

BACKSCATTERING BASED SENSING TECHNOLOGIES, EQUIPMENT AND USE CASES

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20th November 2025



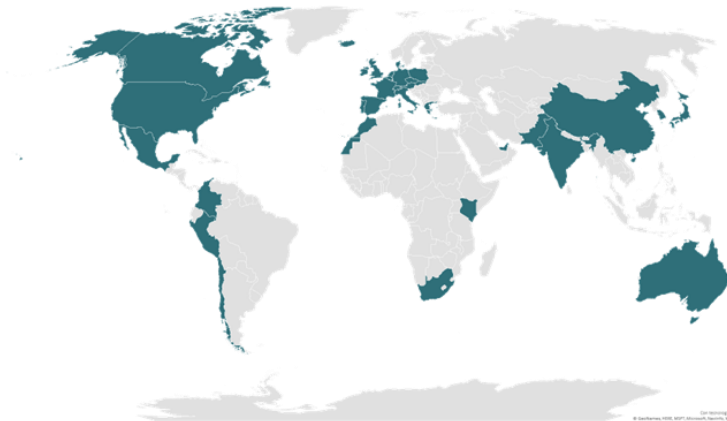
Manufacturer of photonic test, measurement & sensing equipment started in Zaragoza (Spain) in 2004.

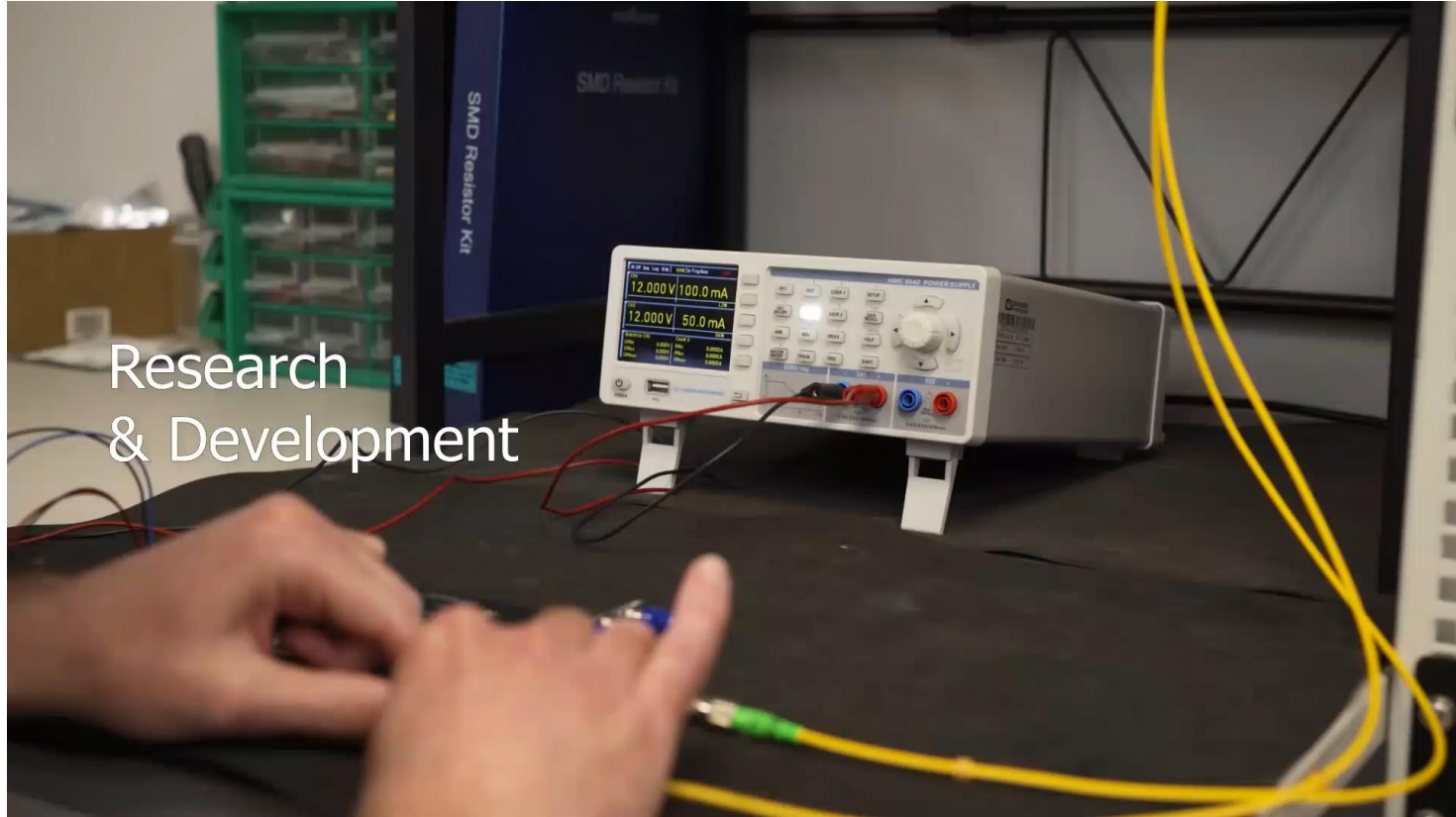


Innovative: exploiting 11 patents, highly technical staff (5 PhD), strong R&D collaboration with Universities in Spain.



International: Sales in >25 countries, strong network of distributors & partners, exhibiting in major industry trade shows.





FIBER OPTIC SENSING

Our **product development division** has been manufacturing equipment with own and patented technology for more than a decade.



HDAS
Distributed Acoustic Sensor



BLAST
*Distributed Strain and
Temperature Sensor*

For the future ...

High Spatial resolution DAS development in progress

cm resolution DAS patented:
US11549860B2 and EP3916365A1

Our **solutions development division CAPTA** has been working for more than five years on the design and creation of distributed sensing solutions for various markets.



Geophysics



Civil



Defense



Geophysics



Tsunamis



Earthquake



Volcanoes



Geotechnics



Defense



Critical
infrastructures



Maritime



Border



Security



Civil



Power



Telecomm



Railway



Highways



Oil & Gas



Water

3rd gen



- **HDAS** = High Fidelity DAS = Chirped pulse Φ OTDR
 - Intrinsically Linear and Quantitative
 - Homogeneous SNR along the fiber
 - Fading points immune
 - **Seafom Selfnoise:**
 - **< 1 $\mu\epsilon/\sqrt{\text{Hz}}$ at 1, 10 and 100 Hz**
 - **< 1 $\text{n}\epsilon/\sqrt{\text{Hz}}$ at 0.1, 0.01 and 0.001 Hz**
 - >100 km reach per channel, 2 simultaneous channels
 - **RAW Strain**, open access platform

2nd gen
Q1 2026



- **BLAST** = Brillouin Loop Analyzer of Strain & Temperature = DTSS
 - Advanced BOTDA
 - Low noise direct T°
 - **Accuracy:**
 - **0.15 MHz; 3 $\mu\epsilon$; 0.15 $^{\circ}\text{C}$ @ 6 mHz**
 - **0.05 MHz; 1 $\mu\epsilon$; 0.05 $^{\circ}\text{C}$ @ 71 mHz**
 - >100 km reach per channel, 2 simultaneous channels



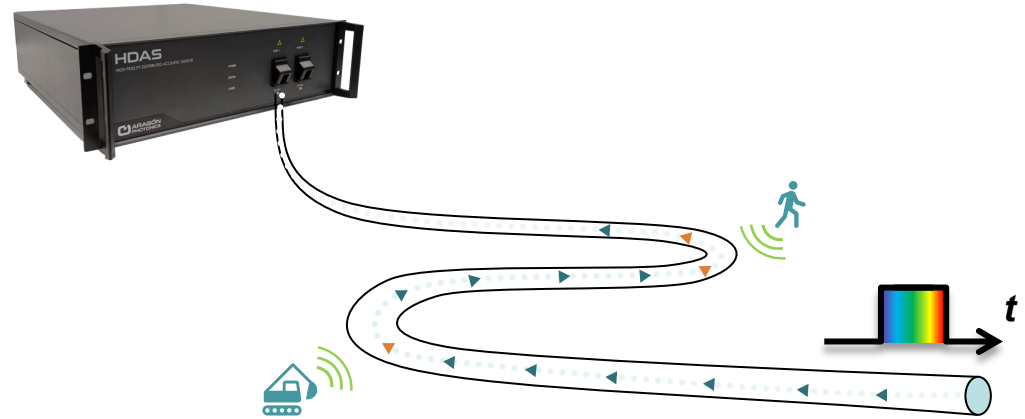
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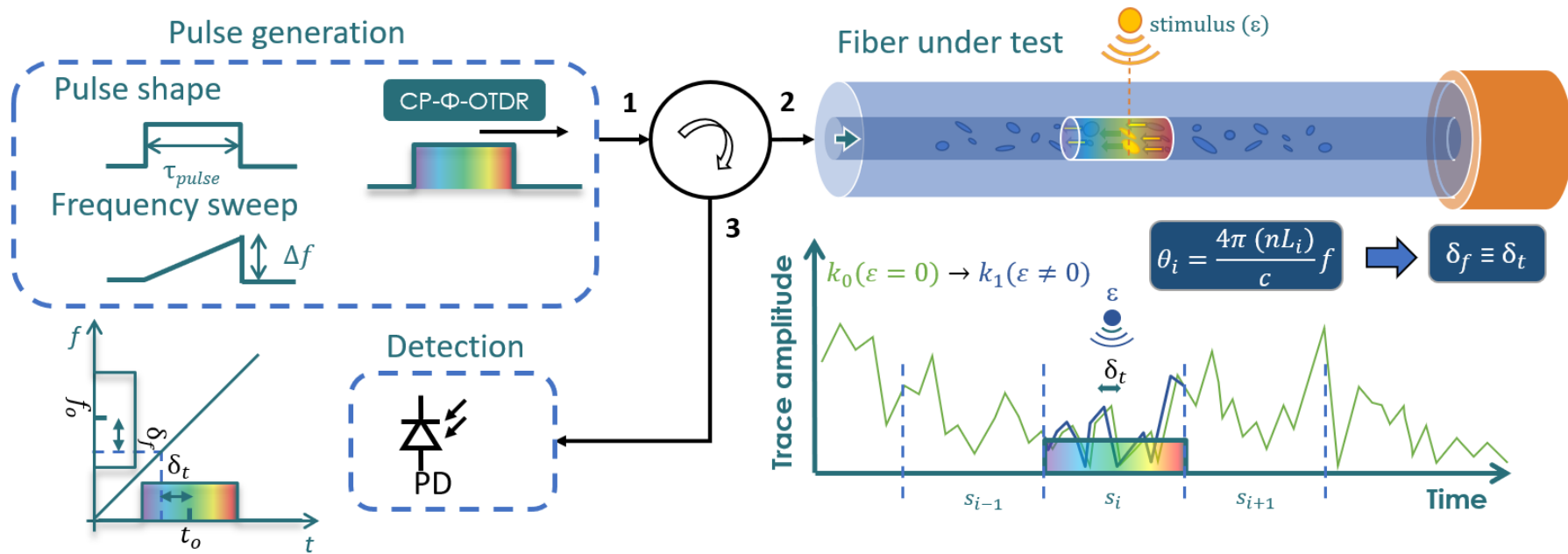
- **DAS** system is widely used as **event detector** on rollout **optical fiber** along **large infrastructures**.

DAS system **advantages:**

- It can sense from **tens of km to >100 km** with a single unit (metric spatial resolution). **Acoustic sampling** of few kHz.
 - It can use **already deployed infrastructures**.
 - Its operation is **distributed**.
- These systems detect **variations** in the **interference pattern** of the **backscattered** signal. The variation of the interfering signal comes from **phase changes** produced by external **perturbations** to the fiber.
 - In Aragon Photonics we perform different approach in DAS market:

Chirped-pulse DAS





➤ Main advantages HDAS

- **No fading** points
- **Uniform SNR** along the fiber
- **Linear** and **quantitative** measurement
- **Wide frequency response** from ~ 1 Hz to kHz's
- Outstanding performance at **low frequency**

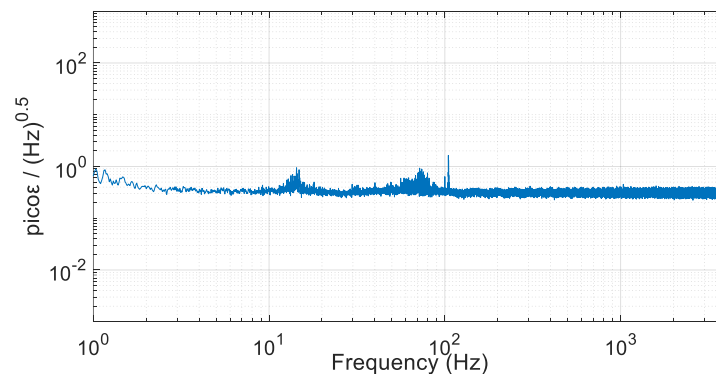
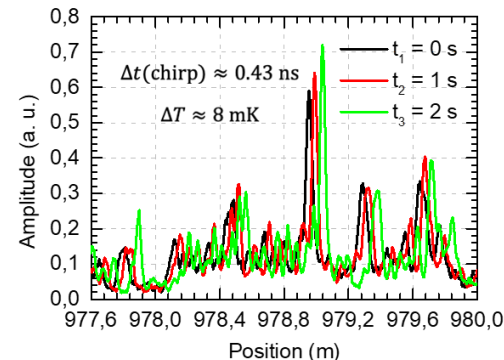
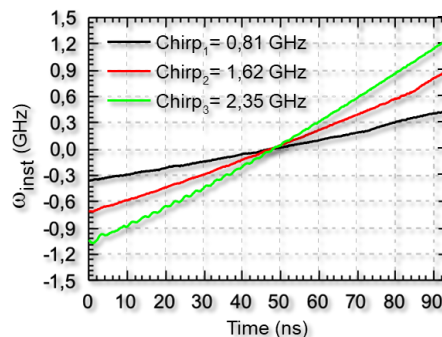
➤ High Fidelity DAS (**HDAS**)

- HDAS uses **chirped pulses** (linear frequency sweep in a single pulse).

➤ **Strain variations** turn into **local shifts** with **linear** relation to strain.



Pastor-Graells, J, et al., Opt. Express (2016)



➤ HDAS 3rd gen selfnoise:

- Amplitude Spectral Density (ASD) **noise floor**:

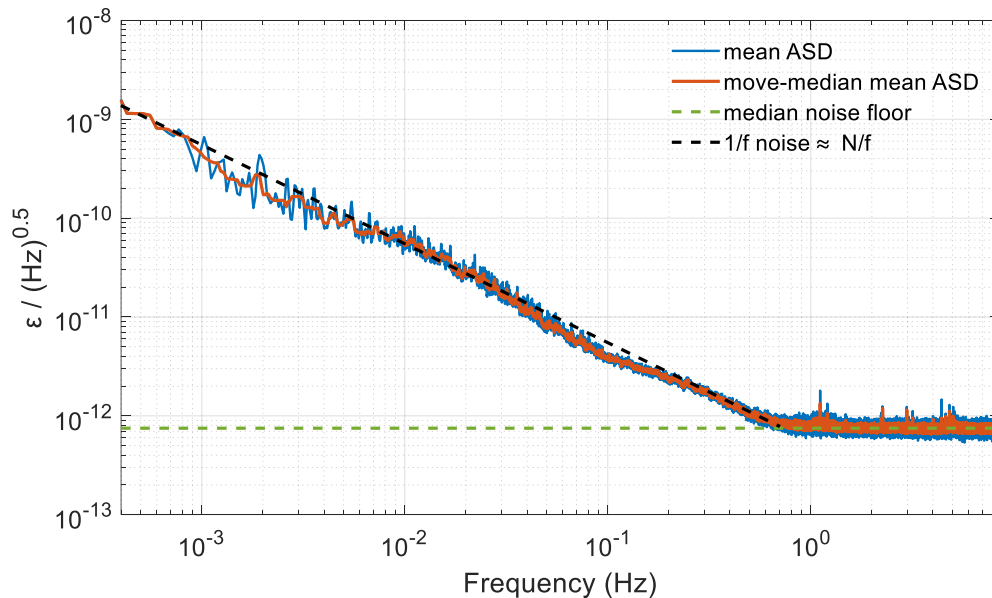
$$\sim p\epsilon / \sqrt{\text{Hz}} \quad \text{at } 1, 10, 100 \text{ Hz}$$

$$\sim n\epsilon / \sqrt{\text{Hz}} \quad \text{at } 0.1, 0.01, 0.001 \text{ Hz}$$

- Configuration:

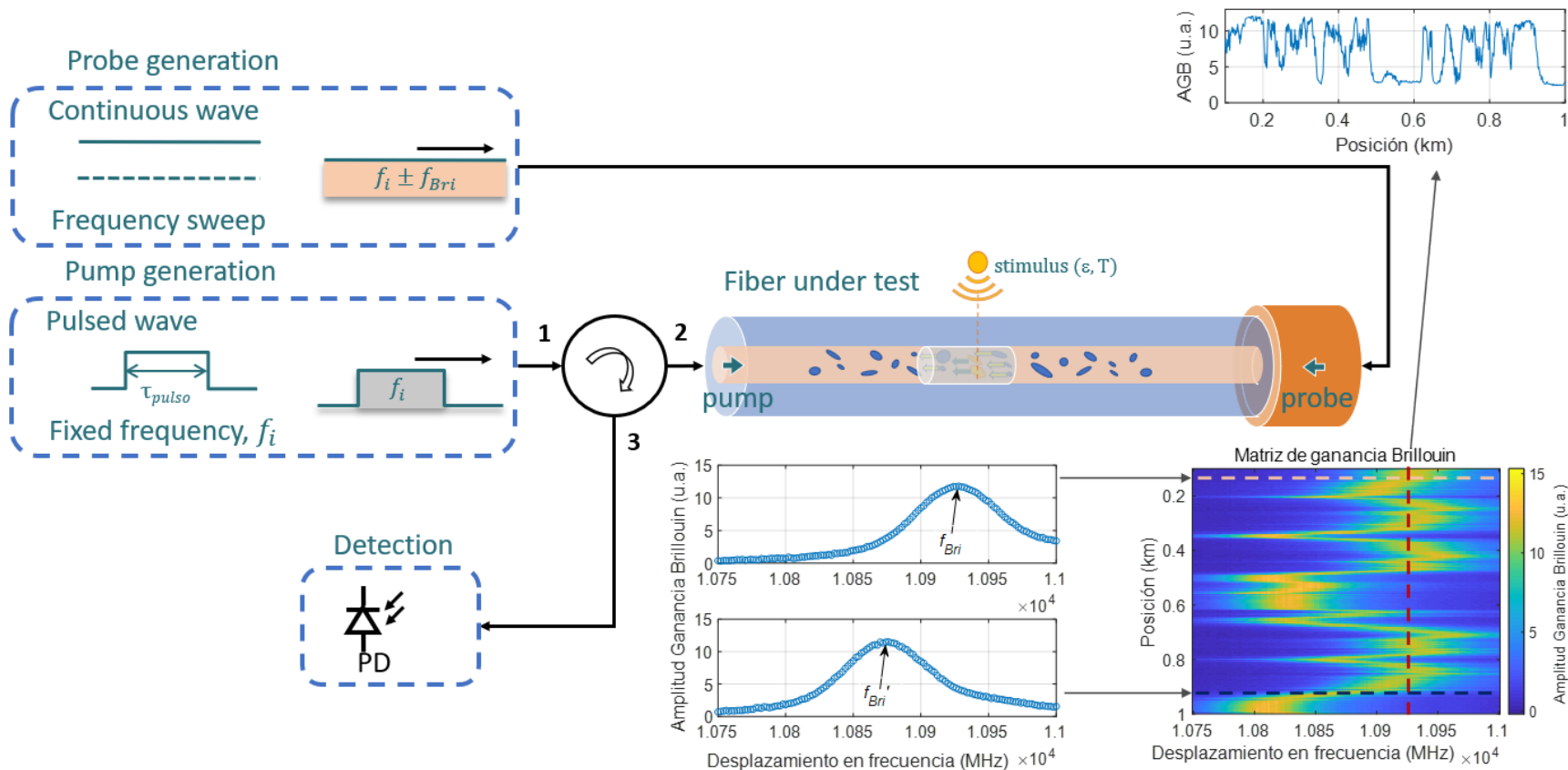
200 Hz acoustic sampling

50 m spatial resolution and GL





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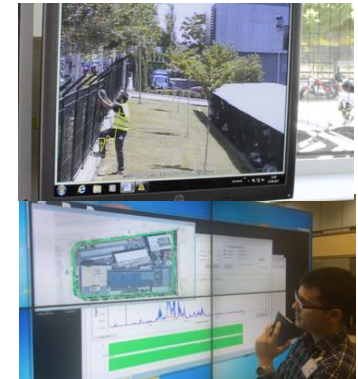




Lumetec.



- Perimeters and Borders
- Highways and Railways
- Pipelines (Water, O&G)
- Cables (Elec. & Telecom)
- Industrial Activity
- Civil Works (Construction)
- Geology (Explor. & Extraction.)
- Seismology
- Structural health monitoring
- Landslide monitoring



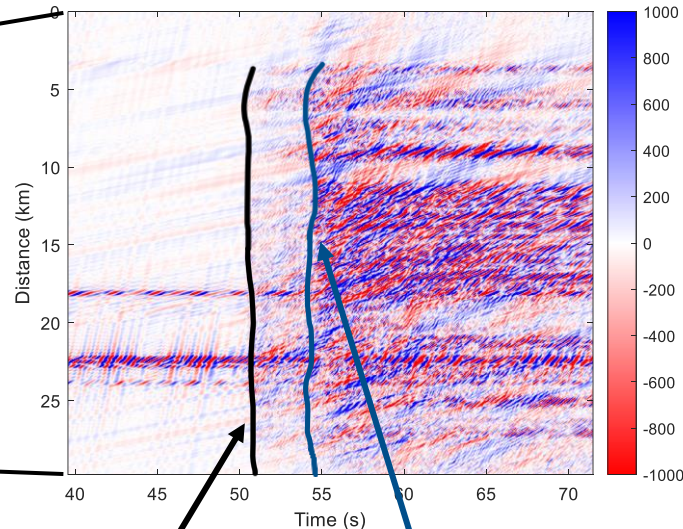
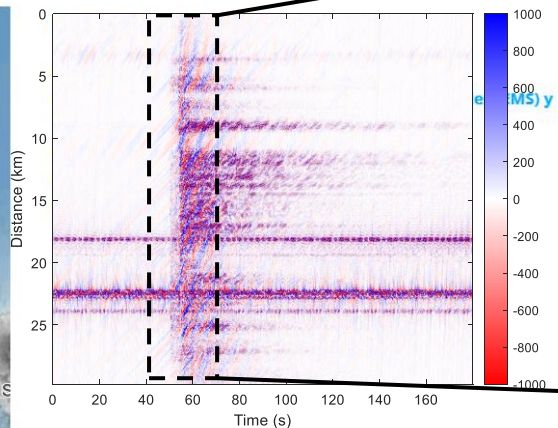
– Cumbre Vieja volcano activity in La Palma island (Spain)

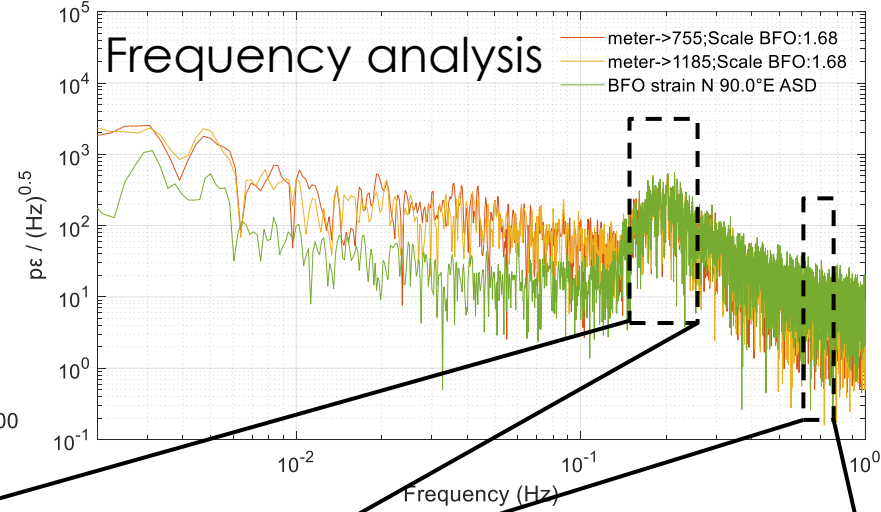
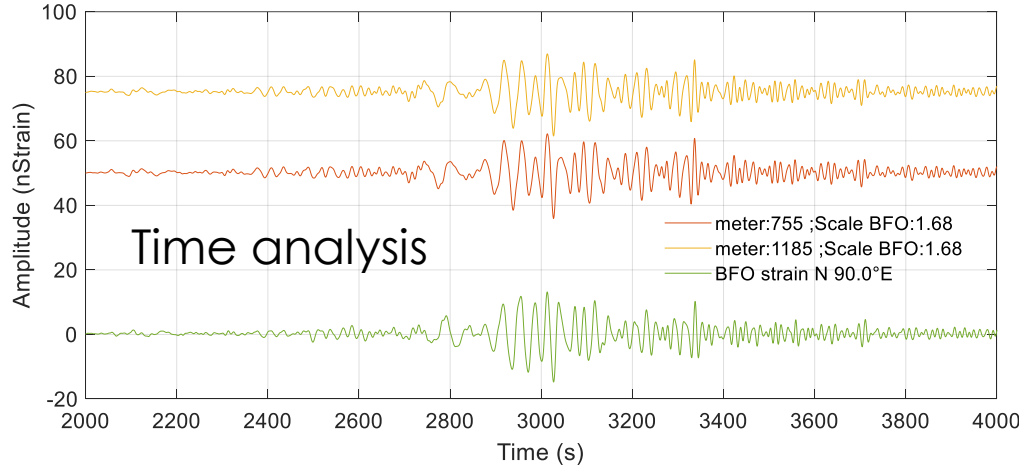


ITER
Instituto Tecnológico y de
Energías Renovables

canalink

Evento	Fecha	Hora UTC	Hora Local (*)	Latitud	Longitud	Profundidad (km)	Magnitud	Tipo Mag.	Int. max.	Localización
es2021wccir	11/11/2021	03:37:58	03:37:58	28.5684	-17.8238	35.9	5.0	mbLg	IV	SW VILLA DE MAZO, ILP



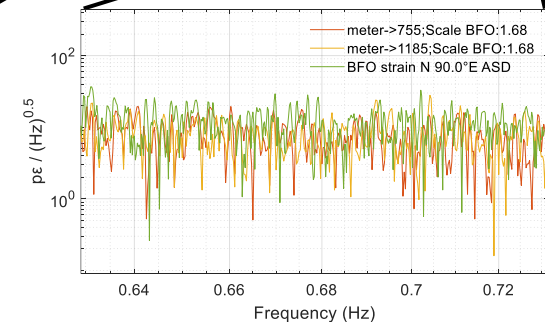
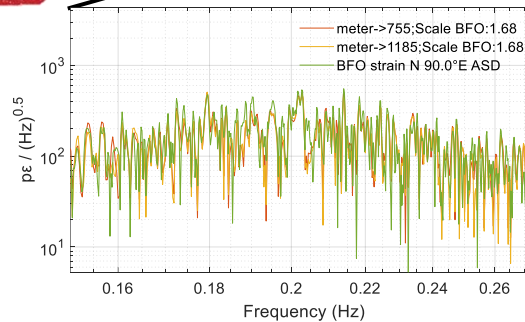


PRELIMINARY RESULT

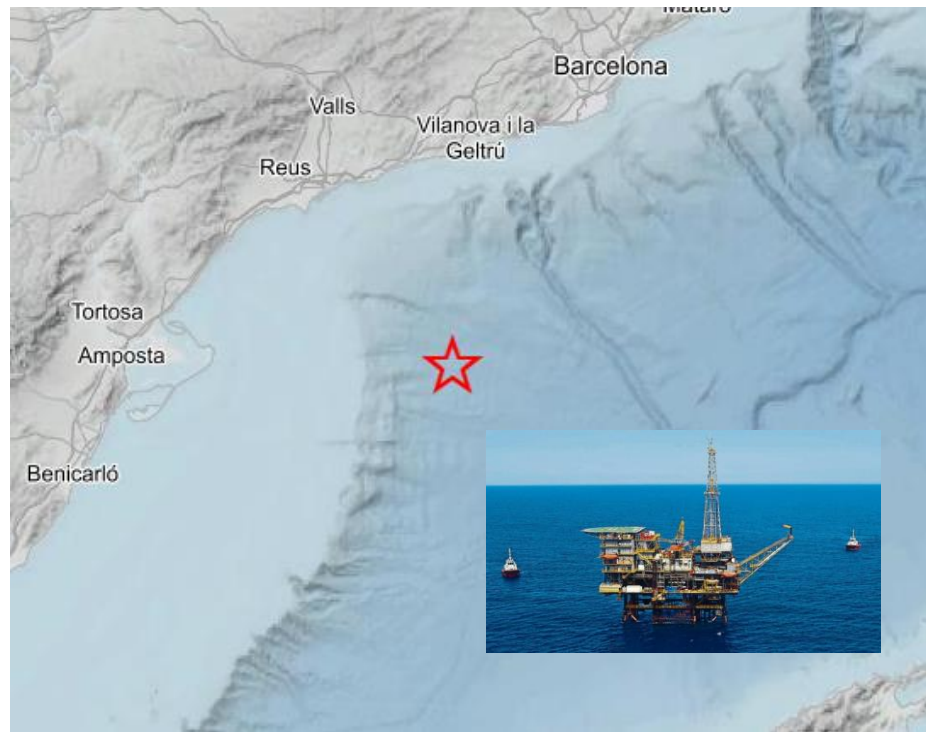
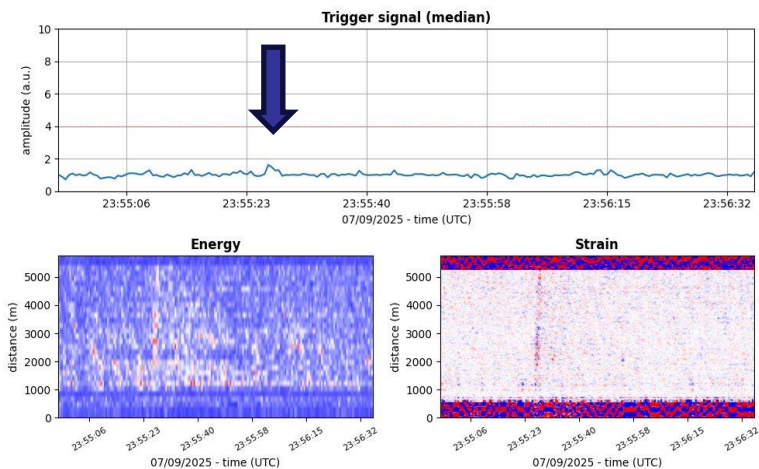
- Black Forest Observatory (BFO), Karlsruhe Institute of Technology:
- Equivalent time-frequency response to strain array meter!!

Yellow-orange curve → HDAS

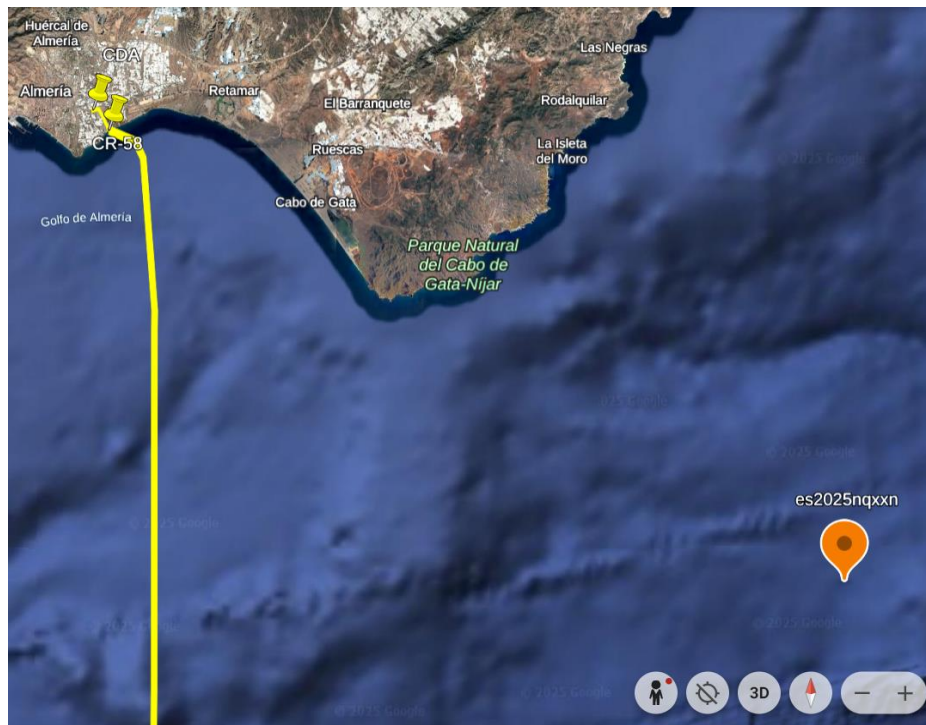
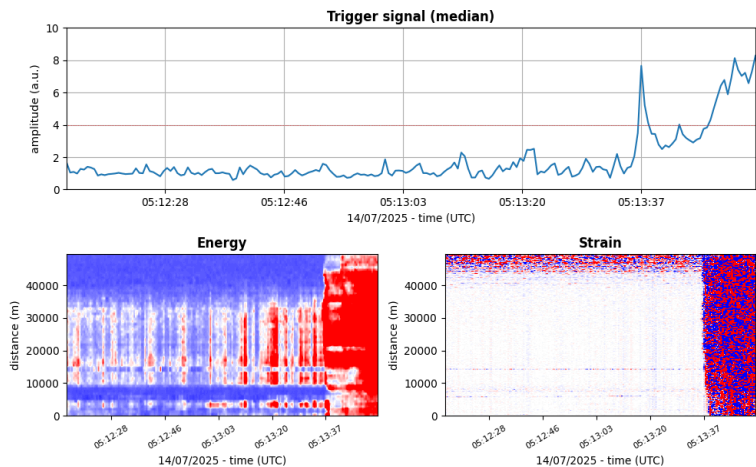
Green curve → strain array meter



- Location, costero-catalana
- 07/09/2025 23:55:15 (UTC)
- ~1.7 Mw
- Located at 28 km from the fiber

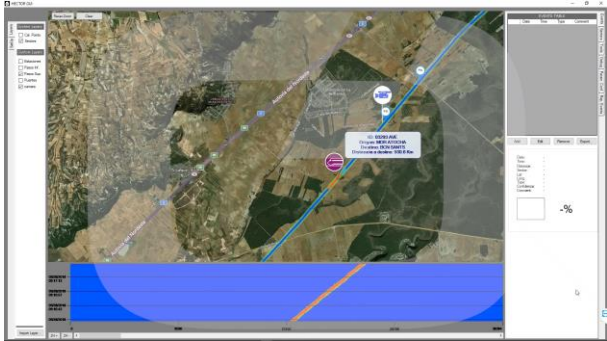


- Mediterráneo ocean – Levante Sur
- 14/07/2025 05:13:27 (UTC)
- 5.3 Mw
- Located at 48 km from the fiber





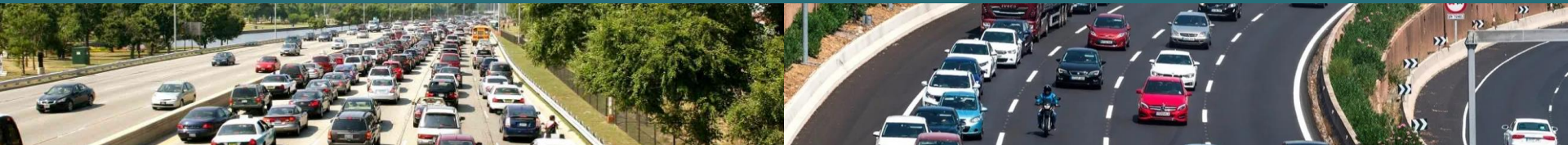
- Detecting the **position of the train** on the track



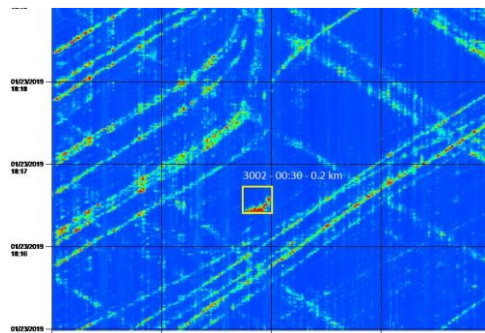
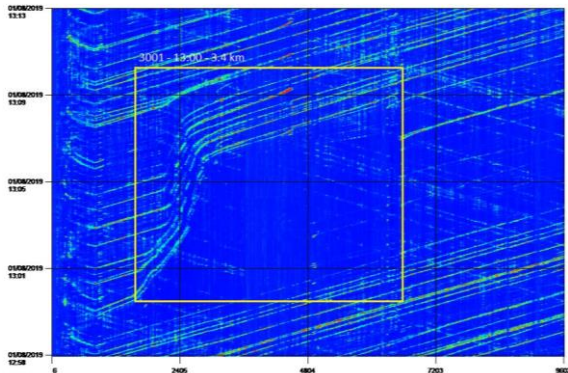
- Real-time detection of **rockfall** on railroad tracks.

- Detect unauthorized **cable tampering**



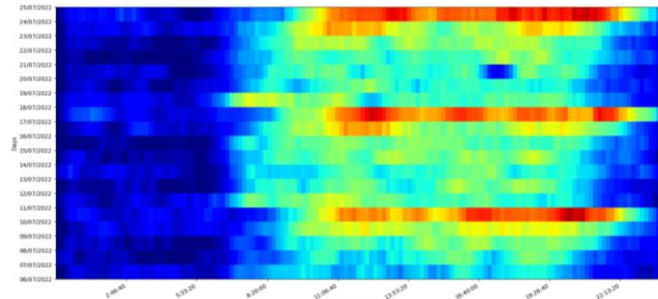


- **Efficient management** of roads
traffic jam detection



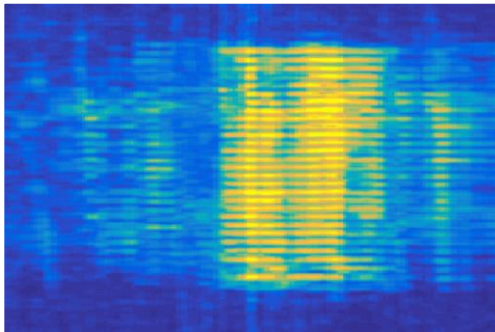
- **Prompt response** from emergency services

- Know the **traffic density** by days and hours





– Protect cable integrity (TPI)

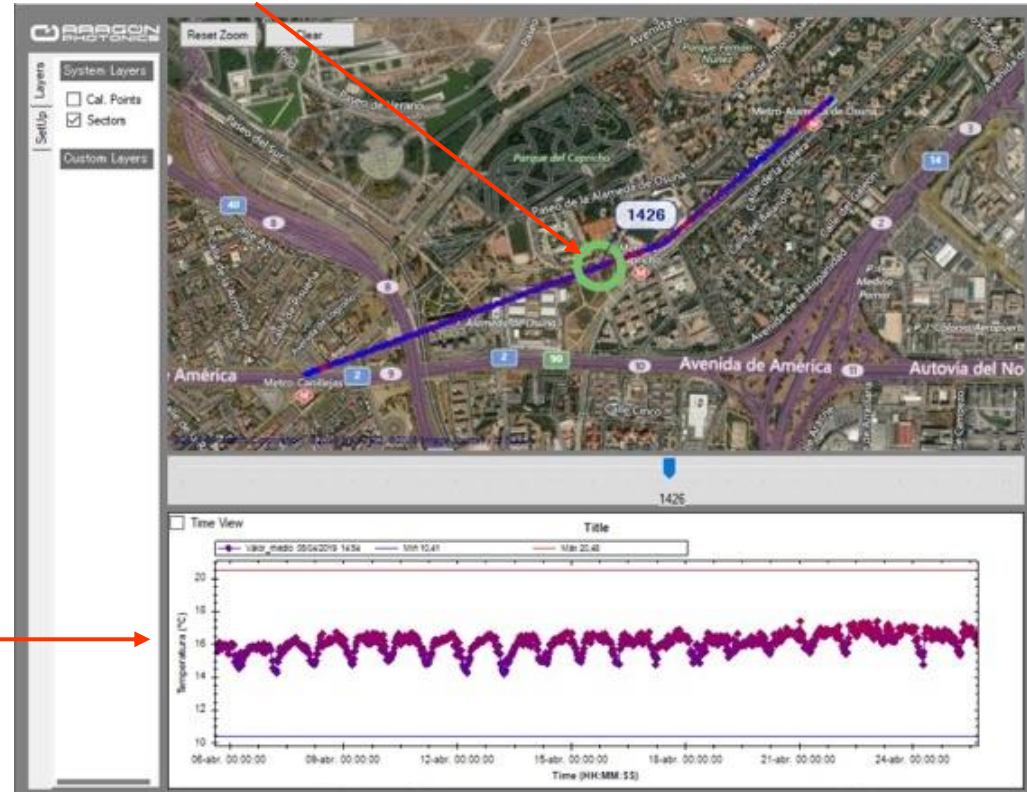


Temperature map of the tunnels

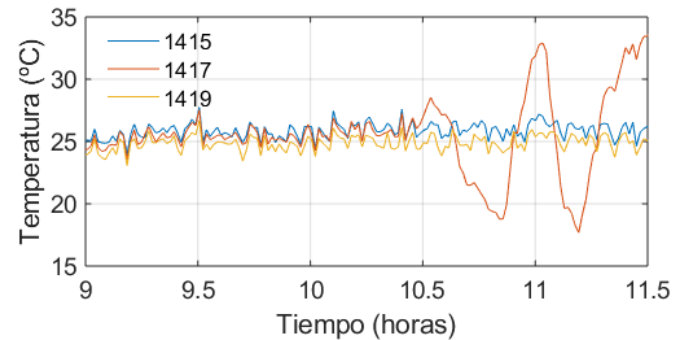
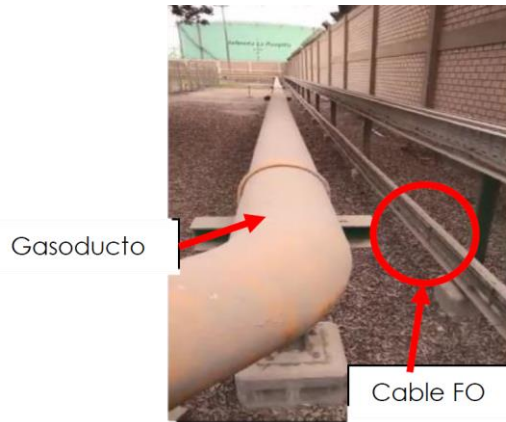


- Madrid subway

Evolution of
temperatura in
any point



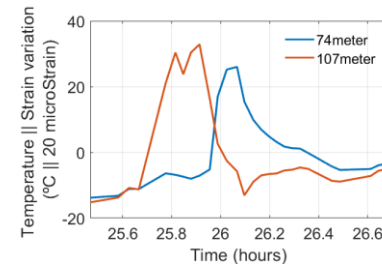
- Oil & Gas industry



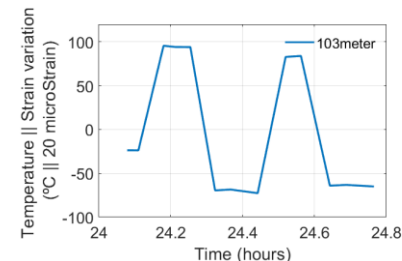
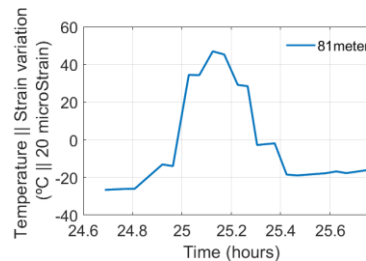
- Water industry



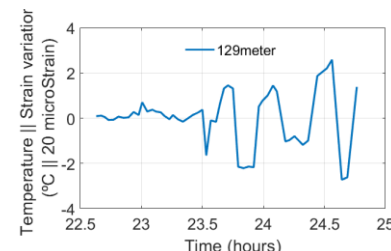
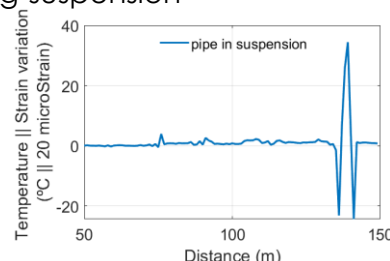
- Temperature variation



- Pipe deformation: angle



- Pipe deformation: flattening-suspension





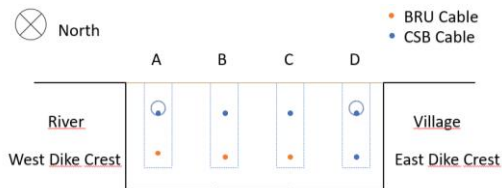
Universidad Zaragoza



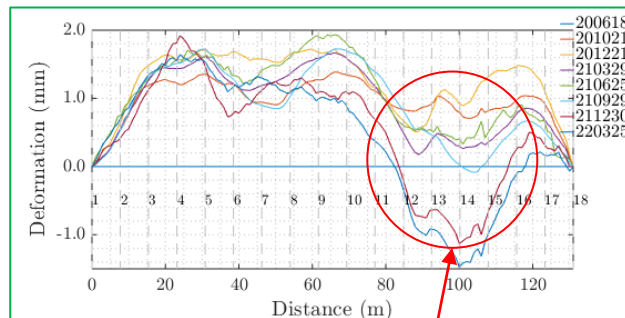
Universidad de Alcalá



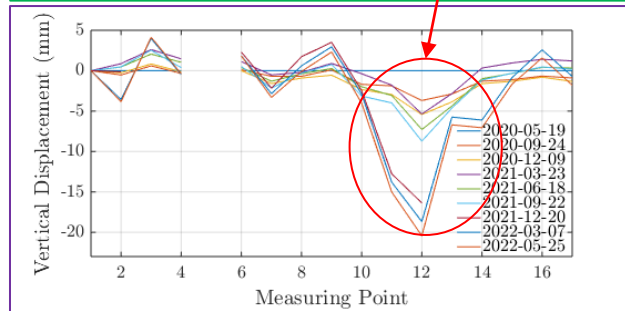
Instituto Universitario de Investigación en Ciencias Ambientales de Aragón



- Alcalá de Ebro, sinkhole monitoring



BLAST



High precision leveling



aragonphotonics.com