

ReSAC Forest Cover Monitoring and Forest Damage Assessment in the Frame of GMES Projects – Case Study from Bulgaria

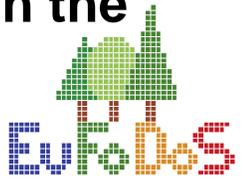


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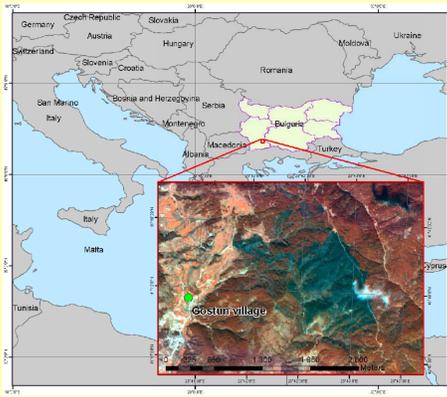
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FIRE EVENT

On Saturday – 09/04/2011, in the vicinity of the forest area fund in the Blata area above Gostun village, Bansko municipality, Bulgaria - fire event initiates. Immediately fire brigades are sent to fight the disaster. The fire is spread over forest massif in difficult to reach area. The strong wind and the rugged terrain make the fire extinguishing activities more difficult. As a result around 230 ha forest is burned (according to data from Executive Forest Agency) - mainly coniferous species: Pinus nigra, Pinus sylvestris, Picea abies and Abies alba. In the late 10/04/2011 the fire is localized and the spread of the fire in new territories is stopped. The fire is extinguished completely on 11/04/2011.



PROJECT FRAMEWORK

Satellite images for this research were received in the frame of EC SAFER Project (Emergency Response Service GMES). The research leading to these results has received funding from European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement number 262786 EUFODOS Project (European Forest Downstream Services - Improved Information on Forest Structure and Damages).

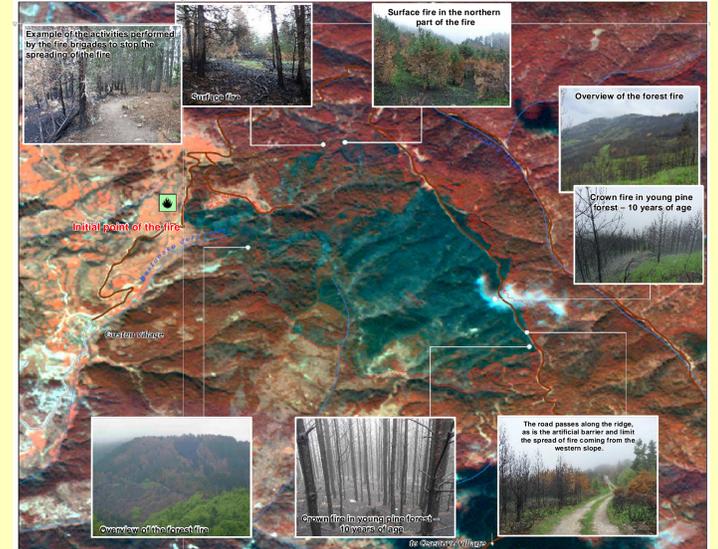
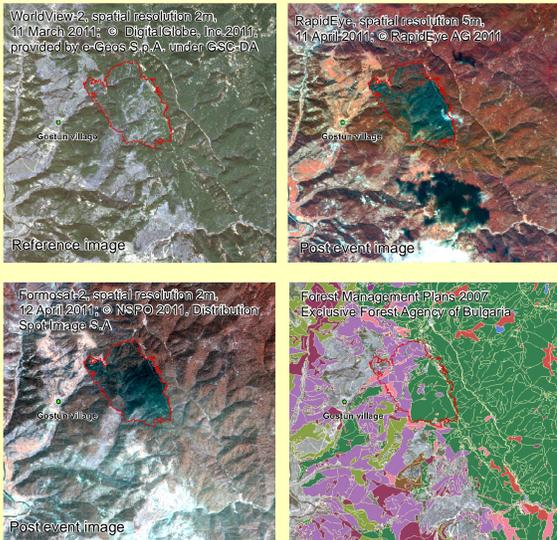


DATA USED

For the purposes of the above mentioned tasks three types of satellite images are used: WorldView-2 (reference image acquired on 11th of March 2011, spatial resolution 2m); RapidEye (post event image, acquired on 11th of April 2011, spatial resolution 5m); Formosat-2 (post event image acquired on 12th of April 2011, spatial resolution 2m). The satellite data supplied are from project SAFER, after the GMES SAFER mechanism was activated through the National Focal Point for Bulgaria. In order to extract information on forest species and forest density Forest Management Plans supplied from Executive Forest Agency were used.

FIELD WORK

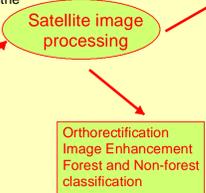
On 18th of May 2011 team from Remote Sensing Application Center - ReSAC together with representative from the local forestry made a field trip to the burned area. The main goal was to collect ground truth data for the extent of the fire, as well as the type of the fire (crown or surface). The trace was selected with the support of the experts from the Mesta forestry. During the field trip key locations were chosen with good visibility through the National Focal Point for Bulgaria. In order to extract information on forest species and forest density Forest Management Plans supplied from Executive Forest Agency were used.



STAGE OF THE WORK

The processing of the satellite images requires preprocessing related to orthorectification and image enhancement in order to assist the later analyses. In order to analyse the forest area burned classification between forest and non-forest land cover is needed. Unsupervised approach using ERDAS Imagine was used resulting in good differentiation of the boundaries of the forest area. In addition the resulting data were processed in order to smooth the boundaries between forest - non-forest areas as well as to correct some wrongly classified pixels.

EO DATA



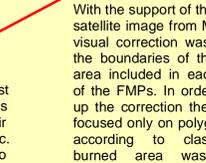
GIS Operations

The satellite images from RapidEye and WorldView-2 were used in order to classify the burned area. Supervised classification was used with the ground truth collected data during the field trip. Later on the resulting data were manually corrected. Based on this analyses the area of crown and surface fire was derived.

FIELD WORK

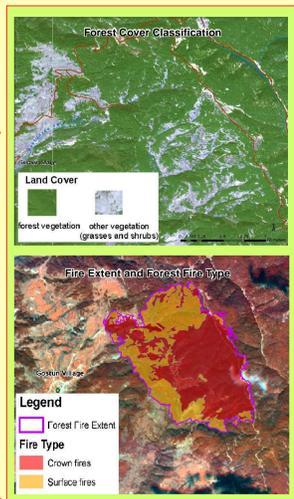
Processing of the Forest Management Plans

Relation of Graphical and attributes data



Update and actualization of Forest Management Plans

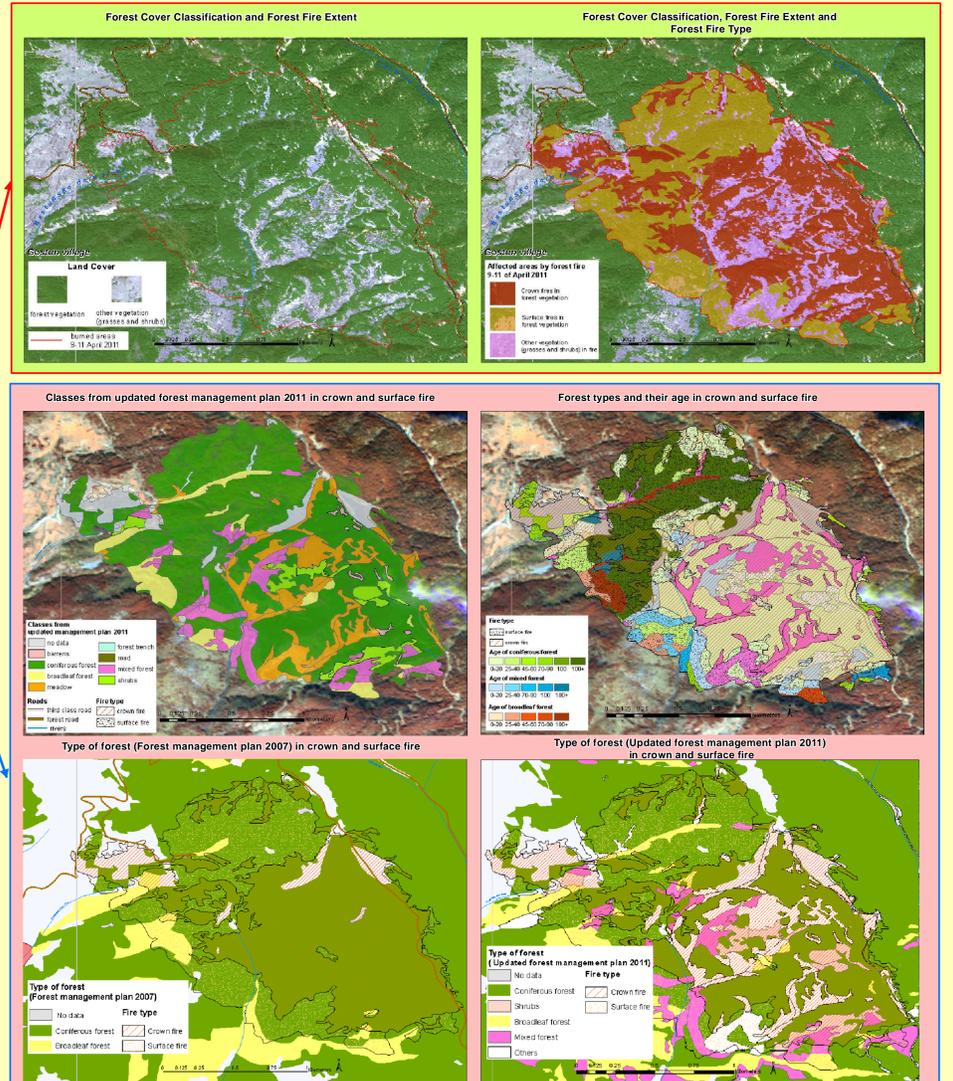
Relation of Graphical and attributes data



The resulting thematic data for the forest territories, as well as the information for the extent of the forest fire were spatially analysed and gave information for the concrete forest structures damaged. The results derived were processed in the forms of maps and tables.

GIS & RS Integration Spatial Analysis

After the correction of the FMPs, spatial analyses were performed in order to estimate the forest area types, forest age and density damaged by the fire. The results obtained were delivered as maps and tables.



Fire type	Type of forest	Area (ha)		Total Sum	
		Surface fire (SUM)	Crown fire (SUM)		
Surface fire	Coniferous	79.96		90.59	
	Broadleaf	10.63			
	No data		2.72	93.31	
Crown fire	Coniferous		129.13		130.97
	Broadleaf		1.84		
	No data		10.76	141.73	
Total					235.04

Classes	Type of forest	Area (ha)		Total
		Surface fire (SUM)	Crown fire (SUM)	
Coniferous	Forest	61.31	84.22	145.47
Broadleaf	Forest	11.85	2.17	
Mixed	Forest	11.06	9.26	20.32
Barren	Others	0	1.49	
Meadow	Others	5.7	23.59	29.29
Road	Others	0.1	0.37	
Shrubs	Others	0.56	9.45	10.01
Cutting	Others	0.31	0.26	
No Data		2.7	10.7	13.4
Total				

RESULTS

As a final result from the analyses performed information for the area and types of the forest cover was delivered, based on three types of source information – satellite images, FMPs and updated FMPs. The results are presented in Table 3. The results from the updated FMP and satellite images are very close. The difference of 4.4 ha could be explained by the forested areas classified from the image, but not included in the FMP. The big discrepancy between the classification results and not-updated FMP are explained by some inaccuracies in the FMP – meadows, roads, etc. area included in the forested polygons, which are cleared after the update. This fact shows the advantage of the use of recent satellite images for more accurate detection of the area subject to forest fires. On the other hand only the satellite images and especially high and medium resolution data could not give accurate enough information on forest species and forest density – values which are of high importance for the foresters when calculating the forest damages after disasters. Using the combined approach we overcome the limitations of the datasets and provide more accurate results to decision-makers.

Fire type	Forest vegetation	Area	Total area
Surface fire	Coniferous and deciduous forest	82.42	184.23
Crown fire	Coniferous and deciduous forest	101.81	
Areas in hectares affected by fire (forest management plan 2007)			
Fire type	Forest vegetation	Area	Total area
Surface fire	Coniferous and deciduous forest	90.59	221.56
Crown fire	Coniferous and deciduous forest	130.97	
Areas in hectares affected by fire (updated forest management plan 2011)			
Fire type	Forest vegetation	Area	Total area
Surface fire	Coniferous and deciduous forest	84.24	179.83
Crown fire	Coniferous and deciduous forest	95.59	
Areas in hectares declared to Executive Forest Agency			
Fire type	Forest vegetation	Area*	Total forest area
Surface fire	Coniferous and deciduous forest	101.4	216.3
Crown fire	Coniferous and deciduous forest	129.2	

Area in hectares affected by fire (by different source data). * in this figure 14.3 ha of non-forest area is included.