Instrument Asepticism

Or How I Started Loving And Stopped Worrying About The Combination

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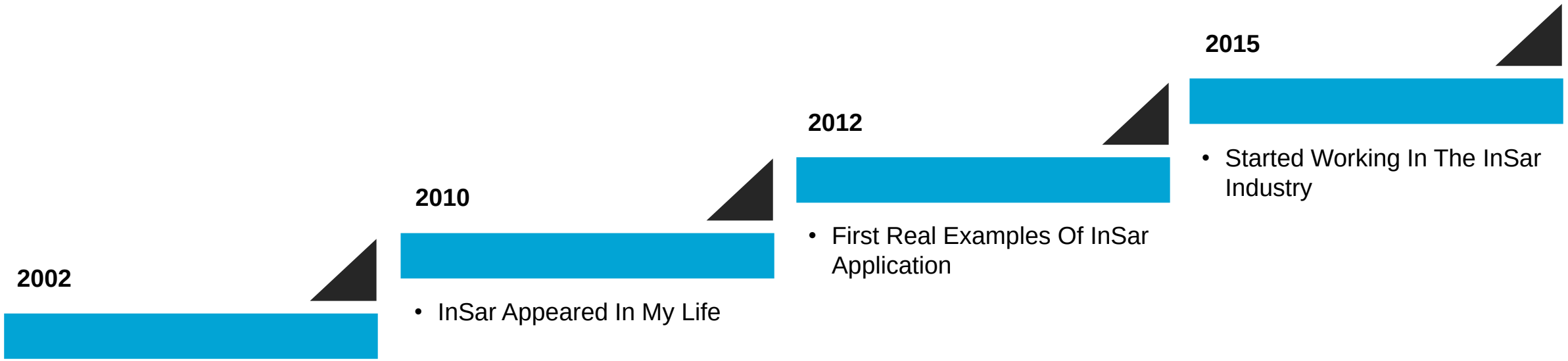
11TH INTERNATIONAL SYMPOSIUM FIELD MONITORING IN GEOMECHANICS

Agenda

- Introduction / My Journey
- InSAR: Features and Benefits
- GI: Features and Benefits
- Case studies
- The MP paradigm
- Calls to Action

My Journey - The Roadmap To InSar



- Beginning Of My Professional Career

Discovered A Lot Of Benefits. However, Insar Was Being Sold As An Alternative To Geotechnical Instrumentation.

- InSar Appeared In My Life

Having worked in both GI and InSAR, I concluded that a combination of both is the best approach.

- First Real Examples Of InSar Application

- Started Working In The InSar Industry

Then, I started championing for the combination

2. InSAR Features and benefits

Feature	Benefit
Remote sensing technique	**No need to install** anything on the ground
Ground displacement tool with **millimetric accuracy**	**Reliable and useful** data
Historical displacement analysis	Information retrieval **before the Project starts**
No physical interaction between the instrument and the ground	Better **conformity**
Allows the **study of large areas**	Cost **effective**

InSAR spotlight

Results highly dependent on processing and post processing

Not always possible to provide some concrete technical information prior to project start.

GI Features And Benefits

Able To Obtain Additional Important Information During The Installation (Human Observation, Geotechnical Survey, Etc.)

Feature	Benefit
• On site technique. • **Groundwork** is required	Provides **valuable information** at a very low scale .
Results can be **obtained shortly** after the instrument installation	**Fast** response
Wide range of technologies available	Allows us to measure an **extensive range of parameters**
Manual and automated readings available.	**All range** of acquisition frequencies and geographic ranges available.
From **low to large scale** monitoring	Able to obtain **local** information **and fast** changes

GI Spotlight

Customized Solutions To Ground And Project conditions

Reliability and accuracy of the obtained results are linked with the Quality Of The Installation and the way data is managed.

Common Features

G.I Features

- On site technique.
- **Groundwork** is requir

Results can be **obtai**
the instrument instal

Wide range of technologi

Manual and automated re
available.

From **low to large scale** monitoring

InSAR Features

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tool with

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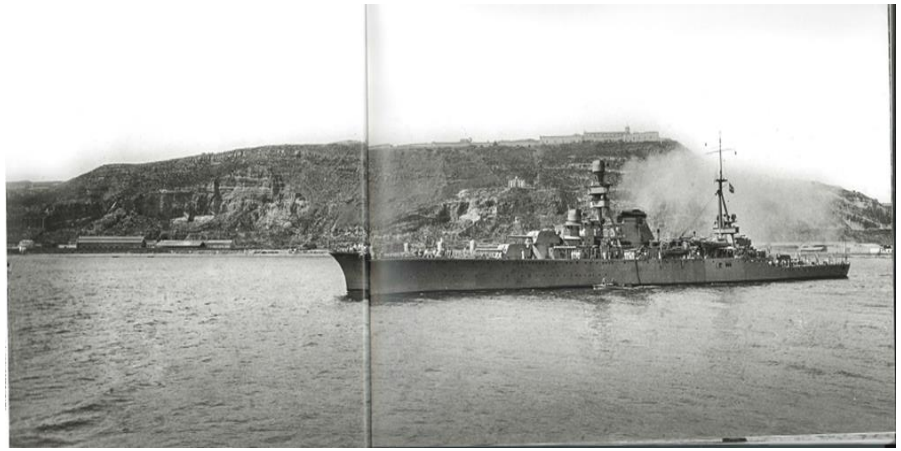
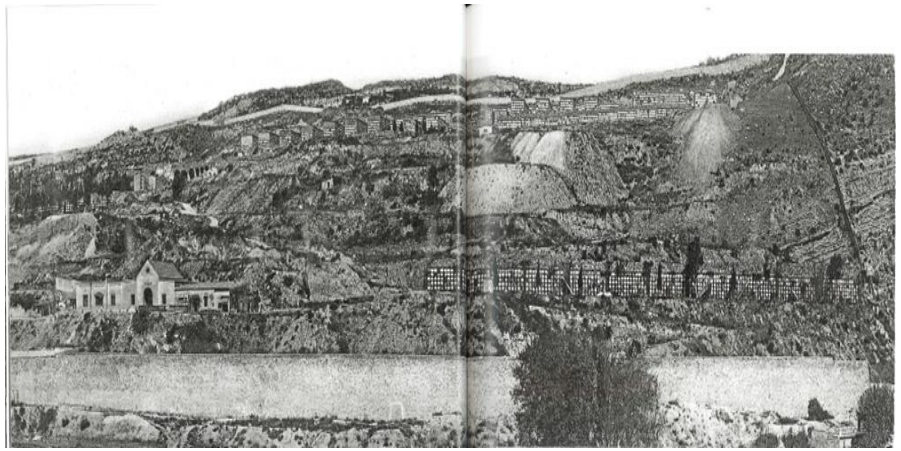
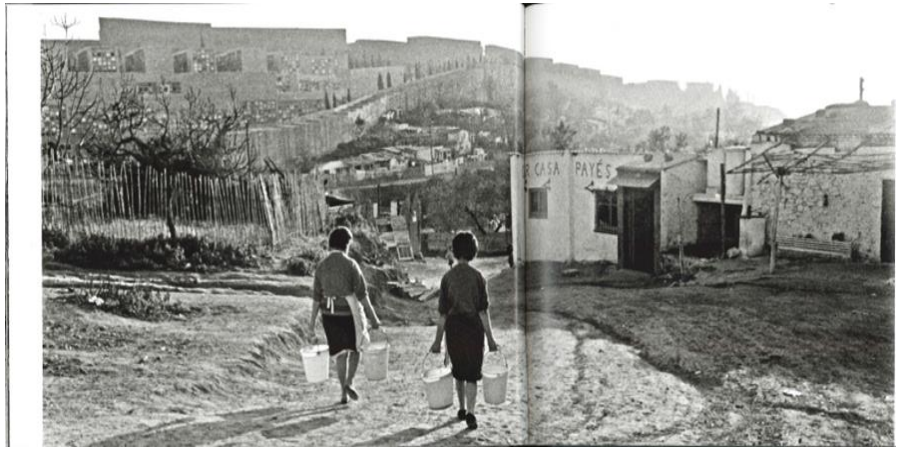
interaction between the
and the ground

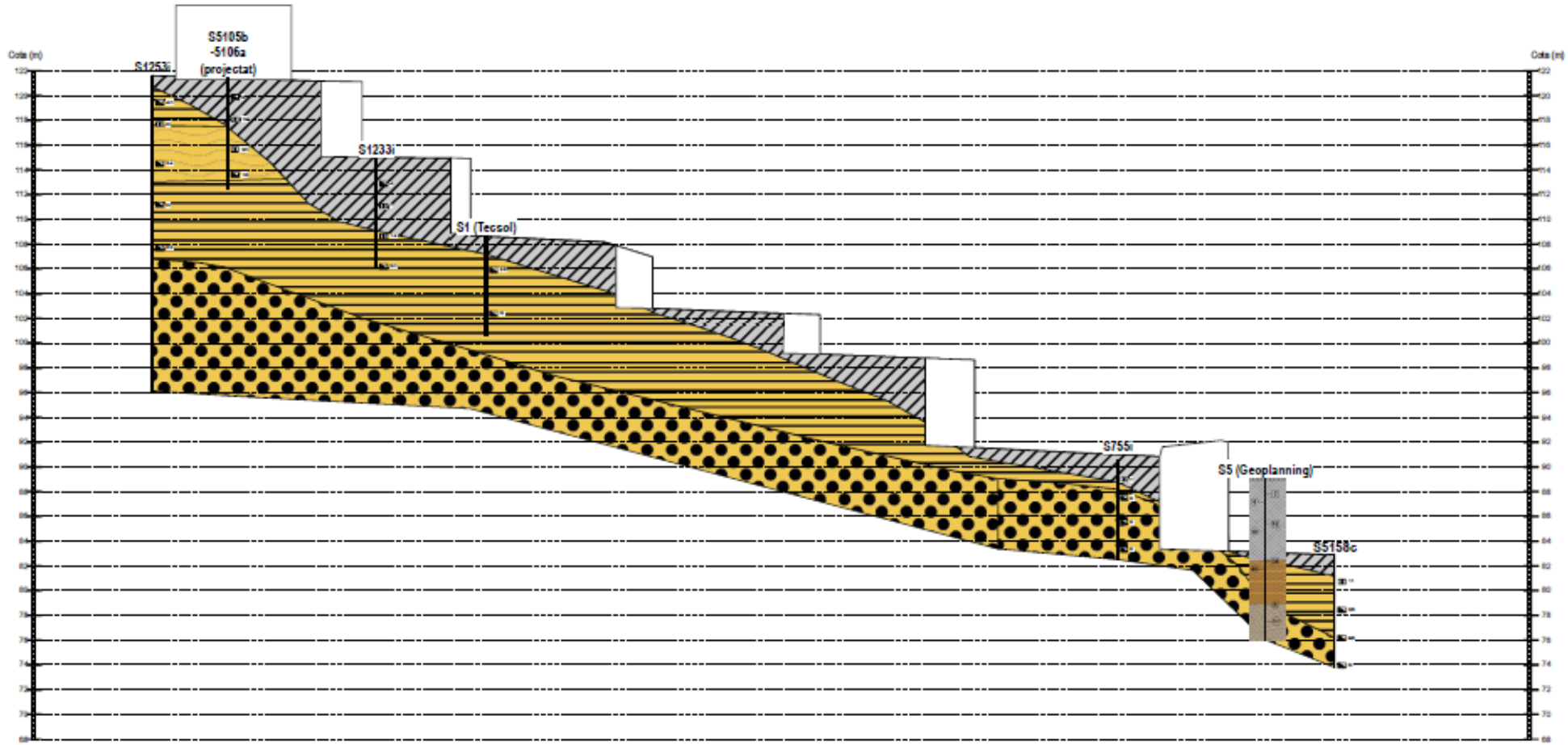
Allows the **study of large areas**

4. Case Studies. Montjuïc Cemetery





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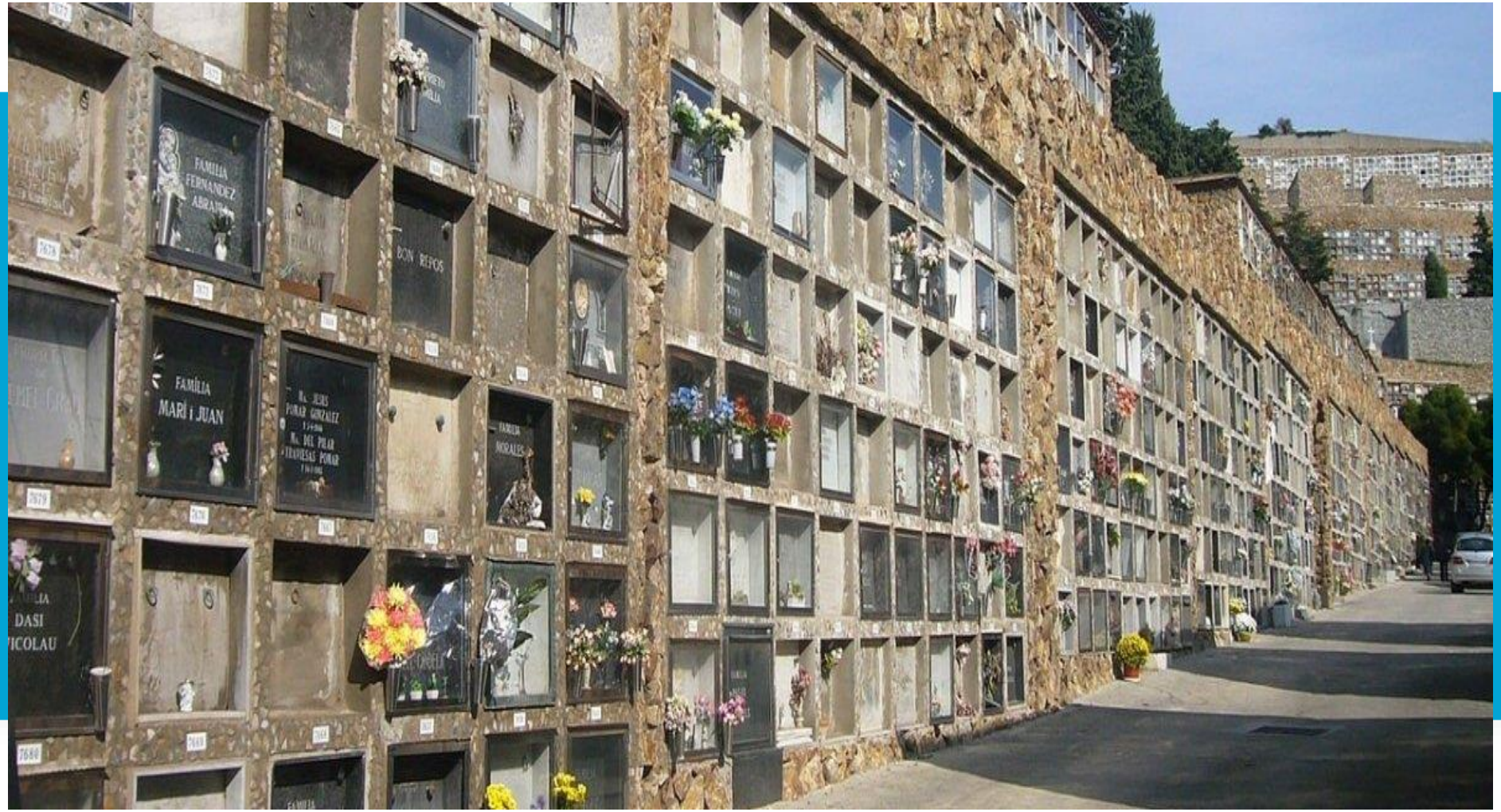
FAMILIA
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Project Development

03

Risk Map

4 Categories Of Damage.
Manual Or Automated
Monitoring

02

Insar Historical Study

Complement And
Double Check The
Visual Inspection

01

Visual Inspection

Focus On Buildings
With Structural
Perspective

04

Monitoring Plan

Development And
Implementation

05

Geotechnical Investigation

Improve The
Geotechnical Knowledge-
Focus On Fill- And
Instrumentation

06

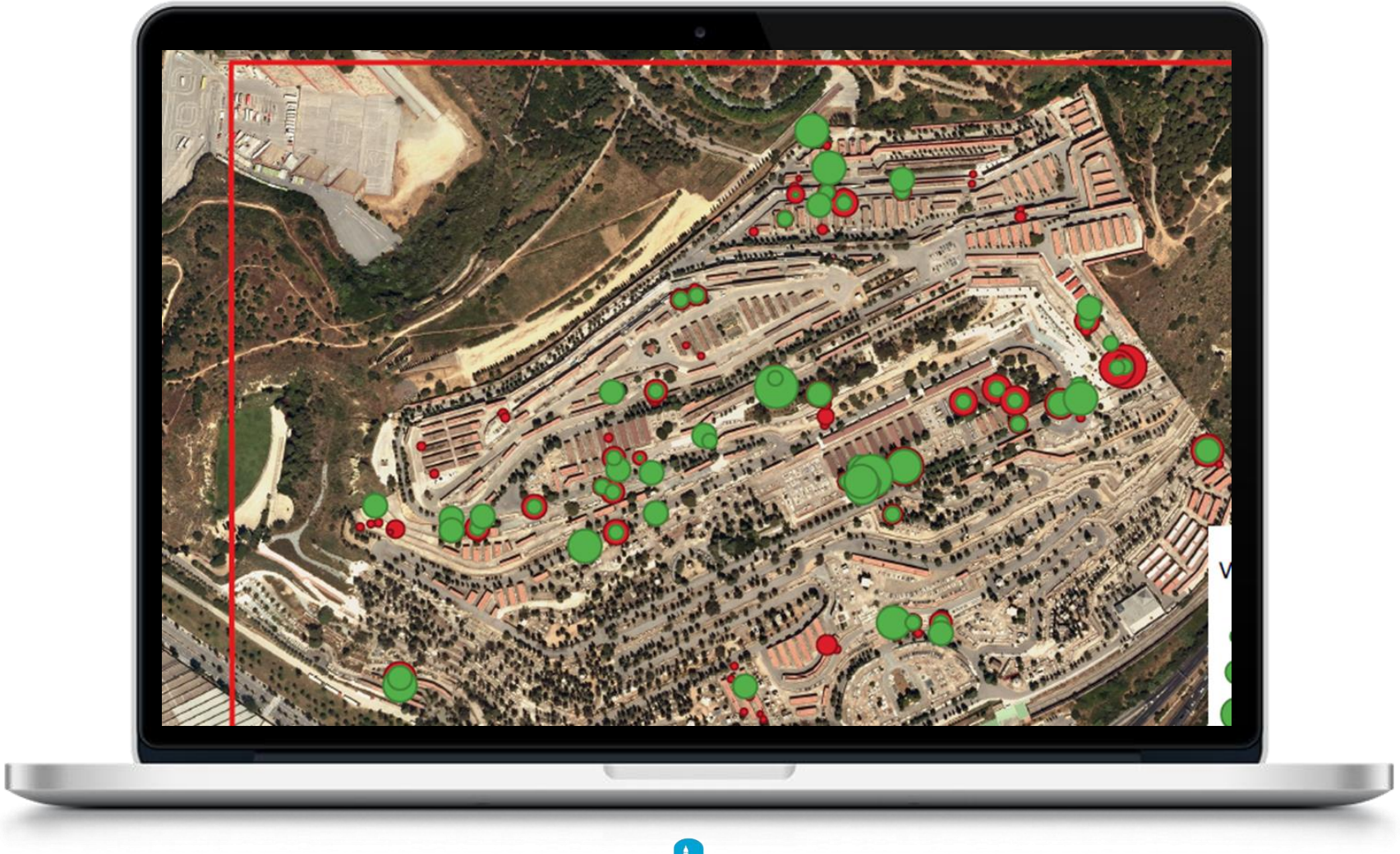
Monitoring Follow Up

Update The Risk Map
And Upgrade The
Monitoring System

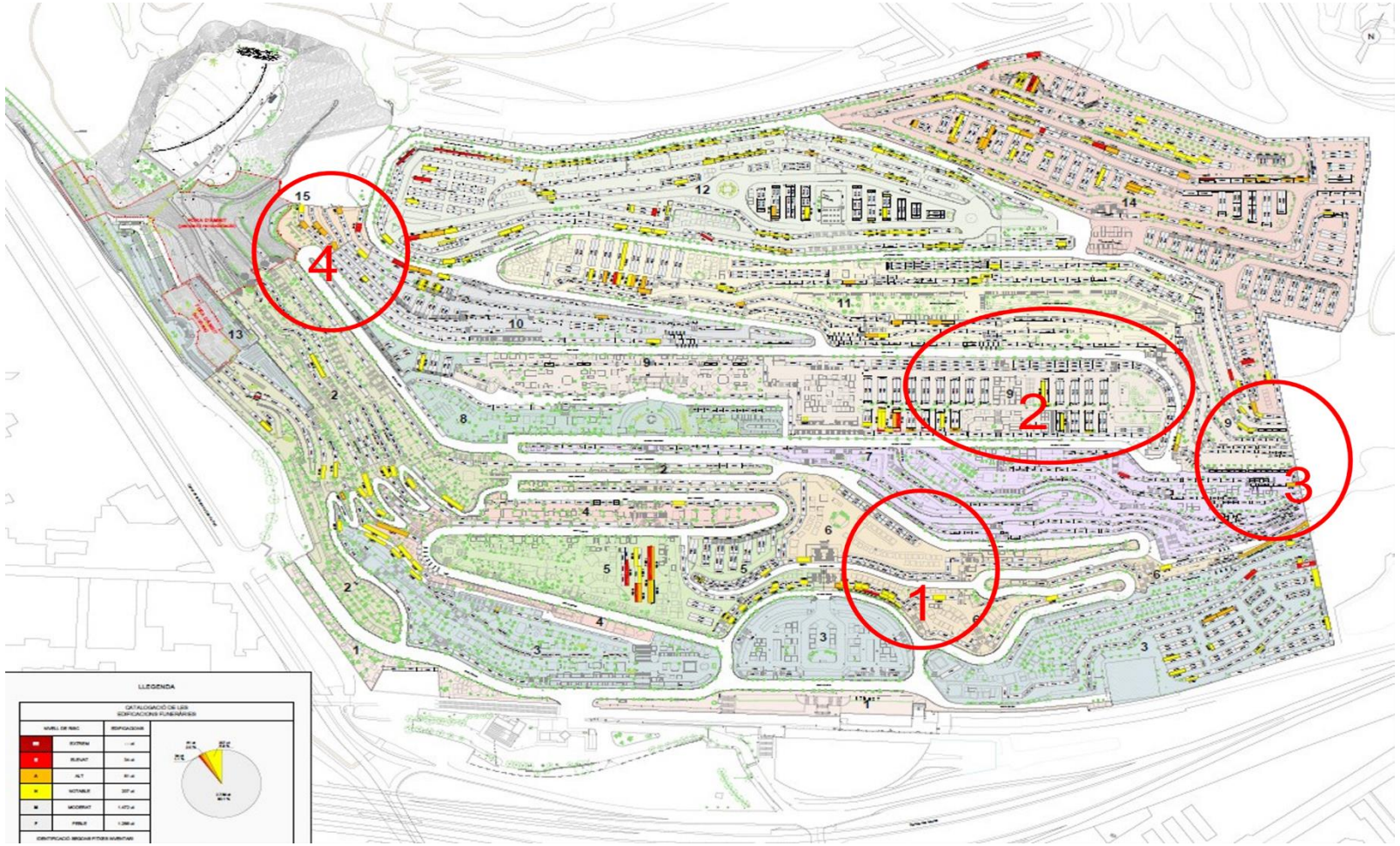
InSAR


LLEGENDA
CATALOGACIÓ DE LES EDIFICACIONS FUNERÀRIES
NIVELL DE RISC
RESPOSTA

Geotechnical Context



Geotechnical Context

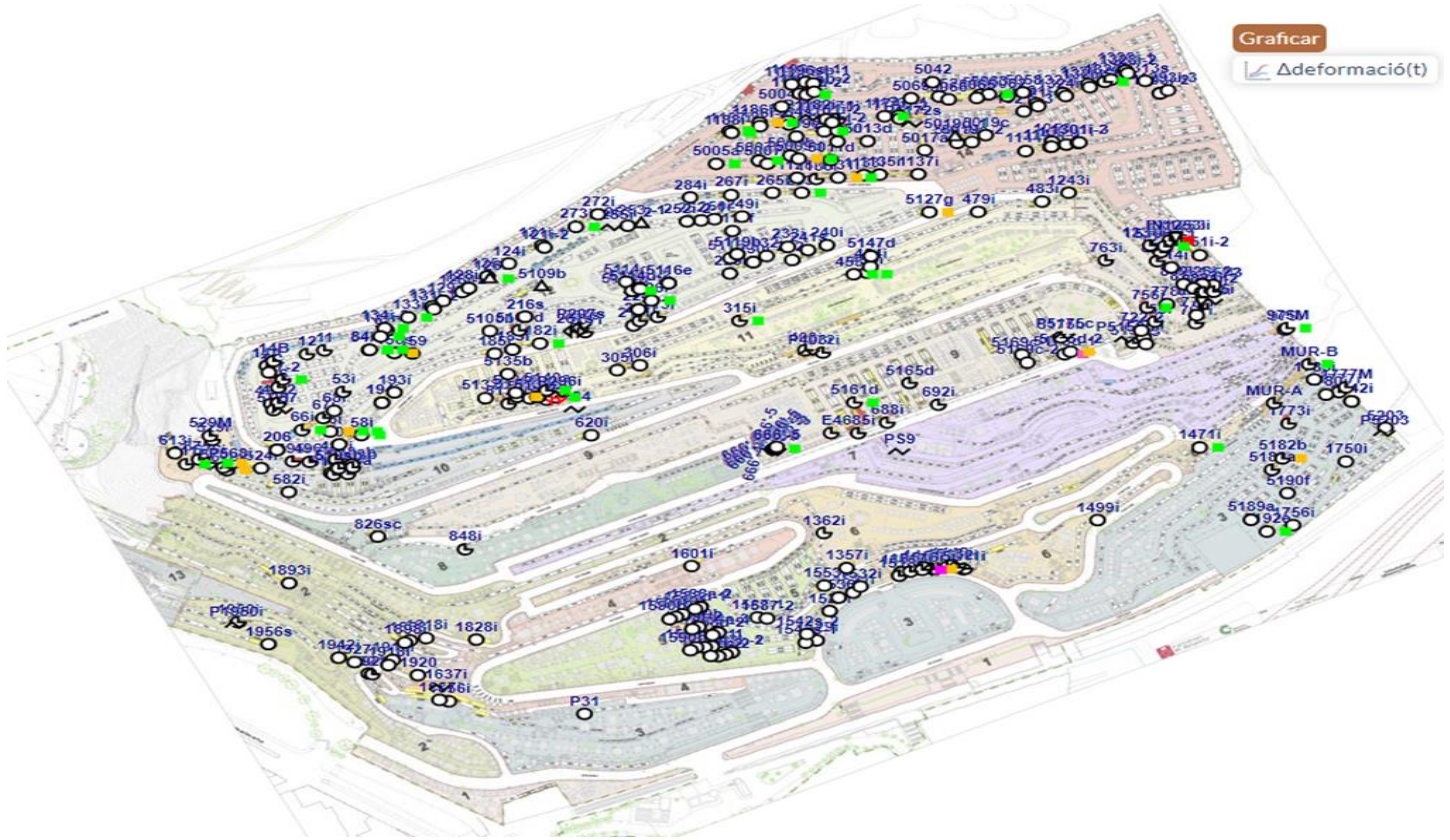


Instrumentation

Manual Topographic Control Of Buildings With Lower Risk Level

4 robotic total station to control around 300 prisms installed in the buildings with high risk and together

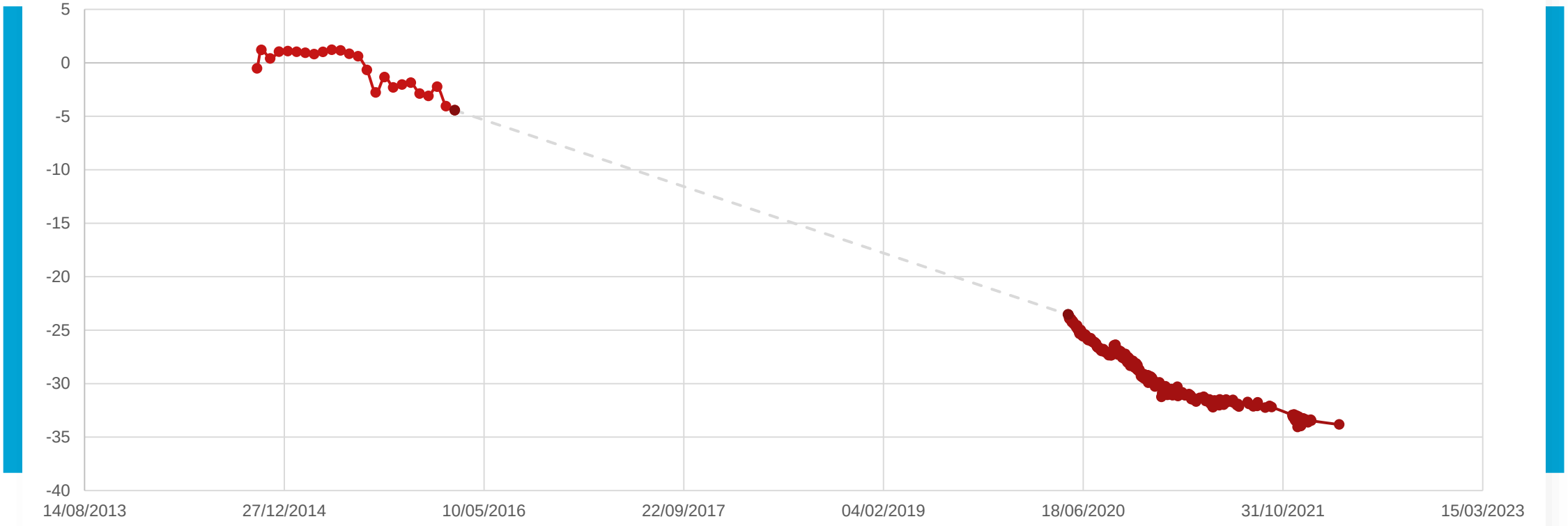
Automated tiltmeters (around 100) to control isolated buildings with higher risk



Online Platform Allows For:

- Data management
- Visualization
- Information sharing

Zone 2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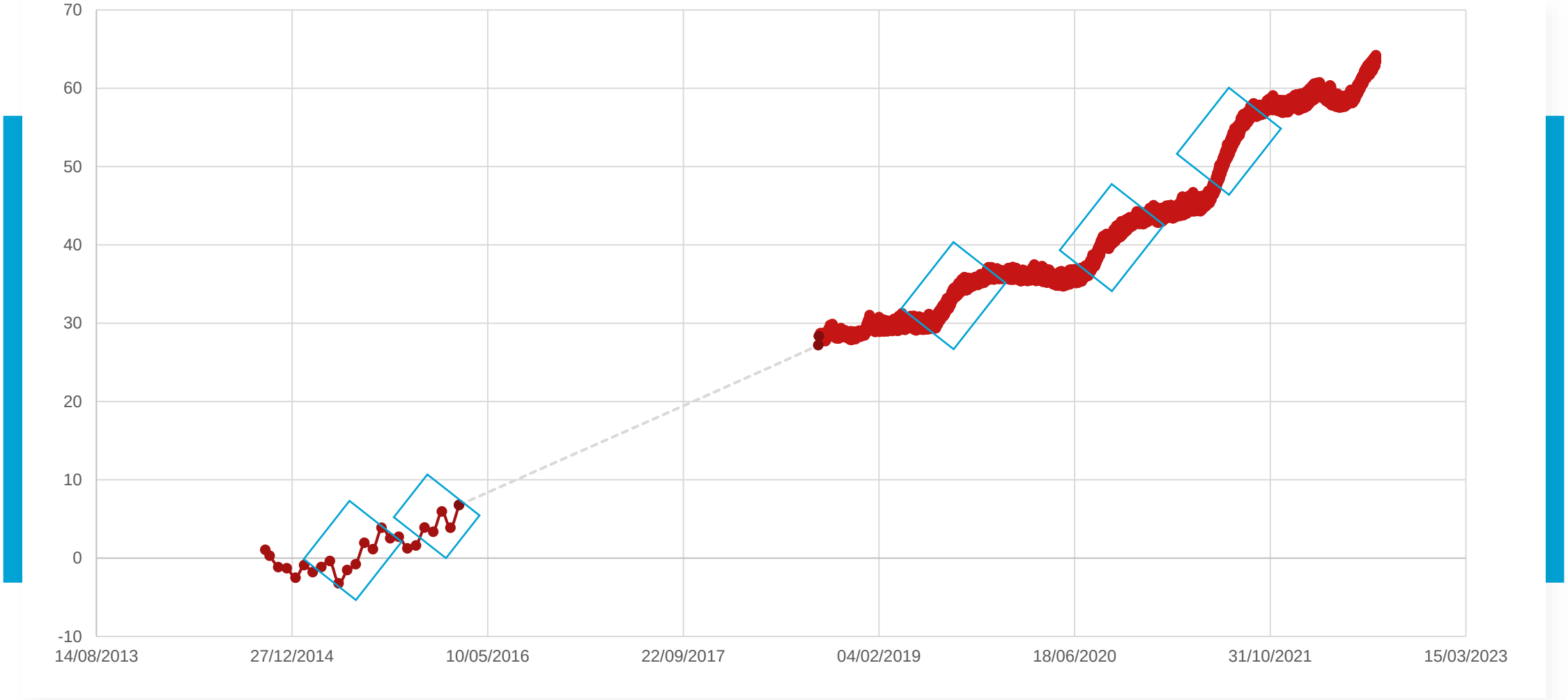
15/03/2023

Zone 2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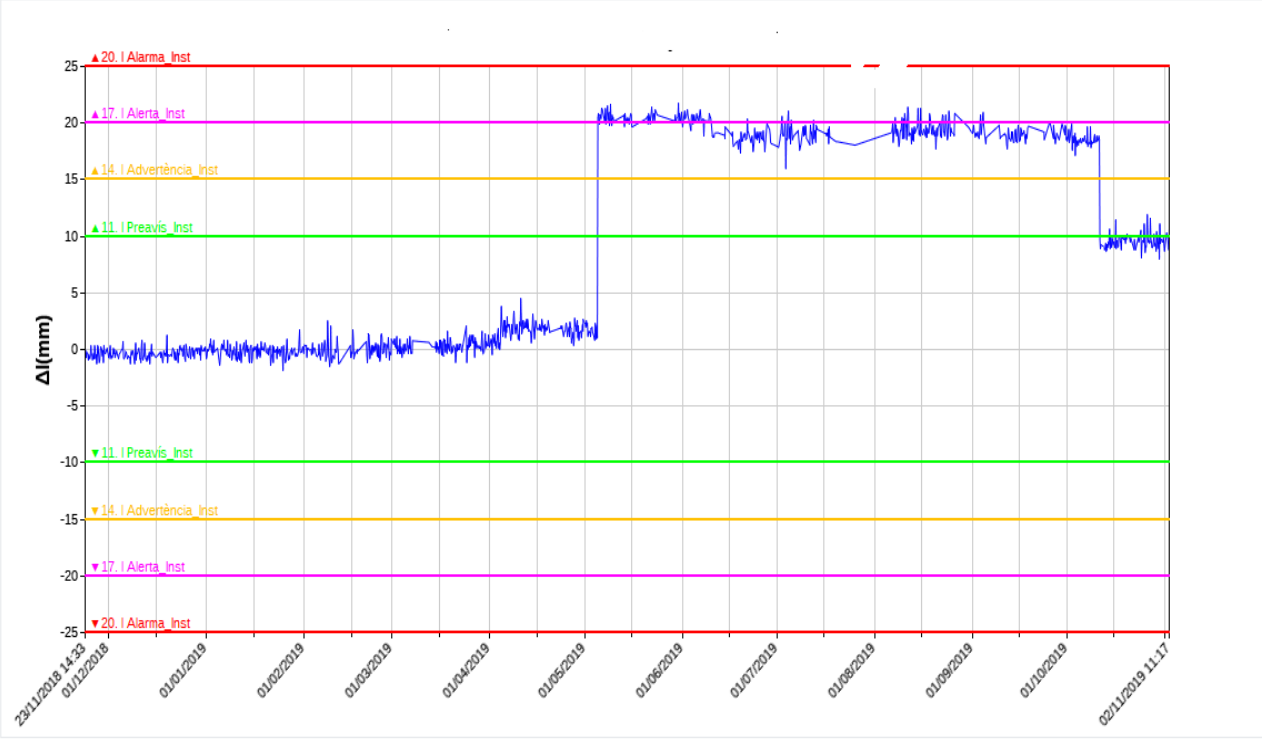
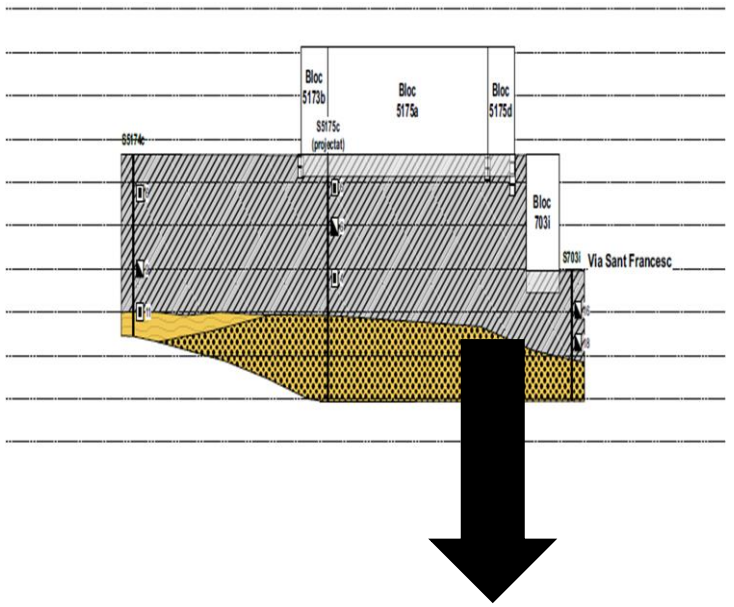
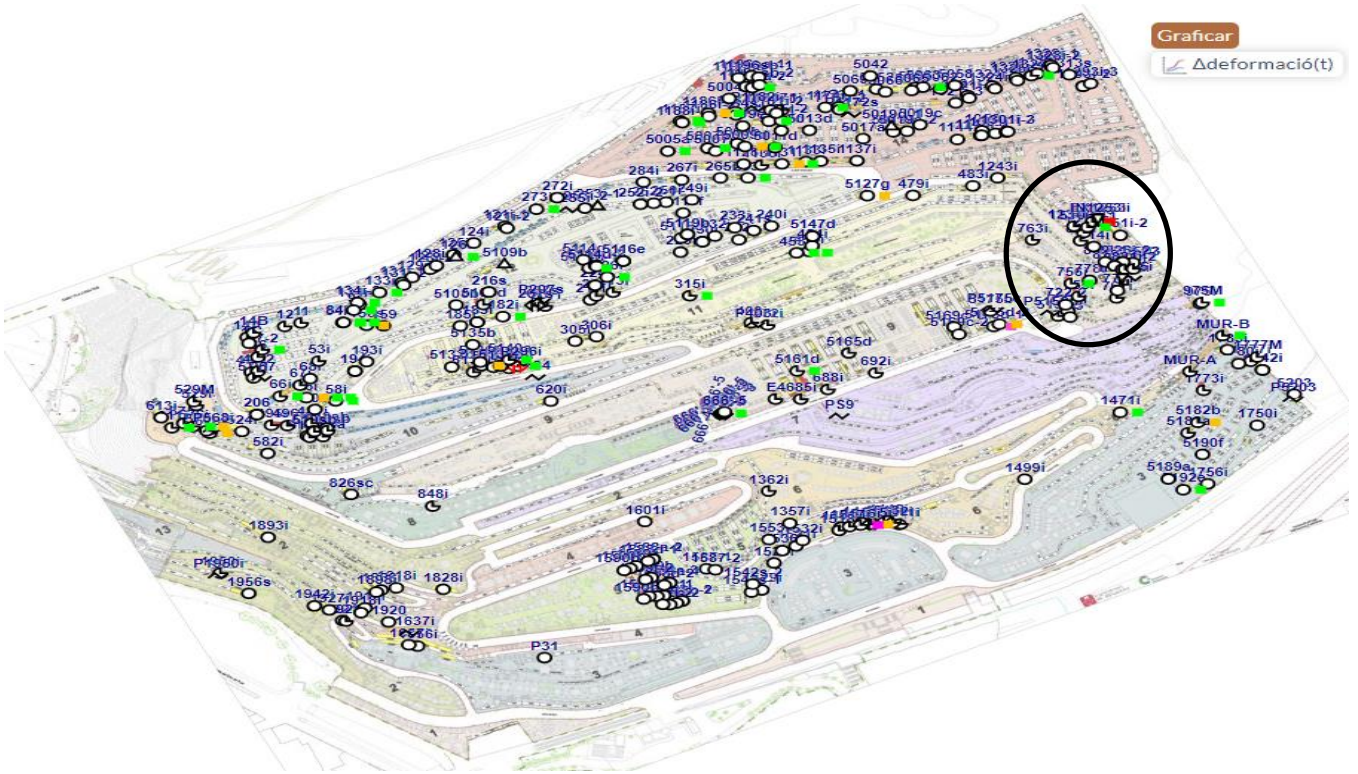
18/06/2020
31/10/2021
15/03/2023

Zone 2. Results



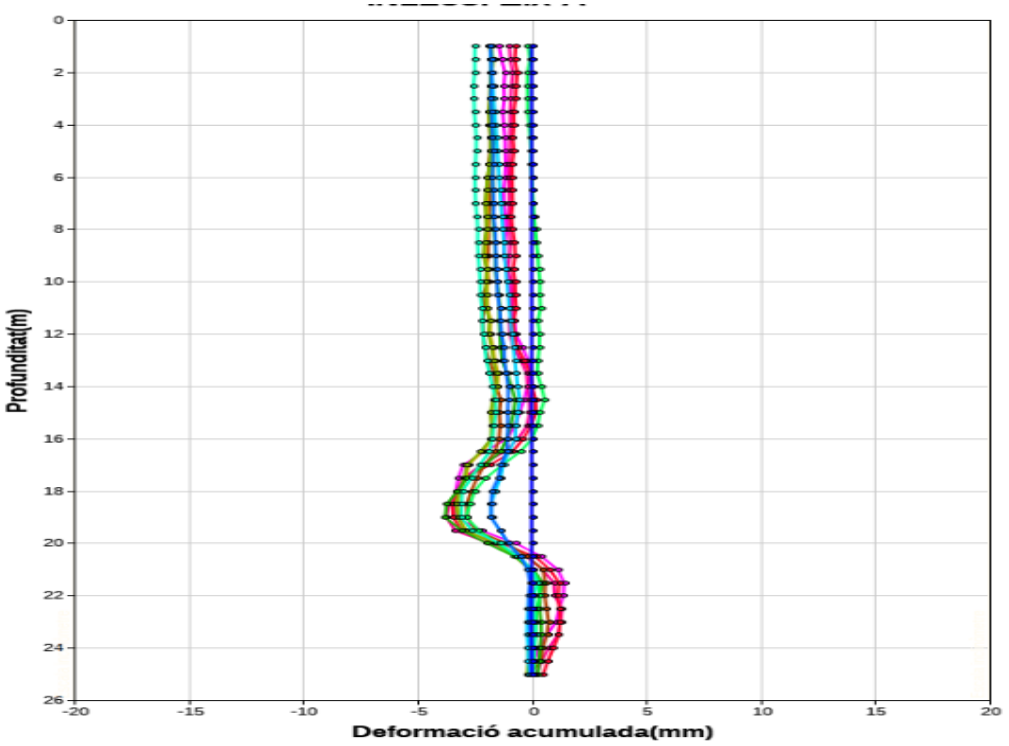


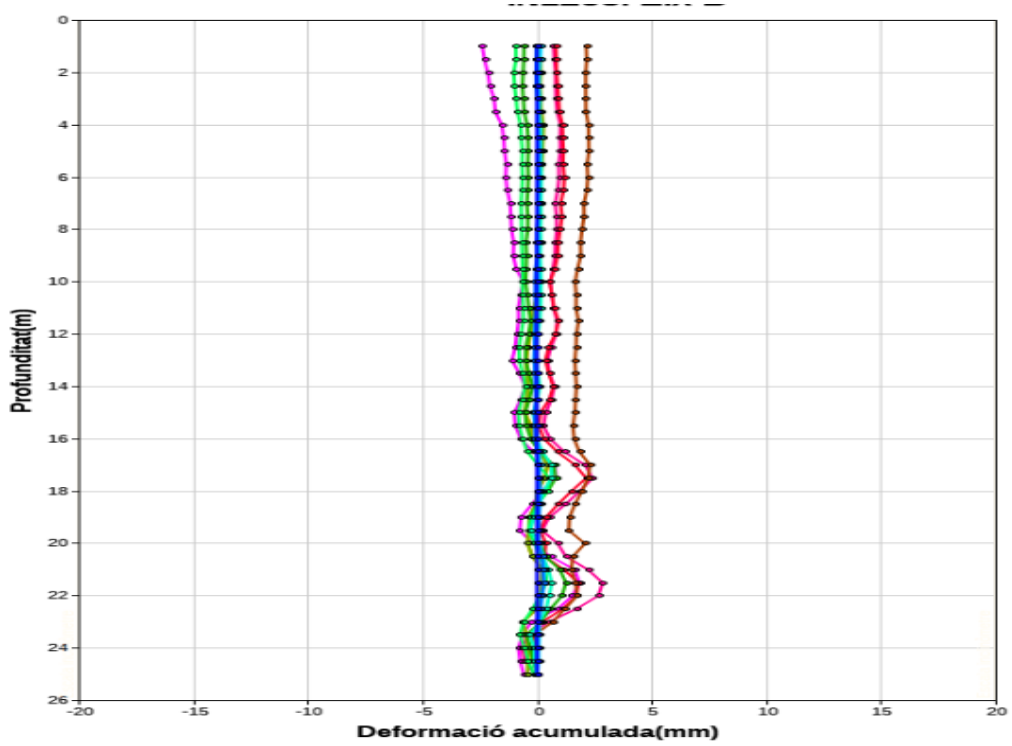
Geotechnical instrumentation



Instrumentation of
- Extensometers,
- Inclinometers
- Piezometers

Geotechnical Instrumentation



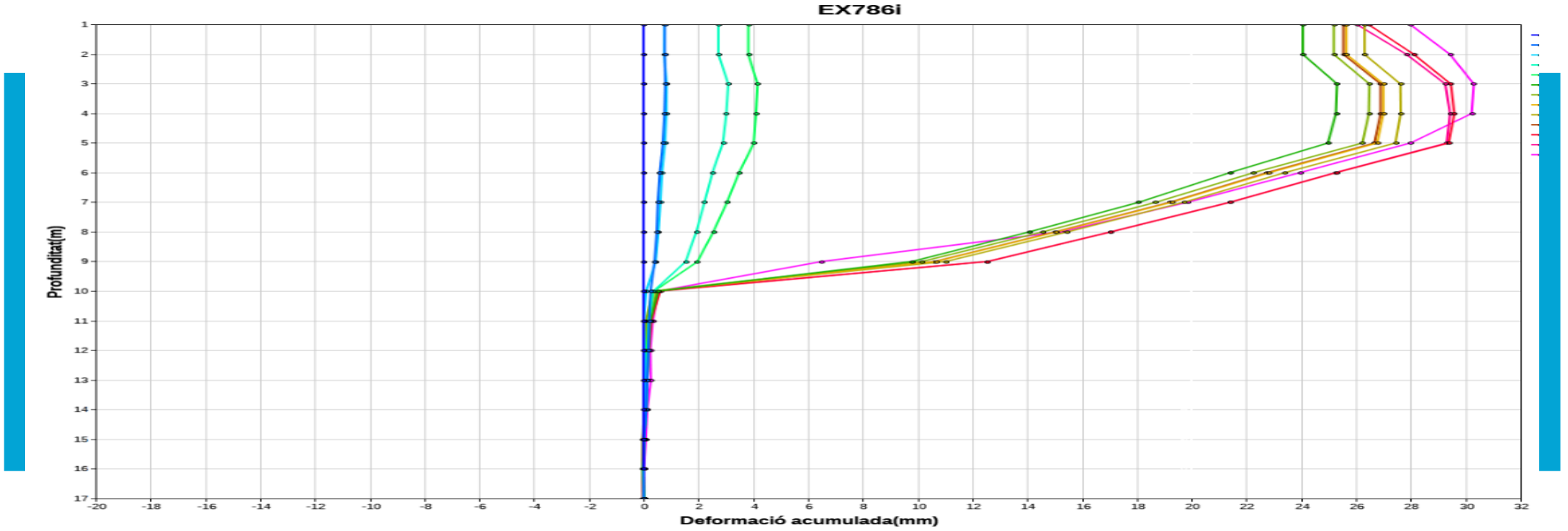


Inclinometers showed

Displacements in the contact between insitu ground and embankment

Significant displacements in the embankments

Geotechnical Instrumentation

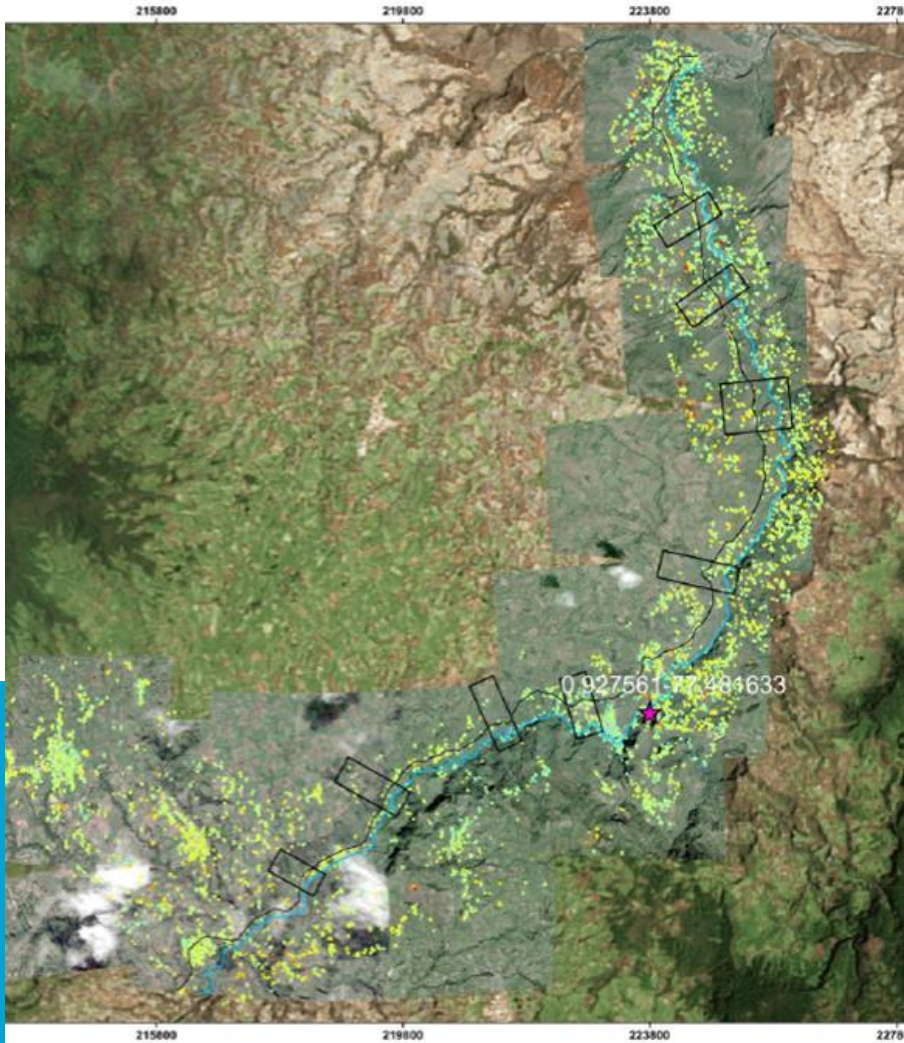


Extensometers showed

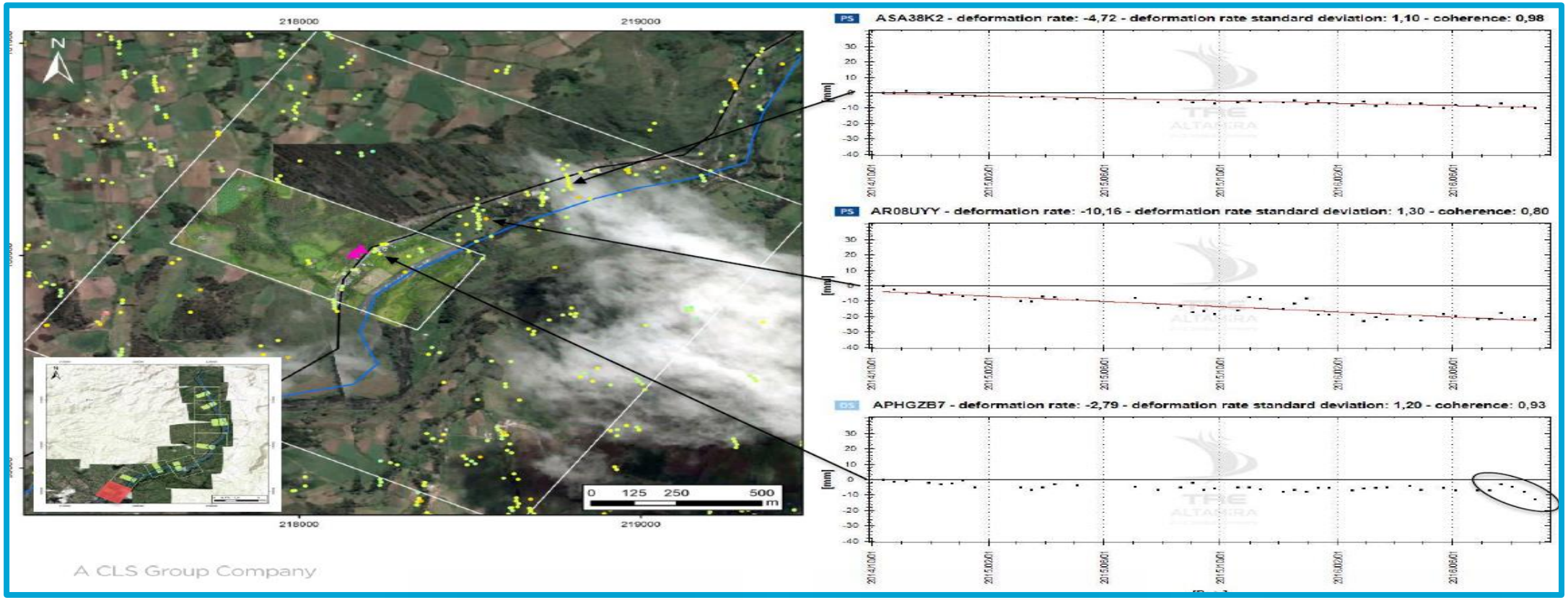
Displacements within the embankments

Clear acceleration of displacement due to remediation works (micropile construction)

Rumichaca-Pasto 4G Project



RUMICHACA- PASTO



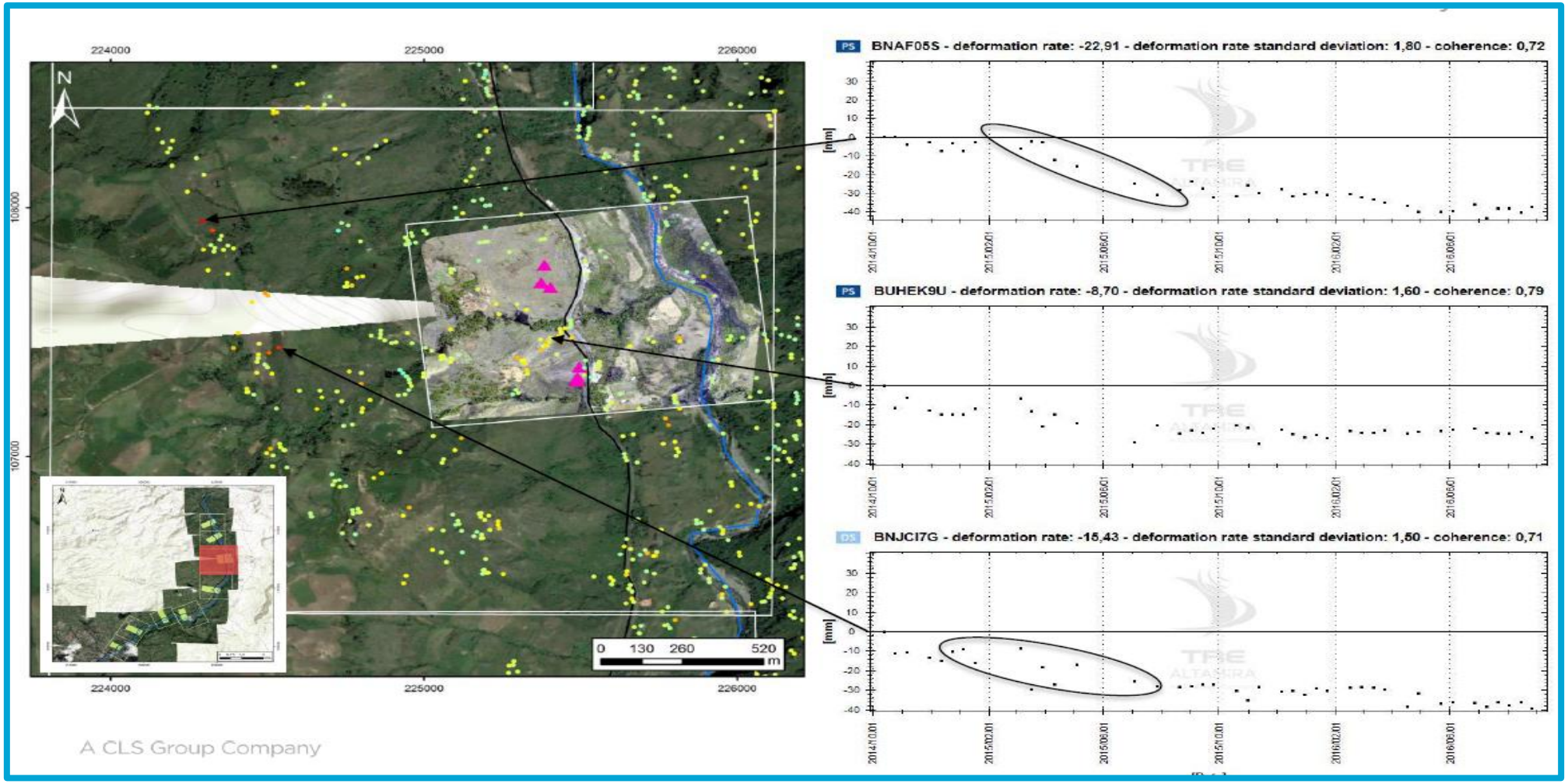
Existing road that will be improved and upgraded

Several areas of instabilities detected

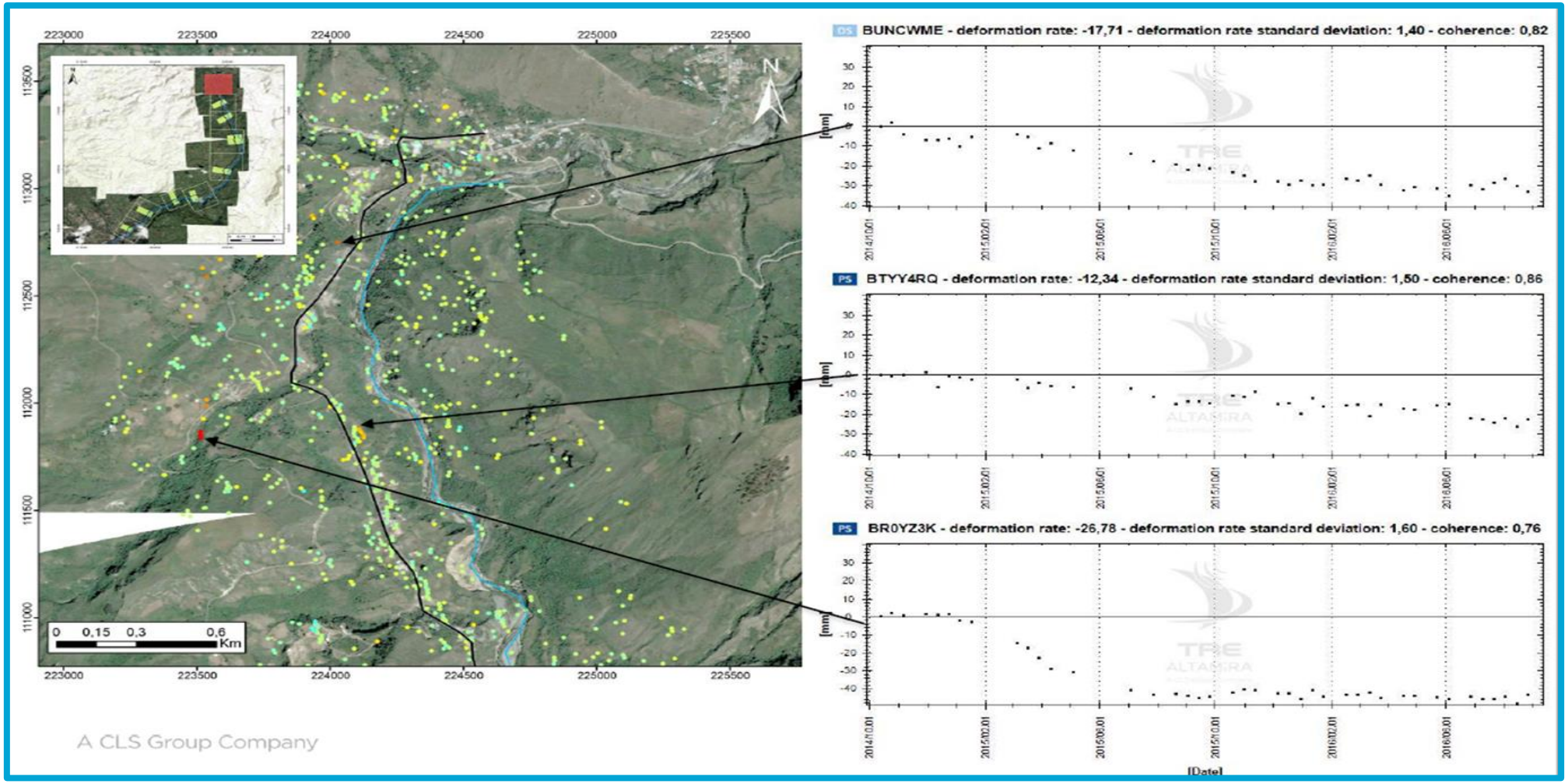
Geotechnical instrumentation was used to monitor this ares

Historical analysis was performed to assess:
1. detected areas
2. potential new areas

RUMICHACA- PASTO



RUMICHACA- PASTO



Brumadinho Dam

All that glitter is not gold

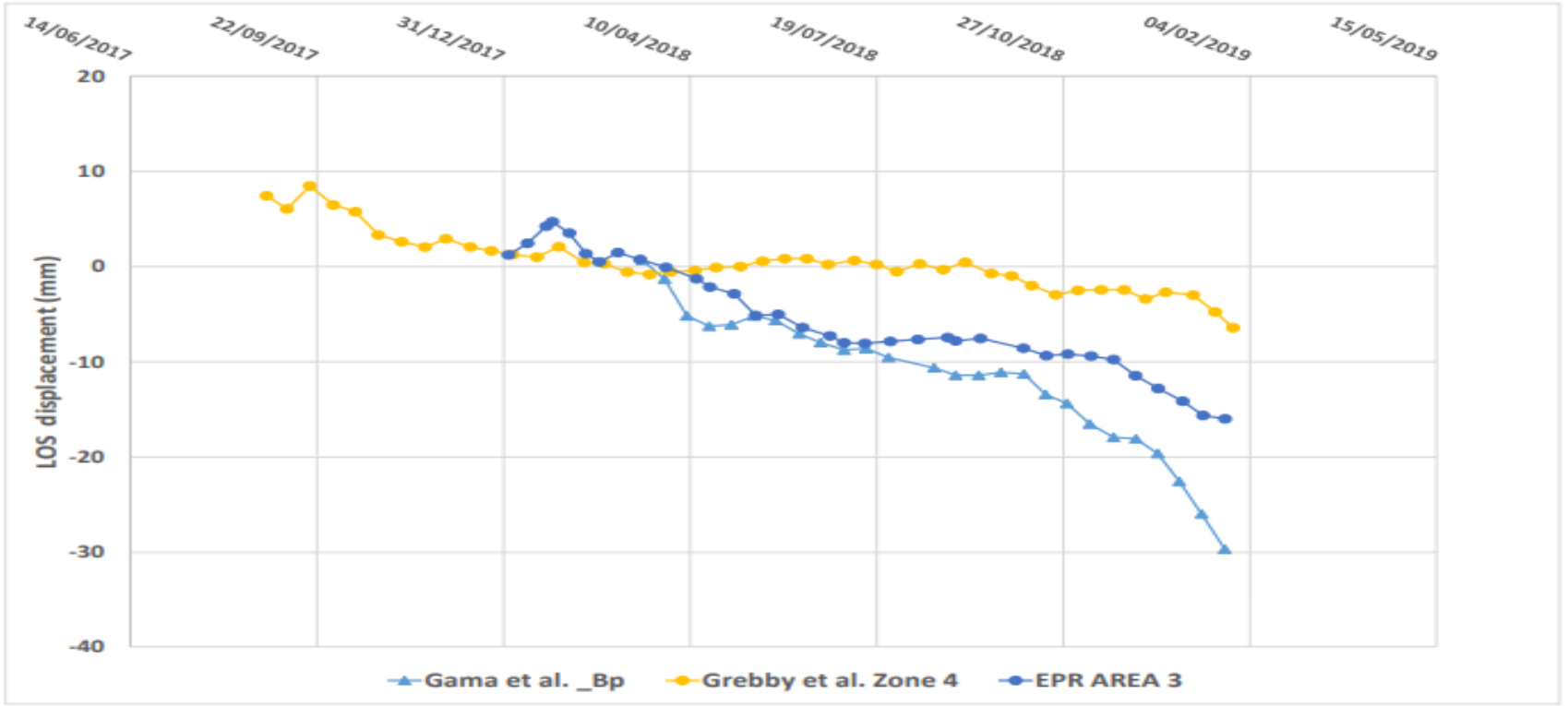
AFTER THE FAILURE, SEVERAL INSAR STUDIES APPEAR

SOURCE	SATELLITE	STARTS	ENDS
EPR	SENTINEL 1 T53	ene-18	ene-19
EPR	TerraSAR-X	feb-18	ene-19
EPR	COSMO-SkyMed	sep-17	ene-19
Silva Rotta et al. 2019	SENTINEL 1 T53	ene-18	ene-19
Du et al. 2020	SENTINEL 1	mar-18	feb-19
Gama et al. 2020	SENTINEL 1 T53	mar-18	ene-19
Grebby et al 2021	SENTINEL 1 T53	ago-17	ene-19
Grebby et al 2021	SENTINEL 1 T155	ago-17	ene-19
Holden et al. 2020	SENTINEL 1 T53	ene-16	ene-19
Holden et al. 2020	SENTINEL 1 T155	jun-15	ene-19
Holden et al. 2020	TerraSAR-X	mar-17	ene-19
Holden et al. 2020	COSMO-SkyMed	jun-17	ene-19

Satellite	Radar wavelength (cm)	Ground resolution (m)	Revisit period (days)	Look direction
TerraSAR-X	3	4	11	Asc
COSMO-SkyMed	3	4	1–8*	Dsc
Sentinel-1 (track 53)	5.6	20	12	Dsc
Sentinel-1 (track 155)	5.6	20	12	Dsc

*COSMO-SkyMed is a constellation of four unevenly spaced satellites, such that the revisit period between successive satellites varies between 1 and 8 days. For Dam I, no images were available with repeat intervals less than 4 days.

Average Velocity, Last Year Before Failure



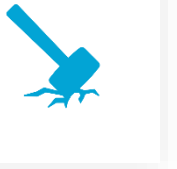
Consolidation on the dam rear, due to the tailing disposal

Discrepances on the behaviour of the dam, even with the same raw data (Sentinel Track 53).

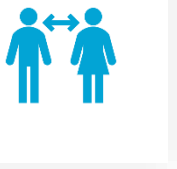
Case Studies: Summary

01 Instrumentation

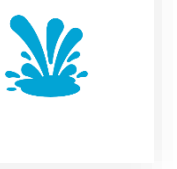
- Geotechnical Instrumentation Provides Real Time-low Scale Information On Parameters Related To:



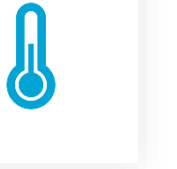
stress/strain



Displacement



Water pressure



Environmental parameters (temperature, humidity, etc)

02 InSAR

- Insar Provides Large Scale Displacement Information To Understand:

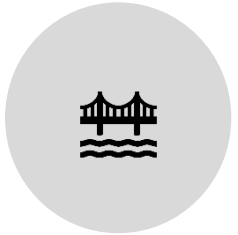
nonlinear trends of displacement

historical displacement data

Global view of the displacement, including areas where no instrumentation has been installed

The M.P Paradigm

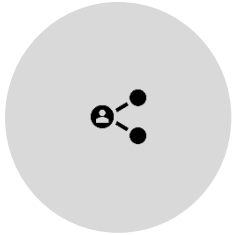
Calls To Action



Bridge The Gap

InSAR should include a geotechnical perspective in the processing and post processing stages

Taskforce ISO TC182/WG2 has initiated the inclusion of InSAR as a valuable technique in its documentation.



Focus on Benefits

InSAR needs to start speaking a language that resonates with the users.

That is to say, the value of the results in terms of ground behavior.

Actively Promote

Promote the combined use of InSAR and geotechnical instrumentation and encourage both communities to work together

TRE ALTAMIRA
A CLS Group Company

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cementiri és ciutat

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Further discussions

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THANK YOU