AREAS AFFECTED BY WILDFIRES IN
THASOS ISLAND USING GIS

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Abstract*: In this paper we want to highlight the areas affected by wildfires in Thasos using Esri technology. The study is based on images from before and after the event. GIS possibilities offer us the appropriate environment to develop the study. The workflow was created in ArcGIS Pro10.3, using Chain Function.*

Keywords: *wildfire, ArcGIS Pro, multispectral images*

1. Introduction

After the wildfire in Thasos Island, in September, 2016, thousands of square meters of forests had been burned. In this paper we identified burn scars and sharing geographic information in response to a disaster like a wildfire can help first responders and other emergency management personnel make decisions, assist with relief efforts, and learn valuable lessons. The purpose is to use multispectral data to better understand of the situation after fire.

The remotely sensed data via the United States Geological Survey (USGS) is a valuable resource for developing a study, satellite imagery being used to travel back in time to observe remote areas.

2. Materials and Methods

The situation of areas at risk of wildfires can be found at *http://forest.jrc.ec.europa.eu/effis/applications/global-viewer/* In figure 1 is an image that highlights the risk of fire danger forecast on that date in which can be seen the Thasos Island at risk.
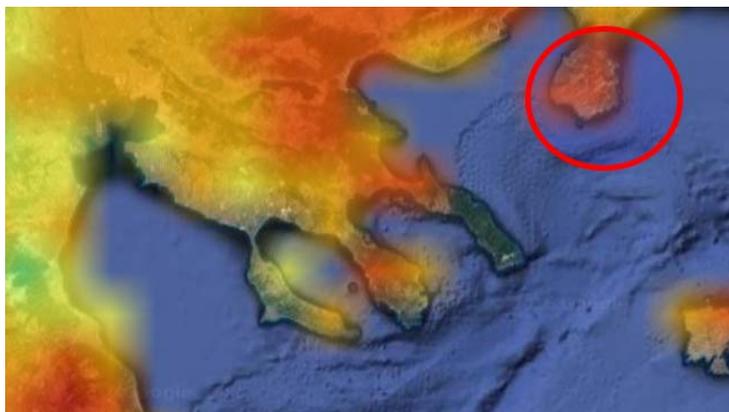

Fig. 1. Viewing Risk Areas [4]

Landsat is a multispectral satellite with characteristics from near infrared to shortwave infrared to even thermal energy. Certain features on the earth had different responses to these wavelengths.

Vegetation absorbs blue and red energy and reflects some of the green energy that it receives from the sun, reflecting, to a higher degree, the amount of near infrared energy it receives. The characteristic of reflecting near infrared while absorbing red energy is used to identify vegetation and the degree of its health. Multispectral bands have several environmental uses, depending on what it is trying to observe.

Another useful resource is Copernicus. According with [6] "Copernicus (previously Global Monitoring for Environment and Security - GMES) is an EU programme for developing European information services based on satellite Earth Observation and in situ (non space) data." This program is implemented by the European Commission (EC) with the support from the European Space Agency (ESA) for the Space component and the European Environment Agency (EEA) for the in situ component. The main objective of Copernicus is to monitor and forecast the state of the environment on land, sea and in the atmosphere, in order to support climate change mitigation and adaptation strategies, the efficient management of emergency situations and the improvement of the security of citizens.
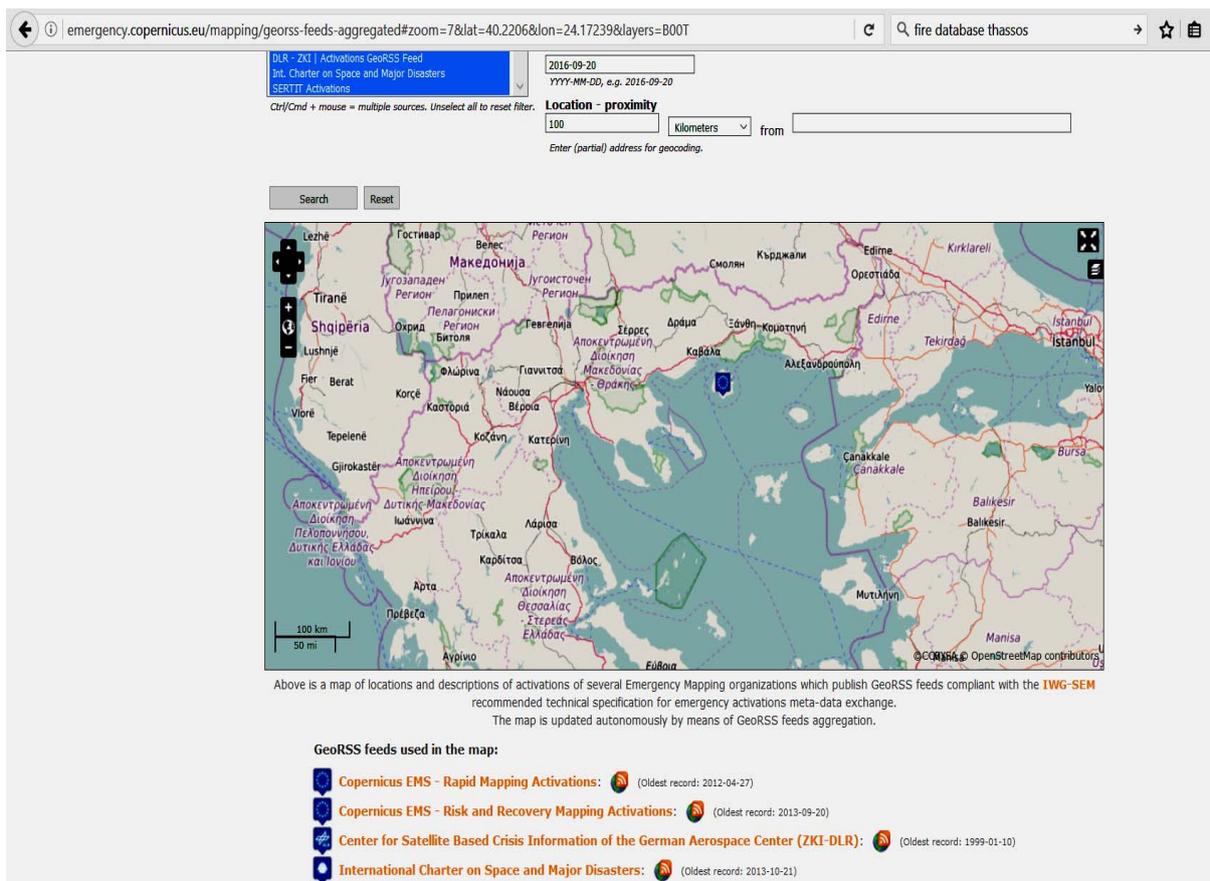

Fig. 2. http://emergency.copernicus.eu/

As software was used ArcGIS Pro 1.3. According with [4], ArcGIS Pro is the essential application for creating and working with spatial data, providing tools to visualize, analyze, compile, and share the data, in 2D and 3D environments. Image classification is enhanced in the last version of the software. Remote sensing image classification is a workflow that results

in a thematically classified map of imagery. There are many stages of processing that are necessary to create an accurate classification map. The Image Classification Wizard – which had been used in the paper - is a new tool composed of image classification best practices for guiding te users through the classification process in an efficient manner.

The ArcGIS Pro tool reference contains detailed information about all the tools provided with ArcGIS Pro. The tools are grouped into toolsets, which are then collected into toolboxes. By expanding a specific toolbox there could be found the following information: an overview that describes the purpose of the toolbox and gives a summary of each toolset the toolbox contains (when applicable, the summary also includes links to related topics), a licensing topic that summarizes the licensing requirements for every tool in the toolbox and nodes for each toolset in the toolbox.

By expanding a specific toolset there could be found the following information: an overview page that describes the organizing principle of the toolset and gives a summary of each tool in the toolset with a reference page for each tool in the toolset, when applicable, there will also be a Concepts node and this contains more detailed information about specific tools in the toolset.

3. Case Study

On 11th of September, 2016, extremely hot and dry conditions were present in Thasos Island, Greece. All of these provided conditions for a series of wildfires that were set naturally, intentionally by humans, and by accident. It had been created a map project for multispectral analysis and added some pre-fire and post-fire imagery.

The pre-fire imagery used in the study was taken on 28th of August, 2016. The post-fire imagery was taken on 13th of September, 2016. [7] It had been used the tool Band Combination. Band combinations allow to visualize multispectral imagery using parts of the electromagnetic spectrum that are invisible to human eyes. Combining different bands, certain features are highlighted by comparison with their surroundings, giving us a better understanding of phenomena. It had been created a custom band combination using the shortwave infrared and near infrared bands.

According with [3], the ratios are used between bands to create indexes that quantify a feature of interest. An index is different from a band combination because it's a way to quantify the state of the feature you're interested in. A simple index for example is to divide the near infrared band by the red band to understand vegetation and was one of the first instances of using this kind of band arithmetic. The number and complexity of band indexes has evolved in time. The most common approach is the normalized difference vegetation index (NDVI), which has the following expression: (Near Infrared - Red) / (Near Infrared + Red)

This formula can be used to create a burn index ratio. With Landsat, Band 5 is the Near Infrared band and Band 7 is the Shortwave band. The NBR equation mathematically compares the Near Infrared and Shortwave Infrared 2 bands (bands 5 and 7) to determine band severity. Another approach is: (Near Infrared – Shortwave Infrared)/(Near Infrared + Shortwave Infrared).
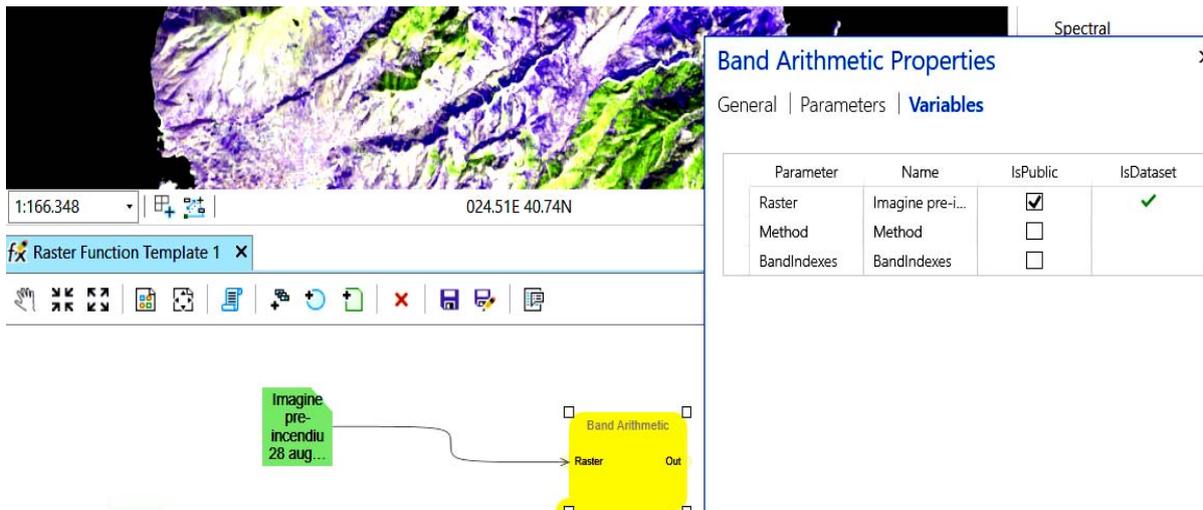
Fig. 4. Band Arithmetic Properties

The raster variable needed to be declared as public. The result of applying Burn Index Ratio is an imagery created is a grayscale image where the bright white areas are the deepest burns. There is a lot of noise in this image. In the second image were some clouds, which are being interpreted as heavily burned areas in the output. The assisted interpretation of the image is fundamental because of confusion due to these kinds of erroneous artifacts. Knowing generally where the burn scars are, the clouds can be successfully ignored.
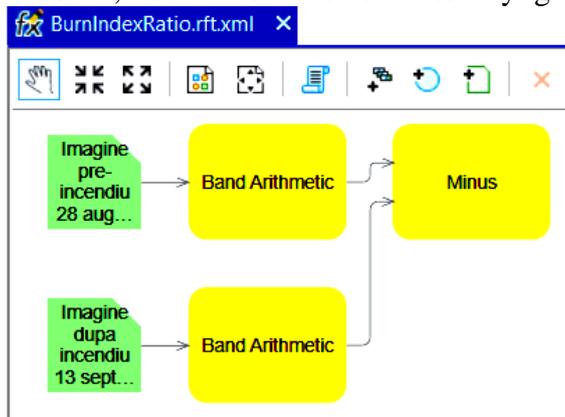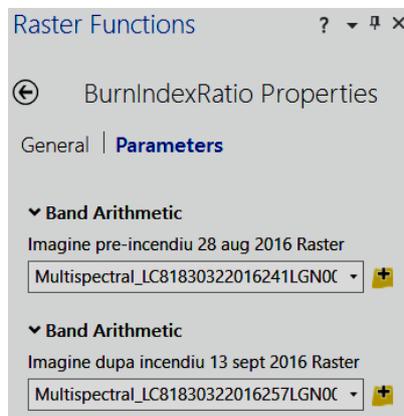

Fig. 5. Creating a Burn Index Ratio

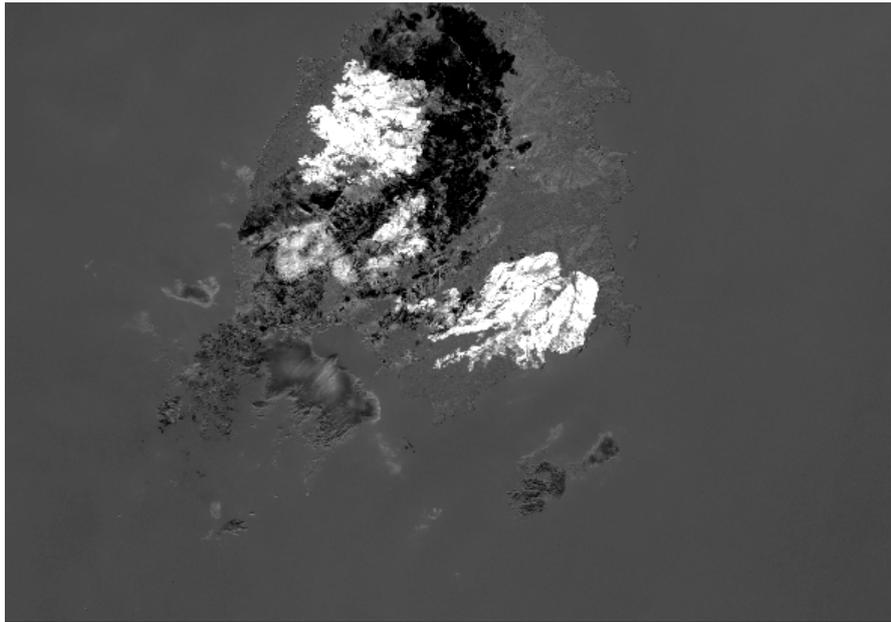Fig. 6. Parameters in Burn Index Ratio

Fig. 7. Result of Applying Burn Index Ratio

Based on figure 7 it can't be seen how the vegetation is affected in any quantifiable sense. For this reason it had been added in the model one more step, remapping the values according to the figure 8. (adapted from [3])
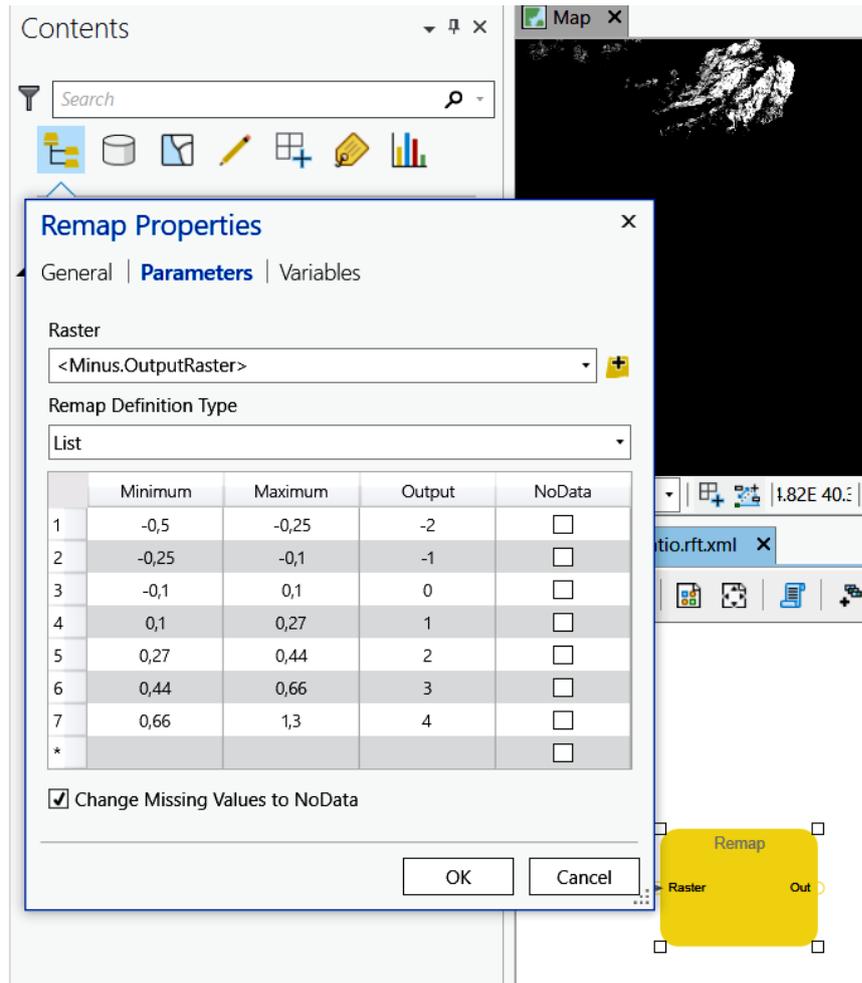

Fig. 8. Values for Remap
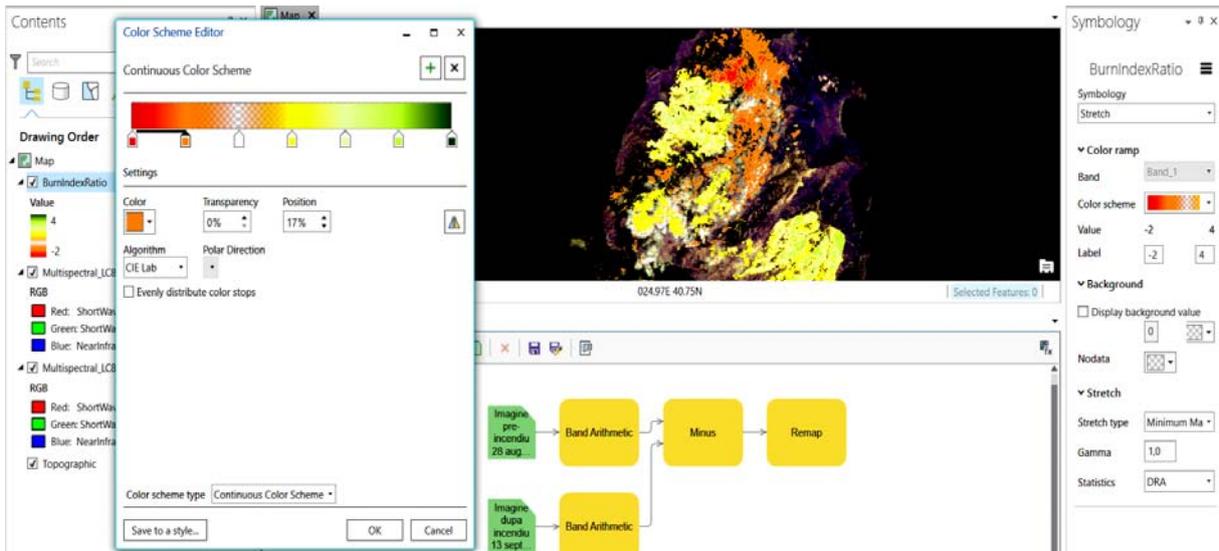
Fig. 9. Adding the Remap Function to the Model
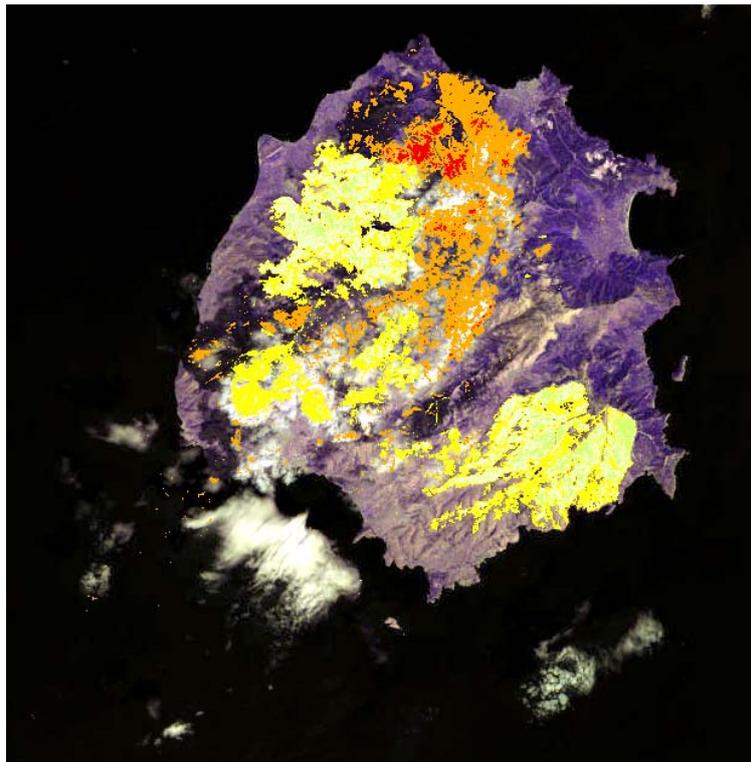

Fig. 10. Setting the Color Scheme

Fig. 11. Remap Results (yellow areas)

4. Comparison with the Results Published on Copernicus

On Coperncus had been pblished EMSR180: Fires on Thassos Island, Coverage map: GeoRSS feed of all maps in this activation visualized on a map

The product is at Release: r02 - Version: v1 and it had been delivered on 2016-09-15,17:51. The authorized user is Greece - General secretariat for Civil protection - Directorate for Emergency Planning and Response. Activation Reason was that „on Saturday 10-09-2016 morning, four fires that started on the island of Thassos (NE Greece) and continue to burn for a third day. The fires were probably caused by strong lightning activity in the island that was not followed by rain (Dry storm). Villages have been evacuated." The requested product consisted by delineation and monitoring. [6]

The available shapefiles are those from figure 12. We made a comparison with the published product that can be seen in figure 13.

EMSR180_01THASOS_01DELINEATION_MONIT01_v1_50000_area_of_interest.shp
EMSR180_01THASOS_01DELINEATION_MONIT01_v1_50000_crisis_information_poly.shp
EMSR180_01THASOS_01DELINEATION_MONIT01_v1_50000_general_information_poly.shp
EMSR180_01THASOS_01DELINEATION_MONIT01_v1_50000_hydrography_line.shp
EMSR180_01THASOS_01DELINEATION_MONIT01_v1_50000_populated_places_point.shp
EMSR180_01THASOS_01DELINEATION_MONIT01_v1_50000_settlements_poly.shp
EMSR180_01THASOS_01DELINEATION_MONIT01_v1_50000_transportation_line.shp
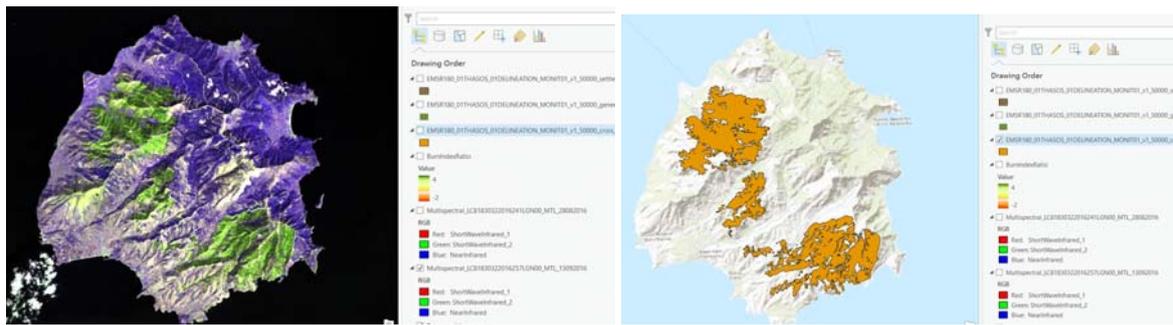
Fig. 12. Available shapefiles

Fig. 13. Comparing results

5. Conclusions

It had been created images of post-fire analysis using multispectral analysis. After the vegetaion will grow, in the Summer of 2017, this type of analytical model could be a useful tool for understanding vegetation regeneration in Thasos Island after a devastating fire. It is important to notice that - after studying this images - it would be important to send people out to inspect the affected area and to verify that the ranges that have been identified for each level of burn are accurate. The results obtained in ArcGIS Pro 1.3 using Remap function are quite well by comparison with Copernicus dataset.

From educational viewpoint it is important to develop academic curricula [8] according to the events of the present. Our faculty is making a lot of effort to implement sustainability thinking and environmental issues.

6. References

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