



The Center of Earth Observation Research and Satellite Remote Sensing BEYOND for Disaster Management and Civil Protection



**Alexia Tsouni on behalf of Haris Kontoes, UN-SPIDER Regional Support Office Greece
Research Center of Excellence BEYOND (www.beyond-eocenter.eu)
Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing
National Observatory of Athens**



Flood



Land-slide



**Earth-quake
Erosion**



**Forest
Fire**



**Extreme
Phenom
ena**



Volcano



**Industrial
accident**



Tsunami

Aim

**Disaster
monitoring**
Area of interest:
**Southeast
Europe,
Mediterranean,
Middle East,
North Africa**

Aim

**Risk and disaster
assessment and
mitigation measures**
Area of interest:
Global scale



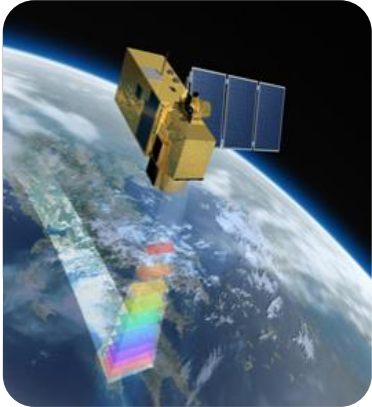
www.beyond-eocenter.eu



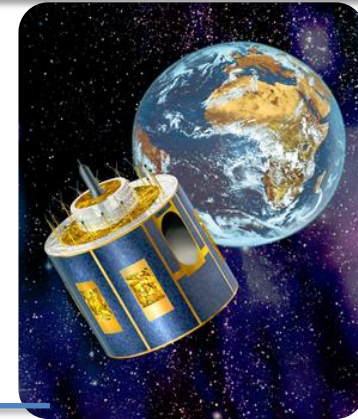
Project funded by the
EUROPEAN UNION



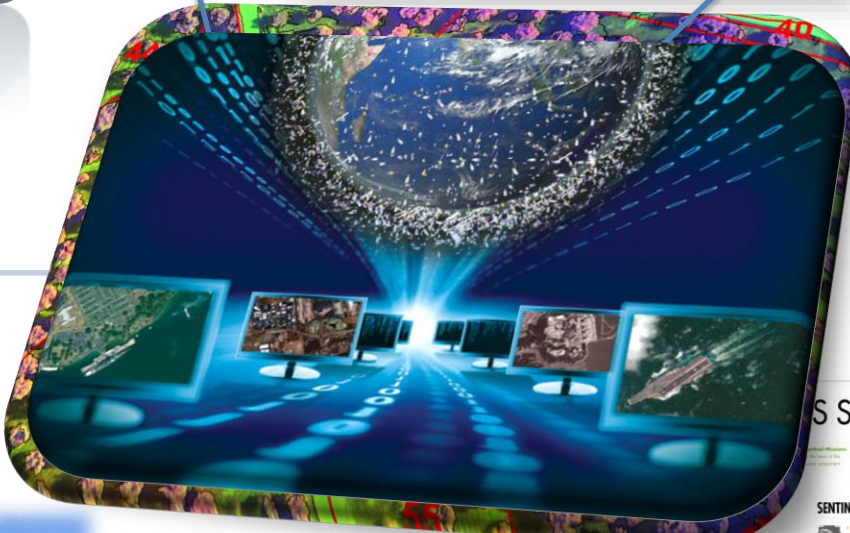
Monitoring Systems



Satellites
Polar Orbit
X-/L-band
Station
Sentinel
Mirror Site



Satellites
Geostationary
Orbit
MSG Seviri



in-situ

Terrestrial
Platforms and
Networks



Unmanned
Aerial
Vehicle




SENTINEL-1

- All-weather, day/night radar imaging enables the first real-time monitoring of the Earth's surface.
- 12 ground tracks with 10-20 m resolution and 120 km swath.
- Global coverage of the Earth's land surface every 12 days.
- Active Caliber and Space prime contractor for satellites and hardware.

SENTINEL-2

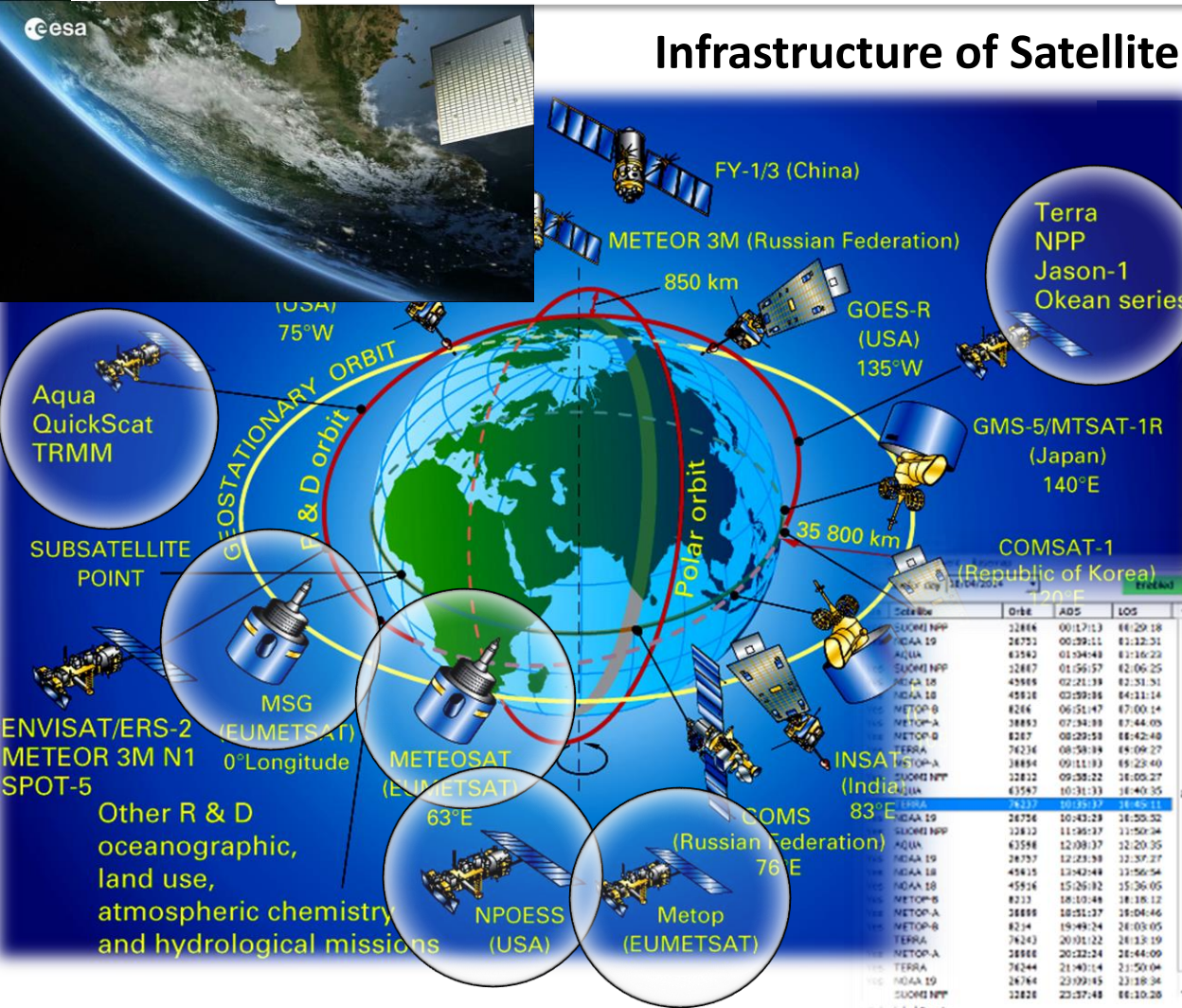
- 13 spectral bands with 10, 20 and 60 m resolution.
- 10-day revisit time.
- 2900 km swath.
- Global coverage of the Earth's land surface every 5 days.
- Active Caliber and Space prime contractor for satellites and hardware.

SENTINEL-3

- 6 spectral bands with 300 m resolution.
- 2400 km swath.
- Global coverage of the Earth's land surface every 3 days.
- Active Caliber and Space prime contractor for satellites and hardware.



Infrastructure of Satellite EO Data Collection

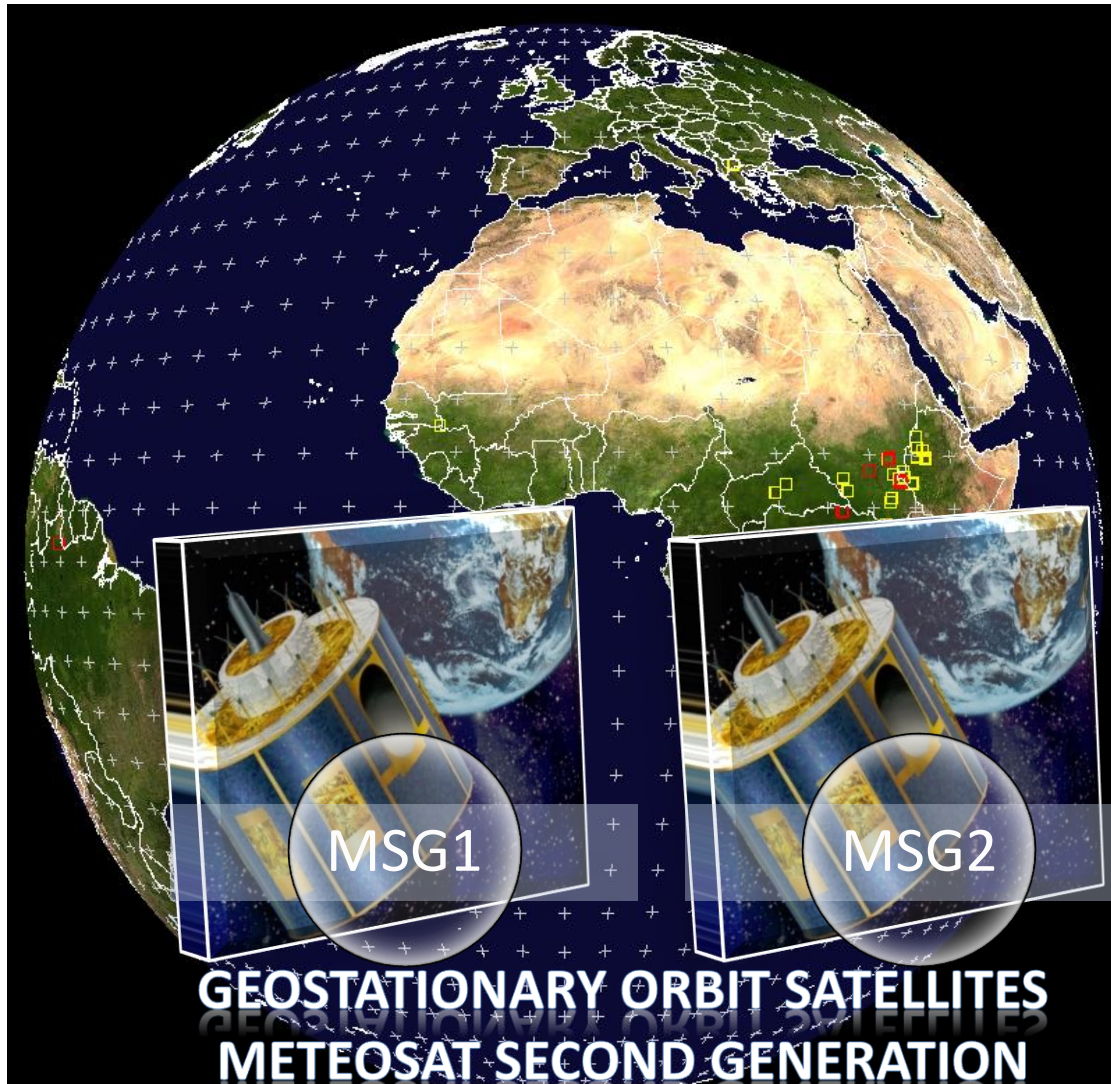


Orbit	AOS	LOS
SUOMI NPP	00:17:13	06:29:18
NOAA 19	00:29:11	01:12:31
AQUA	01:34:48	01:16:23
SUOMI NPP	01:56:57	02:06:25
NOAA 18	02:21:39	02:31:31
NOAA 18	02:29:36	04:11:14
METOP-A	06:51:47	07:00:14
METOP-B	07:34:39	07:44:05
METOP-B	08:29:58	08:42:48
TERRA	08:58:39	09:09:27
METOP-A	09:11:33	09:23:40
SUOMI NPP	09:28:22	10:05:27
SUOMI NPP	10:31:33	10:40:35
NOAA 19	10:43:23	10:50:32
SUOMI NPP	11:36:37	11:50:34
AQUA	12:08:37	12:20:35
NOAA 19	12:23:38	12:37:27
NOAA 18	13:42:48	13:56:54
NOAA 18	15:26:32	15:36:05
METOP-B	18:10:46	18:18:12
METOP-A	18:21:27	18:04:46
METOP-B	19:49:24	18:03:05
TERRA	20:01:32	18:13:19
METOP-A	20:22:24	18:44:09
TERRA	21:43:14	21:50:04
NOAA 19	23:09:15	23:18:34
SUOMI NPP	23:37:48	06:10:28



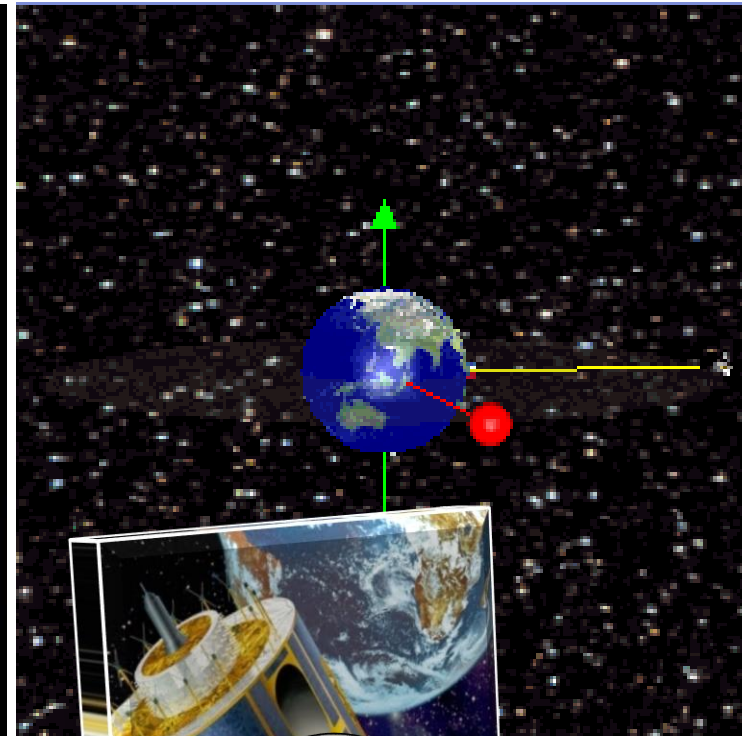
SATELLITES OF POLAR ORBIT, X-/L-BAND
300TB ARCHIVE – SERVICE 24/7

Infrastructure of Satellite EO Data Collection



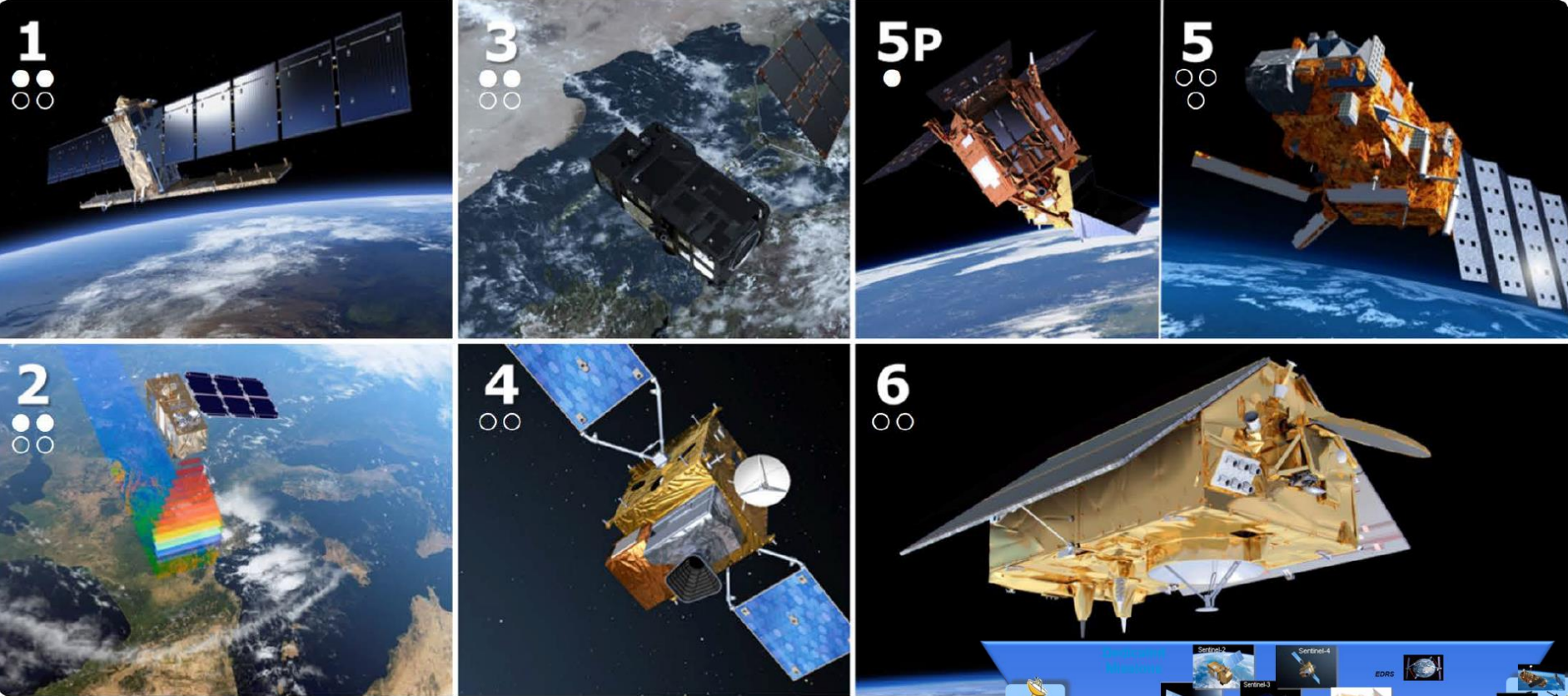
MPEF FIRE 2015-02-13 23:30 UTC

EUMETSAT



MSG3





Copernicus Sentinel Missions and Data Access



COPERNICUS and its SENTINELS

OBSERVING OUR PLANET FOR A SAFER WORLD

Copernicus follows and greatly expands the work of the European Envisat Programme with a global, continuous and high quality Earth observation capacity, by providing accurate, timely and easily accessible Earth Observation data. The EO data that are constantly collected by the Copernicus Sentinel satellites are used to address the monitoring of six main thematic areas: Atmosphere, Marine Environment, Land, Climate, Emergency and Security.

SENTINEL-1
All-weather, day/night radar imaging satellite for land and ocean services
• Able to "see" through clouds and rain
• Main Instrument: C-Band Synthetic Aperture Radar (CSAR)


SENTINEL-2
Medium resolution multispectral optical satellite for the observation of land, vegetation and water
• 13 spectral bands with 10, 20 or 60m resolution and 200km swath width
• Main Instrument: MultiSpectral Instrument (MSI)

SENTINEL-3
Measures sea surface topography with a resolution of 300m, sea and land surface temperature and soil moisture with a resolution of 1km
• Measures water vapour, cloud water content and thermal radiation emitted by the Earth
• Determines global sea surface temperatures with an accuracy greater than 0.3K
• Main Instruments:
- Ocean and Land Colour Instrument (OLCI)
- Sea and Land Wide-of-view Temperature Radiometer (SLWTR)
- SAR Radar Altimeter (SRAL)


SENTINEL-5P
Global observation of key atmospheric constituents, including ozone, nitrogen dioxide, sulphur dioxide and other environmental pollutants
• Improves climate models and weather forecasts
• Provides data continuity during the five-year gap between the retirement of Envisat and the launch of Sentinel-5
• Main Instrument: TROPOMI (Tropospheric Monitoring Instrument)

SENTINEL-4
Provides hourly updates on air quality and data on trace gas concentrations and aerosols in the atmosphere
• Provides information on short and spectral radiation balance
• Main Instrument: METSAT's Advanced Third Generation

COPERNICUS DATA HUB Operations Center



grnet
serco
Copernicus
esa
EU



The workstation features several monitors displaying various data visualizations:

- A large central monitor showing a world map with satellite orbits and a data table below it.
- A monitor on the left displaying a grid of data points, likely representing global temperature or sea level rise.
- A monitor on the right displaying a detailed map of the Mediterranean region with satellite data overlays.
- A monitor at the bottom center displaying a grid of data points, similar to the left monitor.
- A monitor at the bottom right displaying a dashboard with various charts and indicators.

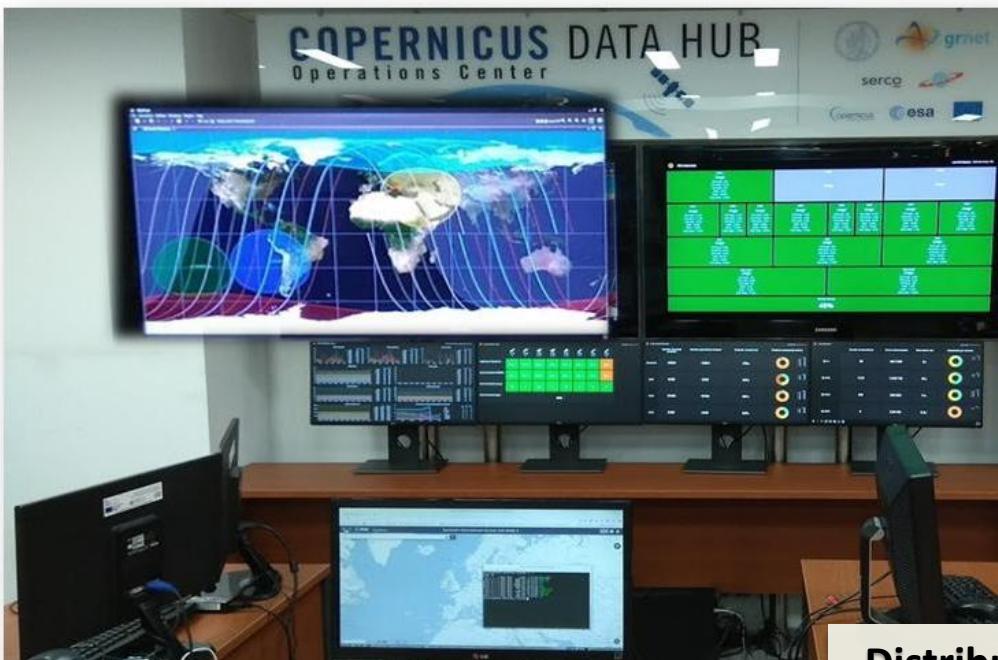
Sentinels Greek Hub | Operations bridge

Sentinel DataHub

PARTNERSHIP ESA – NOA – GRNET S.A.

COPERNICUS DATA HUB

Operations Center

- INTHUB #1
- COLHUB #3
- DIASHUB #3
- AfricaCastHub
- S-5p PreOps Hub
- S-5p Expert Users Hub
- TMPHUB #1
- HNSDMS

Distributes 55 TB Data/ Day
Operations 24/7/365
Speed GEANT 500-700 Mbps

60 VMs
storage: 800 TiB,
680 CPU cores,
2.2 TiB RAM

A 550 TB network filesystem for storing > 500 thousand Sentinel products at any time



<http://sentinels.space.noa.gr>

Role of Center of Excellence BEYOND in Global Emergency Management Program Copernicus



Regulation (EU) No 377/2014 - Copernicus

Program of work Copernicus

Sendai Framework – UN Agenda 2015-2030

ESA's Coll
Data HUB

ΕΛΛ
Μirr

COPERNICUS
Emergency Management Service

Home | What is Copernicus | EMS - Mapping | EMS - Early Warning System

LATEST NEWS - 2017-03-08 | [EMSN038] Post-disaster situation analyses of flood and landslides in Lima, Peru

EMS - MAPPING

- Service Overview
- Who can use the service
- How to use the service
- Products: Rapid Mapping
- Products: Risk and Recovery
- Quality control / Feedback
- User Guide

RAPID MAPPING

- Activations
- Map of Activations
- GeoRSS Feed

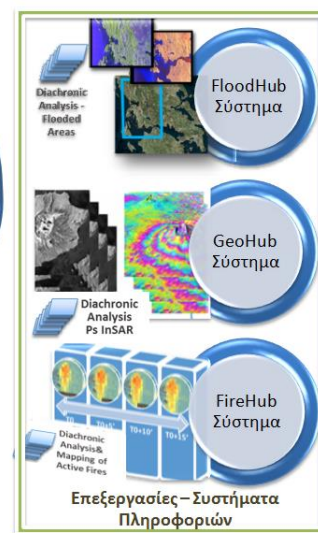
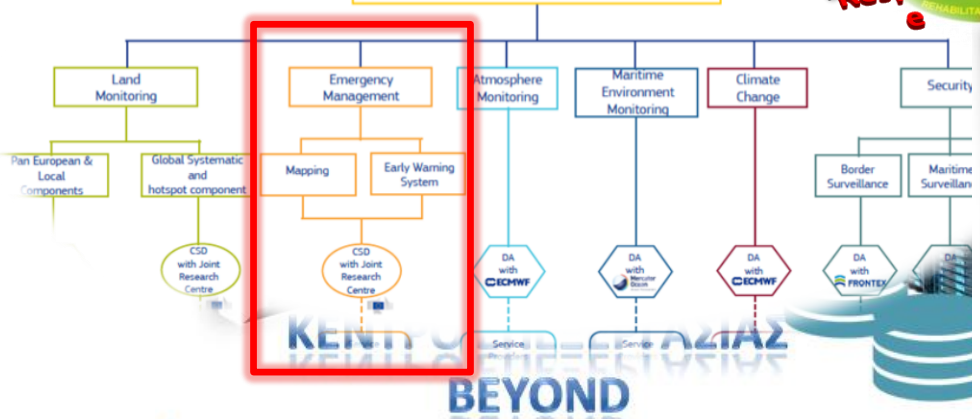
List of EMS Risk and Recovery Mapping Activations

Title	Event Type	Event Date (UTC)	Affected Countries
Contains	Drought Epidemic Extreme temperature Humanitarian Infestation Mass movement	Start date E.g. 2017-10-08 End date E.g. 2017-10-08	Afghanistan Albania Australia Austria Bangladesh Belgium Bermuda

Act. Code	Title	Country/Terr.	Feed
EMSN043	Tsunami risks assessment in Southern Italy	Italy	
EMSN041	Forest fire risks assessment in Croatia	Croatia	
EMSN040	Nation-wide asset mapping Finland	Finland	
EMSN039	Seismic risk assessment in Croatia	Croatia	
EMSN038	Post-disaster situation analyses of flood and landslides in Lima, Peru	Peru	
EMSN037	Multiple natural hazards risk assessment for UNESCO in three	Chile, Peru,	



Copernicus Services



Copernicus EMS Risk & Recovery Activations

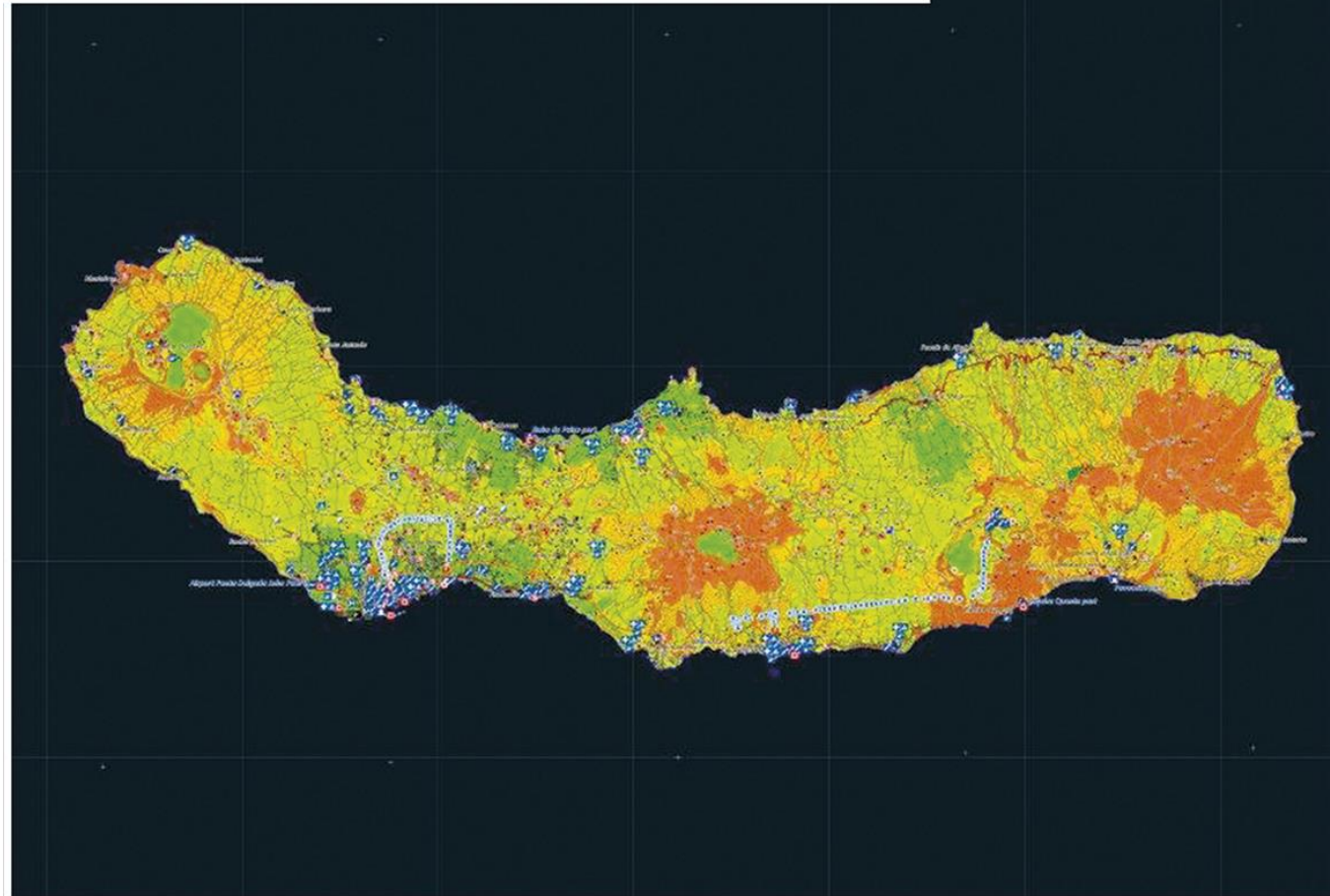
Azores islands, Portugal
[EMSN018](#)

Multiple natural hazards:

- Seismic
- Flash Flood
- Tsunami & Storm Surges
- Landslide & Erosion
 - Lava Flow
- Coastal Erosion

Σάο Μιγκελ - Πορτογαλία

Εκτίμηση κινδύνου για ισχυρές βροχοπτώσεις - κατολισθήσεις, 2015



Activation of BEYOND in the Copernicus Emergency Management Service EMS
Prevention – Preparedness – Assessment – Response – Recovery

CIVIL PROTECTION ACTIVATIONS



**Activation of
BEYOND in the
Copernicus
Emergency
Management
Service EMS
Prevention –
Preparedness –
Assessment –
Response –
Recovery**



Humanitarian Crisis

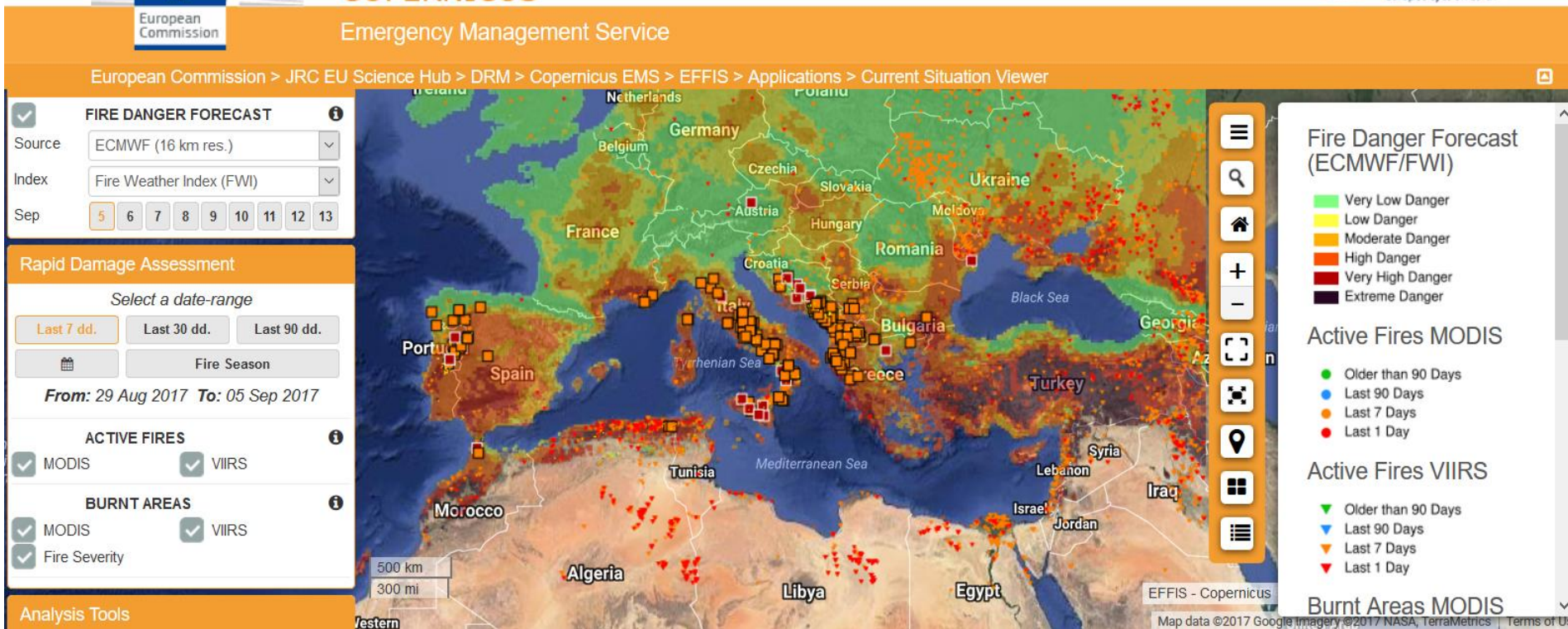


Activation of BEYOND in the framework of the European Fire Information System Program

Real time EFFIS – Collaboration NOA - DLR-e-GEOS-SERTIT



COPERNICUS
Emergency Management Service

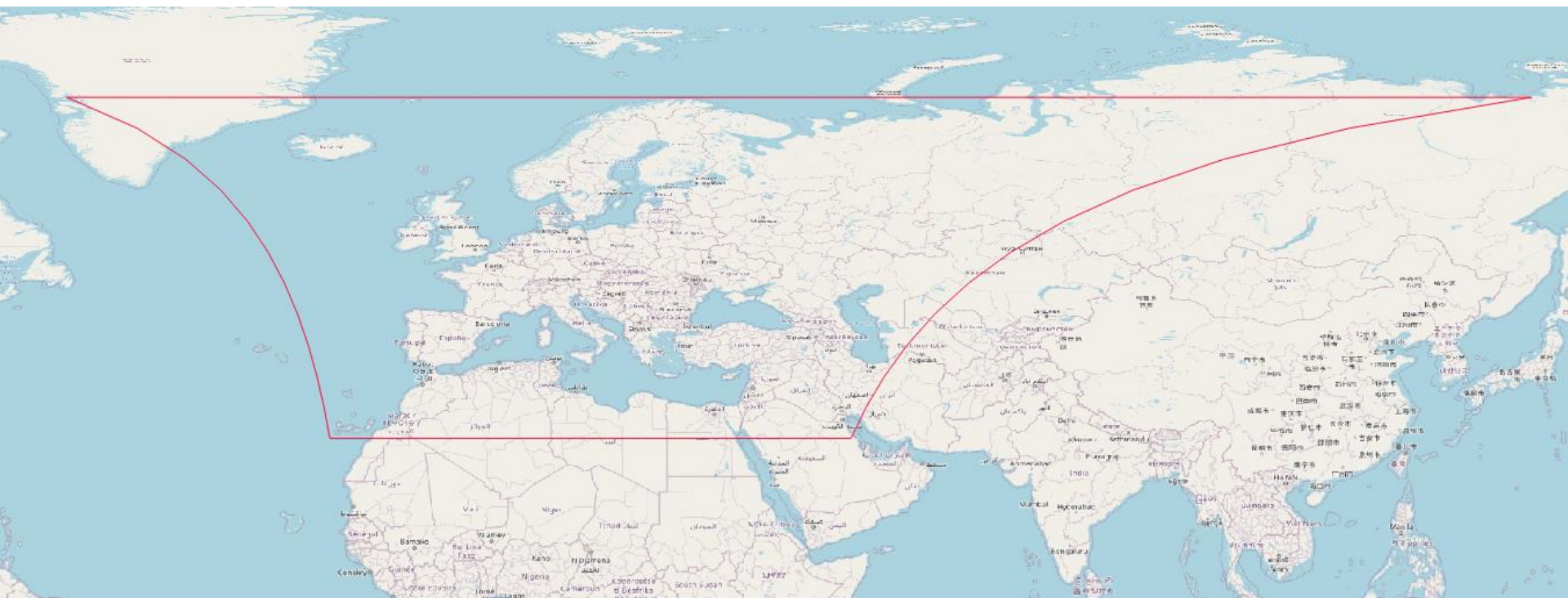


Area(s) of responsibility Europe, N. Africa, M. East, Balkans

POSSIBLE SUPPORT OF THE UN-SPIDER REGIONAL SUPPORT OFFICE GREECE TO AFRICA:

Set up data flows to provide shapefiles or other formats for Near Real-Time Fire Monitoring system and Burned Scar Mapping through processing of medium resolution satellite images (NPP & JPSS - VIIRS)

EFFIS AOI partly covering North Africa



FIREHUB: A SPACE BASED HUB OF FIRE MANAGEMENT SERVICES



Early fire detection and real-time fire monitoring



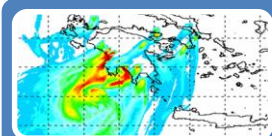
Rapid Burnt Scar and Fire Severity Mapping during crisis



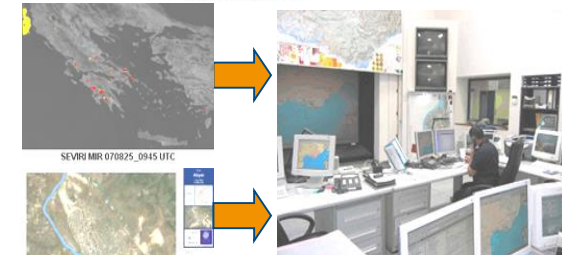
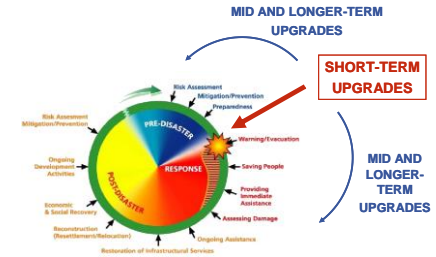
Detailed Burnt Area Mapping and Damage Assessment



Diachronic Burnt Area Mapping and Damage Assessment



Hourly Forecasting of Fire Smoke Dispersion during crisis

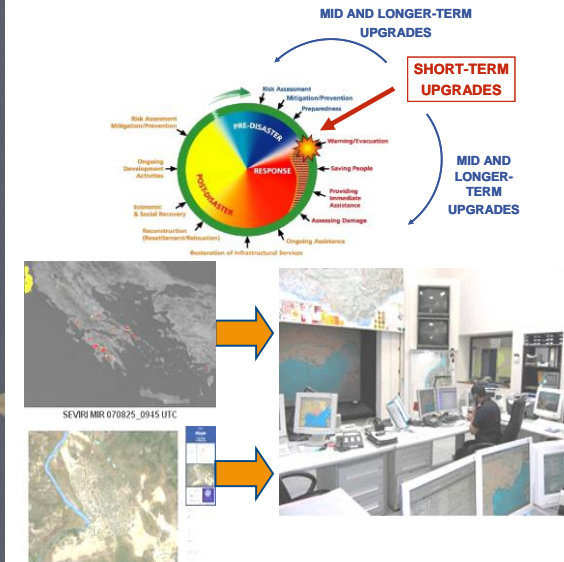


FIREHUB: A SPACE BASED HUB OF FIRE MANAGEMENT SERVICES

**PATENT
INDUSTRIAL
PROPERTY
ORGANISATION**

10:00 AM
12:00 AM
4:00 AM

**BEYOND
FireHub**



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



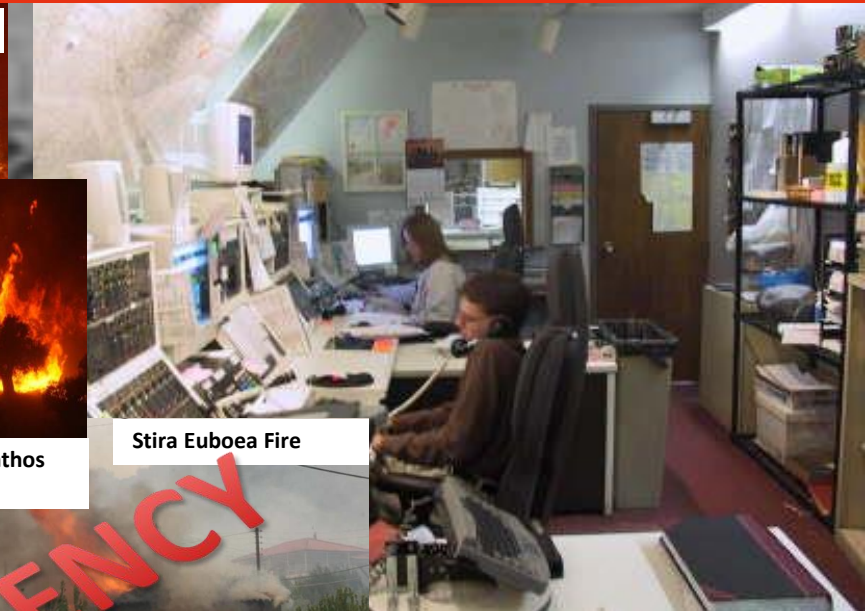
Zaharo Fire



Olympia site Fire



AliveriEuboea Fire



Korinthos Fire

Stira Euboea Fire



Parnon Mt Fire



Taygetos Mt Fire



Megalopolis Fire



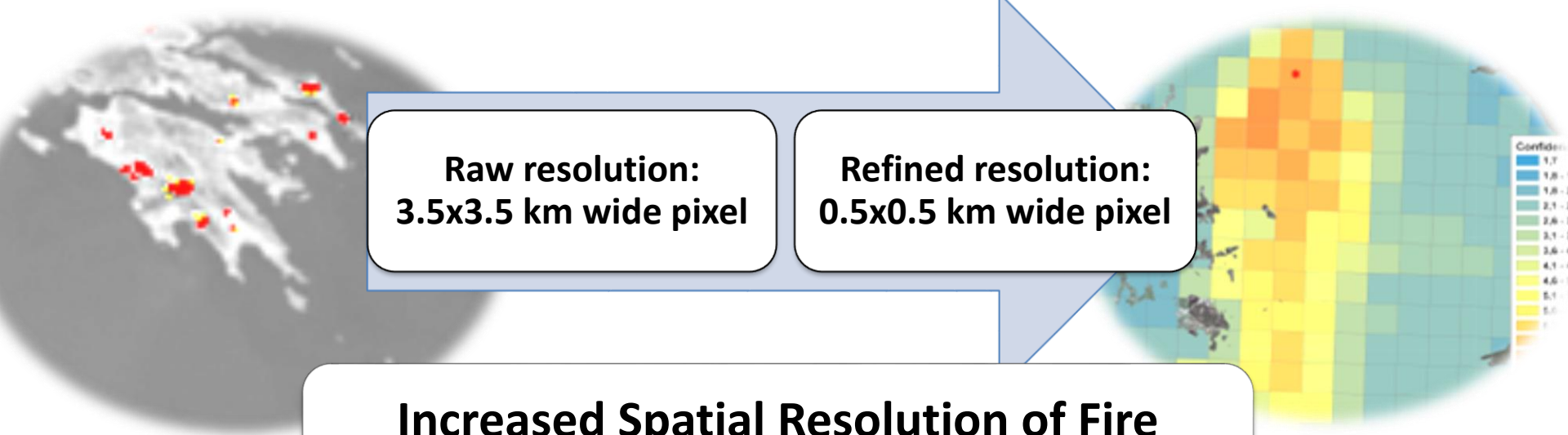
Otilon Fire



SEVIRI MIR 070823_1030 UTC

POTENTIAL FIRE
CONFIRMED FIRE

FIREHUB: INNOVATIVE EARLY DETECTION AND RT FIRE MONITORING



**Raw resolution:
3.5x3.5 km wide pixel**

**Refined resolution:
0.5x0.5 km wide pixel**

**Increased Spatial Resolution of Fire
Monitoring by 49 Times – (500mx500m)**
– Multi Source Multi Resolution EO Data
Fusion in RT

Meteo Data
(Wind
Forecasts
direction,
speed)

**Detailed
Fuel Maps &
Historical
Assessments
of Fuel
Vulnerability**

**Geographic
Aspects:**
Altitudinal
Zones,
Slope/Aspect

**Fire Spread
Modelling**
Assimilation
with RT
SEVIRI
Observations

Results @ 150 minutes after fire ignition

+30'

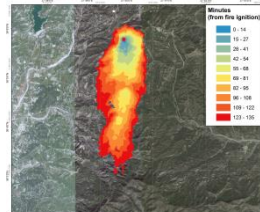
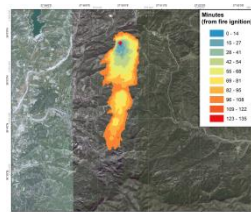
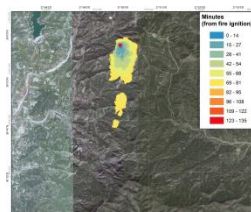
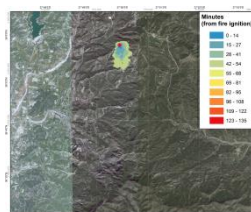
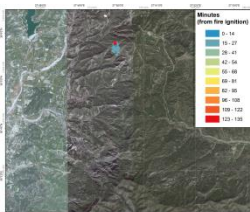
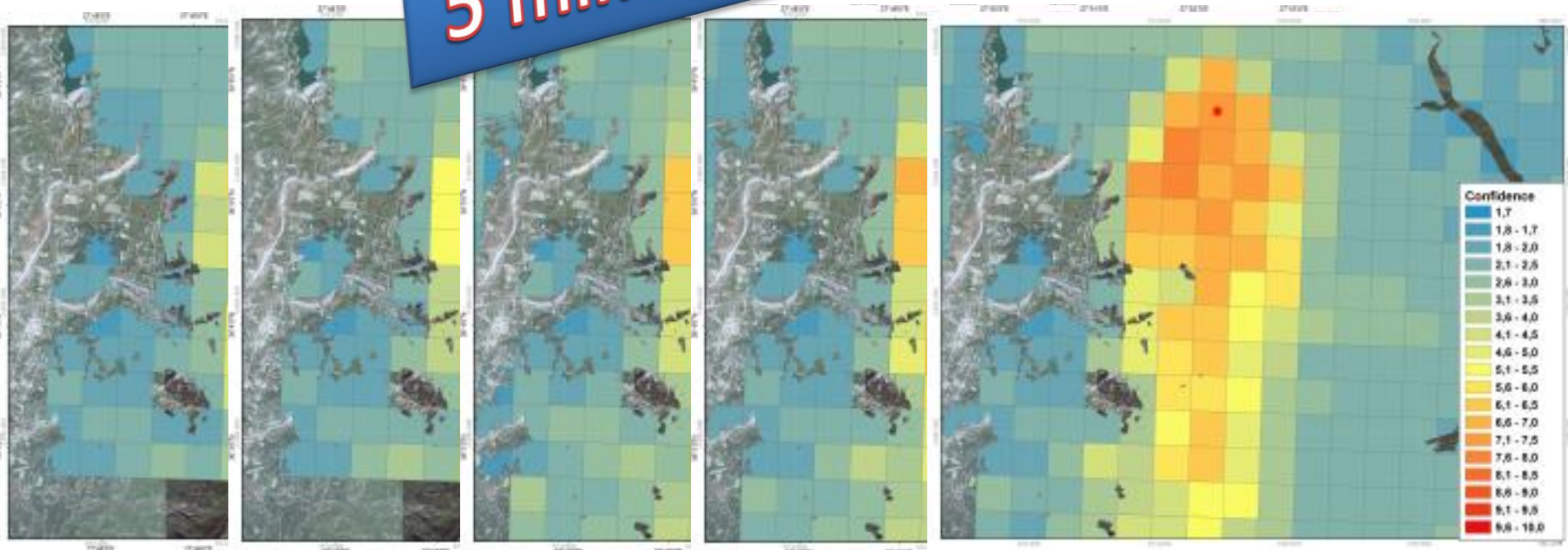
+35'

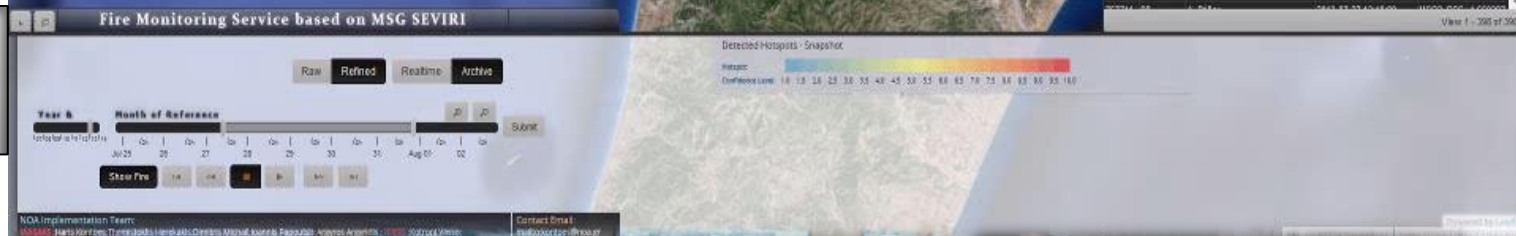
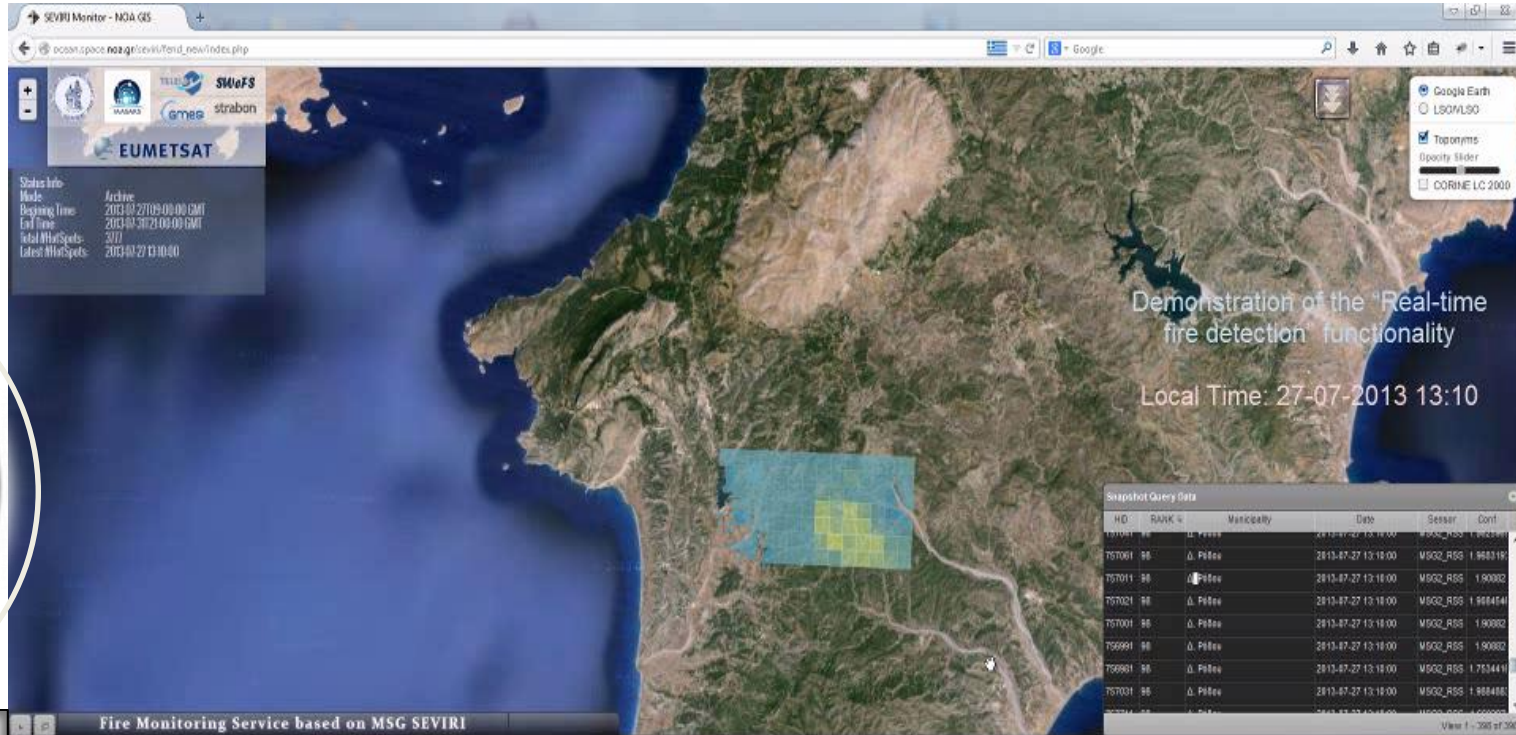
+40'

+45'

+50'

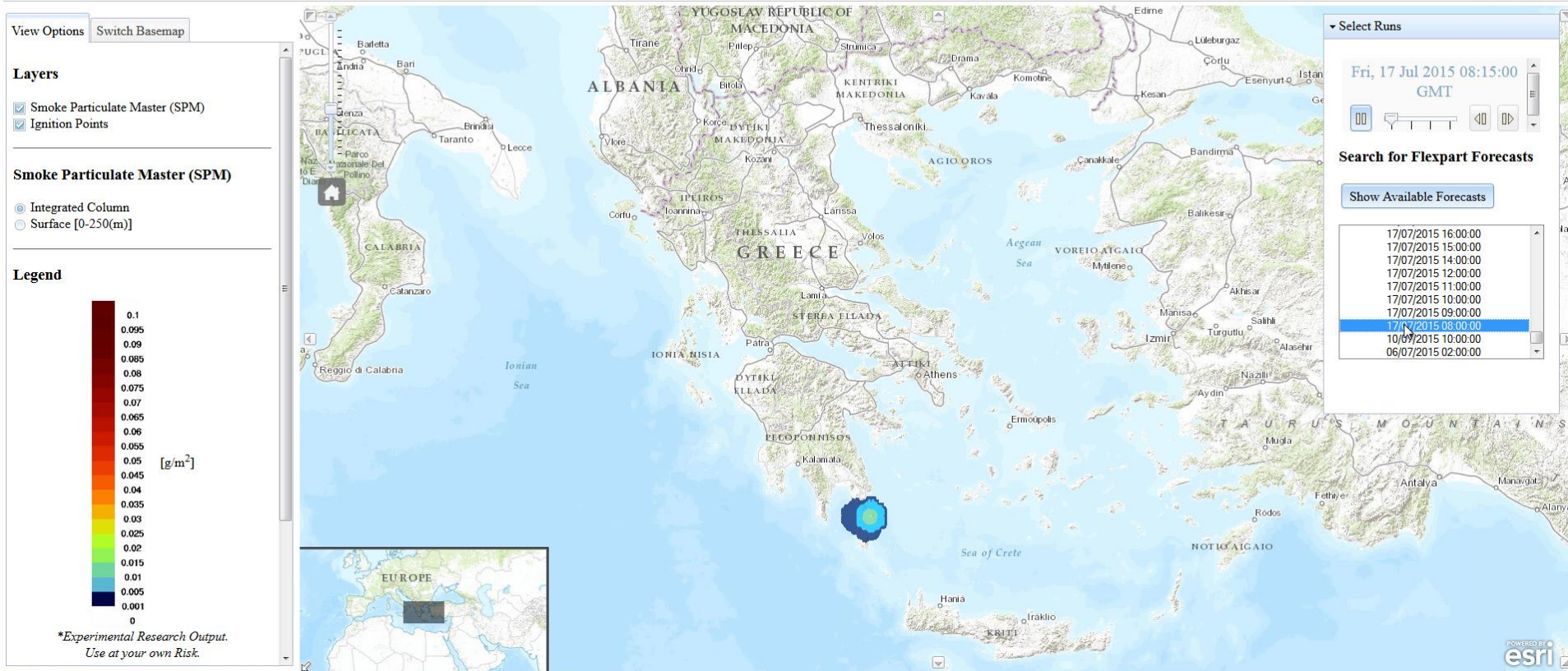
5 minutes basis





Rhodes Island
27/7/2013



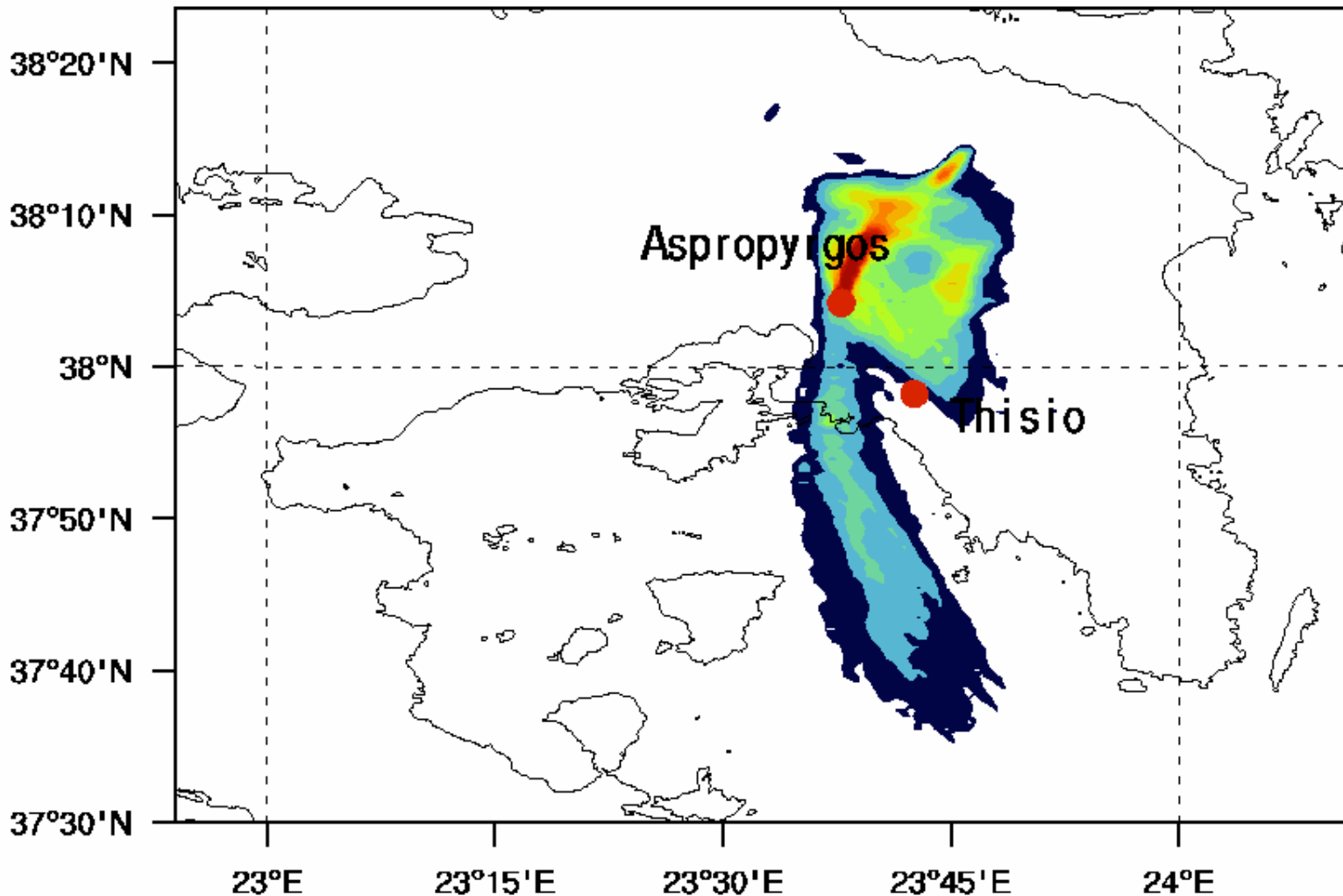


Spatial and temporal smoke dispersion of the smoke from wild fires

FireHub

BEYOND / NOA FLEXPART
Smoke Integrated Column

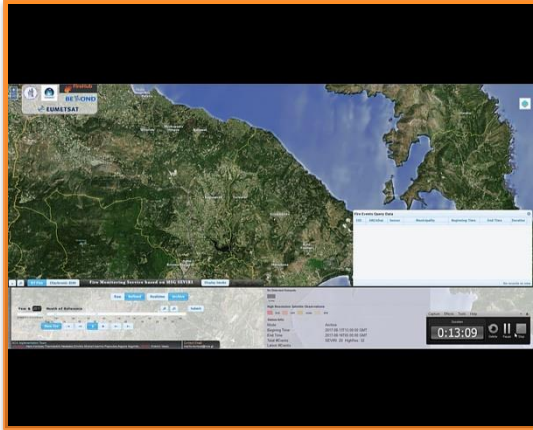
valid:09-06-2015 1300 UTC
(Arbitrary Values)



**Spatial
and
temporal
toxic
plumes
dispersion
from
industrial
accident**

FireHub

**First fire detection
in 10'**



Meteosat SG –SEVIRI

Day #1
NPP-VIIRS
MR=375m
20170817 11:14



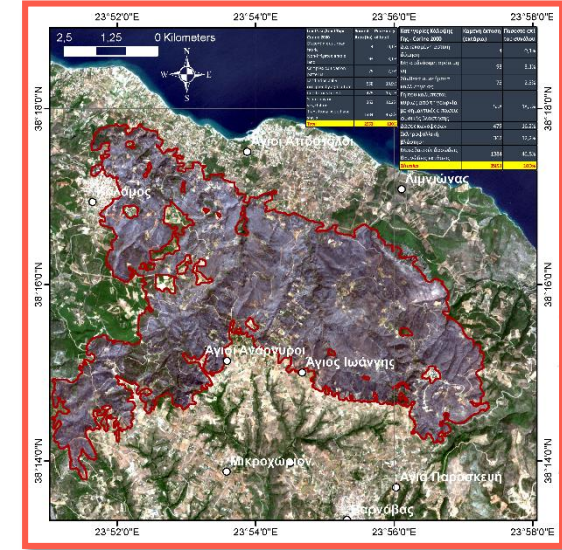
Day #2
MODIS-Terra
MR=250m
20170818_1055



Day#3
NPP-VIIRS
MR=375m
20170819_1057



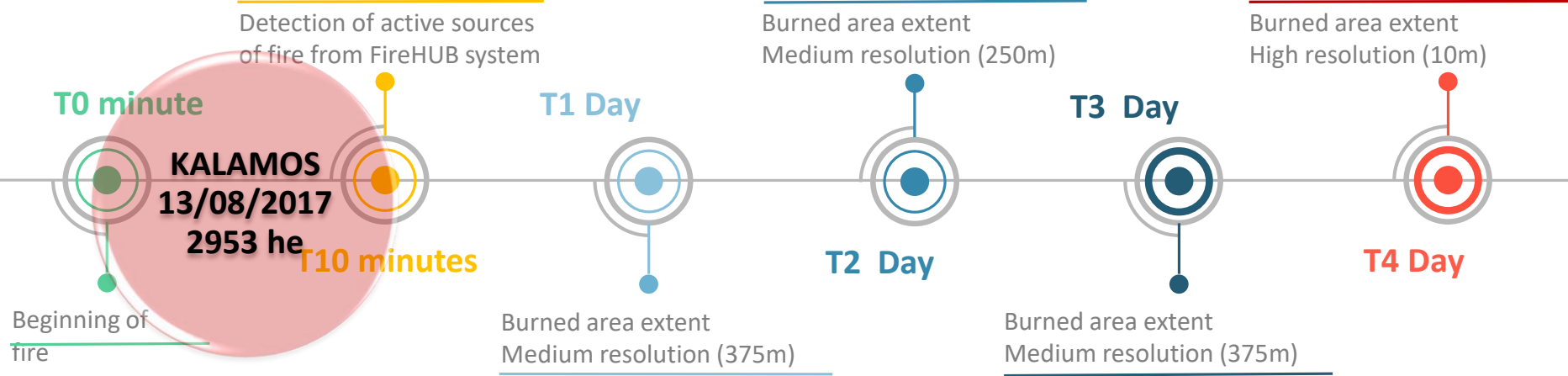
Day #4 Sentinel-2 HR-10 m



P1 **Detection - Fire Monitoring**
- Resolution 500 m/5 minute

P2 **Rapid daily Mapping at Medium**
Resolution - 2-3 times /day

P3 **Rapid Mapping at High Resolution/**
5 days





FireHub

MATI
EAST ATTICA

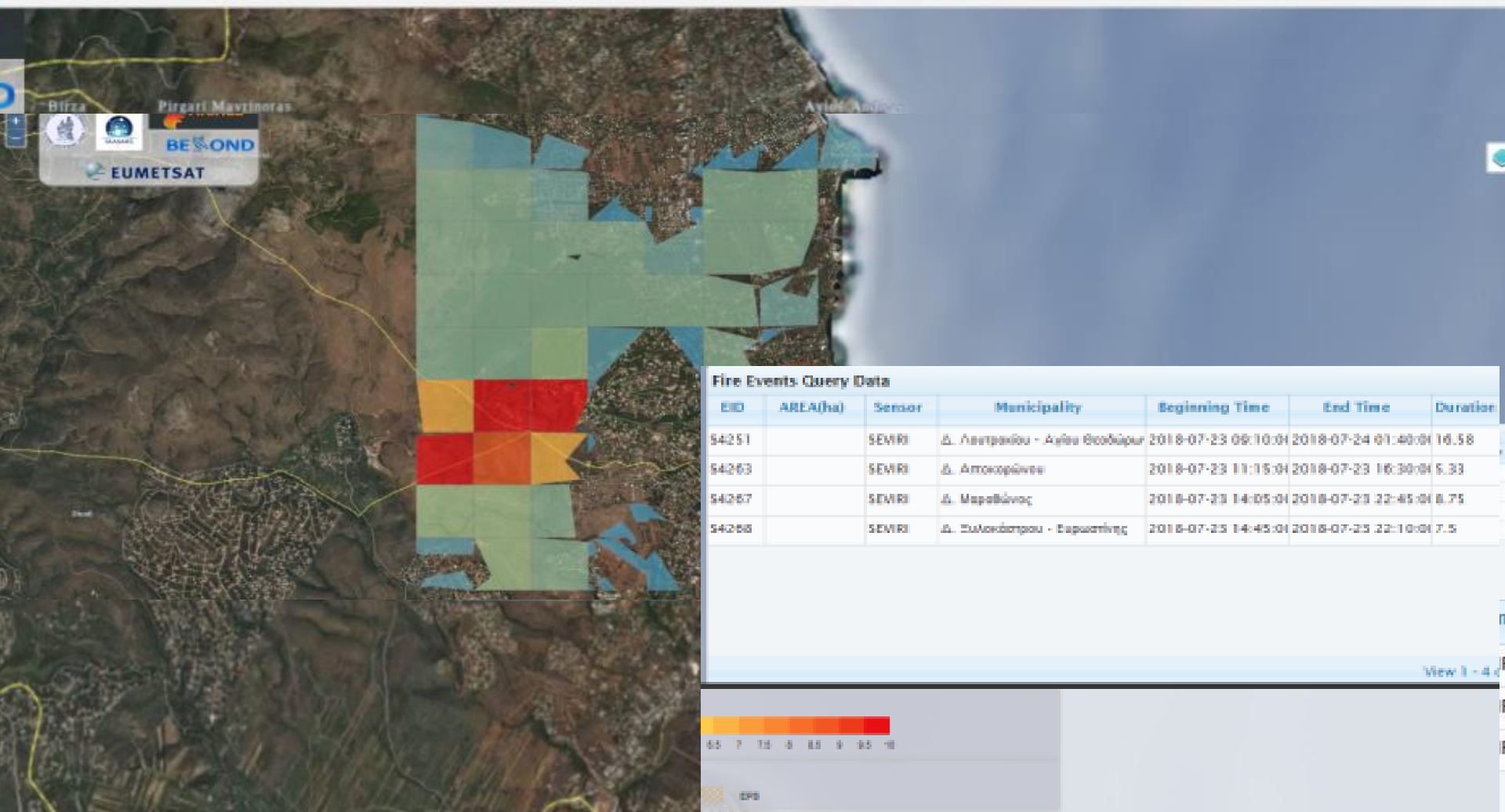
10 August 2018

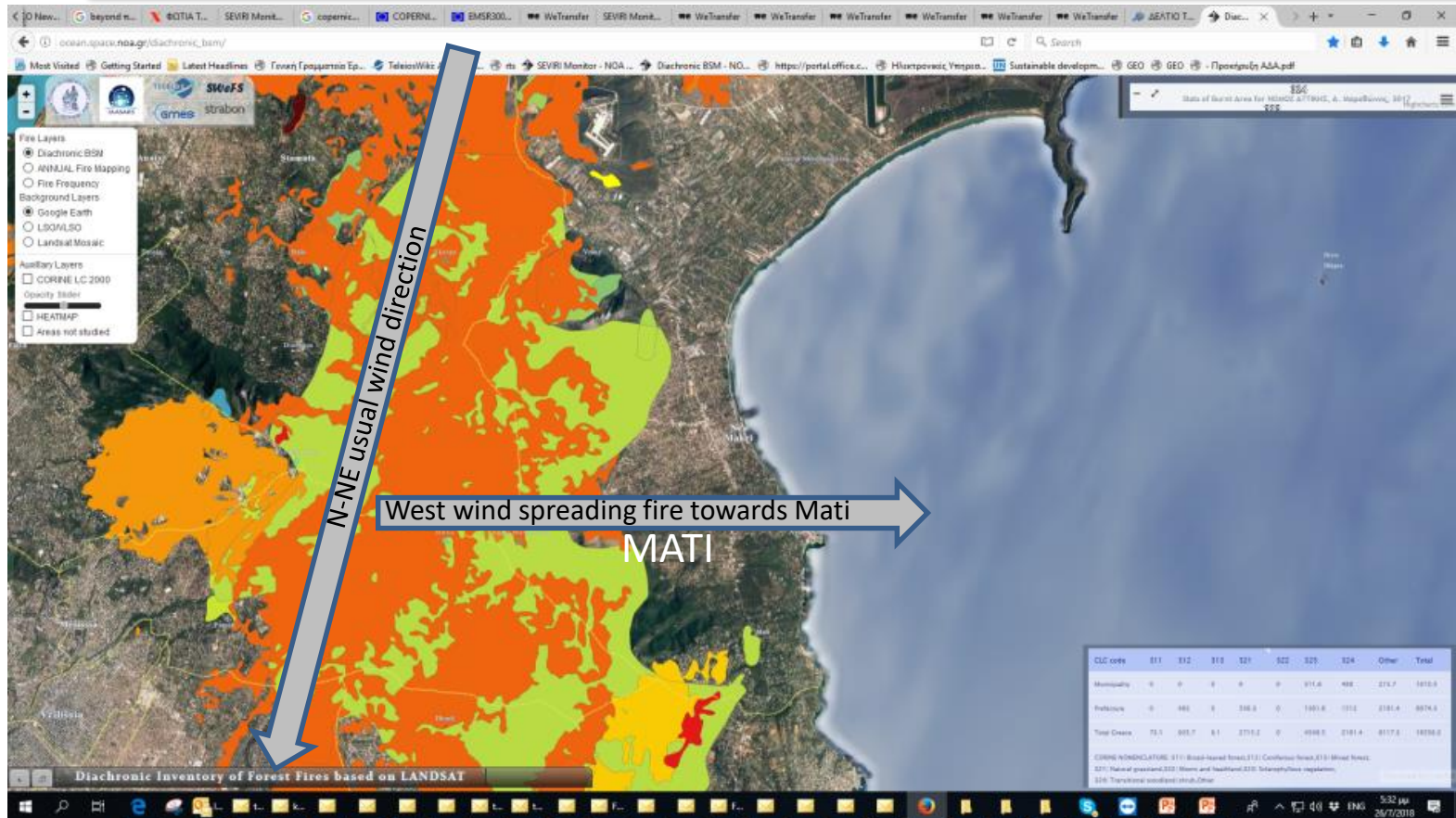
Deadly Forest Fire
103 dead people
126 ha burnt



On 23/07/2018 at 17:05, FireHub detected source of fire in the Municipality of Marathon, above Mati.

1.203.238/seviri/





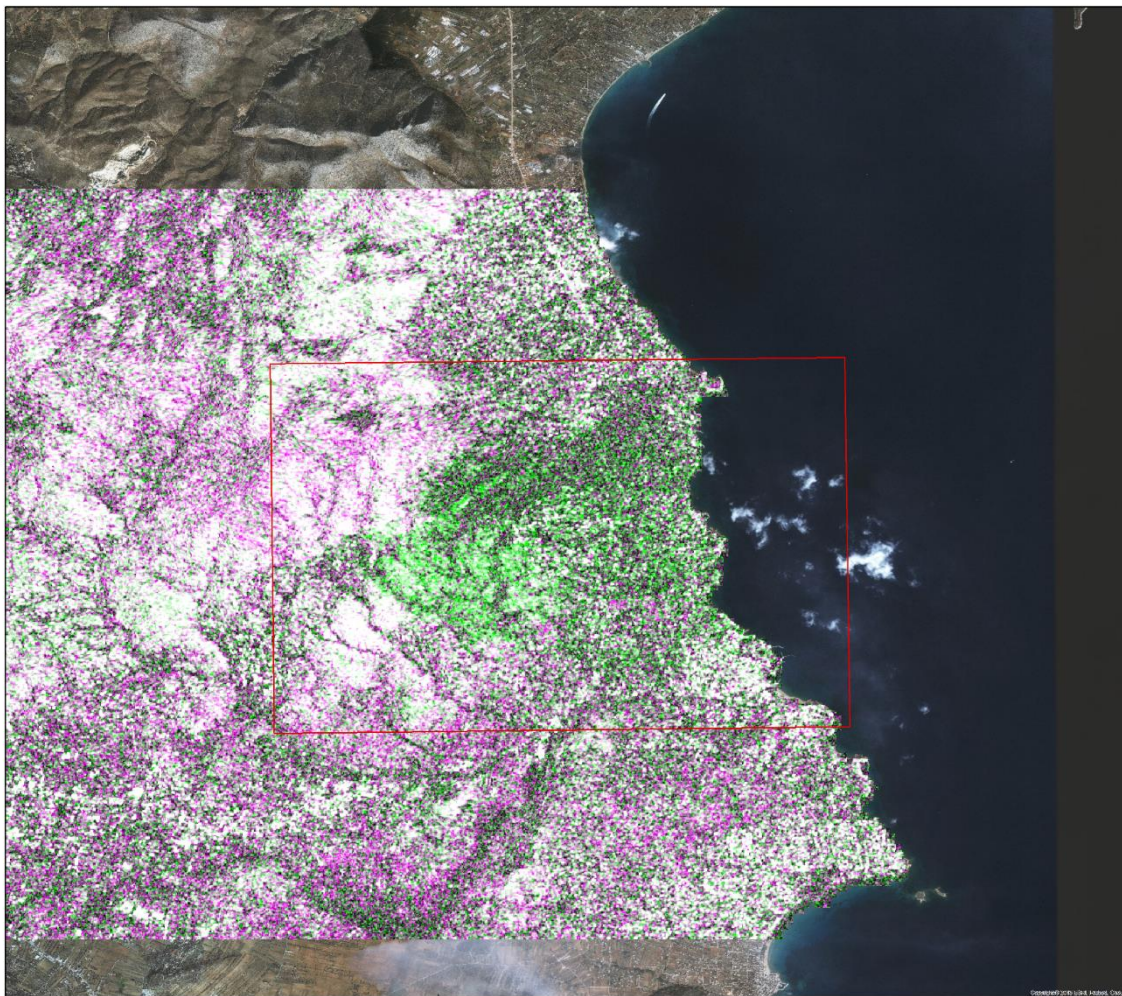
- This map shows the diachronic mapping of fire over the last 35 years in Attica. Different colours indicate fires in different years. Detailed information for each fire polygon can be found at http://ocean.space.noa.gr/diachronic_bsm/
- The site provides also information on the frequency of fire occurrence, therefore depicts areas around Athens that have been burned twice or three times over the years. The important element is that the fires over the years have a N-S distribution because of the usual N-NE winds affecting Athens (grey arrow). The black arrow shows the direction of the unusual wind pattern that facilitated the spread of the devastating fire towards Mati (the dramatically affected area-the circled one). Because of the non occurrence of fires towards Mati the last years, that is the undisturbed forest development in the area, and the high mixture of forested lands with the residential uses largely developed over the last years, resulted in the dramatic casualties in only a few hours.

Satellite SAR images Sentinel-1A acquisition date 12-7-2018 & 19-5-2018 (pre-event) and 24-7-2018 (post-event).



BEYOND

FireHub



Μάτι (Ανατολική Αττική)
Πρώτη εκτίμηση των καμμένων εκτάσεων με χρήση τηλεοπτικής τηλεπισκόπησης 24-07-2018

Ημερομηνία Παραγωγής: 25/07/2018



Χαρτογραφικές Πληροφορίες

1:32.847 Grid: WGS 1984 Coordinate System

Υπόμνημα

Περιοχή εκτίμησης καμμένων εκτάσεων

Sentinel-1A SLC (VV polarization)

RGB Pseudocolor

Red: Coherence_12-07-2018 & 24-07-2018 (μετά-γεγονός)

Green: Coherence_12-07-2018 & 19-05-2018 (προ-γεγονός)

Blue: Coherence_12-07-2018 & 24-07-2018 (μετά-γεγονός)

Πληροφορίες Χάρτη

Ο χάρτης έχει δημιουργηθεί από το Κέντρο Αριστίας BEYOND του ΙΑΑΔΕΤ/ΕΑΑ. Ο σκοπός του προϊόντος αυτού είναι να δώσει μία πρώτη εκτίμηση για την επάρκεια των καμμένων εκτάσεων της πυρκαγιάς που έλαβε χώρα στις 23 Ιουλίου 2018 στην ευρύτερη περιοχή γύρω από τον οικισμό Μάτι στην Ανατολική Αττική.

Πηγές Δεδομένων

Ενέτες χάρτες με βάση ESRI Imagery World 2D, Πνευματικά δικαιώματα: © 2013 ESRI, i-cubed, GeoEye, Επεξεργασμένες Δορυφορικές Εικόνες Sentinel 1 SAR SLC (VV) που αποκτήθηκαν στις 19-05-2018, 12-07-2018 & 24-07-2018.

Παραγωγή Χάρτη

Χρησιμοποιήθηκαν δεδομένα Sentinel-1A SLC (Single Complex Look), κατά της πολωσης (VV) με καθόλη τη τροχιά Αήλιου, με ημερομηνίες 12-07-2018 & 19-05-2018 (προ-γεγονός) και 24-07-2018 (μετά-γεγονός). Η πρώτη εκτίμηση των καταστροφών υλοποιήθηκε εφαρμόζοντας την τεχνική της συμβολομετρικής συνθέσεως σε δυο ζευγή εικόνων, με το πρώτο ζεύγος να αφορά τις δυο προ-γεγονότος εικόνες (12-07-2018 & 19-05-2018) και το δεύτερο τις εικόνες μετά-γεγονότος (24-07-2018) και προ-γεγονότος (12-07-2018). Ειδικότερα, οι αλλαγές του τοπίου ανιχνεύονται μέσω της δημιουργίας μιας μεμβρανικής εικόνας και εντοπίζονται στις περιοχές που απεικονίζονται με πράσινο χρωματισμό.

Δημοσίευση

Το προϊόν διατίθεται μέσω της ιστοσελίδας του BEYOND στην ακόλουθη διεύθυνση URL: <http://beyond-eccenter.eu/index.php/fires>

Πλαίσιο

Ο χάρτης εκπονήθηκε από το Κέντρο Αριστίας BEYOND. Όλες οι γεωγραφικές πληροφορίες έχουν περιορισμούς λόγω της κλίμακας, της ανάλυσης και της ημερομηνίας των αρχικών δεδομένων.

Στοιχεία Επικοινωνίας

Δρ. Χάρης Κοντοές, Διευθυντής Ερευνών ΕΑΑ
E-mail: kontoes@noa.gr



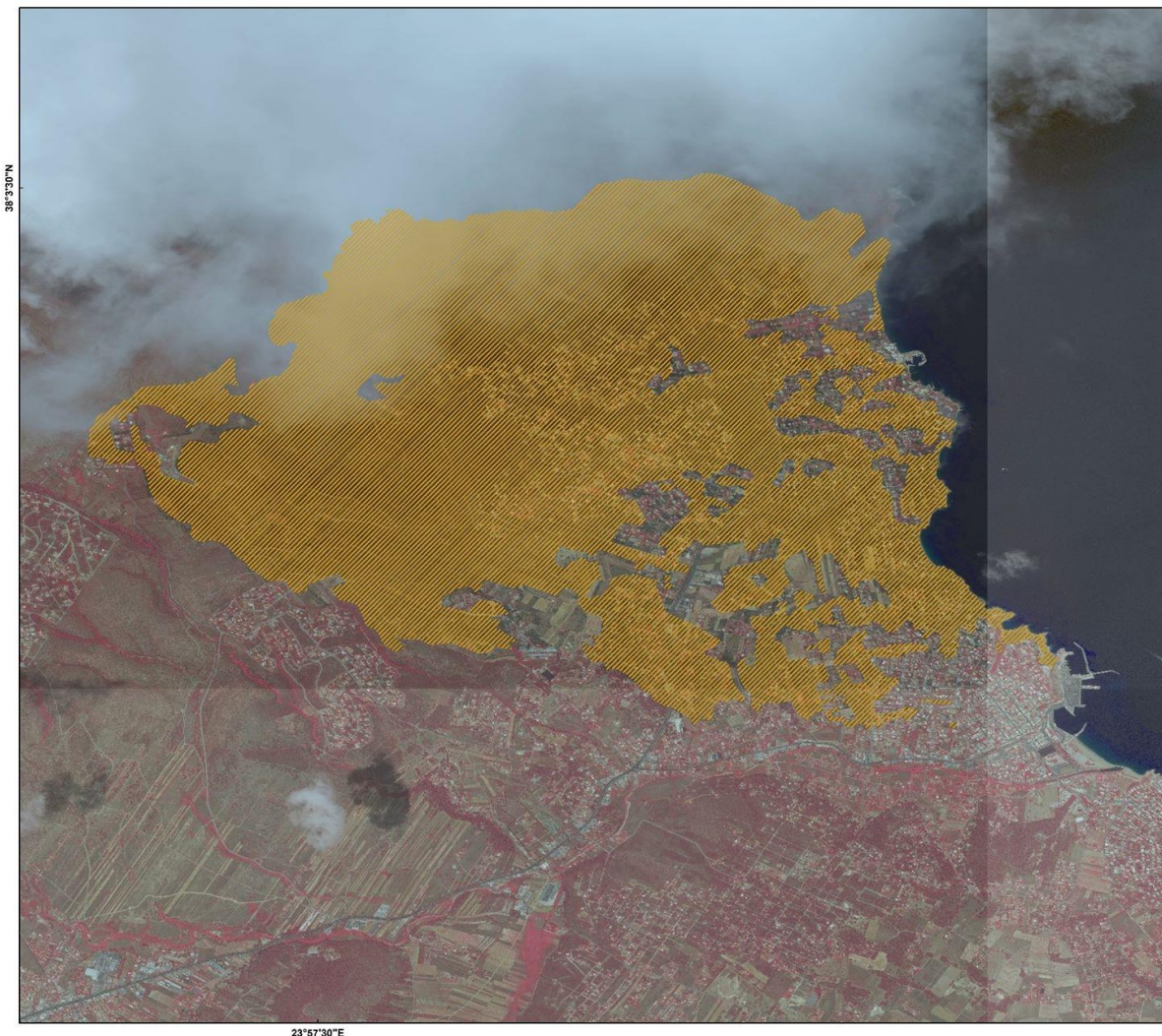
Satellite image WORLDVIEW-3 very high spatial resolution (30 cm), sponsored by TotalView.



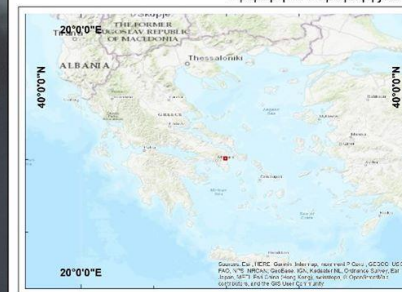
BEYOND

FireHub

Μάτι (Ανατολική Αττική)
Λεπτομερής εκτίμηση των καμμένων
εκτάσεων 26-07-2018




Ημερομηνία Παραγωγής: 27/07/2018



Χαρτογραφικές Πληροφορίες

1:15.000
Grid: WGS 1984 Coordinate System

Υπόμνημα

 Περιοχή εκτίμησης καμμένων εκτάσεων 26-07-2018, συνολικής έκτασης της τάξης των 1260 ha

Πληροφορίες Χάρτη

Ο χάρτης έχει δημιουργηθεί από το Κέντρο Αριστίας BEYOND του ΙΑΑΔΕΤ/ΕΑΑ. Ο σκοπός του προγράμματος αυτού είναι να δώσει την επικαιροποίηση της προηγούμενης εκτίμησης της επιφάνειας των καμμένων εκτάσεων της πυρκαγιάς που έλαβε χώρα στις 23 Ιουλίου 2018 στην ευρύτερη περιοχή γύρω από τον οικισμό Μάτι στην Ανατολική Αττική, η οποία βασίστηκε σε δορυφορικά δεδομένα υψηλής ανάλυσης. Η νέα εκτίμηση είναι της τάξης των 1260 ha.

Πηγές Δεδομένων

Επιτελεσμένη δορυφορική Εικόνα WORLDVIEW-3 πολύ υψηλής χωρικής ανάλυσης (30 εκ.) ημερομηνίας λήψης 26/07/2018, χορηγία της εταιρείας TotalView.



Παραγωγή Χάρτη

Πραγματοποιήθηκε φωτομετρία της δορυφορικής εικόνας WORLDVIEW-3, η οποία ελήφθη 3 ημέρες μετά το γεγονός. Η λεπτομερέστερη εκτιμώμενη έκταση των καμμένων περιοχών είναι της τάξης των 1260 ha. Θα ακολουθήσουν ακριβέστερες εκτιμήσεις υπερψηφικής ανάλυσης με χρήση UAV.

Δημοσίευση

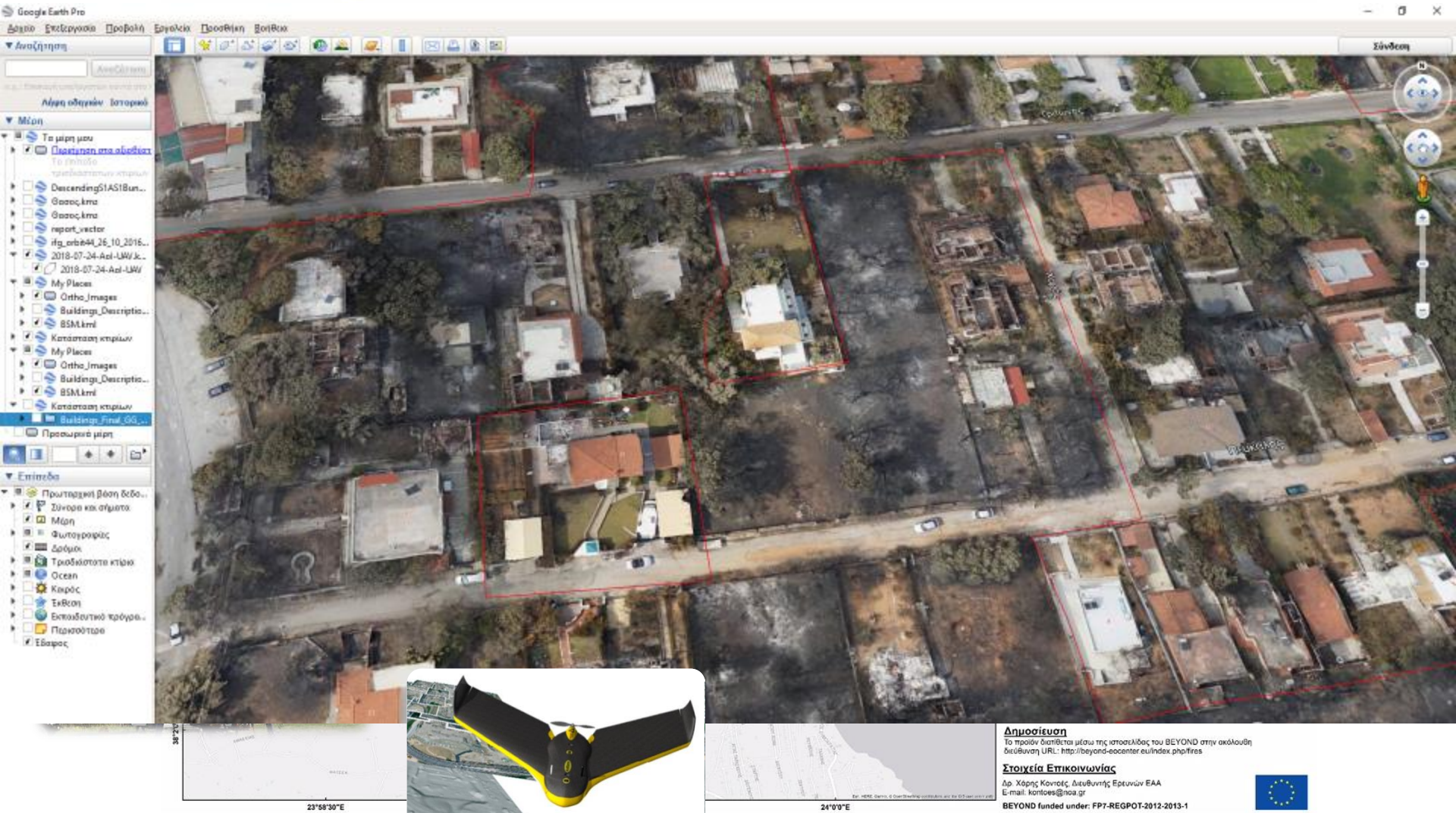
Το προϊόν διατίθεται μέσω της ιστοσελίδας του BEYOND στην ακόλουθη διεύθυνση URL: <http://beyond-eocenter.eu/index.php/fires>

Στοιχεία Επικοινωνίας

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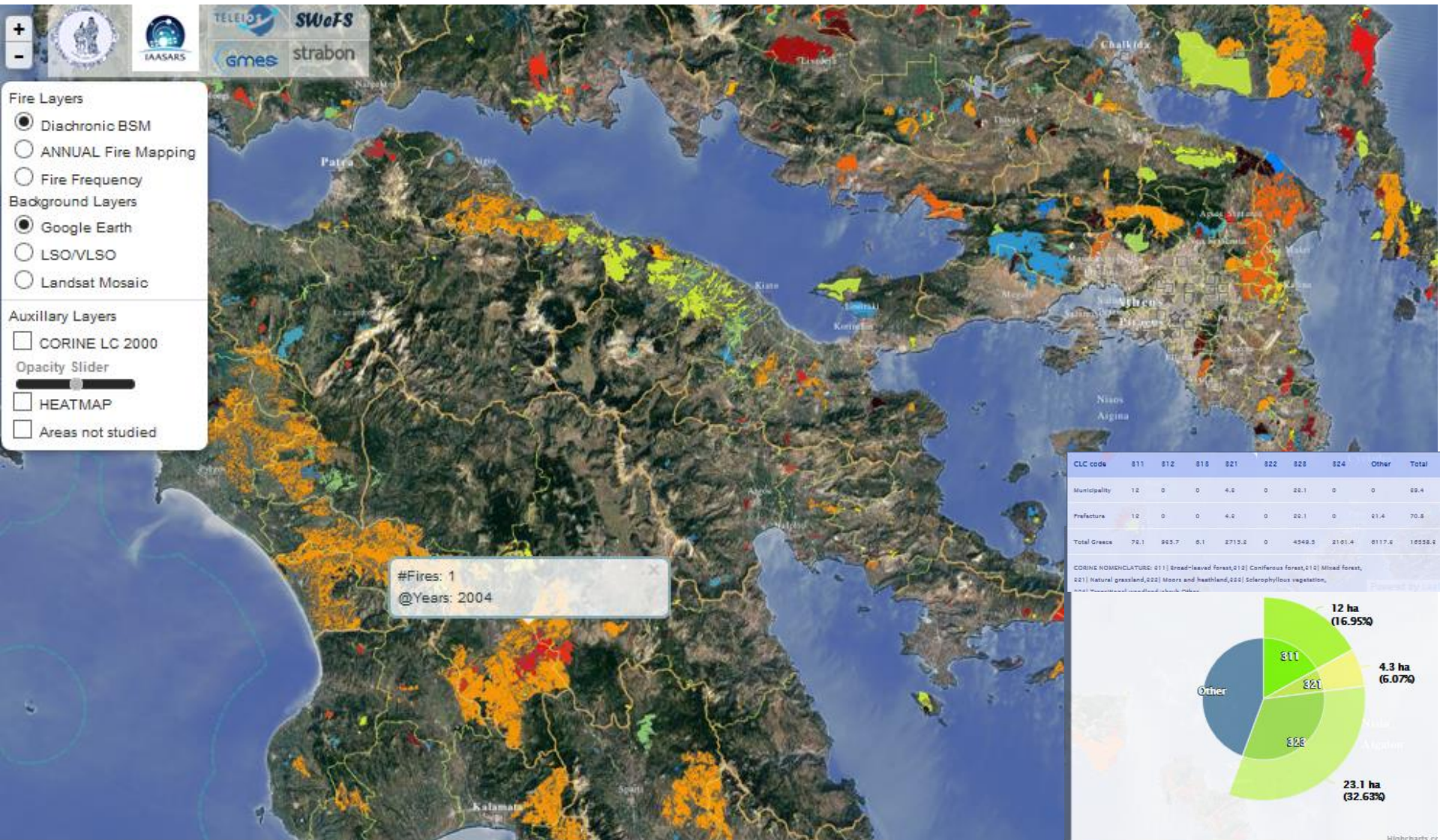


Orthographic map with detailed hazard assessment at building block level using Drones / UAV (Falcon type) very high spatial resolution (3,5 cm) (DAEFK - YPOMEDI)



DIACHRONIC MAPPING SINCE 1984

HIGH RESOLUTION SATELLITE IMAGES LANDSAT TM, SPOT, IKONOS, SENTINEL-2



**Fire
Monitoring
Service
based on
MSG SEVIRI
for the
Fire Brigade**



POSSIBLE SUPPORT OF THE UN-SPIDER REGIONAL SUPPORT OFFICE GREECE TO AFRICA:

Transfer of know-how based on NOA's experience on the FireHub system:

- ✓ Development of an operational / Early Fire Detection and Real-Time Fire Monitoring system, through the processing of low resolution images (MSG SEVIRI) and upscale to medium resolution.
- ✓ Mapping of diachronic burned areas / Burned Scar Mapping, through the processing of high resolution images (Sentinel-2 & Landsat).

thank you!

