

Centri urbani tra alluvioni e siccità

ripensare la città in funzione del cambiamento climatico



venerdì
4 aprile
2025
Ancona

GeoAI: nuovi approcci di monitoraggio e modelli previsionali per la prevenzione del rischio digitalizzazione e intelligenza artificiale

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"If you do what you've always done, you'll get what you've always gotten."

Henry Ford ?



COMPUTER
SCIENCE

GEOMATICS

Geomatics is defined in the [ISO/TC 211](#) series of standards as the "[discipline](#) concerned with the collection, distribution, storage, analysis, processing, presentation of [geo data or geo information](#)". Under another definition, it "consists of products, services and tools involved in the collection, integration and management of geographic data".

Geospatial Sciences

Wikipedia

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<http://www.gapgeomatica.it>



Eva



Roberto



Francesco



Stefano



Mattia



Lucrezia



Nikhil



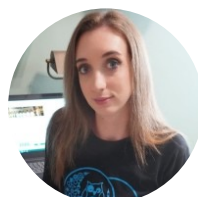
Marsia



Jonatan



Bojana



Giada



@GAP_UNIVPM

Master Degree
Building engineer
and architecture



PhD
Informatics
Engineering



Adjunct professor
Forestry
Statistics
Geomatics



Startupper
SMI founder



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Il ruolo della GeoAI

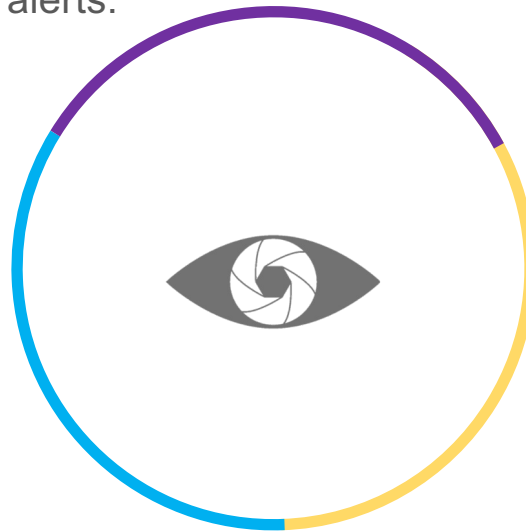
Enables real-time analysis of satellite and sensor data to accurately map flood-prone areas. It supports early warning systems by predicting flood risks and triggering timely alerts.

Il ruolo del GIS

GIS integrate spatial data to visualize flood extents, vulnerable zones, and infrastructure at risk. They support decision-making by enabling dynamic mapping and analysis of flood scenarios and response strategies.

Il ruolo della XR

Helping stakeholders understand risks and plan responses more effectively. XR and simulation enable interactive training, virtual drills, and scenario testing for enhanced disaster preparedness.



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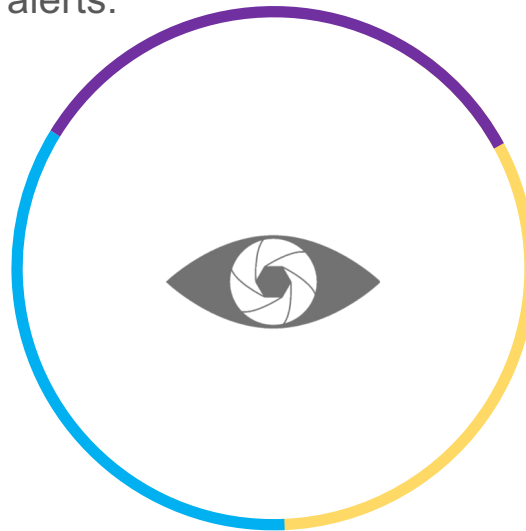
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Space intelligence (Spatial AI) - the ability to process visual data, make predictions and act upon those predictions

Fei Fei Lee

Geo-spatial intelligence - geospatial intelligence is intelligence about the human activity on Earth derived from the exploitation and analysis of imagery, signals, or signatures with geospatial information

GEOINT - USA

Semantic understanding - the capability to interpret data of a scene starting from 2D/3D sensors

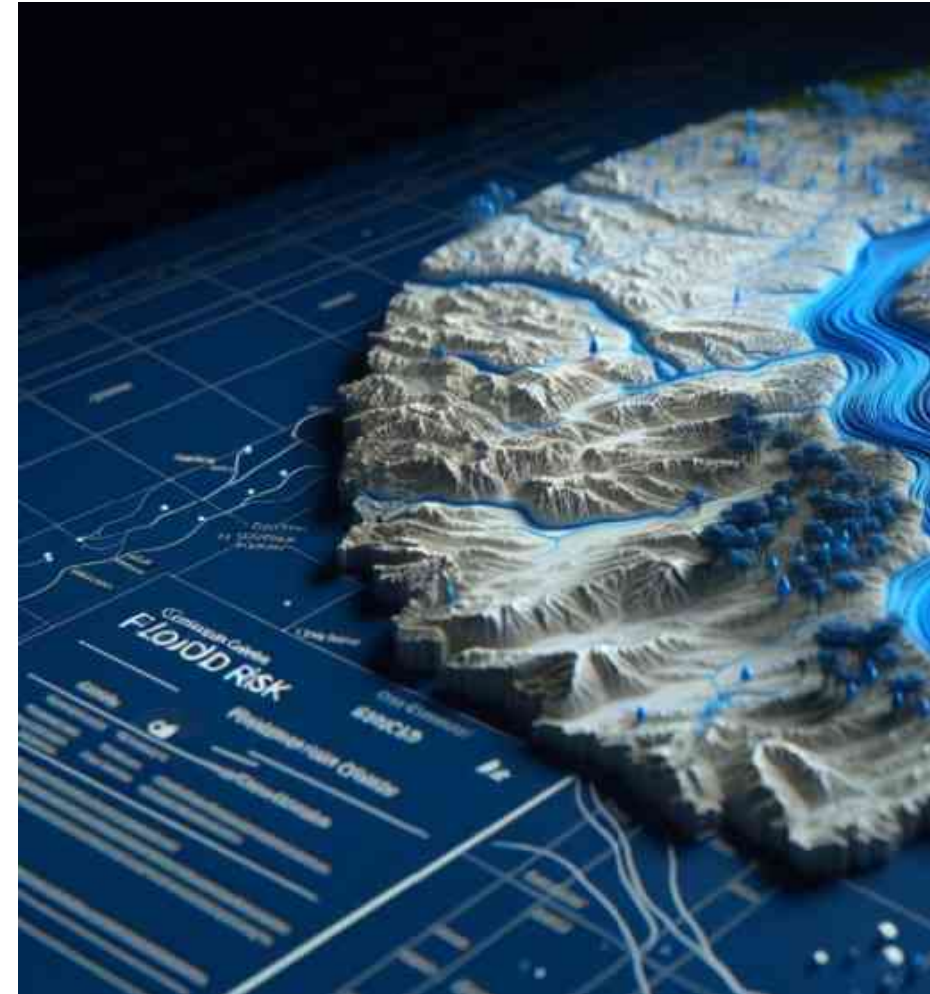
ISPRS

Digital Twin - A digital twin is a virtual model of a physical object. It spans the object's lifecycle and uses real-time data sent from sensors on the object to simulate the behavior and monitor operations.

Amazon

Knowledge representation - Prior knowledge integration helps identify semantic entities and their relationships in a graphical representation

NeurIPS

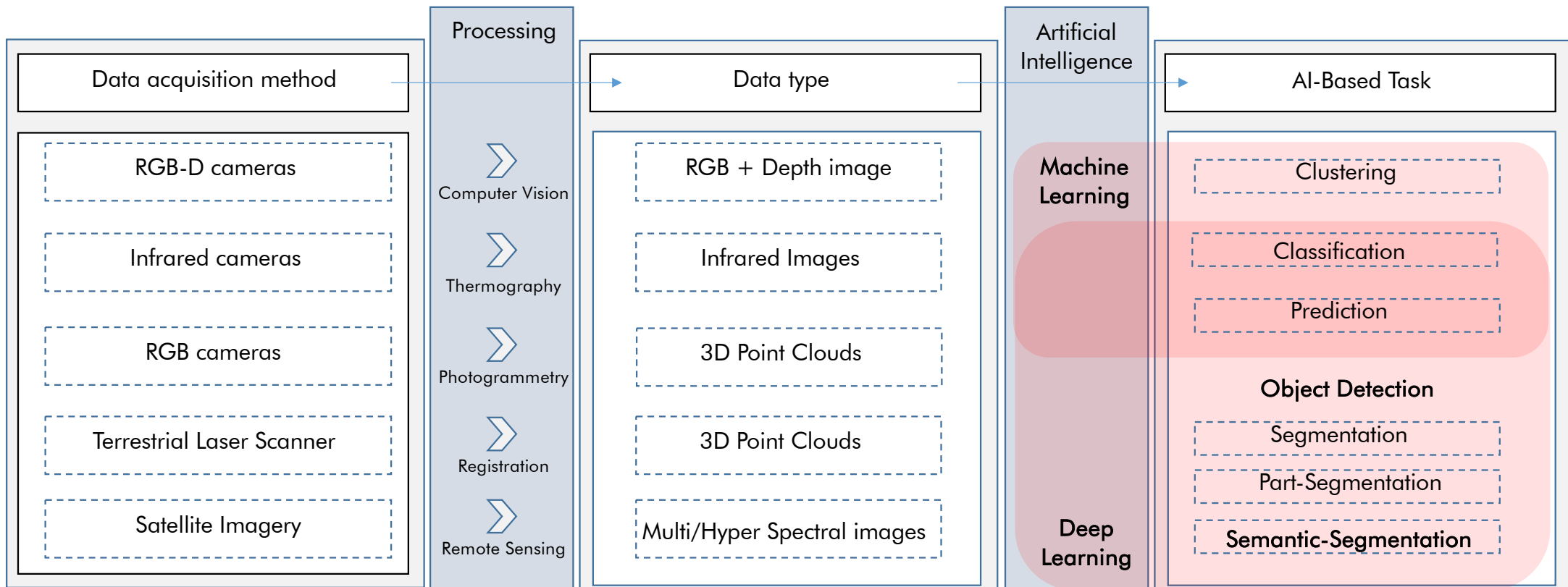


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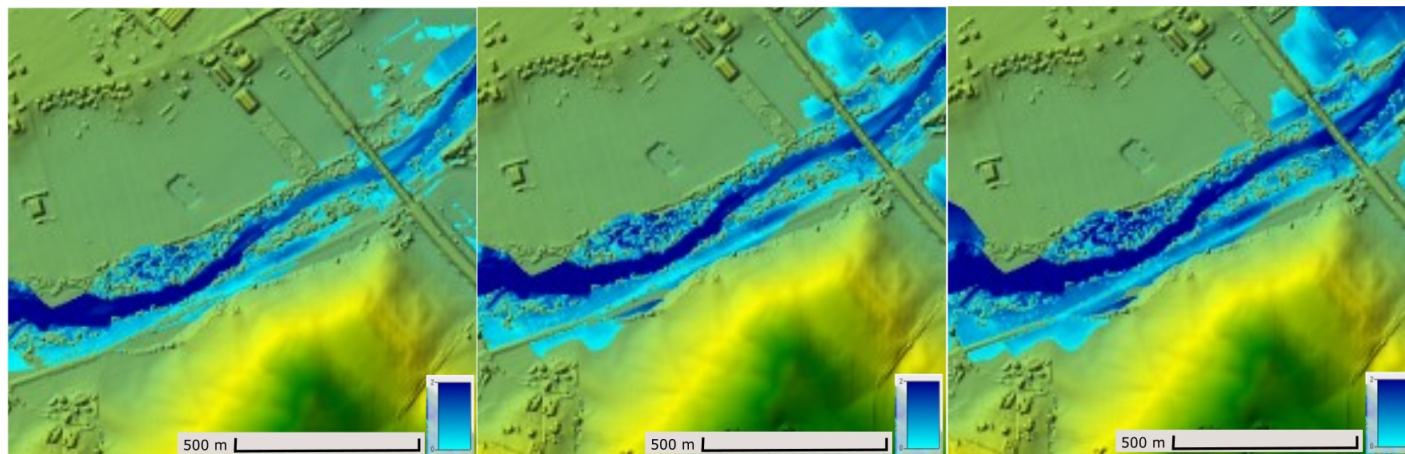
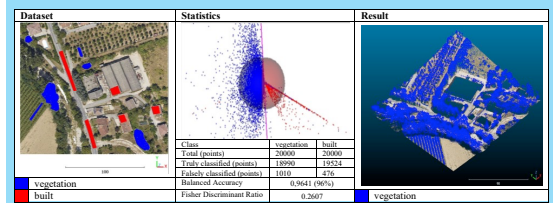
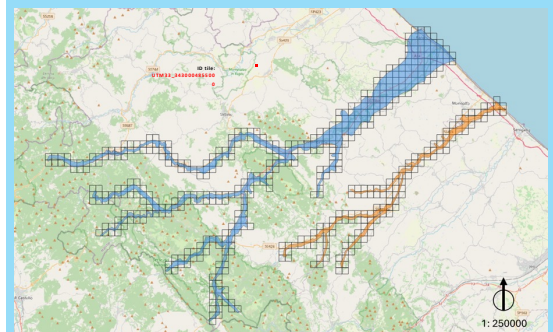
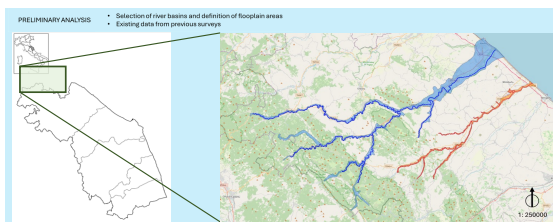
GeoAI



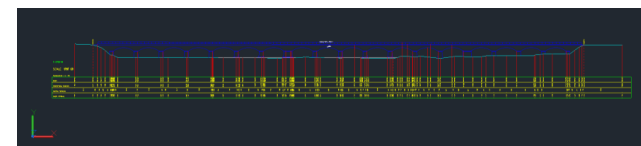
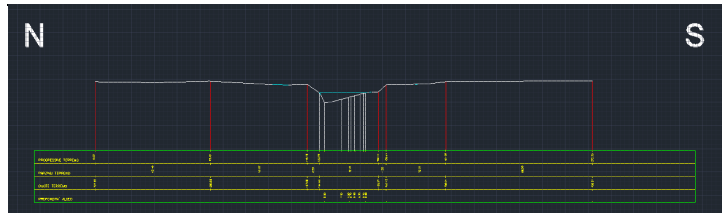
Pierdicca, R., & Paolanti, M. (2022). GeoAI: a review of artificial intelligence approaches for the interpretation of complex geomatics data. *Geoscientific Instrumentation, Methods and Data Systems Discussions*, 2022, 1-35.

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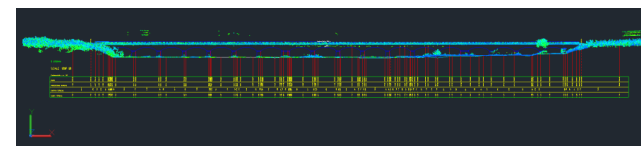




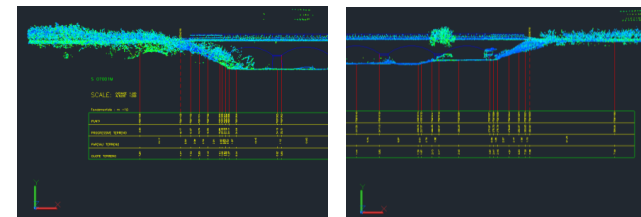
Cross-river section



Altitude profile of the cross-section of the structure processed following the 2001-2002 survey.



Comparison of the reference points through the overlay of the cross-section of the structure processed following the 2001-2002 survey with the section extracted from the 2024 survey point cloud.



Details of the above comparison

Di Stefano, F., Chiappini, S., Sanità, M., Pierdicca, R., & Malinverni, E. S. (2024). Geomatics-enabled Interdisciplinary Approach Based on Geospatial Data Processing for Hydrogeological Risk-analysis. *Geomatics and Environmental Engineering*, 18(3).

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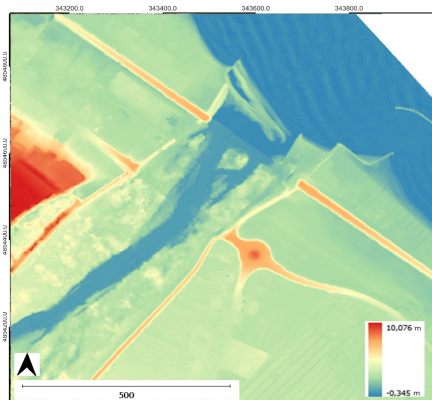
An example of monograph of a hydraulic infrastructure located in the riverbed of Metauro river.



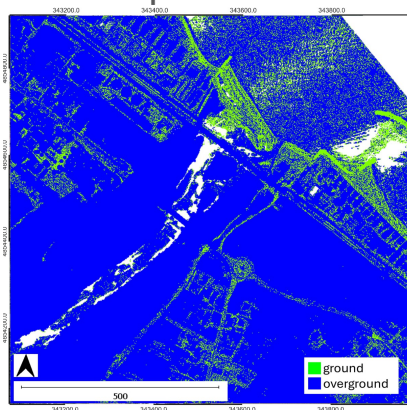
Airborne LiDAR point cloud in RGB scale



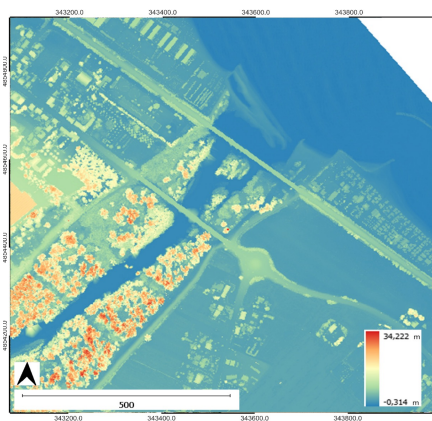
DTM



Classified Airborne LiDAR point cloud



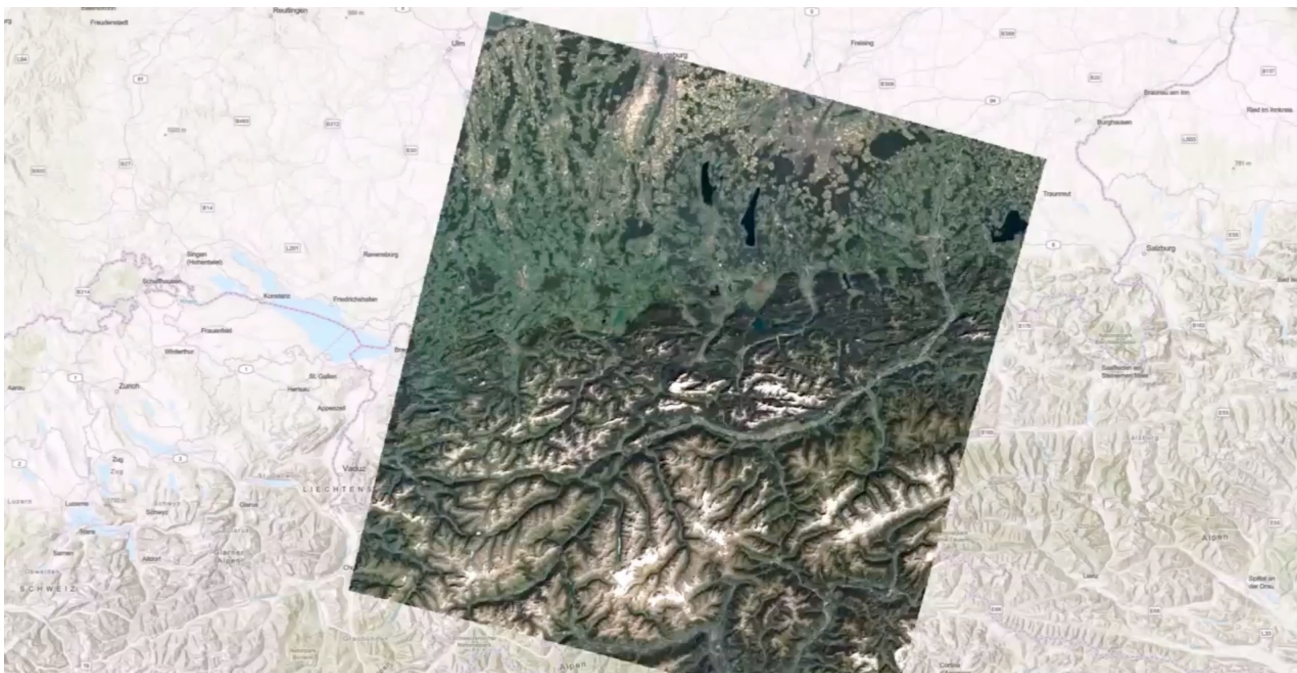
DSM



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AI e DATI GEOSPAZIALI



<https://browser.dataspace.copernicus.eu>

Efficiency: Quickly generate high-quality land cover maps without the need for extensive training data

Versatility: Ideal for urban planning, resource management, environmental monitoring, and more.

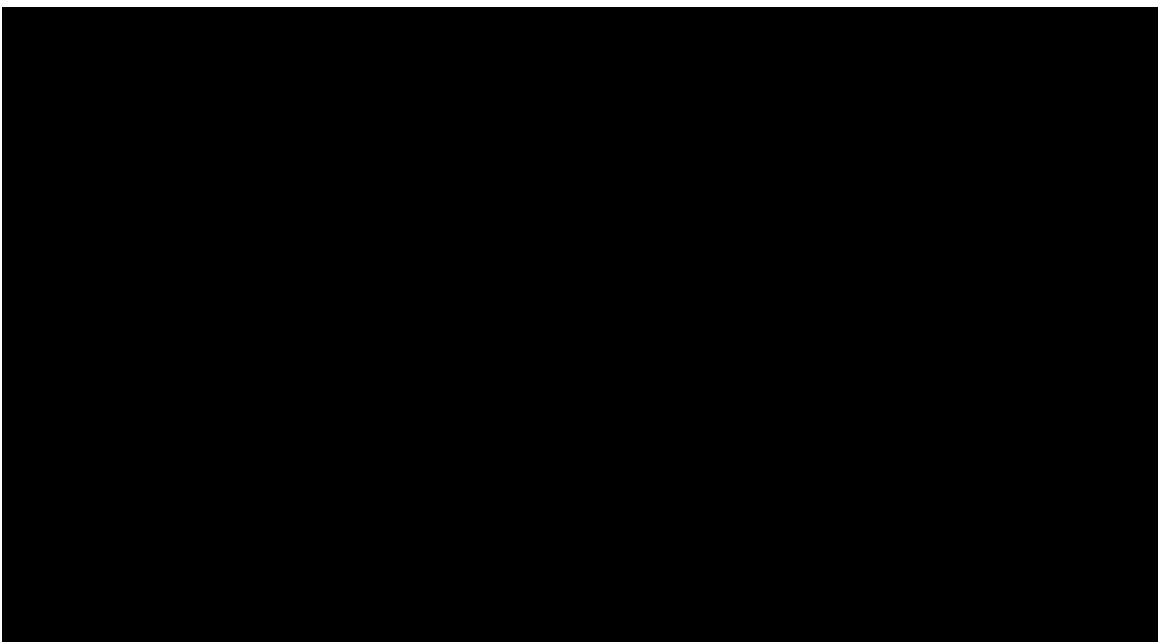
Accuracy: Trained on the 2016 National Land Cover Database (NLCD), ensuring reliable and precise results.

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ESTRAZIONE AUTOMATICA



https://www.linkedin.com/posts/matthias-staengel_ai-geospatial-deeplearning-activity-7304837182987366400-y_UW/?utm_source=share&utm_medium=member_ios&rcm=ACoAAA3E2hYBNCWwEmwqTimpmmWTxwvje9Rr2Sw

Pre-trained Deep Learning models. Elevation information using the DSM and the Point Cloud is highly valuable for more precise feature extraction and attribution such as height of the extracted features (buildings, trees, etc.),

For Flood simulation you also can simply use the global elevation model already available and a 3D Basemap to include buildings in the flood simulation

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Il ruolo della GeoAI

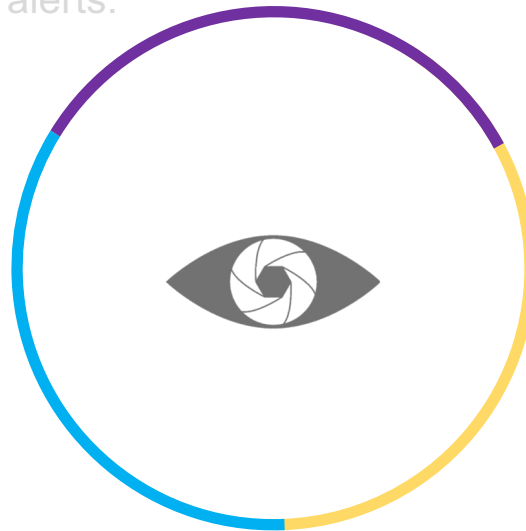
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Real-time Data Integration: Modern GIS platforms can ingest and visualize live data from sensors, drones, and satellites, enabling timely situational awareness during emergencies.

Cloud-based Collaboration: Cloud GIS allows multiple stakeholders to access, update, and analyze spatial data simultaneously, improving coordination and transparency in decision-making.

AI and Machine Learning Integration: Advanced GIS tools use AI to detect patterns, predict risks, and automate mapping processes, supporting faster and more informed decisions.

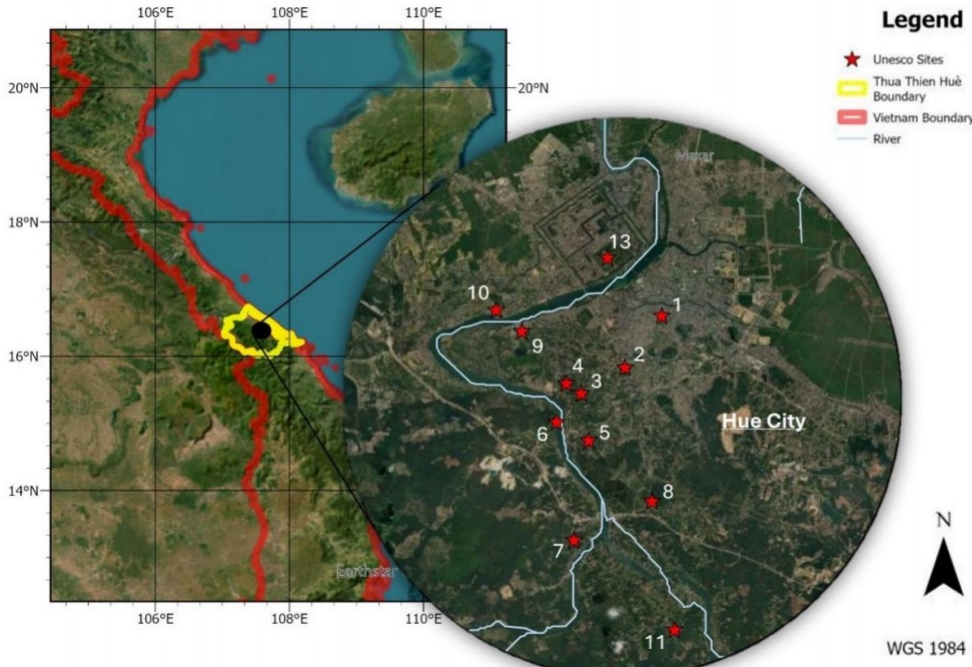
3D and Immersive Visualization: Enhanced 3D mapping and XR integration provide realistic models of terrain and infrastructure, helping planners assess vulnerabilities and simulate interventions.

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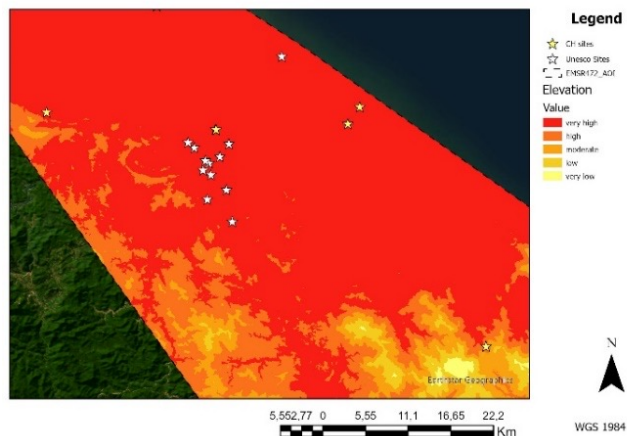


n.	Name	Area [ha]
1	Duc Duc Tomb	8.55
2	Nam Giao Esplanade	12.41
3	Dong Khanh Tomb	2.29
4	Tu Duc Tomb	12.99
5	Thieu Tri Tomb	27.90
6	Hon Chen Temple	0.87

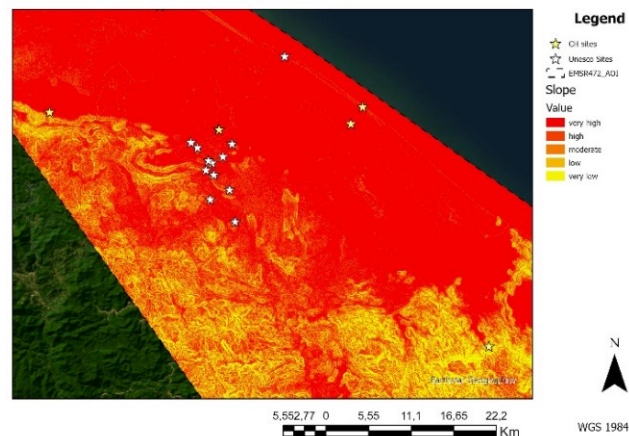


n.	Name	Area [ha]
7	Minh Mang Tomb	34.15
8	Khai Dinh Tomb	18.19
9	Voi Re Temple	2.45
10	Thien Mu Pagoda	4.24
11	Gia Long Tomb	20.72
13	Citadel of Hue, including Imperial City, Purple Forbidden City, Royal Canal, Museum of Hue, National University, Lake of the Serene Heart	159.71

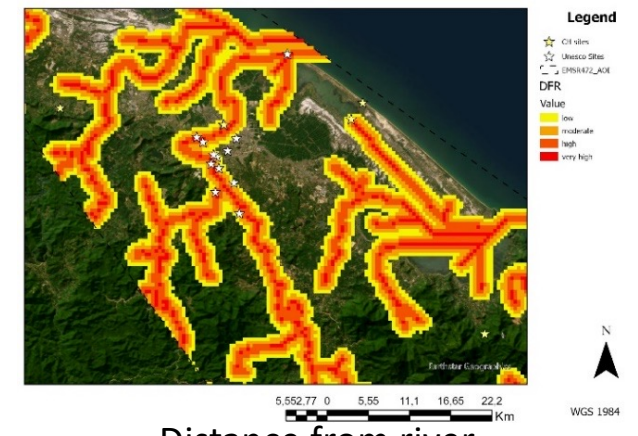




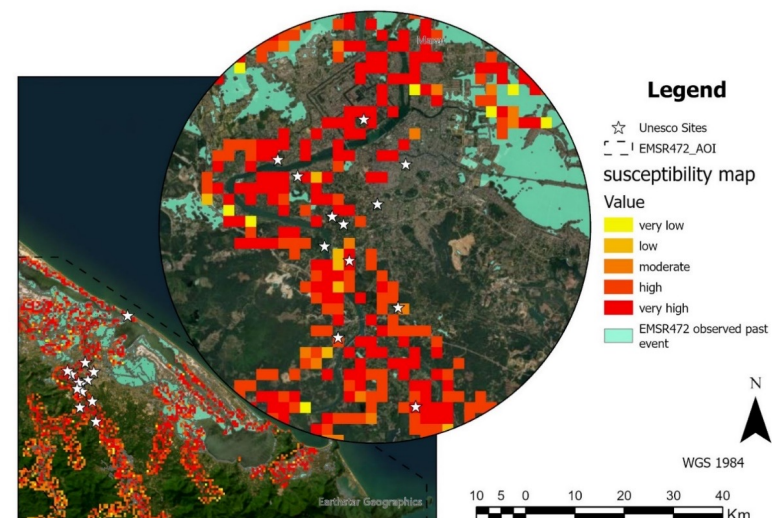
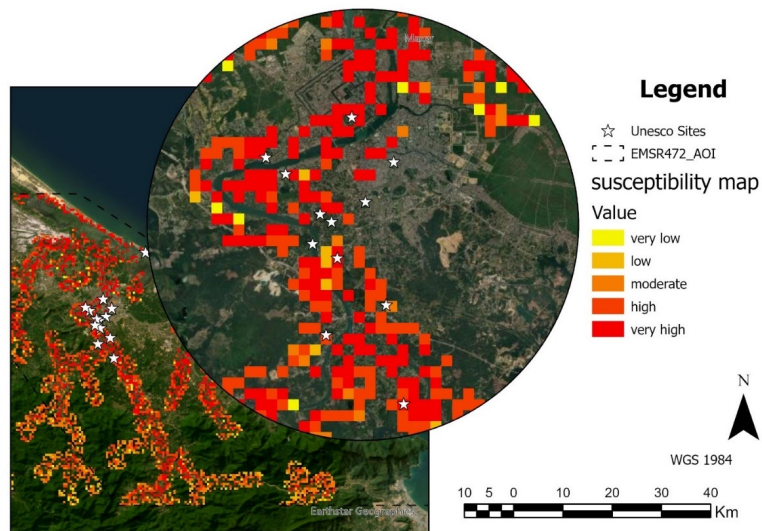
Elevation



Slope



Distance from river



Progetto Ita-Viet grande rilevanza 2021- 2023 MAECI Research Experiences on the Significance of International Cultural Heritage. How to understand and manage data for educational and economic support.

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GIS enables us to link economic, ecological, and social aspects seamlessly. This holistic view allows us to understand the intricate relationships between these factors.

GIS helps us make potential risks visible. By analyzing data, we can identify areas vulnerable to climate impacts, such as flooding or drought, leading to more informed decision-making.

With GIS, stakeholders can access critical information that supports strategic planning and resource allocation. This capability is essential for creating sustainable solutions that benefit both communities and the environment.

GIS plays a vital role in disaster management, helping communities prepare for and respond to natural disasters effectively.

Cities leverage GIS for better urban planning, optimizing land use, and enhancing infrastructure to improve residents' quality of life.

GIS tools are crucial for monitoring ecosystems, managing natural resources, and promoting conservation efforts.

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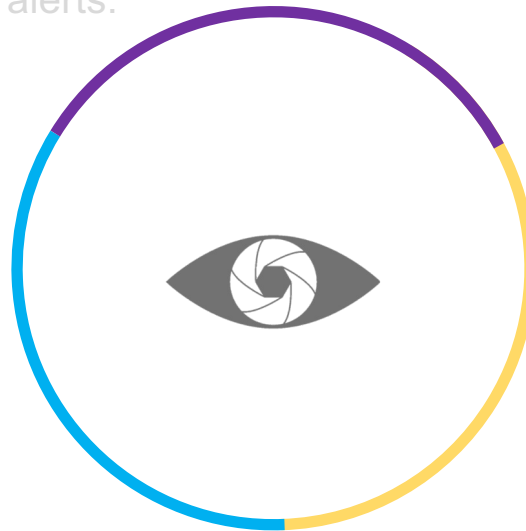
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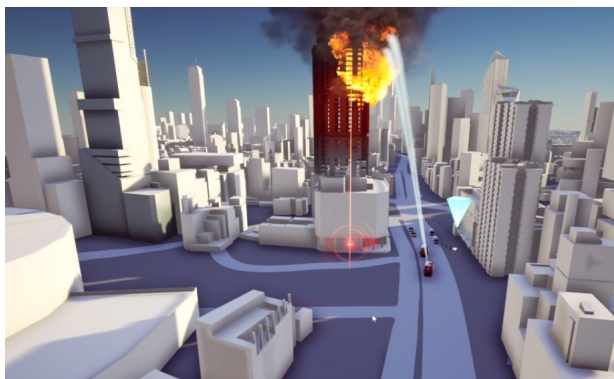
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The Future of VR in Emergency Management



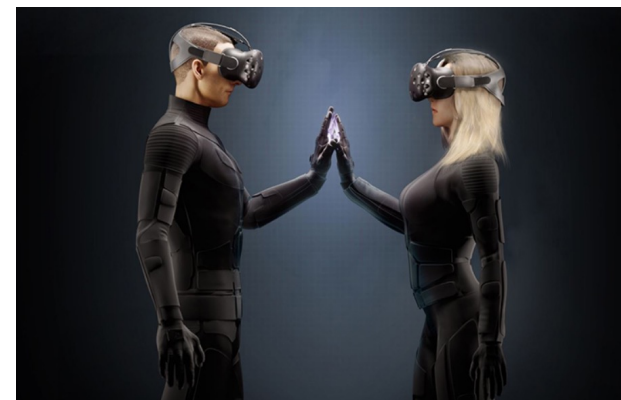
AI & Digital Twins

VR generates **real-time digital twins** of disaster areas, helping emergency teams plan interventions more effectively.



Drone-Assisted VR

Live drone footage in VR provides a **360° view of disaster zones**, improving risk assessment and response strategies.



Haptic Suits & Motion Simulators

Advanced **haptic feedback and motion simulation** enhance realism, preparing responders for high-risk operations.

*As this technology evolves, **VR will not just prepare us for disasters—it will help prevent them***

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Flood Simulations

Urban environments with rising water levels and safe escape routes.



Earthquake Training

Identifying safe areas and evacuation routes in urban settings.



3D Risk Assessment

Real-time modelling improves decision-making capacity.



<https://tracenet.fbk.eu>

<https://civil-protection-knowledge-network.europa.eu/projects/tracenet>

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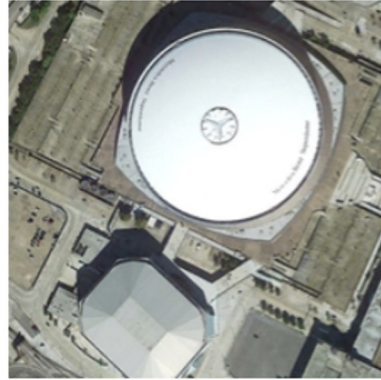
TAKE HOME MESSAGE



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Geo LLMs and Foundation Models

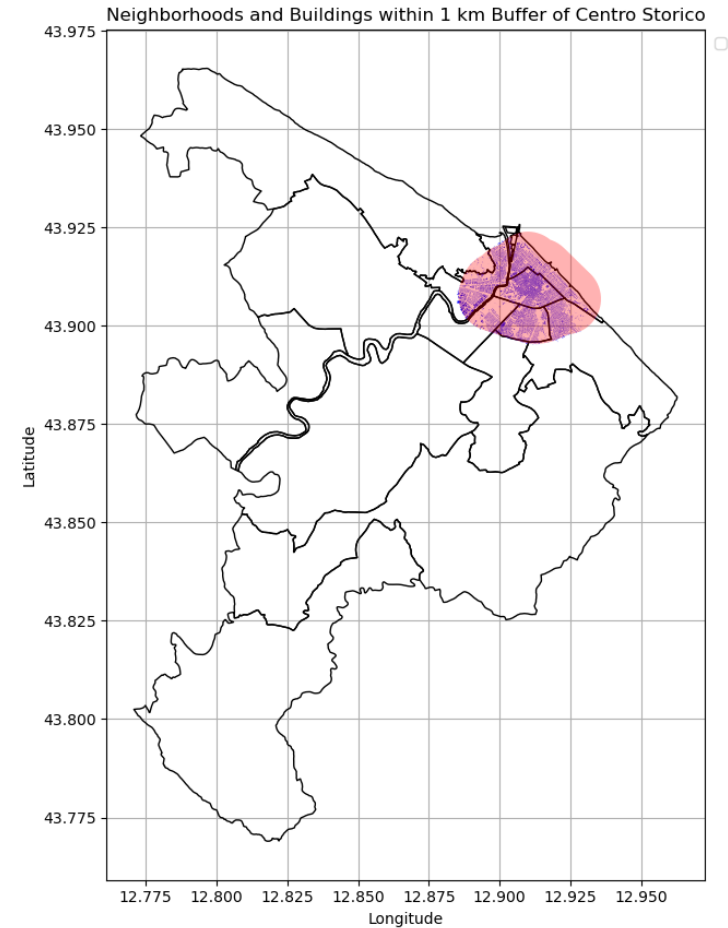
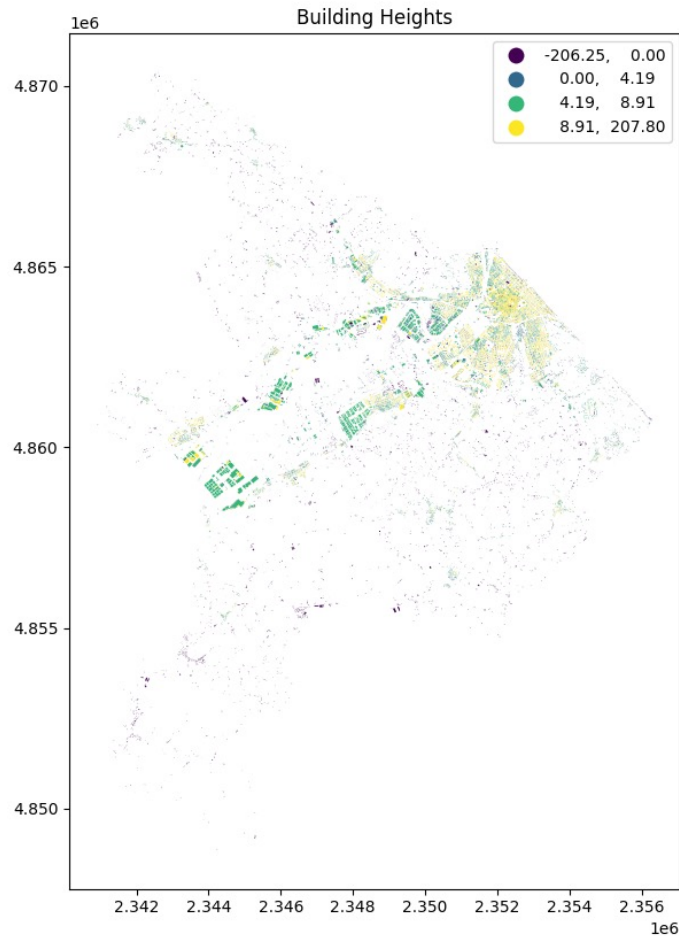
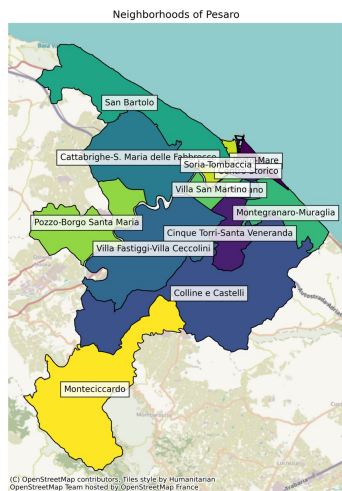
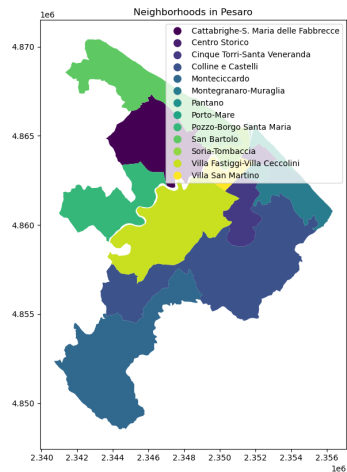
Test Imgs				
ZS	A large body of water surrounded by trees and buildings.	A large industrial complex with multiple tanks and a train track running through it.	A large body of water with a bridge and buildings surrounding it.	A large white dome structure with a clock on top of it.
MICL	A large park with a pond and many green trees is near a road and several buildings.	A large number of storage tanks are in a factory near a road.	A large park with many green trees and a pond is near several roads.	A large white building with a circular shape is surrounded by parking lots.
GT	some buildings are around a park with many green trees and a pond near a river.	eight white storage tanks are next to a road.	there are many tall buildings in the park.	several parking lots are near a circle white building.

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GeoGPT (?)

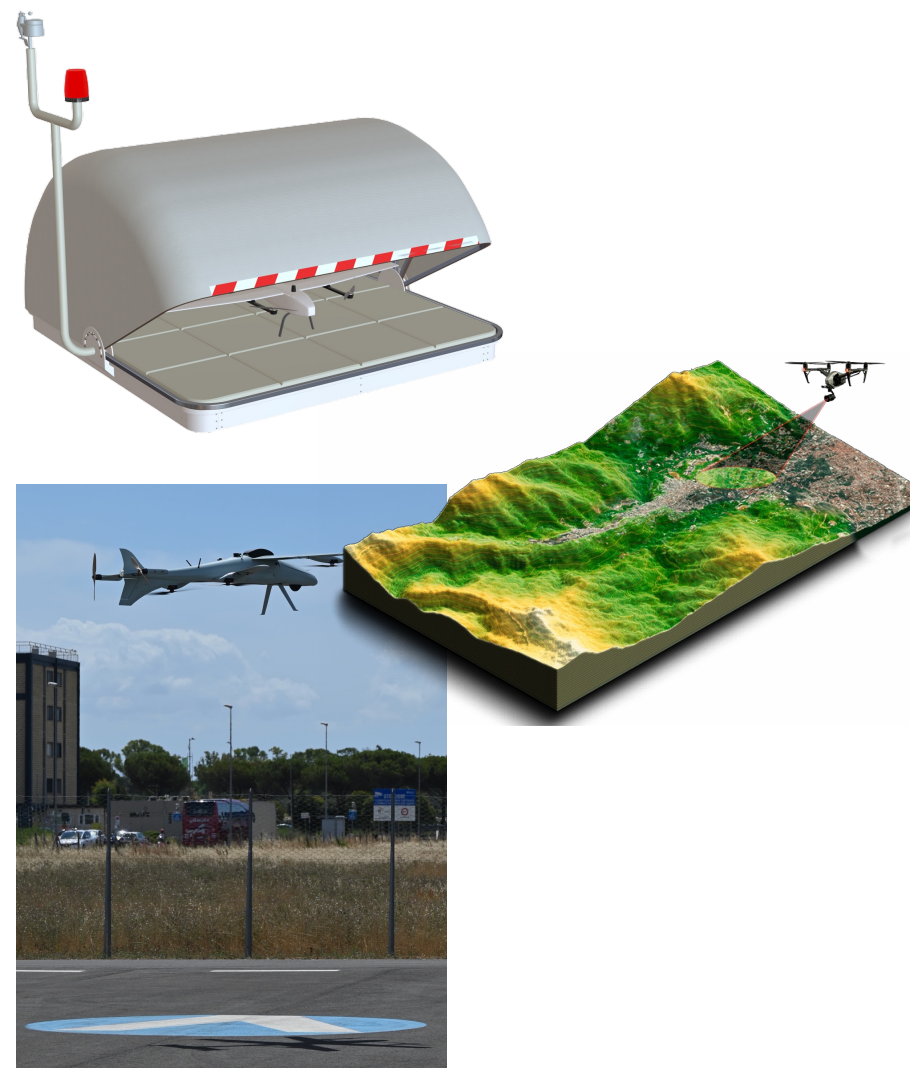
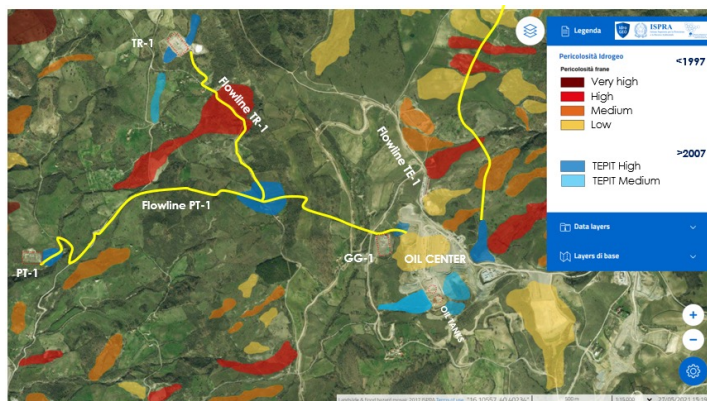


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Piattaforma Digitale di Monitoraggio

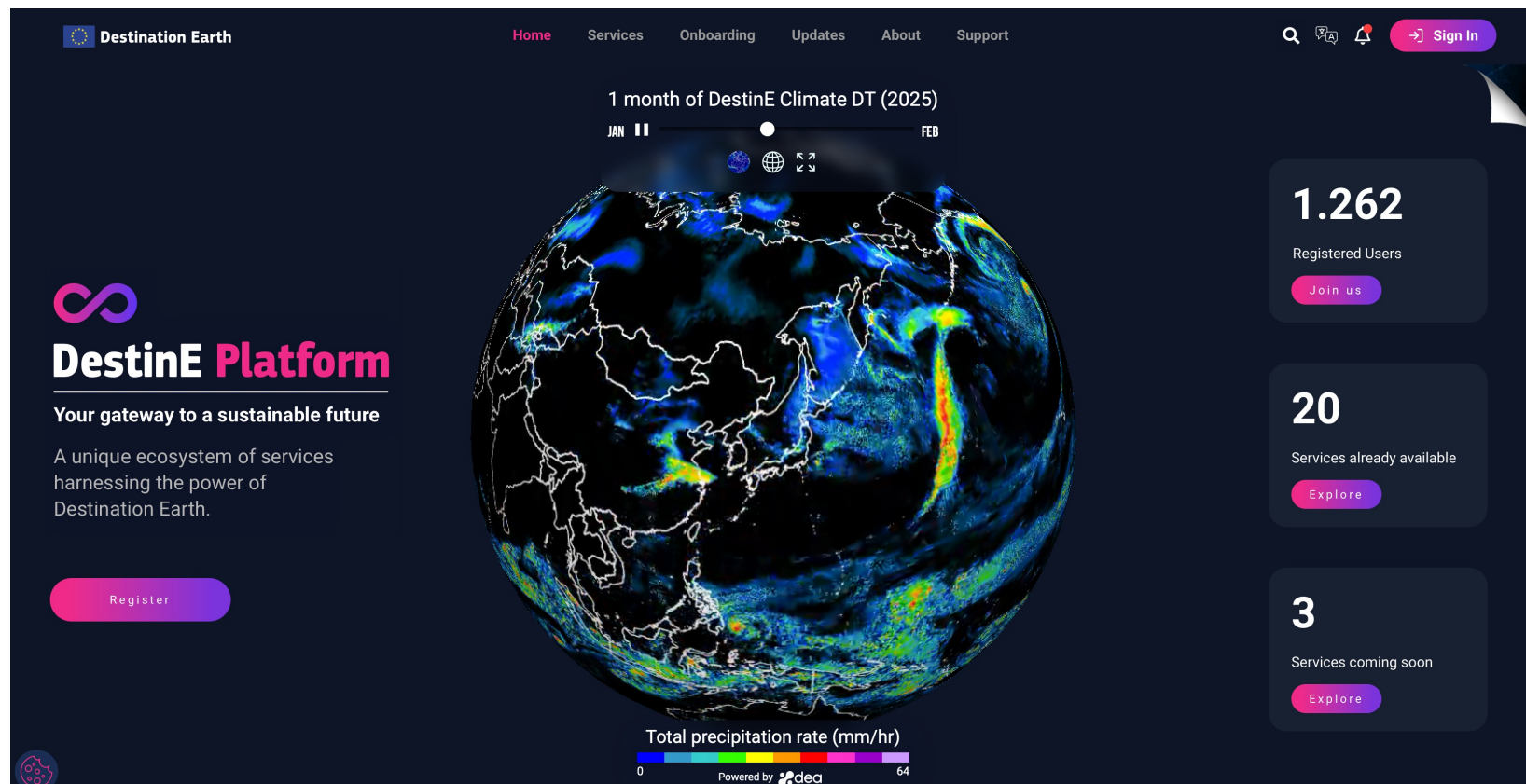
DRONE AS A SERVICE



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“...la misura del mondo...”



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Reaching "Human Level AI" may be a useful goal, but even humans are specialized.

Yan Le Cun

Geomatica, GeoAI, GeoSpatialIntelligence e “la misura del mondo”



Roberto Pierdicca



UNIVERSITÀ
POLITECNICA
DELLE MARCHE

VRAI vision robotics
artificial
intelligence

GAP
GEOMATICS
APPLICATIONS &
PROCESSING

Grazie



r.pierdicca@staff.univpm.it

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