



From Earth Observation Data to Operational Decisions: Platform-as-a-Service Solutions for Geohazard and Infrastructure Risk Management

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THE PLATFORMS

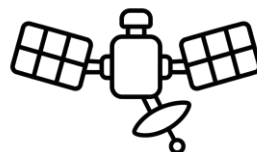


SGAM

Smart Geotechnical Asset Management



ARTES – Business Application
(Demonstration)



I4DP Market

ISABHEL



CITTÀ DI TORINO

5G for L'ART
(Demonstration)

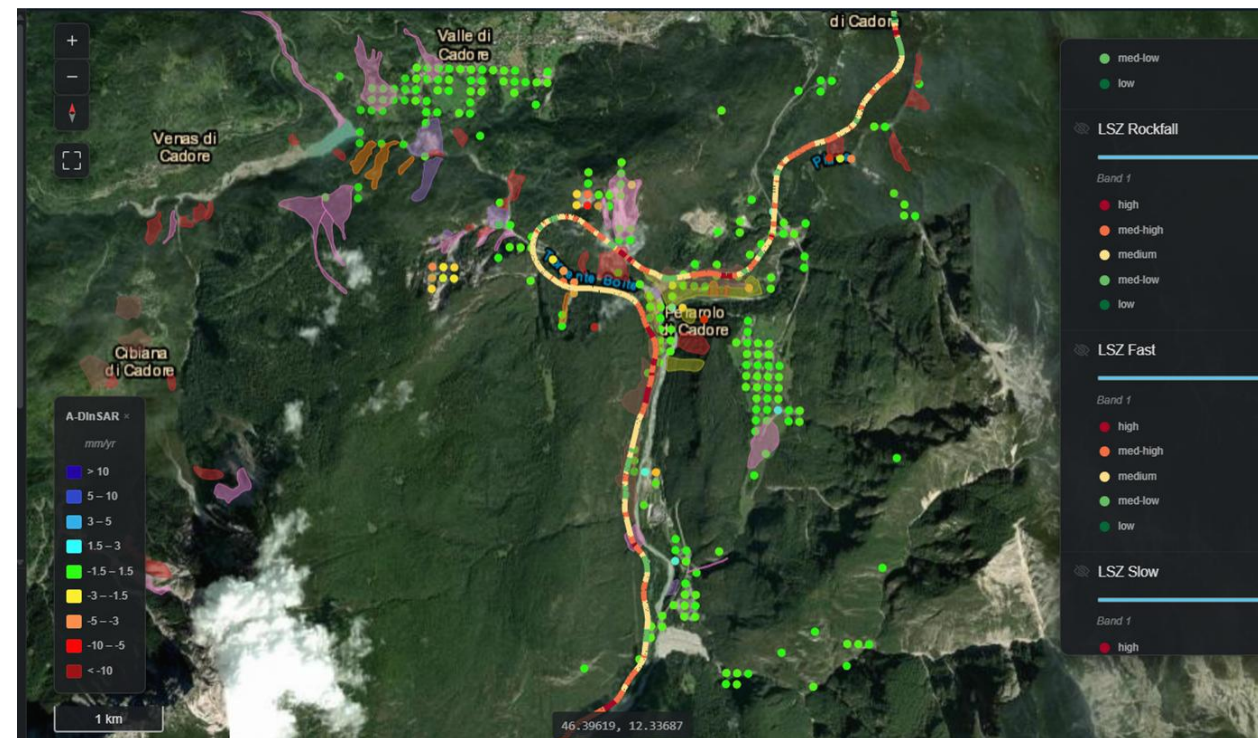
THE PLATFORMS

Value-added PaaS for geotechnical and structural risk management integrating:

- **EO data:** multi-mission InSAR, optical/multispectral imagery;
- **non-EO data:** IoT sensors, geohazard databases, digital twins.

They provide tailored data analysis and visualization for:

- Public authorities
- Infrastructure managers
- Technical operators

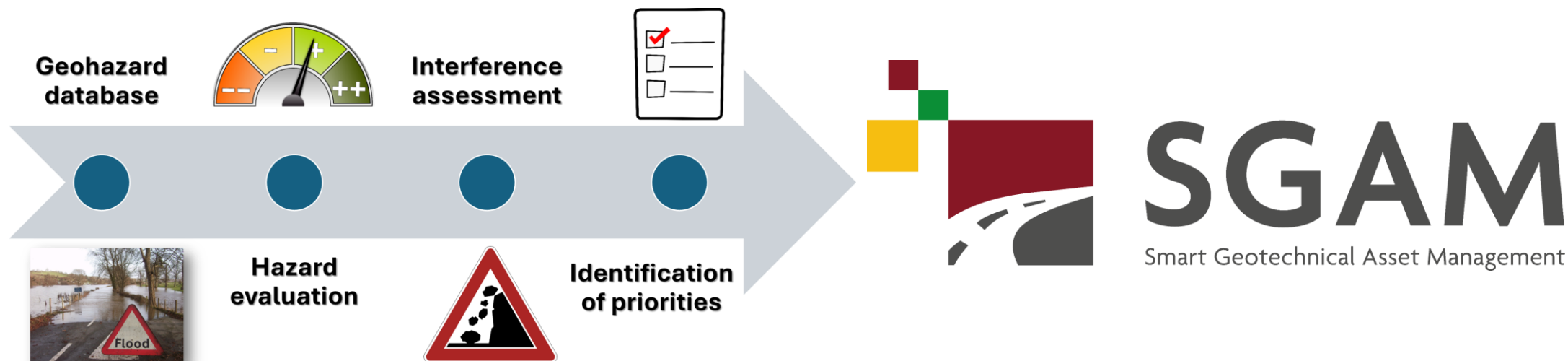


SGAM – SMART GEOTECHNICAL ASSET MANAGEMENT

DEFINITION & GENERAL WORKFLOW

SGAM is an innovative product for linear infrastructure risk assessment and predictive maintenance.

- Data Fusion + Machine Learning for infrastructure asset analysis
- Integration of **EO satellite data**, **geohazard databases** and infrastructure data
- Large-scale screening of infrastructure networks
- Identification, mapping and classification of risk-related anomalies
- Support to predictive maintenance and risk reduction



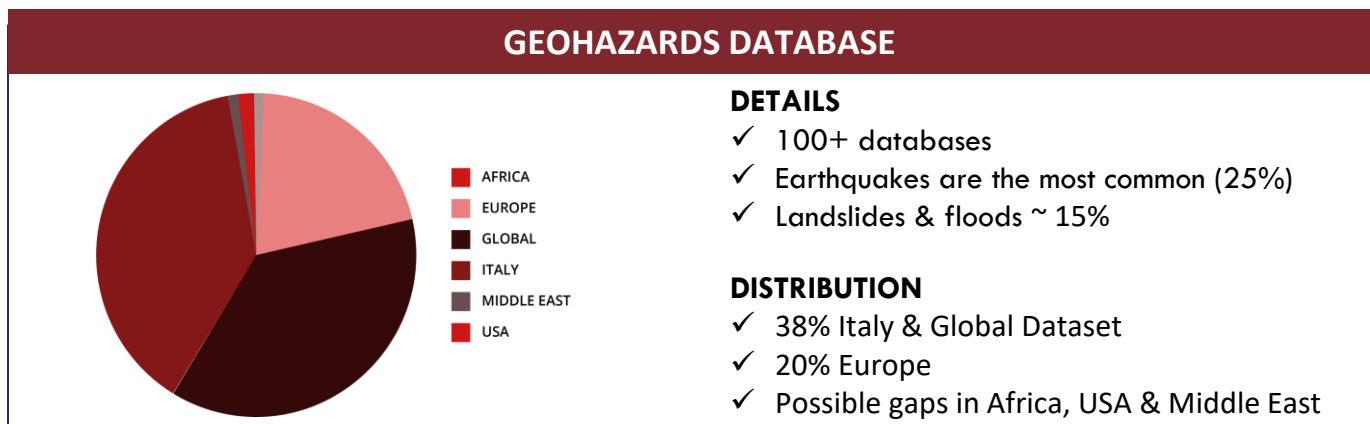
SGAM – SMART GEOTECHNICAL ASSET MANAGEMENT

A SOLID STARTING POINT: PROPRIETARY GEOHAZARDS DATABASE

SGAM doesn't just collect data: it synthesises them!

- ✓ By integrating a variety of databases, SGAM relies on a single, powerful database specifically tailored to understanding active geohazards potentially threatening the infrastructures.
- ✓ SGAM harnesses the vast amount of data that is available (data that is often **under-utilised and lacking in integration**) and turns it into a **valuable asset for comprehensive analysis**.

100+ GEOHAZARDS
DATABASES FROM
ALL OVER THE
WORLD



SGAM – SMART GEOTECHNICAL ASSET MANAGEMENT

DATA FUSION



ISABHEL - Integrated SATellite and ground-based monitoring for Bridge HEalth

Lifetime assessment



5G connectivity –
real-time data
transfer



Contact sensor
Monitor static/dynamic
behaviours



Photomonitoring™
cameras + image
analysis (Change
Detection & DIC)



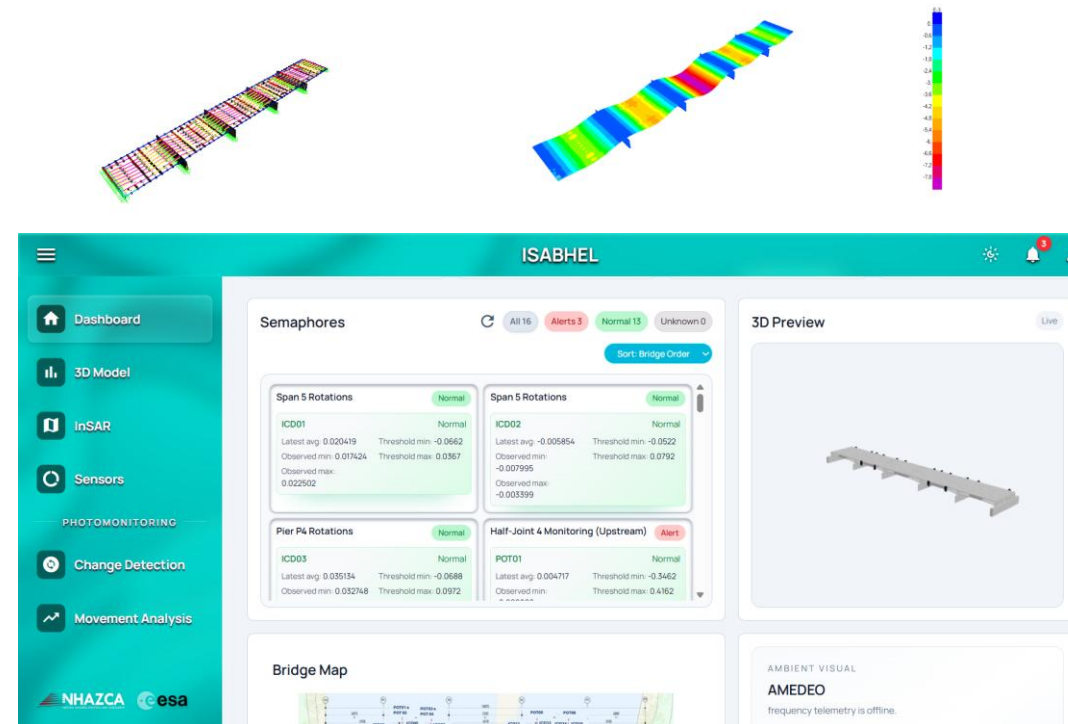
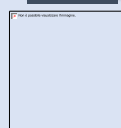
Satellite InSAR
detect deformations
and geological
instabilities



Digital twin:
Calibrated Finite
Element Models using
satellite, sensor &
historical data



ISABHEL



Output: Web platform for real-time monitoring, early warning, and smart asset management

ISABHEL – 5G SHM SENSORS

Technology

- Bi- and tri-axial accelerometers and inclinometers
- 5G Connectivity

Objective

- Continuous monitoring of the static and dynamic behavior of the bridges
- Early warning



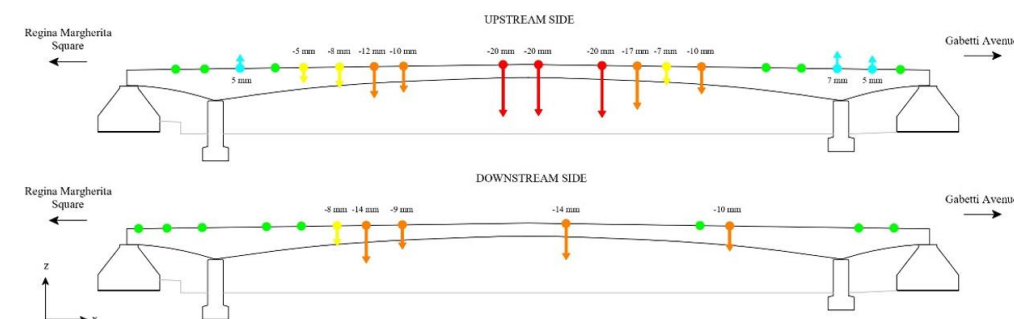
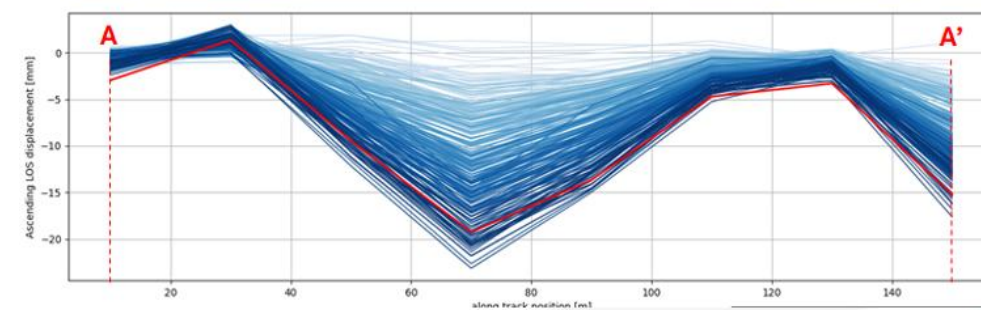
ISABHEL – SATELLITE INSAR

Technology

- Persistent Scatterer Interferometry (PSI) by COSMO-SkyMed (2011-2025)

Objective

- Assess the deformation pattern of surrounding areas of the bridge (including abutment)
- Get the vertical and east-west displacement components of the bridge
- Analyze seasonal variations



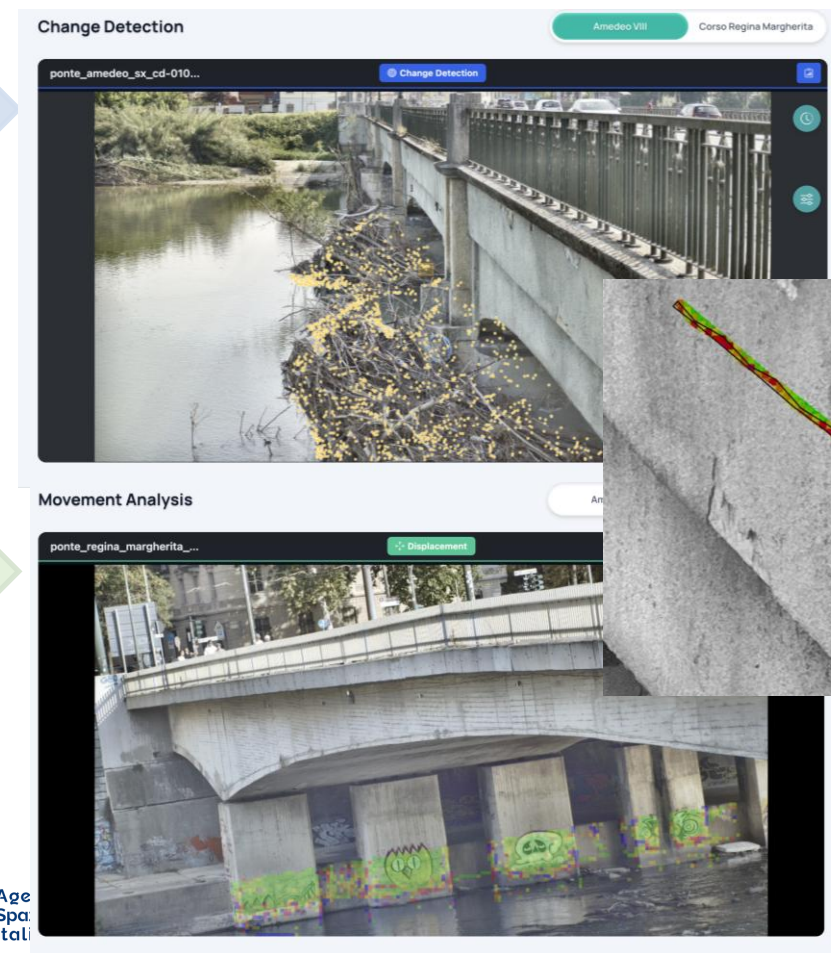
ISABHEL – PHOTOMONITORING

Technology

- Industrial-grade varifocal high resolution optical camera

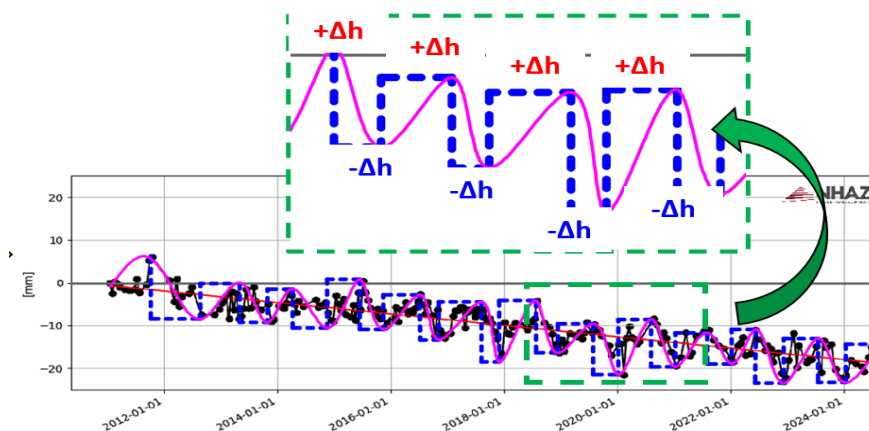
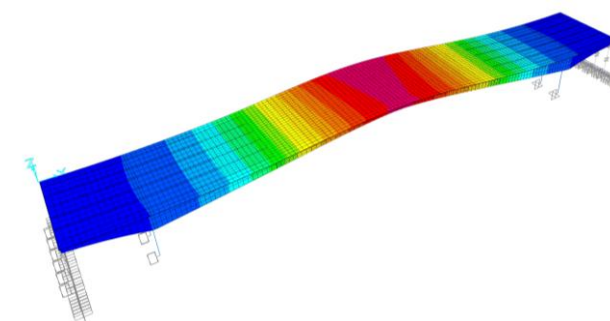
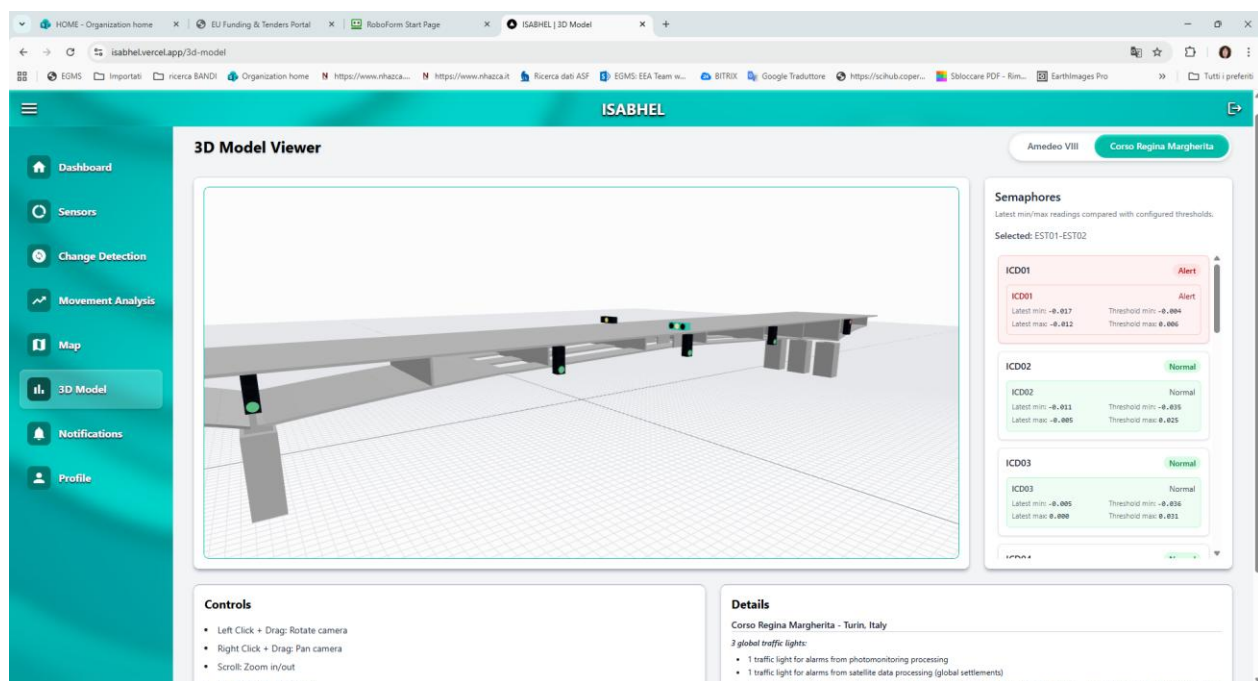
Objective

- Detection of debris accumulating around bridge piers;
- Monitoring the progression of structural deterioration (e.g., crack propagation).

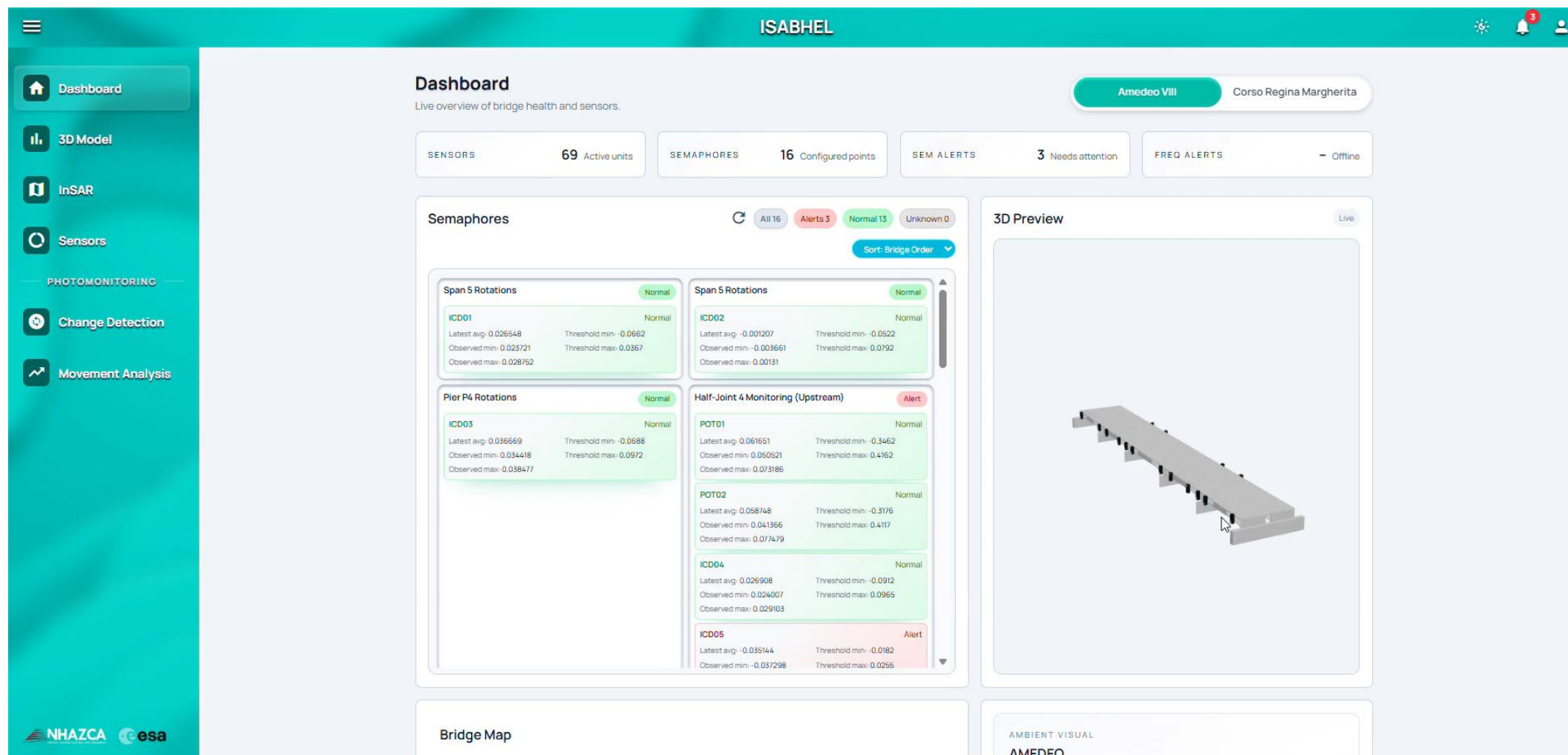


ISABHEL – FINITE ELEMENT MODEL

MODAL ANALYSIS FEM CALIBRATED WITH MONITORING DATA



ISABHEL PLATFORM – MODULES



DEM-EO – DEMOCRATIZATION OF EARTH OBSERVATION

THE CHALLENGE

- Fragmented access to EO data & services
- Complex processing & interpretation → outsourcing
- Scarce in-house EO expertise

THE ANSWER

- One web-based environment, from data to decision
- A-DInSAR + PhotoMonitoring™, multi-mission
- Training & support → user autonomy

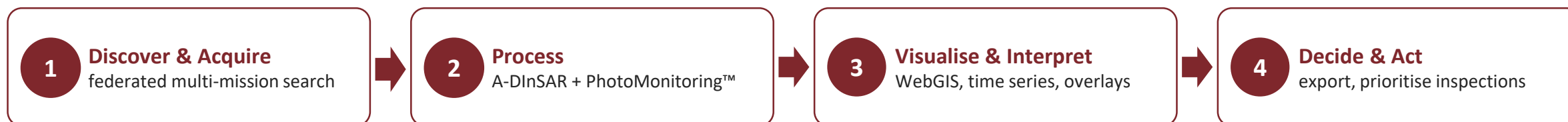
KEY FACTS

Programme: ASI I4DP_MARKET

Partners: NHAZCA + Titan4

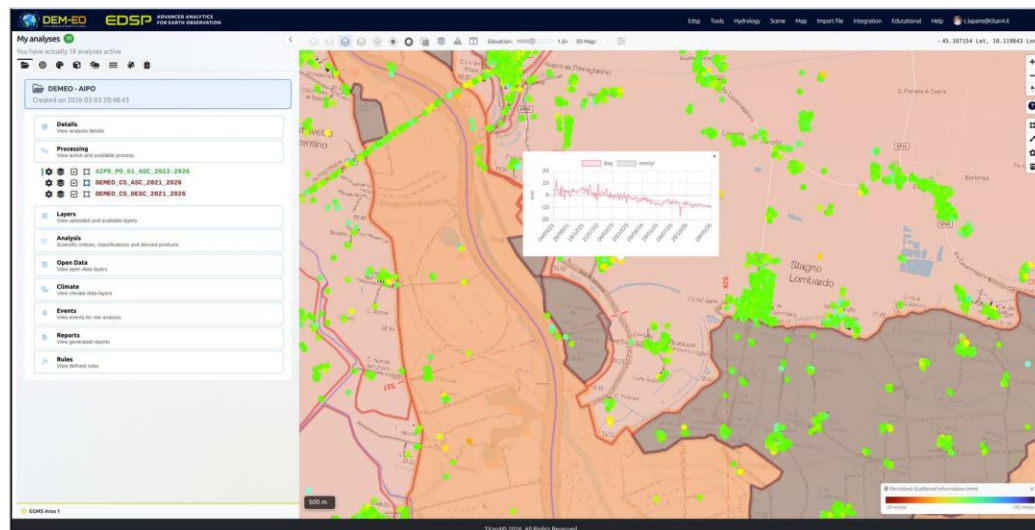
Pilot User: AIPO — Po River Agency

Duration: 18 months · completed June 2026



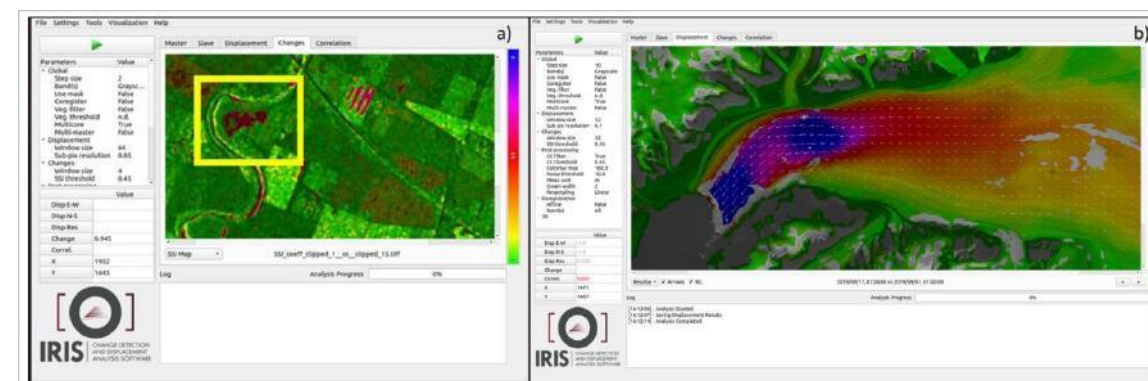
DEM-EO – A-DINSAR & PHOTOMONITORING™

A-DInSAR — ground motion (SAR)



- mm-precision displacement & time series (PSI / SBAS)
- Sentinel-1 · COSMO-SkyMed · SAOCOM
- Periodic surveillance of levees, dams, infrastructure

PhotoMonitoring™ — change & displacement (optical)



- Change Detection (SSIM, NDVI...) & sub-pixel DIC
- Sentinel-2 / Landsat → Pléiades / SPOT / WorldView
- Pre/post event or year-on-year checks

SAR + optical, better together — each technique covers the other's blind spots

DEM-EO – PILOT USER: AIPO, THE PO RIVER BASIN

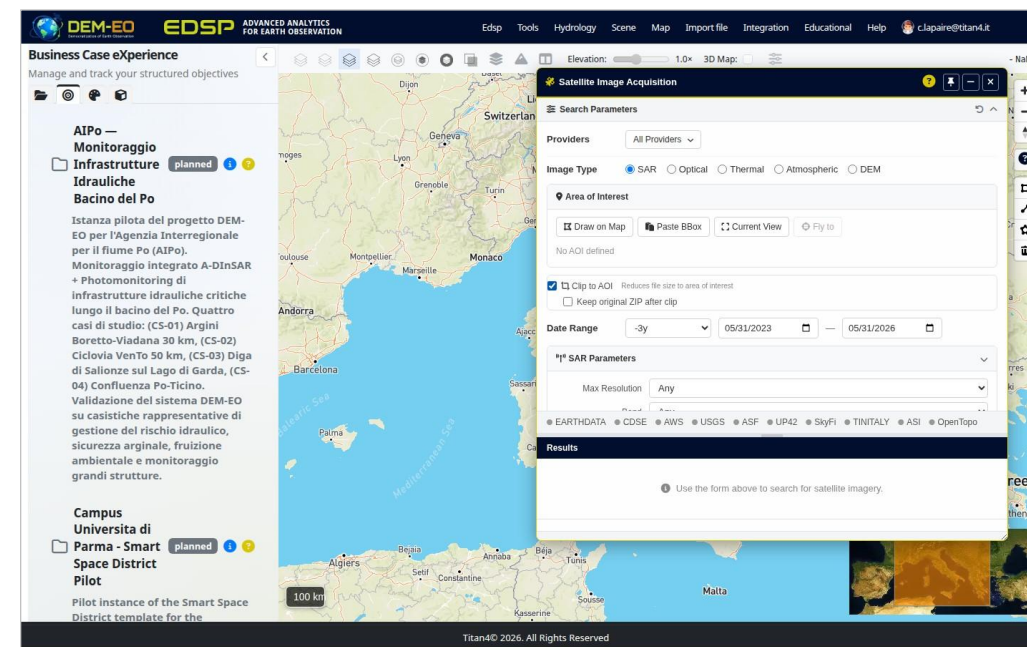
User need	EO technique
Levees & passive works — sand boils, seepage, deformation	PhotoMonitoring + A-DInSAR
Linear assets — VENTO cycleway	PhotoMonitoring · A-DInSAR
Hydraulic safety & surveillance	PhotoMonitoring
Large structures — Salionze dam	A-DInSAR
Riverbed planimetry — channel shifts	PhotoMonitoring

74,000 km²
river basin

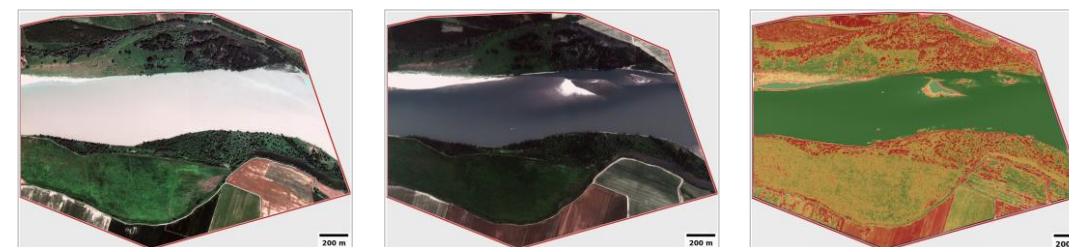
4
regions

5
use-case domains

Use cases co-designed with the agency and tested on its own areas of interest



Guided workflow scoped to the AIPO pilot



Jun 2024

Jun 2025

change map

DEM-EO – CASE STUDIES: PO RIVER FLOOD EVENTS

SAND BOILS — BORETTO & GUALTIERI Po flood, Nov 2014

- WorldView-2 → Pléiades, 0.5 m
- Change localised at the sand boil & access tracks



Pre · 22 Oct 2014



Post · 28 Jan 2015



SSIM change map

PARMA EXPANSION BASIN (MARANO) Flood of 25 Oct 2023

- Sentinel-2, 10 Oct → 7 Nov 2023
- Change only where hydraulically connected



Pre · 10 Oct 2023



Post · 7 Nov 2023



SSIM change map

SSIM change map: green = unchanged · yellow → red = changed

CONCLUSIONS

Integrated data for risk assessment

Combining EO observations with ground sensors, geohazard databases and digital twins supports infrastructure risk assessment.

From network screening to asset monitoring

SGAM identifies geohazard exposure across infrastructure networks, while **ISABHEL** monitors individual bridges

Monitoring to support action

Deformation measurements and change detection help prioritize inspections, guide maintenance and support early warning.

Accessible EO services

DEM-EO provides a guided web platform, interoperable interfaces and training help institutional users interpret data and make informed decisions.

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