

living planet | BONN symposium | 23-27 May 2022

TAKING THE PULSE
OF OUR PLANET FROM SPACE



An advanced and multi-technology system for Cultural Heritage monitoring and safeguard – The case of Pomerium.

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Date: May 26th, 2022

Pomerium is an **ESA IAP “5G for l’Art”** project, managed by a Consortium lead by **e-Geos** and including:

- ADPM Drones S.r.l.
- ARAKNE S.r.l.
- CISTEC – University of Rome «Sapienza»
- DBW S.r.l.
- Emersum S.r.l.

The scope of the project is to realize a multi-technology System for the Advanced Monitoring of Cultural Heritage.

The project is under completion (July 2022).

Reference Users

- Sovrintendenza Speciale Archeologia, Belle Arti e Paesaggio di Roma (territorial Public Entity depending from MIC)
- Parco Archeologico del Colosseo (dedicated Public Entity depending from MIC)
- Soprintendenza Capitolina di Roma (territorial Public Entity depending from Rome’s Municipality).

Pomerium investigates four main scenarios that may represent a risk for the exposed CH:



1. **Ground movements**
2. **Waste**
3. **Weed vegetation**
4. **Air pollution**

Pomerium system aims to support the Managers, usually Public Entities, in their ordinary and extraordinary prevention and maintenance activities, by giving them access to a wide set of data and value added information in a **centralized** and **simplified** way.



Tevere River from the confluence with Aniene River to Marconi Bridge.
Investigated scenarios:

- Waste detection
- Air Pollution

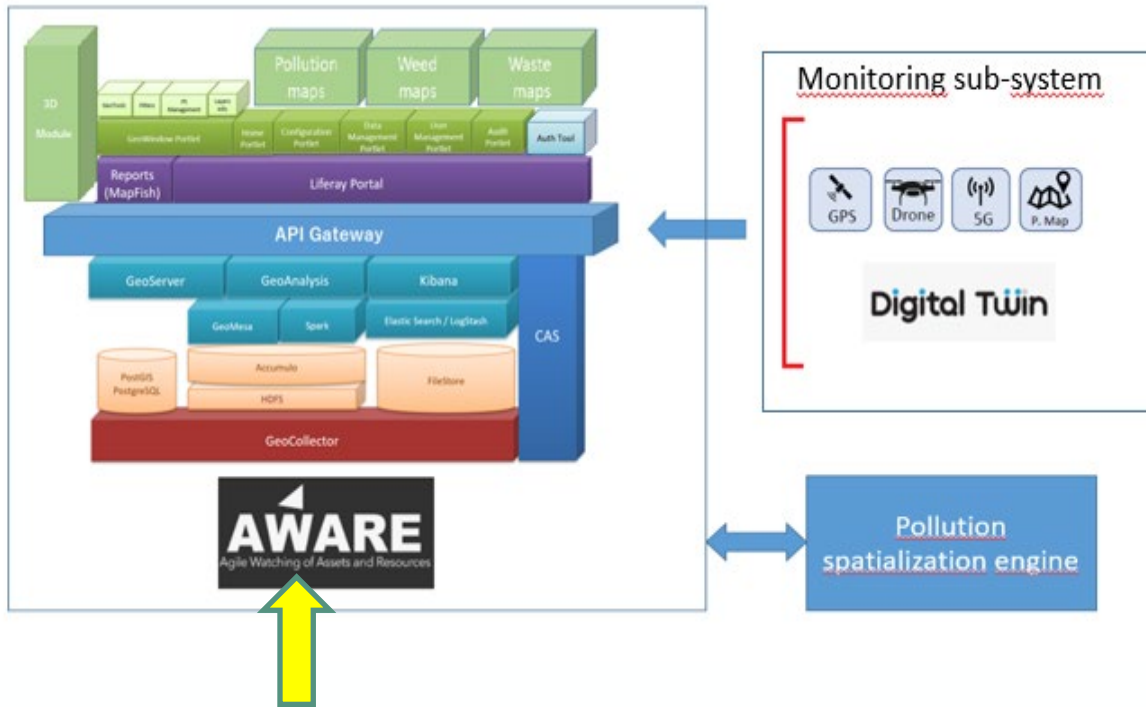
Colosseum
Investigated scenarios:

- Ground movements
- Air Pollution

Cestia Pyramid and Aurelian Walls.
Investigated scenarios:

- Ground movements
- Air Pollution
- Weed vegetation

Architectural overview



Monitoring sub-system is an integrating part of the Pomerium system, supplying remote and on site data for visualization and modelling



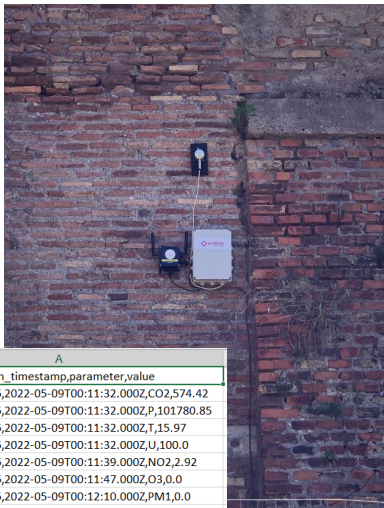
Pomerium is based on the AWARE WebGIS Platform developed by e-GEOS and completed by 3D functionalities and by an external service for Digital twin models management.

- Modelling engine:
- DIFSAR analysis
 - Pollutants dispersion
 - Material regression



Investigated scenarios

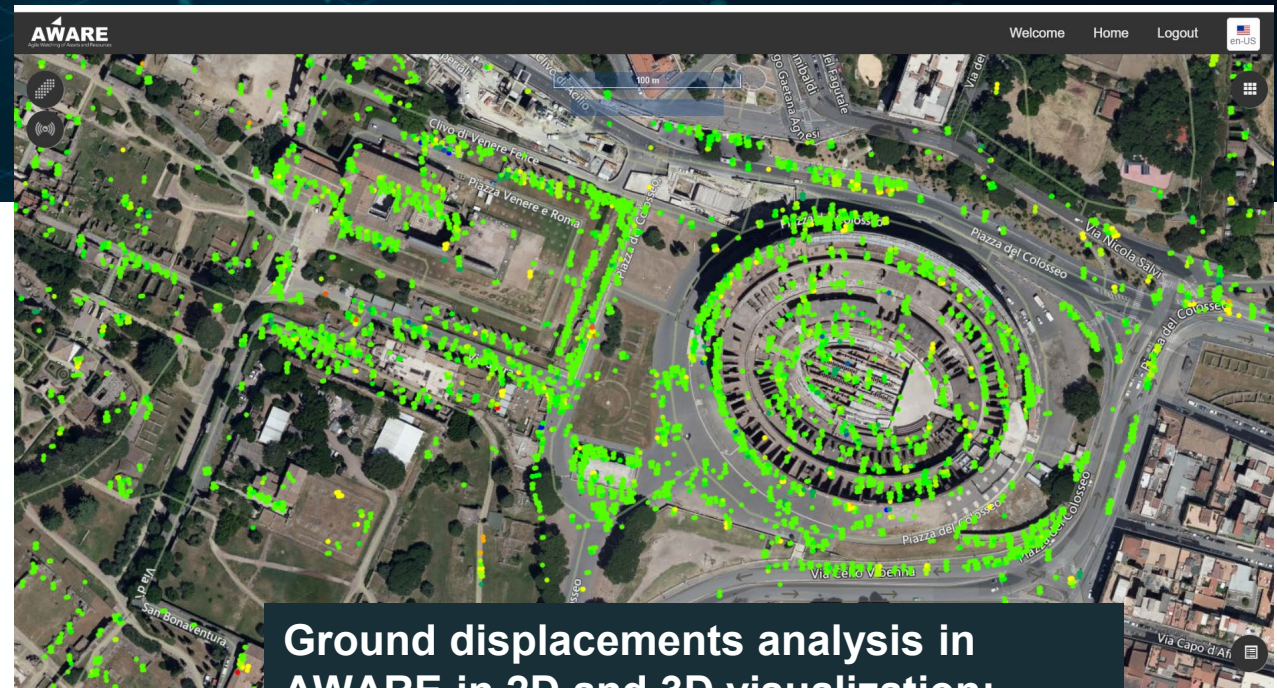
1. Ground movements: This investigation is based on the use of the DIF-SAR methodology on Cosmo SkyMed SAR data, for the detection and monitoring of the ground movements along time. Such movements may seriously affect the stability and integrity of CH, so it is necessary to become aware of the phenomena, in order to put in place the necessary maintenance strategies. The remote investigation is completed by a set of IOT movement sensors applied to a portion of the ancient structures selected between the most vulnerable, whose data are transmitted in real time to AWARE.



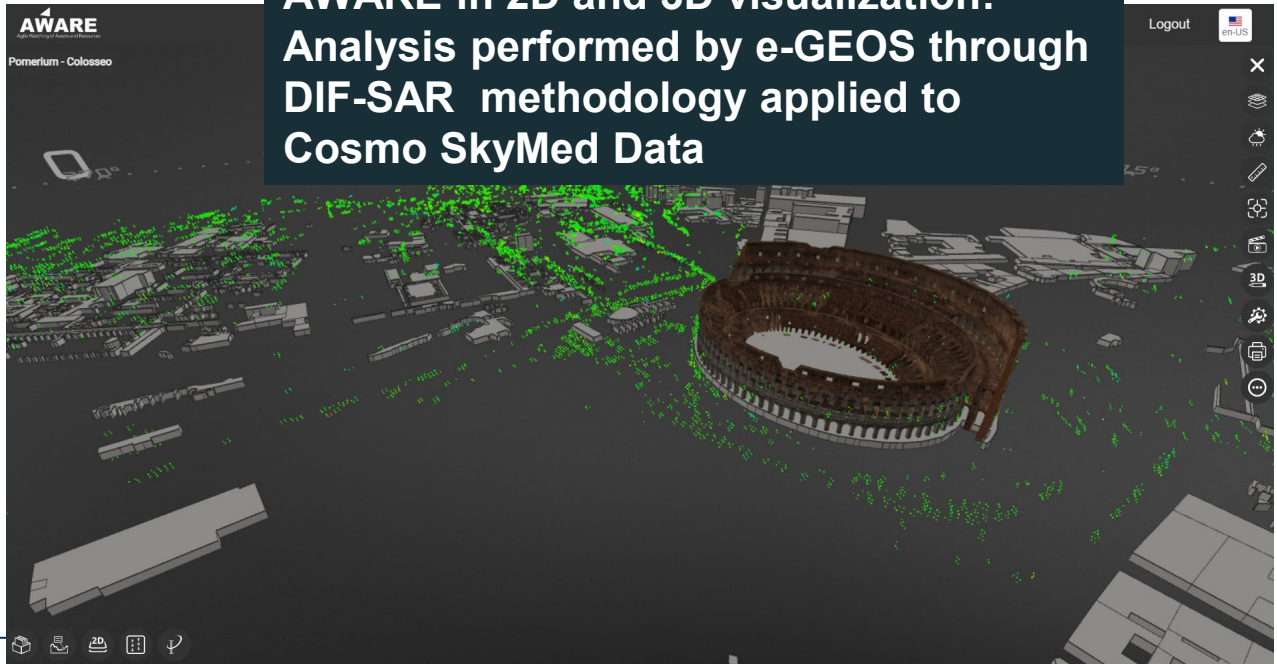
IOT displacement sensors installed on site and transmitting data in real time through 4G/5G network to AWARE

	A
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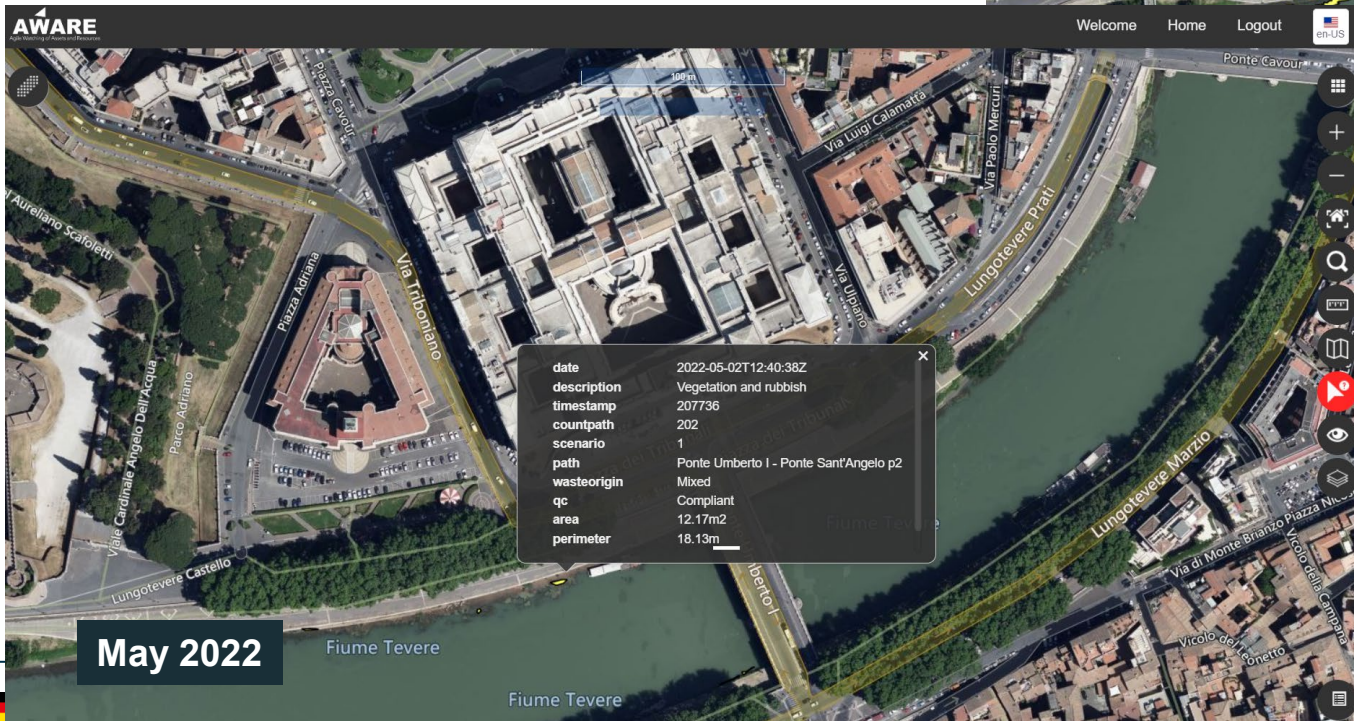
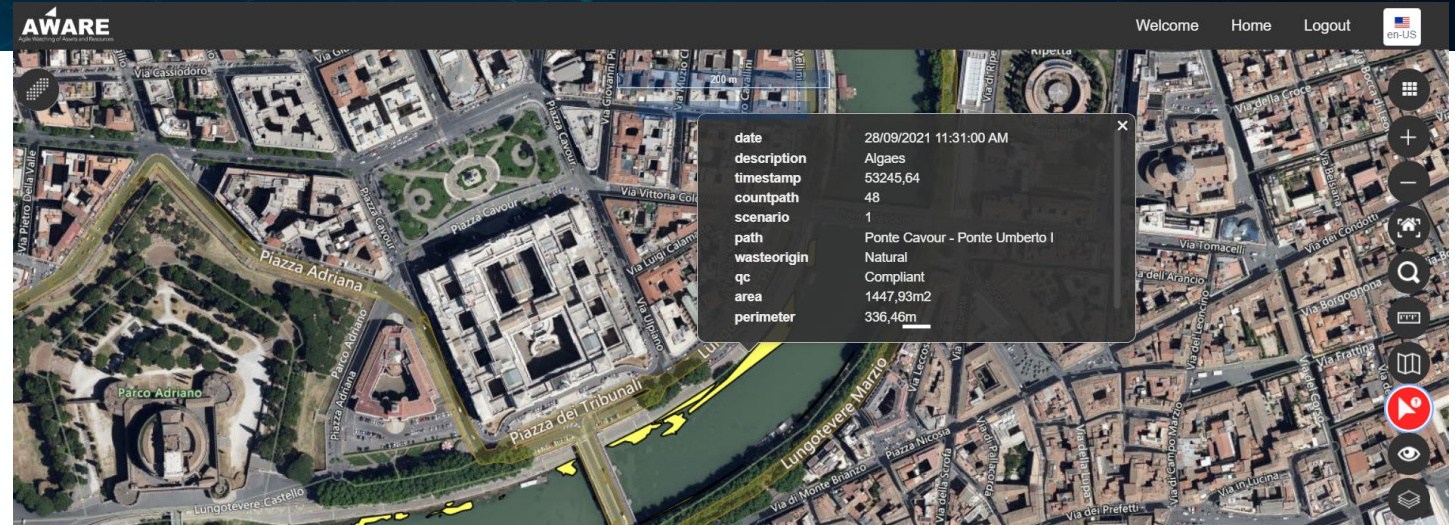


Ground displacements analysis in AWARE in 2D and 3D visualization: Analysis performed by e-GEOS through DIF-SAR methodology applied to Cosmo SkyMed Data

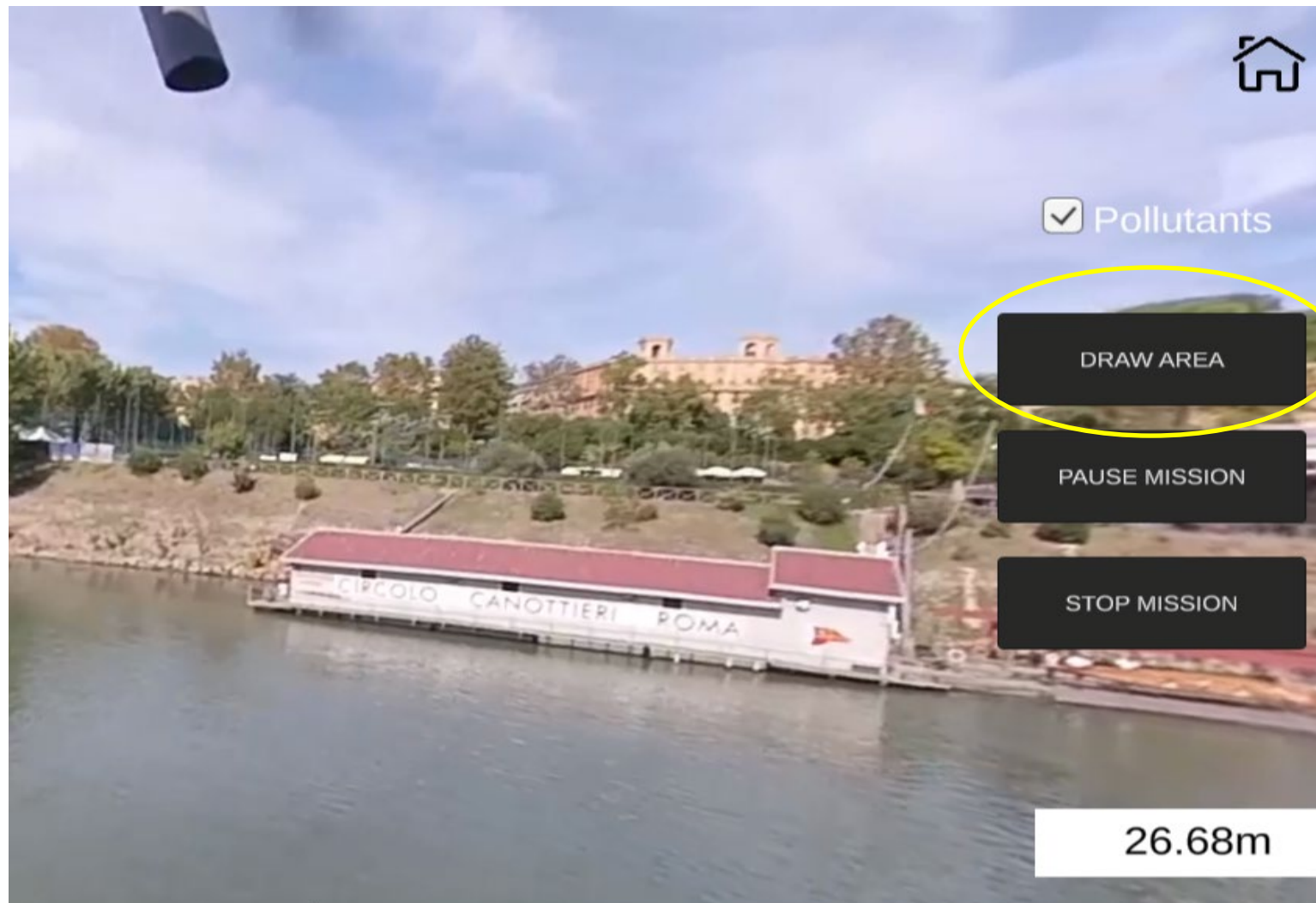


Investigated scenarios

2. **Waste:** This scenario investigates the presence of waste and debris along the urban path of Tevere River. Waste deposits are dangerous for the ancient bridges stability, in case of rise of river water level, causing the occlusion of the arches and hindering the flow of water. The use of a **drone equipped by optical photo and video camera** for the regular survey of the exposed area, allows the detection of the deposits and the assessment of their evolution in time.



2. **Waste:** On the base of RPAS 260 videos a Digital Twin was built, in order to allow Users to navigate data without phisical inspections. Users may also create points or polygons on an object of interest (e.g. a waste pile) by drawing in DT environment. All edited data will be transmitted to AWARE for visualization and consultation.



DSM 41.921886 12.467775 51.65



Investigated scenarios

3. **Weed vegetation:** weed vegetation represents a very serious danger for the affected ancient surfaces. The assess of the consistence of vegetation in the different periods of the year is useful to plan more specific maintenance activities. Also in this case, the use of **the drone equipped with RGB and IR camera** may reduce inspection costs. The detection of tufts of parietal vegetation is performed in Digital Twin environment and the data are then transmitted to AWARE for 3D visualization

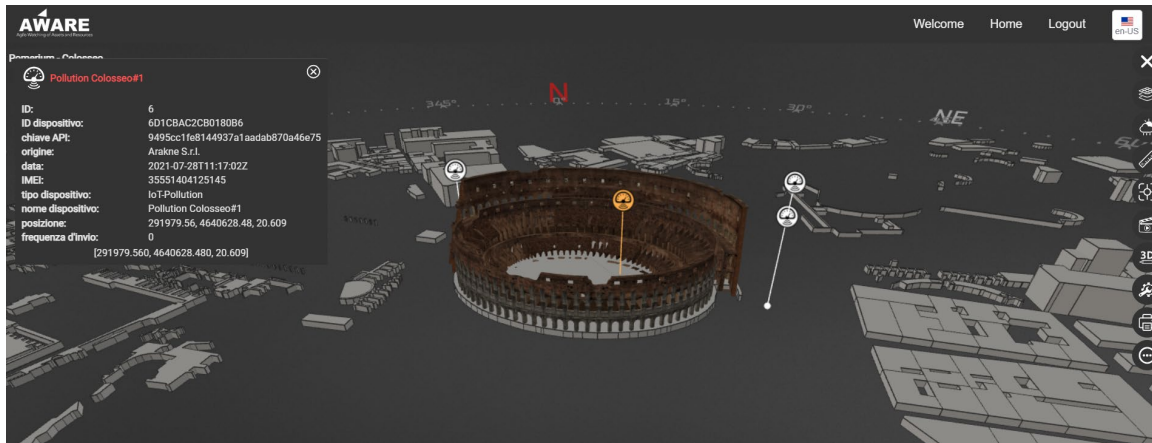


Editing interface

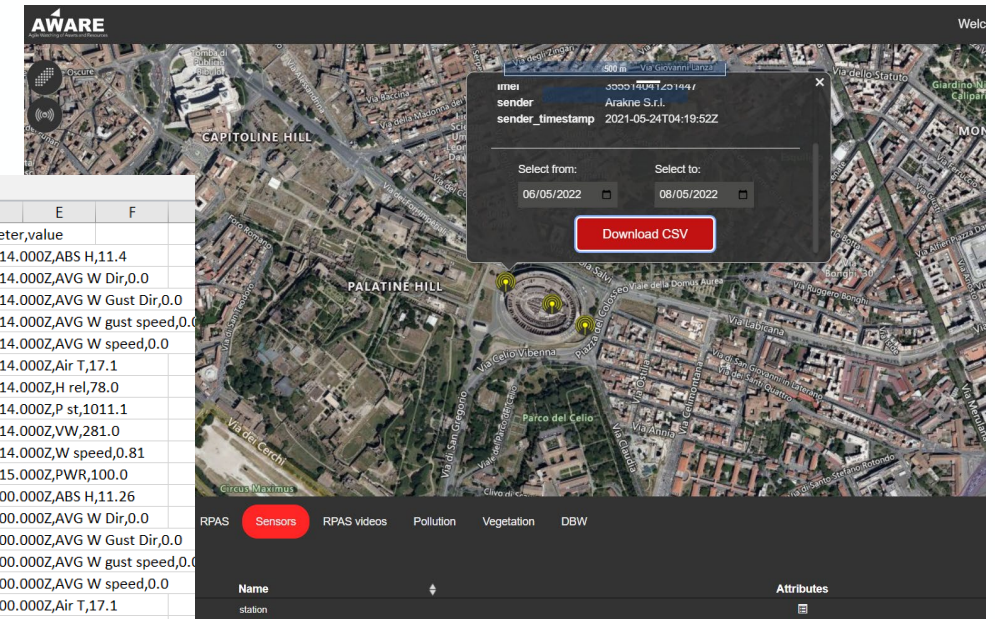


AWARE 3D environment

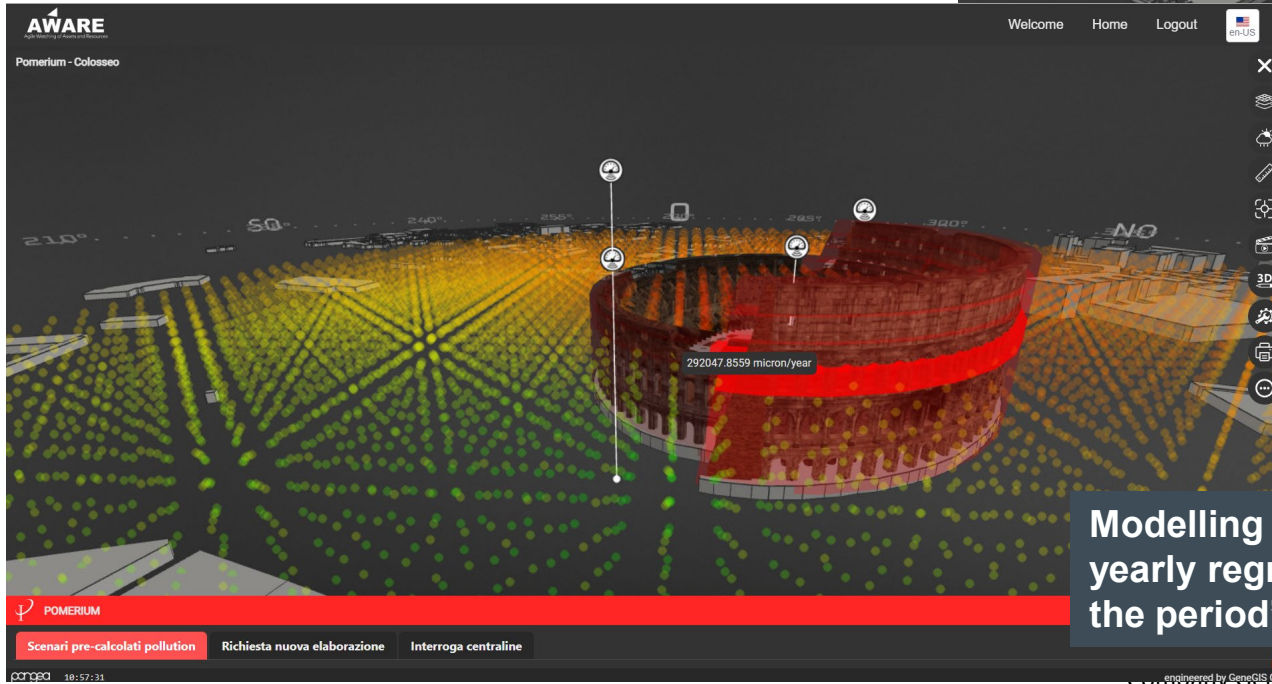
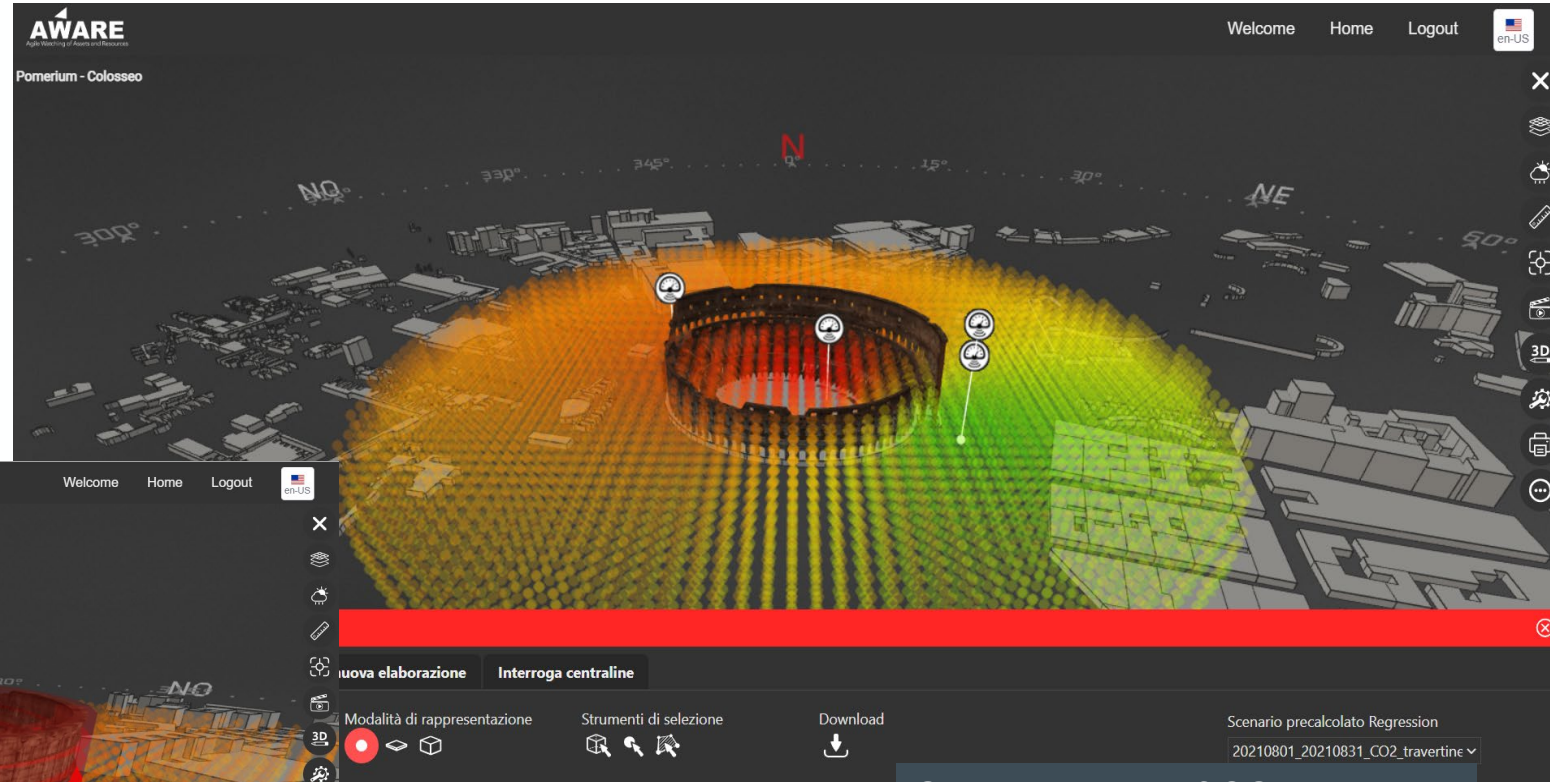
4. Air Pollution: Pollutants and chemical sprays are one of the most dangerous enemies for the CH exposed to urban environment. Through the integration of data coming from **IOT sensors on site** and a set of dedicated models, Pomerium is able to predict the dispersion of the pollutants around the monuments and the regression effects on the exposed stone surfaces (micron/year). Sensors are visible on AWARE and they can be queried by User. Acquired data are ready for visualization and download.



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Modelling of estimated travertine yearly regression under exposure to the period's concentrations of CO2.

Spazialization of CO2 dispersion around Colossum on Nov 2021 data.

4. **Air Pollution:** Pollutants and chemical sprays were also monitored by a mobile labotaroy, a set of AQ sensors mounted on a drone. Flights were performed over Tevere river. Results of pollution concentrations are visible on Digital Twin environment as a red point cloud . Pollutants of interest may be selected by a dedicated list.

NO2 point cloud

Pollutants

DRAW AREA

PAUSE MISSION

STOP MISSION

LAT: 41.901957
LON: 12.464801
ALT: 5.30m
SPEED: 0.00km/h
SAT: 12

Nitrogen Dioxide (NO2)

Nitrogen Dioxide (ppm): 0.179

External Temperature: 9.46°C

External Humidity: 85.13%

158.34m

DSM 41.903046 12.465959 47.22

POMERIUM Digital Twin VR PomeriumMixed VR

Pollutants selection menu

Pomerium aims to demonstrate the validity of a technical and methodological integrated approach to CH conservation.

The strengths of this approach are:

- **Unique point of access to different data sources and applicative capabilities (AWARE is developed according to applicative cooperation standards – OGC standard and API Gateway)**
- **2D and 3D contents management**
- **Virtual Reality environment**
- **Multi-technology approach for the deeper knowledge of the same phenomena**
- **Multiscale capability**
- **Multi data sources**
- **Modelling capabilities**
- **Dedicated instruments for data analysis**
- **Modularity, scalability and**
- **OGC standard product**

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Thanks for your attention

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