Enhancing disaster risk reduction through Artificial Intelligence: Capitalizing on the capacity building activities of the AI-OBSERVER Twinning project

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ABSTRACT

In the framework of the AI-OBSERVER project, the capabilities of ERATOSTHENES Centre of Excellence (CoE) on Earth Observation (EO) based Disaster Risk Reduction are significantly enhanced through a series of capacity building activities on Artificial Intelligence (AI) that are provided by the project's two advanced partners, the German Research Centre for Artificial Intelligence (DFKI) from Germany, and the University of Rome Tor Vergata (UNITOV) from Italy. These were designed, following a gap analysis of the existing staff and scientific capacity of the ERATOSTHENES CoE researchers, on the thematic research areas of: (i) Land movements (Earthquakes, Landslides and Soil erosion); (ii) Forest fires; (iii) Floods and extreme meteorological events; and (iv) Marine Pollution (oil spills, illegal waste damping, etc.). DFKI and UNITOV are transferring their scientific expertise through several workshops, webinars, short-term staff exchanges, summer schools and expert visits covering a combination of these AI-related topics, aiming to fill the identified gaps. All these will enable the ERATOSTHENES CoE researchers to build AI models for large scale image processing and Big EO data. Up to date, over thirty early stage and senior researchers have participated in these trainings. The knowledge transferred to ERATOSTHENES CoE will be utilised by its staff in a research exploratory project applying Artificial Intelligence on Earth Observation for multi-hazard monitoring and assessment in Cyprus, with the support of the advanced partners, leading to the development of the first ERATOSTHENES CoE product integrating EO and AI for Disaster Risk Reduction.

Keywords: Artificial Intelligence, Disaster risk reduction, Earth Observation, Big data, Capacity building

1. INTRODUCTION

Nowadays, Artificial Intelligence (AI) is already in everyday use, from ChatGPT to global connectivity, and big data processing, with the variety of activities that utilize AI continuously expanding [1-3]. In the last couple of years, Artificial Intelligence (AI) has become crucial for the exploitation of the vast amount of Earth Observation (EO) data that is available through Copernicus and commercial satellite providers, to extract information, to enhance forecasting capabilities, and develop tailor-made products and services to the needs of end users and stakeholders [4-6].

In this direction, the AI-OBSERVER project has received funding from the European Union's Horizon Europe Framework Programme HORIZON-WIDERA-2021-ACCESS-03 (Twinning) under Grant Agreement No 101079468 [7, 8]. The project aims to significantly strengthen and stimulate the scientific excellence and innovation capacity on the topic of AI used on EO for Disaster Risk Reduction, as well as the research management and administrative skills of the ERATOSTHENES Centre of Excellence (CoE). The ERATOSTHENES CoE, an autonomous and self-sustained Centre of Excellence envisioning to become a world-class digital innovation hub for Earth Observation, space technology and geospatial information in the Eastern Mediterranean, Middle East and North Africa (EMMENA) [9], is the project coordinator. The consortium also consists of two internationally top-class leading research institutions, the German Research Centre for Artificial Intelligence (DFKI) from Germany and the University of Rome Tor Vergata (UNITOV) from Italy, and an industrial partner CELLOCK Ltd from Cyprus.

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2. METHODOLOGY

An initial step to design and develop the curriculum of capacity building activities was to identify the gaps (Figure 1) in terms of the existing staff and scientific capacity of the ERATOSTHENES CoE researchers. This would allow the determination of activities necessary for capacity building after the integration of advanced Al technologies in their Disaster Risk Reduction related EO activities.

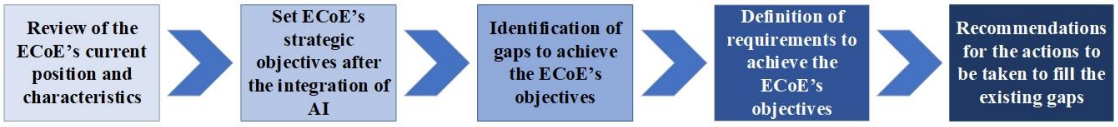

Figure 1. Gap analysis performed for the development of capacity building activities.

The gap analysis also outlined the infrastructure required to enhance the Centre's competitiveness in the AI for EO market. This is critical for the implementation of the knowledge acquired during the project and for its exploitation beyond the end of the project. Based on the results of the gap analysis, a curriculum of capacity building activities was designed to fill these gaps on the thematic research areas of:

- Land movements (Earthquakes, Landslides, Soil erosion, etc.).
- Forest fires.
- Floods and extreme meteorological events.
- Marine Pollution (oil spills, illegal waste damping, etc.).

The capacity building is being carried out by the advanced partners, German Research Centre for Artificial Intelligence (DFKI) and the University of Rome Tor Vergata (UNITOV), throughout the duration of the project in the form of workshops, webinars, short-term staff exchange, joint summer schools and expert visits, covering a combination of these topics, aiming to fill the identified gaps.

Figure 2. Workshops and summer school carried out at ERATOSTHENES CoE premises in Limassol, Cyprus.

More specifically, DFKI are transferring their scientific expertise on fundamentals and theory of AI, as well as their technical knowledge for the establishment of an infrastructure at ERATOSTHENES CoE premises, capable to cope with the analysis and processing of Big EO datasets. On the other hand, UNITOV provide their scientific expertise on AI applied on the environmental hazards mentioned above.

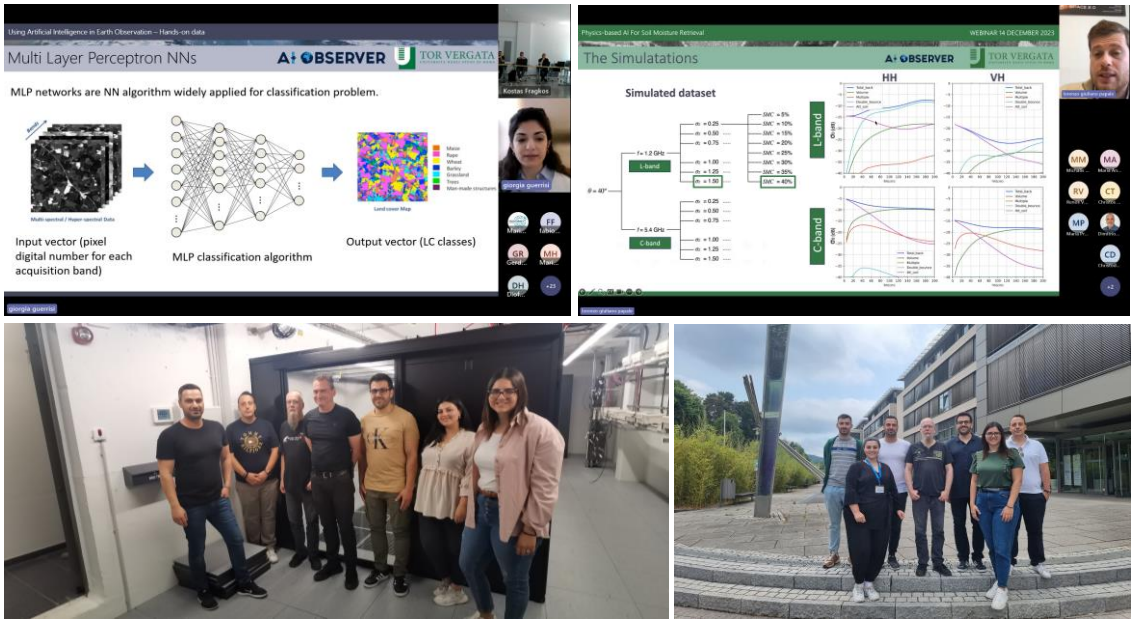

Figure 3. Webinars via Microsoft Teams (top) and short-term staff exchanges at DFKI premises at Kaiserslautern, Germany (bottom) carried out.

The capacity building activities have covered various topics, ranging from fundamentals and basic principles of AI to Deep Learning approaches and more advanced AI-related methods applied to the environmental hazards presented earlier. All these will enable the ERATOSTHENES CoE researchers to build AI models for large scale image processing and Big EO data. Up to date, over thirty early stage and senior researchers have participated in these trainings, taking advantage of the knowledge transferred by the project's advanced partners.

3. DISCUSSION AND CONCLUSIONS

The knowledge transferred will be utilized by ERATOSTHENES CoE's staff in a research exploratory project applying Artificial Intelligence on Earth Observation for multi-hazard monitoring and assessment in Cyprus, with the support of the advanced partners, and the continuous interaction with the local, regional and national stakeholders and end-users in Cyprus, such as the Geological Survey Department, the Department of Forests, and the Water Development Department of the Ministry of Agriculture, Rural Development and Environment, the Department of Public Works of the Ministry of Transport, Communications and Works, and the Cyprus Civil Defence of the Ministry of Interior.

This activity will lead to the development of the first ERATOSTHENES CoE products integrating AI with EO-based and other auxiliary datasets for Disaster Risk Reduction, and specifically on land movements, forest fires, floods, extreme meteorological events and marine pollution. The developed tools can be used by end users in their activities, covering all disaster risk reduction aspects, i.e., preparedness, mitigation, response, recovery and prevention.

Last but not least, the increased scientific excellence of the ERATOSTHENES CoE in the field of AI for Earth Observation on Disaster Risk Reduction has raised the visibility of the Centre in the EO scientific community, providing additional opportunities for attracting new high calibre personnel on the specific thematic area. This has led to conference and journal publications [10], and new funded research projects in the specific field. The introduction of AI in the ERATOSTHENES CoE is also expected to benefit all the Centre's research clusters and departments, advancing the profile of its researchers individually, but also the Centre's as a whole.

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