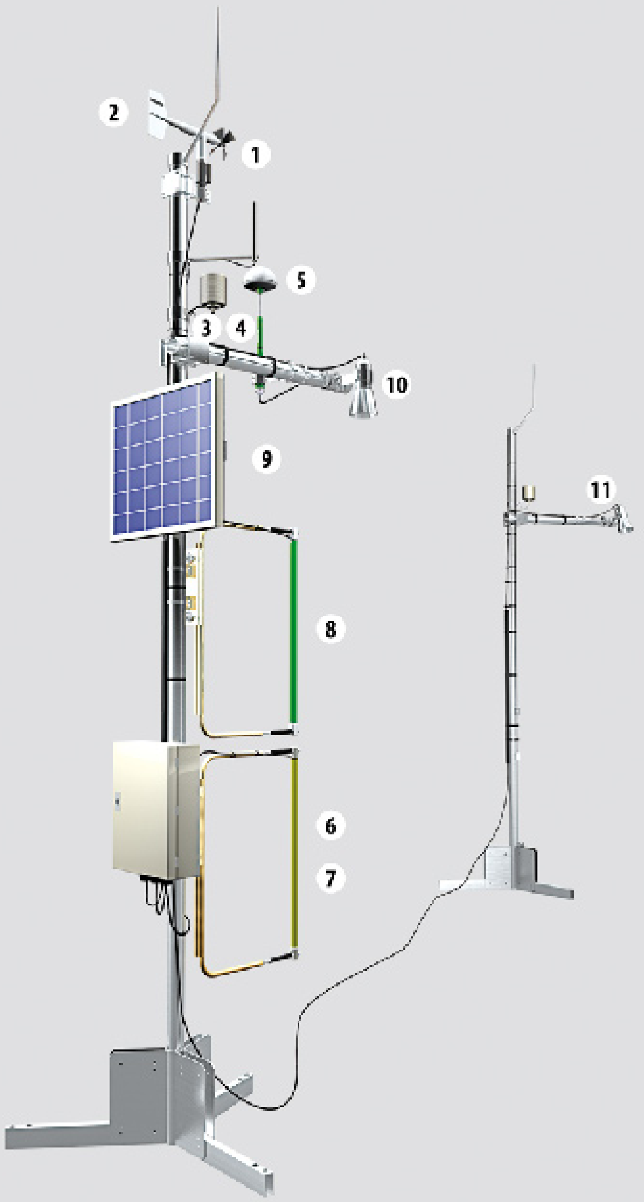
Since data interpretation for avalanche warning is only possible taking into account the characteristics of the snow drift index over periods of a few hours up to several days programming examples are furnished in order to produce most meaningful data possible for the user of the snowdrift monitoring system.



12 FlowCapt Station

GENERAL DESCRIPTION

A FlowCapt station is a fully integrated, autonomous measurement system for remote snowdrift monitoring. Snowdrift measurement is supplemented by data of additional nivo-meteorological sensors. The station automatically provides round the clock data from remote sites optionally to local data interfaces as well as to the www.isaw.ch website by way of radio or GSM/GPRS data communication.



Snow Wind Air Rain

1. Wind Force 2. Wind Direction	Re-inforced RM Young 05103 Wind Monitor
3. Air Temperature 4. Air Relative Humidity	CS215 Temp. & Rel. Humidity Probe
5. Rain Gauge (option)	RainFlow High-Resol. Acoustic Sensor
6. Snowdrift Flux 0-1m 7. Ground Wind Force	FlowCapt Eroding Mass Flux Sensor
8. Snowdrift Flux 1-2m	
9. Snowdrift Flux 2-3m (option)	
10. Snow Height @ Erosion Zone	SR50A Sonic Ranging Sensor
11. Snow Height @ Deposit Zone (option)	

Typical applications

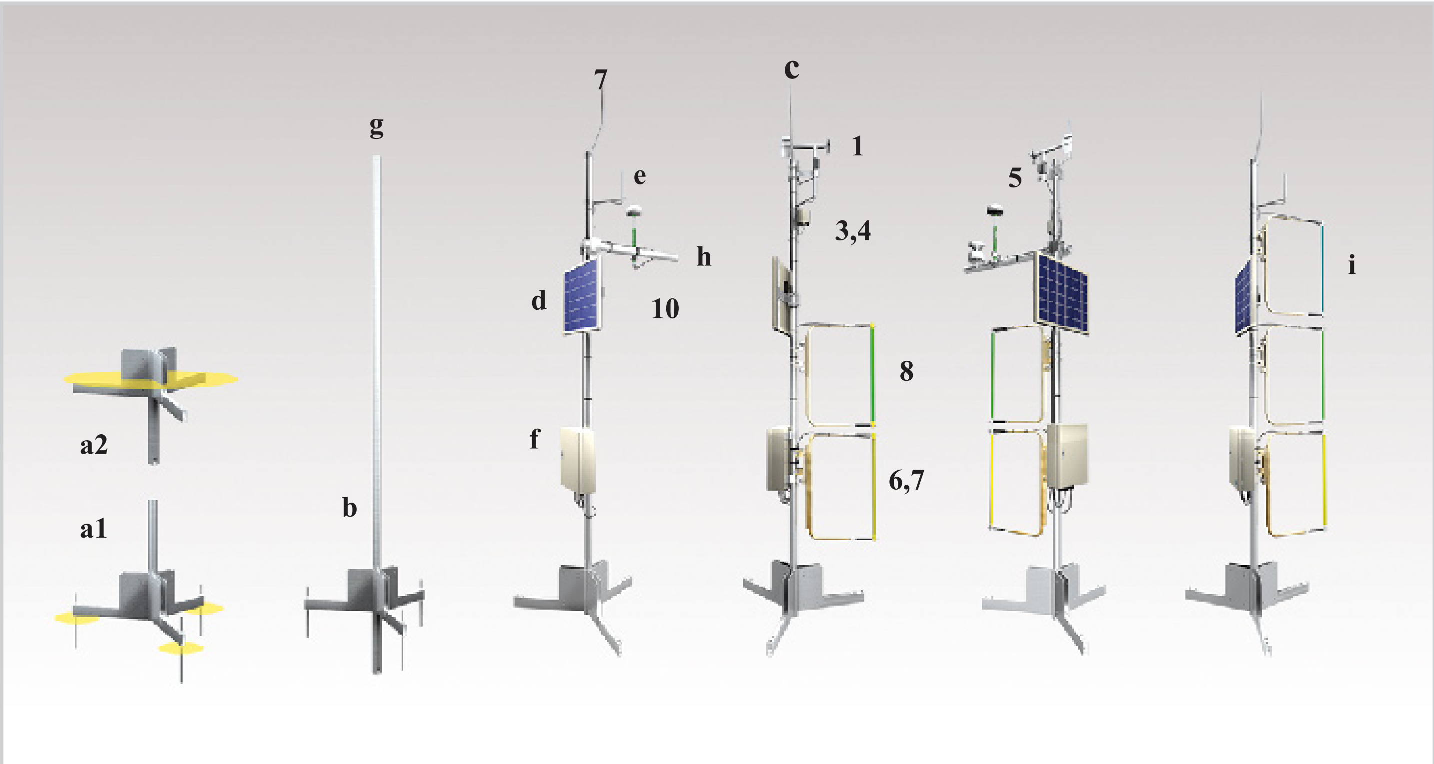
- *Avalanche warning for settlements, trafic axis, mountain activities, construction sites.*
- *Planning of artificial avalanche release.*
- *Scientific applications.*

Global specifications

- *Autonomous energy supply by solar panel and battery.*
- *GSM/GPRS or radio communication for local data access and Internet data server.*
- *Easy installation in every terrain and ground. without concrete foundation.*

MODULARITY

The FlowCapt Station is fully modular, allowing any kind of specific configuration to meet the requirements of a given site and end-user application.



Base System

a) Anchoring system to be screwed (1) on rocky surfaces or (2) buried into soil

b) Pylon (aluminium or steel tube with diameter of 80mm)

c) Lightning rod

d) Solar panel with clamp

e) GSM/GPRS or radio antenna with clamp

f) Electronics housing

g) Transport flange

h) Horizontal sensor arm (2m)

Standard Sensors

1,2) Wind speed and direction: Young 05103 (special version)

3,4) Temperature and humidity of the air : Campbell CS215

5) Rain Gauge

6,7) FC1 FlowCapt ground segment L = 1m

8) FC2 FlowCapt top Segment L = 1m

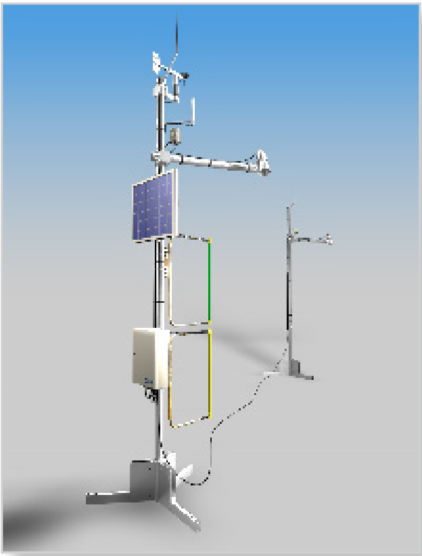
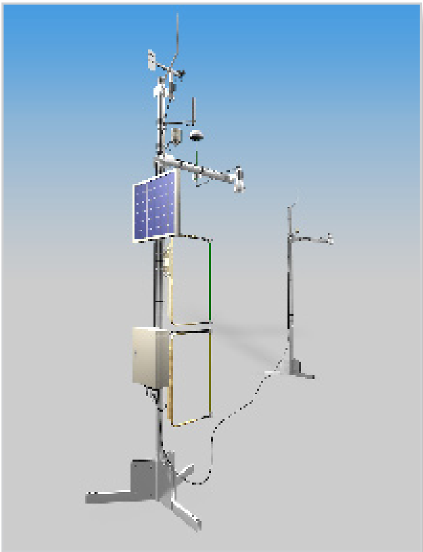
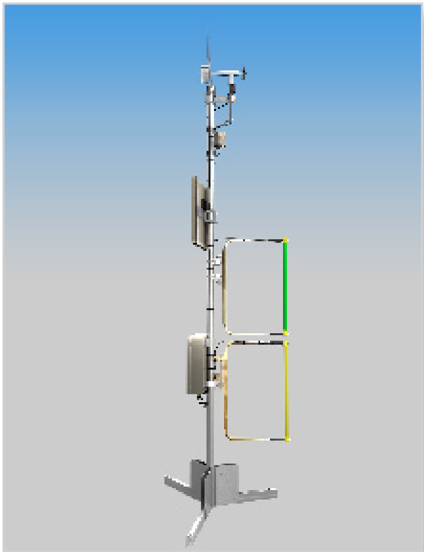
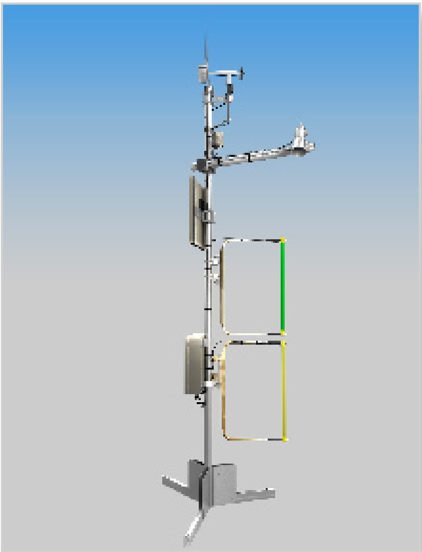
9) FC2 FlowCapt top Segment L = 1m

10) Snow depth: Campbell SR50A

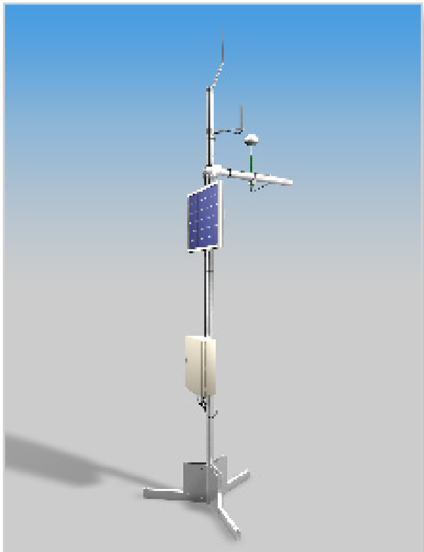
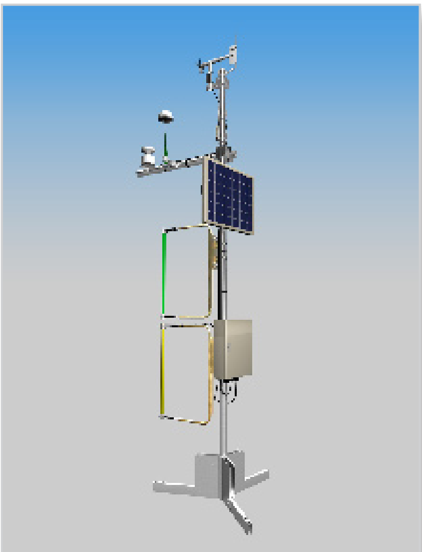
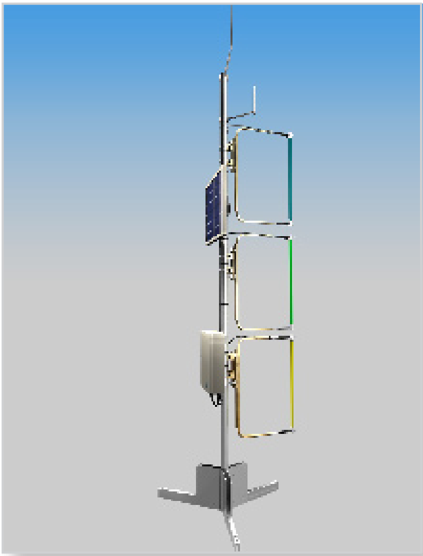
Option

11) Remote pylon with additional snow depth Campbell SR50A measurement located in the deposition zone and connected by cable or radio link a wide range of additional sensors is available on request

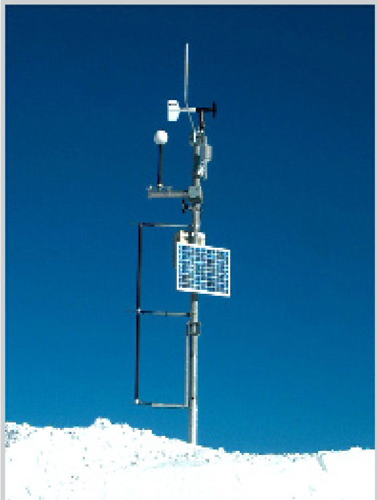
CONFIGURATION EXAMPLES

Modular Solution


TYPICAL CONFIGURATIONS



SELECTION OF SITE FOR A FLOWCAPT STATION

In order to get reliable data with a certain regional significance from a local snowdrift monitoring station it is important to carfully choose a well adequate site. To do so the following criteria have to be fulfilled as well as possible. It is particularly important to take them into account for the predominant wind directions.

1) The station has to be installed at the end or at the downwind side of an erosion zone.
2) Snow depth should permanently be very small at the installation site.
3) The wind field and therefore the snowdrift profile at the installation site should be homogenous – that is to say it should not be disturbed by any obstacle or strong variation of steepness of the terrain near the upwind side of the station.
4) Snow cover properties in the erosion zone should not be changed by any human activities.
5) The installation site has to be out of avalanche runout zones.
6) Communication links (gsm network coverage or line of sight radio communication. for example) have to be available at the installation site.

Often the selection of an installation site is a result of the best possible trade-off between some of these criteria. Anyway a good and reliable interpretation of data measured by a FlowCapt station is only possible after some years of gathering reference field data and comparing them to the automatic measurements. It is very important to understand that a automatic measurement instrumentation can never replace but only support the knowledge and experience of the local decision makers.

ORIENTATION OF THE FLOWCAPT STATION

Local selection criteria

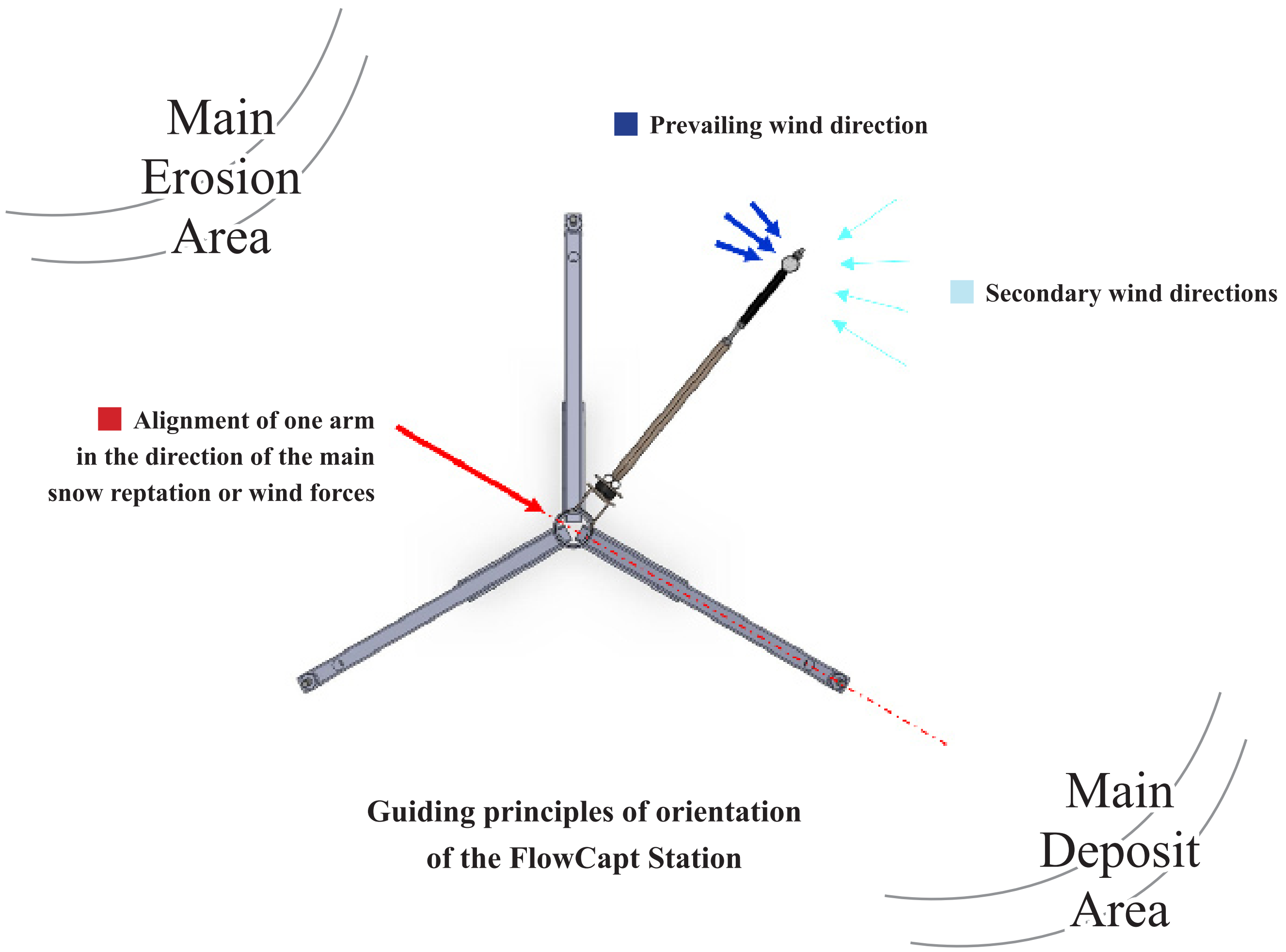
- After choosing a well adequate installation site it is important to properly install the station at this site – notably to choose the best orientation for the FlowCapt Sensors:

  - Minimize the risk of having the sensors covered by snow.

  - Avoid to disturb the wind field and snowdrift profile by the mechanical structure of the station.

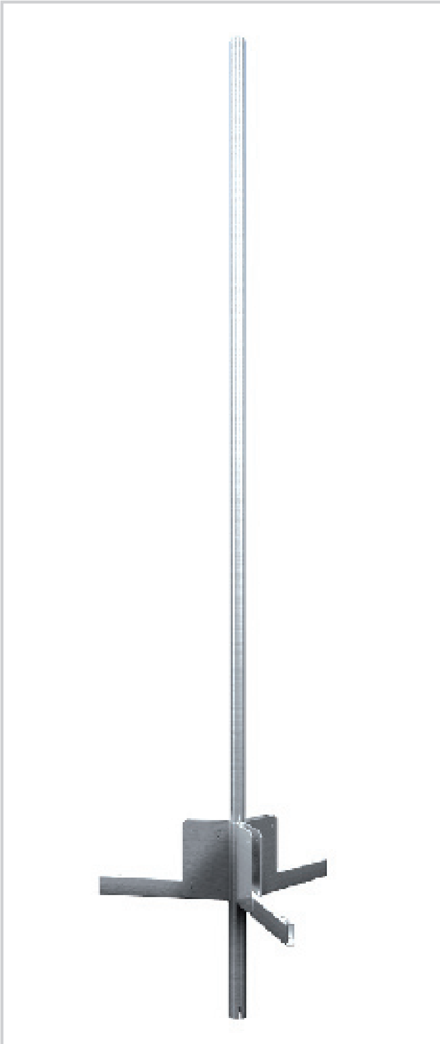
  - Solar orientation to take advantage of maximum direct sun exposure and possible local reflections on the snow cover.

  - Make sure that a correct orientation of the solar panel (south) and the GSM/GPRS or radio antenna is possible.

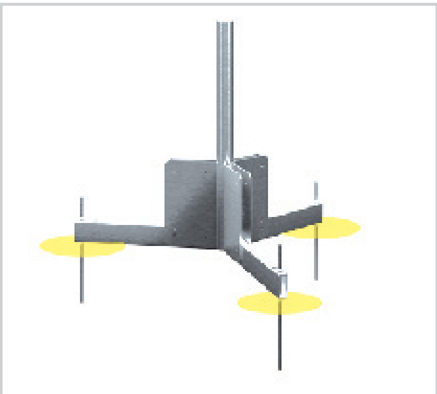


Guiding principles of orientation of the FlowCapt Station

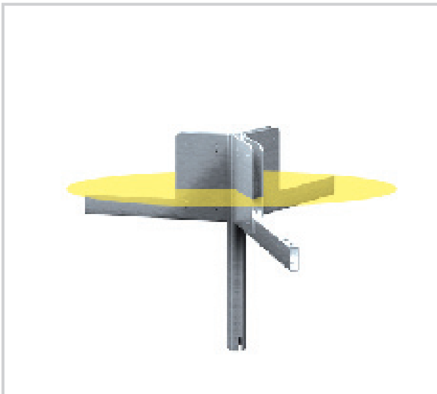
THE ORIGINAL MINIMAST SYSTEM



For installation on rock :
cramp oriented upward



For installation on loose soil :
cramp oriented downward



The FlowCapt Station is equipped with the famous AlpuG MiniMast system and its universal cramp making it possible to place the station on various type of ground, without requiring the realization of a concrete base.

When installing the cramp simply make sure that one of the three side arms is aligned with the direction of the maximum forces of wind or reptation of the snow cover. In the event of pre assembly of the equipment on the mast before helicopter transport, locate the position of the top notch to allow a correct angular positioning of the equipments around the mast.

ANCHORING SYSTEM SCREWED ON A ROCKY SURFACE

Preparation of the cramping before the installation

Drilling and installation

Tools and materials (not provided).

- 2x 19mm open end or ring spanner.
- Rock drill with ø25 mm x 480 mm bit.
- 3x M20 rods (standard HAS M20x400 Hilti 0033 3113 or equivalent), with 6 nuts and spastic cement (standard HIT HY 150 00335512 or equivalent).
- Metal drill with number 13mm bit for a possible final repo sitioning of the arms out of the original drillings.
- Spirit level or plumb line.

Operations

- Clean the rock face.
- Choose an area flat enough to provide maximum stability for all three arms.
- Position the base on the rock so as to have the top central tube at the chosen place.
- Orient the whole piece so that the arm aligned with the notch of the tube (see also Sect. 3) is in the direction of the prevailing wind or of the principal snow reptation forces
- Assemble the arms at the lower ends of the flanges ; in the case of positioning of the arm inclined upwards or downwards, make additional clamp holes (drilling machine with number 13mm bit).
- Drill the 3 ø25mm holes in the rock.
- Test the fitment of the arms in the threaded rods.
- Seal the three threaded rods HAS M20 with the plastic cement HIT HY 150 Hilti.

Installation

- Screw the set of base nuts and washers on the three threaded rods.
- Position the complete cramping on the three threaded rods.
- Regulate vertical alignment tightening the base nuts.
- Tighten strongly the other set of nuts and washers on the three threaded rods.

ANCHORING SYSTEM BURIED INTO SOIL

Preparation of the cramping before the installation

Excavation and installation of the cramping

Tools and materials (not provided).

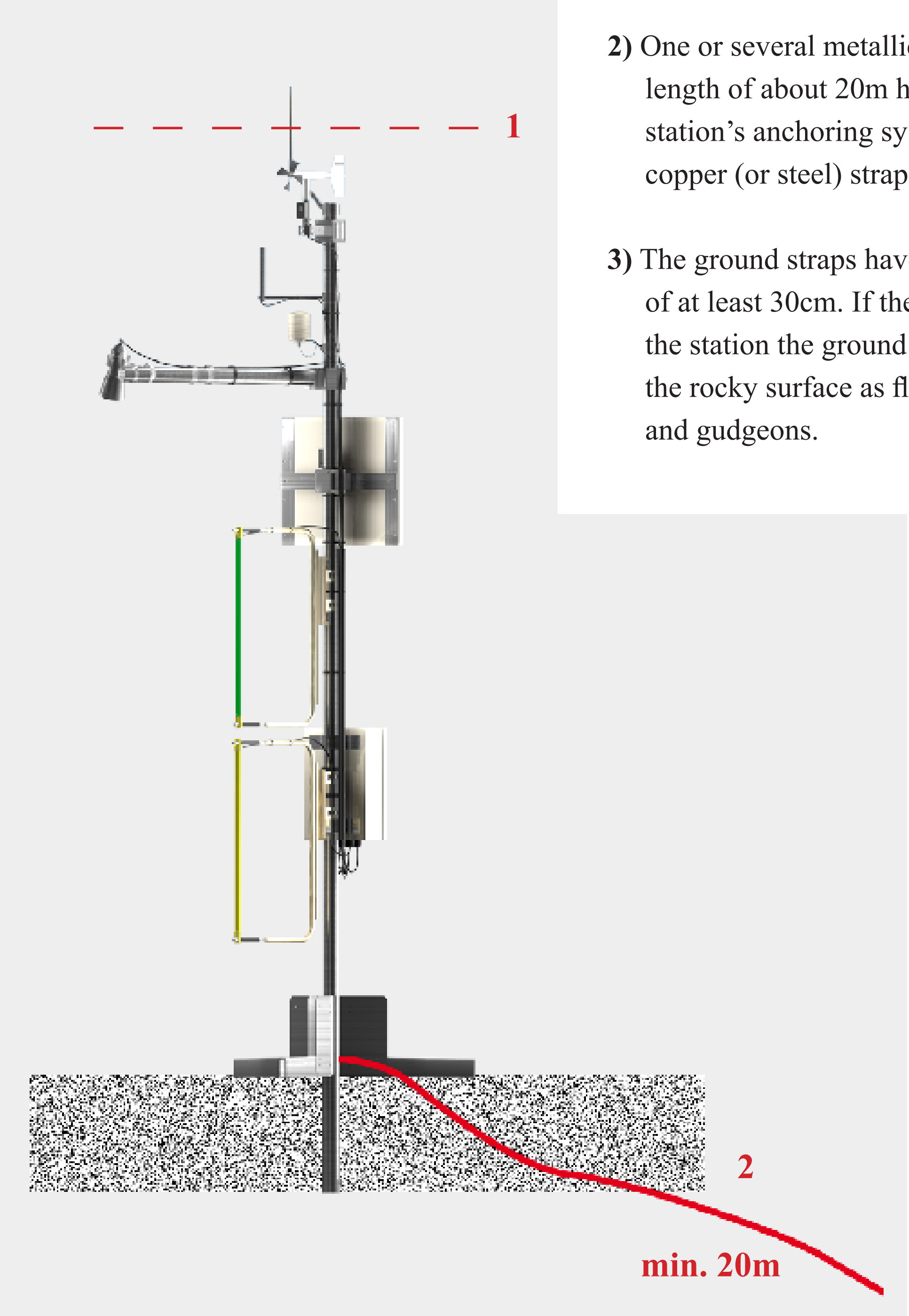
- 2 x 19mm open end or ring spanner.
- Shovel.
- Jumper rod.
- Sledgehammer.
- Pick.
- Stopper to seal the foot of mast at the time of the installation (or rock).
- Three concrete-reinforcing steels ø16mm X 1m to fix the arms in the ground.
- Level or plumb line.

Operations

- Excavate a hole approximately 1m deep.
- Position the central tube with the flanges to the top, so that the side arm aligned with the notches of the tube (See Sect. III) is well in the direction of the prevailing wind or the largest reptation forces; adjust the vertical alignment of the central tube with the assistance of a block placed at the bottom of the hole.
- Cover the lower third of the tube with soil and stones, and pack it well.
- Excavate lateral openings of the length of the side arms and at a depth of the bottom of the flanges.
- Assemble the side arms on the bottom holes of the flanges
- Drive a stake in the ground the three concrete-reinforcing steel, tilted towards outside, through the end holes of the side arms.
- Bury the tube and cover well.
- Cover the side arms.

  If necessary block up the top of the tube to prevent filling before the final installation of the mast.

LIGHTNING PROTECTION



Ground connection of the station

1) The top of the lightning rod has to tower clearly above all other components of the station.

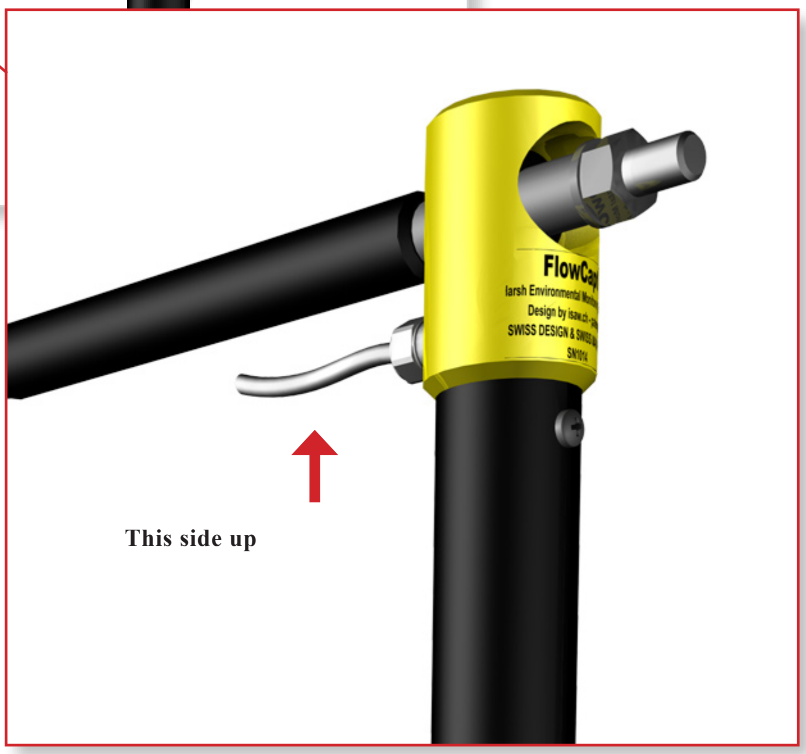
To provide best protection from damages due to lightning storms the station has to be grounded properly.

2) One or several metallic ground straps with an overall length of about 20m have to be connected tightly to the station's anchoring system. We recommend to use copper (or steel) straps with a 3 x 30mm cross section.

3) The ground straps have to be buried into soil in a depth of at least 30cm. If there is only rocky ground all around the station the ground straps have to be screwed onto the rocky surface as flat as possible using metallic bolts and gudgeons.

INSTALLATION OF SENSORS & OTHER ELEMENTS

The FlowCapt Station is delivered with all needed mounting components and a manual including detailed mounting instructions.



Tools and materials (not provided)

2 x 17mm open end or ring spanner.
Plastic Serflex.

Operations

Assemble segment(s) with the end of the cable to the top.

Minimize the height on ground at the base of the bottom segment and fix cable every 20cm with Serflex.

ONLINE ISAW DATA WEB PORTAL

A FlowCapt Station can be equipped by almost any kind of wired or wireless communication. In most common applications FlowCapt Stations communicate by GSM/GPRS, radio or analog phone line.

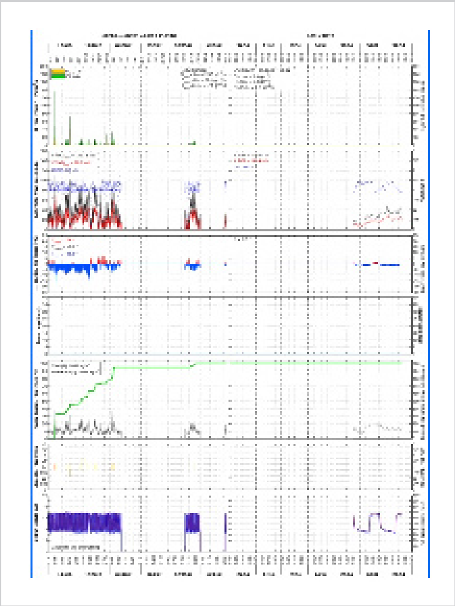
Whatever means of communication are used, the FlowCapt stations continuously store and periodically transmit data files to a host computer. Depending on the end-user's needs and facilities, the host computer can either be a dedicated local data acquisition server or any ISAW data server.

In both cases data are available worldwide by way of the sophisticated, well acknowledged and free of charge web interface www.isaw.ch and as an option additionally on a local system.

Survey of the station's correct operation, annual on-site maintenance and permanent user support can be assured by signing an optional maintenance contract. A permanent internet connection as well as a remote access to the local data acquisition server are necessary conditions for the provision of all these services.

DATA INTERPRETATION

For a correct use and interpretation of FlowCapt snowdrift data you have to keep in mind the following points:



1) A correct interpretation of the FlowCapt snowdrift measurement is possible only based on a good knowledge of the local installation site and the surrounding topography since they have a huge influence on the relation between the local measurement and the regional mass transport of snow by the wind.

2) The avalanche risk due to snowdrift processes can be estimated correctly only taking into account more than only instantanous snowdrift values – typically the evolution of snowdrift intensity and duration over a few hours up to several days has to be taken into account.

3) Comparing the measured data with good and regular field observations over at least a few winter periods provides a indispensable base of experience for a good estimation of the local and regional snow drift situation.

4) Misinterpretations can be avoided by always keeping in mind that measured data can be corrupted due to technical failures like:
- Electronic failures.
- Communication problems.

Or meteorological phenomena like:
- Lightning storms.
- Rime-ice on sensors, solar panels, antennas.
- A thick snow cover deafening the acoustic sensor.

It is important to keep in mind that all information provided to our users on the www.isaw.ch web interface are based on uncorrected und uninterpreted measurement data. Therefore ISAW declines every liability for the accuracy and quality of the data as well as any responsibility for any consecutive damages coming from errors in the data or wrong interpretation of the station's information. Furthermore in order to continuously improve it's services and products ISAW reserves it's right to change the station's hardware, software definitions and the properties of the web interface.

POSSIBLE DYSFUNCTION/SKEW OF THE DATA

The following situations must always be kept in mind for a suitable analysis of the data.

Topographical effects and actual local snow distribution

- In comparison with a theoretically ideal situation, the topography, the local relief and the actual local snow distribution, and the instrumentation itself may strongly influence the local distribution of the flux.

Riming / Icing

- Possible partial or total underestimation of the snowdrift or blowing snow due to a temporary loss of sensitivity on a FlowCapt Sensor because of the vibrations damping generated by the formation of an ice coating upwind or around the sensor body.
- Temporary fading or loss of communication, due to the obstruction of the antenna.
- Temporary freezing of the wind monitor's propeller or swivel body, that may lead to its destruction.
- Temporary obstruction of the air temperature sensor, resulting in skewed measurement.
- Temporary fading or loss of battery voltage due to the obstruction of the solar panel.

Snow burying

- Possible partial or total underestimation of the snowdrift or blowing snow if a FlowCapt sensor is partially or totally buried
- Temporary locking of the wind monitor's propeller or swivel body.
- Temporary obstruction of the snow height sensor resulting in loss of measurements
- Temporary obstruction of the air temperature sensor, resulting in skewed measurement.

Lightning

- Possible partial destruction of the station caused by lightning. Very careful grounding of the station is crucial for the effectiveness of lightning protection measures.

Temporary disturbances of the communication network or the local computers linked.

- Delay in the supplying of the data (without data loss).

(Indicative and non exhaustive list).

DATA DEFINITIONS (1/4)

0-1m Flux Index (FI)

The chart indicates an index of the intensity of the blowing snow and/or the impact of snowdrift particles, intercepted by the 1m FC1 FlowCapt segment, at an effective height of 0 to 1 meter from the ground.

Unit:	* g/m2/s.
Type:	Index.
Source:	Measured raw data.
Sensor:	1m FC1 FlowCapt segment.
Measurement step:	1 minute.
Displayed and stored data:	Hourly average.
Vertical axis:	Left & right, automatic scale [* g/m2/s].
Display:	Yellow stacked column.

1-2 m Flux Index (FI)

The chart indicates an index of the intensity of the blowing snow and/or the impact of snowdrift particles, intercepted by the 1m FC1 FlowCapt segment, at an effective height of 1 to 2 meters from the ground. Apart from particular situations (See Sect. 8):
Snowdrift episodes are theoretically characterized by a higher intensity on the 0-1m bottom segment.
Pure blowing snow episodes may be characterized by similar intensity on both segments or even higher intensity on the upper segment.

Unit:	* g/m2/s.
Type:	Index.
Source:	Measured raw data.
Sensor:	1m FC2 FlowCapt segment.
Measurement step:	1 minute.
Displayed and stored data:	Hourly average.
Vertical axis:	Left & right, automatic scale [* g/m2/s].
Display:	Green stacked column.

0-1 m. Normalized Cumulated Flux Index (0-1 m Norm. Cumul. Flux Index)

This chart indicates (in %) , the current cumulative flux FC1 (data No. 1) relative to the last current total value or the known historical maximum. This representation allows the visualization, as successive steps, of the major snowdrift and/or blowing snow episodes, or, on the contrary, periods without any snowdrift nor blowing snow (flat intervals).

Unit:	0 to 100 %.
Type:	Normalized cumulated index (integrated proportional value brought back to the last current total value).
Source:	Data calculated using the measured raw data No. 1.
Calculation step:	1 hour.
Displayed and stored data:	Hourly value.
Vertical axis:	Left [0 … 100 %].
Display:	Yellow stacked column.

1-2 m. Normalized Cumulated Flux Index (1-2m Norm. Cumul. Flux Index)

This chart indicates (in %) the current cumulative flux FC2 (data No. 2) relative to the last current total value or the known historical maximum. Combined with previous data No. 3, this chart also informs about the episode,s intensity and the snowdrift type.

Unit:	0 to 100 %.
Type:	Normalized cumulated index (integrated proportional value brought back to the last current total value).
Source:	Data calculated using the measured raw data No. 2.
Calculation step:	1 hour.
Displayed and stored data:	Hourly value.
Vertical axis:	Left [0 … 100 %].
Display:	Green stacked column.

DATA DEFINITIONS (2/4)

FC Ground Wind Velocity Index (FC Ground Wind Vel. Index)

The chart is an indicator of the hourly maximum velocity of the wind between 1 and 2 meters from the ground, useful in particular for stations not equipped with a wind monitor, or when the wind monitor is temporarily inoperative (See Sect. 8). Intrinsic to the measurement principle, winds lower than 3 m/s are not detected.

Unit:	* m/s or *km/h.
Type:	Index (proportional value).
Source:	Measured raw data.
Sensor:	1-2 m FC2 FlowCapt segment.
Measurement step:	1 minute.
Displayed and stored data:	Hourly average.
Vertical axis:	Right, (*m/s or *km/h).
Display:	Black line.

6 Hours Directional Flux Index N (<6h> Dir. Flux Index N)

This graph represents the snowdrift or blowing snow events according to the corresponding prevalent wind directions.

Unit:	* g/m2/s.
Type:	Index representing the gliding cumulated intensity over 6/24h of the sum of flux No. 1 and No. 2 as a function of wind direction and time.
Source:	Data calculated using the measured raw data No. 1, No. 2 and No. 9.
Calculation step:	1 hour.
Displayed data:	Hourly value of the index averaged within the last 6 hours.
Stored data (.xls):	Hourly value of the index averaged within the last 24 hours.
Vertical axis:	Left & right, wind directions.
Display:	By color level increasing from the lightest (white = lowest cumulated flux) to the darkest (black = highest cumulated flux), going successively through yellow, orange red and brown.

Average Wind Velocity (AVG Wind Vel.)

The chart gives the hourly average velocity of the wind on the wind monitor (default height = 3.5 m above the ground).

Unit:	m/s or km/h.
Type:	Wind velocity.
Source:	Measured raw data.
Sensor:	Reinforced AlpuG RMYoung.
Measurement stop:	1 minute.
Displayed and stored data:	Hourly average.
Vertical axis:	Left, (m/s or km/h).
Display:	Red line.

Maximum Wind Velocity (MAX Wind Vel.)

The chart gives the hourly maximal velocity of the wind on the wind monitor (default height = 3.5 m above the ground).

Unit:	m/s or km/h.
Type:	Wind velocity.
Source:	Measured raw data.
Sensor:	Reinforced AlpuG RMYoung.
Measurement step:	1 minute.
Displayed and stored data:	Hourly maximum.
Vertical axis:	Left, automatic scaling (m/s or km/h).
Display:	Black line.

DATA DEFINITIONS (3/4)

Wind Direction (Wind Dir.)

The chart gives the hourly average dominant wind direction on the wind monitor (default height = 3.5 m above the ground).

Unit:	Direction in ° from North.
Type:	Wind direction.
Source:	Measured raw data.
Sensor:	Reinforced AlpuG RMYoung.
Measurement step:	1 minute.
Displayed and stored data:	Hourly average.
Vertical axis:	Straight, 8 cardinal directions.
Display:	Blue markers.

Internal Air Temperature (Int. Air Temp)

The indicated temperature is the one given by a sensor situated inside the electric box that measures the temperature inside the box. In the absence of an external air temperature sensor, this information is a good indicator of the external air temperature when there is no direct or diffused solar radiation. Therefore this temperature provides only a valid air temperature measurement as long as the electronic box is in complete shadow (no charging of the battery).

Unit:	°C.
Type:	Temperature measurement.
Source:	Measured raw data.
Sensor:	CR510 internal probe.
Measurement step:	1 minute.
Displayed and stored data:	Hourly average.
Vertical axis:	Left & right, red/blue area, 5°C steps automatic scale.
Display:	Red (T>0°C) / blue (T≤0°C) line.

External Air Temperature (Ext. Air Temp)

Ambient air temperature

Unit:	°C.
Type:	Temperature measurement.
Source:	Measured raw data.
Sensor:	T107 sensor, AlpuG modified.
Measurement step:	1 minute.
Displayed and stored data:	Hourly average.
Vertical axis:	Left & right, 5°C steps automatic scale.
Display:	Red (T>0°C) / blue (T<=0°C) area.

Snow Height

The chart indicates the average snow height perpendicular to the ground's local plane in the sensor's axis.

Unit:	cm.
Type:	Snow height measurement.
Source:	Measured raw data.
Sensor:	Ultrasonic sensor type SR50, modified AlpuG.
Measurement step:	1 minute.
Displayed and stored data:	Hourly average without extreme values picked out during the hour (measurement artifact).
Vertical axis:	Left & right, automatic scale.
Display:	Light blue area.

DATA DEFINITIONS (4/4)

Minimum Battery Voltage (MIN Batt. Volt.)

The chart indicates the minimal hourly voltage measured on the battery terminals. This chart, combined with the average battery voltage, gives information about the functioning of the supplying system and the station's consumption.

Unit:	Volt (DC).
Type:	Voltage measurement.
Source:	Measured raw data.
Sensor:	Electric box's internal probe.
Measurement step:	1 minute.
Displayed and stored data:	Minimal hourly value.
Vertical axis:	Left, from 11 to 16 Volts, by 0,5 Volt steps.
Display:	Blue line.

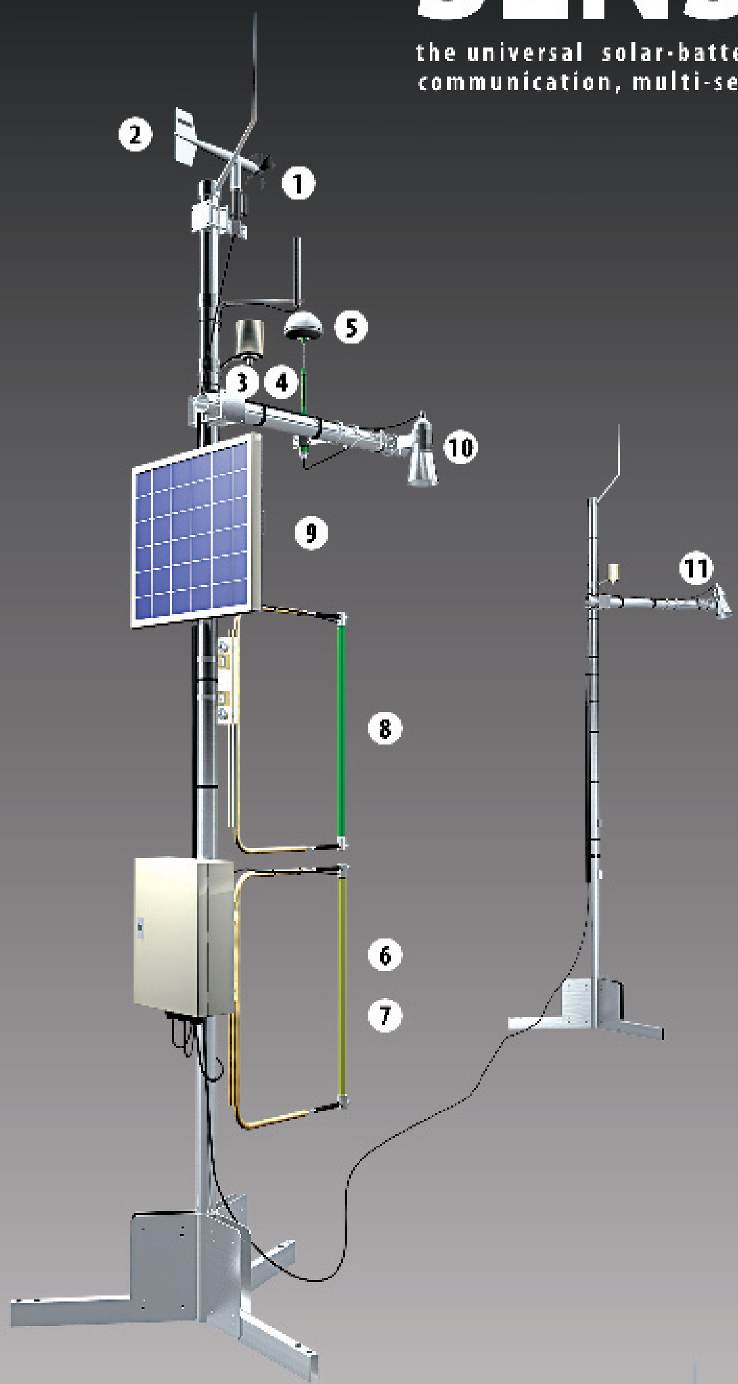
Average Battery Voltage (AVG Batt. Volt.)

The chart indicates the hourly average voltage measured on the battery' terminals. This chart gives information partially about the solar panel's exposure to the solar reflections on the show, and thus indirectly about the site's cloud covering during the day, except in particular situations. (see § F).

Unit:	Volt (DC).
Type:	Voltage measurement.
Source:	Measured raw data.
Sensor:	CR510 internal probe.
Measurement step:	1 minute.
Displayed and stored data:	Hourly average value.
Vertical axis:	Left, from 11 to 16 Volts, by 0,5 Volt steps.
Display:	Red line.

SENSORS

the universal solar-battery powered, GSM/radio communication, multi-sensors solution by ISAW



Snow Wind Air Rain

1. Wind Force 2. Wind Direction	Re-inforced RM Young 05103 Wind Monitor
3. Air Temperature 4. Air Relative Humidity	CS215 Temp. & Rel. Humidity Probe
5. Rain Gauge (option)	RainFlow High-Resol. Acoustic Sensor
6. Snowdrift Flux 0-1m 7. Ground Wind Force 8. Snowdrift Flux 1-2m 9. Snowdrift Flux 2-3m (option)	FlowCapt Eroding Mass Flux Sensor
10. Snow Height @ Erosion Zone 11. Snow Height @ Deposit Zone (option)	SR50A Sonic Ranging Sensor

MODULARITY