National scale EO based fire disaster management services delivered to operational users over Greece

Enhanced Real time fire monitoring

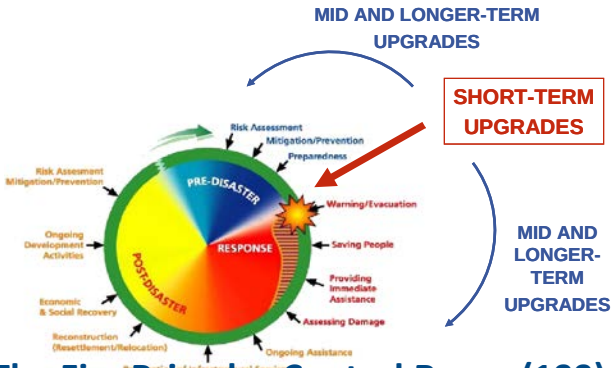
Rapid/Seasonal /Diachronic Burnt Area Mapping at national scale according to GMES standards

Dr Haris KONTOES, Research Director

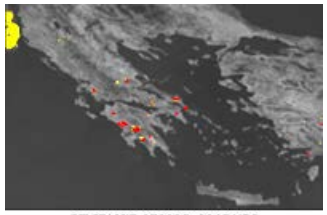
NATIONAL OBSERVATORY OF ATHENS

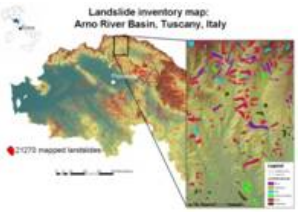
INSTITUTE OF ASTRONOMY & ASTROPHYSICS,
SPACE APPLICATIONS AND REMOTE SENSING

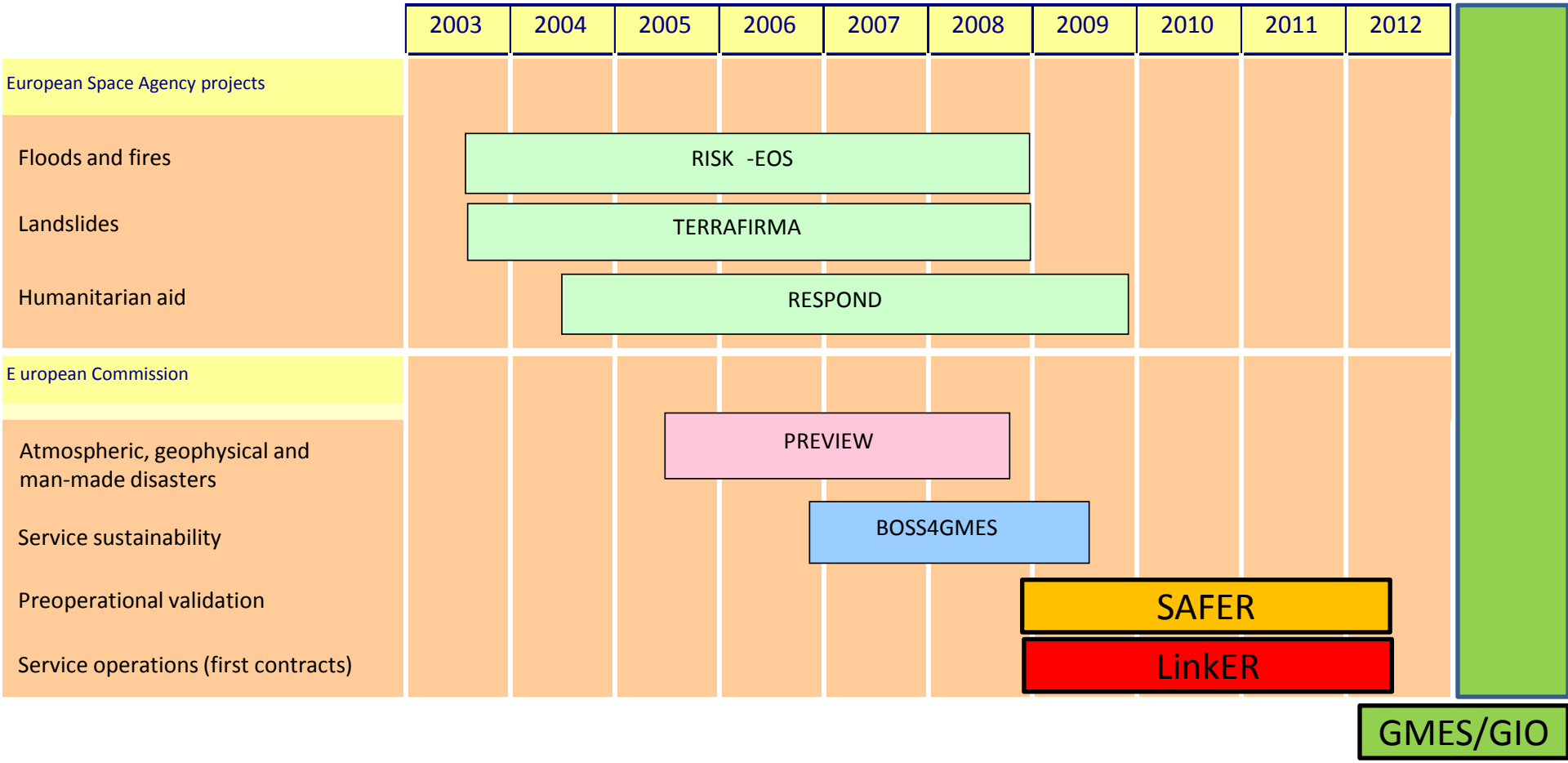
Institutional End Users and stakeholders in Greece and Europe receiving the fire disaster services delivered by NOA during and after crisis:



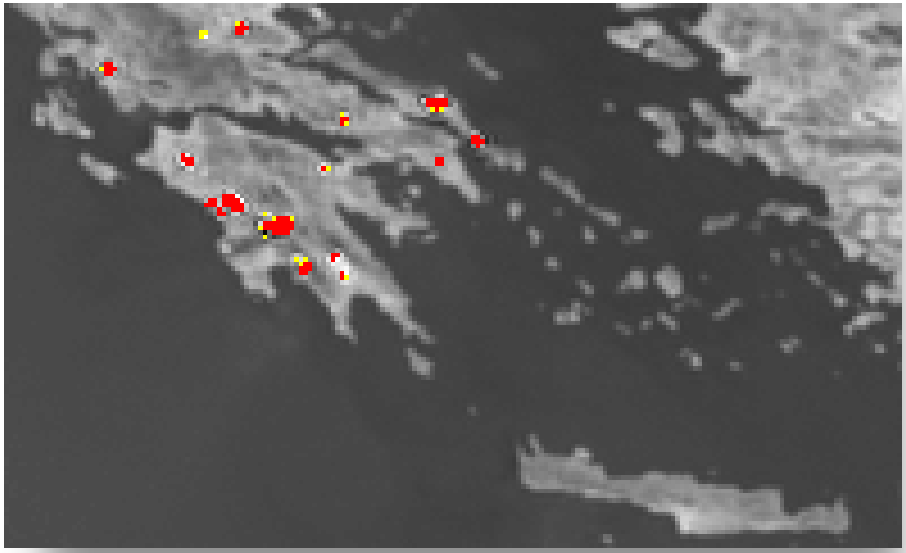
- The Fire Brigades Control Room (199)
- The Ministry of Env. (Directorate for Forests Protection
- The Gen. Sec. Civil Protection
- The Forestry Services over Greece
- The National Cadastral Organisation
- The Local Authorities & Environmental Organisations
- The National Agriculture Research Foundation
- The Hellenic Centre for Greek Biotopes
- The Greek Army
- The Private sector

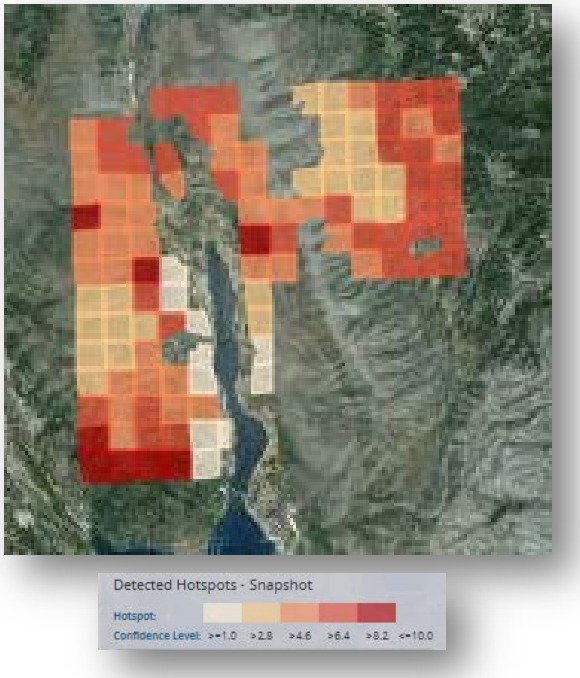

SEVIRI MIR 070825_0945 UTC




2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
European Space Agency projects
Floods and fires
RISK -EOS
Landslides
TERRAFIRMA
Humanitarian aid
RESPOND
E uropean Commission
Atmospheric, geophysical and man-made disasters
PREVIEW
Service sustainability
BOSS4GMES
Preoperational validation
SAFER
Service operations (first contracts)
LinkER
GMES/GIO

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





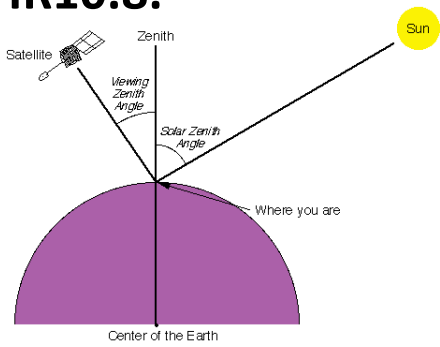
Raw resolution: 3.5x3.5 km wide pixel over entire

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

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

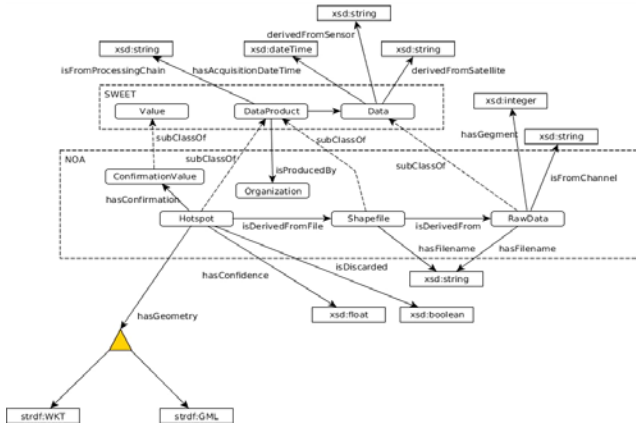
CLASSIFICATION PROCESS

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 using geo-spatial ontology schemes and reasoning queries, accounting for the a) thematic consistency (e.g. eliminate false alarms e.g. in sea, or on top of inconsistent LC types due to coarse initial resolution, and keep only the land part of the polygon), **b)** account for the time persistence of the fire observations.

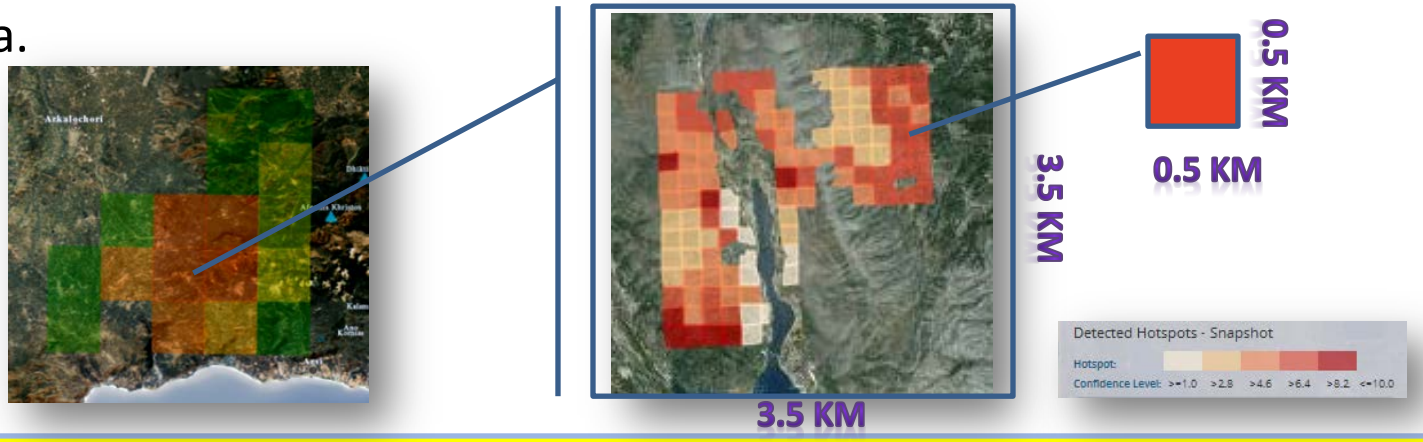


Regional Real Time Fire Monitoring Service based on EUMETSAT MSG SEVIRI Data

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

Eumetsat @ 9.5° East

External Sources

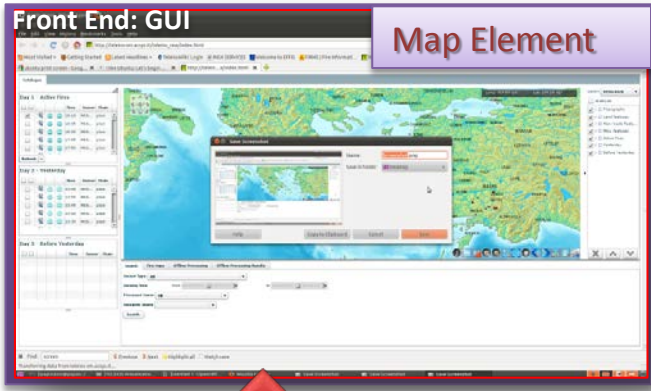
Back End: MonetDB / Strabon

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

Geospatial Ontology

Front End: GUI

Map Element



Web access based on Semantics

Cataloguing Service & Metadata Creation

Linked Geospatial Data Semantic technologies

/www.

Data Vault

HotSpots

Raw Data

Processing Chain (SciQL based)

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

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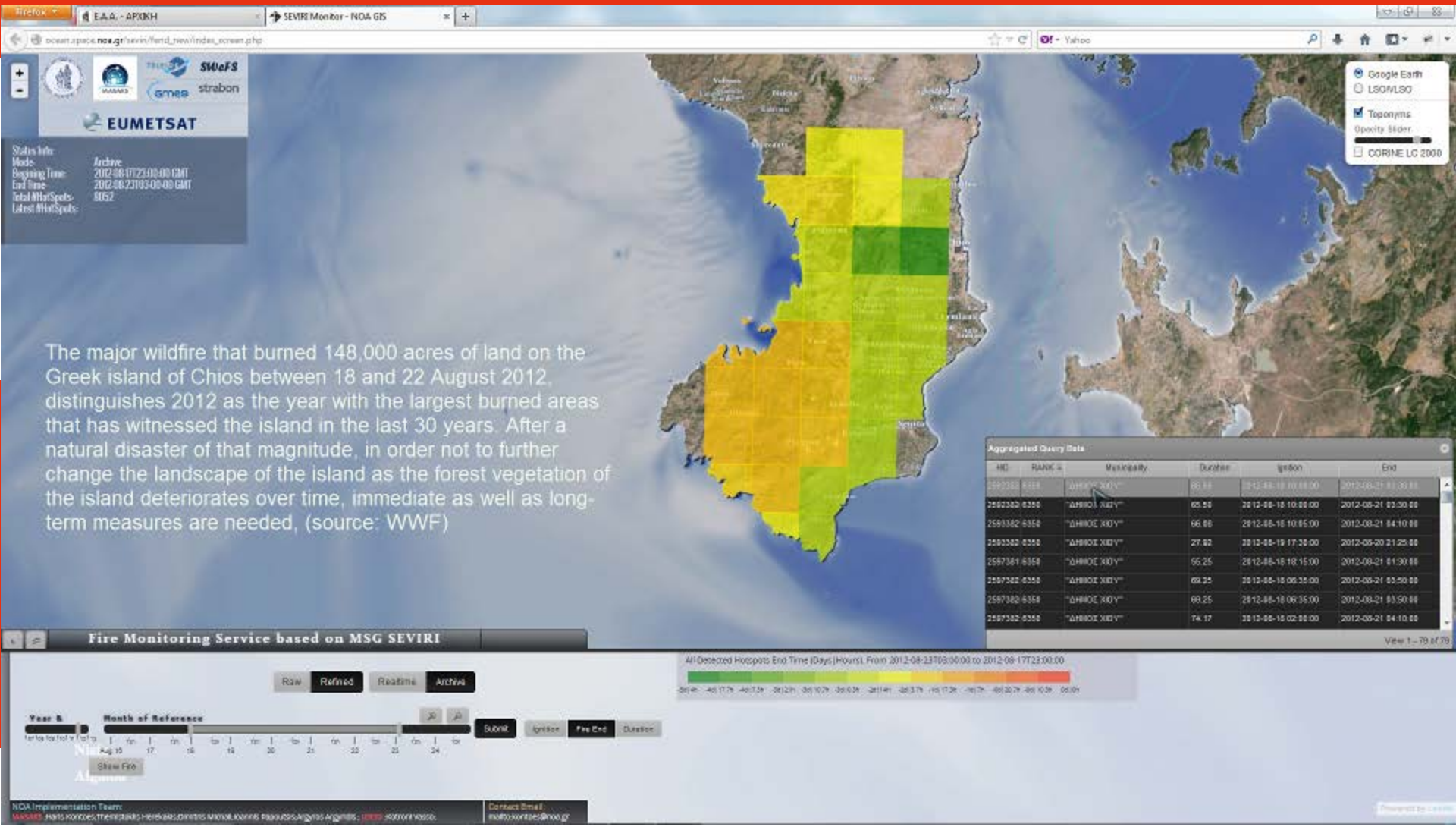
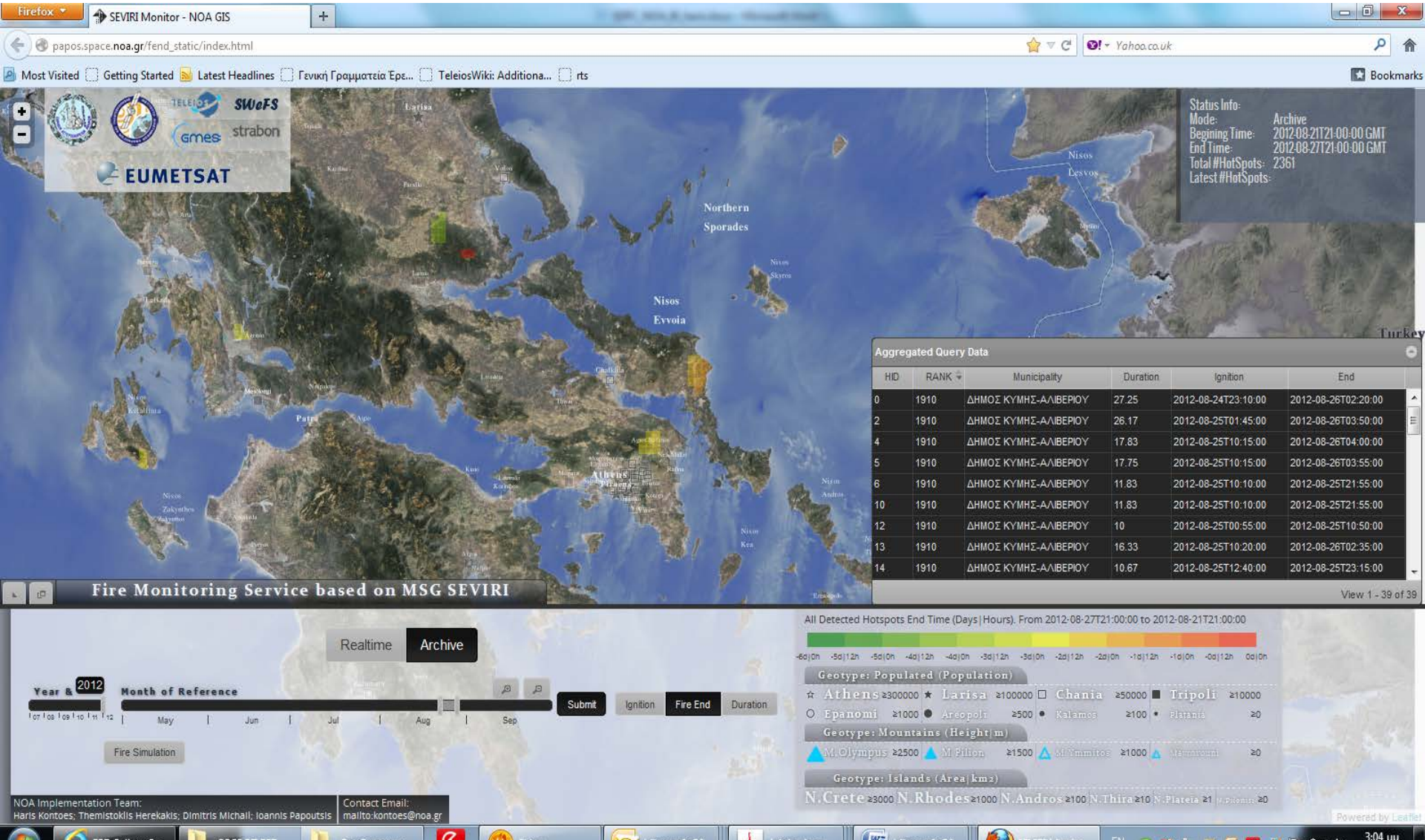
Regional Real Time Fire Monitoring - NOA's MSG SEVIRI Station – Raw Resolution mode

SEVIRI MIR 070823_1030 UTC

POTENTIAL FIRE
CONFIRMED FIRE


SWeFS
strabon
EUMETSAT
The major wildfire that burned 148,000 acres of land on the Greek island of Chios between 18 and 22 August 2012, distinguishes 2012 as the year with the largest burned areas that has witnessed the island in the last 30 years. After a natural disaster of that magnitude, in order not to further change the landscape of the island as the forest vegetation of the island deteriorates over time, immediate as well as long-term measures are needed, (source: WWF)
Fire Monitoring Service based on MSG SEVIRI

On-line Fire Services dissemination through NOA's dedicated web interface (http://ocean.space.noa.gr/seviri/fend_new/index.php)



Burnt Area Mapping for Emergency Response and Emergency Support

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)

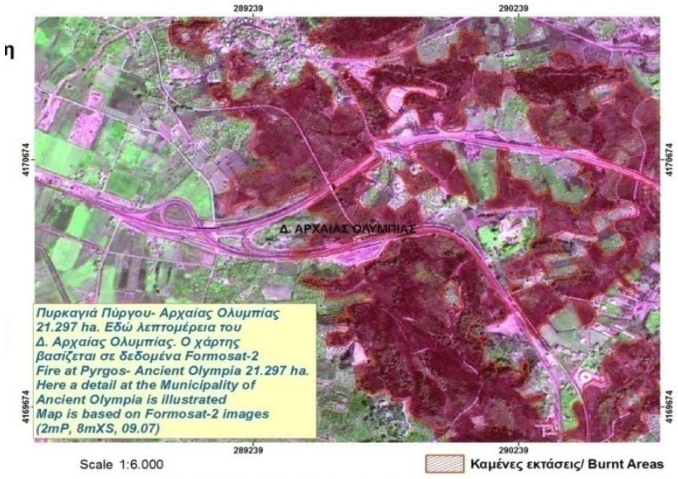
Advanced Informatics Processing Languages

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)

Burnt Area Mapping for Emergency Response and Emergency Support

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 senor 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

Burnt Area Mapping for Emergency Response and Emergency Support

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, $NDVI_{diff}$, 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

Burnt Area Mapping for Emergency Response and Emergency Support

Rapid Mapping During Crisis - Off-line Mapping After Crisis

BSM_NOA Post Processing

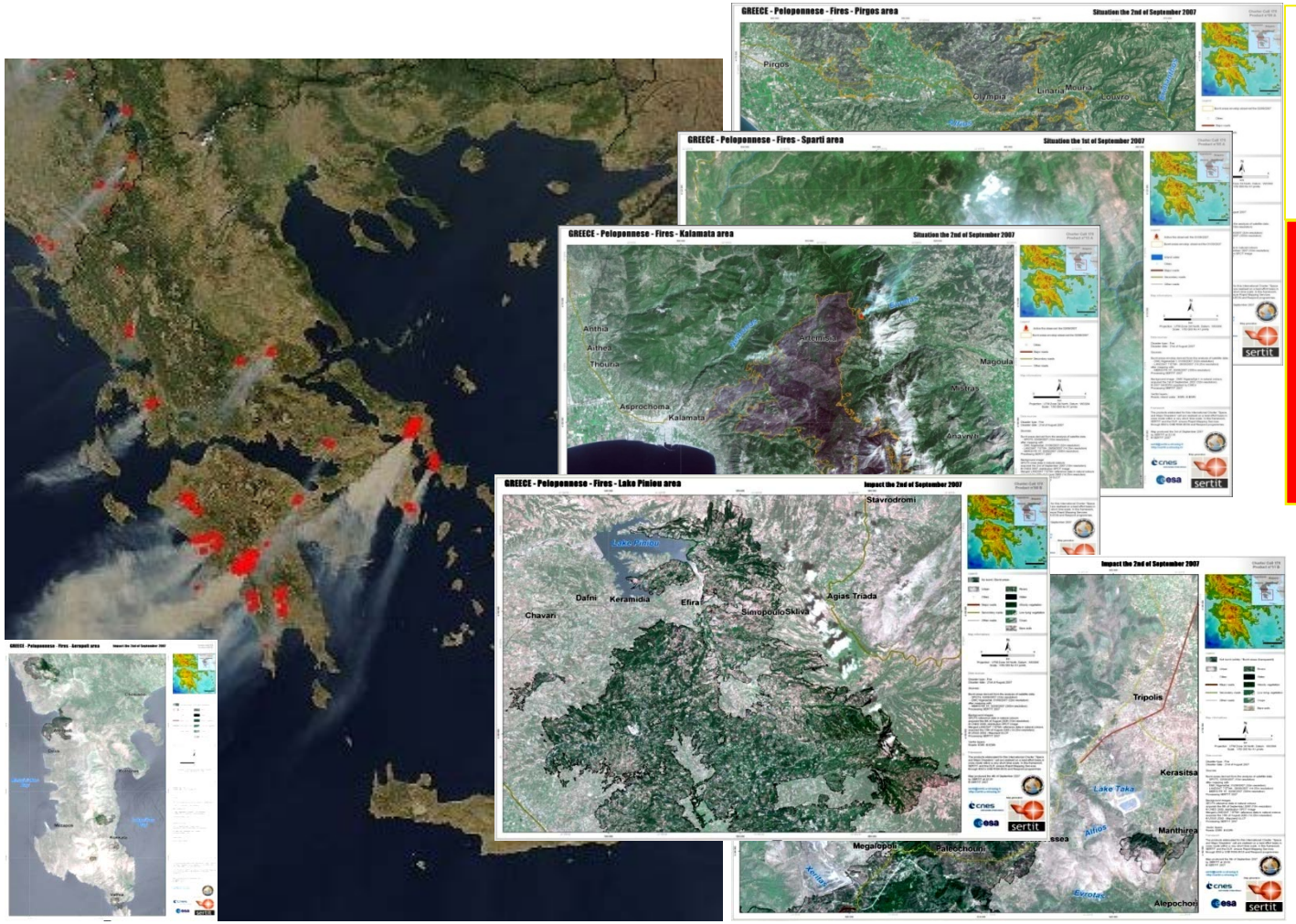
(1) **Clean** from isolated pixels, and small area classification noise using a 3x3 smoothing kernel, and proceed with the join of small disconnected fire pixel clubs to larger segments (>1ha) . Filter out objects smaller than 1ha

(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)

Rapid Fire Mapping Activation in Greece – Peloponnesus 2007

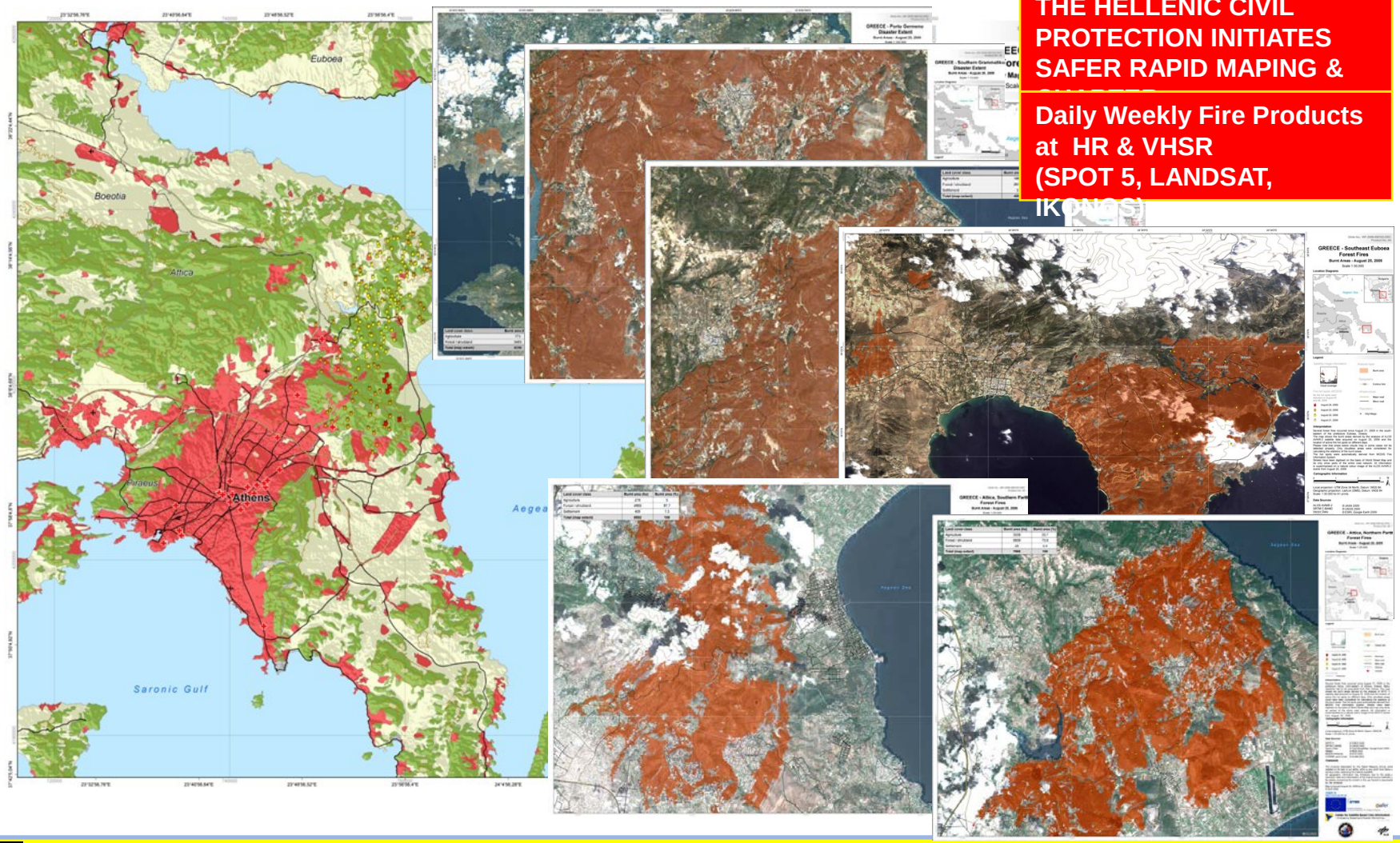


INTERNATIONAL CHARTER OF MAJOR DISASTERS IS ACTIVATED

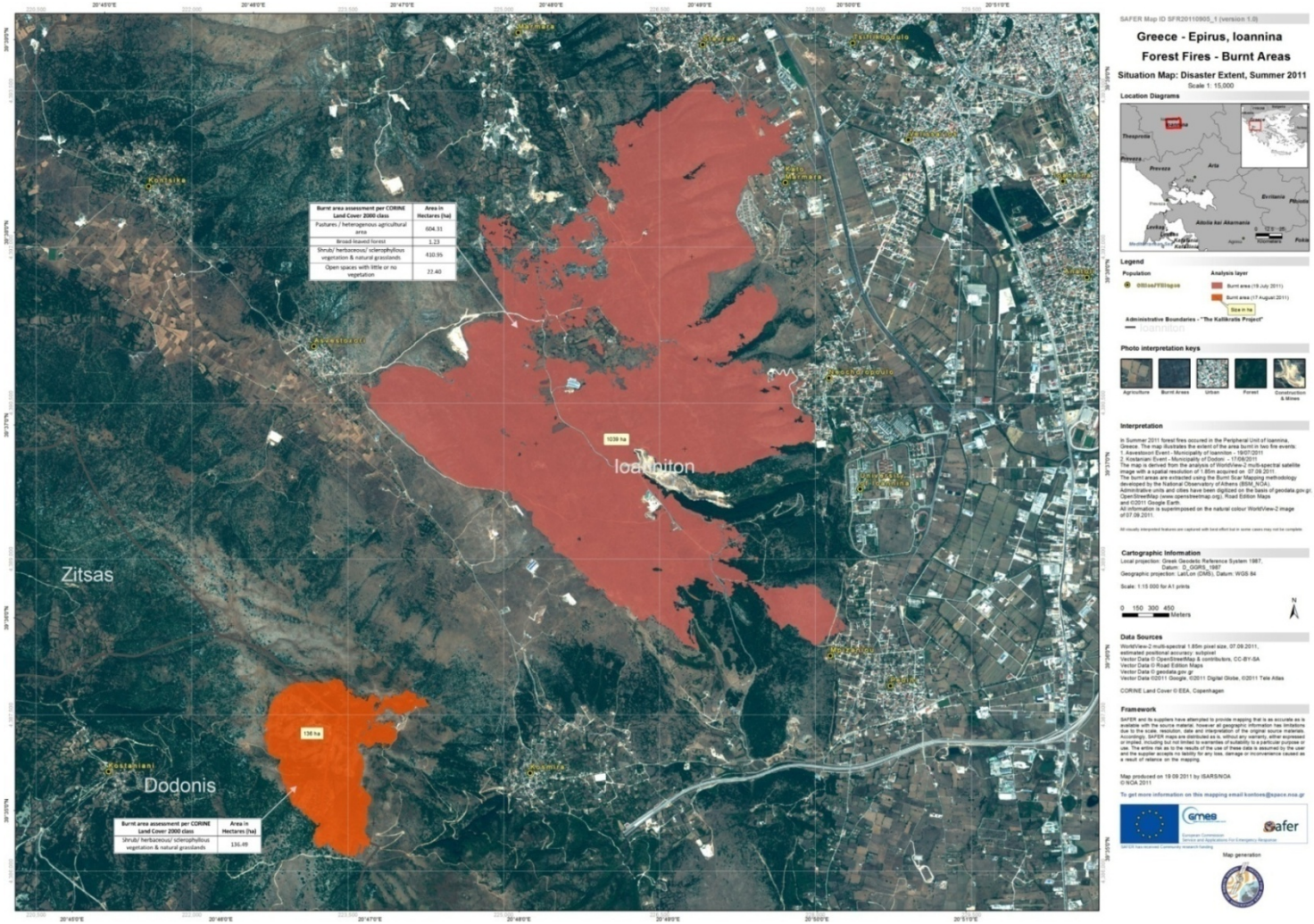
Rapid Fire Mapping Activation in Greece – Athens 2009

THE HELLENIC CIVIL PROTECTION INITIATES SAFER RAPID MAPING &

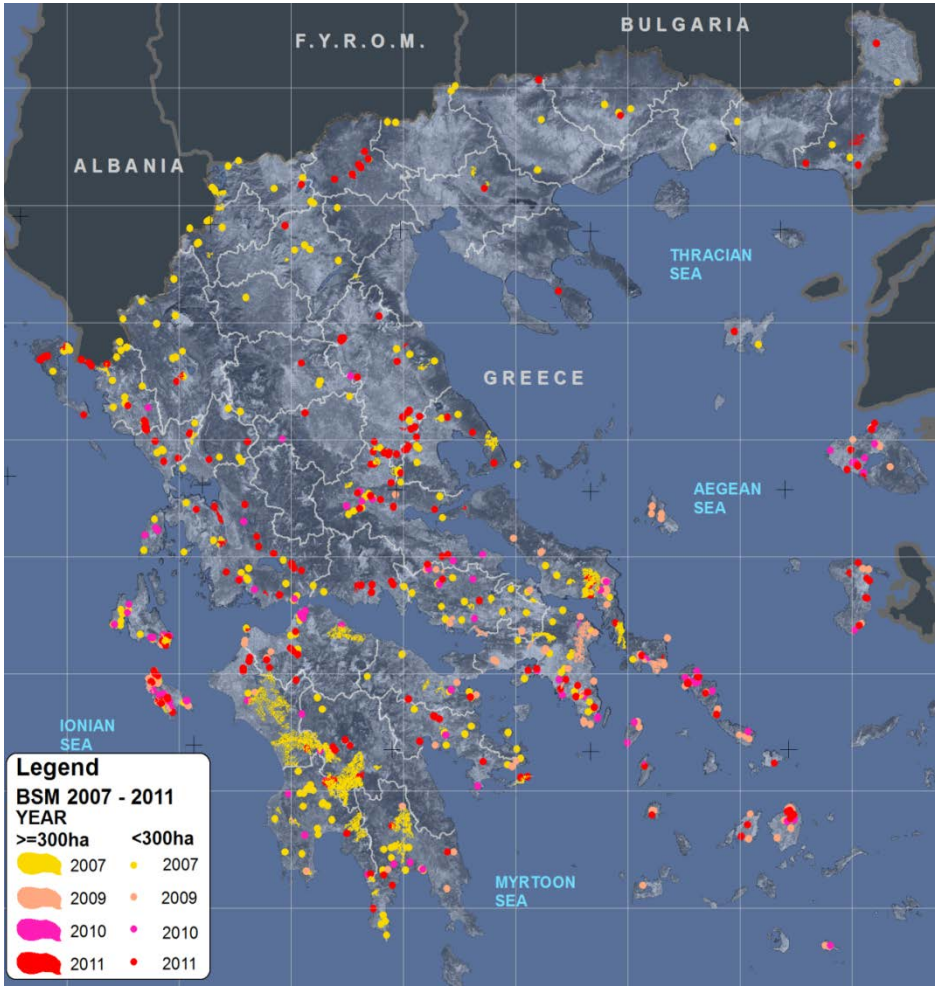
Daily Weekly Fire Products at HR & VHSR (SPOT 5, LANDSAT, IK[illegible])

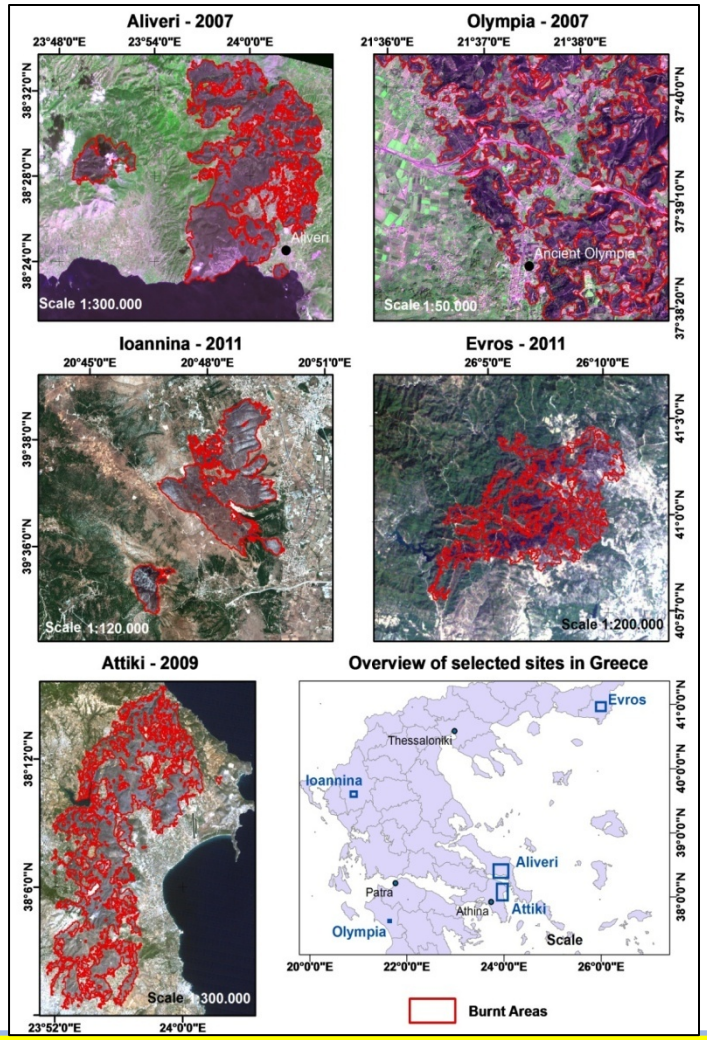


Fire Mapping - Emergency Support Activation – Ioannina (Greece) 2011



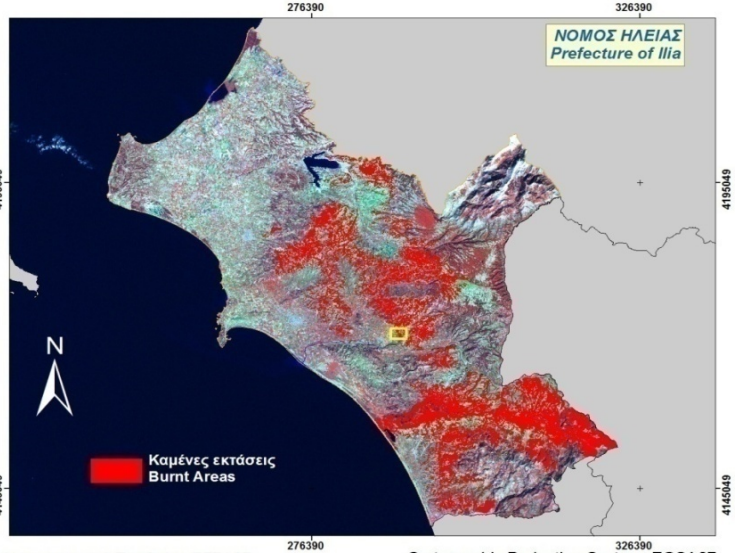
Seasonal Burn Scar Mapping & Damage Assessments – Recovery Phase





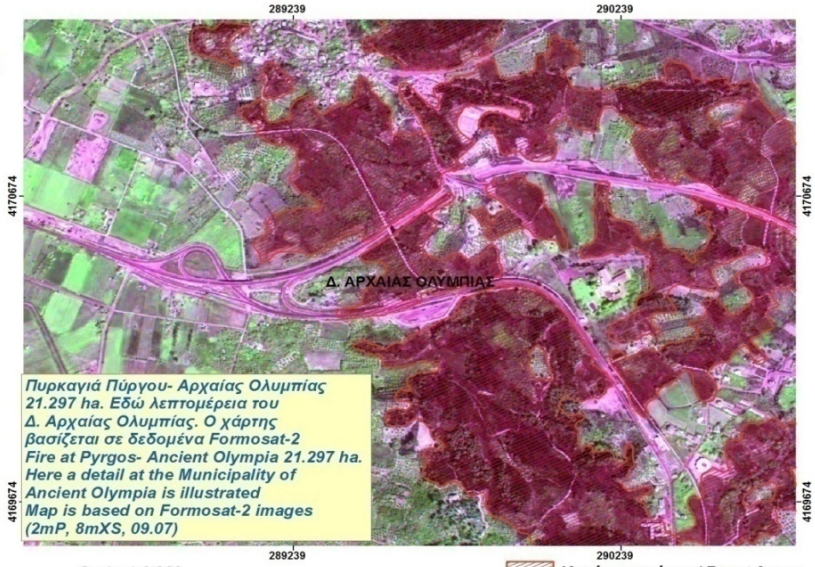
Seasonal Burn Scar Mapping & Damage Assessments at VHSR

Αρ. Φύλλου Χάρτη
Sheet No.
BSM GR11.1



Χαρτογραφική Προβολή: ΕΓΣΑ87
Ελλειψοειδές: WGS84
Scale 1:300.000

Cartographic Projection System: EGSA87
Ellipsoid: Geodetic Reference System 80
Landsat-5 TM, 28.09.07



Scale 1:6.000

Καμένες εκτάσεις/ Burnt Areas

ΚΑΜΕΝΕΣ ΕΚΤΑΣΕΙΣ ΣΤΟ ΣΥΝΟΛΟ ΤΟΥ ΝΟΜΟΥ
Burnt surfaces in the entire Prefecture

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 Βοσκότοποι (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**

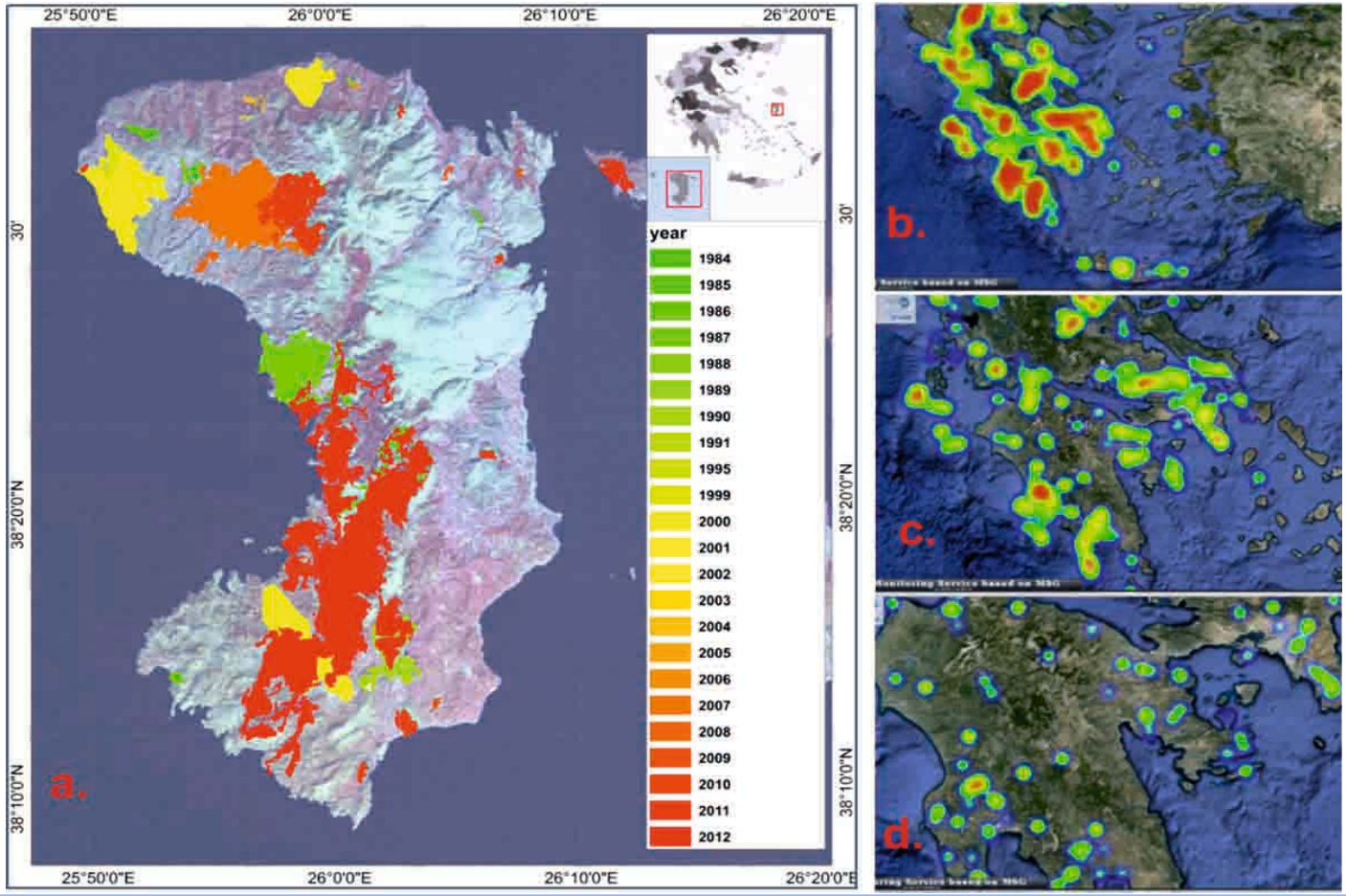
ΝΟΜΟΣ ΗΛΕΙΑΣ
Prefecture of Ilia

Χαρτογράφηση Καμένων Εκτάσεων 2007
με χρήση Δορυφορικών Εικόνων
Επέκταση του προγράμματος RISK-EOS στην Ελλάδα
Burn Scar Mapping in Greece for Year 2007
RISK-EOS, Extention to Greece

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

Diachronic Burn Scar Mapping & Damage Assessments – 1984-2013

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


National Observatory of Athens
Continuous offer to the Scientific Research since 1842
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

Burnt Area Mapping – Service Validation Results

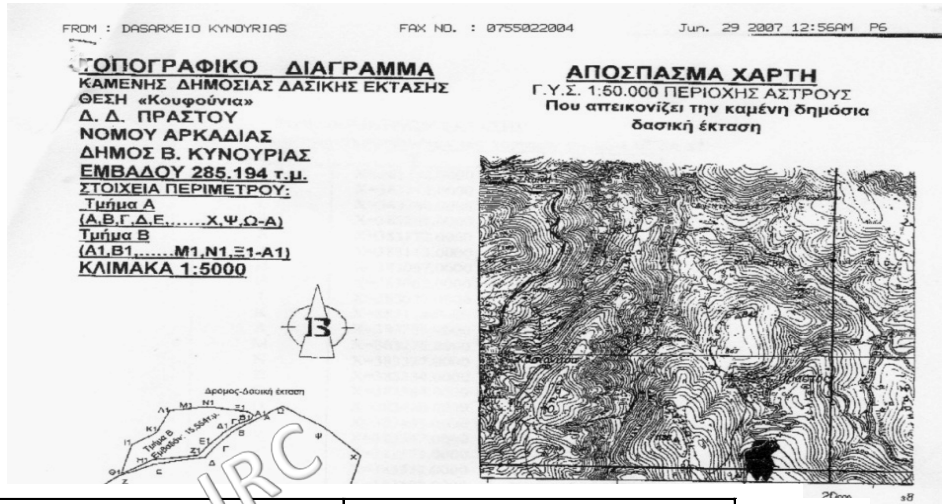
Validation Scheme

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

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

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

- 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

Real Time Fire Monitoring – Service Validation Results

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	ΑΦC	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			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										[illegible]	134	7	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																		
154921	Π.Κ. ΑΣΤΡΟΥΣ	Ορεινή Μελιγού- Καδέλες	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		5		150																
154987	2ος Π.Σ. ΒΟΛΟΥ (ΒΙΠΕ)	Αγ.Αθανάσιος	13:10	18:40	07:00	0[illegible]								16	17				7							
9		Δ. ΚΙΛΕΛΕΡ	31-07			[illegible]				20			80														
155032	1ος Π.Σ. ΛΑΡΙΣΑΣ	Δ.Δ. ΜΥΡΩΝ	[illegible]:50			[illegible]								2					1							
10		Δ. ΚΙΛΕΛΕΡ	[illegible]-08			01-08							50													
155038	1ος Π.Σ. ΛΑΡΙΣΑΣ	-	[illegible]:4[illegible]			07:25								2					1							
11	Δ.Π.Υ. ΗΡΑΚΛΕΙΟΥ	Δ. [illegible]ΡΣΟΝΗΣ[illegible]	[illegible]-08	01-08						110				3					1							
155044	Π.Κ. ΧΕΡΣΟΝΗΣΟΥ	Πεδιά[illegible]ολ[illegible] Γου[illegible]ων	12:13	19:30										18	12				7	3			1			
12	Δ.Π.Υ. ΛΑΡΙΣΑΣ	[illegible]ΦΑ[illegible]ΣΑ[illegible]ΩΝ	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													

Real Time Fire Monitoring – Service Validation Results

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 30 minutes in comparison to the Fire Brigade logs. The mean delay in fire detection is ~18.5 minutes.

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].

Thank You

For Further Information
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