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UNIVERSITÄT BONN GEOGRAPHIE ZFL

UN-SPIDER Bonn International Conference, 16 to 18 November 2021

Use of space technologies to forecast and monitor forest fires in Greece

Haris Kontoes, Stella Girtsou

National Observatory of Ethens – IAASARS – BEYOND Center of Excellence

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Centre of EO Research & Satellite Remote Sensing

FireHUB

http://beyond-eocenter.eu

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http://beyond-eocenter.eu/index.php/web-services/firehub

FireHUB Click the FireHUB Button to visit the **24/7 Real-Time Fire Monitoring service**

FireHUB Click the FireHUB Button to visit the **Diachronic Burnt Scar Mapping**

FireHUB Click the FireHUB Button to visit the **Forest Fire Information System in Europe, N. Africa, Middle East, Balkans, Black Sea**

FireHUB Click the FireHUB Button to visit the **Smoke Dispersion Service**

New service

National Fire Risk Prediction

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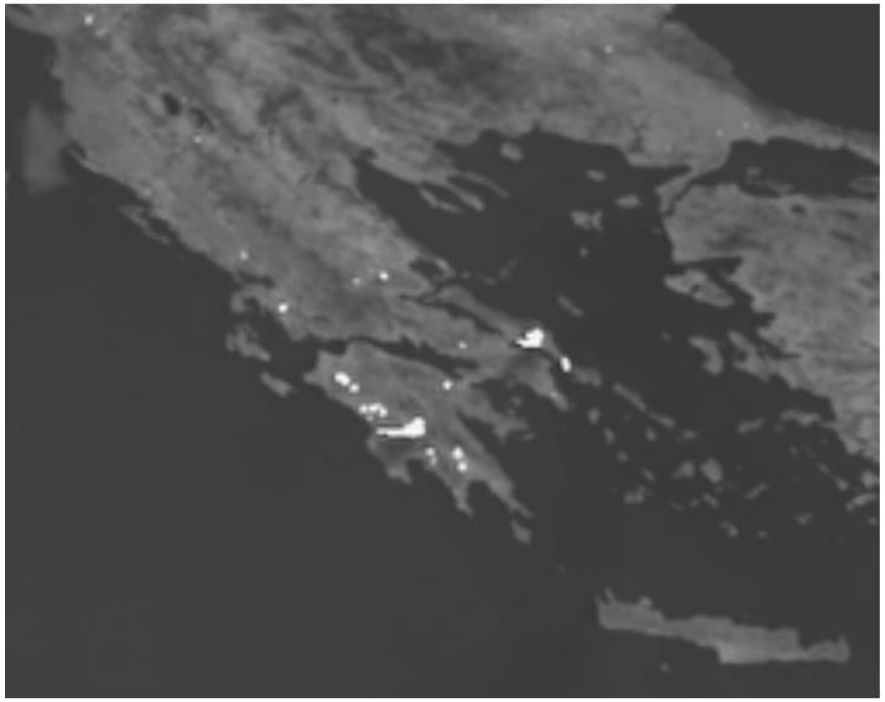
FireHUB

24/7 Real-Time Fire Monitoring service

- Active fire detection by **MSG SEVIRI** Instrument (IR 3.9, IR 10.8)
- 3 Classification steps:
  1. EUMETSAT Fire mapping algorithm (**FIR**) based on fixed thresholding approach, applied on the spectral bands IR 3.9 and IR 10.8 -> dynamic
  2. Create and integrate classification evidence through geospatial ontology schemes and reasoning queries, accounting for the a) thematic consistency by eliminating false alarms and b) time persistence of the fire observations
  3. Downscaling the first classification output and calculate the fire occurrence probability in sub-areas of **500m x 500m** wide, inside the initial observation area of 3.5km x 3.5km



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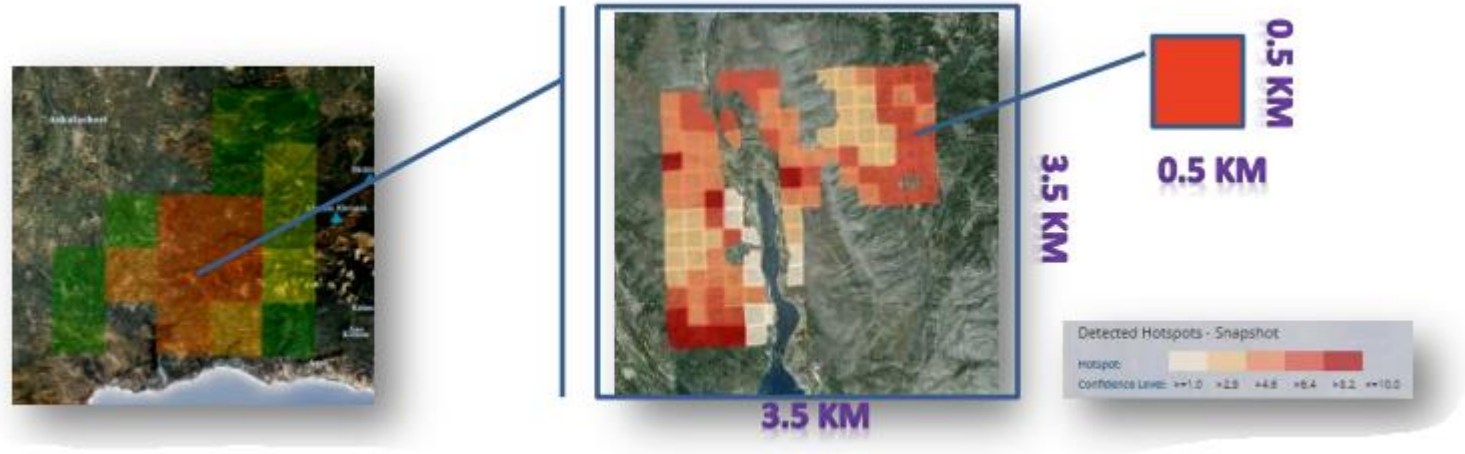
FireHUB

24/7 Real-Time Fire Monitoring service

- The downscaling process accounts 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 500mx500m area



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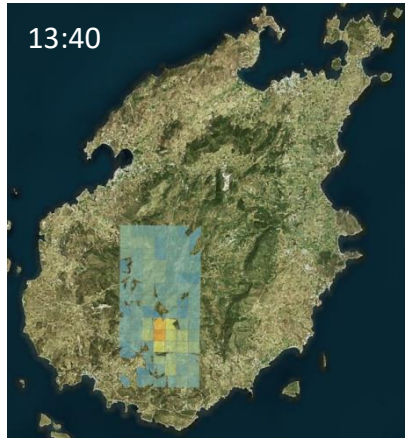
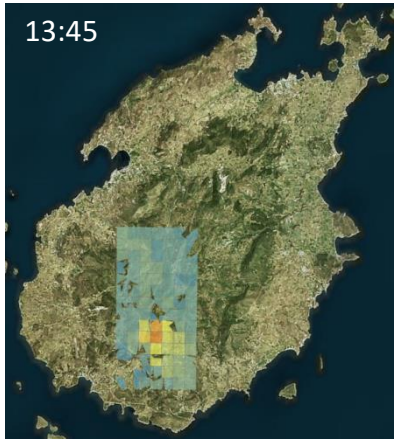
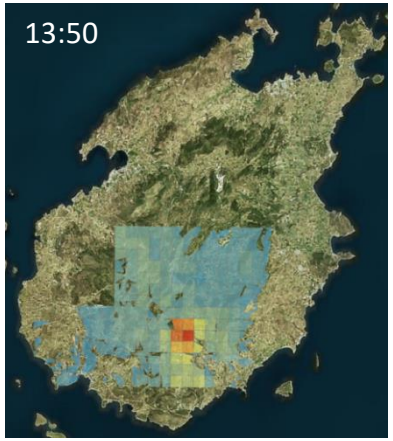
FireHUB

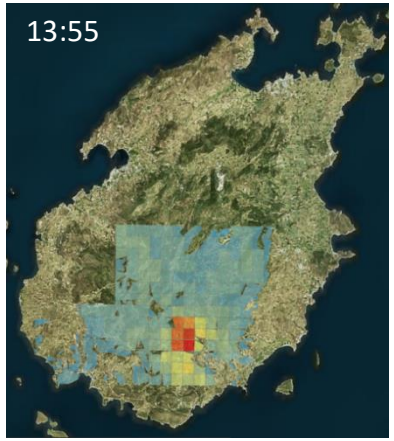
24/7 Real-Time Fire Monitoring service

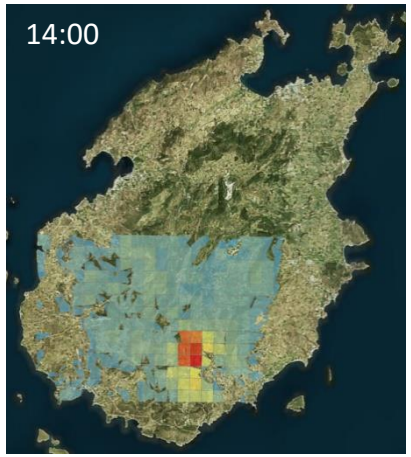
- FireHub continuously ingesting real time satellite acquisitions every 5 minutes

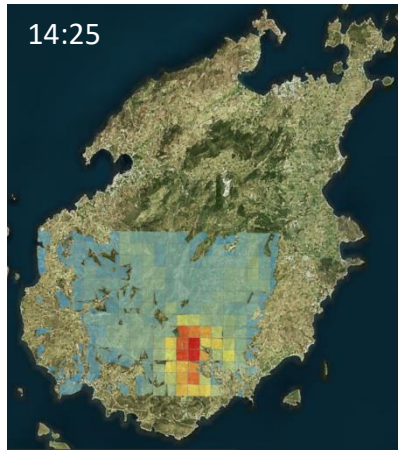


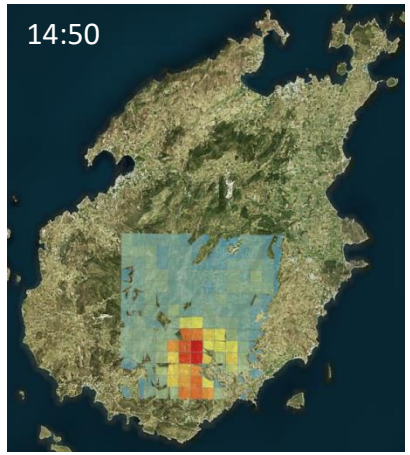


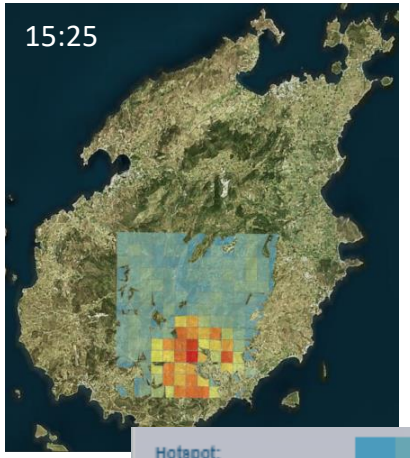


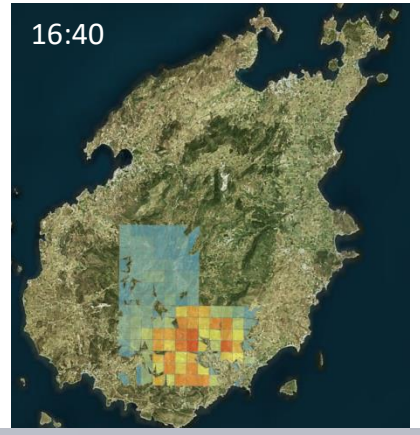


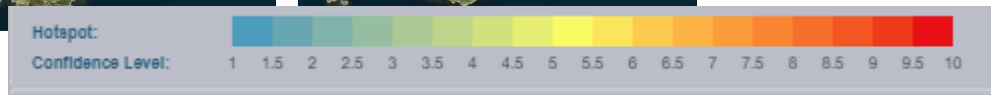












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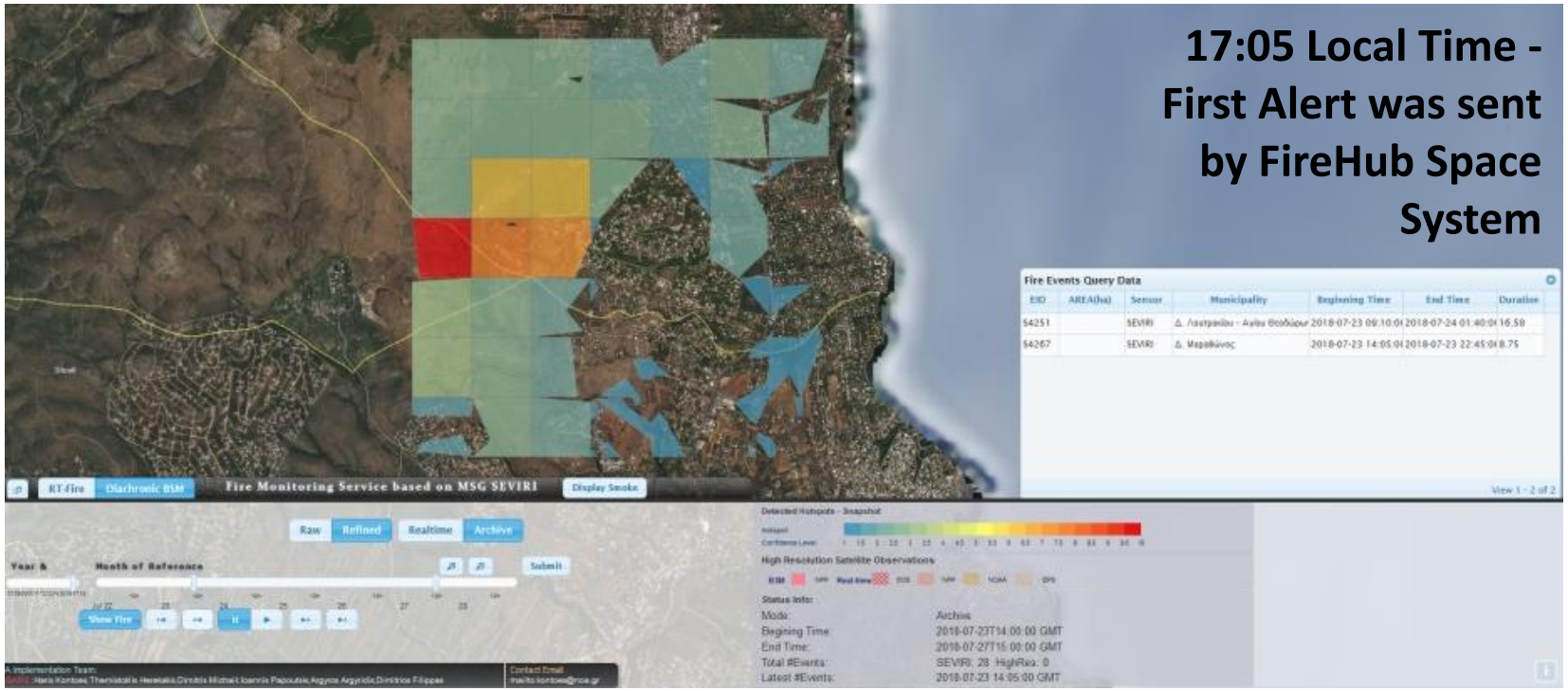
24/7 Real-Time Fire Monitoring service

MSG Seviri

7.5 km -> 500 m



- **This screen shows the first alert that was sent by the FireHub system of BEYOND at 17:05 local time, that is 5-7 minutes later than the official start of the fire (between 16.55-17:00).** The FireHub web site is open and accessible at that time by all and the authorities of Fire Brigades at http://195.251.203.238/seviri/
- The system provided the starting area (red rectangle - 500mx500m wide) at 17:05 local time and was updating the situational picture every five minutes. The more reddish the cell the higher the active fire occurrence in it. The masked out area is what FireHub considers as urban. FireHub does not update the fire occurrence picture inside the urban zones. The urban area fringe is also apparent by looking at the background Google Earth map.

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24/7 Real-Time Fire Monitoring service

- 25-30% of the detected fires are reported 10 -15 minutes earlier than Fire Brigades logs
- 60% of the detected fires, are reported in the first ~15 minutes after the ignition timestamp reported in the Fire Brigade logs
- All the fires larger than the 112ha are completely detected without any omission
- Smaller fires, that are in the range of [4.7ha - 112 ha] are 50% detected
- The smallest detected fire has been of the order of 4.7 ha
- The omitted fire detections, are summing up to the 5,8% of the total Burned Area.
- Omissions are caused mainly due to a) cloud cover, b) fire intensity (e.g. small fires – small burned areas), c) area topography, and d) fuel characteristics (e.g. less vegetative areas, pasture lands, sparse vegetation resulting in low fire intensities)
- The 82-85% of the 500mx500m cells which are assigned a high fire occurrence probability that is in the range of [6, 10], are located in the Burned Area Polygons

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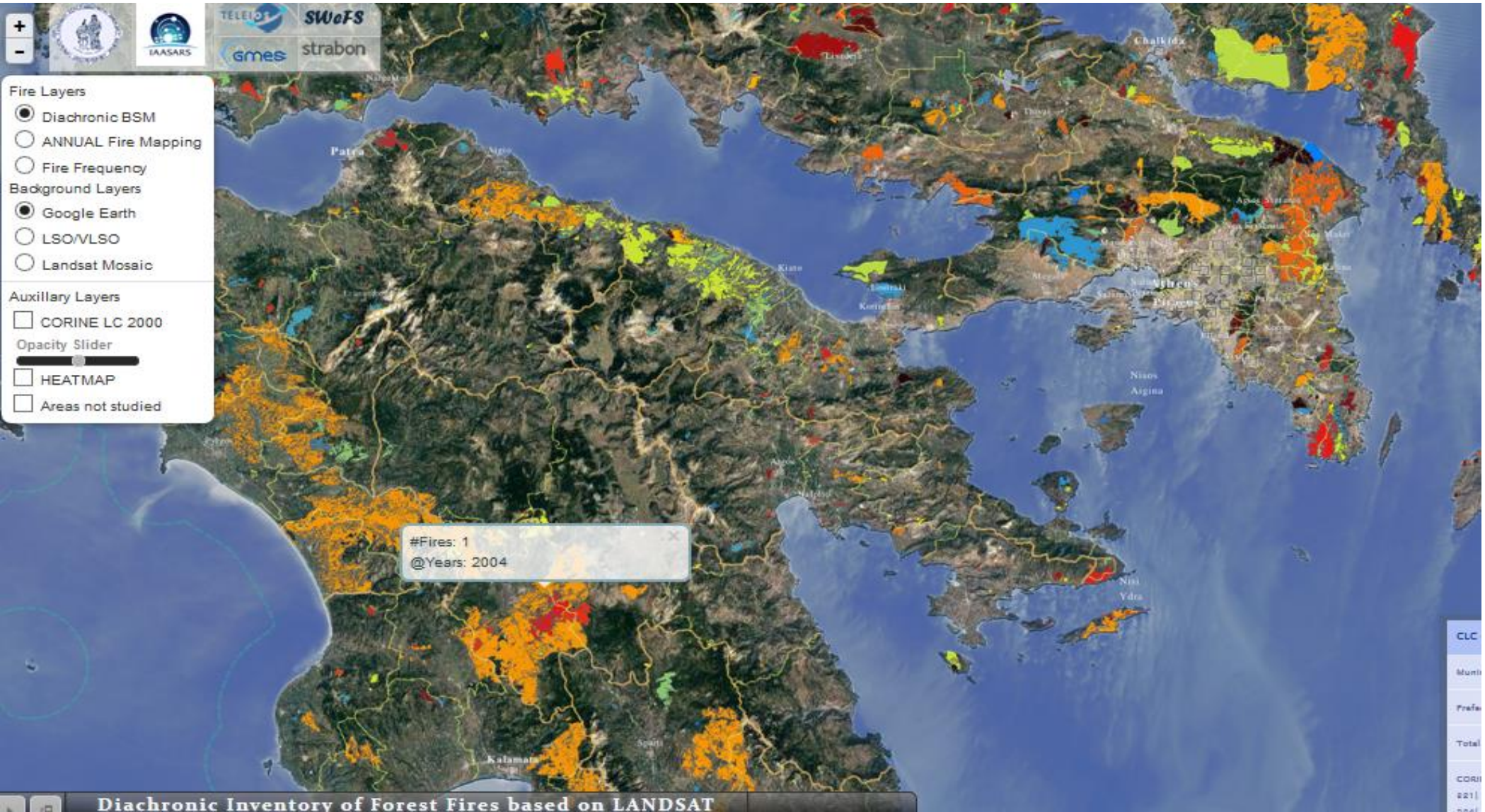
Diachronic Burnt Scar Mapping



1984-2020, Greece , ~1100 satellite images LANDSAT TM, SPOT, IKONOS, SENTINEL-2

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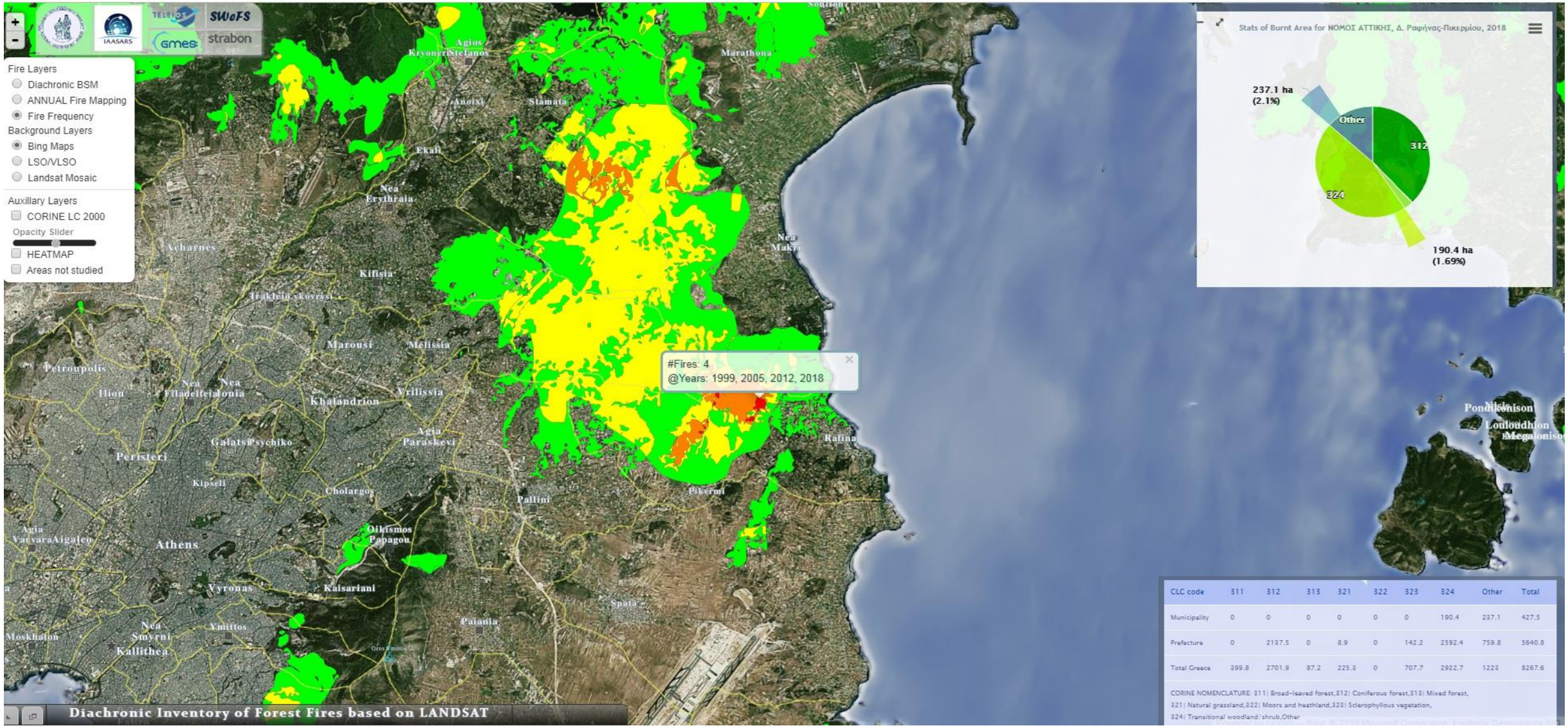
FireHUB

Diachronic Burnt Scar Mapping



CLC code	311	312	313	321	322	323	324	Other	Total
Municipality	0	0	0	0	0	0	190.4	237.1	427.5
Prefecture	0	2137.5	0	8.9	0	142.2	2592.4	759.8	5640.8
Total Greece	399.8	2701.9	87.2	225.3	0	707.7	2922.7	1223	8267.6

CORINE NOMENCLATURE: 311| Broad-leaved forest,312| Coniferous forest,313| Mixed forest,
321| Natural grassland,322| Moors and heathland,323| Sclerophyllous vegetation,
324| Transitional woodland/shrub,Other

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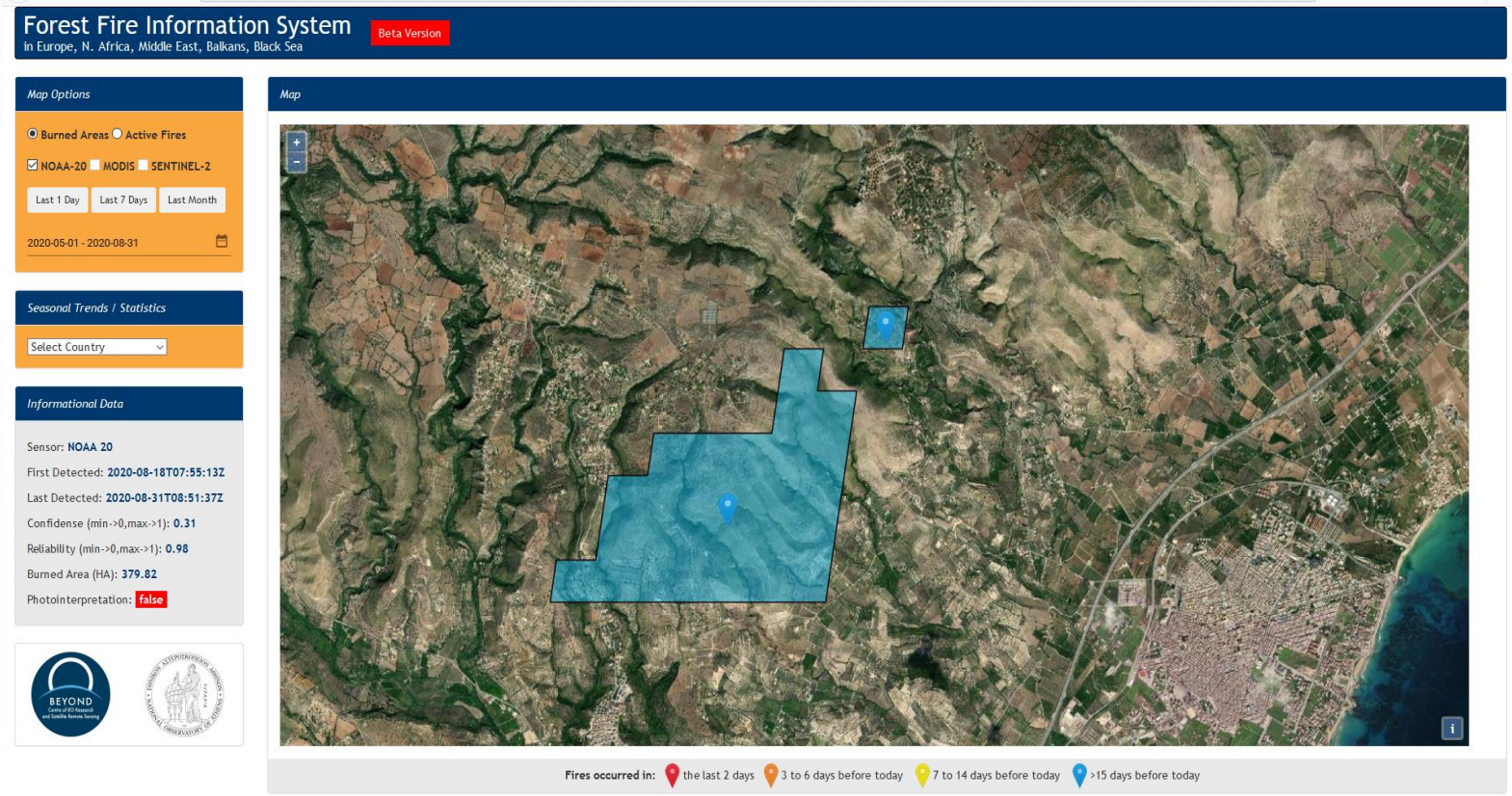
A new service has been developed, known as **Forest Fire Information System** in Europe, N. Africa, Middle East, Balkans, Black Sea and provides daily near real time information on active fires and burned areas, as well as statistics on the affected areas per time period and country over the large area covering Europe, North Africa, Middle East, Balkans, and Black Sea.

MODIS, VIIRS

Sentinel-2



Processing in Real Time of SUOMI-NPP, NOAA-20, MODIS, and S2 data

http://ffis.beyond-eocenter.eu/

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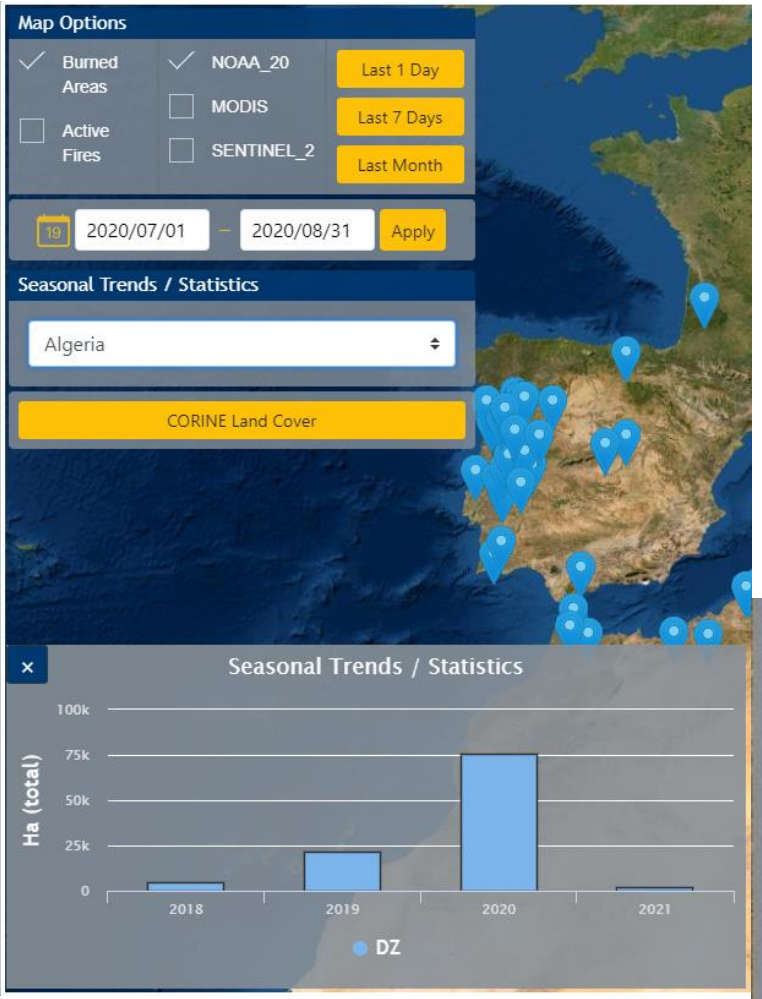
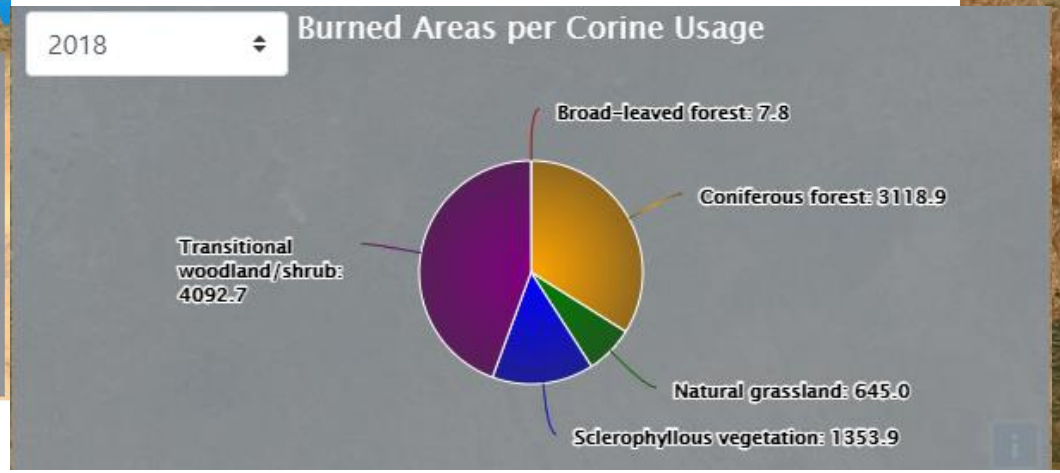
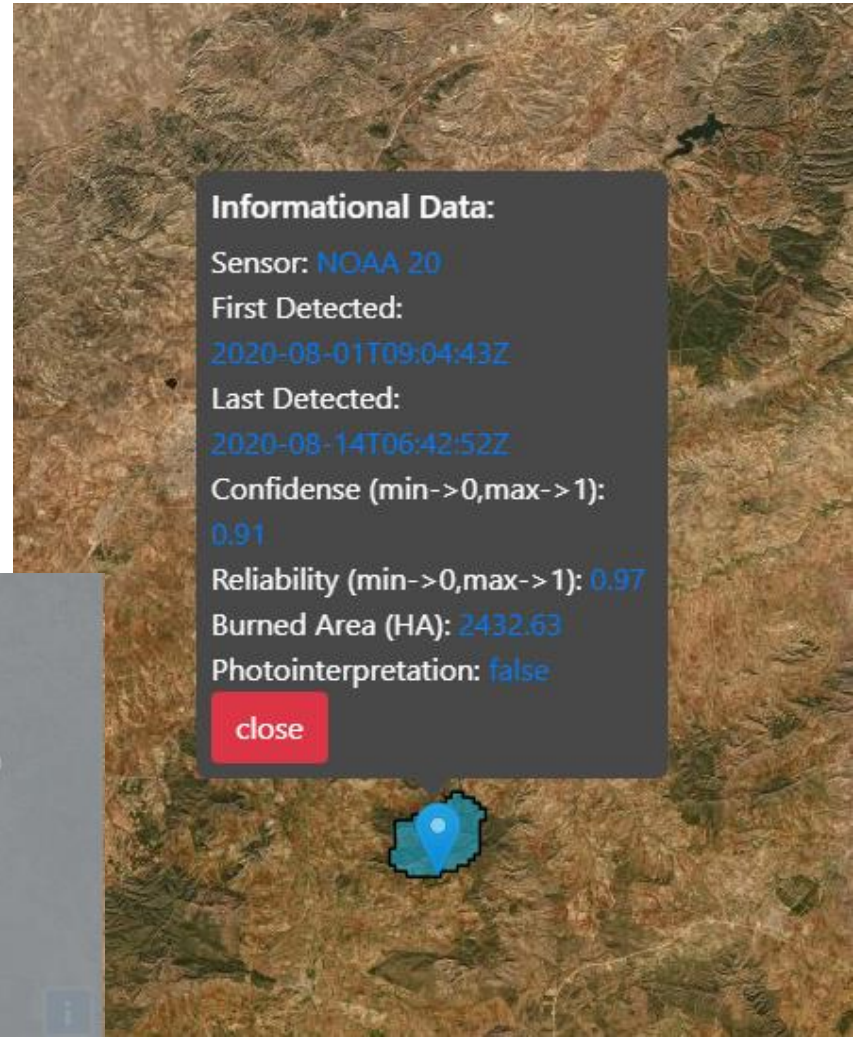
Forest Fire Information System



http://ffis.beyond-eocenter.eu/





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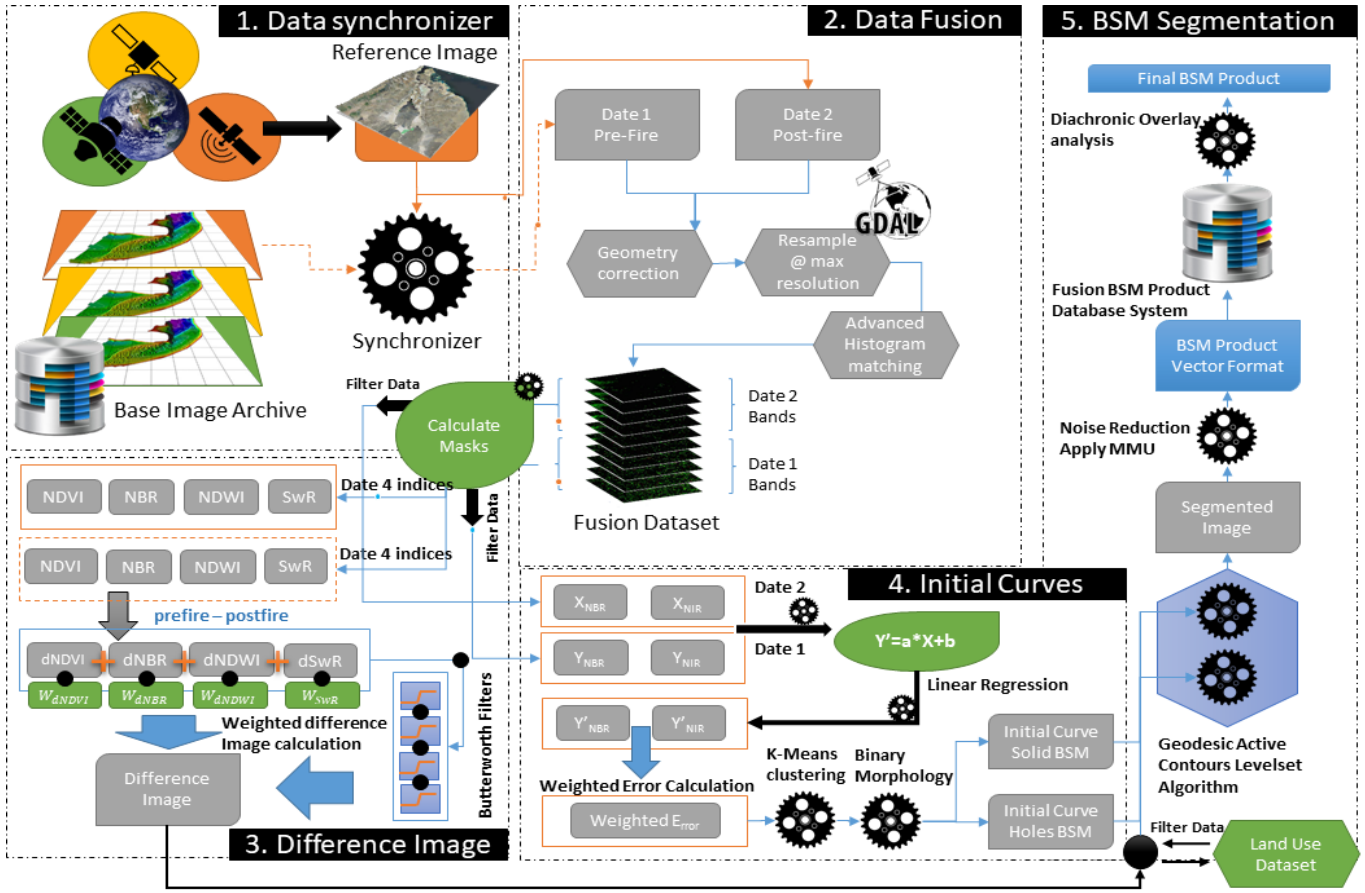
Forest Fire Information System



3 steps prototype Algorithm for Burnt Scar Mapping (BSM)

- Basic preprocess of the acquired images
- Generation of cloud and sea masks and enhanced histogram matching of pre and post fire images.
- Temporal changes detection by the analysis of numerous diverse spectral features for base and reference image.
- Custom spatial database post-processing chain stores, attributes, validates and keeps track of the BSM polygons that are about to be published in the WebGIS platform.

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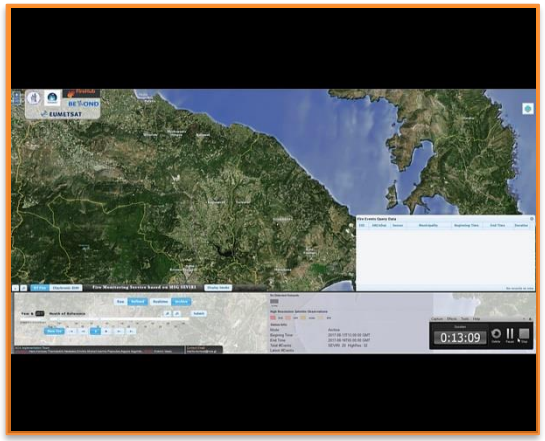
FireHUB

First fire detection in10'

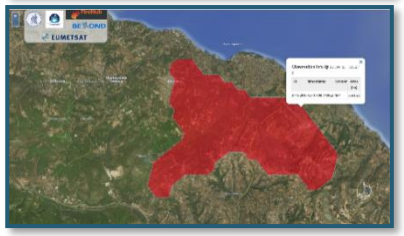


Meteosat SG –SEVIRI

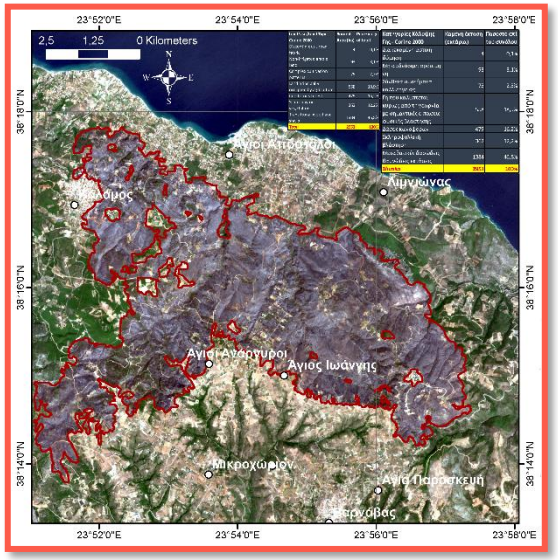
Day #1
NPP-VIIRS
MR=375m
20170817
11:14

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

Detection of active sources of fire from FireHUB system

Burned area extent Medium resolution (250m)

Burned area extent High resolution (10m)

T0 minute

KALAMOS 13/08/2017 2953 hectare

T10 minutes

Beginning of fire

T1 Day

Burned area extent Medium resolution (375m)

T2 Day

T3 Day

Burned area extent Medium resolution (375m)

T4 Day

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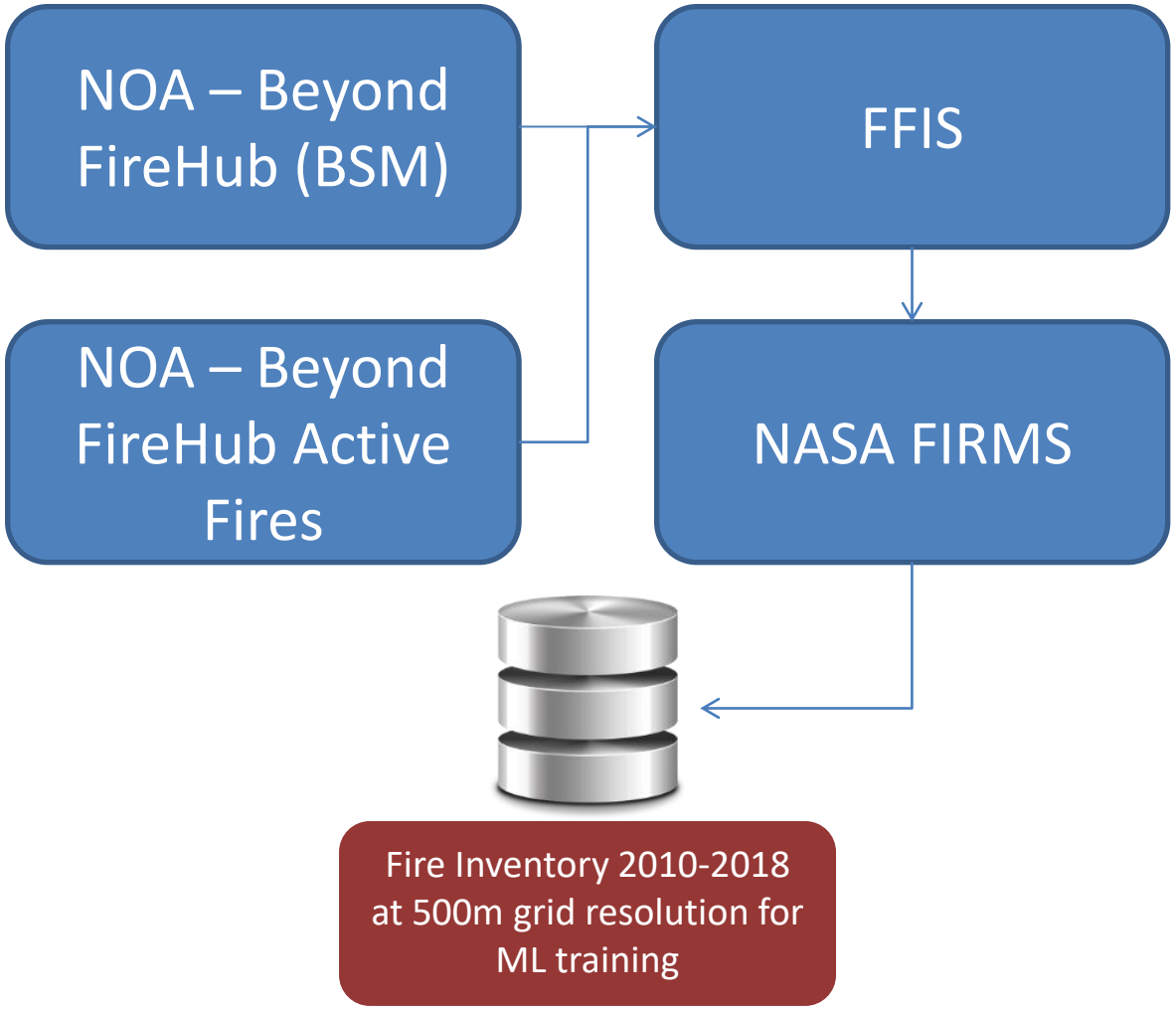
Forest Fire Prediction System

- Theoretical models (i.e. FWI) are entirely based on equations that describe the physics of the related to the fire ignition physical phenomena
- Machine Learning algorithms are designed to automatically formulate the complex mathematical relations between the input parameters.



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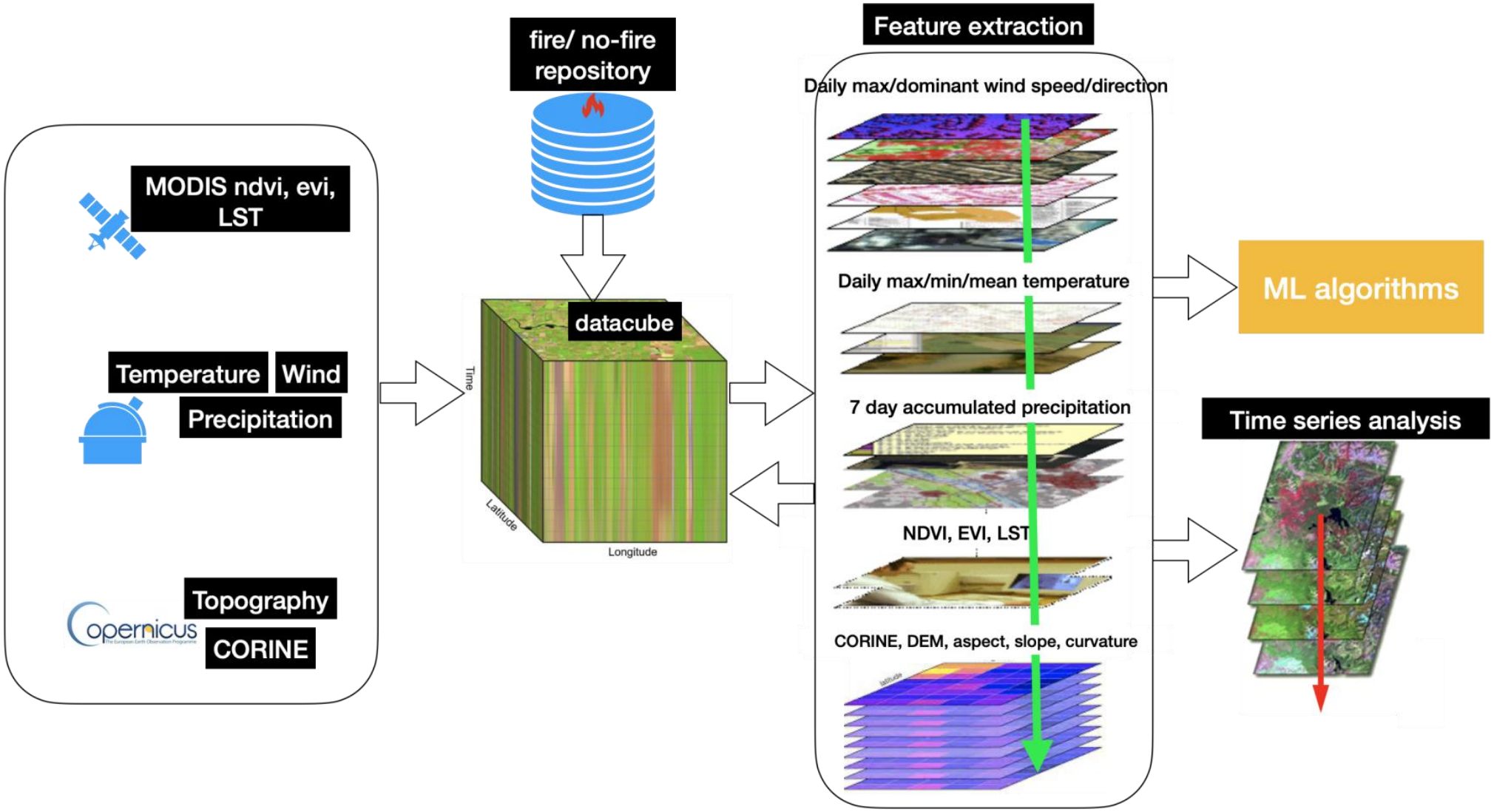
Forest Fire Prediction System



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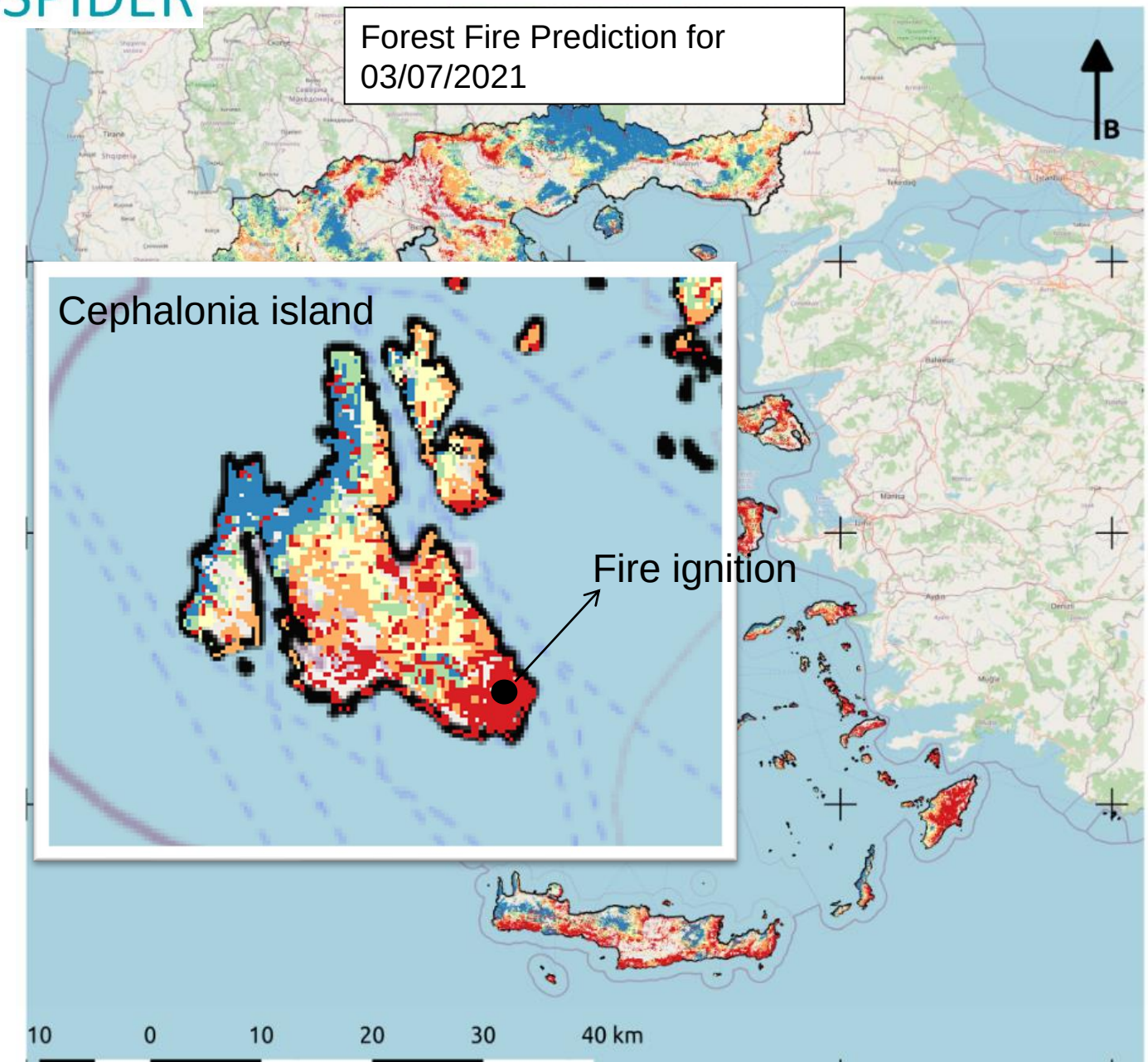
Forest Fire Prediction for 03/07/2021



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Κέντρο Επιστημών Παρατήρησης της Γης και Δορυφορικής Τηλεπισκόπησης

Ημερήσιος χάρτης πρόβλεψης κινδύνου πυρκαγιάς

Πληροφορίες χάρτη

Ο χάρτης έχει δημιουργηθεί από το Κέντρο Παρατήρησης της Γης και Δορυφορικής Τηλεπισκόπησης Beyond (www.beyond-eocenter.eu) του Εθνικού Αστεροσκοπείου Αθηνών. Βασίζεται σε συνδυασμό τεχνολογιών και μοντέλων Μηχανικής Μάθησης, που αξιοποιούν γνώση αναφορικά με την συμπεριφορά της πυρκαγιάς στην Ελλάδα τις τέσσερις τελευταίες δεκαετίες, προγνώσεις καιρού για την επόμενη ημέρα, καθώς και δυναμική εκτίμιση περιβαλλοντικών παραμέτρων. Ο χάρτης απεικονίζει τον κίνδυνο έναρξης πυρκαγιάς στην χωρική ανάλυση των 500 μέτρων.

Υπόμνημα

Ακτογραμμή

Επίπεδα ρίσκου

- Very high risk
- High risk
- Medium risk
- Low risk
- No risk

Χαρτογραφική προβολή: WGS 84 / Pseudo-

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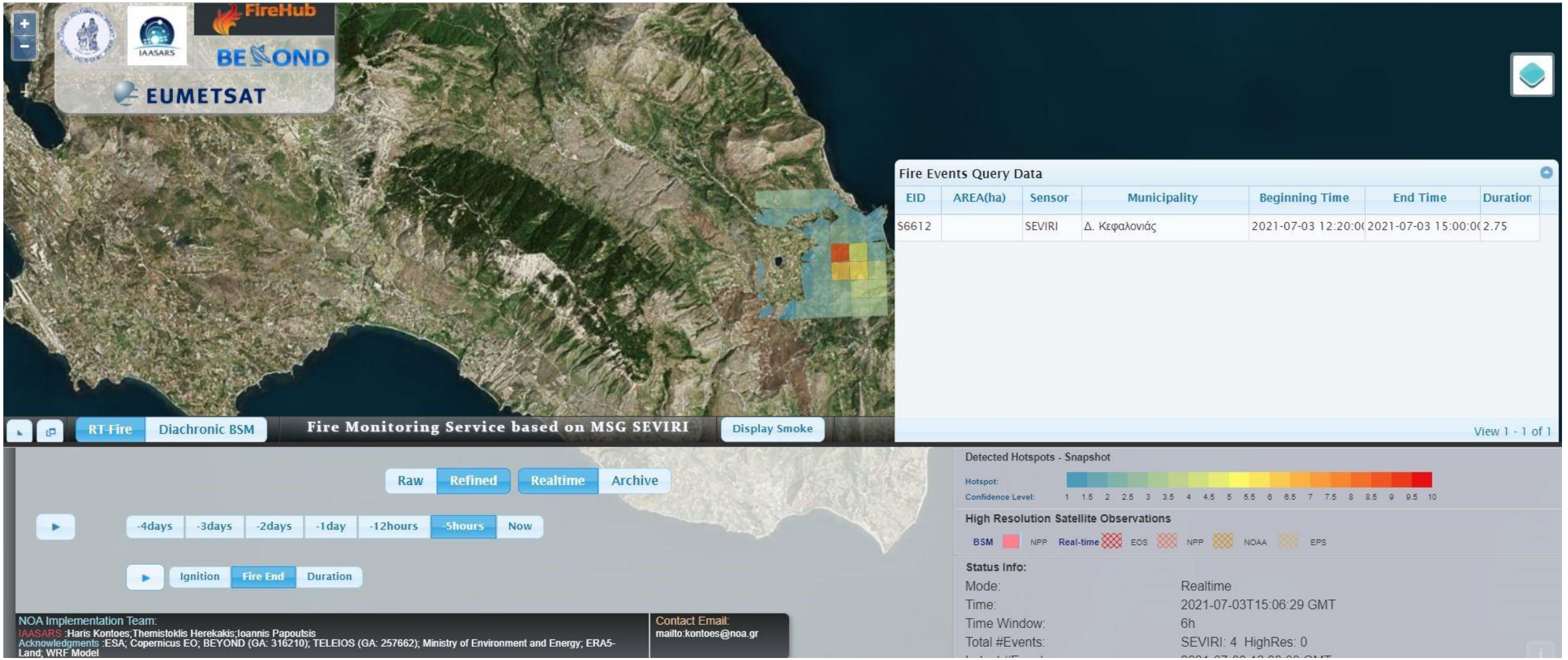
Fire in Cephalonia – 03/07/2021

24/7 Real-Time Fire Monitoring service



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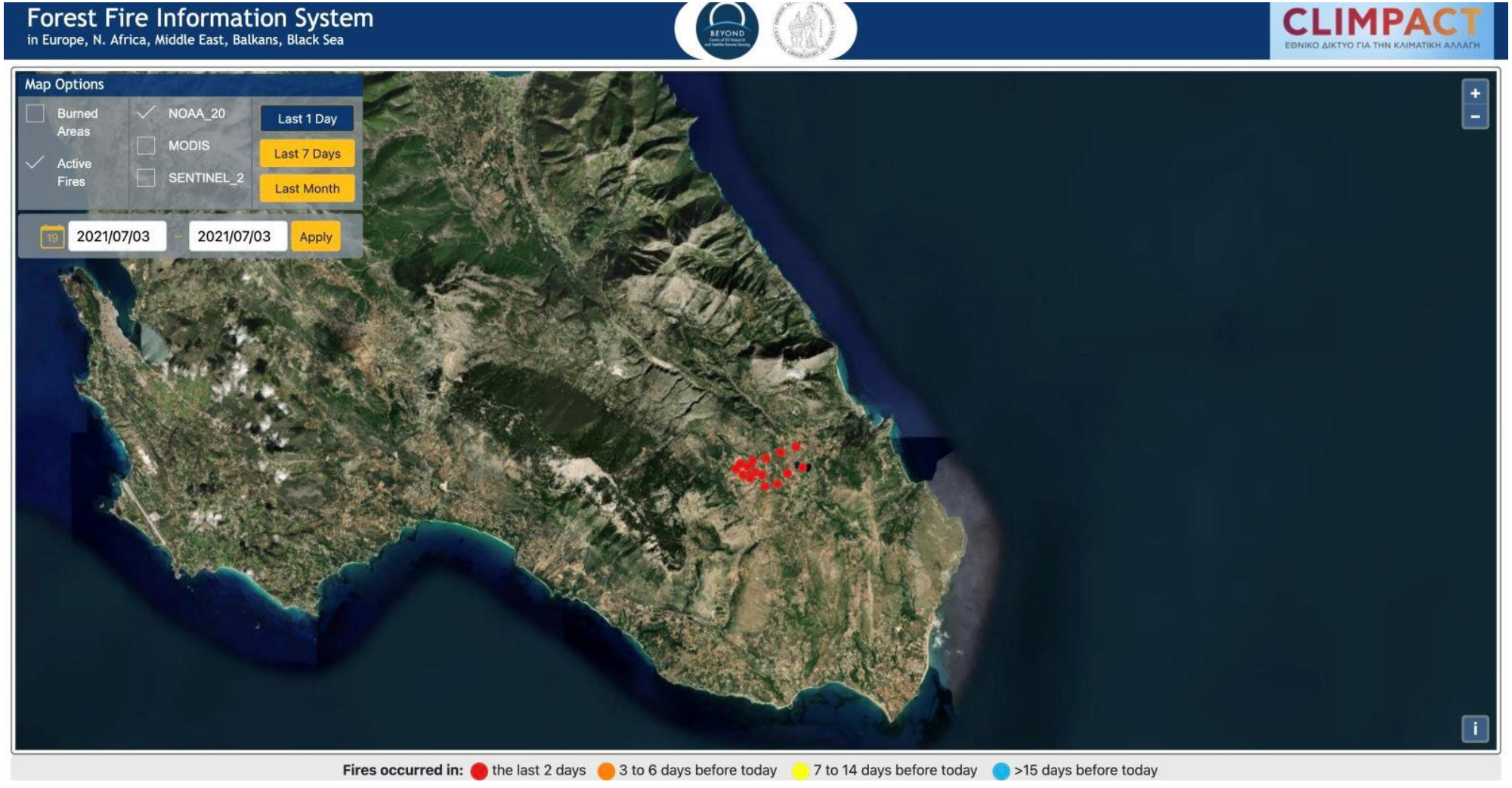
Fire in Cephalonia – 03/07/2021

Forest Fire Information System – Active Fires



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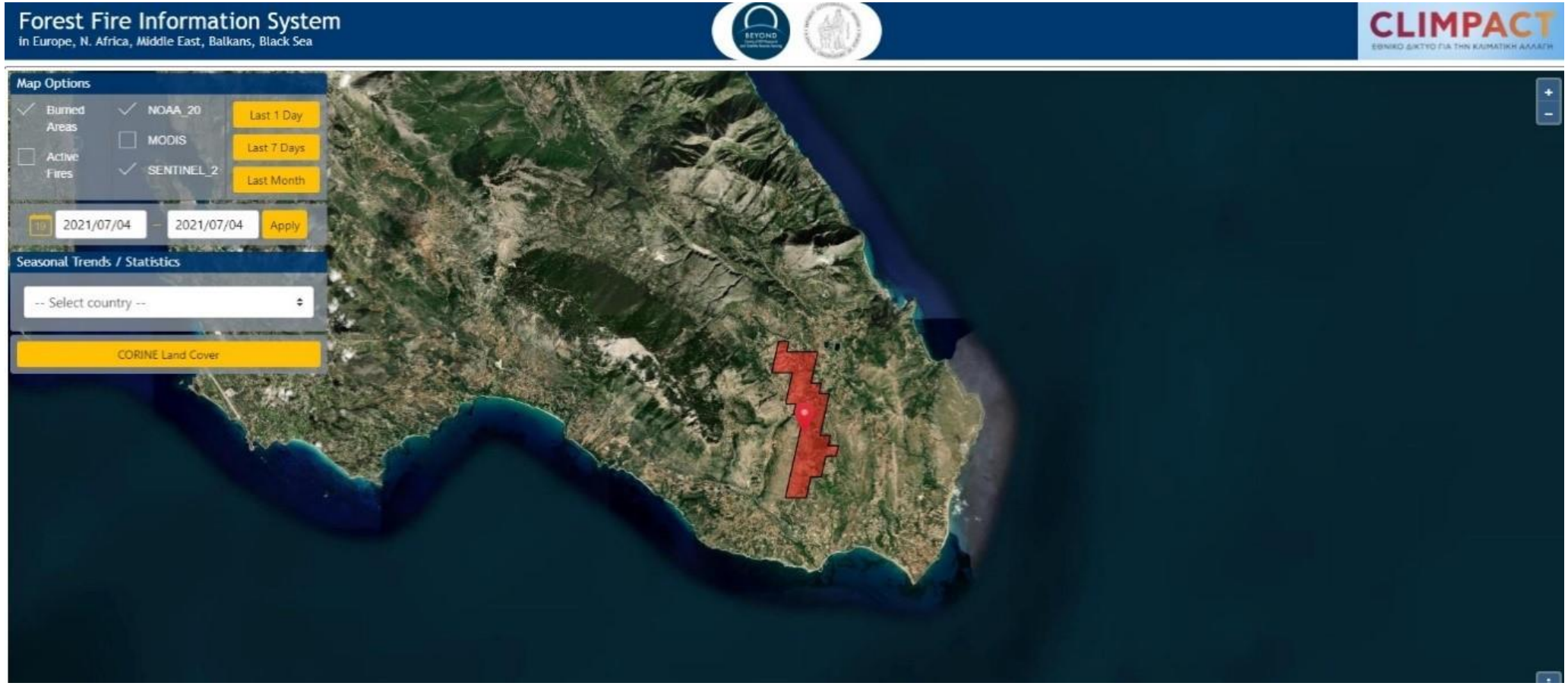
Fire in Cephalonia – 03/07/2021

Forest Fire Information System – VIIRS Burned Scar Map



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Fire in Cephalonia – 03/07/2021

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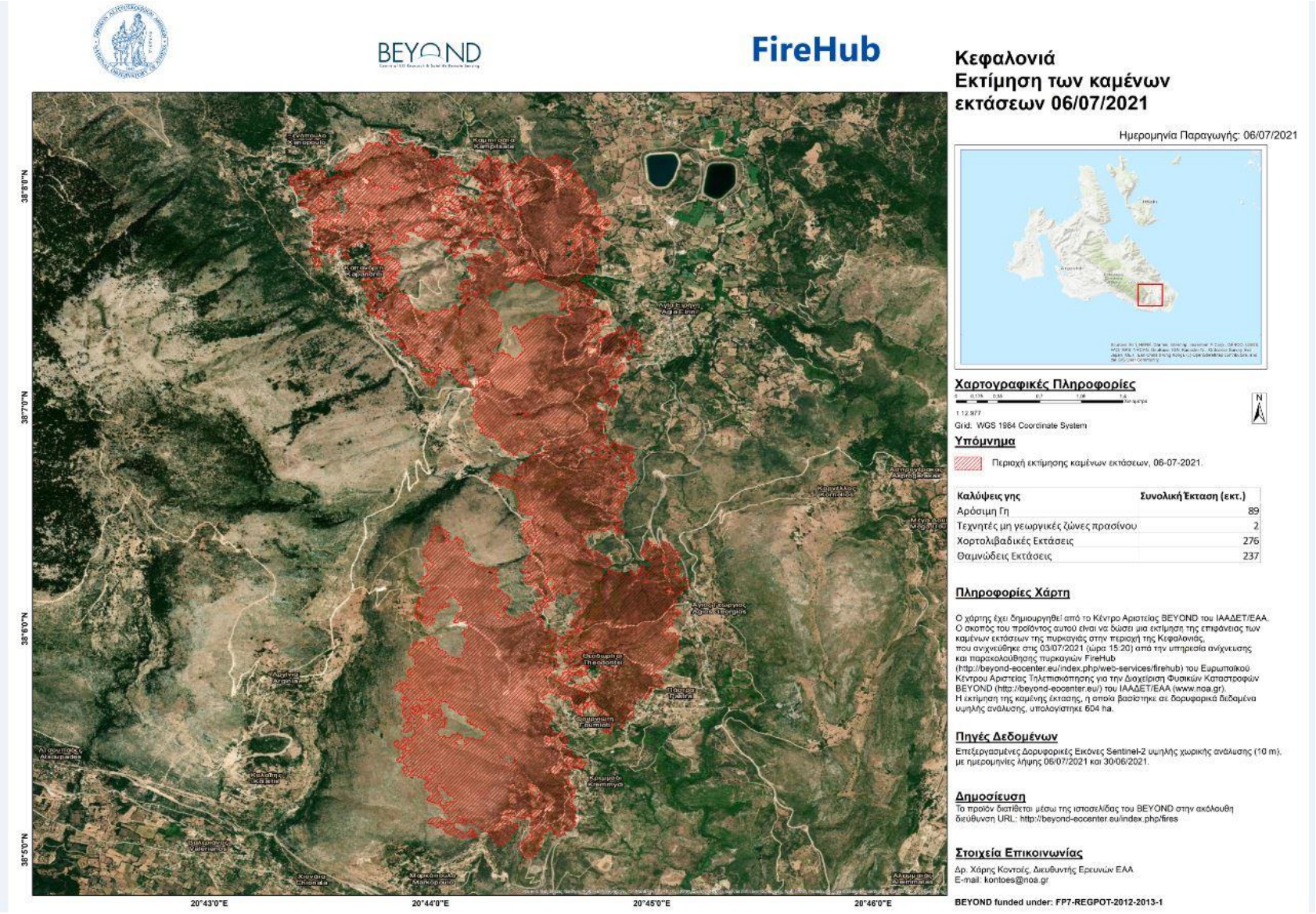
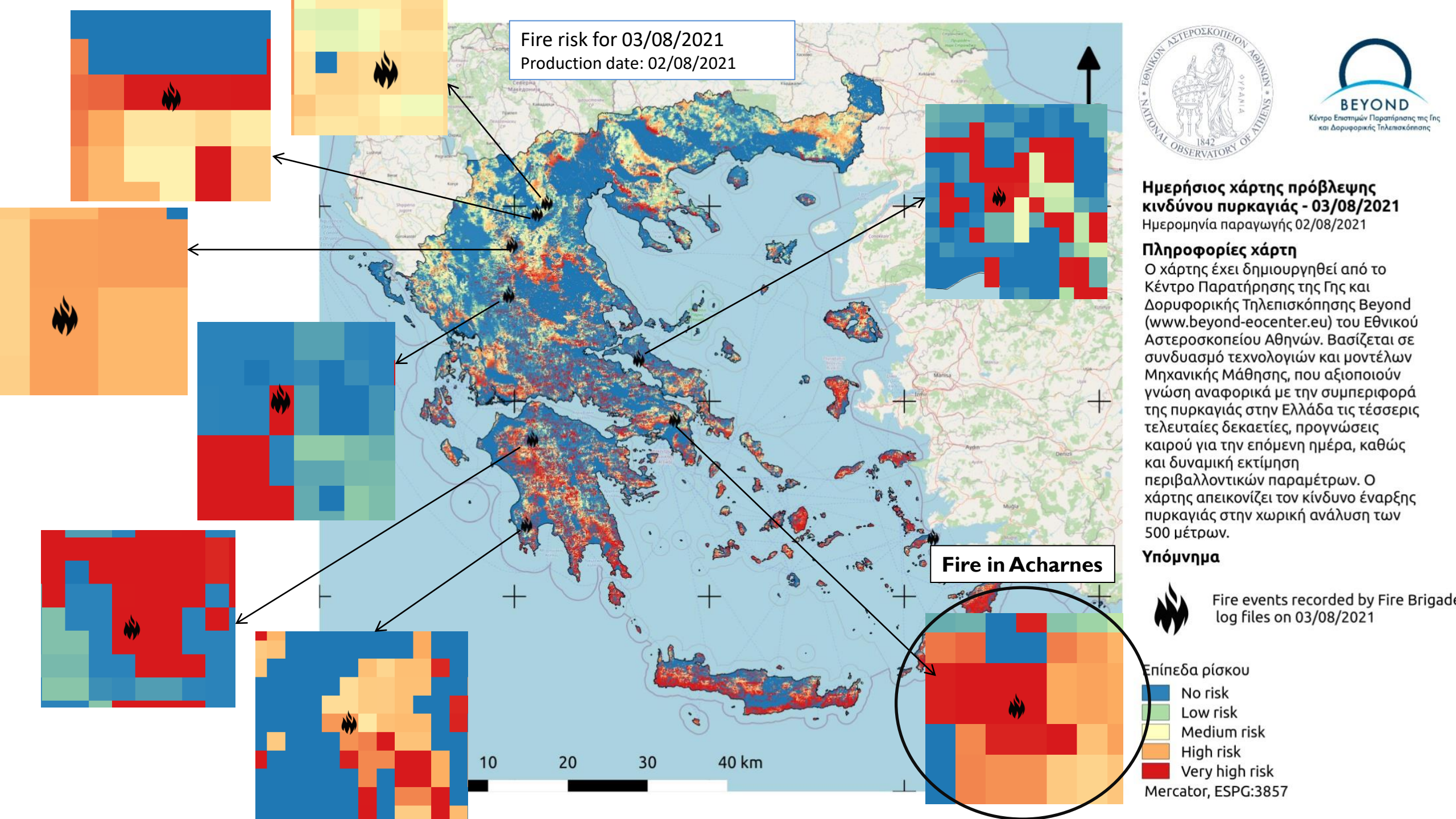
Forest Fire Information System – Sentinel-2 burned Scar Map





Ημερήσιος χάρτης πρόβλεψης κινδύνου πυρκαγιάς - 03/08/2021

Ημερομηνία παραγωγής 02/08/2021

Πληροφορίες χάρτη

Ο χάρτης έχει δημιουργηθεί από το Κέντρο Παρατήρησης της Γης και Δορυφορικής Τηλεπισκόπησης Beyond (www.beyond-eocenter.eu) του Εθνικού Αστεροσκοπείου Αθηνών. Βασίζεται σε συνδυασμό τεχνολογιών και μοντέλων Μηχανικής Μάθησης, που αξιοποιούν γνώση αναφορικά με την συμπεριφορά της πυρκαγιάς στην Ελλάδα τις τέσσερις τελευταίες δεκαετίες, προγνώσεις καιρού για την επόμενη ημέρα, καθώς και δυναμική εκτίμηση περιβαλλοντικών παραμέτρων. Ο χάρτης απεικονίζει τον κίνδυνο έναρξης πυρκαγιάς στην χωρική ανάλυση των 500 μέτρων.

Υπόμνημα

Fire events recorded by Fire Brigade log files on 03/08/2021

Επίπεδα ρίσκου

- No risk
- Low risk
- Medium risk
- High risk
- Very high risk

Mercator, ESPG:3857

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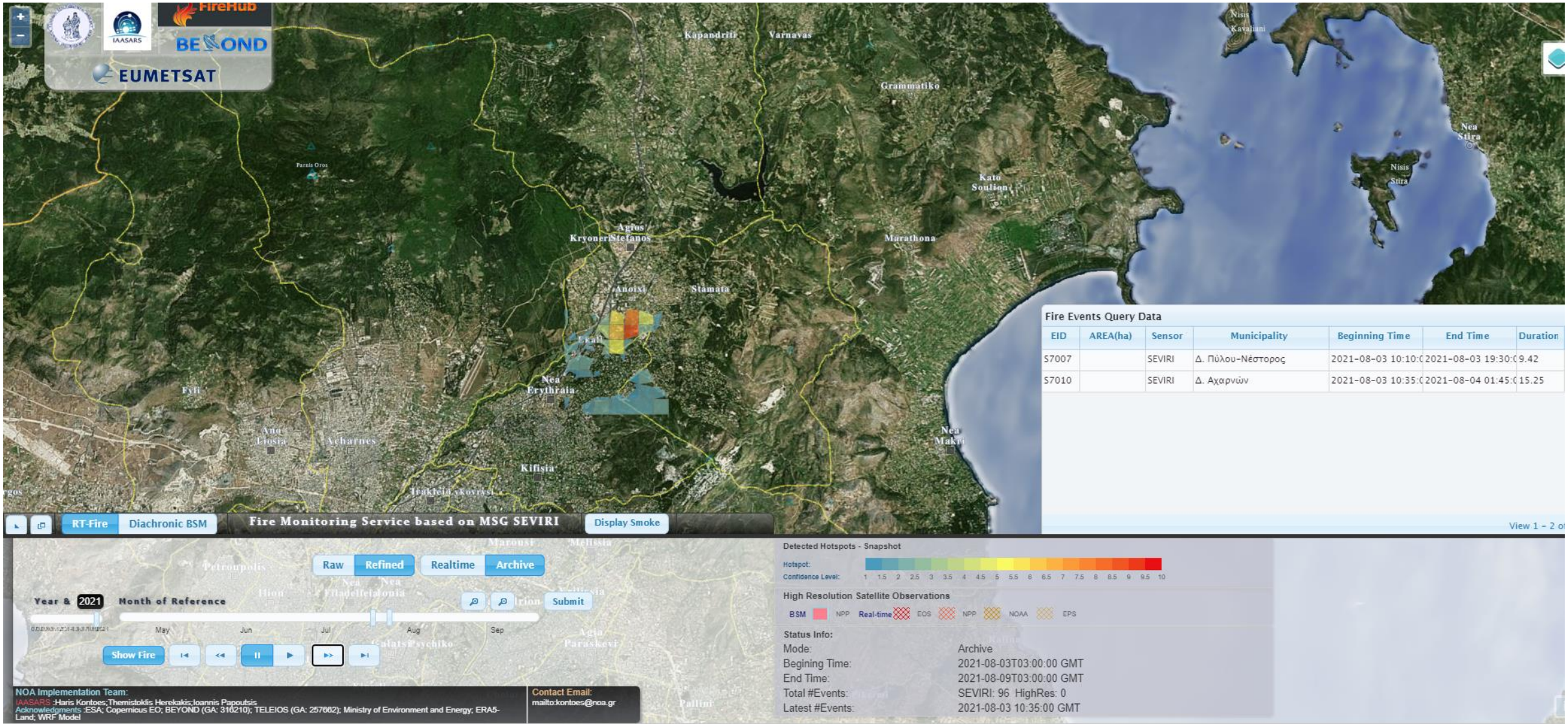
Fire in Acharnes – 03/08/2021

24/7 Real-Time Fire Monitoring service



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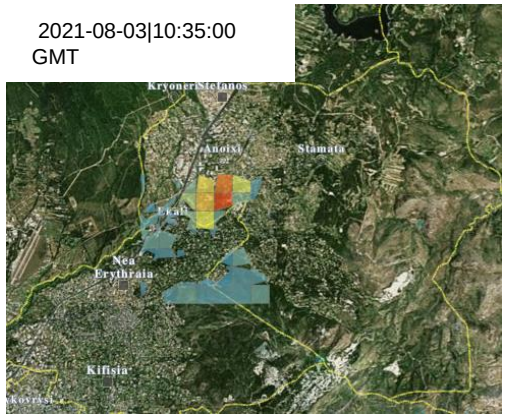
FireHUB

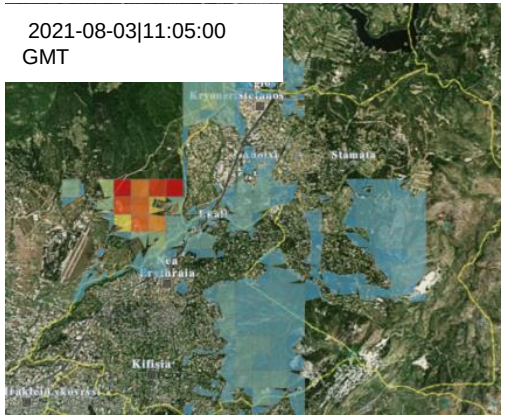
Fire in Acharnes – 03/08/2021

24/7 Real-Time Fire Monitoring service

2021-08-03|10:35:00 GMT



2021-08-03|11:05:00 GMT



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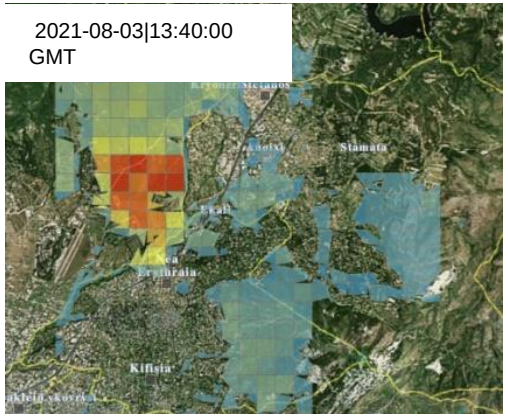

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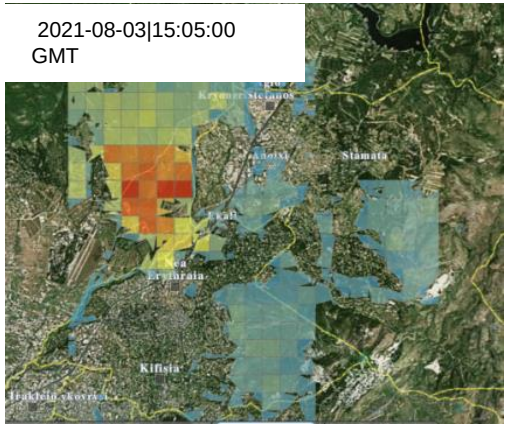

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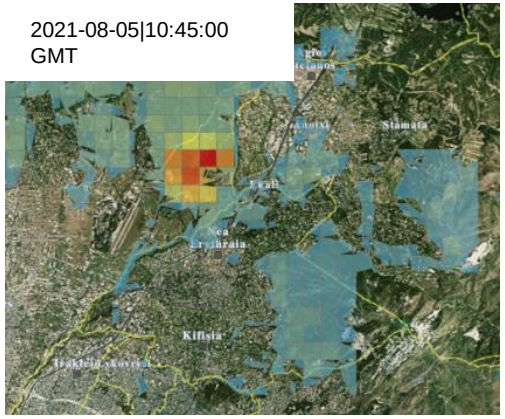

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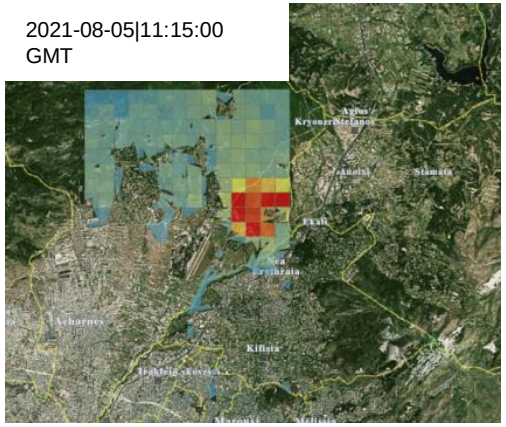

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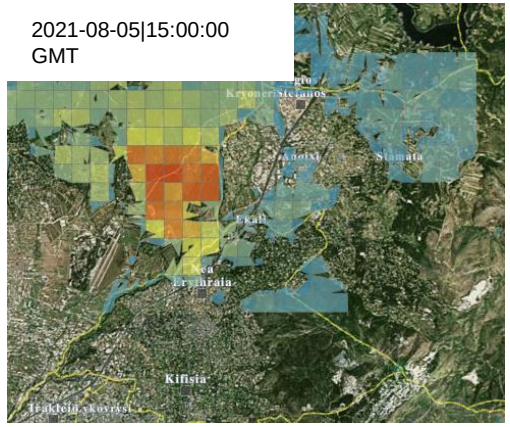

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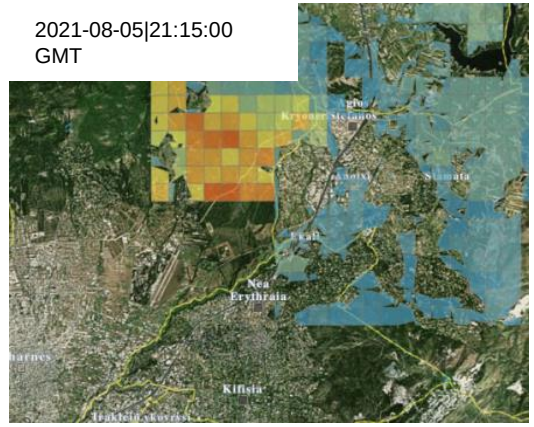

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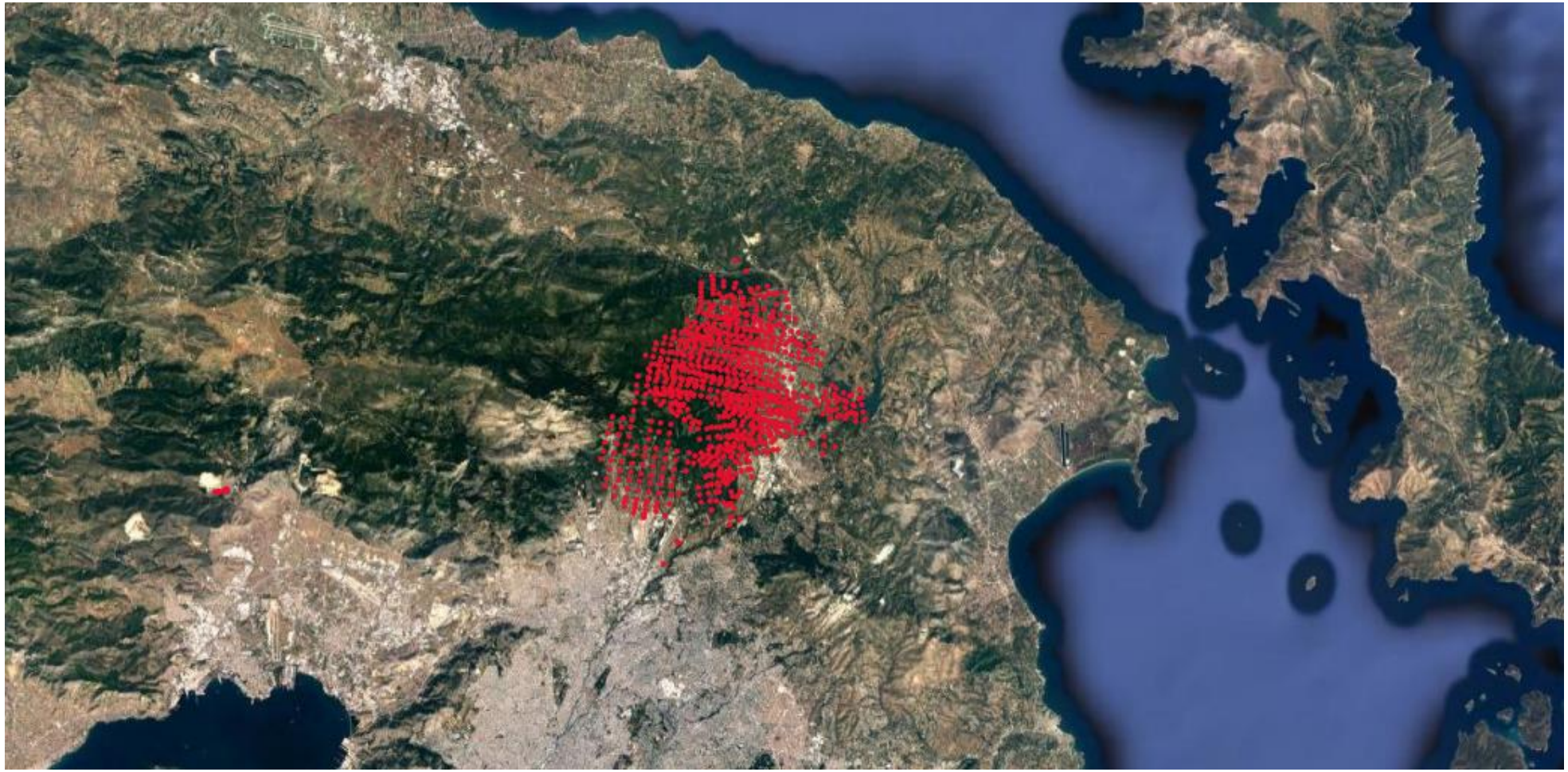
Fire in Acharnes – 03/08/2021

Forest Fire Information System – Active Fires



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Fire in Acharnes – 03/08/2021

Forest Fire Information System – VIIRS Burned Scar Map

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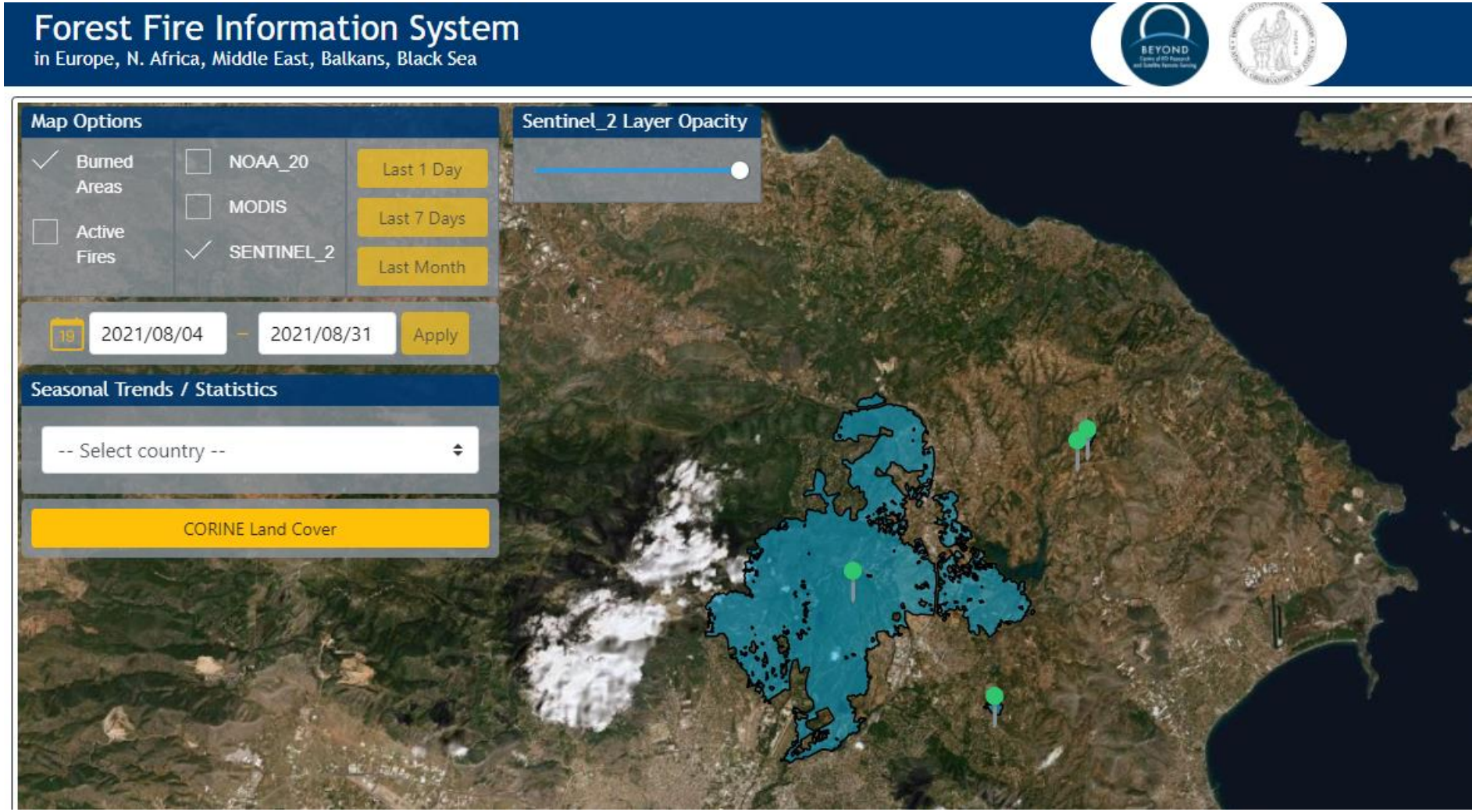
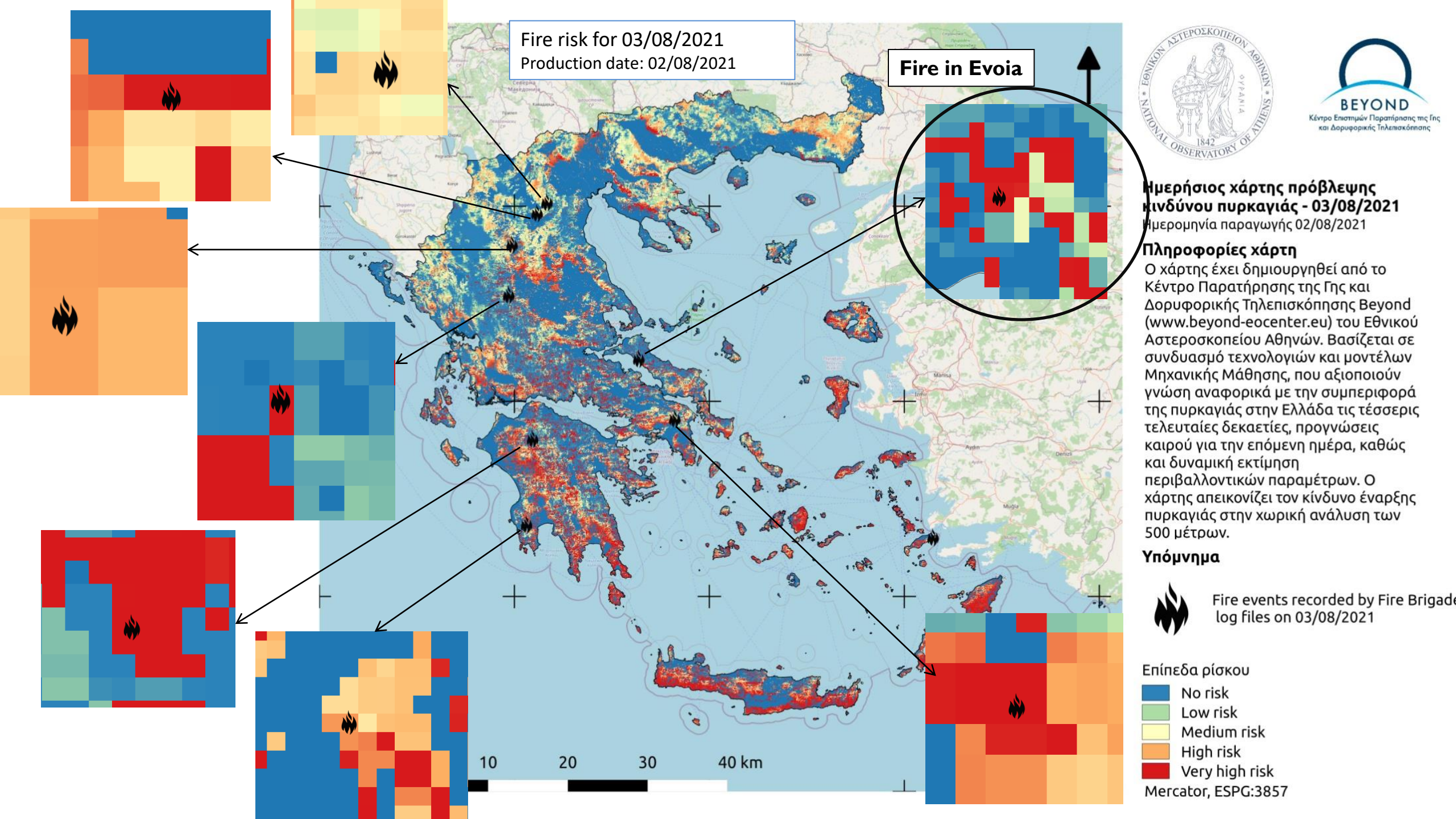
Fire in Acharnes – 03/08/2021

Forest Fire Information System – Burned Scar Map – Sentinel-2





Ημερήσιος χάρτης πρόβλεψης κινδύνου πυρκαγιάς - 03/08/2021

Ημερομηνία παραγωγής 02/08/2021

Πληροφορίες χάρτη

Ο χάρτης έχει δημιουργηθεί από το Κέντρο Παρατήρησης της Γης και Δορυφορικής Τηλεπισκόπησης Beyond (www.beyond-eocenter.eu) του Εθνικού Αστεροσκοπείου Αθηνών. Βασίζεται σε συνδυασμό τεχνολογιών και μοντέλων Μηχανικής Μάθησης, που αξιοποιούν γνώση αναφορικά με την συμπεριφορά της πυρκαγιάς στην Ελλάδα τις τέσσερις τελευταίες δεκαετίες, προγνώσεις καιρού για την επόμενη ημέρα, καθώς και δυναμική εκτίμηση περιβαλλοντικών παραμέτρων. Ο χάρτης απεικονίζει τον κίνδυνο έναρξης πυρκαγιάς στην χωρική ανάλυση των 500 μέτρων.

Υπόμνημα

Fire events recorded by Fire Brigade log files on 03/08/2021

Επίπεδα ρίσκου

- No risk
- Low risk
- Medium risk
- High risk
- Very high risk

Mercator, ESPG:3857

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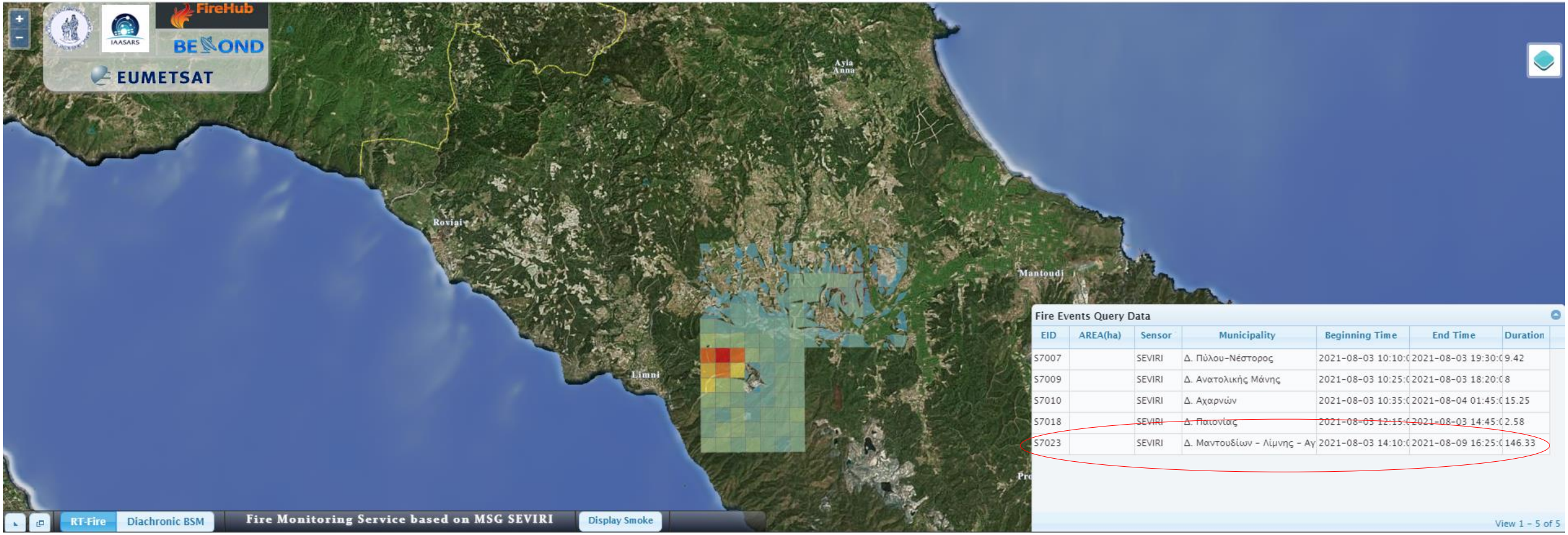
Fire in Evoia – 03/08/2021

24/7 Real-Time Fire Monitoring service



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Fire in Evoia – 03/08/2021

Forest Fire Information System – Active Fires

03/08/2021

04/08/2021

05/08/2021

06/08/2021

07/08/2021

08/08/2021

09/08/2021

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Fire in Evoia – 03/08/2021

Forest Fire Information System – VIIRS Burned Scar Map

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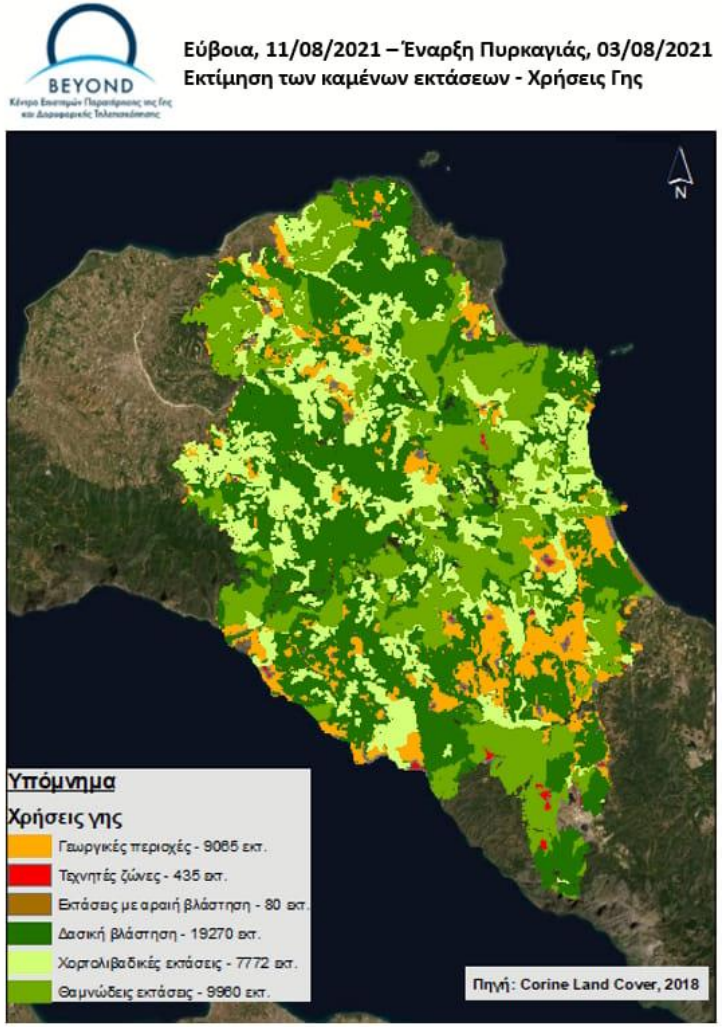
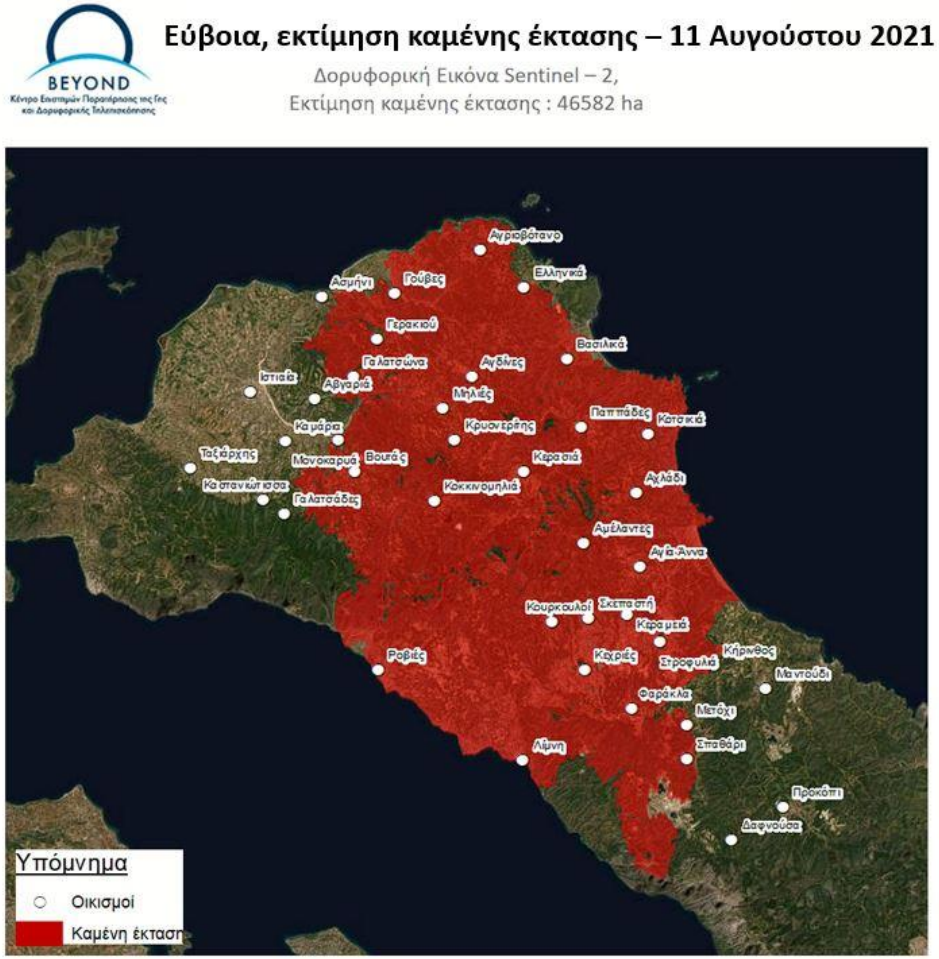
Fire in Evoia – 03/08/2021

Forest Fire Information System – Burned Scar Map – Sentinel-2





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Thank you!