FireHub: A Space based Fire Management Hub

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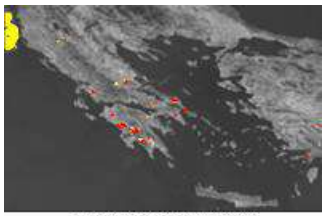
BEYOND participated in the

Best Service Challenge Copernicus-Masters competition

with the operational EO based fire management service, known as:



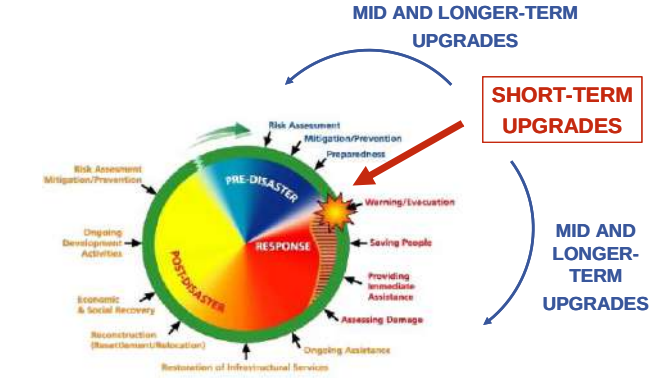
"FireHub: A Space Based Fire Management Hub "

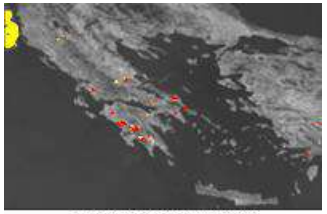
The service consists of three pillars:

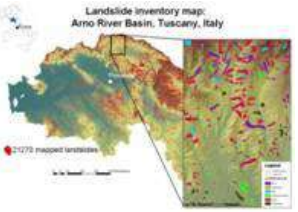
1. The real-time fire detection and monitoring application
2. The large scale Burnt Scar Mapping during and after wildfires and the Diachronic BSM
3. The fire smoke dispersion forecasting tool

"FireHub: A Space Based Fire Management Hub "

Institutional End Users and stakeholders in Greece and Europe receive the fire disaster services:




SEVIRI MIR 070825_0945 UTC



- The European Copernicus Program (EMS service)
- The Fire Brigades Control Room (199)
- The Ministry of Env. (Directorate for Forests Protection
- The Gen. Sec. Civil Protection
- The Forestry Services over Greece and Europe
- The National Cadastral Organisation
- The Local Authorities & Environmental Organisations
- The Greek Army
- The Private sector

European Commission

Greek GEO Office

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GEO GROUP ON EARTH OBSERVATIONS

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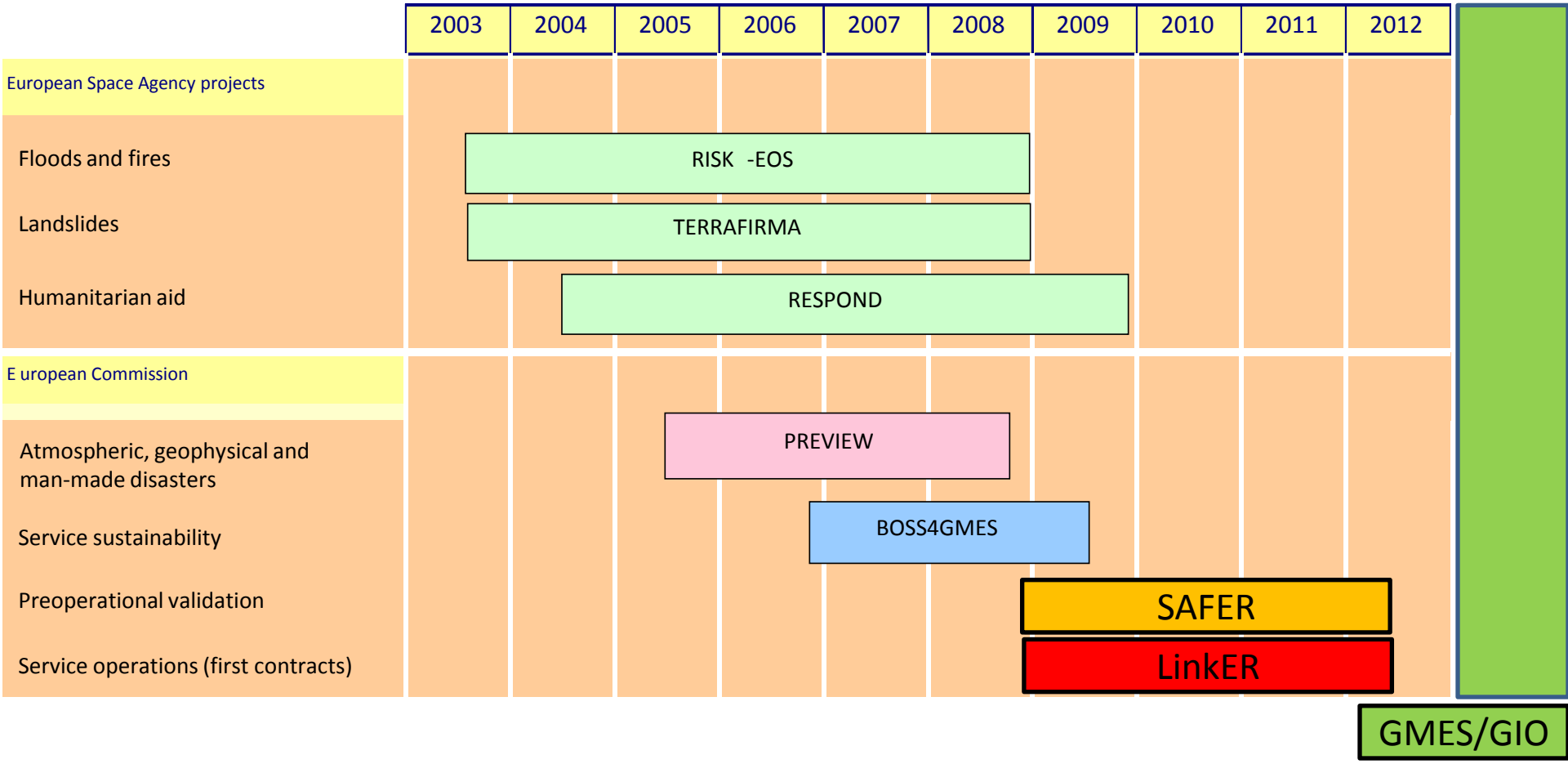

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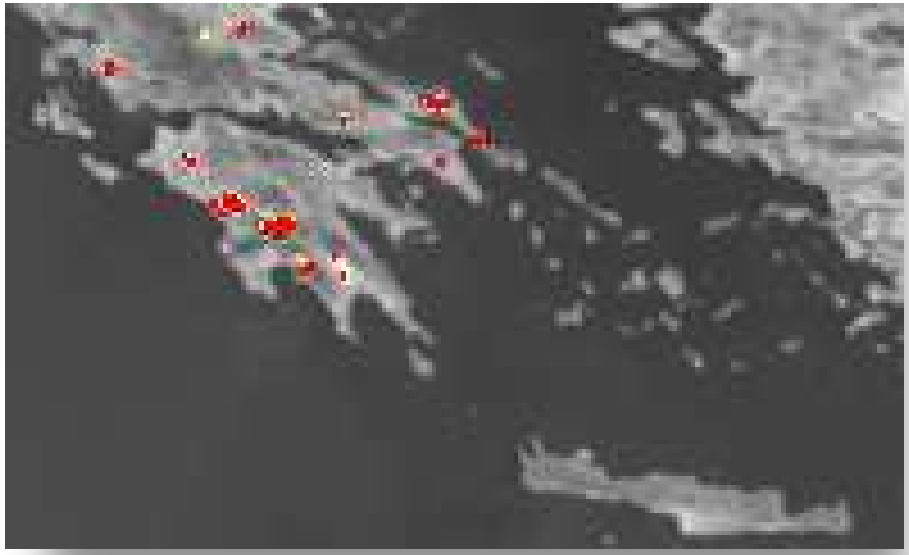
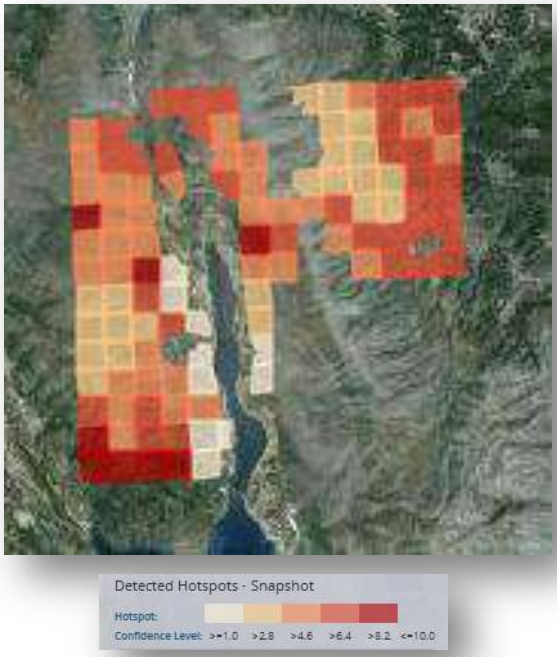
Regional Real Time Fire Monitoring Service based on EUMETSAT MSG SEVIRI Data Monitoring





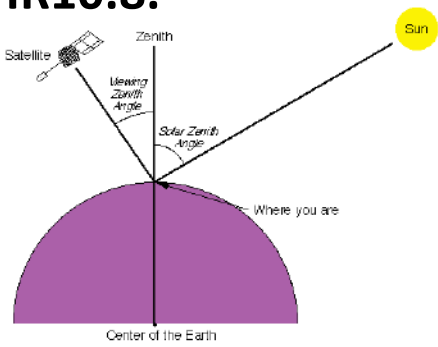
Raw resolution: 3.5x3.5 km wide pixel over entire

Refined resolution: 0.5x0.5 km wide pixel over entire Greece

CLASSIFICATION PROCESS

Classification #1: The EUMETSAT Fire mapping algorithm (FIR) based on fixed thresholding approach, applied on the spectral bands **IR 3.9** and **IR10.8.**

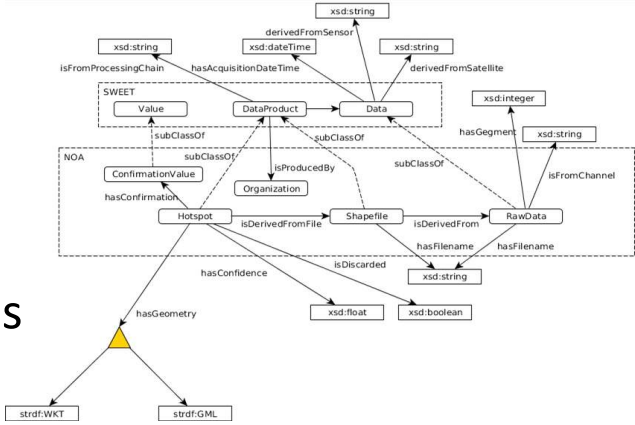
Classification enhancement # 1: The thresholds are dynamically changing calculated for each image and every pixel location on the basis of the seasonally variations and time depended Solar Zenith Angle.



Classification enhancement # 2 : Create and integrate classification evidence through geo-spatial ontology schemes and reasoning queries, accounting for the

a) thematic consistency by eliminating false alarms, and

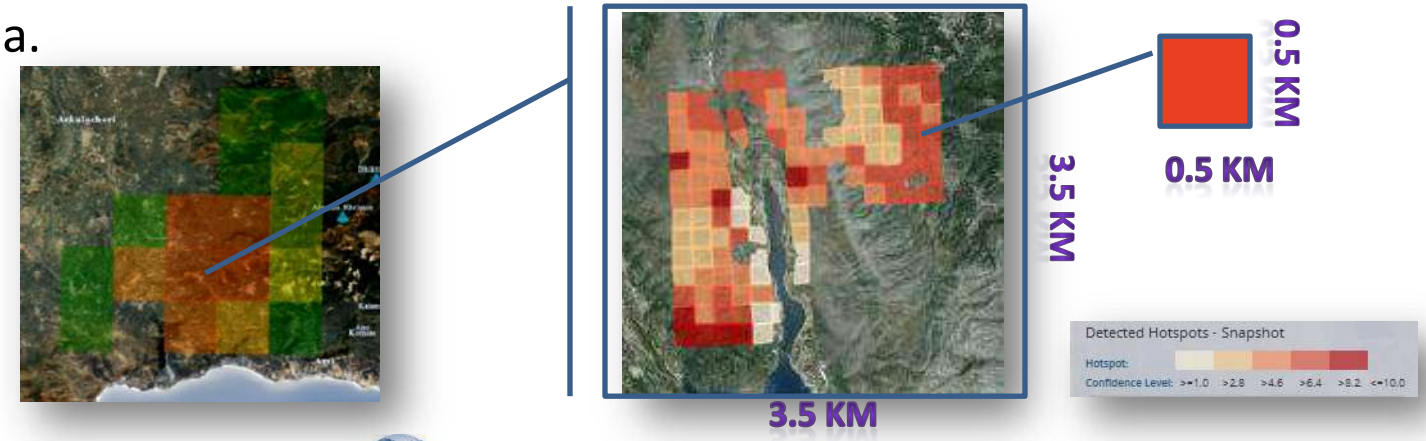
b) account for the time persistence of the fire observations



CLASSIFICATION PROCESS

Classification enhancement # 3: Downscaling the first classification output and calculate the fire occurrence probability in sub-areas of 500 m x 500 m wide, inside the initial observation area of 3.5km x 3.5 km, accounting for the real meteorological, physical / ecological, and morphological conditions in the affected area such as,

a) Wind conditions (speed/direction), **b)** Fuel types and fuel type's proneness to fire, **c)** Altitudinal zone, **d)** Slope and Aspect elements of each of the 500m x500m area.



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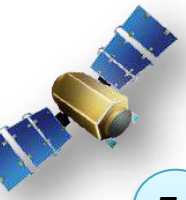
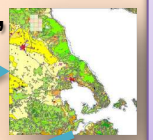
Eumetsat @ 9.5°East

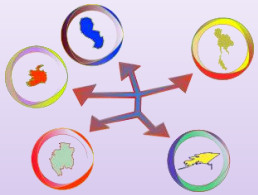


External Sources

Back End: MonetDB /Strabon/FireHub Models

- Corine Landcover
- Admin Boundaries
- POIs
- Meteo
- DTM, Slope, Aspect
- Fuel Maps





Geospatial Ontology

Cataloguing Service & Metadata Creation

Front End: GUI

FireHub GUI

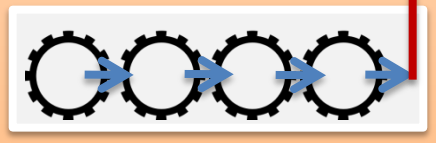
Web access based on Semantics

Linked Geospatial Data Semantic technologies

Data Vault

Raw Data

HotSpots



Processing Chain (SciQL based)

- Search & Display
- Search for raw & Processing
- Real-time Fire Monitoring
- Refinement (Post-Processing)
- Linked Data

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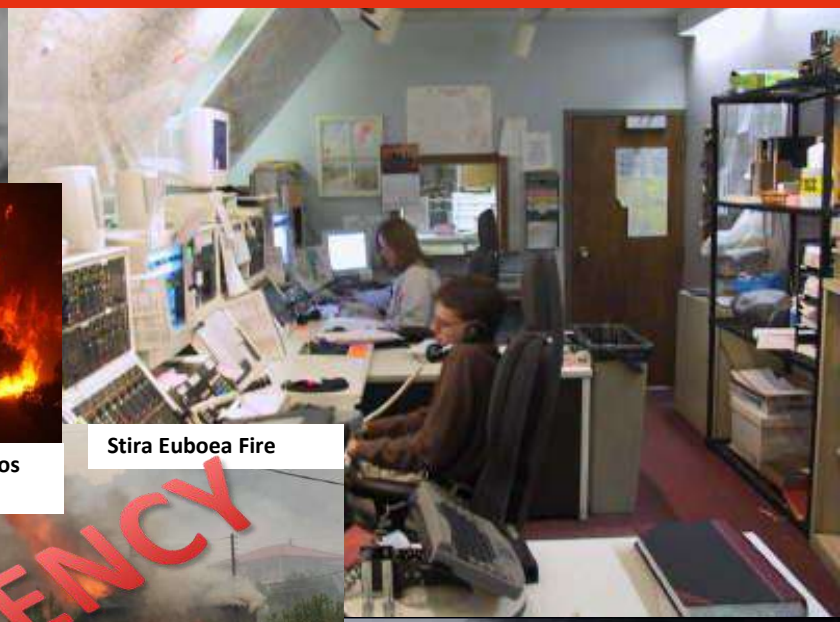
Regional Real Time Fire Monitoring - NOA's MSG SEVIRI Station – Raw Resolution mode

Zaharo Fire

Olympia site Fire

AliveriEuboea Fire

Korinthos Fire



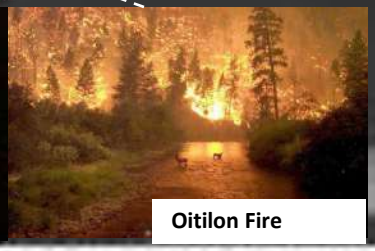
Stira Euboea Fire

Parnon Mt Fire

EMERGENCY

Taygetos Mt Fire

Megalopolis Fire



Oitilon Fire

SEVIRI MIR 070823_1030 UTC

POTENTIAL FIRE

CONFIRMED FIRE

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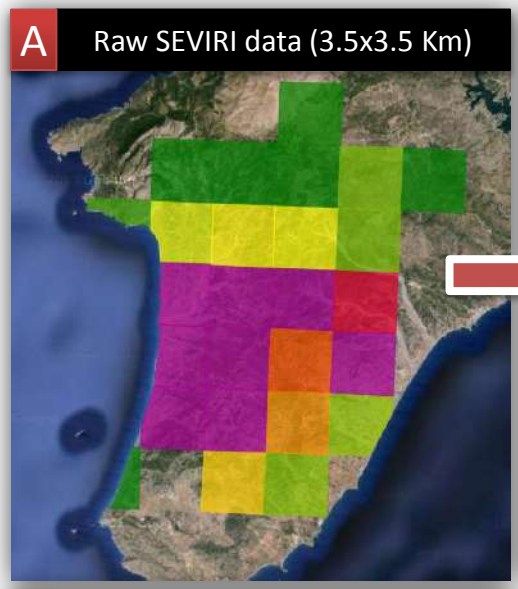

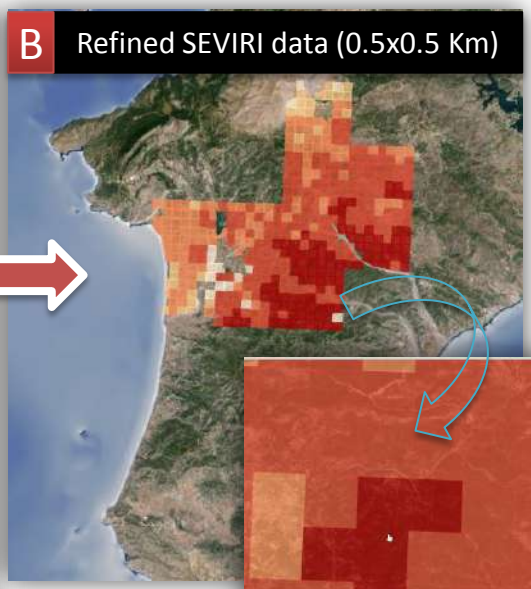

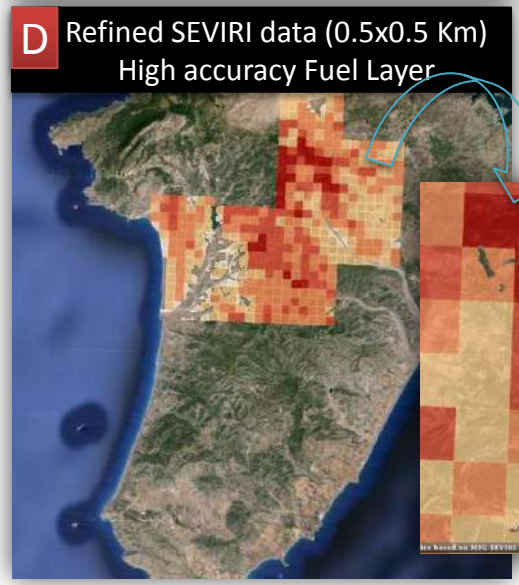

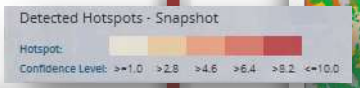

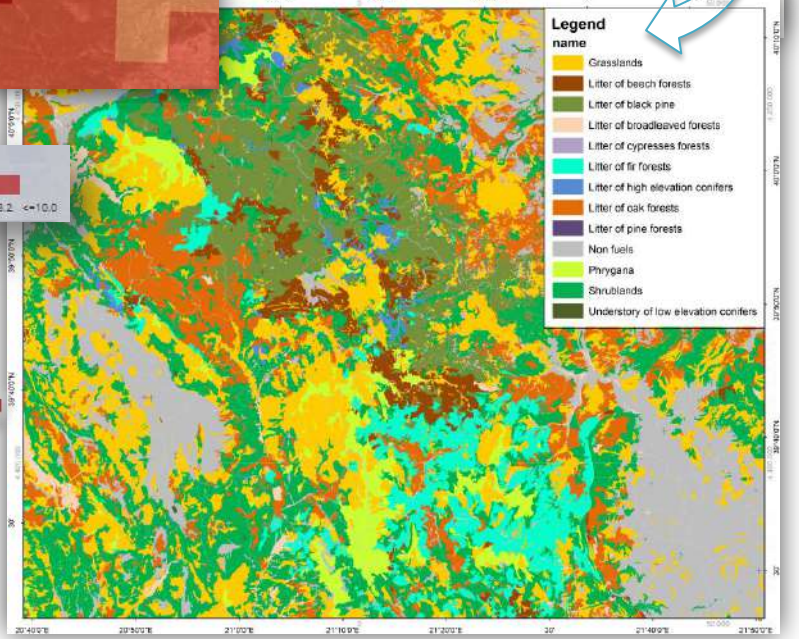

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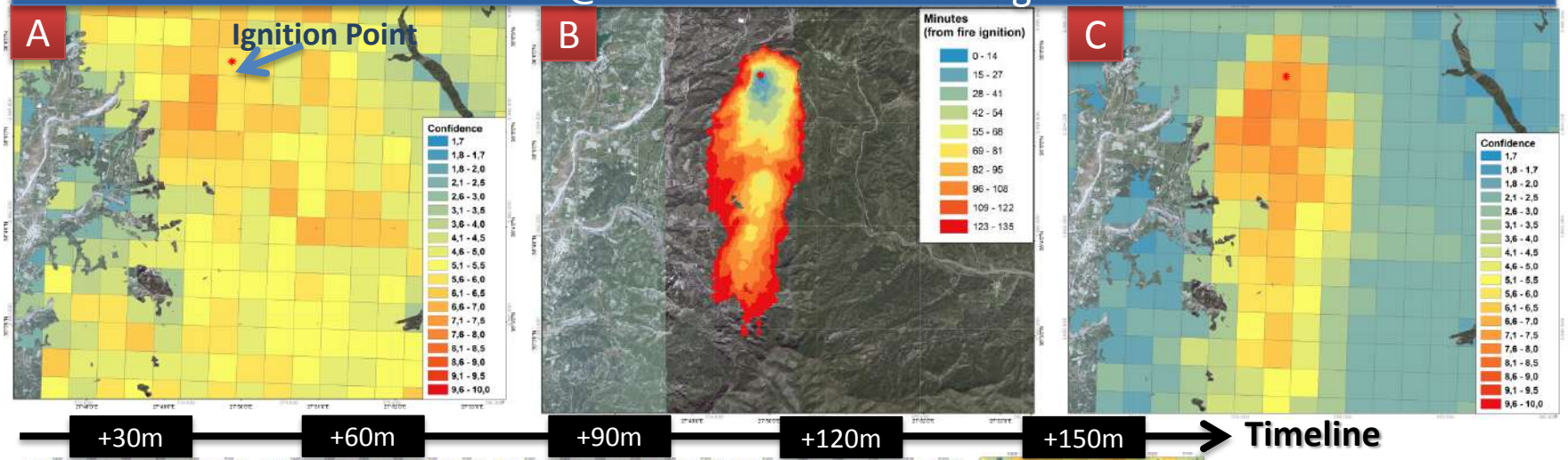
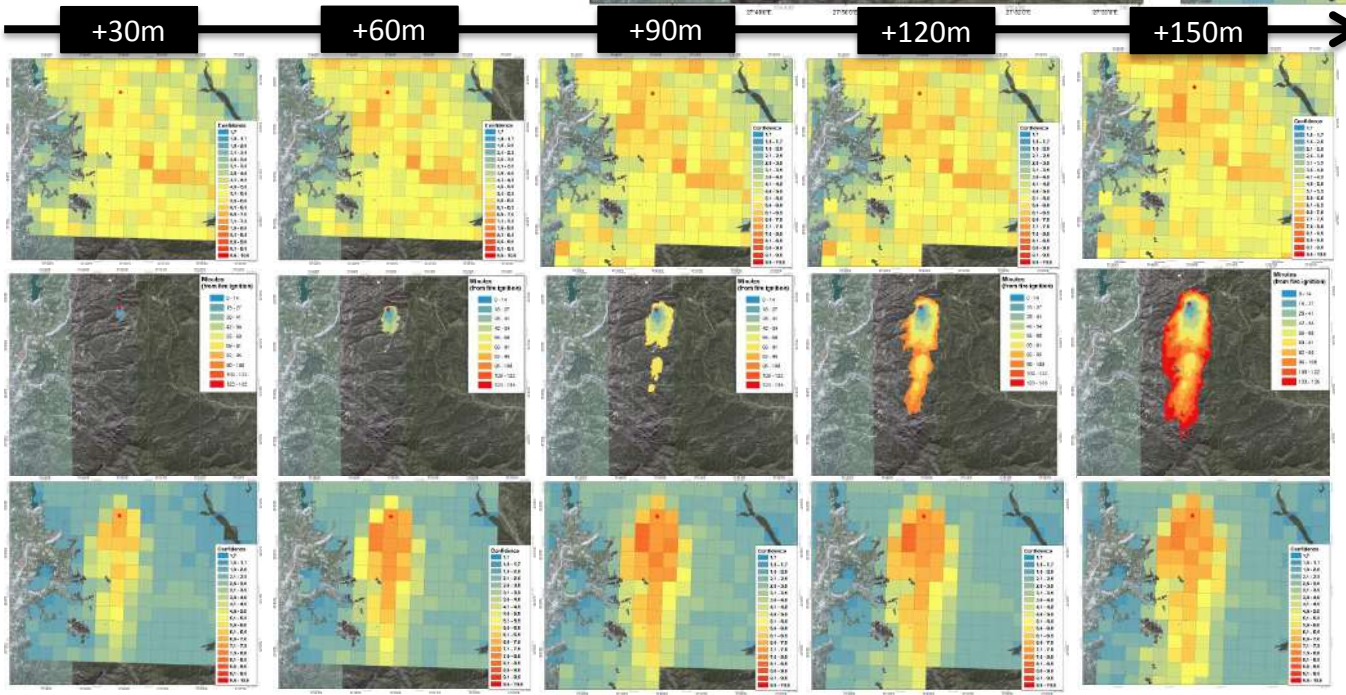
Results @ 150 minutes after fire ignition





A — Real-time fire monitoring service

B — **FlamMap** fire behaviour mapping and analysis software

C — Enhanced real-time fire monitoring service

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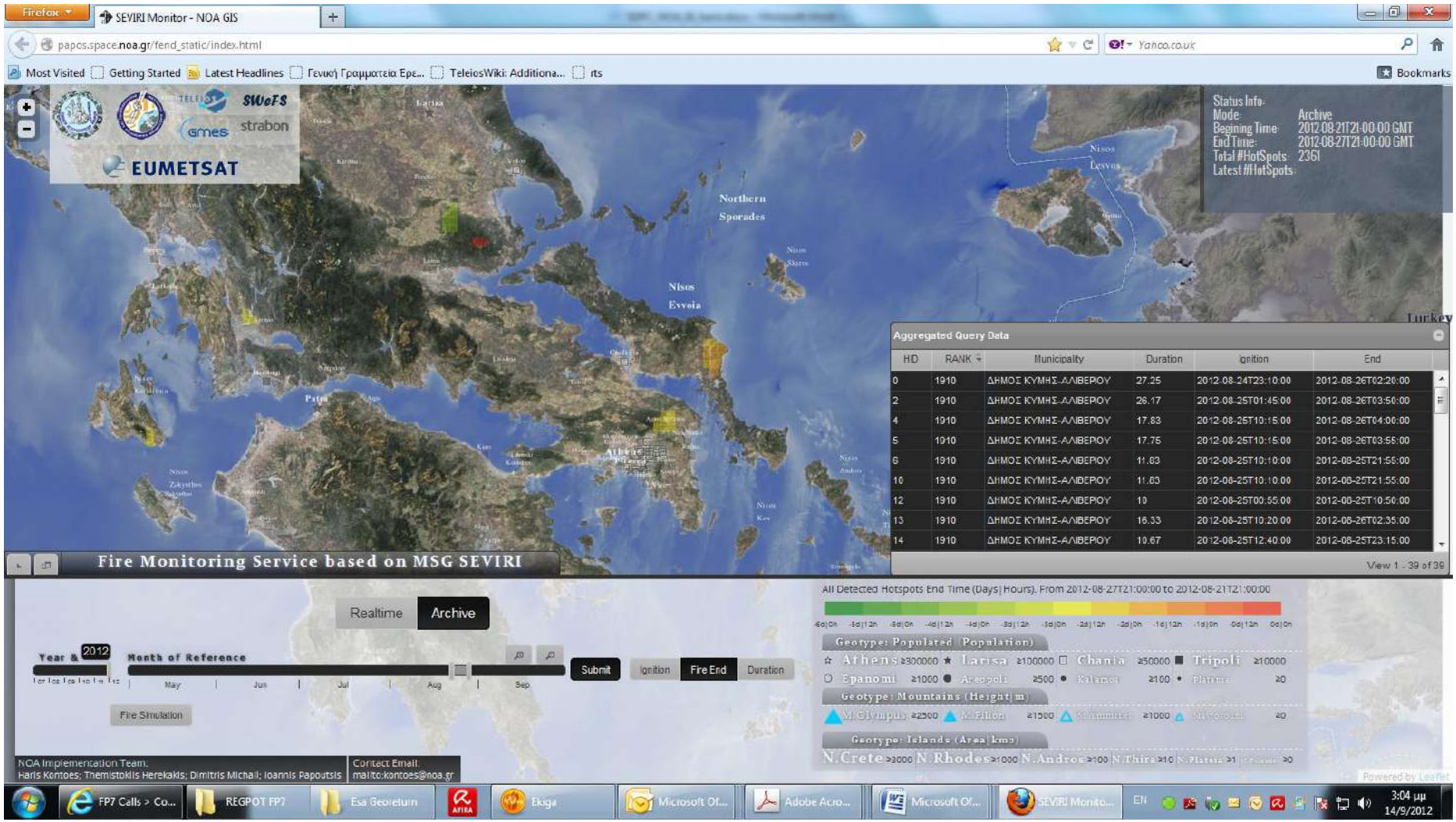

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Rapid Mapping During Crisis - Off-line Mapping After Crisis

Fully Automatic Processing Chain

Applies to any type of High and Very High Resolution Satellite Data

(Landsat TM, SPOT XS, IKONOS, Formosat-2, Worldview, Quickbird)

Advanced Informatics Processing Languages

Array Data Base processing - SciQL

Scientific Python, ontology schemes and ontology based queries for linking open geo-spatial data (e.g. geo-names, administrative boundaries)

Rapid Mapping During Crisis - Off-line Mapping After Crisis

BSM_NOA Pre- Processing

(1) Separate clouds from vegetation – Create masks

(2) Isolate water bodies and shadows – Create masks

(3) Perform sensor radiometric calibration and scene radiometric normalisation to create compatible time series of satellite image acquisitions for multi-date analysis

(4) Geo-reference the input satellite data using fully automatic image co-registration techniques with appropriate sensor geometric models

Rapid Mapping During Crisis - Off-line Mapping After Crisis

BSM_NOA Processing

(1) Generate band transformation indices Normalised Burn Ratio Index, Albedo, NDVI, multi-date NDVI, NDVIdiff, multi-date derived Radiometric Change Vectors

(2) Define appropriate image /sensor/land use dependent threshold values and apply to the band transformation indices in order to: a) identify yearly changed from unchanged areas due to fire disasters and other ecosystem disturbances, b) identify burnt spectra on the image plane, and c) resolve for open, urban, and less vegetative areas' confusion

Rapid Mapping During Crisis - Off-line Mapping After Crisis

BSM_NOA Post Processing

(1) **Clean** from isolated pixels, and small area classification noise using a 3x3 smoothing kernel, and proceed with the join of small disconnected fire pixel clubs to larger segments (>1ha) . Filter out objects smaller than 1ha

(2) **Convert** raster fire classification layer to vector fire polygons and **smooth** the fire polygon boundaries to resolve from pixel effect

(3)**Apply** a series of expert knowledge and geospatial reasoning queries in GIS to generate refined classifications of Burnt Areas

(4)**Assign** attribute data to the fire vector polygons (administrative data, land cover data, toponyms, area (ha), perimeter, etc)

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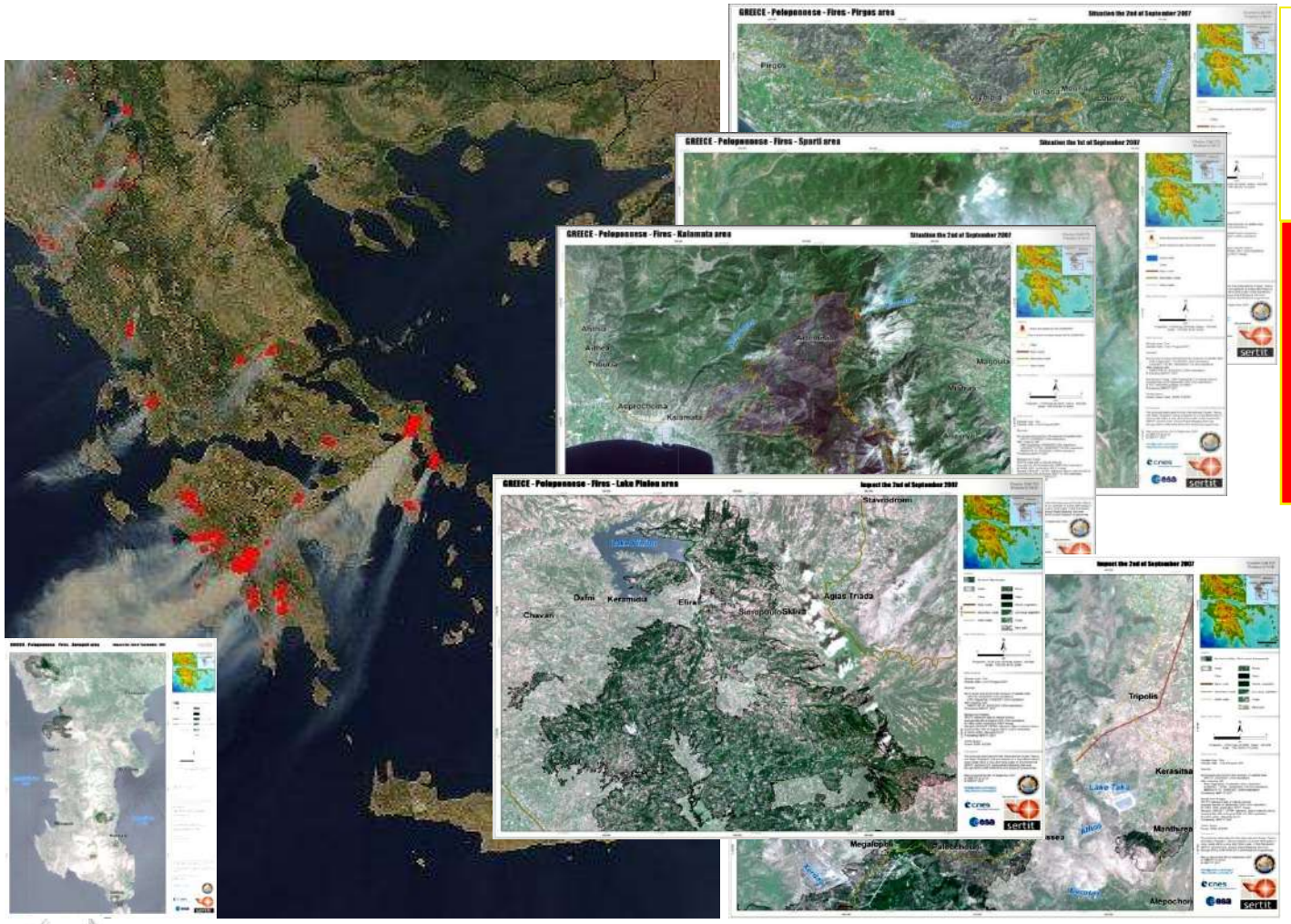
BEYOND FireHub



International Charter Space & Major Disasters
Charte Internationale Espace et Catastrophes Majeures

INTERNATIONAL CHARTER OF MAJOR DISASTERS IS ACTIVATED

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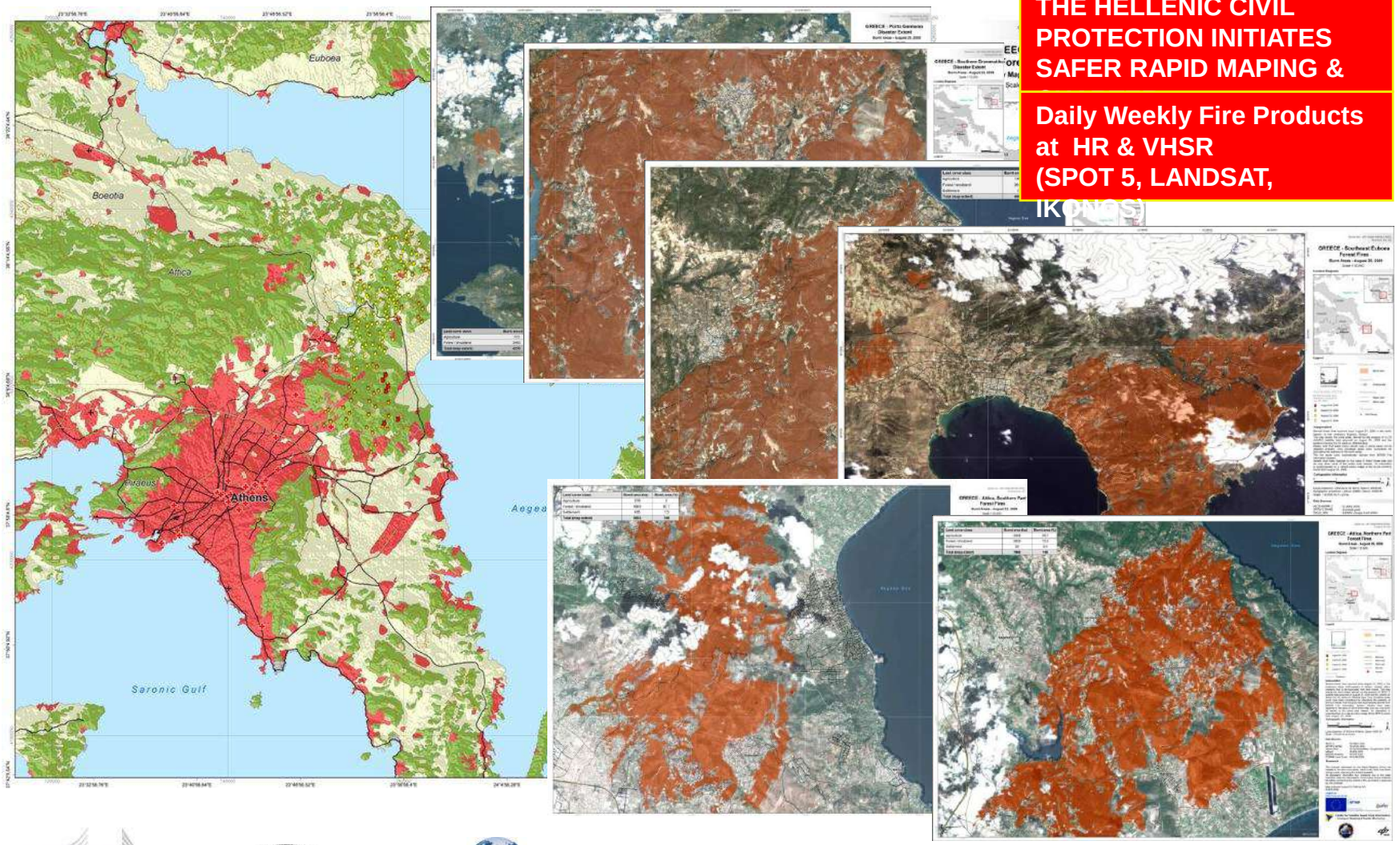
BEYOND FireHub

IAASARS

THE HELLENIC CIVIL PROTECTION INITIATES SAFER RAPID MAPING &

Daily Weekly Fire Products at HR & VHSR (SPOT 5, LANDSAT, IKONOS)



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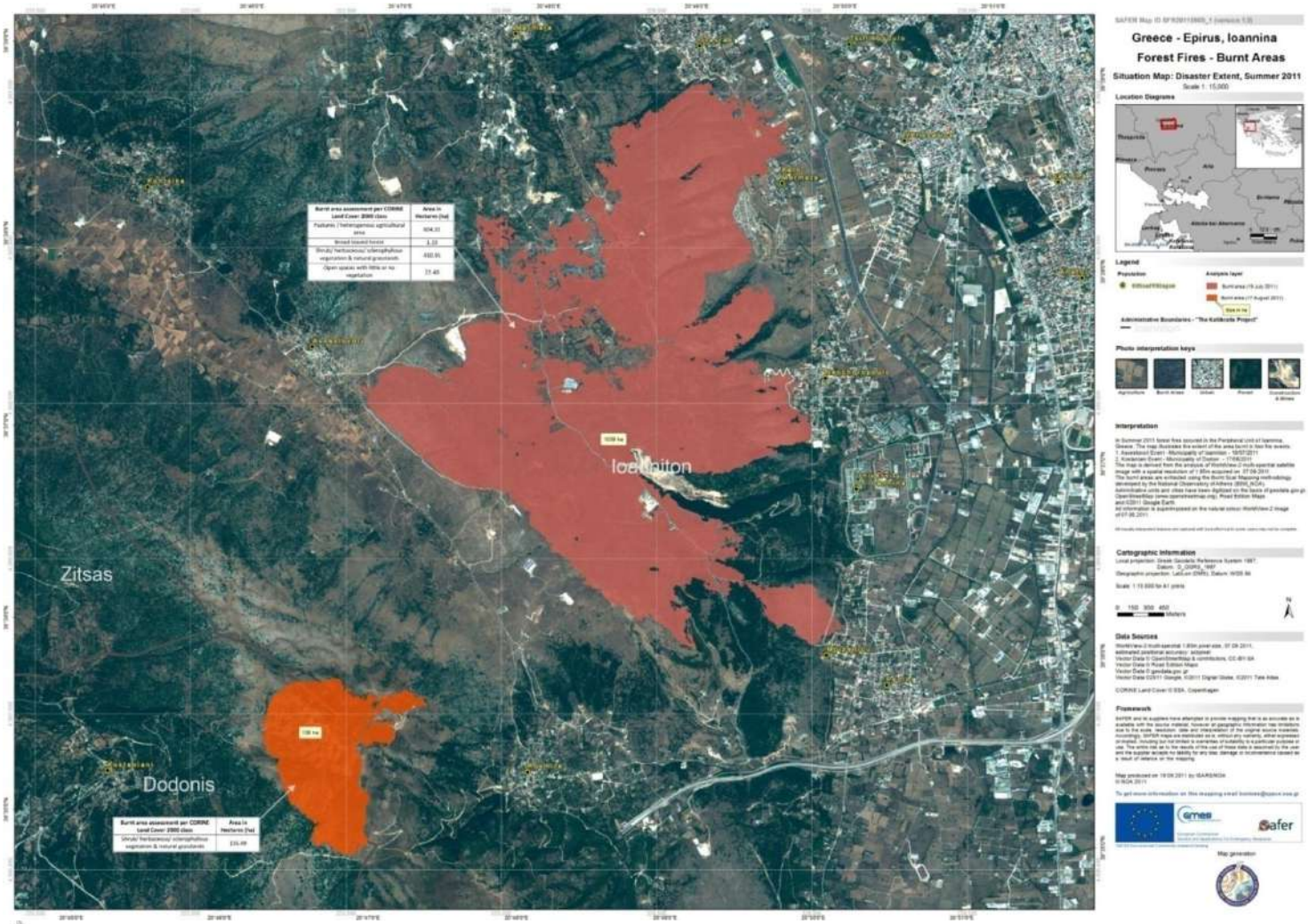

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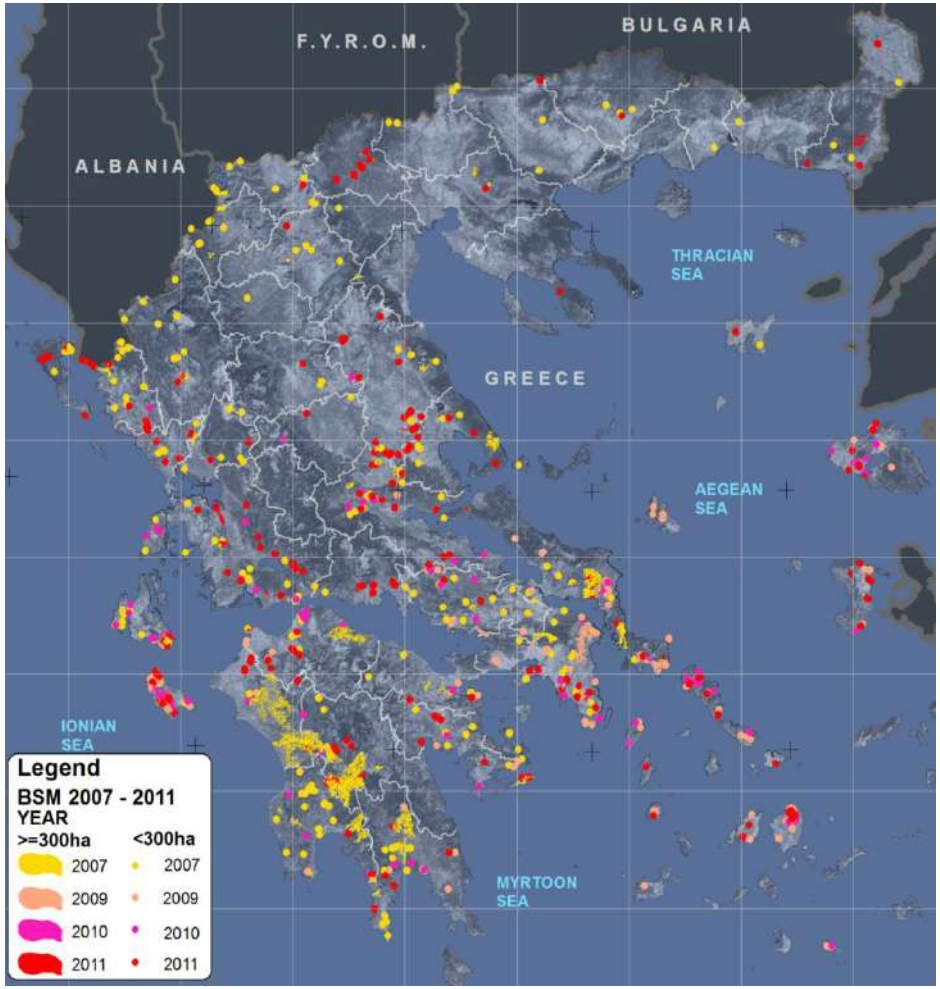

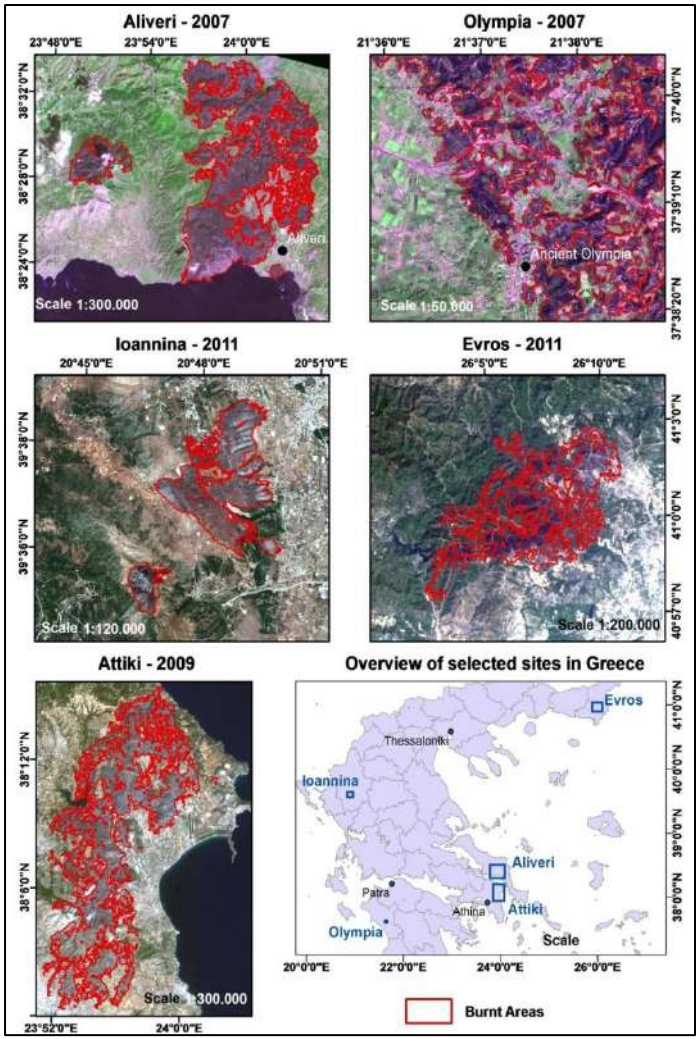

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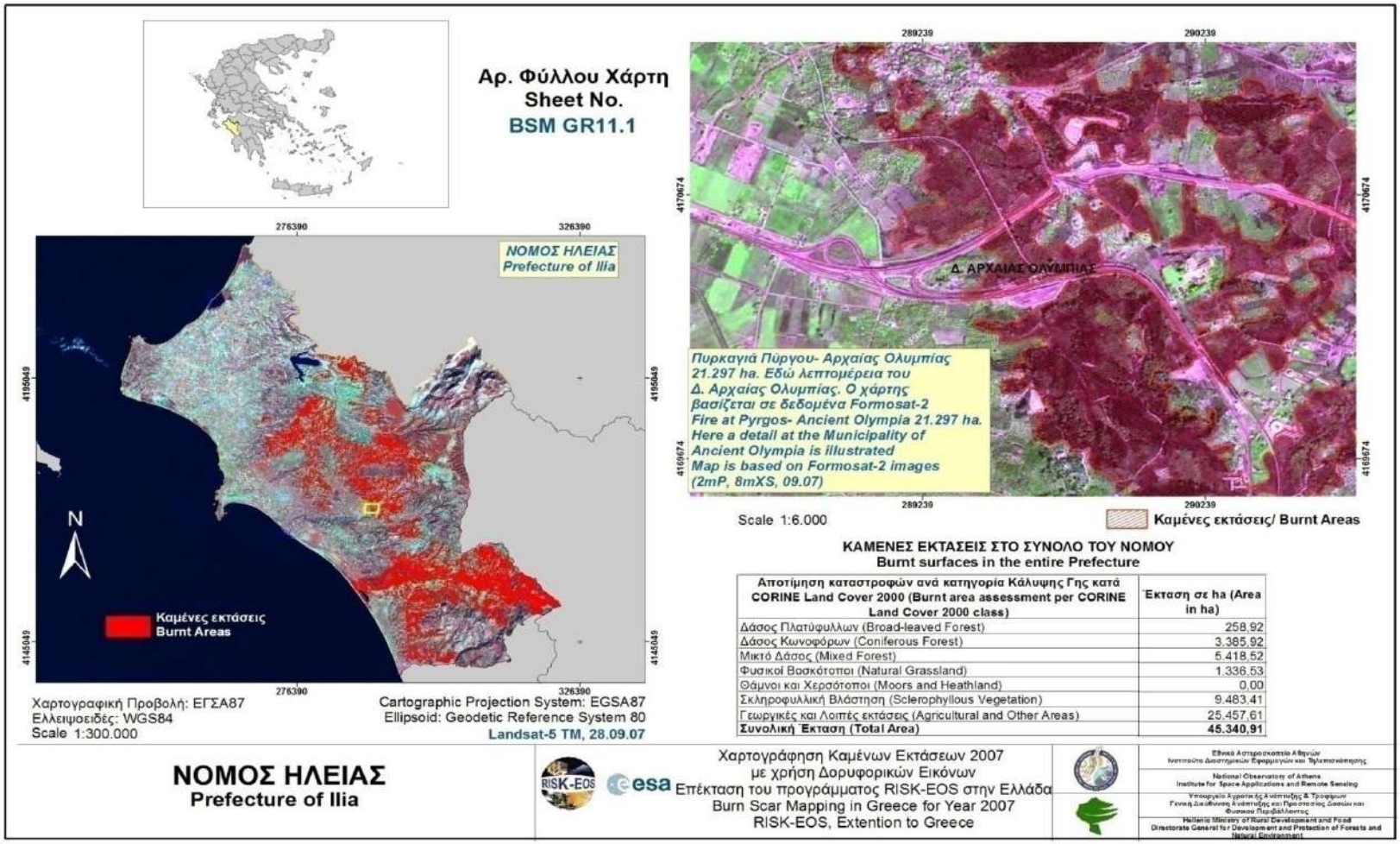

Αποτίμηση καταστροφών ανά κατηγορία Κάλυψης Γης κατά CORINE Land Cover 2000 (Burnt area assessment per CORINE Land Cover 2000 class)	Έκταση σε ha (Area in ha)
Δάσος Πλατύφυλλων (Broad-leaved Forest)	258,92
Δάσος Κωνοφόρων (Coniferous Forest)	3.385,92
Μικτό Δάσος (Mixed Forest)	5.418,52
Φυσικοί Βασκότοποι (Natural Grassland)	1.336,53
Θάμνοι και Χερσότοποι (Moors and Heathland)	0,00
Σκληροφυλλική Βλάστηση (Sclerophyllous Vegetation)	9.483,41
Γεωργικές και Λοιπές εκτάσεις (Agricultural and Other Areas)	25.457,61
Συνολική Έκταση (Total Area)	**45.340,91**

Εθνικό Αστεροσκοπείο Αθηνών
Ινστιτούτο Διαστημικών Εφαρμογών και Τηλεπισκόπησης
National Observatory of Athens
Institute for Space Applications and Remote Sensing
Υπουργείο Αγροτικής Ανάπτυξης & Τροφίμων
Γενική Διεύθυνση Ανάπτυξης και Προστασίας Δασών και Φυσικού Περιβάλλοντος
Hellenic Ministry of Rural Development and Food
Directorate General for Development and Protection of Forests and Natural Environment

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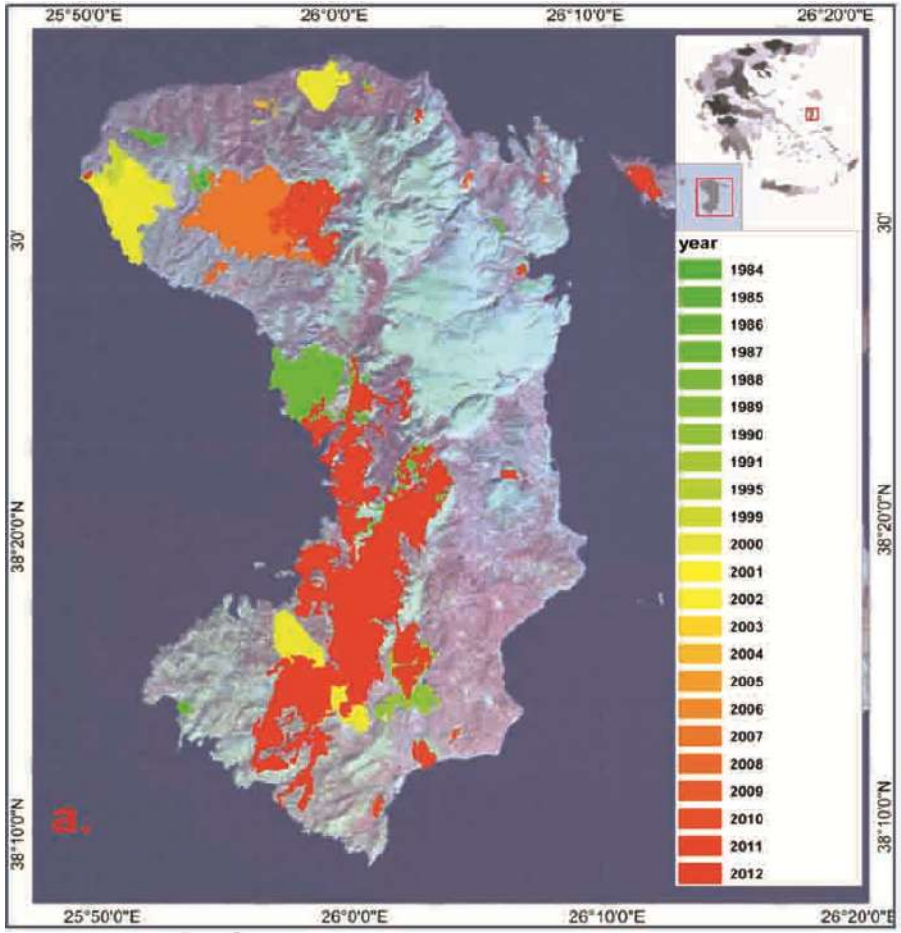
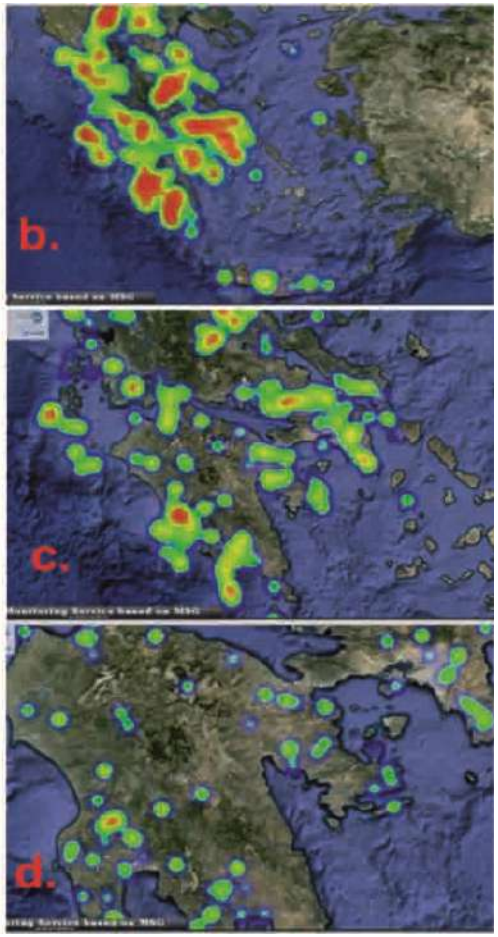
http://ocean.space.noa.gr/diachronic_bsm/index.php





1) More than 450 Landsat TM images acquired over Greece in the period 1984-2013 residing on USGS archives were downloaded and processed fully automatically using the NOA processing chain.

2) Yearly maps of Burned Areas have been produced

3) Yearly statistics per land cover type and administrative data have been generated

4)On-line dissemination of the produced maps and statistics through the NOA's dedicated web interface

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Greek General Secretariat for Research and Technology

Event Logo

http://ocean.space.noa.gr/bsm

DIACHRONIC INVENTORY OF FOREST FIRES OVER GREECE FROM 1984 TO PRESENT, WITH USE OF LANDSAT 4,5,7 SATELLITE DATA

URL: http://www.noa.gr

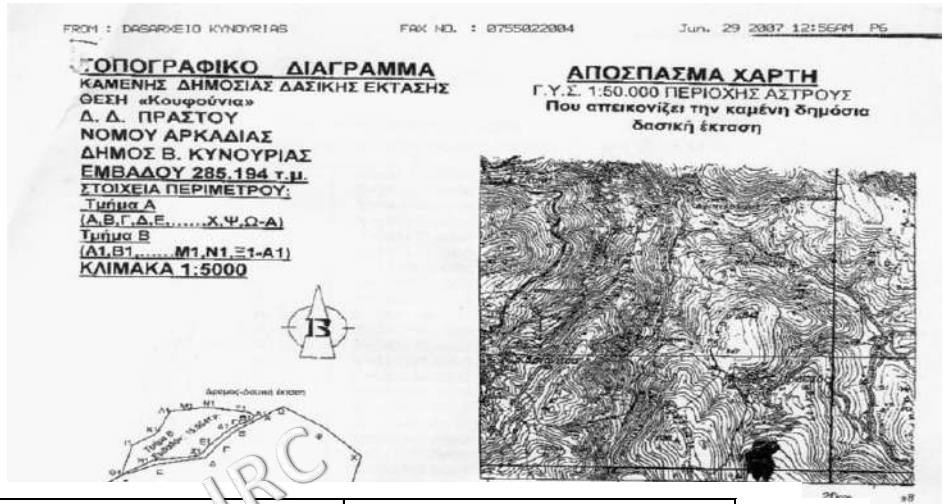
Validation Scheme

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

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

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

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



Region	Tolla	Aullène
Commission error	13.10%	5.76%
Omission error	9.32%	12.70%
Producer's accuracy	90.68%	87.30%
User's accuracy	86.90%	94.24%
Fuzzy Kappa	0.843	0.892

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΥΠΟΥΡΓΕΙΟ ΔΗΜΟΣΙΑΣ ΤΑΞΗΣ ΚΑΙ ΠΡΟΣΤΑΣΙΑΣ ΤΟΥ ΠΟΛΙΤΗ
ΓΕΝΙΚΗ ΓΡΑΜΜΑΤΕΙΑ ΠΟΛΙΤΙΚΗΣ ΠΡΟΣΤΑΣΙΑΣ
ΑΡΧΗΓΕΙΟ ΠΥΡΟΣΒΕΣΤΙΚΟΥ ΣΩΜΑΤΟΣ
-199-
ΣΥΝΤΟΝΙΣΤΙΚΟ ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΚΕΝΤΡΟ ΥΠΗΡΕΣΙΩΝ ΠΥΡΟΣΒΕΣΤΙΚΟΥ ΣΩΜΑΤΟΣ

ΚΑΤΑΣΤΑΣΗ ΔΑΣΙΚΩΝ ΠΥΡΚΑΓΙΩΝ 01-08-2013

Α/Α	ΠΥΡ/ΚΗ ΥΠΗΡΕΣΙΑ	ΔΗΜΟΣ - ΚΟΙΝΟΤΗΤΑ	ΧΡΟΝΟΛΟΓΙΑ				ΚΑΜΜΕΝΗ ΕΚΤΑΣΗ (Στρέμματα)							ΠΡΟΣΩΠΙΚΟ					ΜΕΣΑ							
Α.ΕΓΓΡ			ΕΝΑΡΞ.	Μ.ΕΛ.	ΕΛΓΧ.	ΚΑΤΑ	ΔΑΣ.	Δ.Ε.	ΑΛΣ.	Χ.Ε.	ΚΑΛ.	Γ.Ε.	Υ.Κ.	Π.Υ	ΠΕΖ	ΕΘΕ	ΣΤΡ	Α.Δ.	Π/Ο	ΟΤΑ	ΒΥΤ	ΜΗΧ	ΕΛΙ	ΑΦΣ	ΑΦΡ	ΑΦG
1		Δ. ΣΑΜΟΥ	21-07	23-07	30-07	01-08		600																		
154504	Π.Υ. ΣΑΜΟΥ	ΑΚΡΩΤΗΡΙ ΖΩΟΔΟΧΟΥ ΠΗΓΗ	15:15	09:15	09:20	08:00								20	46	60			7	20			1	4			
2		Δ. ΧΙΟΥ	25-07	26-07	29-07		1100			100		100		6					3							
154682	Π.Υ. ΧΙΟΥ	ΑΓ. ΙΣΙΔΩΡΟΣ-ΠΙΤΥΟΣ	11:25	19:05	20:50									45	22	100	10		15	5	6		1	5			
3		Δ. ΣΕΡΙΦΟΥ	25-07	26-07	30-07	01-08				300																
154696	Π.Υ. ΕΡΜΟΥΠΟΛΗΣ	ΣΚΛΑΒΟΓΙΑΝΝΗ	15:20	11:35	07:30	19:30								2	9								1	2			
4		Δ. ΣΕΡΙΦΟΥ	26-07	28-07	30-07	01-08				1000																
154772	Π.Υ. ΕΡΜΟΥΠΟΛΗΣ	ΑΓΙΑ ΜΑΡΙΝΑ	21:00	18:10	07:30	19:35								13	9					1	1		1	6			
5		Δ. ΡΟΔΟΥ	27-07	31-07				35000				3000							25							
154797	Π.Υ. ΡΟΔΟΥ	ΙΣΤΡΙΟΣ	16:10	11:30											134		70		39	7	3	5	5	8		
6		Δ. ΠΡΕΣΠΩΝ	29-07	29-07	01-08	01-08				50																
154896	Π.Υ. ΦΛΩΡΙΝΑΣ	"Μπέλα Βόδα"	17:15	23:00	07:00	14:00									10				8							
7	Π.Υ. ΤΡΙΠΟΛΗΣ	Δ. ΒΟΡΕΙΑΣ ΚΥΝΟΥΡΙΑΣ	30-07	30-07	31-07	01-08		65				70														
154921	Π.Κ. ΑΣΤΡΟΥΣ	Ορεινή Μελιγού- Κοδέλες	11:35	21:00	17:00	18:00								34	14				14	2	2			3	2	
8		Δ. ΡΗΓΑ ΦΕΡΑΙΟΥ	31-07	31-07	01-08	01-08				150																
154987	2ος Π.Σ. ΒΟΛΟΥ (ΒΙΠΕ)	Αγ.Αθανάσιος	13:10	18:40	07:00	07:00								16	17				7							
9		Δ. ΚΙΛΕΛΕΡ	31-07			0				20			80													
155032	1ος Π.Σ. ΛΑΡΙΣΑΣ	Δ.Δ. ΜΥΡΩΝ	23:50			80								2					1							
10		Δ. ΚΙΛΕΛΕΡ	21-08			01-08							50													
155038	1ος Π.Σ. ΛΑΡΙΣΑΣ	-	05:5			07:25								2					1							
11	Δ.Π.Υ. ΗΡΑΚΛΕΙΟΥ	Δ. ΧΕΡΣΟΝΗΣ	01-08	01-08						110				3					1							
155044	Π.Κ. ΧΕΡΣΟΝΗΣΟΥ	Πεδι Βολ Γου	12:13	19:30										18	12				7	3			1			
12	Δ.Π.Υ. ΛΑΡΙΣΑΣ	ΦΑΡΣΑΛΩΝ	01-08			01-08							30													
155053	Π.Κ. ΦΑΡΣΑΛΩΝ	ΑΥΡΑΣ	14:05			14:45								2					1							
13		Δ. ΧΑΛΚΗΔΟΝΟΣ	01-08	01-08		01-08				1	0.5		30													
155055	6ος Π.Σ. ΘΕΣΣΑΛΟΝΙΚΗ	ΞΗΡΟΧΩΡΙ	14:20	16:47		19:00								4					2							
14	Π.Υ. ΓΥΘΕΙΟΥ	Δ. ΚΥΘΗΡΩΝ	01-08											28	24				12	2	6					
155060	Π.Κ. ΚΥΘΗΡΩΝ	Κομνιάνικα- Αγία Ελλέσα	15:23											28	24				12	2	6			2		
15		Δ. ΚΙΛΚΙΣ	01-08	01-08	01-08	01-08				10	5		50													

1) 22% of the detected by the NOA service fires, were reported 10 -15 minutes earlier in comparison to the Fire Brigades logs

2) 58% of the detected by the NOA service fire events, were reported with a delay of less than ~18 minutes in comparison to the Fire Brigade logs

3) Fires larger than the 112ha are completely detected by the NOA system

4) Smaller fires, that are in the range of [4.7ha - 112 ha] are 50% detected by the NOA system

5) The smallest fire detected had the size of 4.7ha. It occurred in the Fourni island on 08.09.2013

6) The omitted detections for the entire fire season, were summing up to a surface of 5,8% of the Burned Area Mapped. Omissions were mainly due to, a) cloud cover, b) small burned area size, c) area morphology, and d) fuel characteristics (e.g. less vegetative areas, pasture lands, sparse vegetation)

7) More than 82% of the 500mx500m cells located in within the Burned Area Polygons have been assigned by the algorithm a probability of fire occurrence in the range of [6, 10]. The remaining 18% is in the range of [4, 6].

FireHub

A Space based Fire Management Hub

Thank you for your attention!

For more information

ocean.space.noa.gr/FireHub