WEB-BASED MONITORING OF THE FIRES IN THE BALKANS USING SATELLITE DATA DURING JULY AND AUGUST 2007

R. Nedkov, M. Dimitrova, M. Zaharinova, I. Ivanova

Abstract: A space data-based monitoring of the massive forest and agrarian fires which sprang up in the Balkans in 2007 are presented. This monitoring has been performed by the Aerospace Information Center of the Space Research Institute at the Bulgarian Academy of Sciences since the summer of 2007. On the basis of satellite and GPS data, it is shown how to perform the localisation of the fire zones as well as to estimate the consequences from the fires. The fires sprung up in July 2007 around Stara Zagora and Topolovgrad were observed. Òhe results of the satellite monitoring of the fires which took place in Macedonia and the Peloponnesian peninsula of Greece are shown too.

Keywords: satellite monitoring, ecology, fires, image processing.

1. INTRODUCTION

As a system of permanent monitoring, measurement and objective estimation of natural conditions, aero and space methods have come to have considerable role.

As a base for remote sensing we use some physical phenomena, connected with energy radiation and transfer as well as electromagnetic field's characteristics. These are the characteristics of solar energy, and on the other hand – it is self-radiation from the Earth. These different radiations are unified by the laws of reflection, diffraction and polarization of light.

Satellites Landsat, Spot, NOAA, Terra, Aqua, Quick Bird, Ikonos, ERS, Radarsat, DMC are used for ecological monitoring of forests in the world, for estimation of conditions, dynamics, mapping and other similar reasons.

The advantage of these satellites is due to their optimal space, spectral and time resolution that is very suitable for investigation of phenomena on the earth surface. Their images spectral channels and space resolution and the frequency of data receiving are suitable for basic spectral characteristics of earth surface components and intensity of many processes and phenomena.

Since the summer of the 2005 in Space Research Institute (SRI-BAS) has been performed daily Web-based monitoring of atmospheric pollution on the territory of Stara Zagora. This monitoring is financed by the municipality [1]. Web-site has been created [2], where every day we put processed images from Terra and Aqua satellites from MODIS program. When there is some pollution, we mark it on the image.

At 19 July 2007 a fire sprang up in the region north from the Stara Zagora. The municipality requested from Aerospace Information Center in SRI-BAS to define the coordinates of the fire. These data you can find on the archive at the above mentioned Internet site [2].

Soon we have started daily monitoring for fires on the whole territory of the Balkans. A site has been made [3], where we put processed satellite data from Terra and Aqua about fires in Bulgaria and in the Balkans.

2. METHODOLOGY

The main source we use to find fires and thermal anomaly regions at label 2 (MOD14) is on the base of files HDF and TDF, which contains the results from the algorithm for fire localization for each pixel with resolution of 1 km. In these files there is information about position, bright temperature and full amount of energy for each pixel, marked as a fire. On the base of TSF file is generated ASCII code, which containes geographic coordinates, and the row and column of the pixel where the fire is. Active fires and other attributes we can see on the graphic with the help of TeraVision [4, 5].

We can find the additional options of the SeaSpace Corporation code TeraScan® VULCAN, one of the most perfect for localization and analyzation of fires, based on satellite data. Based on the data from MODIS, AVHRR, AMSU and VULCAN, it is automatically possible to find, localize and estimate intensity and size of devastating fires.

With goal-raising visualization the pictures are showed in pseudo-colors. Localization of fires is done by the means of spectral sources of MODIS (4 and 11 μm) for bright temperature.

An integer value is given to each of the pixels in accordance to the classification done in Table 1.

Table 1

Pixel value	Acceptation
0	no data
2	not processed
3	water surface
4	clouds
5	territory without fires
6	undefined class
7	fire with weak intensity
8	fire with middle intensity
9	fire with strong intensity

The data of level 2 is used for generating all future products, associated with the fires and contains the following parts:

- A mask to the acting fires that marks the fires and another due pixels (for example clouds);
- A picture for appraisal of the quality to the pixel that includes 19 bits of information for estimation of the quality for each pixel;
- A table to the fire that guarantees 19 degrees in radiometric information and information on the algorithm about each pixel of the merchandise in which the fire is seen;
- Extended meta-data and meta-data, specific for this code;
- The layer of the data, associated with the ocular chock, for simplifying the design of the ocular chock for the climatic modeling (CMG) of the merchandise for the fires.

The procedure for finding fires is based on the absolutely finding the fire, if it is strong enough, and on localizing close to the fire objects, which is connected with the change in the temperature on the surface. Each of the satellites Terra and Aqua pass over each points of the Earth two times every day. The MODIS data can be used for observation in the burning to agricultural regions, the type and the state in the vegetation, the smoke aerosols, the water steam and the clouds, and this served for entire monitoring to the process of development of the fire and its influence on the ecosystems, the genius loci and the climate. That includes the location to originating of the fire, the degree to a heat radiating in the fire and ruffianly estimate to the coefficient of correlation between a smoldering and a burning. This information can be used for monitoring of time distribution of the fires in the different ecosystems, seeing of changes in the fire distribution and determining new limits of the fire, naturally emergent fires and changes in the frequency to the fires and their relative intensity [5, 6].

3. RESULTS

In the middle of July 2007, because of the heat and dry climate, the conditions have become favourable for forest and field fires. At 19 July a forest fire arose in the area north of the city Stara Zagora. On the municipal-lity's request, together with the monitoring for atmospheric pollutions, the group of the Center for Aerospace Information at SRI-BAS determined the coordinates of the hearths of fires as well. On the Fig. 1, Fig. 2 and Fig. 3 below we show data processed satellite imagines from MODIS for the period of 19-28 July 2007. On the pictures with arrows the domains that find themselves of the border-airing burning are shown. The same pictures can be found in the archive at the site for monitoring to the atmospheric pollutions of this area [2].

Satellites Terra and Aqua from MODIS program pass two times every day behind each ground point – once at day part and once at night part of the calendar day. In cases of long duration fires it gives us the opportunity to track its dynamics as well as to except the coordinates of the place of the fire.

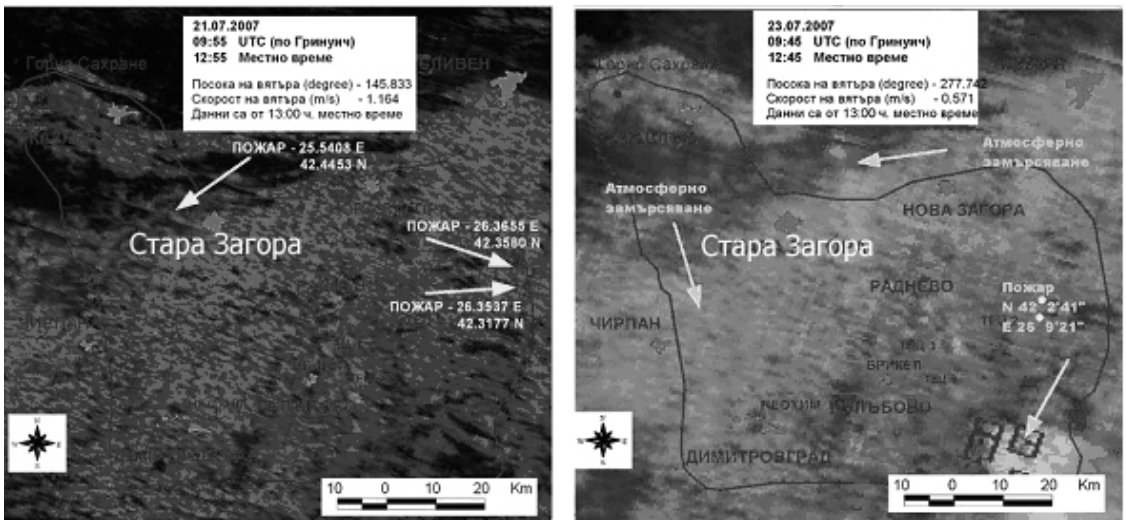


Fig. 1. Fires at the territory around Stara Zagora at 21 and 23 July 2007

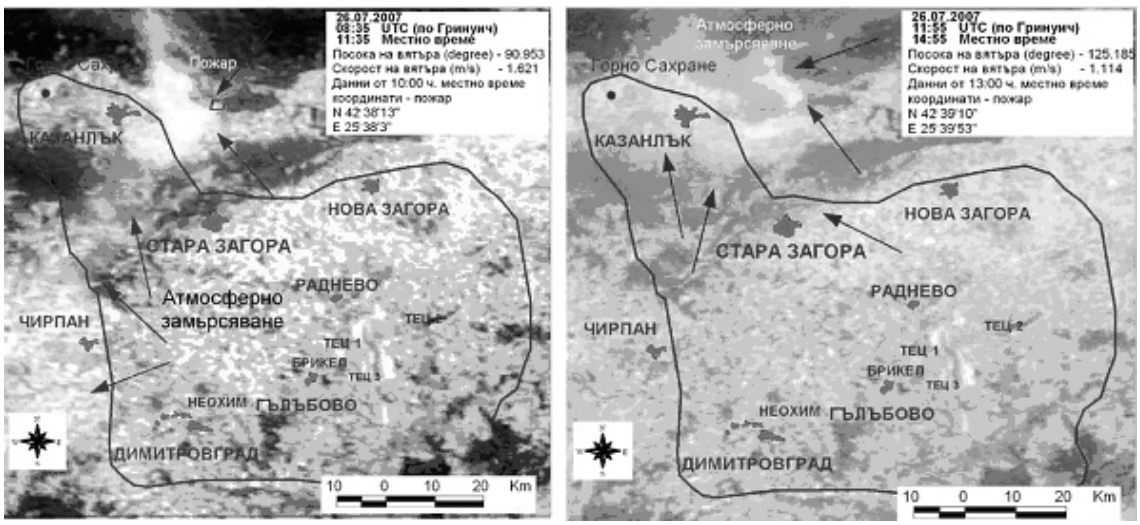


Fig. 2. Fires at the territory around Stara Zagora at 26 July 2007

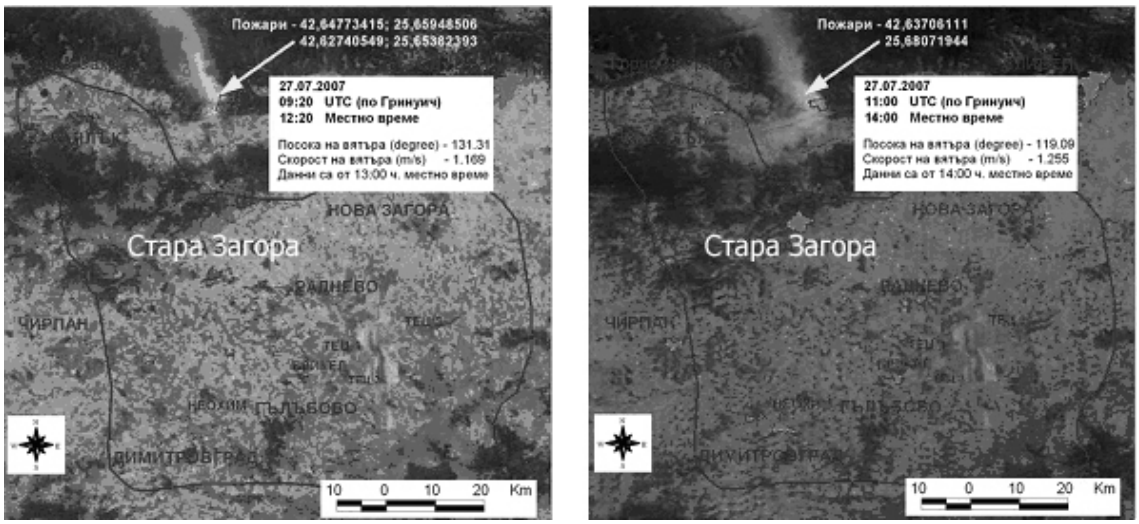


Fig. 3. Fires at the territory around Stara Zagora at 27 July 2007

The site was made and was kept in July 2007 [3], on which cultivated satellite data are published for Balkans and Bulgaria. In addition when any big fire appeared more detailed image of this territory is published [4].

On Fig. 4 satellite data for fires on the territory near Topolovgrad at 23 July 2007 are shown. These images show whole territory of Republic Bulgaria.

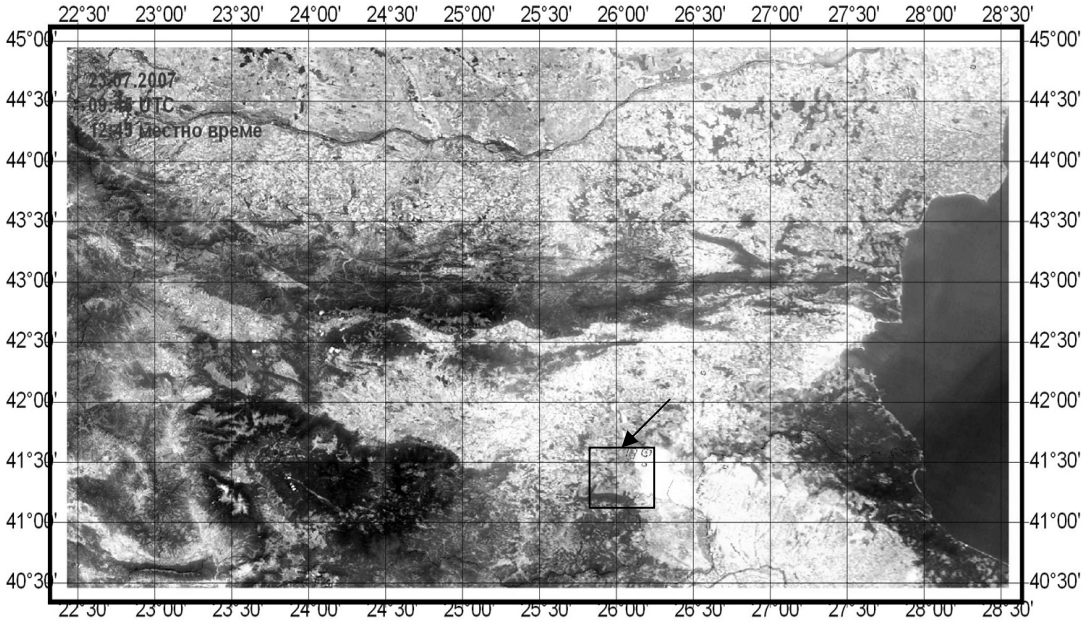


Fig. 4. Fires at the territory around Topolovgrad at 23 July 2007 – an image from Terra-MODIS satellite

From satellite images in destined spectral diapasons the damages from the fire could be estimated (Fig. 5). Images used here have spatial resolution of 250 m, which define the precision of the estimation. On Fig. 6 the vector of the burned stain as well as its area, determined by this resolution of the satellite image, are shown. In the concrete case, the territory damaged by the fire is nearly 105 km^2. The degree of the mob is nît the same everywhere. If the satellite image with resolution 1 - 5 m is used, more details can be seen, e.g. the number of the damaged buildings, etc.

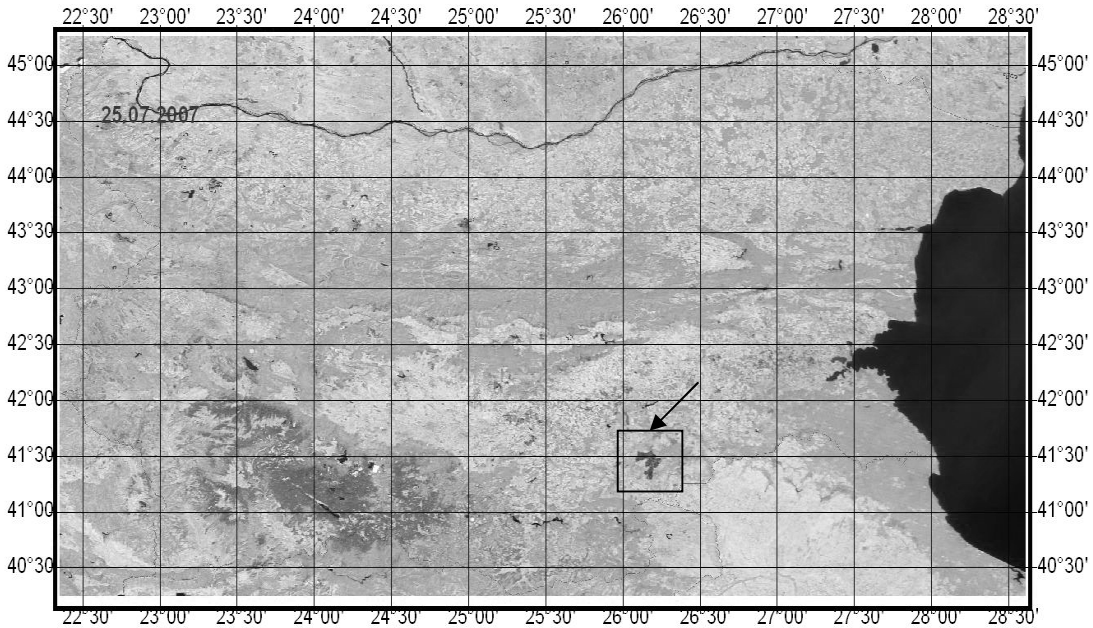


Fig. 5. An image of the territory around Topolovgrad at 25 July 2007 – channels 7-2-1 from Terra-MODIS satellite. On picture the burned region as result of the fire is shown.

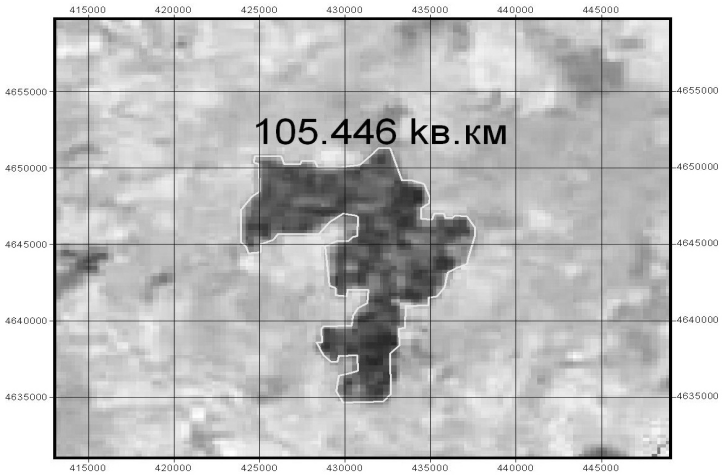


Fig. 6. Damages from the fire – burnt place and area in squire km

Fires most endlessly rage on the territory of Macedonia from the middle of July to the beginning of September 2007. As illustration on Fig. 7 pictures of the fires at 26 July and 30 August are shown.

Through months July to September 2007 devastating fires rage on the territory of Peloponnesian, Greece. From 21 August to the first days of September fires raged on and covered huge areas around the entire peninsula. On Fig. 8 and Fig. 9 pictures from Terra and Aqua satellites – program MODIS are shown. The smoke from the fires is seen clearly as well as the development in the fires in the period of 23 - 25 August.

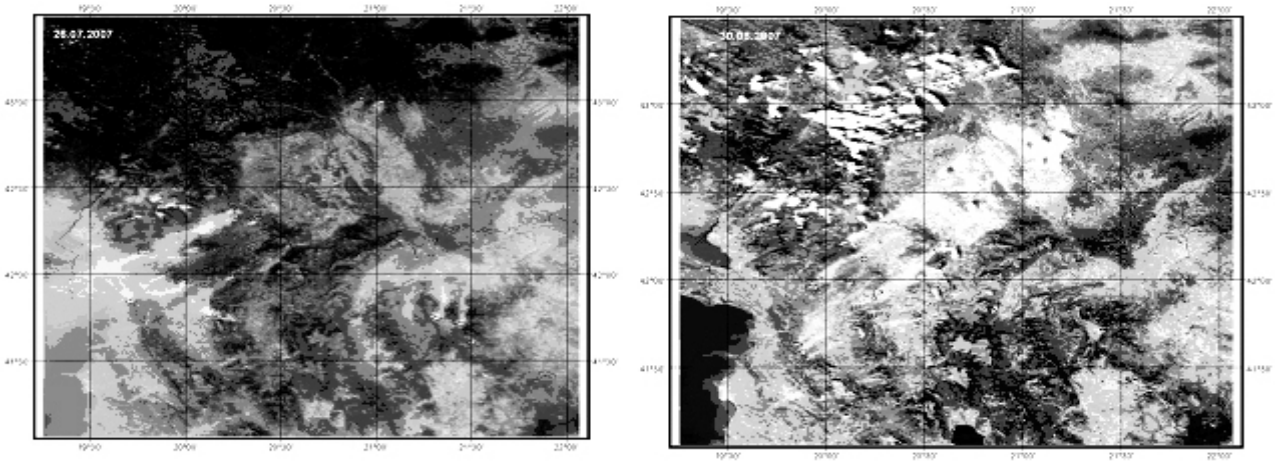


Fig. 7. Fires on the territory of Macedonia at 26 July and 30 August 2007

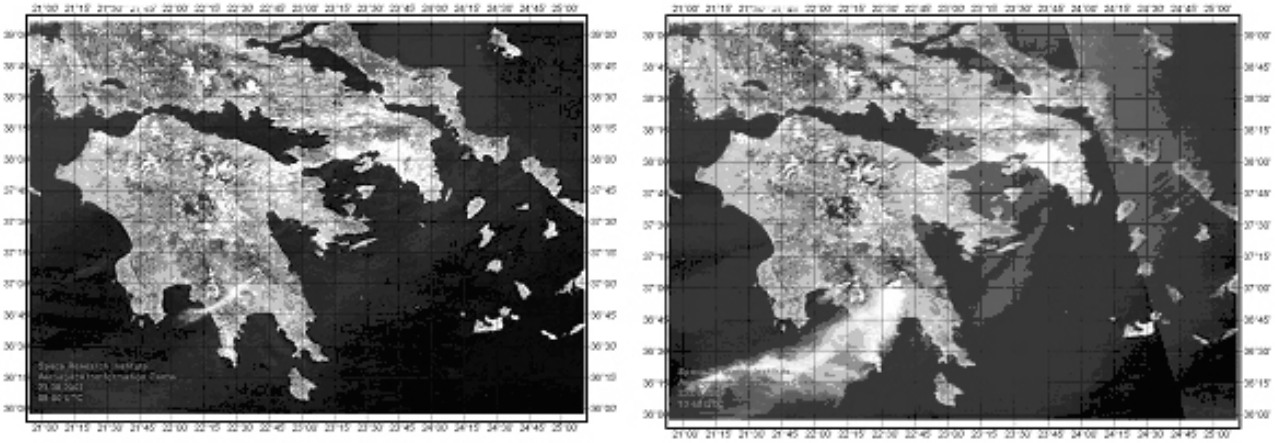
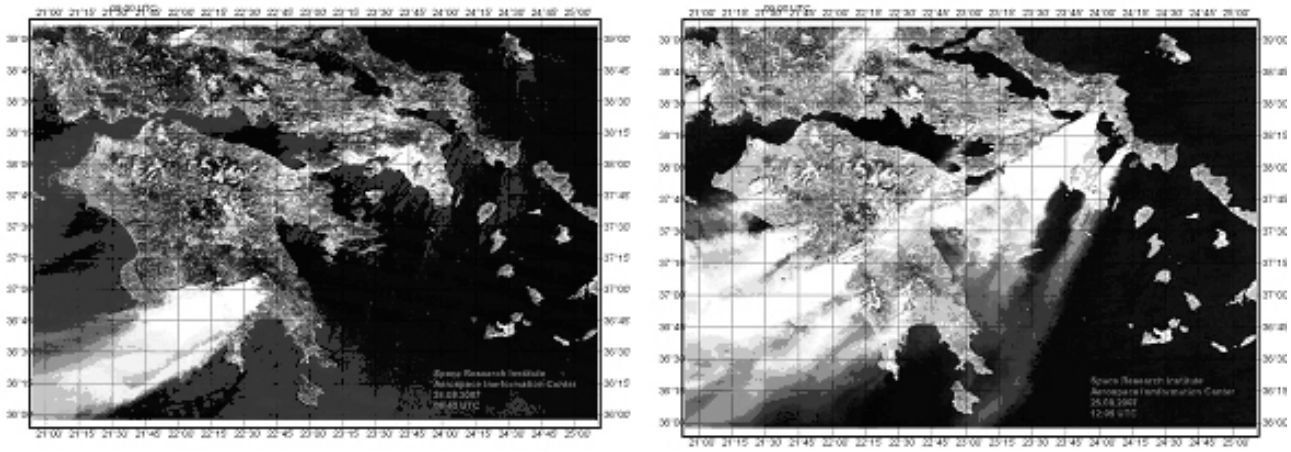


Fig. 8. Fires on the territory of Peloponnesian-Greece at 23 August 2007



2007 Fig. 9. Fires on the territory of Peloponnesian-Greece at 24 and 25 August

Using satellite data the consequences from fires could be estimated. On Fig. 10 damaged areas from all fires on the territory of Peloponnesian-Greece in 2007 are shown.

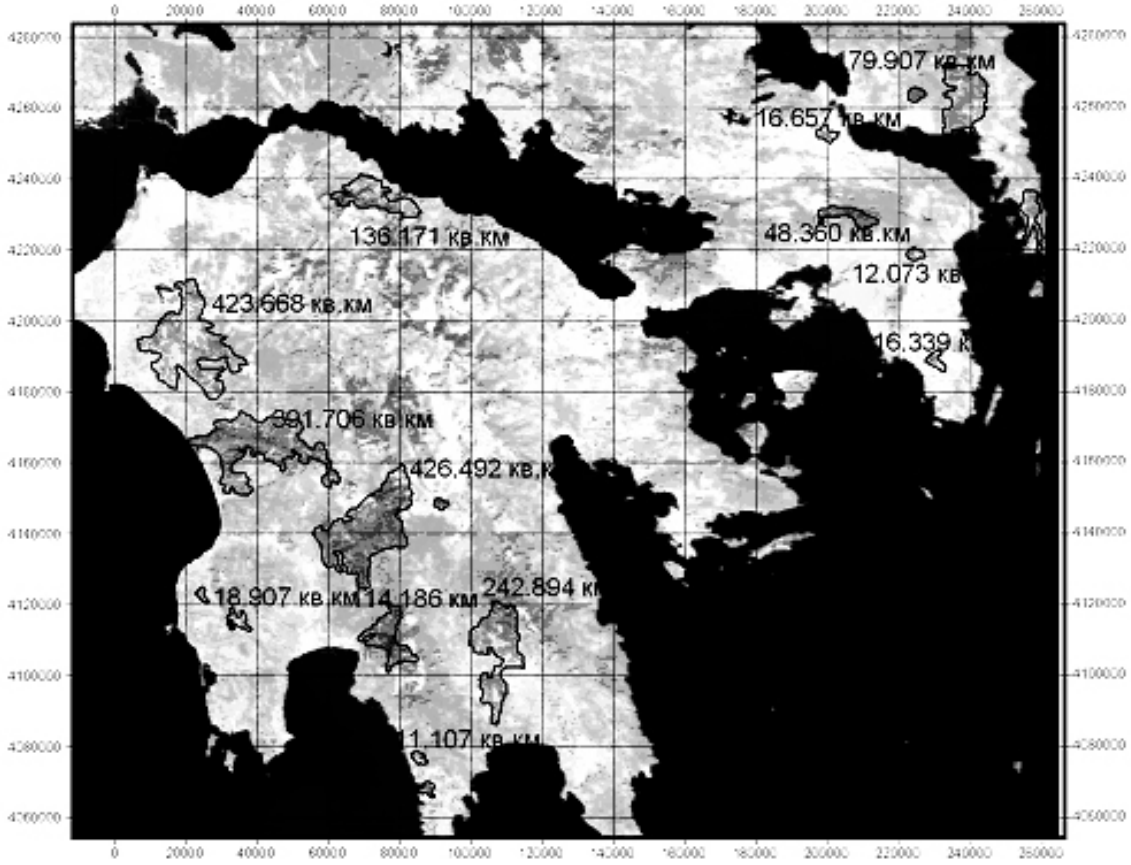


Fig. 10. The Peloponnesian-Greece, August 2007 – burnt places and their areas in squire km

CONCLUSION

Satellite data with optimal space, spectral and time resolution is a good instrument for estimation of dynamics of fires and damage areas. They give a possibility for following evolution of fires in real and near real time. On this base we realize web-based monitoring of fires on the Balkans, the results of which is public.

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Ð. Íåäêîâ, Ì. Äèìèòðîâà, Ì. Çàõàðèíîâà, È. Èâàíîâà

Ðåçþìå: Â ðàáîòàòà å ïðåäñòàâåíî ïðîåêòúò íà ñàòåëèòåí ìîíèòîðèíã íà ãîëåìèòå ãîðñêè è ïîëñêè ïîæàðè, âúçíèêíàëè íà òåðèòîðèÿòà íà Áàëêàíñêèÿ ïîëóîñòðîâ, êîåòî ñå èçâúðøâà â Öåíòúðà çà àâðîêîñìè÷åñêè èíôîðìàöèÿ êúì ÈÊÈ-ÁÀÍ îò ëÿòîòî íà 2007 ãîäèíà. Ïîêàçàíî å êàê íà áàçàòà íà ñïúòíèêîâè è GPS äàííè ìîæå äà áúäå îïðåäåëåíî ìåñòîïîëîæåíèåòî íà ïîæàðè, êàêòî è ñëåä ïîòóøàâàíåòî ìó äà ñå îöåíÿò ïîñëåäèöèòå îò íåãî. Îñîáåíî âíèìàíèå å îòäåëåíî íà ïîæàðèòå, êîèòî áóøóâàòà ïðåç ìåñåö þëè 2007 íà òåðèòîðèÿòà íà îáëàñòèòå Ñòàðà Çàãîðà è Òîïîëîâãðàä. Ïîêàçàíè ñà ðåçóëòàòèòå îò îáðàáîòêàòà íà ñïúòíèêîâè äàííè çà ïîæàðèòå â Ìàêåäîíèÿ è îáëàñò Ïåëîïîíåñ â Ãúðöèÿ.