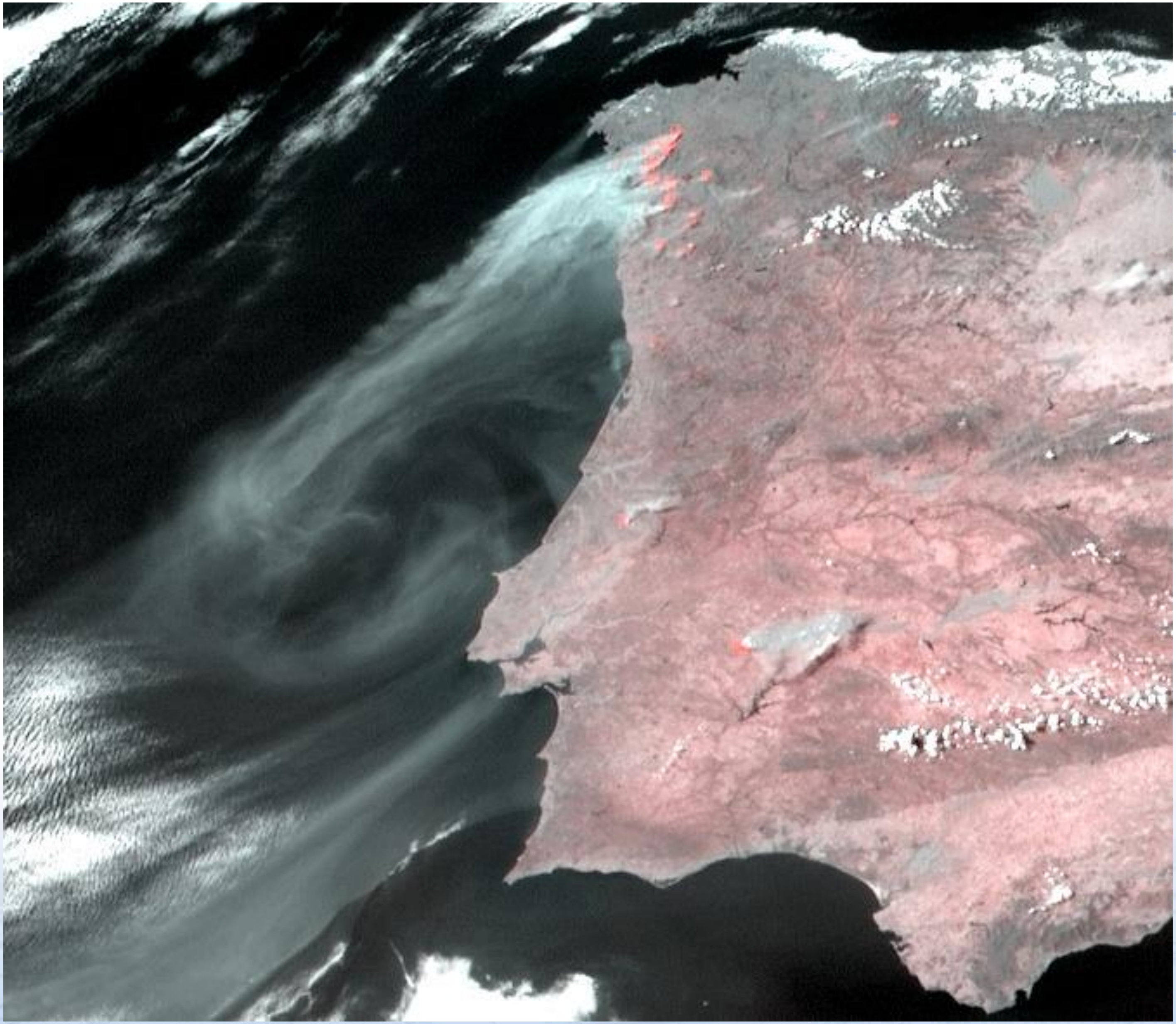
Fire detection by Meteosat

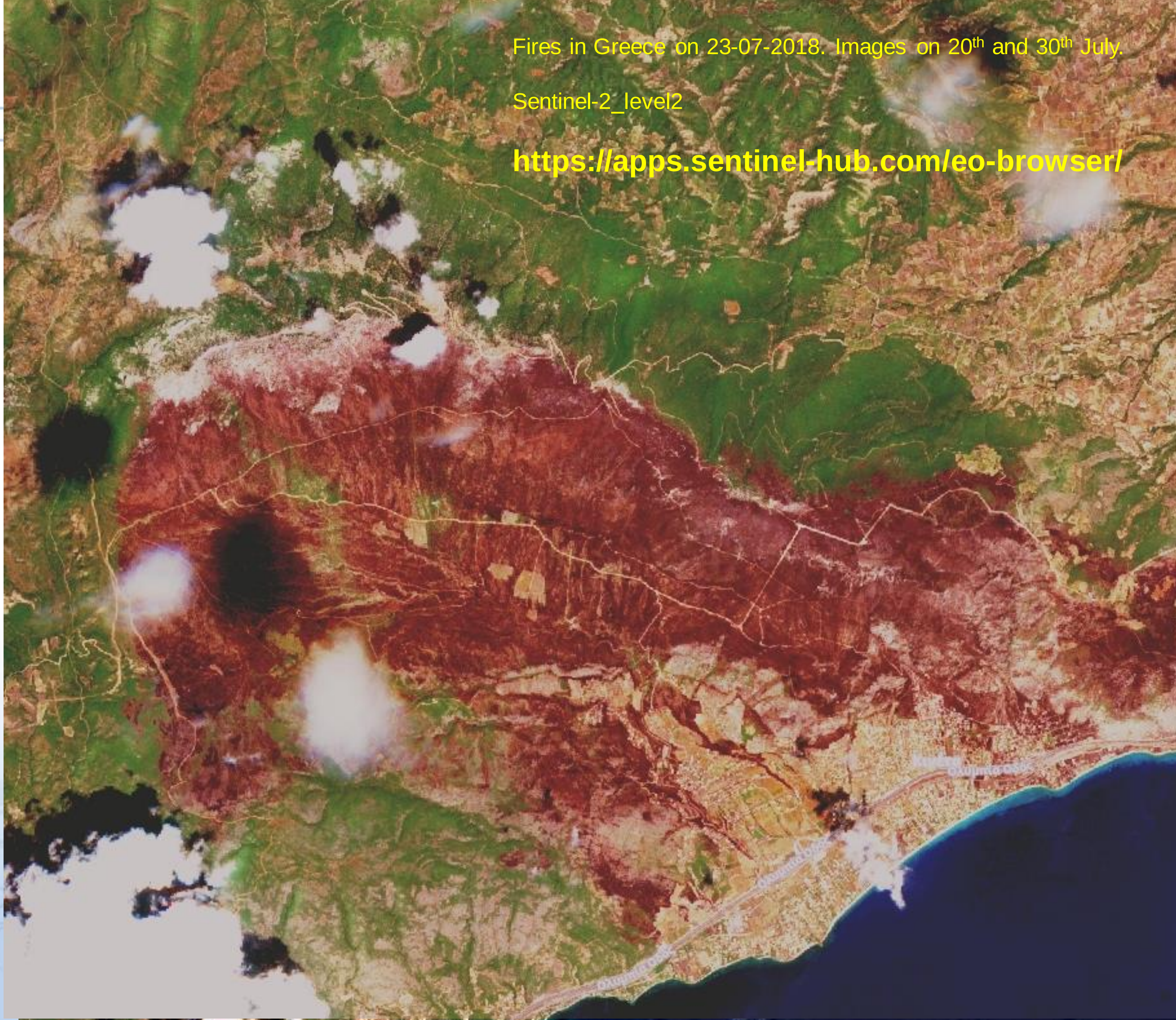
jose.prieto@eumetsat.int

EUMETSAT

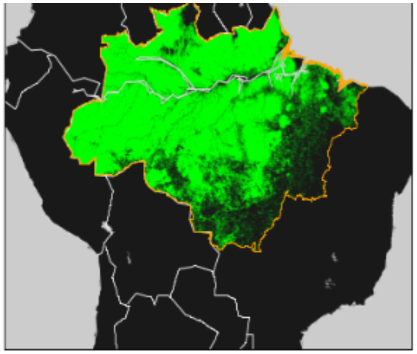


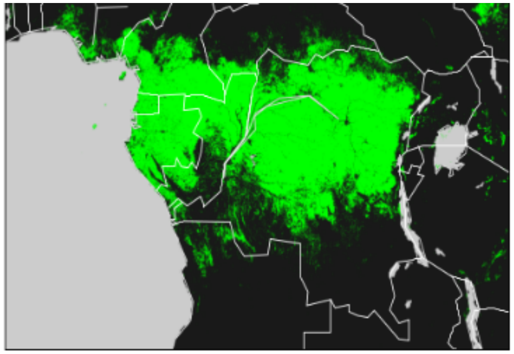
Meteosat: 30% of channel 3.9µm on top of HRV

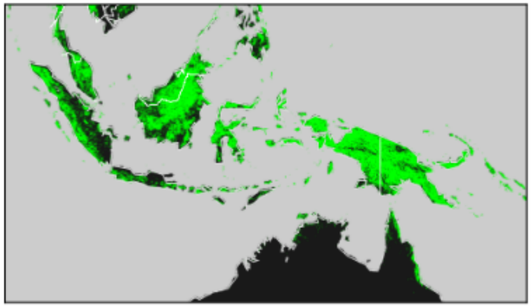
2006-July-7 16:00

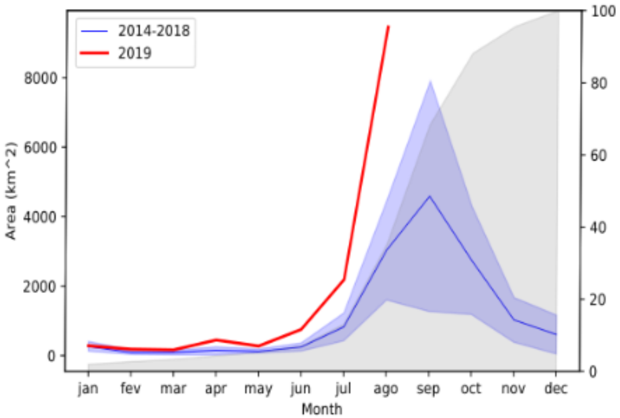

Fires in Greece on 23-07-2018. Images on 20th and 30th July.
Sentinel-2_level2
https://apps.sentinel-hub.com/eo-browser/

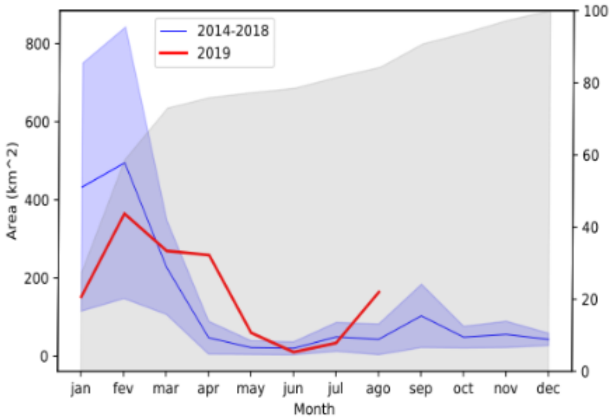
Copernicus monitoring forest fires. Then forecast

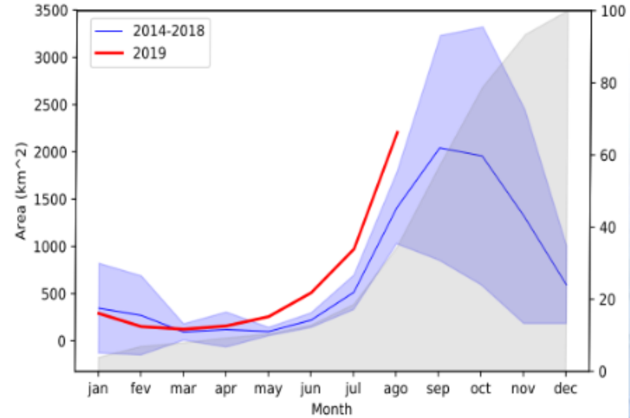












Towards Sentinel-3 fire products (ATBD)

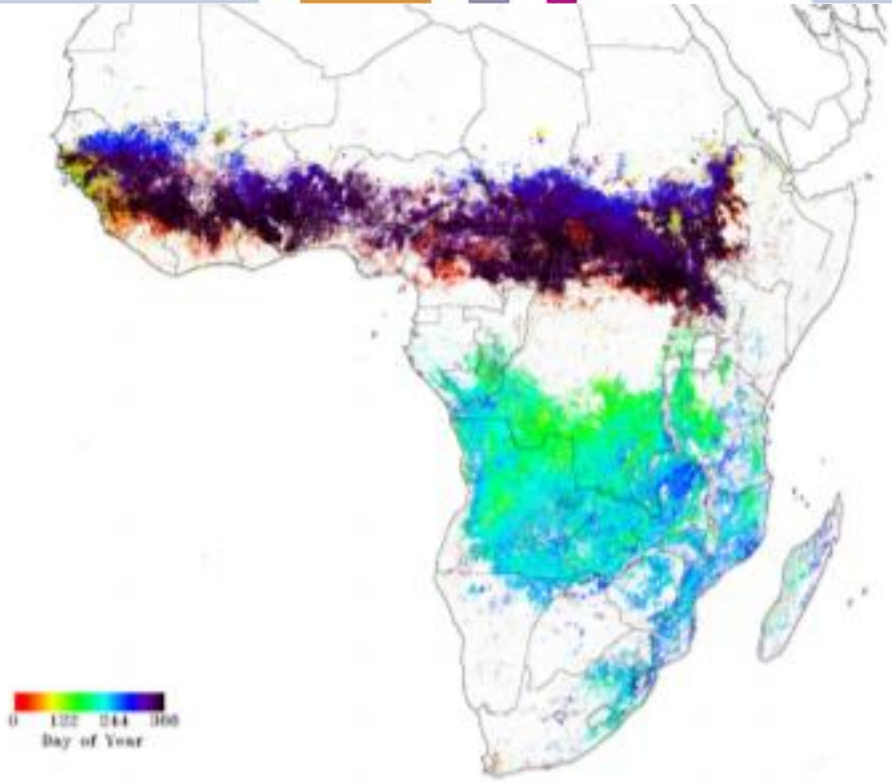
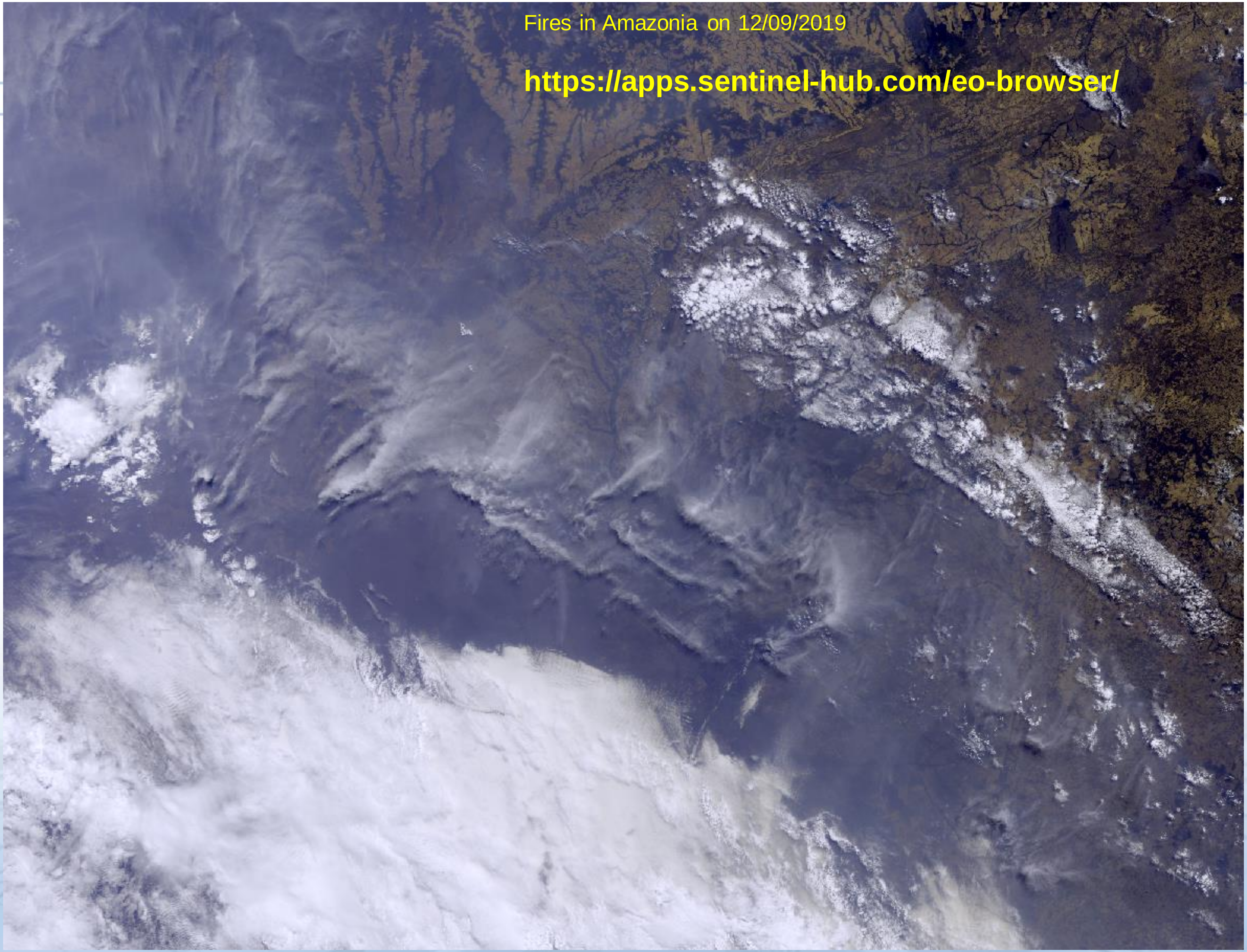
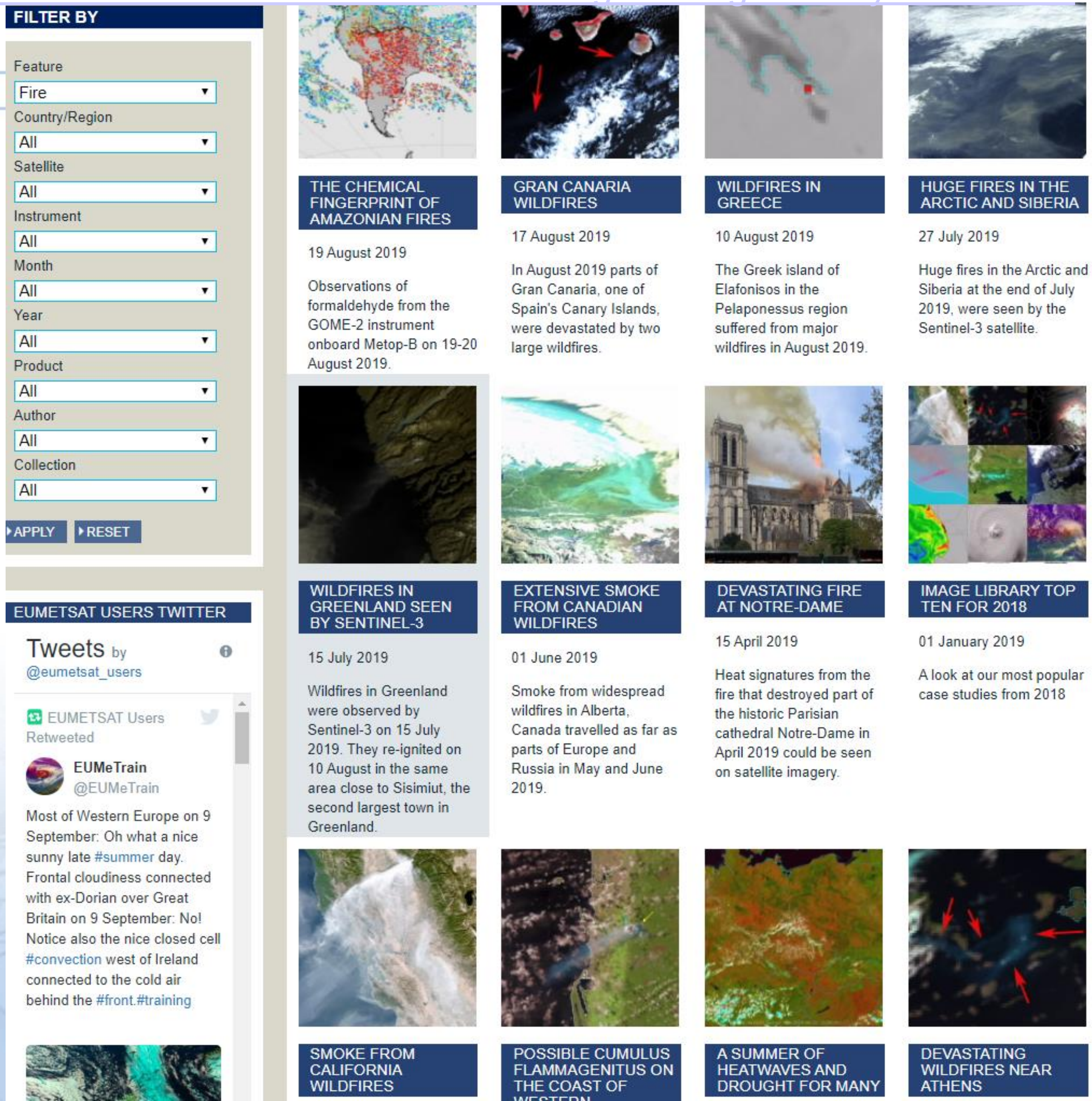


Figure 1. Fire location and timing across Africa as derived from the operational Meteosat SEVIRI Fire Radiative Power product delivered by the Land Satellite Applications Facility (Roberts and Wooster, 2008; http://landsaf.meteo.pt/). The marked seasonality follows the dry seasons in north and southern Africa.


Fires in Amazonia on 12/09/2019
https://apps.sentinel-hub.com/eo-browser/

www.eumetsat.int/website/home/Images/ImageLibrary/index.html



FILTER BY

Feature: Fire
Country/Region: All
Satellite: All
Instrument: All
Month: All
Year: All
Product: All
Author: All
Collection: All

APPLY | RESET

EUMETSAT USERS TWITTER

Tweets by @eumetsat_users

EUMETSAT Users Retweeted

EUMeTrain @EUMeTrain

Most of Western Europe on 9 September: Oh what a nice sunny late #summer day. Frontal cloudiness connected with ex-Dorian over Great Britain on 9 September: No! Notice also the nice closed cell #convection west of Ireland connected to the cold air behind the #front.#training

THE CHEMICAL FINGERPRINT OF AMAZONIAN FIRES

19 August 2019

Observations of formaldehyde from the GOME-2 instrument onboard Metop-B on 19-20 August 2019.

GRAN CANARIA WILDFIRES

17 August 2019

In August 2019 parts of Gran Canaria, one of Spain's Canary Islands, were devastated by two large wildfires.

WILDFIRES IN GREECE

10 August 2019

The Greek island of Elafonisos in the Pelaponessus region suffered from major wildfires in August 2019.

HUGE FIRES IN THE ARCTIC AND SIBERIA

27 July 2019

Huge fires in the Arctic and Siberia at the end of July 2019, were seen by the Sentinel-3 satellite.

WILDFIRES IN GREENLAND SEEN BY SENTINEL-3

15 July 2019

Wildfires in Greenland were observed by Sentinel-3 on 15 July 2019. They re-ignited on 10 August in the same area close to Sisimiut, the second largest town in Greenland.

EXTENSIVE SMOKE FROM CANADIAN WILDFIRES

01 June 2019

Smoke from widespread wildfires in Alberta, Canada travelled as far as parts of Europe and Russia in May and June 2019.

DEVASTATING FIRE AT NOTRE-DAME

15 April 2019

Heat signatures from the fire that destroyed part of the historic Parisian cathedral Notre-Dame in April 2019 could be seen on satellite imagery.

IMAGE LIBRARY TOP TEN FOR 2018

01 January 2019

A look at our most popular case studies from 2018

SMOKE FROM CALIFORNIA WILDFIRES

POSSIBLE CUMULUS FLAMMAGENITUS ON THE COAST OF WESTERN

A SUMMER OF HEATWAVES AND DROUGHT FOR MANY

DEVASTATING WILDFIRES NEAR ATHENS

http://www.eumetrain.org/data/3/30/index.htm

Forest Fires

Table

- The Fire Triangle
- Weather
- The Continuity Equation
- Fuel
- Topography
- Fire Weather Index
- Summary

- Table of Contents
- Print Version
- Download Version
- EUMeTrain

As you have seen in the previous chapter, synoptic patterns are not enough to indicate the locations where forest fires are likely to occur and spread. In fact, aside from the weather, a fire's behaviour also strongly depends on fuel and topography, creating the three sides of what is usually known as the *fire triangle* (Figure 3.1).

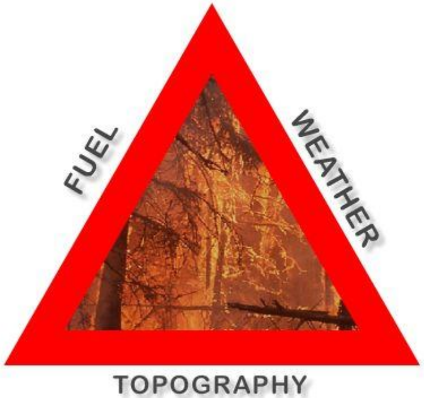


Fig 3.1 – Fire triangle. Fire hazards are influenced by fuel, weather and topography.

In this third chapter the three sides of this triangle will be further explained. After answering the following multiple choice question the chapter will continue with "weather".

Fire ignition depends most on which of the following meteorological factors:

a) Temperature

EUMETSAT

FIR product (active fire monitoring)

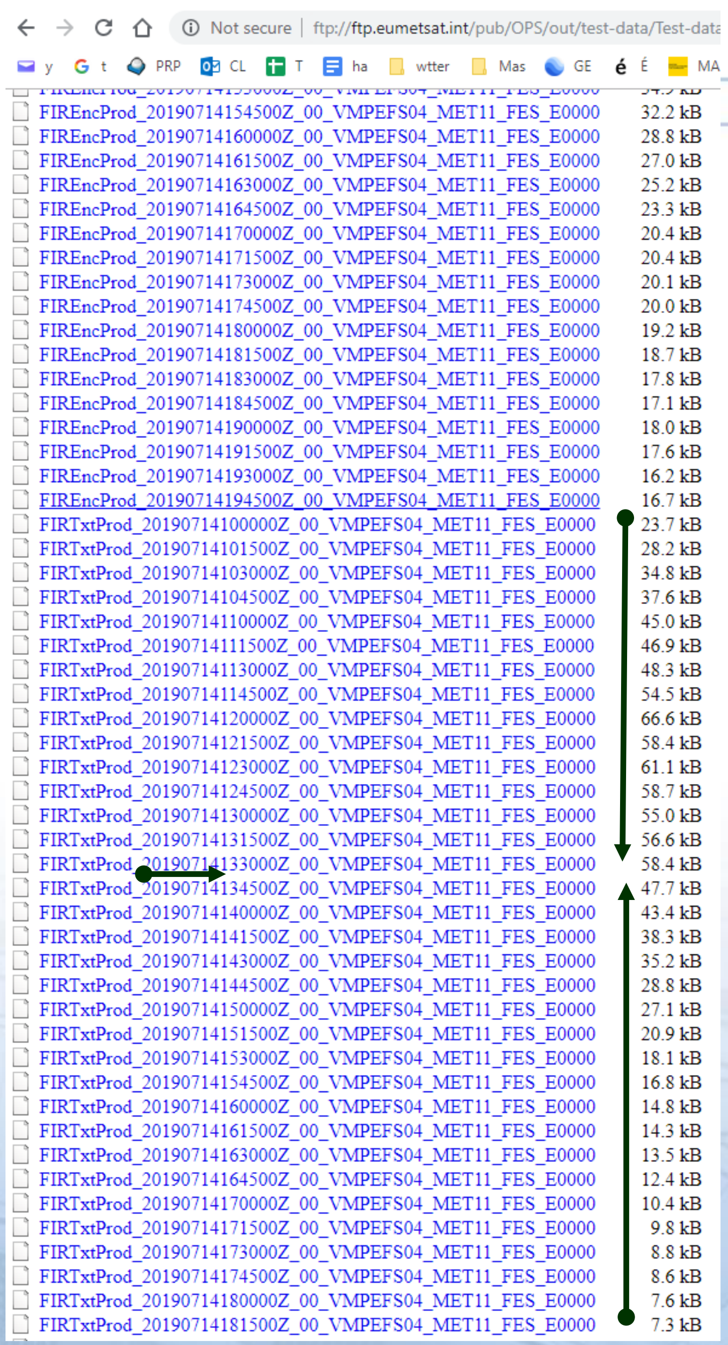
Enhanced higher resolution land-sea mask

Bayesian threshold tests. Each individual test will have a minimum and maximum threshold. All tests together will yield a 'fire probability' between 0 and 100%, encoded with parameter number of 192 of GRIB table 4.2.3.1, currently reserved for local use.

Migration to using a WMO template

There will be no changes for the FIR CAP product

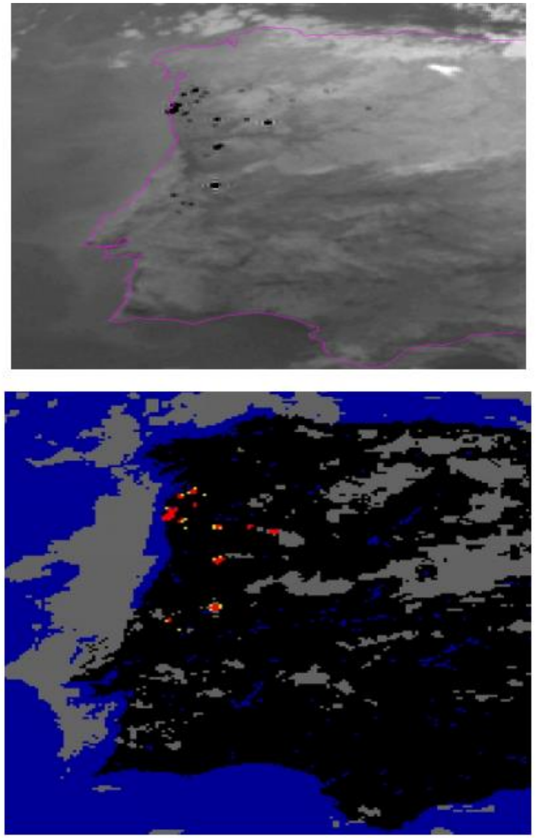

```
<?xml version = "1.0" encoding= "UTF-8"?>
<alert xmlns = "urn:oasis:names:tc:emergency:cap:1.1">
  <identifier>urn:oid:2.49.0.3.1.1.70</identifier>
  <sender>urn:oid:2.49.0.2.1</sender>
  <sent>2019-07-14T12:30:00-00:00</sent>
  <status>Actual</status>
  <msgType>Alert</msgType>
  <scope>Public</scope>
    <info>
      <category>Geo</category>
      <event>FIRE</event>
    <responseType>Assess</responseType>
    <responseType>Monitor</responseType>
      <urgency>Immediate</urgency>
      <severity>Moderate</severity>
      <certainty>Likely</certainty>
    <effective>2019-07-14T12:15:00-00:00</effective>
    <expires>2019-07-14T12:45:00-00:00</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.</description>
      <web>http://oiswww.eumetsat.org/IPPS/html/MSG/PRODUCTS/FIR</web>
      <area>
        <areaDesc>List of detected fires (latitude, longitude, radius)</areaDesc>
        <circle>-27.859,30.851 1.976</circle>
        <circle>-27.857,30.811 1.975</circle>
        <circle>-27.825,30.838 1.975</circle>
        <circle>-27.823,30.798 1.975</circle>
        <circle>-25.659,30.956 1.941</circle>
        <circle>-25.657,30.9
```

FIREncProd_20190714154500Z_00_VMPEFS04_MET11_FES_E0000	32.2 kB
FIREncProd_20190714160000Z_00_VMPEFS04_MET11_FES_E0000	28.8 kB
FIREncProd_20190714161500Z_00_VMPEFS04_MET11_FES_E0000	27.0 kB
FIREncProd_20190714163000Z_00_VMPEFS04_MET11_FES_E0000	25.2 kB
FIREncProd_20190714164500Z_00_VMPEFS04_MET11_FES_E0000	23.3 kB
FIREncProd_20190714170000Z_00_VMPEFS04_MET11_FES_E0000	20.4 kB
FIREncProd_20190714171500Z_00_VMPEFS04_MET11_FES_E0000	20.4 kB
FIREncProd_20190714173000Z_00_VMPEFS04_MET11_FES_E0000	20.1 kB
FIREncProd_20190714174500Z_00_VMPEFS04_MET11_FES_E0000	20.0 kB
FIREncProd_20190714180000Z_00_VMPEFS04_MET11_FES_E0000	19.2 kB
FIREncProd_20190714181500Z_00_VMPEFS04_MET11_FES_E0000	18.7 kB
FIREncProd_20190714183000Z_00_VMPEFS04_MET11_FES_E0000	17.8 kB
FIREncProd_20190714184500Z_00_VMPEFS04_MET11_FES_E0000	17.1 kB
FIREncProd_20190714190000Z_00_VMPEFS04_MET11_FES_E0000	18.0 kB
FIREncProd_20190714191500Z_00_VMPEFS04_MET11_FES_E0000	17.6 kB
FIREncProd_20190714193000Z_00_VMPEFS04_MET11_FES_E0000	16.2 kB
FIREncProd_20190714194500Z_00_VMPEFS04_MET11_FES_E0000	16.7 kB
FIRTxtProd_20190714100000Z_00_VMPEFS04_MET11_FES_E0000	23.7 kB
FIRTxtProd_20190714101500Z_00_VMPEFS04_MET11_FES_E0000	28.2 kB
FIRTxtProd_20190714103000Z_00_VMPEFS04_MET11_FES_E0000	34.8 kB
FIRTxtProd_20190714104500Z_00_VMPEFS04_MET11_FES_E0000	37.6 kB
FIRTxtProd_20190714110000Z_00_VMPEFS04_MET11_FES_E0000	45.0 kB
FIRTxtProd_20190714111500Z_00_VMPEFS04_MET11_FES_E0000	46.9 kB
FIRTxtProd_20190714113000Z_00_VMPEFS04_MET11_FES_E0000	48.3 kB
FIRTxtProd_20190714114500Z_00_VMPEFS04_MET11_FES_E0000	54.5 kB
FIRTxtProd_20190714120000Z_00_VMPEFS04_MET11_FES_E0000	66.6 kB
FIRTxtProd_20190714121500Z_00_VMPEFS04_MET11_FES_E0000	58.4 kB
FIRTxtProd_20190714123000Z_00_VMPEFS04_MET11_FES_E0000	61.1 kB
FIRTxtProd_20190714124500Z_00_VMPEFS04_MET11_FES_E0000	58.7 kB
FIRTxtProd_20190714130000Z_00_VMPEFS04_MET11_FES_E0000	55.0 kB
FIRTxtProd_20190714131500Z_00_VMPEFS04_MET11_FES_E0000	56.6 kB
FIRTxtProd_20190714133000Z_00_VMPEFS04_MET11_FES_E0000	58.4 kB
FIRTxtProd_20190714134500Z_00_VMPEFS04_MET11_FES_E0000	47.7 kB
FIRTxtProd_20190714140000Z_00_VMPEFS04_MET11_FES_E0000	43.4 kB
FIRTxtProd_20190714141500Z_00_VMPEFS04_MET11_FES_E0000	38.3 kB
FIRTxtProd_20190714143000Z_00_VMPEFS04_MET11_FES_E0000	35.2 kB
FIRTxtProd_20190714144500Z_00_VMPEFS04_MET11_FES_E0000	28.8 kB
FIRTxtProd_20190714150000Z_00_VMPEFS04_MET11_FES_E0000	27.1 kB
FIRTxtProd_20190714151500Z_00_VMPEFS04_MET11_FES_E0000	20.9 kB
FIRTxtProd_20190714153000Z_00_VMPEFS04_MET11_FES_E0000	18.1 kB
FIRTxtProd_20190714154500Z_00_VMPEFS04_MET11_FES_E0000	16.8 kB
FIRTxtProd_20190714160000Z_00_VMPEFS04_MET11_FES_E0000	14.8 kB
FIRTxtProd_20190714161500Z_00_VMPEFS04_MET11_FES_E0000	14.3 kB
FIRTxtProd_20190714163000Z_00_VMPEFS04_MET11_FES_E0000	13.5 kB
FIRTxtProd_20190714164500Z_00_VMPEFS04_MET11_FES_E0000	12.4 kB
FIRTxtProd_20190714170000Z_00_VMPEFS04_MET11_FES_E0000	10.4 kB
FIRTxtProd_20190714171500Z_00_VMPEFS04_MET11_FES_E0000	9.8 kB
FIRTxtProd_20190714173000Z_00_VMPEFS04_MET11_FES_E0000	8.8 kB
FIRTxtProd_20190714174500Z_00_VMPEFS04_MET11_FES_E0000	8.6 kB
FIRTxtProd_20190714180000Z_00_VMPEFS04_MET11_FES_E0000	7.6 kB
FIRTxtProd_20190714181500Z_00_VMPEFS04_MET11_FES_E0000	7.3 kB

Active fire monitoring (FIR) product

- From Scenes Analysis
- Exclude thick cloud, off-shore oil fires, active volcanoes, small islands
- Exclude bare soils, sun glint and small cloud
- Use IR3.9 and IR10.8 and its standard deviations, e.g.



op panel: Initial IR3.9 image for 21 August 2005 at 02:00 UTC. Bottom panel: Active Fire Monitoring product applied to IR3.9 image.

$$L_{RED/MIR} > \bar{L}_{RED/MIR}$$

$$\Delta T_{MIR-TIR} > \Delta \bar{T}_{MIR-TIR} + 3.2\sigma_{\Delta T_{MIR-TIR}}$$

$$\Delta T_{MIR-TIR} > \Delta \bar{T}_{MIR-TIR} + 5.6K$$

$$T_{MIR} > \bar{T}_{MIR} + 3\sigma_{T_{MIR}}$$

$$T_{TIR} > \bar{T}_{TIR} - 4K$$

$$\sigma'_{MIR} > 5K$$

KING'S College LONDON University of London	SENTINEL-3 OPTICAL PRODUCTS AND ALGORITHM DEFINITION SLSTR ATBD FIRE PRODUCT	REF: S3-L2-SD-03-T04-KCL-ATBD VERSION: 3.2 DATE: 2012-10-10 PAGE 16 OF 2

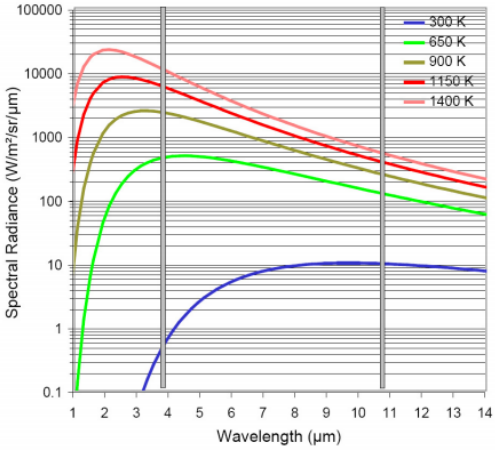
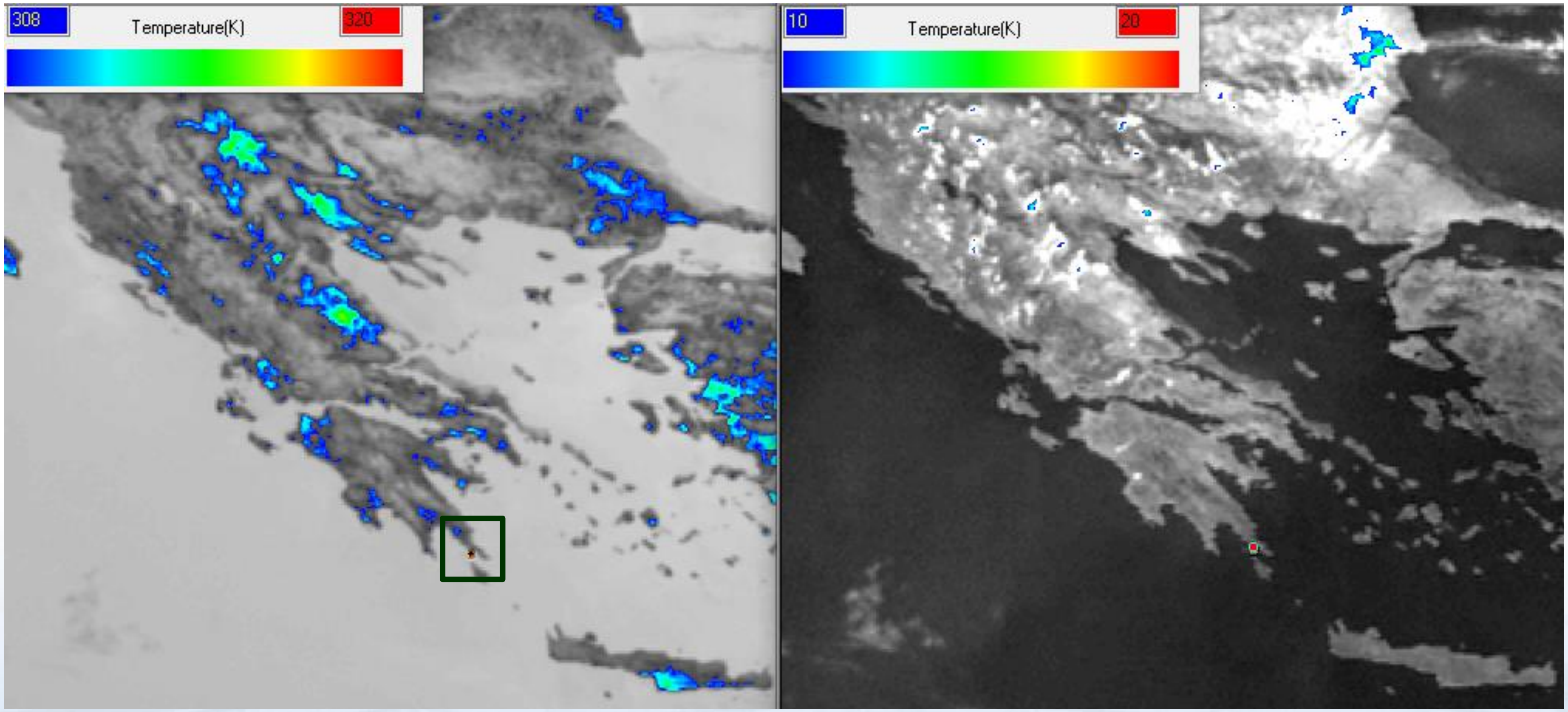
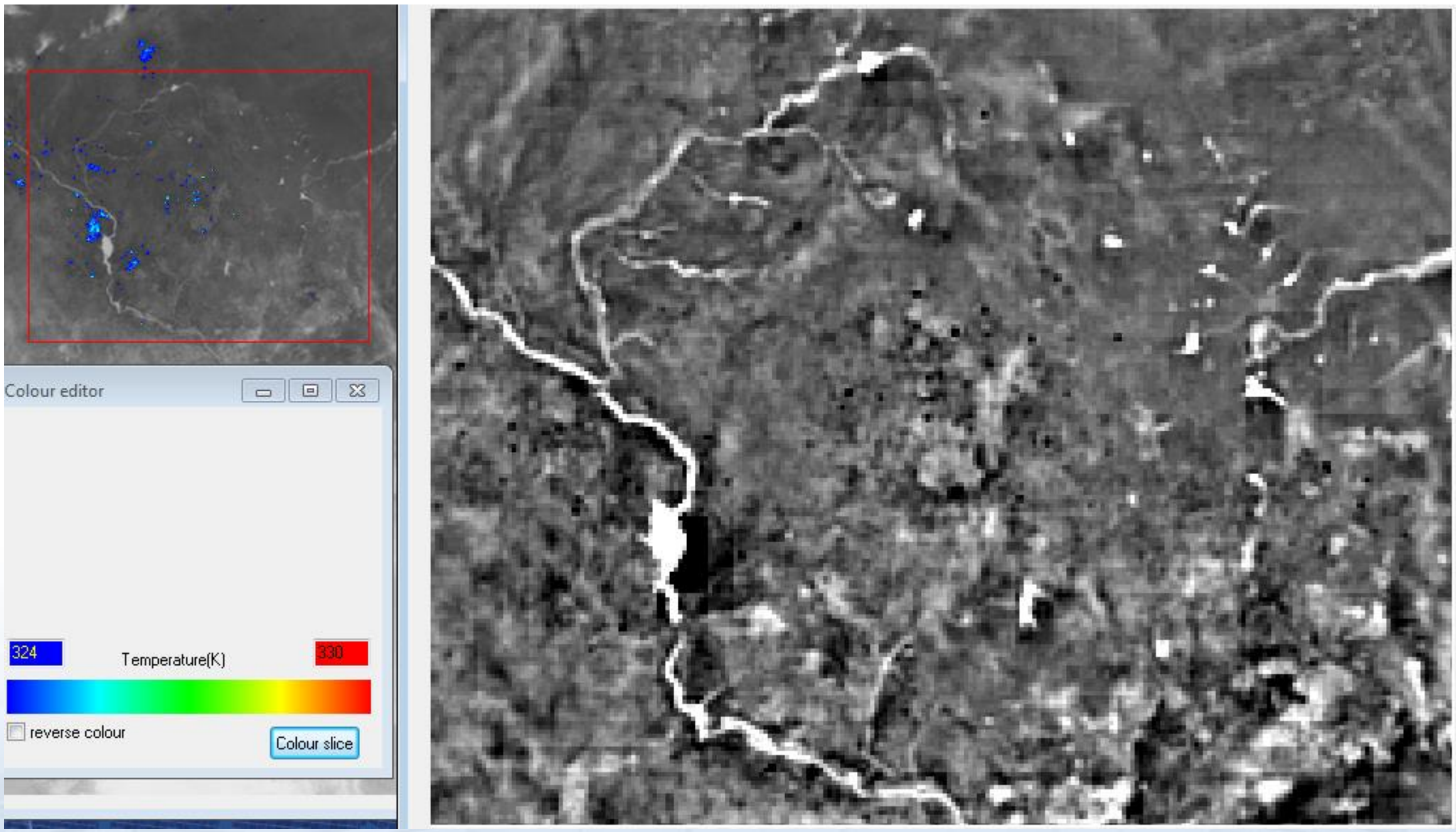


Figure 3. Spectral radiance emitted from blackbodies at Earth ambient temperature (300 K) and a range of possible vegetation fire temperatures (650 – 1400 K). The approximate central wavelengths of the SLSTR MIR (3.7 µm) and TIR1 (10.8 µm) channel are also indicated. As temperature increases the spectral radiance increases more rapidly at MIR wavelengths than at TIR wavelengths. Note the logarithmic y-axis scale.

Fires: day confusion with barren soil or reflective cloud



3.9 µm (left) and difference 3.9µm-10.8µm



2015-02-09_15UTC, channel 4, Meteosat-10

Contrast with neighbours is better than thresholds in 3.9 µm to spot **fires**

EUMETSAT

Fire assimilation. The theory

OLD: CONVERT

NWP ancillary

Radiance ALGORITHM >>>Fire!

Assumptions/filters

NEW: FORECAST

Assimilation

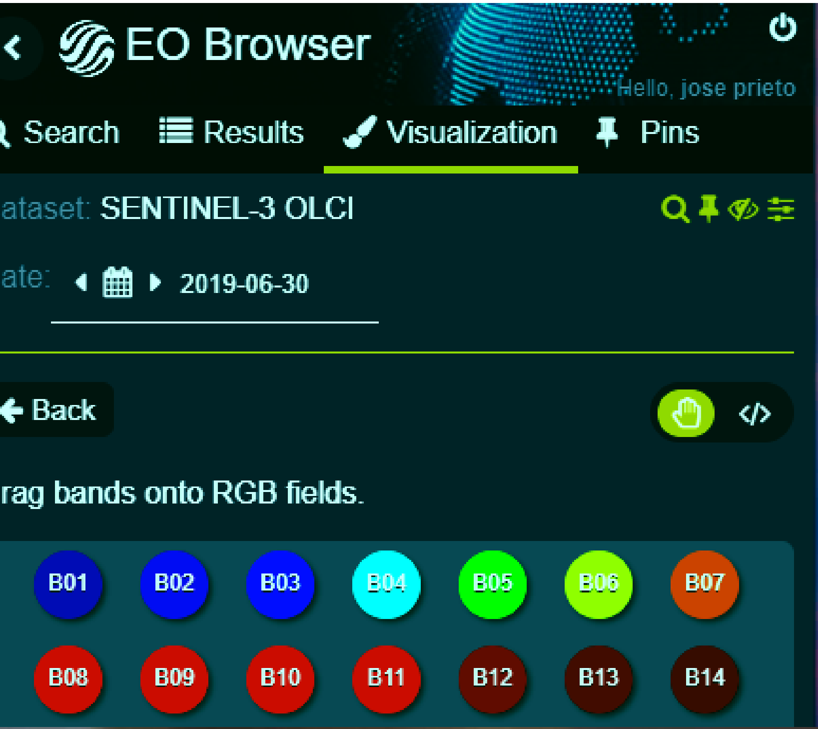
Radiance (RTM operator) NWP MODEL (mapping) >>>Variable (propagated!)

Location

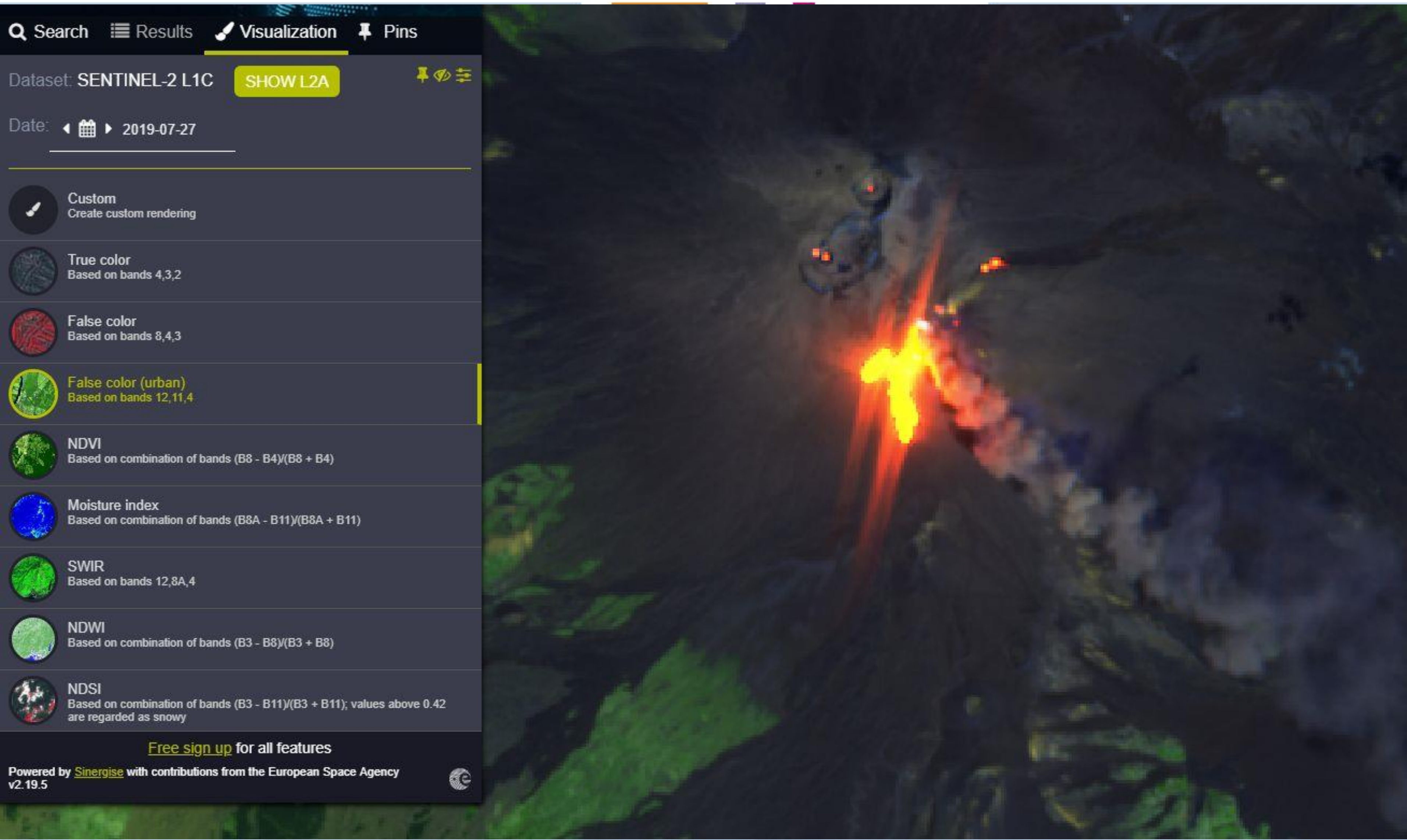
FUTURE: PREVENT

FIR (risk map) NWP (correlation or AI-NN) >>>Predictors

EUMETSAT


EO Browser
Hello, jose prieto
Search
Results
Visualization
Pins
ataset: SENTINEL-3 OLCI
ate:
2019-06-30
Back
rag bands onto RGB fields.
B01 B02 B03 B04 B05 B06 B07
B08 B09 B10 B11 B12 B13 B14


Cenicientos


Search
Results
Visualization
Pins
Dataset: SENTINEL-2 L1C
SHOW L2A
Date: 2019-07-27
Custom
Create custom rendering
True color
Based on bands 4,3,2
False color
Based on bands 8,4,3
False color (urban)
Based on bands 12,11,4
NDVI
Based on combination of bands (B8 - B4)/(B8 + B4)
Moisture index
Based on combination of bands (B8A - B11)/(B8A + B11)
SWIR
Based on bands 12,8A,4
NDWI
Based on combination of bands (B3 - B8)/(B3 + B8)
NDSI
Based on combination of bands (B3 - B11)/(B3 + B11); values above 0.42 are regarded as snowy
Free sign up for all features
Powered by Sinergise with contributions from the European Space Agency
v2.19.5

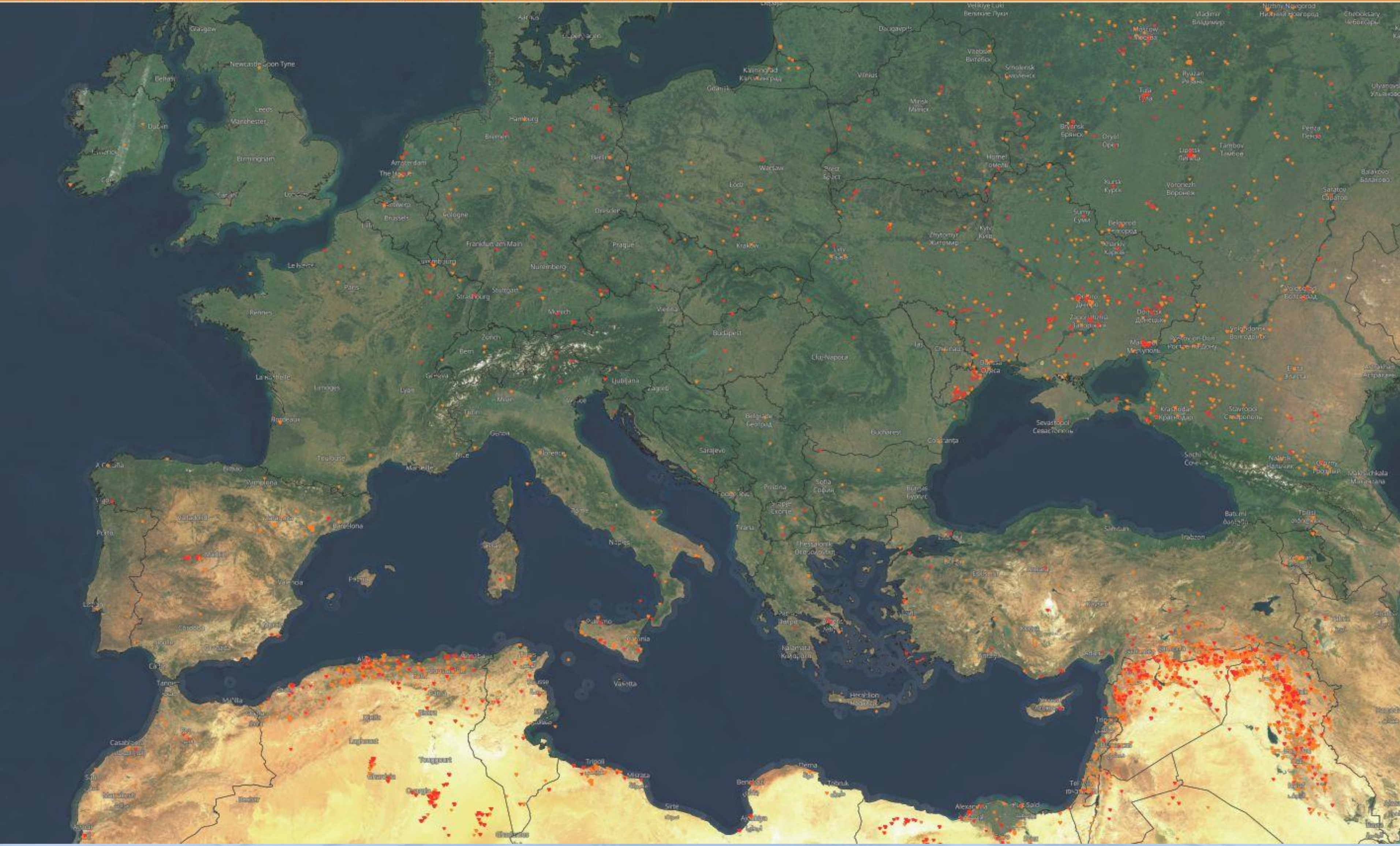
EUMETSAT

COPERNICUS

Emergency Management Service

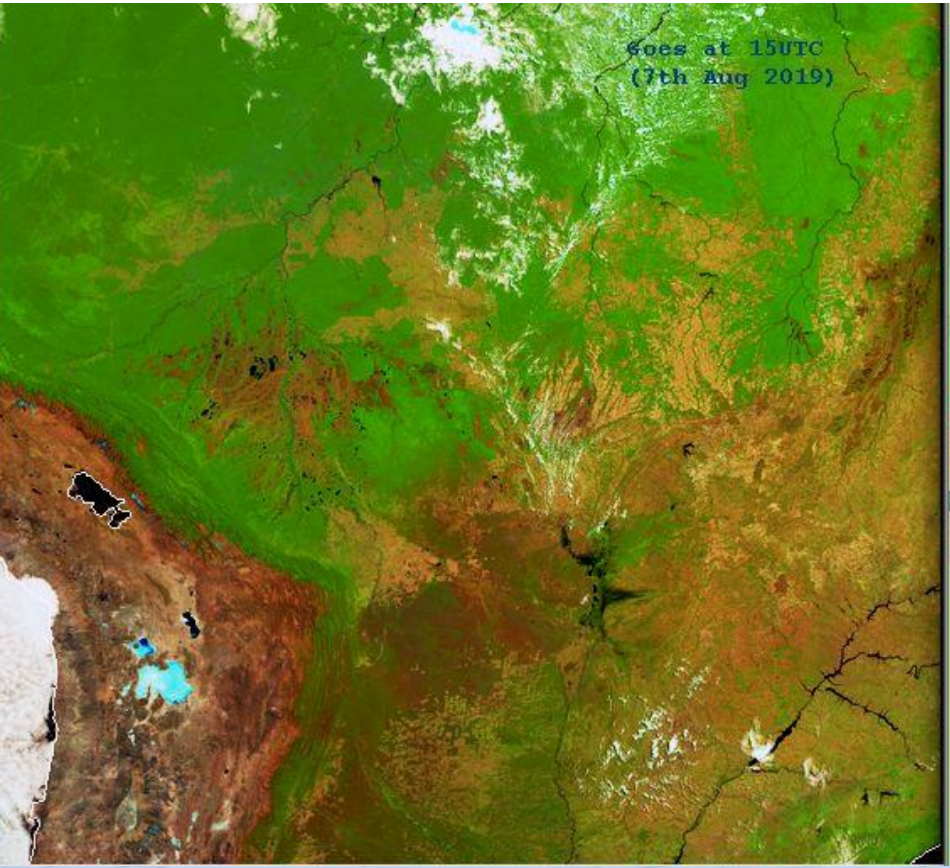
EFFIS service for forest fires

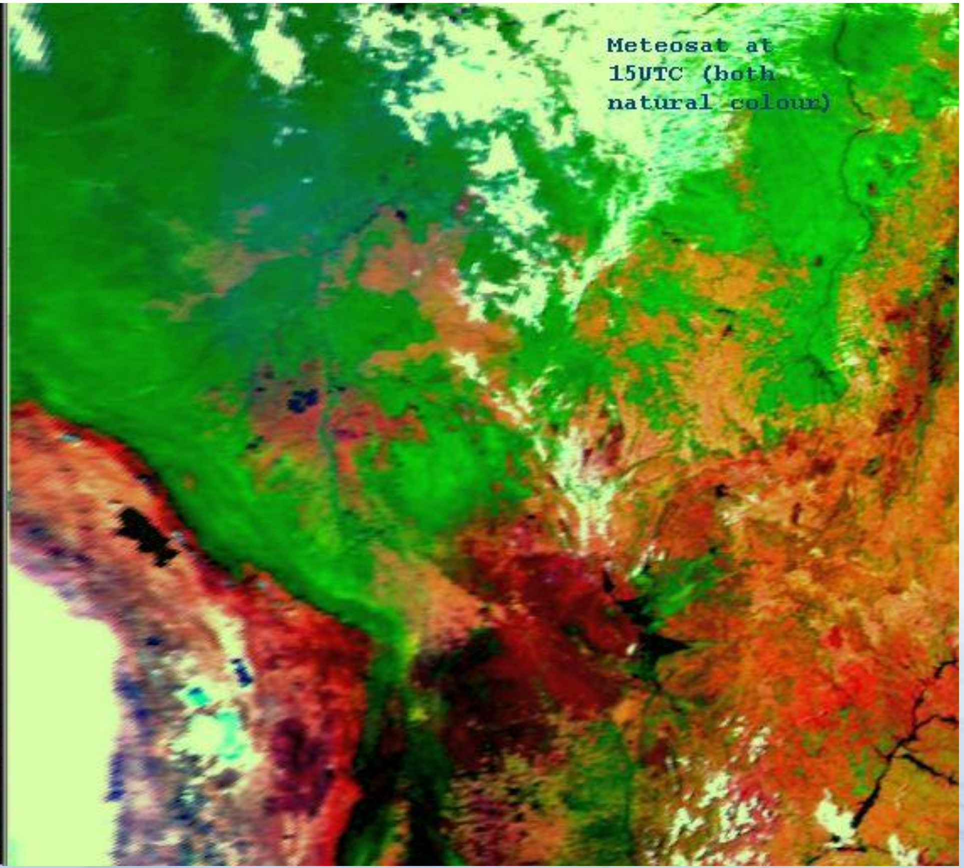
http://effis.jrc.ec.europa.eu/



Oblique view favours smoke detection

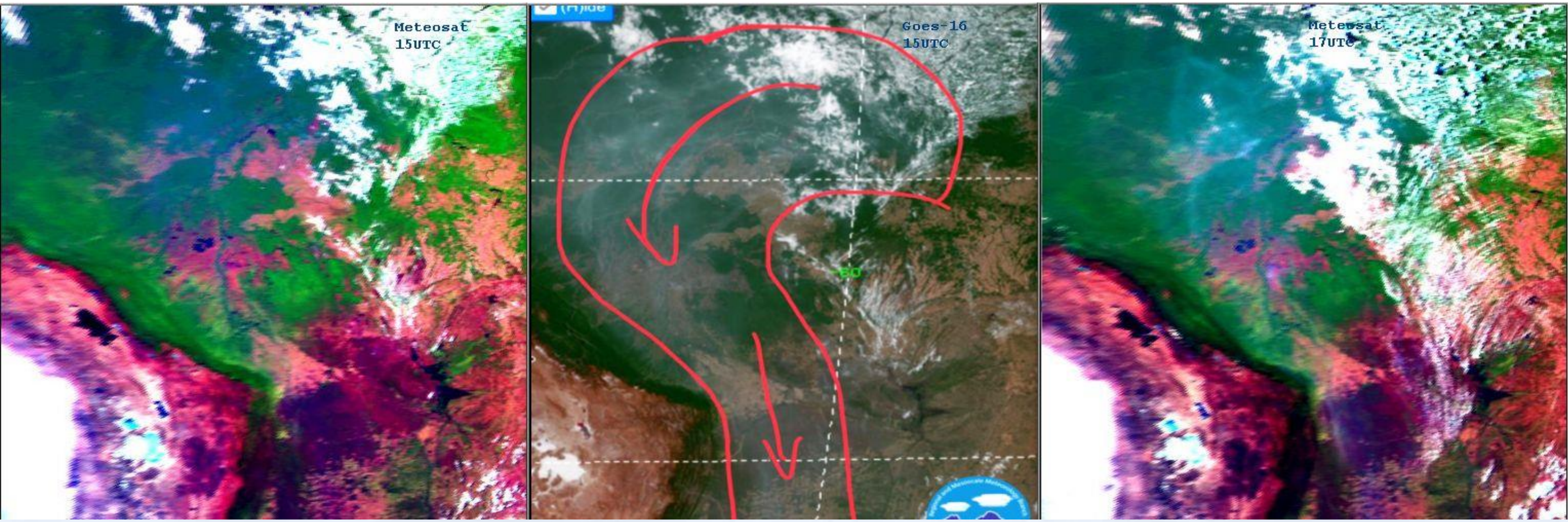
(increased optical depth in the atmosphere
Goes-16 (l.h.s.) and Meteosat-11 (r.h.s.) imagery





EUMETSAT

Smaller smoke particles are better grasped by lower wavelength channels



Forward propagation and different RGBs result in different sentivity to smoke:
15 and 17 UTC Natural colours (Meteosat) and
15 UTC True color (Goes-16)

EUMETSAT

3.9µm characteristics: mark the true!

Maximum emission by flames

+ Response to subpixel thermal anomalies

Small sun contribution

+ No absorption by water vapour

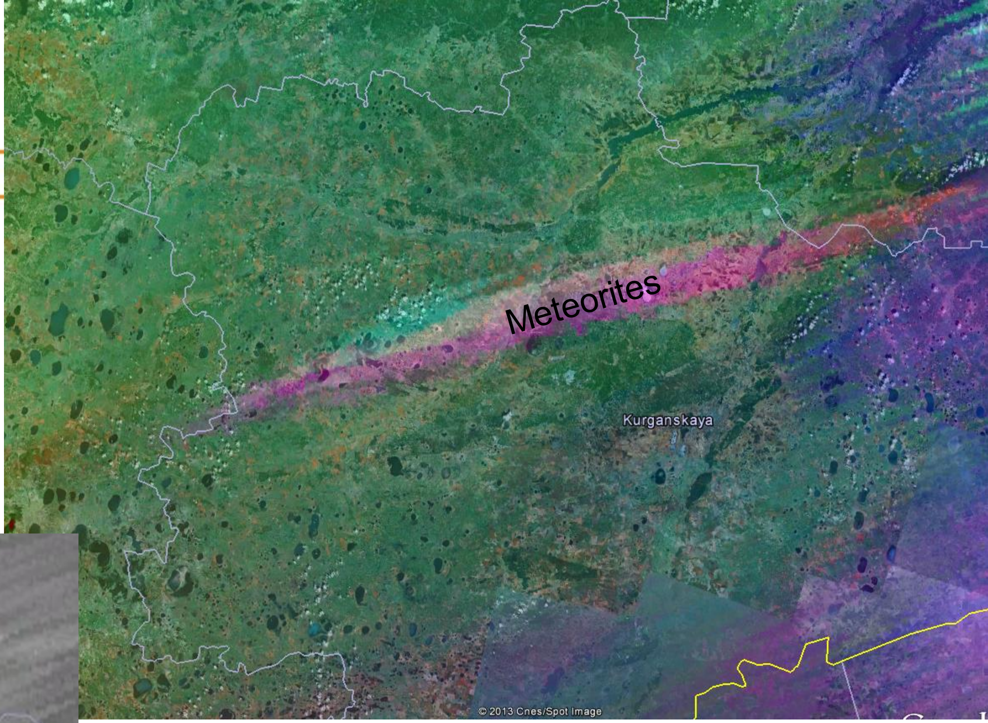
No absorption by carbon dioxide

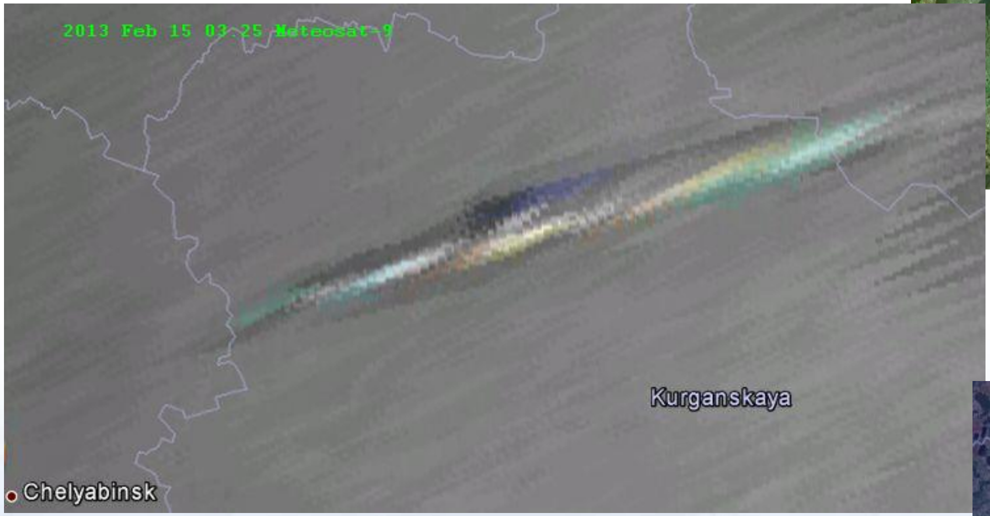
+ Meteosat pixel saturation for fires

+ Low ground emissivity

EUMETSAT

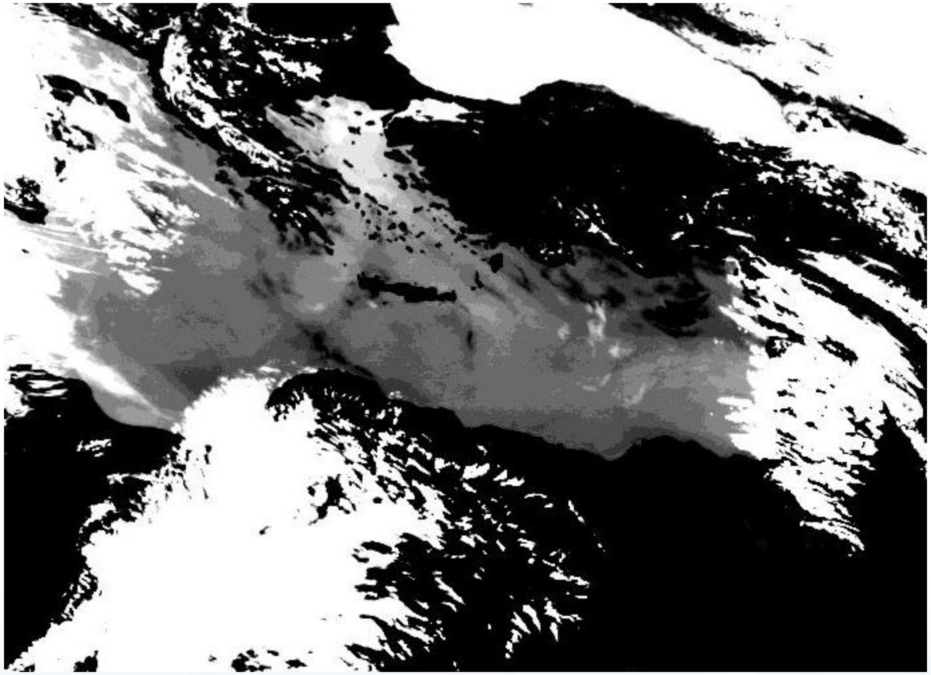
Subpixel detection at 3.9µm



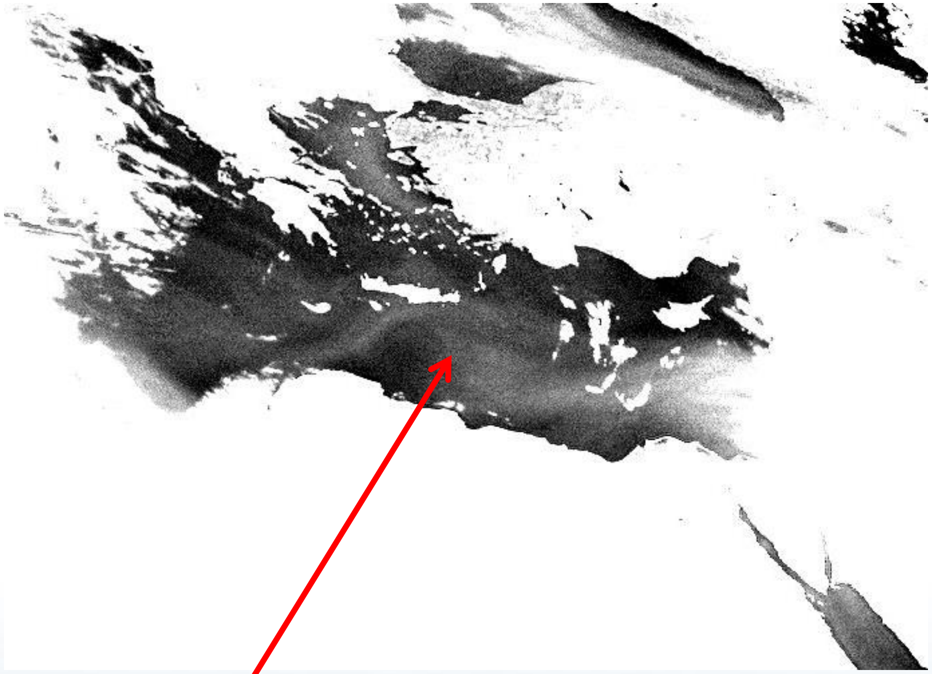


Colour from Meteosat-9 channel 3.9µm.
Blue=270K Red=280K

3.9 µm and 10.8µm channels: water vapour total column



2016_Apr_05 10UTC Channel 10.8µm [215K .. 315 K]

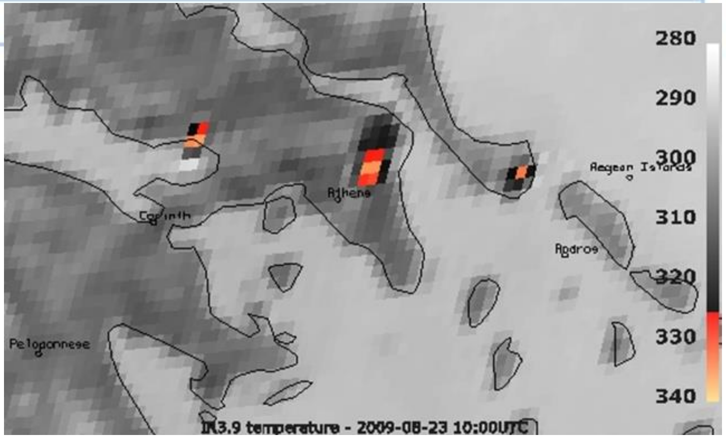


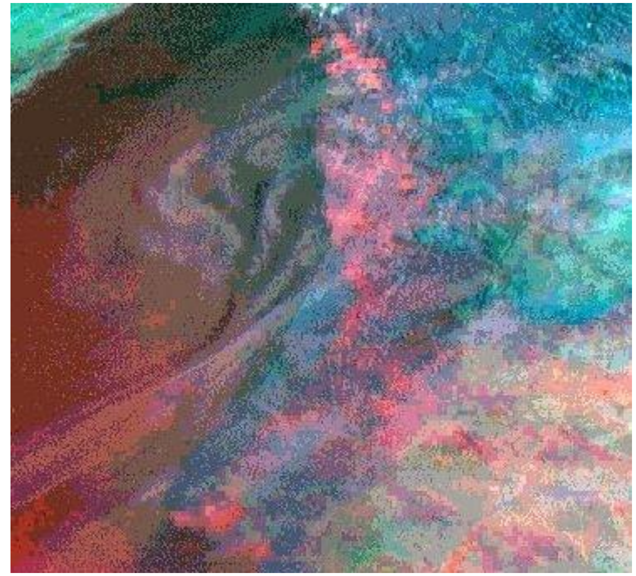
Difference 3.9µm - 10.8µm [-8K .. +60K]

Over water, 10.8µm roughly shows SST fields
But 3.9µm – 10.8µm shows humidity at low level

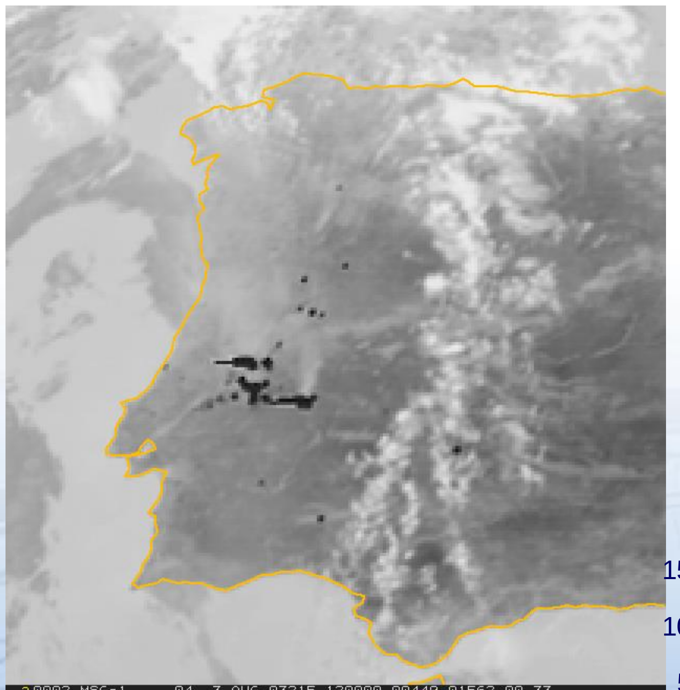
EUMETSAT

3.9 µm and 10.8µm channels: sensor blinding and filters





2006_08_07 06-19UTC
rgb_HRV + 4-3-2
HRV can be combined with lower horizontal resolution for more **spectral** information

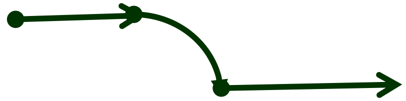


For pixels west of the fire the sensors can be blinded, following geometrical patterns (rings)

3.9 µm and 10.8µm: window channels

3.9 µm

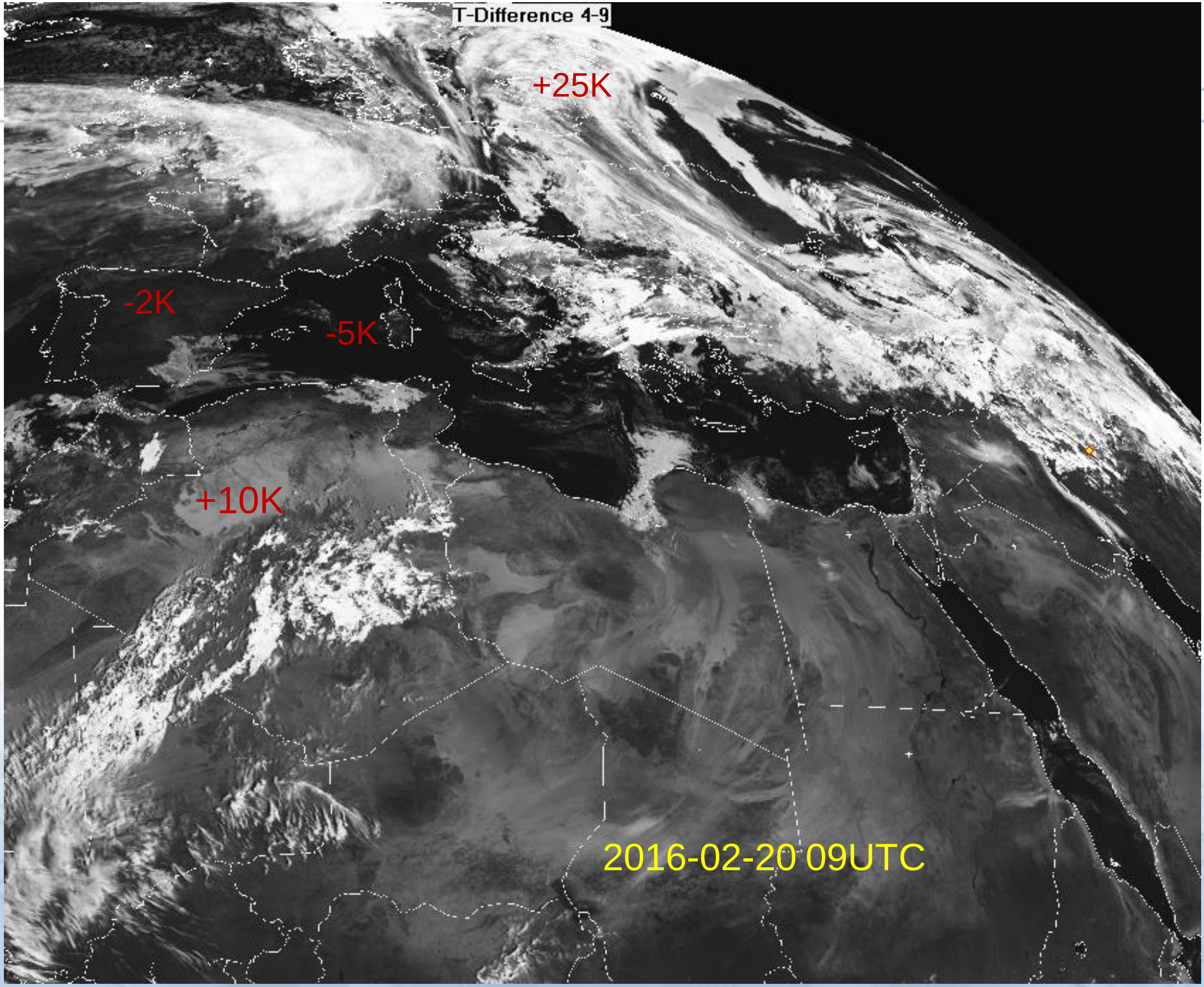
- ❖Negligible absorption by atmospheric humidity
- ❖Close to a **CO_2 absorption** band, 4-7 Kelvin signal reduction
- ❖High temperature **sensitivity** (big sub-pixel effects) ~14 * ΔT/T
- ❖**Blinding** effect by hot pixels, affecting measurements west of the saturated pixel

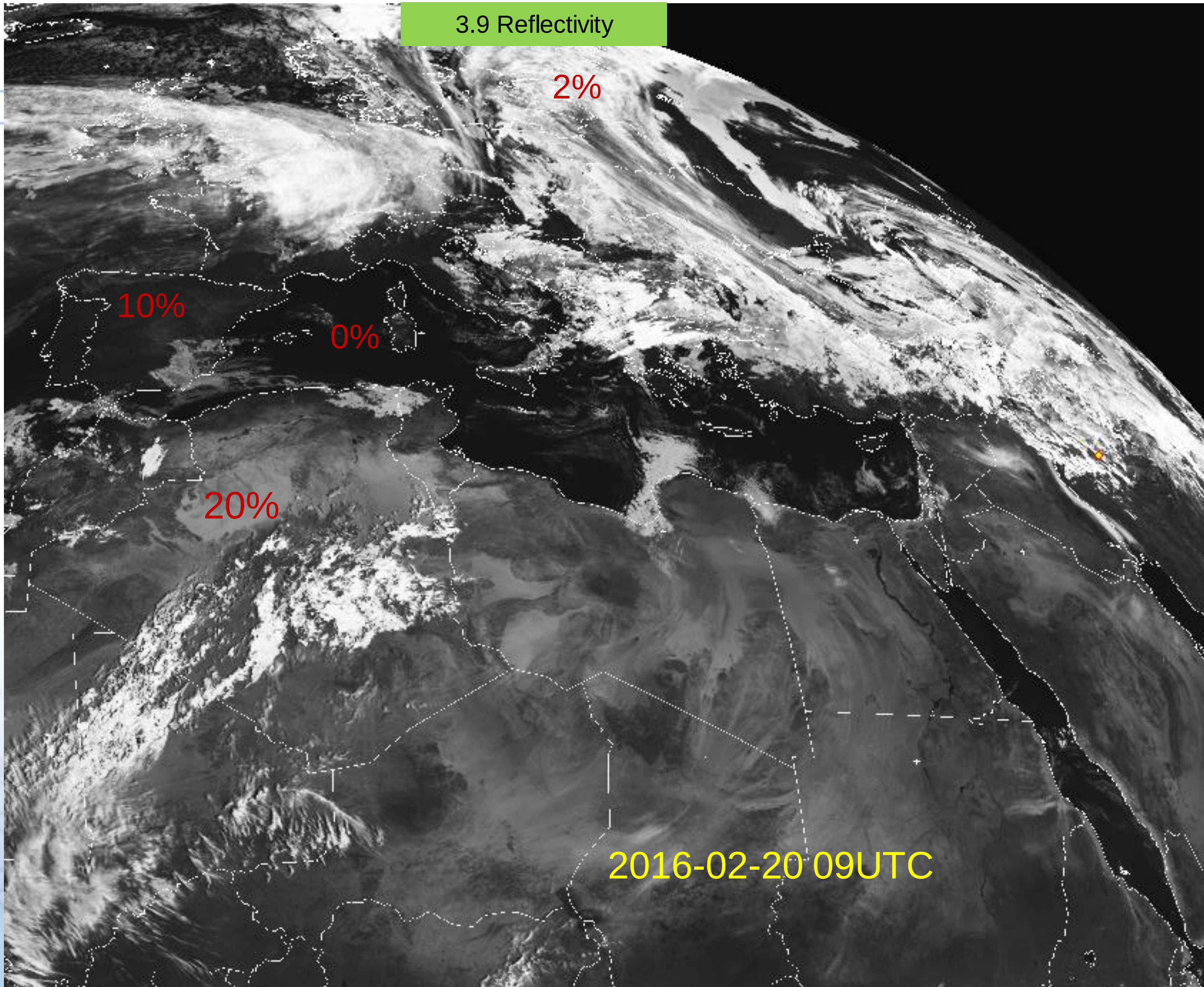


- ❖Fog warnings: daytime start or night dissipation onset
- ❖**Sun** enhancement during day, emission effects during night

10.8 µm

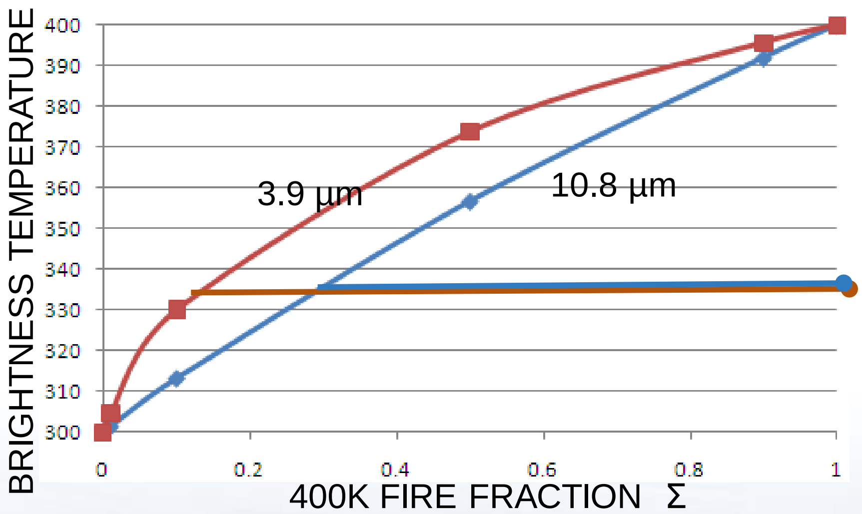
- ❖1-2 Kelvin absorption by atmospheric humidity
- ❖No signal reduction by CO_2
- ❖Lower temperature sensitivity (small subpixel effects) ~ 4 * ΔT/T
- ❖No risk of sensor blinding by fires
- ❖Low values compared with 3.9µm due to semitransparent cloud or smoke.

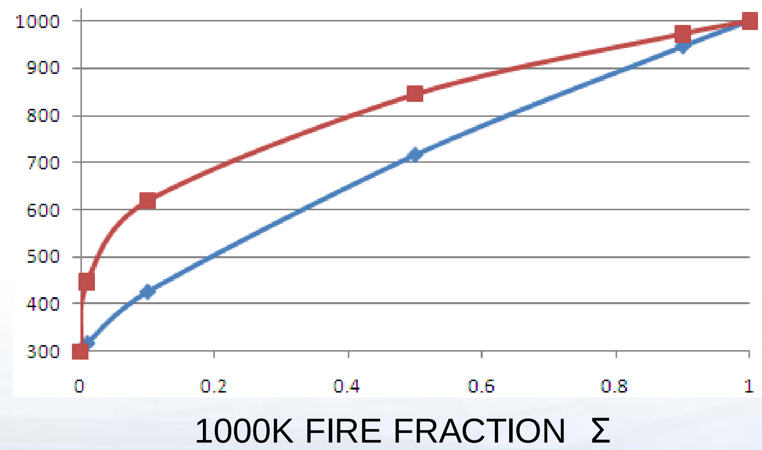

T-Difference 4-9
+25K
-2K
-5K
+10K
2016-02-20 09UTC

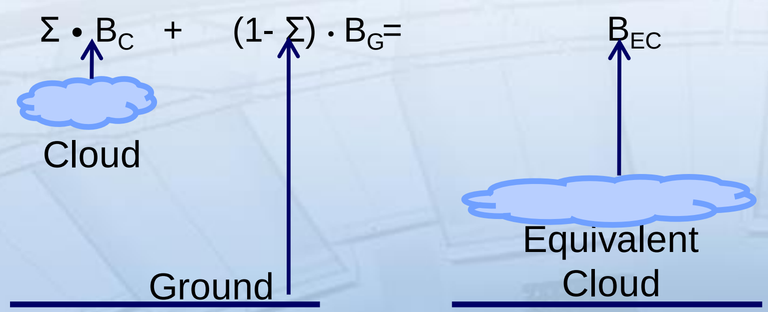

3.9 Reflectivity
2%
10%
0%
20%
2016-02-20 09UTC

Subpixel effects = temperature sensitivity = warm bias

Widespread fires (15%) show less difference 3.9µm – 10.8µm than small ones (5% of the pixel)

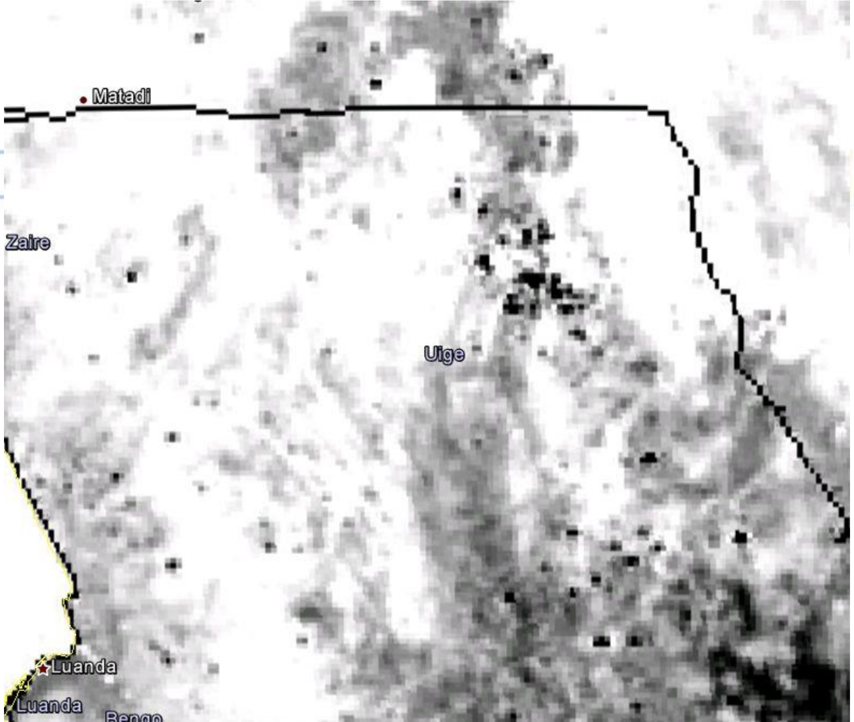




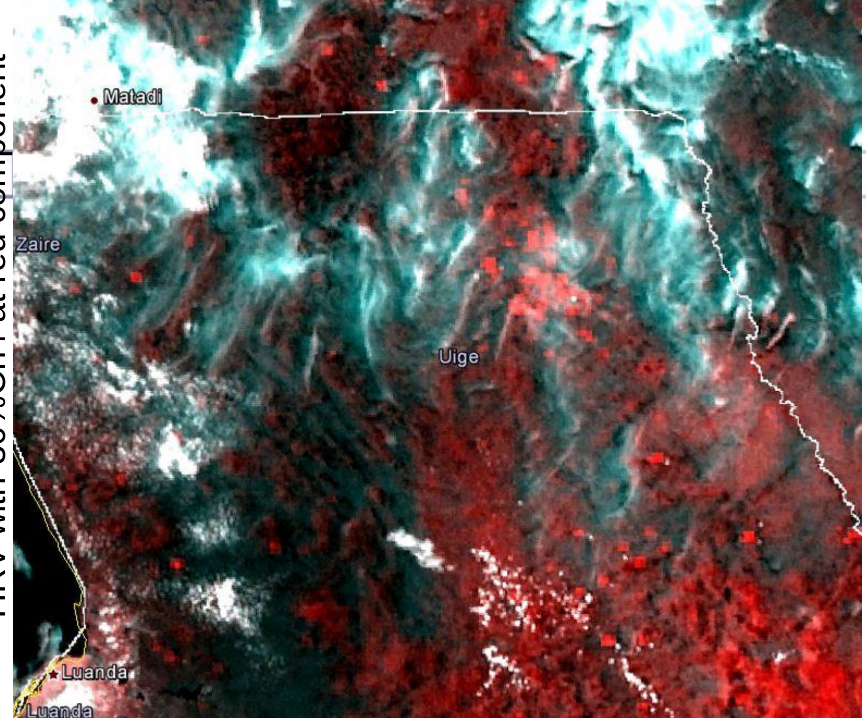


EUMETSAT

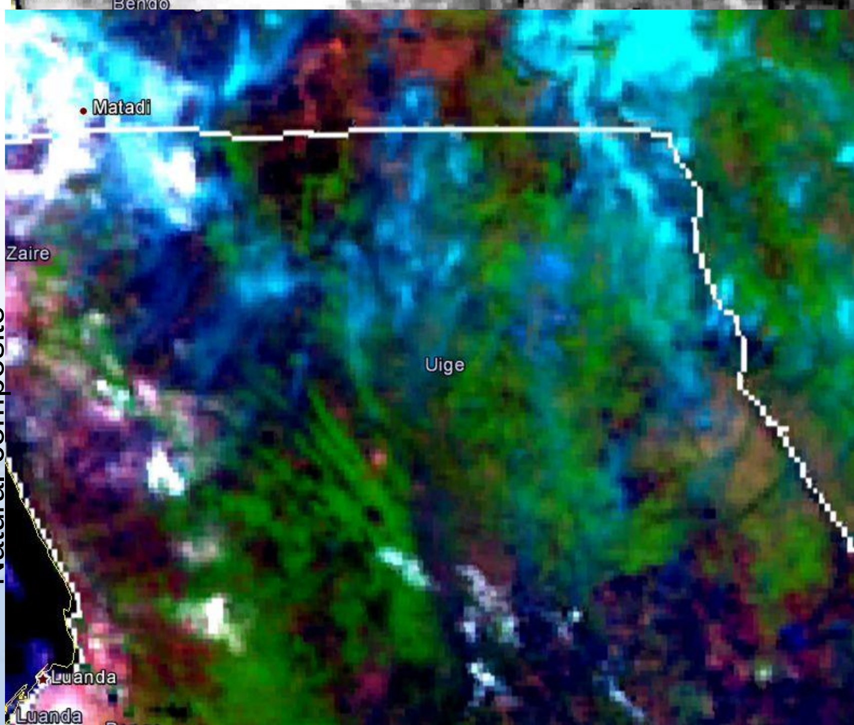
Channel 4 2011-09-01 12:00 M9



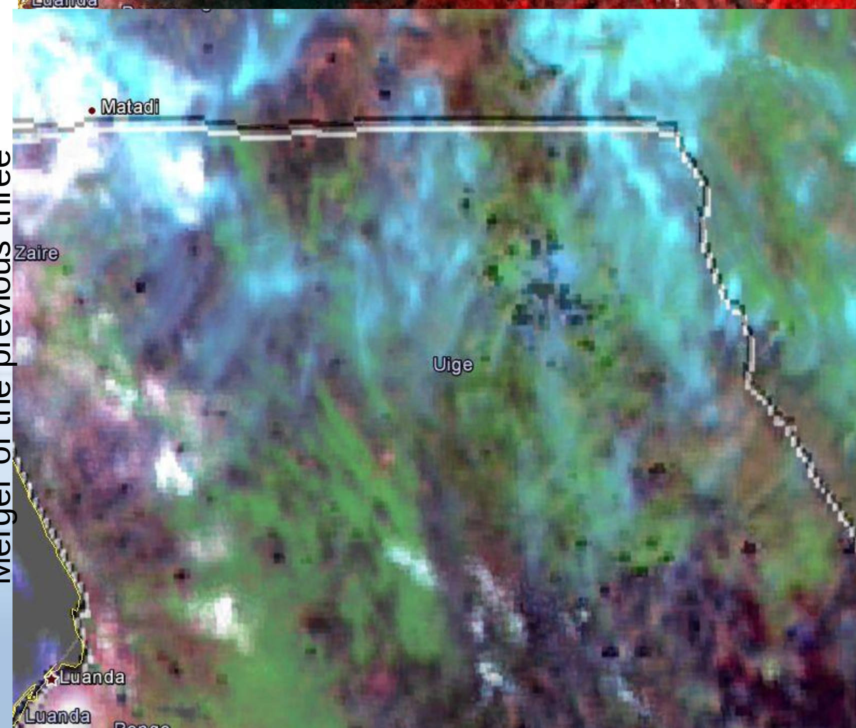
HRV with 30%Ch4 at red component



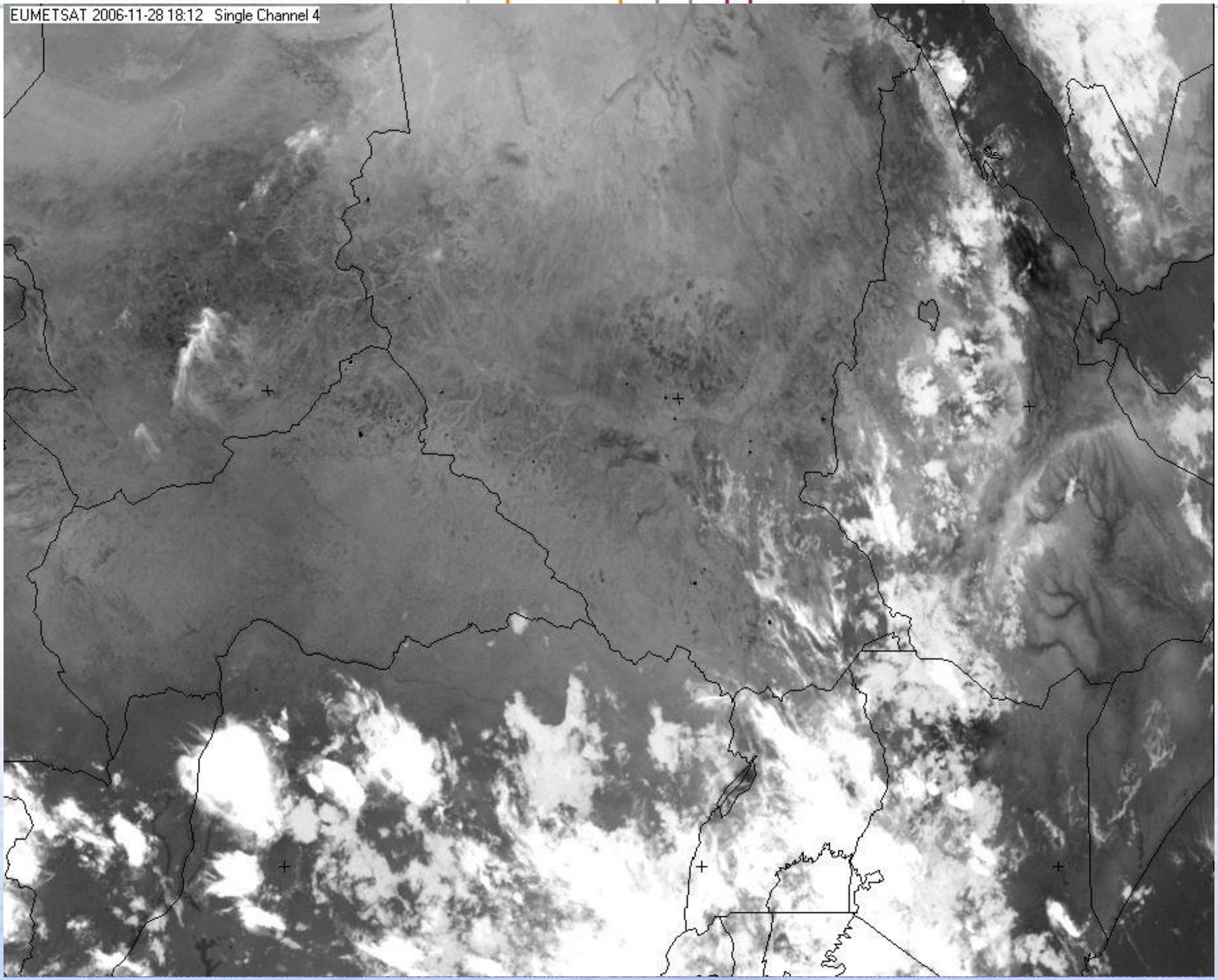
Natural composite



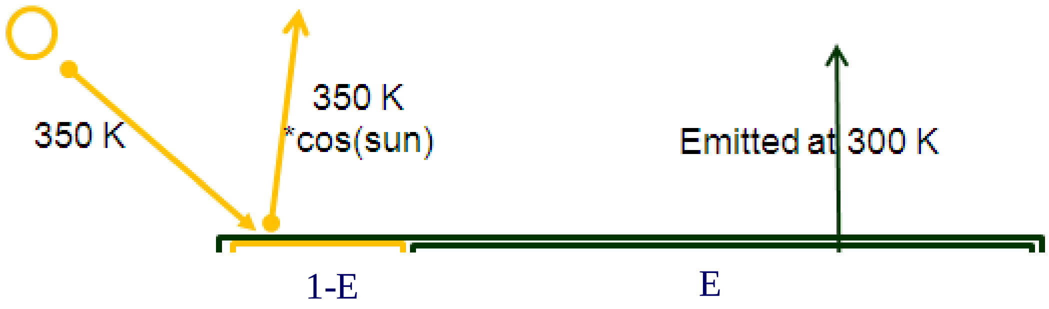
Merger of the previous three



Fires on 1.6µm images



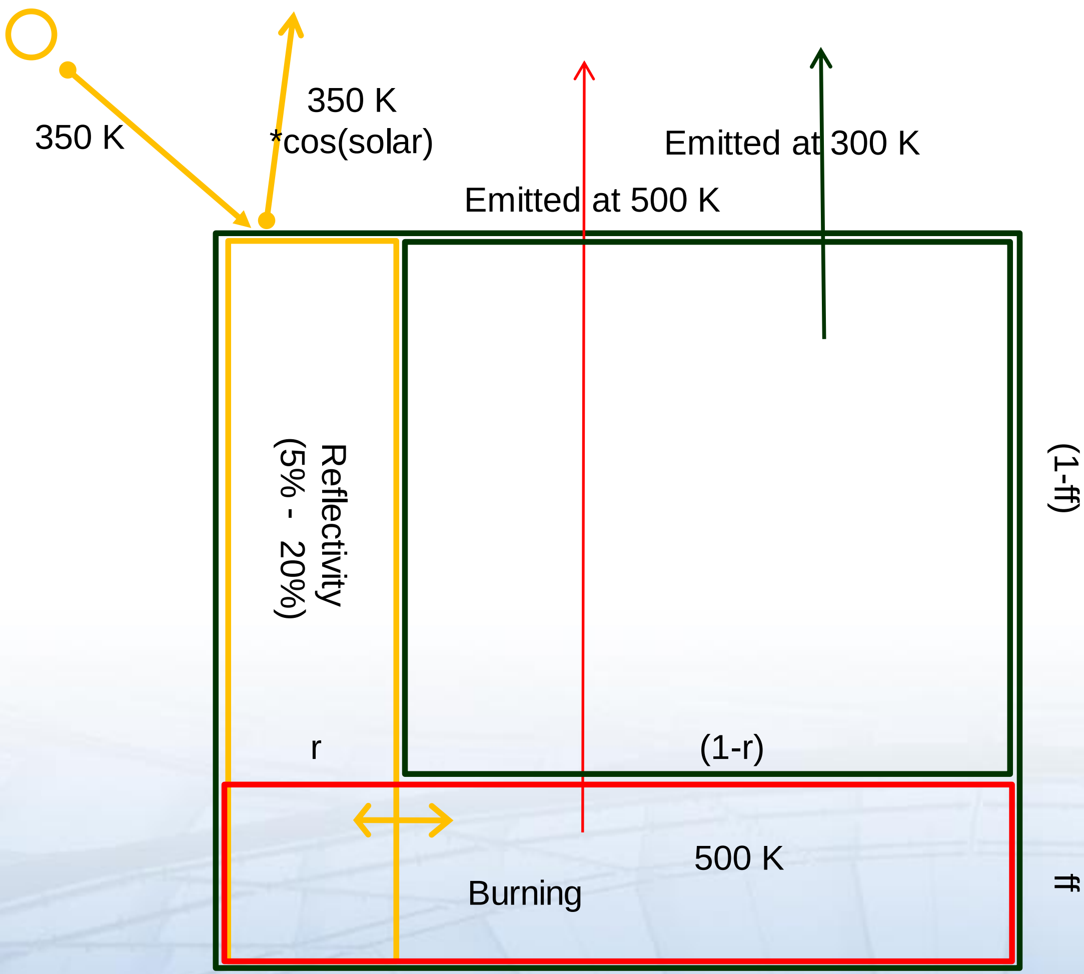
Solar reflection and emission combined (3.9µm)



$$B(BT) = (1-E) * B(350K) + E * B(300K)$$

- Warm bias in brightness temperature towards 350K (depends on illumination)
- During night, brightness temperature (BT) is lower than 300K
- Albedo (1-E) varies with type of soil: 20% (savannah) to 5% (forest)
- Cloud (1-E=2%) is usually present in burning areas

Hot spots contributions in a pixel (3.9µm)



DAY BT	Reflectivity 3.9µm 5% Forest	20% Savannah
Fraction burning		
0	314	333
0.01	328	339
0.1	380	370
0.5	449	425
1	490	460

NIGHT BT	Reflectivity 3.9µm 5%	20%
Fraction burning		
0	296	284
0.01	318	304
0.1	377	356
0.5	448	421
1	489	457

Sunrise and sunset change 3.9µm BT but normally **outside of the detection** range of SEVIRI

Not only 3.9µm allows fire detection

NEAR INFRARED (e.g. 1.6µm)

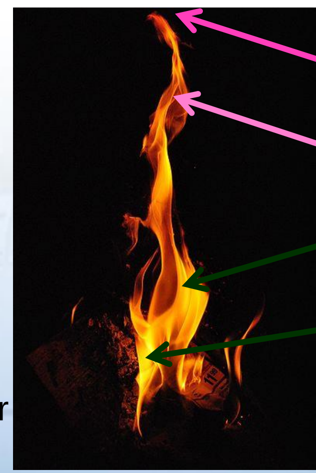
•More adequate for smoke detection than 3.9µm
•Small fires not visible (below threshold)
•No CO_2 absorption (higher “fire temperature”)
•High sub-pixel sensitivity

3.9µm

•Hotspots are easily detected
•Total absorption of ground radiation by CO_2
• BT is temperature of the **CO_2 layer** above the fire
•100m minimum fire size for Meteosat pixel
•Sun interference noticeable (~20 K), but truncated by 3.9µm channel dynamic range limit (333K)
•Difficult statistics due to man-made fire generation (e.g. after harvest)

Karthala, Met-8, 29 May 2006, 12:15 UTC
Natural colours RGB 1.6µm-0.8µm-0.6µm

How hot is lava?



Which one is the “fire temperature”?

Not only 3.9µm allows fire detection

A fire one Modis pixel in size shows colder in Meteosat pixel (100 times bigger)

meteosat	modis
300	300
301	350
305	400
312	450
323	500
336	550

Influence of gas in brightness temperature

Gas T	Tb
300	290
330	310
350	320
370	335
400	360
450	400

3% absorption by CO_2 in 100HPa of atmosphere

50% absorption by CO_2 directly above fire

Which one is the “fire temperature”?

EUMETSAT

The fire traffic lights

•A fire at 500K will be sensed, as it grows

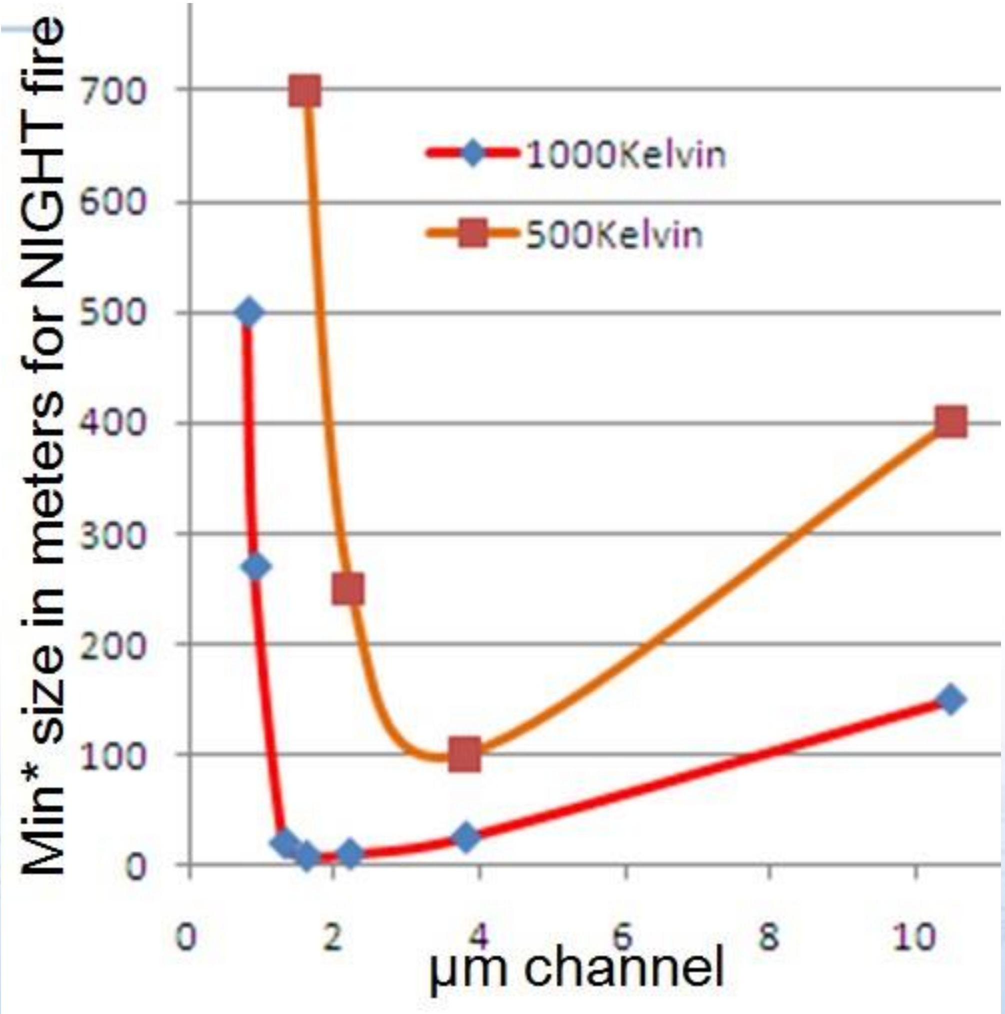
•first by 3.9µm(at ~100m)

•second by 2.25µm (250m)

•third by 10.8µm (400m)

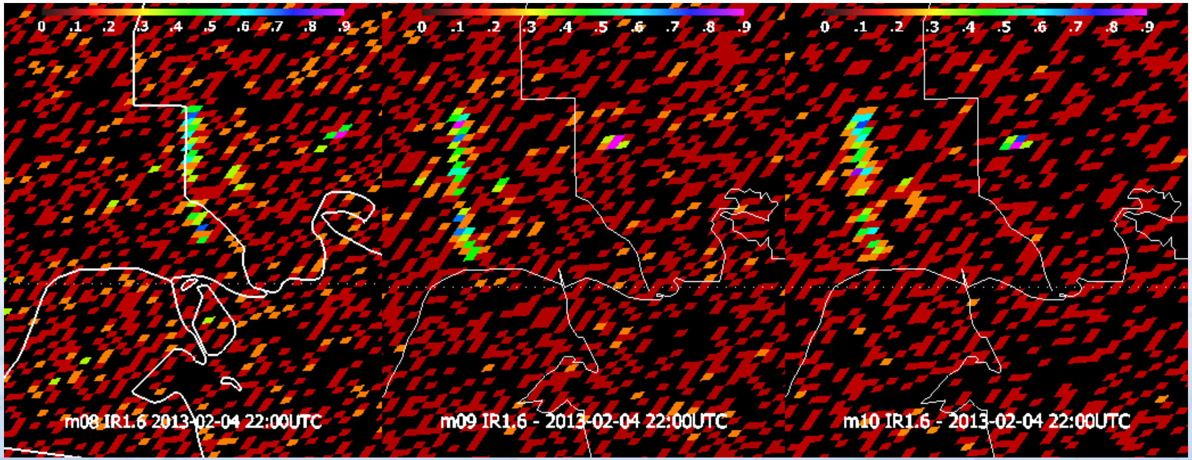
•An RGB=(3.9;2.2;10.8) might be a good indicator for severity of a fire.

•For a hotter fire (1000K), typically gas flares, channels in the solar domain react faster than 3.9µm

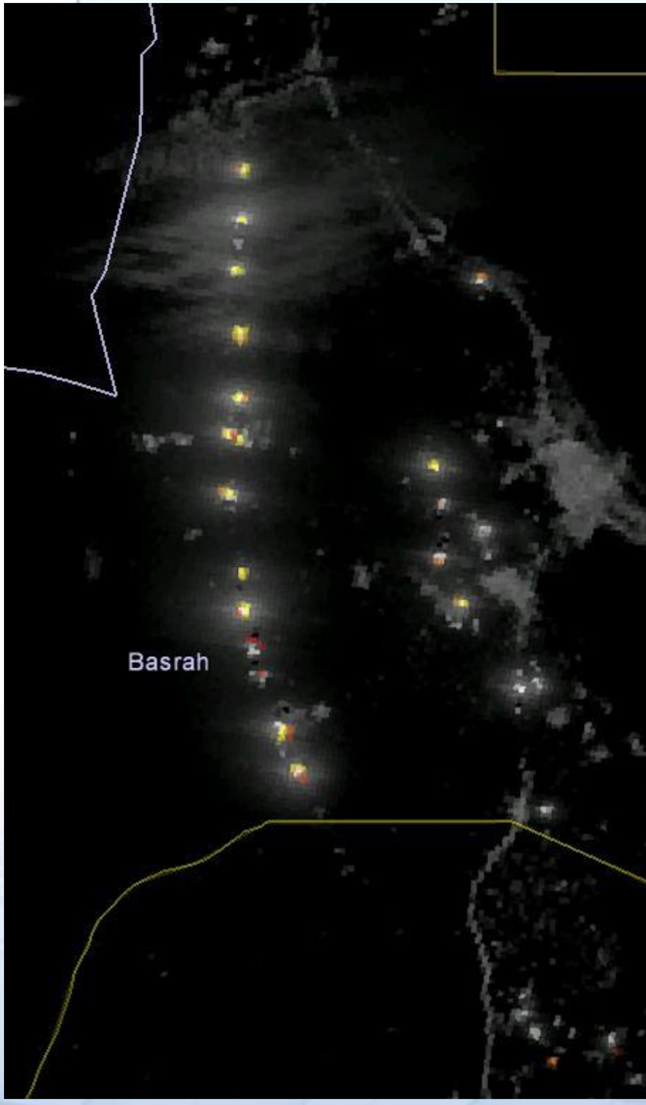


Meteosat IR dynamic range top limits (kelvin)

Channel (µm)	3.8	8.7	9.7	10.5	12.3	13.3
Absorber	$CO2$	SOx	O_3		H_2O	CO_2
MSG	333	300	310	333	333	300
Dynamic MTG	580	330	310	340	340	300



Meteosat-8,9,10 looking concurrently at gas flares in Kuwait through channel 1.6µm

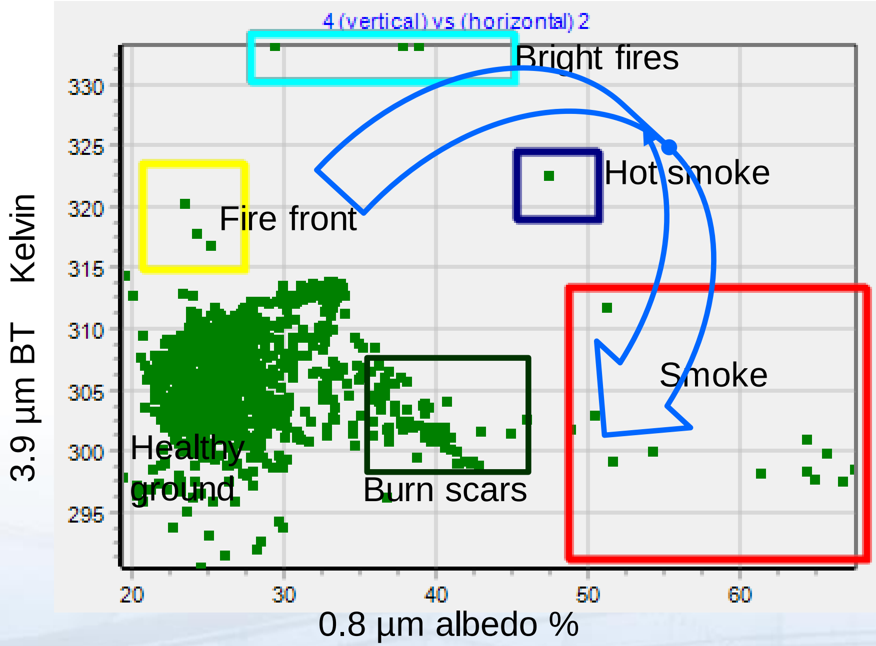


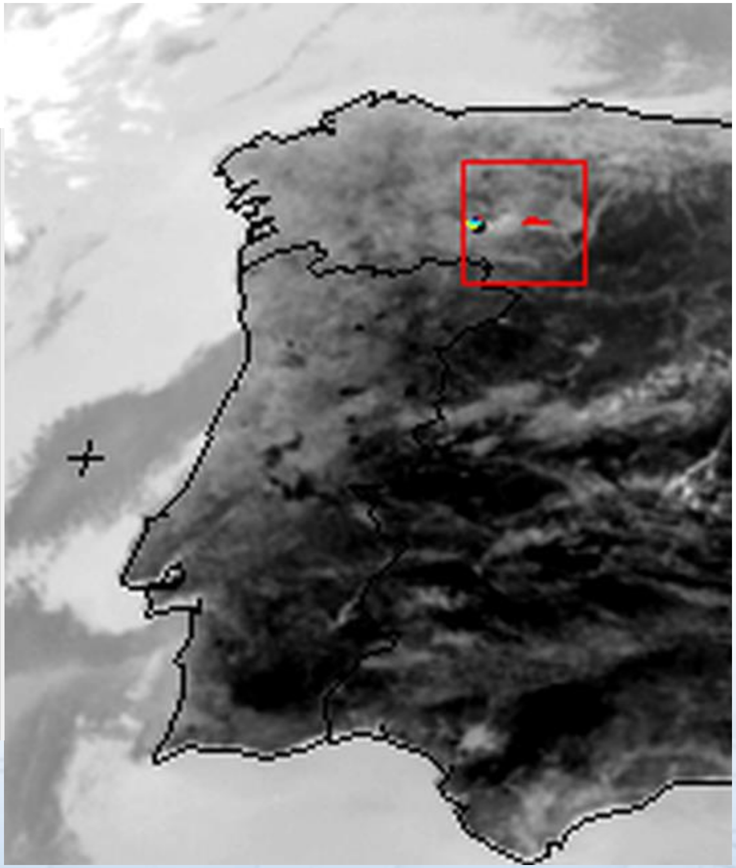
VIIRS 2013-02-17:2200

EUMETSAT

The fire cycle, pixel by pixel

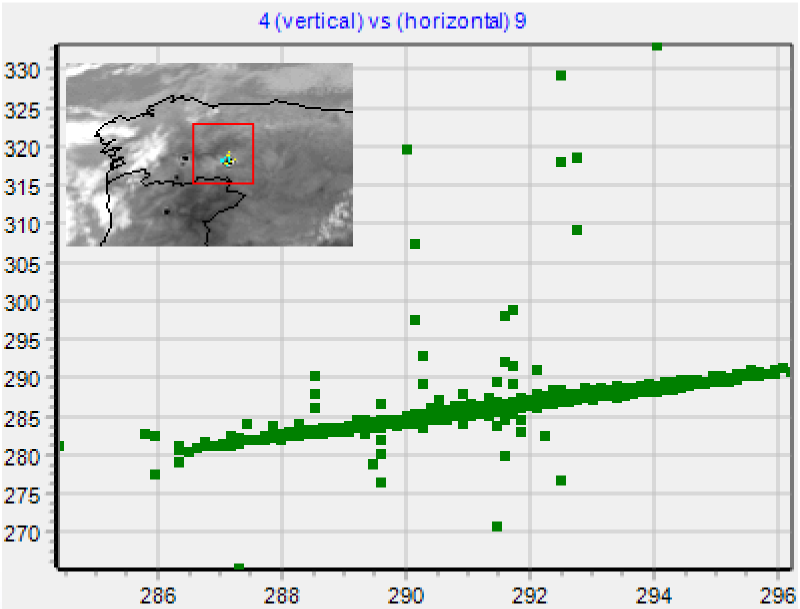
Met-10 Ch4 2017-08-22 14Z

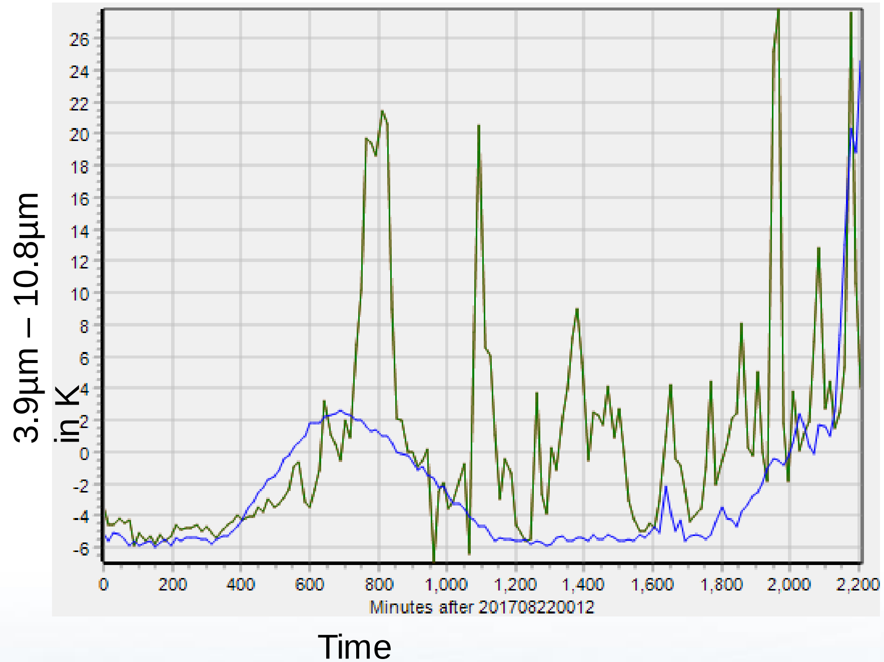




Fire fronts can increase the pixel albedo, first by the flames emission, later by changing the ground into a burnt surface, more reflective than a forest.
West wind

Burnt pixels and hot pixels





The diagram shows in green values for pixels inside the red square (inset)

What are the pixels above the main long cluster?

What are those pixels under the cluster?

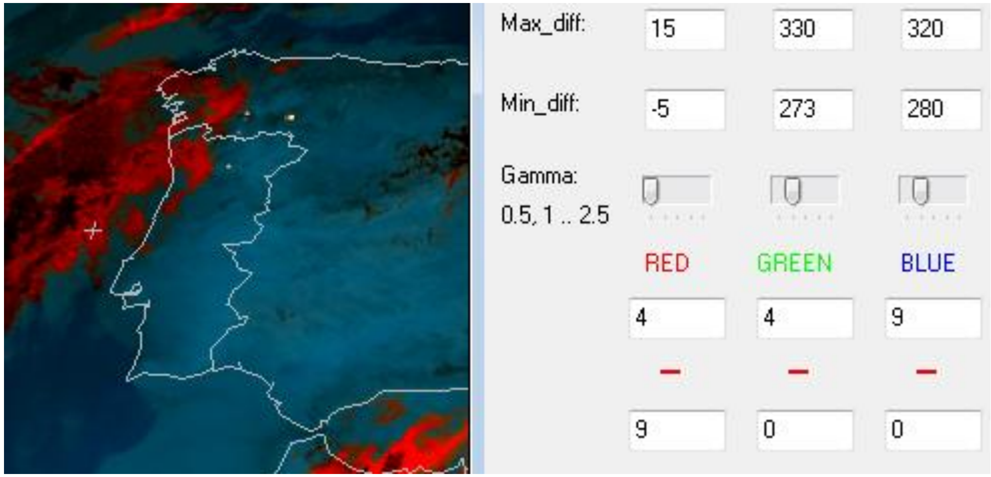
When was the main burning phase for the pixel in green? (blue pixel is fire and cloud free, 200 km south)

What are the other peaks in the green curve?

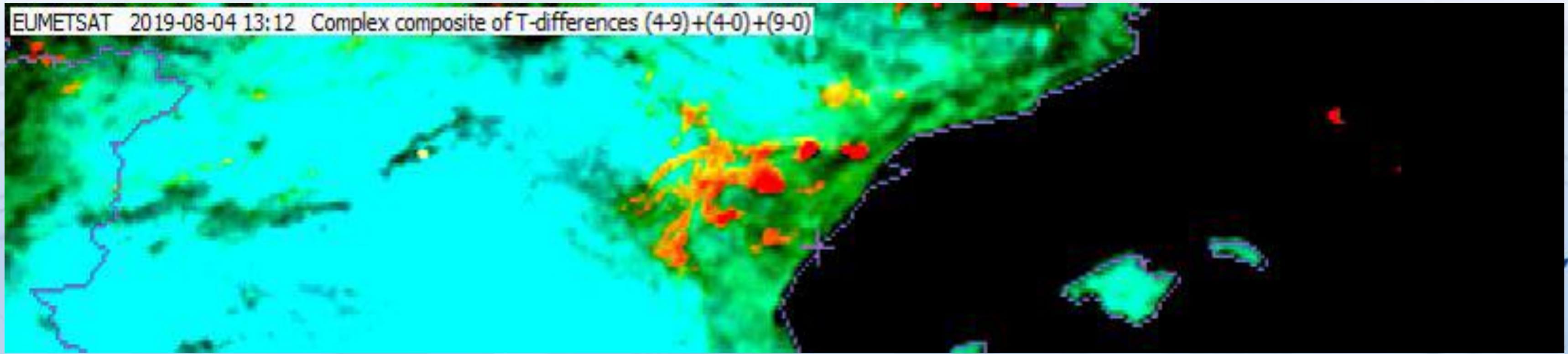
Does the fire get variable in intensity?

EUMETSAT

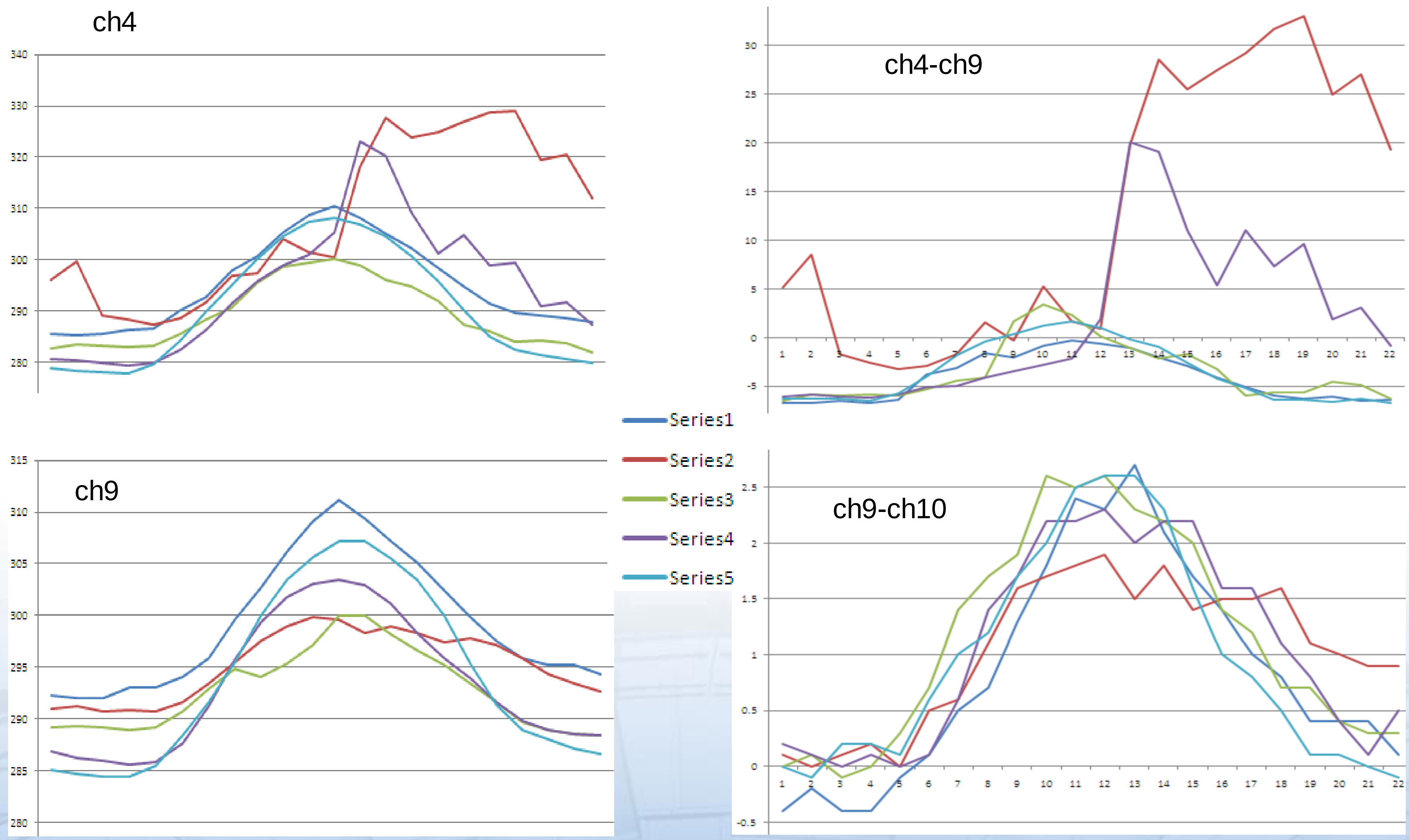
One more fire RGB (4-9, 4, 9) recipe for MSG



Cloud, as a hiding factor, in reddish hues
Fire in yellow, more intense for stronger fire.
fermoselle.gif

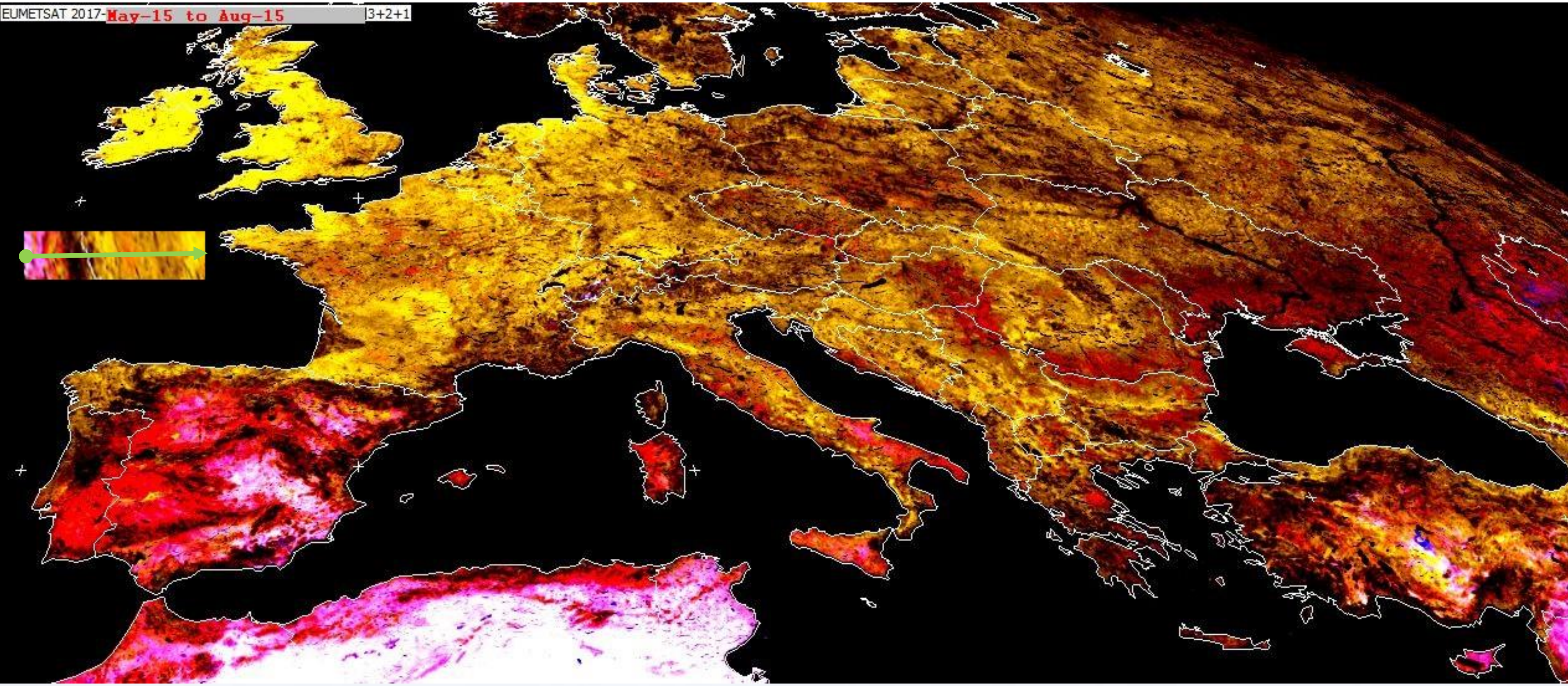


Hot spots, brightness temperature daily evolution



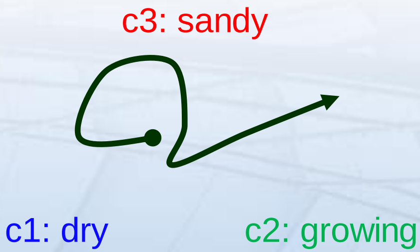
- Stronger response in 3.9µm than in 10.8µm or 12µm
- Optimal index is 3.9µm – 10.8µm
- Alternative index 10.8µm – 12µm, due to humidity increase?

Drought as a fire risk indicator



Dry + Vegetation = Fire risk

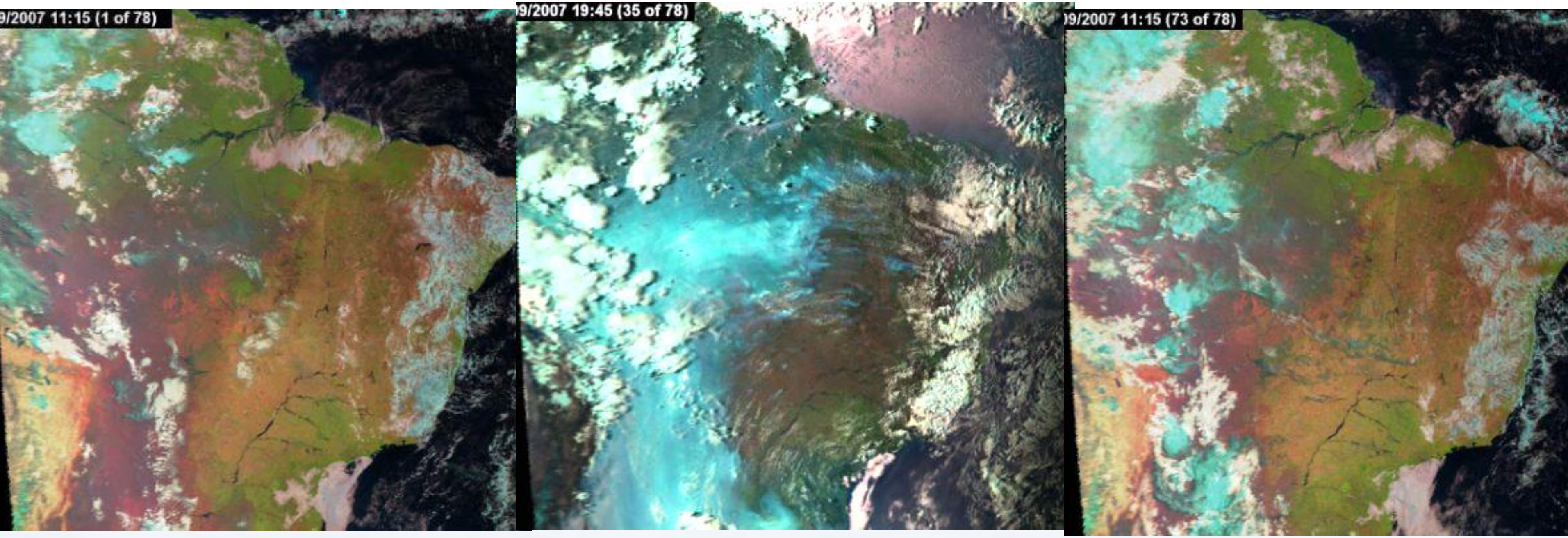
Algorithm based on RGB=(min_in_sequence(max_on_pixel(c3,c2))
min_in_sequence(c2)
min_in_sequence(c1))



Fire risk areas in brown or red.

EUMETSAT

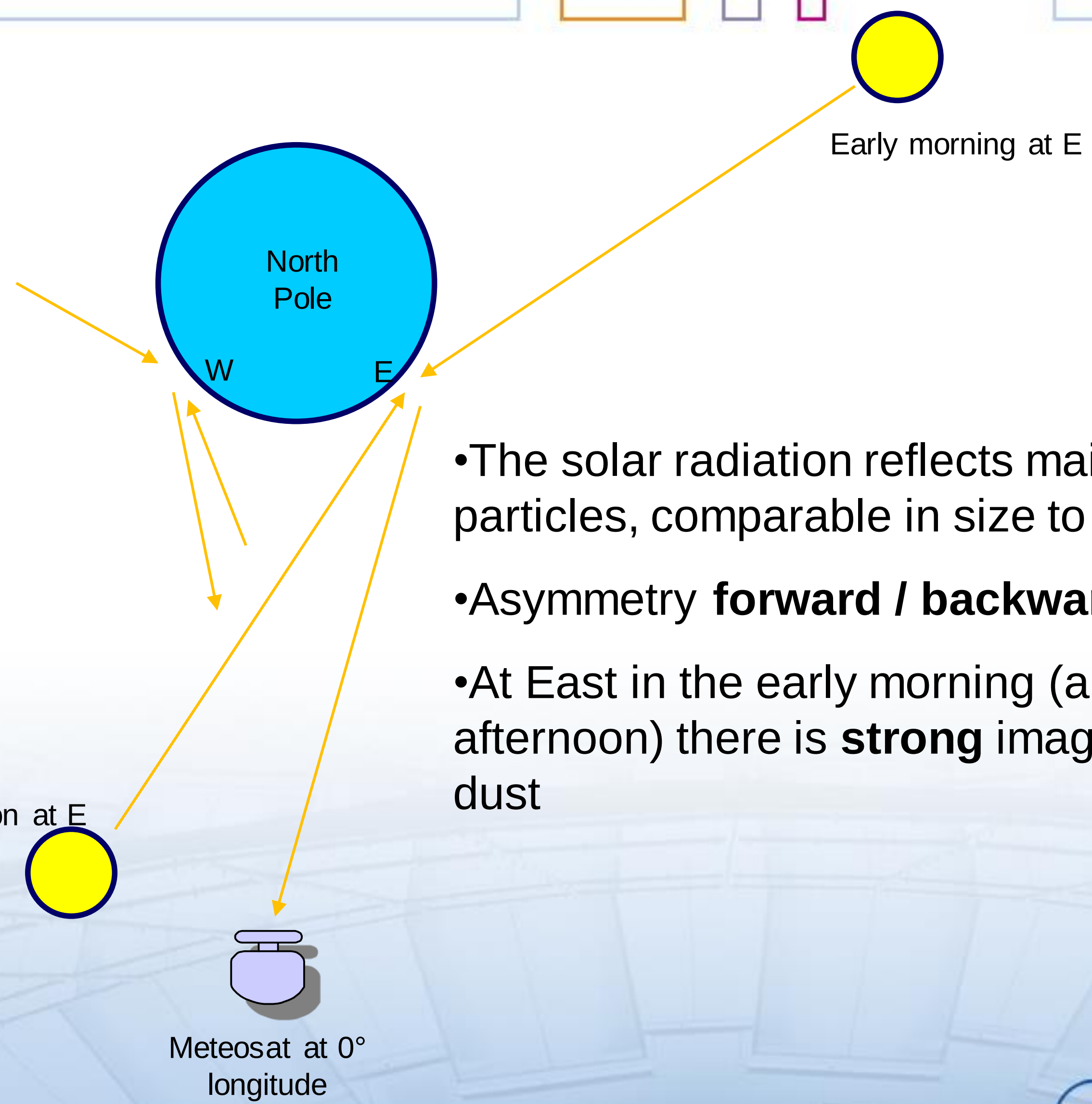
Smoke



5-6 September 2007, Meteosat-9
Around sunrise and sunset times for central south America

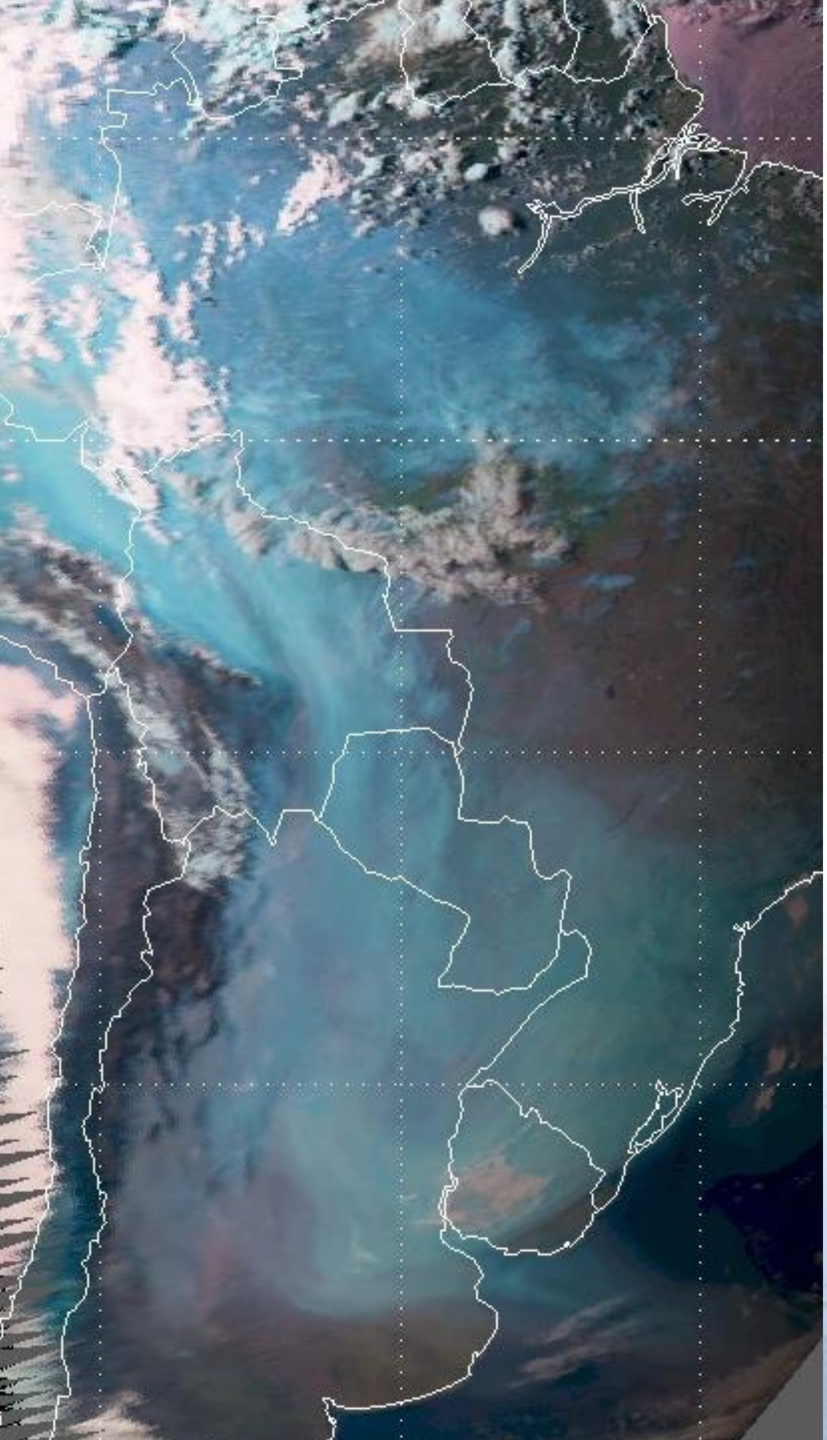
Assuming no major smoke sink or source in 24 hours, the intensity difference is due to the sun angle

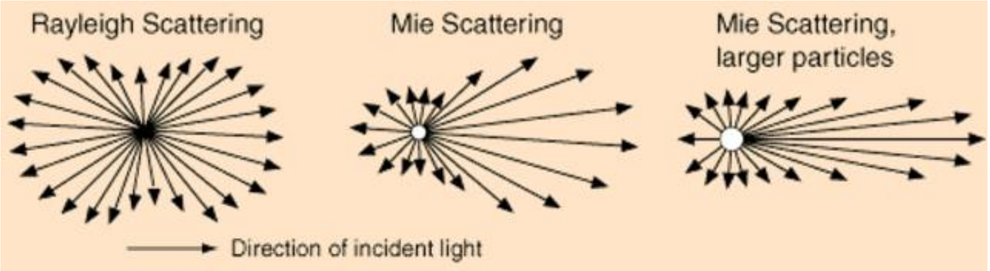
Image contrast for smoke or dust in solar images



- The solar radiation reflects mainly **forwards** on smoke particles, comparable in size to the wavelengths (Mie)
- Asymmetry **forward / backward** for a.m and p.m.
- At East in the early morning (and at West in the late afternoon) there is **strong** image contrast for smoke or dust

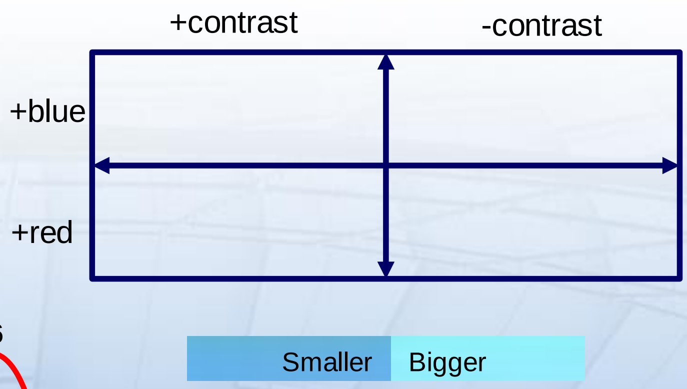
Meteosat9, 2010-08-21 2015 UTC

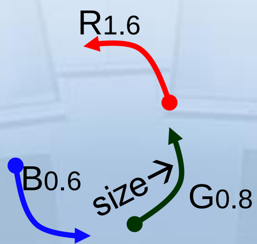




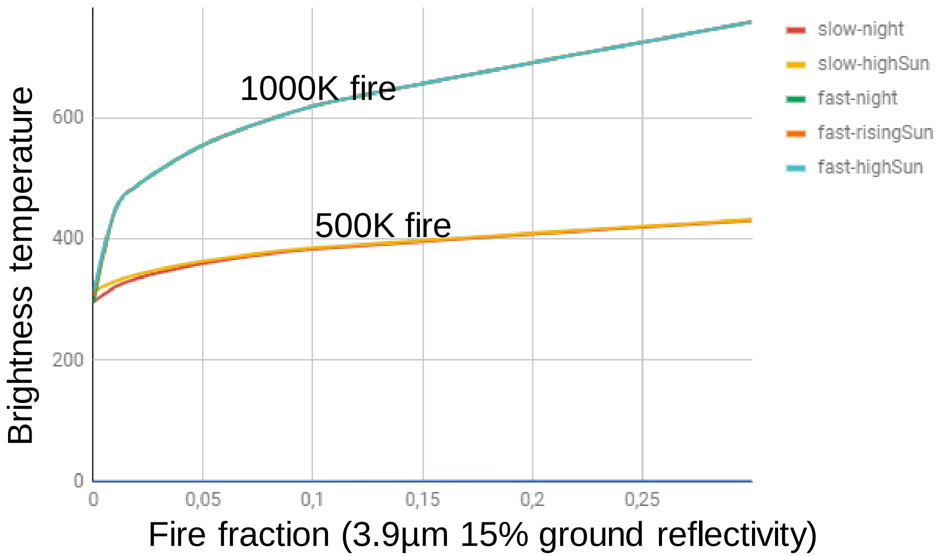
- Smaller wavelengths favoured by forward scattering
- Blue-cyan colour due to 1.6 µm rather Rayleigh
- Scattering intensity higher in the western late afternoon

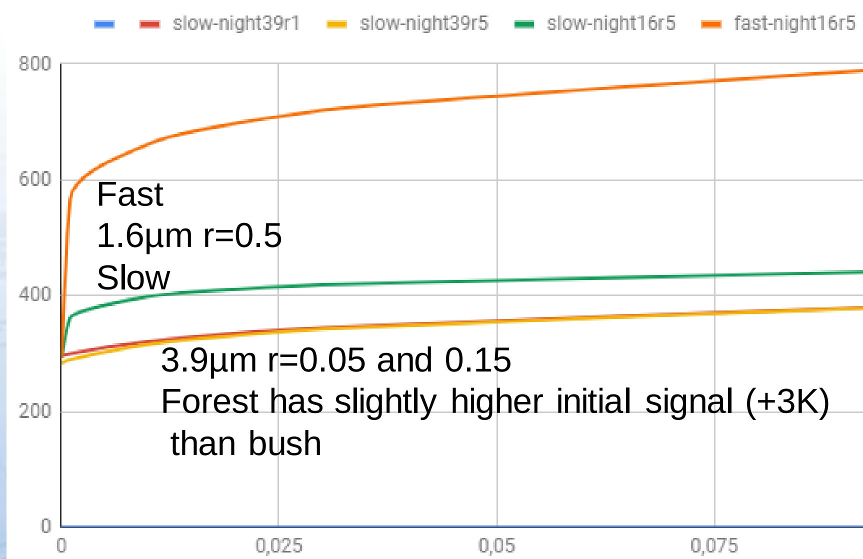
What if smoke particles were **smaller**?
More contrast (intense)? Redder or bluer in hue?





Characterise a fire





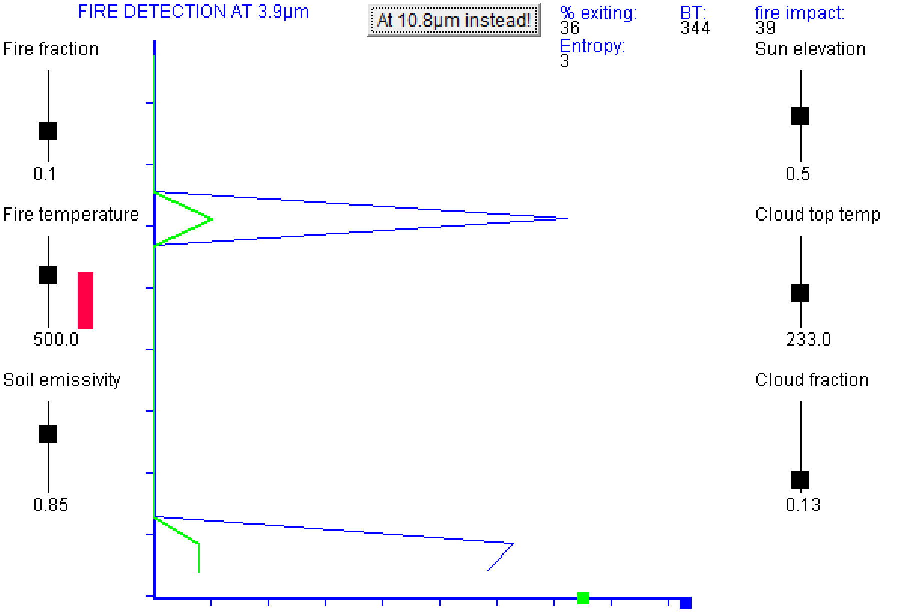
http://training.eumetsat.int/pluginfile.php/12356/mod_resource/content/8/fire.html

In the EUMETSAT moodle repository above. Not easy to display in Chrome

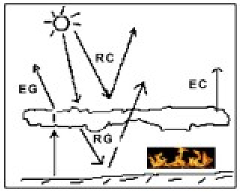
Fires brightness temperature (BT)
This applet interface describes with sliders the characteristics of the atmosphere, and provides the BT at 3.9µm (or 10.8µm with the button) for different types of soil, times of the day (sun elevation), intense and extensive fires and cloud above.
Green indicates the amount of cloud, fire and soil emissivity (bottom green square). Blue is the fraction of radiation from different sources exiting the Earth, the rest being absorbed by the Earth-atmosphere. The global value is given in upper line. The reddish square close to the Fire Temperature slider gives an idea of the extent and intensity of the fire and its size depends on the first two sliders. Its colour is given by the brightness temperature difference (fire impact) with and without the fire. Red indicates that the difference is above 5 K, so the satellite could see the fire.
The bottom table specifies the actual amounts of energy exchanged by the elements in the scene, relative to 100000 photons emitted in total by all surfaces, upwards and downwards.
Back to work:
1. First, set all sliders to 0, but "Soil emissivity" to 1 (absolutely non-reflective ground. Usually, it should be between 0.50 for desert or savannah and 0.85 for thick forest). Notice 100% of the emitted radiation reaches the satellite. This proportion will decrease when new sources are added.
2. Set the Cloud thickness to some intermediate value, and observe the changes. What do you expect for a brightness temperature, as a function of the Cloud top temperature? Are you correct? If not, why?
3. Back to Cloud thickness zero, try with Sun elevation, the sun rising over the horizon and sending radiation at 3.9µm into the atmosphere and back to the satellite. Any changes when you move the slider? How does BT vary when we change Soil emissivity on the ground?

EUMETSAT

Brightness temperature at 3.9 micron for detecting fire in the pixel



	ToGround	ToFire	ToSmoke	ToCloud	ToSatel
From Ground	15	625	587	644	4370
From Fire	13548	230	1807	2081	14134
From Smoke	12163	1802	209	2419	15207
From Cloud	21	1	1	1	32
From Sun	17974	2627	2854	4299	2343



jose.prieto@eumetsat.int

Conclusions

- Channel 3.8µm in MTG is an excellent detection tool for active fires above 100m across (1 Ha), and for measuring burnt areas as reflectivity changes

- Statistics on fires (natural or man-made) are missing or affected by sensor **saturation**. However, an approximate retrieval can be attempted based on frequency curves below saturation

- The Land SAF offers a large choice of vegetation products to assess vegetation stress and **fire risk**

THANK YOU FOR YOUR ATTENTION!

EUMETSAT