

BURNT AREA STATISTICS USING OPEN SOURCE SOFTWARE – THE KASSANDRA 2006 FIRE CASE STUDY

Anastasia Polychronaki¹, M. Mateescu²

ABSTRACT

High licensing costs of proprietary GIS software led to the development of a free, open-source package for Burnt Area Statistics (BAS2), providing not only reporting but also 3D rendering. Operation of the BAS2 tool has been validated by applying the same analysis using ArcGIS, for the Kassandra (2006) forest fire, finding virtually no difference in computed outputs.

Keywords: GIS, burnt area statistics, forest fires, post fire assessment, kassandra

1. INTRODUCTION

Post-fire assessment is an important issue at Mediterranean and European level (jrc 2008). Existing GIS products can be used for this purpose, but the rationale for developing another GIS tool for Burnt Area Statistics (post-fire assessment) comprises more reasons:

- High costs of proprietary software: one-user license for an industry-standard ArcGIS-based solution, aggregating the necessary packages, would cost from 3000 to 5000 USD (esri 2008). Many countries in the Mediterranean basin, exposed to forest fires, are still developing countries. Use of free software may lead to significant economies, while the price of proprietary software may be prohibitive to small actors (ex.: educational institutions other than universities and research centers, local governmental structures etc.). For example, an Algerian research assistant has a monthly salary of approximately 615 USD (algerie-dz 2007), an Egyptian assistant professor would be paid 830 USD/month on average (salaryexpert 2008); so averting licensing costs could allow an entity to employ a researcher from 5 to 8 months.
- Features: By design (Dr. I.Gitas) and implementation (eng. M.Mateescu) the product has specific features which are lacking from other software (such as ArcGIS): native 3D rendering, 3D surface computing. (Ilies 2006) also uses 3D GIS rendering.
- Compactness, accessibility: the BAS2 software contains only the relevant functions for performing the specific post-fire analysis; the process is wizard-like and very intuitive, enabling any average user to deal with it (Mateescu 2006).

The BAS2 software being operational and delivered for production, it has been applied to a real-world case, the forest fire of Kassandra which occurred in the year 2000.

1 Aristotle University of Thessaloniki – Faculty of Forestry and Natural Environment – Greece

2 Universitatea „Babes-Bolyai”, Cluj Napoca, Romania; Universite de Nice „Sophia Antipolis”, Nice, France

2. THE STUDY AREA

The study area is located in North Greece in the southern part of the Kassandra peninsula and belongs to the prefecture of Chalkidiki (Figure 1). The Kassandra peninsula extends approximately from 25°025' to 25°035' East (longitude) and 39°090' to 40°010' North (latitude). The elevation ranges from sea level to 335 meters and has relatively low slopes and smooth relief. The main type of forest located in the Kassandra peninsula is the pine forest with *Pinus halepensis* being the dominant species.

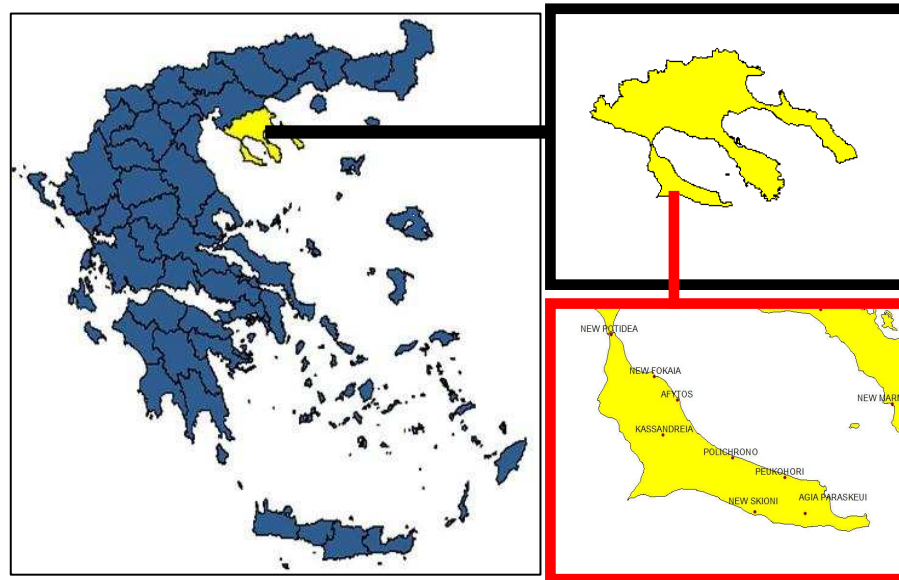


Fig. 1: Localization of the Kassandra peninsula in Greece.

3. EVENT DETAILS

On August 21 2006, a major fire ignited, lasting 4 days. The fire had such an intensity and extent that thousand hectares of vegetation (Fig. 2a) and residential areas (Fig. 2b) burned, and even casualties occurred.



Fig. 2: a) burnt vegetation



b) residential areas affected by fire

4. DATASET

A MODIS/Aqua image (250m spatial resolution) taken on 28th August 2006 (Fig.3), three days after the fire, was obtained. Through segmentation and fuzzy logic classification, a layer containing the fire perimeter (Fig. 4) was deduced (Polychronaki 2007). In addition, the DEM (Fig. 5) and the CORINE land cover (Fig. 6) digital map of the area were used.

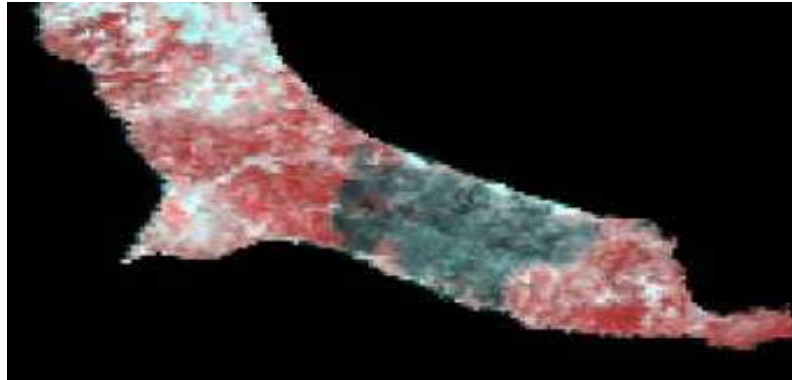


Fig. 3: *MODIS/Aqua surface reflectance daily L2G global 250m SIN grid V004*

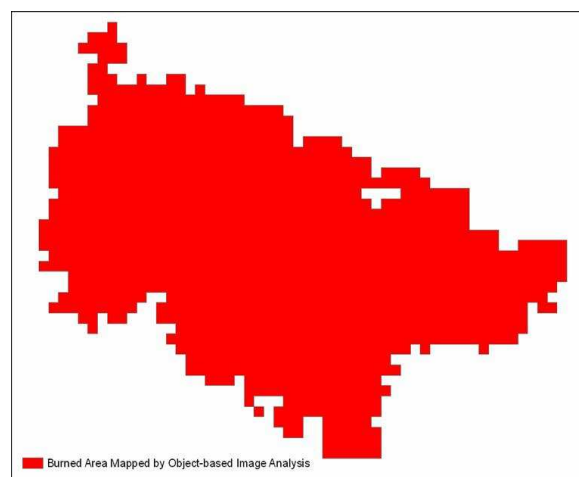


Fig.4: *Burnt area Mapped by object-based Image Analysis*

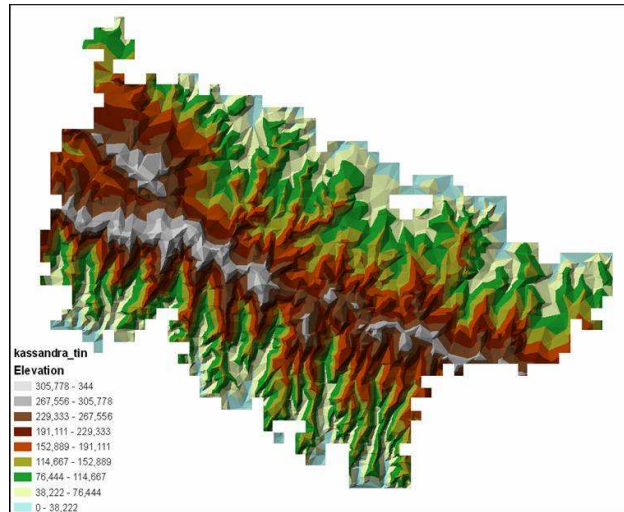


Fig. 5: Elevation map of the Kassandra region (TIN layer)

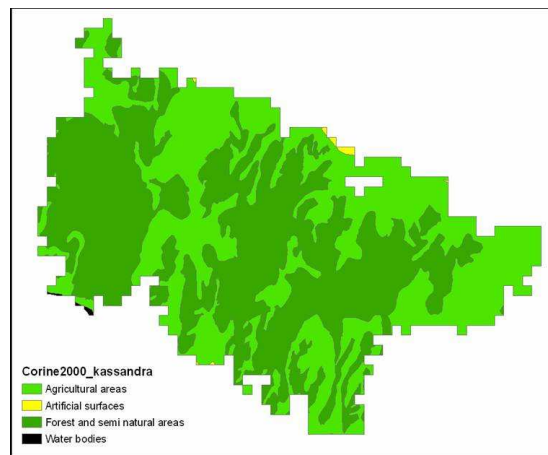


Fig. 6: Land use map of the region (from the CORINE dataset)

5. GIS ANALYSIS

The post-fire assessment analysis was run using both the BAS2 (Fig. 7) software and the ArcGIS package.



Fig. 7: The BAS2 software tool interface

Internally the BAS2 uses the General Polygon Clipper (Murta 2007) algorithm; the three-ways intersections (2D) of layers takes somehow longer than in ArcGIS (not more than 5 minutes however).

The results of the analysis are shown below (Table 1)

KASSANDRA FIRE/	ARCMAP RESULTS	BAS RESULTS	
	AREA (ha)	AREA (ha)	AREA3D (ha)
Agricultural areas	3261.251143	3261.251120	3366.014652
Artificial surfaces	14.572597	14.572596	14.625151
Forest and semi natural areas	3697.630452	3697.630442	3862.858175
Water bodies	6.014652	6.014652	6.018127
SUM	6979.468845	6979.468810	7249.516105

Table 1: *Kassandra 2007 fire results*

Most of the results are quasiidentical (BAS2 returns the actual 3D burnt area as well, not only planimetric) , the differences in results are of range 10^{-5} and may be due to the internal representation of real numbers by 32-bit floating point representations (Goldberg 1991).

Other series of analyses, covering the 2007 Peloponese fires, resulted in quasiidentical results as well (Table 2):

PELOPONNESE FIRES SUMMER 2007	ARCMAP RESULTS	BAS RESULTS	
	AREA (ha)	AREA	AREA3D
Agricultural areas	77261.553652	77261.531106	78266.356792
Artificial surfaces	1491.924104	1491.923347	1497.420795
Forest and semi natural areas	96745.467884	96745.453631	100420.353991
Water bodies	172.762091	172.761962	173.956022
Wetlands	290.518650	290.518552	291.870869
SUM	175962.226381	175962.188598	180649.958468

The relative difference in case 1 is $5 \cdot 10^{-7}\%$ and $2.15 \cdot 10^{-4}\%$ in the second case, values so small that can be considered insignificant.

6. CONCLUSION

The free BAS2 software tool can be used as an alternative to expensive, proprietary software for the purpose of post fire assessment. Real-world examples were comparatively studied (BAS2 vs. ArcGIS), validating the outputs of BAS2 (minor differences encountered). Development of BAS2 is worth continuing with reporting (detailed output) and rendering (3D rendering in Google Earth by KML output).

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