

Real Time Hydrometric and Water Monitoring Platforms – New and Emerging Technologies

Scott Brown, M.Sc. – Integrated Systems



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ENVIRONMENTAL • INSTRUMENTATION • GEOTECHNICAL
SERVICE • INTEGRATED SYSTEMS • RENTALS

Real-Time Water Quality Monitoring Workshop – Govt. NFLD
Wednesday, November 8th, 2023

HOSKIN OVERVIEW



For over 75 years Hoskin Scientific has provided expert consultative support to find the right product to fit your application needs.



Whether you require monitoring or testing instrumentation, rentals or service, we are where you need us to be across Canada.



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ENVIRONMENTAL MONITORING



Sampling and monitoring instruments for air, water and soil for the environmental, agricultural, mining and forestry markets.

- Water Quality
- Meteorology and Climate Monitoring
- Surface Water Hydrology
- Groundwater & Remediation
- Coastal & Oceanographic
- Limnology & Fisheries Equipment
- Soil
- Plant Science
- Data Acquisition, Loggers & Software
- Museums & Conservation
- General Laboratory



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Outline for our time together...

1. Introduction to Sommer Messtechnik

- RQ30 Contact Free Discharge Measurement (new in CAN)
- Snow Water Analyzer (SWE and LWC) (new to market)



2. Sontek RS5 Acoustic Doppler Current Profiler define new...lets call '21 new(ish)



3. Real Time Climate and Camera Systems (always new)



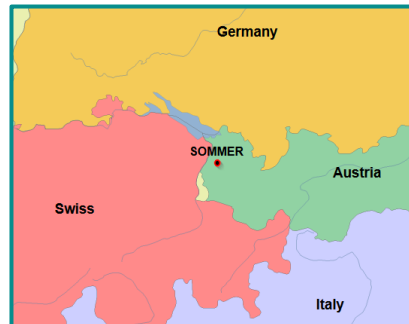

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SOMMER – Company Information

sommer was founded in 1987 in **AUSTRIA** and provides more than 30 years experience in development and production of high quality and **innovative measurement equipment** for hydrology and meteorology.

sommer is a **family owned company** with excellent reputation. Customer focus, reliability, excellent service and high-end products are our commitment to you.



SOMMER Headquarter is located in west Austria



SOMMER production facility





SOMMER – Area of activity



Meteorology – Measurement of different snow parameters and snow melt analysis



Hydrology – Discharge and water level measurement of Rivers and streams
Flood warning systems and networks



Sewer and industrial waters – Discharge measurement of open manmade channels and sewer systems



Mining industry – Measurement of water resources in snow and measuring of water flows in the mining process



Ice detection – Detection of ice and ice growth in different industries. (Wind power, Aviation, Power lines communication, Railway,...)



Sommer RQ-30 Contact Free Discharge Measurements



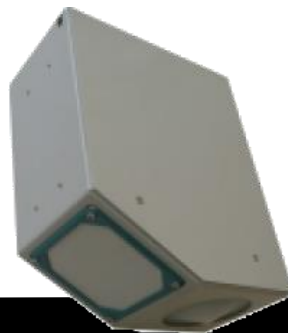


CONTACT FREE DISCHARGE MEASUREMENT



Advantages of Contact free discharge measurement with RQ-30

- ✓ Contact free measurement
- ✓ Easy mounting and installation
- ✓ Maintenance free (because not in the water)
- ✓ High reliability at floods
- ✓ No damage of sensor by flotsam, trees, debris, bed load,...
- ✓ Discharge calculation in the sensor




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RQ-30 WATER LEVEL SENSOR

somer
MESSTECHNIK

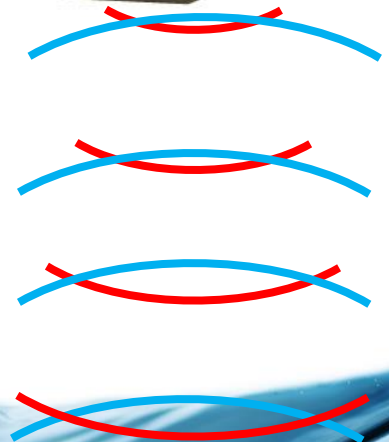
Water level (stage)

Transit time measurement

Radar (26 GHz) Vertical to water surface

Time between transmitting and reflecting the pulse = directly proportional to the distance

Radar: independent of air temperature and medium (e.g. foam)





RQ-30 VELOCITY SENSOR

som_{er}
MESSTECHNIK

Flow velocity

Measurement of Doppler frequency shift (Doppler Effect)

Radar impulse (24 GHz) are shifted by the water surface waves

Frequency shift by movement on the water surface (min. swell 3mm)

Measurement of **surface velocity**, calculation of mean velocity with hydraulic model

Certified velocity measurement by METAS





RQ-30 - RATING CURVE



Water level sensor with Rating Curve

Investment costs look lower (but operation cost are high)

Need Rating curve to calculate discharge

Good rating curve need up to 2 years to create

Very expensive equipment necessary to crate rating curve (current meter, ADCP boats)

No accurate flood measurement (rating curve need to be calculated)

Only water level information to get to the discharge

No information about velocity change

If riverbed change, NEW rating curve necessary !!

Flood warning only with water level

NO information about the real flow

RQ-30 Method

Same infrastructure and same RTU station

Calculates discharge in the sensor

Discharge right after the installation available

NO reference measurements necessary (but possible)

Reliable Measurement even during floods

Water level and velocity to calculate accurate discharge

Detection of dynamic processes in the water

Detection of riverbed change

Hysteresis

...

Input new cross section and DONE

Earlier warning of floods (velocity increase)

Detection of flow stop, blockage and backwater





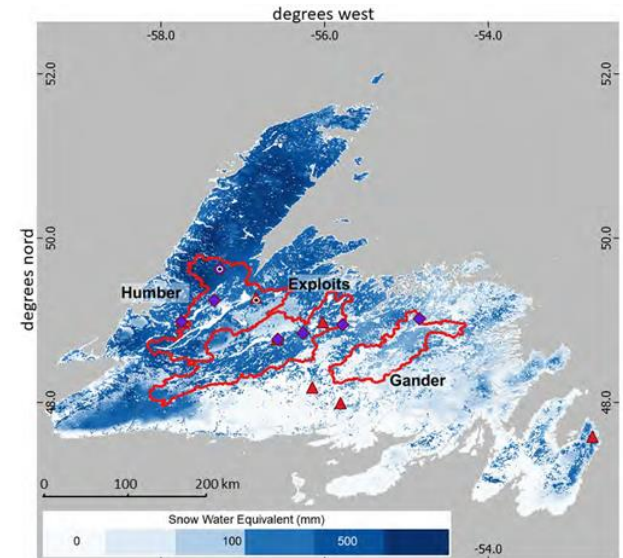
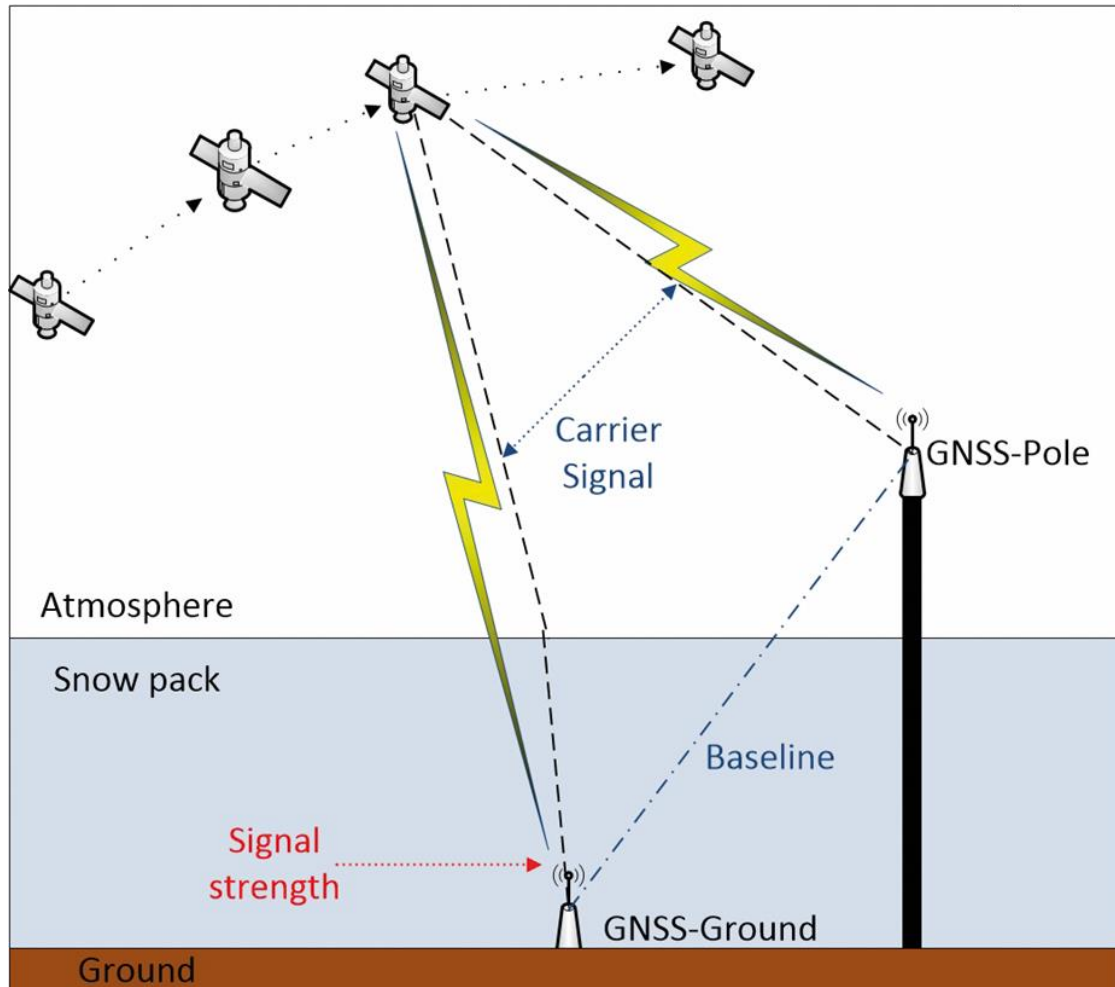
RQ-30 – OPERATING IN FLOODS

Limits of conventional discharge measurement during flood conditions

- Manual measurement (current meter e.g. ultrasound, ADCP boat, ...) not possible
- Damage of instrumentation by bed load, trees,...
- Danger for employees during manual measurement
- Availability of employees during the flood for measurement jobs
- extrapolation of stage-discharge curve $Q(h)$ at high flow conditions



Sommer SWA – Snow Water Analyzer



Article

Advances in Snow Hydrology Using a Combined Approach of GNSS In Situ Stations, Hydrological Modelling and Earth Observation—A Case Study in Canada

Florian Appel ^{1,*}, Franziska Koch ^{2,3}, Anja Rösel ¹, Philipp Klug ¹, Patrick Henkel ⁴, Markus Lamm ⁴, Wolfram Mauser ^{1,3} and Heike Bach ¹

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SWA – Snow Water Analyzer

Unique Concept:

Using GNSS for snow monitoring

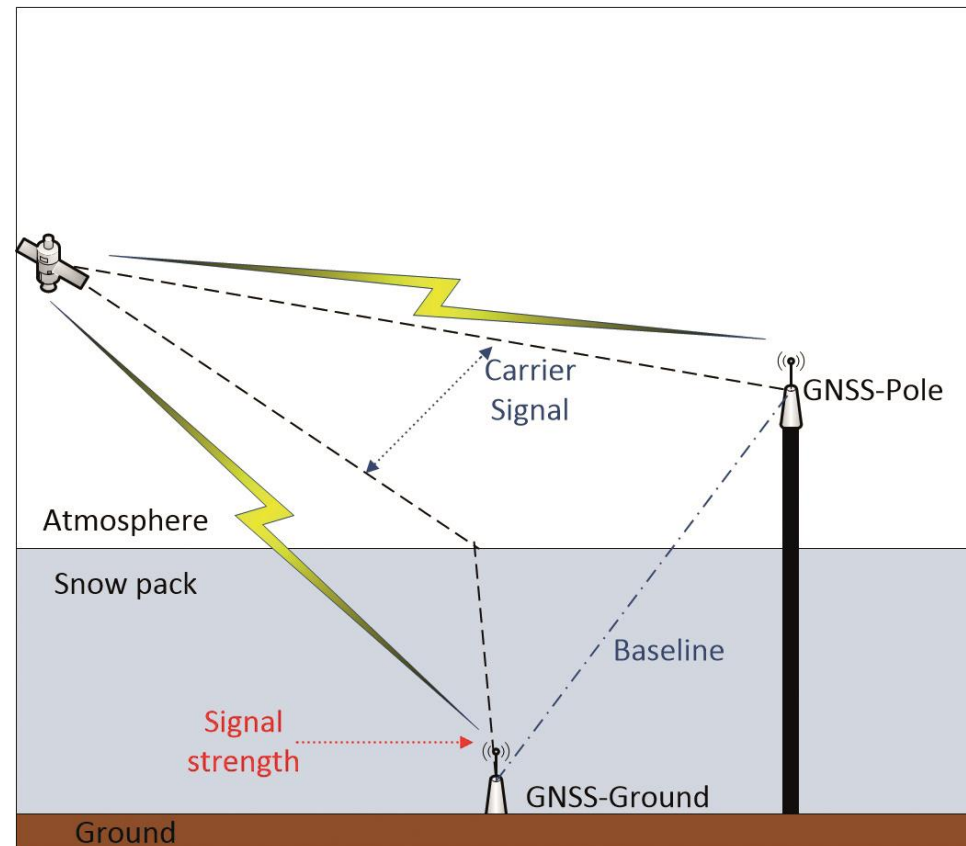
Using energy efficient low-cost hardware

Using state-of-the-art sensor communication

GPS:

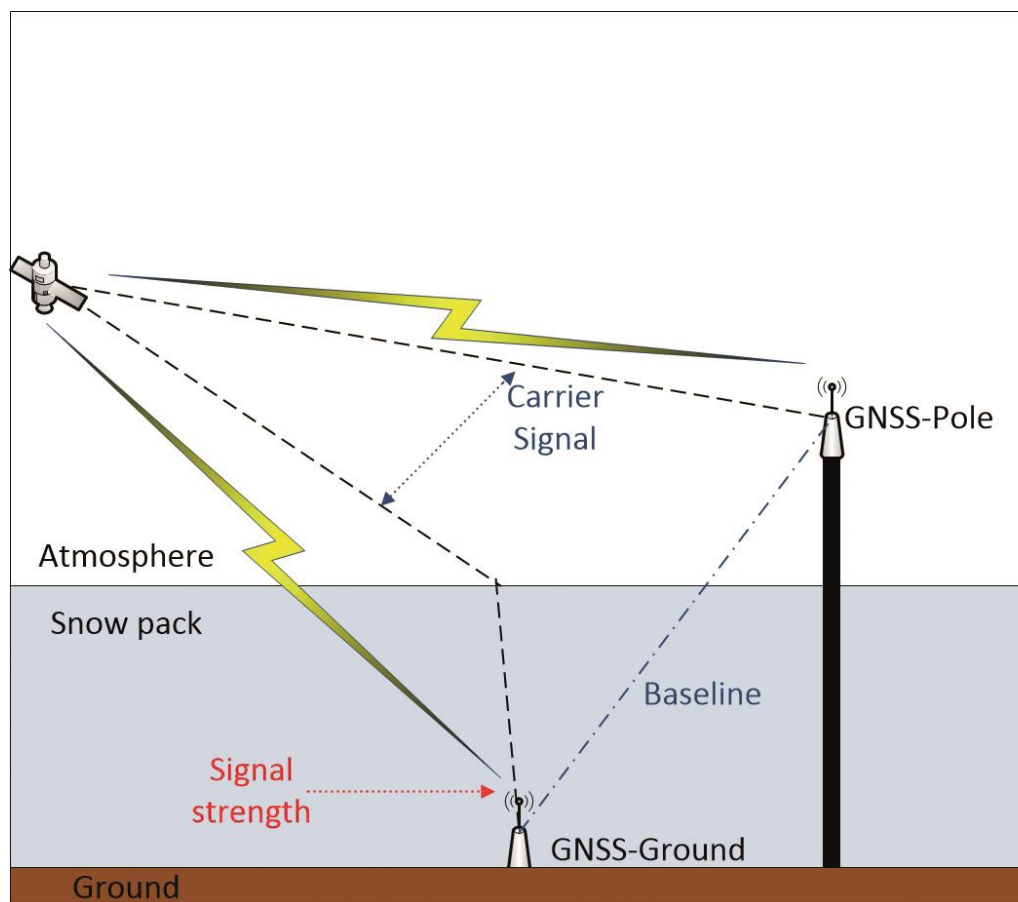
- L1-Band 1.575GHz
- 32 Satellites at 20.200Km Orbit
- 23h56min repetition

Manufactured in cooperation with
SNOWSENSE™





SWA – Snow Water Analyzer

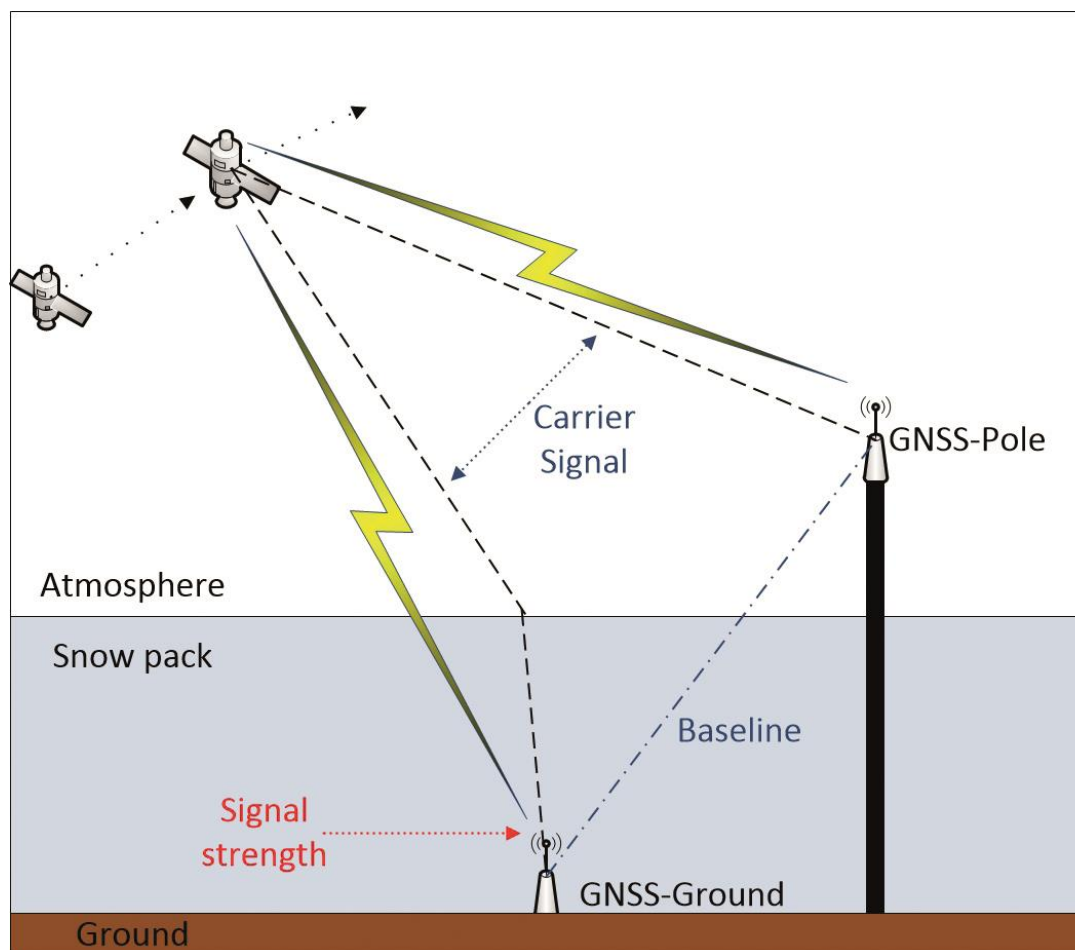



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SWA – Snow Water Analyzer

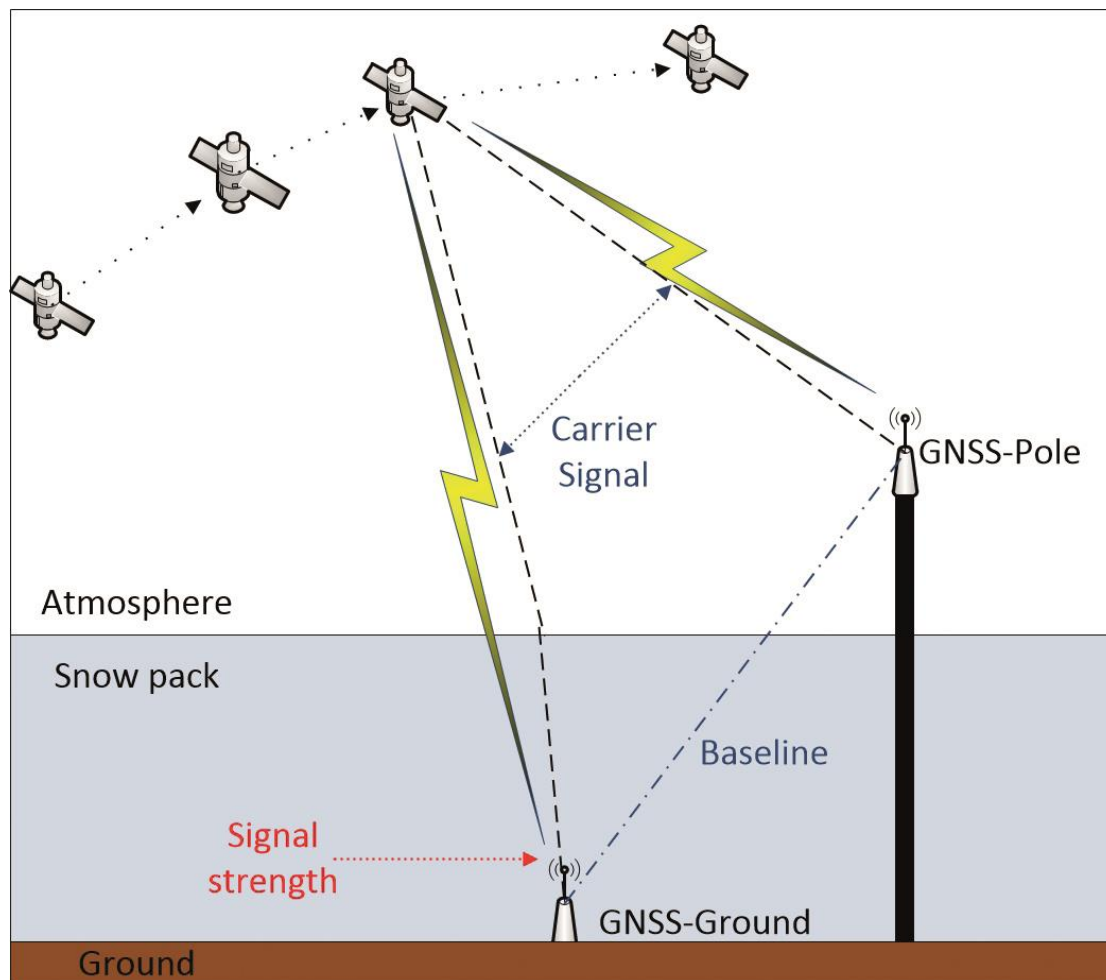



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SWA – Snow Water Analyzer

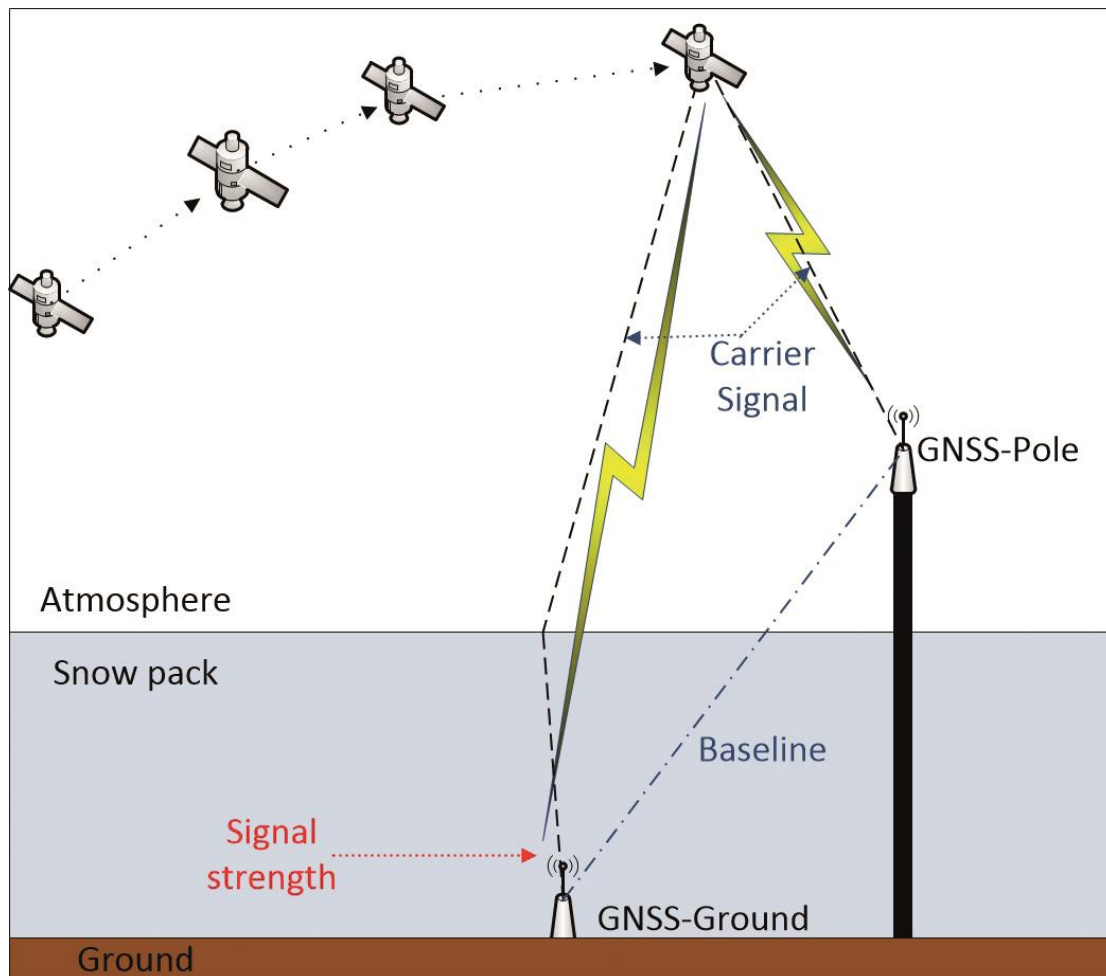



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SWA – Snow Water Analyzer




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SWA – Snow Water Analyzer

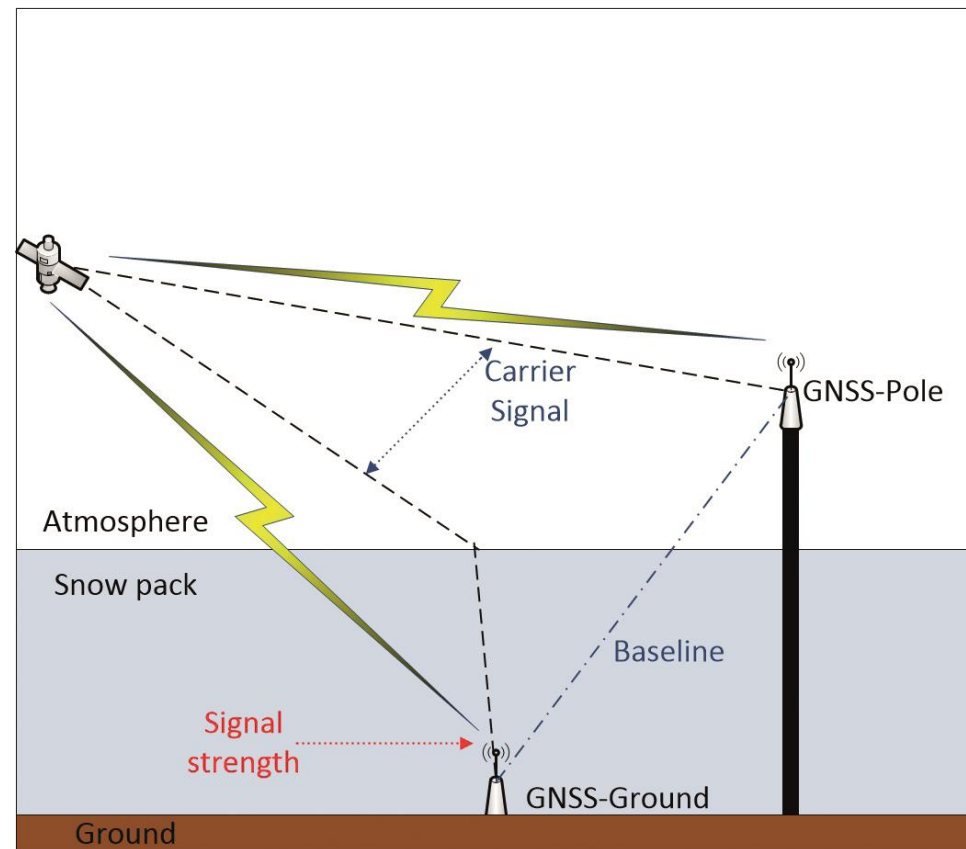
How do we do it?

SWE Measurement:

- Using the delay /Carrier Phase

LWC Measurement:

- Using the C/N0 Signal (Signal strength)
- C/N0 Signal/SNR



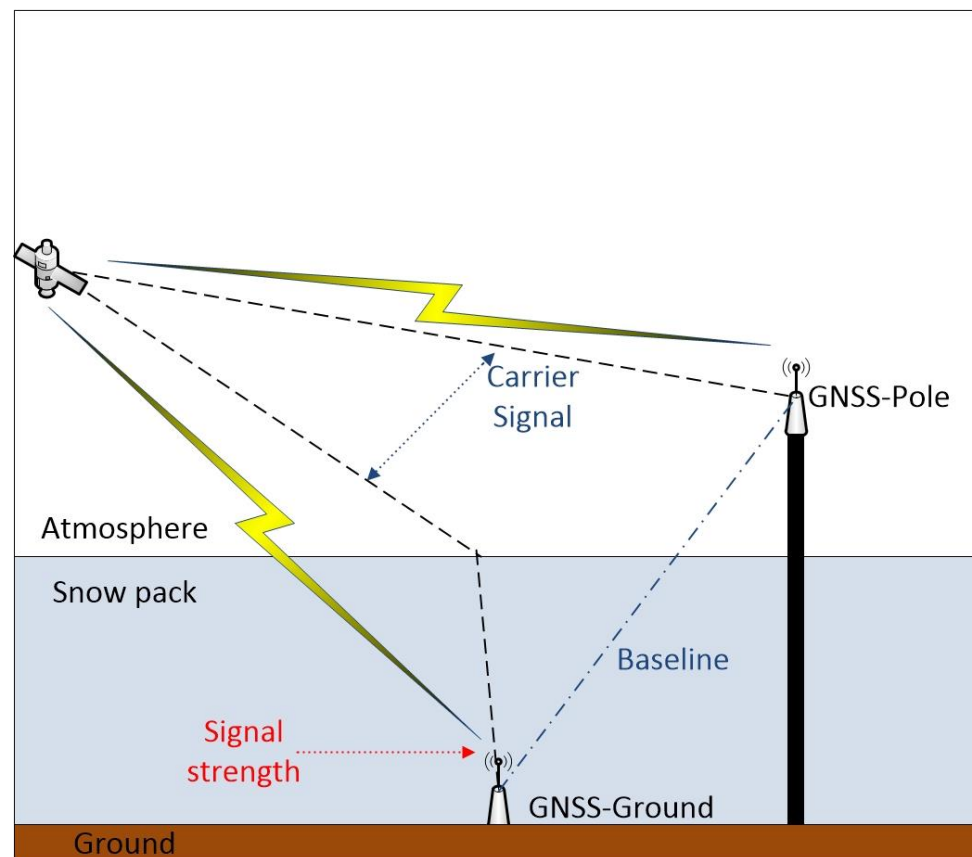


SWA – Snow Water Analyzer

Measuring SWE:

SWE Measurement:

- Using the delay /Carrier Phase
- The SWE is causing a phase shift of the signal

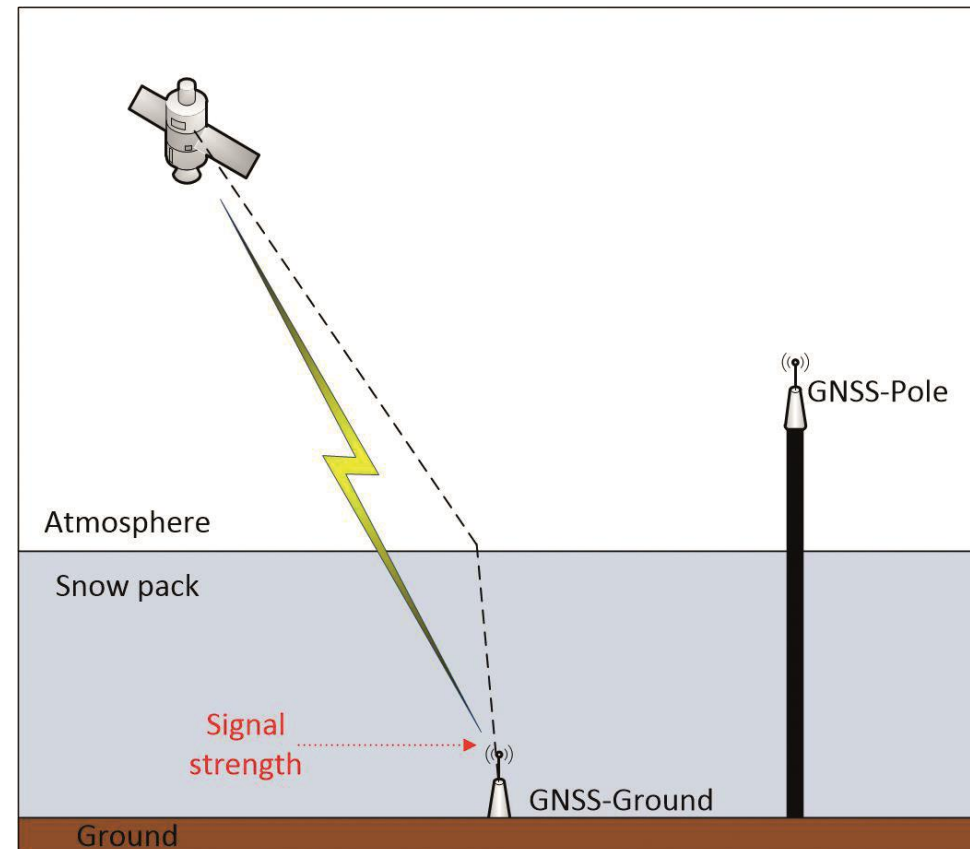


SWA – Snow Water Analyzer

Measuring SWE:

LWC Measurement:

- Using the C/N0 Signal (Signal strength)
- The LWC is damping the signal strength and we are measuring that

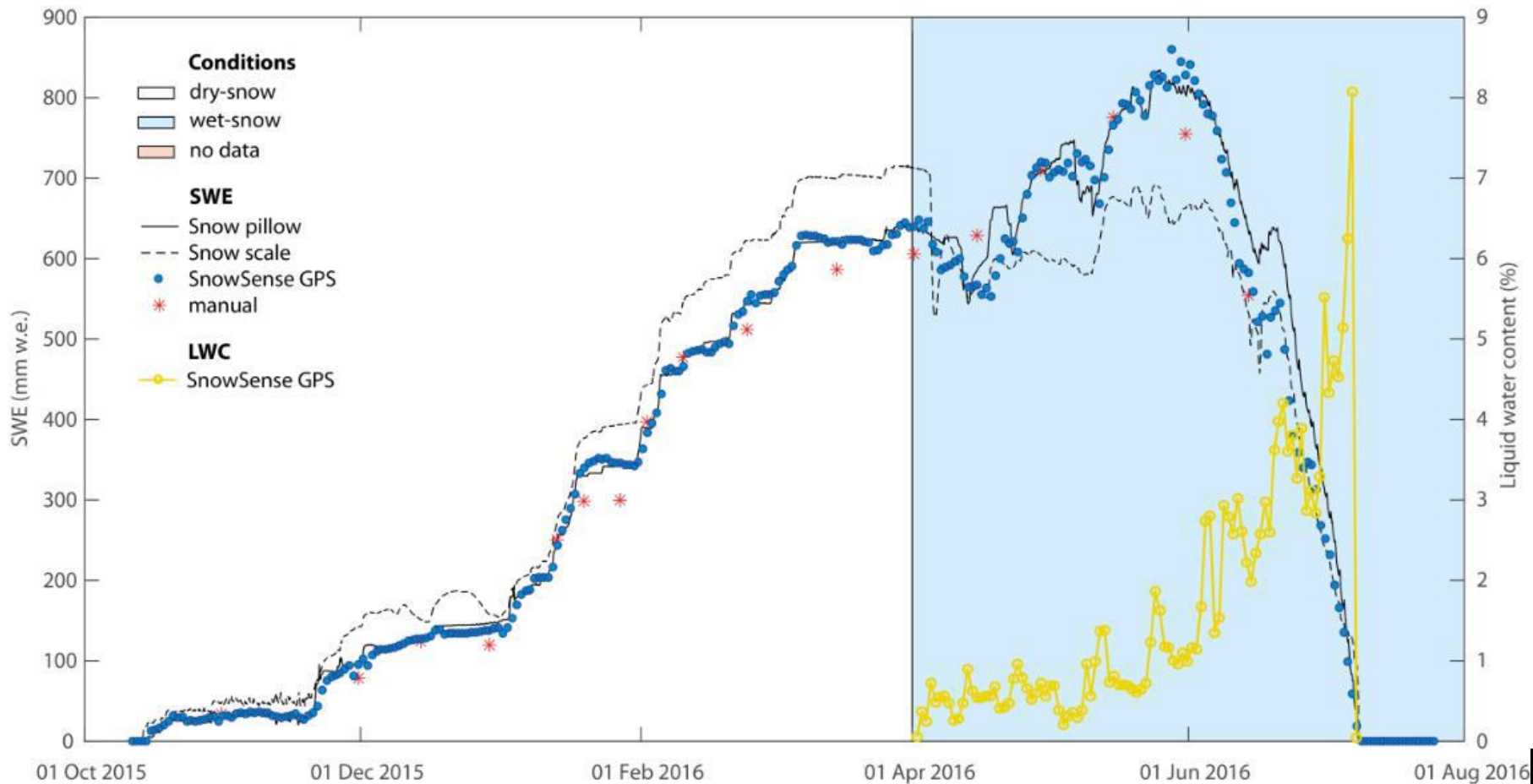




SWA – Snow Water Analyzer

Results from an Alpine Station

- Weissfluhjoch (Swiss)
- At the SLF – Swiss Snow and Avalanche Institute



SWA – Snow Water Analyzer

Physical Installation in the Field?

- Antenna with base plate (right top)
- SWA-Analyzer (right bottom)
- Sensor during the season



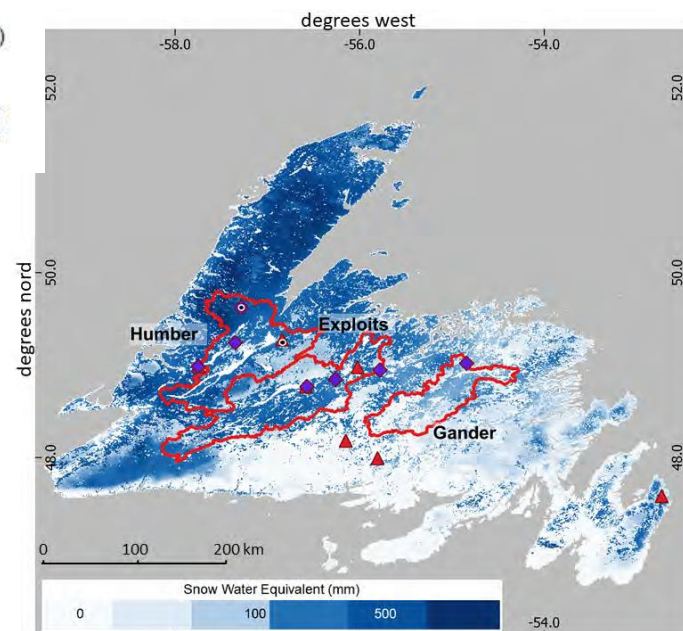
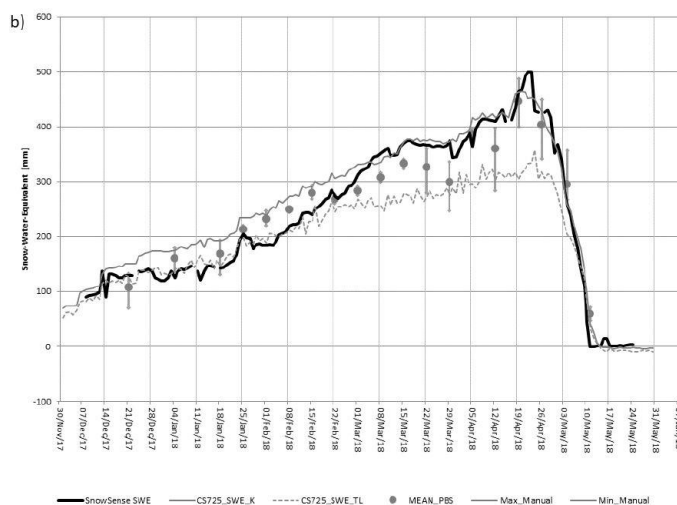
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SWA – Snow Water Analyzer

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 snow bridging

No site preparation

No construction work required

Maintenance free operation



SWA – Snow Water Analyzer

Energy-saving sensor operation

- Sleep mode between the measuring intervals
- Solar-powered stations

No parametrization needed, Easy to install

No antifreeze needed or other chemicals

Information about SWE and liquid water content

- Of the whole snow pack



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Sontek RS5 – The Worlds Smallest ADCP



Originally Released in 2021...

What exactly is the RS5 anyway?



It's a handy grab-and-go ADCP that you can:

- Take anywhere
- Setup in minutes
- Visualize flow data like never before

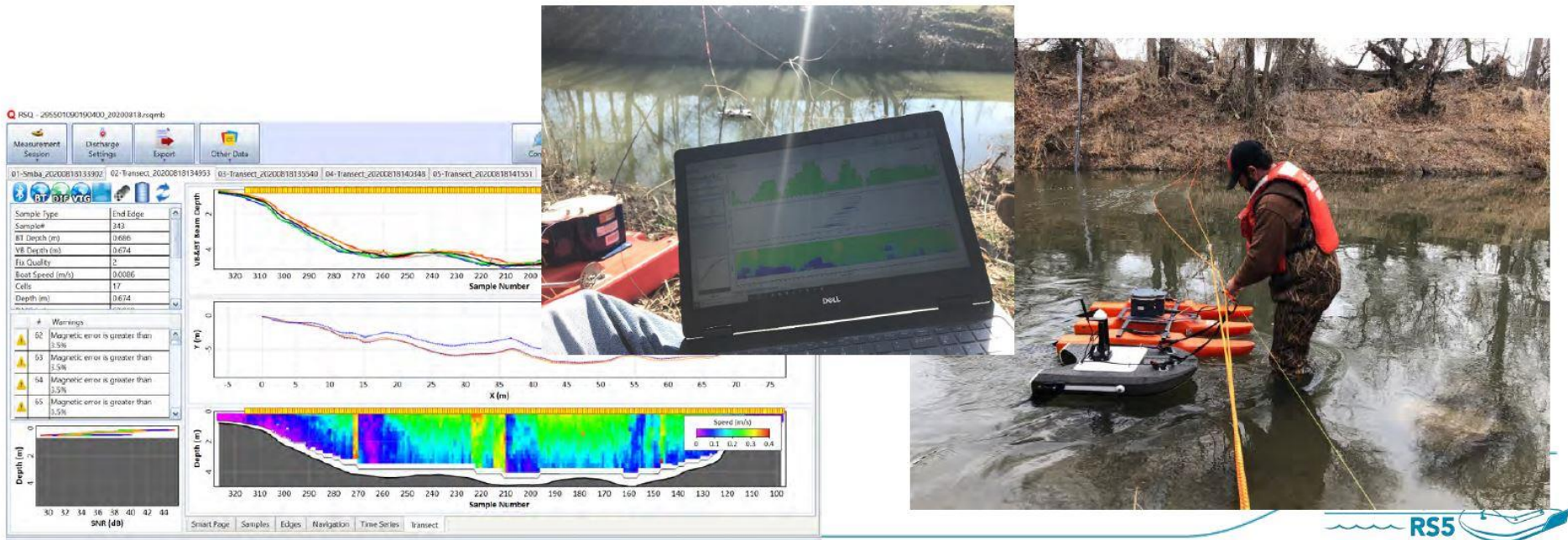
The Improvements...

- Small, easily transportable ADCP
- Improve acoustic performance in common problematic conditions
 - Losing bottom track
 - Ultra-shallow
 - Closer to edges/walls
- Works well in wide range of velocity conditions
- Minimize time in field to make discharge measurements
- Easy to use - Modern software



The Backstory...

- Comprehensive testing began in 2018
- Testing included Xylem Application Engineers and experienced ADCP users from around the world.
- Extensive testing with USGS for over a year (since late 2019)



What's Unique vs. Competition

How is the RS5 different from “those other guys”?

1. Broadband transducers
2. SmartPulse+ - broadband plus pulse coherent acoustic processing
3. Optimized for ultra-shallow conditions
4. Improved bottom tracking
5. RSQ Software – intuitive and familiar, flexible post-processing options

Now it's time to let the data speak for itself...

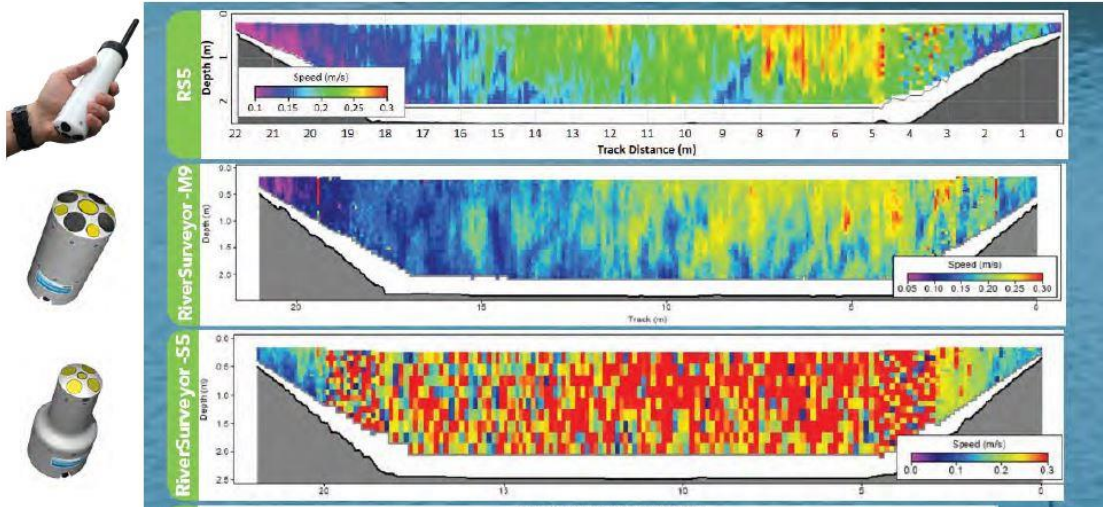


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High Resolution Results...

Broadband Transducers and SmartPulse+

Beautiful, high-resolution data!



Application Engineer RS5 testing, Yuma, AZ (USA).

Capabilities in Difficult Environments...

Collect data in never-before locations

Ultra-shallow capabilities

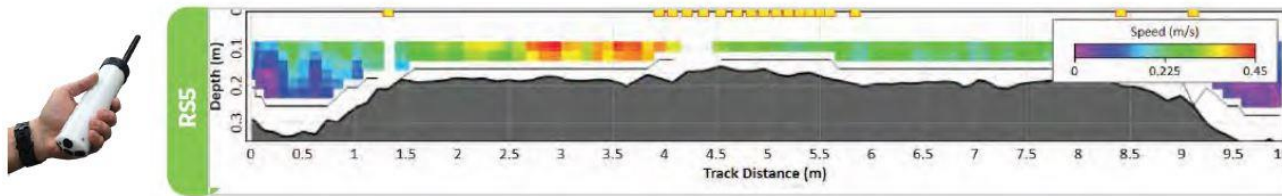
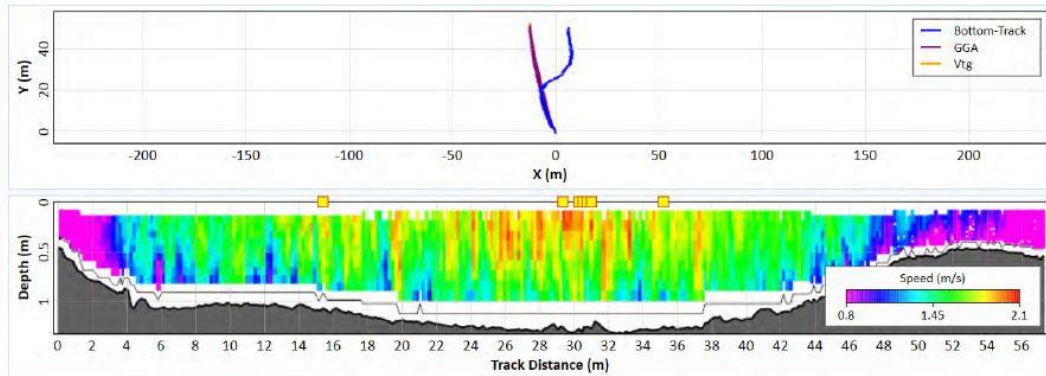


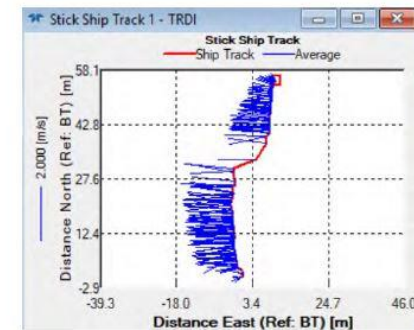
Photo and data courtesy of Tim (Shawn) LeMaster, USGS.

Improvements to Bottom Tracking...

Improved Bottom Tracking



Data courtesy of Icelandic Met Office (site V066 Kljafoss)



Real-Time Climate and Camera Systems – Telemetry is Key



BGAN Satellite Camera equipment

Cameras

Stand-alone cameras

Strategically placed around the site

Photographs collected daily

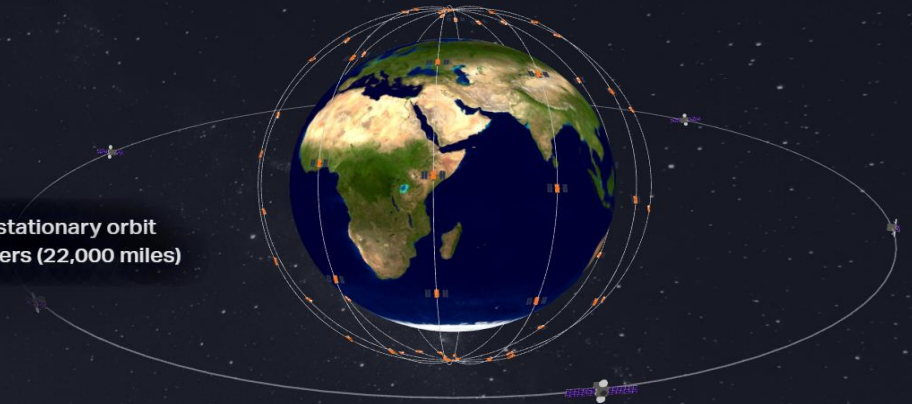


World-Wide Coverage
One-Service Plan






Iridium SBD/Certus Systems

Most other networks use geostationary orbit (GEO) at about 35,000 kilometers (22,000 miles) from the planet.

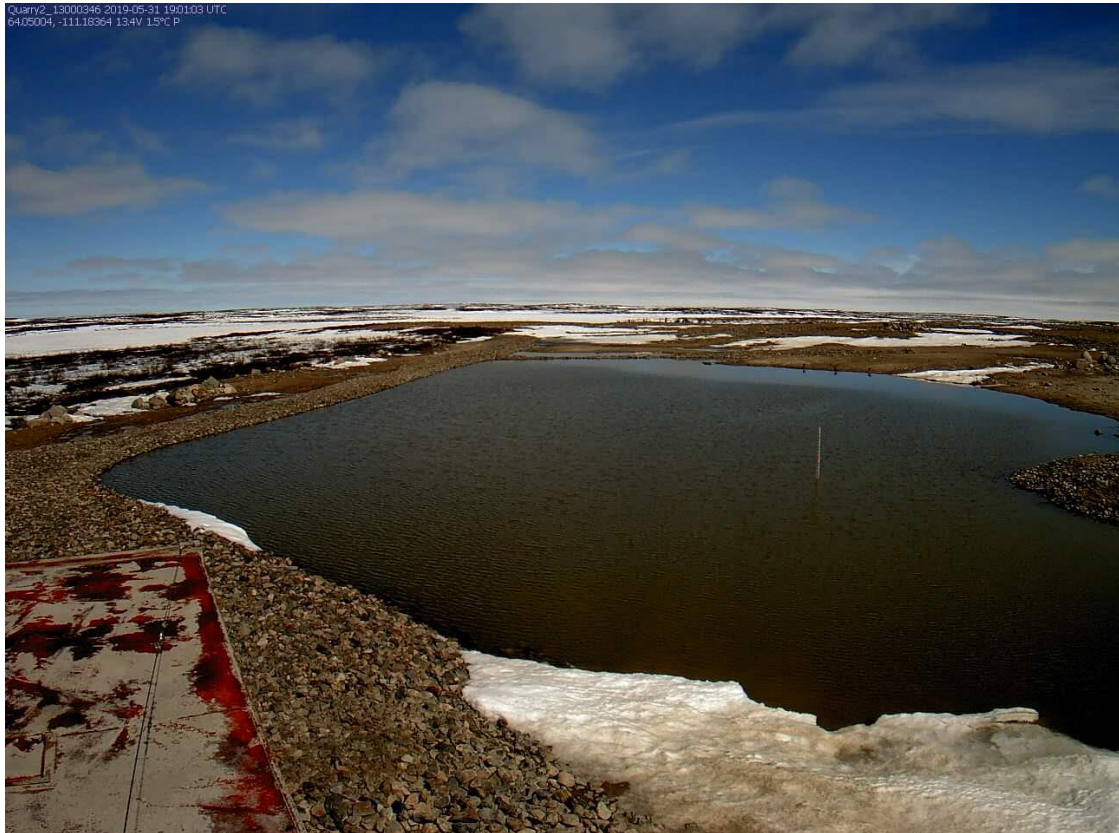


- Complete circumpolar coverage
- Crosslinked mesh architecture
- Certus100 IP data speeds of up to 88Kbps
- Certus200 IP data speeds of up to 176Kbps
- Certus700 IP data speeds of up to 704Kbps

	Short Burst Data® Packet Data	Narrowband 2.4 Kbps	Midband Up to 88 Kbps
			
Data Transfer	Short Burst Data	Circuit Switched Data & Short Burst Data	IP & Iridium Messaging Transport SM *
Gateway Connectivity	Iridium CloudConnect, Direct IP	Direct IP / PSTN	Partner Colocation & VPN*
Applications	Asset Tracking, Fleet Management, Remote Monitoring, Security Alerts, Personal & Personnel Tracking, GPS Location, Telemetry, UAV, Sensor Data	Oceanographic Data & Buoy Data, Tracking, Monitoring, GPS, Command & Control, Environmental Monitoring	Personal & Lone Worker / Personnel Tracking, Messaging, Command & Control, UAV, Remote Telemetry, Still Image Capture, Rail Positive Train Control, Remote Site Connectivity
Pricing	\$ / KB	\$ / Minute	\$ / MB
Module	Iridium 9602, Iridium 9603	Iridium Core 9523	Iridium Certus™ 9770
Go-to-Market Options	Direct from Iridium, Approved Distribution Partners	Approved Partner Products	Approved Partner Products
Monthly Data Usage	~1 KB - 100 KB	~50 KB - 3 MB	~1 MB - 50 MB



High Arctic Water level from Remote Cameras



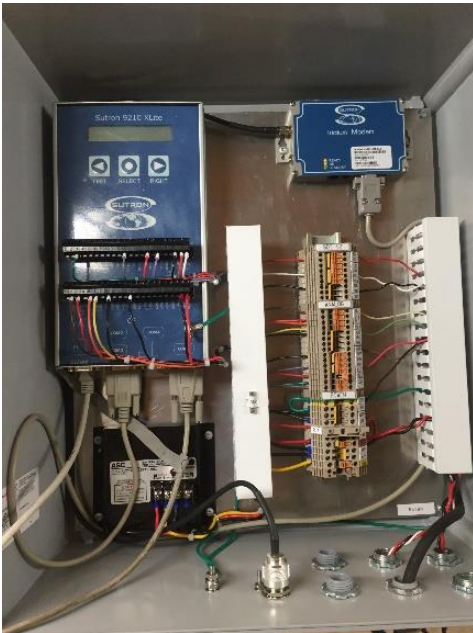
Wildlife Monitoring from Remote Cameras



BC Hydro Peace River Ice Monitoring System



Colomac and Tundra Mines Sutron Iridium Monitoring System



Project Background

- Located 220 km north of Yellowknife, NWT
- Open pit mine
- Started operations in 1990 and abandoned in 1999
- Aboriginal Affairs and Northern Development Canada (AANDC) took responsibility of site
- A Remedial Action Plan was completed in 2004



Yukon Geological Survey Iridium Climate Stations

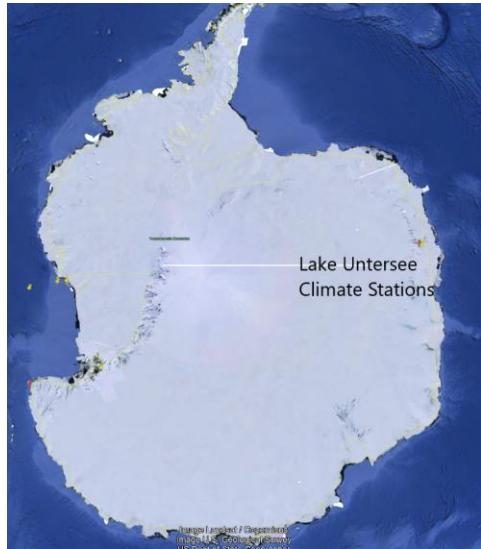


Real Time Ice Floe and Climate Monitoring System using Iridium Telemetry in Beaufort Sea



Lake Untersee

Climate Stations Antarctica



DataGarrison
User Area Lake Untersee

DataGarrison Remote Sites Control Panel Plotting Preferences

Latest Conditions
02/19/19 2:12 am

Transmitter Battery
100%

Pressure
927.650 mbar

Solar Radiation
4.375 W/m²

Temperature_3437864
0.024 °C

Temperature_3437865
0.163 °C

Temperature_3437866
-0.311 °C

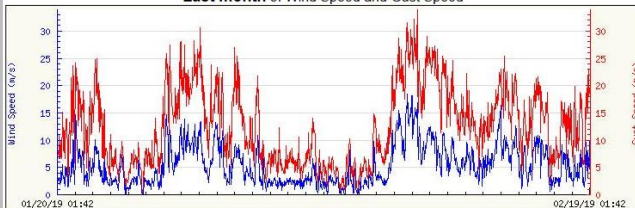
Temperature_3438015
0.715 °C

RH
29.500 %

Backup Batteries
13.086 V

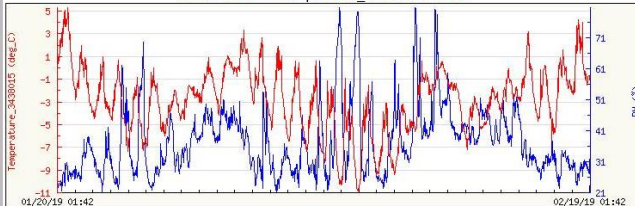
Wind
Speed: 6.042 m/s
Gust: 23.388 m/s
Direction: S (189°)

Last month of Wind Speed and Gust Speed



Edit plot

Last month of Temperature_3438015 and RH



Edit plot

Hoskin Scientific has provided the SETI Institute with Three Real Time Climate Stations Installed at Lake Untersee, Queen Maud Land



Northern Ellesmere Milne Ice Shelf Iridium Climate Station

❖ 83 North
Latitude

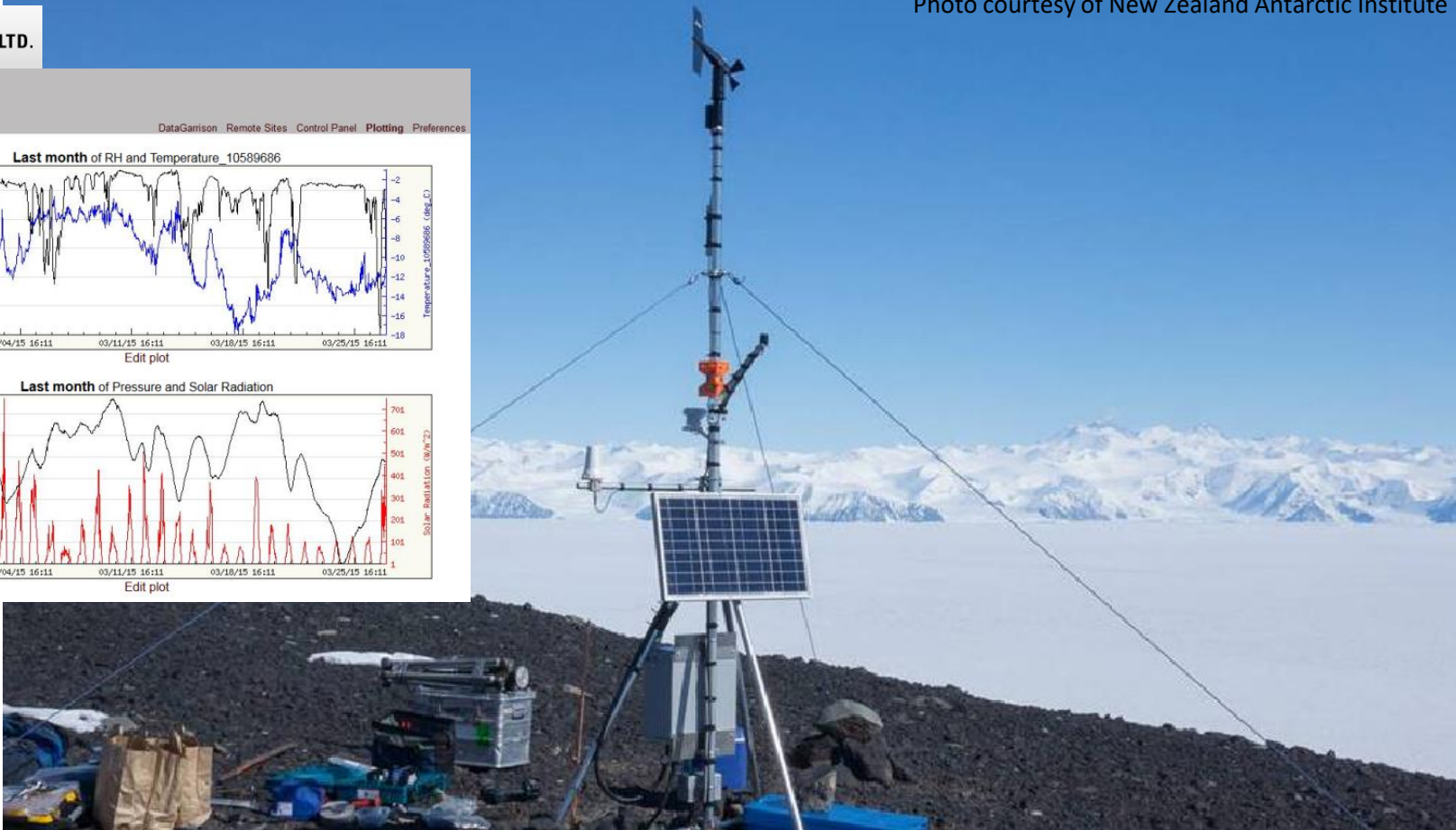
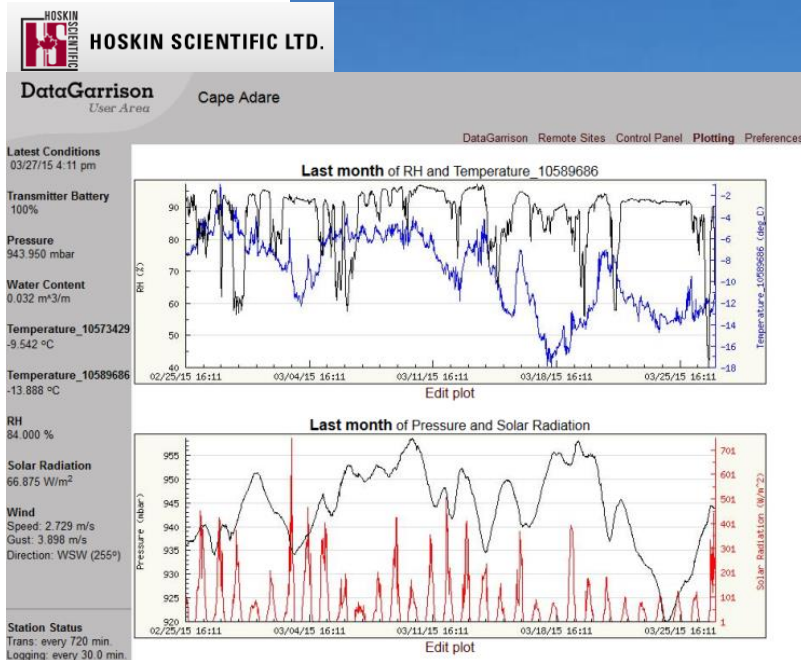
❖ Transmitting
Since 2008 Real
time through Polar
Winters

❖ Captured
Important Climate
Data During Ice
Shelf Release



Real Time Iridium Weather Station Located at Cape Adare next to Ross Ice shelf, Antarctica

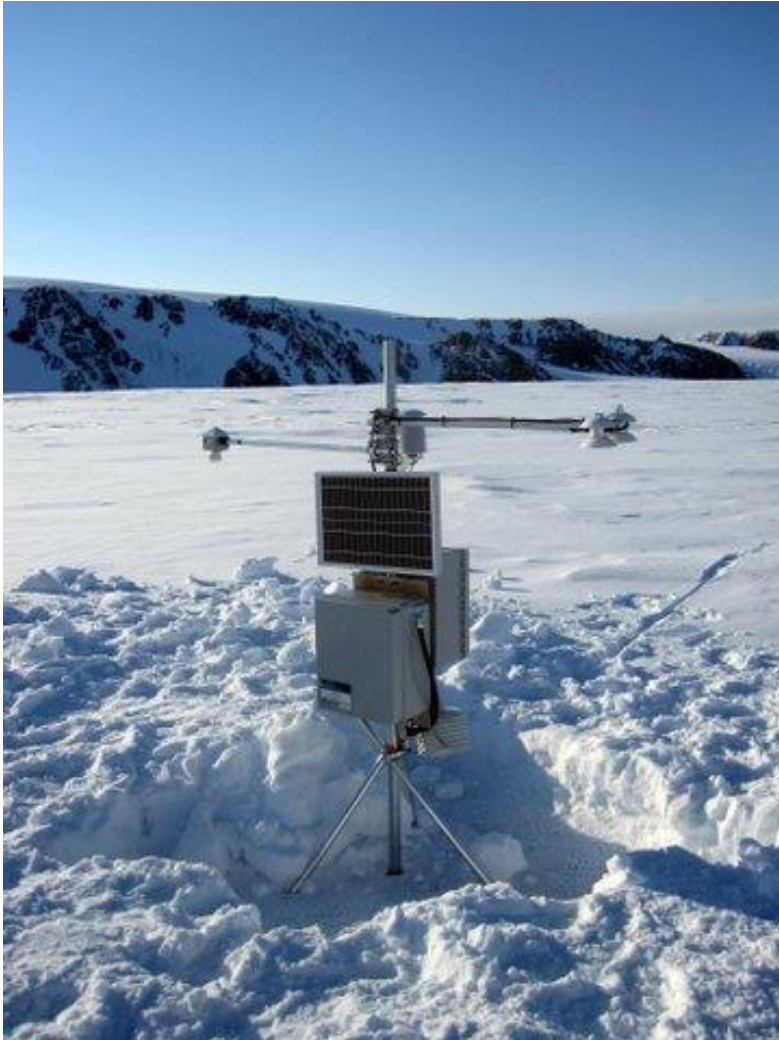
Photo courtesy of New Zealand Antarctic Institute



Mount Logan Iridium Satellite Climate Station for Research and Aviation



Devon Island Ice Cap Glacier Iridium Mass Balance Study



QUESTIONS & ANSWERS



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