Department of Geography and Geology

Evaluating a Post Wildfire Vegetation Loss at Mt. Parnitha, Greece

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Introduction

The study area, (Figure 1) Mt. Parnitha is located in Sterea Ellas (Central Greece) and is the highest mountain in the vicinity of Athens. The entire mountain (~25,000 hectares) extends in a large area, presenting variable topography with several summits, gorges, streams and plateaus. Vegetation on the mountain includes Greek Fir and Aleppo Pine forest. Mt. Parnitha also contains one of the few remaining forests near Athens.

Source: *Parnitha National Park*

Fires are the greatest danger that Mt. Parnitha's natural environment faces and unfortunately they are very common in the area. Recreation in the National Park and natural phenomena such as fires, are a potential threat for Parnitha, especially during the summer, when the number of visitors increases and high temperatures create the danger of spreading wildfire. (http://www.parnitha-np.gr/welcome.htm) Mt Parnitha experienced severe damage from a wildfire outbreak on 28 June 2007, which was suppressed 5 days later on 1 July 2007 (Petropoulos).

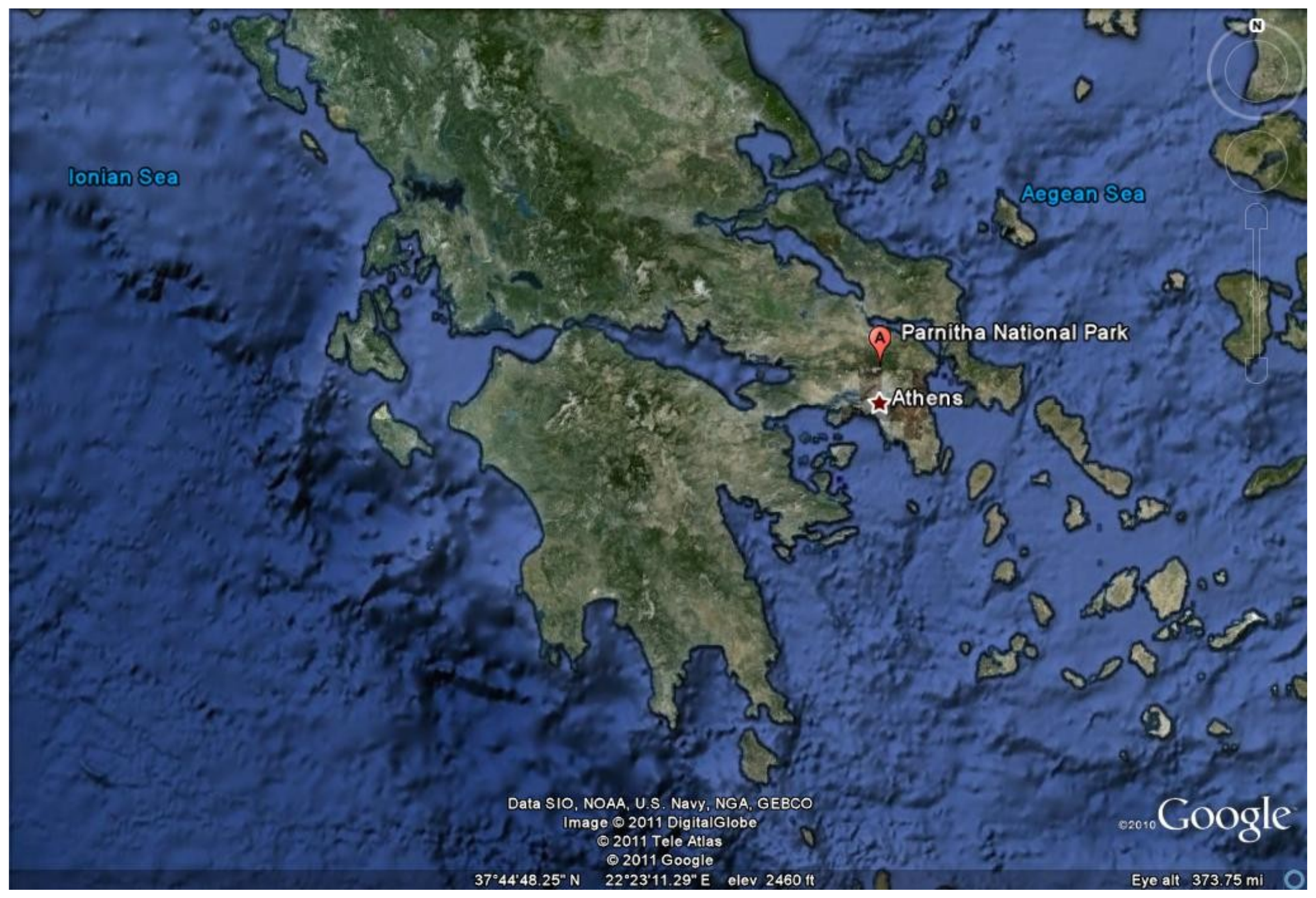

Figure 1. Mt. Parnitha, (Central Greece)

Objective

The objective in this evaluation was to calculate the loss of vegetation from the resulting wildfires of June 28, 2007 by using both supervised and unsupervised classifications. By comparing the results of both classifications, I determined the most effective method of calculating vegetation loss in this area.

Methods

I first began by ordering two Landsat Archive/Landsat 4-5 TM images from the USGS GLOVIS web page. The first image is dated July 2003 (four years before the wildfire) and the second image is dated August 2007 (one month prior to the wildfire). As seen in *Figure 2*, both images were then clipped to the area of interest (Mt. Parnitha) and displayed in False Color effect to expose vegetation.

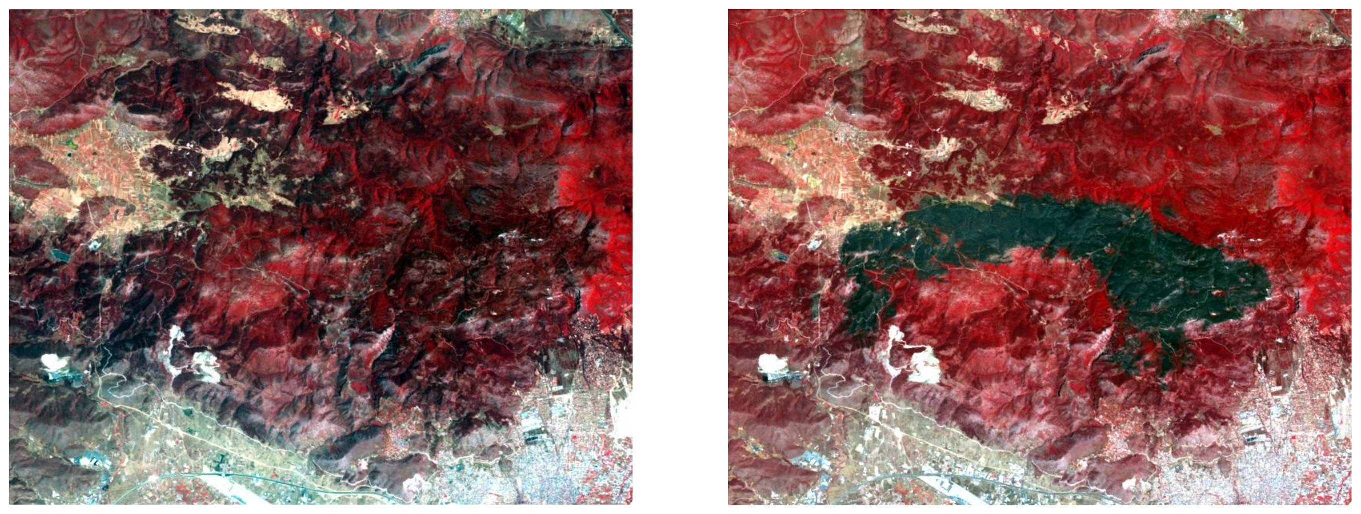

Figure 2. Mt. Parnitha, (Central Greece)
Left: July 2003 displayed in False Color Effect. (R)4, (G)3, (B)2.
Right: August 2007 displayed in False Color Effect. (R)4, (G)3, (B)2.

The first image processing/technique that was utilized was the Maximum Likelihood Supervised Classification. By comparing the before and after images in a false color effect of R(4) G(3) B(2), I was able to create user defined regions of interest (Burned, Urban, Vegetation1, Vegetation2, and Vegetation3) for classification. To smooth the classified image by weeding out isolated pixels, the post classification algorithm Majority/Minority Analysis was performed *(Figure 3).*

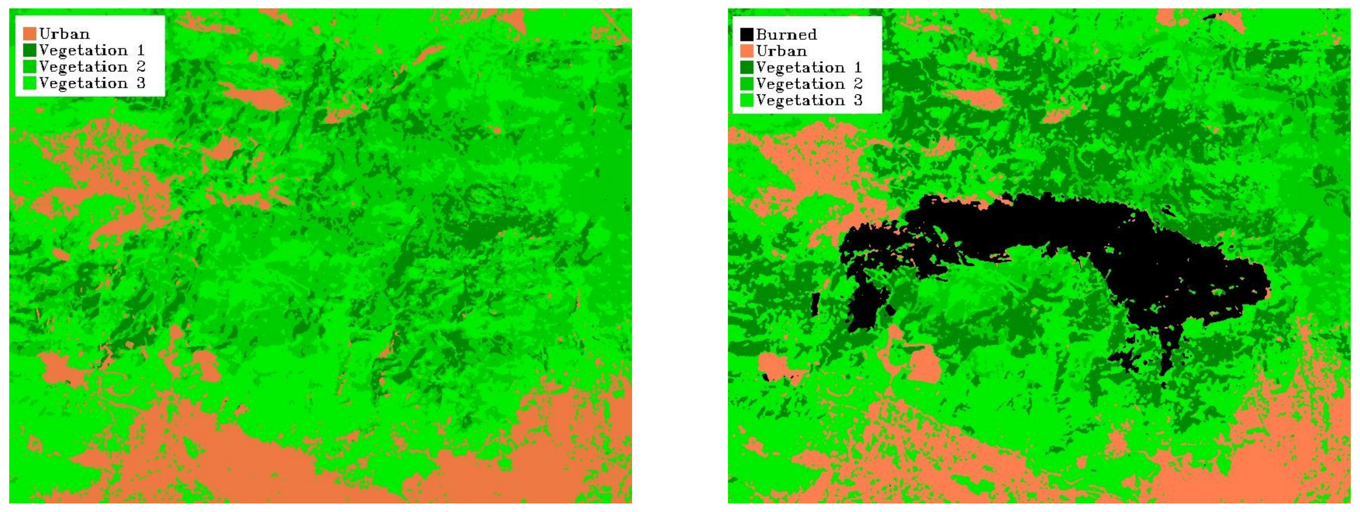

Figure 3. Mt. Parnitha, (Central Greece)
Left: July 2003 Smoothed Maximum Likelihood Supervised Classification
Right: August 2007 Smoothed Maximum Likelihood Supervised Classification

In comparison, an image manipulation technique of Normalized Burn Ratio (NBR) was performed. By applying this technique, slight variations in the actual spectral responses of vegetation were emphasized and I was able to compare before and after wildfire imagery to detect a loss of vegetation as "Burned". The clipped images were first converted from digital numbers to reflectance. Then Ratio combinations in the visible red (band 4) to those in the Near Infrared (band 7) were displayed to monitor vegetation loss from the wildfire while a Normalized Burn Ratio was manually generated by using the following band ratio equation:

$$NBR = (Band\ 4 - Band\ 7) / (Band\ 4 + Band\ 7)$$

Next, an unsupervised classification K-Means method was conducted. By comparing the before and after images in a false color effect of R(7) G(4) B(2), I was able to create user defined regions of interest for multiple classes *(Figure 4).* Similar spectral classes that represent the same land cover class were then combined to include: Burned, Urban, Vegetation 1, and Vegetation 2 for classification. To smooth the classified image by weeding out isolated pixels, the post classification algorithm Majority / Minority Analysis was performed *(Figure5).*

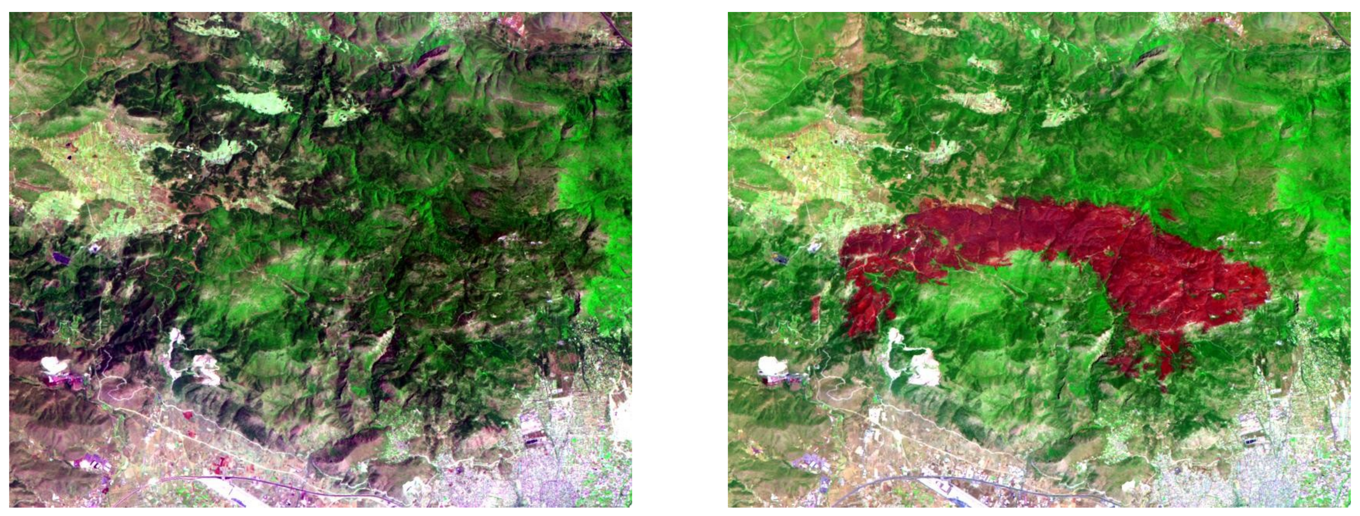

Figure 4. Mt. Parnitha, (Central Greece)
Left: July 2003 displayed in False Color Effect. (R)7, (G)4, (B)2.
Right: August 2007 displayed in False Color Effect. (R)7, (G)4, (B)2.

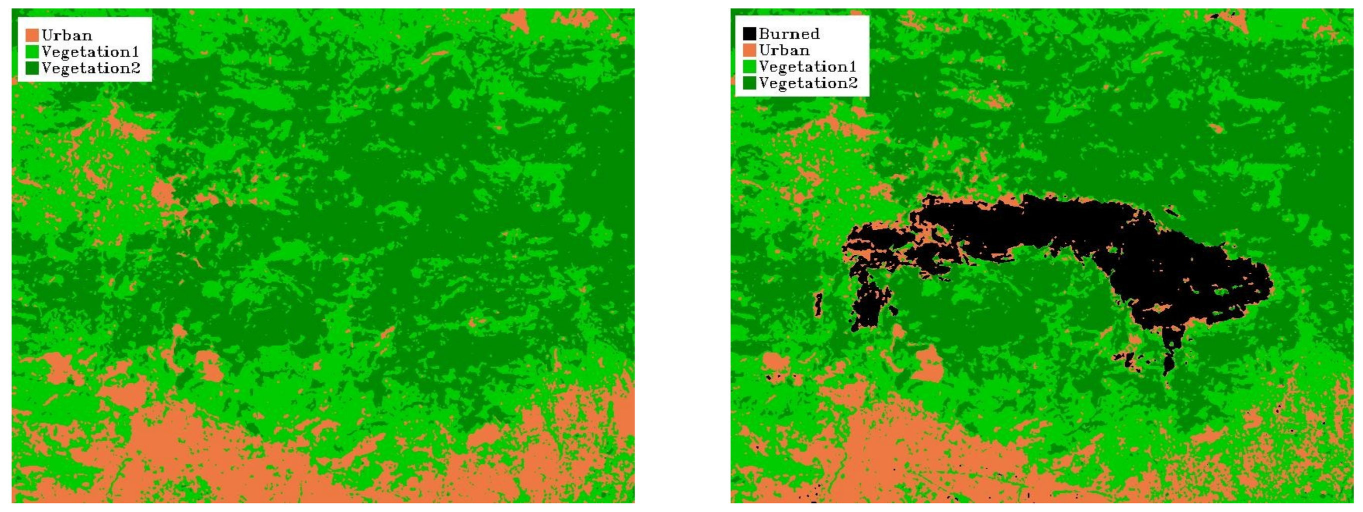

Figure 5. Mt. Parnitha, (Central Greece)
Left: July 2003 Smoothed Maximum Likelihood Unsupervised Classification (NBR)
Right: August 2007 Smoothed Maximum Likelihood Unsupervised Classification (NBR)

Results

Accuracy Assessment was calculated on both 2003 imagery (before) and 2007 imagery (after) to determine the efficiency of the supervised and unsupervised classifications.

Supervised Classification:

	Overall Accuracy %	Kappa Coefficient
July 2003	99.1	0.9876
August 2007	96.0	0.9488

Unsupervised Classification:

	Overall Accuracy %	Kappa Coefficient
July 2003	95.6	0.9336
August 2007	89.3	0.8565

Finally, Post Classification Change Detection was performed to accurately determine loss of vegetation.

Supervised Classification:

	Urban	Vegetation 1	Vegetation 2	Vegetation 3	Class Total
Burned Area (Square Km)	0.59	10.1	24.03	9.82	44.55
Burned Percentages	1.32	22.67	53.94	22.04	100

Unsupervised Classification:

	Urban	Vegetation1	Vegetation2	Class Total
Burned Area (Square Km)	0.46	6.75	32.43	39.63
Burned Percentages	1.16	17.03	81.83	100

Conclusions

This project evaluated the accuracies of both the supervised and the NBR unsupervised classification to study the analysis of Landsat Archive/Landsat 4-5 TM imagery to detect loss of vegetation from the 2007 wildfire of Mt. Parnitha, Greece. Results indicate that supervised classification had a higher Overall Accuracy and Kappa Coefficient as compared to the unsupervised K-means classification. Meanwhile, the NBR unsupervised classification method detected a smaller area of burned vegetation ($39.63 km^2$) than the supervised classification's area ($44.55\ km^2$).

In 2009 G.P. Petropoulos et al. published "A case study from the Greek wild land fires of 2007" by using Aster (15m spatial resolution). In their results $46.49 km^2$ of vegetation was burned as a result to the wildfire. By comparing my Landsat 4-5 TM (30m spatial resolution) results with G.P. Petropoulos et al., I determine the most effective method of calculating vegetation loss in this area is by using the supervised method which detected $44.55 km^2$ of vegetation loss to wildfire.

Acknowledgements

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Data Sources

USGS Earth Resources Observation and Science Center (EROS) *Global Visualization Viewer (GLOVIS).* http://glovis.usgs.gov/

Google Earth. 2011 Europa Technologies. US Dept. of State Geographer. 2011 MapLink/Tele Atlas.

References

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- *Combining ASTER multispectral imagery analysis and support vector machines for rapid and cost-effective post-fire assessment: a case study from the Greek wildland fires of 2007.* G. P. Petropoulos1,W. Knorr1, M. Scholze1, L. Boschetti2, and G. Karantounias3. Natural Hazards and Earth System Sciences.
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