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# DEVELOPMENT OF A GEOSPATIAL ENVIRONMENTAL MONITORING SYSTEM FOR THE NATIONAL PARK OF EAST MACEDONIA-THRACE

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## Abstract

Protected areas are under pressure and various threats, due to increasing anthropogenic activities within or in their immediate vicinity. The inadequate level of protected areas' administration capacity affects the sustainability and their optimum management. The Project BIO2CARE aims at reinforcing the administrative capacities and effectiveness of Protected Areas Management Bodies, in benefit of biodiversity and local communities. Therefore, a decision-making platform (DSS) for understanding the activities and quantifying their respective impacts has been developed. The DSS is a web application that provides advanced geospatial capabilities by integrating data from various sources. The information is presented in an interactive map. Within that platform the monitoring and recording of biodiversity and illegal activities will give a competitive advantage in managing bodies to enhance their capabilities of protecting the areas of interest and mitigating illegal activities.

**Keywords:** BIO2CARE; protected areas; decision-making platform; spatial data infrastructures; geospatial intelligence

## 1 INTRODUCTION

Protected areas (PAs) are a key strategy for the conservation of ecosystems and their services, but many of them, especially non-forestial are under great pressure (Geldmann *et al.*, 2019) and various threats, such as various illegal activities and climate change. Anthropogenic activities in PAs affect the Ecosystem Services derived by the PA, resulting often negatively both on biodiversity and human well-being (Mace *et al.*, 2012). Constantly increasing anthropogenic activities within the PAs or in their immediate vicinity and the inadequate level of their administration capacity are the major threats to the sustainability and the optimum management of PAs, which leads them in failing to stem human pressure.

Spatial knowledge of the type and location of the pressure is essential for effective management. Moreover, Earth Observation and associated techniques, coupled with landscape analysis and modeling of biodiversity distribution can provide information on the state of the ecosystems (Nagendra *et al.*, 2015). Taking those into consideration and aiming at reinforcing the administrative capacities and effectiveness of Protected Areas Management Bodies, in benefit of biodiversity and local communities a geospatial decision-making platform (DSS) for understanding the activities and quantifying their respective impacts has been developed.

The platform aims to integrate all geospatial data into a single access point. Data should be accessible using open standards (OGC: WMS, WFS, WCS) from multiple data sources (UAVs, satellite, environmental sensors) and formats. The access should be enabled using a simple web browser and it should provide spatial analysis capabilities that can be performed easily from non-expert users.

## 2 MATERIALS AND METHODS

Nestos Delta (ND) protected area is located in northern Greece and covers a total of 55000 Ha. The ND is part of the East Macedonia and Thrace National Park, of the Natura 2000 network (GR1150010) and a Ramsar area. The wetland complex of ND comprises seven small lakes, as well as eight lagoons. Furthermore, an area of 450 Ha is covered by the “Great Forest” (Kotza Orman) of huge environmental importance. The East Macedonia and Thrace National Park is managed by Delta Nestos, Lakes Vistonida-Ismarida and Thassos Island Management Body (DNMB), which has recorded as major illegal activities in the area hunting, lumbering, sand extraction and waste disposal (DNMB, 2018).

The BIO2CARE (INTERREG Greece-Bulgaria) project’s main objective is to enhance PA Management Bodies (MBs) administrative capacities on the benefit of biodiversity as of local communities by reinforcing PA MBs efficiency and effectiveness in an innovative and integrated approach. This goal will be achieved both by monitoring and by the development of a decision-making platform (DSS) for understanding the activities and quantifying their respective impacts. The monitoring activities proposed will give a competitive advantage in managing bodies to enhance their capabilities of protecting the areas of interest and mitigating illegal activities.

The DSS was developed using a 3-tier architecture in order to ensure scalability and extendibility. The first tier is the data tier where a spatially enabled database (PostgreSQL with PostGIS) was used to store the data. PostgreSQL supports both vector and raster data providing advanced query and spatial analysis capabilities. The second tier is the application tier. Geoserver was used to create the necessary OGC services for data access, query and download. In the web tier, a web server (Apache) was used to provide a standard way for the communication between the client interfaces and the application/database servers. The web map interface for data visualization and analysis was developed based on the GET SDI PORTAL, an open source web GIS client, developed by GET to provide access and visualization to geospatial data using standard OGC services (WMS, WFS, WCS, CSW) according to the geospatial information management best practices (UN-GGIM, 2015). All software used for the development of the DSS are free and open source with no limitation in their use.

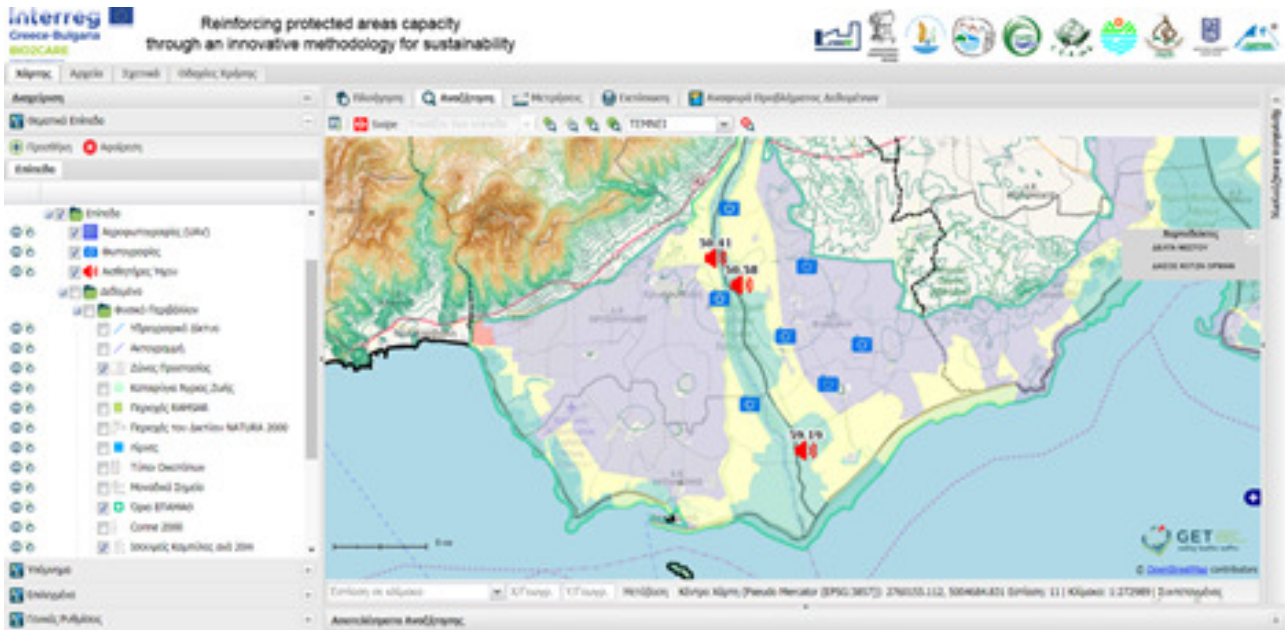


Figure 1: The user interface of the web DSS application.

### 3 ANALYSIS, RESULTS AND DISCUSSION

The web application provides the following capabilities:

1. Access to geospatial data (vector and raster) using standard OGC web services: WMS, WCS, WFS, kml
2. Access to high resolution UAV raster images
3. Integration of noise sensor data. The application provides access both to real time data as well as to time series of the measurements
4. Integration of geotagged images from wildlife monitoring cameras
5. Access to Sentinel 2 images and products (natural color, false color, NDVI)
6. Supports time enabled rasters, with ability to select reference date of the raster datasets
7. Image comparison tool (swipe)

In addition, the application provides all the standard GIS functionalities required for visualization and spatial analysis, like map navigation, layer management, map interaction, feature information, spatial and attribute queries, table view of data, data export, measurements, printing using map layouts etc. The layout of the application is presented in Figures 1 and 2.

### 4 CONCLUSIONS

The BIO2CARE developed DSS could become a valuable asset for the Protected Areas Management Bodies in order to understand the activities and quantify their respective impacts on biodiversity (e.g. measuring ecological footprint, carbon footprint and water footprint). Moreover, within that platform the monitoring and recording of biodiversity and illegal activities could give a competitive advantage in the Protected Areas Management Bodies to enhance their capabilities of protecting the areas of interest and mitigating illegal activities.

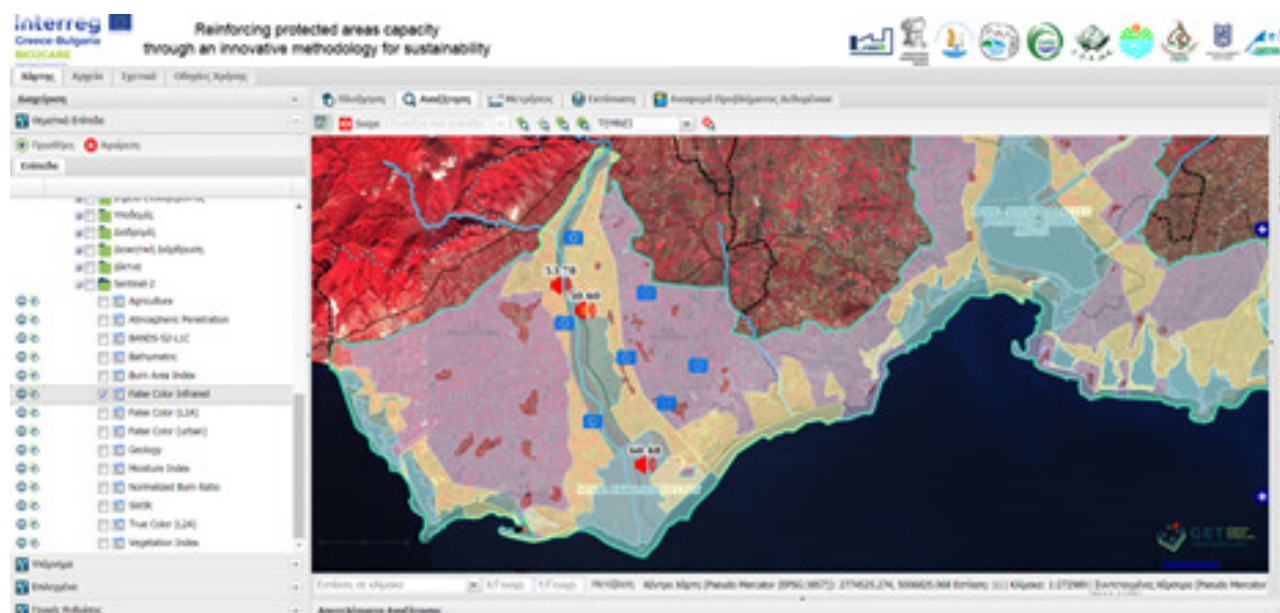


Figure 2: Access to Sentinel 2 images for overtime monitoring of land use and land use change.

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