



CAP Implementation Workshop 2017

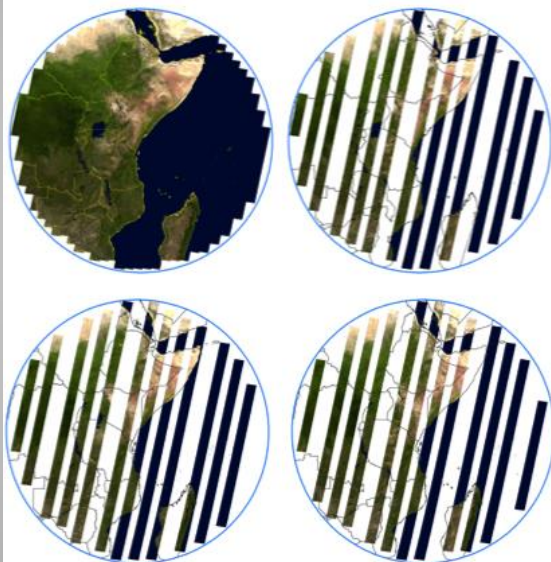
CAP and satellite-based fire detection

Roma 20/09/2017

- Giovanni Laneve, Lorenzo Fusilli & Pablo Marzialetti – SIA Università di Roma “La Sapienza”

SIA remote sensing applications

Training



- **Coastal erosion**
- **Sea color and sea/land temperature**
- **Atmosphere Monitoring**
- **Oil spill detection**
- **Desertification**
- **Water quality (pollution) monitoring**
- **NRT hot spot detection and monitoring**
- **Prompt estimate of damages and population monitoring**
- **indices for border monitoring**
- **Automatic detection of objects/infrastruct.**

Landsat/TM.
 Simulation of one year of acquisition (upper left) and a week of Landsat images that can be acquired at BSC.

Applications examples

- Monitoring of volcanoes;
- Forest fires monitoring;
- Crops classification and monitoring
- Forest status monitoring.



Sun-photometer

Field campaign



Management of forest fires

Prevention	Detection/Monitoring	Damage assessment/ Recovery
Vegetation fuel map	Early detection of wildfires	Burned areas estimate
Hazard map	Forest fires monitoring	Damage severity map
Vulnerability map	Estimate of Fire Radiative Power (fire intensity)	Burned biomass
Risk map	Estimate of the burned biomass and atmospheric emissions	Slope instability (landslide, debris flow)
Fuel reduction map and forecast of suitable conditions for prescribed fire paractices		

Management of forest fires

This short presentation describes the activity made in the framework of the on-going collaboration with the National Fire Corps in the field of satellite based information in support of forest fires management. In particular:

- Products devoted to support fire detection and monitoring based on geostationary (MSG) and polar orbit (MODIS, Sentinel-3) satellites.



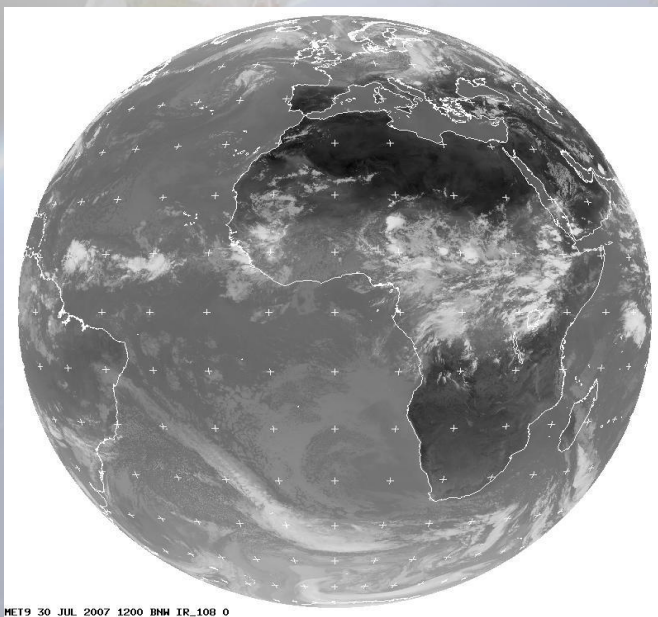
Fire detection and monitoring:

Every 15 min (geostationary MSG/SEVIRI) or 4 times per day (Terra and Aqua MODIS)

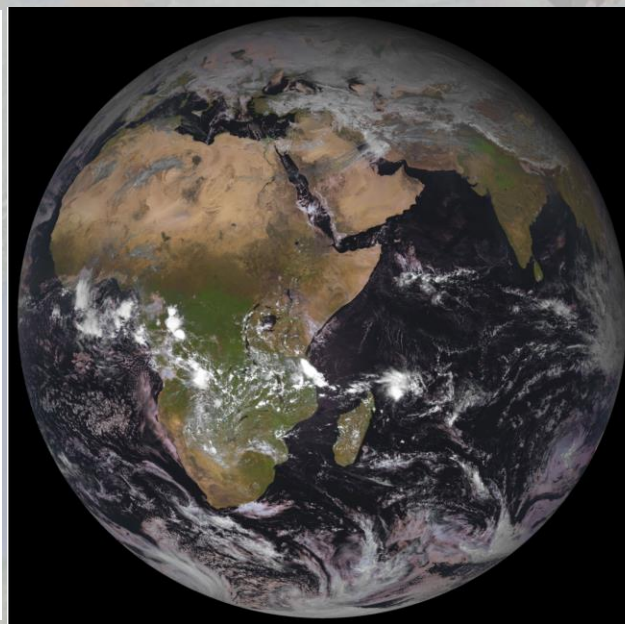
SEVIRI sensor on board of Meteosat Second Generation geostationary satellite provides every 15 min a view of one third of the Earth's surface (MSG-10 or MSG-3).

It offers the possibility to **promptly observe and locate** phenomena causing a sudden increase of the temperature in a wide area of the world.

It result very useful to locate phenomena in remote areas and in an independent way or when wide areas are involved.



MSG - 10



MSG - 8 (IODC)

The images are acquired always in the same observation geometry but the solar illumination conditions are changing:

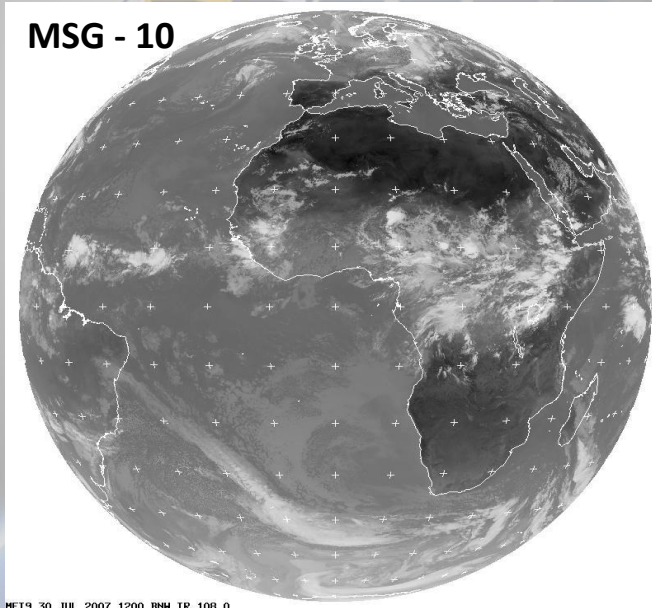
1. Geo-referencing and images registration is not a problem.
2. The change of the illumination conditions must be taken into account during the phase of event monitoring.



Fire detection and monitoring:

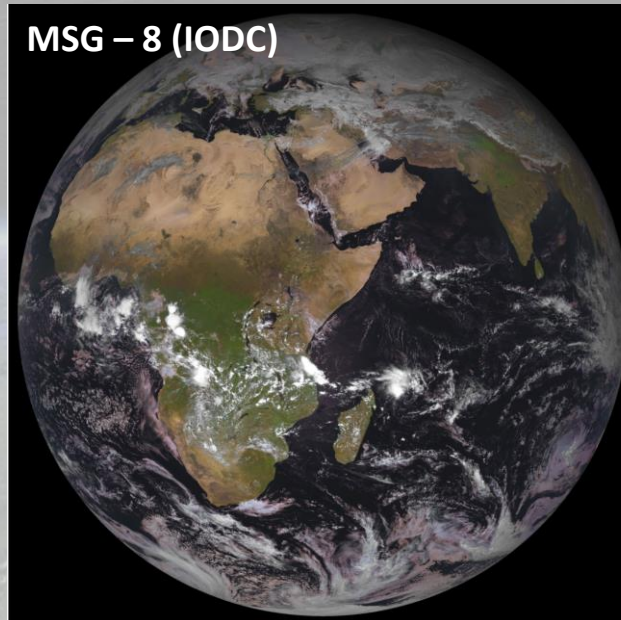
Data from 3 MSG satellites from 5 to 15 min (EUMETCAST)

MSG - 10



MET9 30 JUL 2007 1200 INH IR_108 0

MSG - 8 (IODC)



All SEVIRI/MSG sensors data are acquired and processed:

MSG 10: Lat=0°, Lon=0°, 15 min refresh frequency;

MSG 9 (Rapid Scanning Service): Lat=0°, Lon=9.5°, 5 min refresh frequency;

MSG 8, Indian Ocean Data Coverage: Lat=0°, Lon=41.5°, 15 min refresh frequency.

MSG - 9 (RSS)



RGB image from MSG 9: Red (NIR 1.6), Green (VIS 0.8), and Blue (VIS 0.6)



Fire detection and monitoring:

EUMETSAT CAPs

```
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  <sent>2017-08-20T00:15:00-00:00</sent>
  <status>Actual</status>
  <msgType>Alert</msgType>
  <scope>Public</scope>
  <info>
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    <event>FIRE</event>
    <responseType>Assess</responseType>
    <responseType>Monitor</responseType>
    <urgency>Immediate</urgency>
    <severity>Moderate</severity>
    <certainty>Likely</certainty>
    <effective>2017-08-20T00:00:00-00:00</effective>
    <expires>2017-08-20T00:30:00-00:00</expires>
    <senderName>EUMETSAT</senderName>
    <headline>Fire detection report</headline>
    <description> Fire detection. This is a computer generated report and has not been reviewed by a human.
    <web>http://oiswww.eumetsat.org/IPPS/html/MSG/PRODUCTS/FIR</web>
    <area>
      <areaDesc>List of detected fires (latitude, longitude, radius)</areaDesc>
      <circle>-24.157,28.872 1.877</circle>
      <circle>-24.156,28.835 1.877</circle>
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      <circle>3.462,-59.614 2.971</circle>
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  </info>
</alert>
```

Distributed through EUMETCAST every 15 min

Information available:

- time;
- Coordinates and radius (pixel size);
- Severity;
- Certainty.

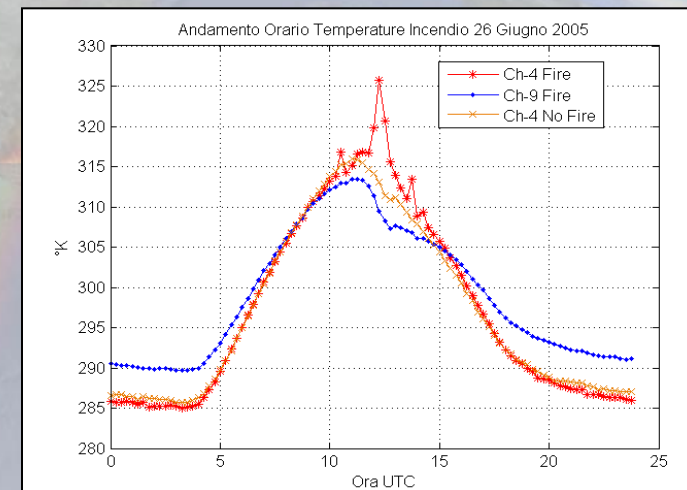
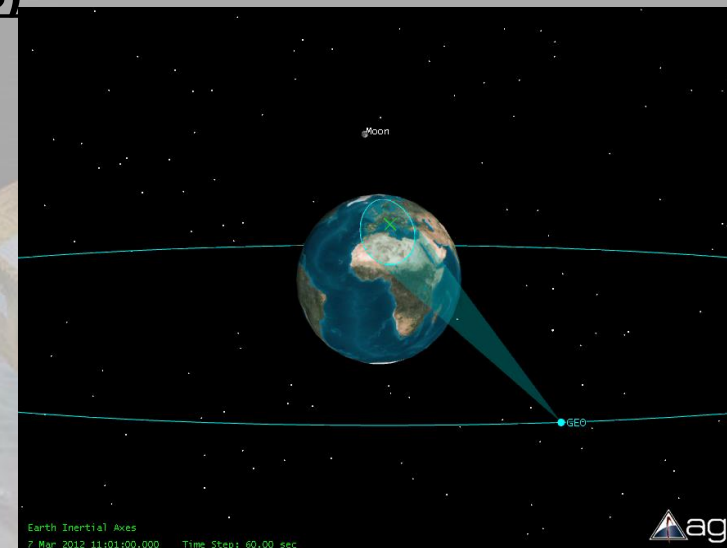
Nome	Ultima modifica	Tipo	Dimensione
20170820000-firc	29/08/2017 10:49	File XML	6 KB
201708200015-firc	29/08/2017 09:46	File XML	6 KB
201708200030-firc	29/08/2017 09:47	File XML	6 KB
201708200045-firc	20/08/2017 02:45	File XML	5 KB
201708200100-firc	20/08/2017 03:00	File XML	5 KB
201708200115-firc	29/08/2017 18:40	File XML	5 KB
201708200130-firc	20/08/2017 03:30	File XML	6 KB
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201708200215-firc	20/08/2017 04:15	File XML	4 KB
201708200230-firc	20/08/2017 04:30	File XML	5 KB
201708200245-firc	20/08/2017 04:45	File XML	4 KB
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201708200445-firc	20/08/2017 06:45	File XML	4 KB
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201708200845-firc	20/08/2017 10:45	File XML	17 KB

Hot Spot SEVIRI (HSS)

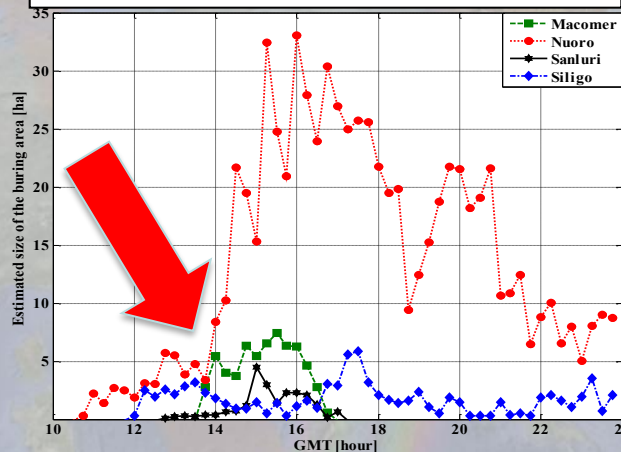
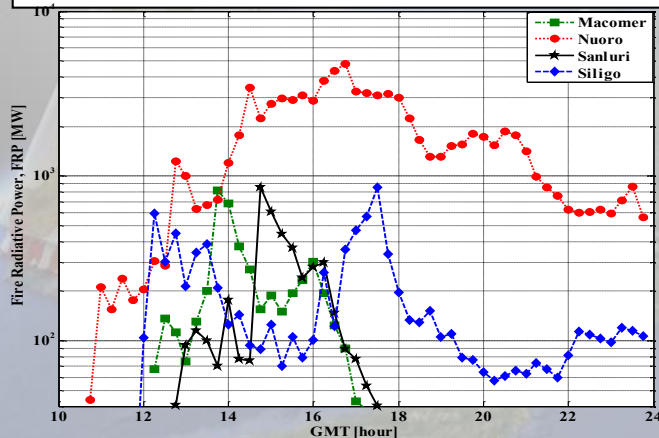
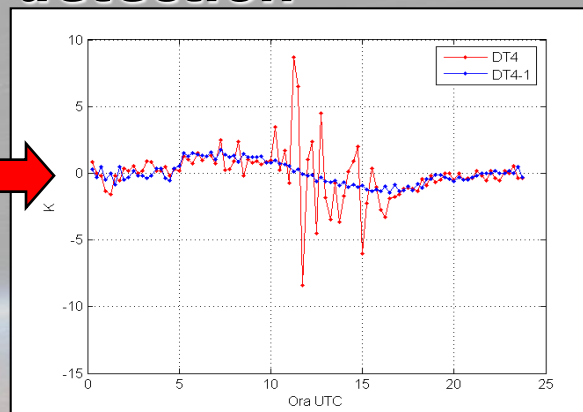
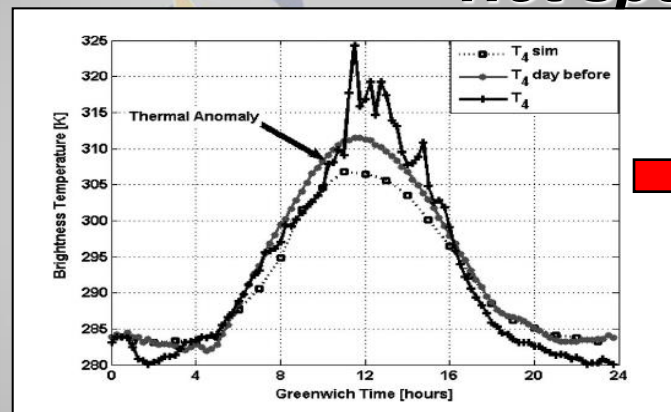
The images source is the SEVIRI geostationary sensor on board of the three MSG satellites Meteosat 8, 9 and 10. The algorithms is:

• **SFIDE® (System for Fire Detection)**, developed by the **Centro di Ricerca Progetto San Marco (CRPSM)** of the **University of Rome "La Sapienza"**, G. Laneve, M. M. Castronuovo, E. Cadau: *Continuous Monitoring of Forest Fires in Mediterranean Area Using MSG*. IEEE Trans. on Geoscience and Remote Sensing, vol. 44, N. 10, pp. 2761-2768, 2006.

CRPSM (SFIDE®) algorithm tries to exploit the image high refreshing frequency guaranteed by the SEVIRI sensor (15 min) for minimizing the sizes of the detectable fire. This objective is achieved by comparing *temperatures variation* between two consecutive images (acquired after 15 min one to the other) with the expected value provided by a suitable model driven by local, instantaneous data.



Hot spot detection



The geostationary system allows to follow the fire temporal behaviour (high refreshing frequency of SEVIRI) and estimate, objectively, its intensity by means of the **FRP** (Fire Radiative Power).

In principle, from FRP, it is possible to compute the FRE (Fire Radiative Energy) and then the burned biomass (BB), if the specific heat of the burning vegetation is known.

Assuming a combustion rate $Cr = 0.368 \text{ kg/MJ}$, it is possible to estimate BB (Roberts et al, 2008).

$$FRP_{SB} = A_f \cdot \varepsilon \cdot \sigma \cdot (T_f^4 - T_b^4)$$

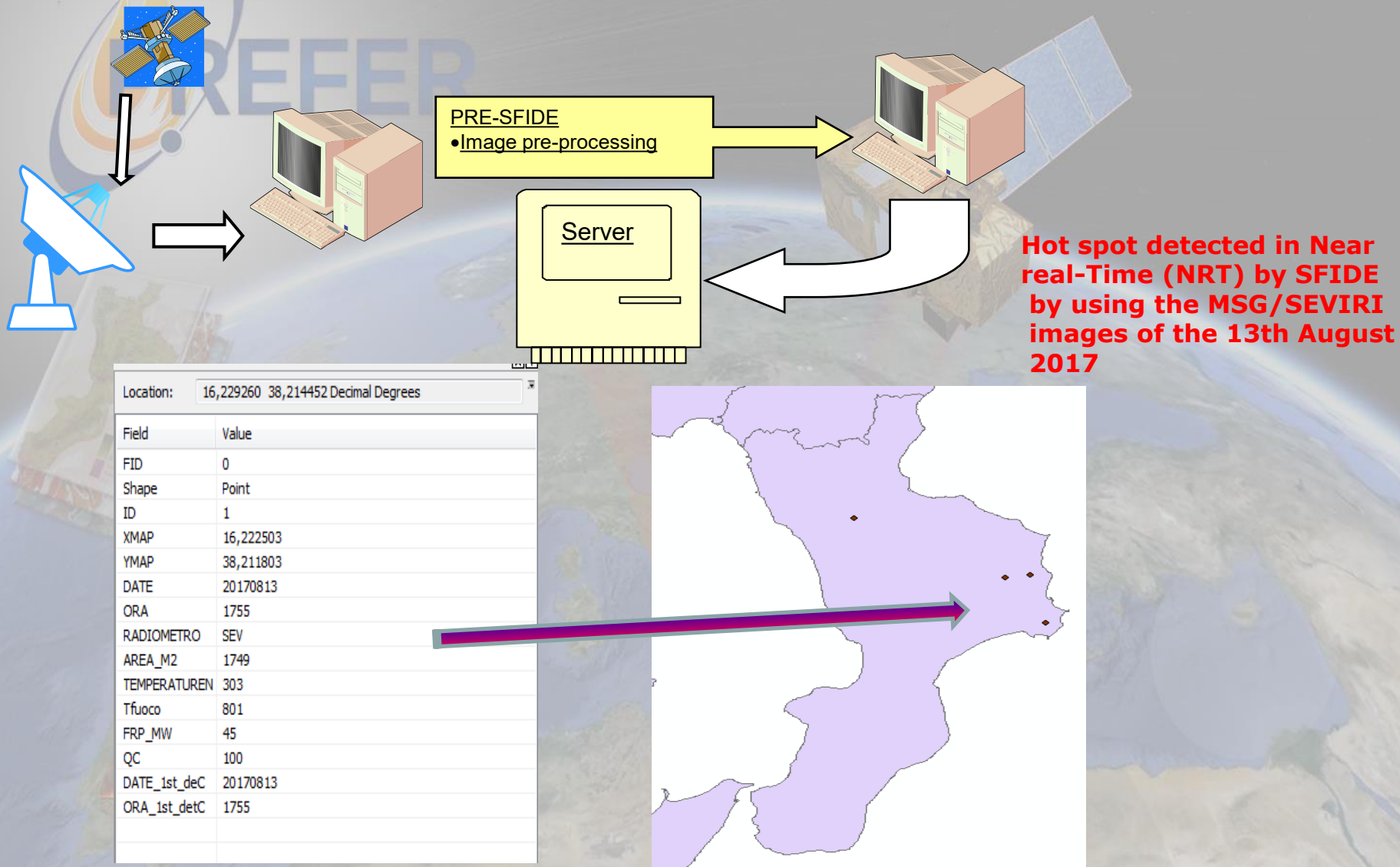
Stefan Boltzmann (LUT)

$$\begin{cases} FRP_W = \frac{A_p \cdot \sigma \cdot \varepsilon_{MIR}}{a \cdot \varepsilon} L_{MIR} \cong \frac{A_p \cdot \sigma}{a} L_{MIR} \\ B(\lambda_{MIR}, T_f) \cong a \cdot T_f^4 \end{cases}$$

Wooster $BB \cong 0.368 \cdot FRE \quad [MJ] \quad [kg]$

$$\rho_B \cong BB / area_B \quad [Kg / m^2]$$

Forest fires monitoring





Fire detection and monitoring:

EOSIAL CAPs

Distributed every 5 min or 15 min
Information available:

- time;
- Coordinates and radius (pixel size);
- Municipality;
- Severity (based on FRP);
- Certainty
- etc.



```

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    <certainty>Likely</certainty>
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    <description>Fire detection. This is a computer generated report.
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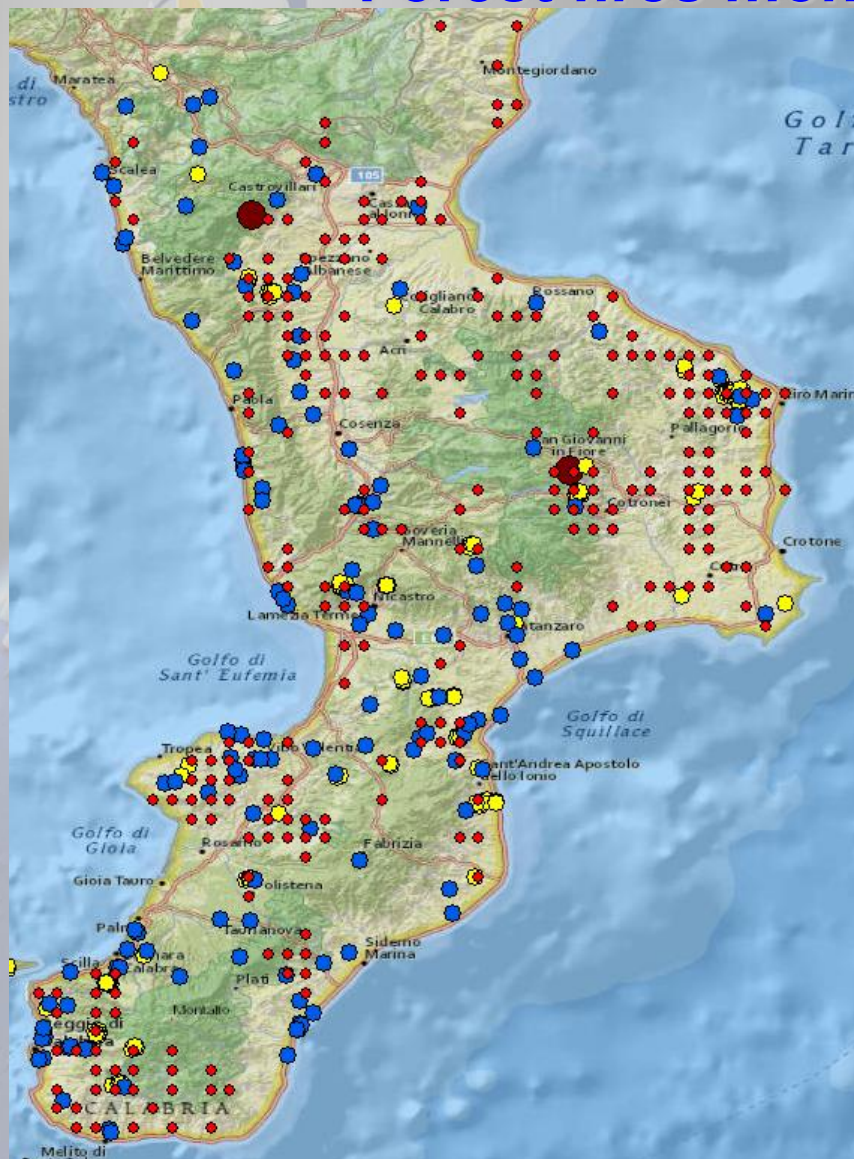
```

```

    </parameter>
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    </parameter>
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      <value>1023</value>
    </parameter>
    <parameter>
      <valueName>Temp</valueName>
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    </parameter>
    <parameter>
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      <value>54</value>
    </parameter>
    <area>
      <areaDesc>List of detected fires: latitude, longitude, radius (km)</areaDesc>
      <circle>39.200489,16.14653 2</circle>
    </area>
  </info>
</alert>

```

Forest fires monitoring



Hot spots detected in Near-Real-Time (NRT) by SFIDE
by using the MSG-2 (or 9)/SEVIRI images (5 min revisit
frequency) of the 20th August 2017

20° of August 2017

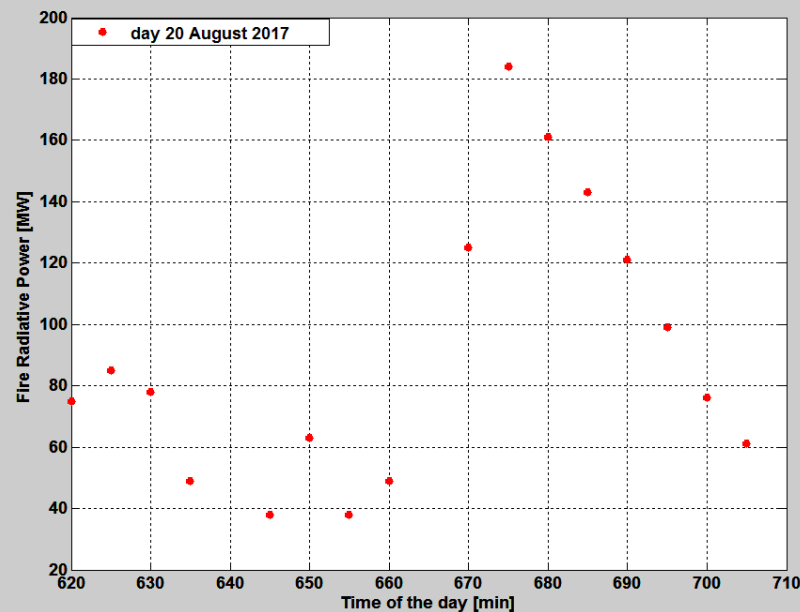
Yellow circle = VVFF fire events

Blue circle = MODIS/VIIRS hot-spots

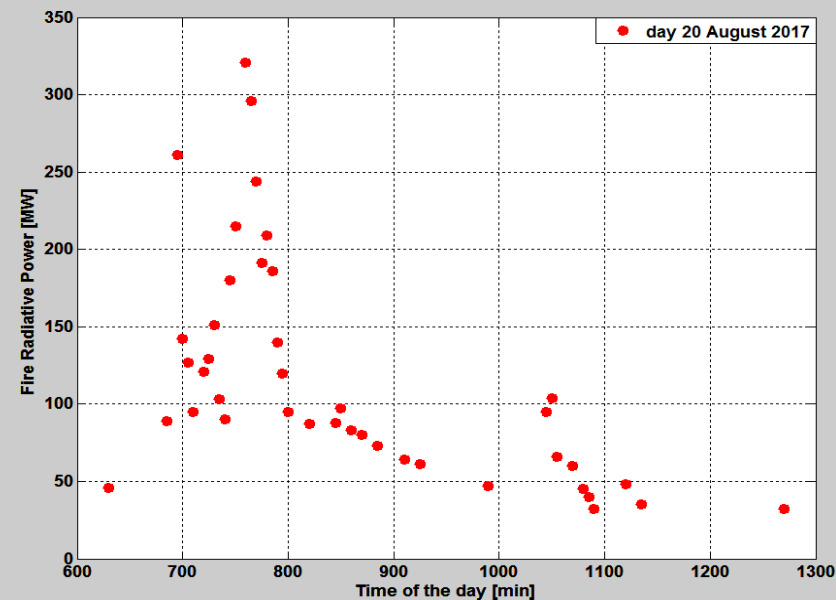
Red circle = = MSG 5 min

Marron circle = CAP EUMETSAT (only 2 events
available for the that day)

Forest fires monitoring



Coordinates:
 lon = 16.1085
 lat = 39.5808



Coordinates:
 lon = 17.0582
 lat = 39.390

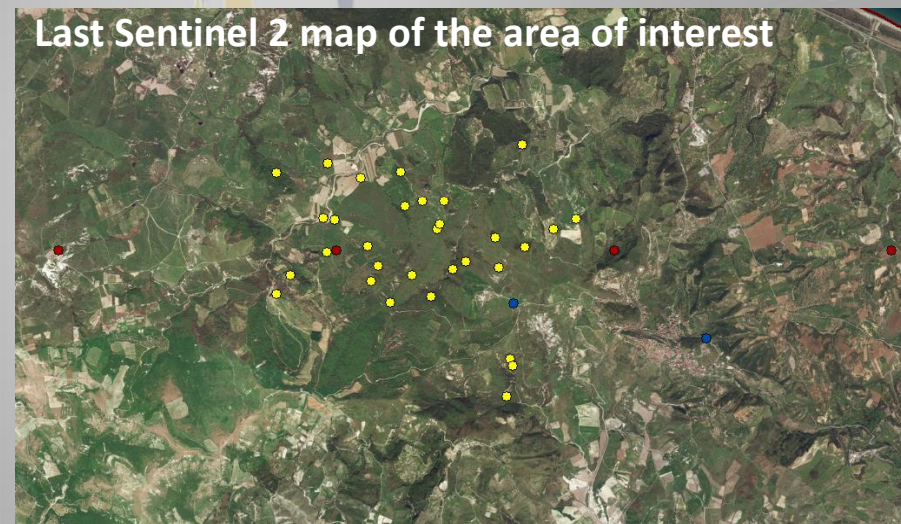
Fire Radiative Power (FRP) as function of the time as retrieved by using SFIDE algorithm and MSG-RSS images (5 min revisit frequency) of the 20th August 2017.

Two events have been considered.

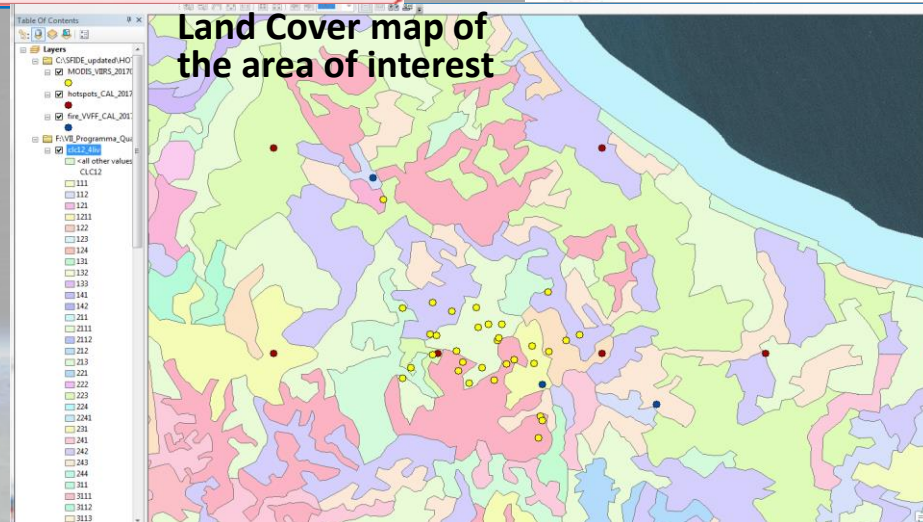


Forest fires monitoring: ancillary data

Last Sentinel 2 map of the area of interest



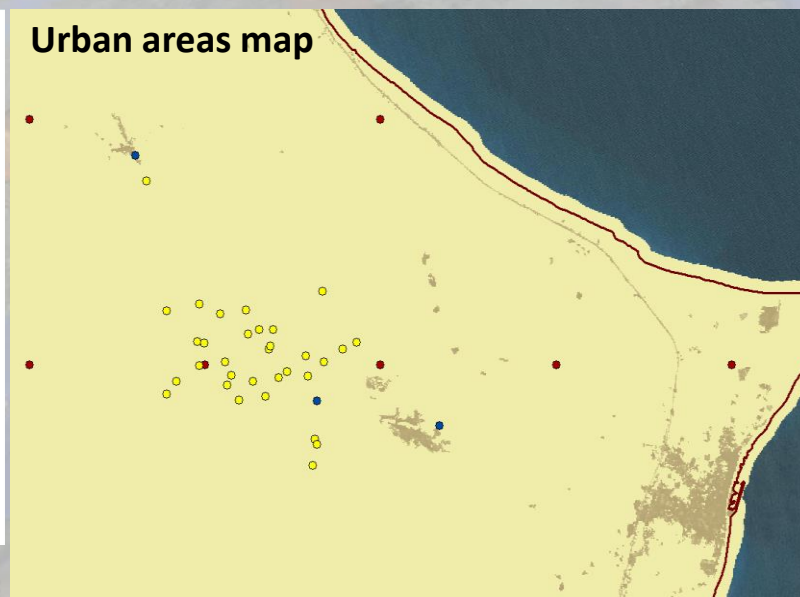
Land Cover map of the area of interest



Corine land cover classes

- 1. Artificial surfaces**
 - 1.1 Urban fabric
 - 1.1.1 Continuous urban fabric
 - 1.1.2 Discontinuous urban fabric
 - 1.2 Industrial, commercial and transport units
 - 1.2.1 Industrial or commercial units
 - 1.2.2 Road and rail networks and associated land
 - 1.2.3 Port areas
 - 1.2.4 Airports
 - 1.3 Mine, dump and construction sites
 - 1.3.1 Mineral extraction sites
 - 1.3.2 Dump sites
 - 1.3.3 Construction sites
 - 1.4 Artificial, non-agricultural vegetated areas
 - 1.4.1 Green urban areas
 - 1.4.2 Sport and leisure facilities
- 2. Agricultural areas**
 - 2.1 Arable land
 - 2.1.1 Non-irrigated arable land
 - 2.1.2 Permanently irrigated land
 - 2.1.3 Rice fields
 - 2.2 Permanent crops
 - 2.2.1 Vineyards
 - 2.2.2 Fruit trees and berry plantations
 - 2.2.3 Olive groves
 - 2.3 Pastures
 - 2.3.1 Pastures
 - 2.4 Heterogeneous agricultural areas
 - 2.4.1 Annual crops associated with permanent crops
 - 2.4.2 Complex cultivation patterns
 - 2.4.3 Land principally occupied by agriculture
 - 2.4.4 Agro-forestry areas
- 3. Forest and seminatural areas**
 - 3.1 Forests
 - 3.1.1 Broad-leaved forest
 - 3.1.2 Coniferous forest
 - 3.1.3 Mixed forest
 - 3.2 Shrub and/or herbaceous vegetation associations
 - 3.2.1 Natural grassland
 - 3.2.2 Mires and heathland
 - 3.2.3 Sclerophyllous vegetation
 - 3.2.4 Transitional woodland shrub
 - 3.3 Open spaces with little or no vegetation
 - 3.3.1 Beaches, dunes, and sand plains
 - 3.3.2 Bare rock
 - 3.3.3 Sparsely vegetated areas
 - 3.3.4 Burnt areas
 - 3.3.5 Glaciers and perpetual snow
- 4. Wetlands**
 - 4.1 Inland wetlands
 - 4.1.1 Inland marshes
 - 4.1.2 Peat bogs
 - 4.2 Coastal wetlands
 - 4.2.1 Salt marshes
 - 4.2.2 Saltpans
 - 4.2.3 Intertidal flats
- 5. Water bodies**
 - 5.1 Inland waters
 - 5.1.1 Water courses
 - 5.1.2 Water bodies
 - 5.2 Marine waters
 - 5.2.1 Coastal lagoons
 - 5.2.2 Estuaries
 - 5.2.3 Sea and ocean

Urban areas map



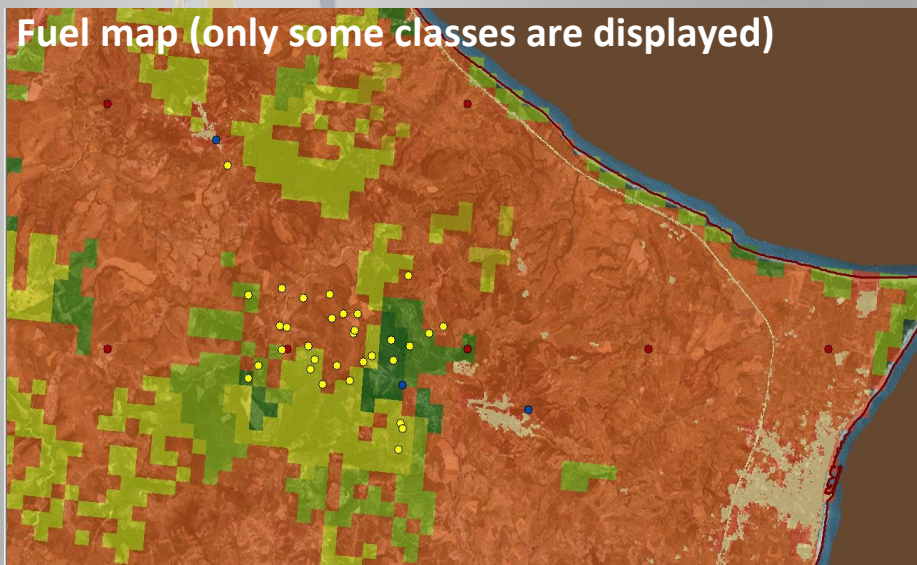
Forest/No-forest (30 m)



Light green = woodland;
Marron = other

Forest fires monitoring: ancillary data

Fuel map (only some classes are displayed)

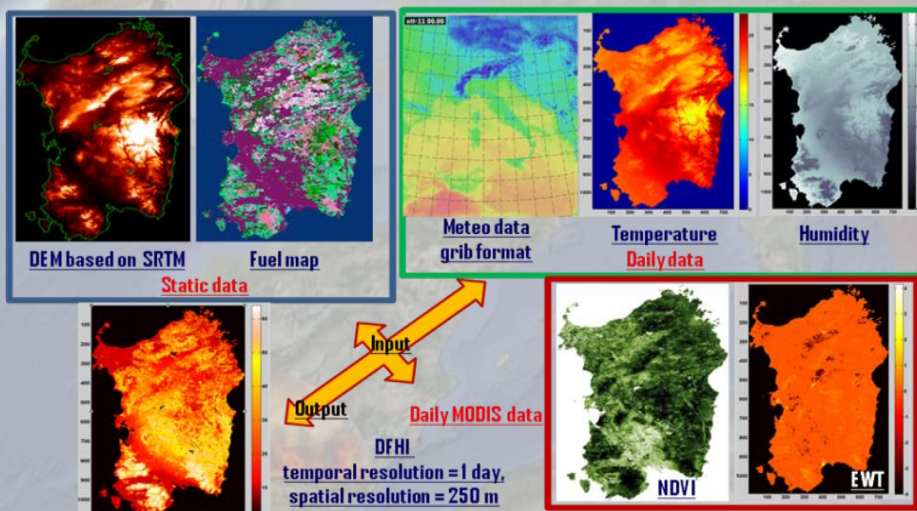
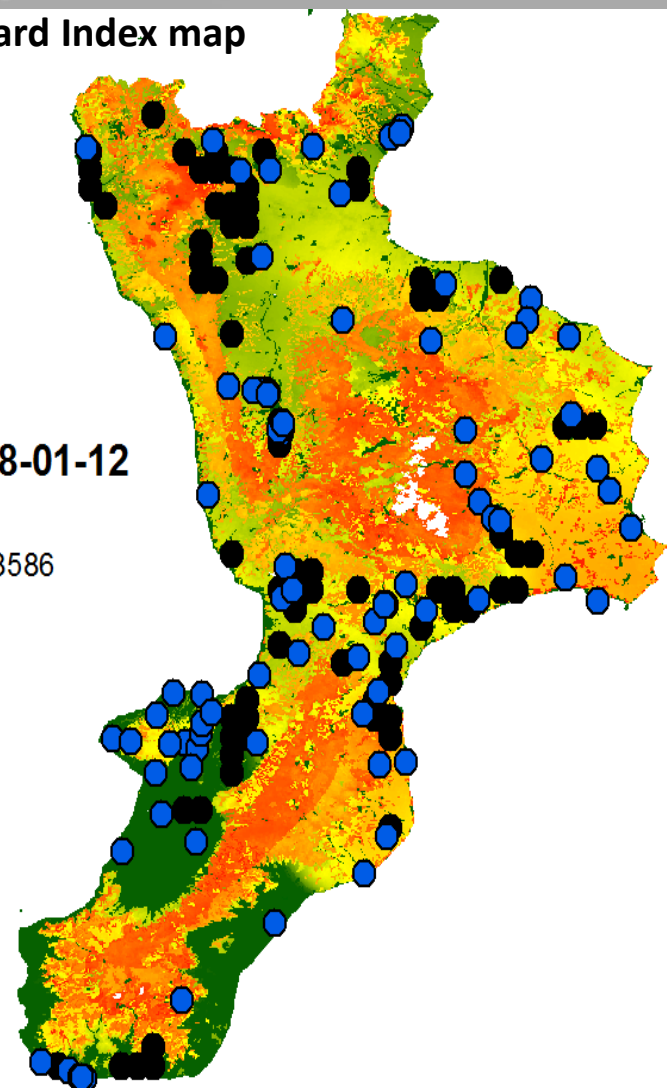
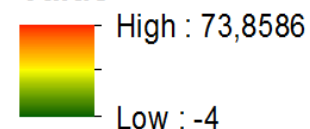


Daily Fire Hazard Index map

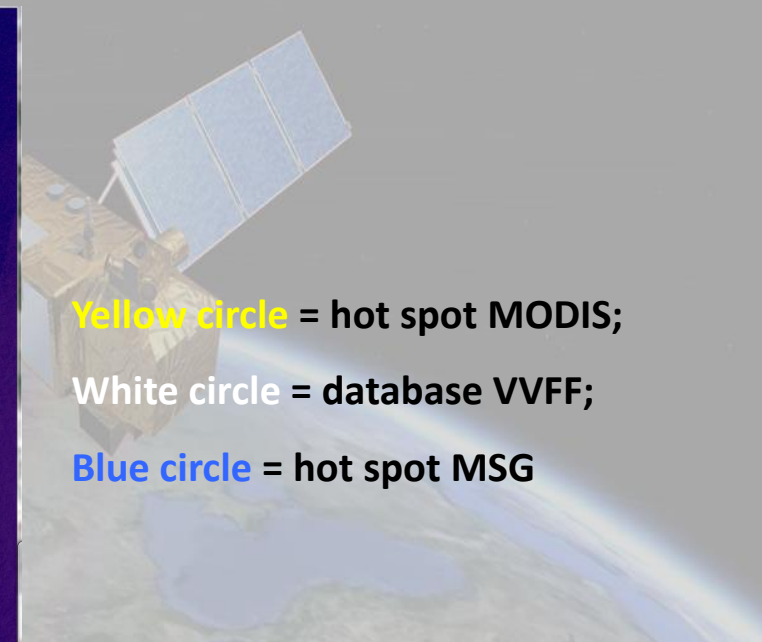
Legend

DFHI_2017-08-01-12

Value



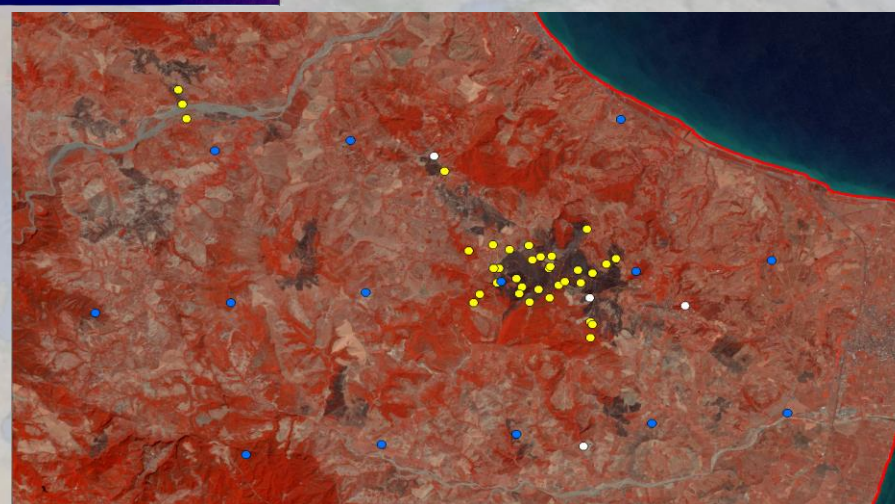
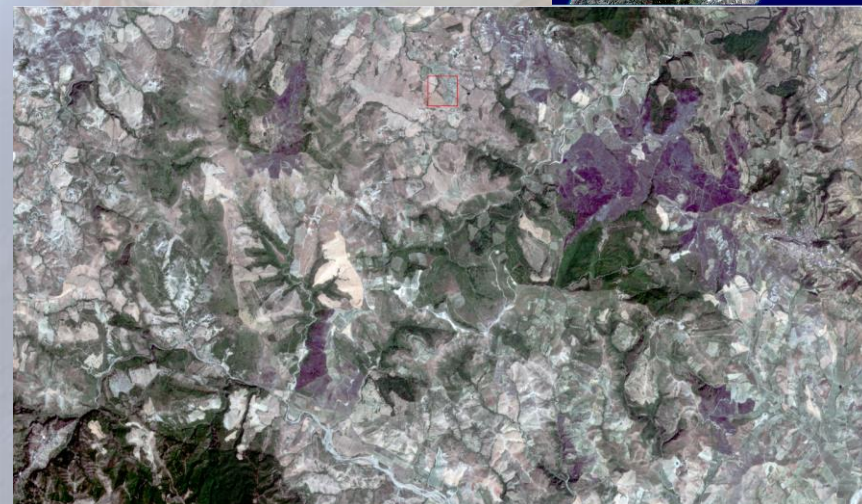
Forest fires monitoring: burned areas



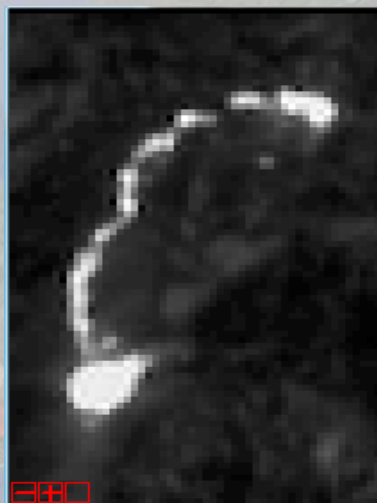
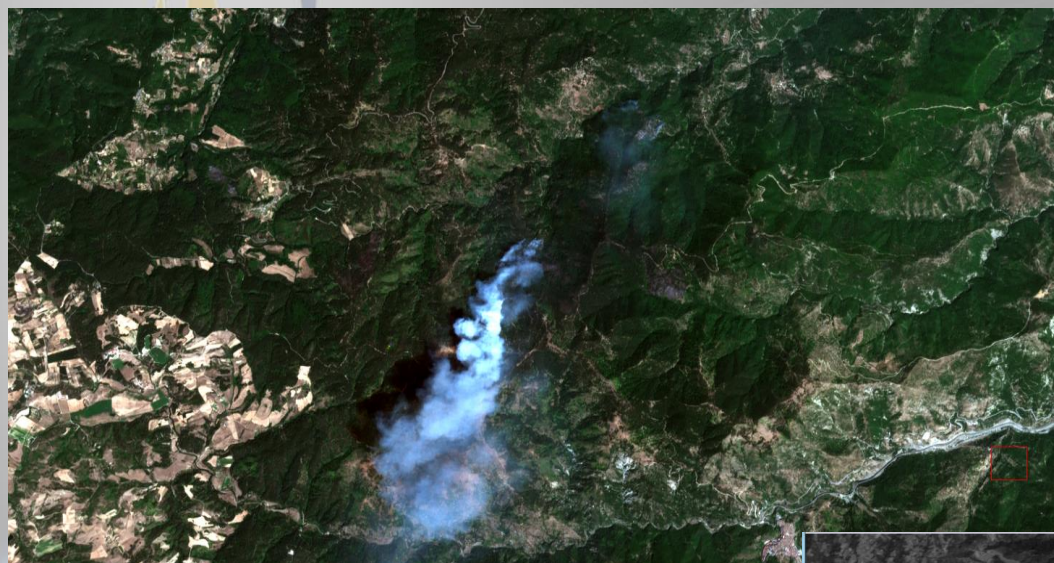
Yellow circle = hot spot MODIS;

White circle = database VVFF;

Blue circle = hot spot MSG



Forest fires monitoring: burned areas





EOSIAL Earth Observation Satellite Images Application Lab.

eosial.psm.uniroma1.it

Forest Fires monitoring

Forest fire maps are automatically-generated in real time by the algorithm every 15 and updated according to the MSG-SEVIRI images acquisition time. Each pixel corresponds to a 16 km² area (sensor resolution); this does not mean that the fire is the same size as a pixel. The absolute position of the fire, is in fact, located within the most positive hot geolocation error is approximately 2 km.

1 2 3 4 5 6 7 8 9

Tweets by @EOSIAL_sapienza

EOSIAL Lab. Retweeted
USGS Landsat @USGSLandsat

Watch a live stream from aboard #Landsat 8 on the new EarthNow! viewer.
earthnow.usgs.gov

Embed View on Twitter

Earth Observation Satellite Images Application Laboratory

The laboratory is focused on the development of innovative applications of satellite/aerial optical (multi- and hyper-spectral) and SAR imagery covering a wide range of fields of interest, as fire monitoring, volcanic eruptions and ash cloud monitoring, oil spill monitoring, environmental monitoring including the development of applications related to security. The laboratory is oriented in particular to the development of automatic applications based on real-time approaches.

Scientific coordinator: Professor Giovanni Lanave

Equipped with software and hardware instruments, and with a wide dataset of satellite images including low as well as very high spatial resolution, both optical and radar, the laboratory relies on two satellite image acquisition systems: one located in Rome, and another one in the Broglio Space Center in Malindi, Kenya.

Rome Station acquires images from SEVIRI (Spinning Enhanced Visible and Infrared Imager), on board Meteosat Second Generation (MSG) satellite, and images from MODIS and AVHRR satellites, while Malindi Station could acquire high resolution images (Landsat, CBERS, etc.)

[Read more](#)

EOSIAL Laboratory joins Godan network

Submitted by admin on Tue, 02/14/2017 - 09:36

EOSIAL Laboratory joins Godan (Global Open Data for Agriculture & Nutrition) network.

Godan supports the proactive sharing of open data to make information about agriculture and nutrition available, accessible and usable to deal with the urgent challenge of ensuring world food security.

[Read more](#)

EUMETSAT

SERVICE STATUS INDICATOR

Service	Status
0° Service	MET-10
3.5°E RSS	MET-9
41.5°E IODC	MET-8
GDS-Metop	Metop-A
GDS-Metop	Metop-B
GDS-NOAA	NOAA-19
OSTM	Jason-2
3rd Party	GOES-13, GOES-15, Himawari-8
Copernicus	Jason-3
Copernicus	Sentinel-1A
EUMETSAT	N/A

Valid for: 2017/09/06 15:33:53 UTC

Add WMS

URL:

Connect

- Floating Vegetation Victoria Lake - KENYA (EOSIAL WMS)
- NDVI Victoria Lake - KENYA (EOSIAL WMS)
- CDOM Victoria Lake - KENYA (EOSIAL WMS)
- CHL Victoria Lake - KENYA (EOSIAL WMS)
- TSS Victoria Lake - KENYA (EOSIAL WMS)
- Dust Storm (from MODIS) - IRAQ (EOSIAL WMS)
- Dust Storm (from MSG) - IRAQ (EOSIAL WMS)
- Dust Storm (from MSG) - LYBIA (EOSIAL WMS)
- Dust Storm (from MSG) - NORTH AFRICA (EOSIAL WMS)
- Hot Spots SFIDE - Sardinia - ITALY (EOSIAL WMS)
- Hot Spots SFIDE - Liguria - ITALY (EOSIAL WMS)
- Hot Spots SFIDE - Calabria - ITALY (EOSIAL WMS)
- Daily Fire Hazard Map - Sardinia - ITALY (EOSIAL WMS)
- EvapoTranspiration - Sardinia - ITALY (EOSIAL WMS)
- EOVSS Hot Spots (EOSIAL WMS)
- ODS3F Layers (EOSIAL WMS)
- Fog Stability Index. ODS3F (EOSIAL WMS)
- Visibility Index. ODS3F (EOSIAL WMS)
- SMB Layers (EOSIAL WMS)

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5. TSS Victoria Lake - KENYA (EOSIAL WMS)

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7. Dust Storm (from MSG) - IRAQ (EOSIAL WMS)

8. Dust Storm (from MSG) - LYBIA (EOSIAL WMS)

9. Dust Storm (from MSG) - NORTH AFRICA (EOSIAL WMS)

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Web Map Services

KENYA
Lake Victoria Floating Vegetation
http://eosial.psm.uniroma1.it/arcgis/rest/services/Threats_Vegetation_Victoria_Lake/MapServer

Service description

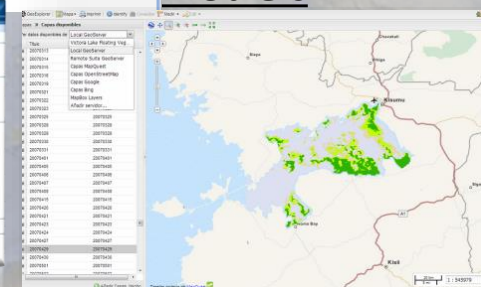
Spatial resolution: 250 m
Temporal resolution: 1 day
Origin Product: MODIS
Data: TSS
Author: EOSIAL

Bibliographic references

Development of an operational system for monitoring and...
Assessment of the abnormal growth of...
Remote Sensing water observation...
Global model for the...

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THANK YOU for your attention !

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