

Advances in Data Acquisition Technology for Water and Hydropower Infrastructure Monitoring

Presented by
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- What is a data acquisition system?
- How are data acquisition systems used for monitoring water and hydropower infrastructure?
- What are the advances in DAS technology?

What is a data acquisition system (DAS)?

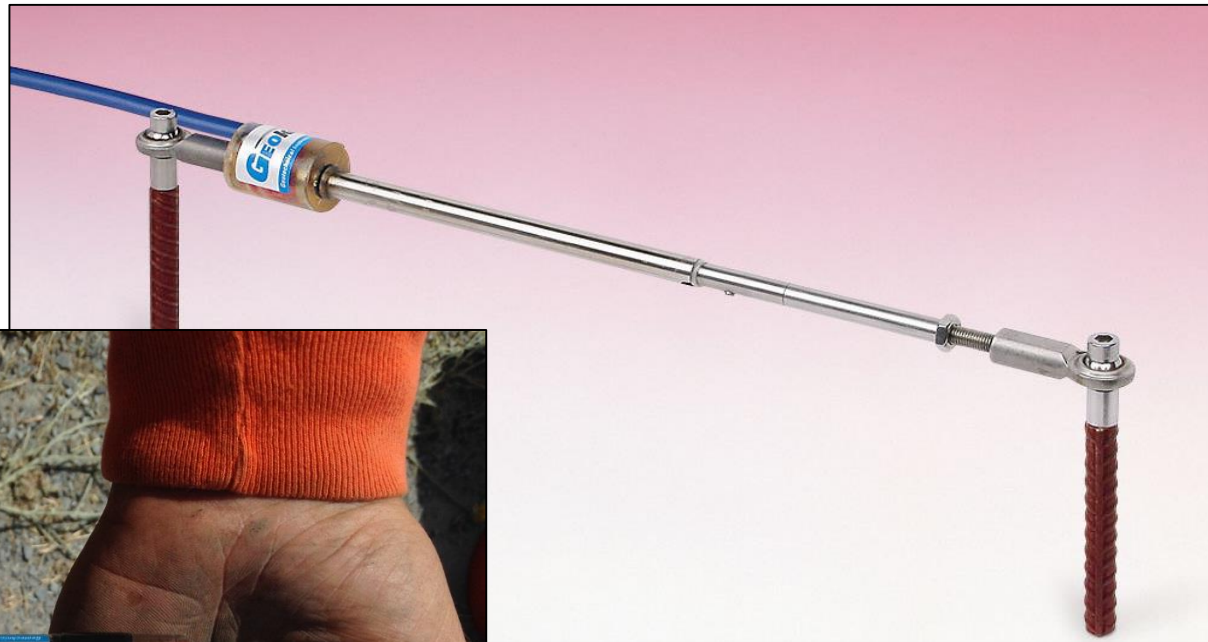
An electronic system that records and stores measurements from sensors.

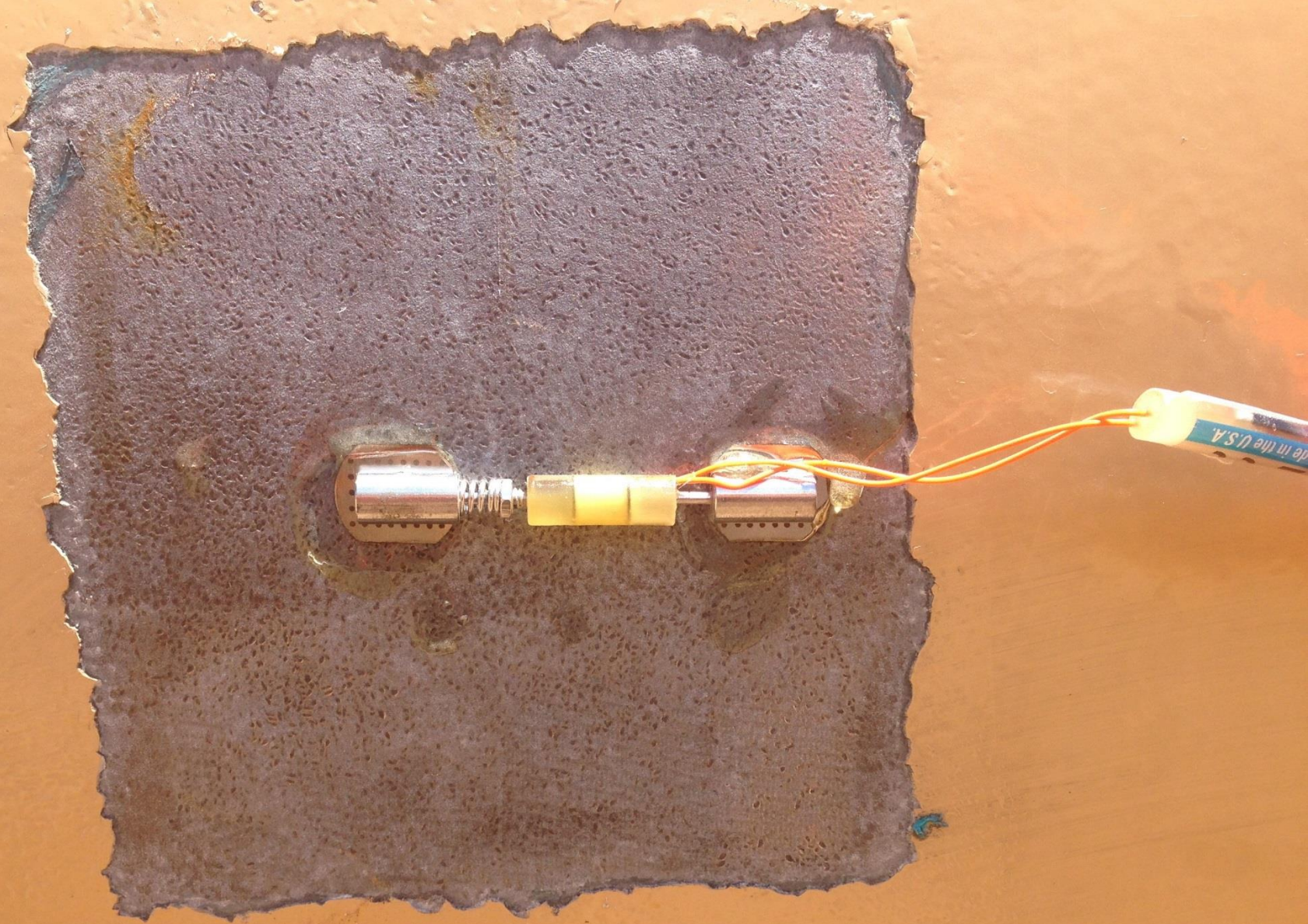
Components of a DAS:

- Sensors
- Measurement and Control Devices (dataloggers)
- Communications
- Power Supply
- Software: Data Collection, Management, and Visualization

Sensors

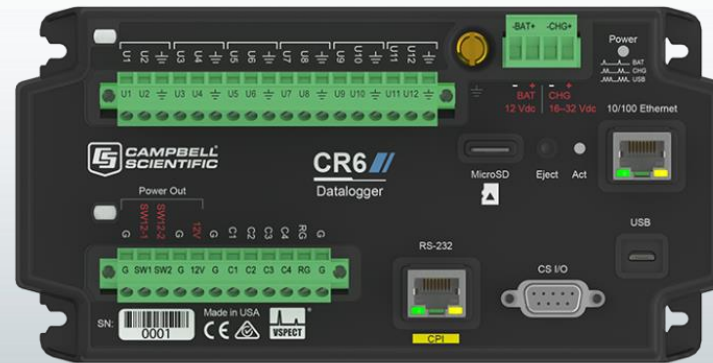
- Sensors: devices that measure
- Common measurements:
 - Displacement/movement
 - Tilt (inclinometer)
 - Temperature
 - Strain/stress (load cell)
 - Pressure and groundwater elevation (piezo)
 - Flow (weir monitor)







Measurement and Control Devices



Basic Datalogger Functions

- Electronic device (field computer)
- Measures signals from sensors
- Converts analog signals to digital data
- Stores (logs) the measurements
- Connected/paired with a computer or handheld device for data collection



Advanced Datalogger Functions

- Can read many different types of signals/sensors.
- Control capabilities
- Custom programming
- Communication options



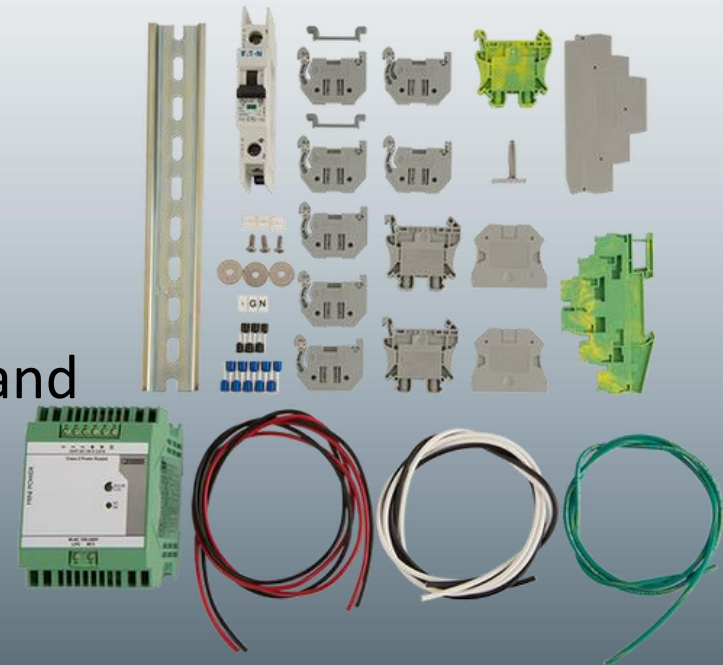
Communications

- Many different communication options:
 - Direct connection
 - Phone modem
 - Digital cell phone modem
 - Radio
 - Internet (Ethernet or WiFi)
 - Satellite



Power Supply

- DAS and dataloggers run on low voltage DC power
- Commonly 12 VDC
- Power supply options
 - Direct hard line power
 - Battery
 - Charging system (solar panel and reserve battery)





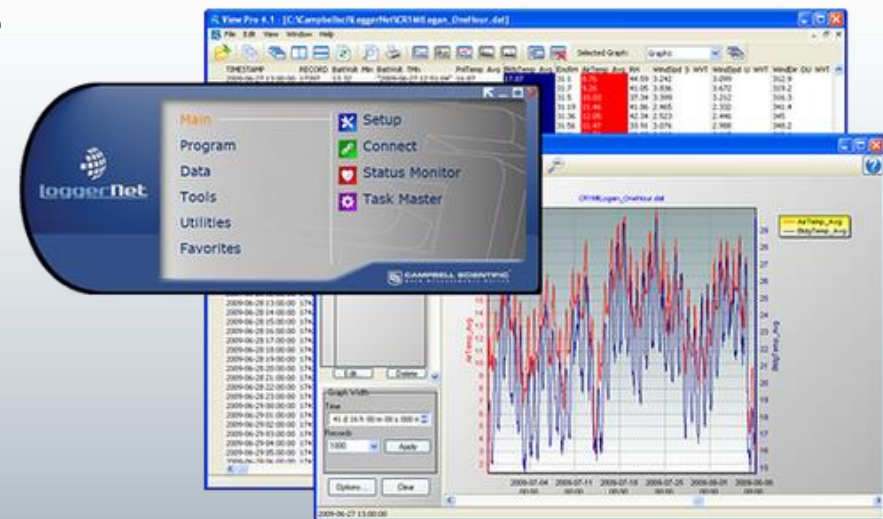
WARNING
GAS
PIPELINE

PELIGRO
TUBERIA
DE GAS

GeoKON

Software

- Software is used to manage the DAS
 - Configure dataloggers and peripheral components
 - Create programs
 - Data collection
 - Scheduled data collection
 - Send alert notifications
 - Data visualization



How are data acquisition systems used for monitoring water & hydropower infrastructure?

- Compliance with Regulatory Monitoring Requirements
- Geotechnical Monitoring
- Flow Monitoring
- Structural Health Monitoring (Asset Management)
- And more...





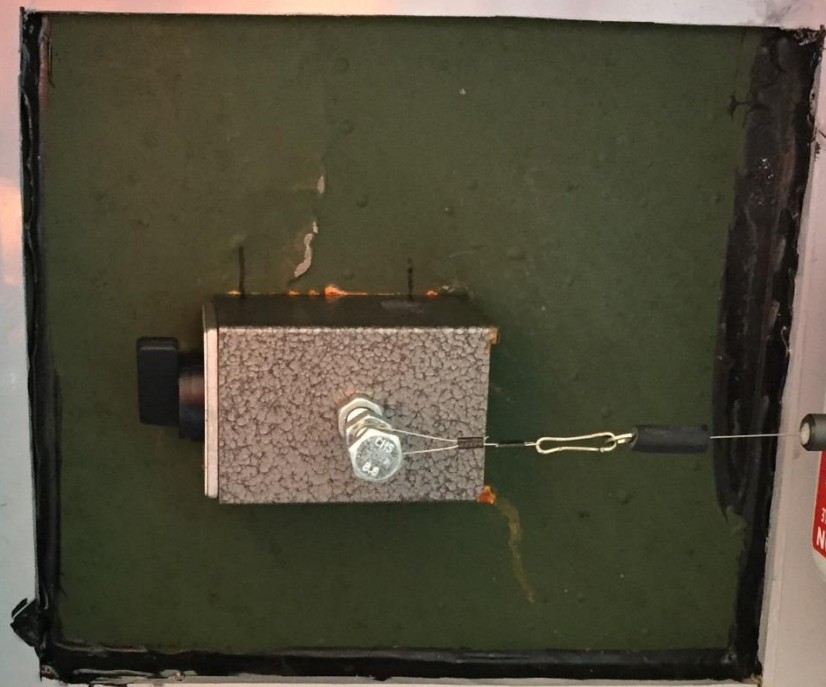








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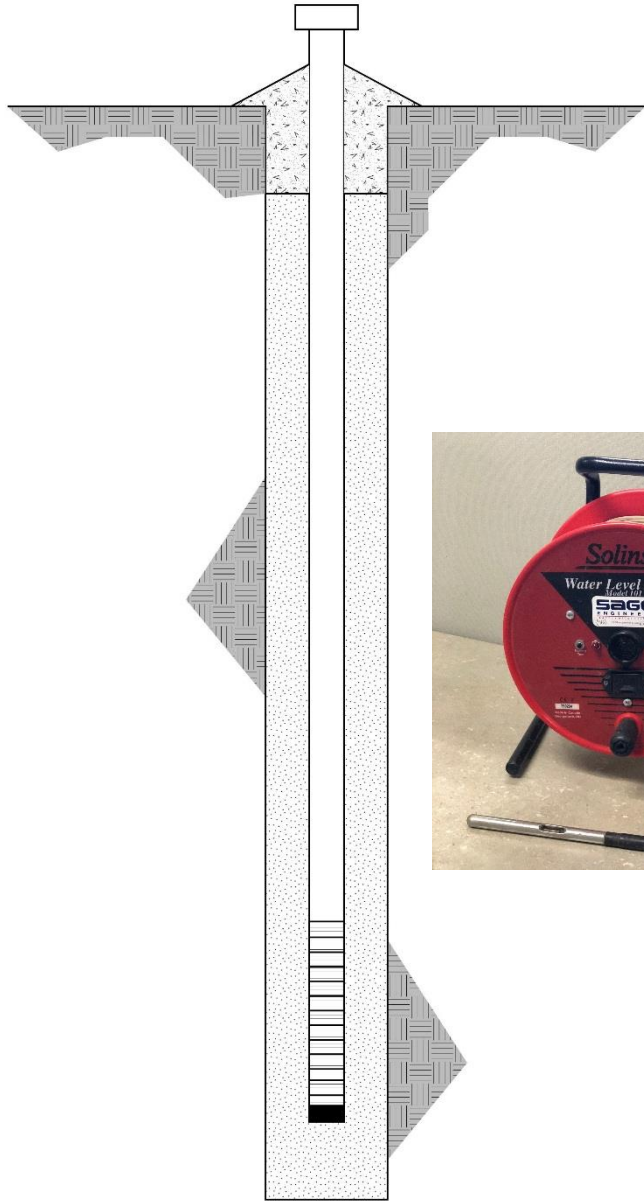
What are the advances in DAS technology?

- Sensors
- Measurement and Control Devices
- Communications
- Software

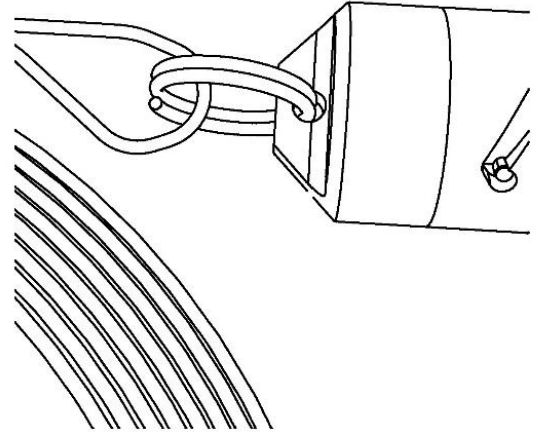
Water-Level Recording Sensor

- Two-for-one: piezometer and datalogger.
- Increase value of existing open-standpipe piezometers



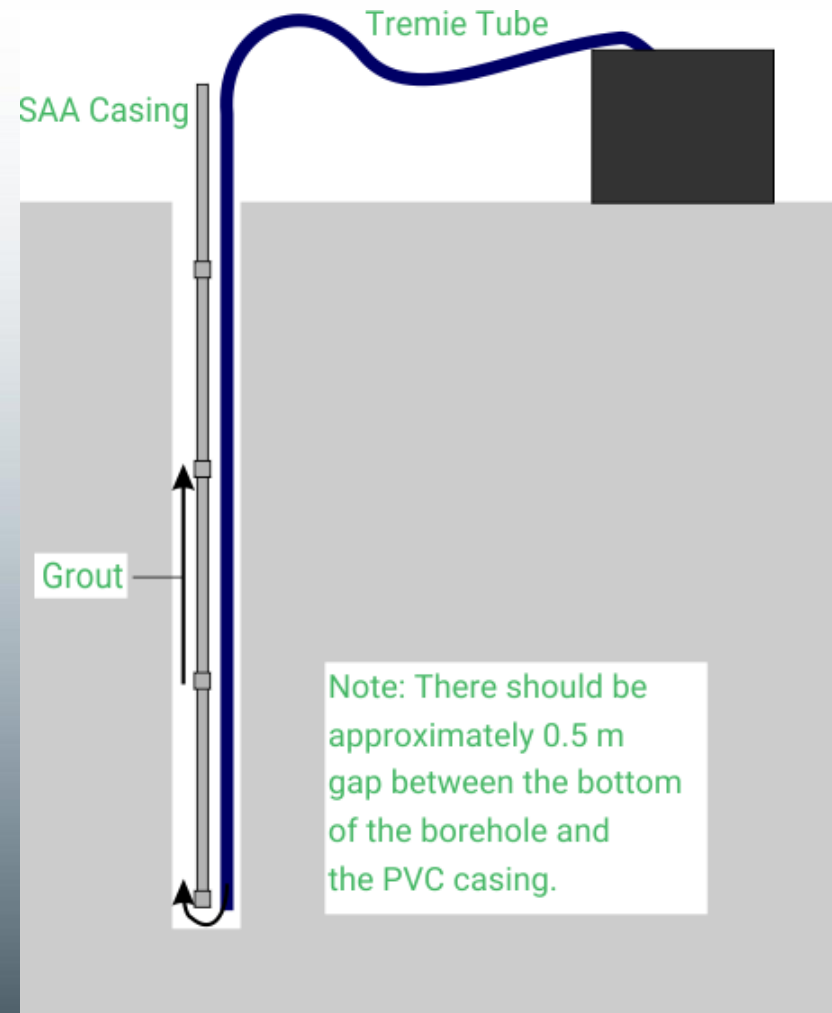


VS.

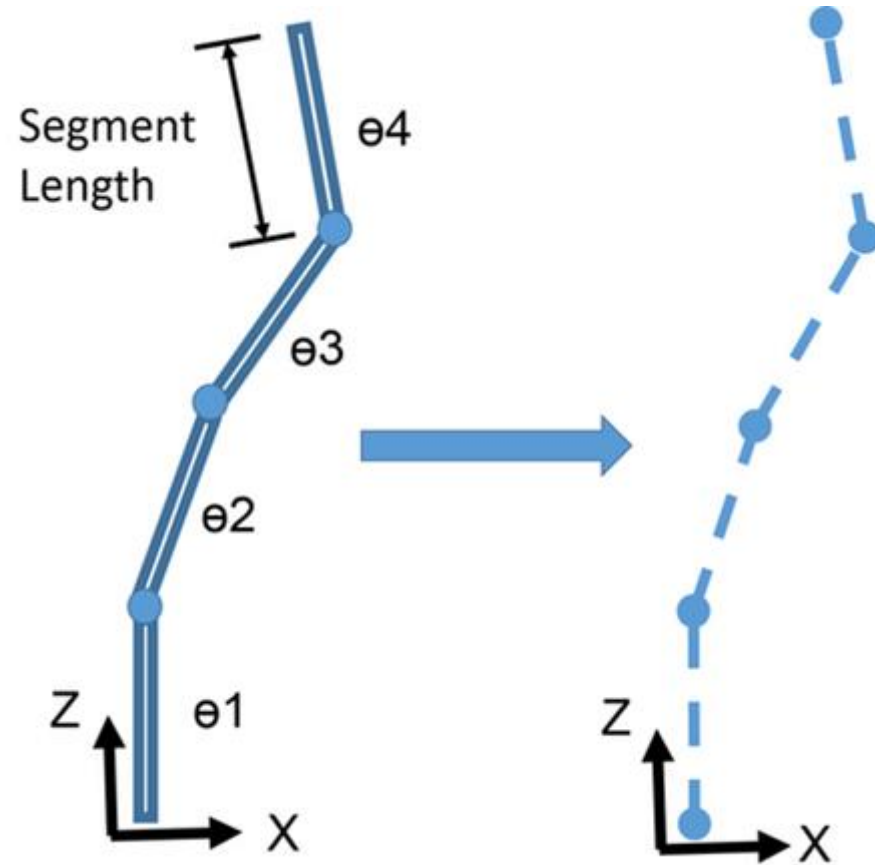


Shape Accelerometer Arrays

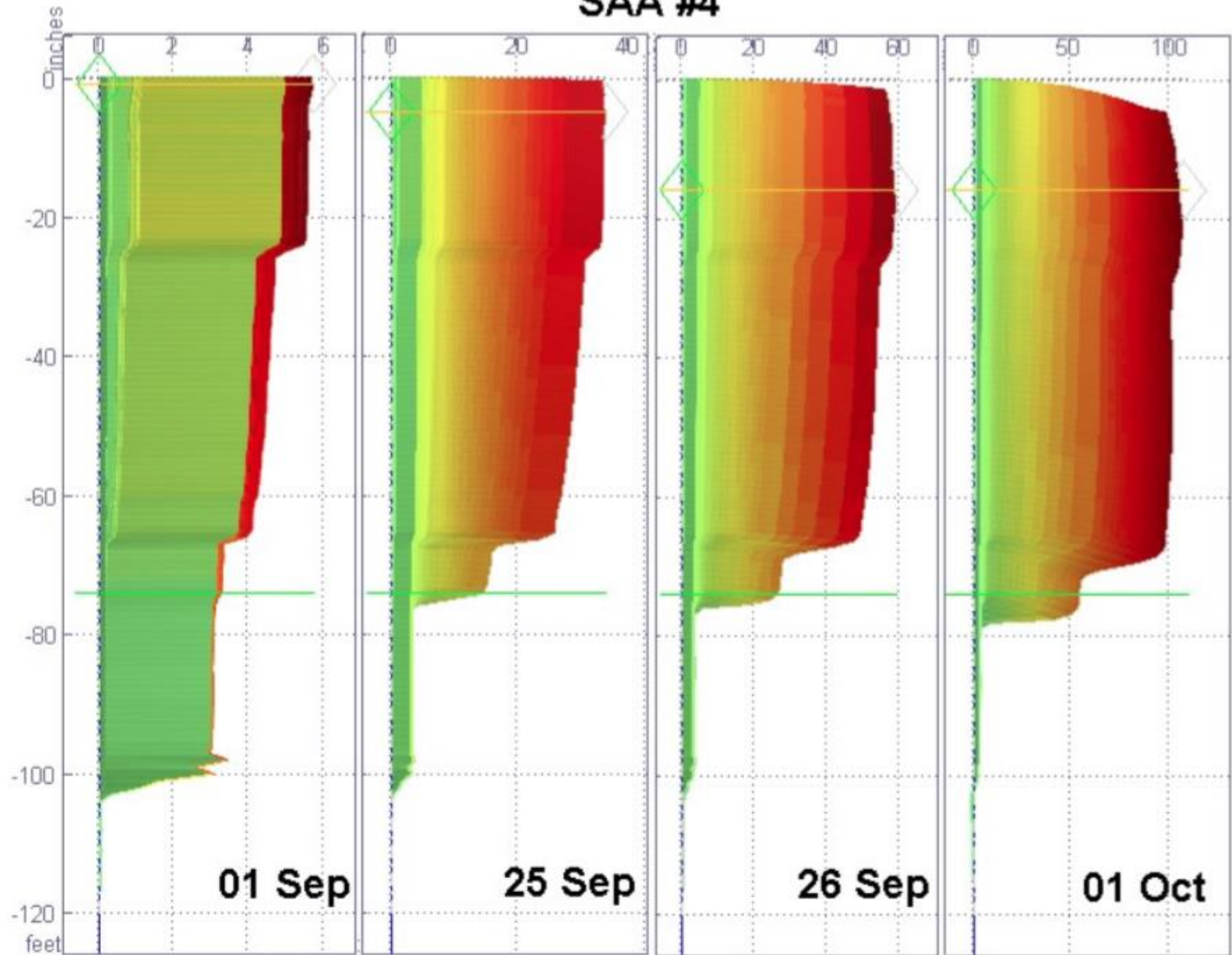
- Similar in concept to an in-place-inclinometer.
- Vertical (3D deformation), horizontal (2D profile), or tunnel cross-section.
- Vibrating monitoring, acceleration (g).







SAA #4



VSPECT: Vibrating-Wire Measurements

- Additional signal diagnostics:
 - Sensor response
 - Installation quality
 - Identify incorrect wiring or damaged sensors
 - Eliminate noise spikes and false alarms



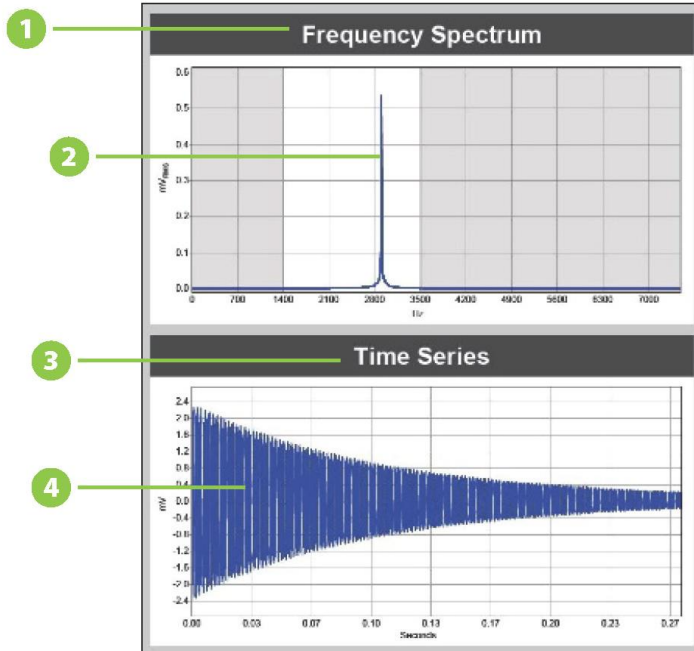


Figure 1. Vibrating-Wire Signal in Quiet Environment.

- 1 Frequency-spectrum (VSPECT) graph (signals with respect to frequency)
- 2 Sensor signal determined as the largest signal within the frequency sweep
- 3 Time-series graph (raw signals observed with respect to time)
- 4 Time series with minimal noise influence

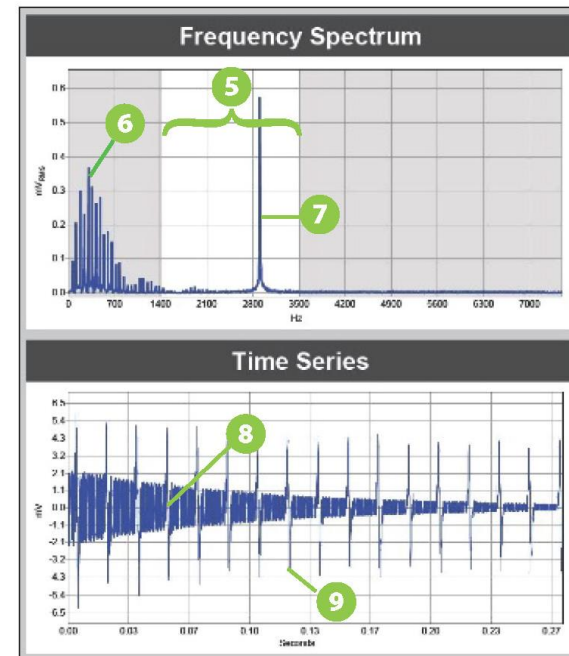


Figure 2. Vibrating-Wire Signal in Noisy Environment.

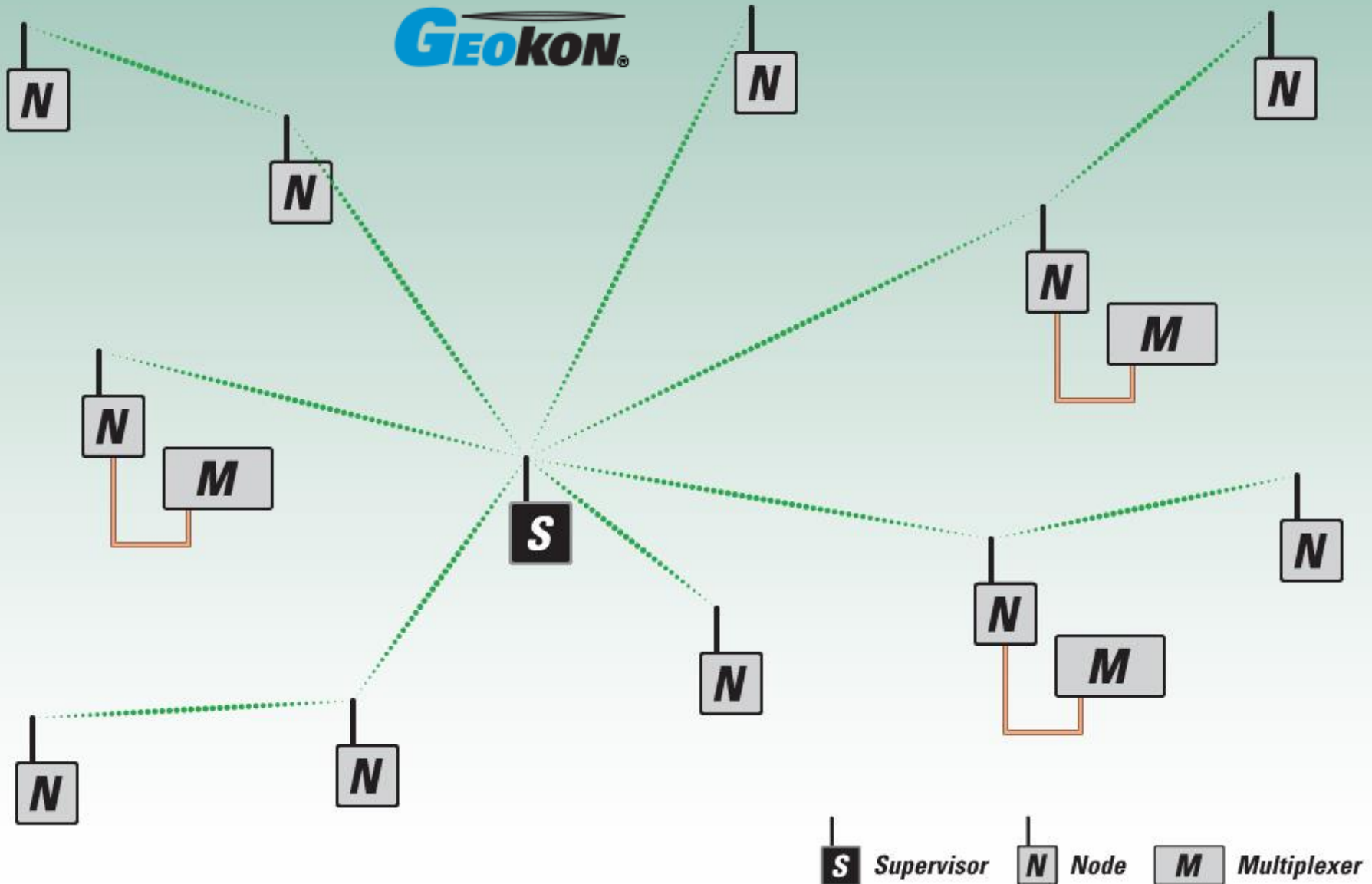
- 5 Frequency sweep (white area in graph). Only signals within the frequency sweep are considered as a possible sensor signal
- 6 Noise identified and ignored
- 7 Sensor signal easily identified even when noise is in measurement
- 8 Time series with observable noise
- 9 Noise in time series (what messes up non-VSPECT devices)

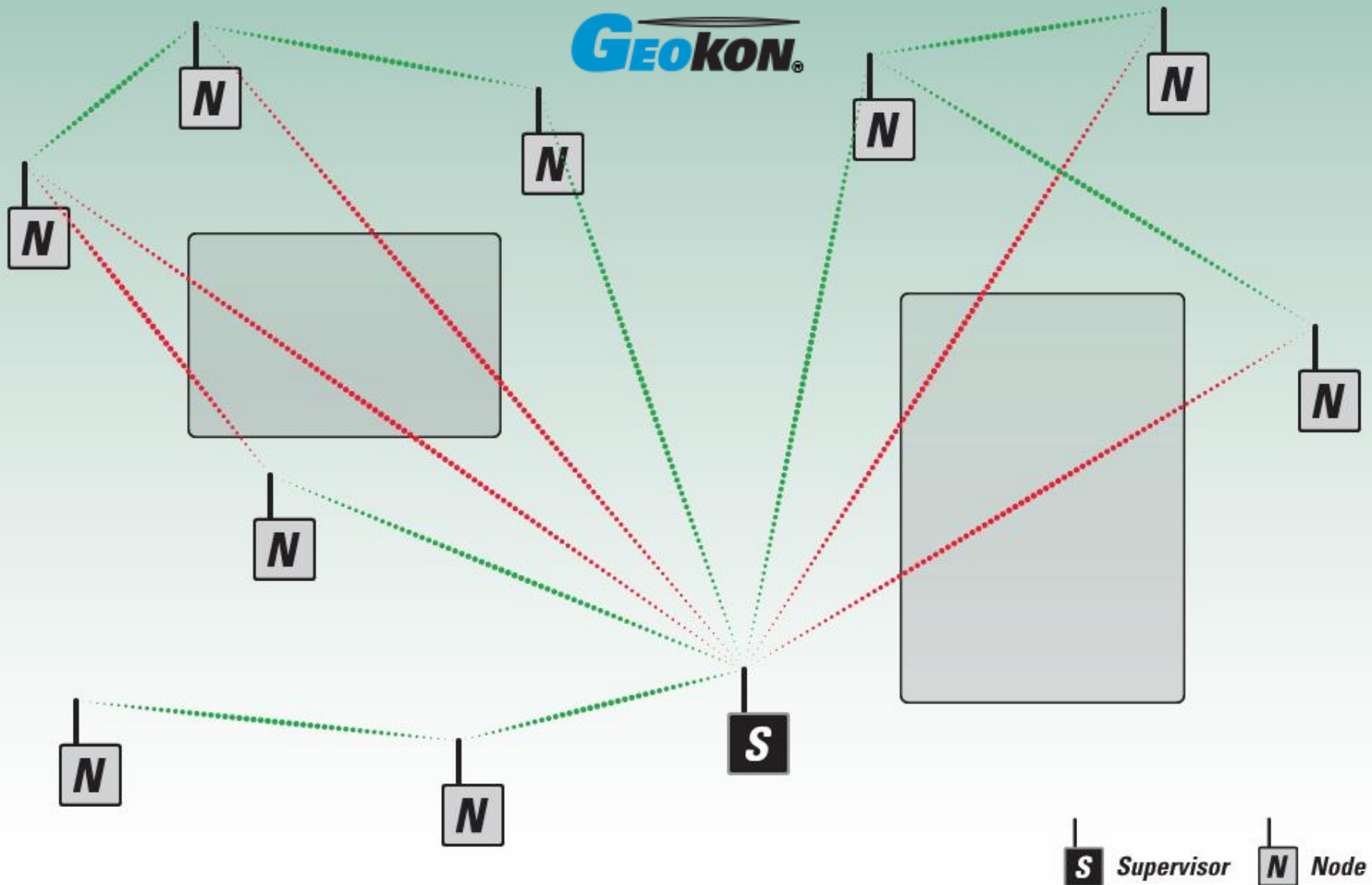
Wireless Networking

GeoNet Wireless Network



GEOKON®





iBridge Networking and Communication Solution

- Existing AC or DC wires can be used, which eliminates the cost for trenching, permits, and additional cables.



Spit-core Inductive Couplers that connect to existing wires



9mm	13mm	18mm	25mm
0.35 in. ID	0.51 in. ID	0.71 in. ID	0.98 in. ID

Serial Communication Adaptors

Universal (RS-232
& RS-485)

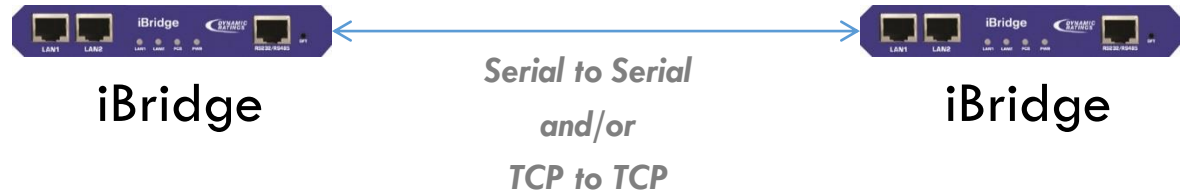


RS-232

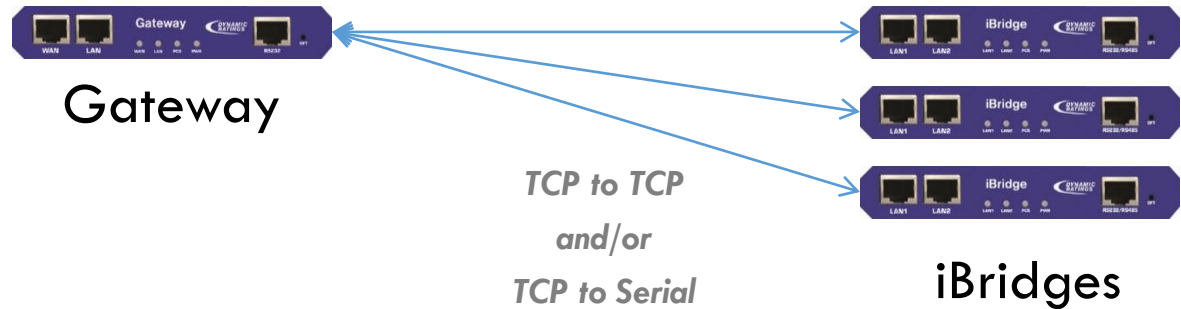


Common Application Network/Arrangements

Communications:
one to one

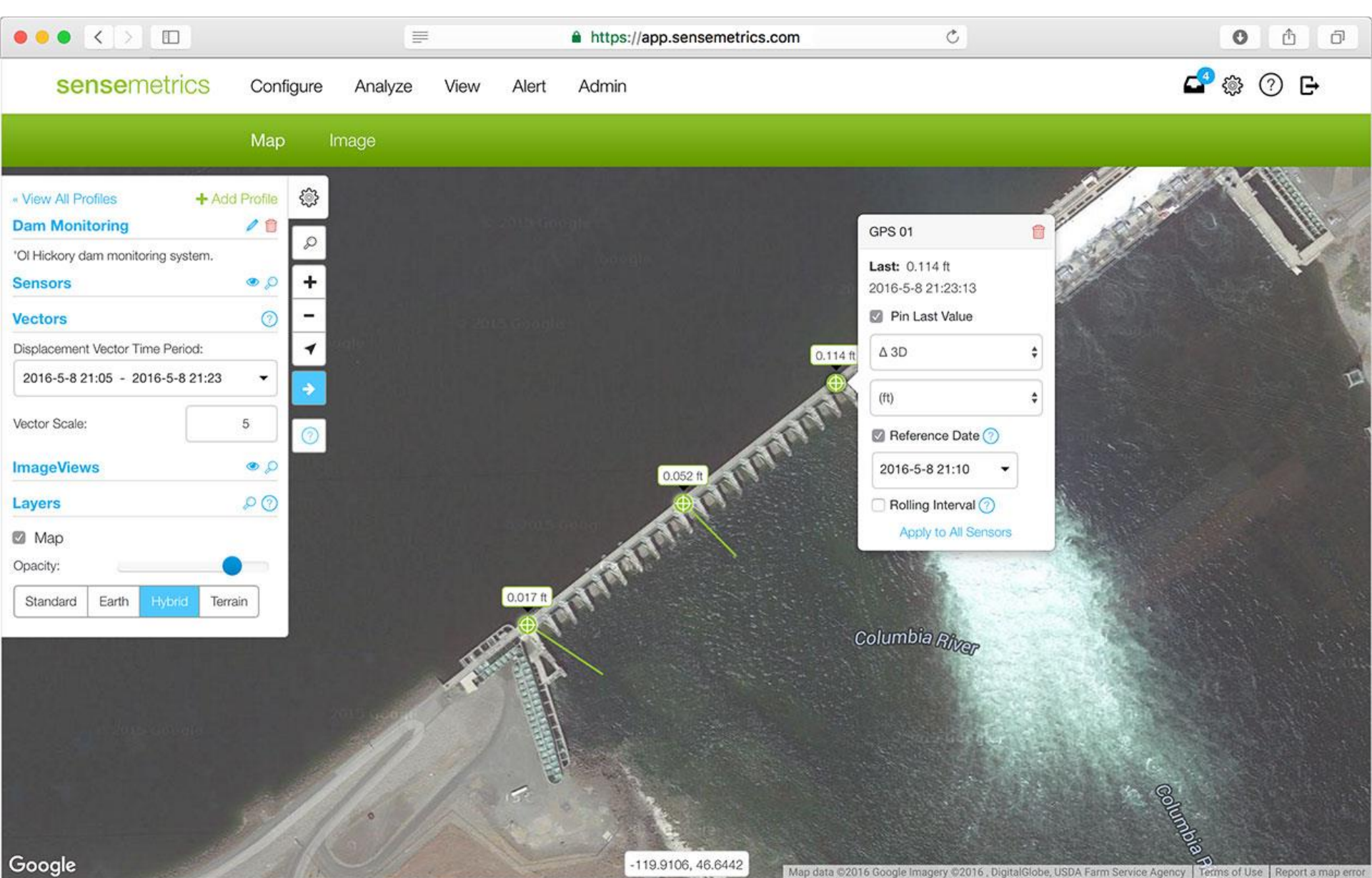


Communications:
one to many

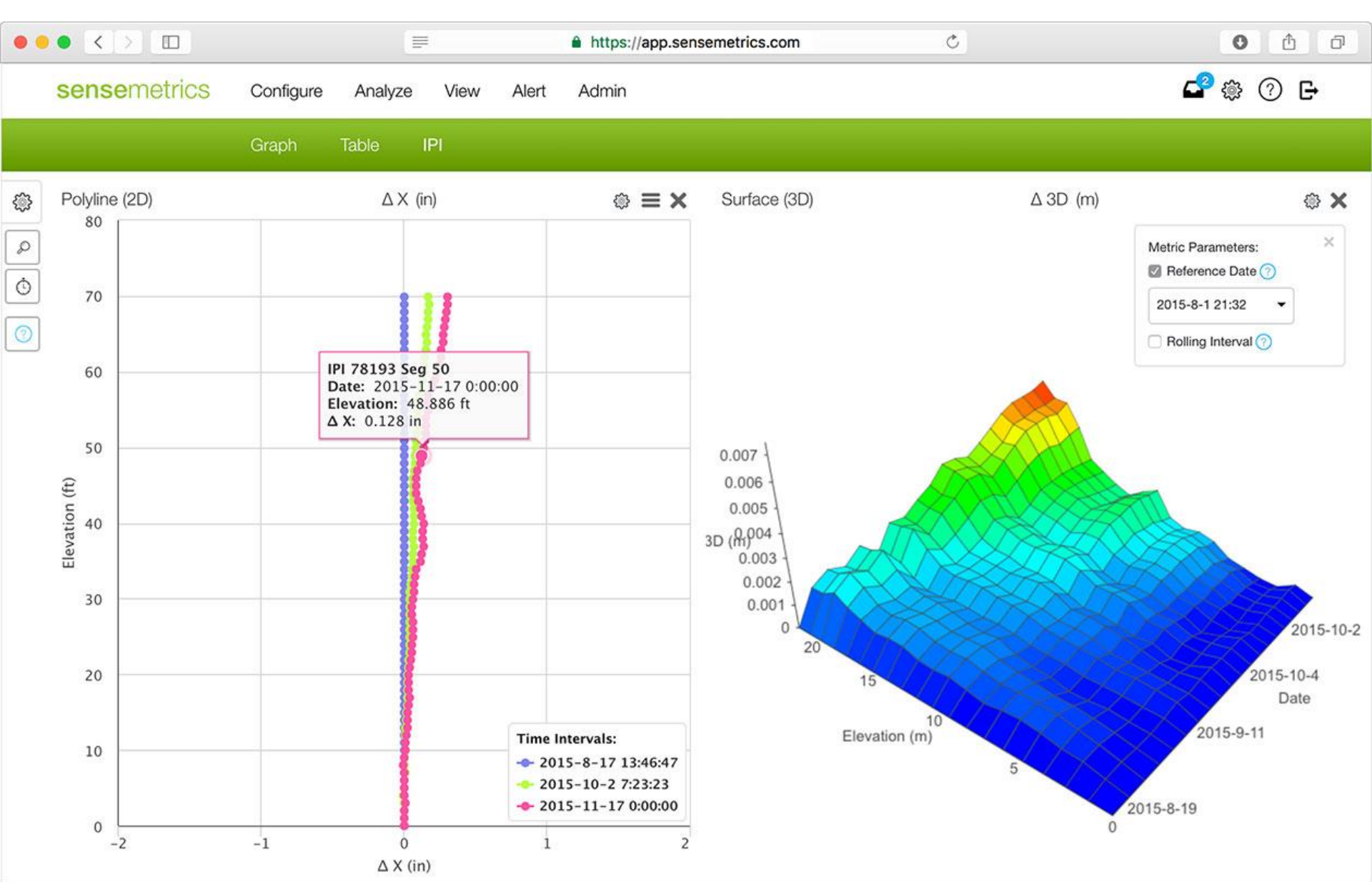


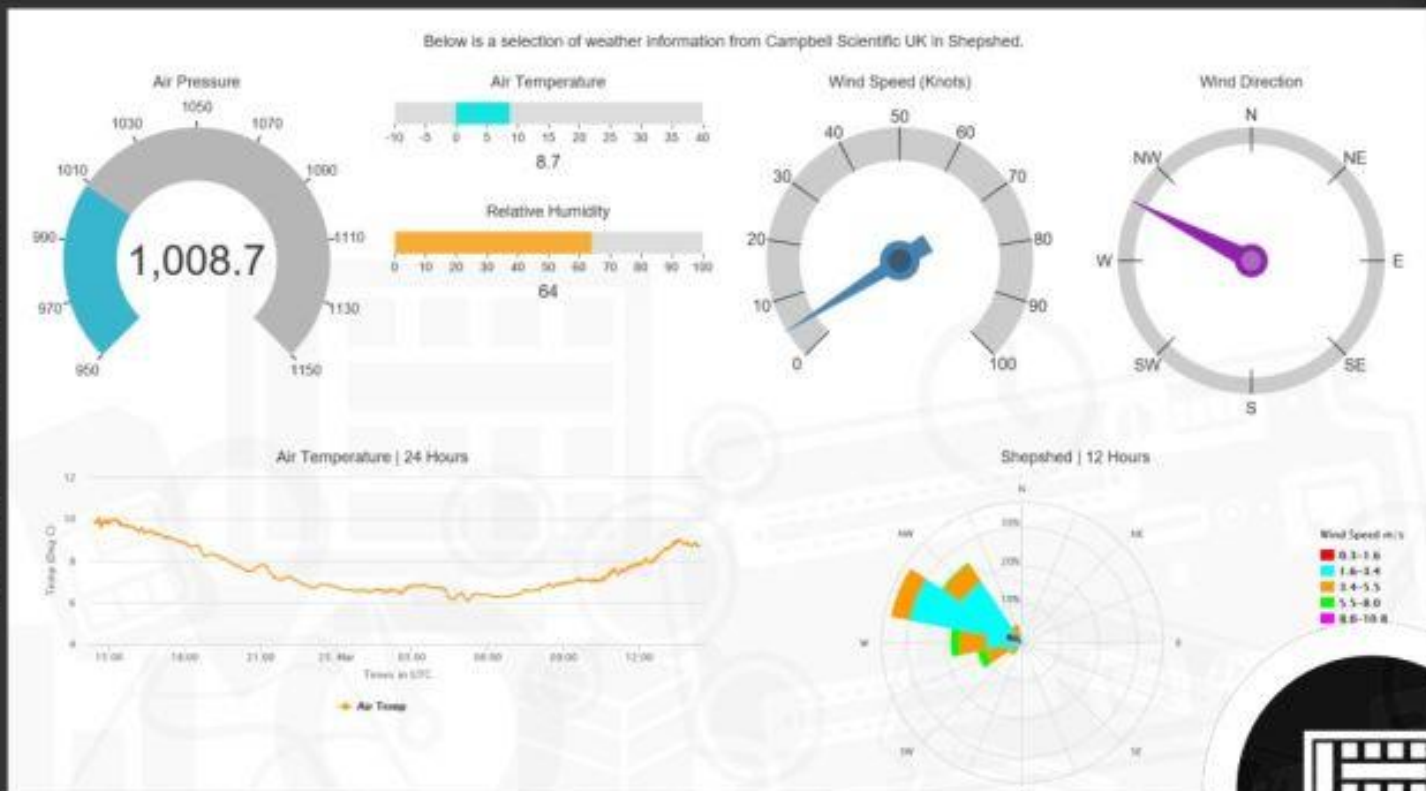
Cloud Storage and Online Reporting

- Online based: data can be accessed from any browser on a computer, tablet, or smartphone.
- Improved visualization.



sensemetrics





Dashboard View

Summary

- DAS continues to perform an important role for water and hydropower infrastructure monitoring applications.
- Innovative sensor, measurement, communication, data storage, and visualization technologies are reducing monitoring costs and putting improved reporting and evaluation tools into the hands of decision makers.

Thank You