Earth Observation and geospatial services in the Artificial Intelligence time

Solutions for Smart and Resilient Cities

Massimo C Comparini

Director Line of Business Geo Information Telespazio/Leonardo
Chief Executive Officer e-GEOS

e-geos

e-geos

e-geos
AN ASI / TELESPAZIO COMPANY

Geoinformation
Digital Services & AI
EO solutions based
on multi sensors &
Big Data

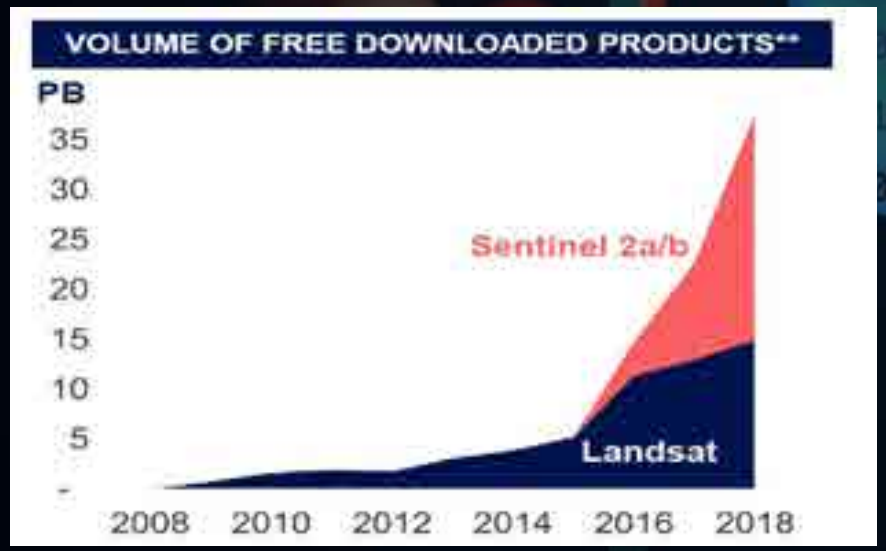
WE SCAN THE EARTH

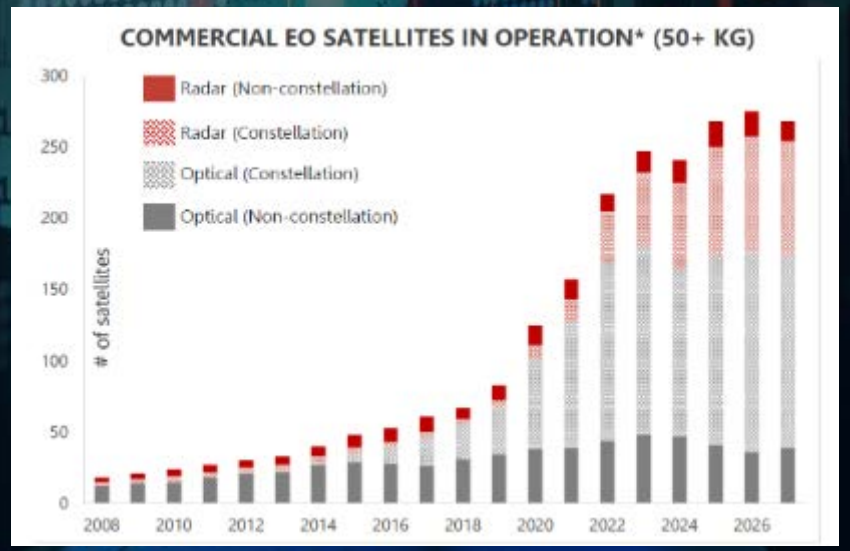
WE MONITOR THE CHANGES

WE GIVE MAPS & REPORTS

Geo Spatial paradigms and Business Models are fast changing

- Data, more and more, are just a part of the game
  - High temporal resolution to complement high and very high spatial resolution sensors
  - Federation of space assets through smart multi missions tasking platforms
- EO data definitive entered in the wider Big Data Analytics & IoT game
- Convergence in the data analytics and AI business for the EO
- Advanced algorithms, ML/DL/AI techniques are essential to address the Information driven market and pushing for timely delivery of reports/insights





Geo Spatial paradigms and Business Models are fast changing

- Data, more and more, are just a part of the game
  - High temporal resolution to complement high and very high spatial resolution sensors
  - Federation of space assets through smart multi missions tasking platforms
- EO data definitive entered in the wider Big Data Analytics & IoT game
- Convergence in the data analytics and AI business for the EO
- Advanced algorithms, ML/DL/AI techniques are essential to address the Information driven market and pushing for timely delivery of reports/insights

Digital Transformation

to

EO Digital Services

SPACE PROGRAMMES

COSMO-SkyMed

Th

Priviledge Access to COSMO-SkyMed Radar constellation

COSMO-SkyMed

Th

Priviledge Access to
COSMO-SkyMed Radar constellation

federation of assets is fundamental in the evolution
to timely information products & EO digital services

from Imagery to Information Reports

From data → Generating information → To customized platforms

The objective of our work is to extract information, reports, patterns through the use of analytics and artificial intelligence techniques from satellite data, in order to build innovative and automatic tools for managing macro vertical needs (before listed), the cities of the future, its territory, its resources and its citizens

from Imagery to Information Reports

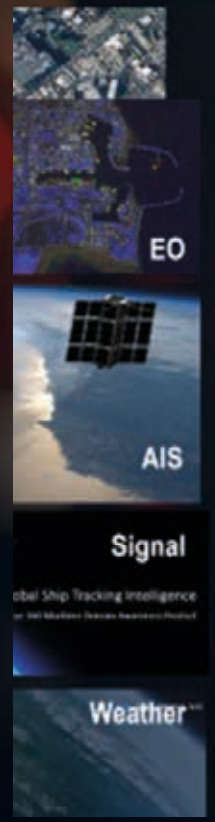
From data → Generating information → To customized platforms

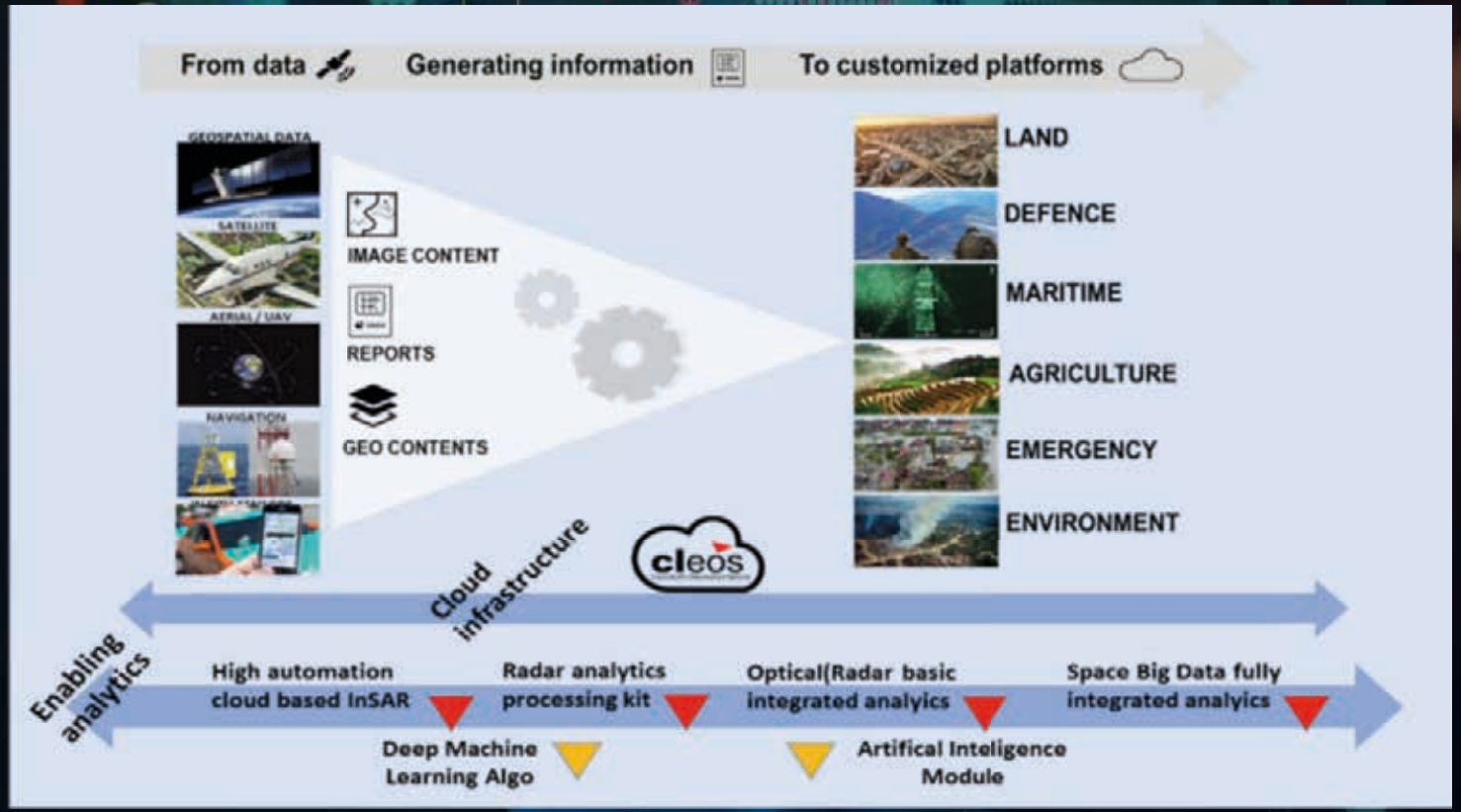
Big data analysis

Information Products

Value Added Services

Data





GEO-SPATIAL PLATFORM SERVICES

MARITIME

DEFENSE

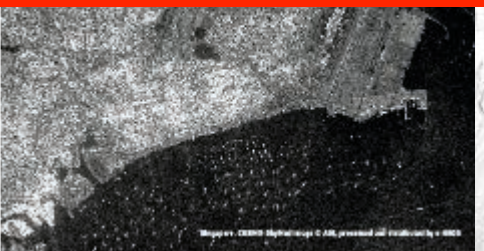
LAND & ASSETS

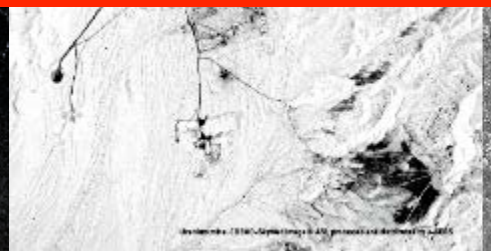
EMERGENCY

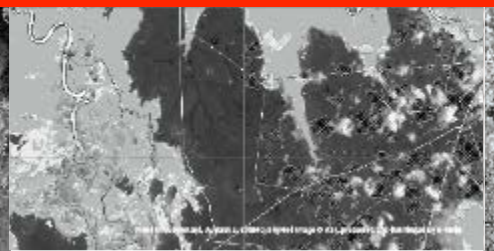
AGRICULTURE

GEO-INFORMATION CENTRE

CLEOS
Cloud Earth Observation Services







e-geos
AN ASI / TELESPAZIO COMPANY

AWARE

Agile Watching of Assets and Resources

LAND MANAGEMENT AND INFRATRUCTURES

CLOUD PROCESSING & SERVICES

MULTISENSOR SOURCES

HISTORICAL EVOLUTION & MONORITING

AI & BIG DATA ANALYSIS

HISTORICAL EVOLUTION & MONORITING

MILLIMETRE PRECISION

For supporting the **planning, management and maintenance of infrastructures and strategic assets**, **for Power Supply Utilities,** Asset Monitoring, Transportation and Infrastructures, Mining, Oil & Gas, Natural Resources Management.

A suite of solutions, based on:

- Ground Motion Analysis (DIFSAR and GPS)
- Change Detection Analysis
- RPAS Monitoring
- IoT Standard Sensors & MEMES
- 3D modeling, GIS Solutions

Services: Heath Control Operations

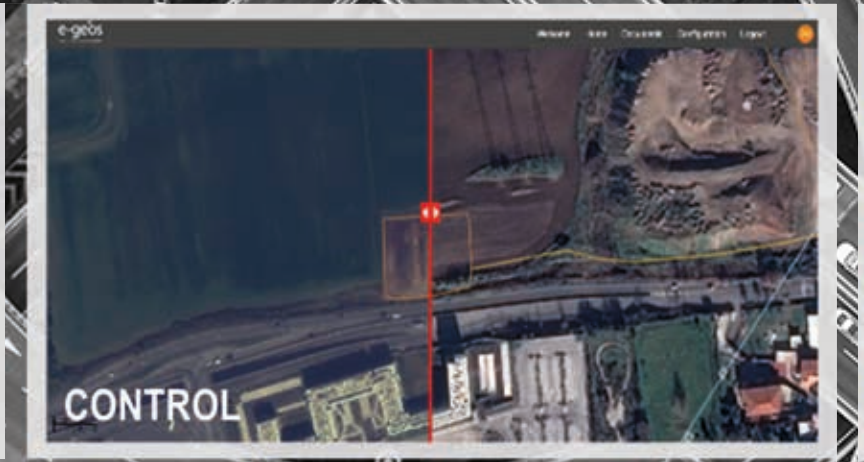
e-geos

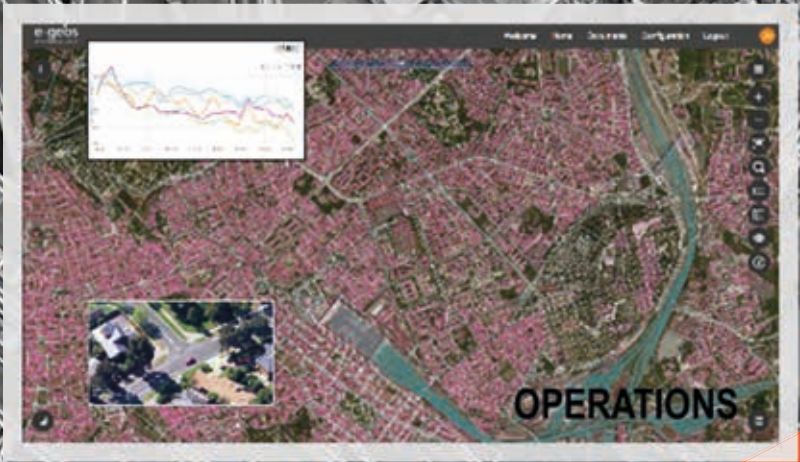
AN ASI / TELESPAZIO COMPANY

AWARE

Agile Watching of Assets and Resources

AWARE, a platform for monitoring assets and infrastructure, through the integration of Earth Observation and in situ data: moving from data to information



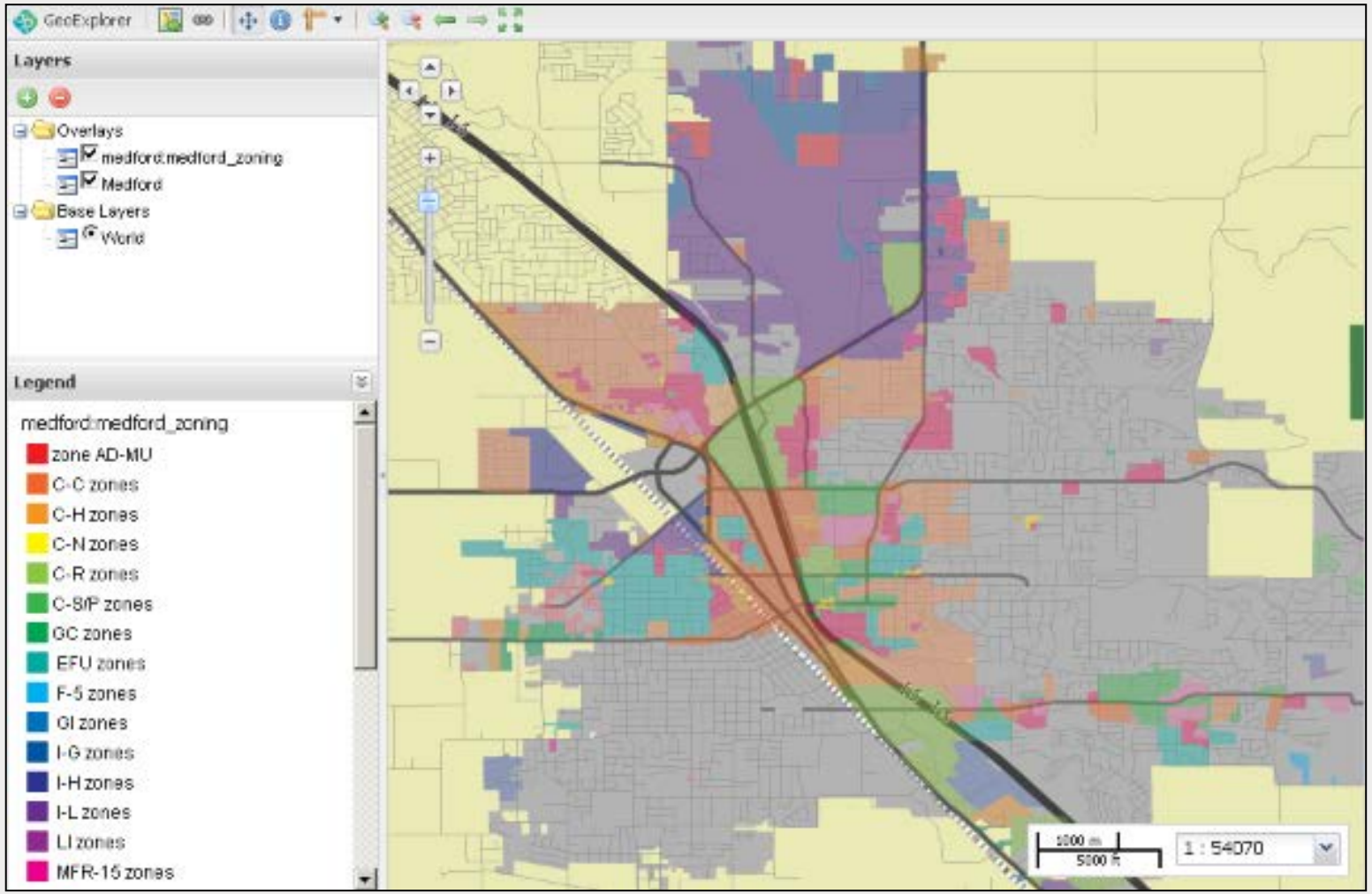


e-geos

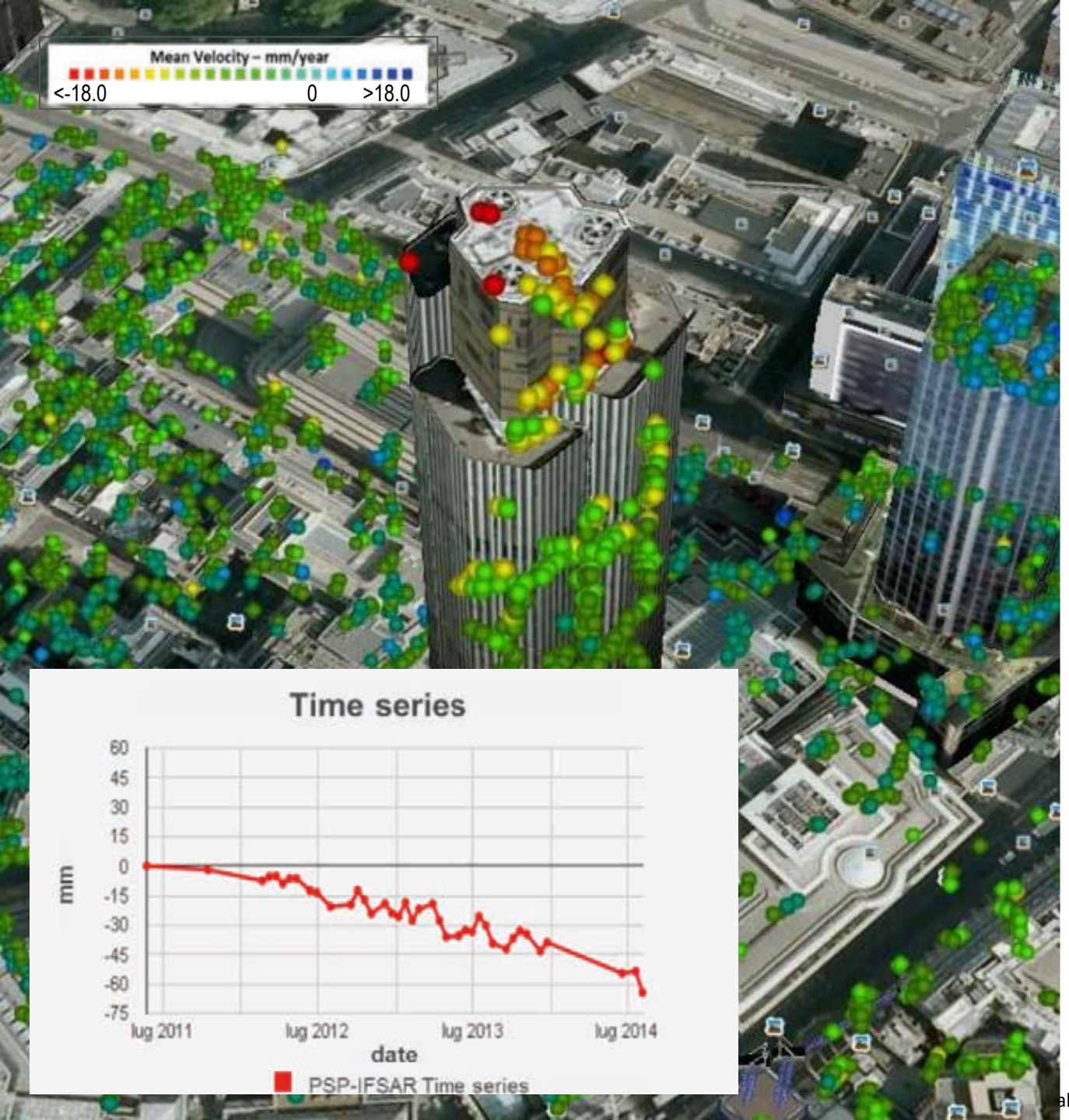
THE NEW PARADIGM OF DATA EXPLOITATION

AWARE
Agile Watching of Assets and Resources

FROM DATA



e-geos
AN ASI / TELESPAZIO COMPANY



SAR Satellite interferometry

Slow deformation monitoring with

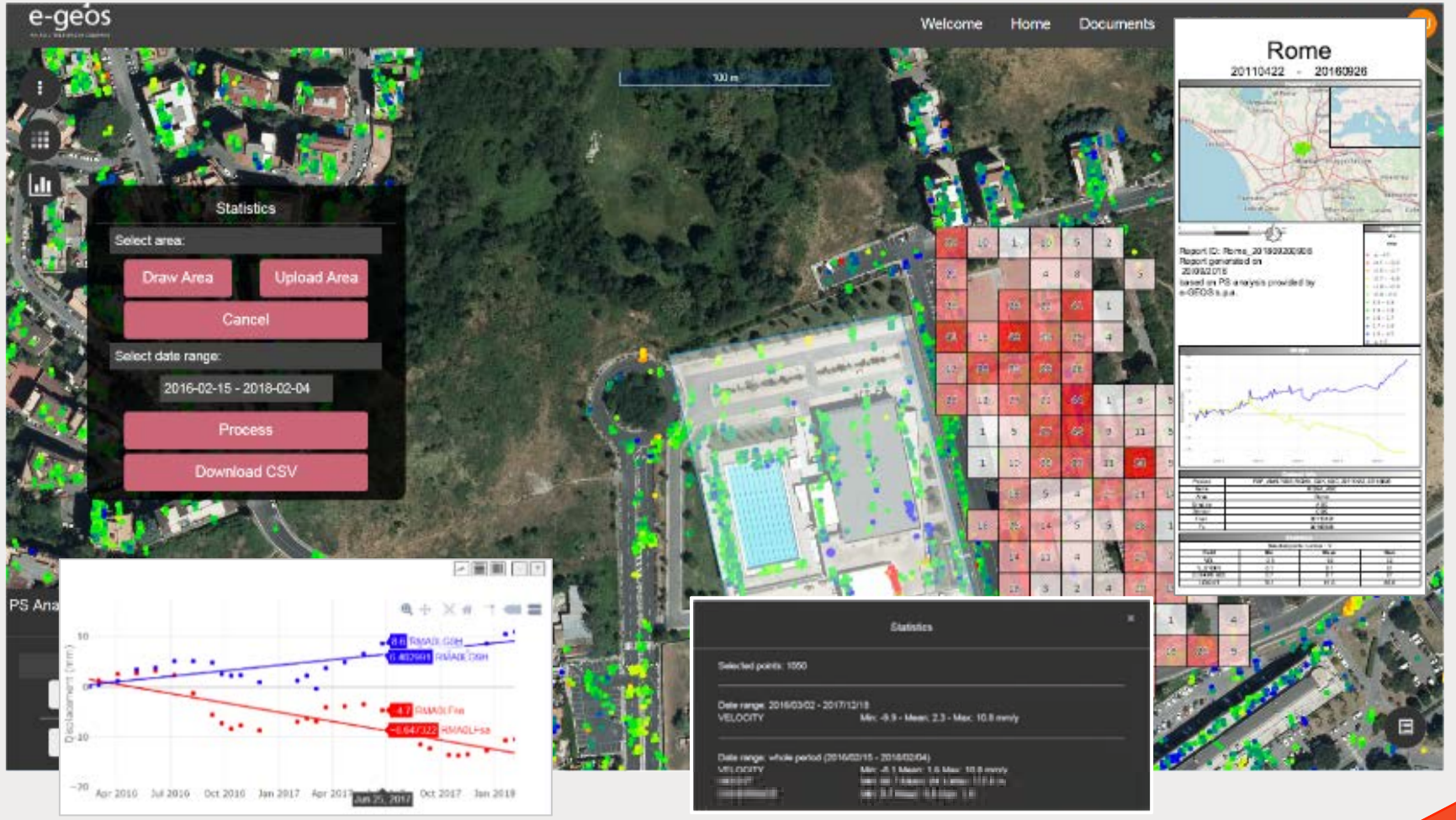
- Millimetre precision

  Displacement and mean velocity
- High measuring points density
- Historical evolution the of phenomena

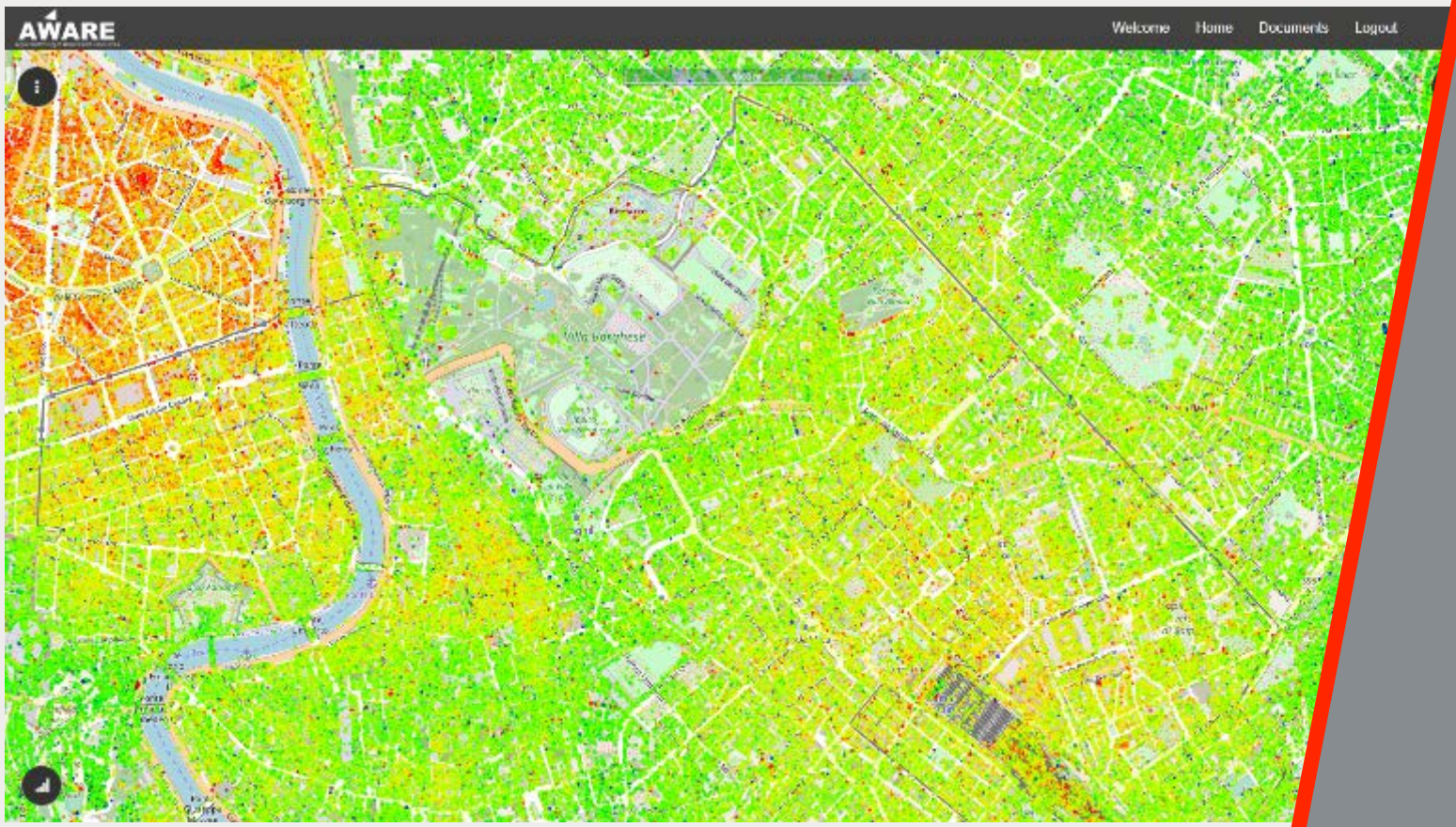
THE NEW PARADIGM OF DATA EXPLOITATION

AWARE
Agile Watching of Assets and Resources

TO INFORMATION



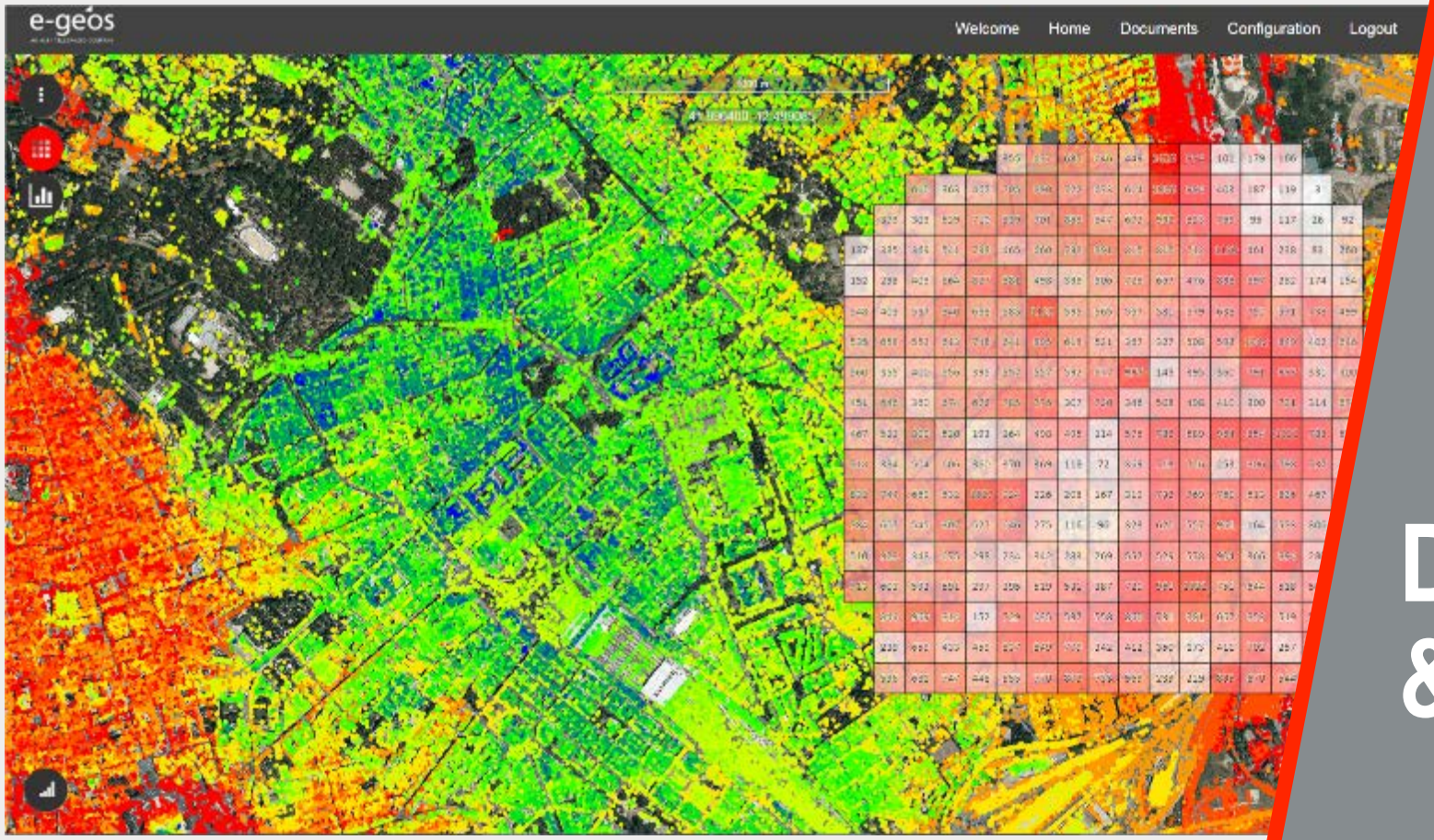
AWARE
Agile Watching of Assets and Resources



BIG DATA MANAGEMENT

e-geos
AN ASI / TELESPAZIO COMPANY

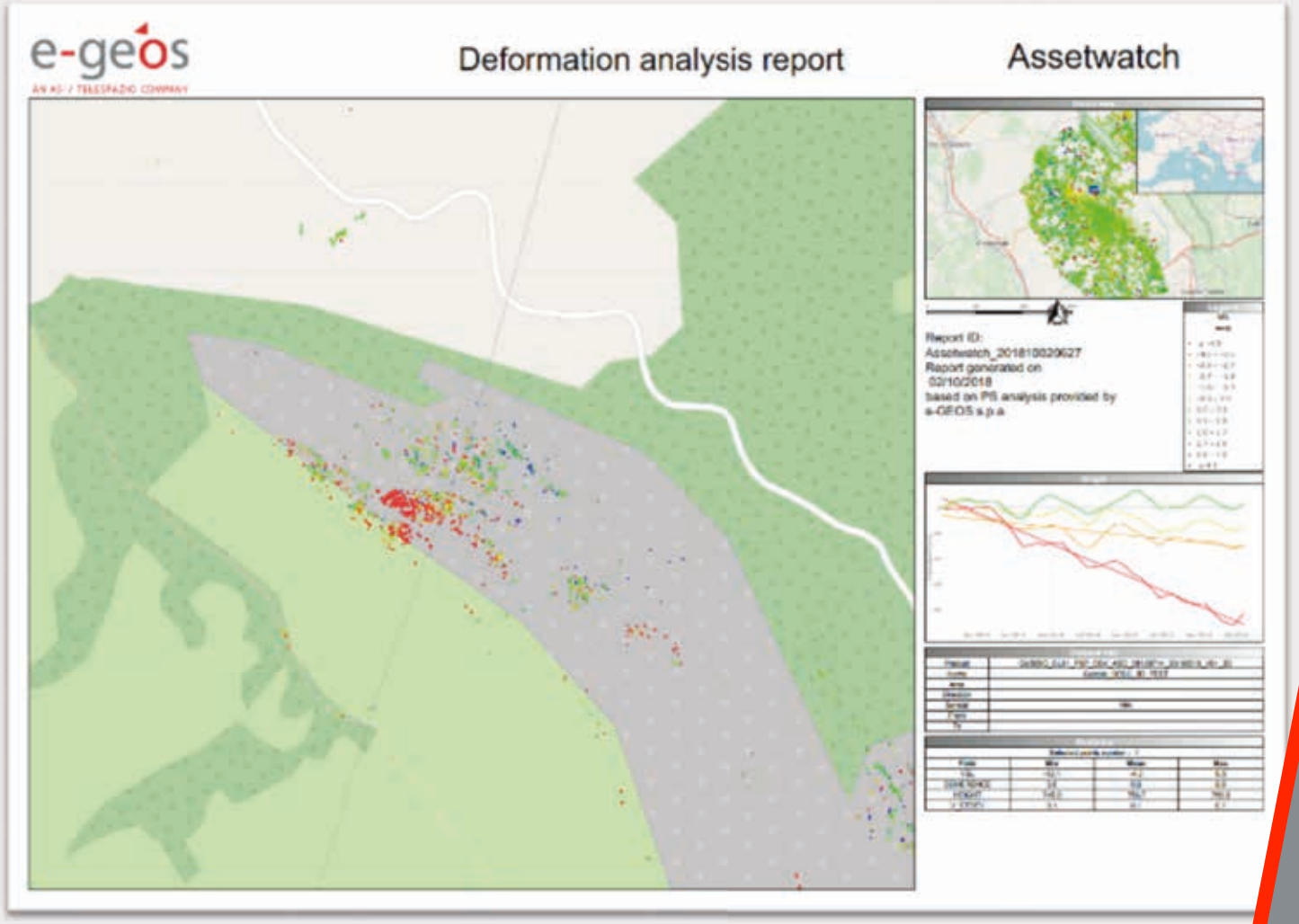
AWARE
Agile Watching of Assets and Resources



DATA ANALYTICS & TOOLS

e-geos
AN ASI / TELESPAZIO COMPANY

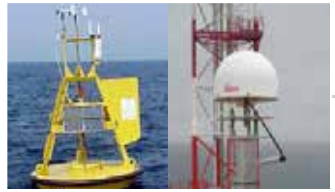
AWARE
Agile Watching of Assets and Resources



SYNTHETIC REPORTS

SATELLITE

AERIAL / UAV SURVEY



IN SITU SENSORS

DRONE

NAVIGATION

MULTIPLE SOURCES INTEGRATION


AWARE
Agile Watching of Assets and Resources
INDUSTRIAL BUILDING
DEFORMATION MONITORING
e-geos

?

Industrial Building

What's the best intervention strategy?

When has the deformation started?

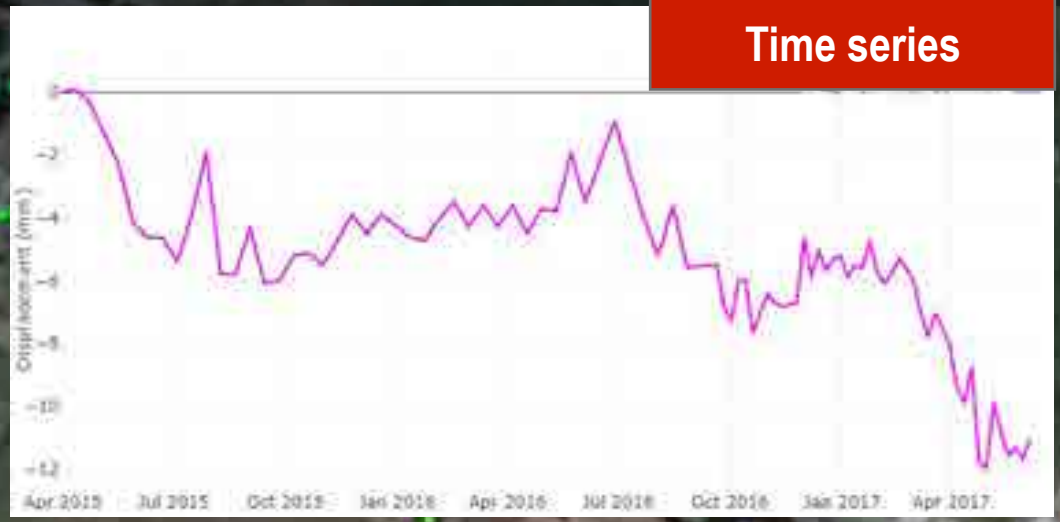
INDUSTRIAL BUILDING

≈10 points per building

≤ -4.5
-4.5 – -3.6
-3.6 – -2.7
-2.7 – -1.8
-1.8 – -0.9
-0.9 – 0.0
0.0 – 0.9
0.9 – 1.8
1.8 – 2.7
2.7 – 3.6
3.6 – 4.5
≥ 4.5

Understanding the phenomenon??
Is S1 density enough?

Time series



PSP analysis based on Sentinel 1 data

INDUSTRIAL BUILDING

100+ points per building

Understanding the phenomenon??
High density analysis

Time series

PSP analysis based on COSMO-SkyMed data

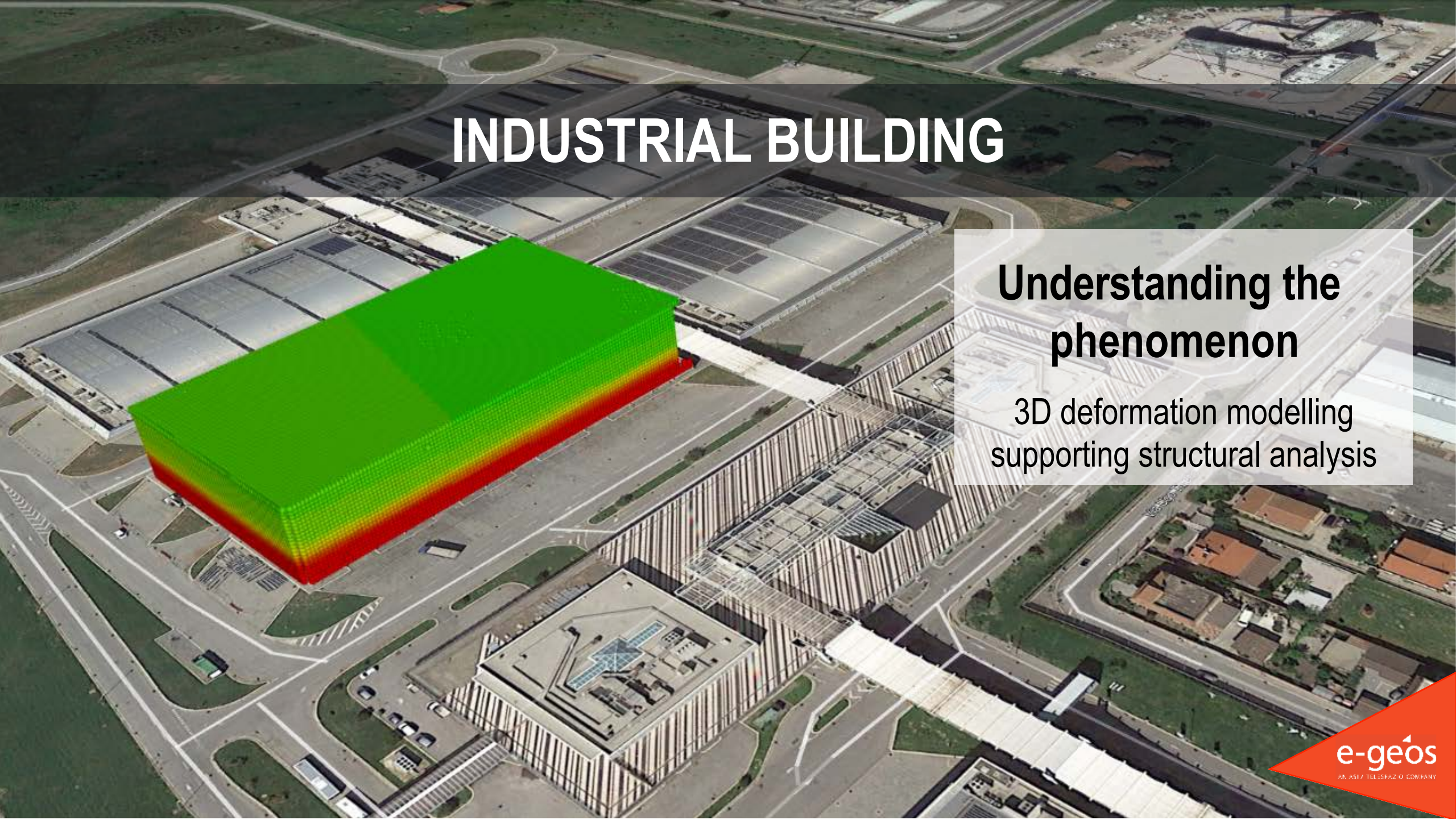
- ≤ -4.5
- -4.5 - -3.6
- -3.6 - -2.7
- -2.7 - -1.8
- -1.8 - -0.9
- -0.9 - 0.0
- 0.0 - 0.9
- 0.9 - 1.8
- 1.8 - 2.7
- 2.7 - 3.6
- 3.6 - 4.5
- ≥ 4.5

INDUSTRIAL BUILDING

Support to works planning

Identification of the best sites to install reference and in situ instrument for a continuous monitoring

INDUSTRIAL BUILDING



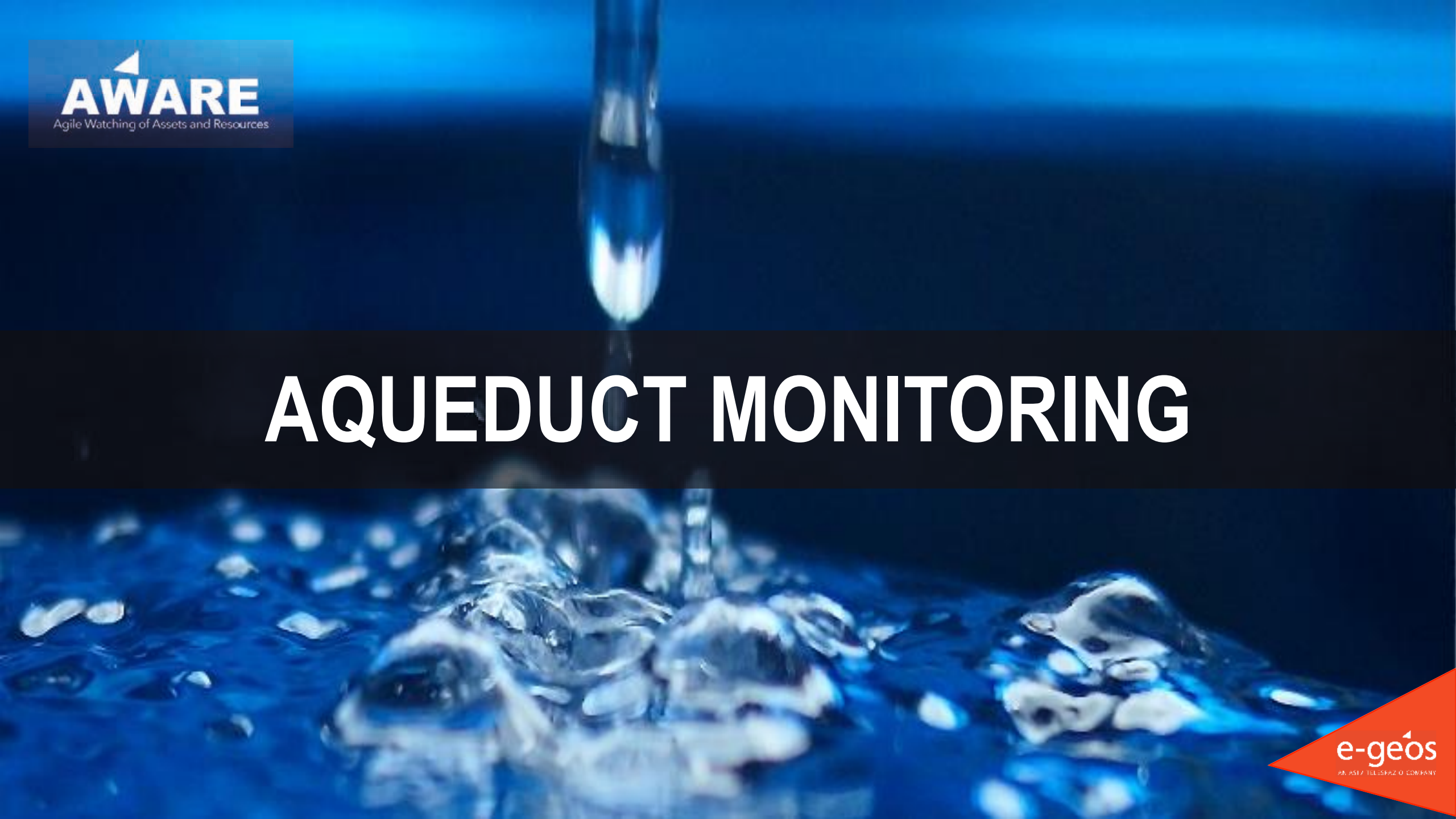
Understanding the phenomenon

3D deformation modelling supporting structural analysis

e-geos

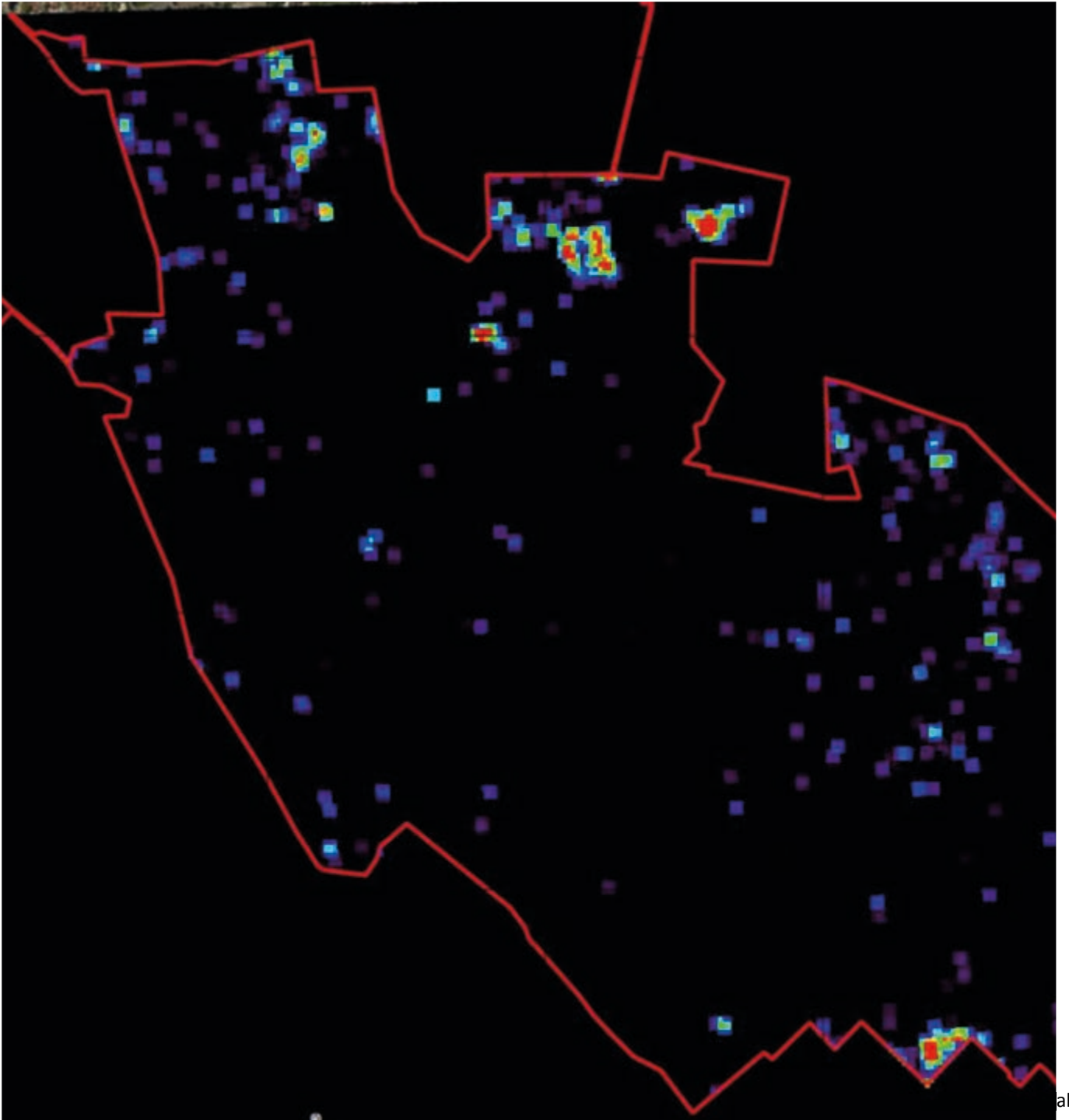
AWARE
Agile Watching of Assets and Resources

AQUEDUCT MONITORING



e-geos
AN ASI / TELESPAZIO COMPANY


AWARE
Agile Watching of Assets and Resources
WATER LAKES DETECTION
e-geos



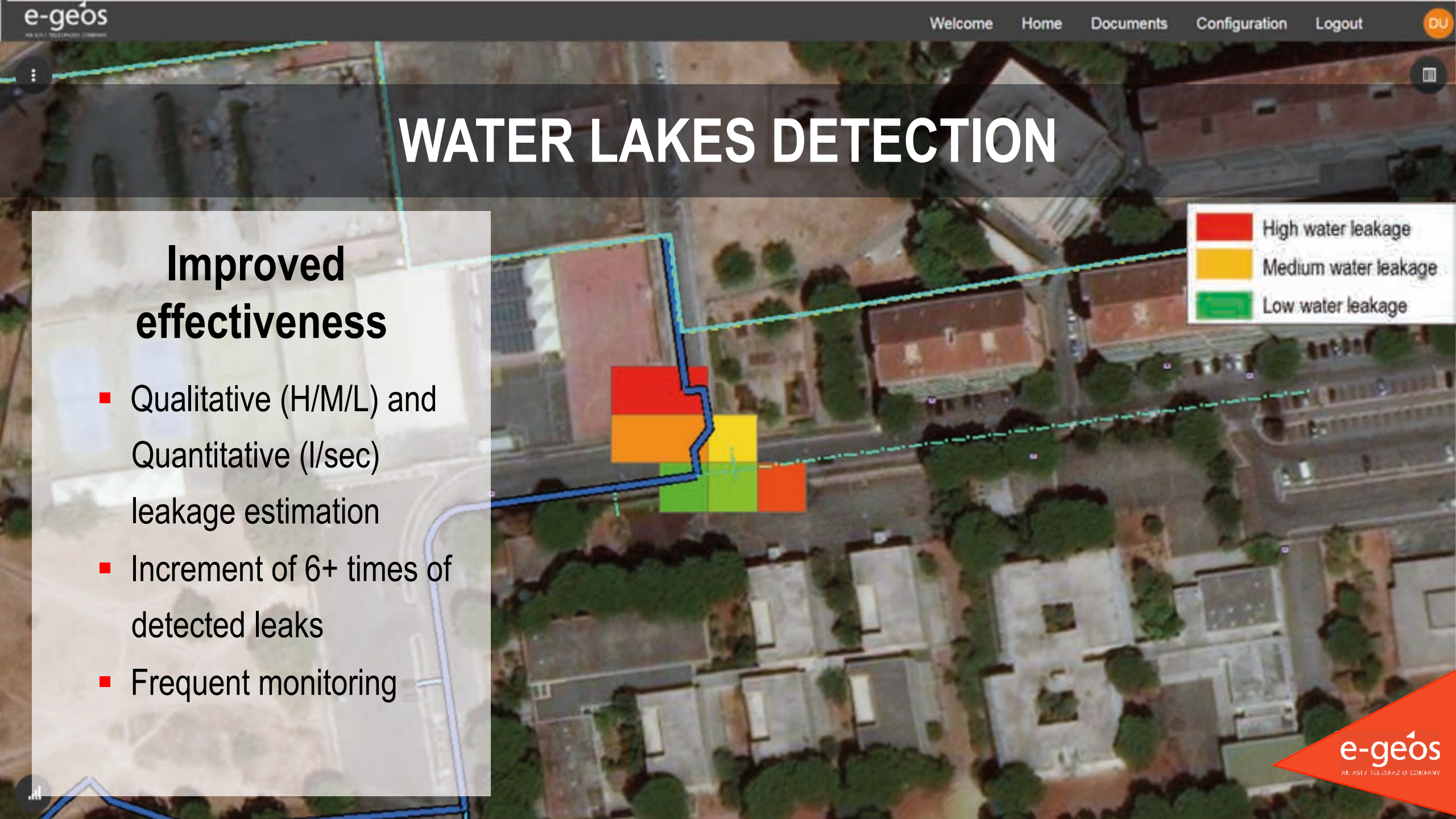
Satellite based techniques

- Based on the radar response to humidity and on capillarity of water
- Satellite analysis to guide the in situ acoustic campaign
- Costs and time reduction

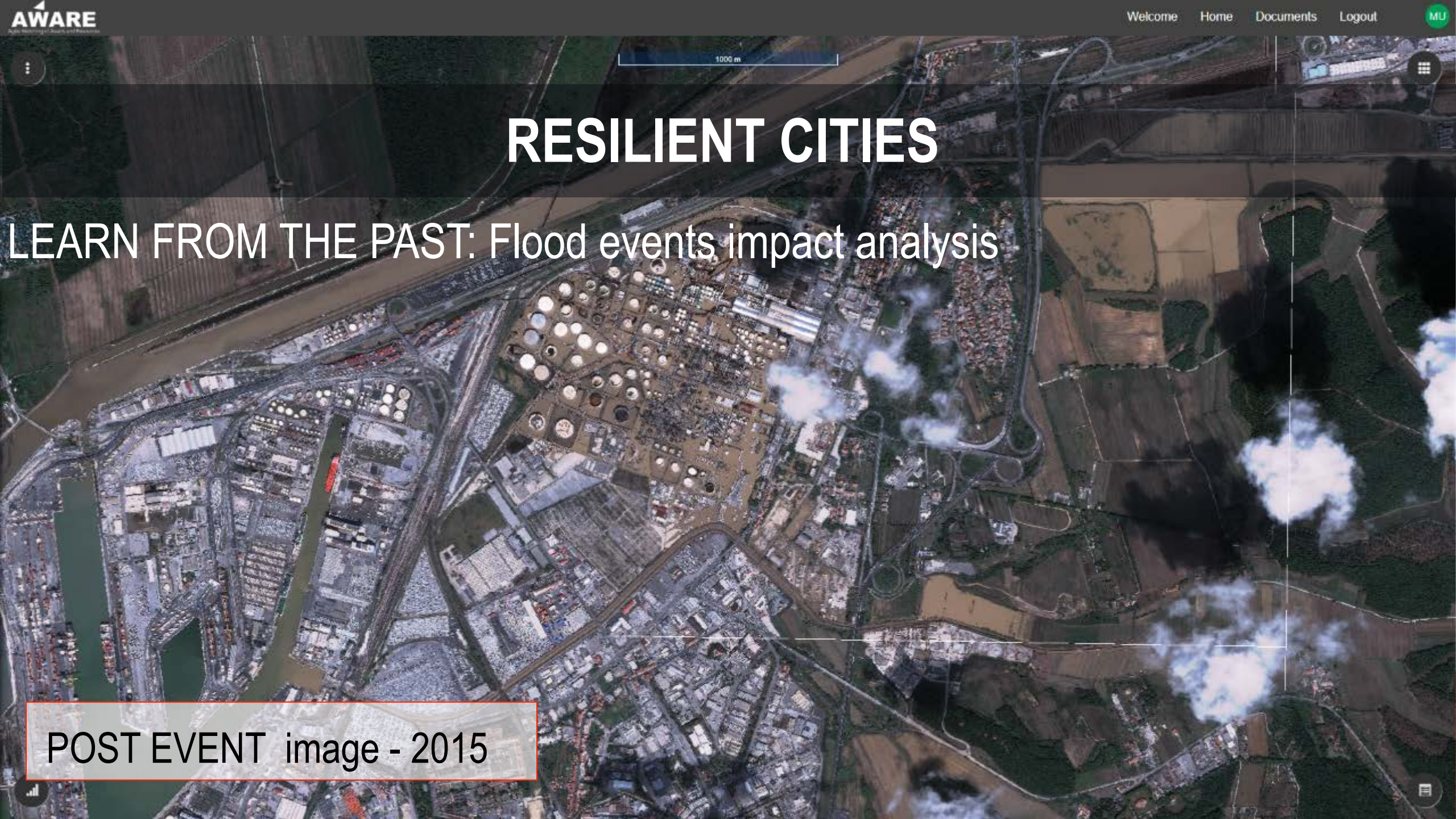
WATER LAKES DETECTION

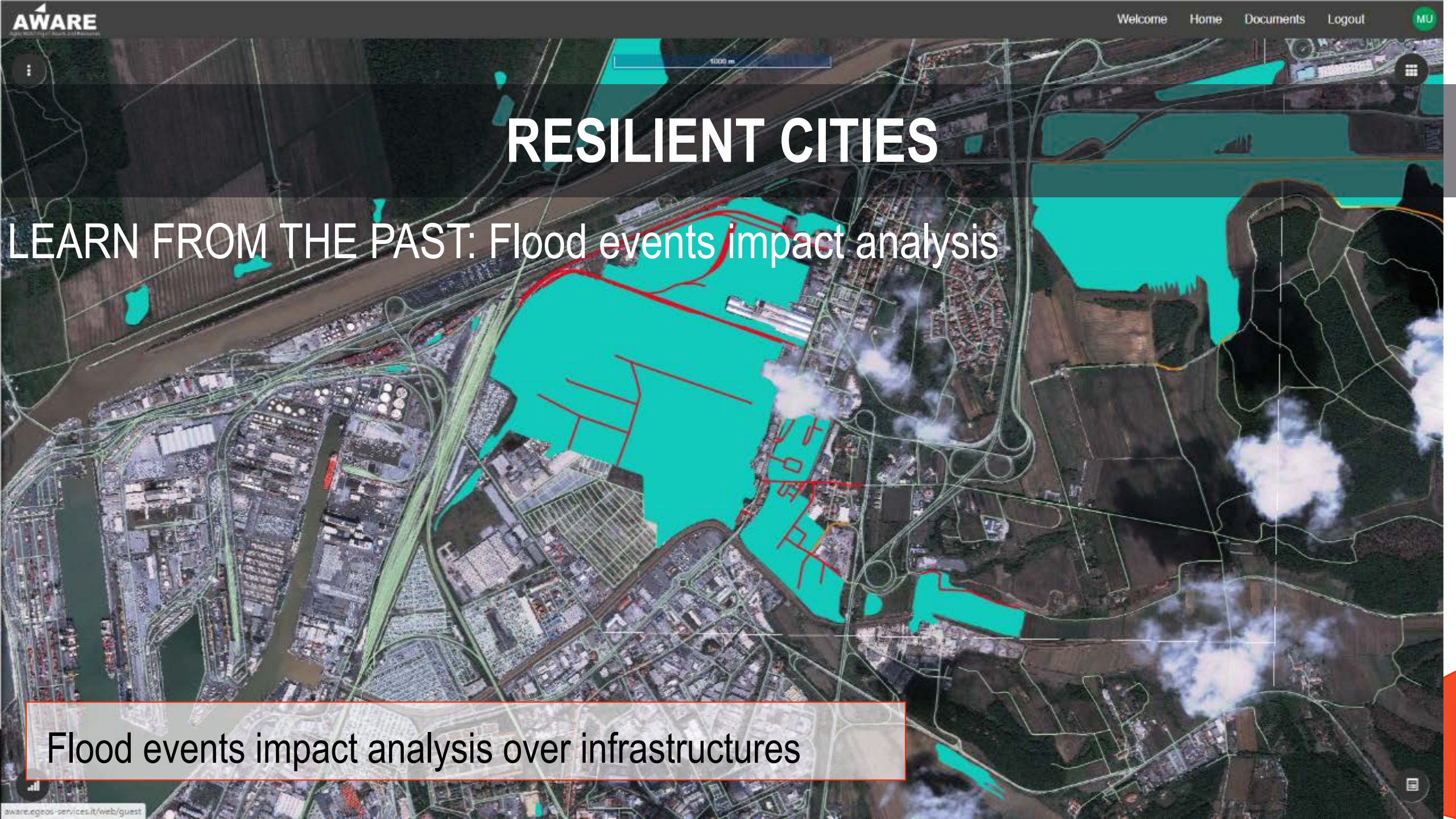
Improved effectiveness

- Qualitative (H/M/L) and Quantitative (l/sec) leakage estimation
- Increment of 6+ times of detected leaks
- Frequent monitoring




AWARE
Welcome
Home
Documents
Logout
MU
1000 m
RESILIENT CITIES
LEARN FROM THE PAST: Flood events impact analysis
REFERENCE image - 2015


AWARE
Welcome
Home
Documents
Logout
MU
1000 m
RESILIENT CITIES
LEARN FROM THE PAST: Flood events impact analysis
POST EVENT image - 2015



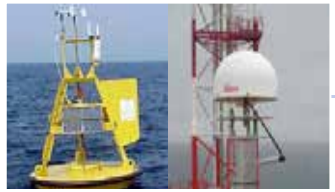
RESILIENT CITIES

LEARN FROM THE PAST: Flood events impact analysis

Flood events impact analysis over infrastructures

SATELLITE VALUE ADDED DATA

RPAS



IN SITU SENSORS

LINEAR INFRASTRUCTURE MONITORING

AWARE

Agile Watching of Assets and Resources

CLOUD PROCESSING & SERVICES

MULTISENSOR SOURCES

HISTORICAL EVOLUTION & MONORITING

AI & BIG DATA ANALYSIS

HISTORICAL EVOLUTION & MONORITING

MILLIMETRE PRECISION

LAND AND INFRASTRUCTURES MANAGEMENT

For supporting the **planning, management and maintenance of infrastructures and strategic assets**, for Power Supply Utilities, Asset Monitoring, Transportation and Infrastructures, Mining, Oil & Gas, Natural Resources, Cultural Heritage, Urban areas Management.

A suite of solutions, based on:

- Ground Motion Analysis
- Change Detection Analysis
- 3D modeling
- GIS Solutions

Services:

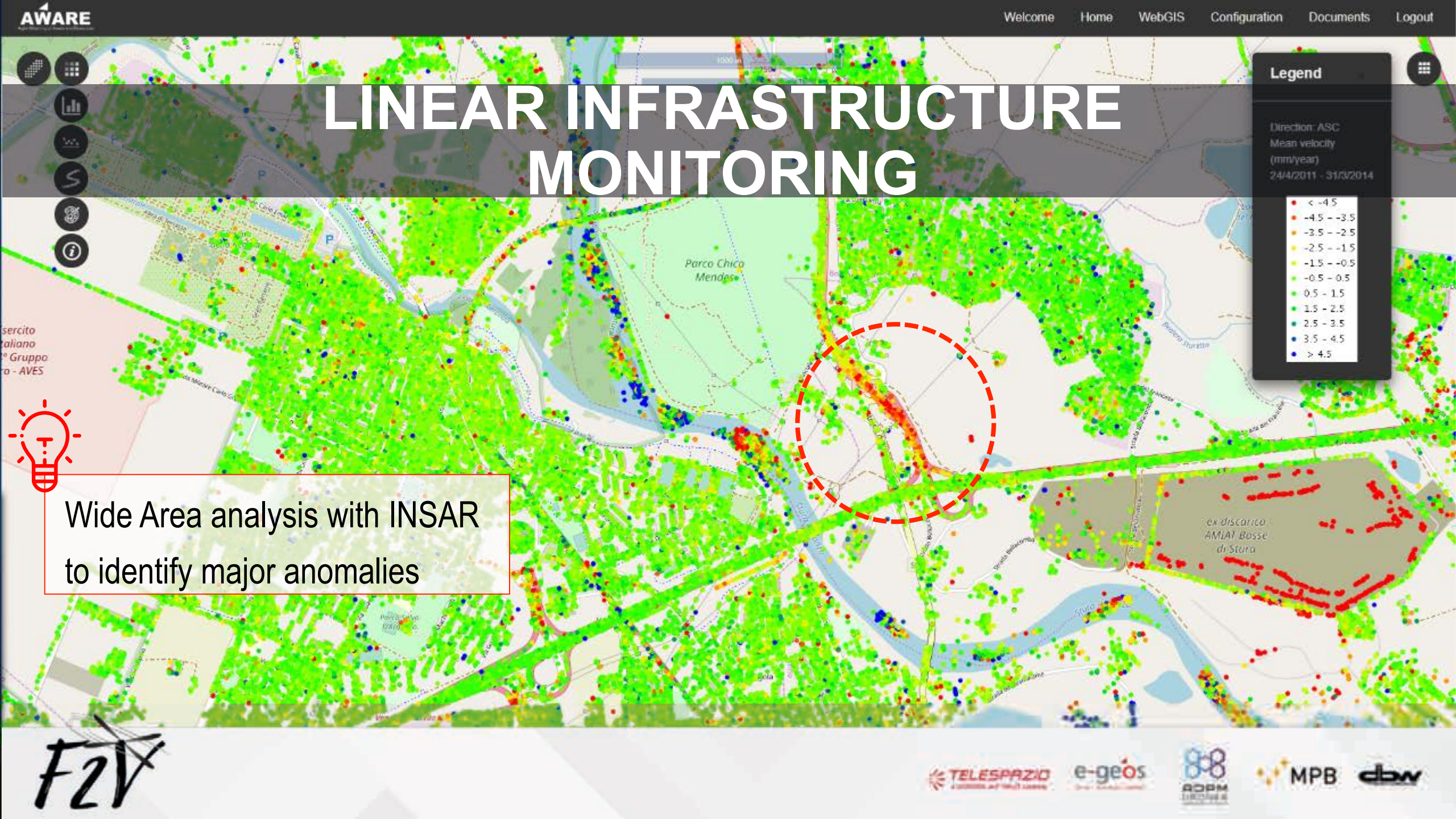
HEALTH – CONTROL - OPERATIONS

e-geos

AN ASI / TELESPAZIO COMPANY

F2V

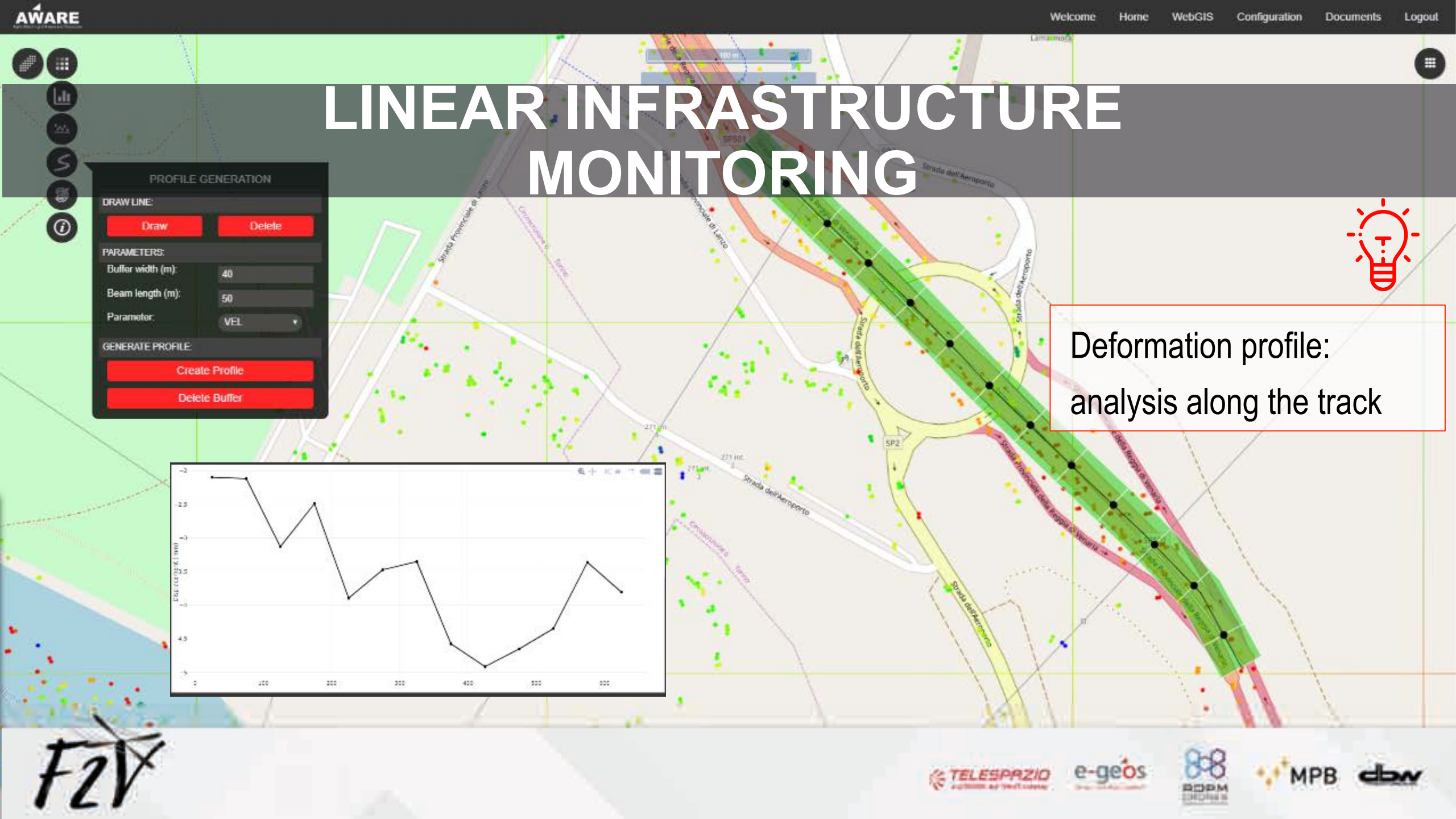
TELESPAZIO e-geos RDPM MPB dbw


AWARE
Welcome
Home
WebGIS
Configuration
Documents
Logout
LINEAR INFRASTRUCTURE MONITORING
Legend
Direction: ASC
Mean velocity (mm/year)
24/4/2011 - 31/3/2014
< -4.5
-4.5 - -3.5
-3.5 - -2.5
-2.5 - -1.5
-1.5 - -0.5
-0.5 - 0.5
0.5 - 1.5
1.5 - 2.5
2.5 - 3.5
3.5 - 4.5
> 4.5
Parco Chico Mendes
ex discarica AMIAT Basse di Stura
Wide Area analysis with INSAR
to identify major anomalies
F2V
TELESPAZIO
e-geos
ADPM
MPB
dbw

LINEAR INFRASTRUCTURE MONITORING

Detailed INSAR analysis to reconstruct the phenomena evolution

LINEAR INFRASTRUCTURE MONITORING



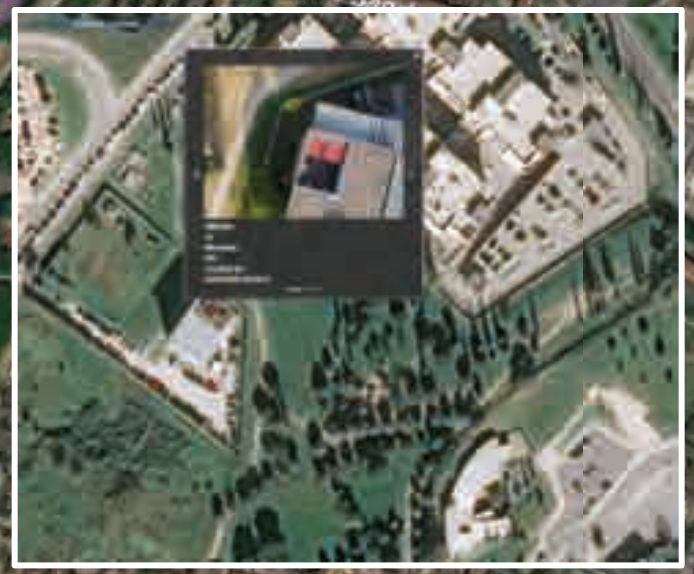
Deformation profile:
analysis along the track

F2V

TELESPAZIO
e-geos
MPB
dbw

RPAS INTEGRATION

- Standard Video
- 360° Video
- Along the track visualization
- Geotagged images



LINEAR INFRASTRUCTURE MONITORING

On site inspection with RPAS

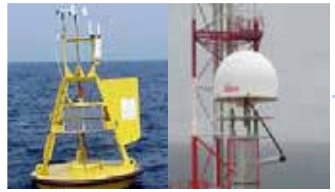
Geotagged photos

Video

On site intervention with in situ sensors

SATELLITE VALUE ADDED DATA

AERIAL / UAV SURVEY



IN SITU SENSORS

RPAS

NAVIGATION

INTEGRATED MONITORING PLATFORM SUPPORTING URBAN PLANNING

URBAN PLANNING

URBAN PLANNING

2015

Allianz Stadium

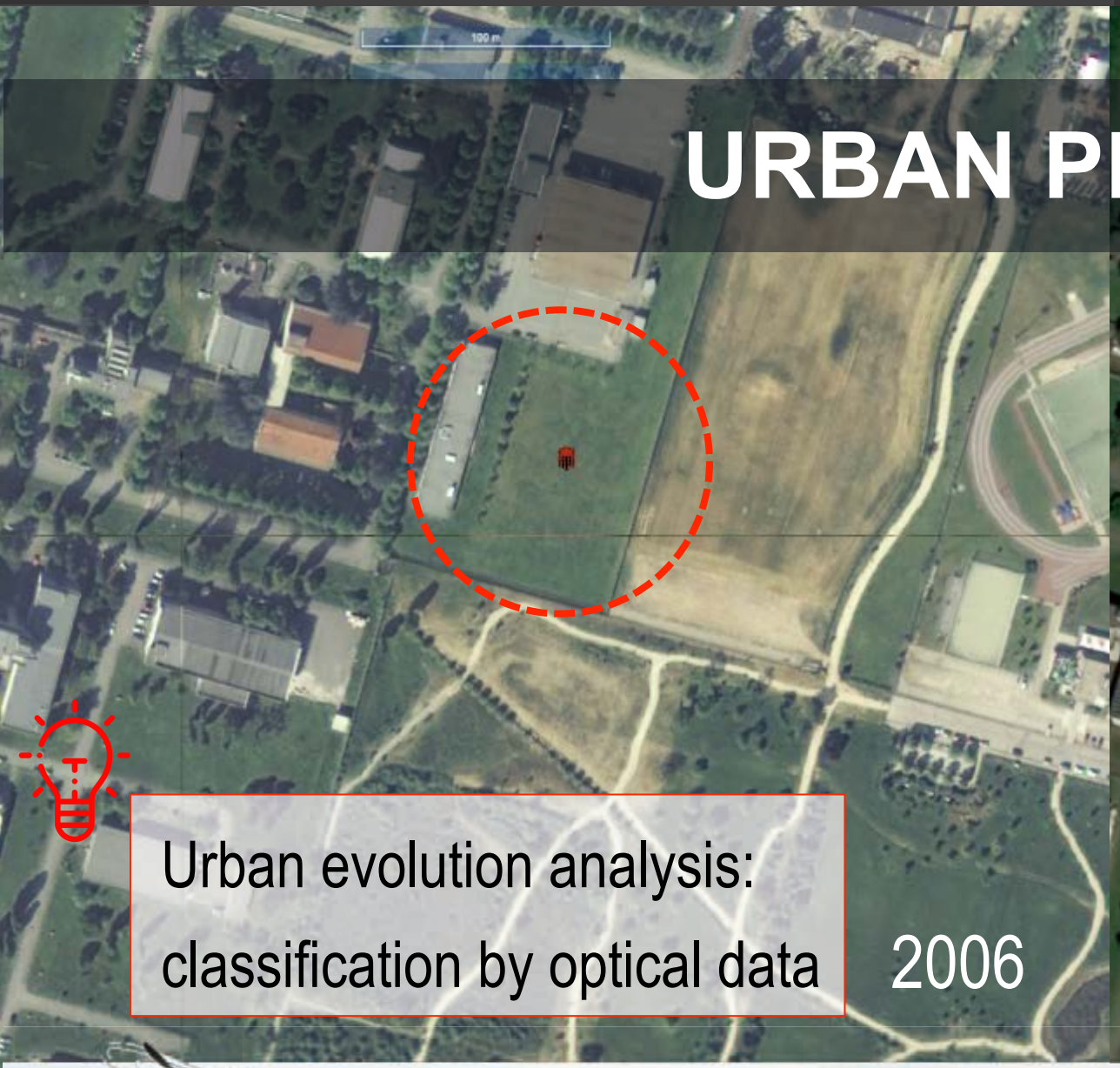
Urban evolution analysis

URBAN PLANNING

SAR Multi temporal analysis

Urban evolution analysis:
automatic detection by SAR data

URBAN PLANNING

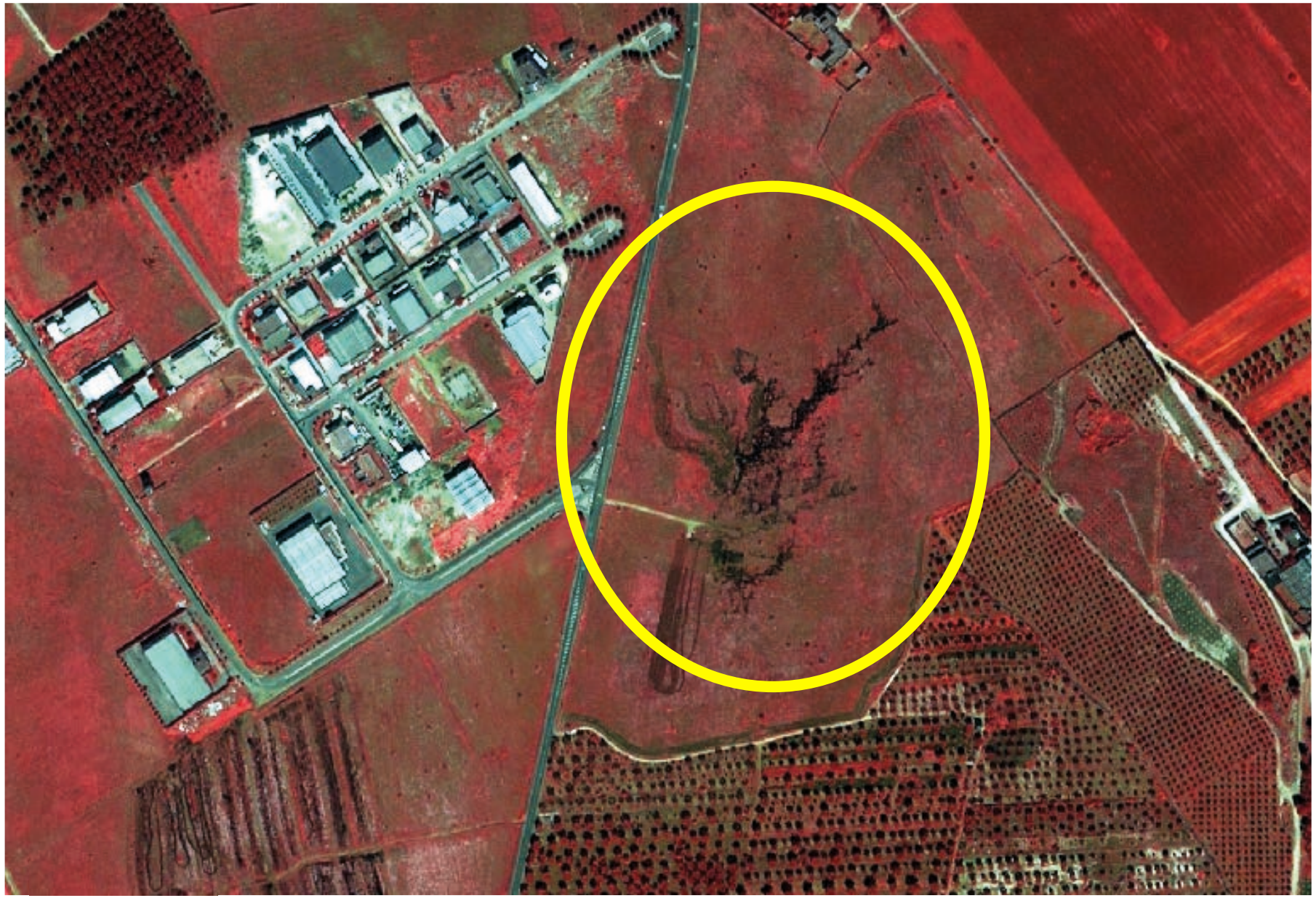


Urban evolution analysis:
classification by optical data

2006

2018

Industrial pollution detection - optical VHR 0,5m



…illegal discharges: agronomic or industrial?

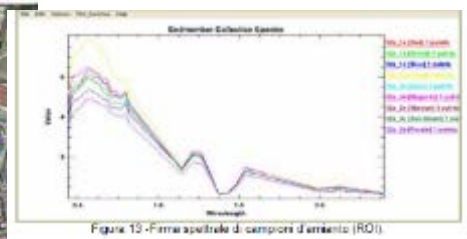
Asbestos /cement-asbestos detection : Workflow

- Acquisition
- Orthocorrection

flight

- Classification
- Vector transferring

Spectral analysis and layer generation

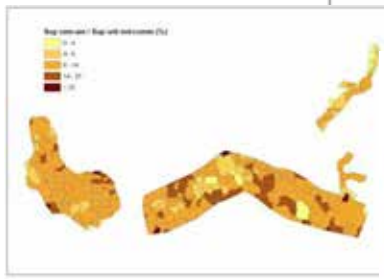


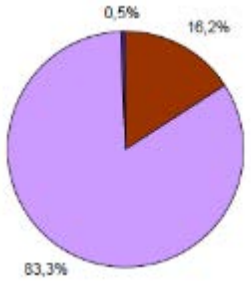
- Accuracy evaluation

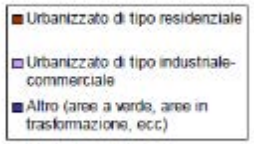
In situ verification

- Regional/ local GeoDatabase
- Statistics
- Publication

GIS updating and reports

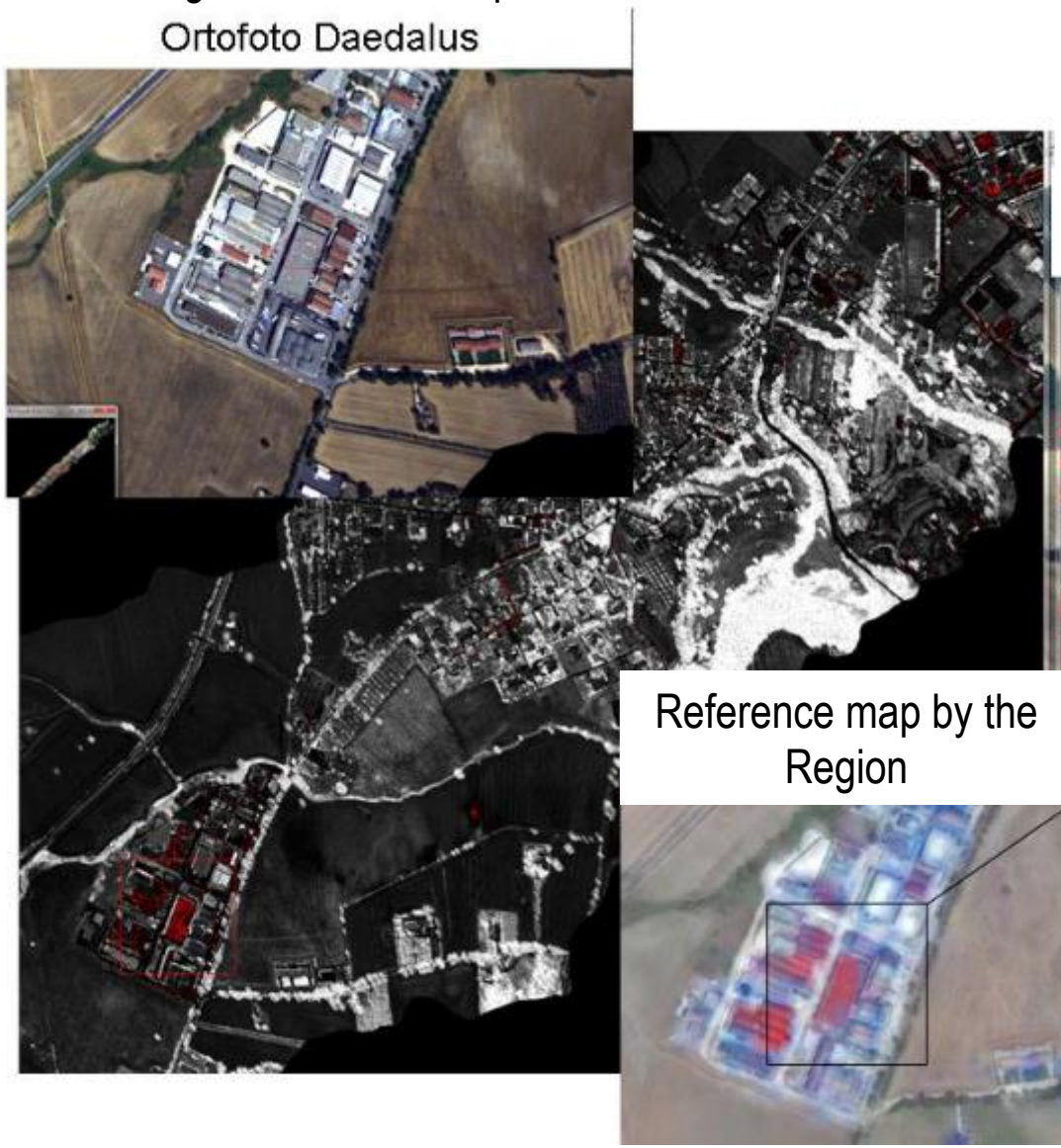




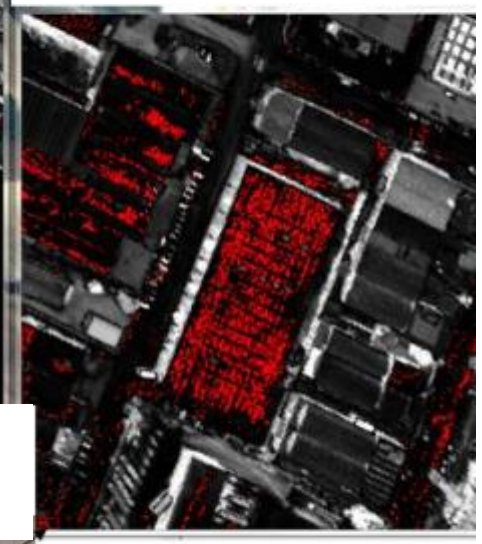


Asbestos extraction and reference map comparison

Orthoimage airborne multispectral



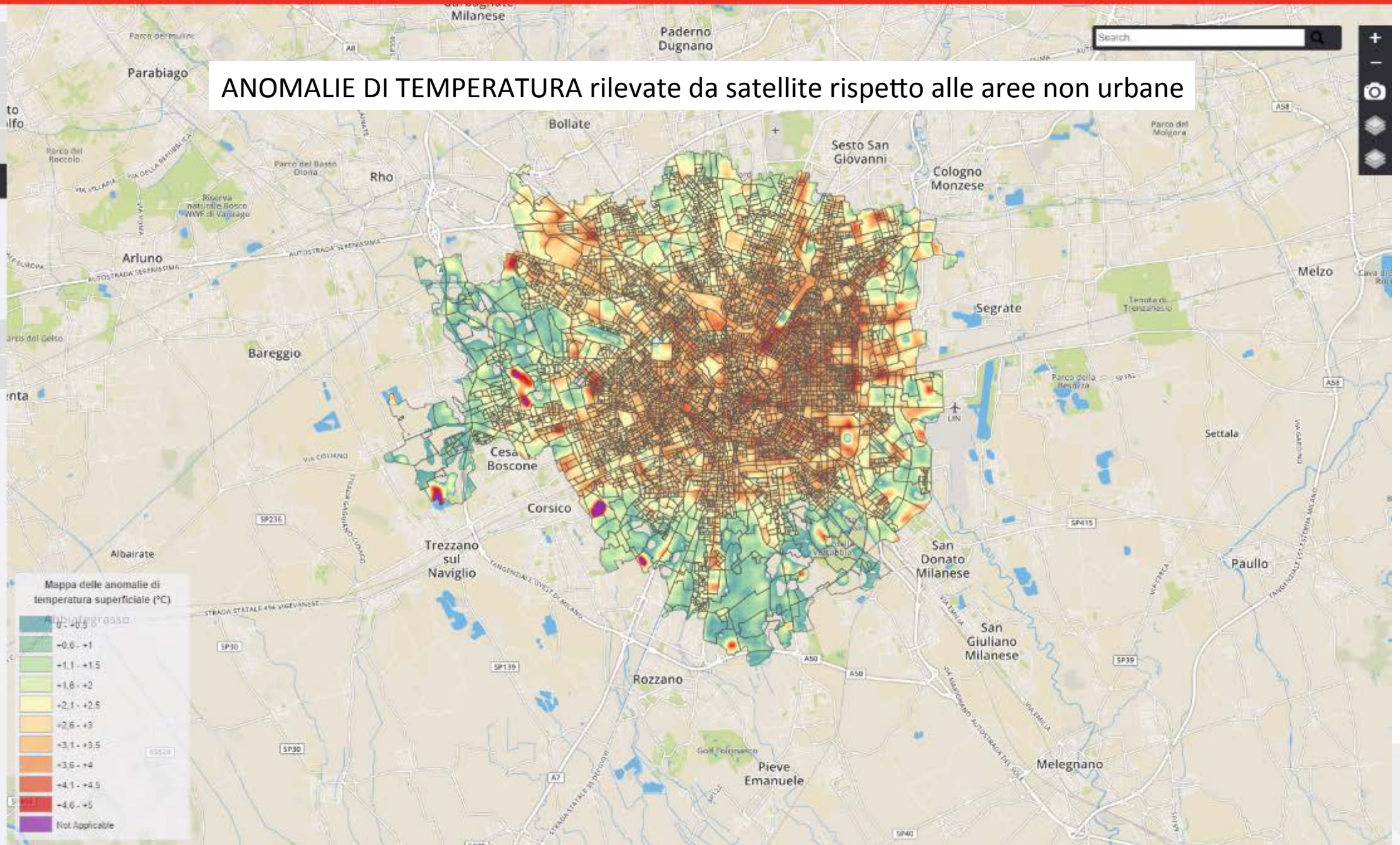
New dangerous sites detection through spectral classification vs the reference




AWARE
Welcome
Home
WebGIS
Configuration
Documents
Logout
Legend
+1 °C
+2 °C
+3 °C
+4 °C
+5 °C
+6 °C
URBAN PLANNING
Urban heat island to plan
heat waves mitigation action
F2V
TELESPAZIO
e-geos
MPB
dbw

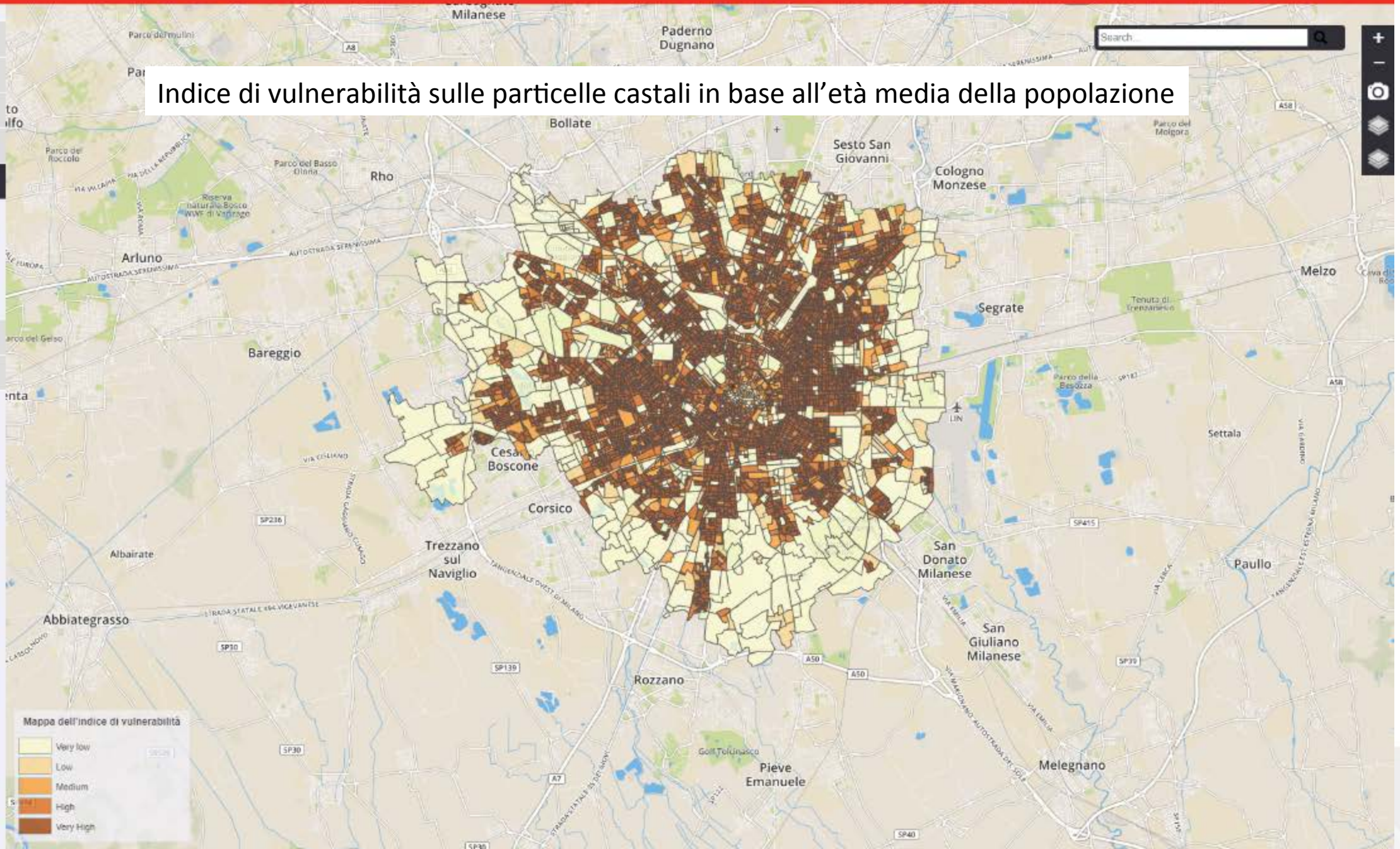
AIELLI
ALIANO
BUCCHIANICO
CAMPODIMELE
MILANO
Heat Waves
Mappa
Status
MONZA
SESTO SAN GIOVANNI

ANOMALIE DI TEMPERATURA rilevate da satellite rispetto alle aree non urbane



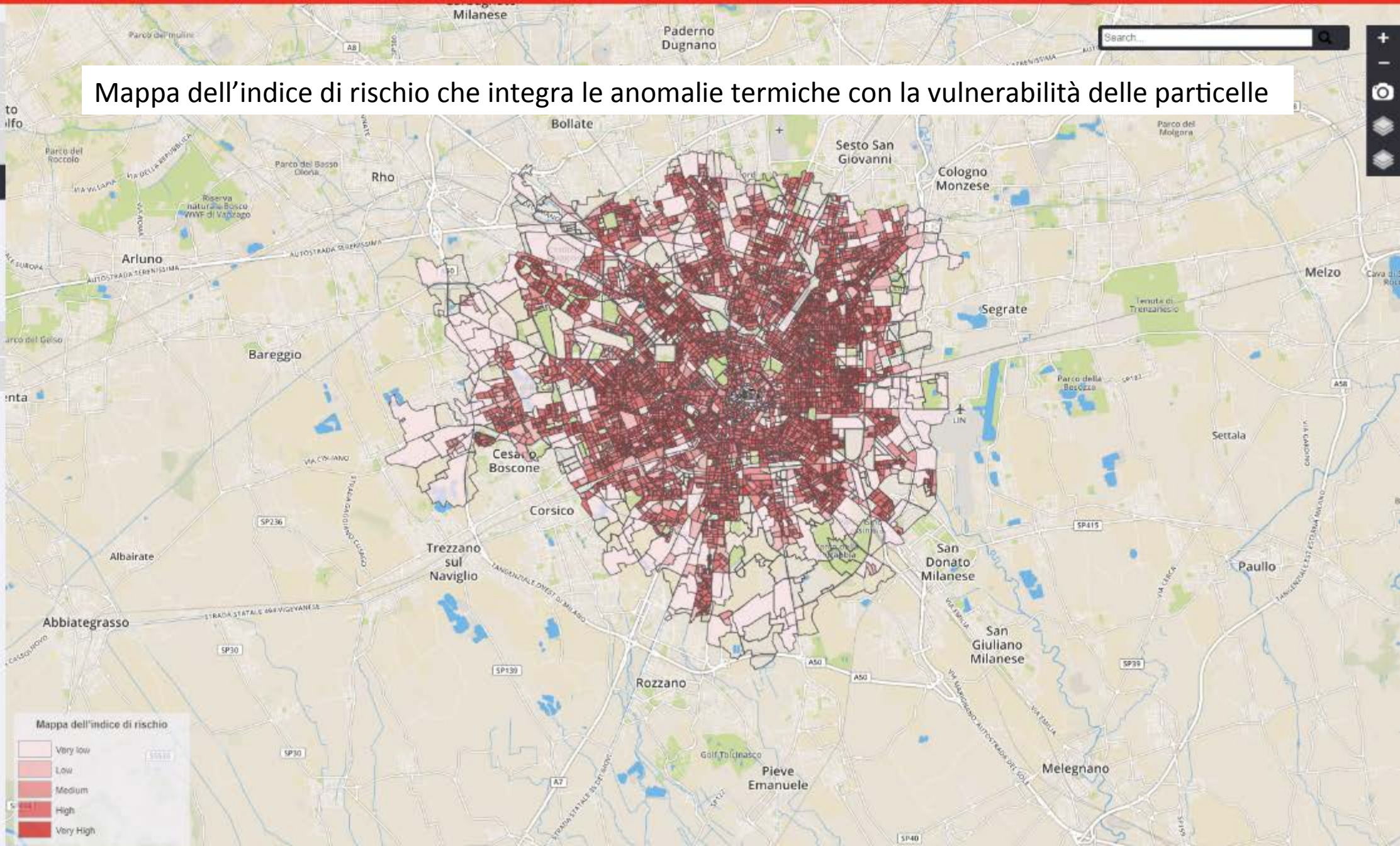
AIELLI
ALIANO
BUCCHIANICO
CAMPODIMELE
MILANO
Heat Waves
Mappa
Status
MONZA
SESTO SAN GIOVANNI

Indice di vulnerabilità sulle particelle castali in base all'età media della popolazione



AIELLI
ALIANO
BUCCHIANICO
CAMPODIMELE
MILANO
Heat Waves
Mappa
Status
MONZA
SESTO SAN GIOVANNI

Mappa dell'indice di rischio che integra le anomalie termiche con la vulnerabilità delle particelle

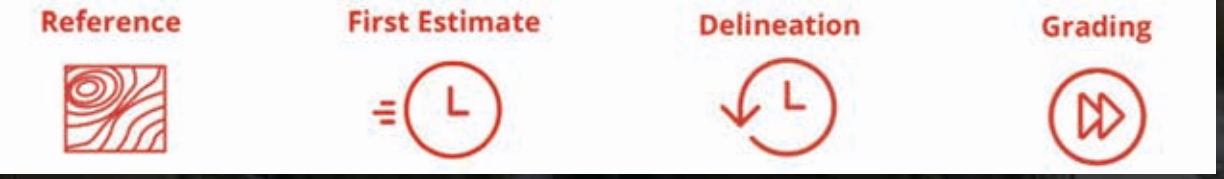


mapcy

On Demand Emergency Mapping Services for Disaster

RISK & DISASTER MANAGEMENT

For supporting **Disaster management operators** through **reports and maps based on multi-temporal data series integrated with Georeferred information** derived by crowdsourcing data for a rapid situational awareness.



On demand Geo-Information mapping and monitoring services based on cartographic standard, with provision of maps and analytics Geo-Information based Business Intelligence Services for :

- Disaster management
- Early Warning Ground deformation
- Rapid mapping Provided on a 24/7 basis

e-geos

EMERGENCY MANAGEMENT SERVICE

We are the EUROPEAN PROVIDER for DISASTER MANAGEMENT MAPS

Geo-information products to support **civil protection** and **humanitarian aid** operators natural/man made disasters

Copernicus
Europe's eyes on Earth

24/7
OPERATIONAL

40+
EXPERIENCED OPERATORS

5000+
MAPS PRODUCED IN 8 YEARS

360+
ACTIVATIONS OF THE e-GEOS EMERGENCY MANAGEMENT SERVICE

ALL
MULTIMISSION SENSORS

40+
COUNTRIES

Users: authorities entitled to manage civil security related aspects in the different European Member States as well as international organizations such as the United Nations, the World bank or other NGOs.

e-geos
AN ASI / TELESPAZIO COMPANY

EMERGENCY MANAGEMENT SERVICE

We are the EUROPEAN PROVIDER for DISASTER MANAGEMENT MAPS

e-geos

AWARE
Agile Watching of Assets and Resources

CULTURAL HERITAGE

For supporting the **planning, management and maintenance of infrastructures and strategic assets**, **for Power Supply Utilities,** Asset Monitoring, Transportation and Infrastructures, Mining, Oil & Gas, Natural Resources Management.

A suite of solutions, based on:

- Ground Motion Analysis (DIFSAR and GPS)
- Change Detection Analysis
- 3D modeling
- GIS Solutions

e-geos
AN ASI / TELESPAZIO COMPANY

GUBBIO HIGH TOWN

e-geos

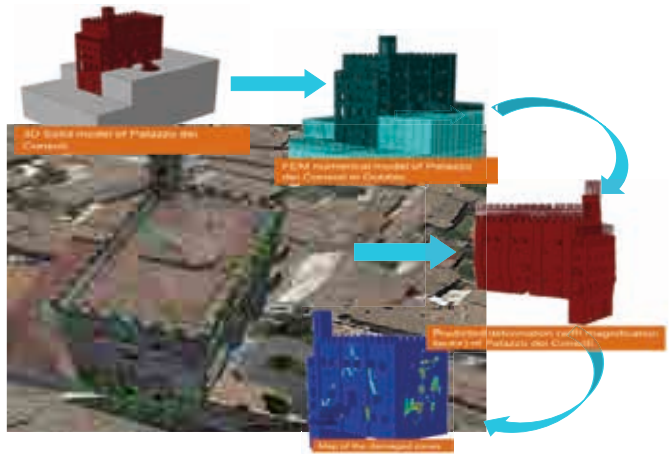
GUBBIO MONITORING

Tools

- **AssetWatch Portal** for the full exploitation and deep analysis of Interferometric data
- Big Data management architecture
- Advanced statistics

Advanced InSAR Analysis

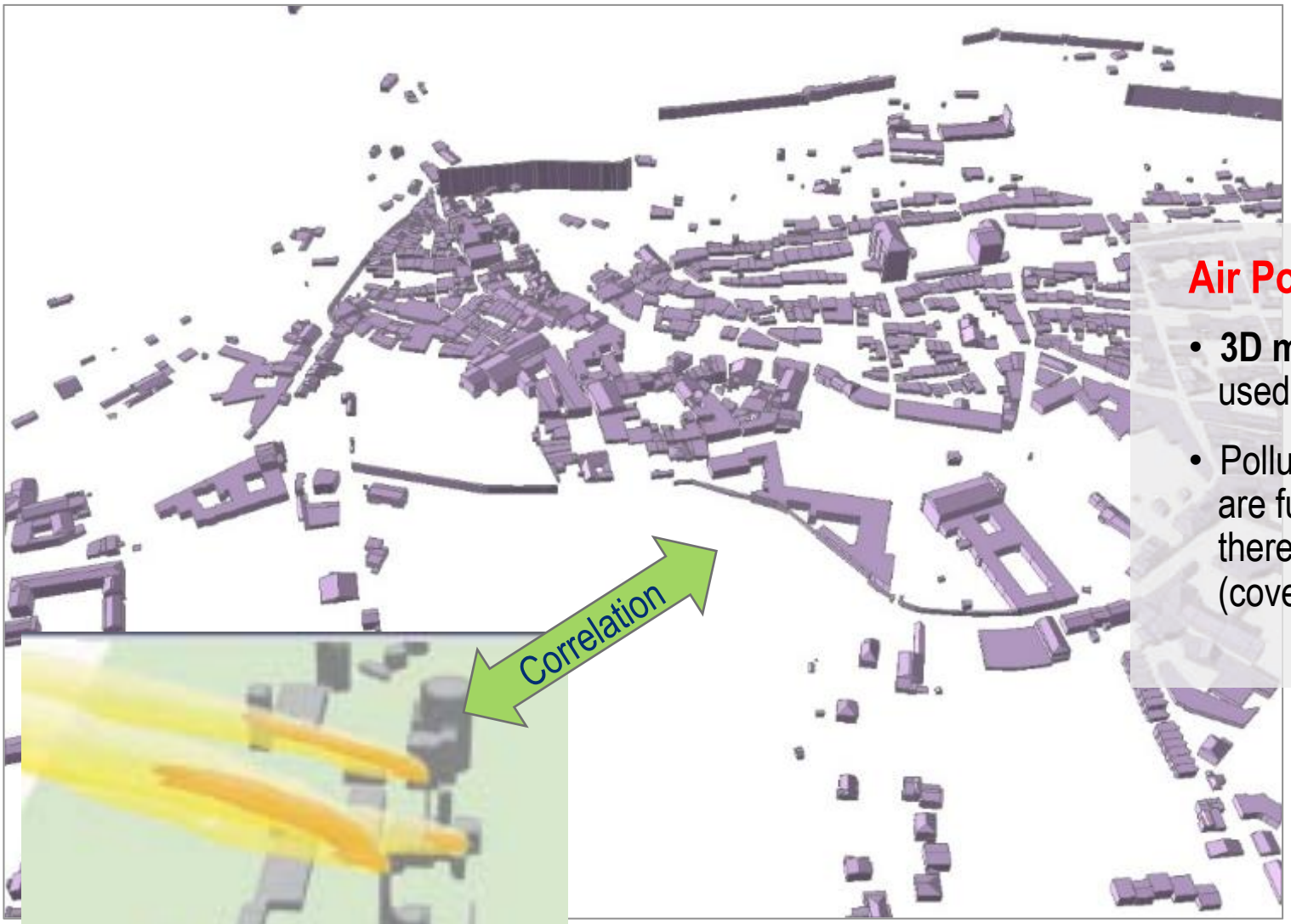
- Very **high density InSAR** analysis have been **coupled with the 3D Models** to associate with high precision deformation points to the building structures
- Data used: **COSMO-SkyMed StripMap HI , period 2011-2017 (Map Italy archive)**



Correlation InSAR and Structural Analysis

- **Very high density InSAR analysis** have been **coupled with the 3D Models** to associate with high precision deformation points to the building structures
- This advanced InSAR analysis has been used as input for structural analysis generating a map of Deformation zones

GUBBIO MONITORING



Air Pollution maps

- **3D models** generated by RPAS acquisitions have been used to generate pollution propagation in the city.
- Polluters may affect the building and artefacts. 3D models are fundamental inputs to model polluters behavior and, therefore, to protect critical assets with specific solutions (coverages, chemical products, etc.)

POMPEII SITE MONITORING

Source Data: COSMO-SkyMed Archive (**Map Italy project**), Stripmap HIMAGE (2011-2016)

HYDROGEOLOGICAL INSTABILITY WORK PACKAGE

- PS interferometric high density analysis over the Pompeii
- 3D models derived by VHR airborne data
- 3D platform to analysis PS results
- Integration with in situ sensors
- Validation through on field campaign

The supporting tools in AW Portal

3D WebGIS for supporting the context analysis and the exploitation of results

Contents

- **3D Models** generated by the use of VHR aerial imagery and automatic generation procedures
- **Interferometric analysis** over the entire site and surrounding

POMPEII SITE MONITORING

Results: Casa dei Vettii

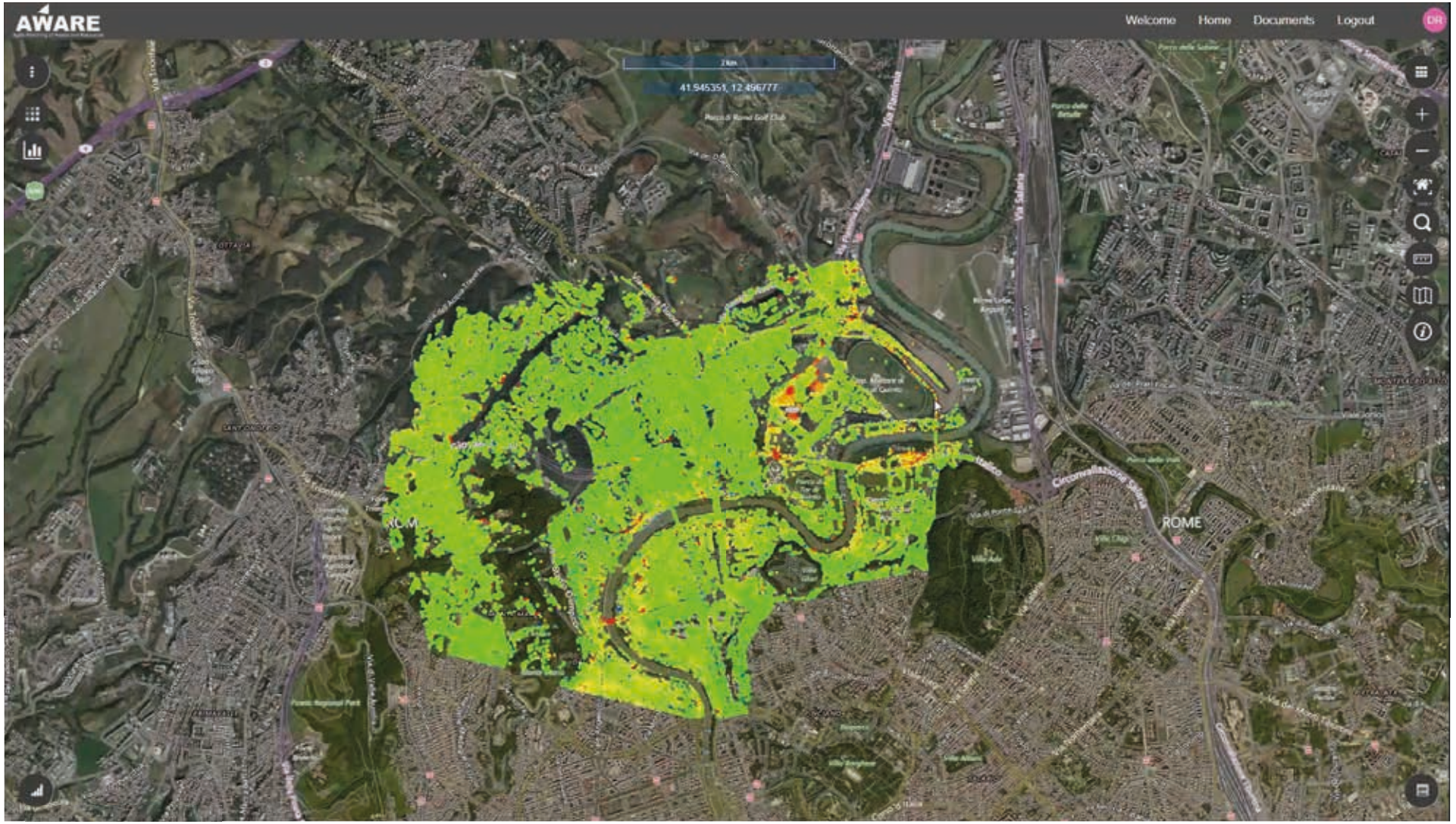
- The Casa dei Vettii has been interested by restoration works (including replacing the roof)
- The analysis with the ascending geometry allowed to identify small deformations on the roof.
- The **on field survey carried out by ISPRA following the interferometric analysis has identified a support beam the roof that needed to be replaced**

ISPRA

Results: Domus dei Gladiatori

- The collapse of the «Domus dei Gladiatori» took place on 6/11/2010.
- The **historical analysis** (05/2010-03/2012) allowed to monitor only points corresponding to the parts of the structure remained standing showing anyway a **continuous trend of deformation** of the wall started before the collapse

COLOSSEO MONITORING



Through satellite interferometry and with AWARE platform it is possible to identify and monitor the deformations taking place at the level of individual buildings.

Satellite interferometry is also useful for monitoring slow ground deformations, which can be precursors to major landslides. This is particularly critical in a country like Italy that is so sensitive and increasingly subject to phenomena related to hydrogeological instability.

AWARE
Agile Watching of Assets and Resources

mapcy
On Demand Emergency Mapping Services for Disaster

UrbanGEO
Smart Technologies for City

e-geos
AN ASI / TELESPAZIO COMPANY

e-GEOS S.p.A – L.O. Contrada Terlecchie snc – Matera / HQ Via Tiburtina, 965 – Roma