



NATIONAL OBSERVATORY OF ATHENS

Institute for Space Applications and Remote Sensing



RISK-EOS

A EUROPEAN NATURAL
DISASTER SERVICE
GMES/GSE ESA

C. C. KONTOES

**ISARS/NOA PRINCIPAL RESEARCHER
PROJECT SCIENTIFIC RESPONSIBLE**

RISK-EOS Product

Fire Products

Product	Updating Frequency	Location Accuracy	Resolution	Format
Burn Scar Maps BSM 1	Yearly	60 meters	30 meters (compatible with a scale 1:50.000/1:25.000)	Vector
Burnt Area Maps BSM 2	Yearly	60 meters	30 meters (compatible with a scale 1:50.000/1:25.000)	Vector
Cloud & water/urban mask BSM 3	Yearly	60 meters	30 meters (compatible with a scale 1:50.000/1:25.000)	Raster
Post Fire Images BSM 4	Yearly	60 meters	30 meters (compatible with a scale 1:50.000/1:25.000)	Raster
GIS File integrated product	Yearly	60 meters	30 meters (compatible with a scale 1:50.000/1:25.000)	Raster & Vector

RISK-EOS Product

Fire Products

Product	Updating Frequency	Localisation Accuracy	Resolution	Format
Near Real Time Fire Extent rapid mapping FRM1	8 to 12h after image acquisition	Depends on EO data	30 meters	Raster
Non Real Time Fire Extent rapid mapping FRM2	2 weeks after image acquisition	Depends on EO data	30 meters	Raster & Vector
Non Real Time Fire damage assessment FRM3	2 weeks after image acquisition	Depends on EO data	30 meters	Vector

RISK-EOS Products

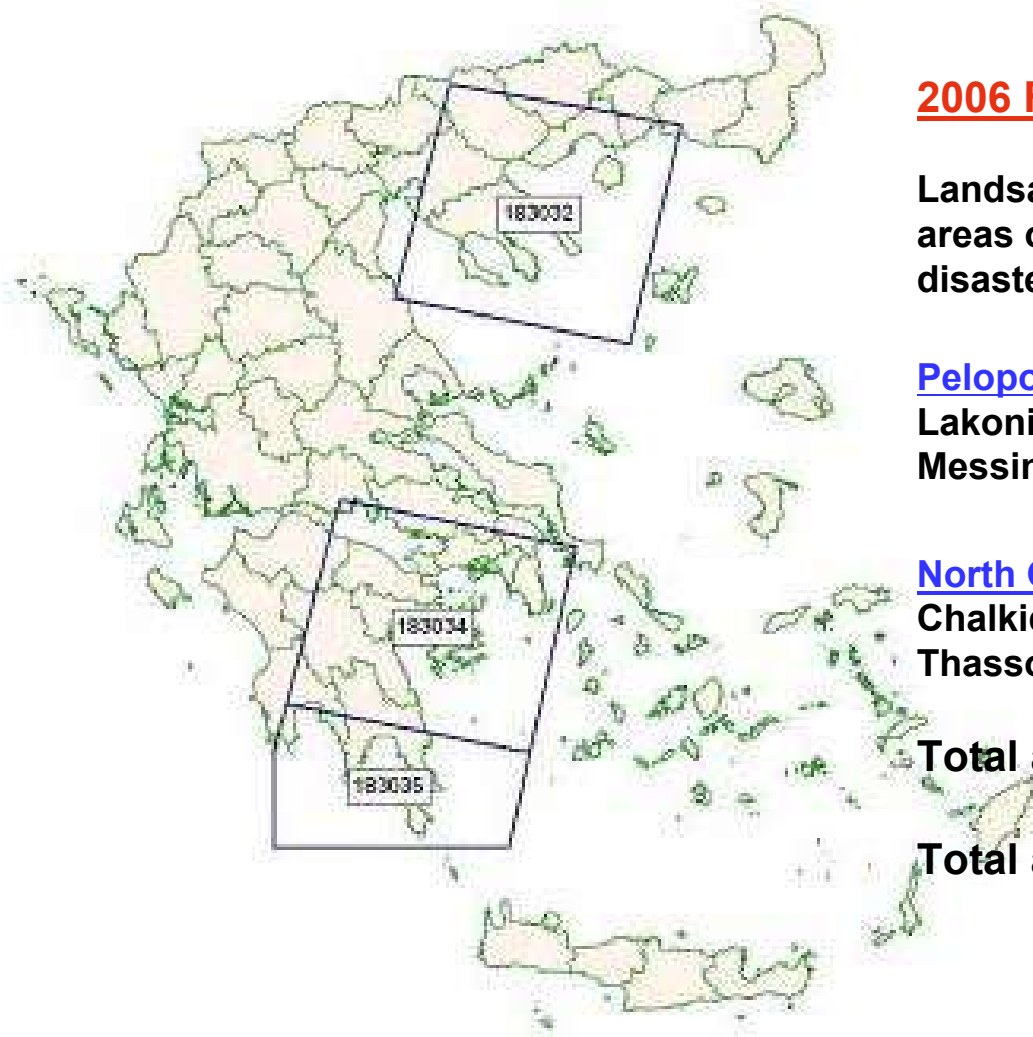
Flash Flood Products

Product	Updating Frequency	Localisation Accuracy	Resolution	Format
Near Real Time Flood Rapid Mapping FLRM1	12h after image acquisition (2 to 3 days)	10 to 60 meters Depends on EO data	5 to 30 meters	Raster
Non Real Time Flood Rapid Mapping FLRM2	2 weeks	10 to 60 meters Depends on EO data	5 to 30 meters	Raster & Vector
Non Real Time Maximum Flood Extent Mapping - FLRM3	2 weeks	10 to 60 meters Depends on EO data	5 to 30 meters	Raster & Vector
Non Real Time Flood Damage assess- ment - FLRM4	2 weeks	10 to 60 meters Depends on EO data	5 to 30 meters	Raster & Vector
Non Real Time Flood Duration per area - FLRM5	2 weeks	10 to 60 meters Depends on EO data	5 to 30 meters	Vector

SLAs reminder

Service	User(s)	Area
BSM_NOA	HELLENIC MINISTRY OF AGRICULTURAL DEVELOPMENT AND FOODS	<u>2006 Fire Season: 20.000 km²</u> <u>Peloponnesus:</u> Prefectures (NUTS III) of Lakonia, east Messinia, Arkadia, Argolida, Korinthia <u>North Greece:</u> Prefectures (NUTS III) of Chalkidiki, Thessaloniki, Serres, Kavala and Thassos
BSM_NOA	NATIONAL AGRICULTURAL RESEARCH FOUNDATION	

SLAs reminder



2006 Fire Season:

Landsat TM coverage for the Greek project areas over Macedonia (including the Chalkidiki disaster) and Peloponnese

Peloponnese: 18.350 km² (prefectures of Lakonia-(including Mani disaster), east Messinia, Arkadia, Argolida, Korinthia)

North Greece: 12.000 km² (prefectures of Chalkidiki, Thessaloniki, Serres, Kavala and Thassos)

Total area covered: 30.350 km²

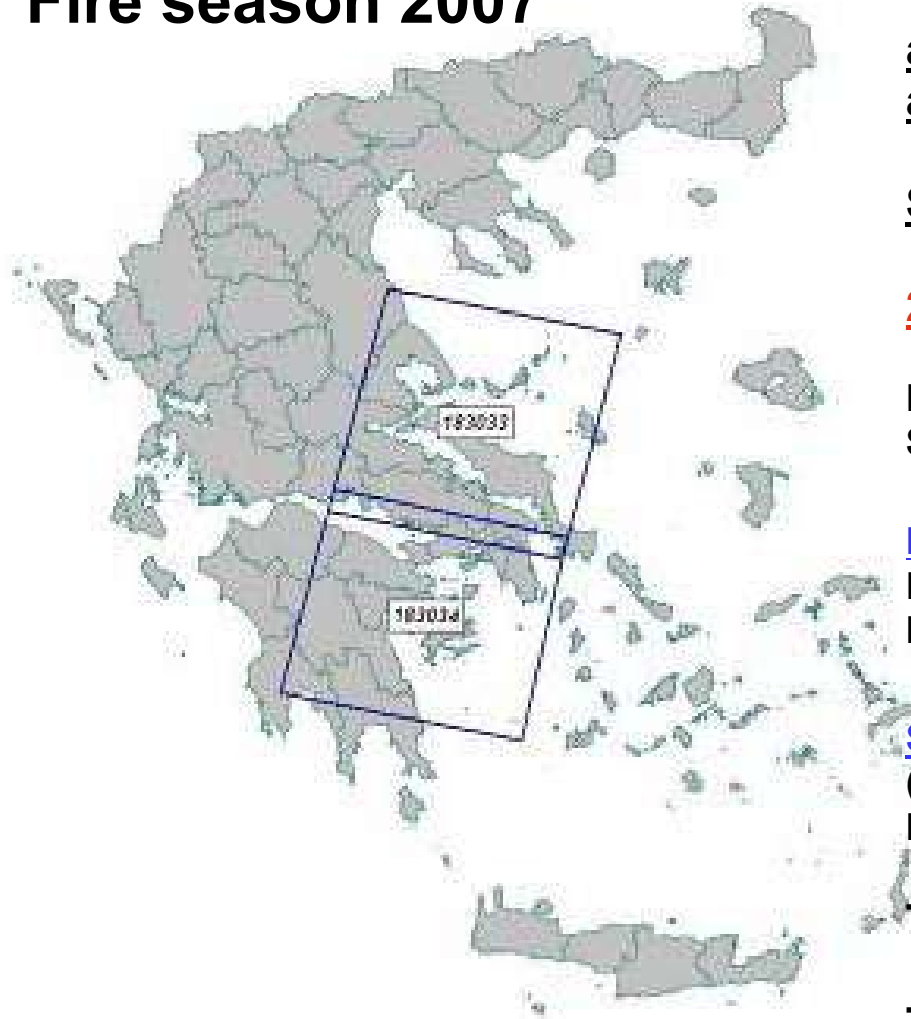
Total area foreseen in SLAs: 20.000 km²

2007 season : Big Fires devastated hundreds of thousands of hectares of Forested Land



MODIS data acquired on August 29th, 2007

In addition to areas of SLAs Fire season 2007



In complement to the areas foreseen in the signed SLAs,

additional BSM analysis was realised in areas affected by big fires in 2007

Studied period: May 1st to July 19th, 2007

2007 Fire Season:

Landsat TM coverage over Peloponnesus and Sterea Hellas

Peloponnesus: 15.750 km² (prefectures of Lakonia-(including Mani disaster), east Messinia, Arkadia, Argolida, Korinthia)

Sterea Hellas (central Greece): 14.550 km² (prefectures nomos of Attiki, Voiotia, Euboea, Magnisia, and part of Fthiotida)

Total area covered: 30.300 km²

Total area foreseen in SLAs: N/A

Production status

- Landsat TM acquisition and rectification

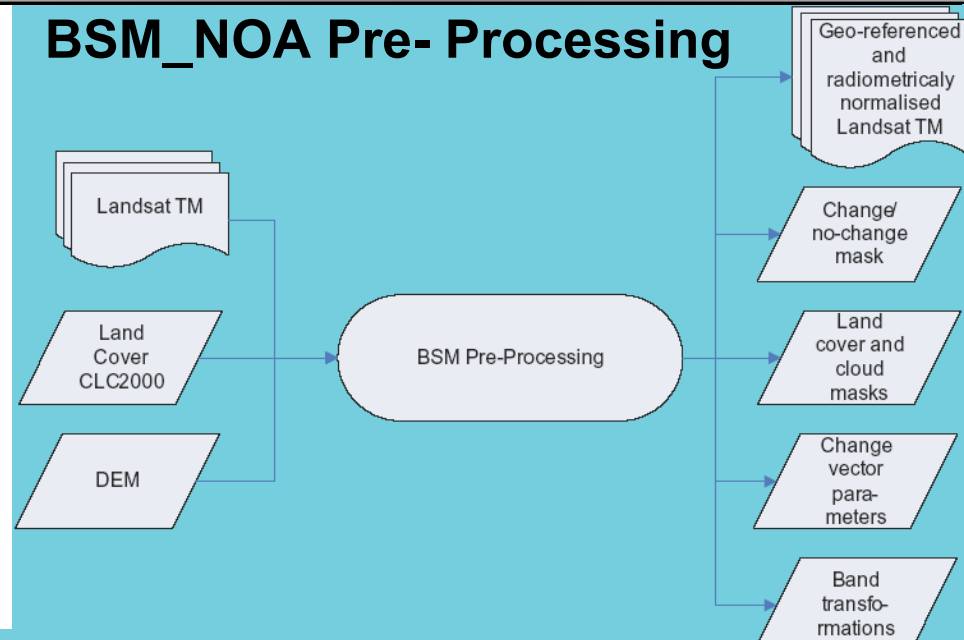


Area	Path	Row	Acquisition Date	GCPs	RMS (m)
Chalkidiki Dpt	183	032	29/05/2006	15	13,278
Chalkidiki Dpt	183	032	17/08/2006	14	10,095
Chalkidiki Dpt	183	032	02/09/2006	14	12,777
Peloponnesus Dpt.	183	034	29/05/2006	16	12,0475
Peloponnesus Dpt.	183	034	17/08/2006	16	12,7568
Peloponnesus Dpt.	183	034	04/10/2006	17	15,7092
Peloponnesus Dpt.	183	035	29/05/2006	14	6,7865
Peloponnesus Dpt.	183	035	04/10/2006	14	8,0158
Peloponnesus Dpt.	183	034	19/07/2007	15	11,083
Stereia Hellas Dpt.	183	033	19/07/2007	21	9,147

- **PROBLEM : INTENSE CLOUD COVER OVER CENTRAL MACEDONIA**

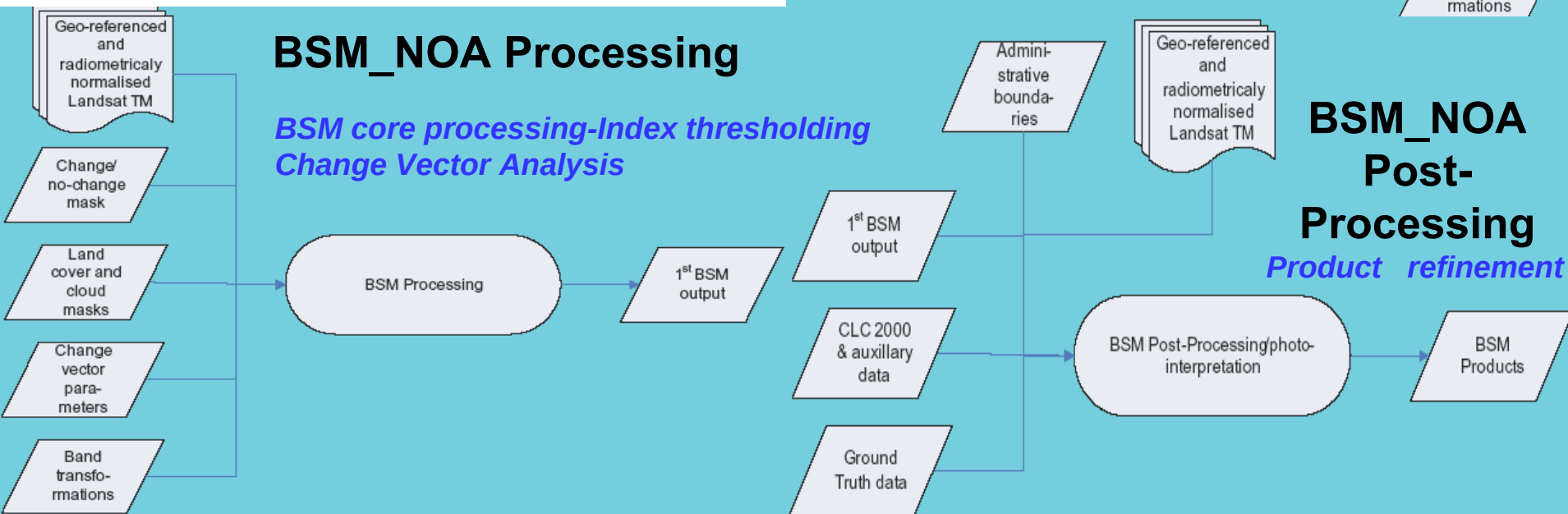
Production status

BSM_NOA Pre- Processing



BSM_NOA Processing

*BSM core processing-Index thresholding
Change Vector Analysis*



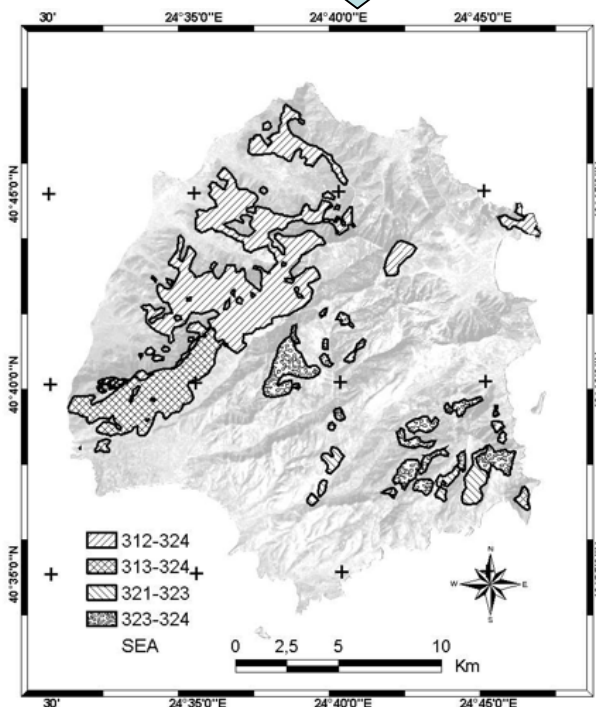
BSM_NOA Post-Processing

Product refinement

ΥΠΟΣΥΣΤΗΜΑ ΧΑΡΤΟΓΡΑΦΗΣΗΣ ΤΟΥ ΤΥΠΟΥ ΤΩΝ ΑΛΛΑΓΩΝ ΣΤΟ ΤΟΠΙΟ (CHANGE DETECTION MAPPING FROM-TO)

ΤΑΞΙΝΟΜΗΣΗ ΔΙΑΝΥΣΜΑΤΟΣ

Z



- ✓ ΜΕΤΑΦΟΡΑ ΑΠΟ ΤΟ ΧΩΡΟ ΤΩΝ ΔΙΑΝΥΣΜΑΤΩΝ ΡΑΔΙΟΜΕΤΡΙΑΣ ΣΤΟ ΧΩΡΟ ΤΩΝ ΔΙΑΝΥΣΜΑΤΩΝ ΑΛΛΑΓΩΝ ΡΑΔΙΟΜΕΤΡΙΑΣ

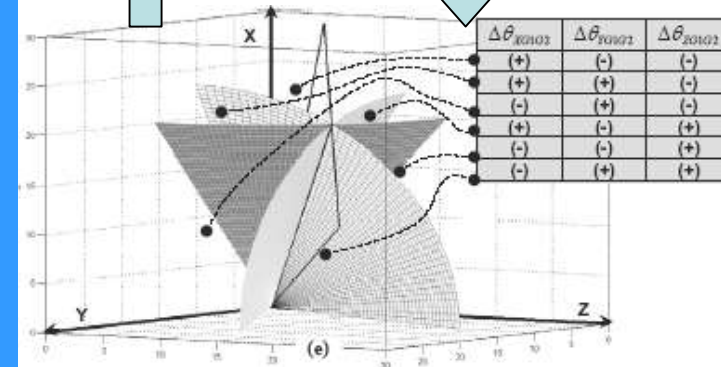
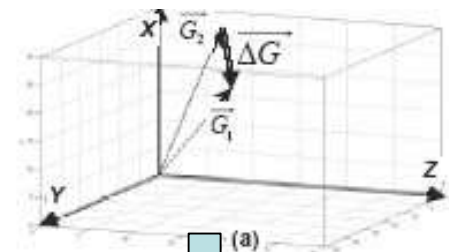
$$c_1 = \arccos \frac{\delta g_1}{|\Delta G|}, c_2 = \arccos \frac{\delta g_2}{|\Delta G|}, \dots, c_n = \arccos \frac{\delta g_n}{|\Delta G|}$$

- ✓ ΔΗΜΙΟΥΡΓΙΑ ΣΥΝΘΕΤΟΥ ΔΙΑΥΣΜΑΤΟΣ «Z» ΠΟΥ ΠΕΡΙΓΡΑΦΕΙ ΤΗ ΣΥΝΘΕΤΗ ΓΕΩΜΕΤΡΙΑ ΤΟΥ ΧΩΡΟΥ ΤΩΝ ΑΛΛΑΓΩΝ
- ✓ CLUSTERING ΤΟΥ ΧΩΡΟΥ ΤΩΝ ΑΛΛΑΓΩΝ ΜΕ ΒΑΣΗ ΤΟ ΔΙΑΝΥΣΜΑ «Z»
- ✓ ΔΗΜΙΟΥΡΓΙΑ ΚΛΑΣΕΩΝ ΑΛΛΑΓΩΝ FROM-TO
- ✓ ΤΑΞΙΝΟΜΗΣΗ ΤΗΣ ΕΙΚΟΝΑΣ «Z» ΚΑΙ ΔΗΜΙΟΥΡΓΙΑ ΤΟΥ ΤΕΛΙΚΟΥ ΧΑΡΤΗ ΑΛΛΑΓΩΝ ΣΤΟ ΦΥΣΙΚΟ ΧΩΡΟ

(Kontoes 2006, IJRS)

ΔΙΑΝΥΣΜΑ Z

$$\vec{Z} = \begin{bmatrix} \frac{|\Delta G|}{|G|} \\ \theta_{x0} \\ \theta_{y0} \\ \theta_{z0} \\ \Delta \theta_{x0} \\ \Delta \theta_{y0} \\ \Delta \theta_{z0} \\ c_{x0} \\ c_{y0} \\ c_{z0} \end{bmatrix}$$



Production status

- **Input data:** Multitemporal set of Landsat TM images
48 Fire reports in the Region of Peloponnesus
Administrative boundaries
DTM for image data ortho-rectification
CORINE 2000 Land Cover data
- **Generated Products:** a) BSM GIS at high resolution (20-30m),
b) BSM GIS at very high resolution (2m)
c) Raster georeferenced and projected satellite images at high res (20-30m)
d) Raster georeferenced and projected satellite images at very high res (2m)
e) Google earth-BSM dissemination

Production status

Statistics on BSM Products realised

SURFACE CLASS	NUMBER OF POLYGONS	SURFACE (ha)
<= 5 ha	22	63.22
5 - 50 ha	36	860.17
50 - 500 ha	16	3283.92
> 500 ha	8	23533.23
Total	82	27740.54

Surface classification of BSM polygons in the study areas

GIS BSM Product Lakonia 2006

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GEOINFORMATION SERVICES FOR NATURAL DISASTERS

GeoMedia Professional - FIRES_2006.gws

File Edit View Insert Tools Analysis Warehouse Legend Window Help

Projection: east; north(m) 363977.95; 4061279.20

BEFORE FIRE **AFTER FIRE**

Fire of Mani/Lakonia 2006

FIRES_2006 Properties

General Attributes

Name	Value
Joinid	200639
AREAINPha	2109.52
AREAINPha_SUM	4924.9
BURNED	NAI
COMMUNITY	Δ.Δ. ΒΑΧΟΥ
MUNICIPALITY	Δ. ΟΙΤΥΛΟΥ
LOCATION	ΚΑΛΑΠΟΘΑΡΙΑΝΙΚΑ
PREFECTURE	Ν. ΛΑΚΩΝΙΑΣ
YEAR	2006
DATE_START	21/08/06
DATE_END	12/09/06
TOTALAREAha	3745.32856004405
INPREMARKS	
Joinid1	200639
Βασικότοποι	605.255884976858
Γεωργικές εκτάσεις	21.2491630566822
Γεωργοδασικές εκτ	927.648719736321
Δασικές Εκτάσεις	2191.17479227419
Λοιπές Εκτάσεις	
ID	22

OK Cancel

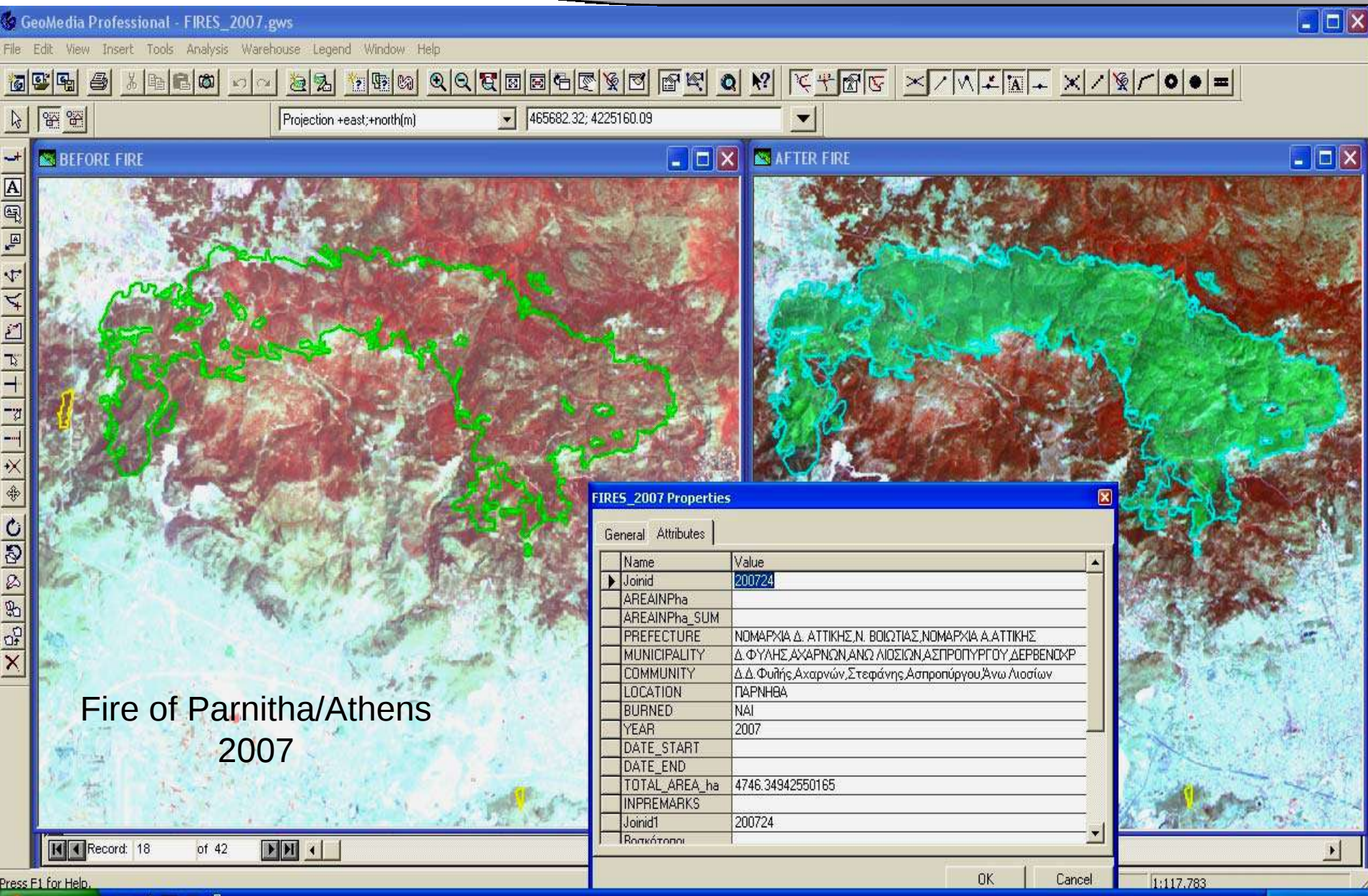
Joinid	AREAINPha	AREAINPha_SUM	BURNED	COMMUNITY	MUNICIPALITY	LOCATION	PREFECTURE	YEAR	DATE_START	DATE_END	TOTALAREA
200638	122.4	292.8	NAI	Δ.Δ. ΚΟΤΡΩΝΑ	Δ. ΑΝΑΤΟΛΙΚΗΣ Μ/ ΜΟΧΩΡΙ	Ν. ΛΑΚΩΝΙΑΣ	2006	22/08/06	25/08/06	271.0241329076	
200639	2109.52	4924.9	NAI	Δ.Δ. ΒΑΧΟΥ	Δ. ΟΙΤΥΛΟΥ	ΚΑΛΑΠΟΘΑΡΙΑΝΙΚΑ	Ν. ΛΑΚΩΝΙΑΣ	2006	21/08/06	12/09/06	3745.328560044
200640	191.31	498.8	NAI	Δ.Δ. ΛΑΓΙΑΣ	Δ. ΑΝΑΤΟΛΙΚΗΣ Μ/ ΔΗΜΑΡΙΣΤΙΚΑ	Ν. ΛΑΚΩΝΙΑΣ	2006	21/08/06	24/08/06	221.8252144393	
200645	38.95	42.4	NAI	Δ.Δ. ΣΚΑΛΑΣ	Δ. ΣΚΑΛΑΣ	ΠΥΡΙ	Ν. ΛΑΚΩΝΙΑΣ	2006	06/08/06	07/08/06	230.4601574624
200660			NAI					2006			8.054949545819

Record: 20 of 43

GIS BSM Product Parnitha 2007

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GEOINFORMATION SERVICES FOR NATURAL DISASTERS

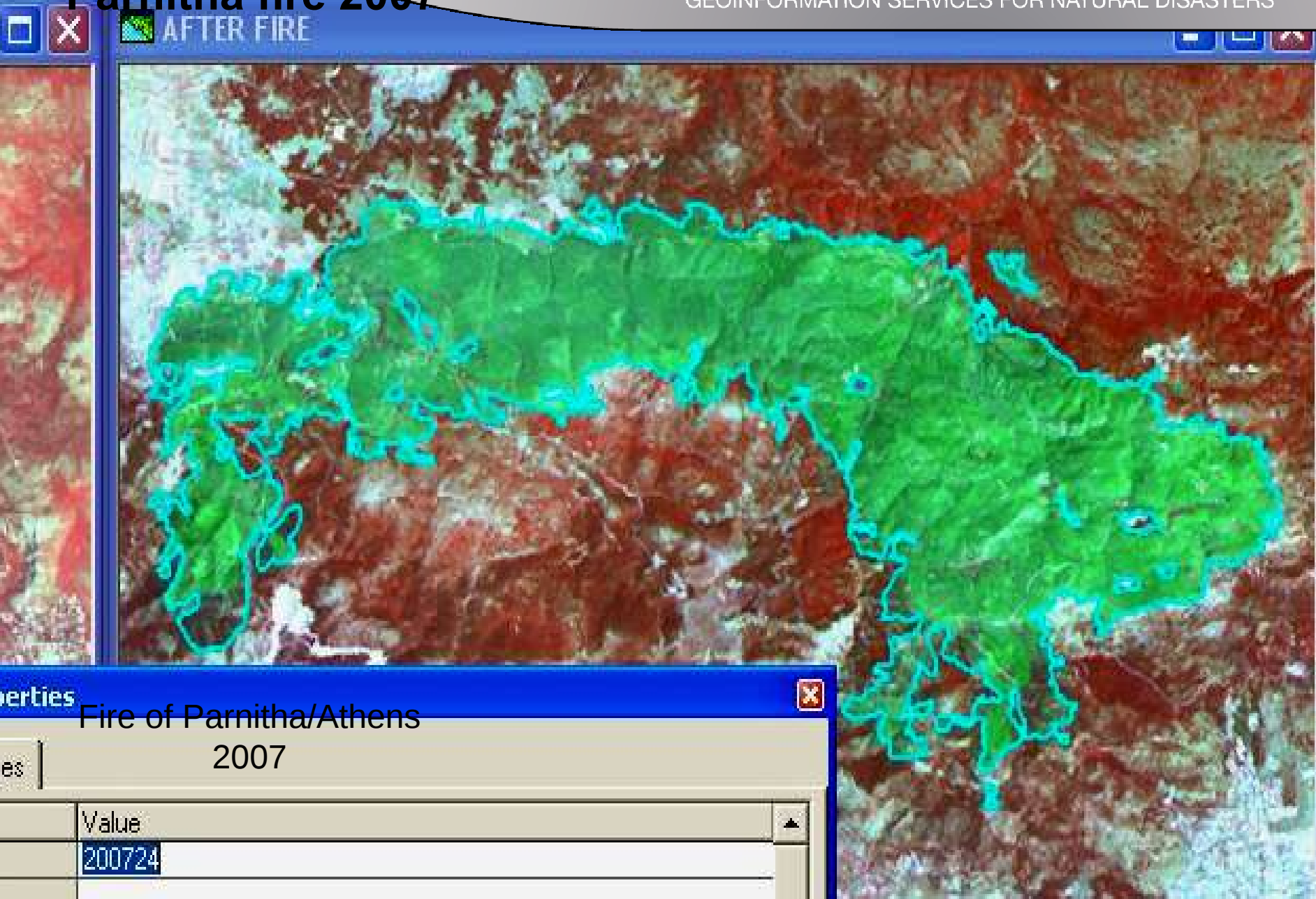


GIS BSM Product

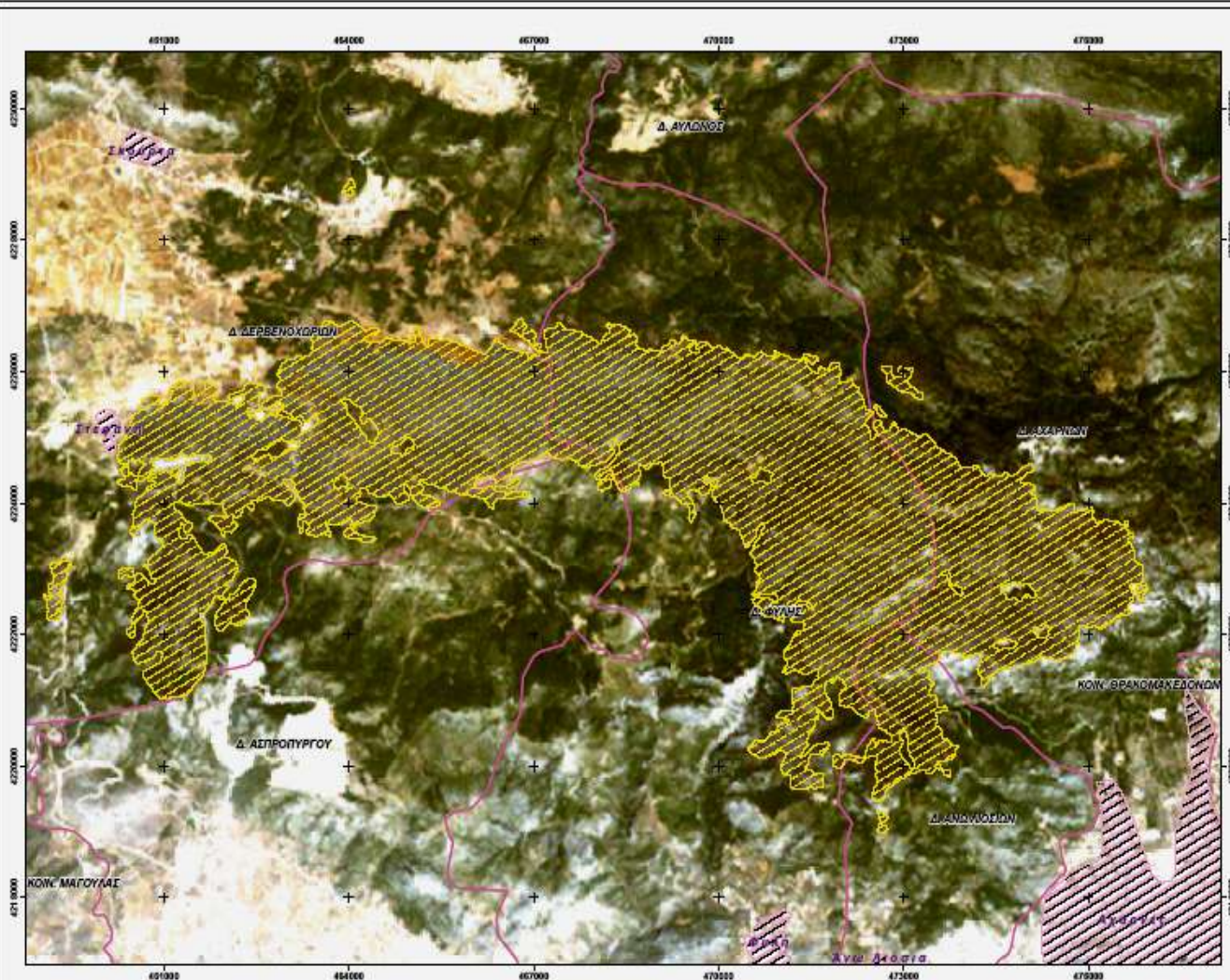
Parnitha fire 2007

RISK-EOS

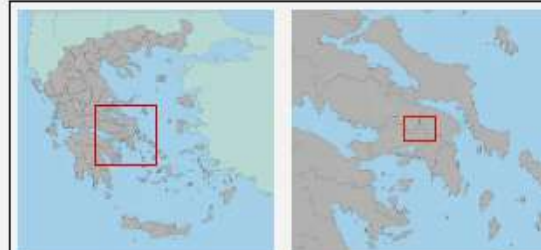
GEOINFORMATION SERVICES FOR NATURAL DISASTERS



ΧΑΡΤΟΓΡΑΦΗΣΗ ΚΑΜΕΝΩΝ ΕΚΤΑΣΕΩΝ ΕΤΟΥΣ 2007 ΜΕ ΧΡΗΣΗ ΔΟΡΥΦΟΡΙΚΩΝ ΔΕΔΟΜΕΝΩΝ



RISK-EOS FLOOD AND FIRE RISK INFORMATION SERVICES EARTH WATCH GMES SERVICES ELEMENT



ΥΠΟΜΝΗΜΑ

- ΟΡΙΑ ΚΑΜΕΝΩΝ ΕΚΤΑΣΕΩΝ
- ΟΡΙΑ Ο.Τ.Α.

ΠΛΗΓΕΙΑ ΠΕΡΙΟΧΗ

ΚΑΛΥΨΗ-ΧΡΗΣΗ ΓΗΣ	ΕΚΤΑΣΗ (ha)
Βοσκότοποι	-
Γεωργικές εκτάσεις	44.43
Γεωργοοικιστικές εκτάσεις	187.85
Δασικές Εκτάσεις	4514.07
Λοιπές Εκτάσεις	-
Συνολική Έκταση:	4746,35

Η ΧΑΡΤΟΓΡΑΦΗΣΗ ΤΩΝ ΚΑΜΕΝΩΝ ΕΚΤΑΣΕΩΝ ΒΑΣΙΣΤΗΚΕ ΣΤΗΝ ΑΝΑΛΥΣΗ ΔΟΡΥΦΟΡΙΚΩΝ ΔΕΔΟΜΕΝΩΝ LANDSAT TM ΣΚΙΝΗ LANDSAT TM 5: 183034 ΧΩΡΙΚΗ ΑΝΑΛΥΣΗ: 30m ΗΜΕΡΟΜΗΝΙΑ ΛΗΨΗΣ: 19/07/2007

Η ΕΚΤΙΜΗΣΗ ΤΩΝ ΚΑΤΗΓΟΡΙΩΝ ΚΑΛΥΨΗΣ-ΧΡΗΣΗΣ ΓΗΣ ΒΑΣΙΣΤΗΚΕ ΣΕ ΔΕΔΟΜΕΝΑ ΤΟΥ ΠΡΟΓΡΑΜΜΑΤΟΣ CORINE 2000 GREECE

General Attributes

Name	Value
PREF	ΝΟΜΑΡΧΙΑ ΑΘΗΝΩΝ
MUN	Δ. ΚΗΦΙΣΙΑΣ, Κ. ΝΕΑΣ ΠΕΝΤΕΛΗΣ
COM	
LOC	ΠΕΝΤΕΛΗ
YEAR	2007
INDST	NO DATA
INDEND	NO DATA
INha_F	
INha_S	
INREM	
PAST	
AGR	
AGR_FOR	
FOR	897.88
OTHER	
TOTAREA	897.88
ID	35

AutoNumber

OK Cancel

LANDSAT_020500_CH4
landsat_190707
FORMOSAT_290807_RGB43

Fire of Penteli/Athens 2007

Formosat-2 data

DAMAGE ASSESSMENT

BSM + LAND COVER MAPPING SPOT5 (10m) (0.1-0.25 Ha)



GIS – Google Earth BSM Product

Pilion-Skiathos 2007

RISK-EOS

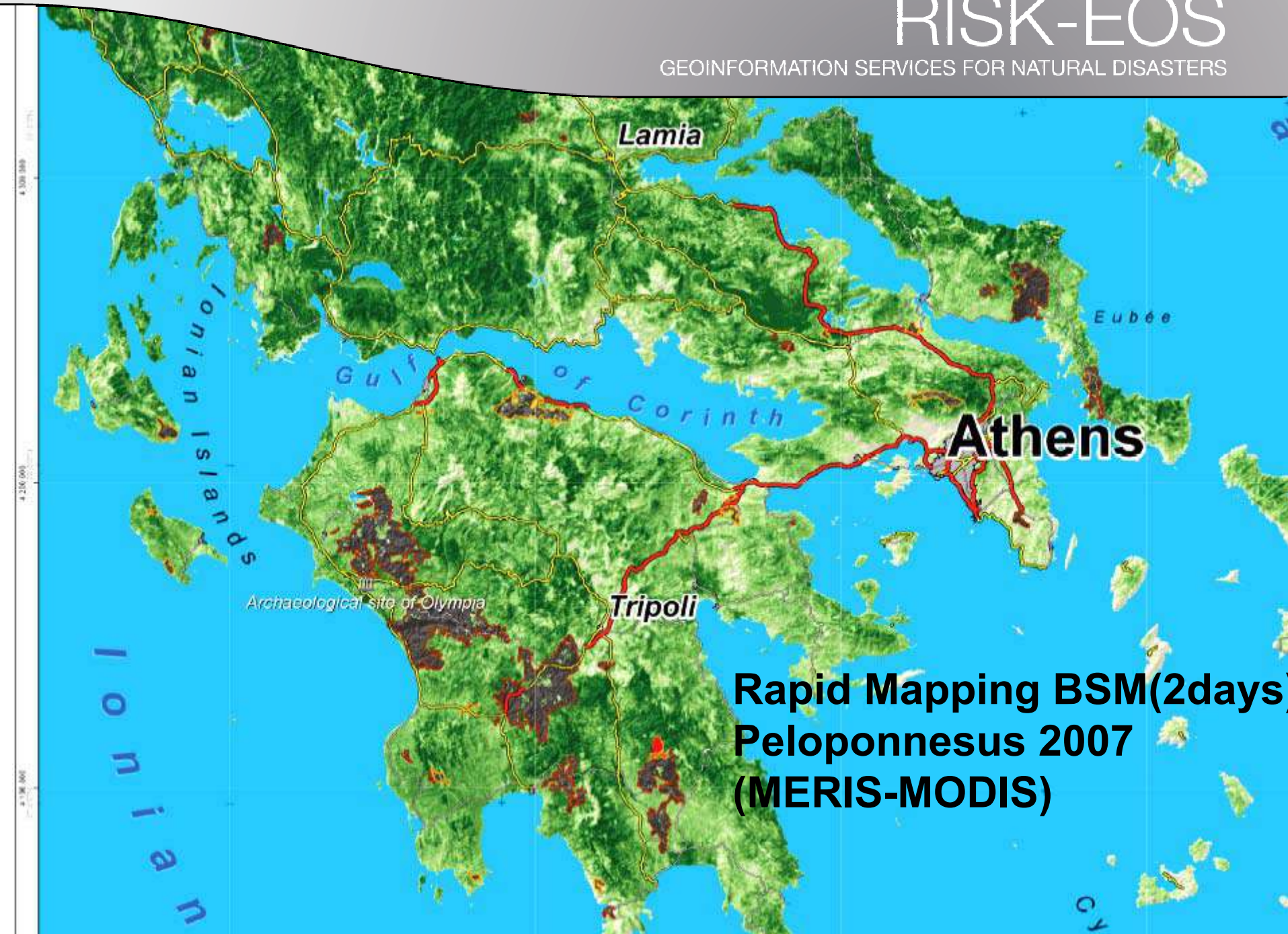
GEOINFORMATION SERVICES FOR NATURAL DISASTERS



Fire of Pilion (5176 Ha) and Skiathos (265 Ha) 2007

RISK-EOS

GEOINFORMATION SERVICES FOR NATURAL DISASTERS



**Rapid Mapping BSM(2days)
Peloponnesus 2007
(MERIS-MODIS)**

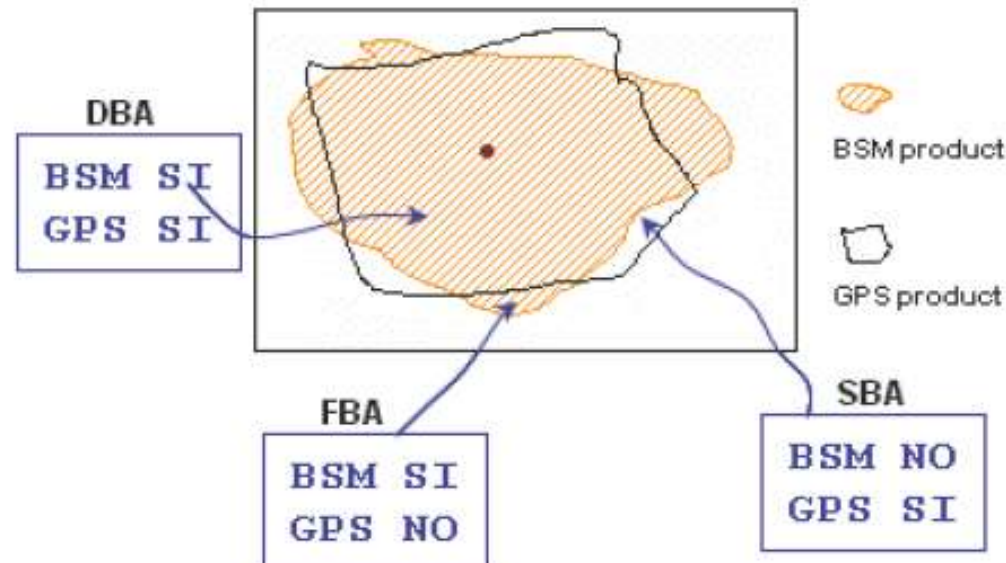
BSM Product validation

$$\text{Detection efficiency rate} = \frac{\text{DBA}}{\text{DBA} + \text{SBA}}$$

$$\text{Commission error (False Alarm rate)} = \frac{\text{FBA}}{\text{DBA} + \text{FBA}}$$

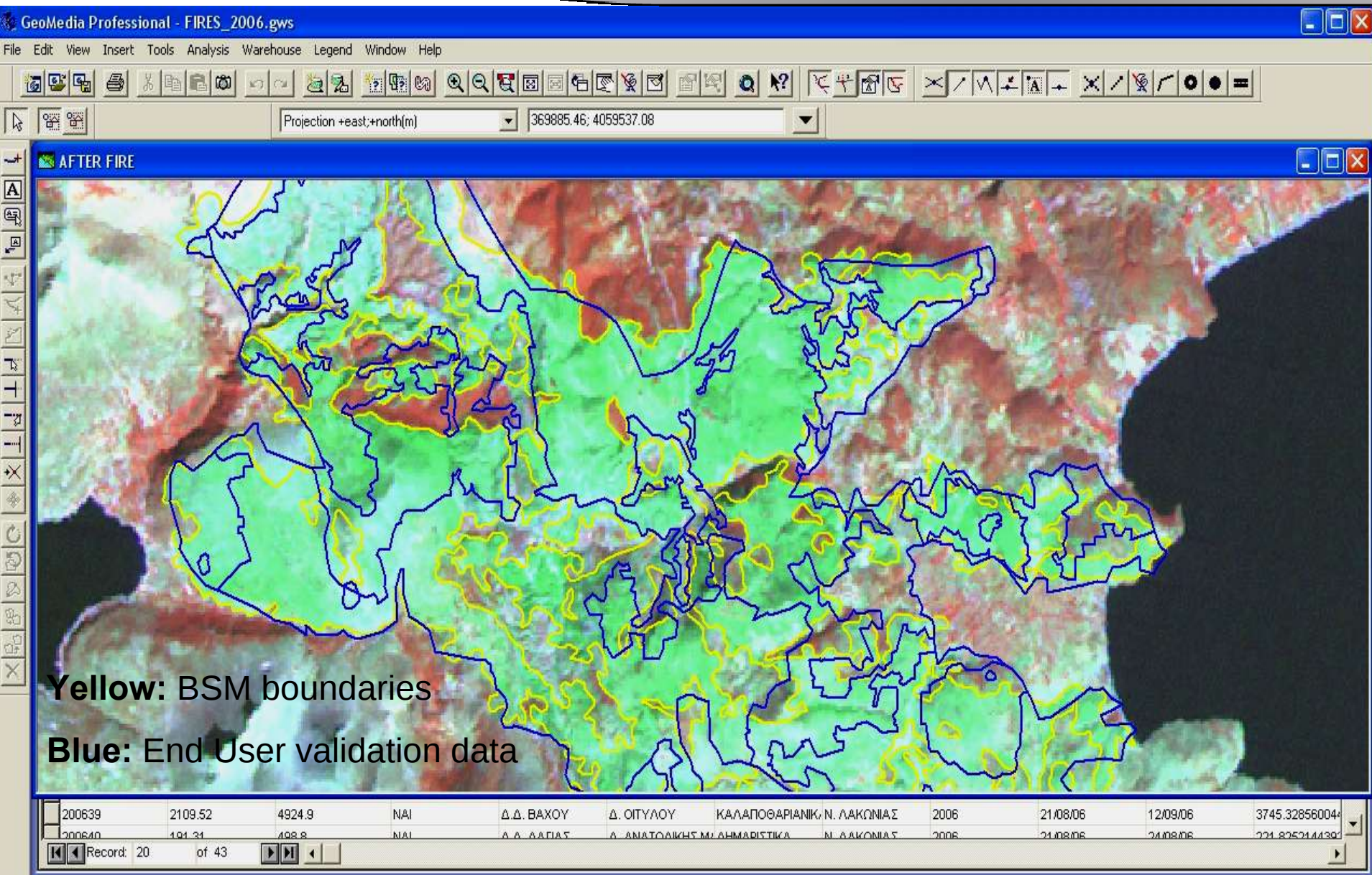
$$\text{Omission error} = \frac{\text{SBA}}{\text{DBA} + \text{SBA}}$$

- DBA: Detected burnt areas
- FBA: False burnt areas
- SBA: Skipped burnt areas



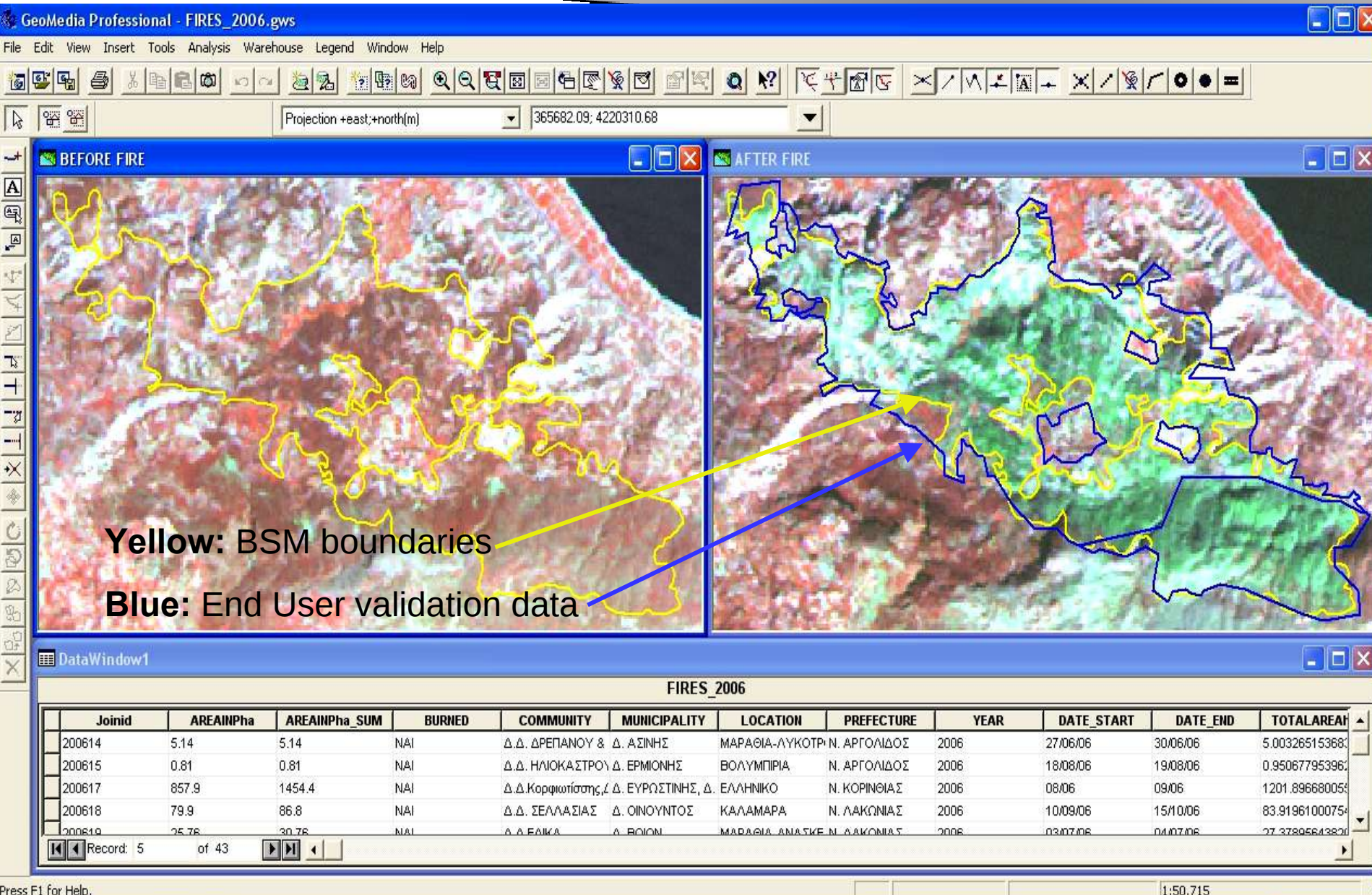
RISK-EOS

GEOINFORMATION SERVICES FOR NATURAL DISASTERS



RISK-EOS

GEOINFORMATION SERVICES FOR NATURAL DISASTERS



DAMAGE ASSESSMENT

BSM + LAND COVER MAPPING SPOT5 (10m) (0.1-0.25 Ha)



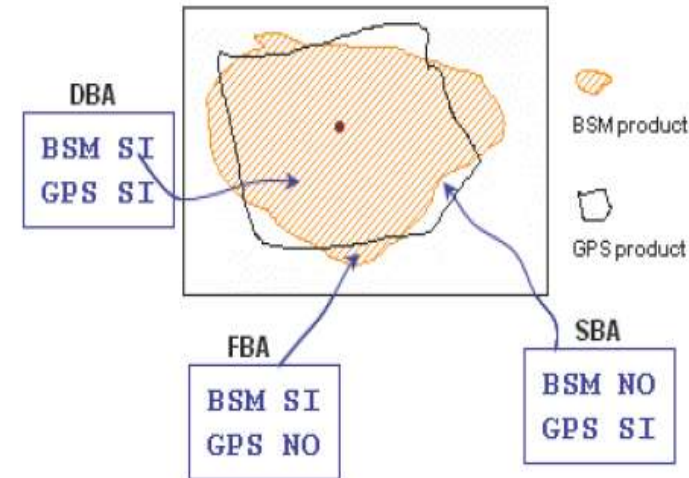
BSM Product validation

$$\text{Detection efficiency rate} = \frac{\text{DBA}}{\text{DBA} + \text{SBA}}$$

$$\text{Commission error (False Alarm rate)} = \frac{\text{FBA}}{\text{DBA} + \text{FBA}}$$

$$\text{Omission error} = \frac{\text{SBA}}{\text{DBA} + \text{SBA}}$$

- DBA: Detected burnt areas
- FBA: False burnt areas
- SBA: Skipped burnt areas



Area statistics (ha)		Accuracy statistics (percentage)	
<i>Detected Burned Areas(DBA):</i>	6125.83	<i>Detection Efficiency Rate:</i>	85%
<i>Skipped Burned Areas(SBA):</i>	1051.85	<i>Omission Error:</i>	3%
<i>False Burned Areas(FBA):</i>	216.84	<i>Commission Error:</i>	15%

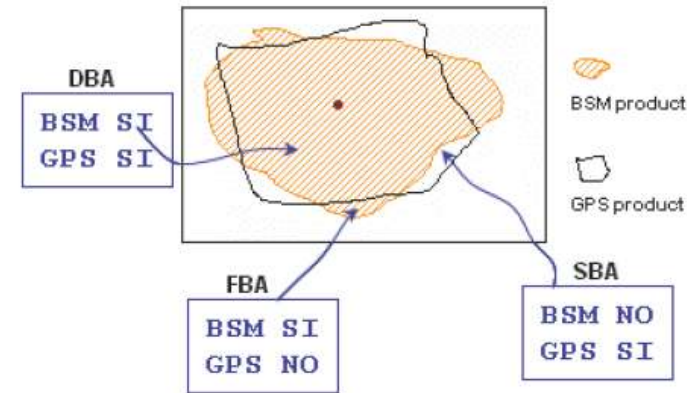
Parnitha BSM Product validation using GPS ground collected data

$$\text{Detection efficiency rate} = \frac{\text{DBA}}{\text{DBA} + \text{SBA}}$$

$$\text{Commission error (False Alarm rate)} = \frac{\text{FBA}}{\text{DBA} + \text{FBA}}$$

$$\text{Omission error} = \frac{\text{SBA}}{\text{DBA} + \text{SBA}}$$

- DBA: Detected burnt areas
- FBA: False burnt areas
- SBA: Skipped burnt areas



Area statistics (ha)		Accuracy statistics (percentage)	
<i>Detected Burned Areas(DBA):</i>	<i>4686.56ha</i>	<i>Detection Efficiency Rate:</i>	<i>93%</i>
<i>Skipped Burned Areas(SBA):</i>	<i>105.65ha</i>	<i>Omission Error:</i>	<i>5%</i>
<i>False Burned Areas(FBA):</i>	<i>68.84ha</i>	<i>Commission Error:</i>	<i>2%</i>

USER FEEDBACK

- a) The HELLENIC MINISTRY OF RURAL DEVELOPMENT AND FOODS
- b) The NATIONAL AGRICULTURAL RESEARCH FOUNDATION
- c) The HELLENIC CENTER OF GREEK BIOTOPES AND WETLANDS
- d) The KTIMATOLOGIO SA

The BSM products were integrated in the GIS systems of Users. The Users provided essential feedback concerning the products' utility compared to the current means

USER ASSESSMENT

A. The BSM_NOA service is useful for:

- a) Fire fighting planning and post-fire management.
- b) Timely, accurate and standardized damage assessments throughout the entire country.
- c) Monitor and control the enforcement of Greek law for maintaining the original land uses.
- d) Support the reforestation activities in respect to the Greek legislation.
- e) Update the biotope maps according to the needs of NATURA 2000.
- f) Support planning and prioritisation actions in the implementation of the National Cadastral Project

USER ASSESSMENT

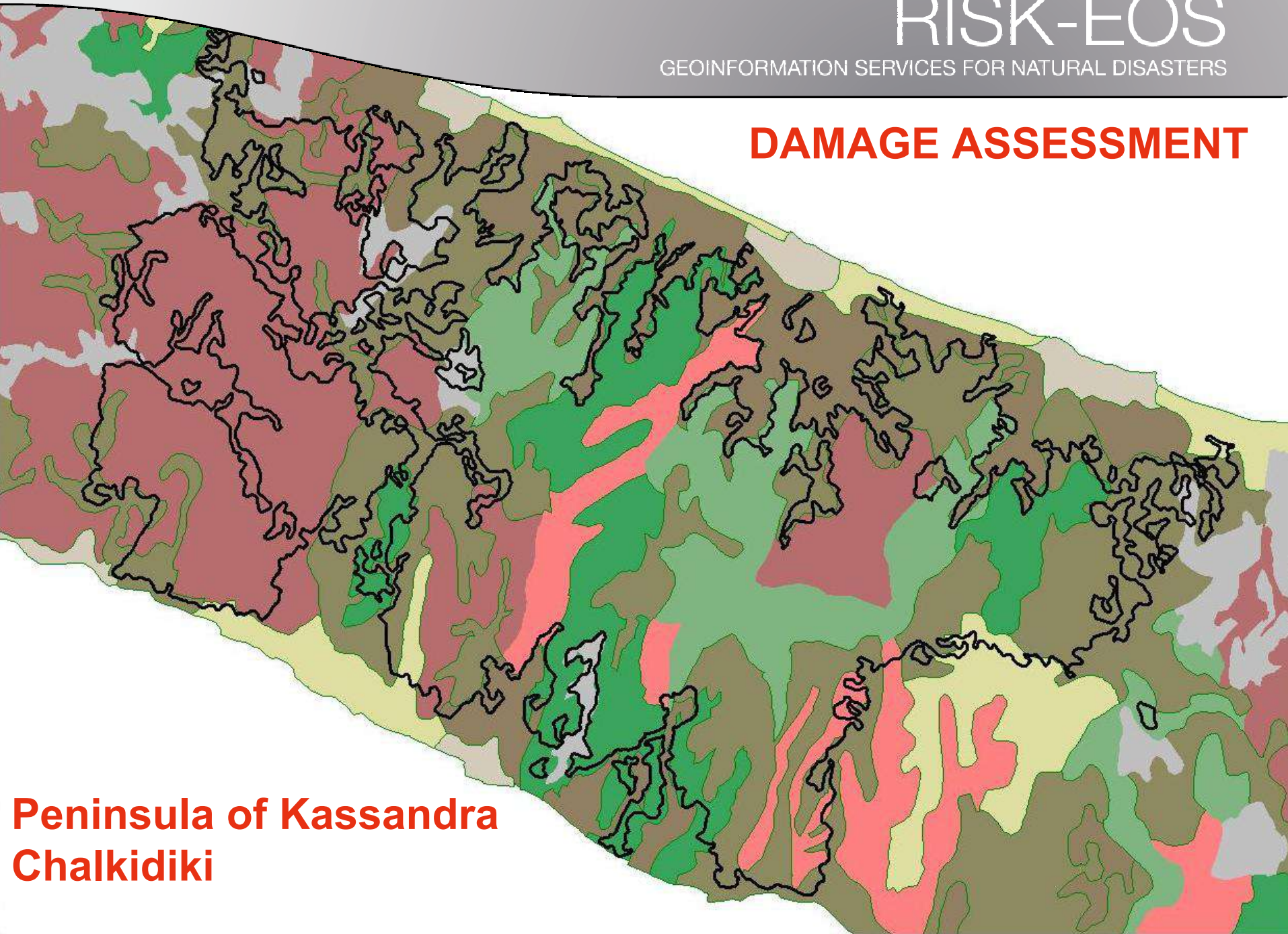
The BSM_NOA service:

- a) Delivers useful products using the same standard (accuracy and cost) throughout the entire country.
- b) Consists the only alternative to the field surveys which in general are:
 - a) non exhaustive and,
 - b) much diversified in terms of mapping accuracy and mapping scale (depending on time and budget restrictions and the mapping method-GPS, ortho-photos).

B. Suggested Improvements:

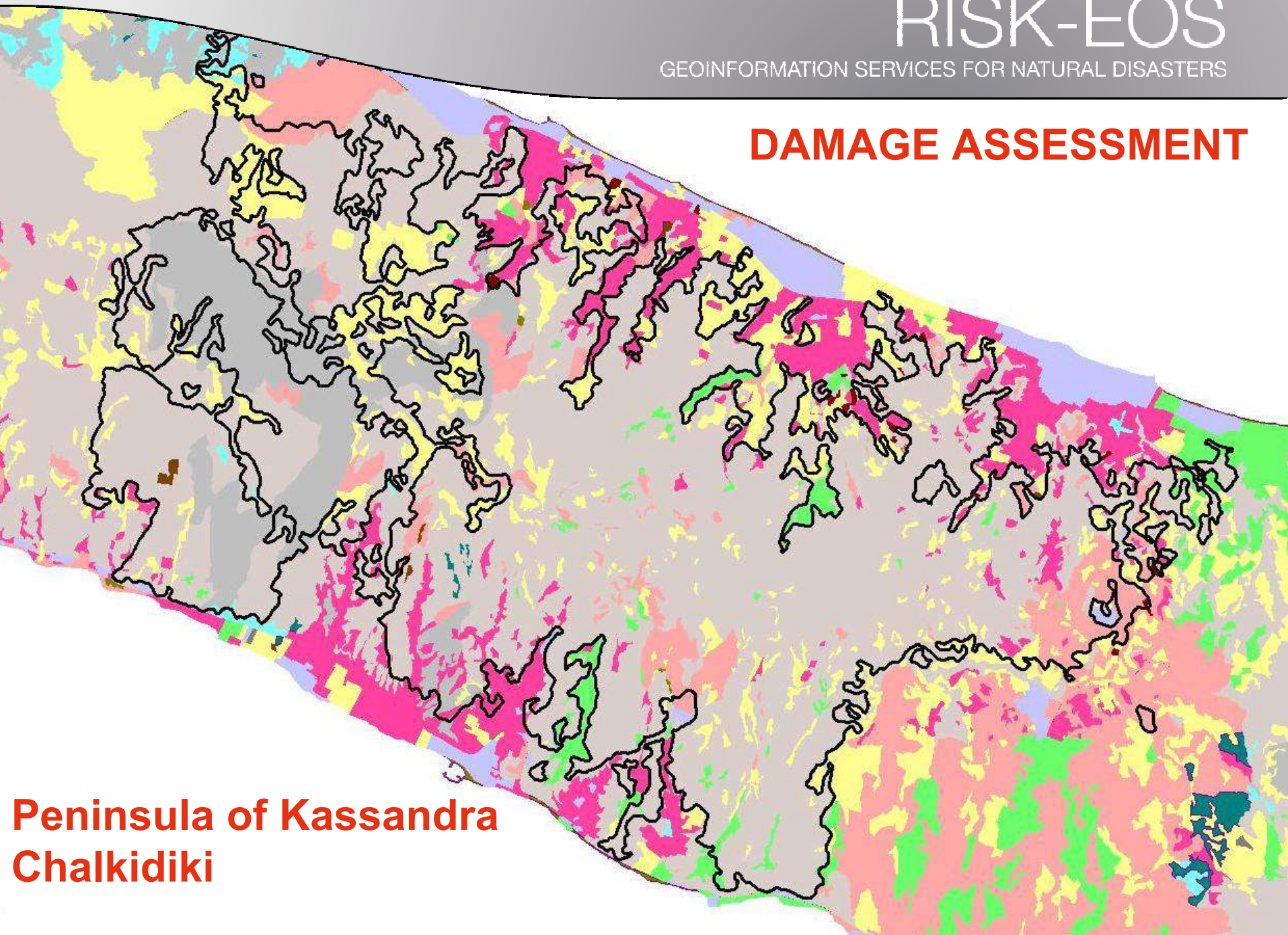
- a) For specific fire events of high economic impact or fires at the fringe of urban areas, the use of VHR satellite data is strongly suggested.

DAMAGE ASSESSMENT



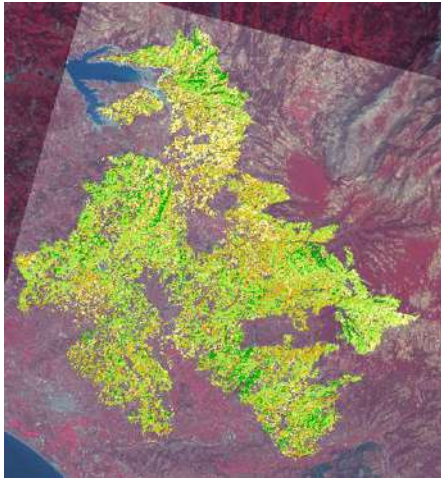
**Peninsula of Kassandra
Chalkidiki**

DAMAGE ASSESSMENT



**Peninsula of Kassandra
Chalkidiki**

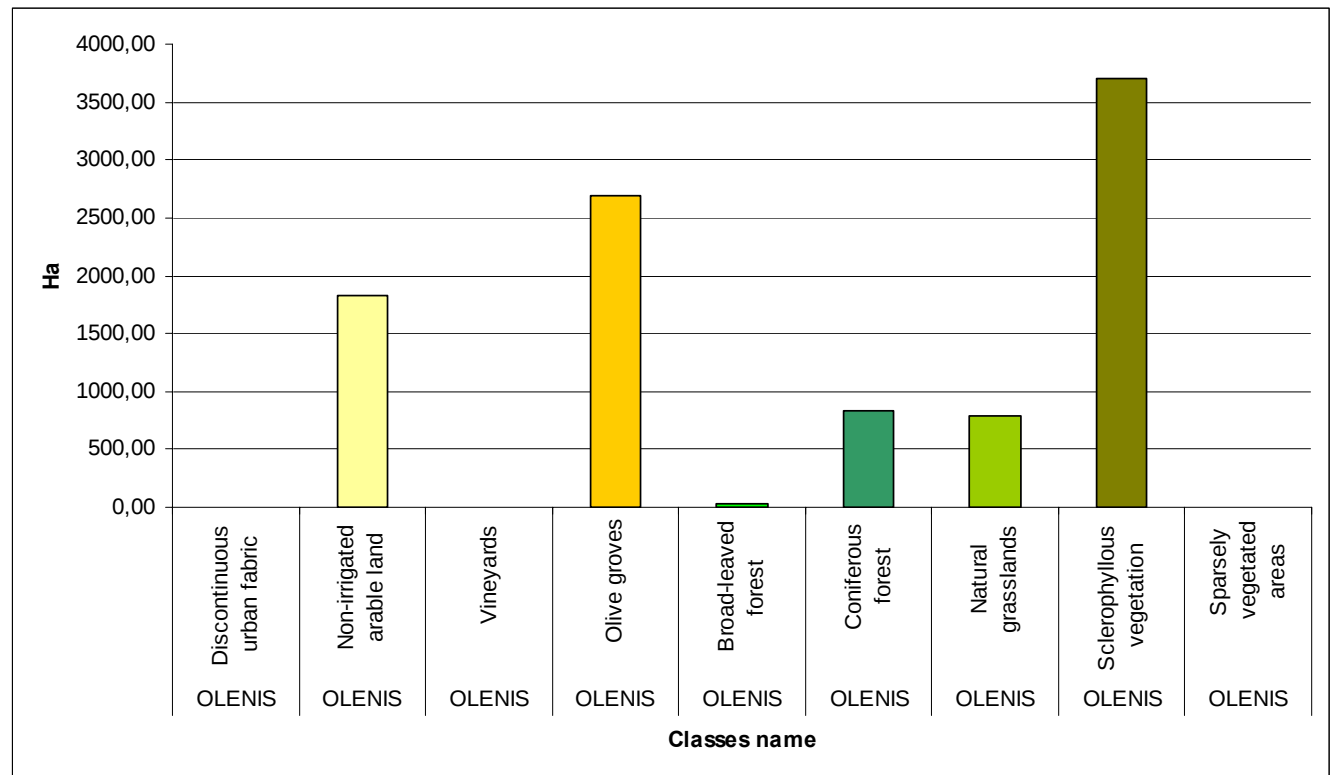
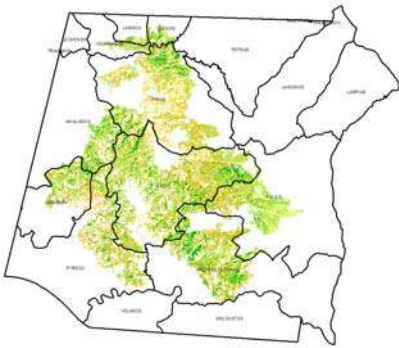
Presentation of the results: Damage assessment



Co de	Class Name	Surf_ha	%
21x	Arable land	6833.62	21.0
223	Olive groves	8445.85	26.0
311	Broad-leaved forest	131.11	0.4
312	Coniferous forest	2575.78	7.9
321	Grassland	2117.16	6.5
323	Sclerophyllous vegetation	12218.50	37.7
	Other		0.5
	<u>Total:</u>	32415.20	100.00

DAMAGE ASSESSMENT

Damage assessment per Municipalities



Product dissemination/promotion

- Contribution to general awareness

Presentation of RISK-EOS in several scientific and user conferences

1. *Conference organised in the occasion of the big fire event of Parnitha mountain (north to the city Athens) on July 3rd, 2007. University of Athens, Friday 20th of July, 2007. Invited speaker.*
2. *6th EARSeL-FFSIG workshop in Thessalonica on 26th-29th of September 2007. Accepted paper and poster presentation.*

Newspaper publications relevant to RISK-EOS GSE project and BSM_NOA service delivered in Greece

1. *Two page publication hosted by the newspaper ELEEFTHEROS TYPOS on Thursday 2nd of August 2007.*
2. *One page publication hosted by the newspaper ELEYTHEROTYPIA on Thursday 29th of August 2007.*

ELEEFTHEROS TYPOS and ELEYTHEROTYPIA are popular newspapers at national level.

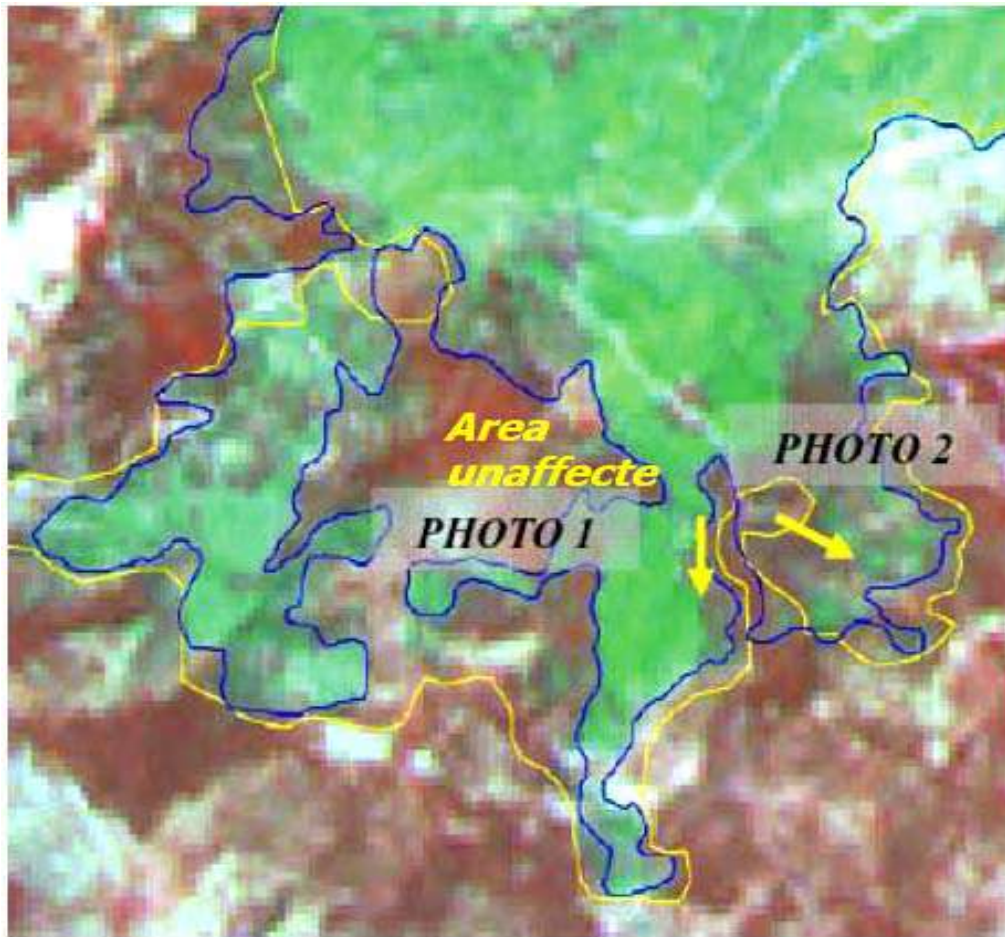
Product dissemination/promotion

- Contribution to general awareness

Participation in TV interviews. TV emissions specifically dedicated to Forest Fires in Greece

- *National TV Channel NET (New Hellenic Television). Interview on Tuesday 28th of August, 2007. 20' minutes. Subjects: RISK-EOS/BSM, MSG fire monitoring, Regional fire mapping*
- *Private TV Channel ALTER. Interview on Tuesday 30th of August, 2007. 30' minutes. RISK-EOS/BSM, MSG fire monitoring, Forest mapping*

Parnitha BSM Product vs MoA true-color ortho-photo maps



The BSM product (blue line) compared to the MMA product (yellow line).

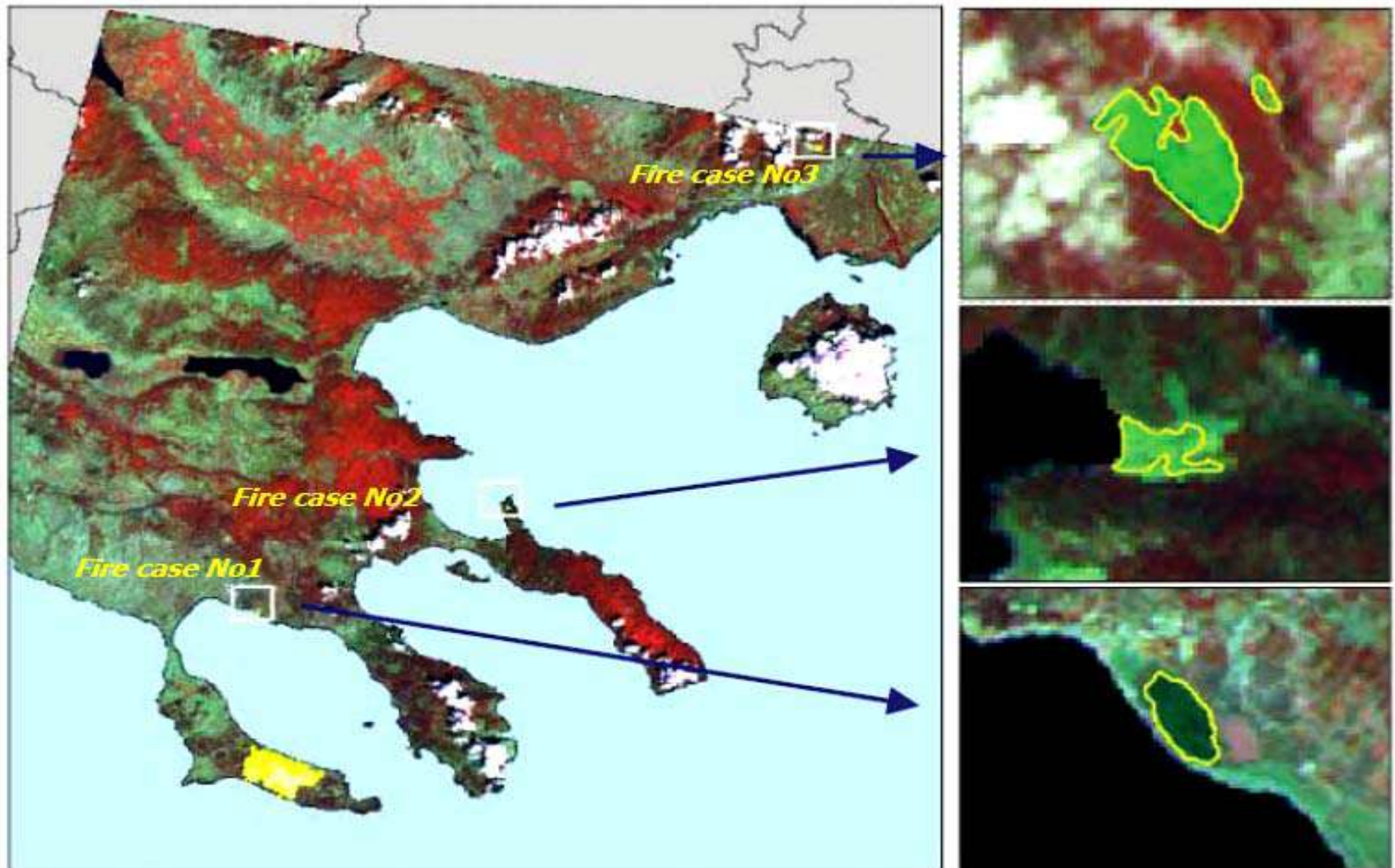


Landscape Photo 2-Direction N-S: The example of a surface fire



Landscape Photo 1-A "false" detected burnt area due to the sole use of true-colour data

BSM Product validation



On-site verification of fire occurrences in the Chalkidiki Department. Ground verification was conducted by User NAGREF during the summer of 2007.

BSM Product planning for 2007 fire season

ESA's decision: Cover the entire Greece- Financial proposal is under evaluation-Decision is expected soon

Data types to be used:

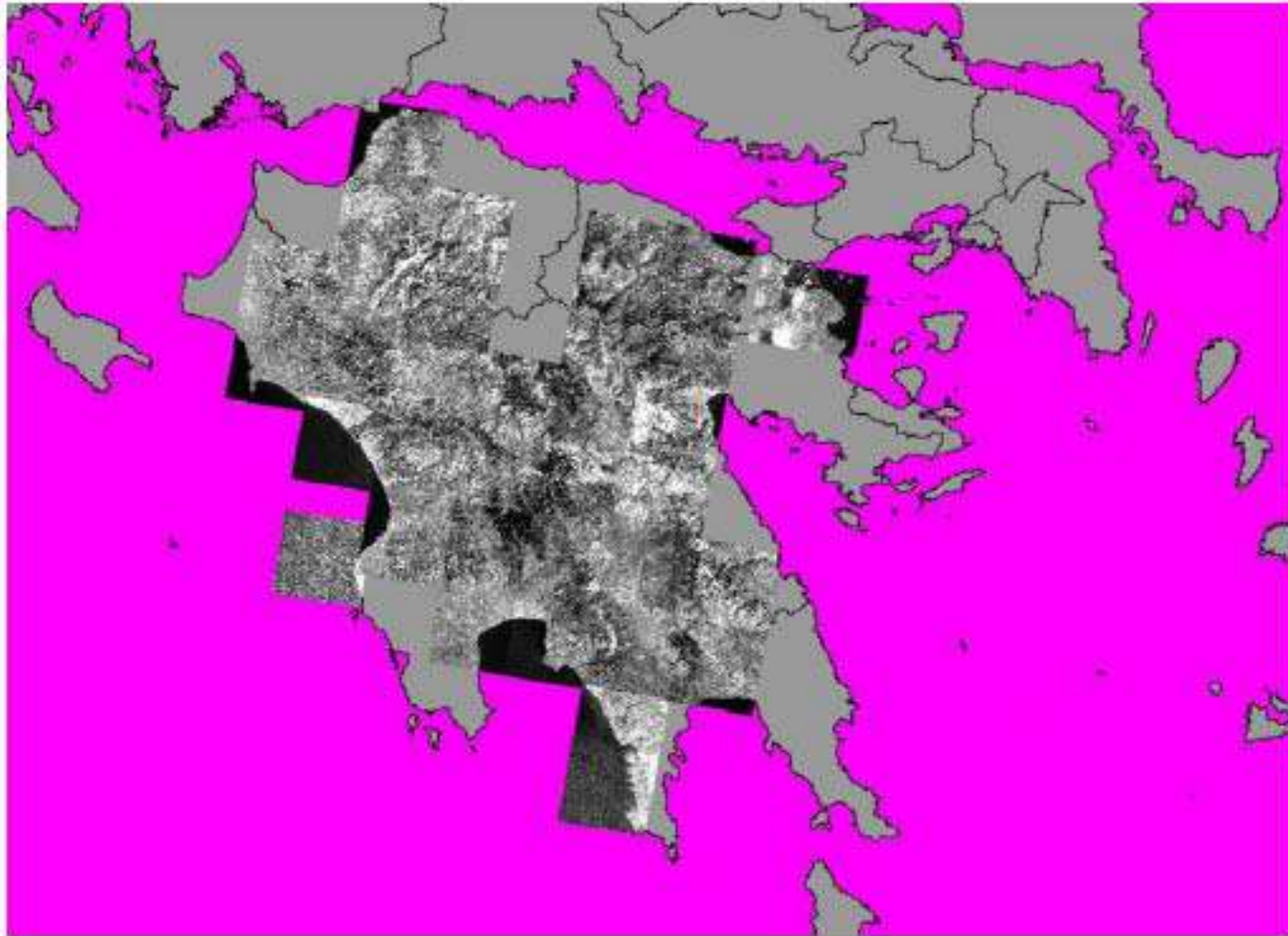
Over Peloponnesus: Use of Very High Spatial Resolution Satellite Data FORMOSAT –2 (2m/pixel)

Over Eubea: SPOT 4 data (20 m/pixel)

Remaining of Greece: LANDSAT TM (30m/pixel)

BSM Product planning for 2007 fire season

Over Peloponnesus: Use of Very High Spatial Resolution Satellite Data
FORMOSAT –2 (2m/pixel). P+XS F2 Data collected in the regions below



PHASE 3 SERVICE DELIVERY PLAN

Service deployment:

Continental Greece
excluding islands of
Aegean Sea and
Peloponnesus –

HR satellite imagery
LANDSAT TM +
SPOT 4 XS (**20-
30m/pixel**)

**Area to be covered
(98.000 Km²)**

