

ATHENA: CENTER OF EXCELLENCE IN CYPRUS IN THE FIELD OF REMOTE SENSING FOR CULTURAL HERITAGE IN THE AREAS OF ARCHAEOLOGY AND CULTURAL HERITAGE

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ABSTRACT:

In periods of economic instability, national considerations are overruling the process of European integration. Cultural Heritage (CH) is an integral element of a European set of values, and respect for heritage is vital for developing a common European identity. The CH sector has always been facing a number of challenges that have increased with the financial crisis that has hit Europe. To name a few, these include the decrease of public budgets, urbanisation, globalisation, and technological changes. Within this context, CH professionals are seeking to improve currently used methodologies, in order to better understand, protect and valorise the common European past and common identity.

The use of satellite and other remote sensing (RS) technologies has progressively been established in the field of environmental monitoring. In the domain of CH and landscape monitoring and in particular with regards to archaeological sites, these technologies have made a significant contribution to research and analysis over the past few decades. The potential use of RS for the understanding, documenting, monitoring and valorization of CH has long been recognised not only by RS experts and archaeologists, but also by the public authorities involved in heritage management, that suggested an increasing use of non-invasive technologies (Valletta Convention, 1992).

The ATHENA project aims to strengthen the Cyprus University of Technology's (CUT) Remote Sensing Science and Geo-Environment Research Laboratory in the field of Remote Sensing Archaeology by creating a unique link between two internationally-leading research institutions: The National Research Council of Italy (CNR) and the German Aerospace Centre (DLR). Through ATHENA, CUT's staff research profile and expertise will be raised, while the S&T capacity of the linked institutions will come out enhanced.

1. INTRODUCTION

Cultural Heritage (CH) remains an important sector for several economies within European Union. Several studies have shown that CH can provide an added value to the real economy of a country. As European Union (2015), highlights that Cultural heritage is now widely appreciated as an essential part of Europe's underlying socioeconomic, cultural and natural capital. This is a significant change in focus as cultural activities have traditionally been regarded as costs to society. The economic benefits of cultural heritage have most commonly been seen in terms of tourism.

According to studies, CH is also strong connected with tourism sector in Cyprus as well. Though that most tourists visit Cyprus for leisure, Cyprus aims at expanding its "special interest tourism", which includes cultural tourism, health and wellbeing, conference and events tourism, religious tourism, agrotourism, weddings and honeymoons and sports tourism. Cyprus' main advantages as a destination for cultural tourism are its culture and heritage, its clean archaeological sites, easy access to these

and valued guide services. For instance, Paphos is a popular coastal town in the southwest of Cyprus. It offers spectacular scenery and some of Cyprus' finest beaches. Paphos offers ancient historical sites, some classified as world heritage sites by Unesco and an attractive harbour. It is expected that Paphos will be subject to intensified cultural activity, as it has been appointed by the EU to be a European Capital of Culture for 2017 (Cyprus Tourism Market Report, 2015). Recent statistics indicates that the archaeological site of Nea Paphos is the most visited monument in the island with more than 200,000 tourists per year.

Though several people recognise the importance of CH both in terms of sustainable economy as well as in terms of common memory and identity, several actions are needed to be taken so as to protect and safeguard these standing monuments. Nowadays, both natural and anthropogenic hazards are threatening CH sites and therefore a robust and systematic tool is needed to help stakeholders. In this perspective remote sensing technologies, including space observation and ground

non-contact techniques can support stakeholders for monitoring and mapping both the monuments and sites as well their threats.

2. AIMS OF ATHENA PROJECT

Given the importance of remote sensing technologies for CH, ATHENA, a three-year duration project, aims to strengthen the Cyprus University of Technology's (CUT) in the field of Remote Sensing Archaeology by creating a unique link between two internationally-leading research institutions: The National Research Council of Italy (CNR) and the German Aerospace Center (DLR). The overall objective of the project is to expand the capabilities of the CUT members so as to establish a science centre in the eastern Mediterranean with advance remote sensing capabilities. This objective will be performed through training and other activities such as workshops and summer schools. ATHENA project also allows researchers to focus in new remote sensing technologies and to examine their potential use in archaeological research and prospection.

Such activities include among other the training of CUT personnel in advance remote sensing algorithms and approaches applied in archaeological research, risk estimation and damage assessment such as fire burned area mapping (Lanorte et al (2013). Object oriented analysis is expected to be carried out through different applications of the ATHENA project for classification purposes e.g. monitoring urban expansion in the vicinity of archaeological sites or detection of buried archaeological remains using segmentation techniques.

A recent example of the application of object oriented analysis is the detection of post-fire areas in the region of Troodos, where recent fires occurred in middle of July 2016 have burnt more than 16 square kilometers of forest. In this area, several important historical monuments exist including World Heritage monuments.

As shown in Figure 1, Landsat 8 multispectral image, taken at 24-06-2016 has been able to map the burnt area (see Figure 1, left, NIR-R-G composite). Segmentation analysis of the image was processed so as to create homogenous clusters of pixels in the image (Figure 1, right).

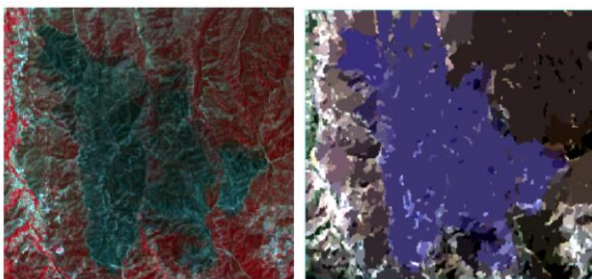


Figure 1: Left: NIR-R-G composite of the Landsat 8 (24-06-2016) and Right: Segmentation of the multispectral image.

The classification result was able to map the burnt areas using simple rule based approaches. This information was used so as to document the threat of the historical ekklesiastical churches of the surrounding area, all protected and enlisted in the World Heritage monuments list (known as the ten byzantine churches of Troodos). The risk map is shown in Figure 2, where burnt areas are indicated with orange colour, villages in red spots and the byzantine churches in green dots. As it is shown three of these ten monuments were in a close vicinity of fire event.

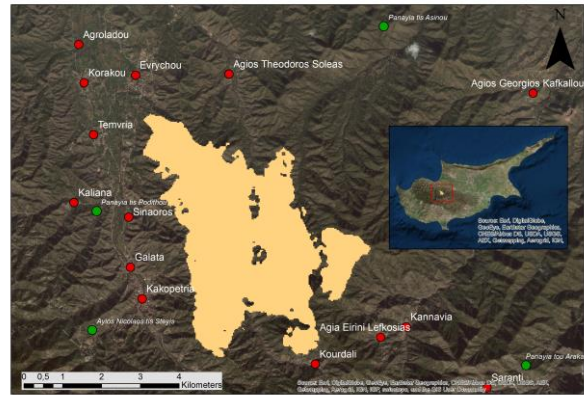


Figure 2: Map indicating the burnt areas (orange color), villages with red dots and the World Heritage Monuments in green dots.

3. DISCUSSION

Remote sensing datasets can provide helpful information for stakeholders so as to monitor cultural heritage sites and landscapes. Recent studies have indicated the importance of Cultural Heritage to real economy and tourism. Recent fires occurred in Cyprus have been used as a case study so as to demonstrate the capabilities of such technologies even in case of emergency.

As demonstrated in this case study, protection and monitoring of sites and monuments (either known or still un-known) is feasible using remote sensing data and remote sensing methodologies. Segmentation and rule based classification can be also used in this direction so as to identify in large scale any illegal activities.

The protection of CH by means of analysing satellite imagery is also in the focus of a EU "strategy for international cultural relations", where specifically the European COPERNICUS program should use its capabilities to monitor sites at risk and to evaluate damage (European Commission, 2016)

In this framework ATHENA project aims to build an advance remote sensing centre in the area of the Eastern Mediterranean and benefit from the new capabilities that new remote sensing sensors provide nowadays.

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