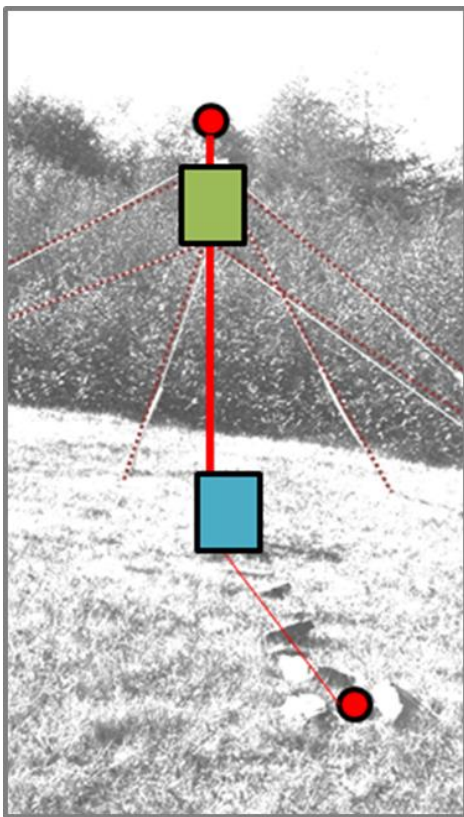


SnowSense®

Snow Water Equivalent Measurements & Service for Remote Areas

Knowledge of the current snow situation, especially on the water stored as snow, is of major interest of hydrological operators everywhere in the world. Due to the low density of reliable in-situ information, or only available from own costly stations or field campaigns, there is a large need for improvements. SnowSense has a solution!



- Reliable measurement of the water stored as snow (SWE) and the liquid water content (LWC) of a snow pack
- Independent power supply and satellite based communication for global application
- Maintenance free installation below and above the snow cover using fixed 2-GNSS-antennas
- Light weight system for easy transportation and installation
- Spatial modelling of the snow cover, incl. runoff and hydropower forecasts for catchments as service option

SnowSense®

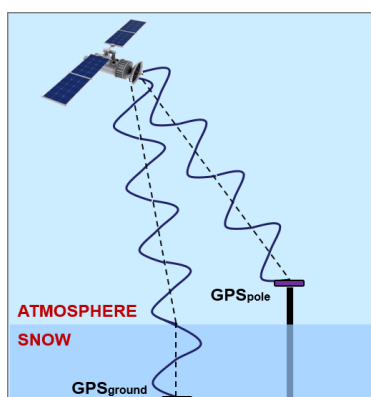
**Snow Water Equivalent
Information for Remote Areas
patent pending**



Snow Water Equivalent direct measurements

The key element of SnowSense is the capability to measure the snow water equivalent SWE at all requested locations by a novel, superior, GNSS based solution. The SWE (in mm) can be retrieved several times a day (requiring permanent power supply) or on a daily basis (common for hydrological users) – using energy-efficient measurement cycles. All stations are pre-processing the data and transfer the measurements via satellite communication or cellular networks (optional).

The stations are designed to be installed independently from any power supply and communication infrastructure, and can be set up permanently or temporarily, e.g. be removed during summer month. Station hardware is modular and easy to be transported and installed. Set up of multiple stations for a spatial measurement networks is advisable .



- Derivation of the water stored as snow (SWE) and the liquid water content (LWC) in the snow
- 2-GNSS-antenna concept with fixed, maintenance free installation below and above the snow cover
- Microwave L-Band signals with excellent attributes for snow monitoring globally available from GNSS satellites
- Proven results from scientific studies and demo operations in Europe and North America for several years
- Method and station are patent pending

References:

- ✓ Henkel, P., et al. (2018): „Snow water equivalent of dry snow derived from GNSS carrier phases“. - IEEE Transactions on Geoscience and Remote Sensing - Volume 56 Issue 6
- ✓ Koch, F., et ai. (2019): Retrieval of Snow Water Equivalent, Liquid Water Content, and Snow Height of Dry and Wet Snow by Combining GPS Signal Attenuation and Time Delay - Water Resources Research, Volume 55, Issue 5
- ✓ Appel, F., et al. (2019): “Advances in Snow Hydrology Using a Combined Approach of GNSS In Situ Stations, Hydrological Modelling and Earth Observation—A Case Study in Canada” - Geosciences 2019, Volume 9(1), Issue 44

SnowSense In-Situ Station Stations



Autonomous station Installation in Newfoundland/Canada

- Weather independent and maintenance free operation also during low sun or cloud conditions
- Independent power supply and intelligent operation management
- On-board processing and satellite or terrestrial based communication
- Light weight system (< 35 kg) for easy transportation and installation
- Low-cost hardware & data transfer

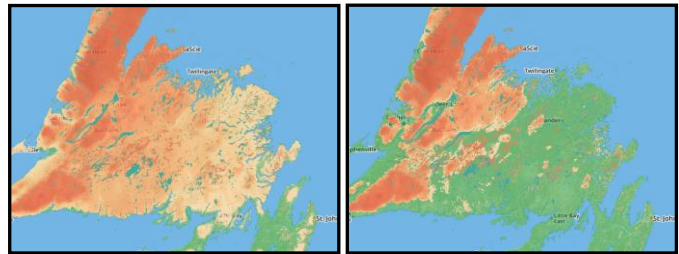
SnowSense stations are available – please contact for details and conditions

SnowSense as Service: Spatial Modelling

To provide spatial and temporal continuous information on the snow cover, the water balance is calculated using meteorological inputs and the parameters of the land surface by a physically model (PROMET). Meteo model inputs / NWP's enable weather station independent calculations and forecasts. The direct snow measurements from the stations and satellite derived spatial snow information are assimilated for exact and reliable results. Calculation of the run-off and aggregated products of hydro-power potential and forecast is optional.

Due to the transferable concept of the stations and the model, all catchments and regions can be monitored and provide large flexibility in performance and products.

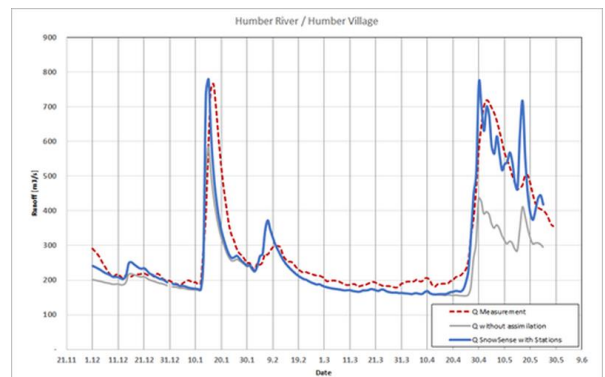
- Spatial calculation of all water balance and runoff components
- Independency from meteorological station due to NWP model coupling
- Assimilation of measured SWE at stations and satellite observations of the spatial snow dynamics



SWE maps of Newfoundland / Canada

Snow maps, run-off & hydropower forecasts

- Provision of weekly or daily maps of the SWE as online map or raster data product
- Provision of the total water storage as snow for selectable locations
- Runoff formation calculation incl. lakes and reservoirs
- Forecast option of 48 or 240 hours
- Tailored products available



Improved run-off modelling using SnowSense Stations and satellite observations

Modelling and forecast services available – please contact for details and conditions

SnowSense applications:

In combination of In-Situ Stations that can be located at remote or critical points and model capabilities, SnowSense is offering snow monitoring and forecasting solutions to a wide range of applications.

Hydro
Power

Flood
Forecast

Weather
Services

Winter
Sports

Logistic

Road
Services

Agri-
culture

SnowSense Contact and Sales

Reference Users & Customers



SnowSense Main Contact



VISTA Remote Sensing in Geosciences GmbH
Gabelsberger Strasse 51, 80333 Munich, Germany
snowsense@vista-geo.de



SnowSense is a development in collaboration between VISTA GmbH, ANavS GmbH and the LMU Munich, resulted from ESA business applications Demo Project SnowSense "Integrated Service for Runoff and Hydropower Assessment and Forecast related to Snow Cover Dynamics in Remote Areas" (2015-2019)



International Sales

- VISTA Remote Sensing in Geosciences GmbH - Munich (Germany)
- MicroStep MIS - Bratislava (Slovak Republic)

