Technical Report

Outcomes of the Project - 2024 ISPRS Educational and Capacity Initiatives

Project Title

Empowering Education and Capacity Building Focusing on Natural Disasters Based on GeoAI and Computer Vision

ISPRS ICWG III/IVa

Disaster Management

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Contents

1. Introduction

In an era of rapid technological advancements, professionals must continuously update their expertise, particularly in emerging fields such as Geospatial Artificial Intelligence (GeoAI), Artificial Intelligence (AI), computer vision, high-definition mapping, and Light Detection and Ranging (LiDAR). These technologies are integral to disaster management and the development of resilient environments.

The 2024 ISPRS Educational and Capacity Initiatives project aimed to bridge the knowledge gap by providing targeted educational resources and training opportunities for ISPRS members, students, researchers, engineers, practitioners, and policymakers. This project focused on the creation of educational materials needs assessments, and interactive workshops to enhance learning experiences in GeoAI and Earth Observation. The initiative aligns with the goals of ISPRS and supports the United Nations Global Geospatial Information Management (UN-GGIM) Academic Network, fostering collaboration among academia, industry, and governments worldwide. Visit https://www2.isprs.org/commissions/comm3/icwg-3-4a/ for more information. For reports, visit: https://www2.isprs.org/commissions/comm3/icwg-3-4a/reports-and-meetings/

2. Project objectives

The project sought to:

- Develop prototype courses to enhance education in GeoAI and remote sensing.
- Provide access to advanced geospatial technologies and AI-driven solutions.
- Facilitate networking and collaboration between international institutions.
- Curate and prepare datasets for research and educational purposes.
- Strengthen the capacity of professionals and students in disaster resilience and emergency response.

3. Key outcomes

3.1. Enhanced expertise

Participants acquired photogrammetry, GeoAI, digital twinning, digital infrastructure, remote sensing, and spatial information sciences skills. These competencies position them as a moving step for leaders in geospatial and disaster management.

3.2. Global knowledge exchange

The project established a collaborative learning environment, facilitating the exchange of innovative ideas, experiences, and best practices among ISPRS members, academic institutions, private enterprises, and governmental agencies.

3.3. Strengthening the ISPRS community

This initiative fostered a stronger ISPRS network, encouraging collaboration, professional networking, and potential research partnerships across multiple geospatial disciplines.

3.4. Course development and educational materials

Two courses, *GeoAI Ethics-Geospatial Ethics* and *Advanced Research & Applications in Geospatial Artificial Intelligence*, were developed and implemented (See Appendix 1). These courses covered key aspects of AI applications in disaster management, including computer vision, ethical considerations, and remote sensing applications. Educational materials and datasets were published on the ISPRS website, enhancing accessibility for researchers, especially in developing

regions. Many other educational materials were developed and can be seen at https://www2.isprs.org/commissions/comm3/icwg-3-4a/educational-materials/.

3.5. Datasets and open sources

To facilitate researchers, this project developed various datasets and open sources that can be used for image processing, capacity building, and disaster management. For more information, visit https://www2.isprs.org/commissions/comm3/icwg-3-4a/datasets/

3.6. Research publications and collaborative proposals

The project laid the groundwork for joint special issues (see https://www2.isprs.org/commissions/comm3/icwg-3-4a/special-issues/), publications and collaborative research proposals in the fields of GeoAI, disaster management, and Earth observation. For example, Geospatial and AHP-based identification of potential zones for groundwater recharge in Haridwar District of India, published in Frontier in Environmental Science, and Social vulnerability: A driving force in amplifying the overall vulnerability of protected areas to natural hazards, published in Heliyon.

4. Activities and events

4.1. Training and capacity building workshops

Attended ISPRS conferences and several workshops (Fig. 1) were conducted to enhance knowledge transfer, including:

- **ISPSRS Symposium**: attended **BRICS Collaboration** in Remote Sensing Applications to empower collaboration and the best capacity-building potential and establish a foundation to write a joint BRICS proposal in future in Changsha, China (May 13 to 17, 2024).
- **AI-Powered Capacity Building for Flood Monitoring Workshop** (May 31, 2024).
- **GeoAI for LiDAR Remote Sensing Workshop** (April 5, 2024, Nanjing Normal University) – Explored AI applications in LiDAR data processing.
- **Boost Collaboration with Industry and Technological Park Workshop**, Shaoxing, China (18 October 2024).
- **Geo-Information for Disaster Management (Gi4DM) Conference** (November 2-3, 2024, Belém, Brazil) – Focused on remote sensing and disaster management.
- **Advanced Research & Applications in Geospatial Artificial Intelligence Workshop** at Chengdu University of Technology, China (21-29 November 2024).
- **Earth Observation and Geospatial Artificial Intelligence for Disaster Risk Management Workshop** in **Geospatial Week 2025** in the UAE (5-12 April 2025) (see Appendix 2).
- Plan to submit a proposal for a session at XXV ISPRS Congress in Toronto in 2026.

Fig. 1. Workshops and training.

4.2. Research and academic contributions

The project contributed to the **development of**

a) Machine Learning and AI:

- Applied for socio-economic and ecological studies in Iran.

b) UAV and Drone Technology:

- Implemented for virtual 3D representation of disasters like floods in Germany and China (Fig. 2).

c) Integration with GIS and GeoIME:

- Platform used for vulnerability assessment and risk estimation for earthquakes (Fig. 3) (https://app.georvs.com/#/).

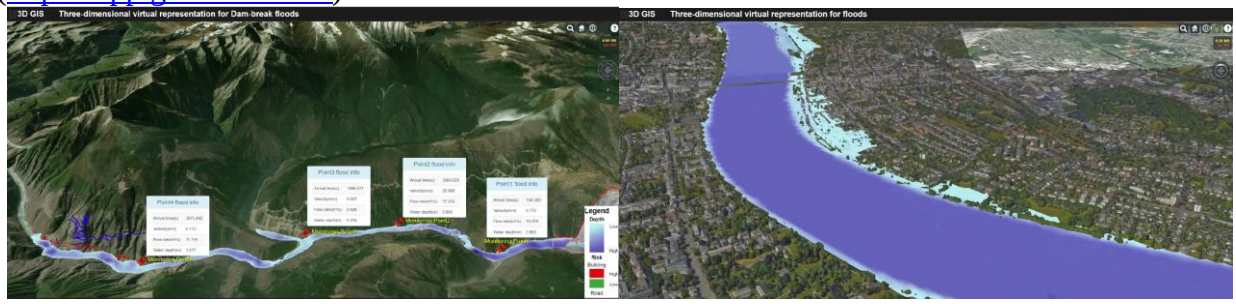

Fig. 2. Virtual 3D representation.

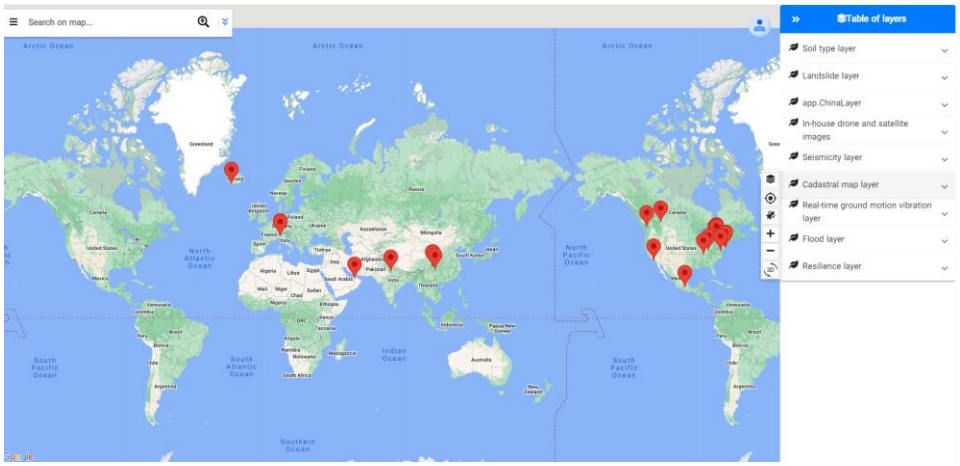

Fig. 3. GeoIME Platform.

5. Challenges and lessons learned

5.1. Data collection and integration

- Standardization, resolution, and temporal alignment remain challenging when integrating diverse data sources.

5.2. Real-time monitoring limitations

- Infrastructure limitations and funding constraints impact the accuracy of real-time disaster monitoring systems.

5.3. Automated image analysis

- Complex disaster scenarios present challenges in automating image classification and damage assessment using AI.

5.4. Crowdsourced data and social media

- Effectively leveraging social media and crowdsourced data remains a key challenge in disaster management applications.

5.5. Big data challenges

- Processing vast amounts of remote sensing data during disasters is hindered by the lack of relevant datasets.

5.6. Financial constraints

- Supporting talented young researchers remains a financial challenge due to limited funding opportunities.

5.7. Event coordination

- Scheduling international workshops and aligning with institutional calendars posed logistical challenges.

6. Future developments and recommendations

6.1. Expanding machine learning and AI applications

- Strengthening AI applications in socio-economic and ecological studies in other parts of the world.
- Enhancing automated disaster damage assessment using deep learning models.

6.2. Advancements in UAV and drone technology

- Enhancing virtual 3D disaster modeling for improved situational awareness.

- Developing drone-based real-time damage assessment workflows.

6.3. Integration with GIS and GeoIME

- Strengthening GeoIME as a platform for vulnerability assessment and disaster risk estimation.
- Implementing AI-driven decision support systems within GeoIME for disaster response planning.

6.4. Promoting resilience and sustainability

- Further refining GeoIME for applications in climate adaptation and sustainable urban planning.
- Establishing partnerships with international organizations to ensure long-term project sustainability.

6.5. Survival bias in remote sensing

- Determining bias in data and paper publication.

7. Conclusion

The 2024 ISPRS Educational and Capacity Initiatives project successfully enhanced expertise in GeoAI and disaster management, fostering collaboration among international researchers and professionals. The project established a solid foundation for future geospatial technologies and disaster resilience advancements through training workshops, academic contributions, and new research directions. Continuing investment in AI-driven solutions, cross-sector collaborations, and sustainable funding mechanisms will be crucial in effectively addressing global disaster challenges. Therefore, we plan to submit a proposal in September 2025 to continue the trend of this research initiative and explore more in-depth to contribute to ISPRS and the geospatial community. However, the integration of AI and geospatial technologies can revolutionize disaster management and improve risk assessment, early warning systems, and emergency response efficiency worldwide, which will be studied in future based on this previous project. More information can be found at https://www2.isprs.org/commissions/comm3/icwg-3-4a/.

Appendix 1:
Course outline: Advanced Research & Applications in Geospatial Artificial Intelligence

Class/Date/Time	**Topic**	**Assignment/Test/Due date**
C1/23 Nov 8:10-11:50	Course overview and introduction-Overview of Earth observation and linkage to GIS and what's about today?	Group sign-up and students' introduction
C2/23 Nov 14:00-17:00	Where we stand, GeoAI applications for disasters management	No Assignment
C3/24 Nov 8:30-12:00	Cartographic principles and how to make good maps/AI for good - Geospatial capacity development	No Assignment
C4/25 Nov 8:30-12:00	**How to write scientific research papers**	
C5/25 Nov 14:00-17:00	Fundamental of LiDAR and applications- Remote sensing images and point clouds processing techniques: Support Vector Machine (SVM)	No Assignment
C6/26 Nov 8:30-12:00	Remote sensing computer vision and GeoAI: satellite images for dynamic maps in agricultural mapping	No Assignment
C7/27 Nov 8:30-12:00	Applications and examples of the use of images and GIS for generating dynamic maps in a specific application, research for a specific purpose and project and writing an article	No Assignment
C8/29 Nov 8:30-12:00	Imagery in action, GeoApps and story maps, big data and data structure, data acquisition including open data and scripting in Python etc. using API open sources extracted from Google, Open ArcGIS, GitHub and ML Hub-Radiant etc.	No Assignment

Week/Date/Posting date	Topic	Assignment (A)/Test/Due date
Week 1	Course overview and introduction	Group sign-up and students' introduction-WECHAT post: Due [date?]
W 2	Introduction of geospatial, GeoAI, and ethics, and where we stand: Reframing geoethics?	A1-WECHAT post: Due [date?]
W 3	Origins of geoethical thought: A brief of data and geoethics	A2-WECHAT post: Due [date?]
W 4	Trustful and ethical use of geospatial data: From ethics to geoethics	No Assignment
W 5	Exploring interdisciplinary of GeoAI ethical thinking to build a spatial data infrastructure (SDI)	No Assignment
W 6	Future trends of geospatial information management and AI: setting the scene	Readings & reflection1-WECHAT post: Due [date?]
W 7	**Reading week**	No lecture/Office hours
W 8	Midterm exam: **Test 1**	WECHAT post: Due [date?]
W 9	Challenges of geospatial infrastructure management ecosystem (GeoIME) and the role of ethics	No Assignment
W 10	The concept of responsibility and the advantage of GeoAI action	Readings & reflection2-WECHAT post: Due [date?]
W 11	Ethical problems and dilemmas in the geosciences and selected applications: The values of GeoAI ethics	Group presentation by students facilitated by the instructor -WECHAT post: Due [date?]
W12	Geoethics and anthropogenic global changes: GeoAI ethics for an ecological humanism The impacts of COVID-19 on GeoAI Ethics	Group presentation by students facilitated by the instructor -WECHAT post: Due [date?]
W 13	Course wrap-up and **Test 2**	WECHAT post: Due [date?]

Appendix 2:


Foundation
2025 TIF Travel Grant Recipients
• Abhishek Rai
• Bhawna Yadav
• Matheus Da Silva
• Ayyappa Reddy Allu
• Abhinav Galodha
• Sampriti Soor
• Peng Ye
• Peyman Jafary
• Raden Putra
• Mahdieh Shirmohammadi
• Ali Hosingholizade
• Priyanka Kumari
• Lucas Dammert


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