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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”**

**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.

SIA remote sensing applications

- **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.**

Training

**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 practices		



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.



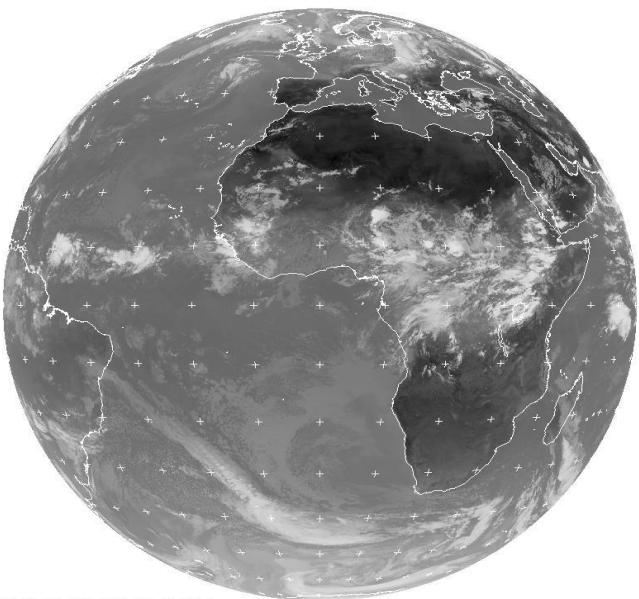
Fire detection and monitoring:

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

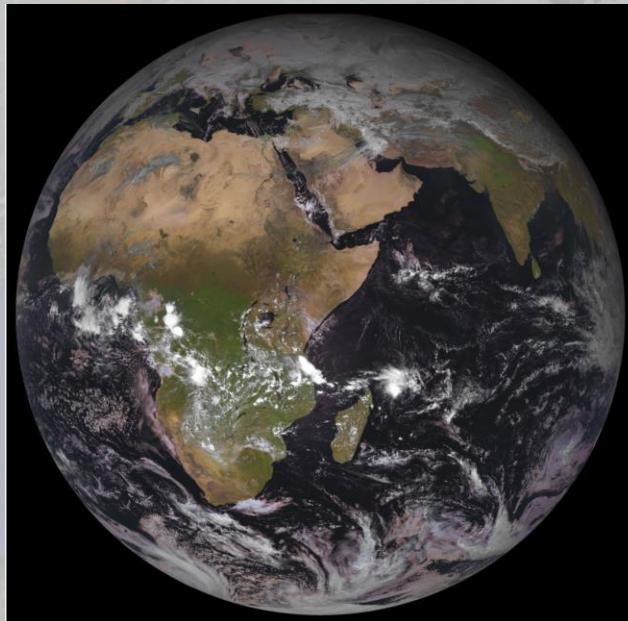
SEVIRI sensor on board of Meteosat Second Generation geostationary satellite provides every 15 min a view of one third of the Earth's surface (MSG-10 or MSG-3).

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:

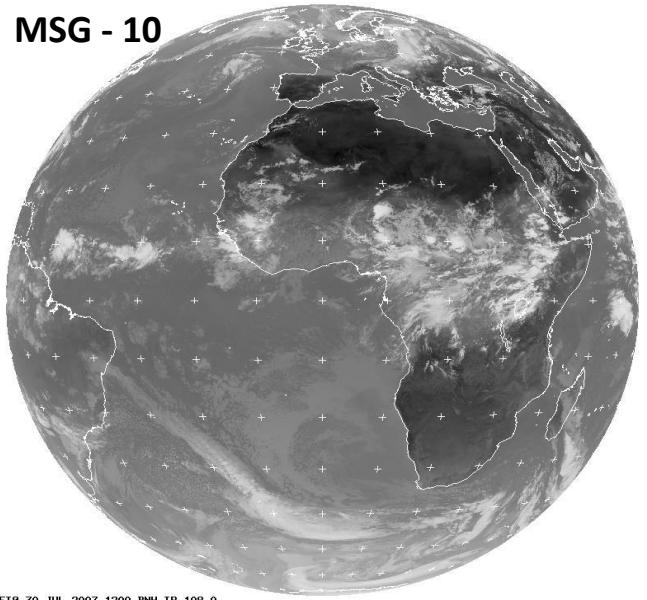
1. Geo-referencing and images registration is not a problem.
2. The change of the illumination conditions must be taken into account during the phase of event monitoring.



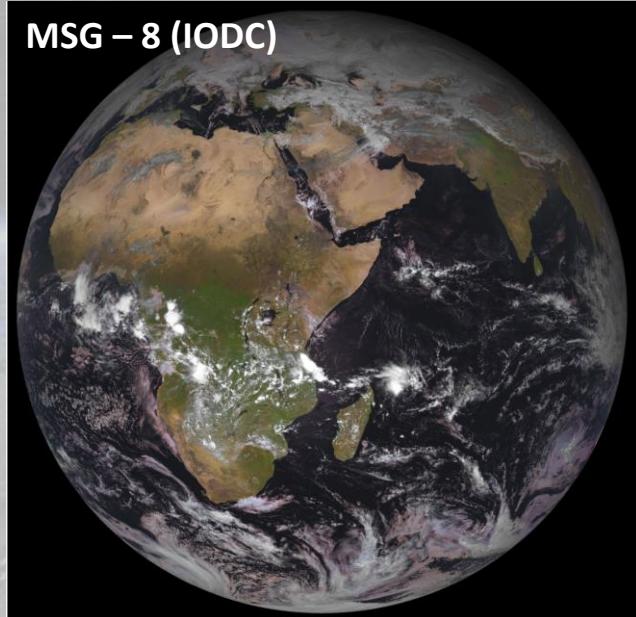
Fire detection and monitoring:

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

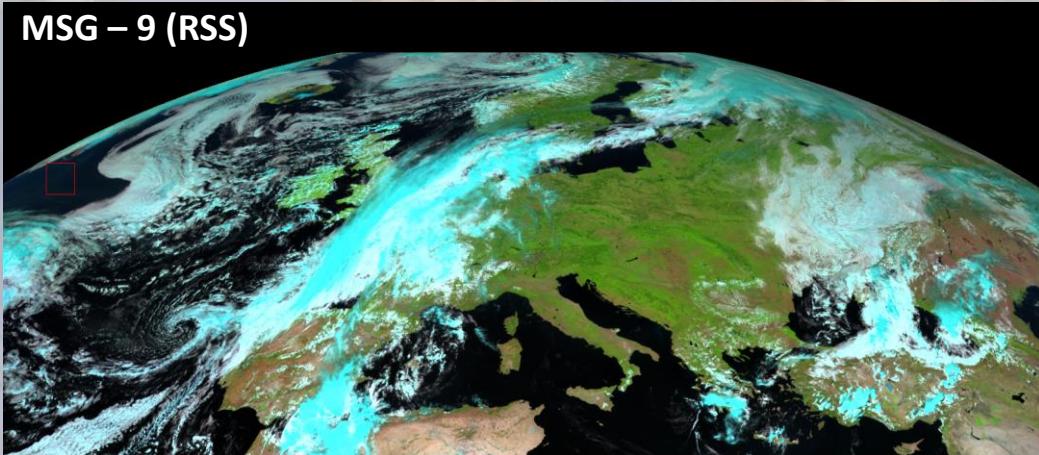
MSG - 10



MSG – 8 (IODC)



MSG – 9 (RSS)



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.

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>
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  <info>
    <category>Geo</category>
    <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.
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    <circle>-24.156,28.835 1.877</circle>
    <circle>-24.125,28.862 1.877</circle>
    <circle>-24.124,28.825 1.876</circle>
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    <circle>-12.043,-48.862 2.331</circle>
    <circle>-9.577,-48.852 2.312</circle>
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    <circle>-5.948,-53.796 2.553</circle>
    <circle>3.462,-59.614 2.971</circle>
  </area>
</alert>
```

Distributed through EUMETCAST every 15 min
Information available:

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

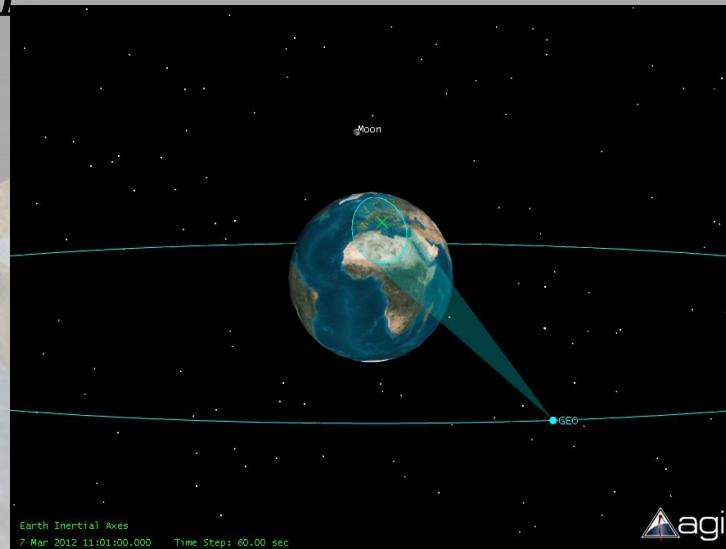
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201708200045-firc	20/08/2017 02:45	File XML	5 KB
201708200100-firc	20/08/2017 03:00	File XML	5 KB
201708200115-firc	29/08/2017 18:40	File XML	5 KB
201708200130-firc	20/08/2017 03:30	File XML	6 KB
201708200145-firc	20/08/2017 03:45	File XML	5 KB
201708200200-firc	20/08/2017 04:00	File XML	5 KB
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
201708200300-firc	20/08/2017 05:00	File XML	4 KB
201708200315-firc	20/08/2017 05:15	File XML	5 KB
201708200330-firc	20/08/2017 05:30	File XML	4 KB
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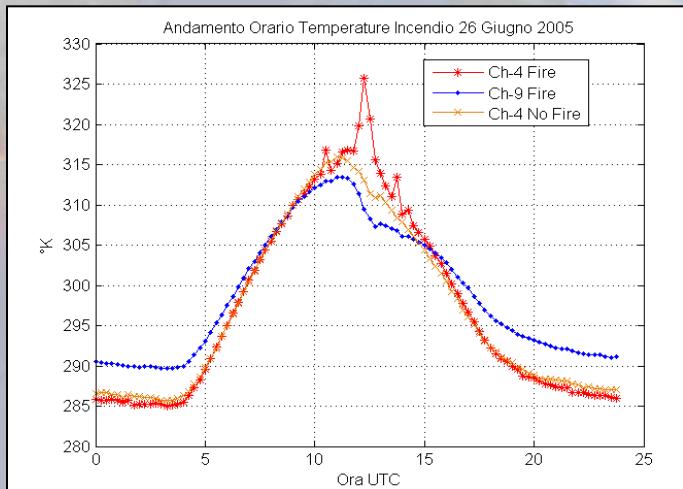
Hot Spot SEVIRI (HSS)

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

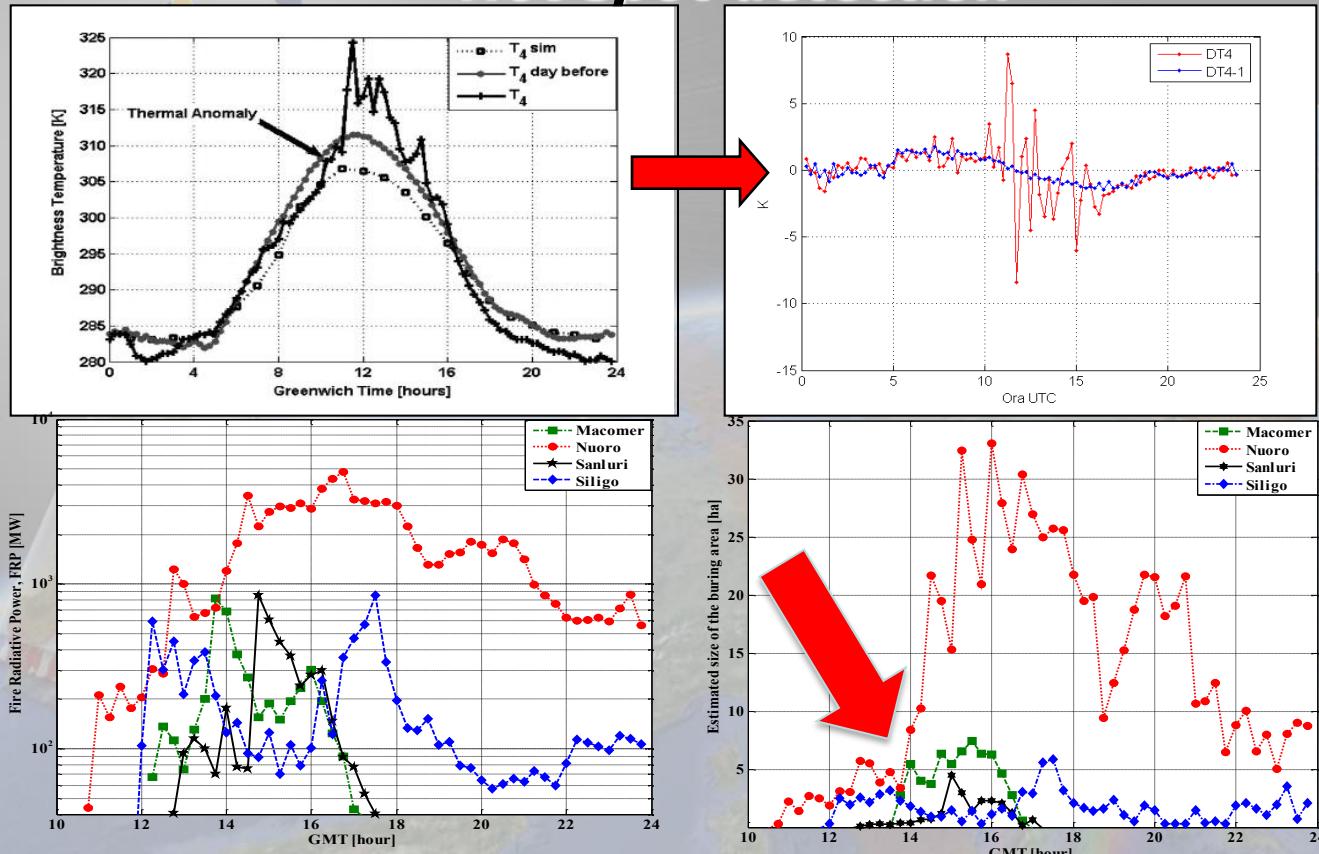
•SFIDE® (System for FIre Detection), developed by the Centro di Ricerca Progetto San Marco (CRPSM) of the University of Rome “La Sapienza”, G. Laneve, M. M. Castronuovo, E. Cadau: *Continuous Monitoring of Forest Fires in Mediterranean Area Using MSG*. IEEE Trans. on Geoscience and Remote Sensing, vol. 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



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

Stefan Boltzmann (LUT)

$$\left\{ \begin{array}{l} FRP_W = \frac{A_p \cdot \sigma \cdot \epsilon_{MIR}}{a \cdot \epsilon} L_{MIR} \cong \frac{A_p \cdot \sigma}{a} L_{MIR} \quad \text{Wooster} \quad BB \cong 0.368 \cdot FRE \quad [MJ] \quad [kg] \\ B(\lambda_{MIR}, T_f) \cong a \cdot T_f^4 \quad \rho_B \cong BB / area_B \quad [Kg / m^2] \end{array} \right.$$

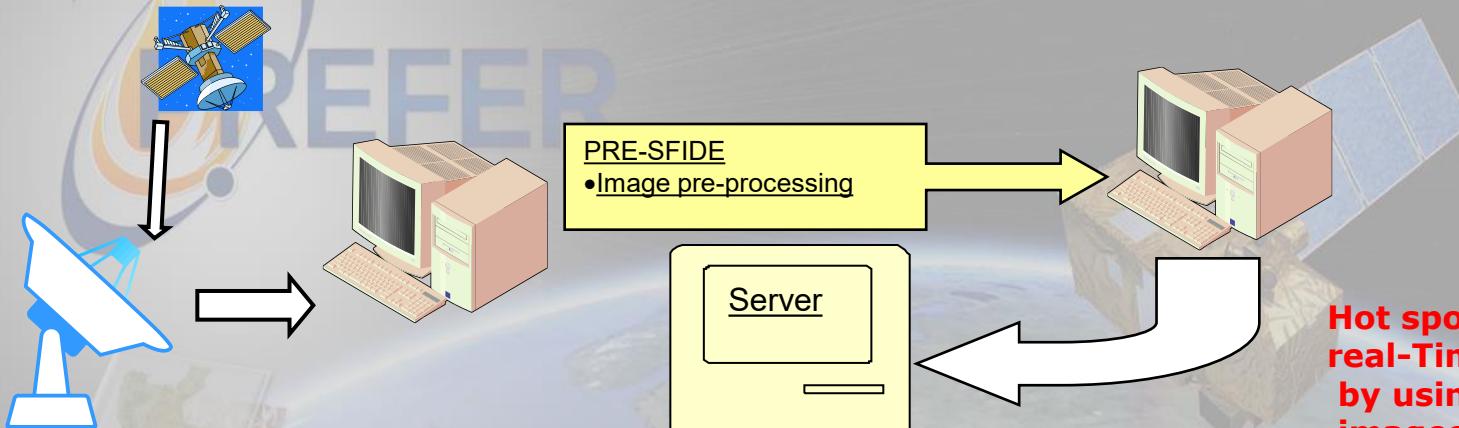
The geostationary system allows to follow the fire temporal behaviour (high refreshing frequency of SEVIRI) and estimate, objectively, its intensity by means of the **FRP** (Fire Radiative Power).

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.

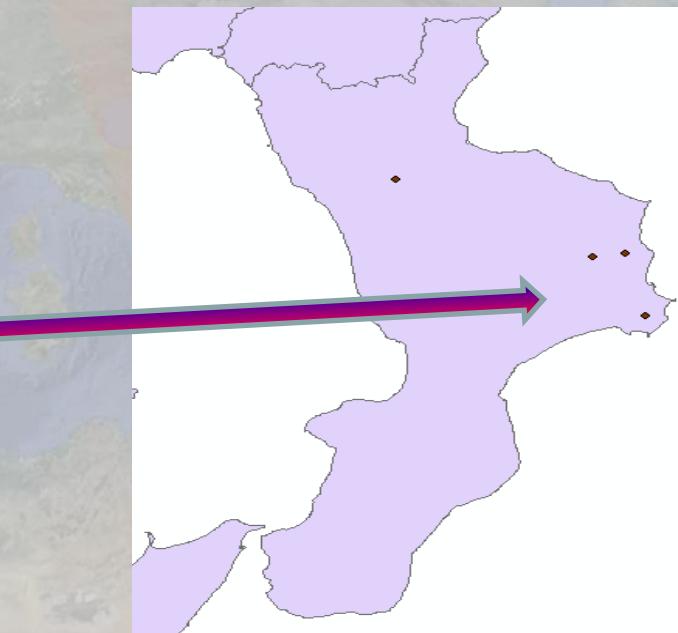
Assuming a combustion rate $Cr = 0.368 \text{ kg/MJ}$, it is possible to estimate BB (Roberts et al, 2008).



Forest fires monitoring

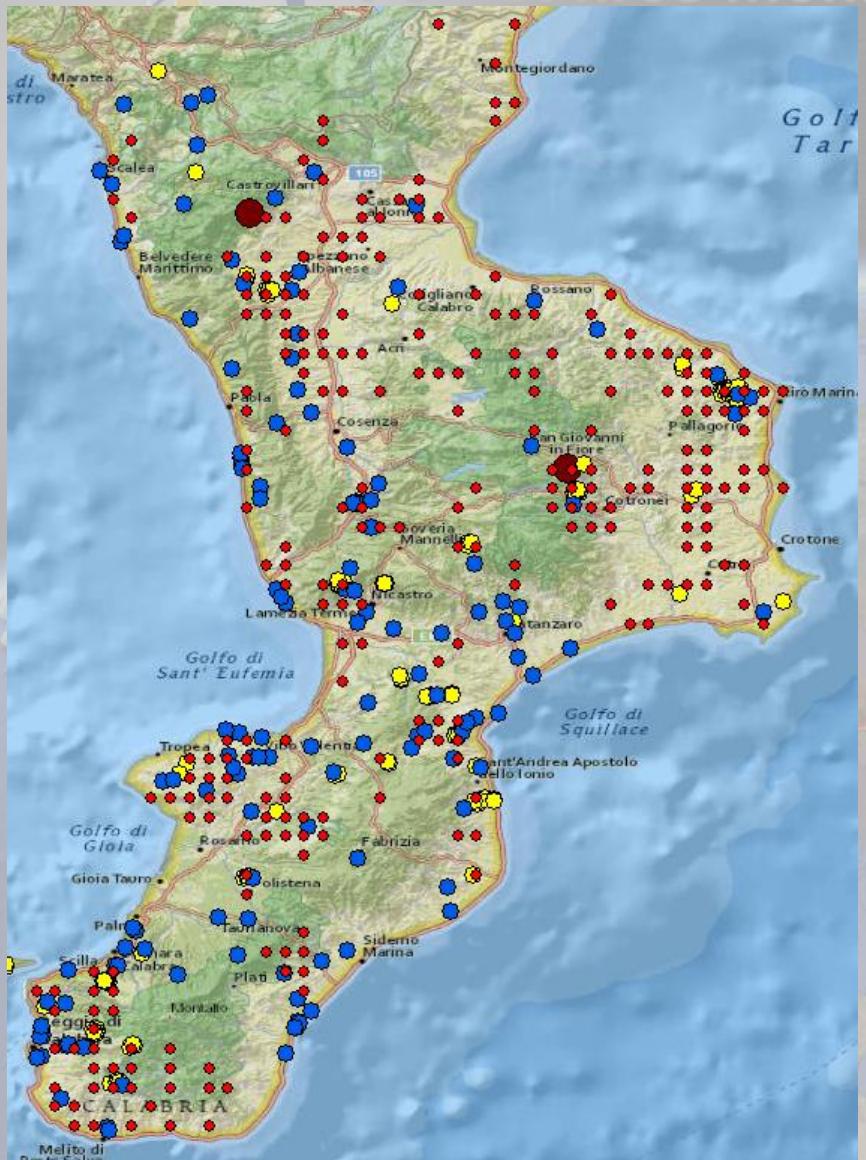


Location:		16,229260 38,214452 Decimal Degrees
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Shape	Point	
ID	1	
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YMAP	38,211803	
DATE	20170813	
ORA	1755	
RADIOMETRO	SEV	
AREA_M2	1749	
TEMPERATUREN	303	
Tfuoco	801	
FRP_MW	45	
QC	100	
DATE_1st_deC	20170813	
ORA_1st_detC	1755	





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

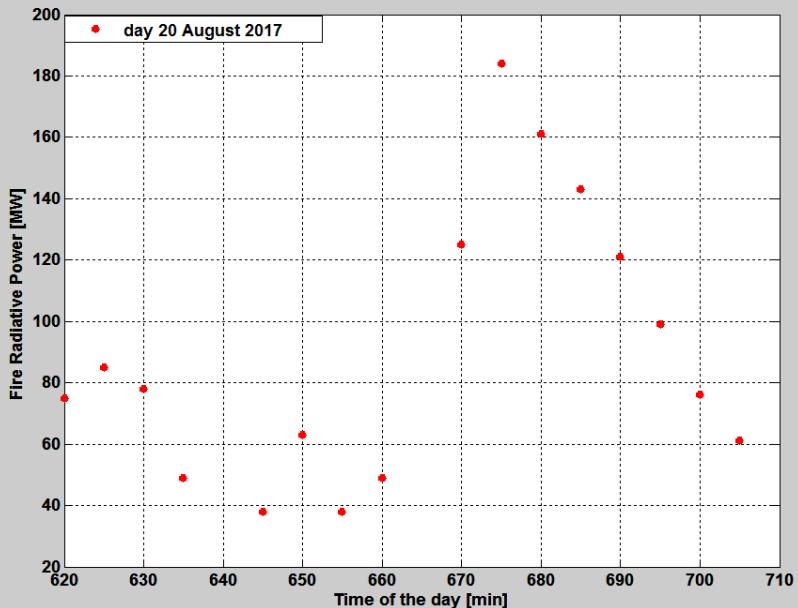
Blue circle = MODIS/VIIRS hot-spots

Red circle = MSG 5 min

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



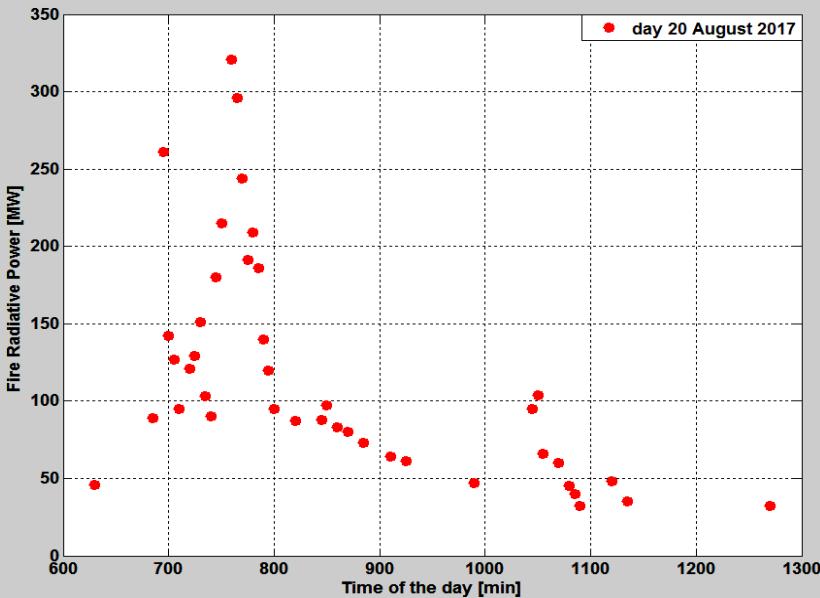
Forest fires monitoring



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

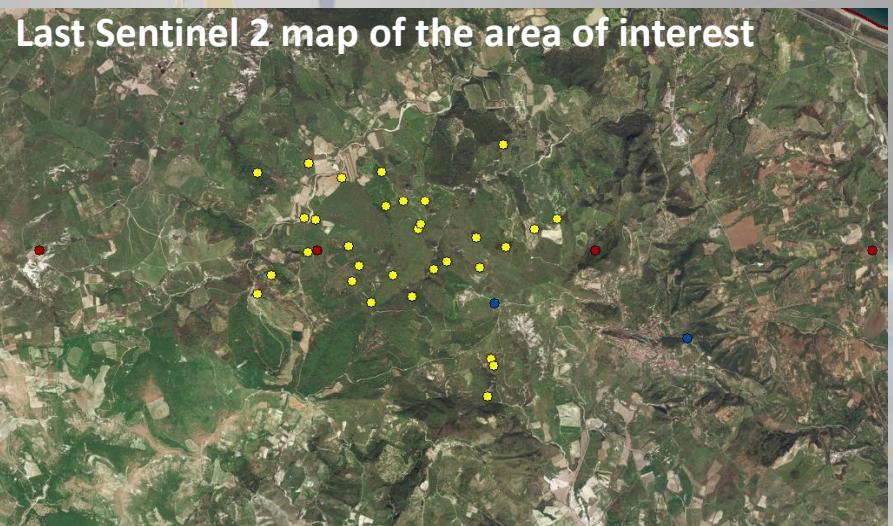
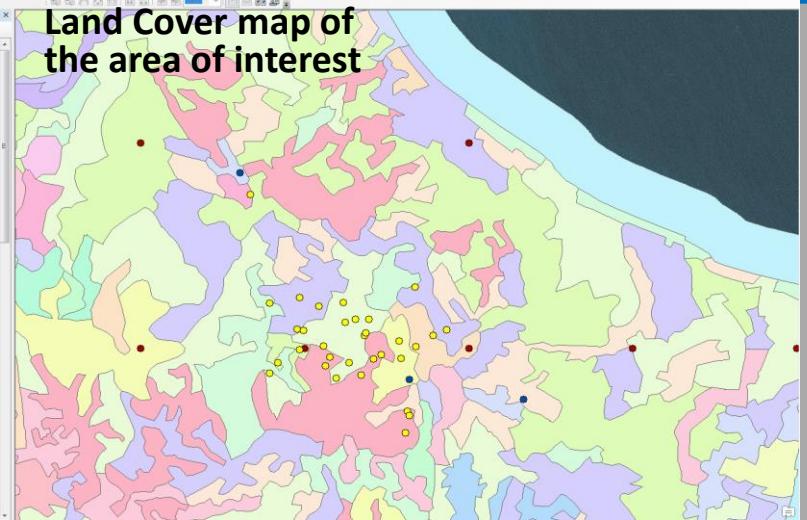


Table Of Contents

Layers	C:\SPIDE_updated\HOT
	✓ 201605_VB03_2017
	✓ hotspots_CAL_2017
	✓ fire_WFF_CAL_2017
	✓ FVB_Programma_Qua
	✓ 0012_04
	✓ all other values
	CLC22
	121
	122
	123
	124
	131
	132
	133
	141
	142
	211
	212
	213
	221
	222
	223
	224
	231
	241
	242
	243
	244
	311
	312
	313

Land Cover map of the area of interest



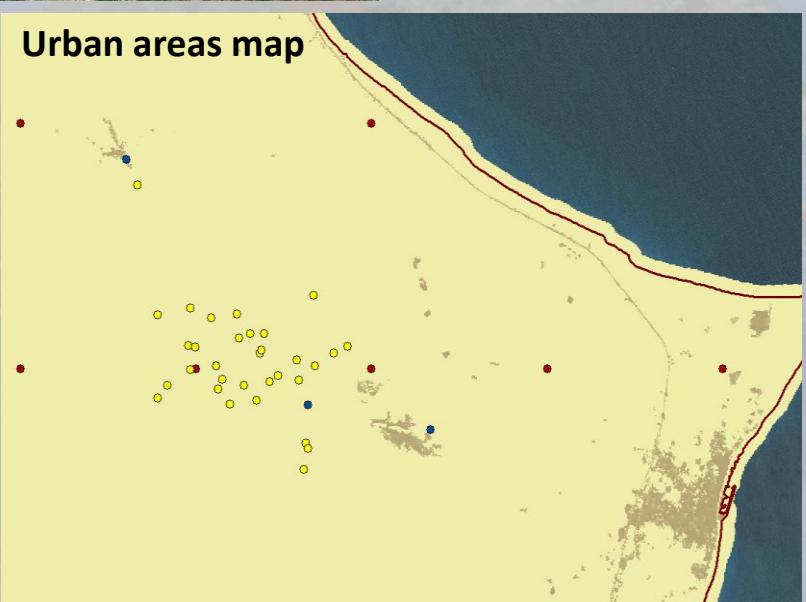
Forest/No-forest (30 m)



Corine land cover classes

1. Artificial surfaces	
1.1 Urban fabric	1.1.1. Continuous urban fabric
1.1	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
1.2.2	1.2.3. Port areas
1.2.3	1.2.4. Airports
1.3 Mine, dump and construction sites	
1.3.1. Mineral extraction sites	1.3.2. Dump sites
1.3.2	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
1.4.2	1.4.3. Artificial, non-agricultural vegetated areas
2. Agricultural areas	
2.1 Arable land	2.1.1. Non-irrigated arable land
2.1.1	2.1.2. Permanently irrigated land
2.1.2	2.1.3. Rice fields
2.2 Permanent crops	2.2.1. Vineyards
2.2.1	2.2.2. Fruit trees and berry plantations
2.2.2	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
2.4.1	2.4.2. Complex cultivation patterns
2.4.2	2.4.3. Land principally occupied by agriculture
2.4.3	2.4.4. Agro-forestry areas

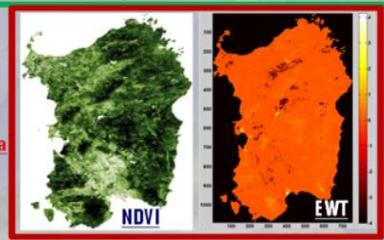
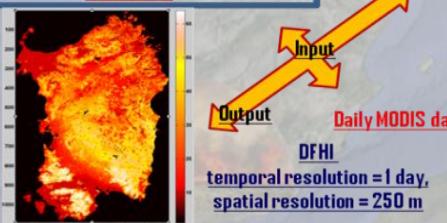
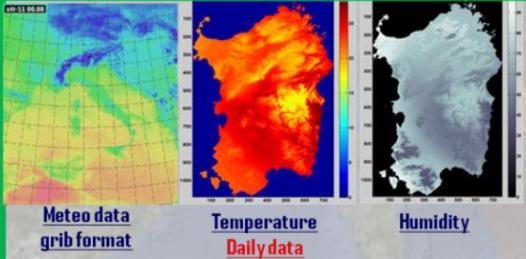
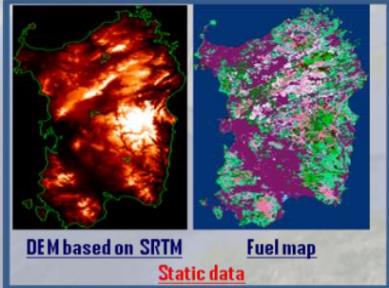
Urban areas map



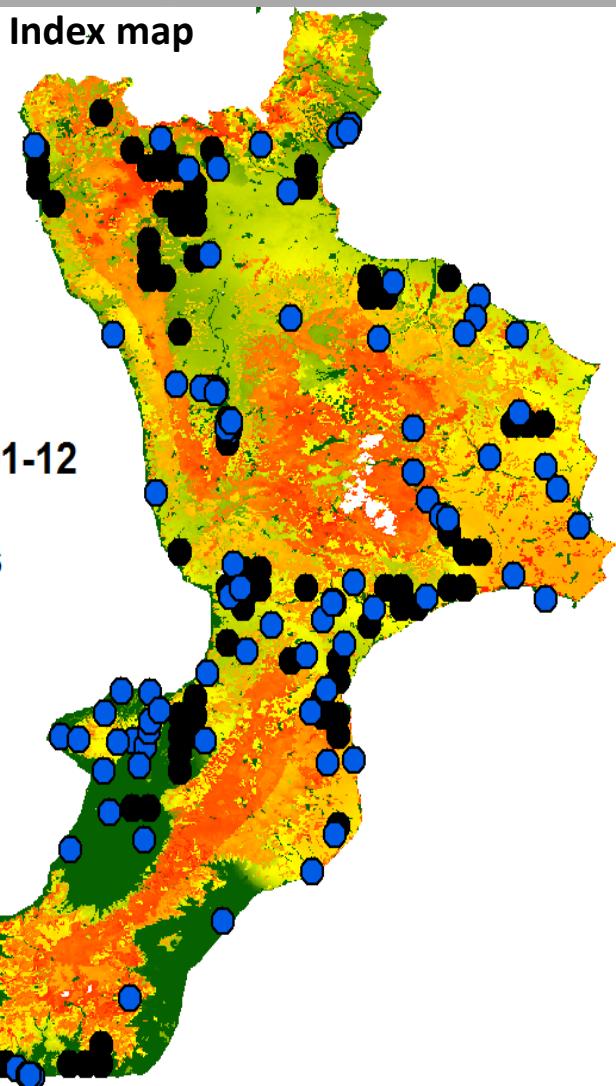


Forest fires monitoring: ancillary data

Fuel map (only some classes are displayed)



Daily Fire Hazard Index map



Legend

DFHI_2017-08-01-12

Value

High : 73,8586
Low : -4



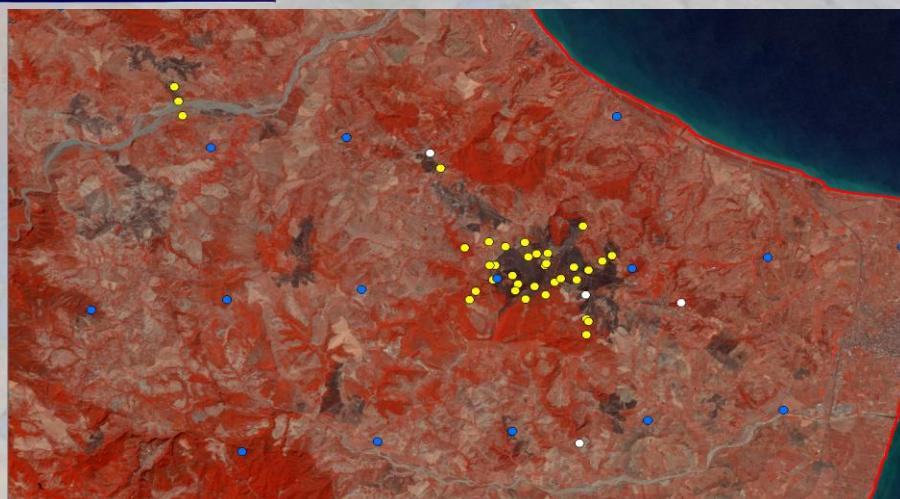
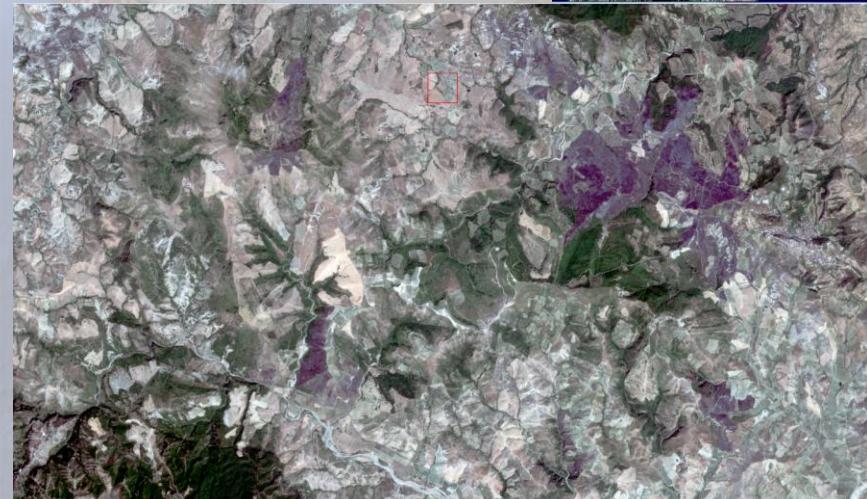
Forest fires monitoring: burned areas



Yellow circle = hot spot MODIS;

White circle = database VVFF;

Blue circle = hot spot MSG





CORPO NAZIONALE DEI VIGILI DEL FUOCO

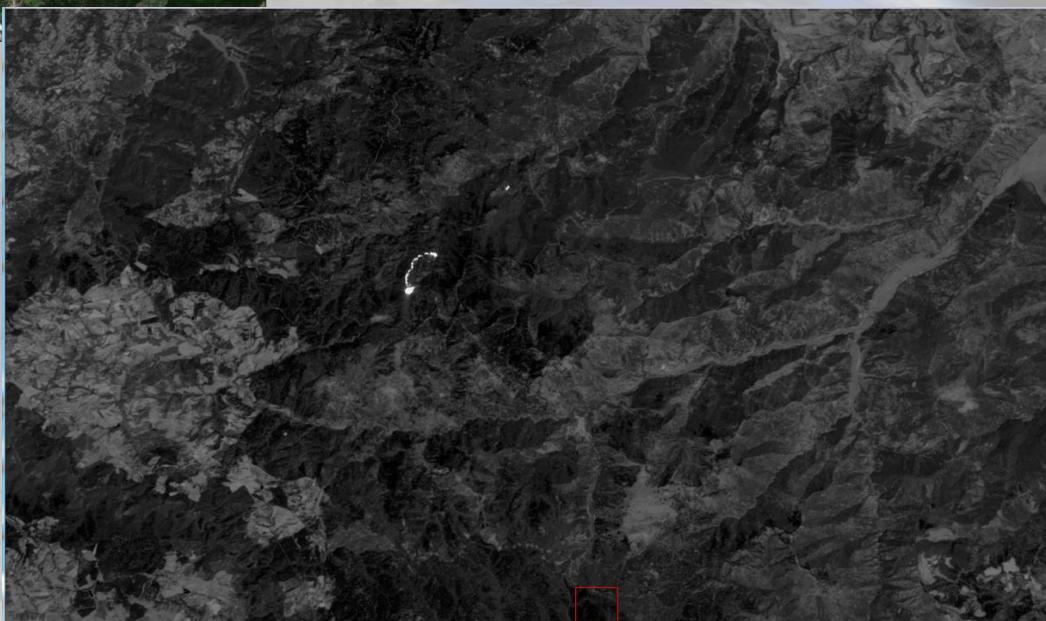
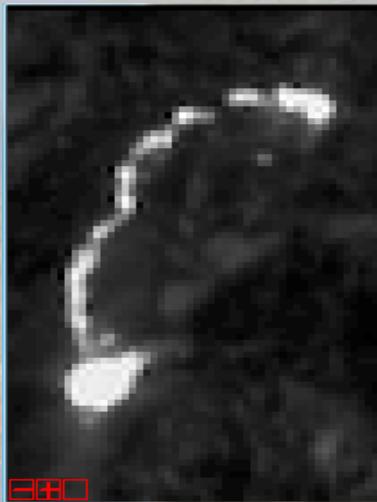
Istituto Superiore Antincendi

Dipartimento dei Vigili del Fuoco, del Soccorso Pubblico e della Difesa Civile



SAPIENZA
UNIVERSITÀ DI ROMA

Forest fires monitoring: burned areas





Forest Fires monitoring

Forest fire maps are automatically-generated in real time by the algorithm every 15 minutes 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 as a pixel. The absolute position of the fire is, in fact, located within the most positive火geolocation error is approximately 2 km.

1 2 3 4 5 6 7 8 9

Tweets by @EOSIAL_Sapienza

EOSIAL Lab Retweeted USGS Landsat

Watch a live stream from aboard [Metsat 6](#) on the new EarthNow viewer [earthnow.usgs.gov](#)

Embed View on Twitter

EUMETSAT

SERVICE STATUS INDICATOR	
10° Service	MET-10
5.5°E RSS	MET-5
41.5°E IODC	MET-8
GDS-Metop	Metop-A
GDS-Metop	Metop-B
GDS-NOAA	NOAA-15
OSTM	
3rd Party	GOES-13, GOES-15, Himawari-8
Copernicus	Jason-3
Copernicus	Sentinel-3A
EUMETCAST	N/A

Valid for: 2017/09/06 15:33:53 UTC ✓

[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](#)

Catalog

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 MODIS) - 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)
- EVOSST Hot Spots (EOSIAL WMS)
- ODS3F Layers (EOSIAL WMS)
- Fog Stability Index. ODS3F (EOSIAL WMS)
- Visibility Index. ODS3F (EOSIAL WMS)
- SVIB Layers (EOSIAL WMS)

EOSIAL Earth Observation Satellite Images Application Laboratory

Web Map Services

Lake Victoria Floating Vegetation:

Service description: http://gs.roma1.sapienza.it/giserver/Floating_Vegetation_Victoria_Lake.wms

Service description: [Service description](http://gs.roma1.sapienza.it/giserver/Floating_Vegetation_Victoria_Lake.wms)

Spatial resolution: 250 mts.

Temporal resolution: 1 day

Origin Product: MODIS (Aqua Terra)

Author: EOSIAL

Water hyacinth is a free-floating perennial aquatic plant (hydrophyte) native to tropical and subtropical South America. With broad, thick, glossy, ovate leaves, water hyacinth may rise above the surface of the water as much as 1 m in height, and float above the water surface. They have long, spongy and bulbose stolons. The flowers, freely hanging roots are purple-black. An erect stalk supports a single spike of 8-15 conspicuously attractive flowers, mostly lavender to pink in colour with six petals. When not in bloom, water hyacinth may be mistaken for frog-bit (Limnobium spongia).

One of the fastest growing plants known, water hyacinth reproduces primarily by way of runners or stolons, which eventually form floating plants. Each plant can produce thousands of seeds each year.

Web Map Services

Web Gis



PREFER

THANK YOU for your attention !

giovanni.laneve@uniroma1.it

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