

## **EXCELSIOR: a European Horizon 2020 Teaming project for the establishment of a Centre of Excellence in the Eastern Mediterranean for Earth surveillance and space-based monitoring of the Environment**

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### 1. Introduction

Earth Observation technologies are vital for providing reliable up-to-date information to better observe, understand, protect, monitor and predict environmental parameters that regard land, water and air. Such valuable inputs are crucial for more informed decision-making oriented towards the protection and management of environment and resources. Earth observation includes, among others, technological solutions including satellite observation, navigation and positioning systems. To date, conventional methods are employed for the detection of threats/risks related to pollution events in air, land and water, including the use of physicochemical sampling campaigns and site visits. These techniques are time consuming and require extensive use of manpower and, the same time, create additional environmental issues.

The aim of this paper is to present the envisioned upgrade the existing Remote Sensing & Geo-Environment Group-ERATOSTHENES Research Centre (ERC) established within the School of the Engineering and Technology, Department of Civil Engineering and geomatics, 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 (EXCELSIOR), which will provide the highest quality of related services on the National, European, Eastern Mediterranean and Middle East (EMME) and Middle East and North Africa (MENA) levels.

The above vision will be addressed through

the implementation of a robust plan that will be developed during the current one-year phase of EXCELSIOR project and will establish the foundations for the development of a competitive and high competence profile to expand the Centre's visibility beyond the national level and develop transnational and transregional cooperation. The long-term aim of the upgraded Centre is to create new opportunities for conducting basic and applied research and innovation (R&I) in the areas of the integrated use of remote sensing and space-based techniques for monitoring the environment with applications in several areas, including (but not limited to) the built environment, natural hazards and cultural heritage.

Five partners that have already strong collaborations between each other have united within EXCELSIOR project with the common vision to upgrade the existing ERC to become a world-class innovation, research and education center, actively contributing to the European Research Area (ERA). These five partners include 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).

The existing ERATOSTHENES Research Center (ERC) conducts state-of-the-art research, integrating novel technologies in the areas of Remote Sensing and space-based earth observation techniques, along with the use of Geographic Information Systems (GIS), to develop sustainable and systematic monitoring of areas of interest and the on-time detection of risks. The ultimate goal of

the CoE will be the protection of the environment, providing critical information, through end user products, not only to policy makers but also to other local, national and regional authorities.

The ERC has demonstrated its innovation and dynamics in the field of Earth Observation over the past 10 years of its existence and is now focused on upgrading the existing ERC into a Centre of Excellence (CoE), which will address the national, regional and international needs regarding remote sensing and Earth Observation. The ERC has received funding for over 60 competitive research programs and funded projects since 2007, with funding Sources from the European Union (EU), the Cyprus Research Promotion Foundation (RPF) and industry. The EXCELSIOR project is built upon the vision for the upgrading of the existing Remote Sensing and Geo-Environment Group (Eratosthenes Research Centre) ERC to a sustainable CoE. The upgrade will regard the expansion of this vision to systematic monitoring of environment using Earth observation, space and ground based integrated technologies focusing on natural and built environment (e.g. land, air and water) related applications. The main pillar will be on conducting basic and applied research to bring innovation in the areas of the integrated use of remote sensing and space-based techniques for monitoring the environment.

The EXCELSIOR's project vision of the significant upgrade of the ERC into a CoE in Earth Surveillance and Space-Based Monitoring of the Environment, is fully aligned with the Smart Specialization Strategy (S3Cy) for Cyprus. The S3Cy has been established by the Government of Cyprus (Government of Cyprus, 2015), based on priority sectors that have been selected for future sustainable economic growth in Cyprus.

Through the H2020 "Spreading Excellence and Widening Participation", the Centre coordinates the 'ATHENA' TWINNING Project ([www.athena2020.eu](http://www.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. This enable the Group to move to the next step of upgrading the existing Centre into a sustainable and viable Centre of Excellence (CoE) for Earth Surveillance and Space-Based Monitoring of the Environment

through the 'EXCELSIOR' Teaming Project (H2020-WIDESPREAD-04-2017) ([www.excelsior2020.eu](http://www.excelsior2020.eu)).

The strong background and individual experience of the ERC in the area of remote sensing and space technologies, combined with the synergy that will be established with the partners of the project, can result in the implementation of a sustainable CoE, which will address crucial research and innovation (R&I) problems of great societal benefit. The research fields of Earth Observations and space technology have matured to the point that many challenges lie in the capitalisation of existing knowledge and technologies to enable advances in many diverse application areas stated in the S3Cy, such as health, tourism, agriculture, cultural heritage, transport, blue growth, natural hazards, natural & built environment etc. The R&I activities of the upgraded ERATOSTHENES CoE are planned to be directly linked with the thematic areas of the horizontal priorities of Environment and Information & Communication Technologies of S3Cy, through future collaboration with the industry not only within Cyprus but also with countries in the Eastern Mediterranean and Middle East (EMME) and Middle East and North Africa (MENA).

## 2. Areas of expertise of the ERATOSTHENES Research Center

In relation to the Copernicus trend, which provides products and services on Land, Marine and Atmosphere monitoring as well as on Emergency management, Security and Climate Change, ERATOSTHENES CoE is organised in 3 main research thematic areas, i.e. Land, Water and Air which are covered under the big umbrella of the natural and built environment. The present research capacities of ERATOSTHENES are summarized below:

(a) The current state-of-the-art includes characteristic services such as the monitoring and forecast of natural environment (forests drylands, crops) and natural geo-hazards (including desertification, earthquakes, landslides, flooding, fire). The research activities of the ERC focus on crop prediction, soil monitoring, pest control and sustainable land use. Additionally, the monitoring of archaeological and built cultural heritage sites for purposes of their better conservation and

valorisation are one of the main activities of the Centre. Systematic services of Land use/land change are of particular importance for urban growth and the built environment (Agapiou et al., 2015; Neocleous et al., 2016). Economic sectors affected by Land Section in Cyprus are hence mainly Agriculture (with focus on Infrastructure and Planning for urban and rural areas) (Papoutsas et al., 2016; Themistocleous et al., 2014a), the built environment (Themistocleous et al., 2012; Themistocleous et al., 2014b) and the efficiency constructions.

(b) The current state-of-the-art focuses on water resources management and agriculture as one of the more important priority sectors for Cyprus, since it has a long history of water challenges, including severe water scarcity problems for centuries. The ERC aims to support public authorities, stakeholders and private interest to retrieve useful information for optimizing water management by using available satellite data. Some of the major research sectors of the Centre, monitoring water quality in dams using satellite remote sensing, with the aim to protect and preserve the quality of available water as well as monitoring coastal areas, and identifying water leakages in urban and rural areas through passive and active remote sensing techniques (Agapiou et al., 2014; 2016). Additional research includes examining drought events due to climate change through earth observation systems as well as Marine Spatial Planning (Hadjimitsis et al., 2015), which focuses on coastal and maritime tourism and the promotion of sea based cargo and passenger transportation are some of the crucial areas included. The Group has a strong research background on monitoring irrigation demand using image-based techniques by integrating remote sensing, UAV and field spectroscopy (Papadavid et al., 2009, 2011).

(c) The current state-of-the-art of the Atmospheric sector of ERC are primarily focused on (1) provision of useful tools and knowledge for the discrimination of manmade from natural sources of pollution, for subtracting the contribution of natural sources before comparing ambient air pollutant concentrations with relevant legally binding limit values (Nisantzi et al., 2014; Nisantzi et al., 2015; Mamouri and Ansmann, 2014), (2) minimization of agricultural losses and

efficient planning through better understanding of precipitation and hail initiating processes, since the on-line knowledge of the background aerosol content in terms of freezing nuclei can provide a valuable source of information for future rainfall enhancement and/or hail suppression operations (Mamouri and Ansmann 2015; 2016), and (3) alert mechanisms for high aerosol concentrations (e.g., dust events, volcanic eruptions), for enabling timely information of the public, minimize exposure and reduce hospital admission and other health related costs (health, tourism) (Hadjimitsis et al., 2013a; 2013b; 2013c; Mamouri et al., 2016) and to improve safety in aviation (transport).

(d) The current state-of-the-art of the Cultural Heritage sector of ERC is focused on the integrated use of field spectroscopy, UAV, geophysical surveys and earth observation for the detection of archaeological buried remains, risk assessment using space-based techniques, protection and surveying. This sector is running three funded projects: the Twinning ATHENA project ([www.athena2020.eu](http://www.athena2020.eu)) and two JPI-CH projects (namely CLIMA: <http://www.clima-project.eu> and PROTHEGO: <http://www.prothego.eu>). The “ATHENA” Twinning project aims to establish a Center of Excellence in the field of Remote Sensing for Cultural Heritage in the areas of Archaeology and Cultural Heritage through the development of an enhanced knowledge base and innovative methods (Hadjimitsis et al., 2016). The “ATHENA” project is built around EU policies and international conventions related to Cultural Heritage protection, management and best practice (e.g. Europa Nostra policy documents; COM (2014) 477; UNESCO and EU conventions and multilateral treaties related to the protection of tangible Cultural Heritage).

### 3. Concluding remarks

The objective of the first phase of the EXCELSIOR project is the development of a detailed and robust Business Plan for upgrading the ERC. Such a Business Plan will target the long term vision to transform ERATOSTHENES itself into an EXcellence Research Centre for Earth Surveillance and Space-Based Monitoring Of the EnviRonment by enhancing the scientific and R&I capabilities of the existing center. This enhancement will enable the provision of new, highly innovative products and services to

national, regional and international public and private sector, in the Space and Earth Monitoring sectors. The development of the Business Plan is key to ensure the sustainability of the CoE and will also provide the necessary guarantees for its long term self-sustained operations. The Business Plan will establish the foundations for the development of a competitive and high competence profile to expand the Centre's visibility beyond the national level and develop transnational and transregional cooperations with European, Eastern Mediterranean and Middle East (EMME) and Middle East and North Africa (MENA) countries

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