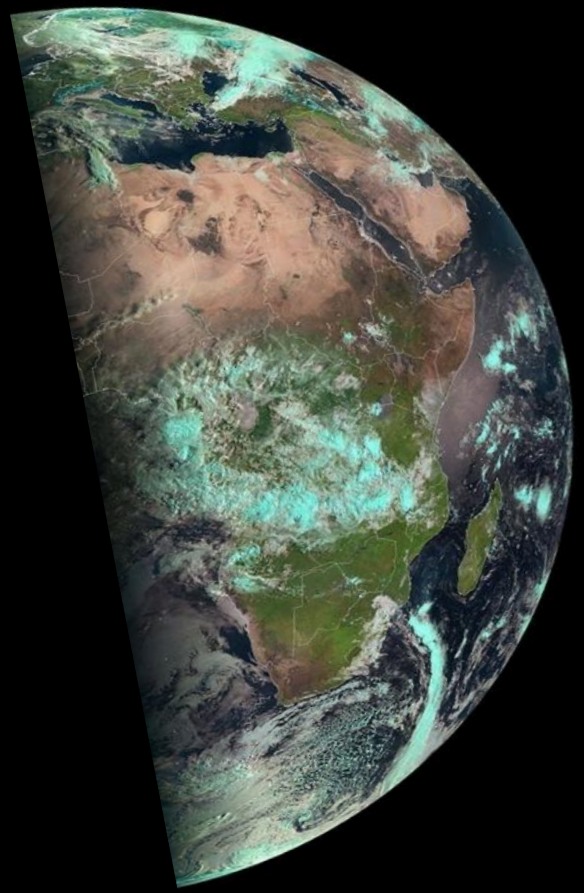


Erath Observing Satellite

RGB images

Ibrahim Al Abdulsalam
i.alabdulsalam@met.gov.om

This Lecture is :

*** To define RGB model and its application in earth observing satellite**

*** To explain the process of making RGB satellite images**

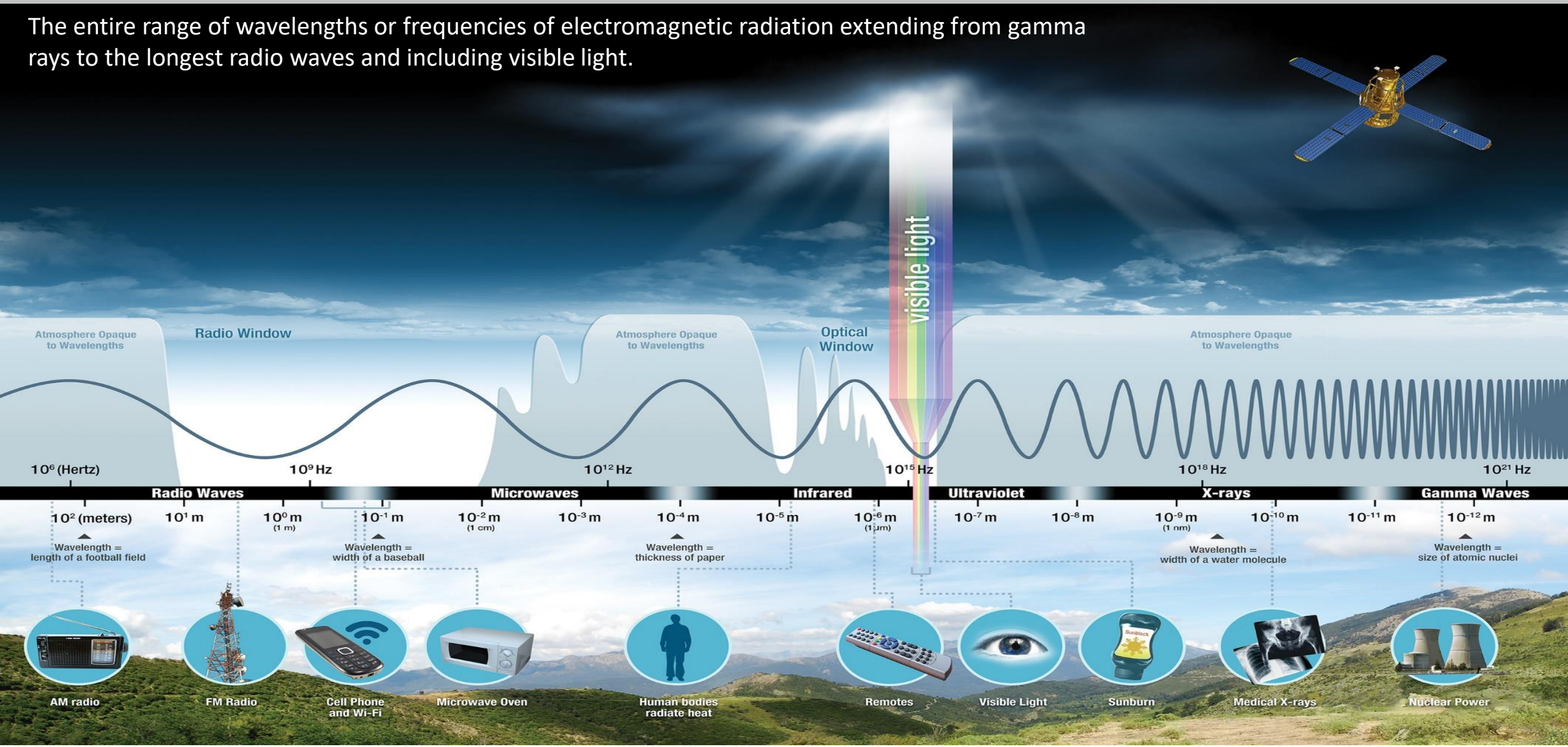
*** Analyze and Interpret a number of RGB images and cases**

Color Vision

How do we see colour ? Where do colour exist after all?
Is there any physical meaning behind colour?

ELECTROMAGNETIC SPECTRUM

The entire range of wavelengths or frequencies of electromagnetic radiation extending from gamma rays to the longest radio waves and including visible light.



By NASA

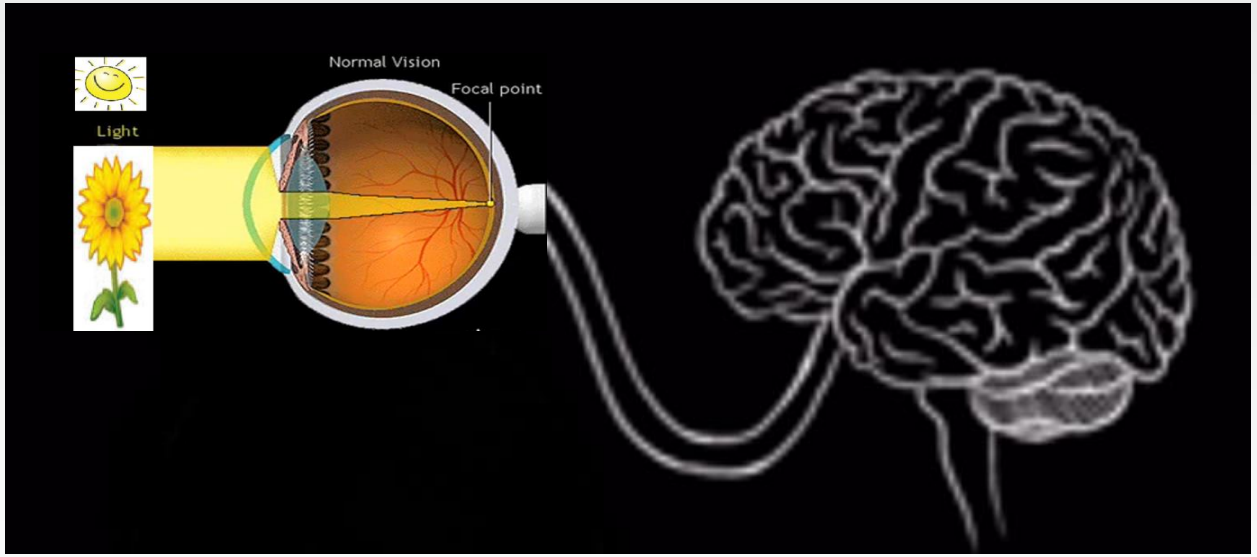
ELECTROMAGNETIC SPECTRUM

***We are in an ocean of EM waves but we can see visible light ONLY**
***We make colour vision from visible light in our brains.**
***Visible light is very small range of the EM spectrum but it is the most important to human beings (maybe that is all what we need!) and many animals.**
***Imagine that we can see all EM spectrum?? How would the world will looks like.**

The Process of Seeing

How do we see the world around us ?

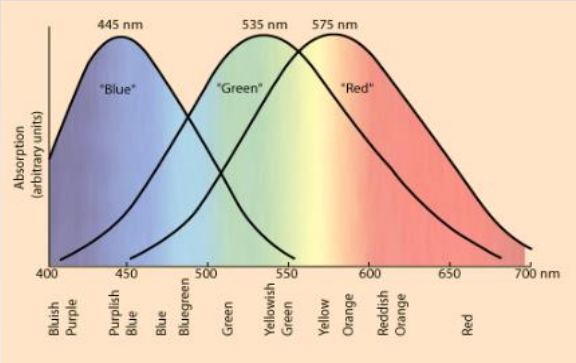
Source of Light /EMR	Sensor	DATA processor and image visualizer
Emitted Reflected Scattered . .	to sense & collect data Like: Human eyes Satellite Sensors Radar ….	Computer Smart Phone (How About Human)



How can we sea color ?

RETINA : plays very important role in eye Function

In our eyes retinas there are two types of photoreceptor cells cons and rods



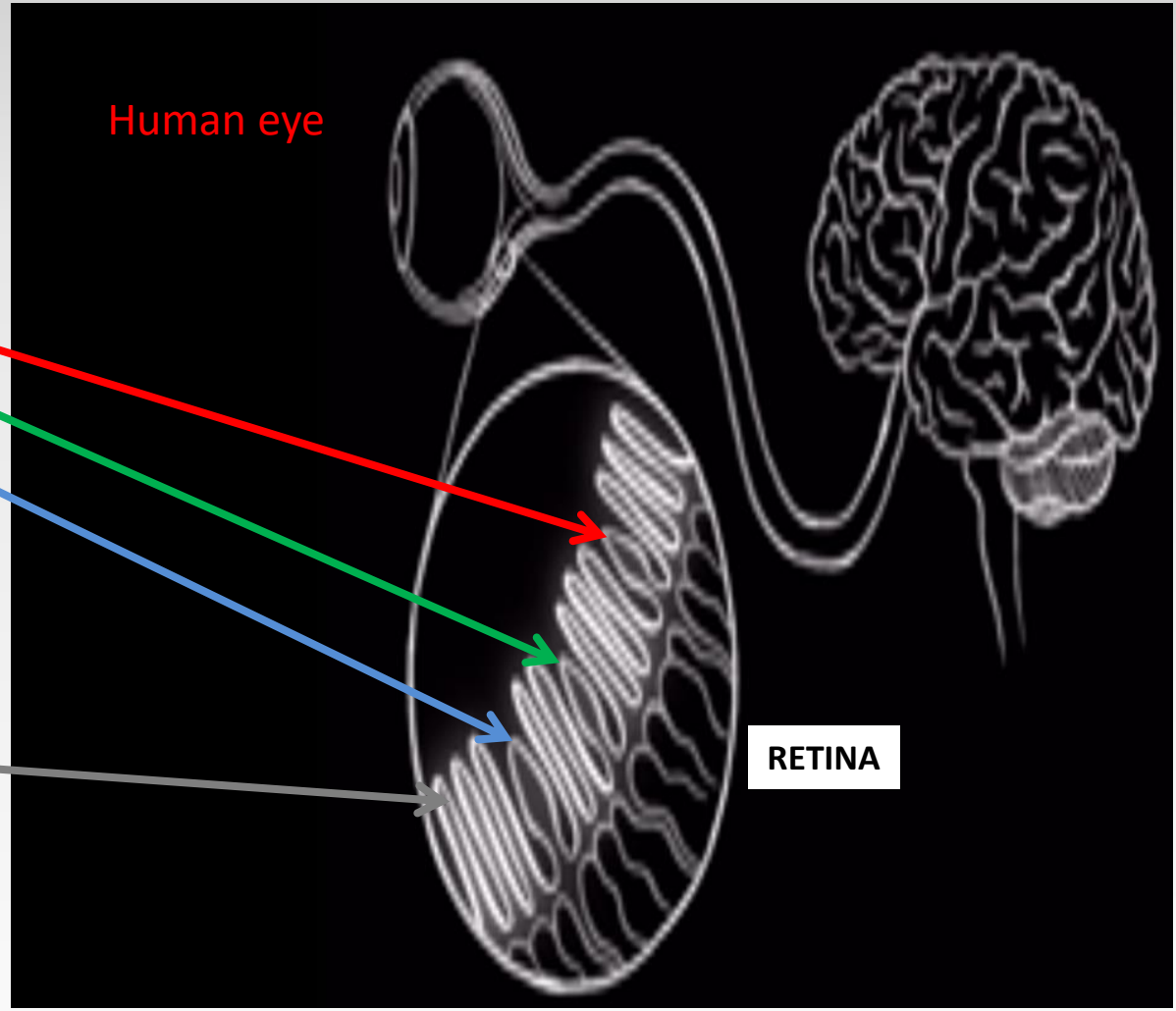
Cons: 6 to 7million

Sensitive to 3 different part of the visible spectrum / 3 types of cones

Red : max sensitivity at 575 nm

Green : max sensitivity at 535 nm

Blue : max sensitivity at 445 nm



Rods: 90 million

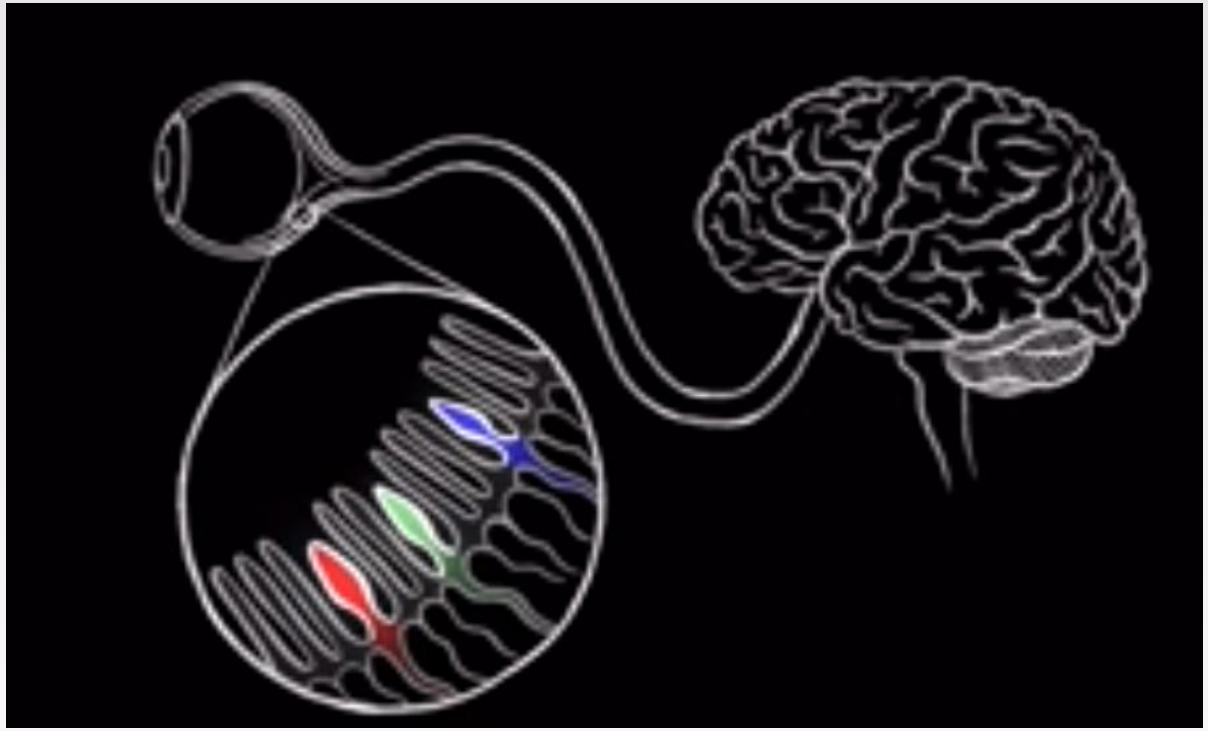
*Sensitive to dim light (dark)

*Responds to all color wavelength but don't make colour vision

RGB model

The **RGB color model** is an additive color model in which **Red**, **Green**, and **Blue** light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, **Red**, **Green**, and **Blue** .

wikipedia.org

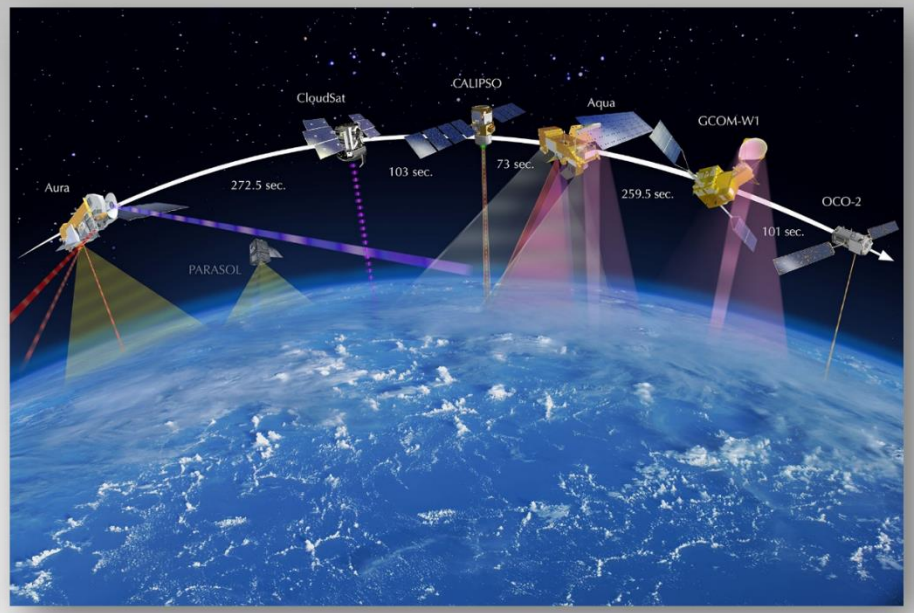


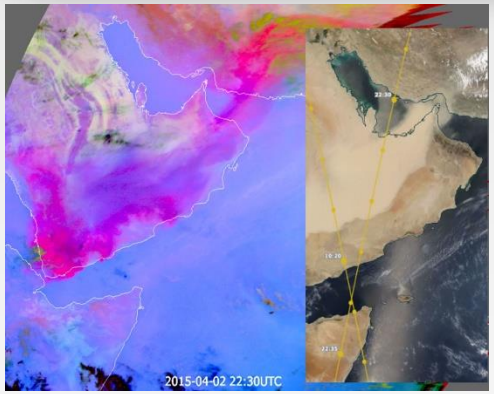
Human Eye

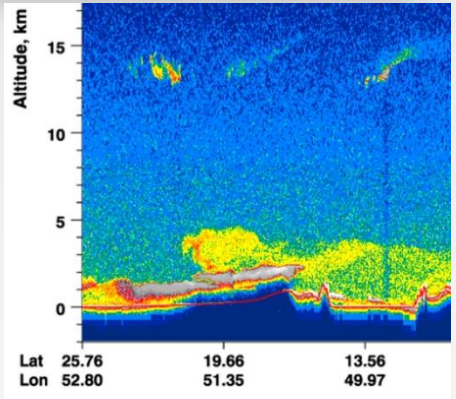
RGB

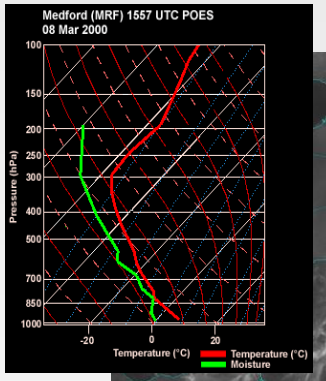

inspirationlaboratories.com

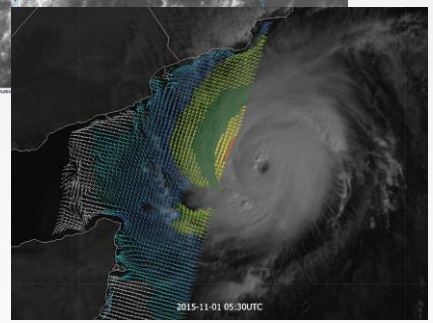
Weather Satellite Now!

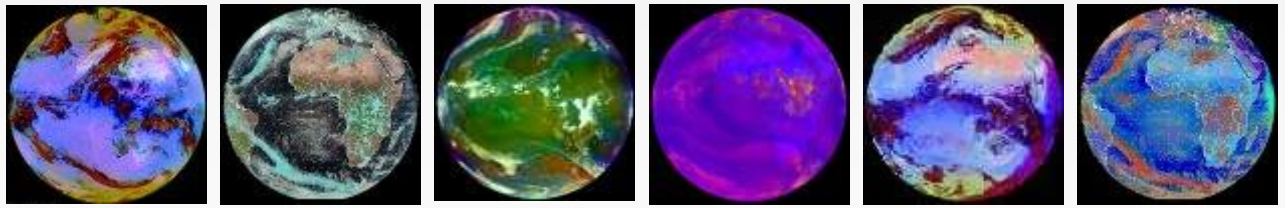












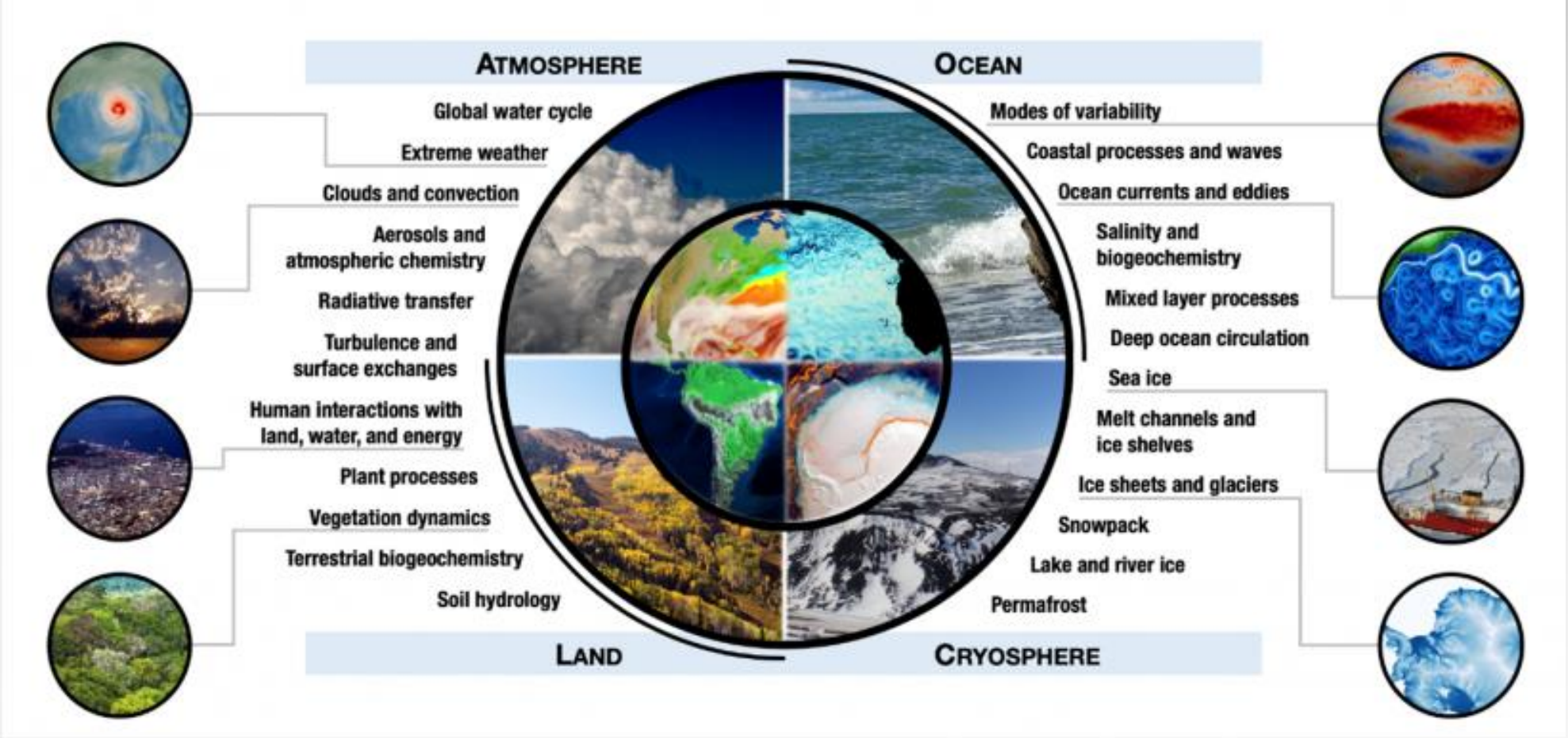
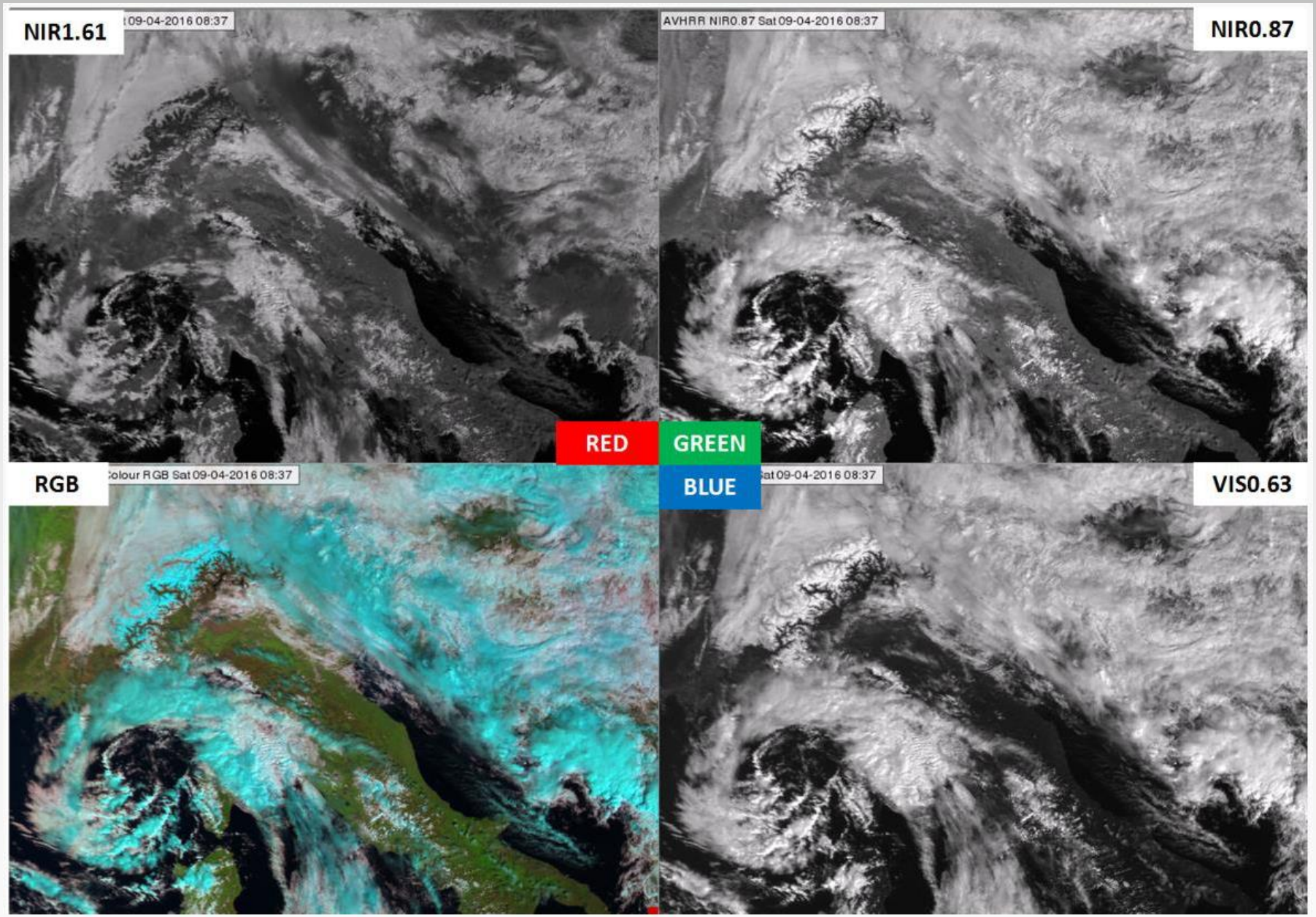


Image courtesy of Paul Ullrich, University of California, Davis


NIR1.61
09-04-2016 08:37
AVHRR NIR0.87 Sat 09-04-2016 08:37
NIR0.87
RED
GREEN
BLUE
RGB
Colour RGB Sat 09-04-2016 08:37
Sat 09-04-2016 08:37
VIS0.63

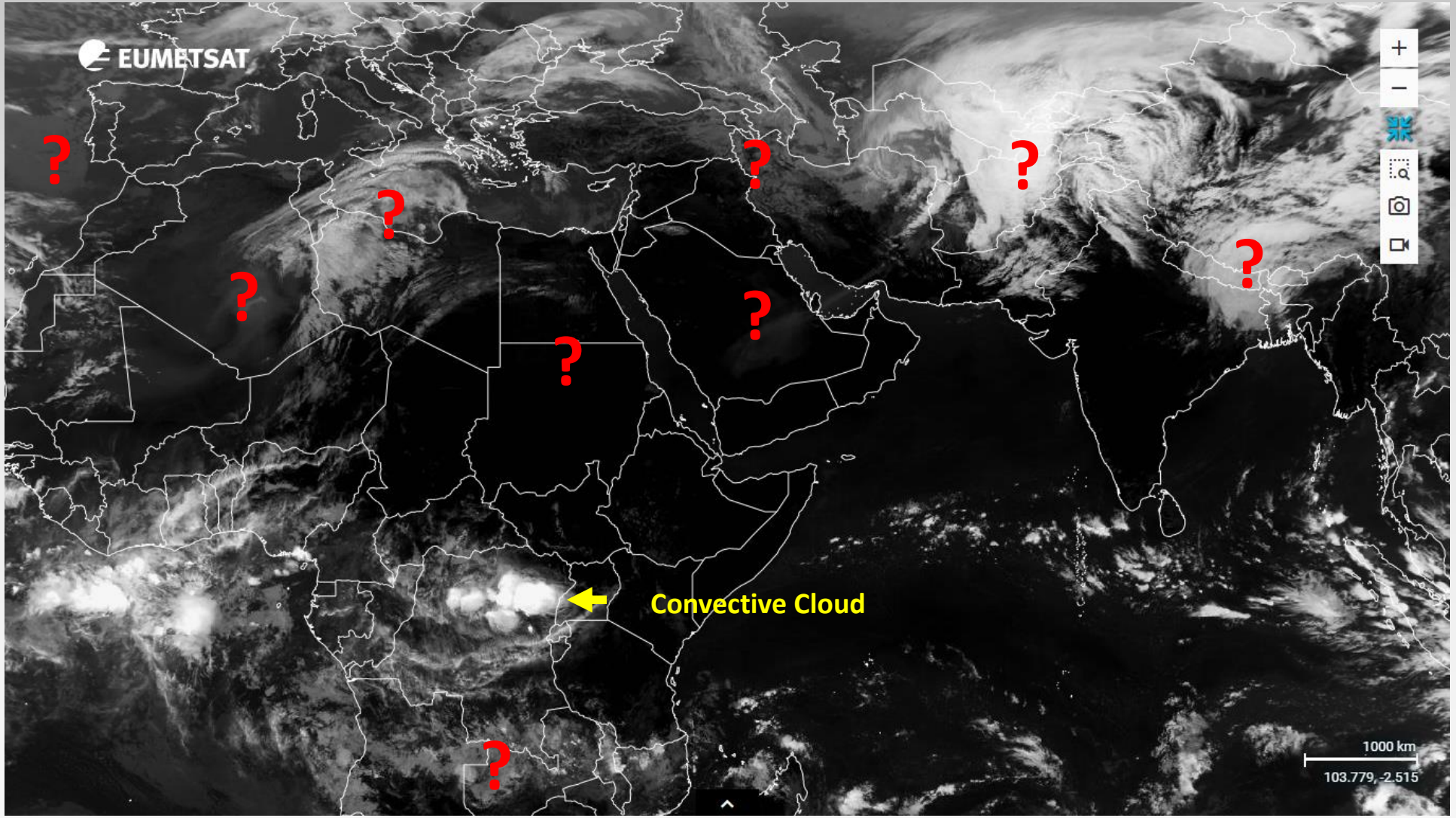
Why RGB?

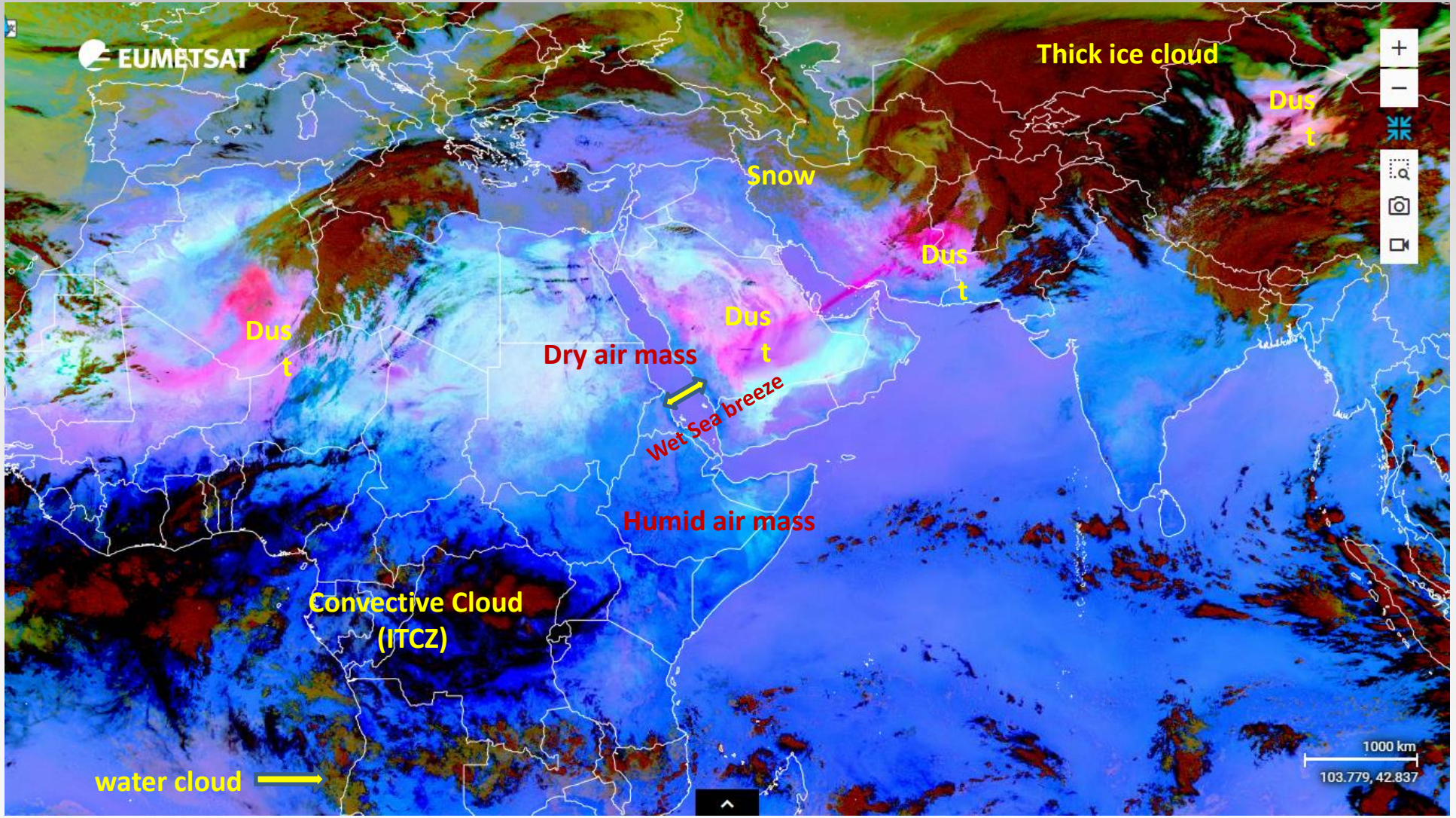
The amount of imager data from the world's weather satellites is impressive and will increase dramatically when new geostationary and polar-orbiting satellites come online. But it poses a challenge: figuring out how to extract, distill, and package the data into products that are easy for forecasters to interpret and use.

"Red, Green, Blue" or RGB processing offers a simple yet powerful solution. It consolidates the information from different spectral channels into single products that provide more information than any one image can provide.
RGB products have long been used in research, education, and applied fields such as land management.

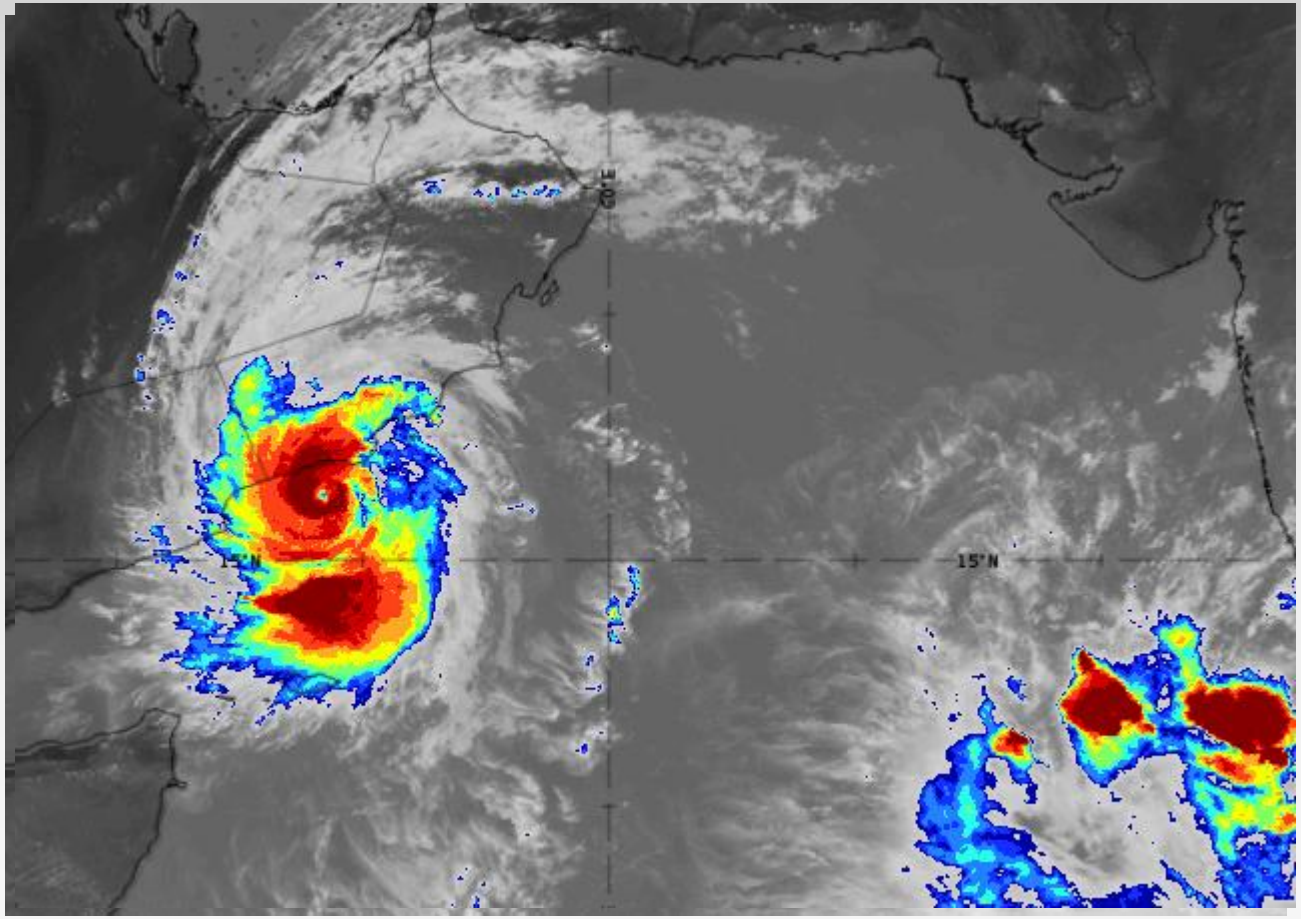
For example, Landsat, an Earth resource satellite, has been observing land cover, vegetation, and water resources to help municipal planners and developers since the early 1970s. As the availability of RGB products continues to increase for a variety of environmental applications, including meteorological analysis, forecasters need information on what these products provide and how to integrate them into their operations.

COMET® Program https://www.meted.ucar.edu/satmet/multispectral_topics/rgb/print.php


EUMETSAT
?
?
?
?
?
?
?
?
?
Convective Cloud
1000 km
103.779, -2.515


EUMETSAT
Thick ice cloud
Dus
t
Snow
Dus
t
Dus
t
Dus
t
Dry air mass
Wet Sea breeze
Humid air mass
Convective Cloud
(ITCZ)
water cloud
1000 km
103.779, 42.837

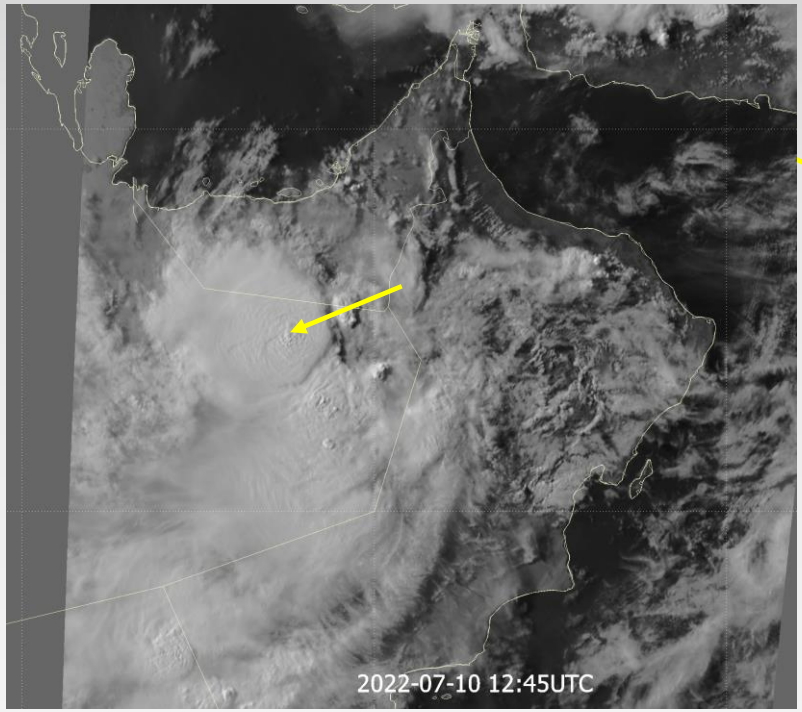
Color enhancement of single channels are similar to grayscale images but the information is displayed using a set of assigned colors, rather than gray shades, to highlight specific features of interest, such as the colder cloud-top temperatures associated with deep convection; products are made from 256 colors

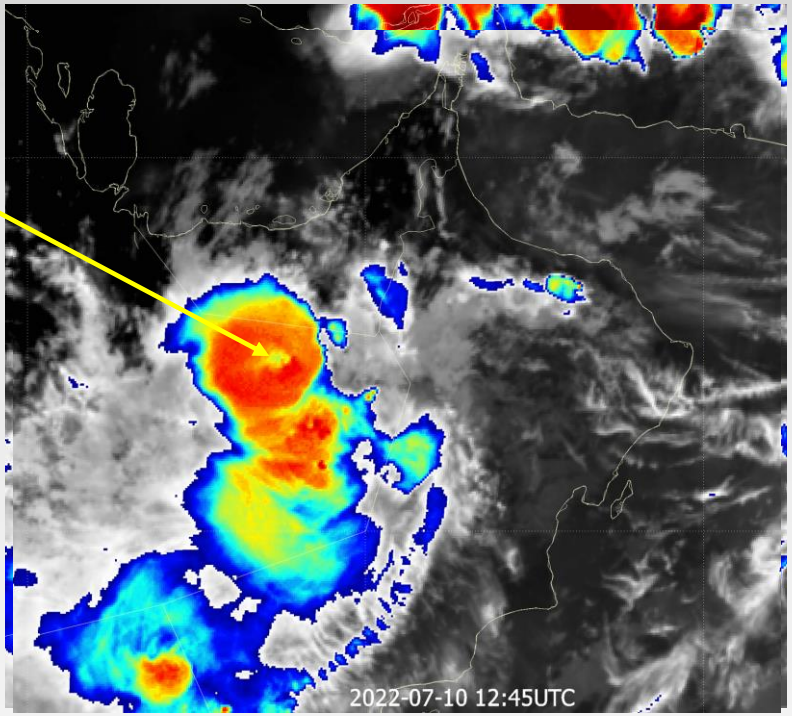


IR and Visible images

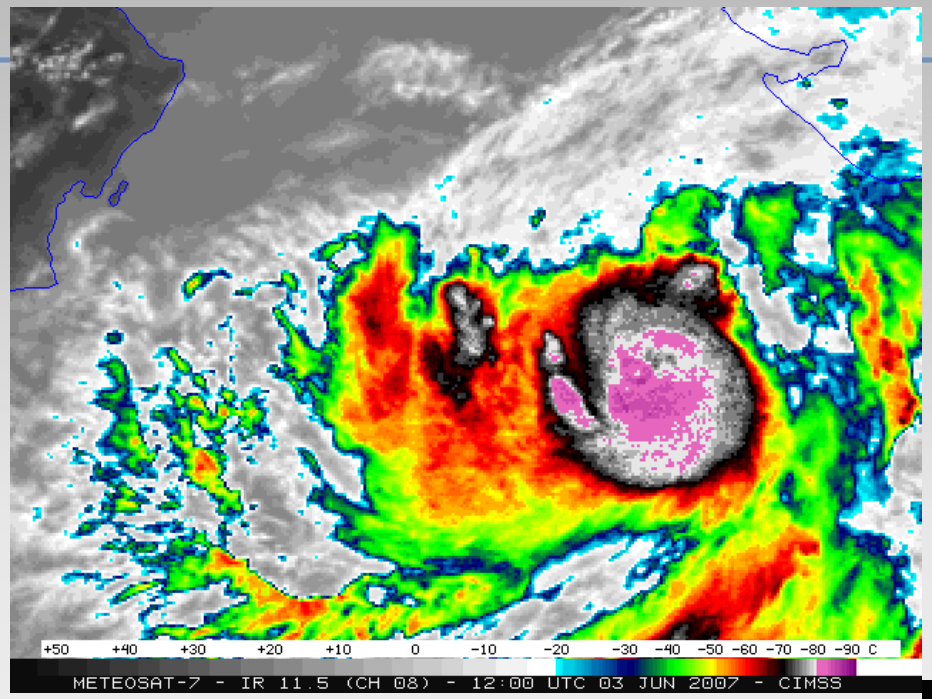
Feature Identification

Empty **Quarter** Storms 10 July 2022



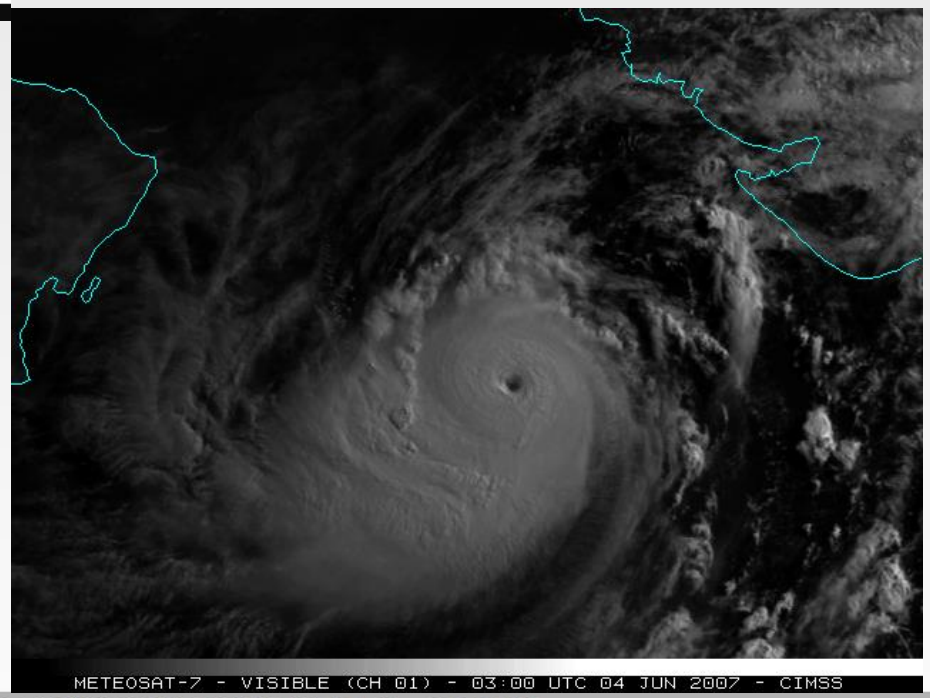


Tropical Cyclone Gonu

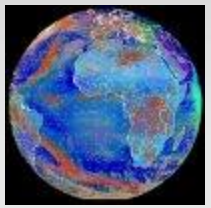


Colour Enhanced IR Image Animation

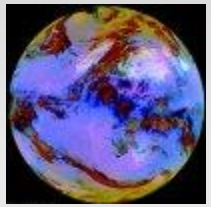
Visible Channel Animation



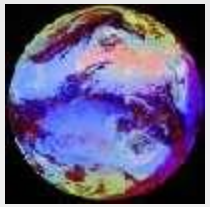
Composite Image (RGB)



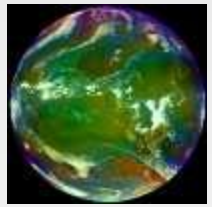
Day Microphysics RGB



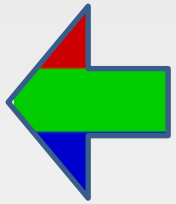
Dust RGB

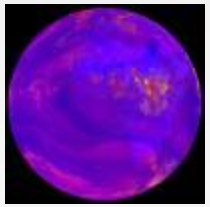


Fog / Low Clouds RGB



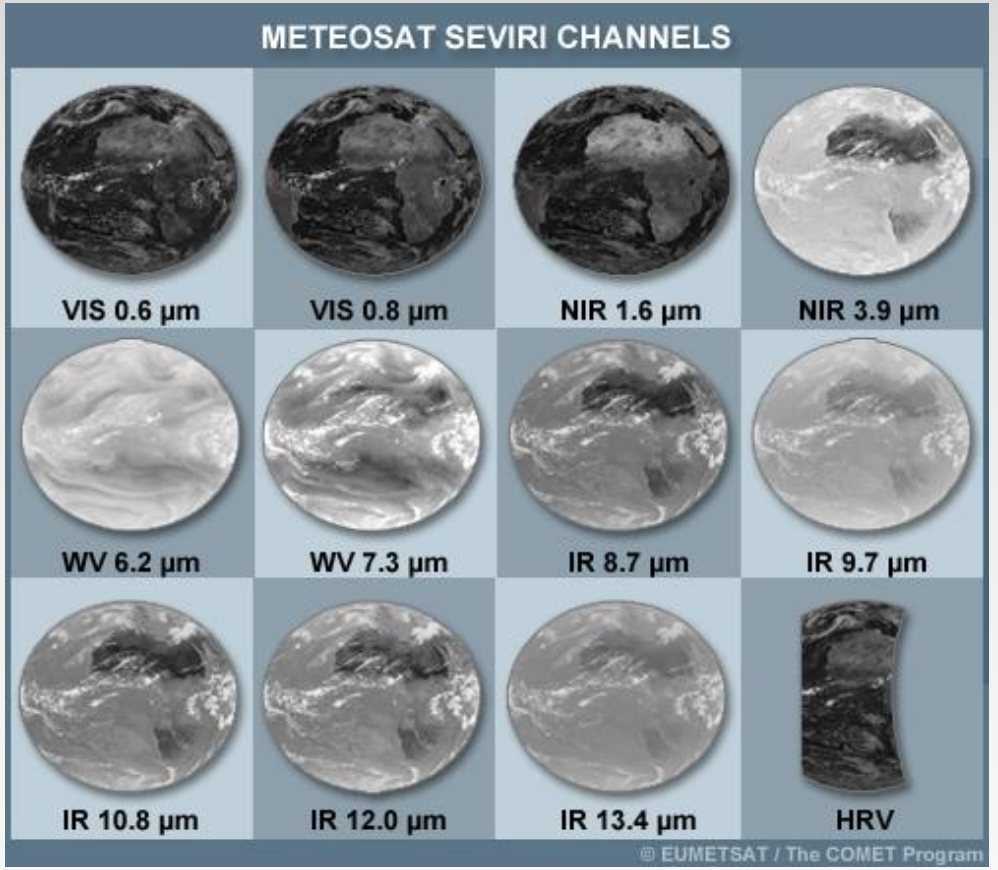
Airmass RGB





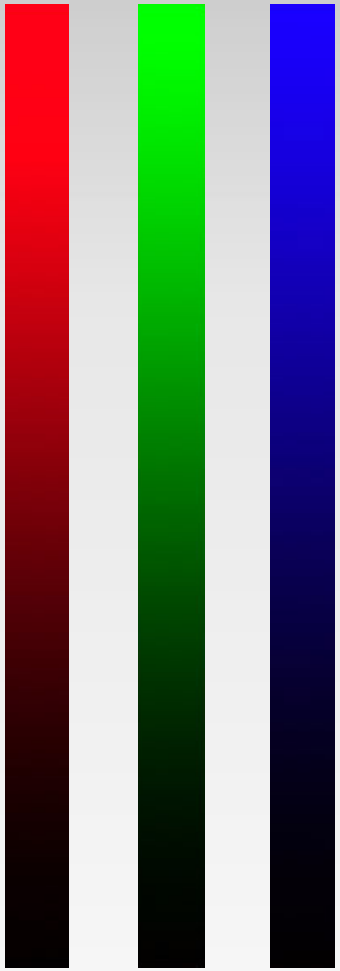
Convection RGB

Natural Color RGB



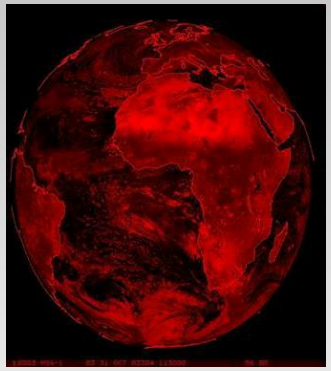
Natural Color RGB

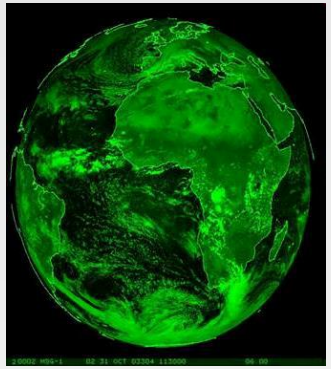
255

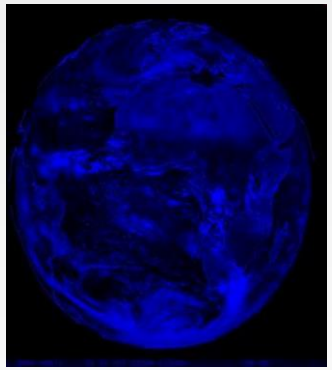


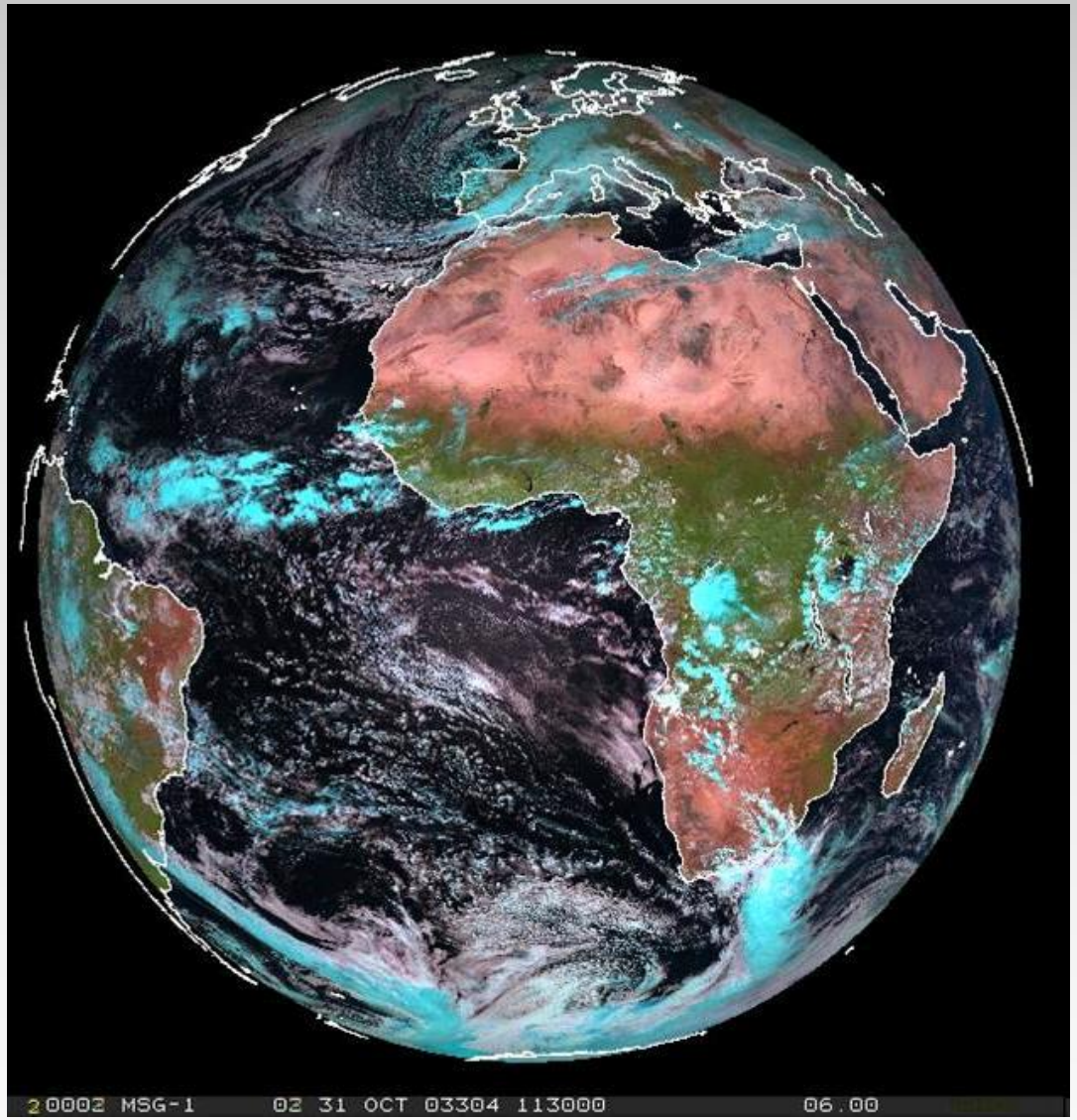
0

Red=NIR 1.6 µm
Green =VIS 0.8 µm
Blue=VIS 0.6 µm

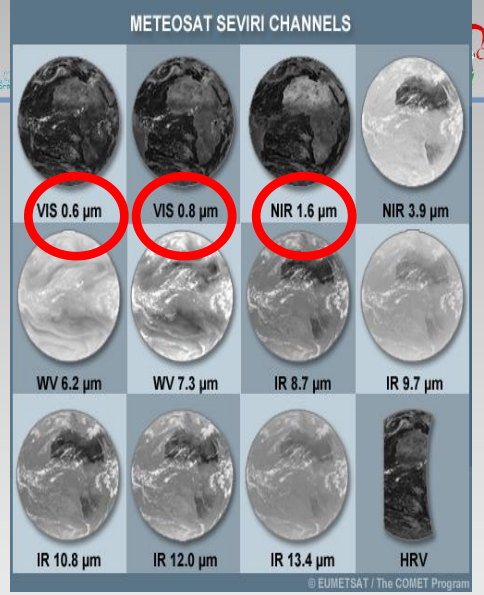






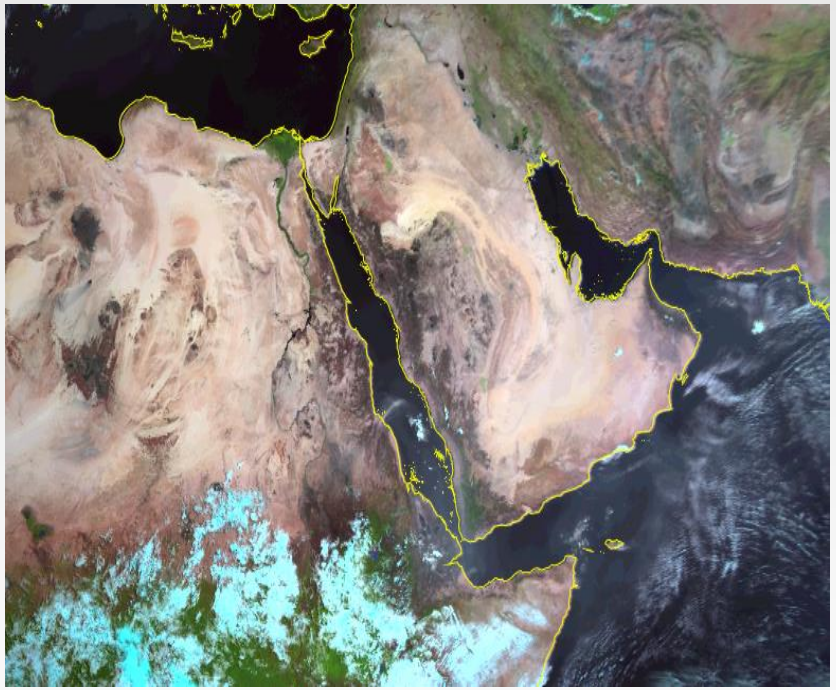


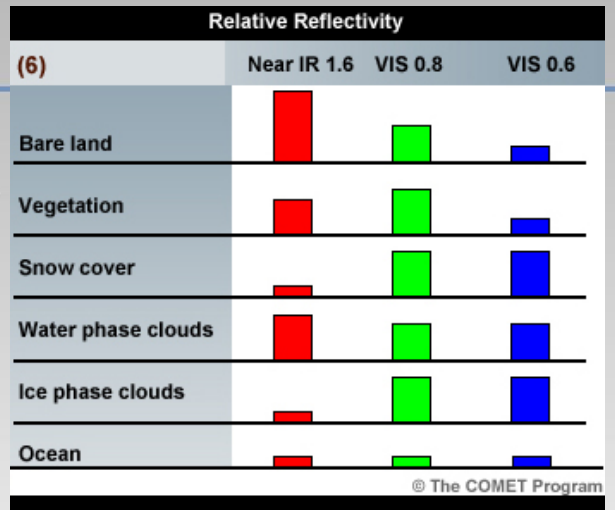
Channels Intensity

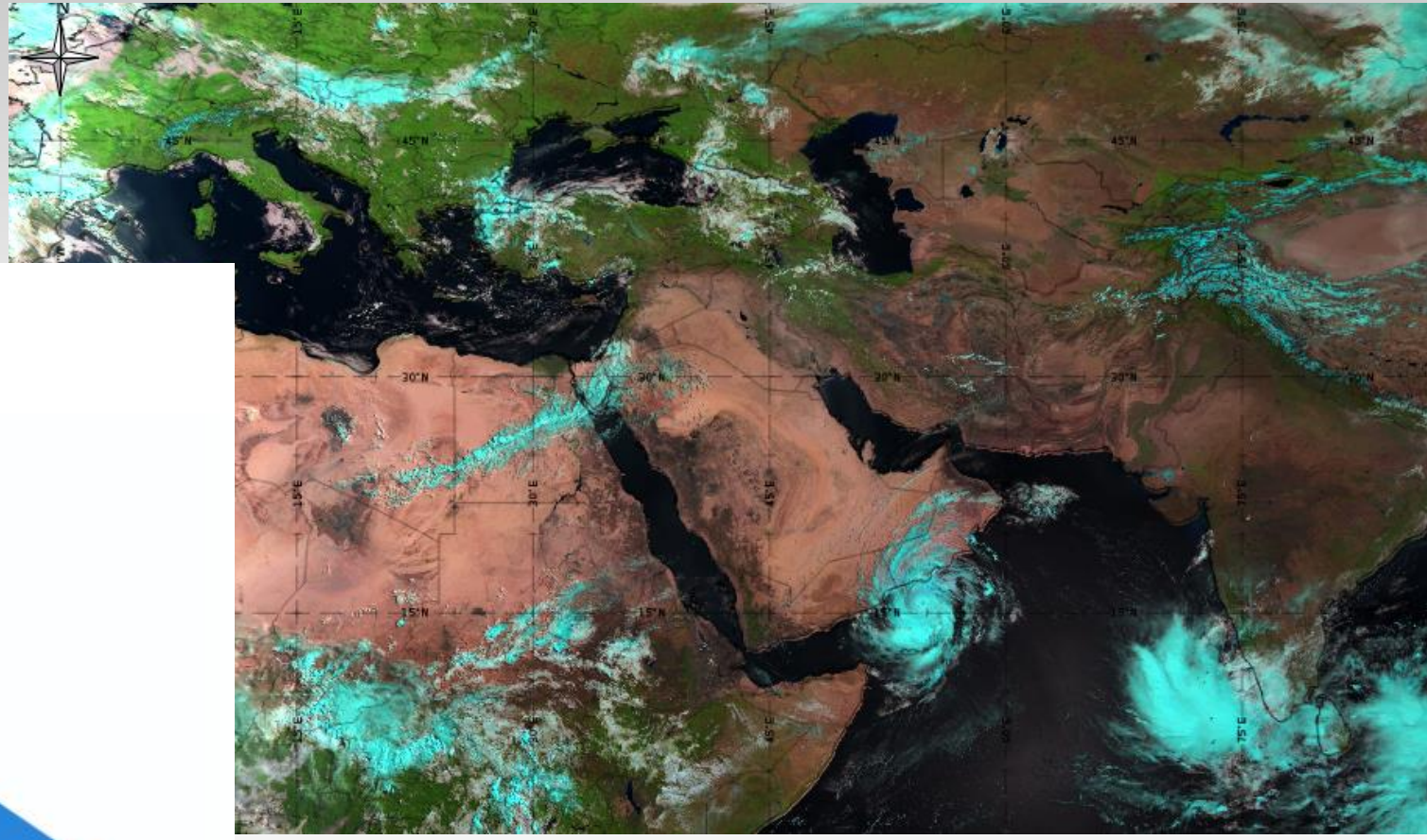


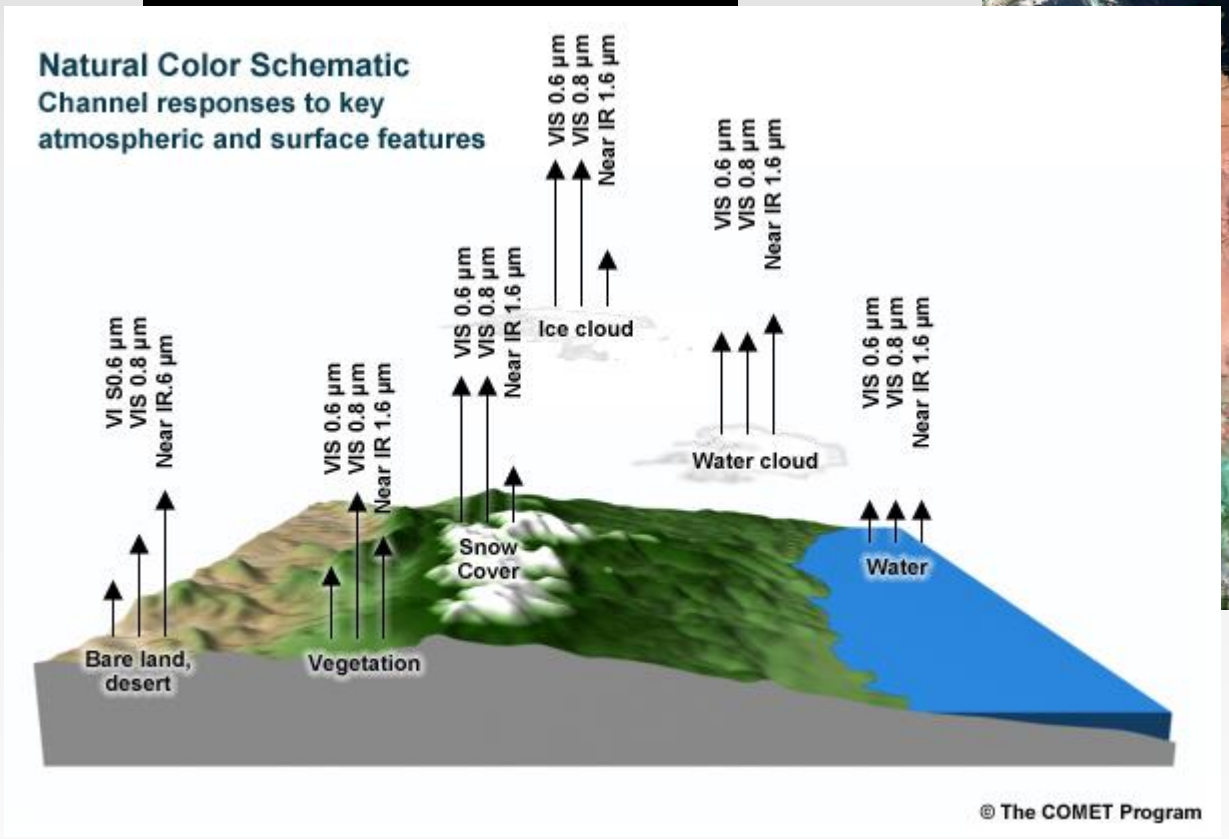
	R	G	B
	255	255	255
	255	255	0
	255	0	255
	0	255	255
	0	0	0
	143	143	143
	255	0	0
	0	255	0
	0	0	255

Natural Color RGB




Relative Reflectivity
(6)
Near IR 1.6
VIS 0.8
VIS 0.6
Bare land
Vegetation
Snow cover
Water phase clouds
Ice phase clouds
Ocean
© The COMET Program

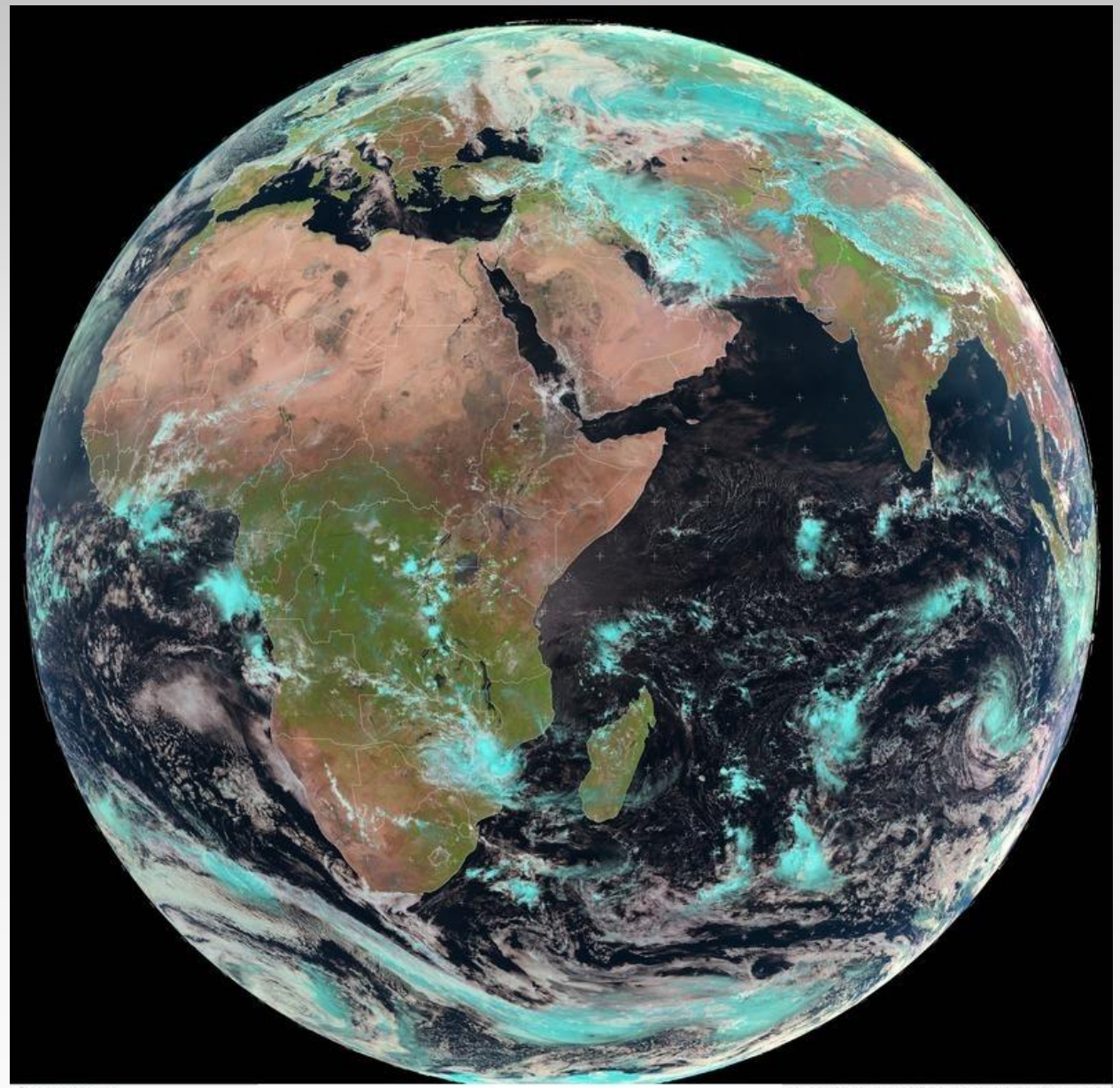



Natural Color Schematic
Channel responses to key atmospheric and surface features
VIS 0.6 µm
VIS 0.8 µm
Near IR 1.6 µm
Ice cloud
Water cloud
Snow Cover
Water
Bare land, desert
Vegetation
© The COMET Program

dtables.com/web/color/RGB_

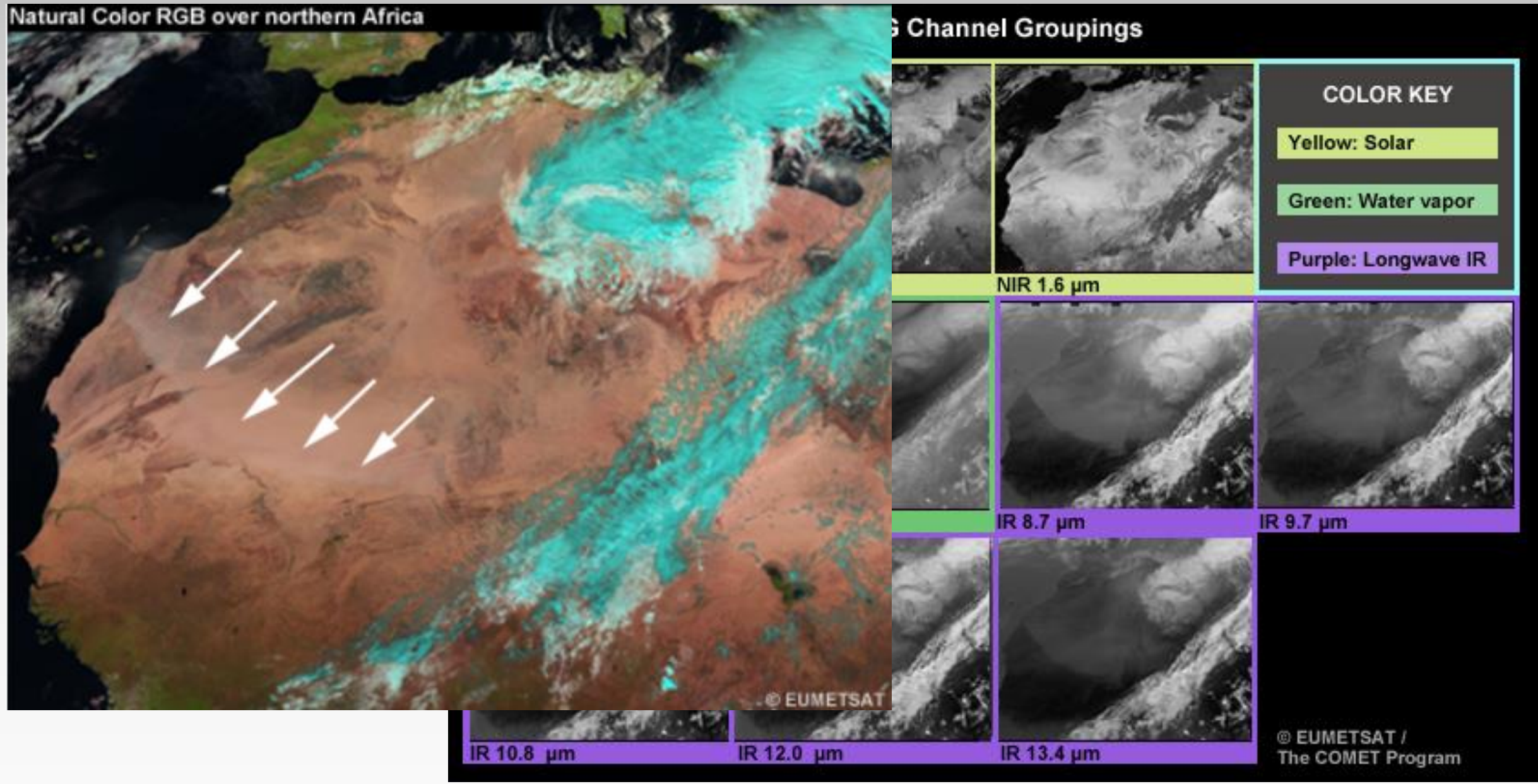
Each pixel has:

256*256*256=16777216 possible colors.

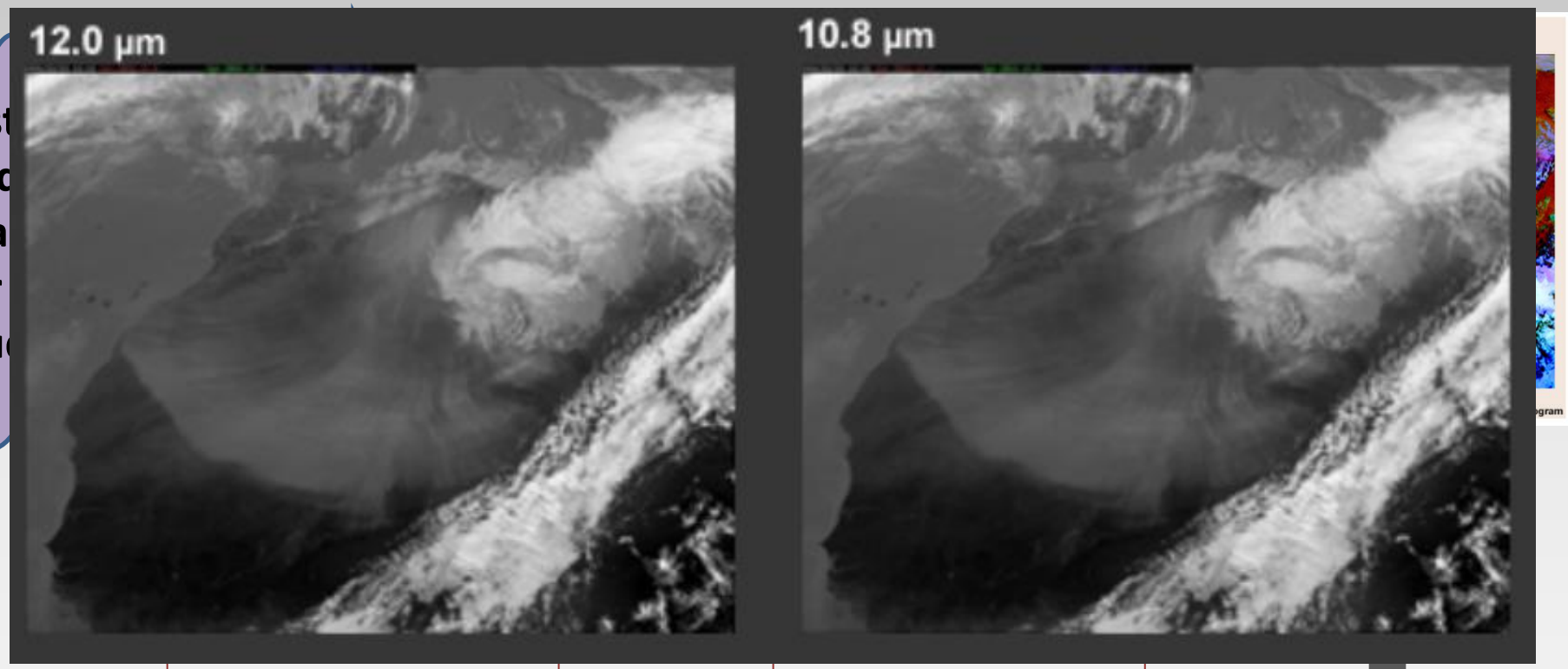


RGBColourTool.zip

Dust RGB (complex RGB)!


Natural Color RGB over northern Africa
© EUMETSAT
Channel Groupings
COLOR KEY
Yellow: Solar
Green: Water vapor
Purple: Longwave IR
NIR 1.6 µm
IR 8.7 µm
IR 9.7 µm
IR 10.8 µm
IR 12.0 µm
IR 13.4 µm
© EUMETSAT /
The COMET Program

Dust
Land
Sea
Air
Clou

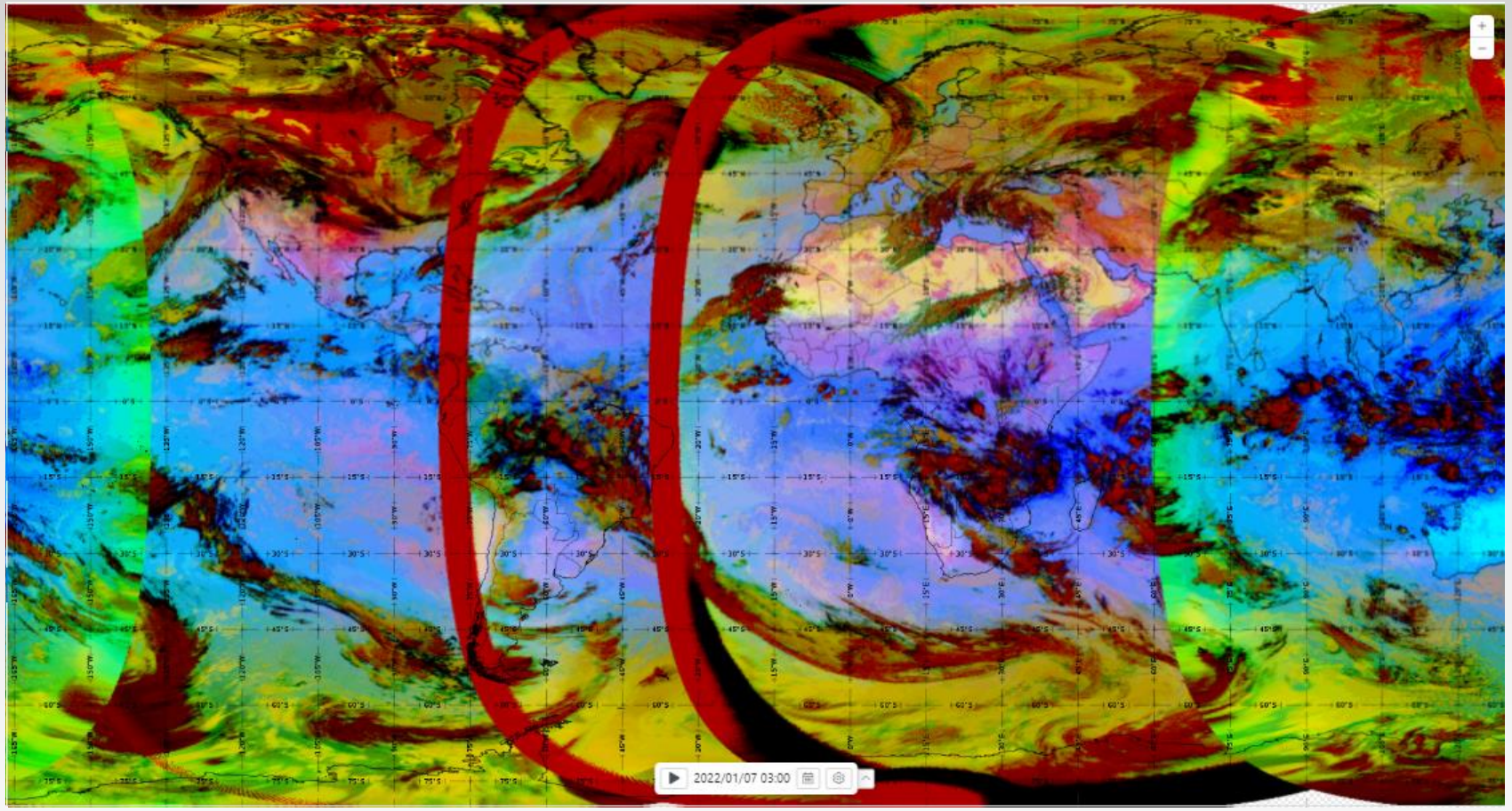


Many other atmospheric features and processes

+

-Hight
-Speed & Direction
-Dispersion
-Settling of Dust
,etc..

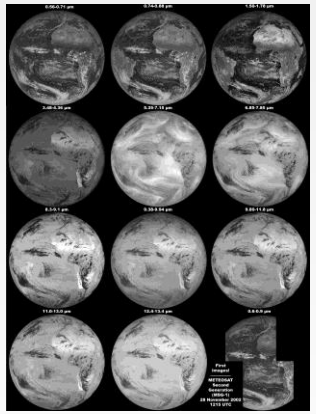
Covering the Whole Earth



THANKS TO EUMETSAT!!

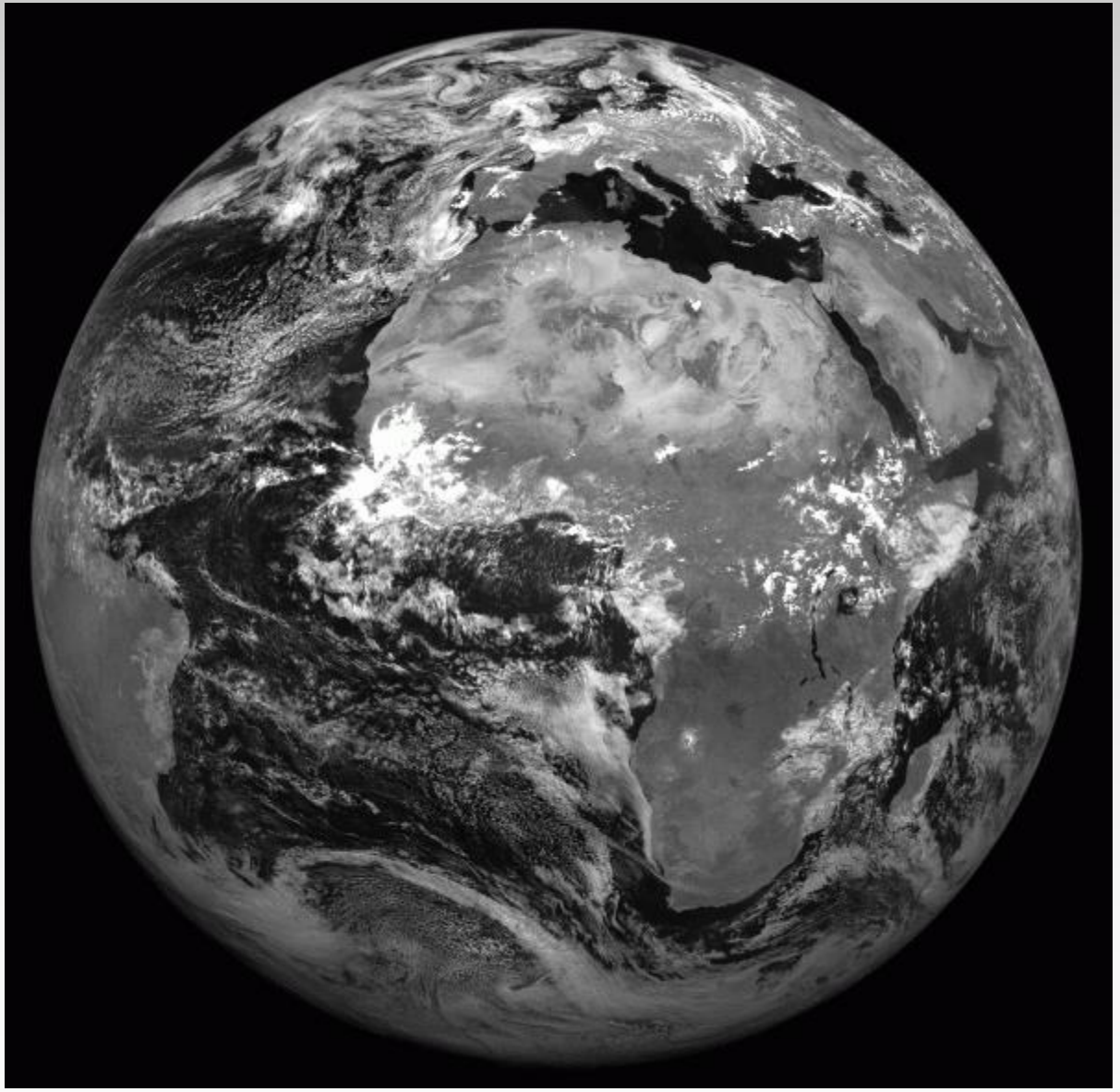
Meteosat-8, one of EUMETSAT's geostationary meteorological satellites, has just completed an 80-day journey from 3.5 degrees East to 41.5 degrees East,

MET 7
3 Ch

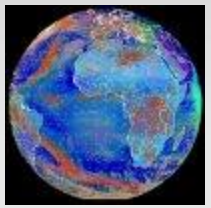


MET 8
12 Ch

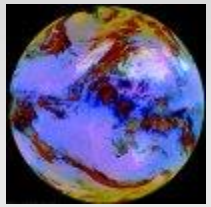
MET 9
12 Ch



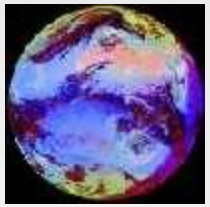
Composite Image (RGB)



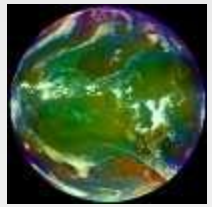
Day Microphysics RGB



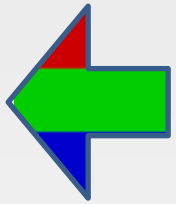
Dust RGB

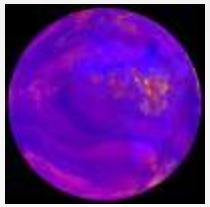


Fog / Low Clouds RGB



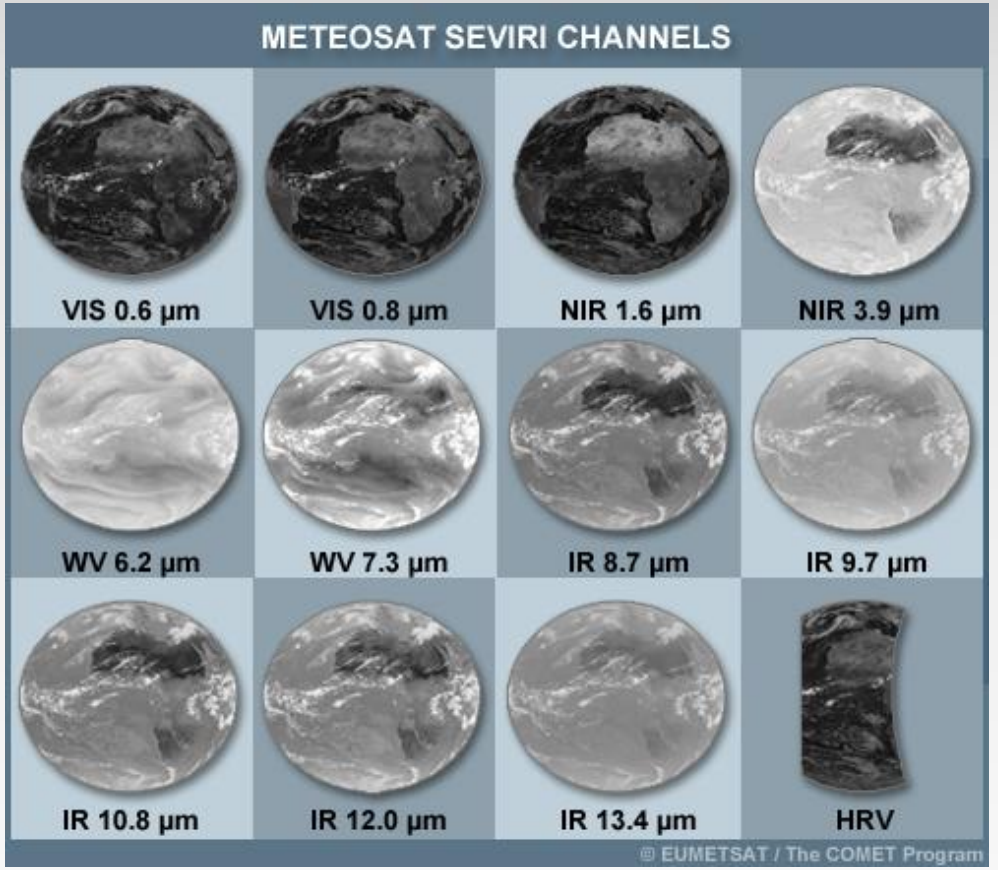
Airmass RGB





Convection RGB

Natural Color RGB



EUMeTrain

https://eumetrain.org/index.php/

NASA WORLDVIEW

https://worldview.earthdata.nasa.gov/

EUMETSAT

https://www.eumetsat.int/

RGBColourTool.zip

CALIPSO carries three instruments: a Cloud-Aerosol Lidar with Orthogonal Polarisation (CALIOP), an Imaging Infrared Radiometer (IIR), and a Wide Field Camera (WFC). CALIOP uses a two-wavelength laser transmitter to obtain vertical profiles of clouds and aerosols from the detected backscatter. IIR provides context to nighttime CALIOP observations and acquires the size of particles within semi-transparent clouds, while WFC provides context for daytime CALIOP observations.

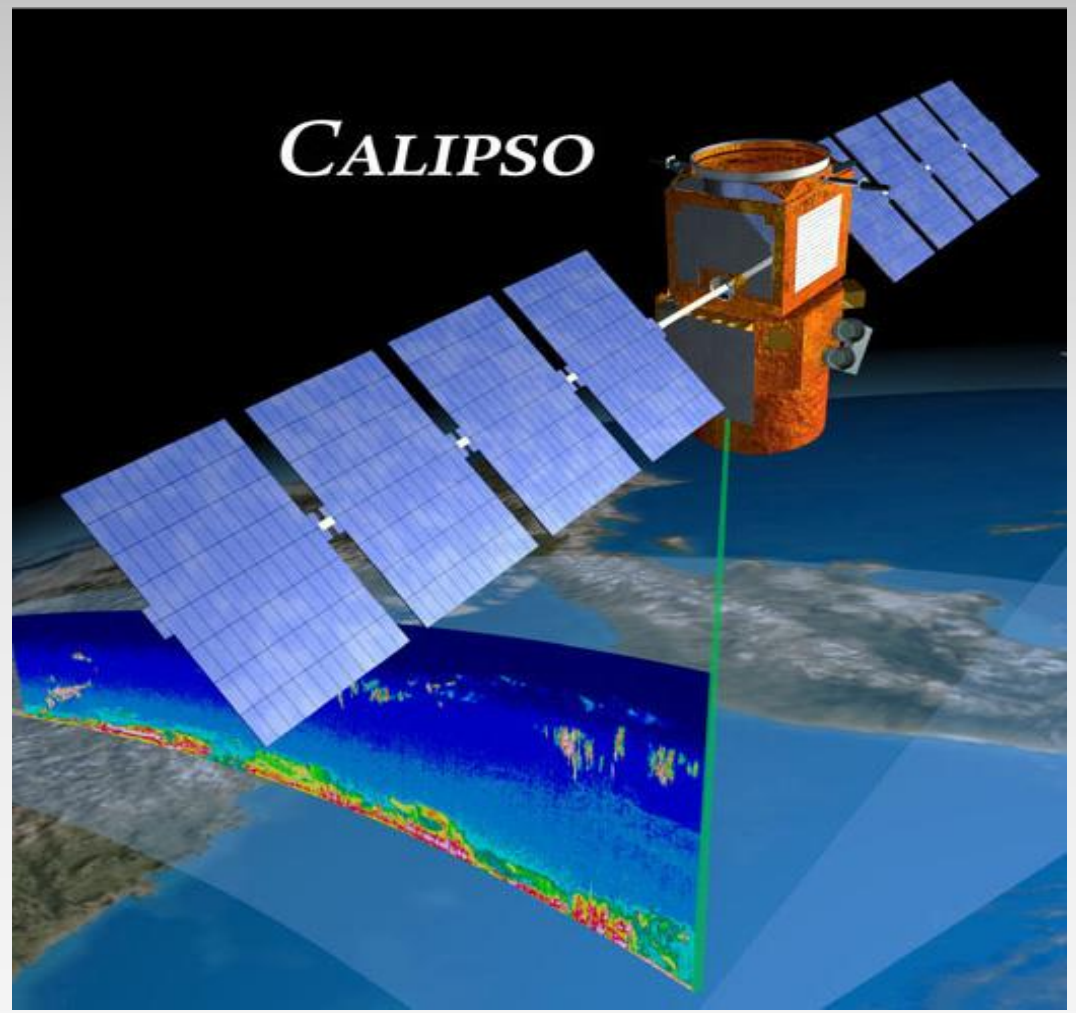
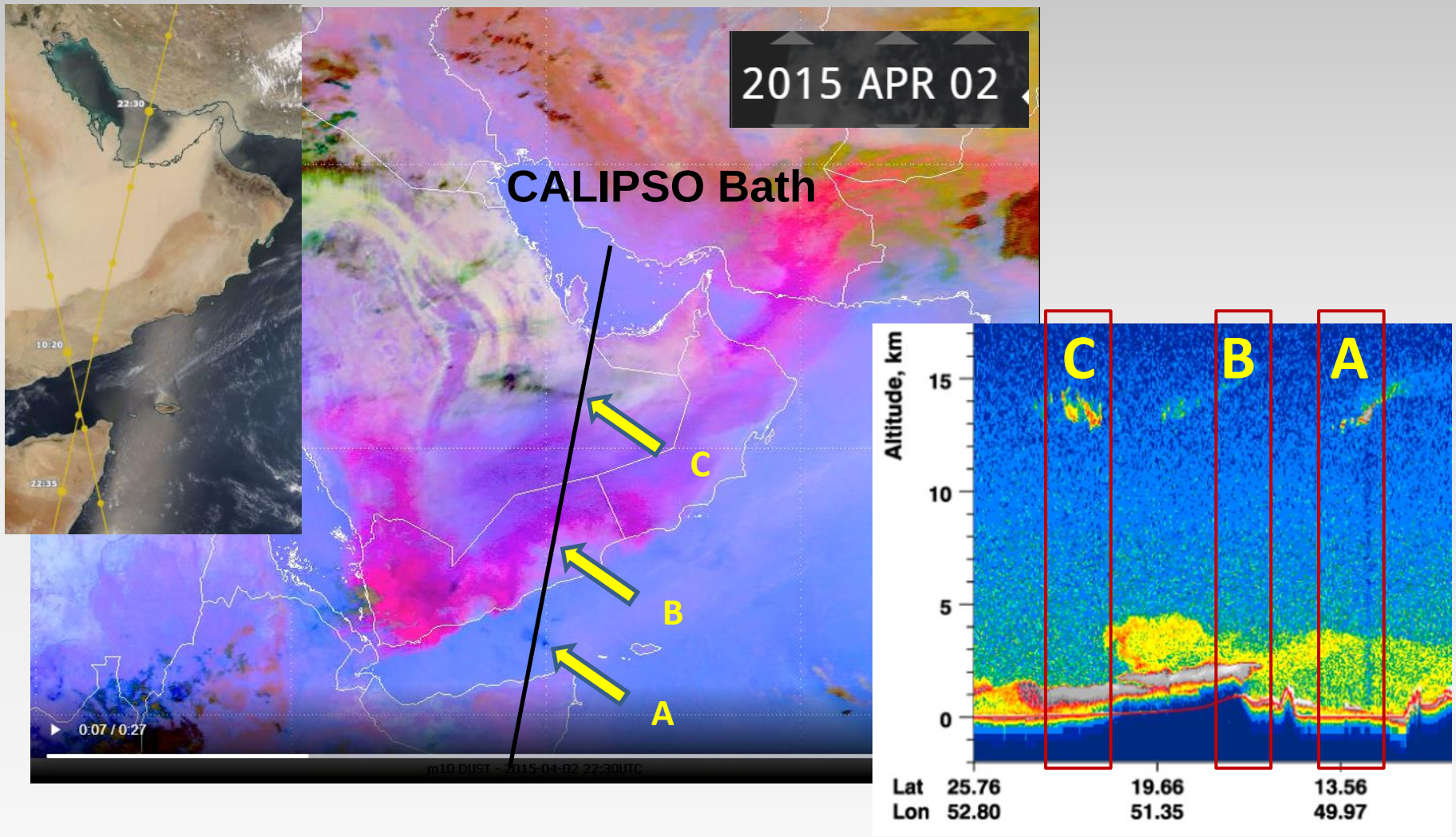
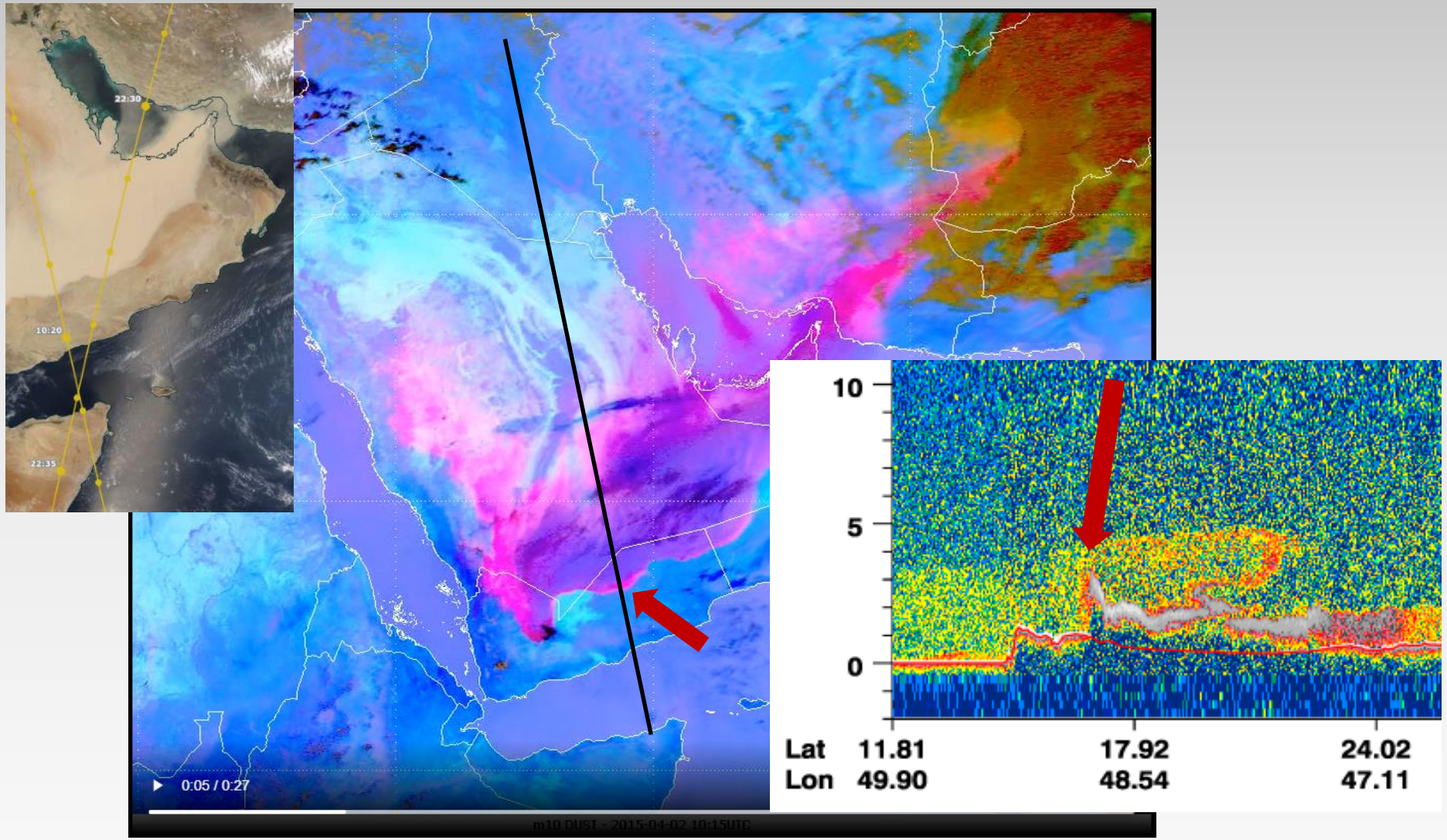
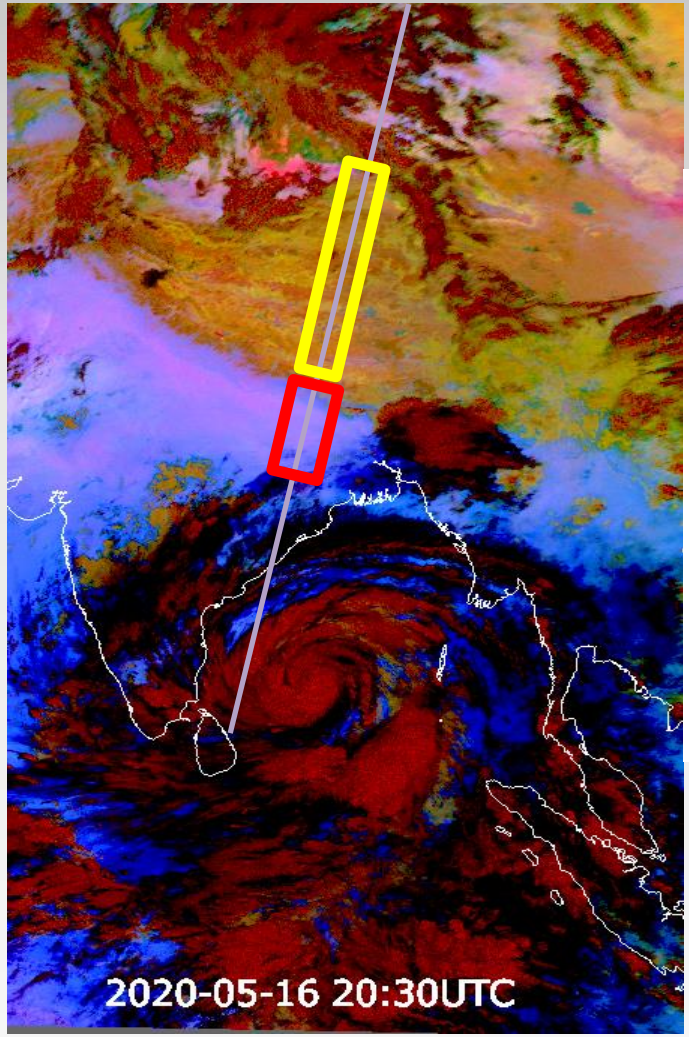
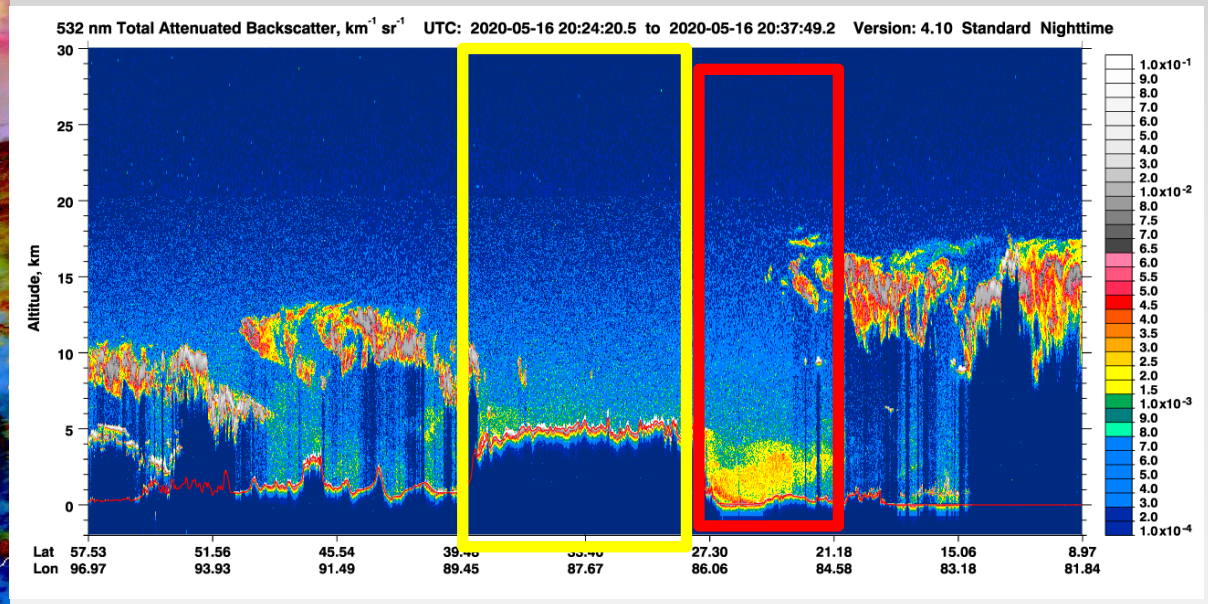


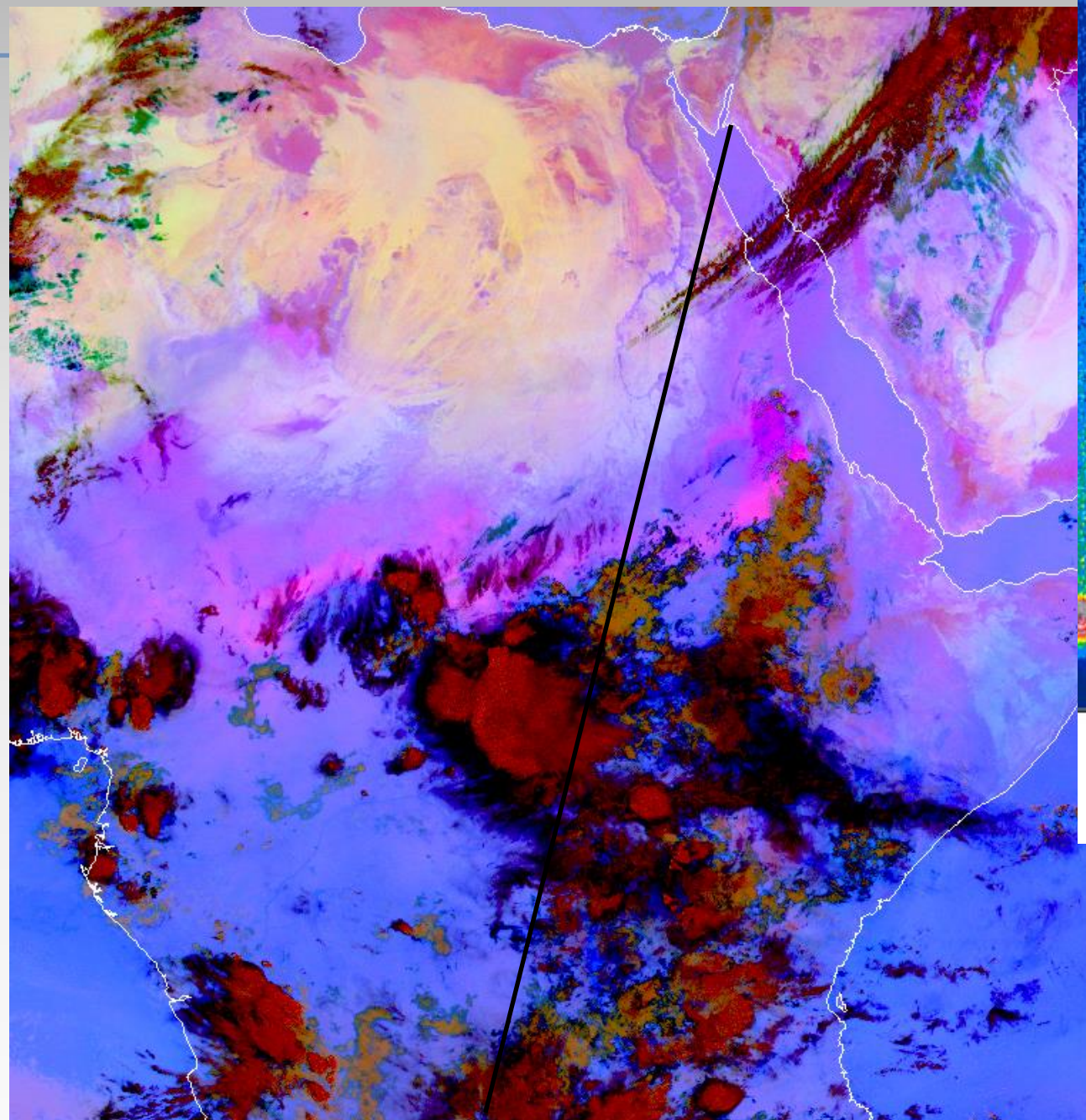
Image above: The CALIPSO spacecraft uses an innovative lidar and imaging system to reveal the secrets of clouds and aerosols. NASA

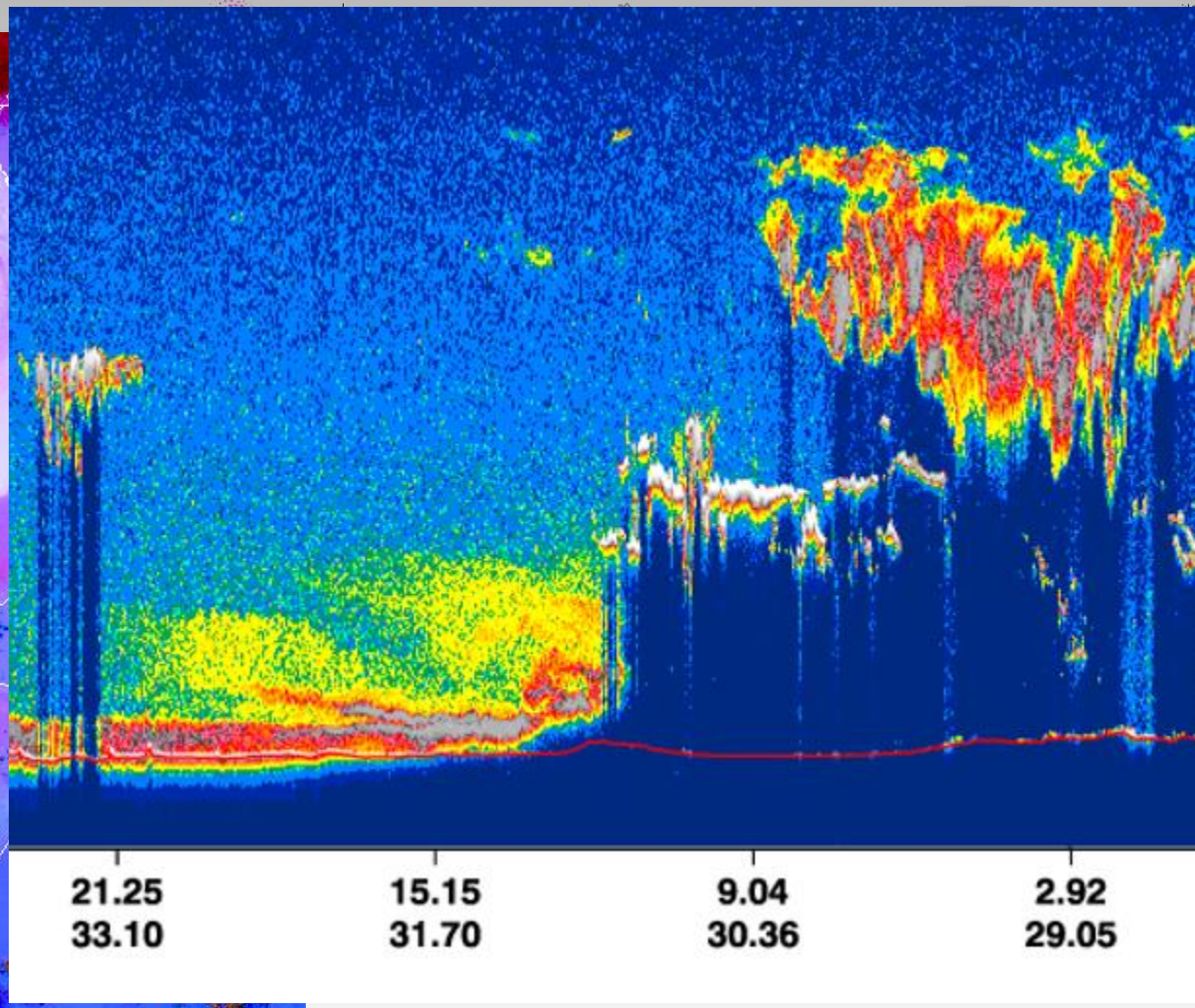

2015 APR 02
CALIPSO Bath
22:30
10:20
22:35
C
B
A
0:07 / 0:27
m10 DUST - 2015-04-02 22:30UTC
Altitude, km
15
10
5
0
C
B
A
Lat 25.76 19.66 13.56
Lon 52.80 51.35 49.97


22:30
10:20
22:35
0:05 / 0:27
10
5
0
Lat 11.81 17.92 24.02
Lon 49.90 48.54 47.11

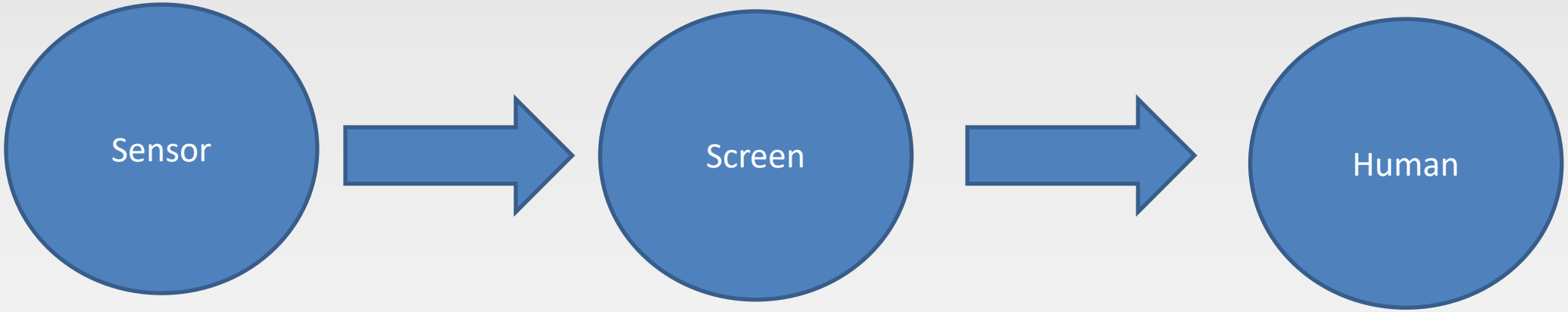

2020-05-16 20:30UTC

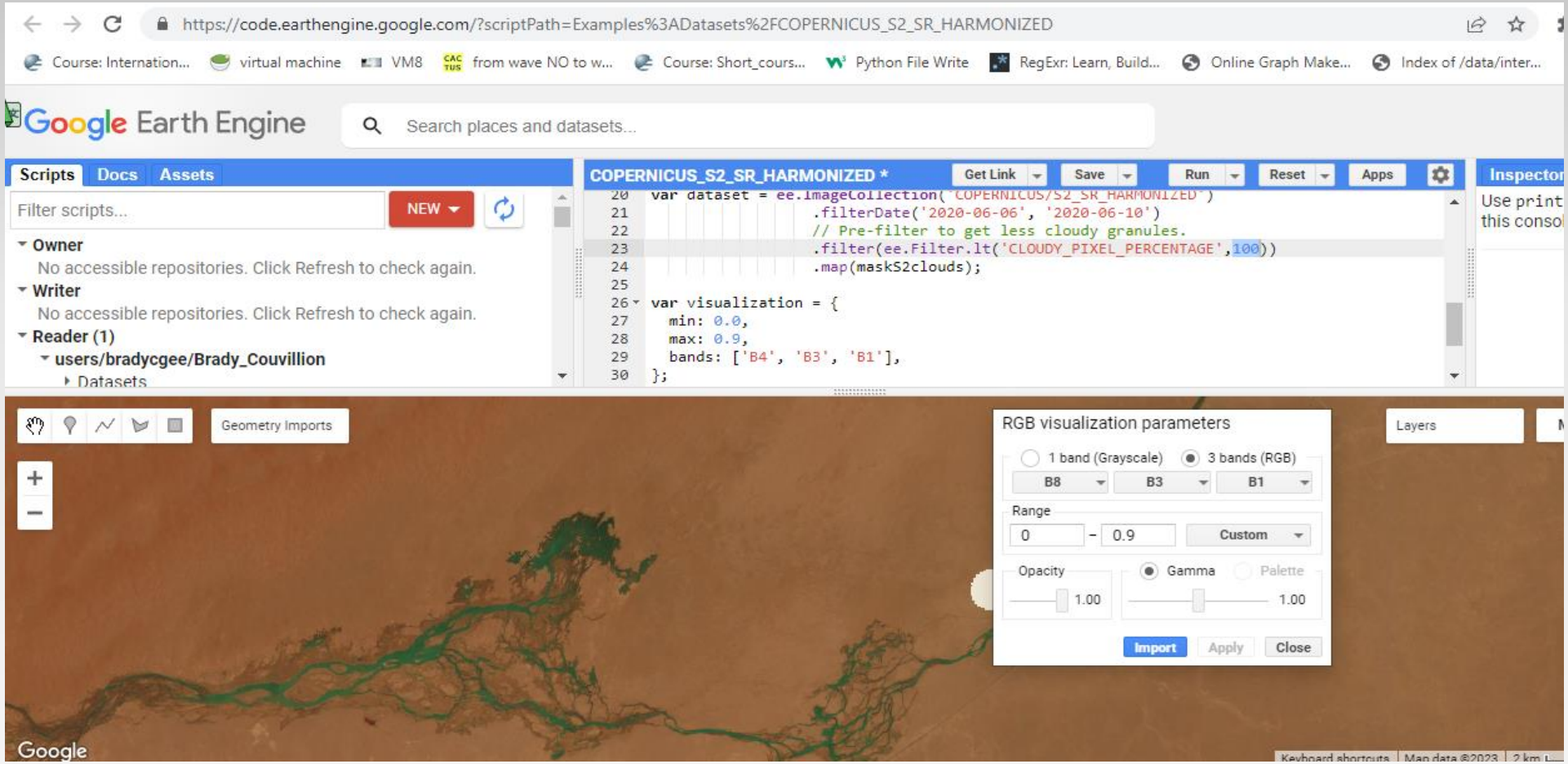

532 nm Total Attenuated Backscatter, km-1 sr-1 UTC: 2020-05-16 20:24:20.5 to 2020-05-16 20:37:49.2 Version: 4.10 Standard Nighttime
Altitude, km
30
25
20
15
10
5
0
Lat 57.53 51.56 45.54 27.30 21.18 15.06 8.97
Lon 96.97 93.93 91.49 89.45 87.67 86.06 84.58 83.18 81.84
1.0x10-1
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10-2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0x10-3
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10-4

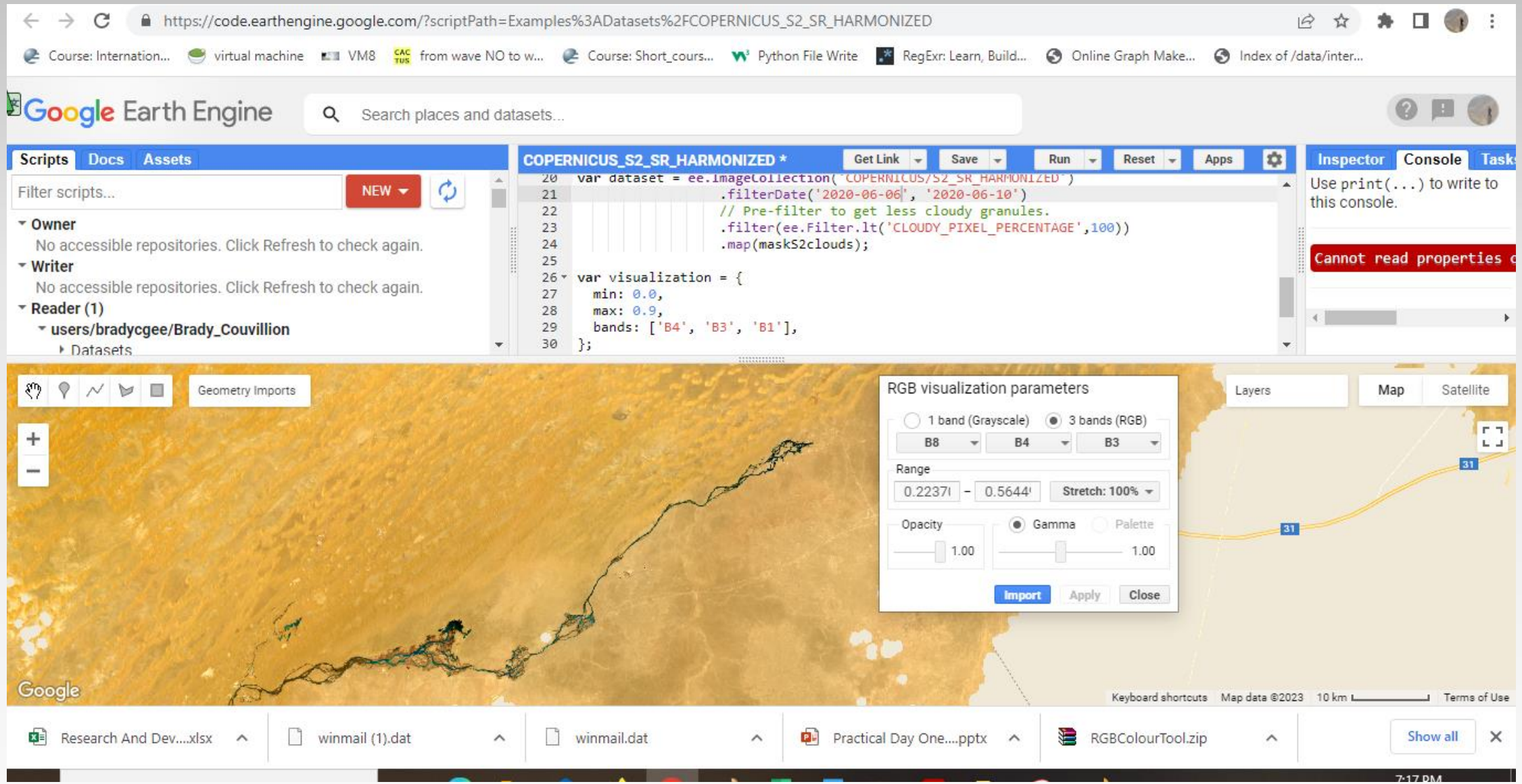

2018-03-29 23:45UTC


21.25
33.10
15.15
31.70
9.04
30.36
2.92
29.05

How Real is the Satellite Image (How real we can see it)




https://code.earthengine.google.com/?scriptPath=Examples%3ADatasets%2FCOPERNICUS_S2_SR_HARMONIZED
Google Earth Engine
Search places and datasets...
Scripts
Docs
Assets
Filter scripts...
NEW
Owner
No accessible repositories. Click Refresh to check again.
Writer
No accessible repositories. Click Refresh to check again.
Reader (1)
users/bradycgee/Brady_Couvillion
Datasets
COPERNICUS_S2_SR_HARMONIZED *
Get Link
Save
Run
Reset
Apps
Inspector
Use print
this conso
var dataset = ee.ImageCollection('COPERNICUS/S2_SR_HARMONIZED')
.filterDate('2020-06-06', '2020-06-10')
// Pre-filter to get less cloudy granules.
.filter(ee.Filter.lt('CLOUDY_PIXEL_PERCENTAGE',100))
.map(maskS2clouds);
var visualization = {
min: 0.0,
max: 0.9,
bands: ['B4', 'B3', 'B1'],
};
Geometry Imports
RGB visualization parameters
1 band (Grayscale)
3 bands (RGB)
B8
B3
B1
Range
0
0.9
Custom
Opacity
1.00
Gamma
Palette
1.00
Import
Apply
Close
Layers
Google


https://code.earthengine.google.com/?scriptPath=Examples%3ADatasets%2FCOPERNICUS_S2_SR_HARMONIZED
Google Earth Engine
Search places and datasets...
Scripts
Docs
Assets
Filter scripts...
NEW
Owner
No accessible repositories. Click Refresh to check again.
Writer
No accessible repositories. Click Refresh to check again.
Reader (1)
users/bradycgee/Brady_Couvillion
Datasets
COPERNICUS_S2_SR_HARMONIZED *
Get Link
Save
Run
Reset
Apps
var dataset = ee.ImageCollection('COPERNICUS/S2_SR_HARMONIZED')
.filterDate('2020-06-06', '2020-06-10')
// Pre-filter to get less cloudy granules.
.filter(ee.Filter.lt('CLOUDY_PIXEL_PERCENTAGE',100))
.map(maskS2clouds);
var visualization = {
min: 0.0,
max: 0.9,
bands: ['B4', 'B3', 'B1'],
};
Inspector
Console
Use print(...) to write to this console.
Cannot read properties
Geometry Imports
RGB visualization parameters
1 band (Grayscale)
3 bands (RGB)
B8
B4
B3
Range
0.2237
0.5644
Stretch: 100%
Opacity
1.00
Gamma
Palette
1.00
Import
Apply
Close
Layers
Map
Satellite
31
Google
Keyboard shortcuts
Map data ©2023
10 km
Terms of Use
Research And Dev....xlsx
winmail (1).dat
winmail.dat
Practical Day One....pptx
RGBColourTool.zip
Show all

https://go.nasa.gov/3Yo3wp1

https://code.earthengine.google.com/?scriptPath=Examples%3ADatasets%2FCOPERNICUS_S2_SR_HARMONIZED

'2022-09-05', '2022-09-28’

'2020-06-06', '2020-06-10'

Thank You