
GEOLaB
Geomatics
and Earth
Observation lab
POLITECNICO
MILANO 1863
GIS GEOLab Project Flyer
Politecnico di Milano – DICA | GEOlab

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Matej Žgela

Ali Badr Eldin Ali Mohamed

Afshin Moazzam

Research topics

GIS, Earth Observation, Citizen Science;
GeoAI development and applications

Teaching

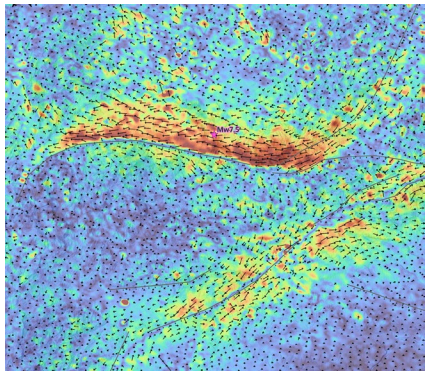
M.Sc. in Geoinformatics Engineering

M.Sc. in Geoinformatics Engineering @ Politecnico di Milano

School of Civil, Environmental and Land Management Engineering

School of Industrial and Information Engineering

- **Geoinformatics Engineers** combine expertise in **Computer Science, Environmental Engineering, and Geomatics** to manage, analyze, and publish spatial and temporal information, focusing on environmental data.
- Their main application fields include urban and agricultural land planning, infrastructure design, transport and traffic management, and environmental modeling, all contributing to sustainable environmental and land management.
- The MSc in Geoinformatics Engineering at Politecnico di Milano, initiated in 2016/2017, leverages extensive experience in Environmental, Geomatics, and Computer Science to produce multidisciplinary experts needed in both private and public sectors.
- A **two-year** international program taught **in English** for both Italian and foreign students.
- The curriculum includes mandatory courses in geospatial data analysis, GIS, positioning services, pollution management, computing infrastructures, computer security, databases, and software engineering.
- Students can choose elective courses to deepen their expertise in areas like computer programming, system design, Earth observation, geophysical data processing, or hydrogeological risk, culminating in an MSc thesis on an original scientific topic.



Ground velocity derived from Sentinel-1 Synthetic Aperture Radar (SAR) data (pixel offset tracking).

Admission Requirements

Students with a bachelor's degree in Computer science or Environmental / Geodetic / Geomatics Engineering/ Civil Engineering / Mathematical Engineering are eligible for application. Students with a different background (for example other Engineering programmes, Geography, Land planning, Natural Sciences, and Physics) will be taken into consideration individually.

Webpage
www.geoinformatics.polimi.it

Coordinator
Prof. Giovanna Venuti, giovanna.venuti@polimi.it

CADEO

Climate change **A**daptation using **D**igital geospatial twins and **E**arth **O**bservation

Objectives:

- **Strengthen human resource training** for both the existing and future qualified labor force.
- Design, implement, and teach **innovative courses** connected to **climate change adaptation** and its enabling technologies.
- Integrate these courses within different and interdisciplinary HEIs postgraduate study programs (master's level) across **Vietnam**.

Courses:

- Earth Observation (10 ECTs)
- Digital Twin Earth (5 ECTs)
- Geospatial Web Applications (5 ECTs)
- Geospatial Intelligence (10 ECTs)

https://cadeo-eu.edu.vn/

ERASMUS-EDU-2022-CBHE (SEP-210836011)

Funded by the Erasmus+ Programme of the European Union

UDENE
Urban Developement Explorations using Natural Experiments

The UDENE project aims to **support evidence-based decision making for urban development**, especially in international partner countries, by creating a **virtual laboratory** for urban planners and visionaries to test their development ideas.

Main objectives:

- Integrate local urban data cubes with Copernicus to quickly analyze urban development impacts using EO data.
- Develop and validate sensitivity analysis algorithms to assess urban development effects on key economic outcomes.
- Build partnerships between European and non-EU entities to enhance and invest in EO technologies for urban development.

Funded under the **Copernicus International Partners Horizon EUSPA Call 24 months** (January 2024 – January 2026)

UDENE
Urban Developement Explorations using Natural Experiments

Exploration and Matchmaking Tools:

- **UDENE Exploration Tool** for natural experiments. Using visualisation technologies, this tool will enable end-users (especially urban planners and developers, as well as decision-makers) to test and validate their ideas and concepts.
- **UDENE Matchmaking Tool** to identify downstream applications and service providers and leverage the exploration tool by linking the existing EO product, process, or service offerings.

Case studies:

Serbia: Testing and validating the effects of new urban infrastructures (ring road and bridge) on pollution reduction and minimization of traffic congestion.

Tunisia: Testing the effects of a linked park system on heat loads and analysing the most efficient development strategy to minimise urban heat islands.

Türkiye: Testing the effects of having a high-rise district on earthquake preparedness and determining the best development options to minimise expected loss in case of earthquake.

UDENE is motivated by sharing its innovation with the public and supporting the uptake of the tools developed within the project.

Through **open calls**, partners will give to beneficiaries the **opportunity to test and validate the Exploration and Matchmaking Tools**, and to benefit from the Data Cube elaborated by technical partners.

Two open calls with two distinct and specific challenges will be announced in 2025.

Follow UDENE

UDENE UDENE_Project UDENE

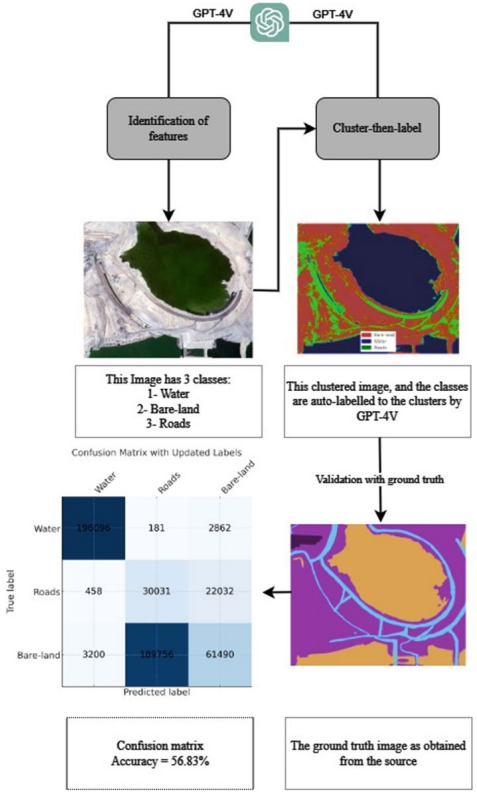
Funded under the **Copernicus International Partners Horizon EUSPA Call 24 months** (January 2024 – January 2026)

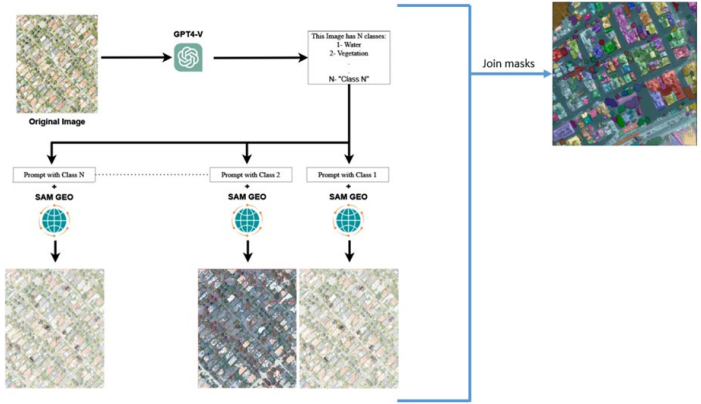
Framework Partnership Agreement
for Copernicus User Uptake

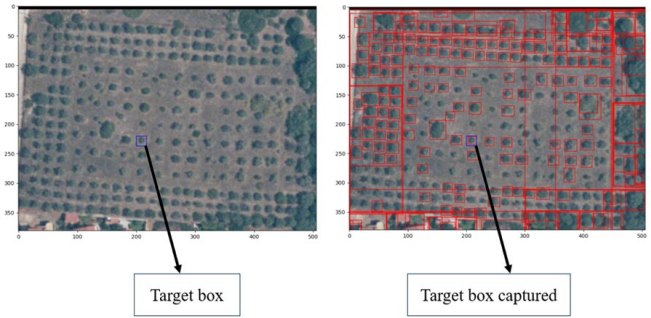
inspire pupils, as well as teachers, to use and better understand the Copernicus programme

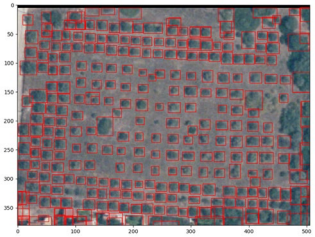
https://cop4schools.readthedocs.io/en/latest/

GEOSPATIAL FOUNDATION MODELS



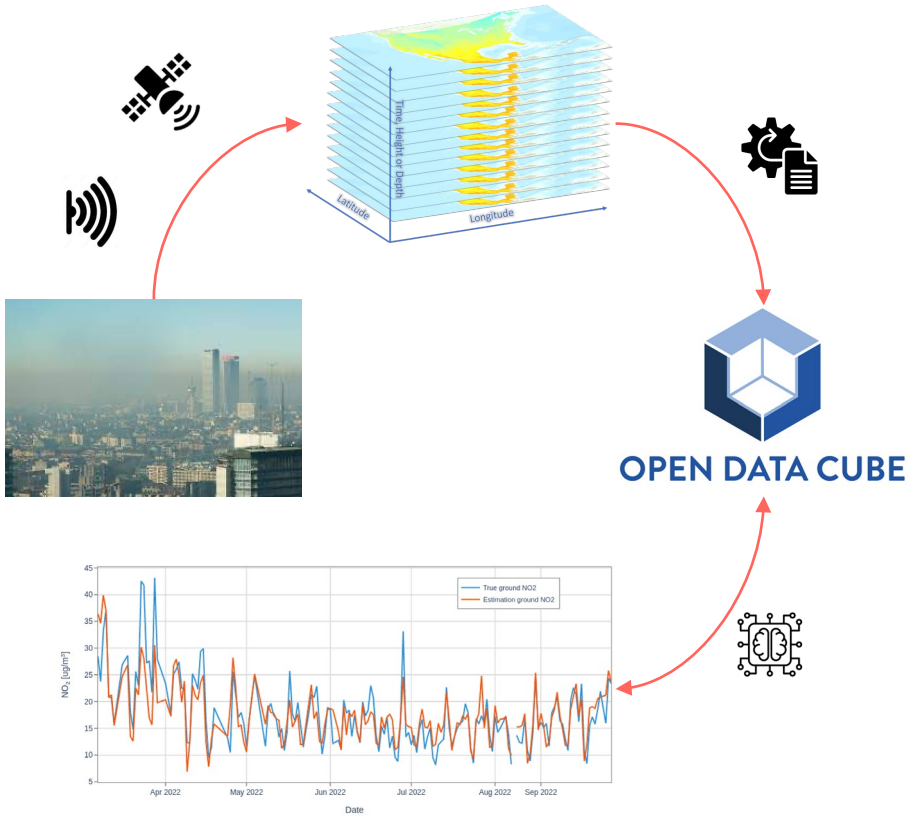




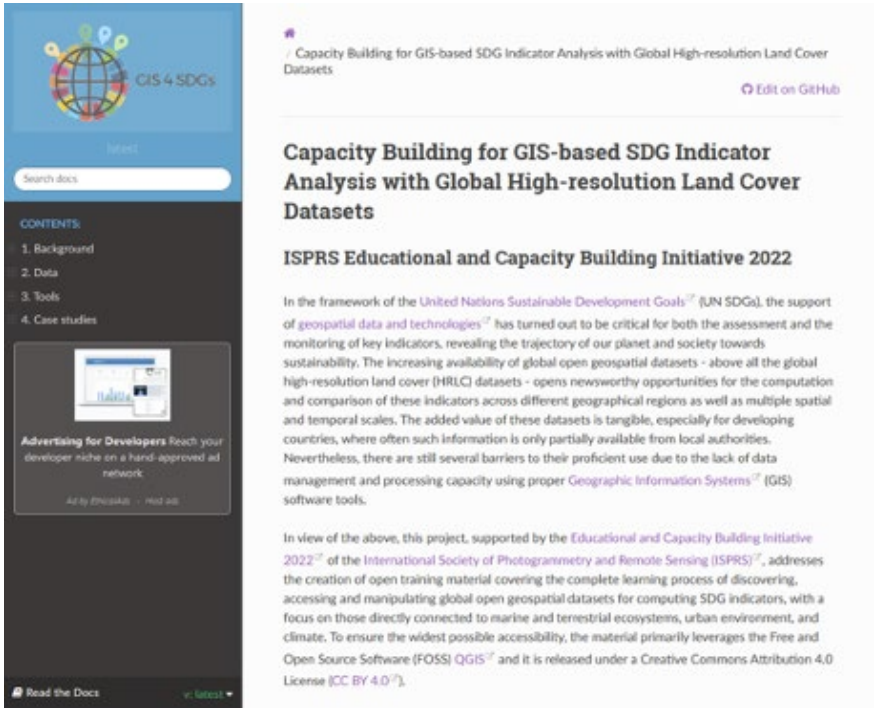


GeoAIr - Geo-Intelligence for improved air quality monitoring and analysis

https://www.cirgeo.unipd.it/geoair



Capacity Building for GIS-based SDG Indicator Analysis with Global High-resolution Land Cover Datasets



https://isprs-gis-sdg.readthedocs.io

SPHINX PYTHON DOCUMENTATION GENERATOR

Read the Docs

QGIS

ISPRS Educational and Capacity Building Initiative 2022 project

EUthmappers

EUthMappers is a project aimed at improving STEM education (Science, Technology, Engineering, Mathematics) and the environmental civic engagement of pupils by introducing open and collaborative mapping in Secondary Schools across the EU.

- Citizen science initiative aimed at Secondary Schools in 5 countries (ES, PT, IT, SK, RO)
- The aim is to raise awareness on the power of open mapping and active participation in solving environmental and humanitarian challenges
- Geospatial data and mapping at schools and civic education:
- Training involving 30 Secondary School teachers and 200 Pupils
- Development of a humanitarian collaborative mapping project in collaboration with UN Mappers

Co-funded by the European Union
KA220-SCH-8A47B4C2

https://euthmappers.gitbook.io/euthmappers-handbook

GeoAI

Geospatial AI (GeoAI), the emerging scientific discipline at the intersection of geospatial data and artificial intelligence, is the new frontier of technological innovation that promises to transform entire business industries.

Geographic information systems (GIS) have been used widely to present a view of our world based on geographic and geospatial data. Started as the basic capability to visualize information on maps to improve efficiency and decision-making, GIS has conceptually evolved to include the Digital Twin Earths for revisiting the past, understanding the present and predicting the future.

Nowadays we are undergoing significant new developments expanding the use of geographic data in a way that promises to disrupt entire sectors as energy, transportation, healthcare, agriculture, insurance and institutions in the public/private sector (weather centres, national labs)

Behind the rise of geospatial AI are three trends: increased availability of geospatial Earth Observation data both from flying (satellites, airplanes, and UAVs (unmanned aerial vehicle)) and on the ground sensors , the advancement of AI (particularly machine and deep learning), and the availability of massive computational power.

This series provides a forum for leading voices in the fields of geospatial and AI across various sectors (private sector, academia, governments, national and international organizations) to describe latest research and real applications of GeoAI to meet the Sustainable Development Goals.

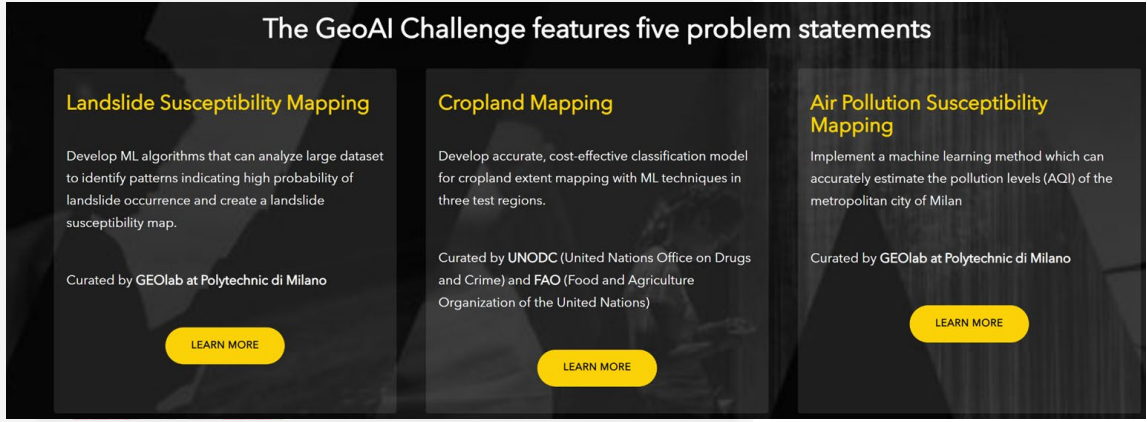
LEARN MORE

Curators

Maria Antonia Brovelli

Professor

Politecnico di Milano



https://aiforgood.itu.int/

SPACE IT UP project aims at developing innovative ideas and disruptive solutions to make Italy one of the leading countries in space exportation and exploitation. The synergies fostered in the project between academy, industry, and research centres are expected to have a strong impact on the Italian space sector and are aimed at the pursuit of the following main objectives:

PROMOTE INNOVATION AND

EXTEND FUNDAMENTAL KNOWLEDGE

From the earliest days, the exploration and exploitation of space required pushing knowledge beyond its limits. SPACE IT UP will develop breakthrough technology to support and promote future space activities. Moreover, SPACE IT UP contributions will impact several fundamental areas, such as numerical models, innovative satellite architectures and constellations, new mission profiles, advanced instrumentation, and AI-based applications.

FOSTERING A SUSTAINABLE FUTURE

Humankind must preserve the planet and space for future generations. Implementing innovative space-based technologies would allow observing climate change and predicting extreme weather events. In addition, SPACE IT UP will propose innovative solutions to enhance the resilience of the space and earth infrastructures to severe space weather.

ENSURE LONG-TERM HUMAN PERMANENCE IN EXTRATERRESTRIAL SPACE

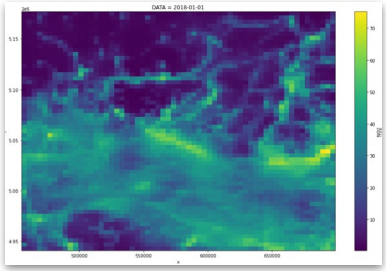
The long-term human permanence in space poses numerous technological challenges that require innovative solutions to be overcome. SPACE IT UP promotes the development of new ideas and the definition of enabling technologies to make humanity a multi-planetary species. The project will address not only technological issues but also those referred to the resource exploitation, in situ manufacturing, circular solutions for sustainable permanence, and neurophysiological aspects.

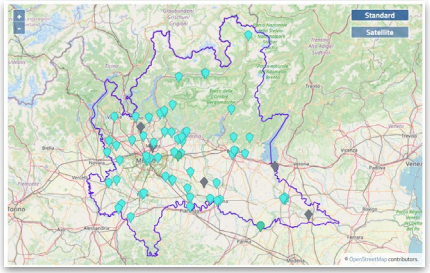
STRENGTHENING THE 'ECOSYSTEM' SPACE IN ITALY

Italy will cover the entire research and development value chain in the space field, thanks to effective coordination between Universities, Research Institutions, and a system of small, medium, and large industries. Furthermore, SPACE IT UP will promote collaborations between partners and new synergies to propose innovative and multidisciplinary solutions. As a result, SPACE IT UP will provide the country with a more robust and competitive space ecosystem.

Our Research:
ZERO EMISSION SOCIETY

Monitoring pollution
Monitoring urban and suburban environment





Health risk factors

Air pollution data (maps or sensor measurements)

NO_2 - O_3 - PM_{10} - $PM_{2.5}$

Health data (emergency calls)

Cardiovascular and respiratory issues

Machine learning techniques and **geographical** analyses

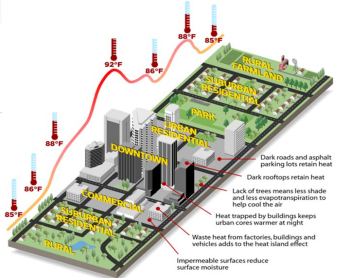
Correlation data and human **health risk maps**

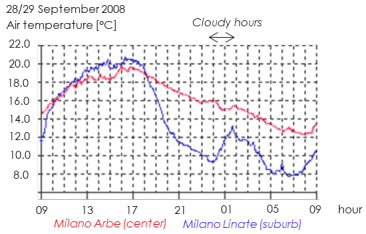
AREU
Sistema Socio Sanitario
Regione Lombardia

LCZ-ODC project

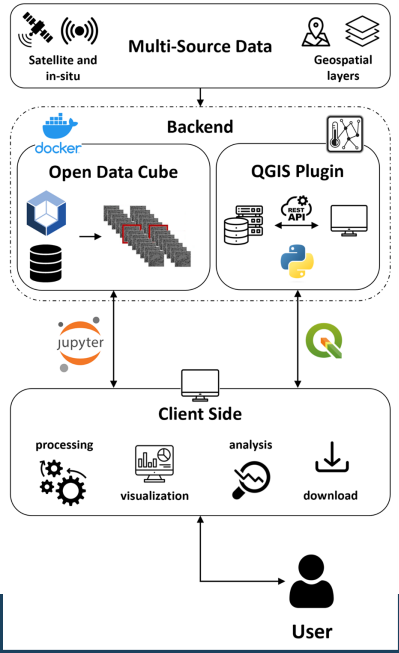
Funded by ASI I4DP_SCIENCE program, the project addressed the problem of Urban Heat Island.
A full processing chain was developed, implemented and made available to final users to produce LCZ maps leveraging on multispectral Sentinel-2 or hyperspectral PRISMA images together with GIS derived Urban Canopy parameters

UHI and local climate zones

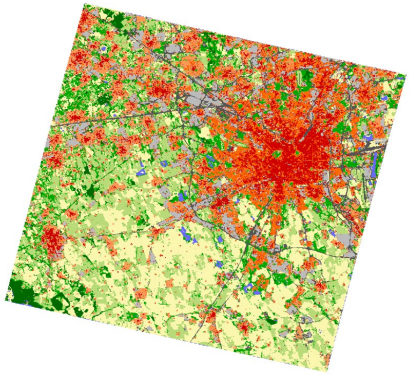


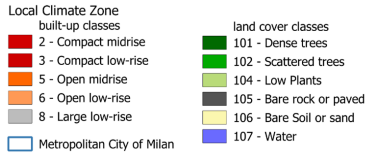


Technologies for mapping & analysis

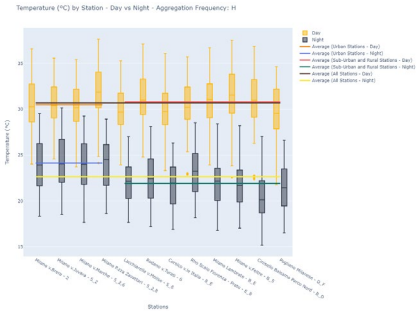


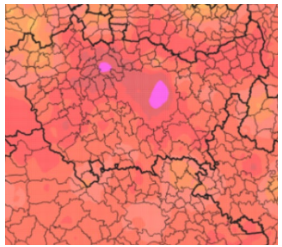
PRISMA - LCZ (Milano)





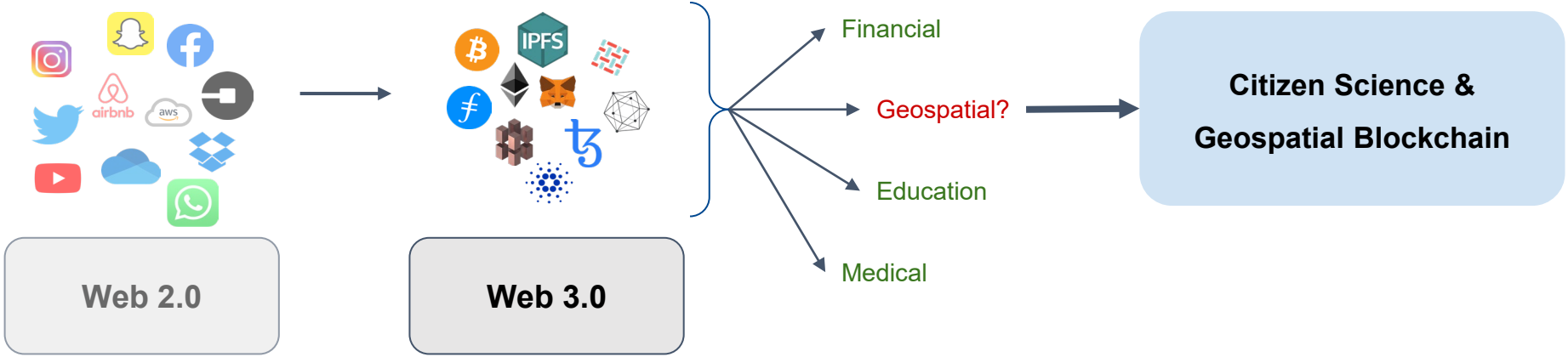
LCZ temperature behavior





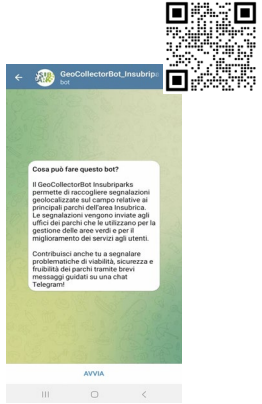
Non-democratic Data

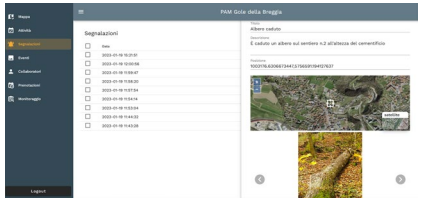
Democratic Data



INSUBRIPARKS

Green and smart tourism promotion for the Insubria region natural parks



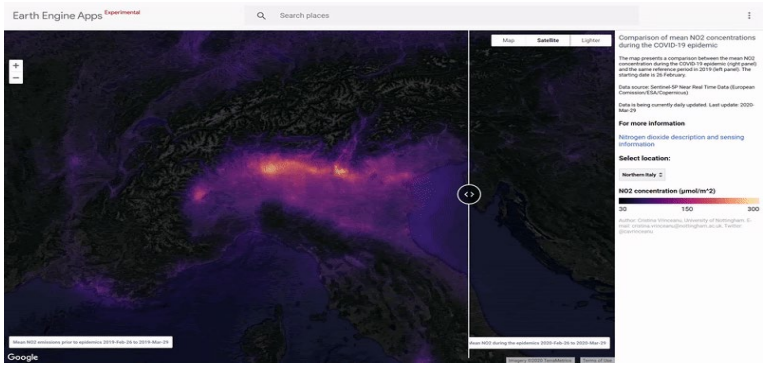


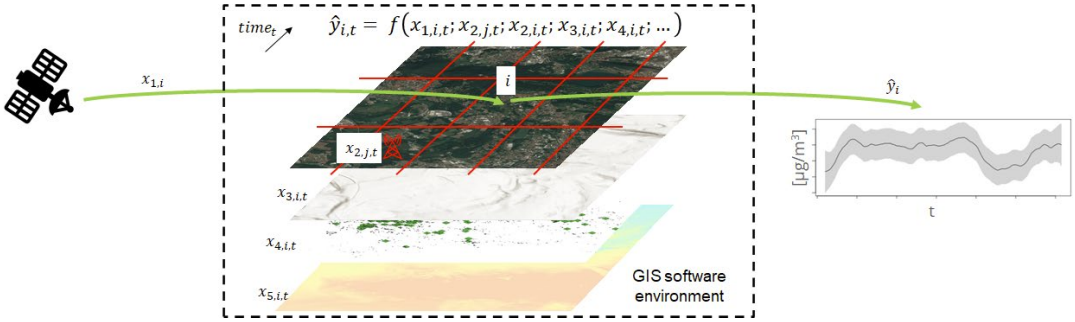
Fondo Europeo di Sviluppo Regionale

Funded by the Interreg Co-operation Programme 2014-2020 (ID 605472)

D-DUST

Data-driven moDelling of particUlate with Satellite Technology aid





D-DUST

Data-driven moDelling of particUlate with Satellite Technology aid

www.ddust.it

POLITECNICO MILANO 1863

UNIVERSITÀ DEGLI STUDI DELL'INSUBRIA

Fondazione Politecnico di Milano

Con il contributo di

Fondazione CARIPLO

HYPERSPECTRAL DATA AND LCZ

PRISMA sensor

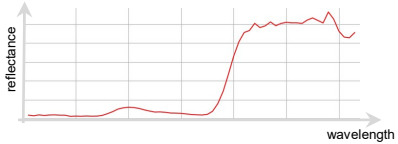
239 bands in **VNIR/SWIR** (**30m**)
1 PAN band (**5m**)

DESIS sensor

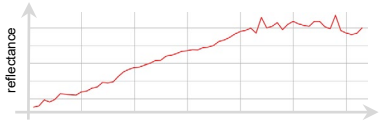
235 bands in **VNIR** (**30m**)

Definition of **spectral signatures of endmembers** (e.g., vegetation and paved)

Spectral signature of vegetation



Spectral signature of paved

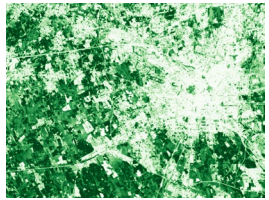


Validation

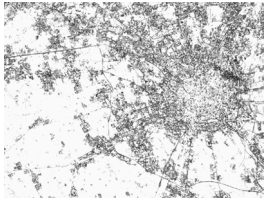
In-situ measurements with hyperspectral camera

Spectral unmixing

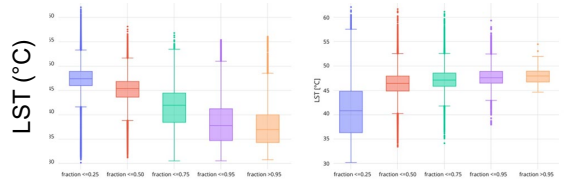
Maps of endmember fractions



Vegetation fraction



Paved fraction

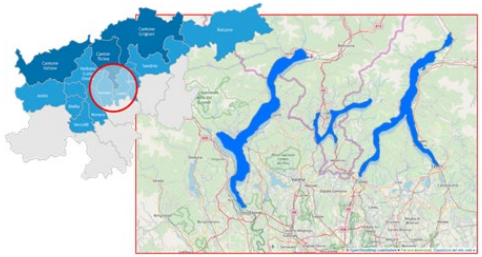


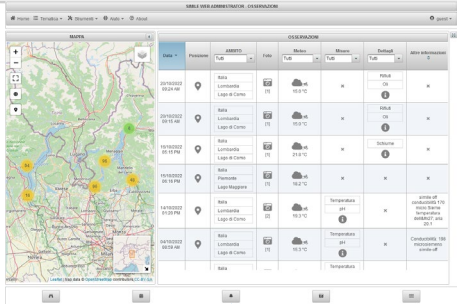
Vegetation fraction *Paved fraction*

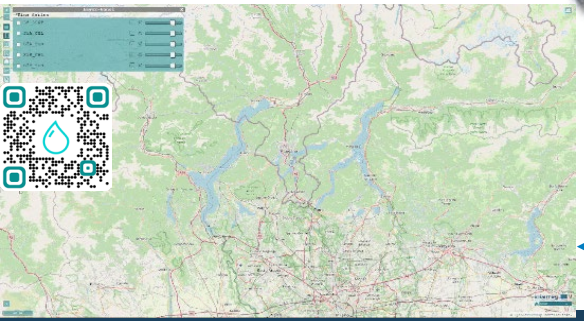
Correlation analysis with **Land Surface Temperature** data from Landsat 8/9

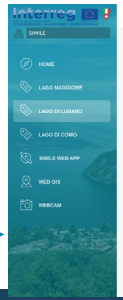
SIMILE
Integrated monitoring system of subalpine lakes and their ecosystems

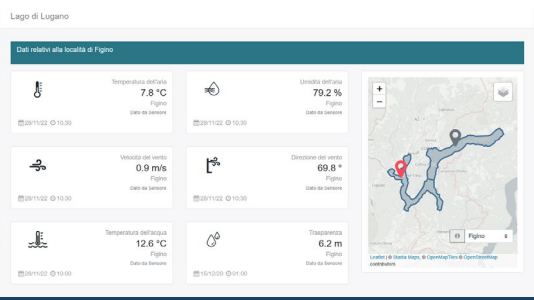
Interreg
ITALIA SVIZZERA - ITALIE SUISSE - ITALIEN SCHWEIZ
SIMILE











HARMONIA
Multi-hazard susceptibility mapping for urban context hazards

Conditioning factors
Socio-economic
Topographic
Land cover
Meteorological

Machine/ Deep Learning techniques.

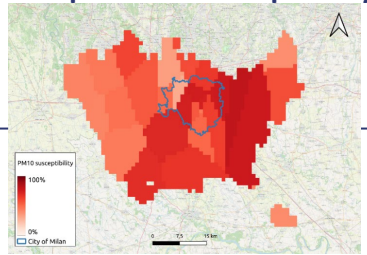
Single-hazard susceptibility maps

Training data

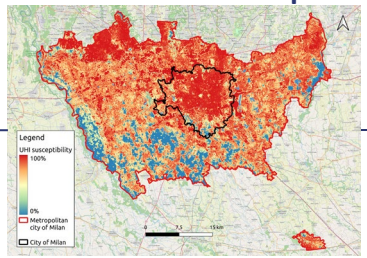
Testing data

Hazard inventory: hazard occurrences data.

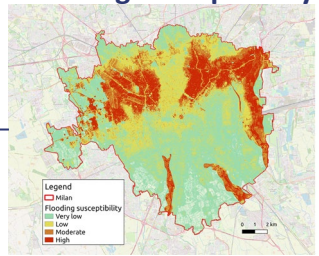
Air pollution susceptibility

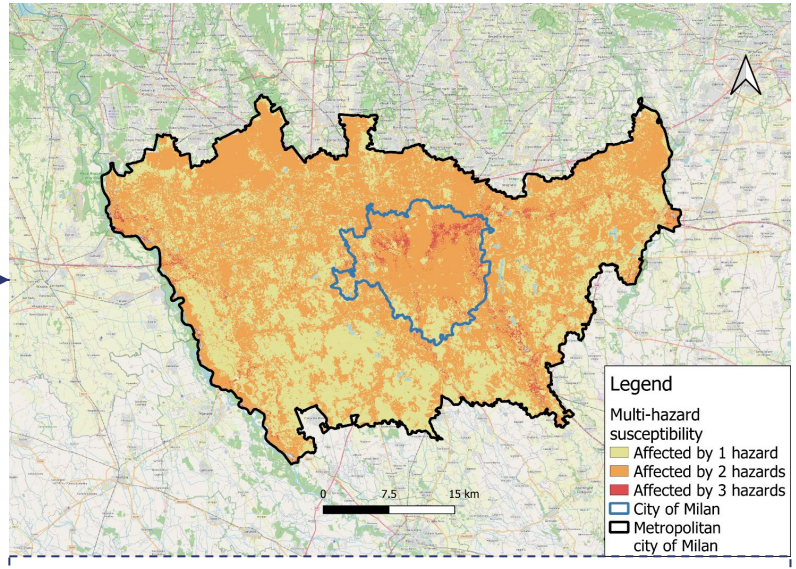


Urban heat island susceptibility



Flooding susceptibility





Multi-hazard susceptibility map in the Metropolitan city of Milan.
The pilot cities were four: Milan, Sofia, Piraeus, and Ixelles.

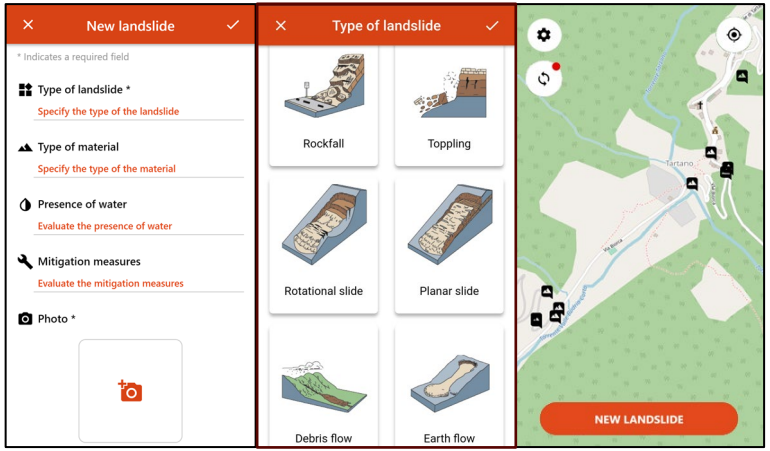
The approach used to produce the multi-hazard susceptibility maps is to sum the occurrence of each single hazard if its susceptibility is above 70%.

The HARMONIA project has received funding from the EU Horizon 2020 research and innovation programme under agreement No. 101003517.

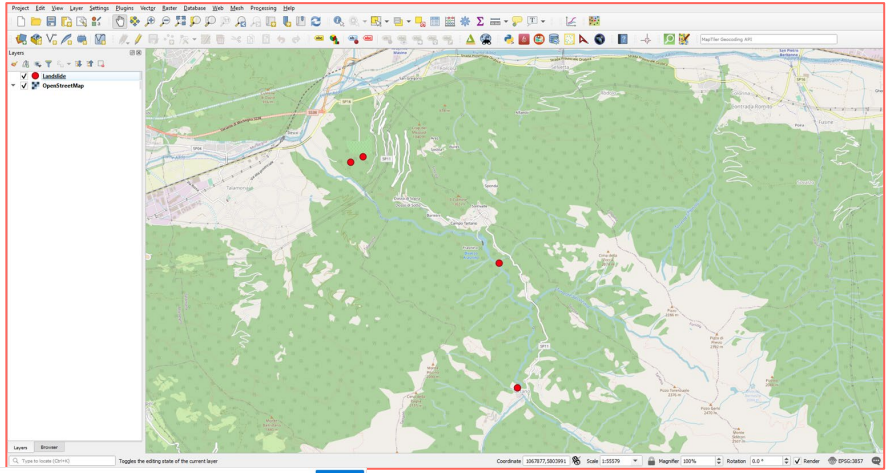
GEOLMIV

Geoinformatics and Earth Observation for Landslide Monitoring Italy – Vietnam

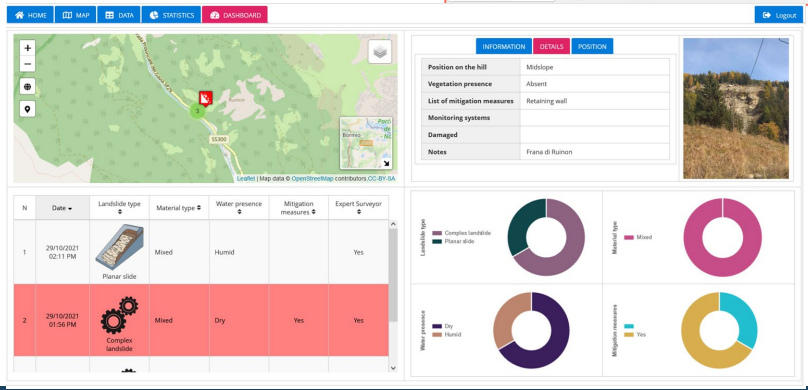
Mobile app

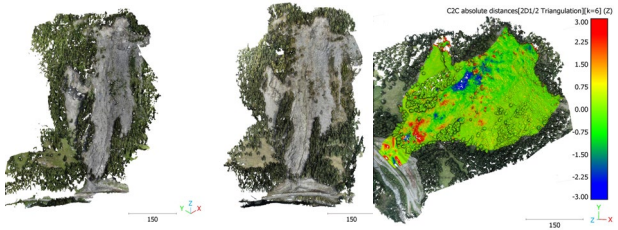


QGIS plugin



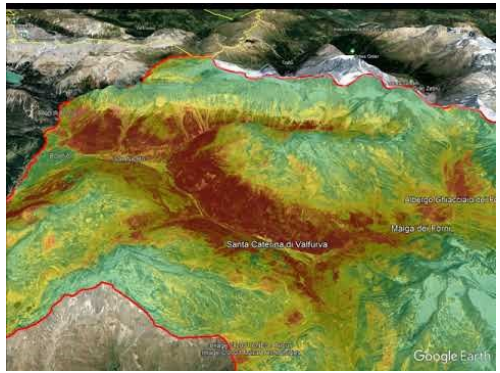
Web app

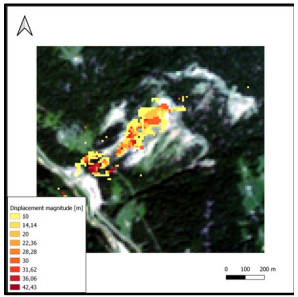


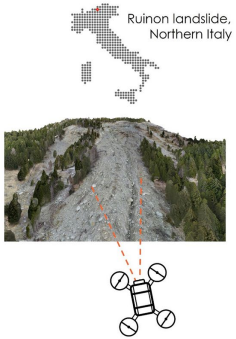


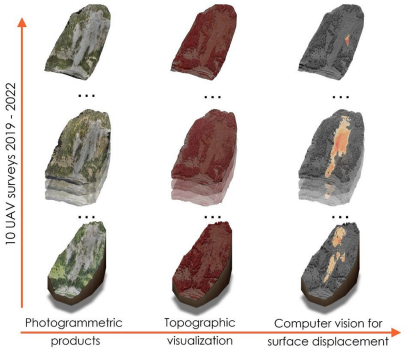
July 2021

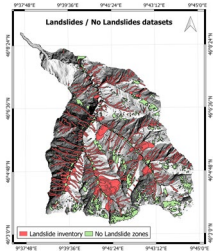
October 2021

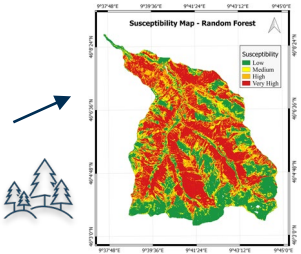


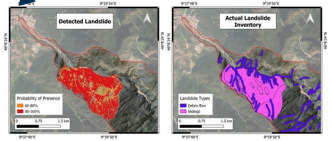


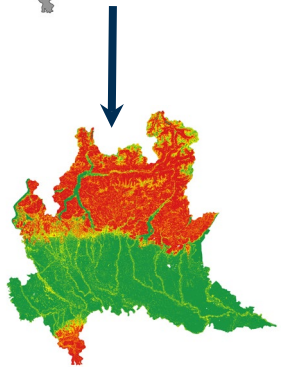












Investigate the possibilities of deep learning-based change detection workflows for landslide identification

1.Create a **global landslide dataset for change detection workflows** with optical **Sentinel-2 data**

2.Apply **change detection workflows** to compare their performances and explore the capabilities of **Deep Learning-based** workflows

DATA – creating a reliable landslide inventory (174 events with corresponding Sentinel-2 pairs)

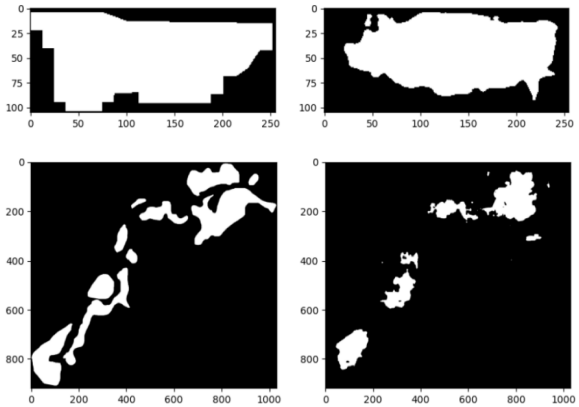
- NASA GLC
- Copernicus EMS
- Italian landslide inventory IFFI
- Irish inventory
- Turkey after 2023 earthquake
- Nepalese landslide inventory
- UT course
- Manually added events (Local news, social media, etc.)

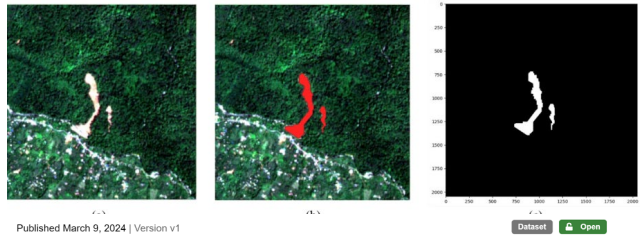
MODELS

Differential Thresholding (as a reference)

Bitemporal Image Transformer Change Detection (BIT-CD)

Change Detection based on image Reconstruction Loss (CDRL)





Published March 9, 2024 | Version v1

Dataset | Open

Global landslide dataset for change detection workflows

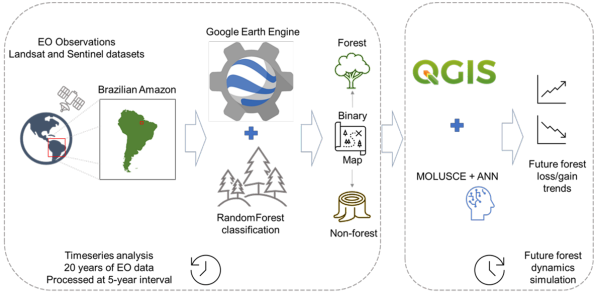
Leonardi, Julia Anna[1]; Yordanov, Vasil[1]; Brovelli, Maria Antonia[1]

Show affiliations

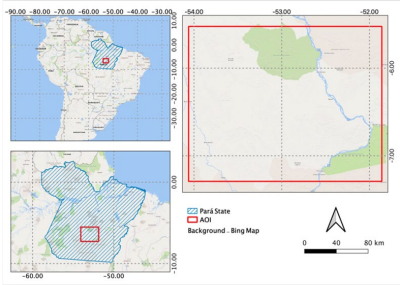
This dataset constitutes one of the outcomes of the Master's Thesis titled 'Landslide identification using deep learning-based change detection and the DeepESDL collaborative cloud platform,' authored by Julia Anna Leonardi, conducted under the supervision of Prof. Maria Antonia Brovelli and Dr. Vasil Yordanov at Politecnico di Milano. The authors extracted the image patches through the DeepESDL platform, which the ESA NoR sponsorship provided access to.

OA [%]	PA [%]	UA [%]	omission error [%]	commission error [%]	IoU [%]	mIoU [%]	F1 [%]	average F1 [%]
69.99	**7.76**	**54.47**	92.24	10.24	**7.12**	37.86	**10.08**	79.41

Monitoring Tropical Forest Change Using Multi-Temporal Remote Sensing Data and Machine Learning on Google Earth Engine

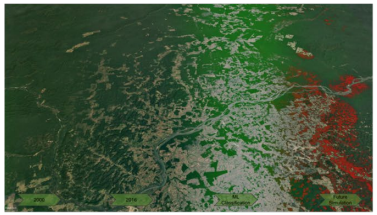


General workflow

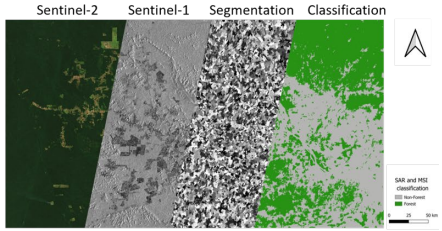


Case study – Pará State, Brazil

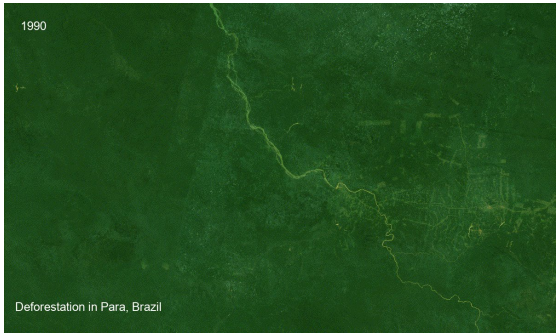
Processing

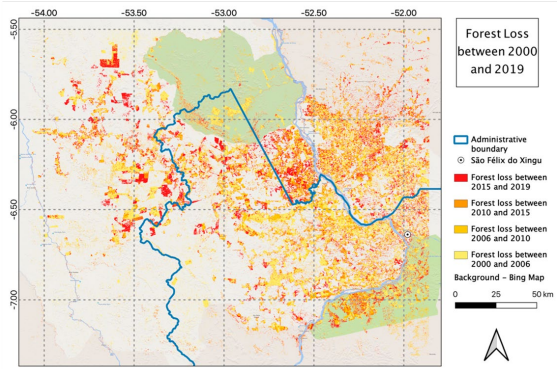


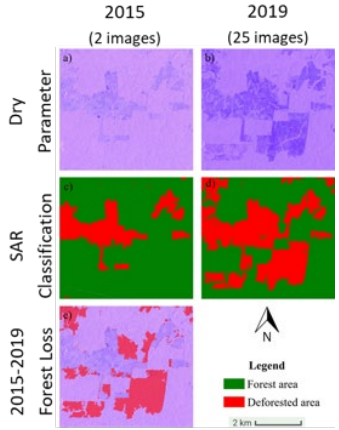
Optical MSI pixel-based approach

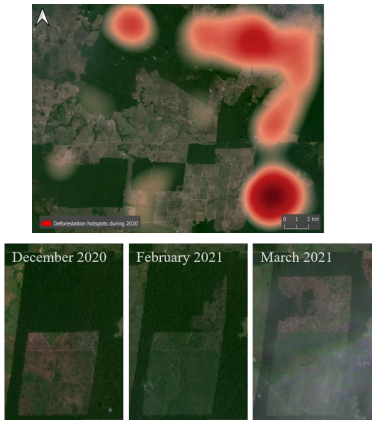


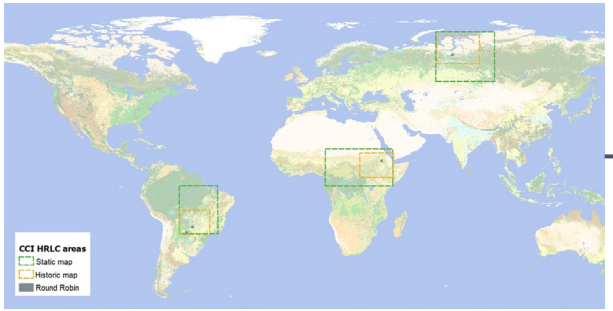
SAR and MSI object-based approach

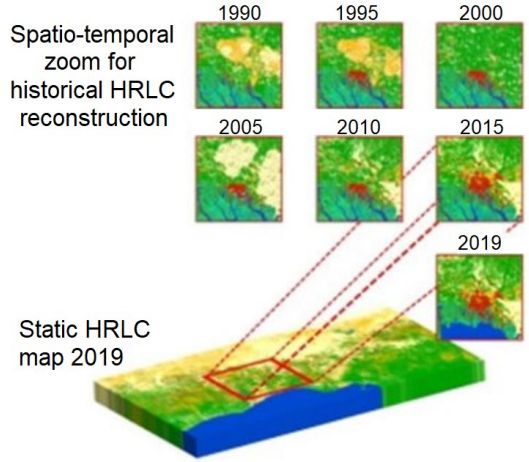


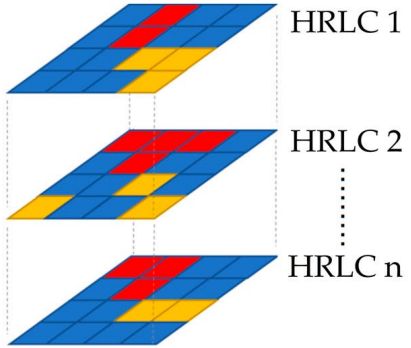












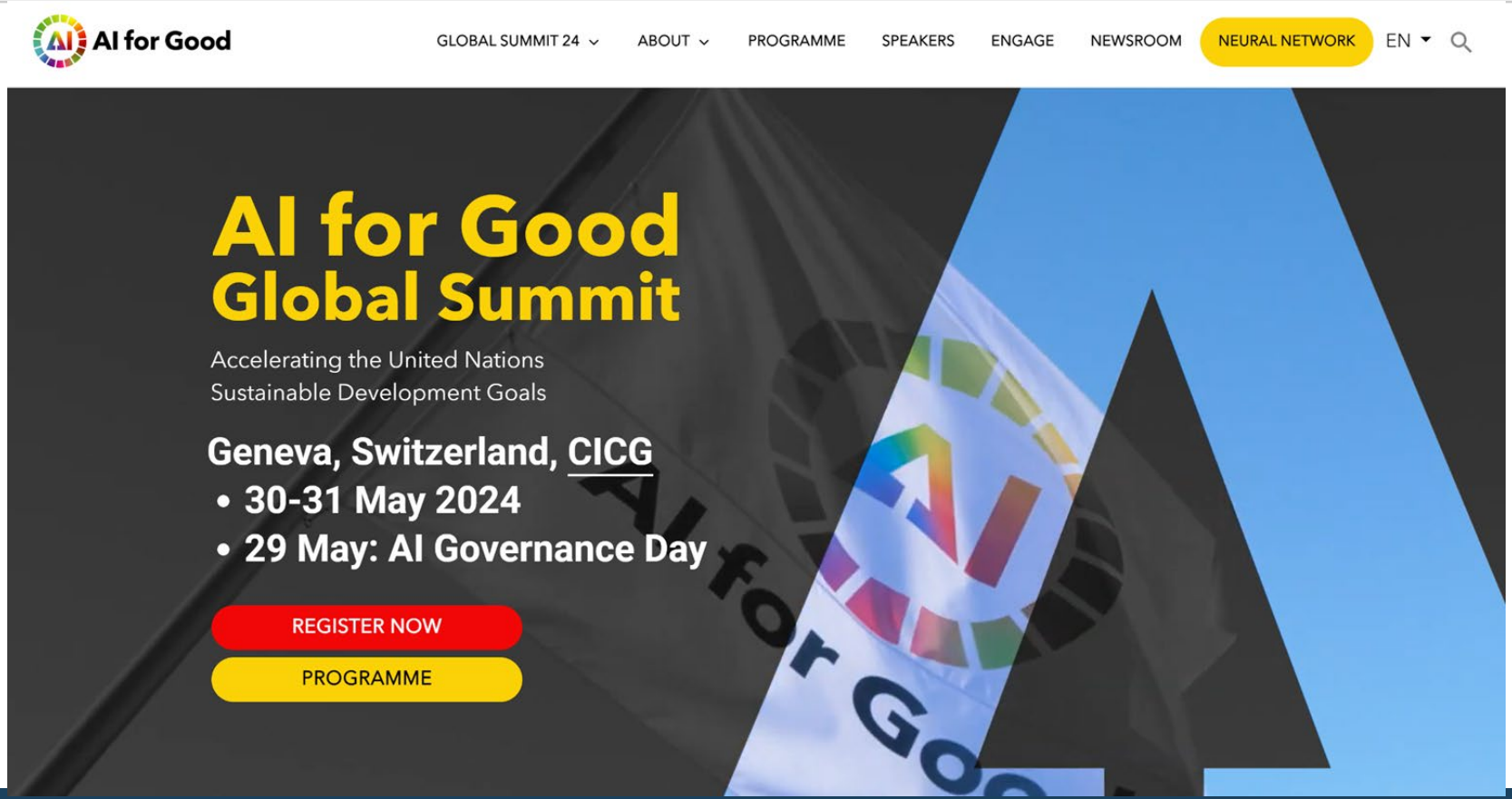
	World Cover		Dynamic World		Esri land cover		*Sentinel-2 allB*	
	PA	UA	PA	UA	PA	UA	PA	UA
Bareland	0%	0%	33%	6%	0%	0%		0%
Built-up	80%	98%	98%	88%	98%	93%	88%	98%
Cropland	6%	85%	9%	20%	4%	60%	59%	60%
Forest	94%	60%	95%	43%	95%	41%	71%	88%
Grassland	63%	56%	27%	72%	51%	80%	61%	65%
Shrubland	72%	75%	57%	81%			90%	67%
Water	98%	99%	93%	97%	100%	97%	97%	100%
Wetland	0%	0%						
Ice and snow	50%	100%	100%	40%				0%
OA	72%		64%		67%		78%	

high resolution land cover cci

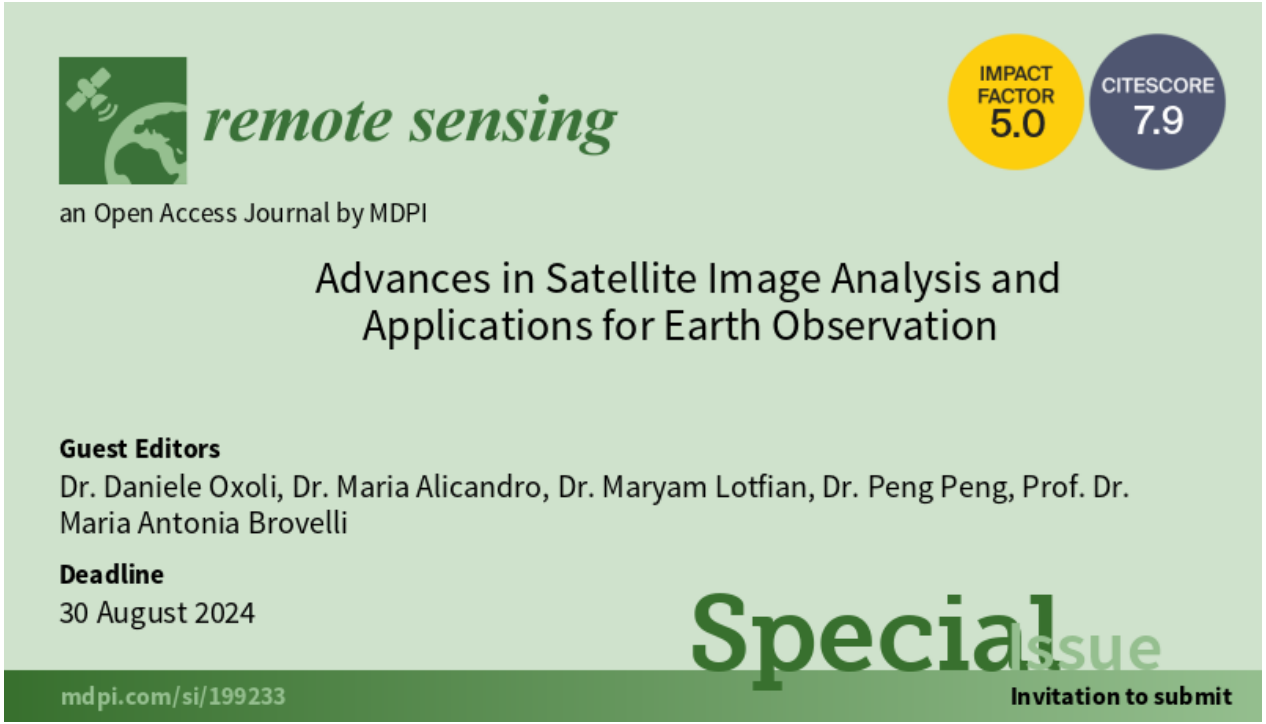
esa

Map of Land Cover Agreement (MOLCA)

GISGeolab invites you to



GISGeolab invites you to


remote sensing
IMPACT FACTOR 5.0
CITESCORE 7.9
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Advances in Satellite Image Analysis and Applications for Earth Observation
Guest Editors
Dr. Daniele Oxoli, Dr. Maria Alicandro, Dr. Maryam Lotfian, Dr. Peng Peng, Prof. Dr. Maria Antonia Brovelli
Deadline
30 August 2024
Special Issue
mdpi.com/si/199233
Invitation to submit

drones

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IMPACT FACTOR 4.8

CITESCORE 6.1

Drones for Natural Hazards

Guest Editors

Dr. Vasil Yordanov, Dr. Luigi Barazzetti, Prof. Dr. Maria Antonia Brovelli

Deadline

16 November 2024

Special Issue

mdpi.com/si/145600

Invitation to submit

Drones for Natural Hazards

Guest Editors

Dr. Vasil Yordanov
Dr. Luigi Barazzetti
Prof. Dr. Maria Antonia Brovelli

Deadline

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IMPACT FACTOR 5.0

CITESCORE 7.9

Earth Observation and Citizen Contributed Data for Urban Sustainability

Guest Editors:

Prof. Dr. Maria Antonia Brovelli
Department of Civil and Environmental Engineering, Politecnico di Milano, P.zza Leonardo da Vinci, 32, Building 3, 20133 Milano, Italy

Dr. Qi Zhou
School of Geography and Information Engineering, China University of Geosciences, Wuhan 430074, China

Dr. Andong Ma
Department of Geography, University of Colorado Boulder, Boulder, CO 80309, USA

Message from the Guest Editors

Dear Colleagues,

This Special Issue invites manuscripts that present new developments and methodologies, practices, and applications related to urban sustainability issues with remote sensing (e.g., high-resolution, multi-spectral, hyperspectral, LiDAR, thermal) and citizen-contributed data (e.g., OSM, social media, file sharing, Internet of Things). Recent advancements in multi-source data integration, multi-scale approaches, big data analysis, data mining, machine learning or studies focused on urban sustainability are welcome. Original research articles, reviews, letters, technical notes, and highlight articles may address, but are not limited to, the following topics:

- Remote sensing image processing;
- Citizen contributed data analysis;
- Multi-source data integration;
- Multi-scale approaches;
- Big data analysis and data mining;
- Machine learning and Earth Observation (citizen contributed data included);
- Internet of Things in an urban context;
- Digital twin cities;
- Geospatial science and techniques for urban sustainability.

We look forward to receiving your contributions.

Deadline for manuscript submissions:
15 September 2024

mdpi.com/si/131837

Special Issue

GISGeolab invites you to submit to

11 October 2023

Imagery analytics for understanding human-urban infrastructure interactions

A better understanding of the interactions between human behavior and urban infrastructure is essential for addressing urban sustainable development challenges. The emerging new imagery data from various sensors, such as nighttime light data, geotagged photos, street view imagery, and drones' data, have been widely accessible, providing much richer materials for a deeper studying of the interactions between citizens and urban infrastructure from a multi-dimensional manner. This special issue focus on the advanced developments and innovative methods and applications of applying imagery processing and analytics for extracting urban human activity patterns towards a better understanding of the mechanisms of the way citizens interact with urban infrastructure. Submissions must address the utilization of imagery data and/or fusion of imagery data and other urban sensing data to develop better understandings. Topics include but not limited to:

- Advanced image processing techniques for urban human activity observation
- Fusion of imagery data and other urban human activity data
- Knowledge-based geo-computation for reasoning human behavior contexts
- Spatio-temporal-semantic data mining methods for uncovering mechanisms of human-urban infrastructure interaction
- GeoAI-based techniques for understanding urban dynamics
- GeoAI ethics for urban human behavior data processing