

GMES Burn Scar Mapping kicks into full gear after 2007 wildfires in Greece

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IN THE SUMMER OF 2007 GREECE EXPERIENCED THE WORST WILDFIRE SEASON ON RECORD WITH SOME 3,000 FIRES, AUGMENTED BY A COMBINATION OF DROUGHT AND HEAT WAVES, CLAIMING OVER 80 LIVES AND 190,000 HECTARES. WHILE THE FIRES CAPTURED THE HEADLINES, NATIONAL AND INTERNATIONAL ASSISTANCE WAS DISPATCHED TO THE STRICKEN AREAS. SINCE THEN, THESE DEVASTATED AREAS HAVE ALSO BECOME PROVING GROUNDS FOR THE DEPLOYMENT OF GMES PRODUCTS AND SERVICES FOR NATURAL DISASTER PREVENTION AND MANAGEMENT.

After wildfires comes the time for damage assessment and reconstruction. In this context national and local governments in Greece have been making extensive use of GMES products and services provided to them through RISK-EOS, a GSE (GMES Service Element) financed by the European Space Agency. RISK-EOS provides services for crisis situations arising from natural disasters such as wildfires and floods. The extension of GSE RISK-EOS to Greece has mapped the consequences of forest fires in a systematic way. The Earth Observation component consists of satellite images that portray the affected areas in various sectors of the electromagnetic spectrum (visible, near infra-red and short-wave infra-red), allowing the automatic production of highly accurate maps of the burnt vegetation.

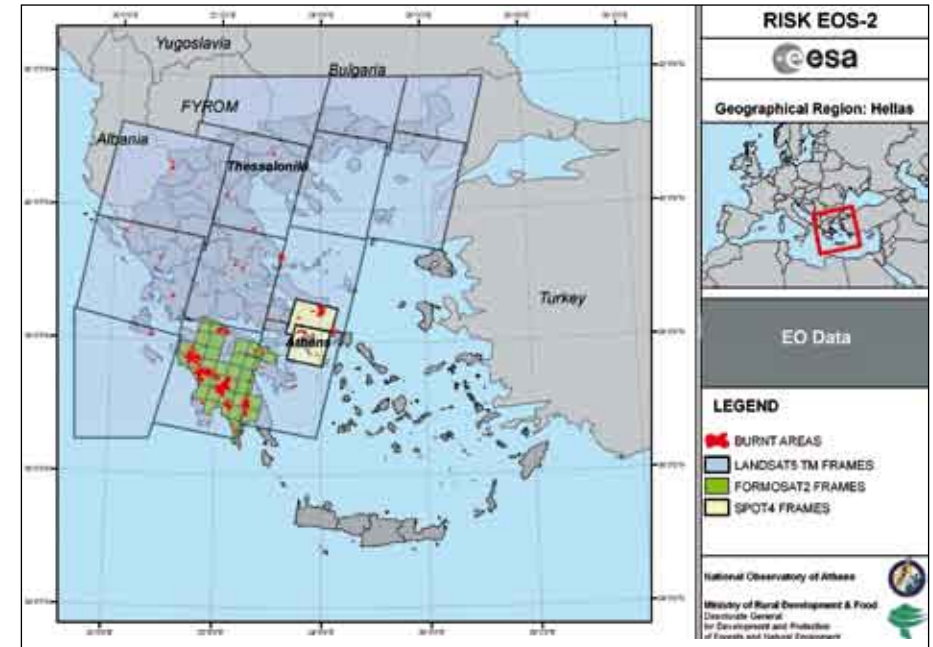
Burn scar mapping (BSM) constitutes one of the basic services of GMES Emergency Response Services. It aims at assessing damage from wildfires, both quantitatively and qualitatively,

and at supporting the rehabilitation of the affected areas.

BSM uses images captured by more than one satellite, depending on the detail and accuracy required by the user (refer to map on top of page 55). Satellites with high spatial resolution sensors such as Landsat, SPOT and IRS are used to cover the entire country, while satellites with very high spatial resolution sensors (FORMOSAT-2, SPOT-5, IKONOS-2 and QUICKBIRD) are used in addition over regions where particular detail in mapping is needed. Maps are produced annually or seasonally (during summer) at various geographical scales, and are provided to those users in Greece, France, Spain, Italy and Portugal who have an institutional role in natural disaster management.

The 2007 Fires

While BSM within RISK-EOS was first applied in Greece as a pilot project during the Summer of 2006, the 2007 season was marred by a series of massive forest fires that broke out all over Greece. That



Imagery coordination is centre-piece for the delivery of operational imagery by GMES. This picture shows how images of different regions of Greece were captured and delivered by different satellites, operating at different resolution levels – Landsat 5, FORMOSAT-2, and SPOT-4 satellites. These pictures were brought together into coherent imagery sets directly accessible by end-users.

year, operational mapping of all forest fires that took place between May and October 2007 over the entire Greek territory was carried out. In all, 91% of Greece’s territory – 120,000 km² – was covered (all but Crete and other islands that kept free of fires). The results of the project, delivered in two digital formats (vector and raster), are the only comprehensive, homogeneous inventory of burnt areas in Greece.

The work performed in the project revealed that the total burnt area was 193,656 hectares. The inventory shows the main fire incidents per prefecture as well as the estimates of the extent of burnt land cover types – coniferous, broad-leaved and mixed forests, natural pastures, bushes and heath land, and scrub (sclerophyllous) vegetation.

National implementation



Greece lost over 190,000 hectares to wildfires in 2007 (Credits: NASA, MODIS image acquired on August 29th, 2007).

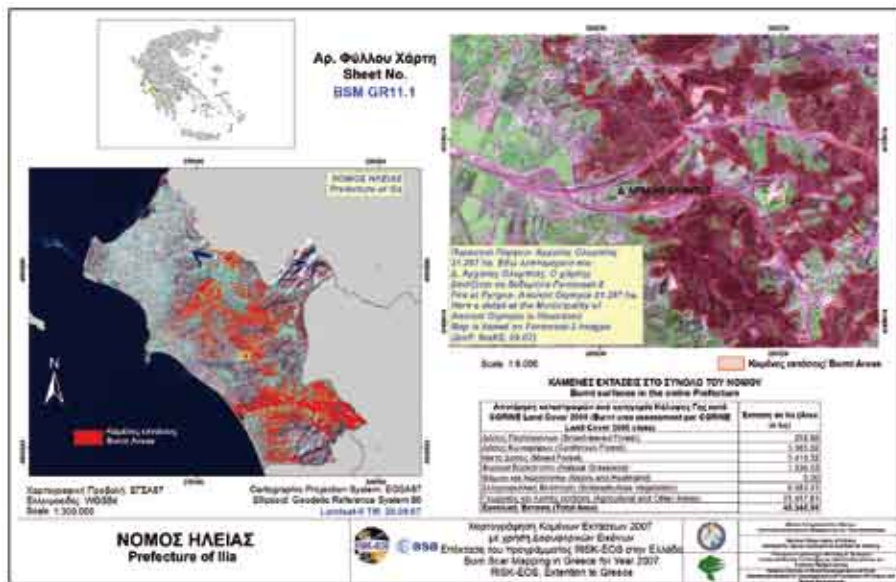
GMES experiment provides Greek citizens with fire detection satellite information

During the wildfires of the summer of 2007, as a pilot experiment, the National Observatory of Athens published on its website the results of the fire detection chain, using images from the SEVIRI sensor onboard Meteosat Second Generation satellites.



Throughout the crisis, starting 15 minutes after the Crisis Centre was activated, the SEVIRI sensor on board METEOSAT satellites delivered a steady stream of images showing the progression of the wildfires (Credits: NOAA/Eumetsat).

The implementation of *Burn Scar Mapping* in Greece was facilitated by the way in which the management of the RISK-EOS project is structured. Each of the national partners in the programme assumes responsibility for interacting directly with the country's end users. Direct communication between the partner-provider and the end users is enabled through personnel permanently assigned to the service who ensure that user needs are fulfilled. In the case of Greece, ESA worked with the National Observatory of Athens (NOA) and most particularly NOA's Institute for Space Applications and Remote Sensing (ISARS). The ISARS scientists worked together with forestry experts from the Ministry of Rural Development and Food and the National Agricultural Research Foundation. They elaborated the specifications and the standardisation of the service, so as to closely follow the needs of both central and local services.



Burn Scar Mapping: on the left is a 1:300 000 scale Landsat image of the prefecture of Ilia. Burnt areas are shown in red. On the right, the area of ancient Olympia is presented in greater detail on FORMOSAT-2 images, with the 21,297 ha of burnt areas now showing in dark purple.

Users testimonies

Dr. Georgios Tsiourlis from the Greek Forest Research Institute gives a detailed account of how GMES services operated during the crisis.

“Ten minutes after alert was first given, the fire monitoring and hot spot location service was activated, acquiring and processing in rush mode images from the SEVIRI sensor. Within 15 minutes of the fire alert, SEVIRI images clearly showed the location of fires all over the region of Peloponnesus.

One of the instructions was to protect sensitive infrastructure – the likes of hospitals, petrol stations and roads. This mission required updated reference maps. The maps delivered in real time by RISK-EOS, based on high and very high resolution satellite imagery, proved especially useful. All the available satellites were pointed towards the areas ablaze as a matter of priority.

Later, after the fires had been put out, the assessment of the damage was completed in only one month, thanks to fast processing of images from the SPOT, Landsat and FORMOSAT-2 satellites.”

Dr. Georgios Tsiourlis, Principal Researcher at the Forest Research Institute of the National Agriculture Research Foundation in Greece (Credits: Gil Denis).



Dr. P. Balatsos has had GMES mapping products in hand in a real-life, operational context. He has been able to compare these with existing tools and indicators. Here are his reflections:

“For the first time, GMES gave us the opportunity to have material to compare the mapping processes of our service with information that comes from other sources. This has helped us to evaluate our mapping process and to determine improvement needs.

We would also like to point out that higher resolution analysis, as delivered by GMES and RISK-EOS, impacts many plans and projects to better manage forests in the future, particularly when it comes to forest fires.

This is the first time we are seeing a joint effort to give information to the people and the services that need information. This is why we suggest to continue!”

Dr. P. Balatsos, Directorate General of Natural Environment and Forest Development and Protection, Ministry of Rural Development and Food of Greece.



The mapping products published are now delivered to and used on a regular basis by a range of institutions, both national (Ministry of Rural Development and Food, Secretariat of Civil Protection, Hellenic Centre of Biotopes and Wetlands, etc.) and regional/

local (Regional Forest Inspection and Rehabilitation Services, etc.).

Concrete applications by end users

End Users of BSM products integrated the data into their Geographic Information Systems (GIS) and used and



The Parnitha mountains after the fire. (Credits: Geraki)

evaluated them in comparison with the existing traditional solutions, namely field surveys. They report that the use of high and very high spatial resolution satellite data provides a unique solution for reliable mapping and post-fire management. After the 2007 fires, the data has, in particular, been of use for the following post-fire activities:

- Improving discrimination and mapping of the affected areas inside highly fragmented and complex areas
- Monitoring and controlling the maintenance of original land uses
- Managing reforestation
- Generating reliable statistics of damage
- Educating forest officers in Fire Prevention and Post Crisis Planning
- Assessing the forest fires impact on Natura 2000 sites (the European Union's nature protection areas network)
- Modelling fire behaviour for the future
- Implementing medium- to long-term soil conservation policies.

GMES *Emergency Response Services* and the *RISK-EOS* project, and in this case Burn Scar Mapping, are thus proving useful and operational for forest and rural land management authorities in regions throughout the Mediterranean basin that are chronically subject to fires.



Fire looms over the Parnitha mountains, on the night of June 18th, 2007. Photo taken from Athens, 16 km away. (Credits: George Havlicek)

BSM mapping products

1. Maps of burnt areas
Seasonal update, vector format, 1:10,000-1:50,000 scale
2. Enhanced cartographic product of burnt areas
Seasonal update, vector format, 1:10,000-1:50,000 scale
3. Ortho-rectified post-fire satellite images
Satellite map ortho-rectified for uniformity of scale, seasonal update, raster/ bitmap format, 1:10,000-1:50,000 scale
4. Geographic Information Systems (GIS) integrating vector/raster BSM and damage assessments information layers
- ~~5. Vector format~~
6. Rapid fire mapping
Daily update, raster format, 1:10,000-1:50,000 scale



Dr. Charalabos (Haris) KONTIOES holds a Ph.D. in Remote Sensing of the Environment. He is a Principal Researcher at the Institute for Space Applications and Remote Sensing (ISARS) of the National Observatory of Athens (NOA), where he is responsible for the *RISK-EOS* extension to Greece Project. He has wide expertise in managing EC and ESA projects focusing on risk assessment and mitigation, risk monitoring and risk management systems relating to forest fires, environmental resource management and land use/land cover mapping. Past roles included Executive Secretary of the Hellenic Space Research and Technology Committee of Greece, Advisor to the Hellenic Ministry of Development in the preparatory work for the adhesion of Greece to ESA and Member of the GMES Steering Committee as well as National Representative of Greece to ESA's PBE0 Programme Board.



Dr. Nicolaos SIFAKIS holds an M.Sc. in Remote Sensing and an M.Sc. in Environmental Physics, as well as a Ph.D. in Remote Sensing from University Paris-7. He is currently Senior Scientist at ISARS-NOA, in charge of the SEVIRI data receiving station. He was a pioneer in mapping air pollution with high spatial resolution. He worked at the European Commission as coordinator for the CORINE Land Cover project. He was also Advisor to the European Environment Agency and to NASA's Environment & Health Programme.



Dr. Iphigenia KERAMITSOGLU holds a Ph.D. in Space and Atmospheric Physics from Imperial College London. She is a Researcher at the Institute for Space Applications and Remote Sensing (ISARS) at the National Observatory of Athens (NOA). She has been contributing as a Research Associate of the Remote Sensing and Image Processing Group of the Physics Dept. of University of Athens and the National Observatory of Athens. She is an expert in remote sensing of forests and eco-systems.