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ERATOSTHENES: excellence research Centre for Earth surveillance and space-based monitoring of the environment, the EXCELSIOR Horizon 2020 teaming project

Diofantos G. Hadjimitsis, Haris Kontoes, Gunter
Schreier, Albert Ansmann, Georgios Komodromos, et al.

ERATOSTHENES: Excellence Research Centre for Earth Surveillance and Space-Based Monitoring of the Environment – The EXCELSIOR Horizon 2020 Teaming Project

Diofantos G. Hadjimitsis^a, Haris Kontoes^b, Gunter Schreier^c, Albert Ansmann^d, George Komodromos^e, Kyriacos Themistocleous^{a*}, Rodanthe Mamouri^a, Silas Michaelides^a, Argyro Nisantzi^a, Christiana Papoutsis^a, Kyriacos Neocleous^a, Christodoulos Mettas^a, Marios Tzouvaras^a, Evagoras Evagorou^a, Andreas Christofe^a, George Melillos^a, Ioannis Papoutsis^b

^aCyprus University of Technology, Eratosthenes Research Centre, Remote Sensing & Geo-Environment Lab, Department of Civil Engineering and Geomatics, Faculty of Engineering and Technology, 2-8 Saripolou, 3036 Limassol, Cyprus; ^bNational Observatory of Athens, Athens, Greece; ^cDeutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Berlin, Germany; ^dLeibniz Institut für Troposphärenforschung, Leipzig, Germany; ^eDepartment of Electronic Communications of the Ministry of Transport, Communications and Works, Nicosia Cyprus

ABSTRACT

The aim of this paper is to present the strategy and vision to upgrade the existing ERATOSTHENES Research Centre (ERC) established within the Cyprus University of Technology (CUT) into a sustainable, viable and autonomous Centre of Excellence (CoE) for Earth Surveillance and Space-Based Monitoring of the Environment, which will provide the highest quality of related services on the National, European and International levels. EXCELSIOR is a Horizon 2020 Teaming project which addresses a specific challenge defined by the work program, namely, the reduction of substantial disparities in the European Union by supporting research and innovation activities and systems in low performing countries. It also aims at establishing long-term and strategic partnerships between the Teaming partners, thus reducing internal research and innovation disparities within European Research and Innovation landscape. The proposed CoE envisions the upgrading of the existing ERC into an inspiring environment for conducting basic and applied research and innovation in the areas of the integrated use of remote sensing and space-based techniques for monitoring the environment. Environment has been recognized by the Smart Specialization Strategy of Cyprus as the first horizontal priority for future growth of the island. The foreseen upgrade will regard the expansion of this vision to systematic monitoring of the environment using Earth Observation, space and ground based integrated technologies. Such an approach will lead to the systematic monitoring of all three domains of the Environment (Air, Land, Water). Five partners have united to upgrade the existing ERC into a CoE, with the common vision to become a world-class innovation, research and education centre, actively contributing to the European Research Area (ERA). More specifically, the Teaming project is a team effort between the Cyprus University of Technology (CUT, acting as the coordinator), the German Aerospace Centre (DLR), the National Observatory of Athens (NOA), the German Leibniz Institute for Tropospheric Research (TROPOS) and the Cyprus Department of Electronic Communications of the Ministry of Transport, Communications and Works (DEC-MTCW).

Keywords: Centre of Excellence, remote sensing, Cyprus, Smart Specialization Strategy, environmental monitoring

*k.themistocleous@cut.ac.cy

1. INTRODUCTION

Earth Observation technologies are critical in providing reliable and up-to-date information needed to better observe, understand, protect, monitor, and predict environmental parameters that regard land, water and air. Earth Observation

data are key factors in all countries' Earth environmental programs in assessing the current information of the environment, feed models, understand relationships among Earth processes, support decision making for sustainable development and involve stakeholders more effectively in environment related decision-making. Climate change, air and water quality, natural hazards, floods, earthquakes, fires, erosion, landslides and other issues are some of the aspects that need to be taken into consideration in several environmental studies, both at a national as well as at a regional and continental levels.

The aim of this paper is to present the strategy and vision to upgrade the existing ERATOSTHENES Research Centre (ERC) (<http://www.cyprusremotesensing.com/>), established within Cyprus University of Technology (CUT), into a sustainable, viable and autonomous Centre of Excellence (CoE) for Earth Surveillance and Space-Based Monitoring of the Environment, which will provide the highest quality of related services on the National, European and International levels. EXCELSIOR is a Horizon 2020 Teaming project which addresses this specific challenge. The proposed CoE envisions upgrading the existing ERC into an inspiring environment for conducting basic and applied research and innovation in the areas of the integrated use of remote sensing and space-based techniques for monitoring the environment. An important aspect of the EXCELSIOR project addresses the disparities in the European Union by supporting research and innovation activities and systems in low performing countries by establishing long-term and strategic partnerships between the Teaming partners. Cyprus is uniquely suited for the EXCELSIOR project due to its unique geographical and environmental location.

2. RESEARCH ACTIVITIES

The ERC, with its significant experience in the field of remote sensing, Earth Observation and space-based techniques, has received funding from European, national and industrial sources, including Horizon 2020; FP6, FP7, INTERREG, LIFE+, JPI, MED, ECHO, MARIE-CURIE (ITN), EUREKA, ERASMUS+, Cyprus Research Promotion Foundation (CRPF), etc. In the last ten years, the Centre secured funding for over than 65 projects. These projects are listed and described at www.cyprusremotesensing.com. The thematic areas of the existing applied and pure research activities are classified into the three main domains of the environment 'AIR', 'LAND' and 'WATER'. All the existing research activities are based on the use of Earth Observation and space-based monitoring of the environment, including applications in aerosols, atmospheric sciences and air pollution [1-4], natural hazards [5-7], blue growth [8], water resources management, irrigation demand and agriculture [9-11], water quality [12-16], land cover changes [17], culture heritage and archaeology [18-22], urban heat [23], water leakage detection [24], coastal water quality [25] etc. The integrated use of remote sensing techniques with other auxiliary methods, such as field spectroscopy and geospatial tools is an additional research activity of ERC. Lastly, the Centre has a great experience in the pre-processing of satellite imagery, with emphasis on the development of novel atmospheric correction methods [26-32] as well as expertise on calibration using test fields. Indeed, in the technical report released by Copernicus /ESA 'Copernicus data Quality Control - Technical Note Atmospheric Corrections' (see [33]), four publications on atmospheric corrections by members of ERC [i.e., 30-32] are listed as key references for guidelines.

Currently, the ERC participates as a partner in a 'SEO-DWARF' HORIZON 2020 MSCA-RISE project (<https://seodwarf.eu/>) with the main aim to promote the resolution of scientific questions formed by the marine application domain regarding satellite image retrieval from the Copernicus programmes. Moreover, the Centre participates in the GEO-CRADLE HORIZON 2020 project (<http://geocradle.eu/>) that coordinates and integrates state-of-the-art Earth Observation activities in the regions of North Africa, Middle East, and Balkans and develops links with GEO (Group on Earth Observations) related initiatives towards GEOSS (Global Earth Observation System of Systems) and implementation of Sustainable Development goals in the fields of Climate Change Adaptation, Raw Materials, Soil & Water management, and Renewable Energy Resources [34]. The Centre also participates in two JPI projects, the 'CLIMA' (<http://www.clima-project.eu/>) and 'PROTHEGO' (<http://www.prothego.eu/>) in the areas of cultural heritage using Earth Observation. Currently, the Centre coordinates the 'DECAT' ECHO project (<http://decatstrophize.eu/>) that aims towards better protection of citizens against disaster risks and strengthening early warning systems in Europe. ERC also participates in the BACCHUS FP-7 project (<http://www.bacchus-env.eu/>) that proposes to quantify the key processes and feedbacks controlling aerosol-cloud interaction (ACI), by combining advanced measurements of clouds and aerosol properties with state-of-the-art numerical modeling.

Finally, through the H2020 “Spreading Excellence and Widening Participation”, the Centre coordinates the ‘ATHENA’ TWINNING Project (athena2020.eu) with the main aim to establish a Centre of Excellence in the field of Remote Sensing for Cultural Heritage in the areas of Archaeology and Cultural Heritage. Through ‘ATHENA’ Twinning project, there is an opportunity to perform a gap analysis by identifying the potential and the future roadmap by using some of the following indicators such as staffing, infrastructure, education, students, outreach, funding, science, publication, services, private sector corporation. This gave the opportunity to move to the next step of upgrading the existing Centre into a sustainable and viable CoE for Earth Surveillance and Space-Based Monitoring of the Environment, through the EXCELSIOR Teaming Project (H2020-WIDESPREAD-04-2017) (excelsior2020.eu).

3. STRATEGIC OBJECTIVE

The intention of the EXCELSIOR project is to provide a clear vision for upgrading the existing ERC to a sustainable CoE. The foreseen upgrade will regard the expansion of this vision to systematic monitoring of all three domains of the Environment (Air, Land, Water) using Earth Observation, space and ground-based integrated technologies. Additionally, by upgrading the ERC into a CoE, it is expected that new, highly innovative products and services will be developed and provided to national, regional and international public and private sectors, in the Space and Earth monitoring sectors. The EXCELSIOR project is built on the objectives of long term vision, science and innovation strategy and growth and economic development.

3.1 Strategic objectives: long-term vision

The long-term vision of the EXCELSIOR project is to upgrade the ERC into a fully functional institution within the CUT that will be self-sustained well beyond the funding period. In order to achieve this, the CoE will focus on research and activities in the domain of environmental monitoring, including the fields of air, land and water. The long-term vision of the EXCELSIOR project is to develop and implement a plan of the strategic positioning in the country, in the region and in the European Union on the topic of space technologies for environmental monitoring.

3.2 Science and innovation strategy objectives

The main focus of the EXCELSIOR project is to promote basic and applied science in Earth Observation and develop innovative strategies in the field. In order to provide the appropriate environment for advanced, cutting-edge research, it will be necessary to identify the appropriate state-of-the art infrastructure needed and proceed with the necessary upgrade.

3.3 Growth and economic development objectives

One of the most important aspects of the EXCELSIOR project is to provide economic benefits to individuals and companies in Cyprus and Europe. The establishment of the ERATOSTHENES CoE will provide new job opportunities and ‘push’ further the development of products and services. The creation of spin-off companies is also a key target.

4. OPERATIONAL MODEL

The Smart Specialisation Strategy for Cyprus (S3Cy) [35], which focuses on the exploitation of resources from the European Structural and Investment Funds for enhancing Research and Innovation (R&I), was approved by the Council of Ministers of the Government of Cyprus to provide a framework for competitive advantage. The priority sectors that have been selected for future and sustainable growth in Cyprus are: Tourism, Energy, Agriculture – Food Industry, Built Environment – Construction Industry, Transportation-Maritime and Health. Additionally, horizontal sectors, such as the Environment and the ICT (Information and Communications Technology), were also defined as significant priorities with societal impacts. The EXCELSIOR project, with the significant upgrade of the ERC into a CoE in Earth Surveillance and Space-Based Monitoring of the Environment, is fully aligned with the S3Cy, significantly enhancing the impact of the targeted regional and national investments.

The existing ERC is the only established laboratory in Cyprus for space-based Earth Observation and possesses significant experience on Earth Observation, Remote Sensing and the technical infrastructure that is needed to

systematically observe, understand, protect, monitor and predict environmental parameters in land, water and air. More specifically, the R&I activities of the ERATOSTHENES CoE will be directly linked with the thematic areas of the horizontal priority of Environment (Adaptation to Climate Change: Risk Prevention, Risk Reduction and Management, Efficient Natural Resource Management, Protection, Promotion and Exploitation of Cultural Heritage, Sustainable Blue Growth) and ICT (applications and state-of-the-art technologies, such as big data, linked data, and crowd data [36]), which is the other horizontal priority of S3Cy, through a close collaboration with the industry (see Figure 1).

The ERC aims to collaborate closely with the German Aerospace Centre (DLR), National Observatory of Athens (NOA - that brings state-of-the-art Earth Observation technology in the fields of big satellite data acquisition and processing, as well as delivery of innovative information in relation to Disaster Risk Reduction and Environmental Crisis Monitoring and Disaster Management [37-40]), Leibniz Institute for Tropospheric Research (TROPOS) and the Department of Electronic Communications of the Ministry of Transport, Communications and Works (DEC-MTCW) and interact with Cypriot and international partners. This interdisciplinary mixture of partners and stakeholders will lead towards the significant expansion and upgrade of ERC, which will be established as a CoE in Earth Observation and Space-based Monitoring of the Environment in Cyprus, Europe and the greater Eastern Mediterranean area. The Centre will continue to be hosted at the Cyprus University of Technology premises in Limassol, Cyprus, which is defined as a low performing country.

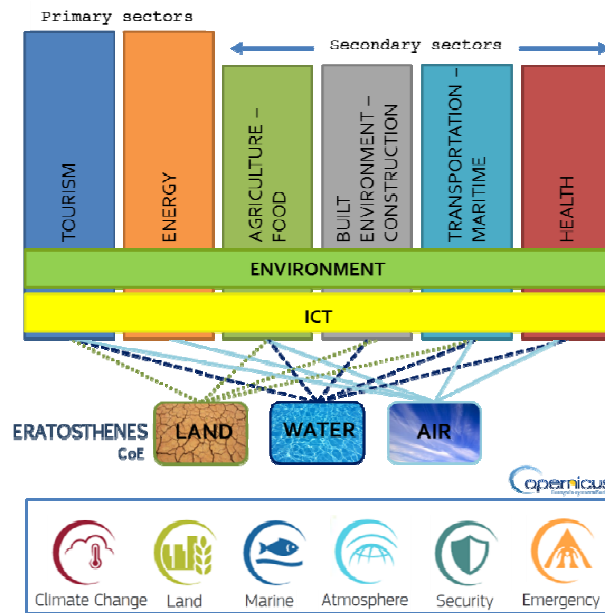


Figure 1. ERATOSTHENES CoE research thematic areas and applications in relation with S3Cy Priorities.

5. EXPECTED IMPACTS

The EXCELSIOR project is expected to have an impact on national and international programs and stakeholders and it will set the basis for a long-term vision in a highly relevant climatic region at the edge of Europe, for the availability of high-quality data in the domains of land, air and water. The EXCELSIOR project is also expected to have an impact on the Cyprus and European Union economy and society. The creation of ERATOSTHENES CoE, which will incorporate the use of integrated Earth Observation information, will increase competitiveness and attract funding with immediate benefit for the economy and employment of the country.

6. CONCLUSIONS

With the close collaboration of all partners in the consortium and the participation in R&I clusters and the private sector, the ERC, can be upgraded into a viable Centre of Excellence providing a service to national stakeholders in the Space and Earth Monitoring sectors while contributing to the growth of the European Space Industry and to the National and European Research and Innovation through the priorities as set in the S3Cy. The upgrade into a CoE will increase the scientific capabilities and innovation performance in Cyprus and provide a competitive edge in seeking funding in the field of Earth Observation research. Active participation of ERATOSTHENES CoE in well-established international networks will help the Centre to remain in the forefront of cutting-edge research, provide access to new technologies and techniques, facilitate access to information for solving different kind of issues, generate opportunities to participate in or organize large experimental campaigns and attract high-esteemed scientists and advanced infrastructure from collaborating institutes. Networking, combined with experience in proposal preparation/coordination, and strong links as well as deep engagement of various stakeholders is the key for attracting constant funding and maintenance, building and enhancement of capacities.

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