



# Advanced Slope Engineering

We monitor the present with the instruments of the future

[www.aseltd.eu](http://www.aseltd.eu)

# WHO WE ARE?



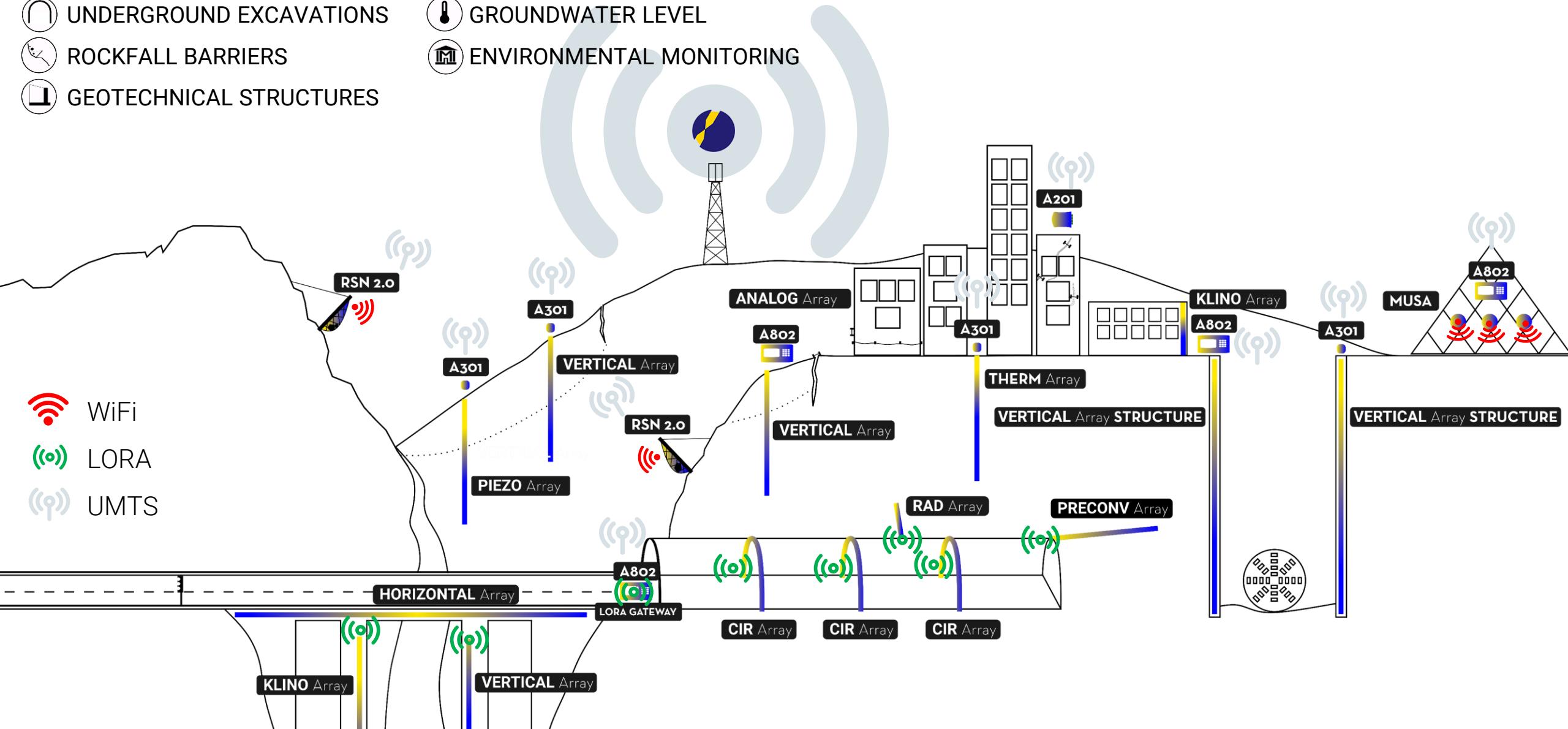
- ASE S.r.l. was born as a Start up, now it is an SME sponsored by the University of Parma;
- Founded by experts in the field;
- Research and Development;
- More than 5000 sensors installed in Europe and Asia.



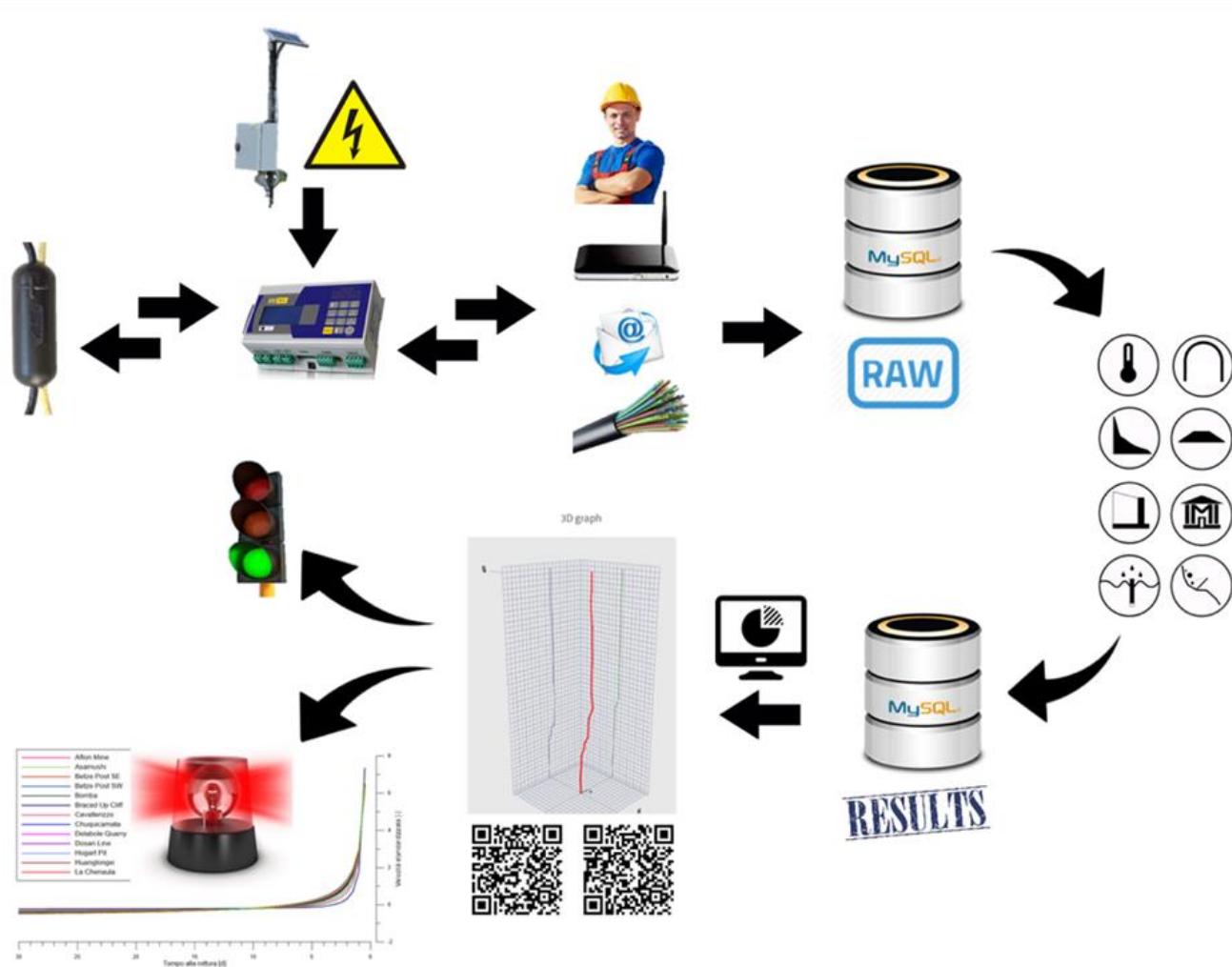
# PRODUCTS

-  LANDSLIDES
-  UNDERGROUND EXCAVATIONS
-  ROCKFALL BARRIERS
-  GEOTECHNICAL STRUCTURES

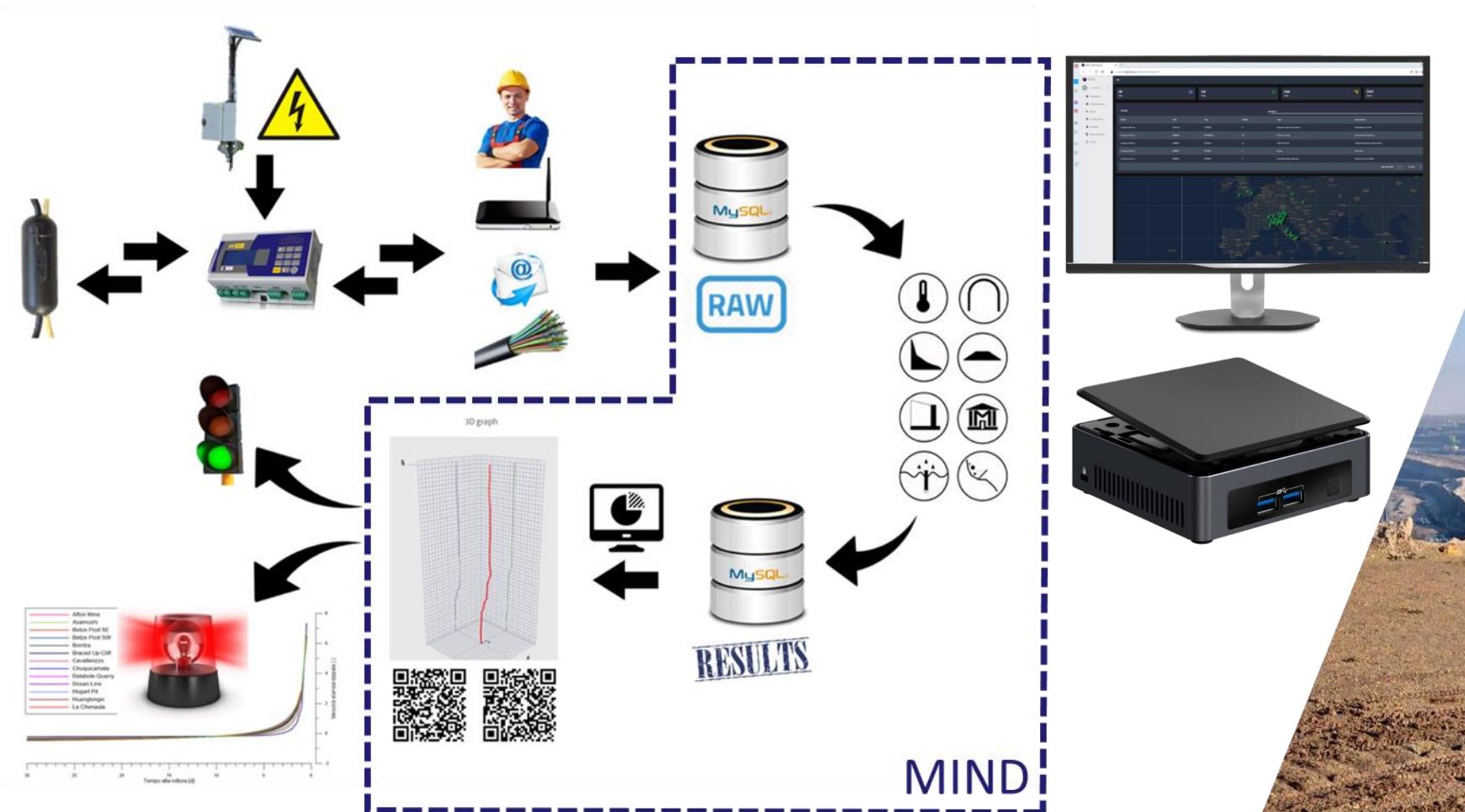
-  SOIL TEMPERATURE
-  GROUNDWATER LEVEL
-  ENVIRONMENTAL MONITORING



# DATA MANAGEMENT



# DATA MANAGEMENT



## What is it?

3D Automatic Inclinometer

## What does it look like?

- Sequence of epoxy resin nodes defined Tilt Link
- Kevlar cable connection
- Node tilt identified by MEMS sensor
- Node orientation identified by magnetometer
- Customizable instrument length and distance between nodes

## What does it measure?

- Slope displacements in landslides
- Deformations of embankments
- Deformations of geotechnical structures (VA Structure)
- Temperature trend along the vertical
- Interstitial pressures and water table level
- Atmospheric pressure

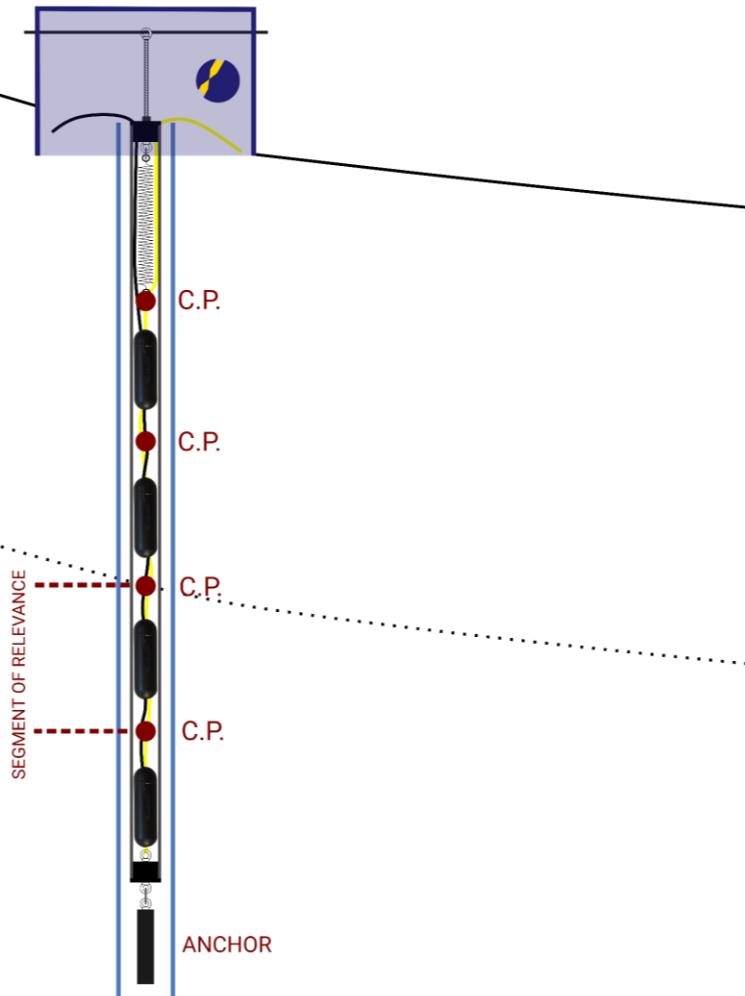


**Tilt Link HD V\***  
**Tilt Link V\***  
**Piezo Link\*\***  
**Therm Link\*\*\*\***

**Baro Link\*\*\***

\*Instrument position in space;  
\*\*Interstitial pressure;  
\*\*\*Atmospheric pressure;  
\*\*\*\*High resolution temperature;

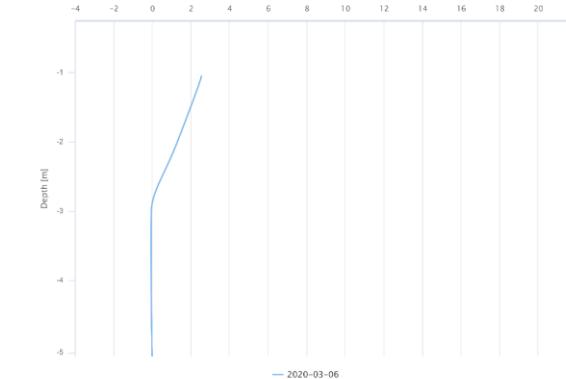
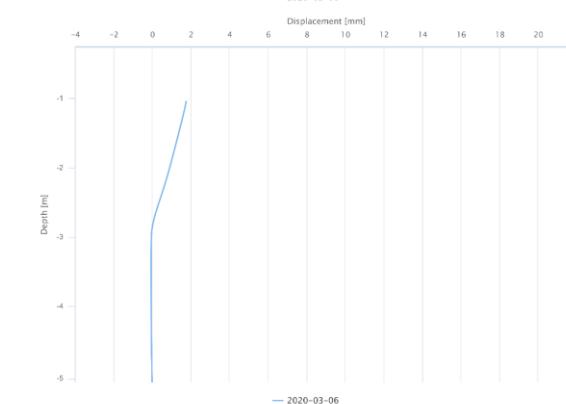
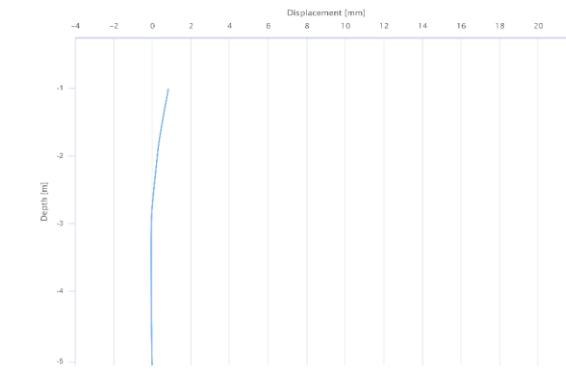
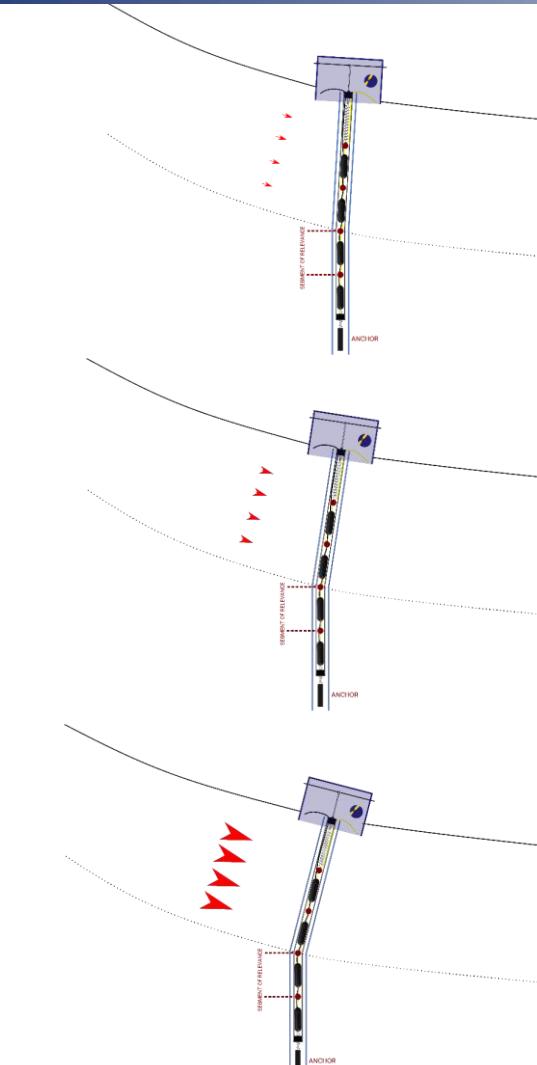
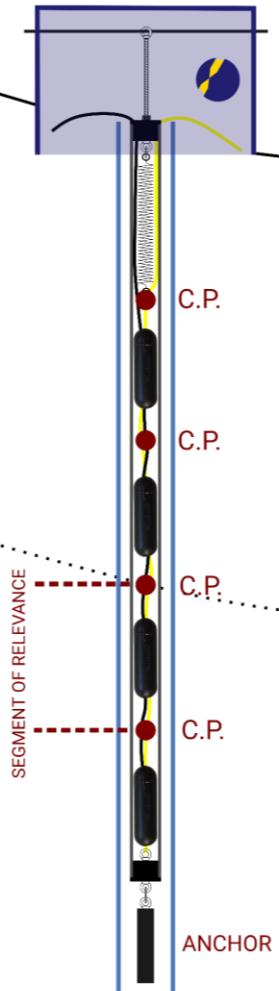
# VERTICAL ARRAY



# VERTICAL ARRAY



ase  
ADVANCED SLOPE ENGINEERING



# VERTICAL ARRAY

01

02

03

SMART

(Data processing using Self and  
Machine Learning algorithms)

EASILY  
INSTALLED

AUTOMATIC

04

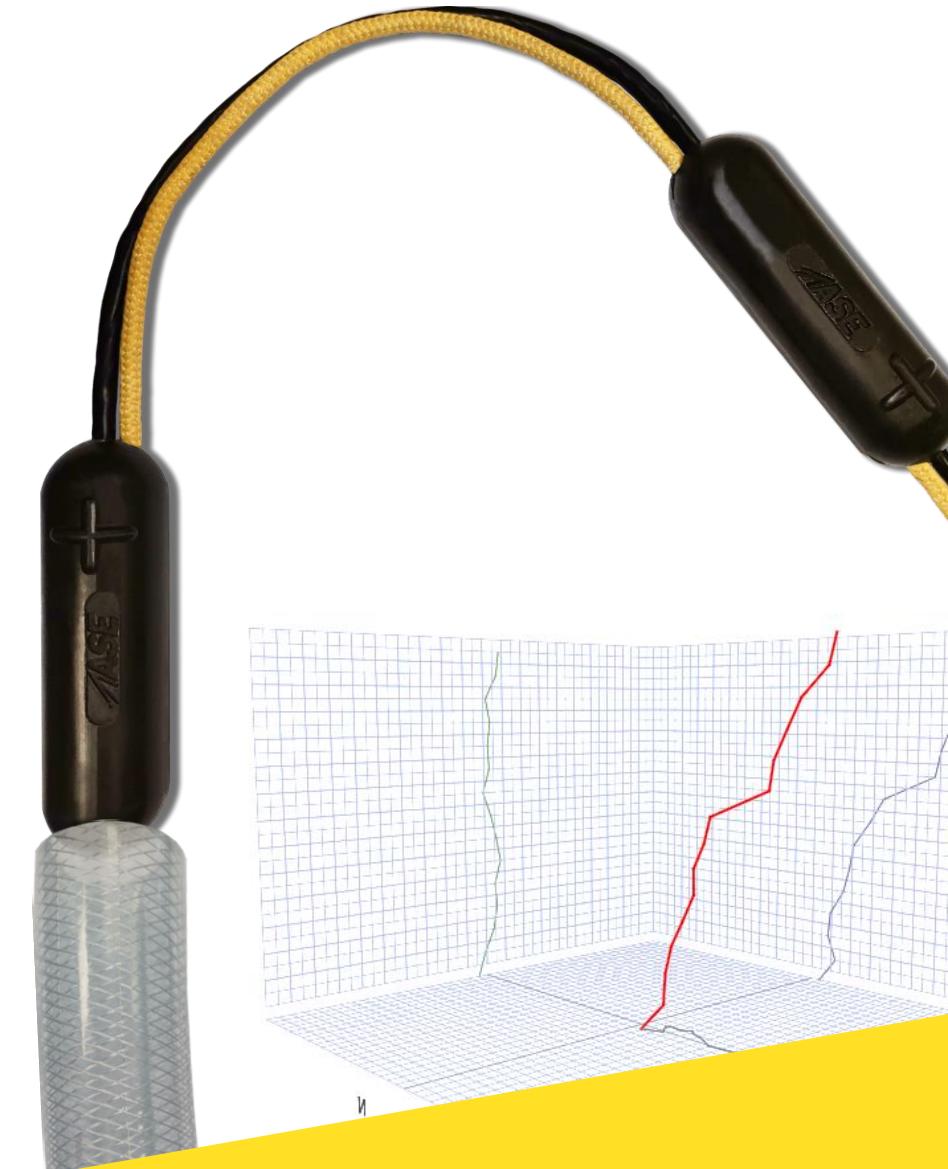
ECONOMIC

05

FLEXIBLE  
AND LIGHT

06

RESISTANT



# VERTICAL ARRAY

The MUMS instrument is very practical and can be easily transported and installed on site, resulting in technical and economic efficiency.

- Execution of the hole (PVC coating if the hole is not stable or reuse of old inclinometer pipe) and effective depth control;
- Preparation of the external fixing system and chain anchorage;
- Chain insertion (orientation is not important);
- Filling with gravel\* or bentonite mixture\*;
- Positioning of control unit and solar panel;
- Activation of automatic acquisition.

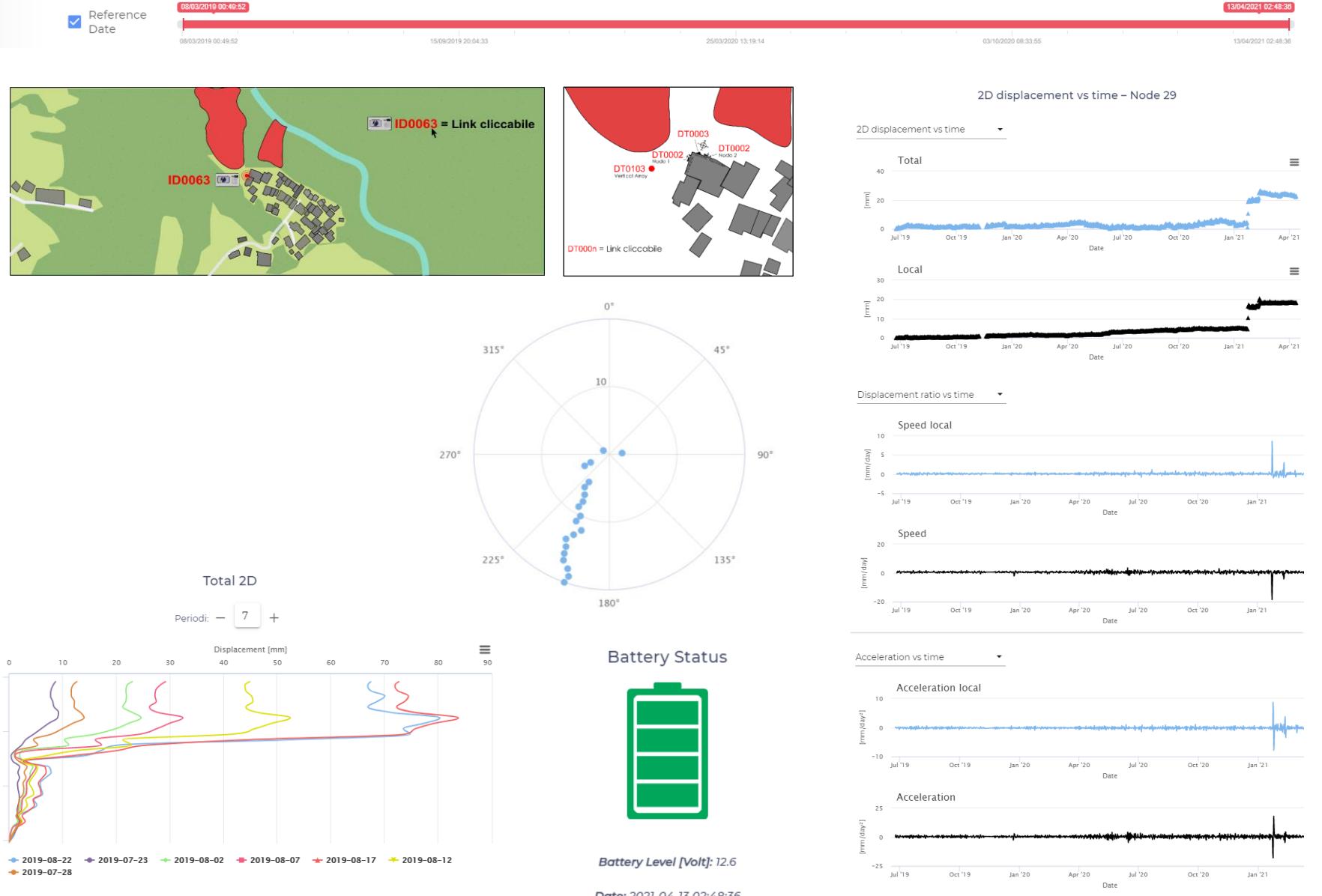


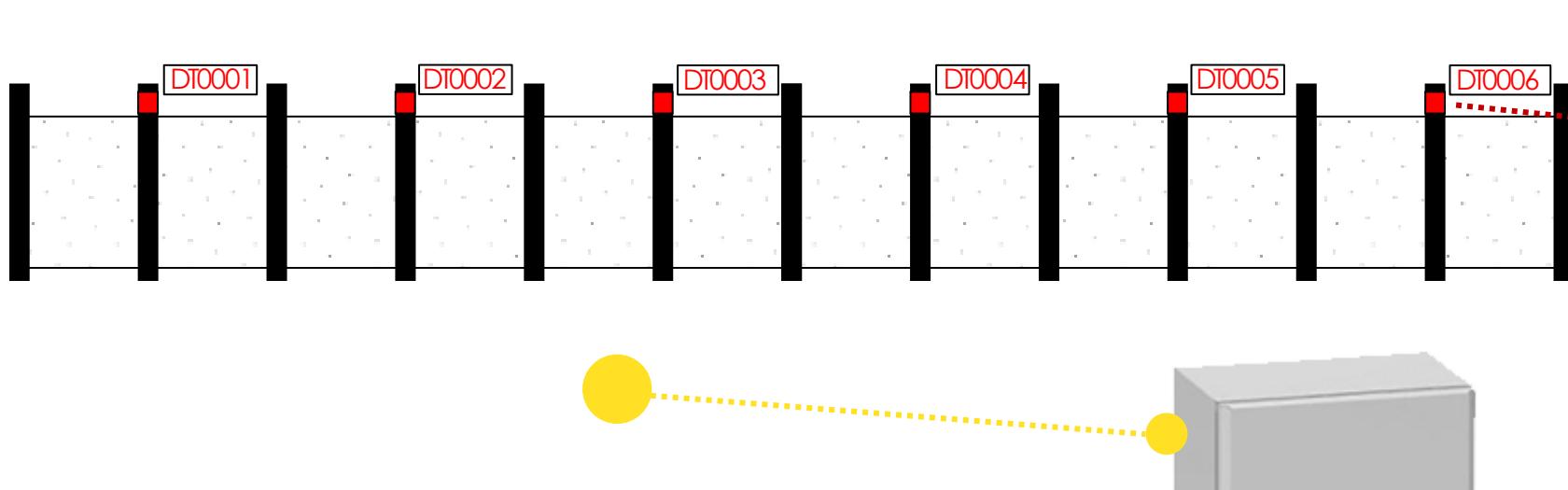
\*as specified by ASE S.r.l.

# VERTICAL ARRAY

## Results

1. Local displacements 2D
2. 2D Cumulative displacements
3. Cumulated displacements N-S
4. Cumulative displacements E-W
5. Local displacements 2D vs time
6. Cumulative displacement 2D vs time
7. Acceleration vs time
8. Velocity vs time
9. Inclination angle vs time
10. Azimuth
11. Temperature (Min, Max, Last)
12. Temperature vs time
13. Battery Level

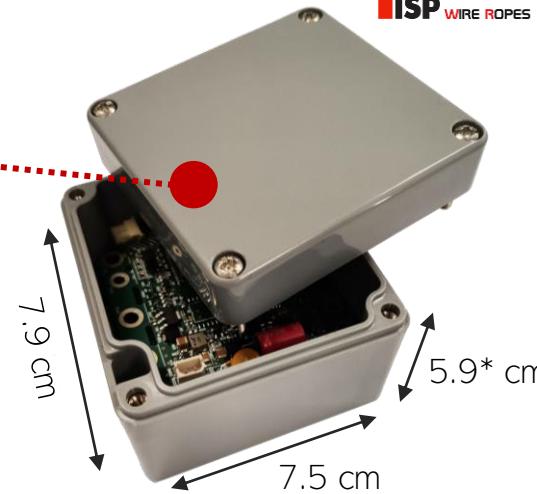




- Near real time measurement of the posts rotation with MEMS sensor (resolution 0.009°);
- Real time measurement of impacts on the barrier by means of a Shock Sensor;
- Connection of D-Fence modules through Wi-Fi network (transmission up to 100 m\*\*).

## DATA ACQUISITION POINT

Wi-Fi Modem  
 Battery  
 Solar panel and charge controller  
 1 data acquisition point every 200m of barrier



## D-Fence Wi-Fi module

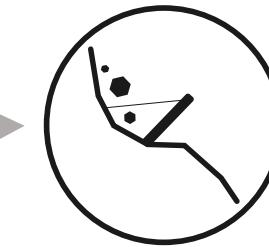
MEMS Sensor  
 Shock Sensor  
 Lithium Batteries  
 Up to 14000 readings  
 Installation on posts  
 Wi-Fi connection  
 1 module every 2 posts

\* Height including closing cover

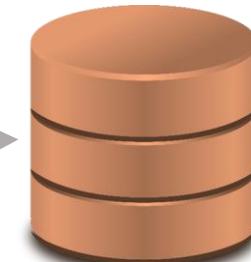
\*\* Perfect visibility conditions



RAW DATA



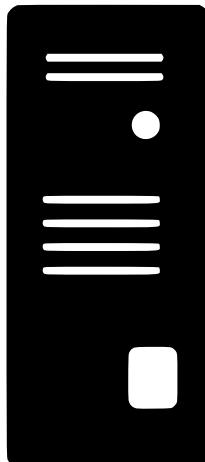
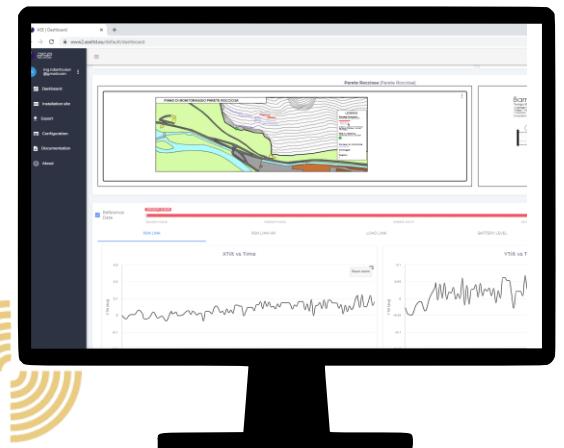
ELABORATED DATA

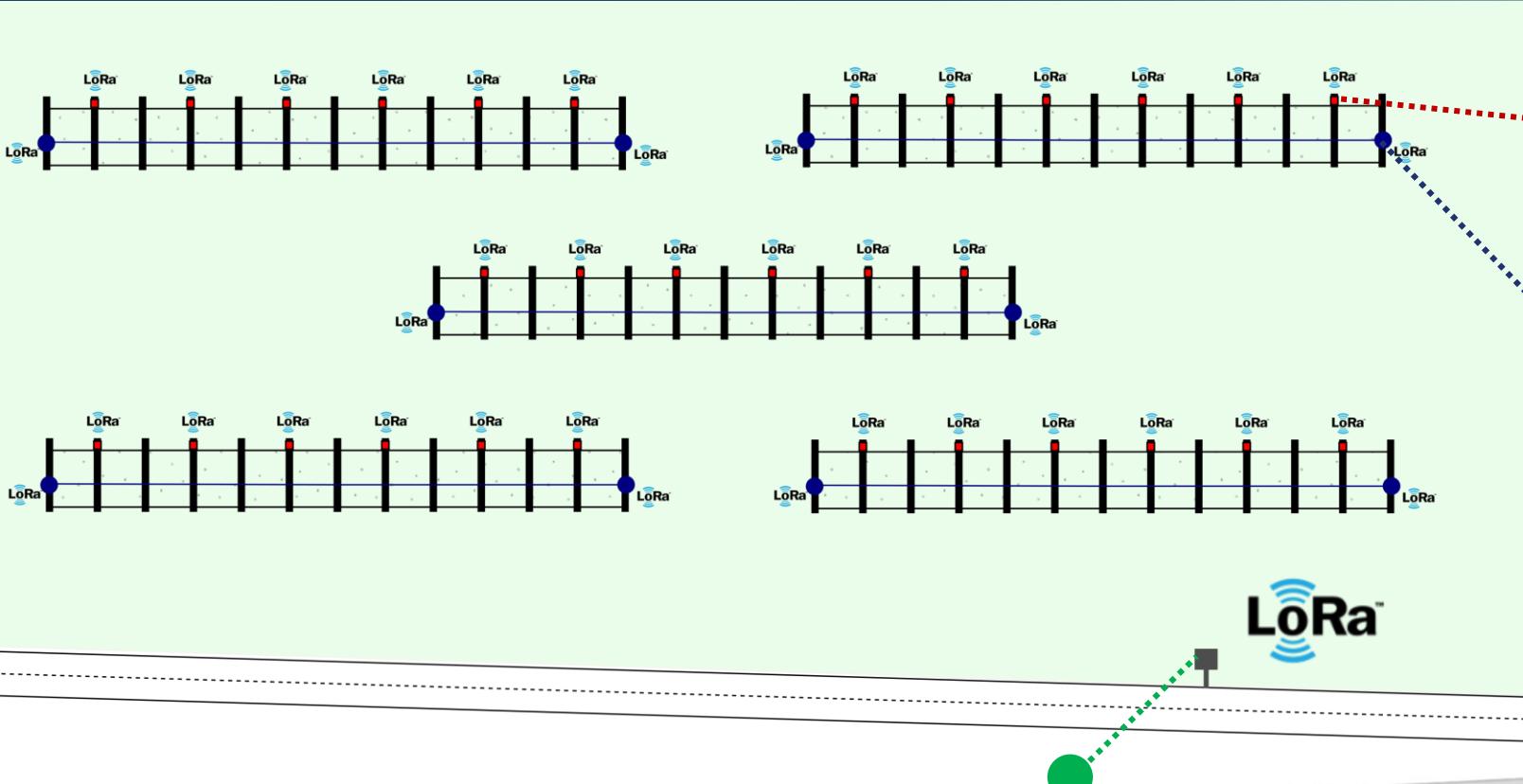


D-Fence  
SOFTWARE

- Connection between D-Fence modules and modem via Wi-Fi network;
- Data transmission via UMTS network;
- Data saving on DB in Cloud;
- Automatic processing;
- Dynamic representation platform;
- Automatic sending of alerts when thresholds are exceeded;
- Sending of informative emails in case of low battery;
- Automatic monitoring reports.

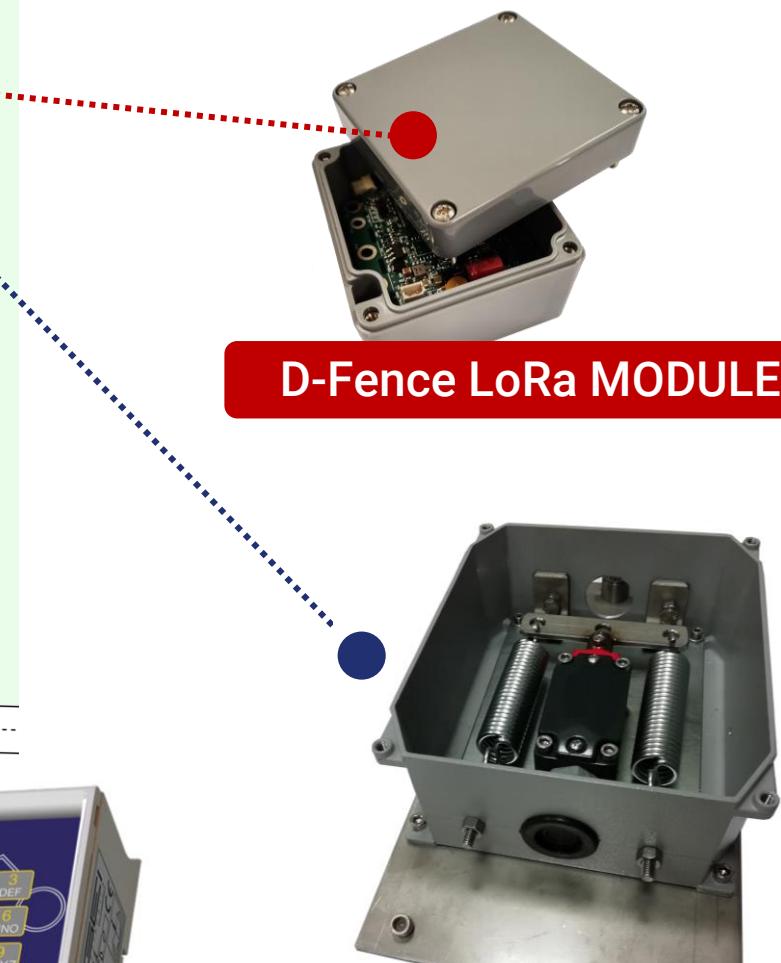
EARLY  
WARNING  
SYSTEM





## DATA ACQUISITION POINT

Datalogger G802  
Power Box or Solar Panel  
Radio Master & Radio Slave LoRa



## Trigger LoRa MODULE



**LoRa®**



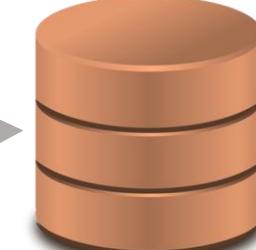
RAW DATA



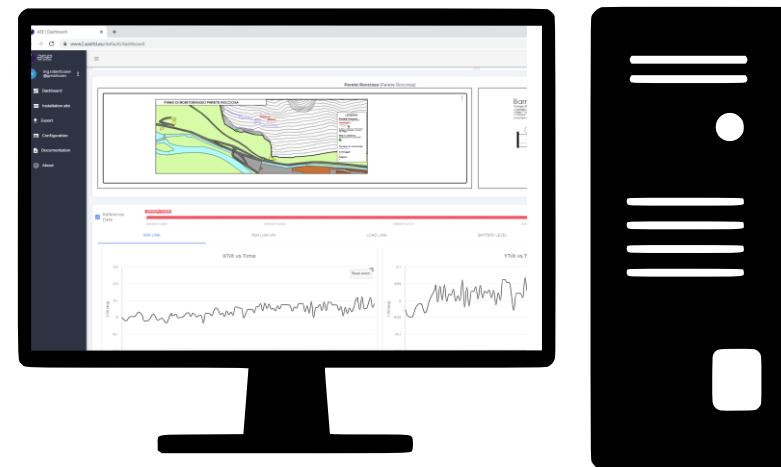
ELABORATED DATA



D-Fence  
SOFTWARE



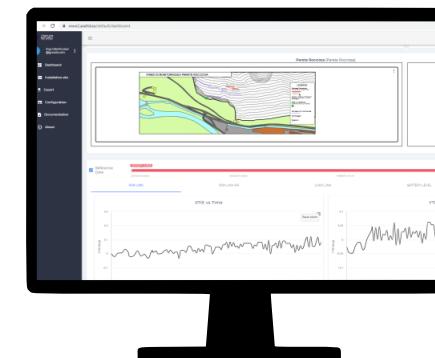
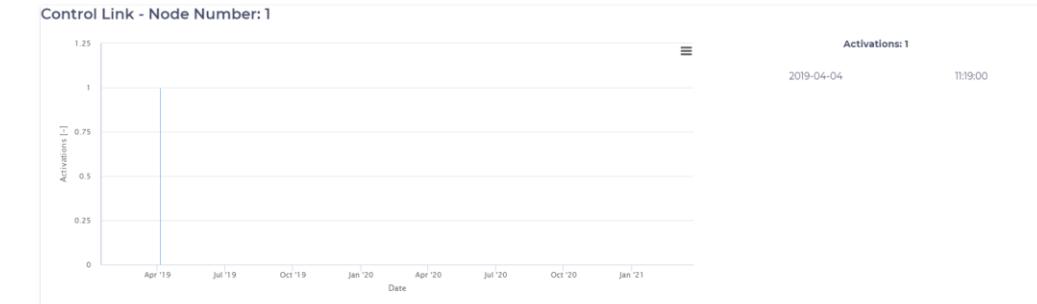
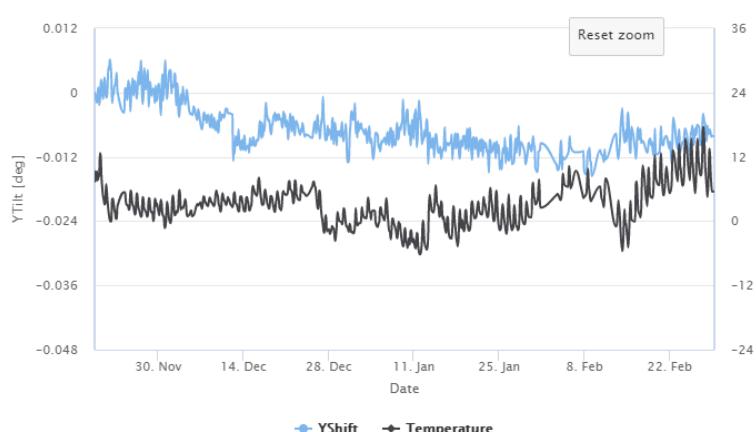
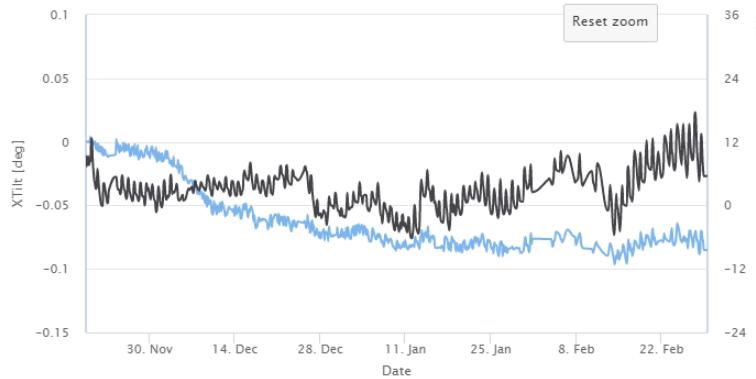
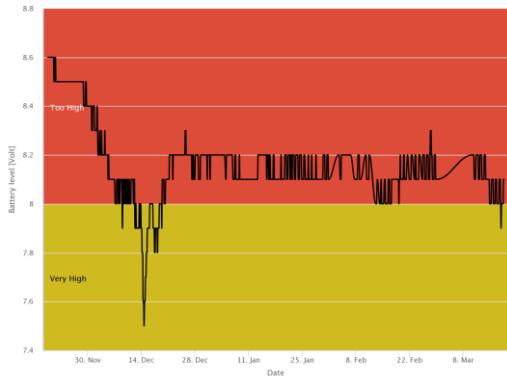
- Connection between the monitoring modules and the A802 control unit via LoRa network;
- Data transmission via UMTS network;
- Data storage on DB;
- Automatic processing;
- Dynamic representation platform.



# DATA REPRESENTATION ON GEO-ATLAS PLATFORM

## Results:

- Post rotation along x
- Post rotation along y
- Temperature
- Shock Sensor or Trigger Activations
- Battery Level
- Weather data display



8.42 °C

Few clouds  
Friday 19/03/2021 09:34:22

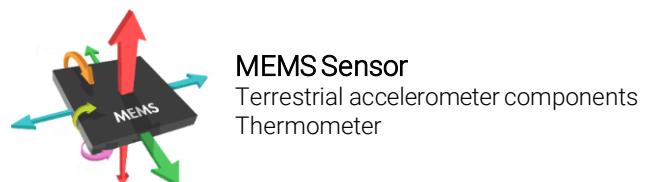
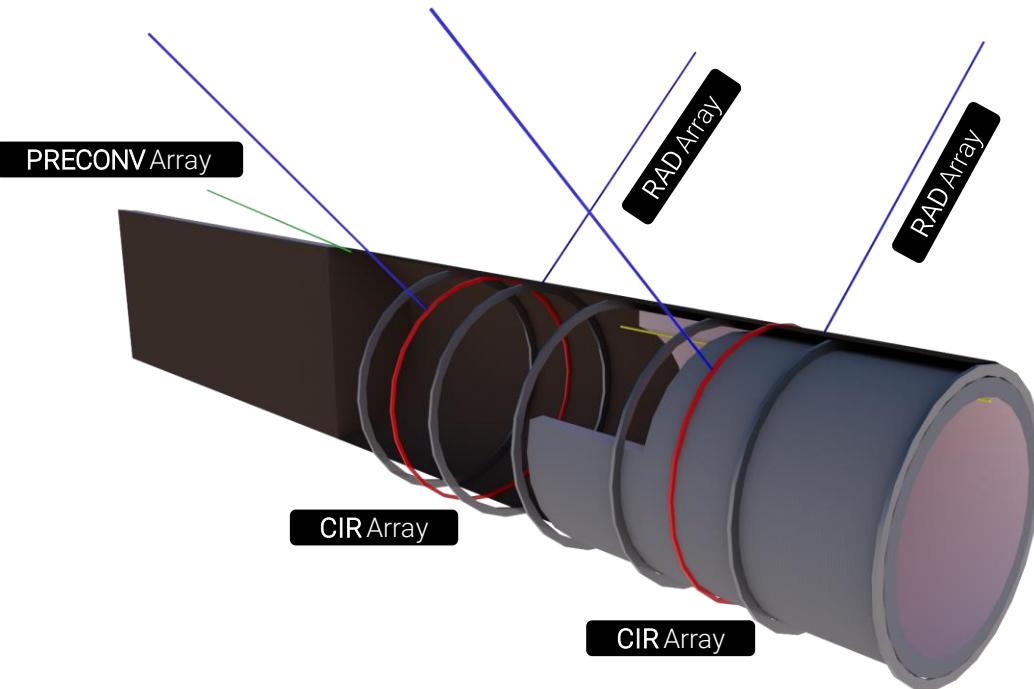
Perceived 4.18 °C  
Wind → 3.09 Km/h  
Visibility 10 Km  
Barometer 1016 mb  
Humidity 53%

Sunrise 06:23:03 Sunset 18:28:35

- Frame and video realization with a user definable frequency;
- Motion Sensor mode even over a defined area;
- Night vision;
- Remote access and configuration possible;
- 4 megapixel resolution;
- Motorized AF lens;
- IP67.

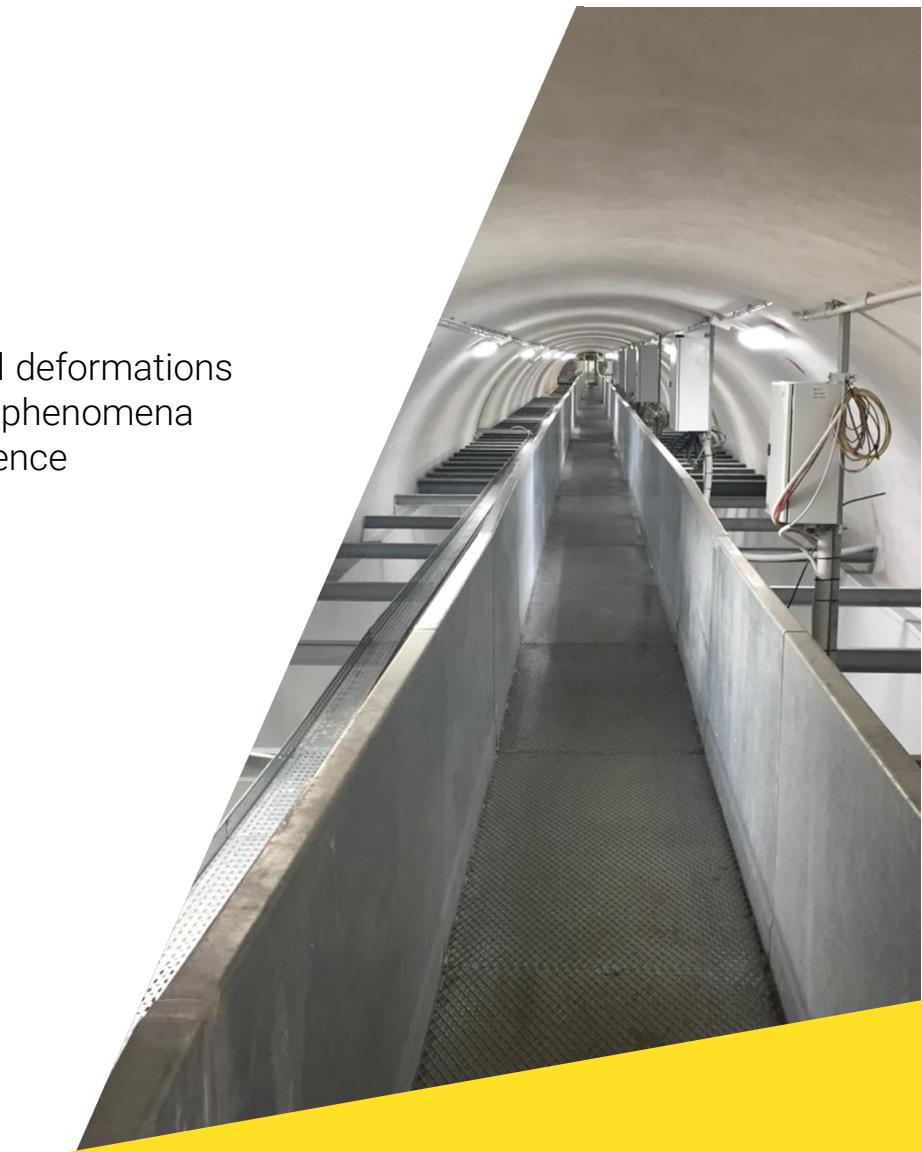


# UNDERGROUND EXCAVATIONS



INSTRUMENT POSITION IN SPACE

**Cir Array** → Convergence, local deformations  
**Rad Array** → Tunnel rotational phenomena  
**PreConv Array** → Pre-convergence



## What is it?

Instrument for automatic measurement of convergence and 3D localized displacement phenomena in tunnels under construction or existing tunnels

## What does it look like?

- Sequence of epoxy resin nodes defined Tunnel Links
- Connection through fiberglass rods
- Azimuth preservation
- Defined distances between nodes
- Kevlar connection of sensors placed in the invert arch
- Customizable

## Where it is installed?

The instrument can be installed:

- In contact with the rock mass
- On the steel ribs
- On the inner concrete lining;



# CIR ARRAY - INSTALLAZIONE

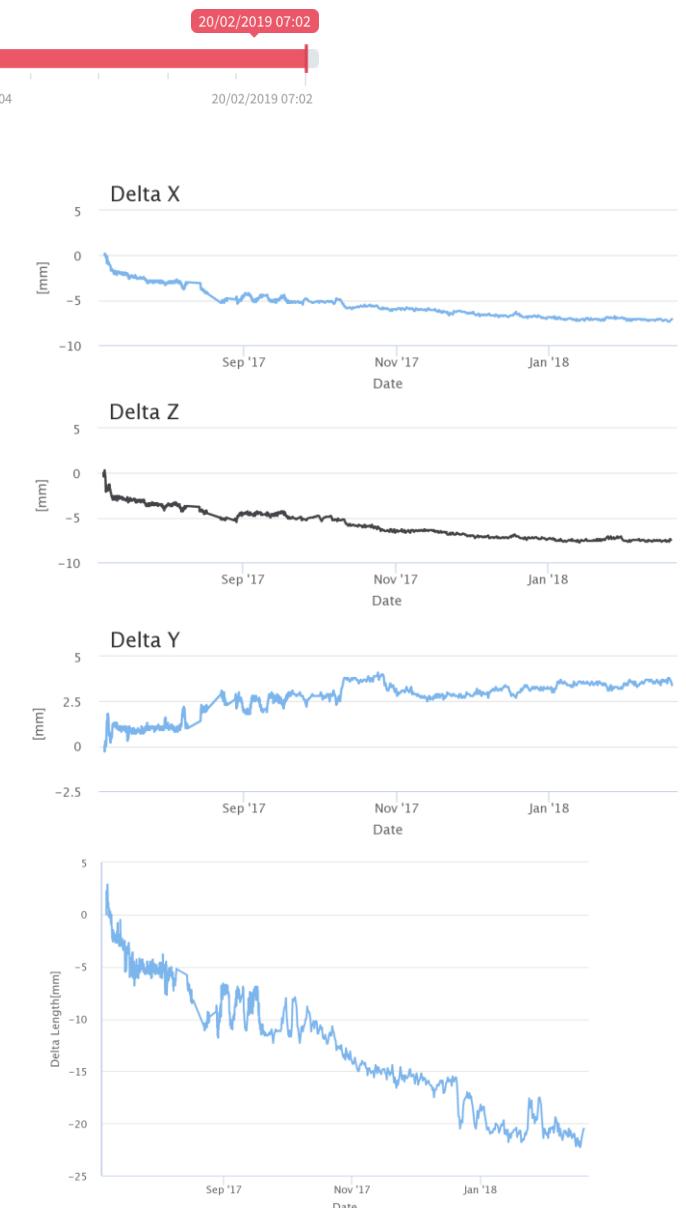
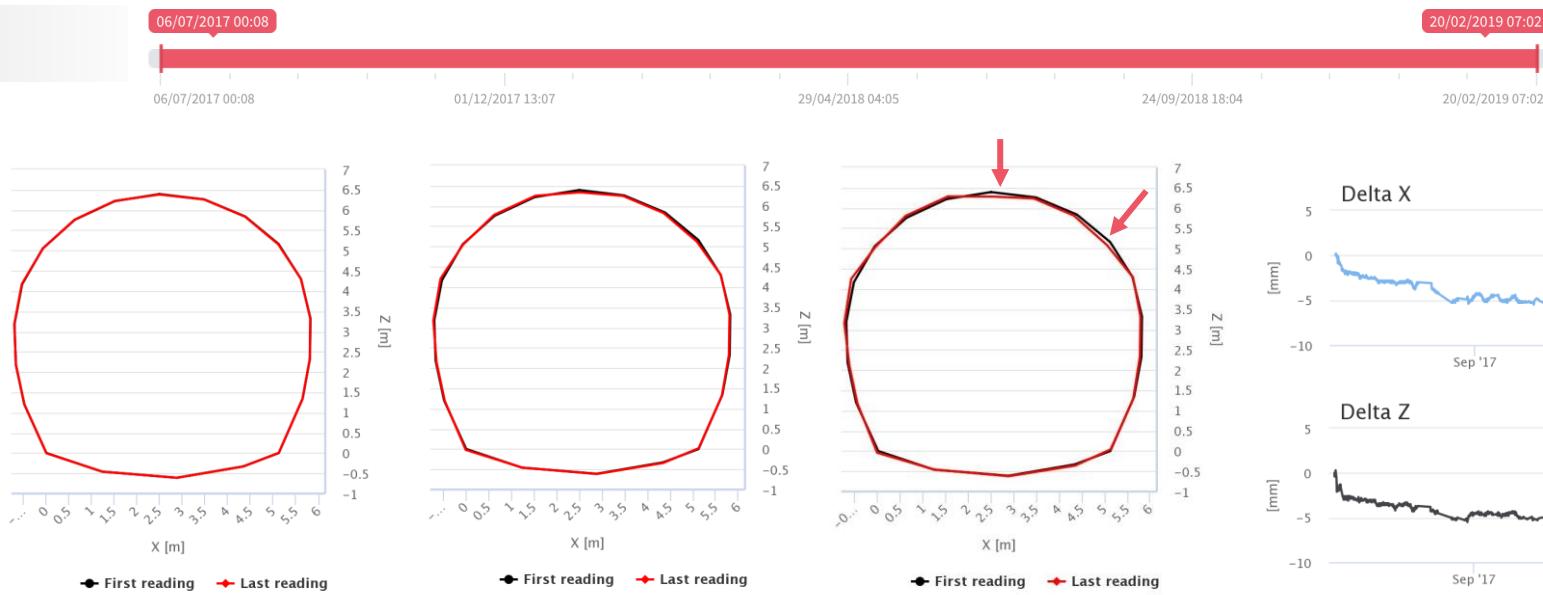
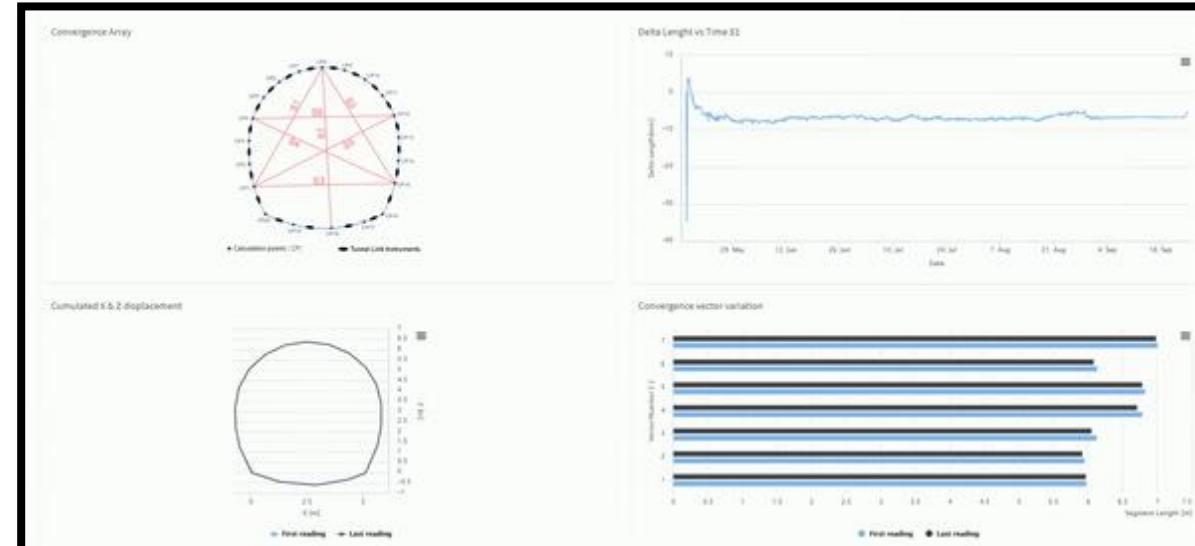
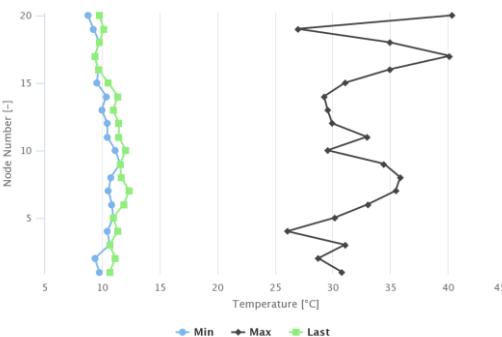
MUMS instrumentation is easy to carry and to be installed on-site, with consequent economical and technical advantages

- Connection of the single fiberglass rods preserving the azimuth;
- Placement of the first node in the upper part of the section;
- Placement of other sensors using collars;
- Spritz-Beton;
- Control unit placement;
- Connection to the electrical power line.

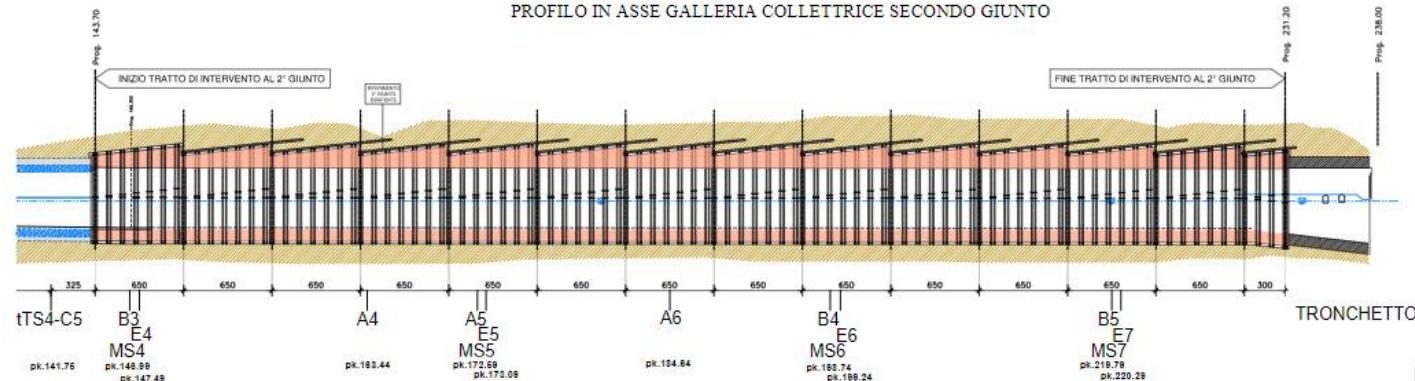


## Results

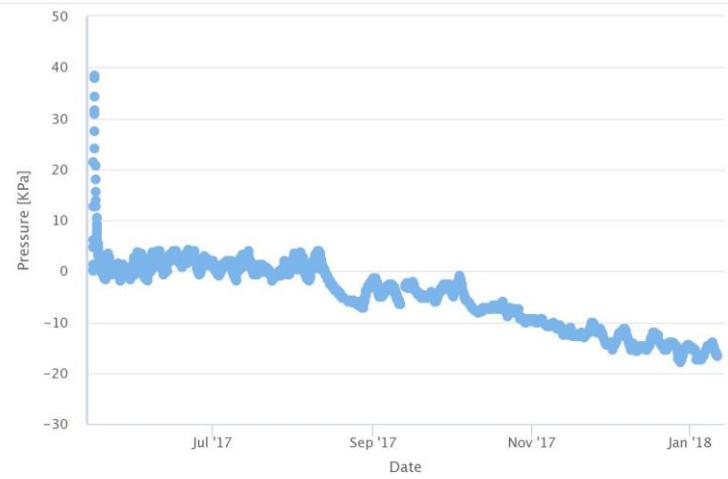
1. Local displacements
2. Cumulated displacements
3. Local displacements over time
4. Cumulative displacement over time
5. Acceleration over time
6. Velocity over time
7. Convergence segments
8. Temperature (min, max, last)
9. T over time
10. Battery
11. Equivalent area
12. Equivalent radius



#### PROFILO IN ASSE GALLERIA COLLETTRICE SECONDO GIUNTO



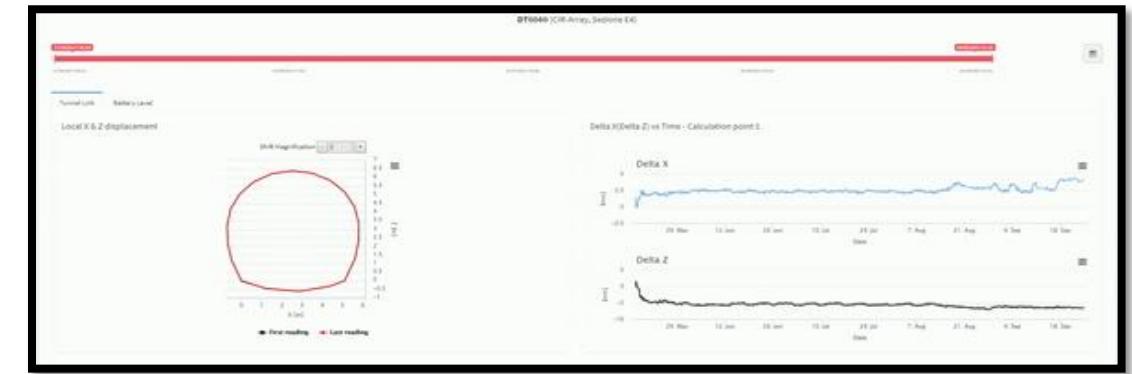
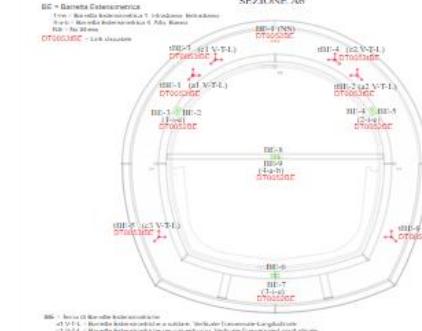
TRONCHETTO



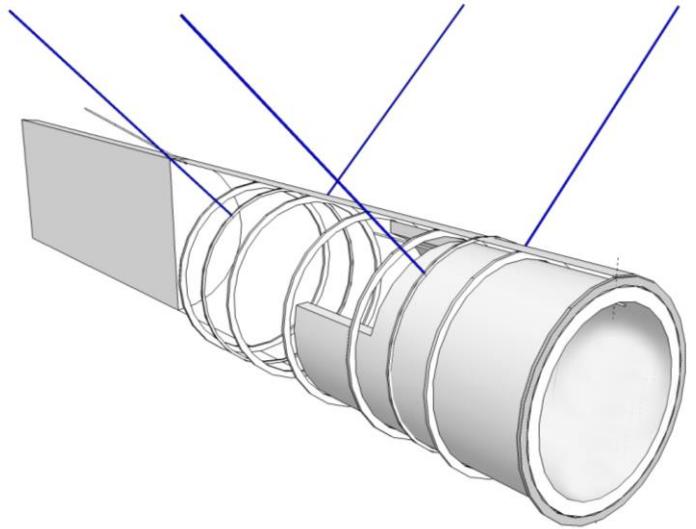
SEZIONE DI MONITORAGGIO SPECIALE

#### GALLERIA COLLETTRICE - RIVESTIMENTO DEFINITIVO SEZIONE A-C

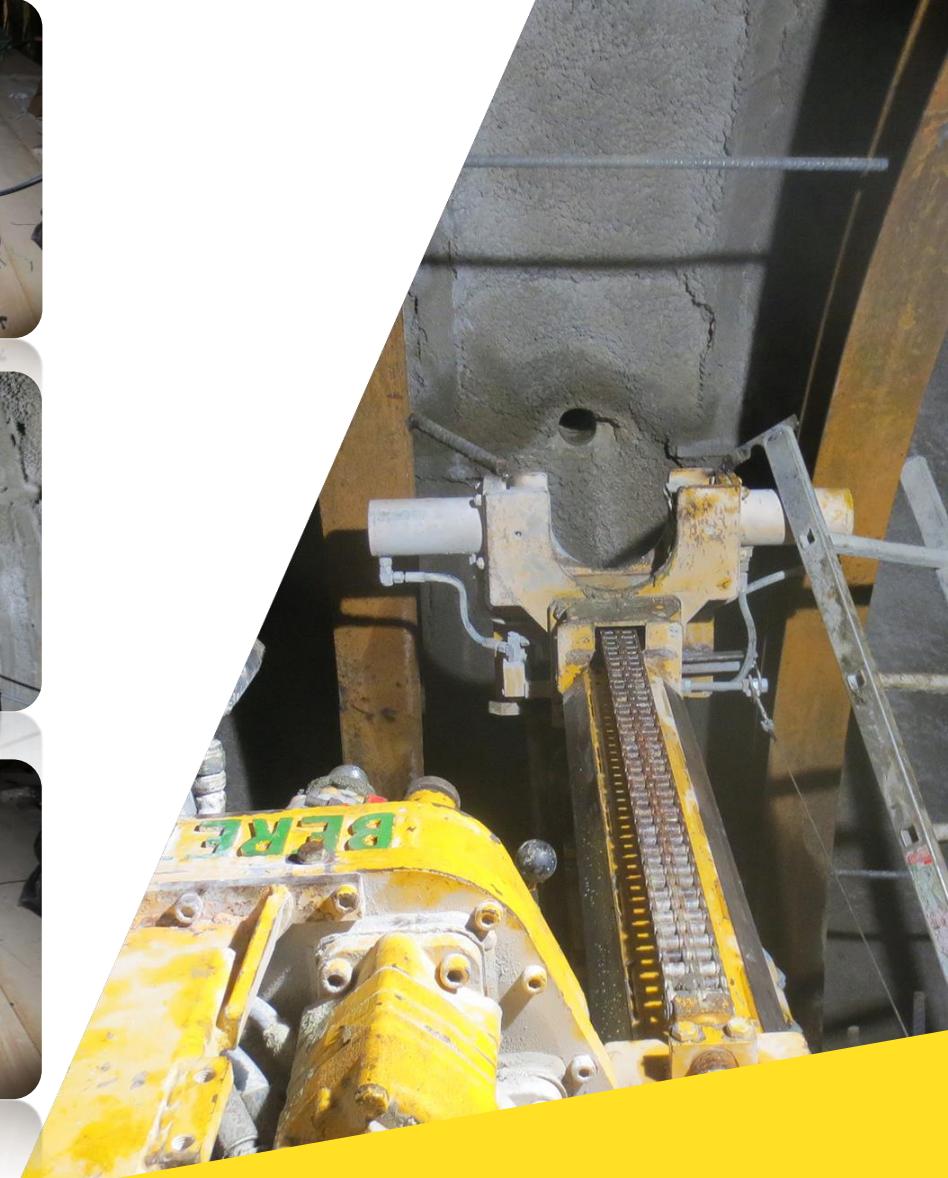
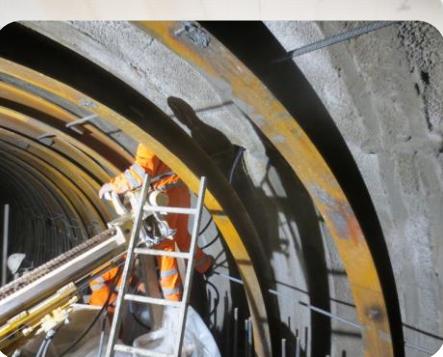
Italia Estadounidense



# RAD ARRAY

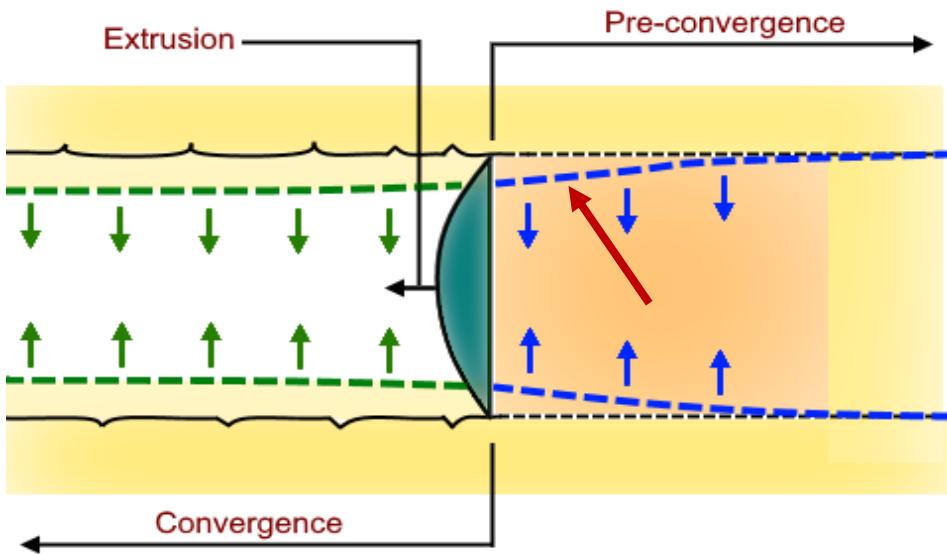


- Monitor deformations around the section
- Instrument can be installed coupled with a multi-point borehole extensometer
- Node connection via fiberglass rods
- Protection by PVC pipe
- Inserted inside radial perforations and cemented in place

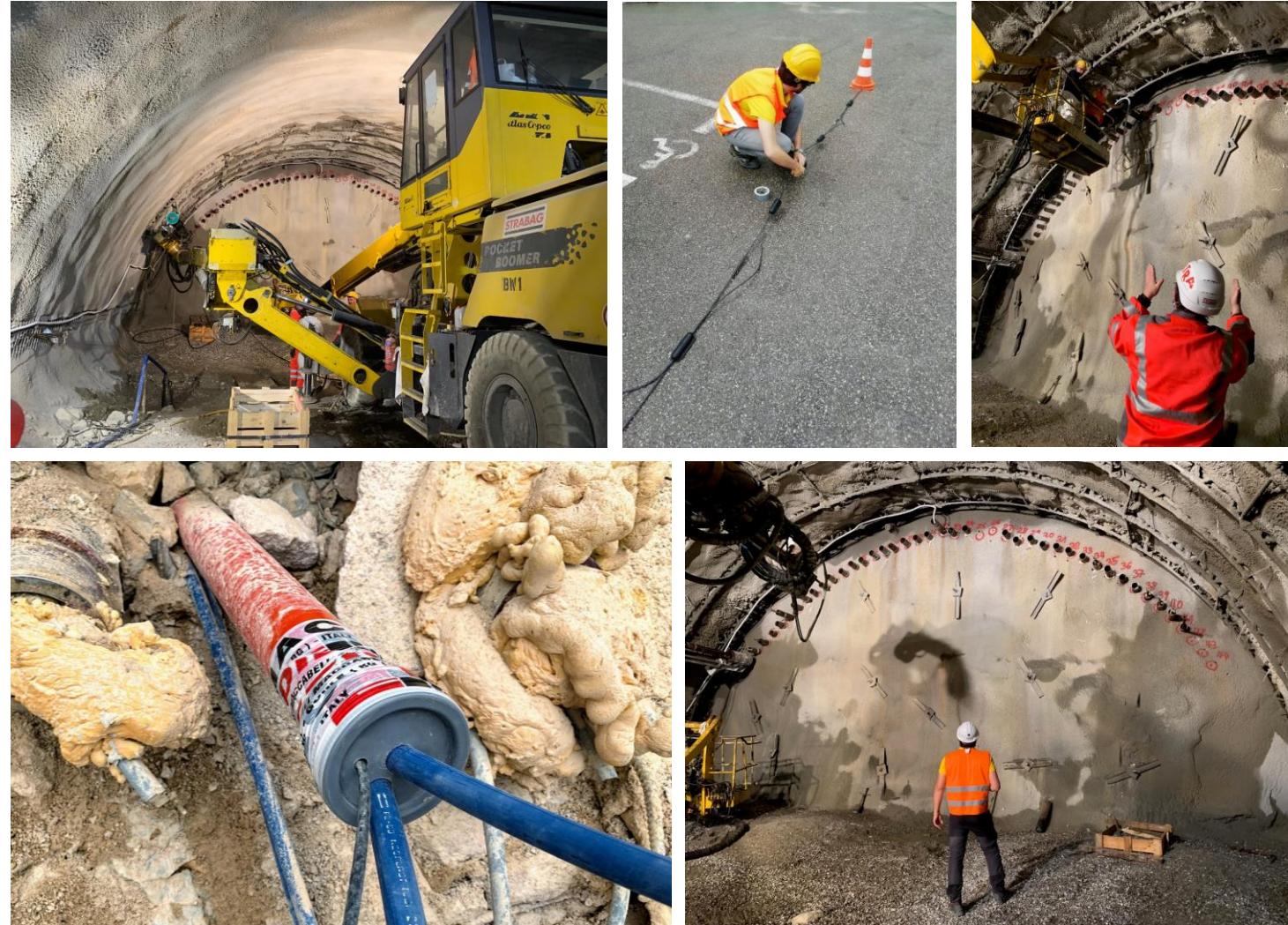
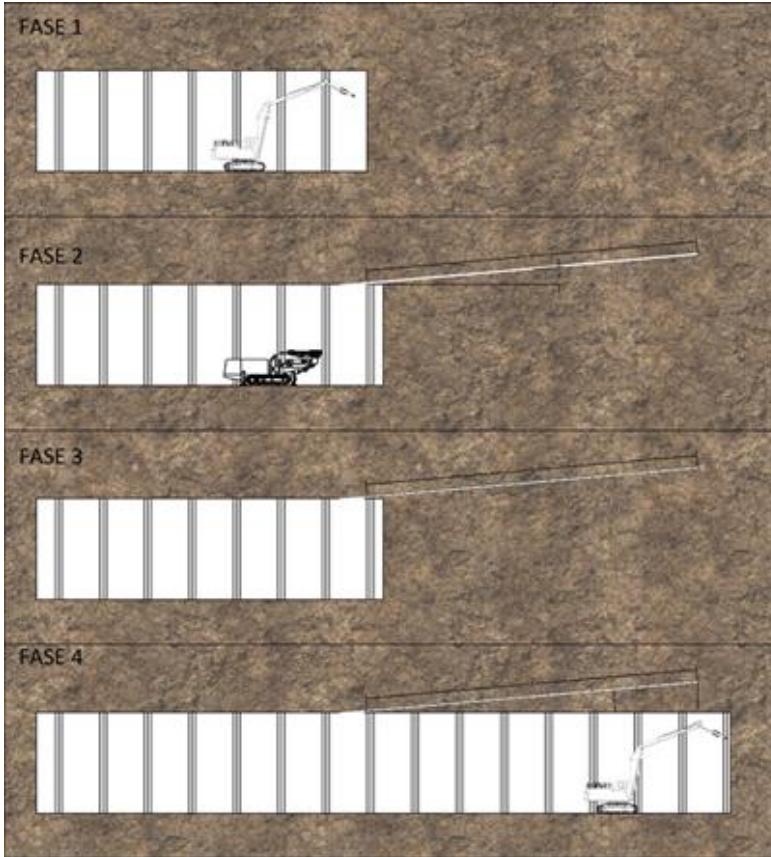


# PRECONV ARRAY

- MUMS philosophy
- Direct Pre-convergence monitoring
- Installation through forward drilling or inside steel pipes in the case of pre-support with umbrella



# PRECONV ARRAY INSTALLATION

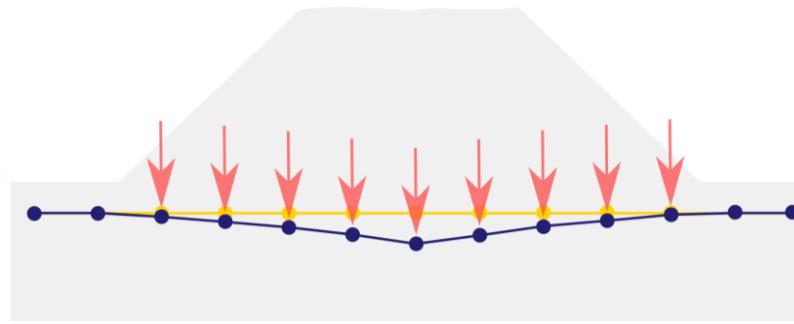


# OTHER ARRAYS

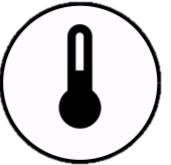
## Horizontal Array



- Subsidence;



## Therm Array



- Temperature with high accuracy ( $\pm 0.01^\circ\text{C}$ ) at different depths;
- Low-enthalpy geothermal applications.



## Piezo Array

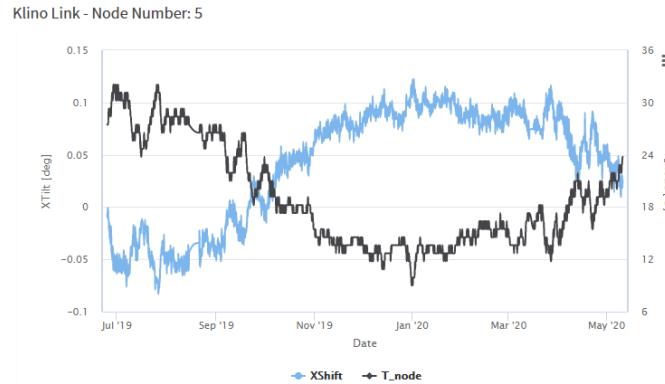
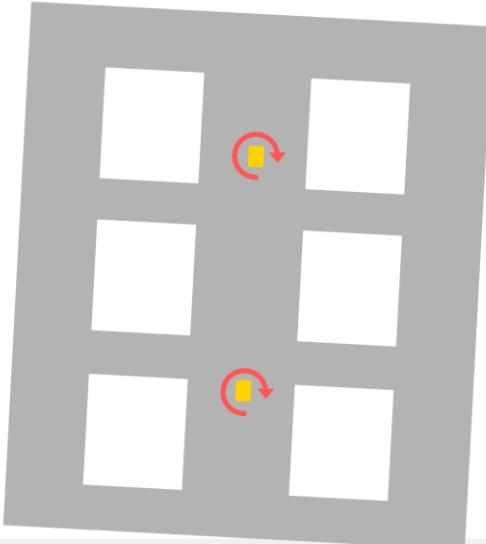


- Interstitial pressure at different depths;
- Several sensors in the same vertical;
- Single electrical cable.



# KLINO ARRAY

- Inclination angle along the instrumental axes;
- Correlations with temperature;
- Early Warning in correlation with other sensors;
- Automatic and real-time monitoring.



# Web-Based Platform GEO-ATLAS

Geo-Atlas is a platform designed for the management, processing and dynamic visualisation of data from the main monitoring systems on the market.

## Some features:

- Accessible from multiple devices (PC, Linux, Mac, Android, iOS);
- Possibility of defining different access profiles (Administrative, Manager, User, Guest, etc.);
- Automatic data storage, processing, pre-validation and representation process;
- Automatic identification of spikes using self-learning algorithms;
- Georeferencing of monitoring tools;
- Ability to upload documents;
- Dynamic graphical display of monitoring data for the desired period;
- Ability to export monitoring data and graphs in common formats;
- Automatic alerting based on user-customisable multi-sensor and multi-level thresholds;
- Ability to send an email/SMS or activate remote light/sound devices when a defined threshold is exceeded;
- Highly dynamic and automated;

[www.geo-atlas.com](http://www.geo-atlas.com)





## Advanced Slope Engineering

We monitor the present with the instruments of the future

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[info@aseltd.eu](mailto:info@aseltd.eu)