Rheticus® Safeland :
New Frontiers in Multi-Risk Management

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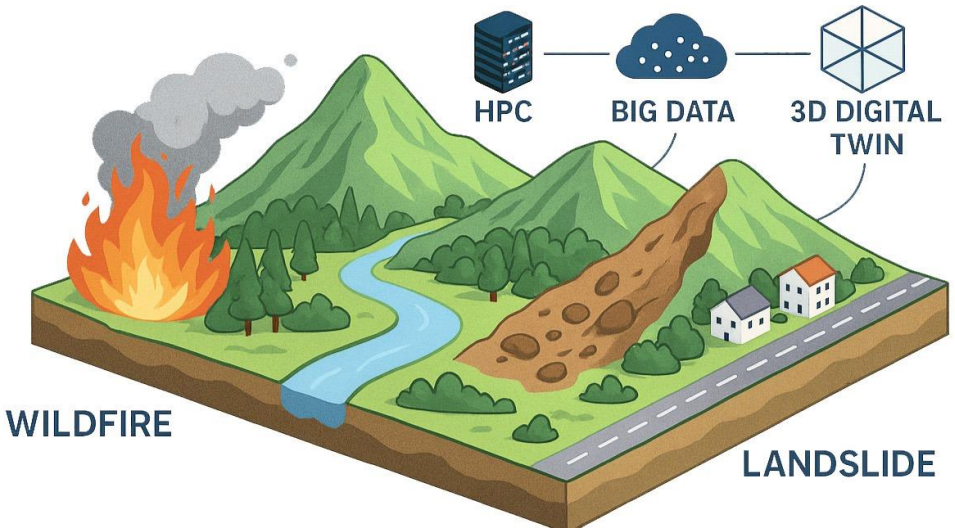
BiDS | BIG DATA FROM SPACE 2025
29 SEPTEMBER – 3 OCTOBER 2025 RIGA, LATVIA
Societal Applications: Risk, Resilience and Resource Monitoring

Riga, October 3th, 2025

INTRODUCTION

Rheticus® Safeland employs **HPC, big data and 3D Digital Twin model** to monitor territories susceptible to **landslides and fires.**



The service offers a dynamic and integrative view of landscape, enabling the identification of critical zones and supporting multi-risk mitigation strategies.

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Finanziato dall'Unione europea NextGenerationEU | Ministero dell'Università e della Ricerca | Italiadomani | ICSC Centro Nazionale di Ricerca in HPC, Big Data and Quantum Computing | Università degli Studi di Bari Aldo Moro

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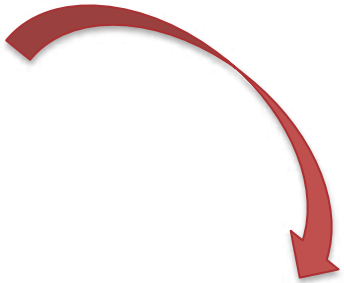
Planetek Italia developed Rheticus® Safeland under the National Recovery and Resilience Plan(PNRR), within the AI-LAND initiative of the "Environment Natural Disasters" Project by the National Centre for HPC, Big Data and Quantum Computing, funded by the EU-NextGenerationEU.



sfera informatica

In this context, geo-analytical indicators generated by the Rheticus® Safeland service, are integrated into an interactive 3D environment, constituting a 3D Digital Twin of the territory, supporting predictive analysis and risk management strategies in complex scenarios.

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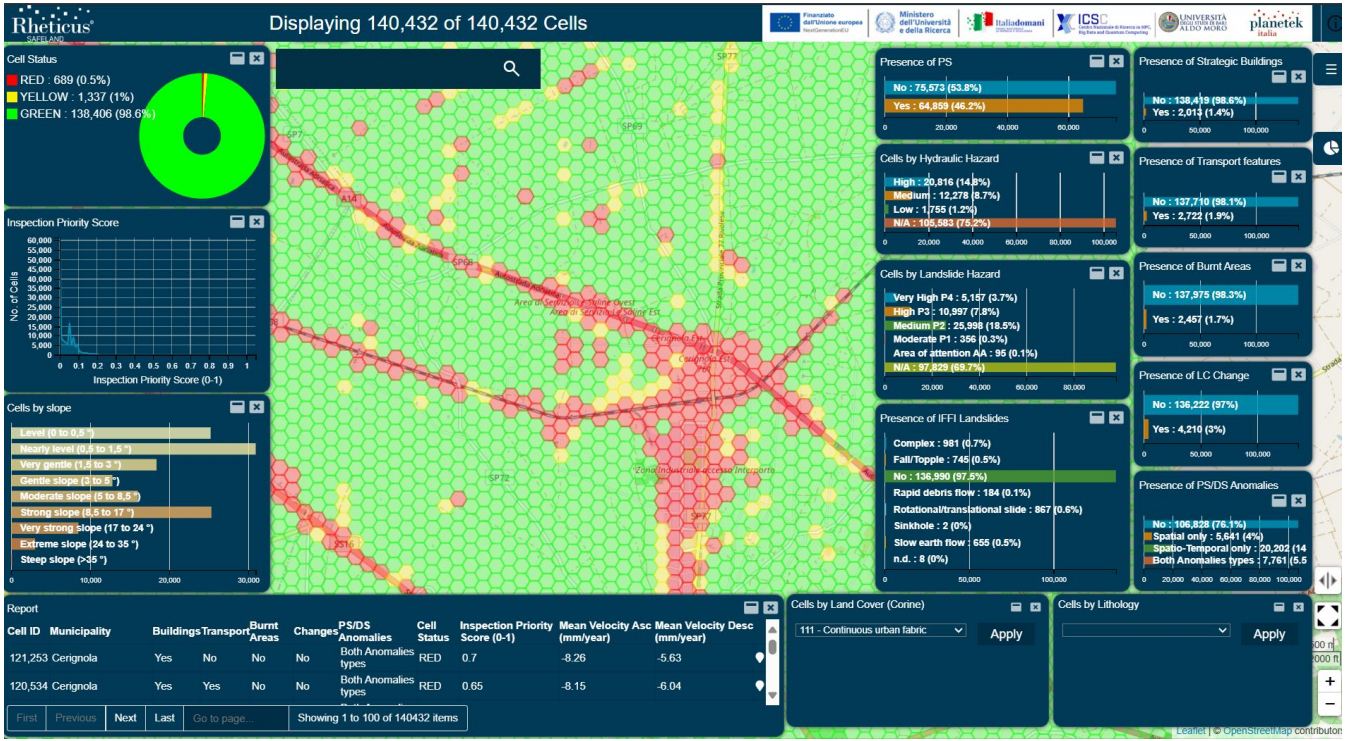
RHETICUS SAFELAND : SERVICE DESCRIPTION



IPS

↓

GEOSPATIAL DATA SOURCES

↓

AMPLIFICATION FACTORS

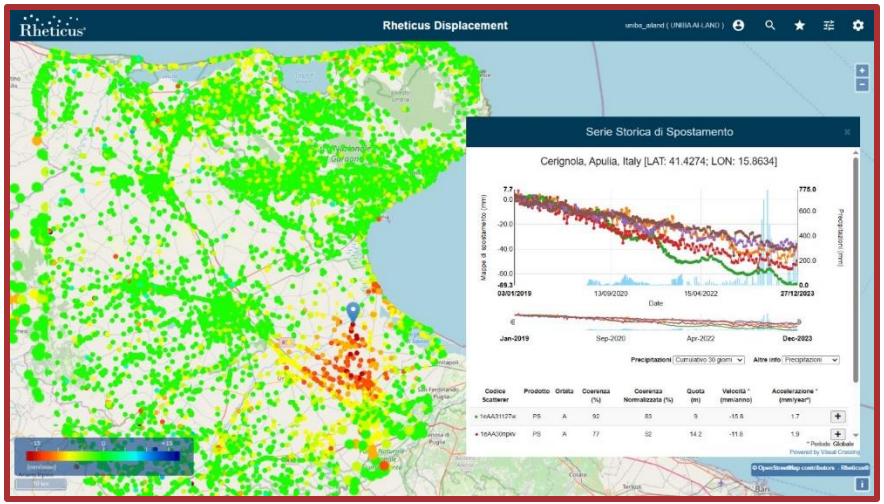
Territorial segmentation is based on a grid of hexagonal cells. These cells are classified by automatic procedures based on the analysis that assess displacement trends and anomaly patterns. Each cell is assigned an attention level calculated by an Inspection Priority (IPS) score used to rank inspection urgency. IPS can vary between 0 and 1.

CELL RANKING METHODOLOGY TO ESTIMATE THE LEVEL OF ATTENTION

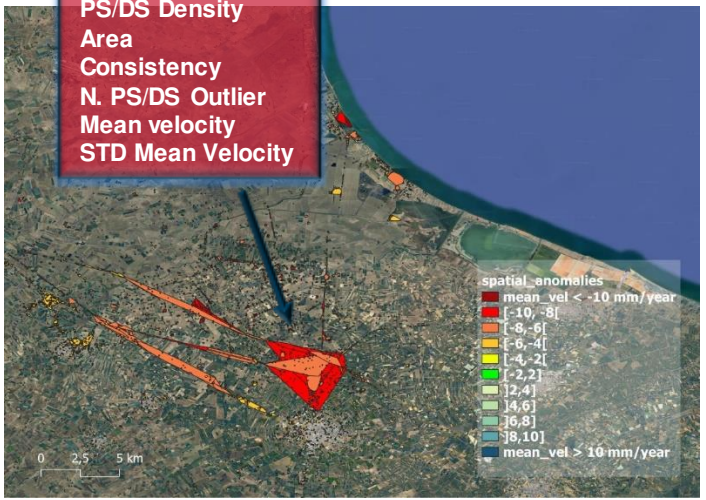
ISPECTION PRIORITY SCORE

GEOSPATIAL DATA

SPATIAL ANOMALIES



Cluster ID
PS/DS Number
PS/DS Density
Area
Consistency
N. PS/DS Outlier
Mean velocity
STD Mean Velocity



The identification of unstable areas is based on the analysis of mean displacement velocity values of Persistent Scatterers (PS) and Distributed Scatterers (DS), measured along the Line of Sight (LOS) and extracted from the EGMS geoportal.

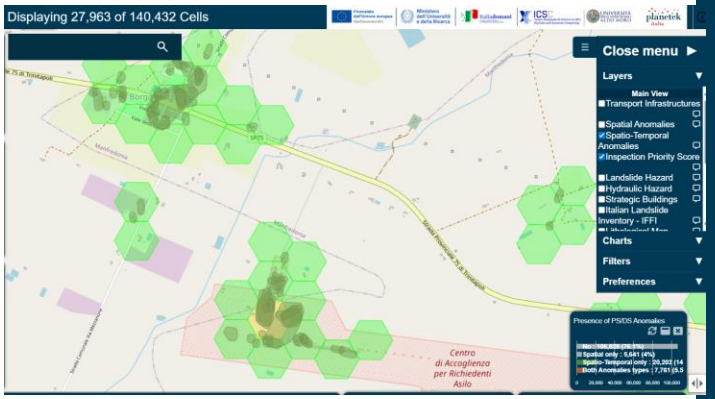
CELL RANKING METHODOLOGY TO ESTIMATE THE LEVEL OF ATTENTION

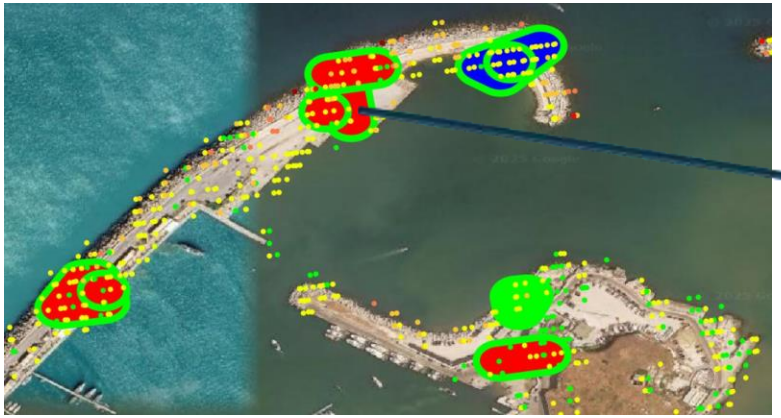
ISPECTION PRIORITY SCORE

GEOSPATIAL DATA

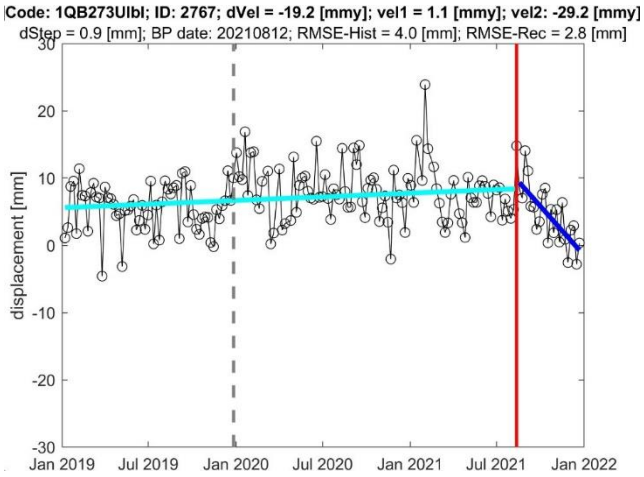
SPATIAL ANOMALIES

SPATIO TEMPORAL ANOMALIES





- Cluster ID
- PS/DS Number
- PS/DS Density
- Area
- Consistency
- N. PS/DS Outlier
- Mean vel 1
- Mean vel 2
- Mean dvel
- Mean dstep
- Mean_when



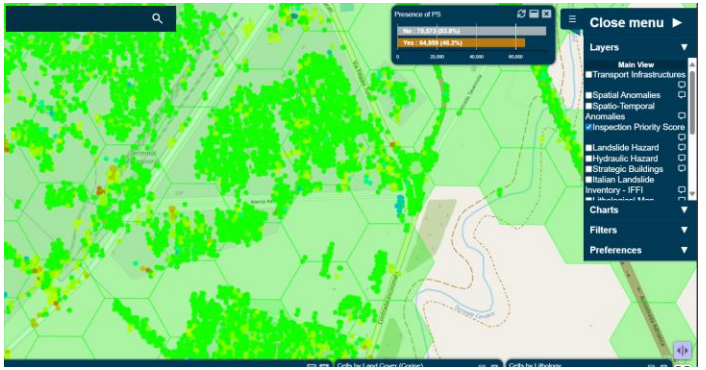
Identified by the analysis of displacement time series of Persistent Scatterers (PS) and Distributed Scatterers (DS) along the Line of Sight (LOS), extracted from the EGMS geoportal. For each acquisition geometry, the first step involves detecting temporal anomalies by identifying breakpoints that appear in the most recent segment of the time series. These breakpoints represent either changes in displacement velocity or abrupt shifts (also referred to as steps), which are temporally well-defined and easily identifiable.

CELL RANKING METHODOLOGY TO ESTIMATE THE LEVEL OF ATTENTION

ISPECTION PRIORITY SCORE

GEOSPATIAL DATA

- SPATIAL ANOMALIES
- SPATIO TEMPORAL ANOMALIES
- **ISOLATED PS/DS**



Isolated PS/DS, i.e., measurement points that do not fall within the clusters of anomalies: PS/DS that do not generate spatial/spatio-temporal anomalies. It is planned to use the displacement time series obtained along the LOS (Line of Sight) and extracted from the EGMS geoportal

CELL RANKING METHODOLOGY TO ESTIMATE THE LEVEL OF ATTENTION

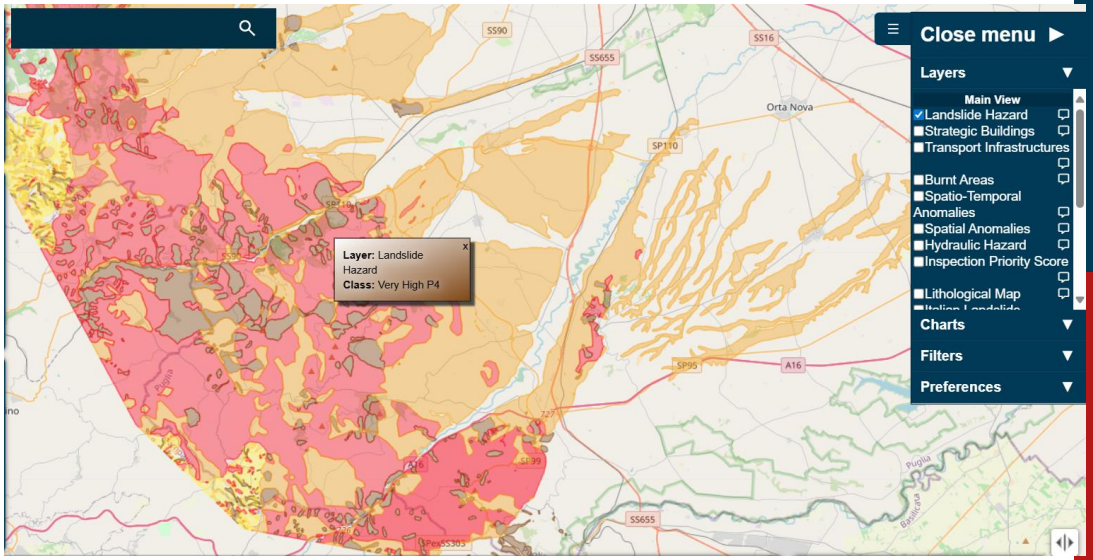
ISPECTION PRIORITY SCORE

GEOSPATIAL DATA

- SPATIAL ANOMALIES
- SPATIO TEMPORAL ANOMALIES
- ISOLATED PS/DS

AMPLIFICATION FACTORS

- LANDSLIDE HAZARD



CELL RANKING METHODOLOGY TO ESTIMATE THE LEVEL OF ATTENTION

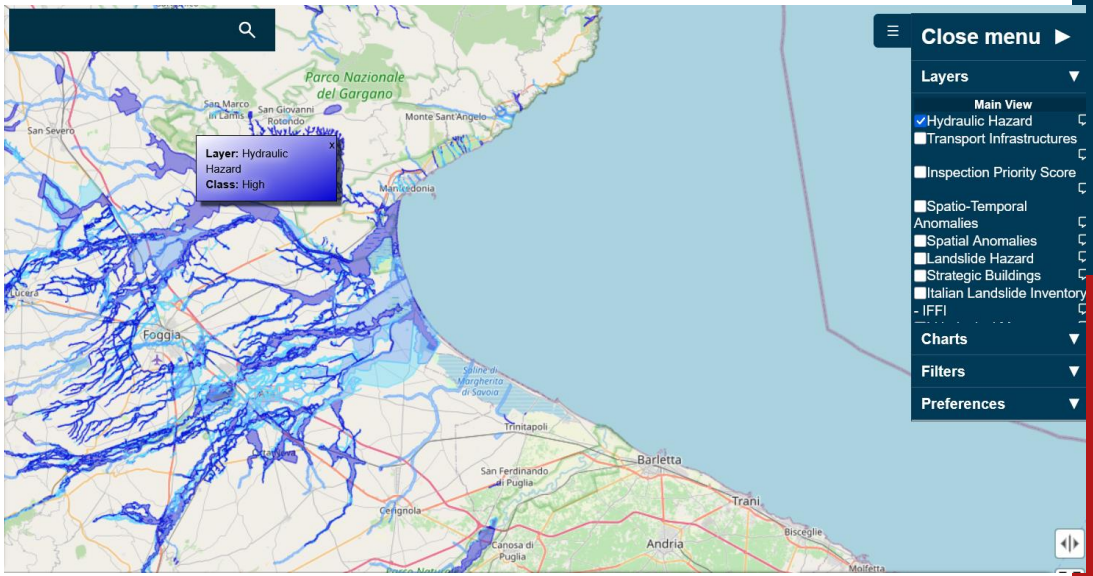
ISPECTION PRIORITY SCORE

GEOSPATIAL DATA

- SPATIAL ANOMALIES
- SPATIO TEMPORAL ANOMALIES
- ISOLATED PS/DS

AMPLIFICATION FACTORS

- LANDSLIDE HAZARD
- HYDRAULIC HAZARD

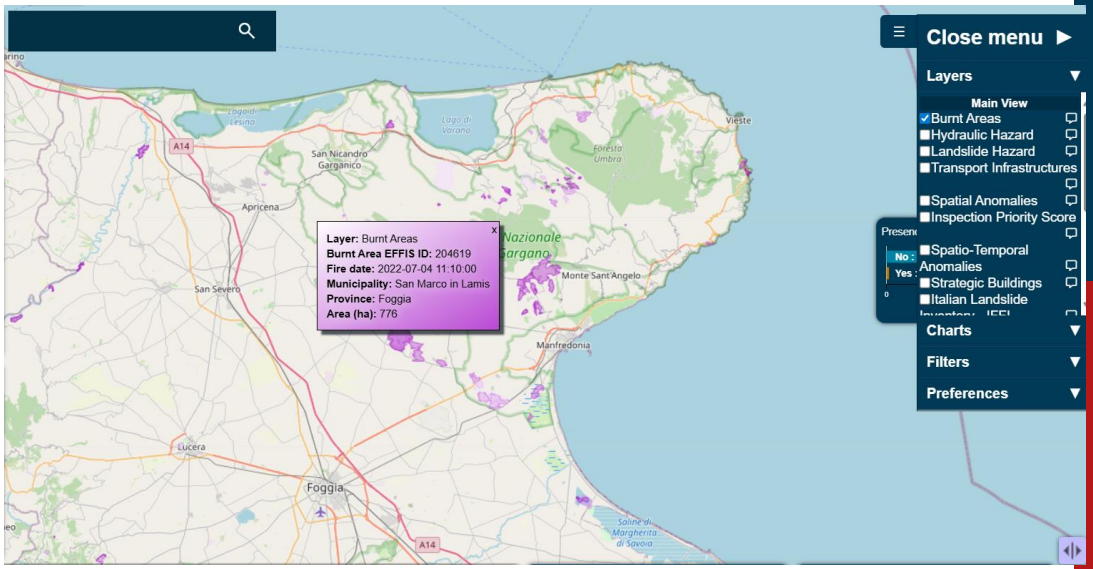


CELL RANKING METHODOLOGY TO ESTIMATE THE LEVEL OF ATTENTION

ISPECTION PRIORITY SCORE

GEOSPATIAL DATA
- SPATIAL ANOMALIES
- SPATIO TEMPORAL ANOMALIES
- ISOLATED PS/DS

AMPLIFICATION FACTORS
- LANDSLIDE HAZARD
- HYDRAULIC HAZARD
- BURNED AREA



CELL RANKING METHODOLOGY TO ESTIMATE THE LEVEL OF ATTENTION

ISPECTION PRIORITY SCORE

GEOSPATIAL DATA

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AMPLIFICATION FACTORS

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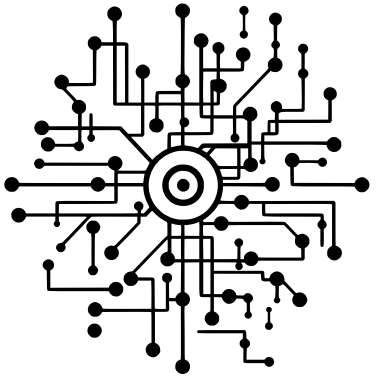
- BURNED AREA



Ordered Weighted Averaging
OWA

A technique that allows multiple factors to be aggregated taking into account a flexible weighting criterion. OWA assigns weights to different information layers based on their relevance in determining the level of attention of a cell, ensuring a balanced approach across different data sources.

CELL RANKING METHODOLOGY TO ESTIMATE THE LEVEL OF ATTENTION

ISPECTION PRIORITY SCORE

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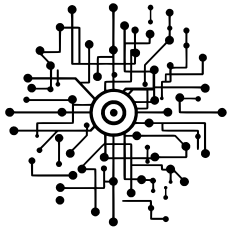
- ISOLATED PS/DS

AMPLIFICATION FACTORS

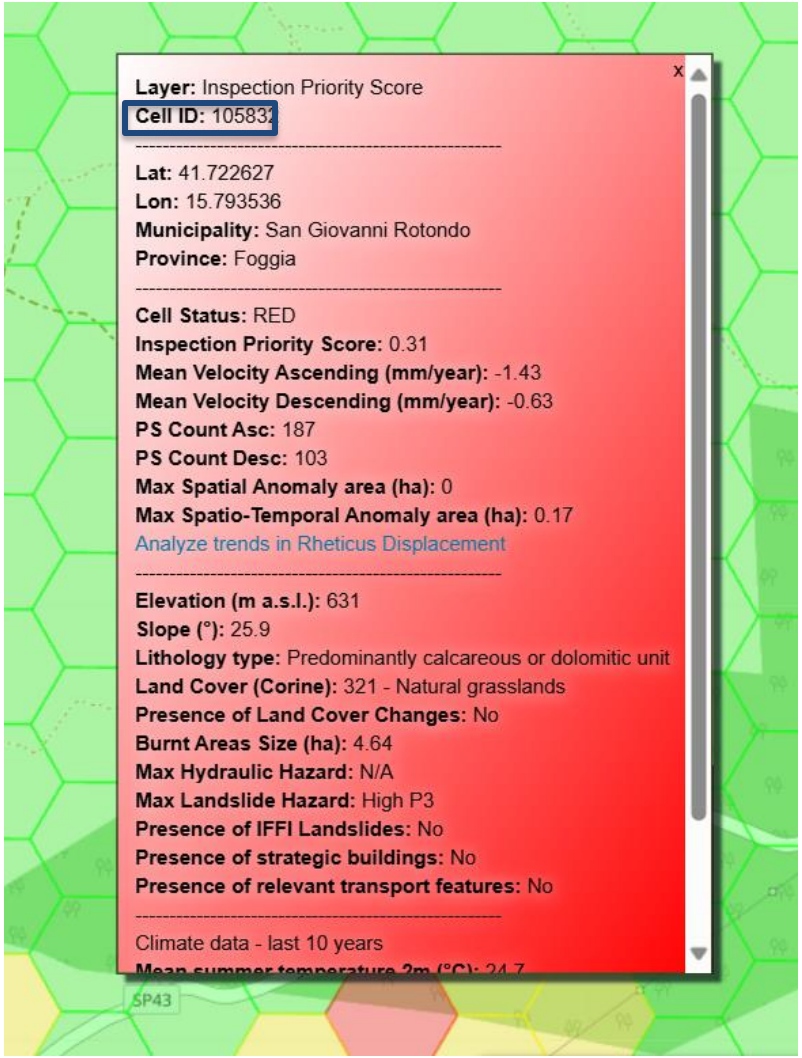
- LANDSLIDE HAZARD
- HYDRAULIC HAZARD
- BURNED AREA



OWA

- LOW: Stable,no intervention needed;
- MODERATE: Potential instability, monitoring advised;
- HIGH: High-risk, inspection required.

RHETICUS SAFELAND : SERVICE DESCRIPTION



EACH CELL IS QUERYABLE AND PROVIDES INFORMATION SUCH AS:

- **Unique cell identifier**

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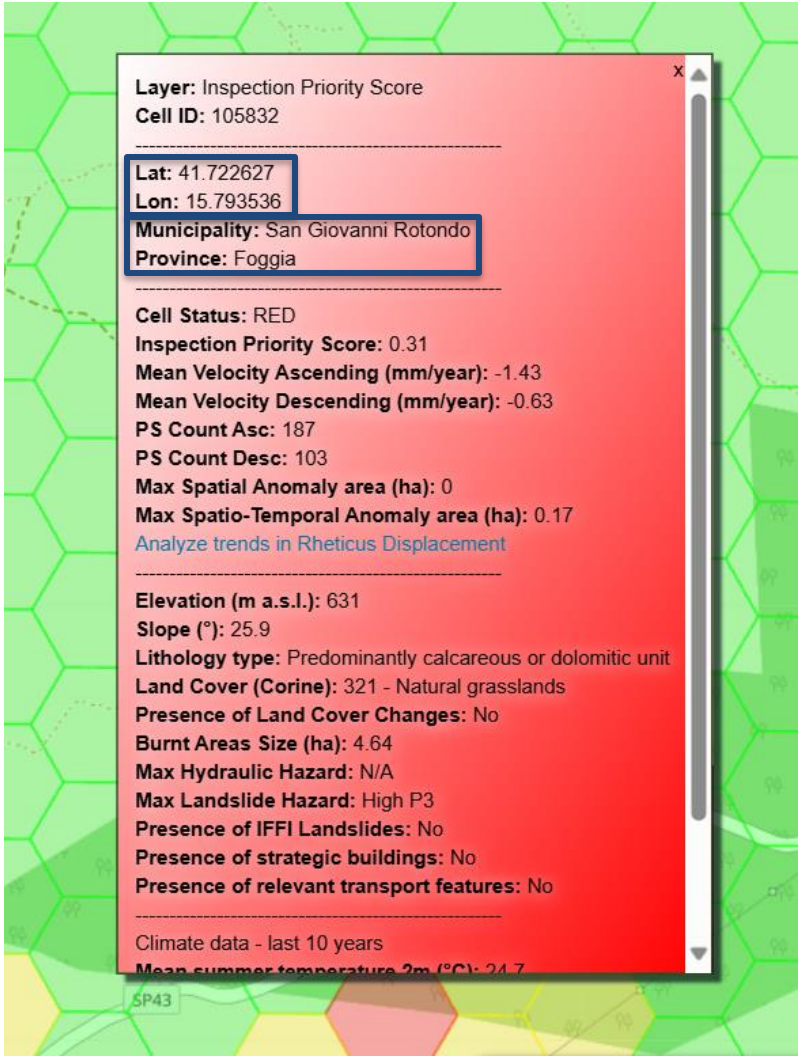

EACH CELL IS QUERYABLE AND PROVIDES INFORMATION SUCH AS:

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- **Geographical coordinates (latitude, longitude)**
- **Municipality and Province**

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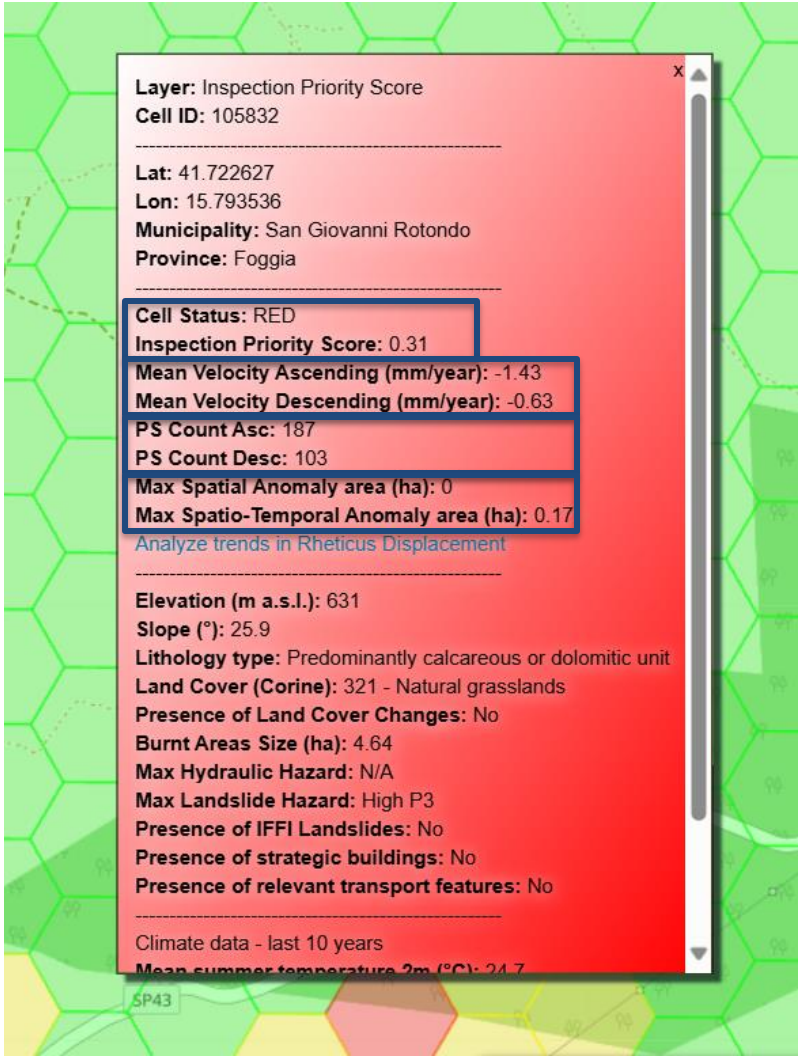

EACH CELL IS QUERYABLE AND PROVIDES INFORMATION SUCH AS:

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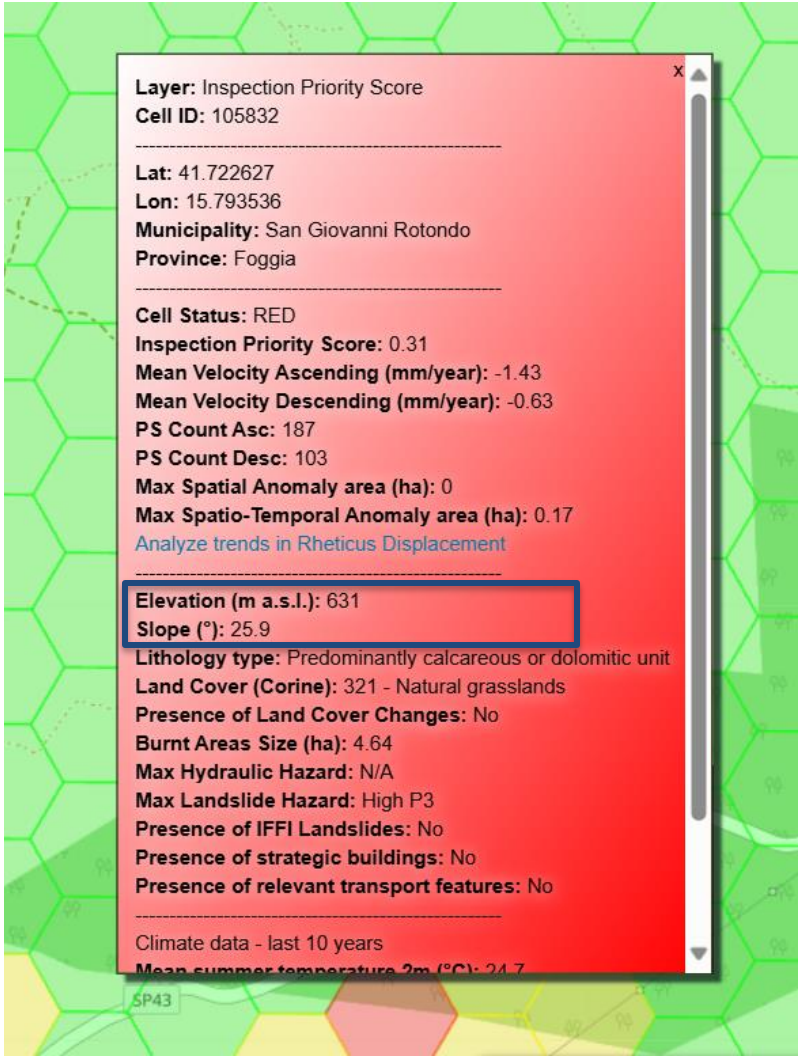
- Municipality and Province
- Inspection Priority Score and Attention level class
- Average speed
- Number of PS/DS
- Area of spatial/spatio-temporal anomaly cluster

RHETICUS SAFELAND : SERVICE DESCRIPTION



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- Number of PS/DS
- Area of spatial/spatio-temporal anomaly cluster
- Altitude and class of slope

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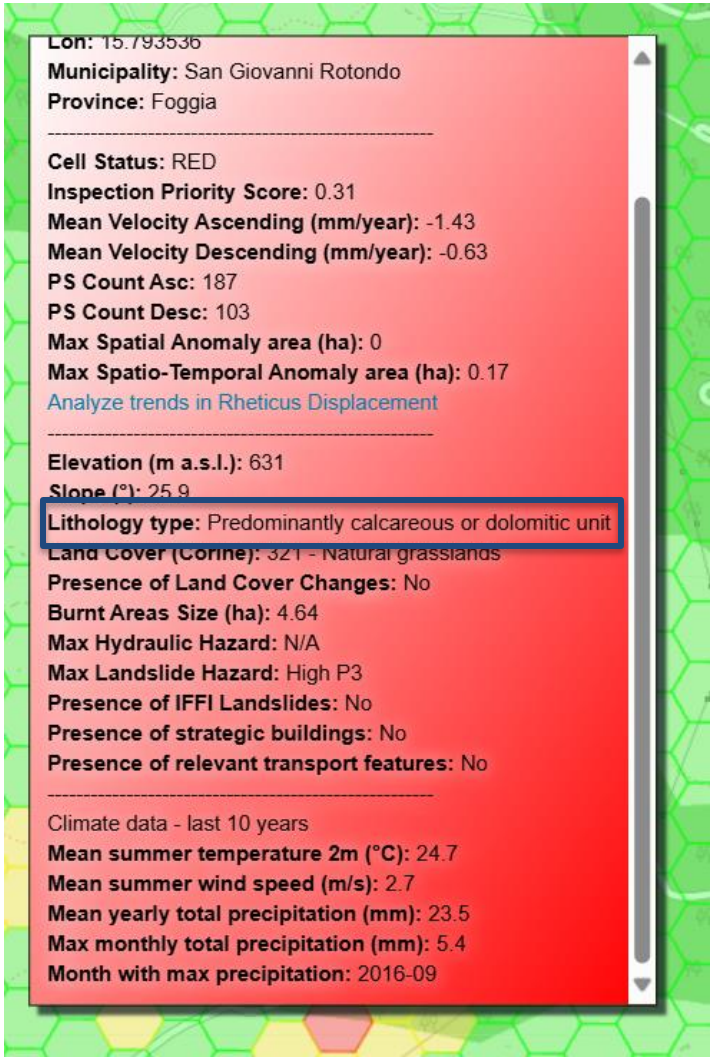

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- Inspection Priority Score and Attention level class
- Average speed
- Number of PS/DS
- Area of spatial/spatio-temporal anomaly cluster
- Altitude and class of slope
- Lithology type

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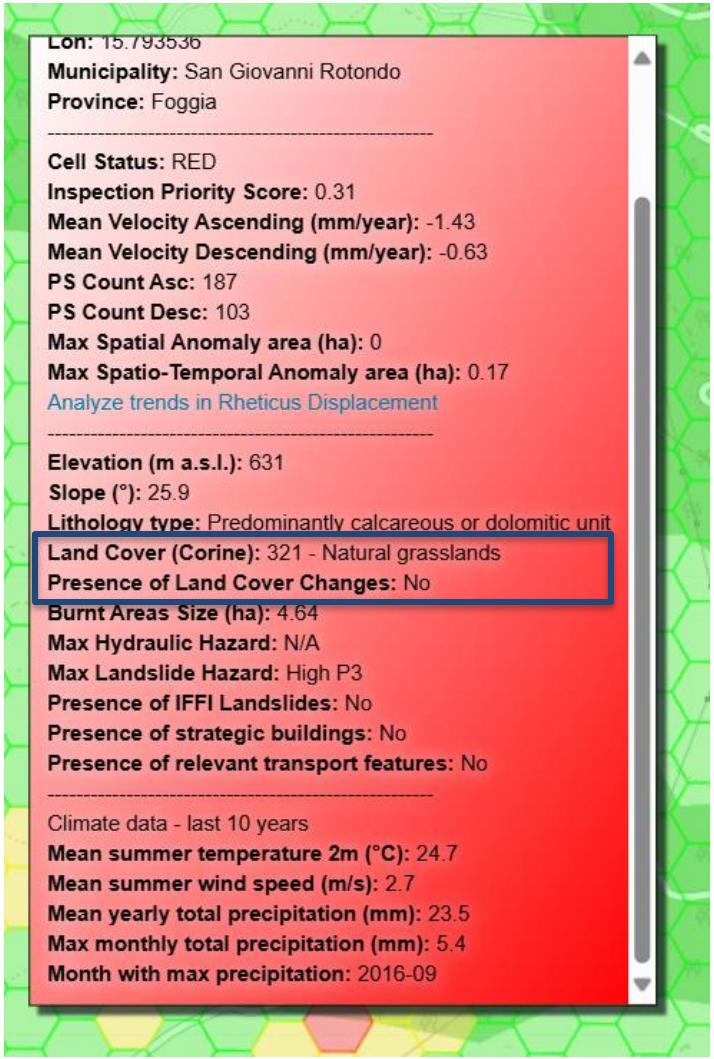

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- Average speed
- Number of PS/DS
- Area of spatial/spatio-temporal anomaly cluster
- Altitude and class of slope
- Lithology type
- Land cover and land cover changes

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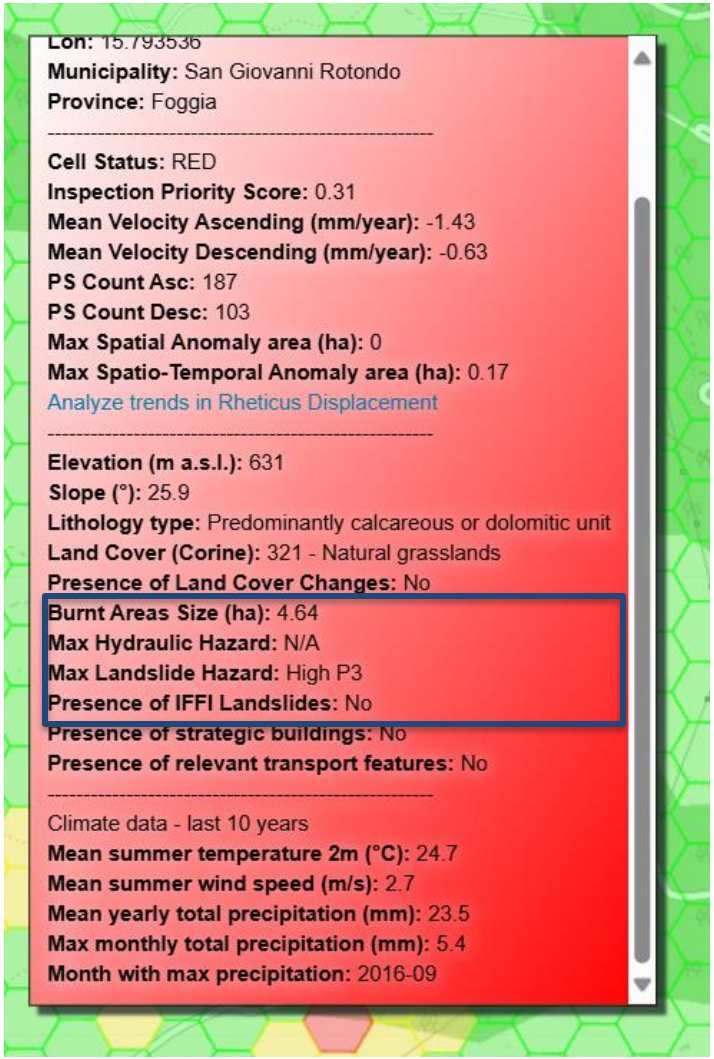

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- Average speed
- Number of PS/DS
- Area of spatial/spatio-temporal anomaly cluster
- Altitude and class of slope
- Lithology type
- Land cover and land cover changes
- Burned Areas Size
- Hydraulic and Landslide hazard
- Presence of landslides

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- Hydraulica and Landslide hazard
- Presence of landslides
- Presence of strategic buildings and infrastructures

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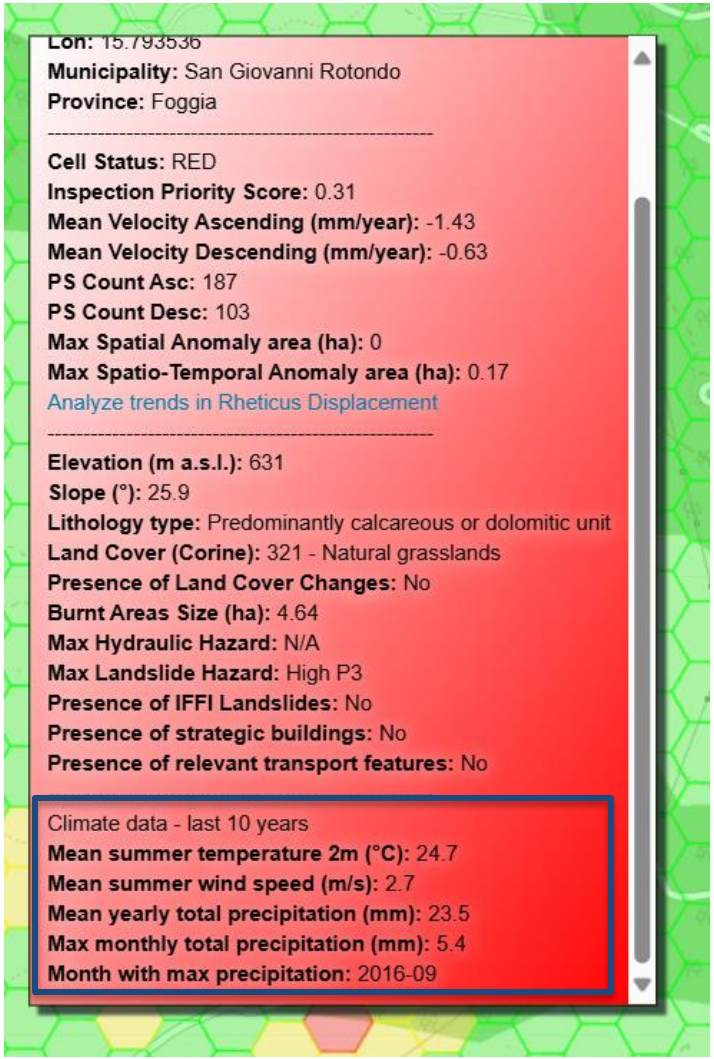

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- Number of PS/DS
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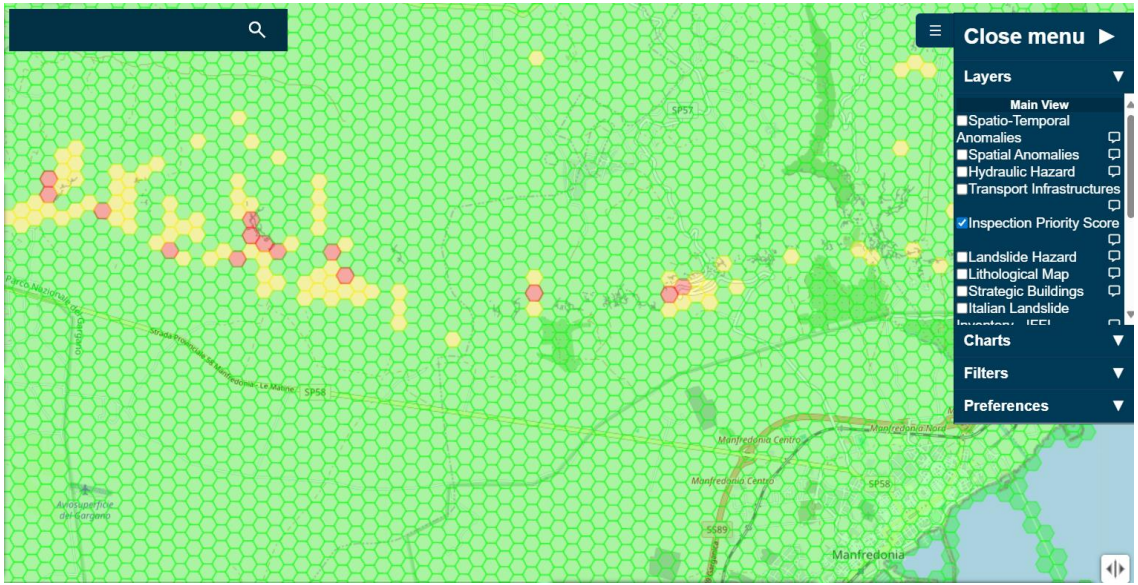
- Altitude and class of slope
- Lithology type
- Land cover and land cover changes
- Burned Areas Size
- Hydraulic and Landslide hazard
- Presence of landslides
- Presence of strategic buildings and infrastructures
- Climate data

INFORMATION LAYERS:

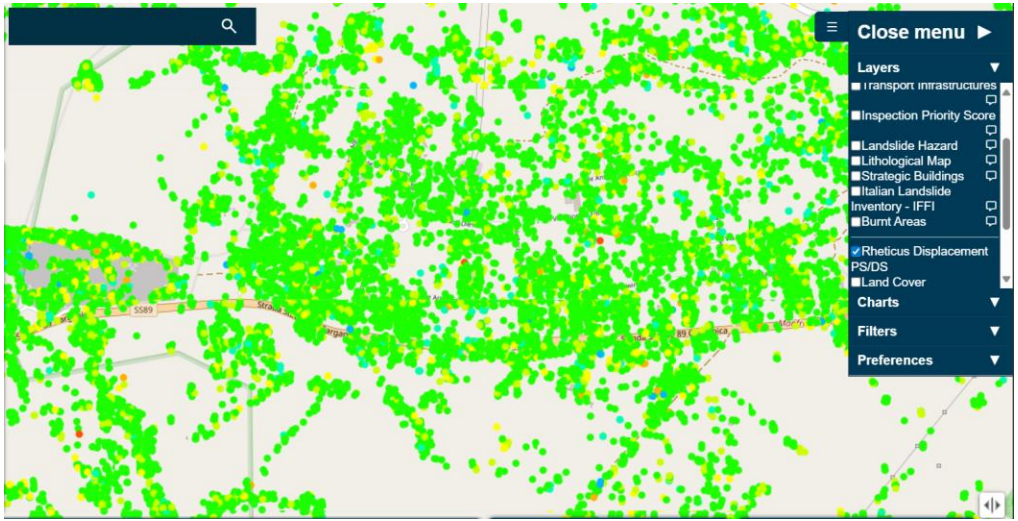
Cells themed through IPS



RHETICUS SAFELAND : SERVICE DESCRIPTION

INFORMATION LAYERS:

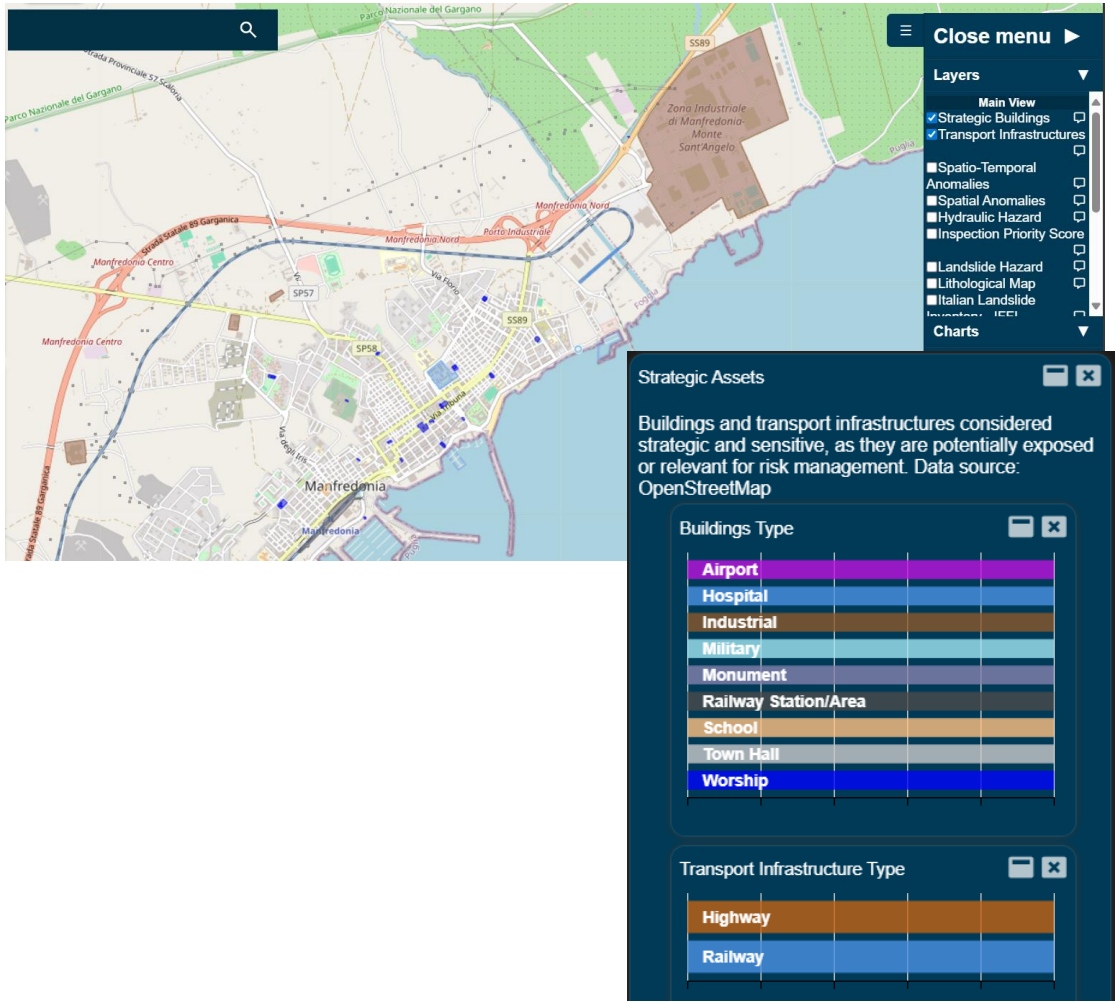
- Cells themed through IPS
- Clusters of spatial anomalies and spatio-temporal anomalies
- Ground motion data (PS/DS)



RHETICUS SAFELAND : SERVICE DESCRIPTION

INFORMATION LAYERS:

- Cells themed through IPS
- Clusters of spatial anomalies and spatio-temporal anomalies
- Ground motion data (PS/DS)
- Strategic assets(buildings, roads, railways)



RHETICUS SAFELAND : SERVICE DESCRIPTION

INFORMATION LAYERS:

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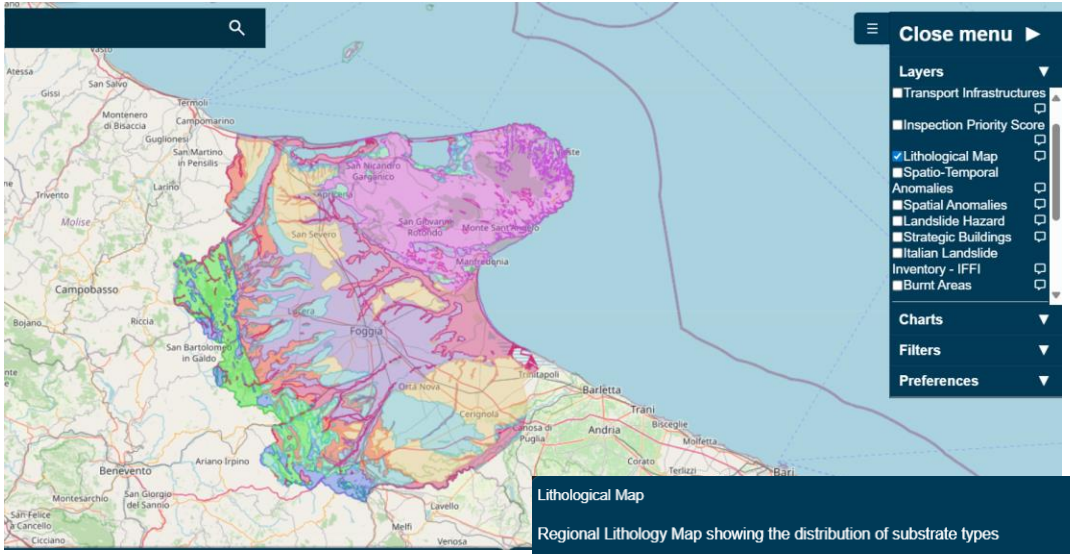
- Clusters of spatial anomalies and spatio-temporal anomalies
- Ground motion data (PS/DS)
- Strategic assets(buildings, roads, railways)
- Lithological mapping



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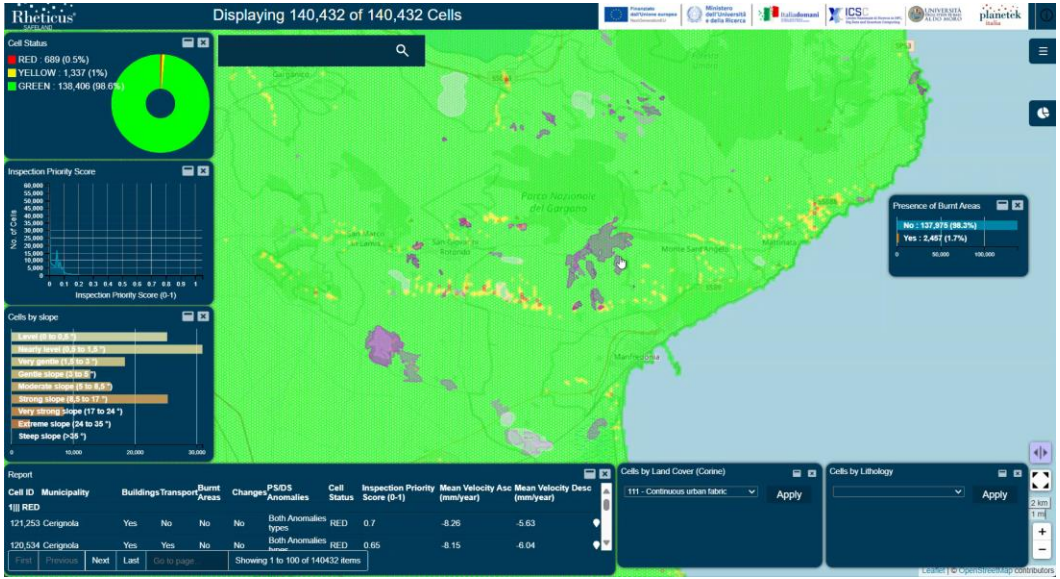
- Lithological mapping
- Burned areas



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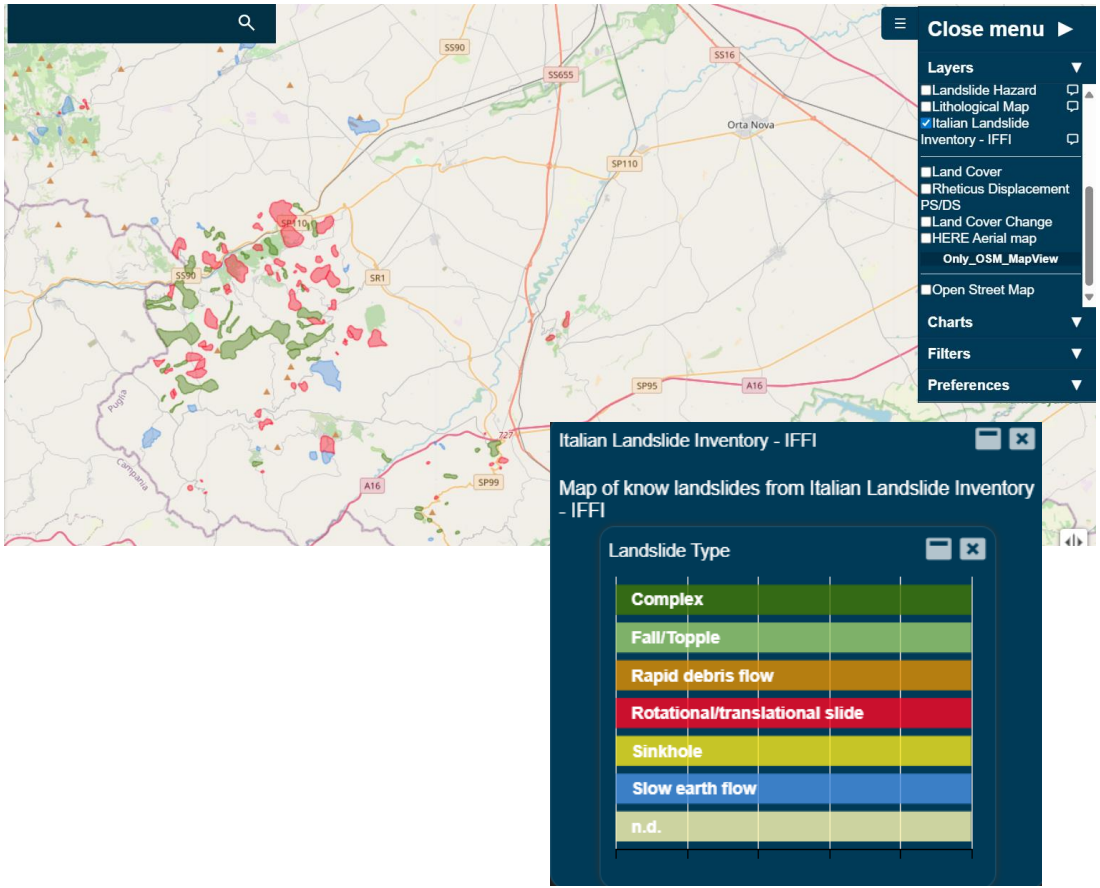
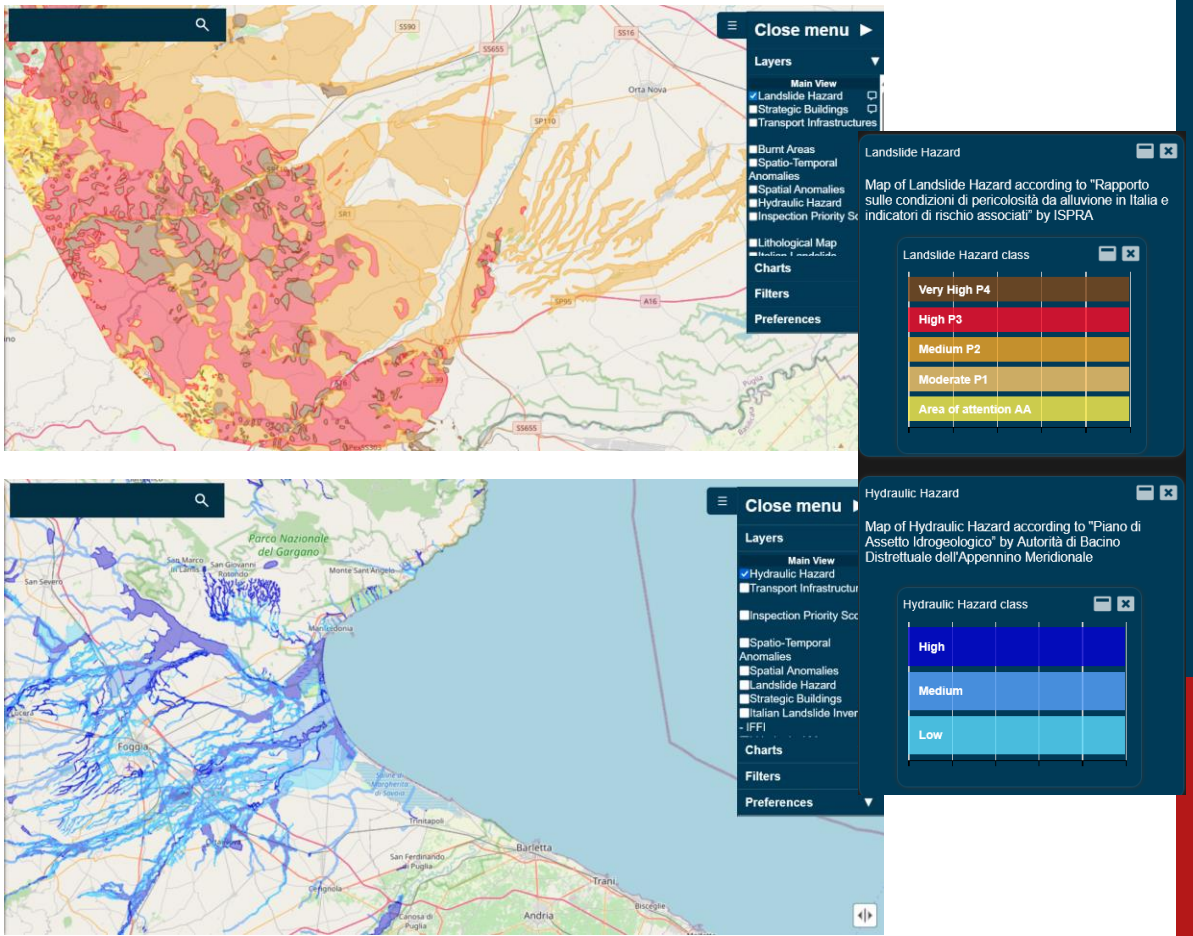
- Strategic assets(buildings, roads, railways)
- Lithological mapping
- Burned areas
- Landslides IFFI



RHETICUS SAFELAND : SERVICE DESCRIPTION

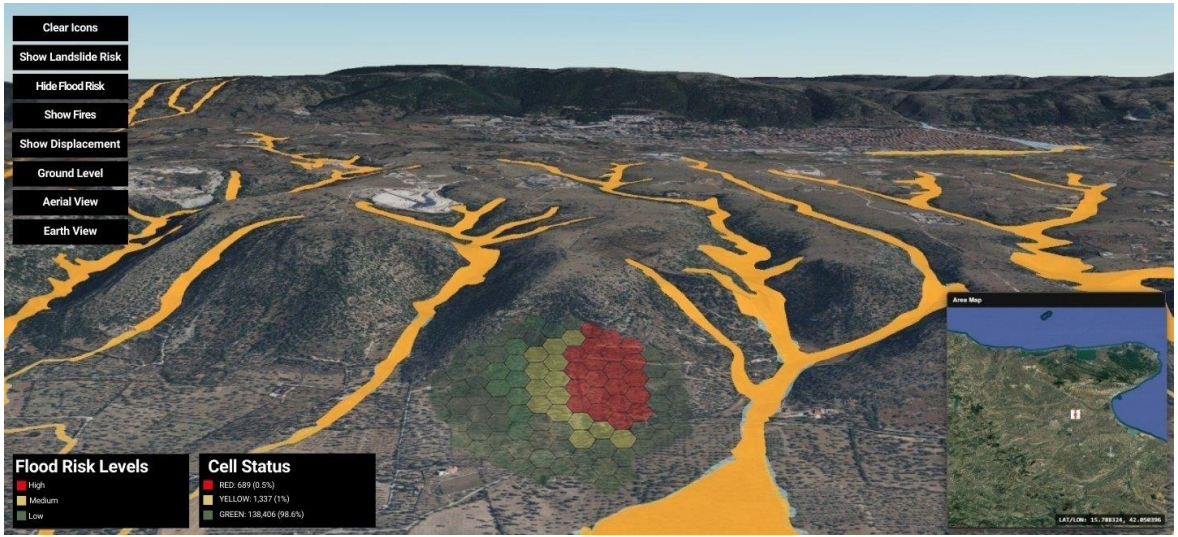
INFORMATION LAYERS:

- Cells themed through IPS
- Clusters of spatial anomalies and spatio-temporal anomalies
- Ground motion data (PS/DS)
- Strategic assets(buildings, roads, railways)
- Lithological mapping
- Burned areas
- Landslides IFFI
- Landslide and hydraulic hazard
- Land cover/Land cover change



3D DIGITAL TWIN MODEL

Geo-analytical indicators generated by the Rheticus ® Safeland service, are integrated into an interactive 3D environment, constituting a 3D Digital Twin of the territory, supporting predictive analysis and risk management strategies in complex scenarios. The advanced 3D interface fuses geospatial, environmental, and topographic data to monitor and forecast hydrogeomorphological and fire-related phenomena.

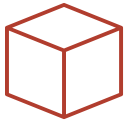


CONCLUSION

The service delivers **timely and detailed information** to support **regulators** and **decision-makers**.

The **IPS algorithm** helps **detect critical zones early** and supports **smart prioritization** of interventions.

Multiple data sources (**interferometric, topographic, hazard, environmental**) are **integrated** into one system.



The **3D Digital Twin** offers a **comprehensive view** of both **current** and **future** risk conditions.

The approach enables **proactive planning**, **efficient resource allocation**, and **multi-risk management**.

Thank you for your attention

Anita Sblano, a.sblano@planetek.it

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29 SEPTEMBER – 3 OCTOBER 2025 RIGA, LATVIA

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