Student exploration with infrared light

Studies with infrared cameras

Studies with satellite images

Experiments with albedo, greenhouse effect and insulation

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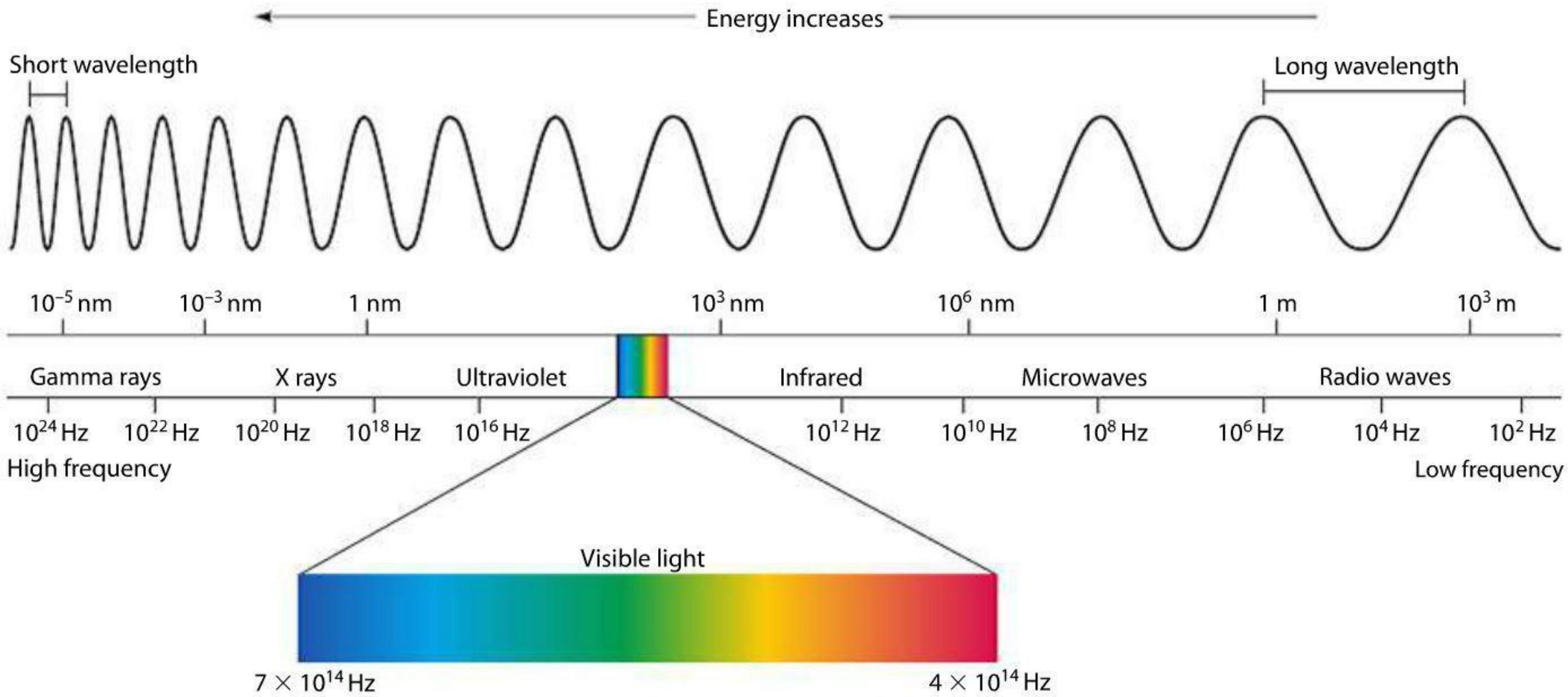

Energy increases
Short wavelength
Long wavelength
10^{-5} nm
10^{-3} nm
1 nm
10^{3} nm
10^{6} nm
1 m
10^{3} m
Gamma rays
X rays
Ultraviolet
Infrared
Microwaves
Radio waves
10^{24} Hz
10^{22} Hz
10^{20} Hz
10^{18} Hz
10^{16} Hz
10^{12} Hz
10^{10} Hz
10^{8} Hz
10^{6} Hz
10^{4} Hz
10^{2} Hz
High frequency
Low frequency
Visible light
7×10^{14} Hz
4×10^{14} Hz

The infrared camera

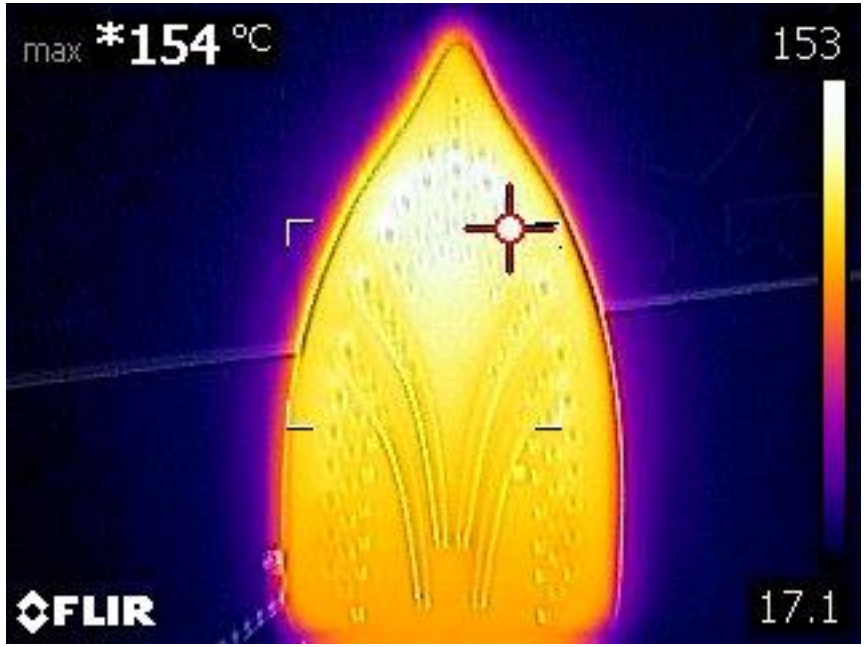
The students learn about the types of electromagnetic radiation.

The students explore with infrared light.

They measure temperature with infrared cameras.

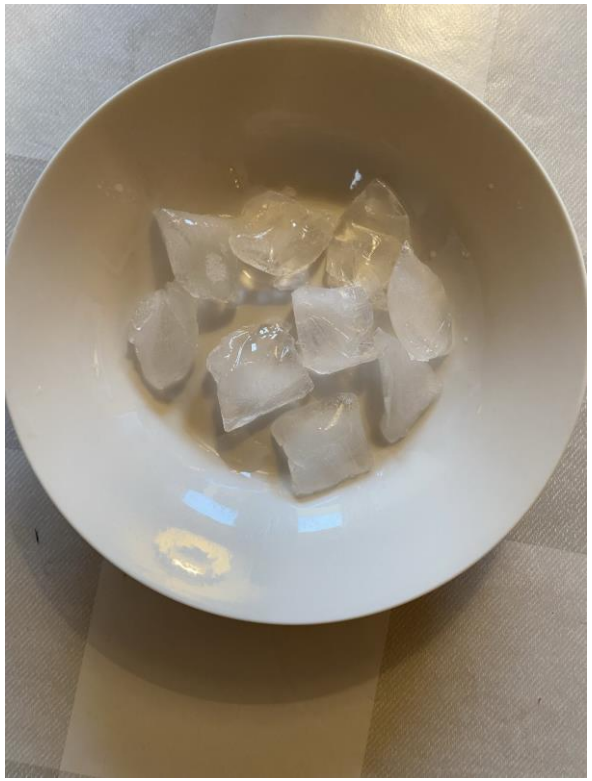
Question for the students:

How is the iron temperature measured on this infrared photo?

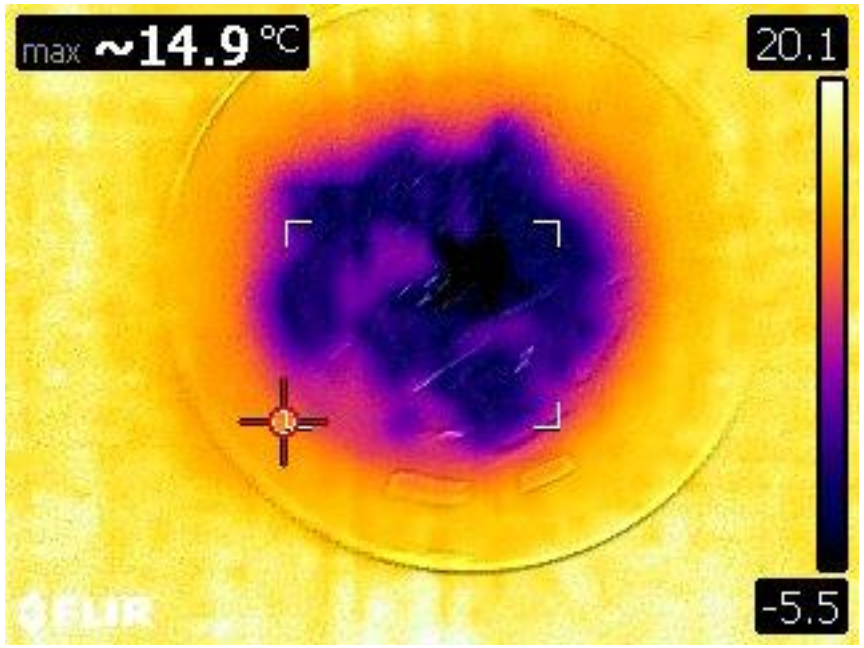


Measure the temperature with an infrared camera

An image of ice in visible light



The same ice photographed with an infrared camera. How cold is the ice?

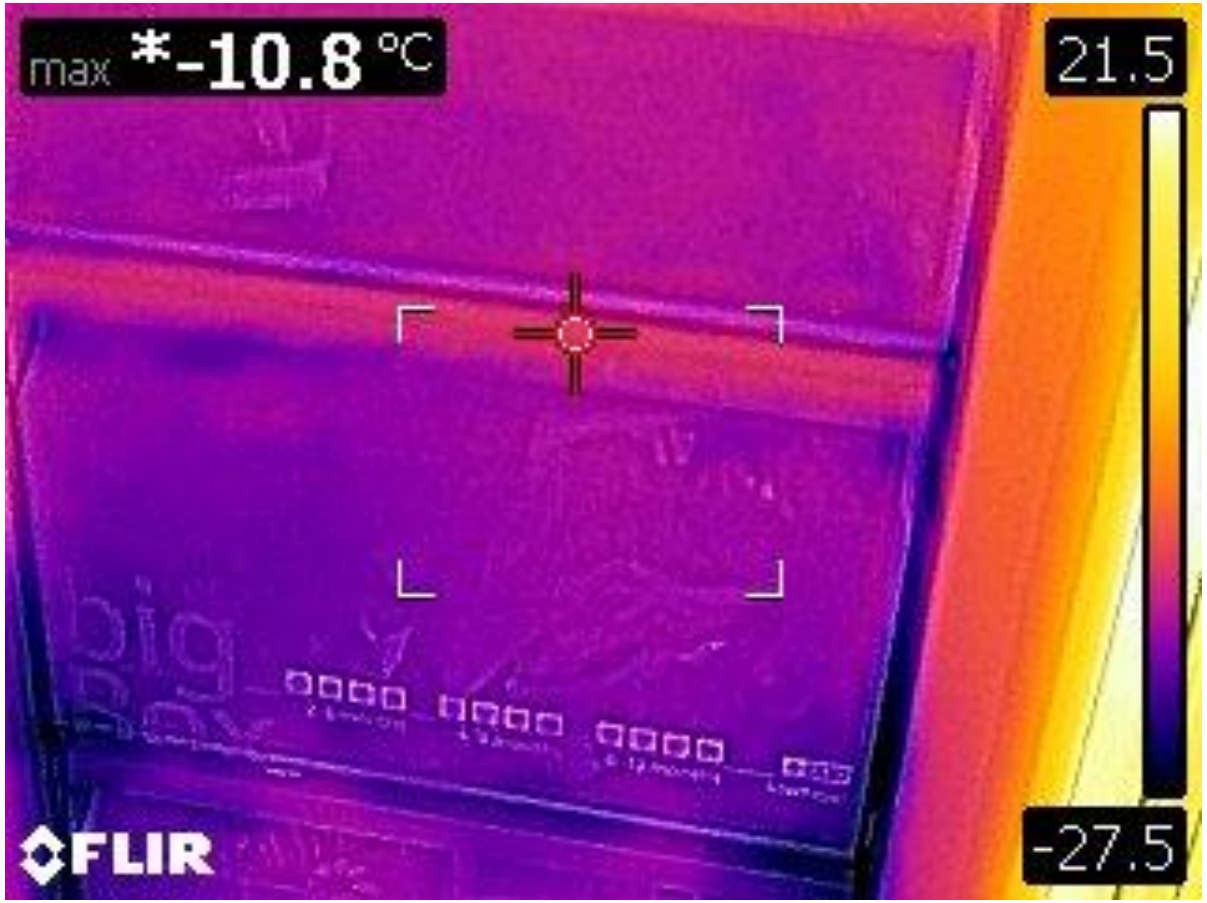


An opened freezer

Here is an infrared image of an opened freezer.

What temperatures are measured?

Use infrared cameras and infrared thermometers to measure different temperatures in your surroundings.



The students take pictures of each other with infrared cameras

How hot is the face?

How warm are the walls?

Why is the infrared radiation less from the clothes than from the skin?

What benefit do you get from the sweater?

How can you make clothes, that insulate better?

Insulation

Take an infrared image of a house from the outside one winterday. The warmest parts of the house will show where the heat is dissipated.

Explore which materals insulate the best.

How to best keep food warm?

How to keep frozen food cold?

Examine with experiments.

What kind of clothes insulate the best?

Project: Find materials that insulate better?

Use your knowledge to suggest new ways of producing clothes and houses.

How do your choises affect our energy consumption?

How does this affect climate change?

A rainbow

Here, NASA shows a rainbow

White light from the Sun has been separated in its colors by passing through droplets of water.

The blue light has got the shortest wavelength and the most energy. It is most deflected.

The red light has got longer wavelength and less enery. It deflects less.

Outside of the red color is the infrared light, which is invisible for the human eye.

Its wavelength is greater than the wavelength of the red light.

Experiment: Go outside in the sunshune and spray water with a water atomizer. In which direction - compared to the direction to the Sun - do you see a rainbow? Why?

The temperature of glowing metal

Which is hottest – white hot metal or red hot metal?

Get help answering by looking at the drawing of wavelengths of electromagnetic radation. Blue light has got a shorter wavelength and more energy. Red light has got a longer wavelength and less energy. White light is a mixture og colors.

You can compare to the rainbow that is formed when light splits in its colors by passing through water droplets.

Here is a picture of a nail that is heated over a bunsen burner untill it is red hot.

Can your infrared camera or your infrared thermometer measure the tempereture of the nail?

My infrared camera cannot measure the temperature of the red hot nail, because it can only measure up to a maximum of 380 degrees Celsius.

The temperature of stars

How to measure the temperature of a star? On the telescope is a spectroscope that measures the wavelenghts of the star´s light.

Which star is hottest – a yellow star or a blue star? Compare with the rainbow and justifi your answer.

Here is a picture from NASA of the star Albireo in the constellation of the Swan. It´s a double star.

In the picture you see two stars with different temperatures – a yellow star and a blue star.

The difference is so obvious that one can see it without separating the colours in a spectroscope.

Project:

Make your foldable paper cellphone spectrometer

How to do

https://www.youtube.com/watch?v=hZkVYuw4pJ4

foldable-2.0.7.pdf

Inspiration

https://spectralworkbench.org/

We measure temperature with infrared cameras

How can you tell if you have a feaver?

What kind of light is used for the measurements?

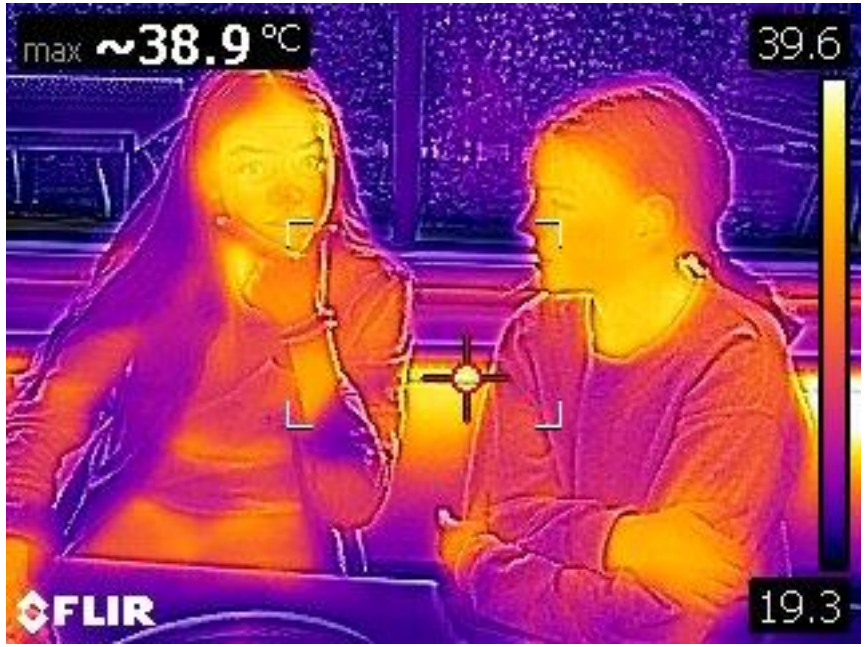
How to best measure temperatures in different places of the Earth – also in the sparsely populated areas?

Why does it get colder at night?

Which nights will be the coldest – clear nights og cloudy nights?

Why?

How can scientists best measure the Earth´s temperature in many areas in a short time?



Albedo – reflection of light

Measure the temperature of objects around you with an infrared thermometer.

Light on different shades of gray with a strong lamp or with an iron. You can also light on a book with light and dark fields.

Measure the temperature of the illuminated shades of gray. Which gets warmer – the light or the dark fields?

Why?

Which color gets warmest in the sunshine – the white or the black? Verify your answer.

When does the sea absorb the most solar energy – when the sea is ice-free or when the sea is covered by sea ice?

What does it mean that large areas of sea ice melts in the late summer? What does it mean for the climate that ever larger areas become ice-free in late summer, so that the albedo becomes smaller?

Here is teaching materal from ESA:

The-Greenhouse-Effect-and-its-Consequences-Investigating-Global-Warming.pdf

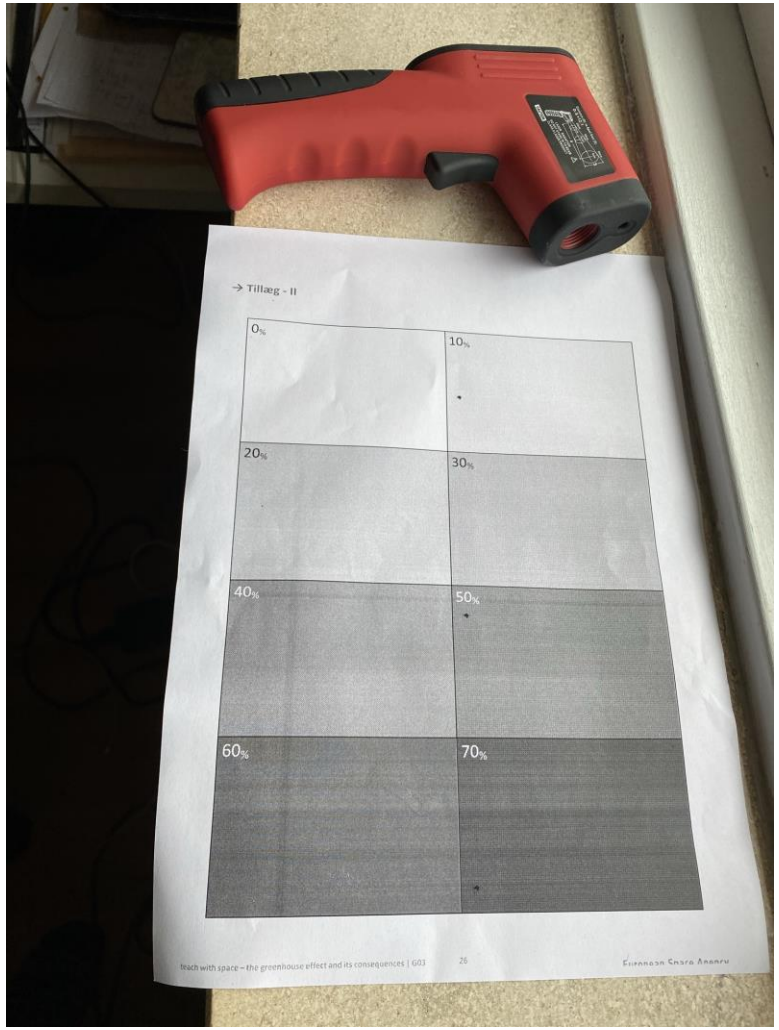
G04_Sea_ice_from_space.pdf

G02_Highways_of_the_Oceans.pdf

https://www.esa.int/Education/Teachers_Corner/After_the_storm_Tracking_Hurricane_Matthew_and_analysing_its_impact_Teach_with_space_G05

https://esero.dk/aktiviteter/efter-stormen/

https://www.esa.int/Education/Climate_detectives



Experiments with greenhouse effect

The water of the clouds has a greenhouse effect – infrared rays from the Earth are absorped by the water in the clouds.

We now want to show that CO_2 also has got a greenhouse effect.

We fill a plastic bag with CO_2 for example by pouring vinegar into baking powder (Sodium hydrogen carbonate) in a flask and holding a plastic bag tightly around the opening while shaking.

Another plastic bag is opened and pulled foreward so that it is filled with atmospheric air, where there is 0,0415 % CO_2 - 415 PPM.

Experiment setup

The two bags are hung in a rack and irradiated with infrared radiation from a hot iron.

The iron is in the middle.

The two bags are closely connected in front of the iron.

To the left hangs the bag of pure CO_2

To the right hangs the bag of atmospheric air.

Behind the bags is a black suitcase.

The infrared camera

With an infrared camera the temperature is measured. You can also measure with an infrared thermometer.

The iron is 128 grader C

Yellow and white colors show high temperatures.

The blue color indicates a lower temperature

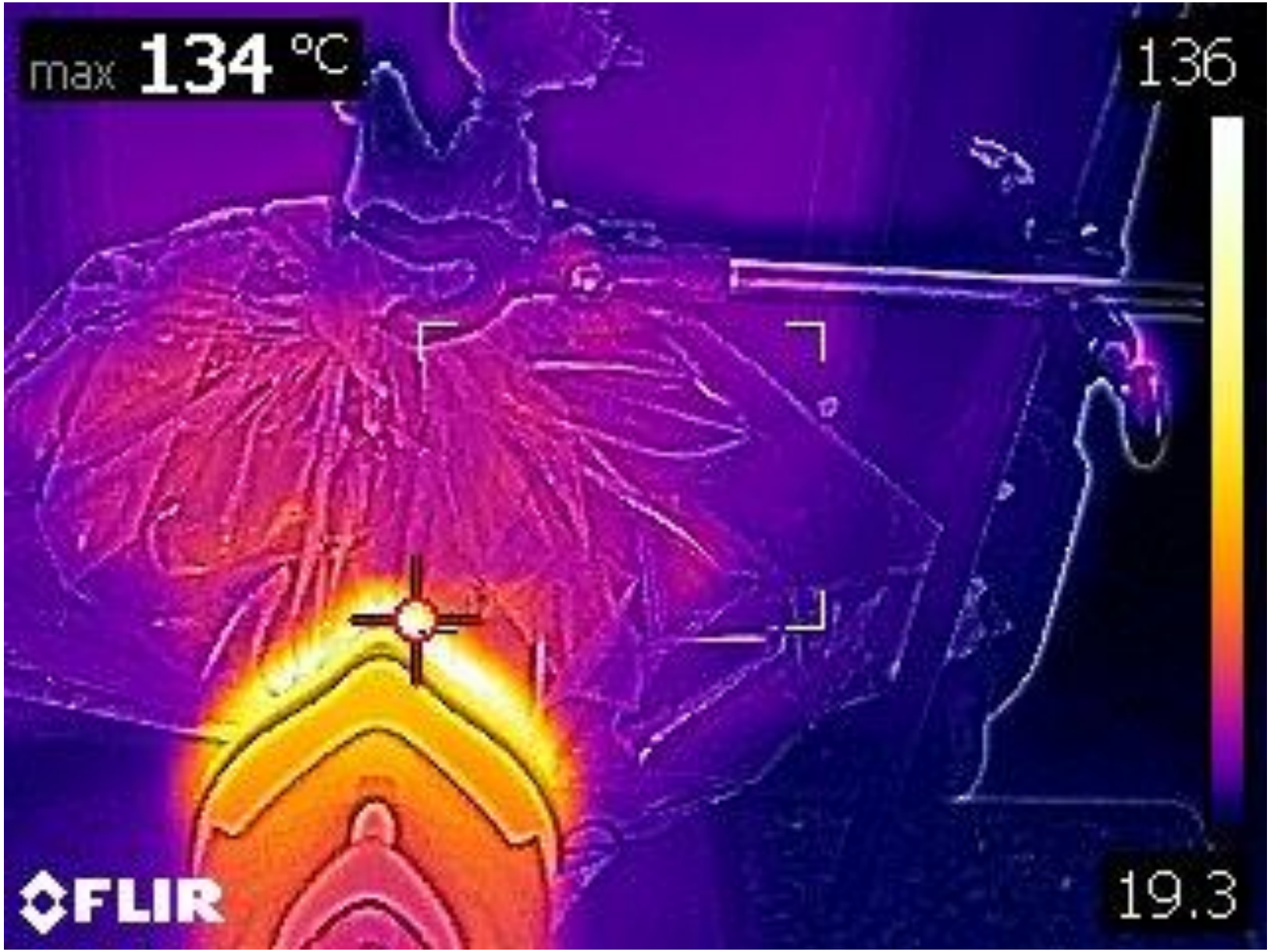
The bags are heated

The radiation from the iron heats the bags and the air within them.

The left bag with pure CO_2 is the warmest.

This suggests that pure CO_2 absorbs more heat radiation than the athmospheric air do.

CO_2 and water vapor are greenhouse gasses.



The temperature behind the bags

With the infrared camerea a photo is taken of the black suitcase behind the bags so that this temperature is measured.

It is warmest behind the right bag with the athmospheric air. The athmospheric air has absorped less heat radiation than the pure CO_2 . Therefore the suitcase becomes warmest on the right.

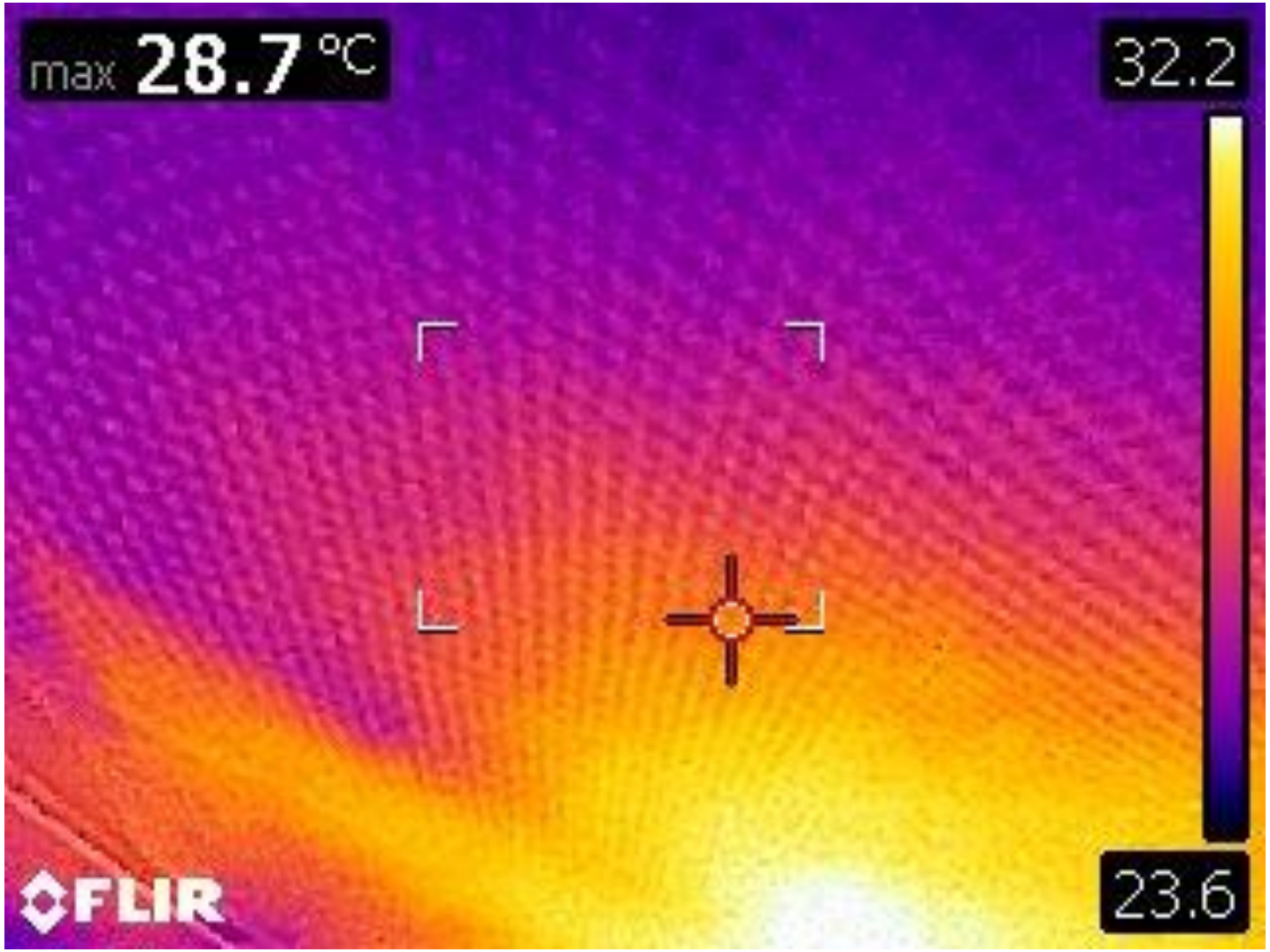
The experiment suggests that pure CO_2 absorbes most heat radiation. The content of CO_2 in the athmosphere has increased from 280 PPM to 415 PPM due to human emissions of CO_2.

This has increased the greenhouse effect, so that we have a global warming.

What can you do to change this trend?

What have the states decided to do about the problem at the COP 26 meeting in Glasgow November 2021?

https://ukcop26.org/

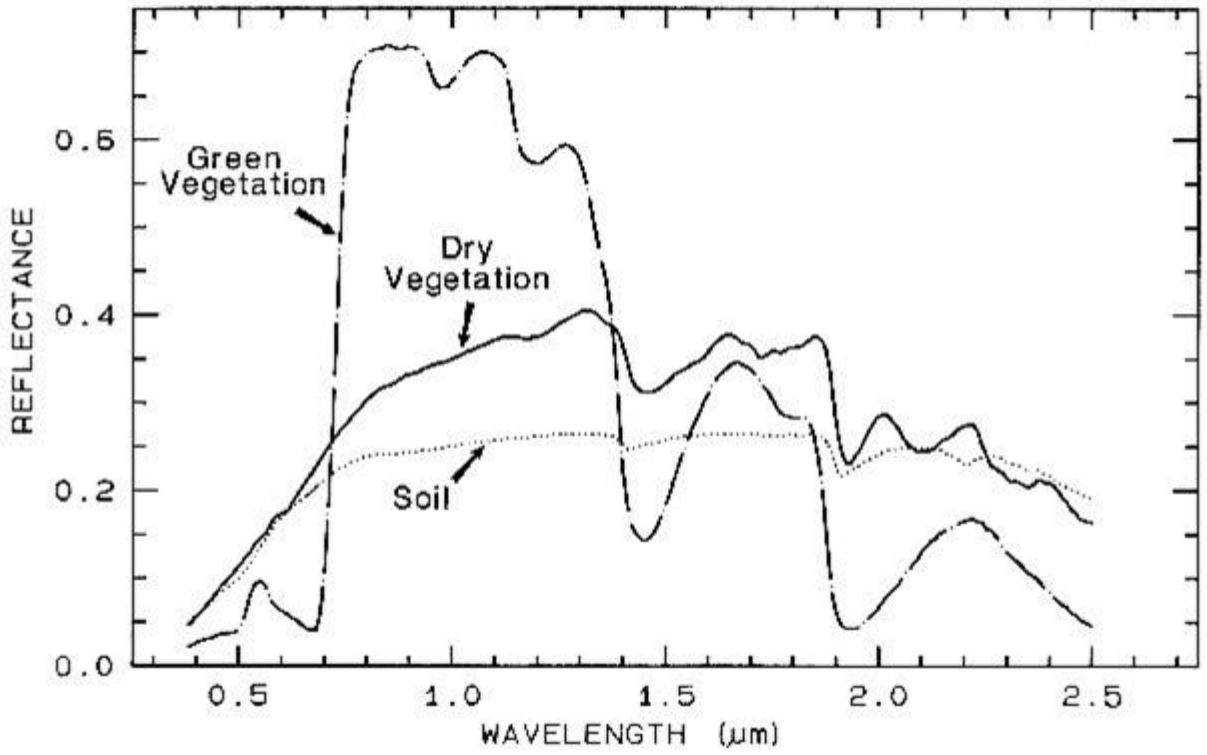


Plants reflects green light and NIR light

Plants absorb red light and blue light, because it is used in their photosyntethesis.

Green light and near infrared light, NIR are reflected because it cannot be used for photosynthesis. This prevents the plants from beeing heated, and they do not have to evaporate as much water to cool.

This reflection of the green plants can be used in geodata to study how the plants thrive.



Different vegitation

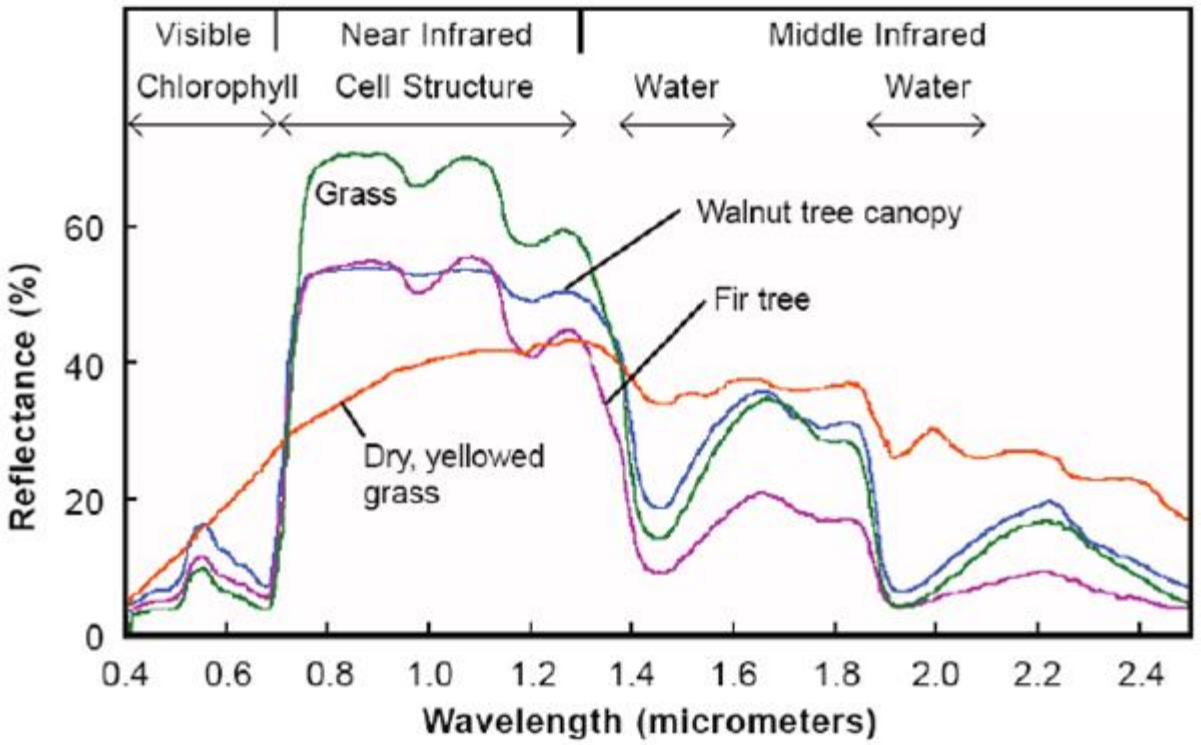
There is a small difference in how different vegetation reflect infrared light.

There is also a difference in how dry and wet areas reflect infrared light.

By using infrared light in imaging, one can read how the plants are doing.

The infrared light is shown in the image with a color we can see. In that way we can image process so that we can examine how our planet is doing.

We can keep an eye on climate change.



The EO Browseren

Satellites fly over the entire Earth in a matter of days.

You can log in at the EO Browser and do your own surveys with satellite images.

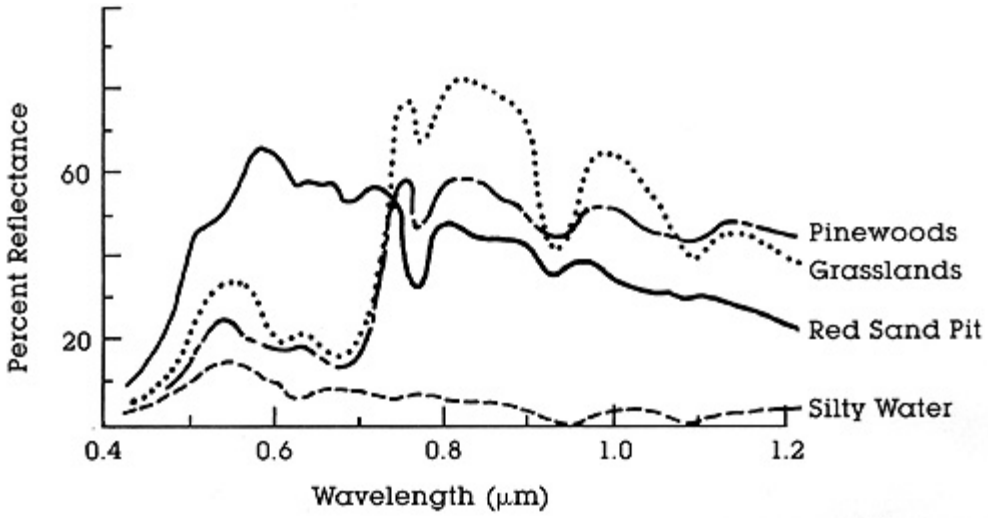
https://www.sentinel-hub.com/explore/eobrowser/

When you choose Education Mode, you can explore in 12 different themes. In each theme the scientists show Highlights. Everything is explained.

The colors are divided into bands. Three bands are combined into one image. You can add different bands to see exiting details. In particular infrared wavelengths are good for showing problems.

In each theme you can choose scripts where you combine bands in a useful way.

When you do your own research in a theme, you are offered to use exactly the scripts that are usefull in this theme. You will also be guided to use the satellite that best suites this theme.



Bands of the Sentinel 2 satellite

You form an image by putting together 3 bands.

An image is created in True Color if you put the red band (Band 4) in the red window, the green band (band 3) in the green window, and the blue band (Band 2) in the blue window.

The infrared bands are:

8 NIR Near Infrared

8a NIR Near Infrared

11 Short Wave Infrared SWIR

12 Short Wave Infrared SWIR

- **Band**
- **Band 1 Coastal Aerosol 0.421 – 0.457 60**
- **Band 2 Blue 0.439 – 0.535 10**
- **Band 3 Green 0.537 – 0.582 10**
- **Band 4 Red 0.646 – 0.685 10**
- **Band 5 Vegetation red edge 0.694 – 0.714 20**
- **Band 6 Vegetation red edge 0.731 – 0.749 20**
- **Band 7 Vegetation red edge 0.768 – 0.796 20**
- **Band 8 NIR (near infrared) 0.767 – 0.908 10**
- **Band 8a NIR (near infrared) 0.848 – 0.881 20**
- **Band 9 Narrow NIR 0.931 – 0.958 60**
- **Band 10 Cirrus 1.338 – 1.414 60**
- **Band 11 SWIR (Short wave infrared) 1.539 – 1.681 20**
- **Band 12 SWIR (Short wave infrared) 2.072 – 2.312 2**

Use infrared bands to explore problems

You can find guides to the EO Browseren here: https://www.boernafgalileo.dk/skriv.htm

When you hear about a global problem or a disaster, you can often find satellite images to investigate it yourself.

In this presentation I will show to you how to explore the big problem that tropical rainforests are drained from water and burned.

This burning emits CO_2 and toxins.

Many species have become extinguised because their habitats are being destoyed. Some times the soil is washed away. In other places the area dries out..

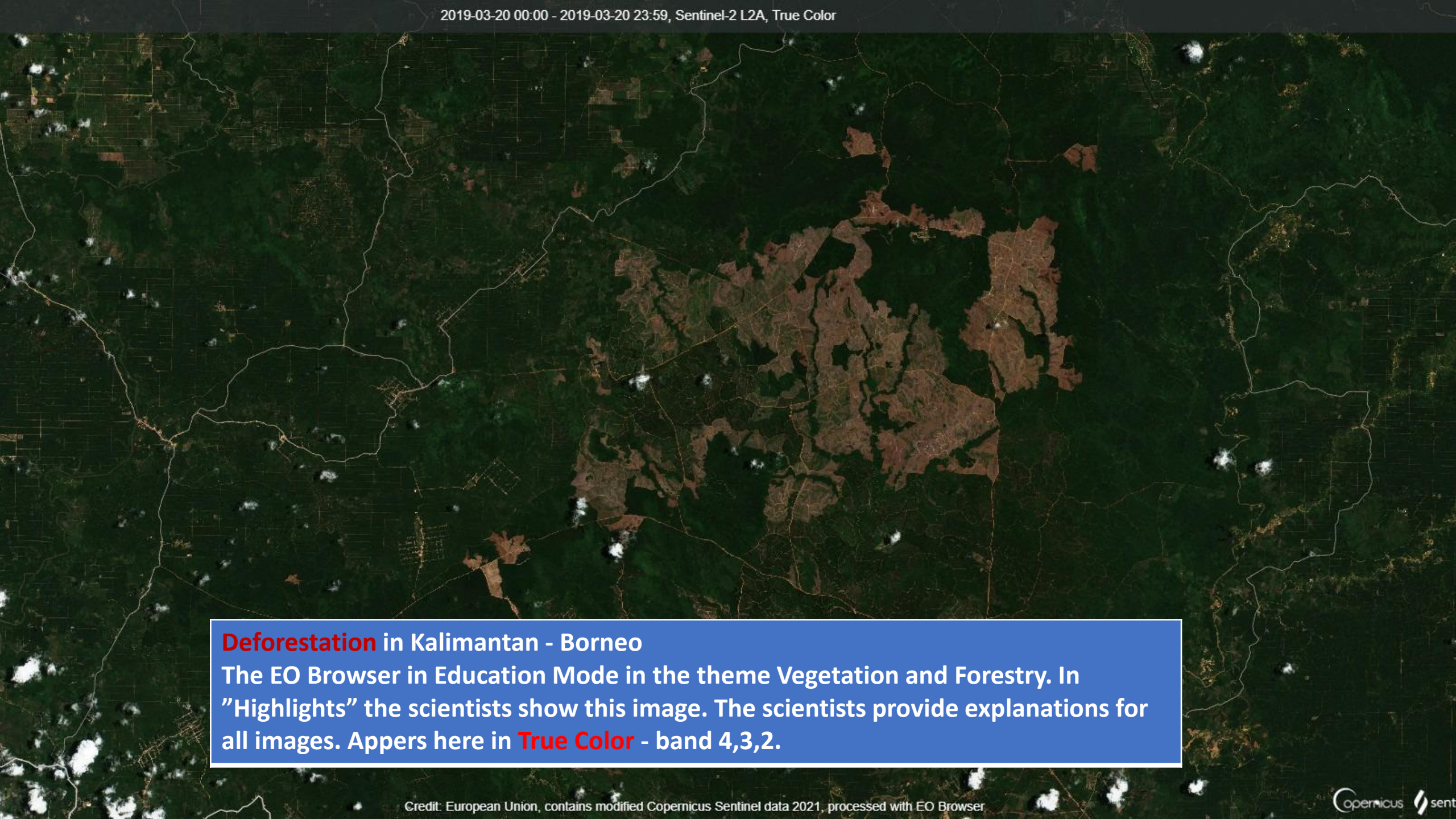
A lot of people make a great effort to prevent that even more rainforests are transformed into monoculture plantations. Can you do something in this matter?

At the COP 26 in Glasgow in November 2021 states have agreed on a declaraton to protect forests from new deforestation for the cultivation of soyabeans, palmoil and breeding of beef cattle.

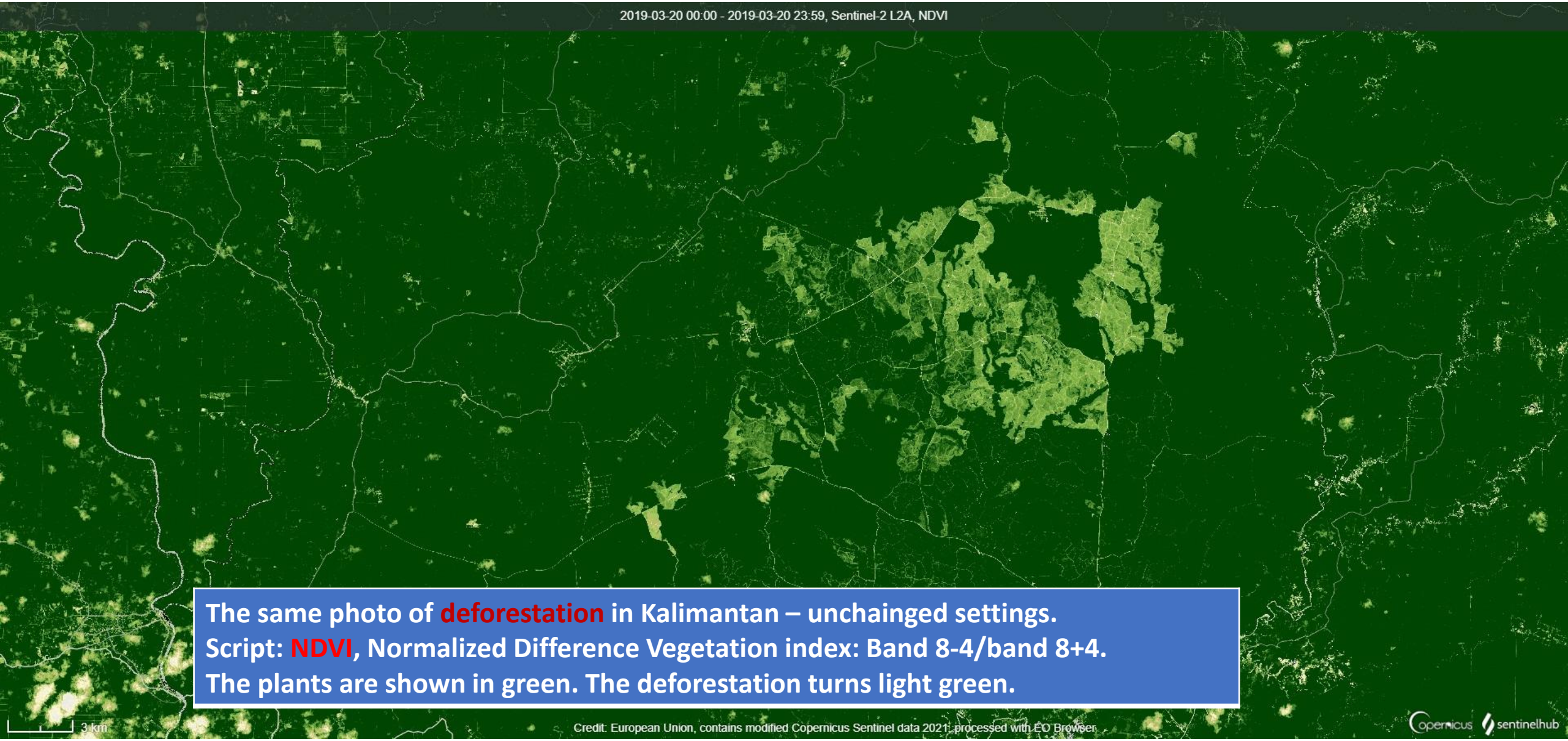
You can rewiew this declaration. What do you think of it?

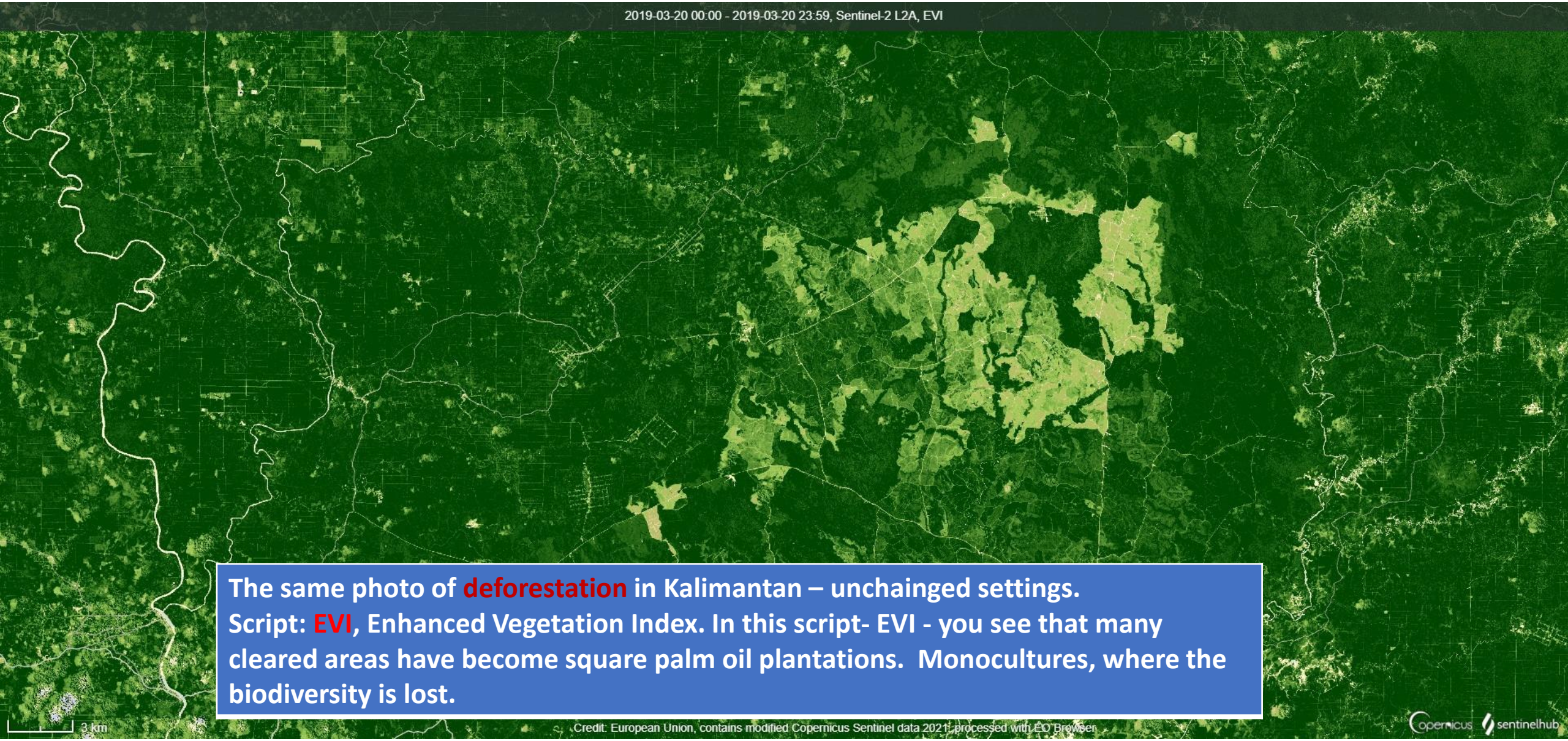
https://ukcop26.org/glasgow-leaders-declaration-on-forests-and-land-use/

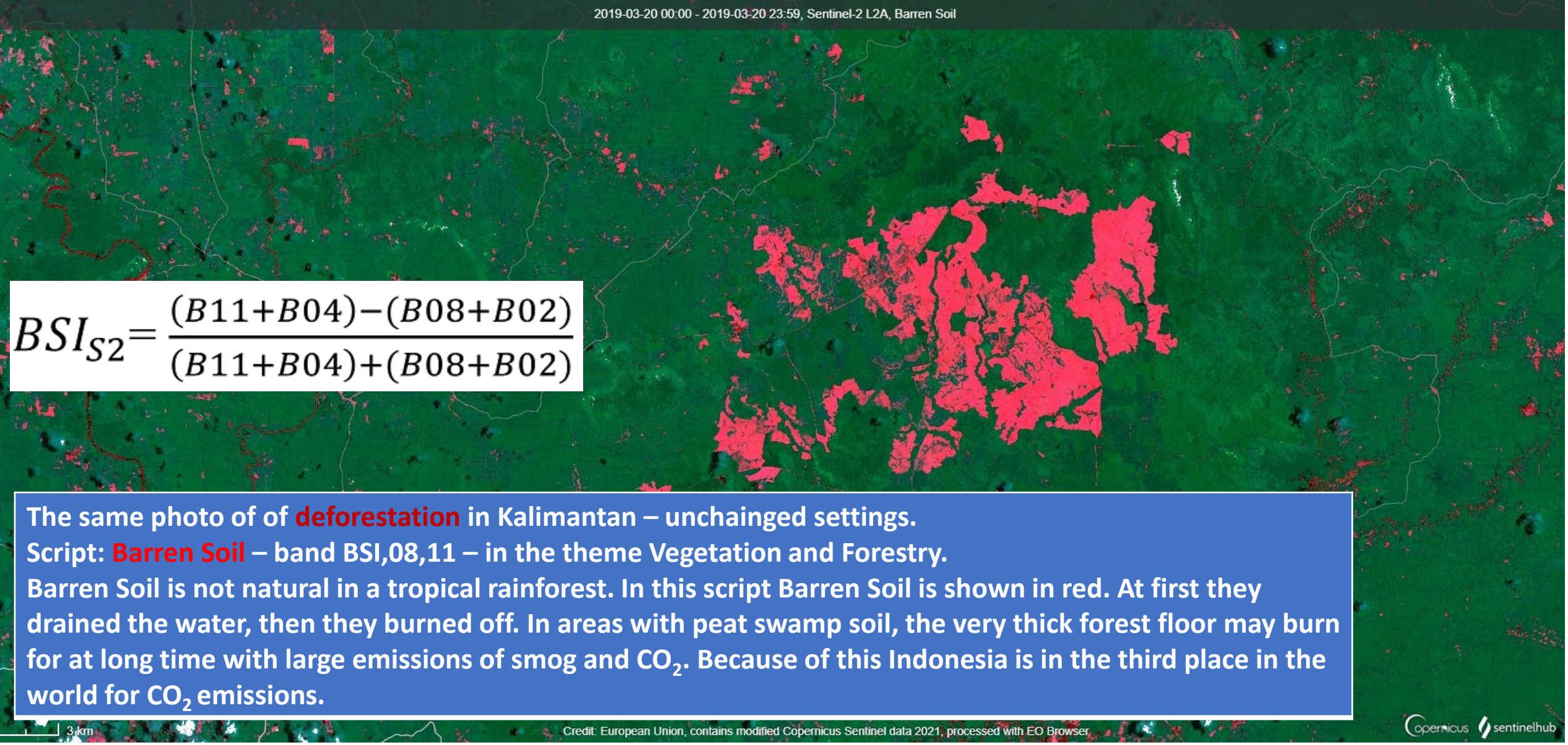
- **CUSTOM: You can make your own script**
- **True Color** Based on bands 4,3,2
- **False Color** Based on bands **8,4,3 vegetation red. 3,8,4 makes vegetation in green – multiplicate band 3 and 4**
- **SWIR** Based on bands **12,8A,4** Short wave infrared
- **False Color Urban** Based on bands **B12, B11, B04**
- **Agriculture** Based on bands **B11, B08, B02**
- **Geology Band 12,8,2**
- **Geology Band 8,11,12**
- **NDVI vegetation** Based on combination of bands **(B8 - B4)/(B8 + B4)**
- **Barren Soil** Based on the combination: **BSI, B08, B11**
- **Moisture Index** Based on combination of bands **(B8A - B11)/(B8A + B11)**
- **Water NDWI** Based on combination of bands **(B3 - B8)/(B3 + B8)**
- **Snow NDSI** Based on combination of bands **(B3 - B11)/(B3 + B11)**


2019-03-20 00:00 - 2019-03-20 23:59, Sentinel-2 L2A, True Color
Deforestation in Kalimantan - Borneo
The EO Browser in Education Mode in the theme Vegetation and Forestry. In ”Highlights” the scientists show this image. The scientists provide explanations for all images. Appers here in True Color - band 4,3,2.
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser

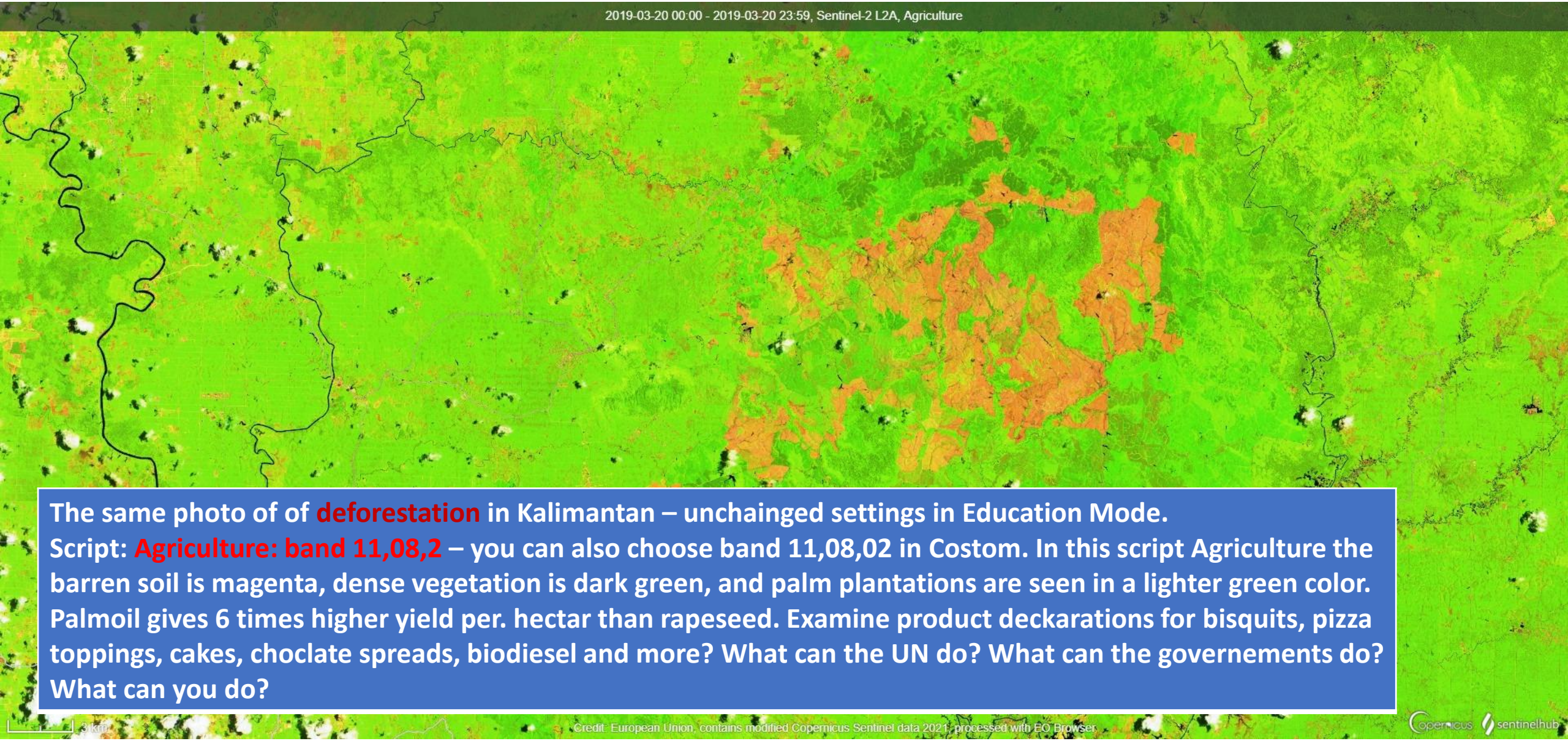

2019-03-20 00:00 - 2019-03-20 23:59, Sentinel-2 L2A, False color
The samme photo of deforestation in Kalimantan – Still Education Mode in the theme Vegetation og Forestry
False Color - band 8a,4,3 – Near Infrared, red,green.
Green plants reflect NIR, Near Infrared-band 8a. Plants appear in red color,
Deforestation is grey in this script
3 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub

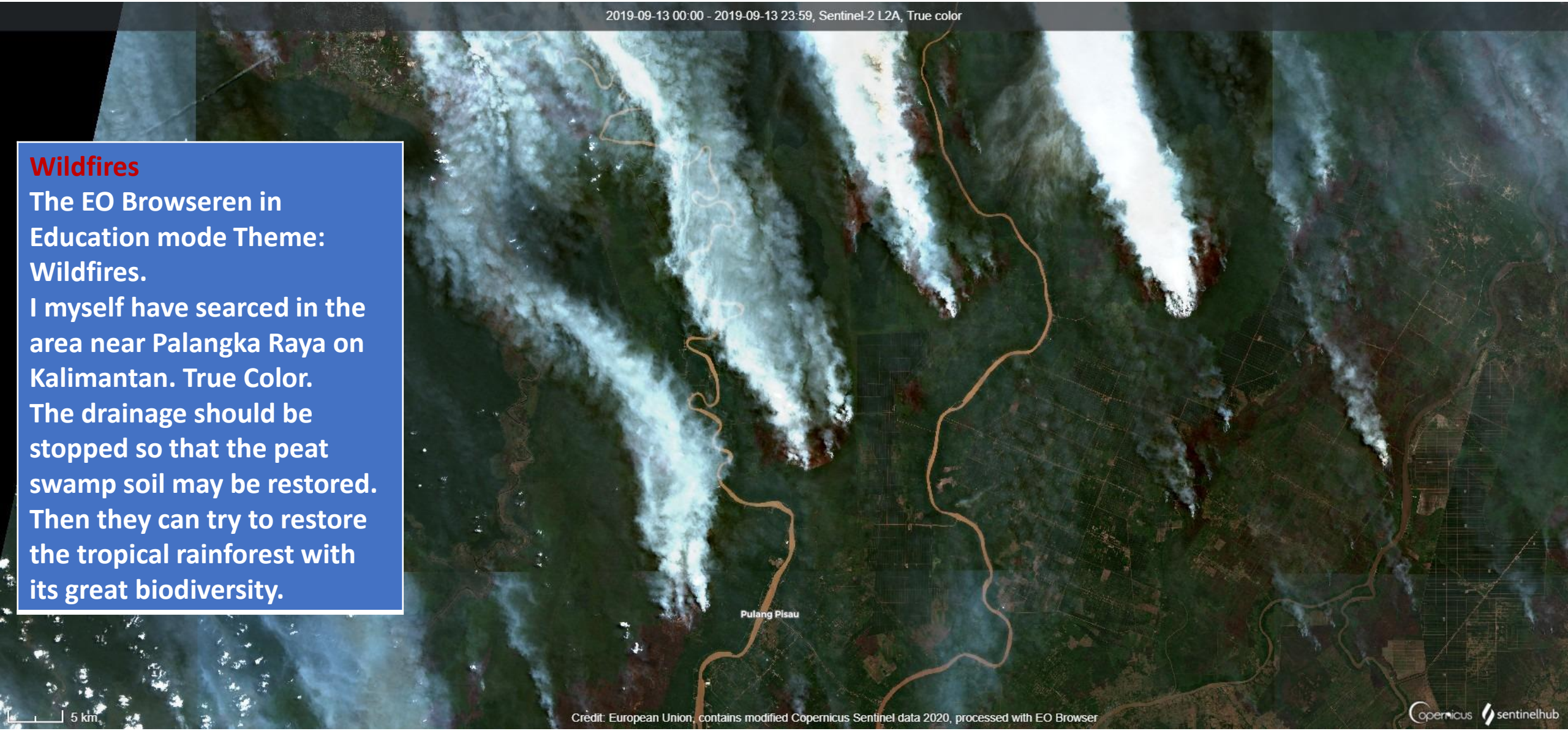

2019-03-20 00:00 - 2019-03-20 23:59, Sentinel-2 L2A, NDVI
The same photo of deforestation in Kalimantan – unchainged settings.
Script: NDVI, Normalized Difference Vegetation index: Band 8-4/band 8+4.
The plants are shown in green. The deforestation turns light green.
3 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub


2019-03-20 00:00 - 2019-03-20 23:59, Sentinel-2 L2A, EVI
The same photo of deforestation in Kalimantan – unchainged settings.
Script: EVI, Enhanced Vegetation Index. In this script- EVI - you see that many cleared areas have become square palm oil plantations. Monocultures, where the biodiversity is lost.
3 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub



The same photo of of deforestation in Kalimantan – unchainged settings.
Script: Barren Soil – band BSI,08,11 – in the theme Vegetation and Forestry.
Barren Soil is not natural in a tropical rainforest. In this script Barren Soil is shown in red. At first they drained the water, then they burned off. In areas with peat swamp soil, the very thick forest floor may burn for at long time with large emissions of smog and CO_2. Because of this Indonesia is in the third place in the world for CO_2 emissions.


2019-03-20 00:00 - 2019-03-20 23:59, Sentinel-2 L2A, Agriculture
The same photo of of deforestation in Kalimantan – unchainged settings in Education Mode.
Script: Agriculture: band 11,08,2 – you can also choose band 11,08,02 in Costom. In this script Agriculture the barren soil is magenta, dense vegetation is dark green, and palm plantations are seen in a lighter green color. Palmoil gives 6 times higher yield per. hectar than rapeseed. Examine product deckarations for bisquits, pizza toppings, cakes, choclate spreads, biodiesel and more? What can the UN do? What can the governements do? What can you do?
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub



Wildfires

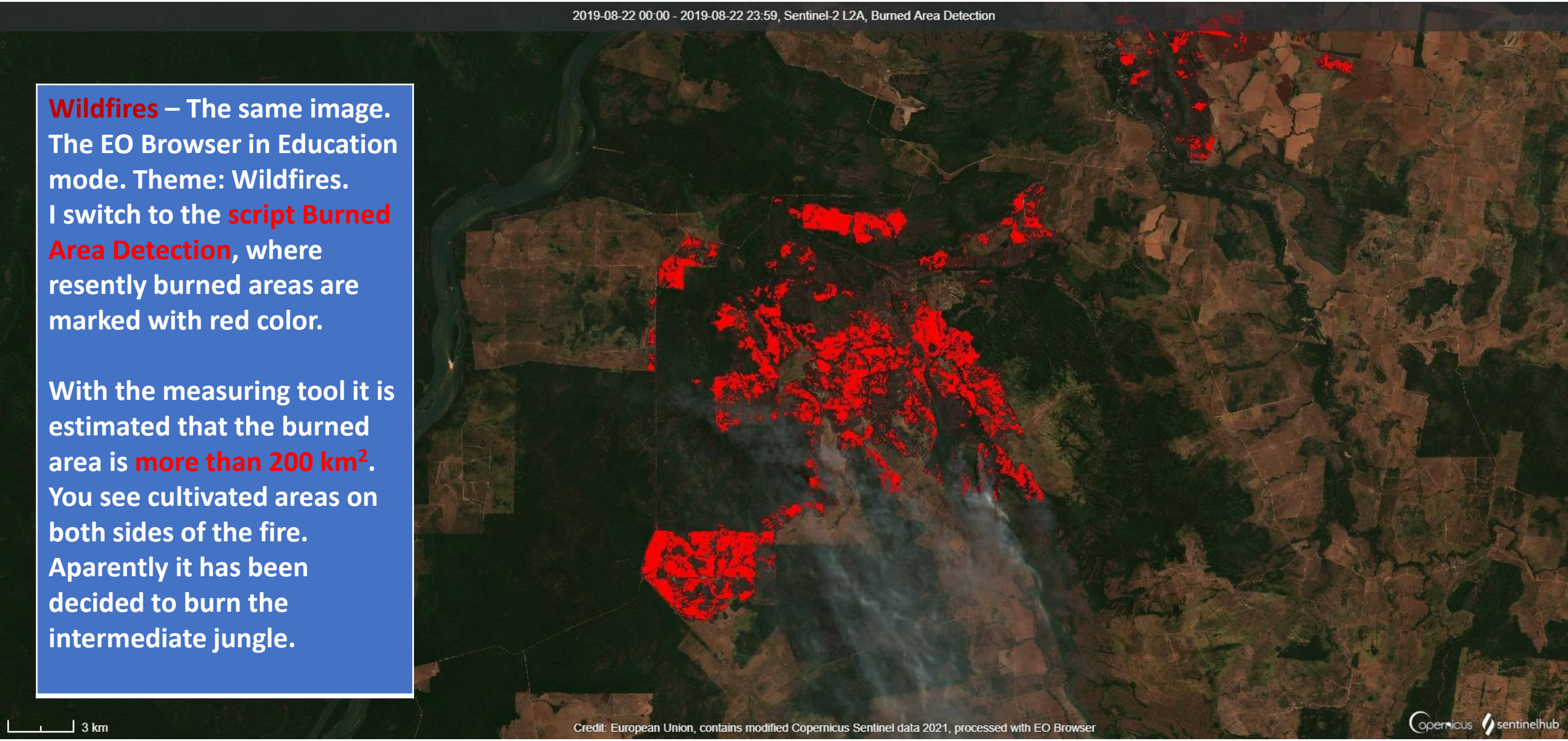
The EO Browseren in Education mode Theme: Wildfires.

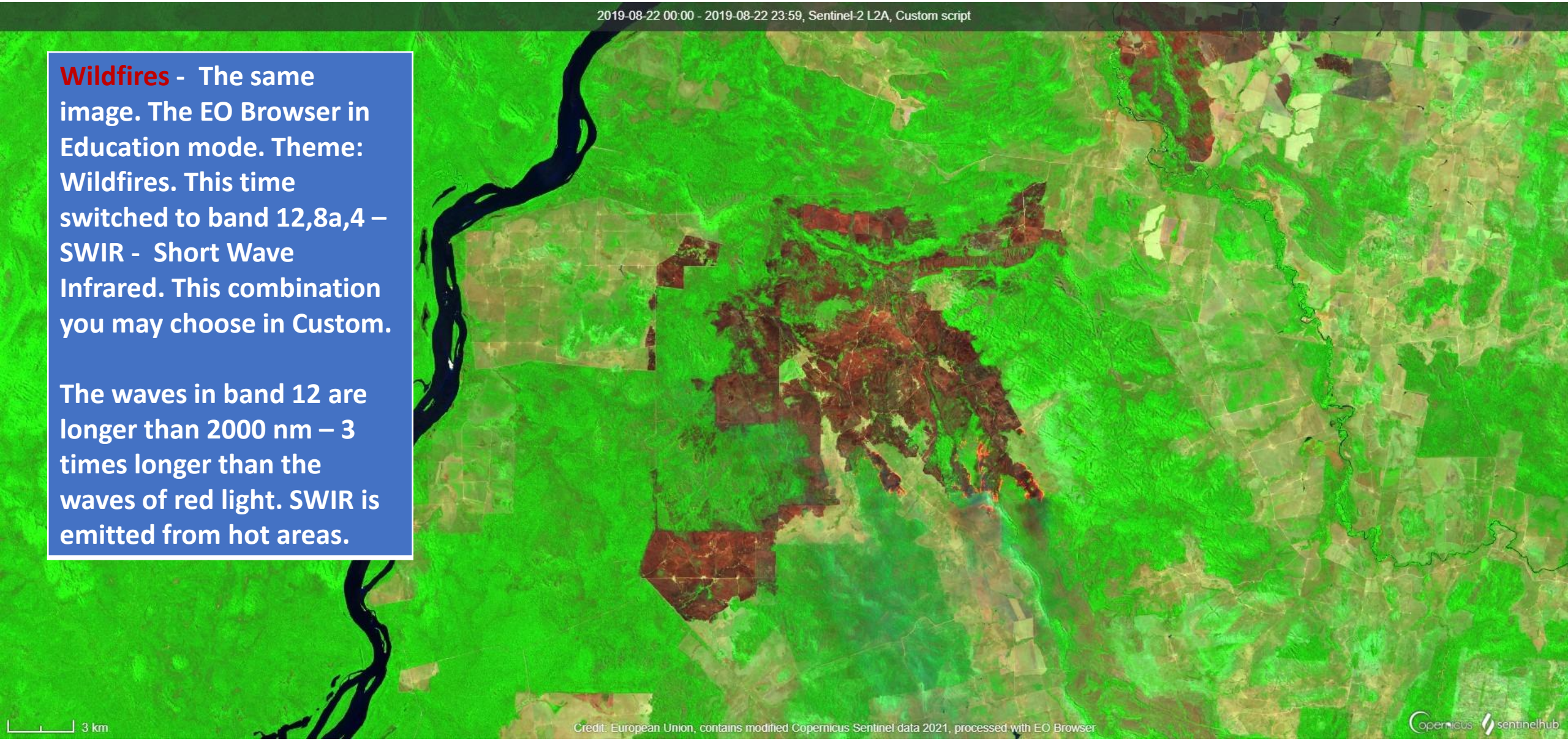
I myself have searced in the area near Palangka Raya on Kalimantan. True Color.

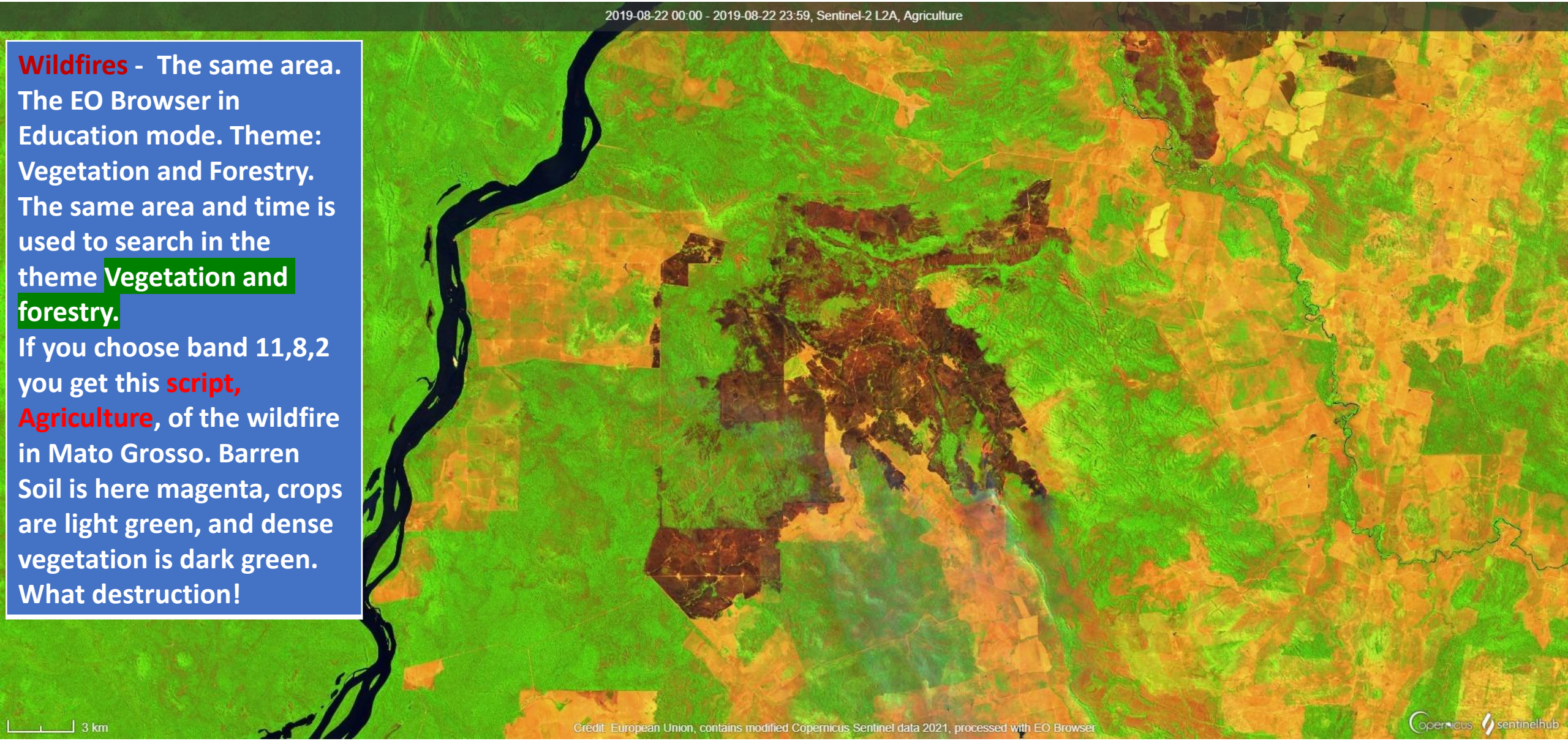
The drainage should be stopped so that the peat swamp soil may be restored. Then they can try to restore the tropical rainforest with its great biodiversity.

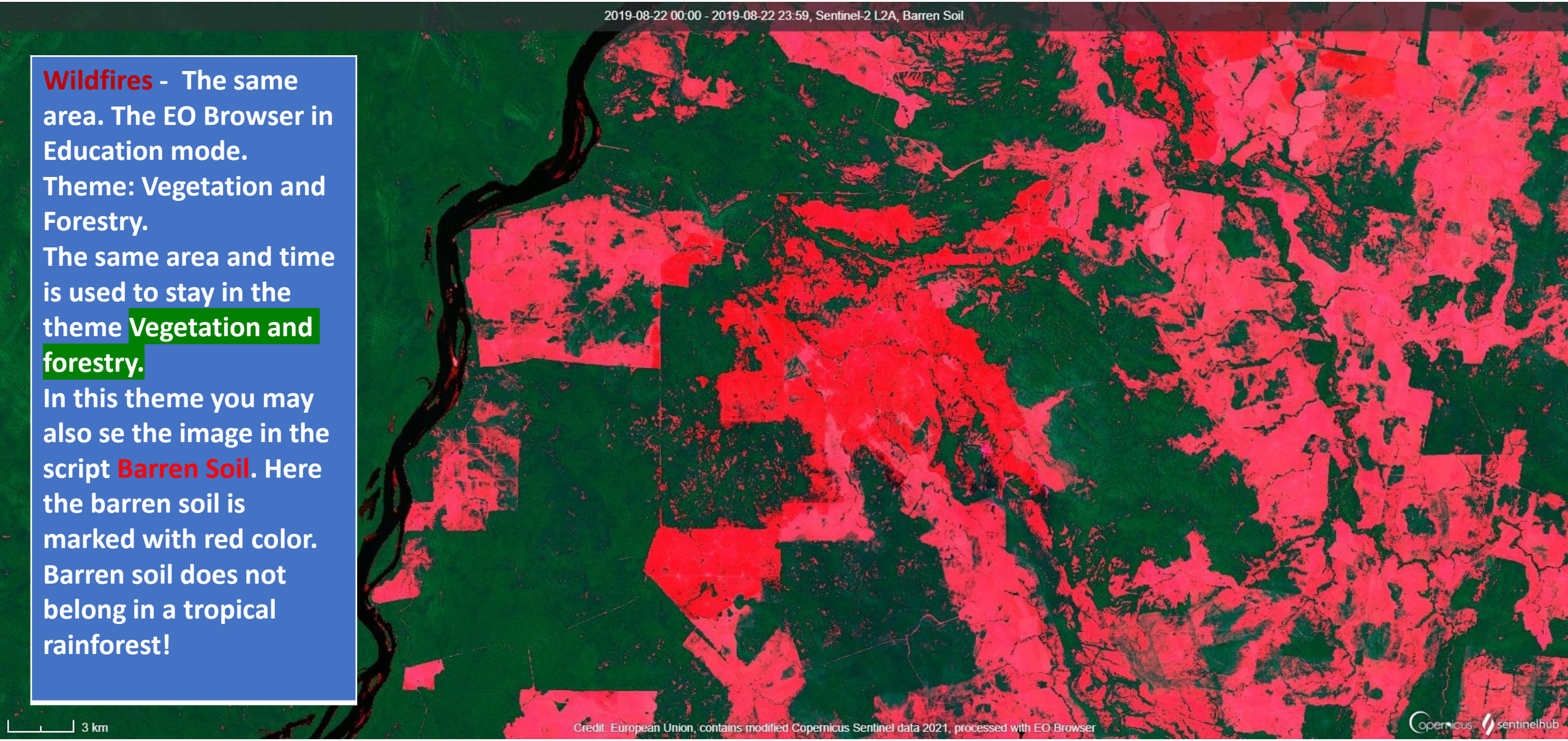

2019-08-22 00:00 - 2019-08-22 23:59, Sentinel-2 L2A, True Color
Wildfires
The EO Browseren in Education mode.
Theme: Wildfires. I have been searching in Mato Grosso in Brazil.
Display in True Color – band 4,3,2.
You see the smoke from the wildfires
3 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub

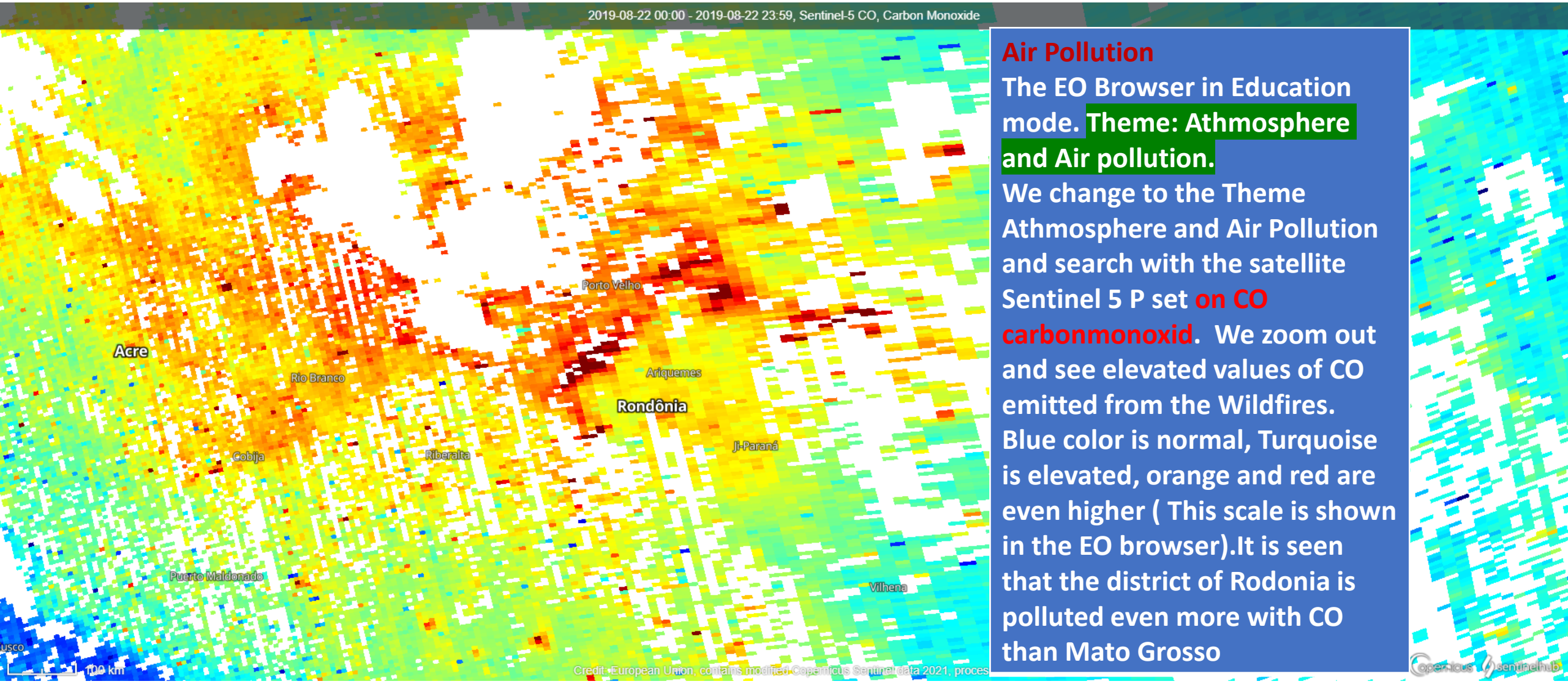

2019-08-22 00:00 - 2019-08-22 23:59, Sentinel-2 L2A, Wildfires
Wildfires
The EO Browser in Education mode. Theme: Wildfires.
The same image from Mato Grosso in Brazil.
I shift to the script: Wildfires.
The infrared wavelenghs highlights the fire.
3 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub


2019-08-22 00:00 - 2019-08-22 23:59, Sentinel-2 L2A, Burned Area Detection
Wildfires – The same image. The EO Browser in Education mode. Theme: Wildfires.
I switch to the script Burned Area Detection, where resently burned areas are marked with red color.
With the measuring tool it is estimated that the burned area is more than 200 km².
You see cultivated areas on both sides of the fire.
Aparently it has been decided to burn the intermediate jungle.
3 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub


2019-08-22 00:00 - 2019-08-22 23:59, Sentinel-2 L2A, Custom script
Wildfires - The same image. The EO Browser in Education mode. Theme: Wildfires. This time switched to band 12,8a,4 – SWIR - Short Wave Infrared. This combination you may choose in Custom.
The waves in band 12 are longer than 2000 nm – 3 times longer than the waves of red light. SWIR is emitted from hot areas.
3 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub


2019-08-22 00:00 - 2019-08-22 23:59, Sentinel-2 L2A, Agriculture
Wildfires - The same area. The EO Browser in Education mode. Theme: Vegetation and Forestry. The same area and time is used to search in the theme Vegetation and forestry.
If you choose band 11,8,2 you get this script, Agriculture, of the wildfire in Mato Grosso. Barren Soil is here magenta, crops are light green, and dense vegetation is dark green. What destruction!
3 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub

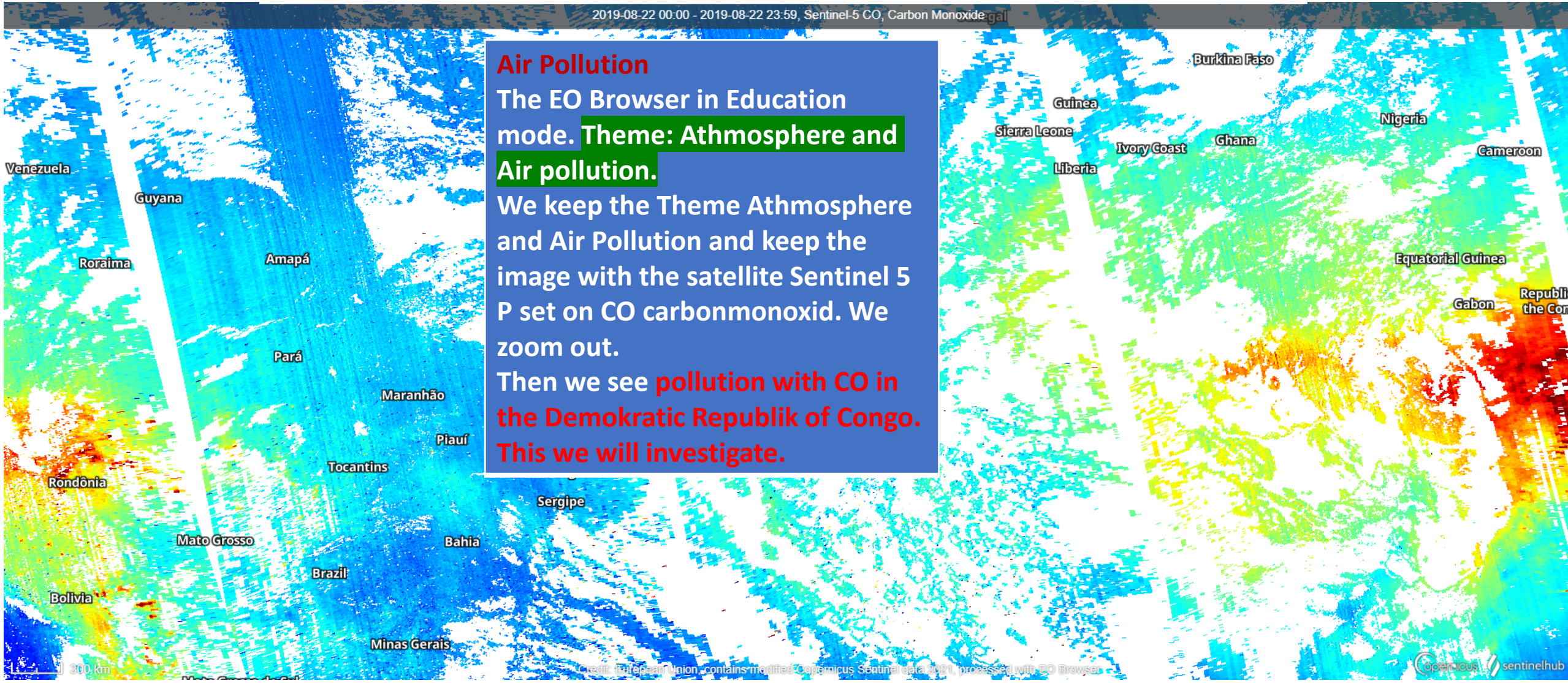

2019-08-22 00:00 - 2019-08-22 23:59, Sentinel-2 L2A, Barren Soil
Wildfires - The same area. The EO Browser in Education mode.
Theme: Vegetation and Forestry.
The same area and time is used to stay in the theme Vegetation and forestry.
In this theme you may also se the image in the script Barren Soil. Here the barren soil is marked with red color.
Barren soil does not belong in a tropical rainforest!
3 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus sentinelhub

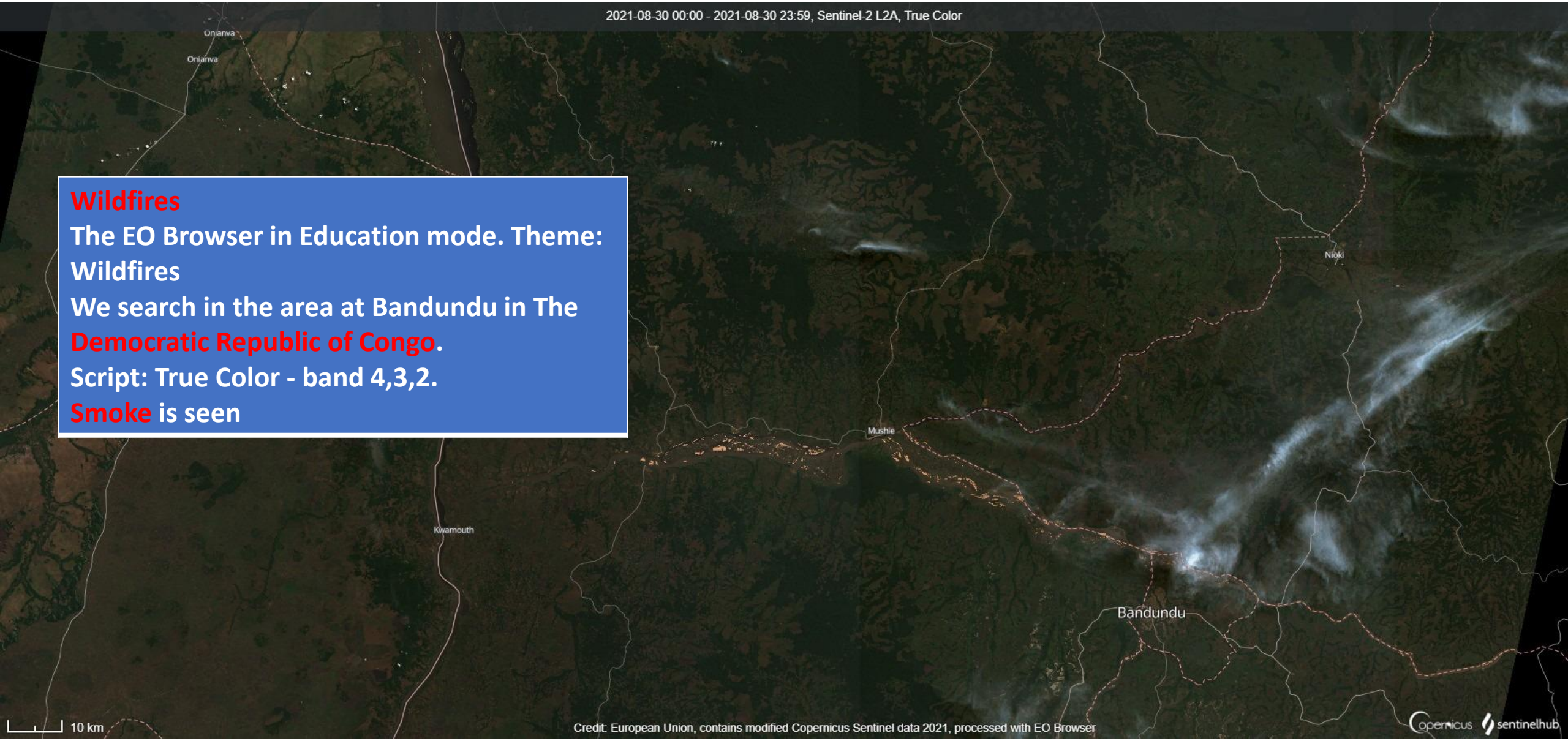


Air Pollution

The EO Browser in Education mode. Theme: Athmosphere and Air pollution.

We change to the Theme Athmosphere and Air Pollution and search with the satellite Sentinel 5 P set on CO carbonmonoxid. We zoom out and see elevated values of CO emitted from the Wildfires. Blue color is normal, Turquoise is elevated, orange and red are even higher (This scale is shown in the EO browser).It is seen that the district of Rodonia is polluted even more with CO than Mato Grosso


2019-08-22 00:00 - 2019-08-22 23:59, Sentinel-5 CO, Carbon Monoxide
Air Pollution
The EO Browser in Education mode. Theme: Athmosphere and Air pollution.
We keep the Theme Athmosphere and Air Pollution and keep the image with the satellite Sentinel 5 P set on CO carbonmonoxid. We zoom out.
Then we see pollution with CO in the Demokratic Republik of Congo. This we will investigate.
Burkina Faso
Guinea
Nigeria
Sierra Leone
Ivory Coast
Ghana
Cameroon
Liberia
Venezuela
Guyana
Roraima
Amapá
Equatorial Guinea
Gabon
Pará
Maranhão
Piauí
Tocantins
Rondônia
Sergipe
Mato Grosso
Bahia
Brazil
Bolivia
Minas Gerais
300 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
sentinelhub



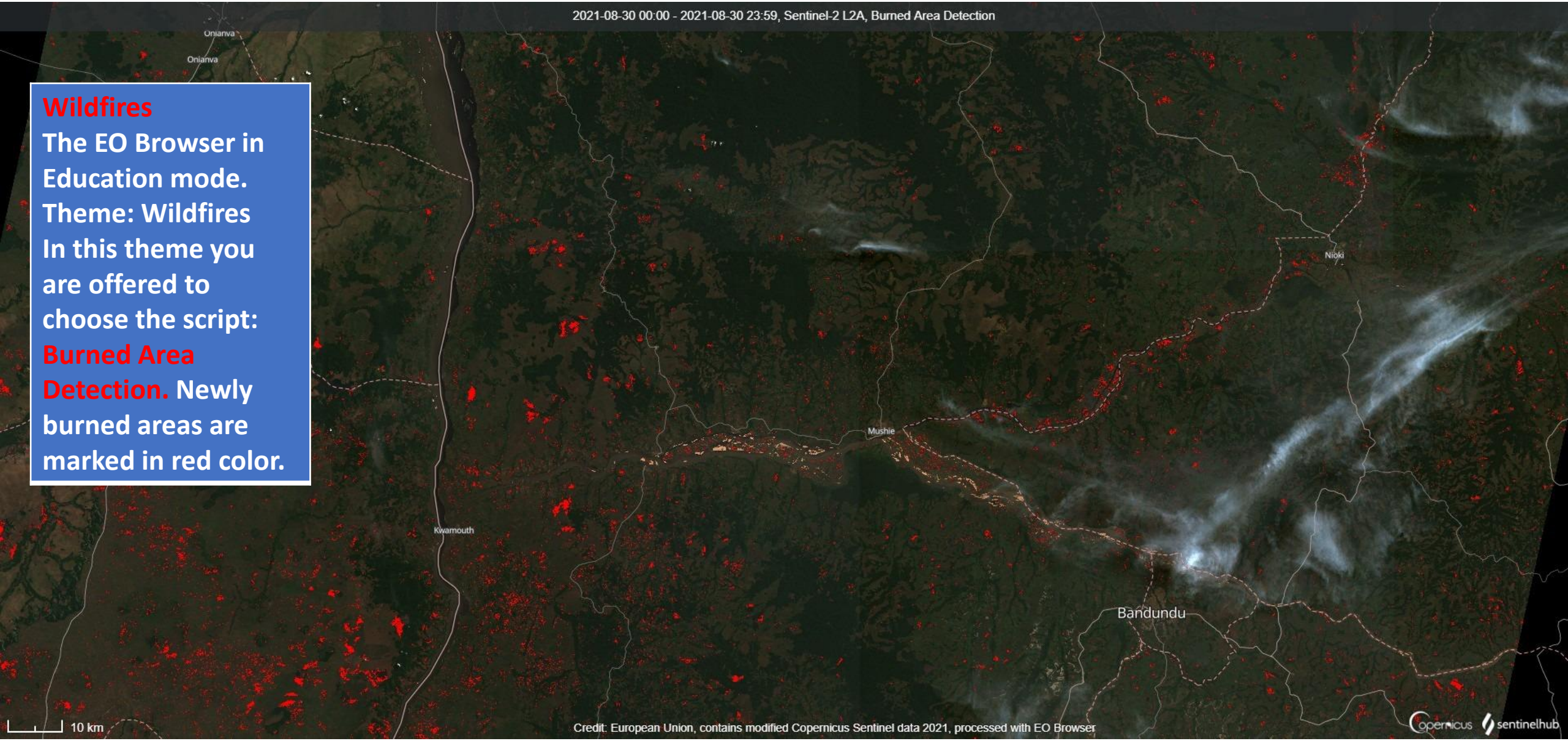
Wildfires

The EO Browser in Education mode. Theme: Wildfires

We search in the area at Bandundu in The Democratic Republic of Congo.

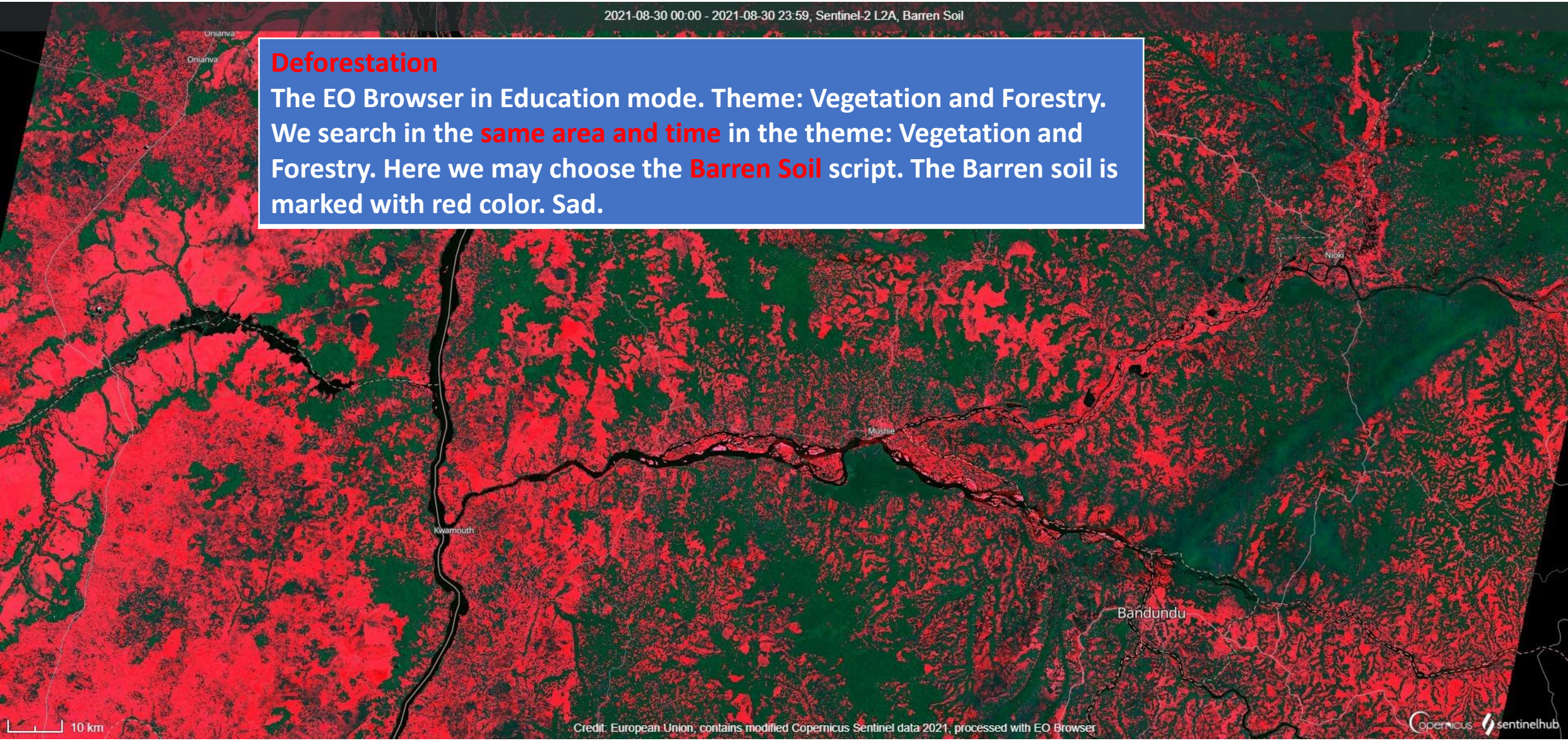
Script: True Color - band 4,3,2.

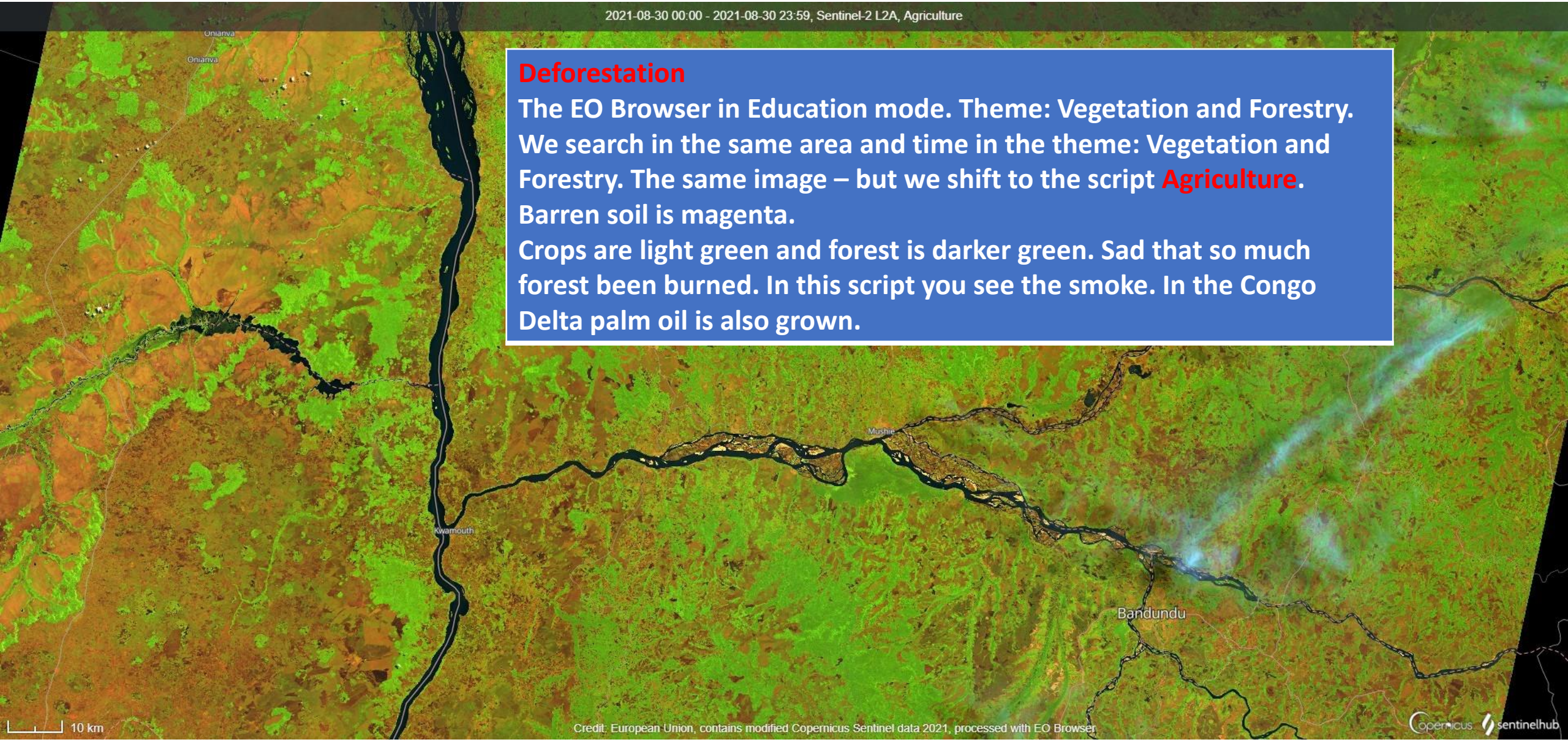
Smoke is seen



Wildfires

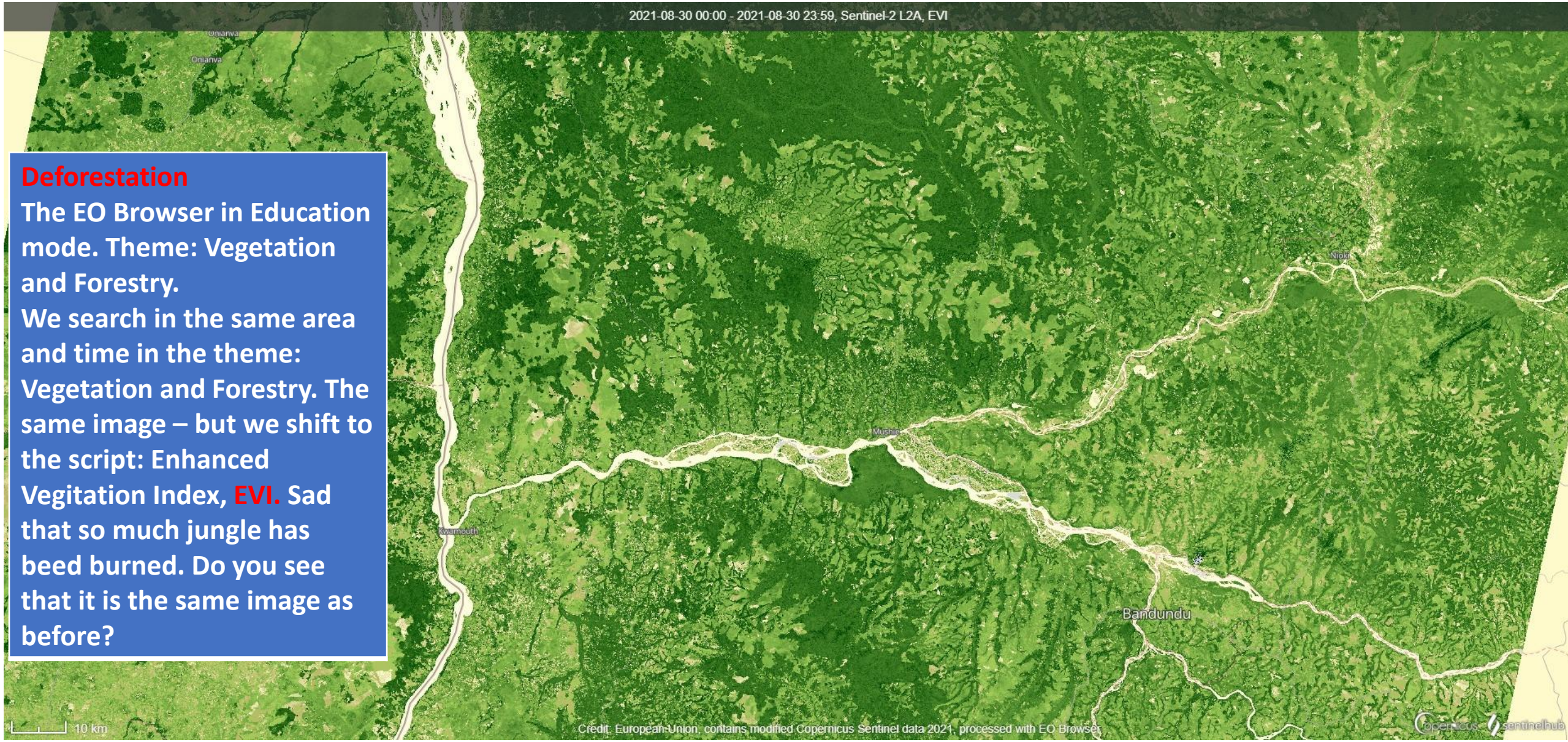
The EO Browser in Education mode. Theme: Wildfires In this theme you are offered to choose the script: Burned Area Detection. Newly burned areas are marked in red color.


2021-08-30 00:00 - 2021-08-30 23:59, Sentinel-2 L2A, Barren Soil
Onianva
Onianva
Deforestation
The EO Browser in Education mode. Theme: Vegetation and Forestry. We search in the same area and time in the theme: Vegetation and Forestry. Here we may choose the Barren Soil script. The Barren soil is marked with red color. Sad.
Nioki
Mushie
Kwamouth
Bandundu
10 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus sentinelhub



Deforestation

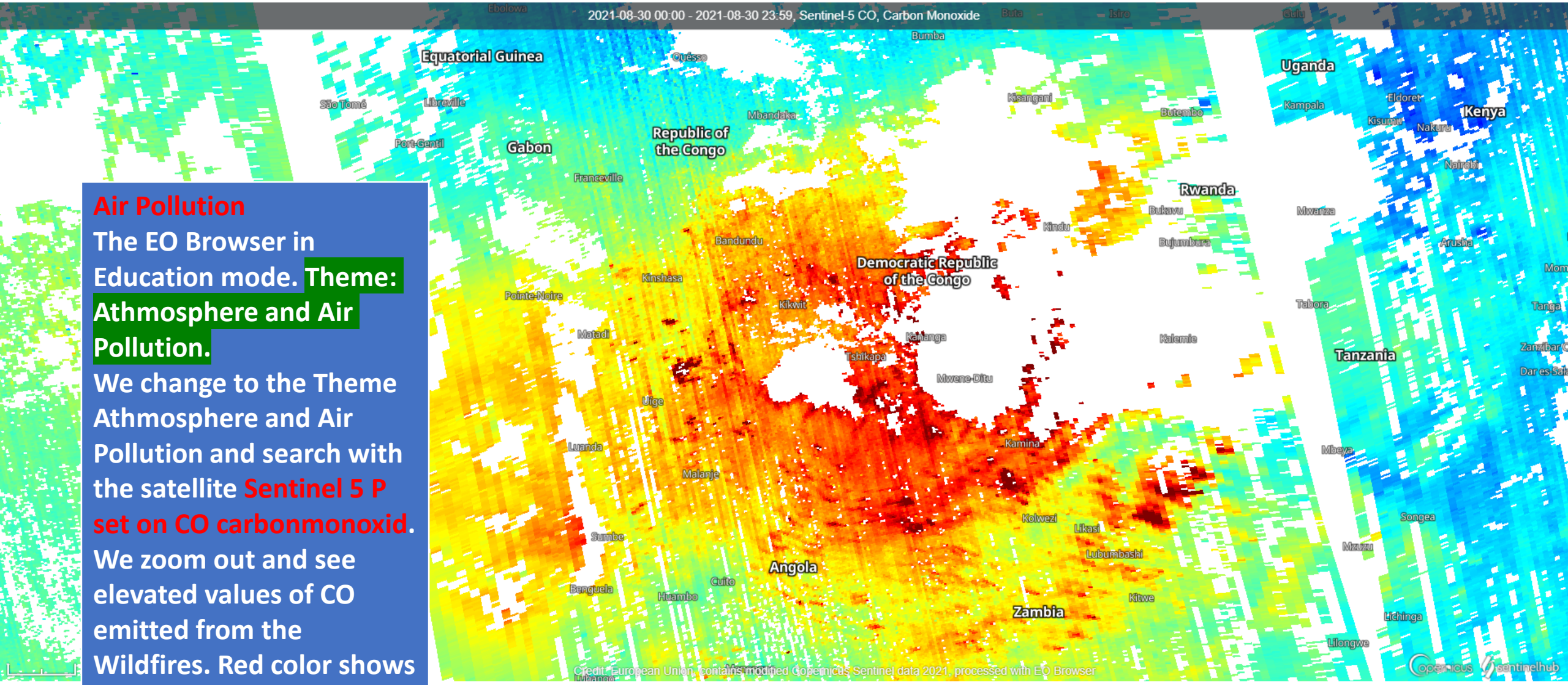
The EO Browser in Education mode. Theme: Vegetation and Forestry. We search in the same area and time in the theme: Vegetation and Forestry. The same image – but we shift to the script Agriculture.
Barren soil is magenta.
Crops are light green and forest is darker green. Sad that so much forest been burned. In this script you see the smoke. In the Congo Delta palm oil is also grown.



Deforestation

The EO Browser in Education mode. Theme: Vegetation and Forestry.

We search in the same area and time in the theme: Vegetation and Forestry. The same image – but we shift to the script: Enhanced Vegitation Index, EVI. Sad that so much jungle has beed burned. Do you see that it is the same image as before?

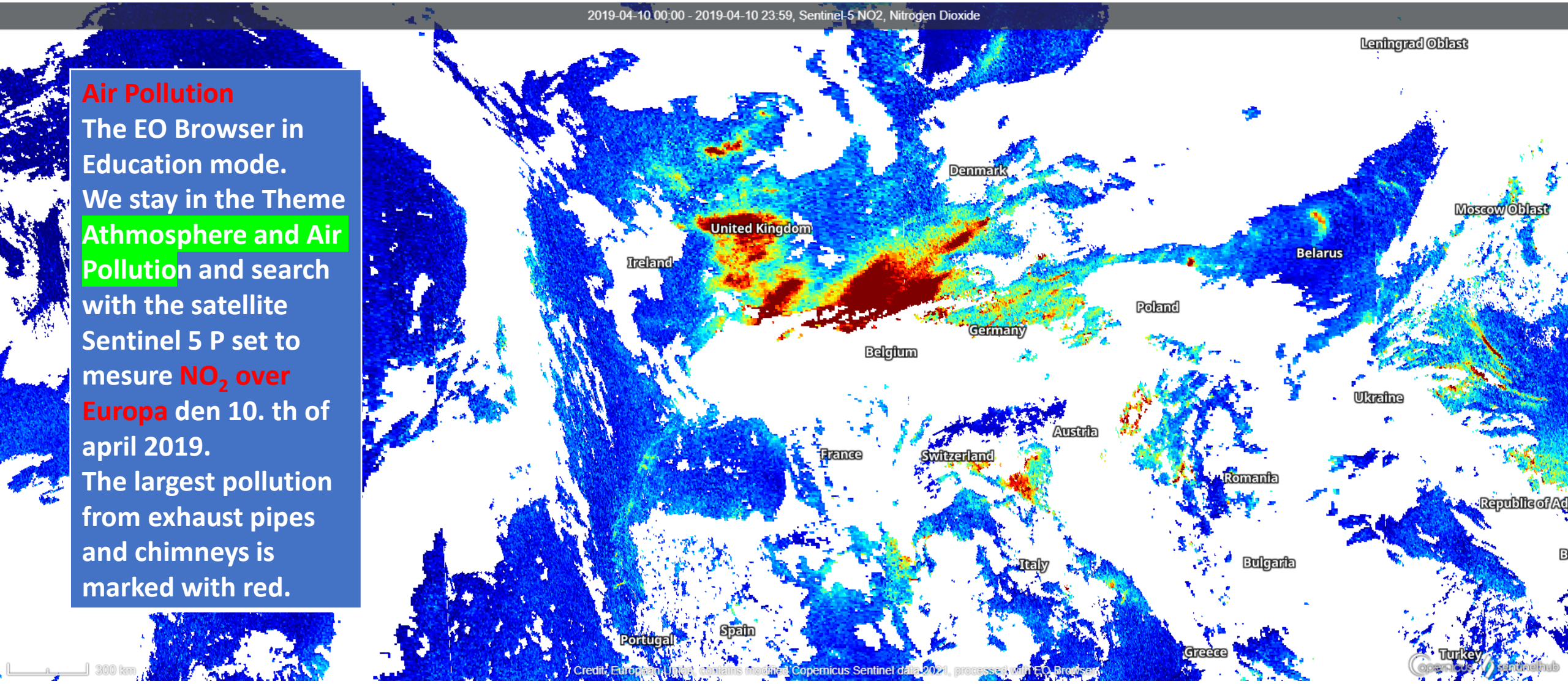


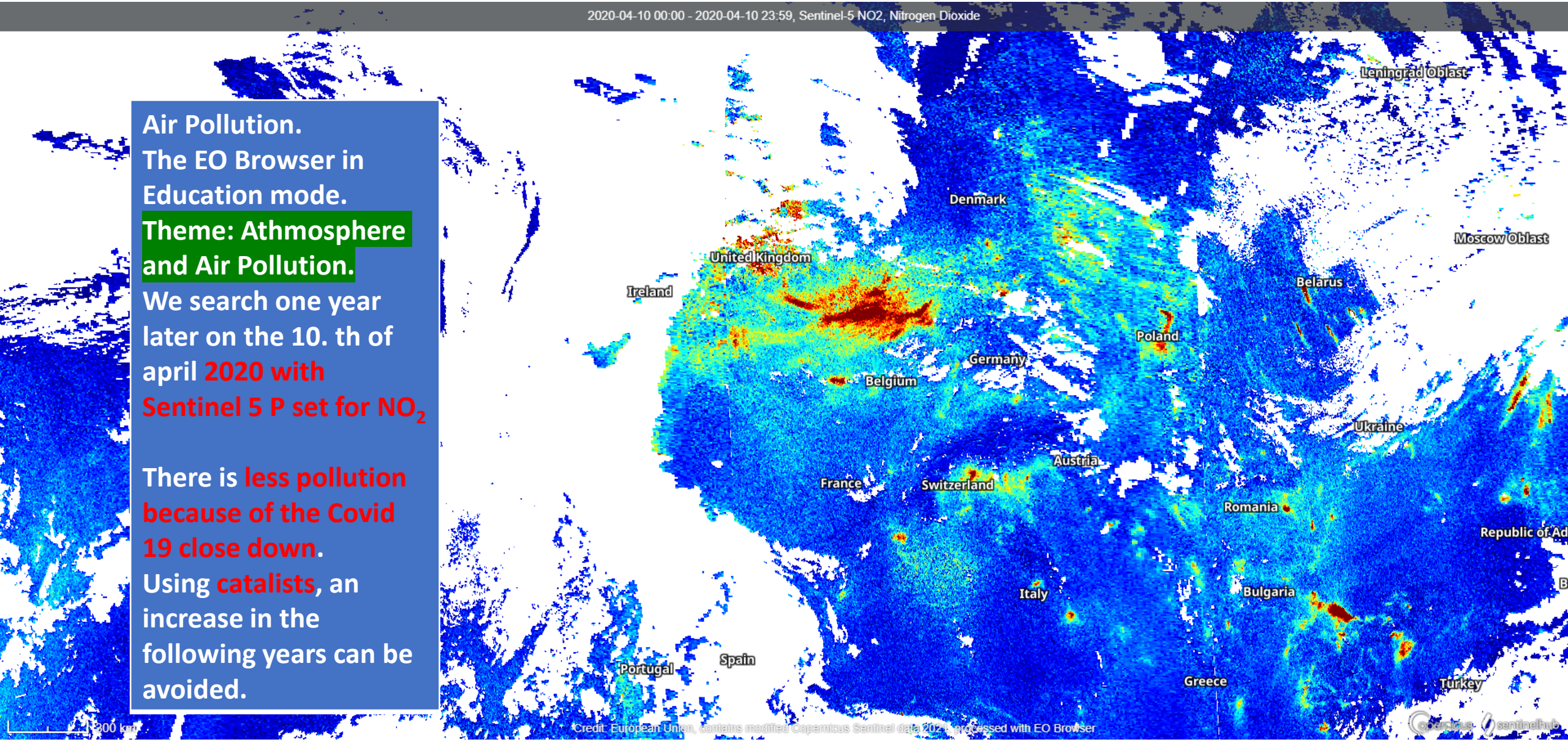
Air Pollution

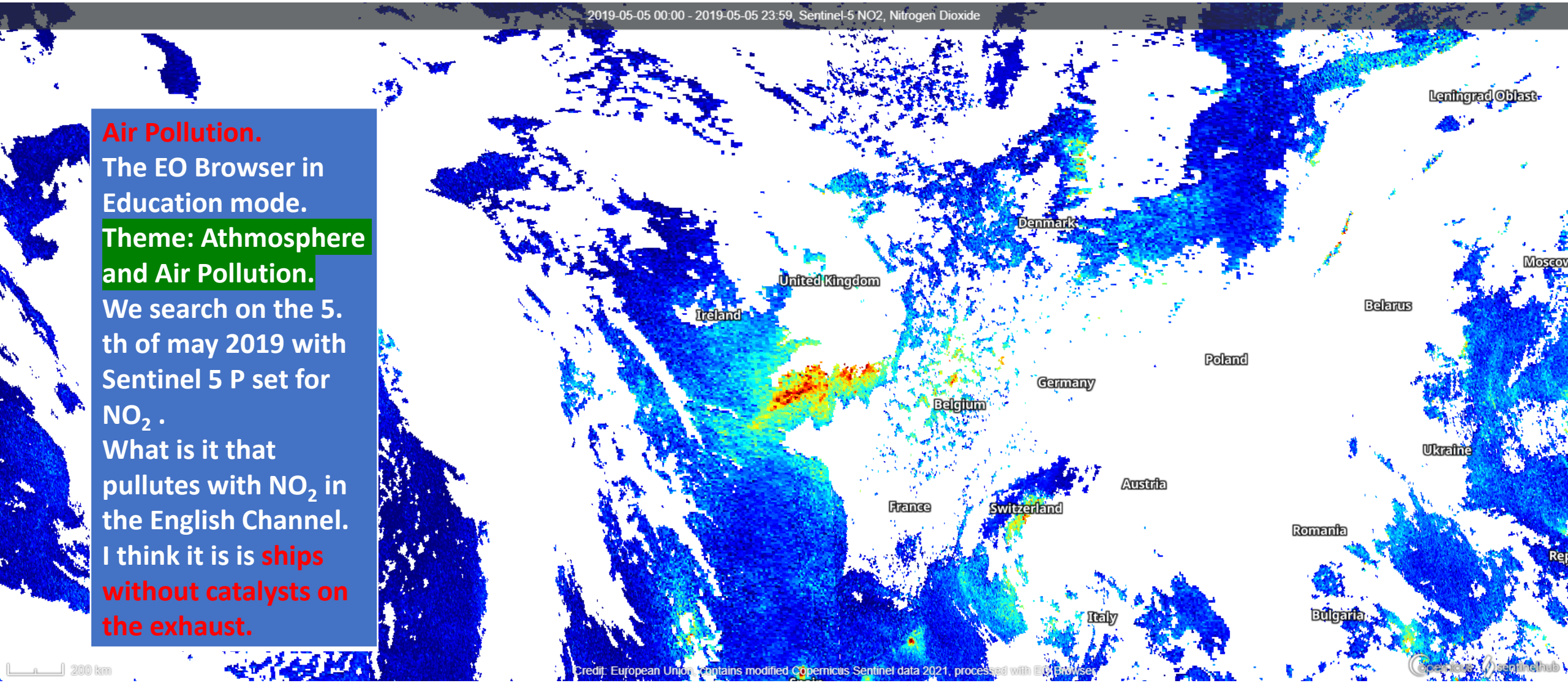
The EO Browser in Education mode. Theme: Athmosphere and Air Pollution.

We change to the Theme Athmosphere and Air Pollution and search with the satellite Sentinel 5 P set on CO carbonmonoxid.

We zoom out and see elevated values of CO emitted from the Wildfires. Red color shows the largest pollution.


2019-04-10 00:00 - 2019-04-10 23:59, Sentinel-5 NO2, Nitrogen Dioxide
Air Pollution
The EO Browser in Education mode.
We stay in the Theme Athmosphere and Air Pollution and search with the satellite Sentinel 5 P set to mesure NO_2 over Europa den 10. th of april 2019.
The largest pollution from exhaust pipes and chimneys is marked with red.
Leningrad Oblast
Moscow Oblast
Denmark
United Kingdom
Ireland
Belarus
Poland
Germany
Belgium
Ukraine
Austria
France
Switzerland
Romania
Republic of Ad
Bulgaria
Italy
Spain
Portugal
Greece
Turkey
300 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser


2020-04-10 00:00 - 2020-04-10 23:59, Sentinel-5 NO2, Nitrogen Dioxide
Air Pollution.
The EO Browser in Education mode.
Theme: Athmosphere and Air Pollution.
We search one year later on the 10. th of april 2020 with Sentinel 5 P set for NO_2
There is less pollution because of the Covid 19 close down.
Using catalists, an increase in the following years can be avoided.
Leningrad Oblast
Denmark
Moscow Oblast
United Kingdom
Ireland
Belarus
Poland
Germany
Belgium
Ukraine
Austria
France
Switzerland
Romania
Republic of Ad
Italy
Bulgaria
Spain
Portugal
Greece
Turkey
300 km
Credit: European Union, contains modified Copernicus Sentinel data 202 , processed with EO Browser


2019-05-05 00:00 - 2019-05-05 23:59, Sentinel-5 NO2, Nitrogen Dioxide
Air Pollution.
The EO Browser in Education mode.
Theme: Athmosphere and Air Pollution.
We search on the 5. th of may 2019 with Sentinel 5 P set for NO_2 .
What is it that pullutes with NO_2 in the English Channel.
I think it is is ships without catalysts on the exhaust.
Leningrad Oblast
Denmark
United Kingdom
Ireland
Belarus
Poland
Germany
Belgium
Ukraine
Austria
France
Switzerland
Romania
Italy
Bulgaria
200 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser

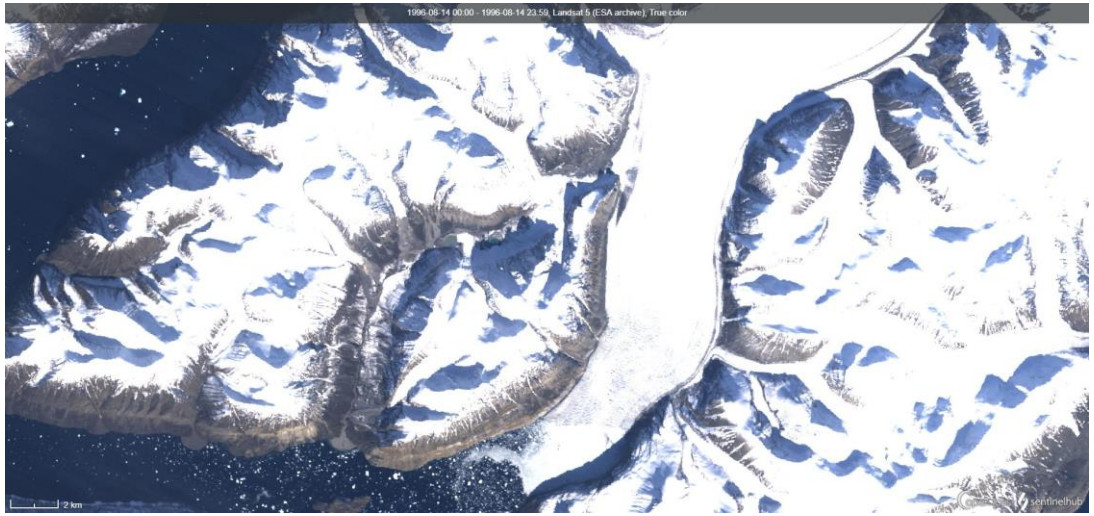
Coral reefs are losing color due to warming and acdification with dissolved CO_2 in the sea

Great Barrier Reef in 2017 with a nice green color – Sentinel 2 - True Color

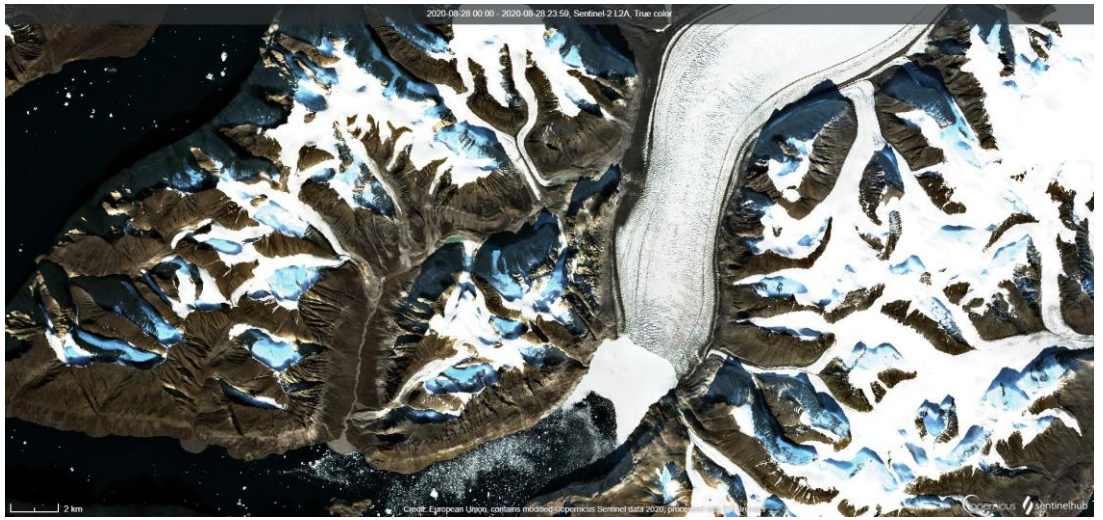
3 years later the color has faded because many corals are dead

Glaciers in Ilulissat are receeding due to global warming

Photographed by Landsat 5 in August 1996

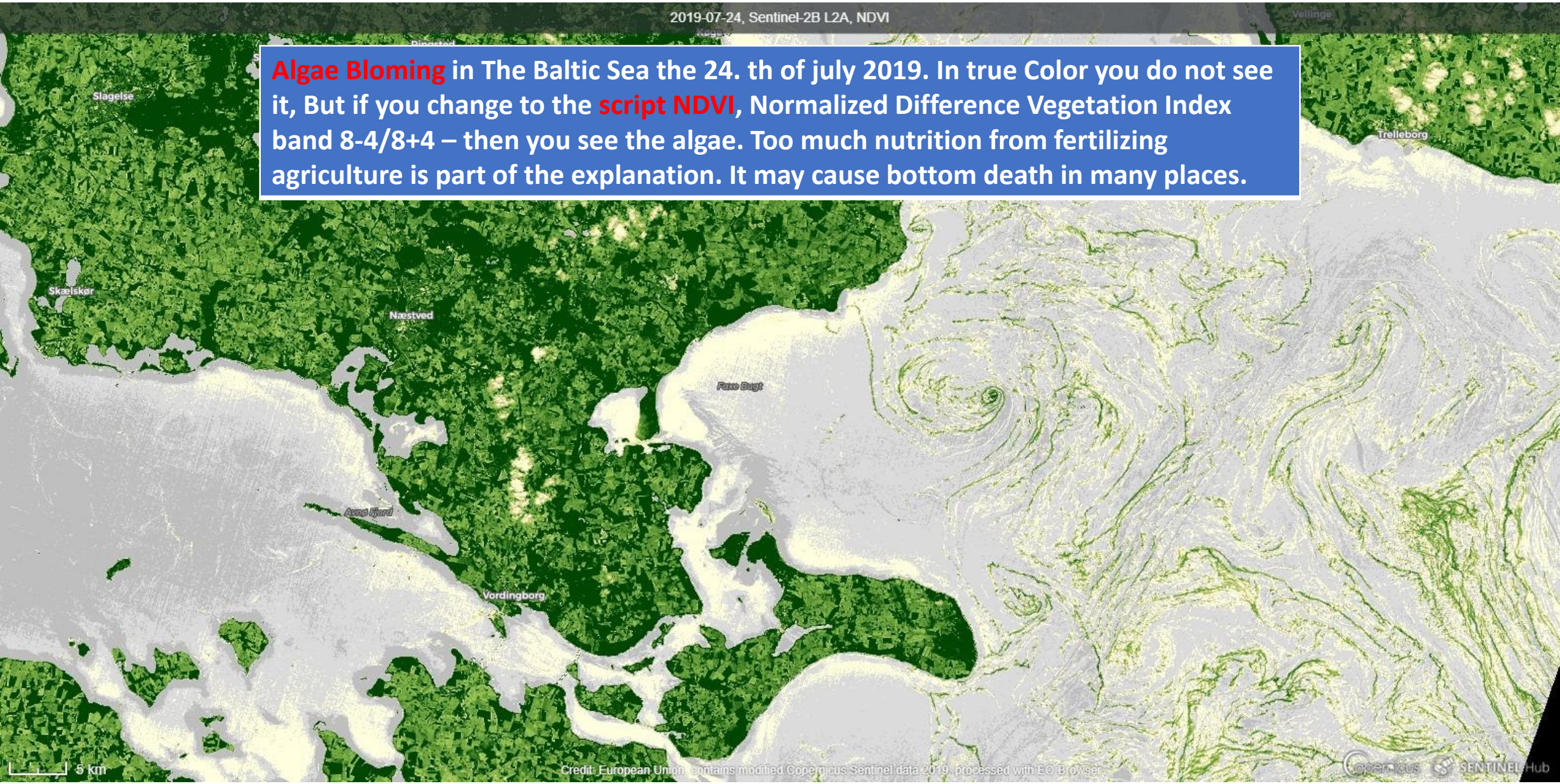


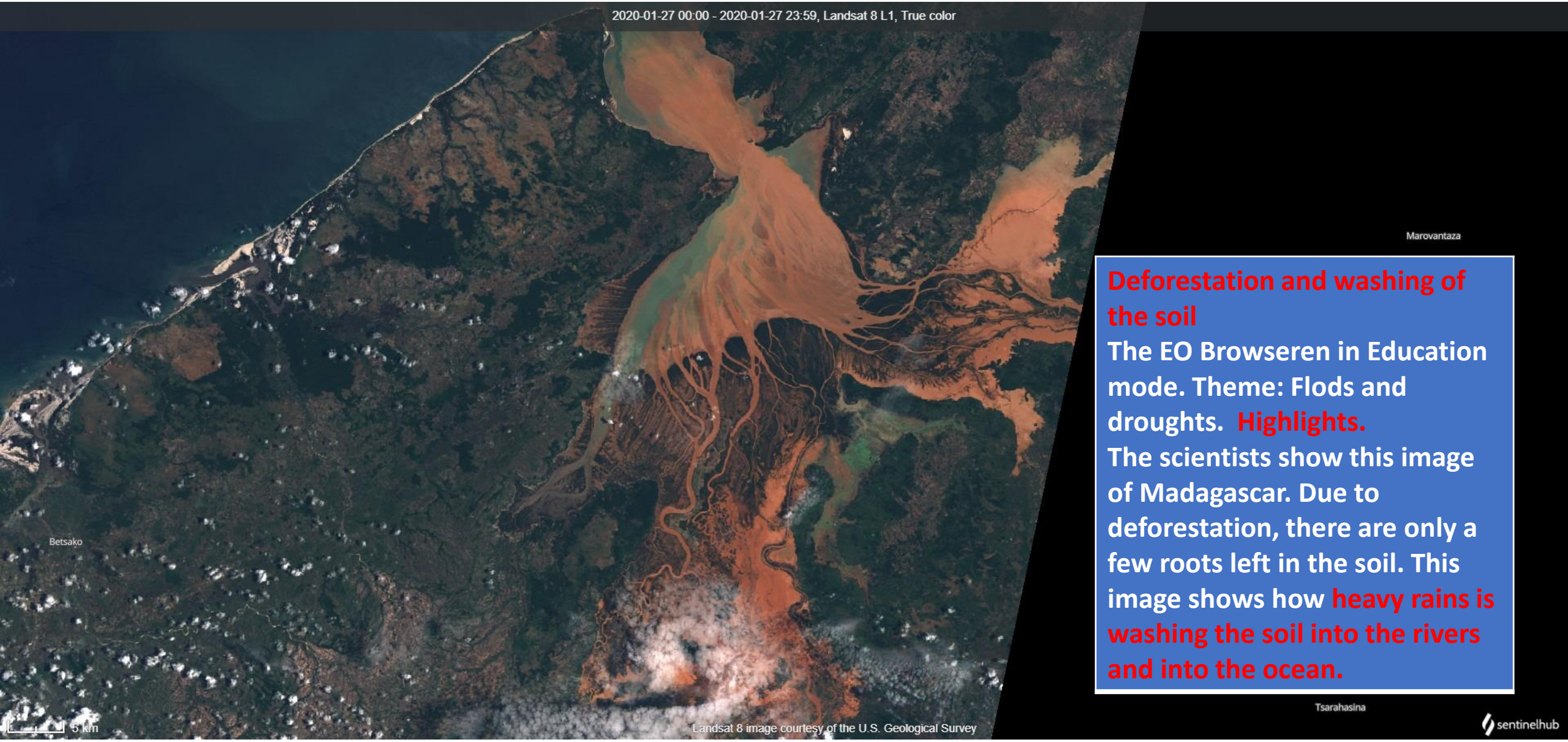
The same area photographed by Sentinel 2 in August 2020



Drought

Drought in Denmark in July 2018 - Sentinel 2, True Color. With NDVI, Normalized Difference Vegetation Index you can analyse the devellopment. Climate change increases the risk of droughts and floods and severe wether.

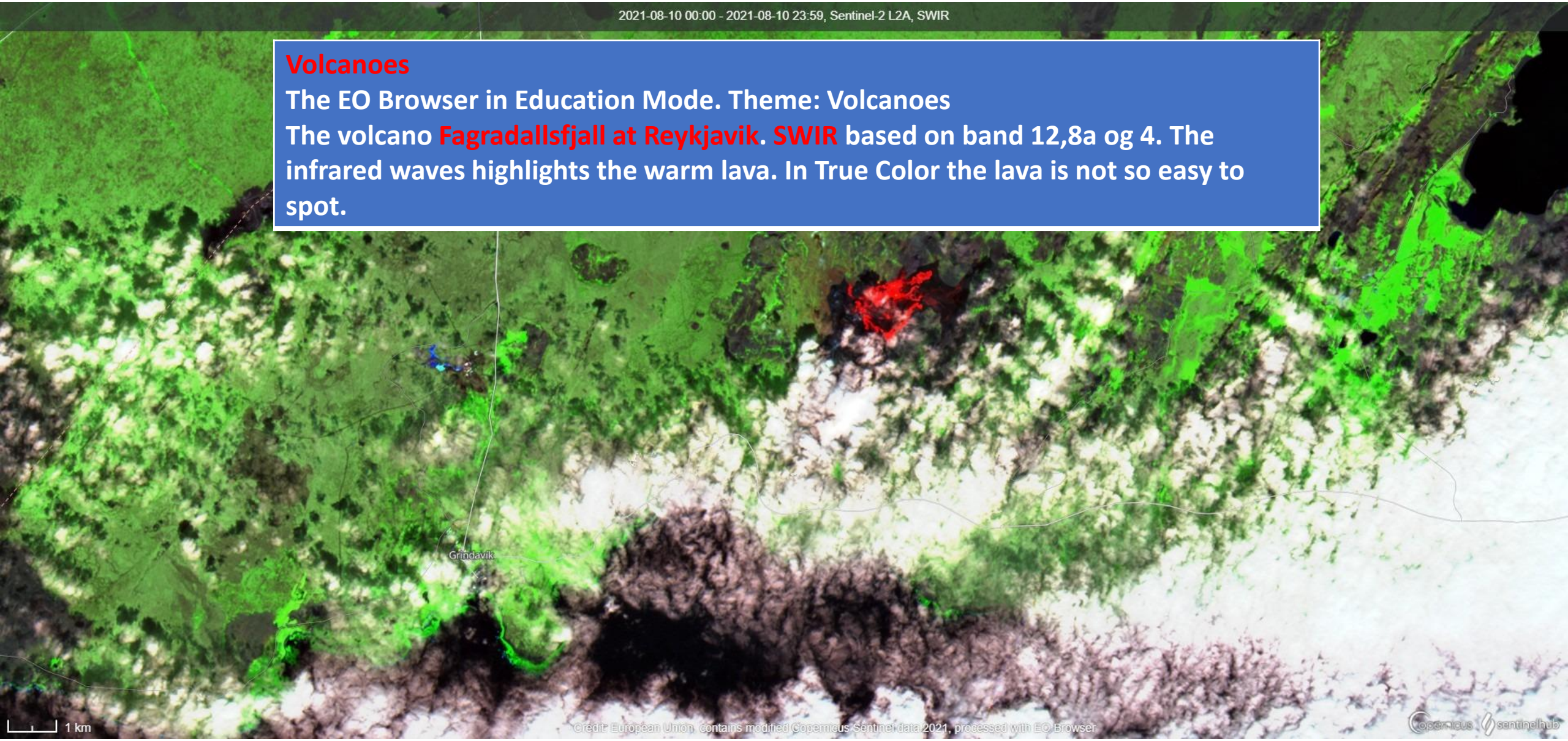

2019-07-24, Sentinel-2B L2A, NDVI
Algae Bloming in The Baltic Sea the 24. th of july 2019. In true Color you do not see it, But if you change to the script NDVI, Normalized Difference Vegetation Index band 8-4/8+4 – then you see the algae. Too much nutrition from fertilizing agriculture is part of the explanation. It may cause bottom death in many places.
Slagelse
Skælskør
Næstved
Faxe Bugt
Trelleborg
Vellinge
Vordingborg
5 km
Credit: European Union, contains modified Copernicus Sentinel data 2019, processed with EO Browser

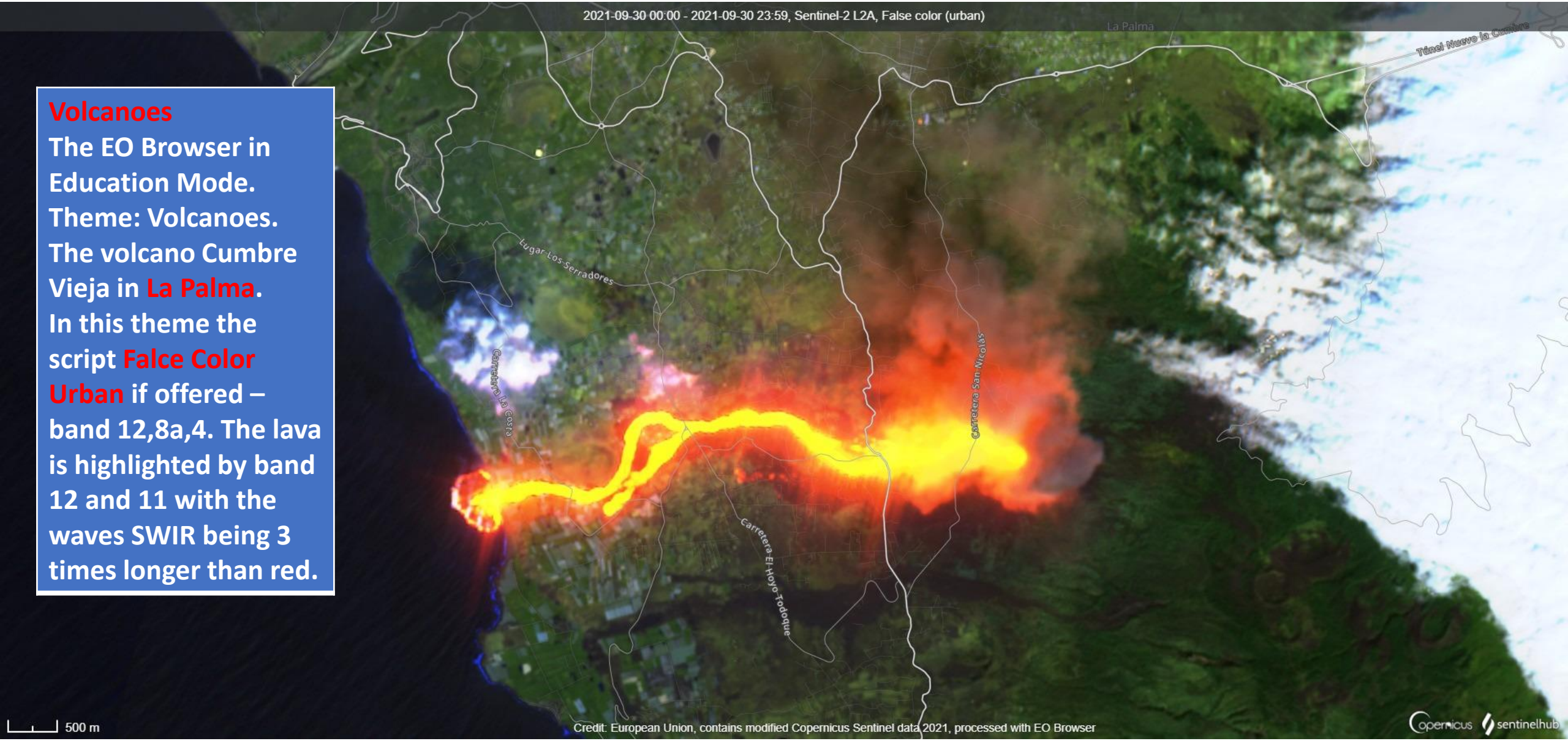


Deforestation and washing of the soil

The EO Browseren in Education mode. Theme: Flods and droughts. Highlights.

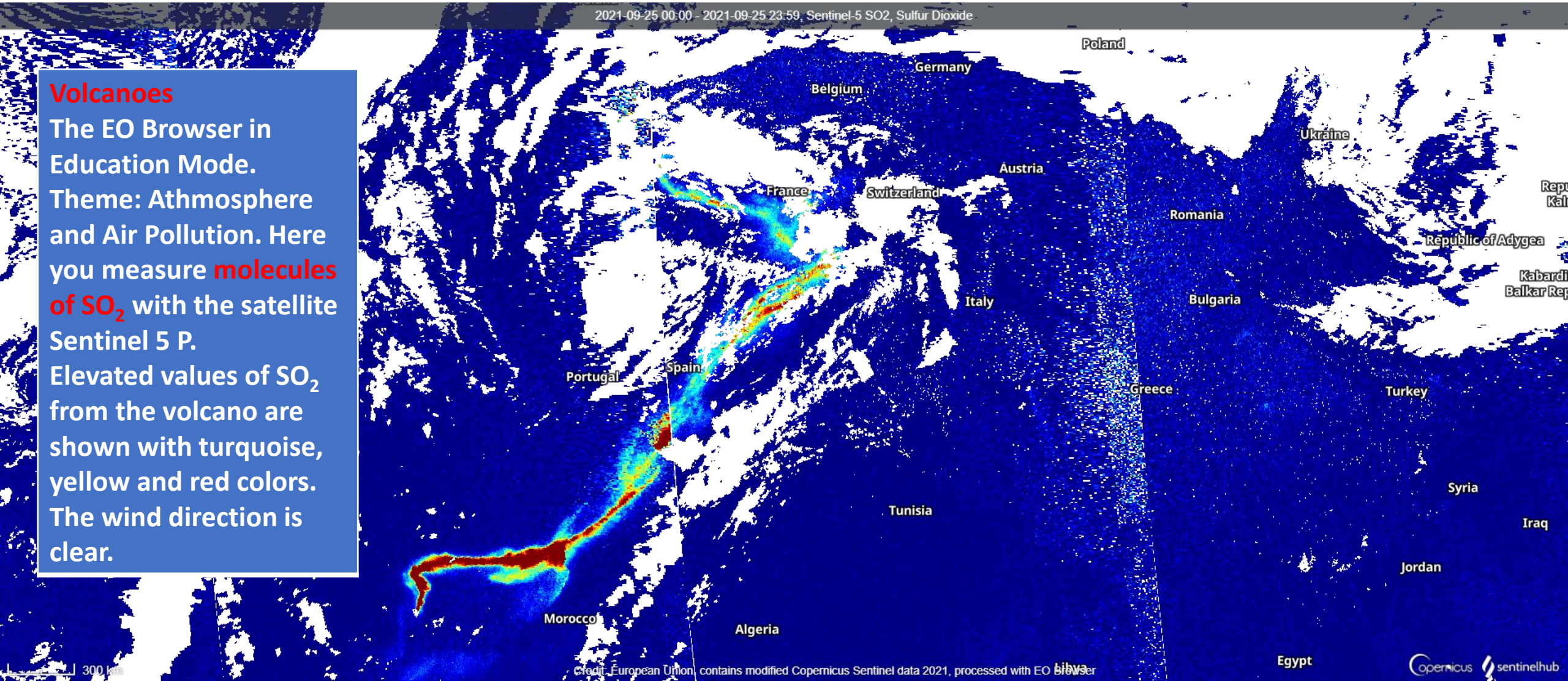
The scientists show this image of Madagascar. Due to deforestation, there are only a few roots left in the soil. This image shows how heavy rains is washing the soil into the rivers and into the ocean.

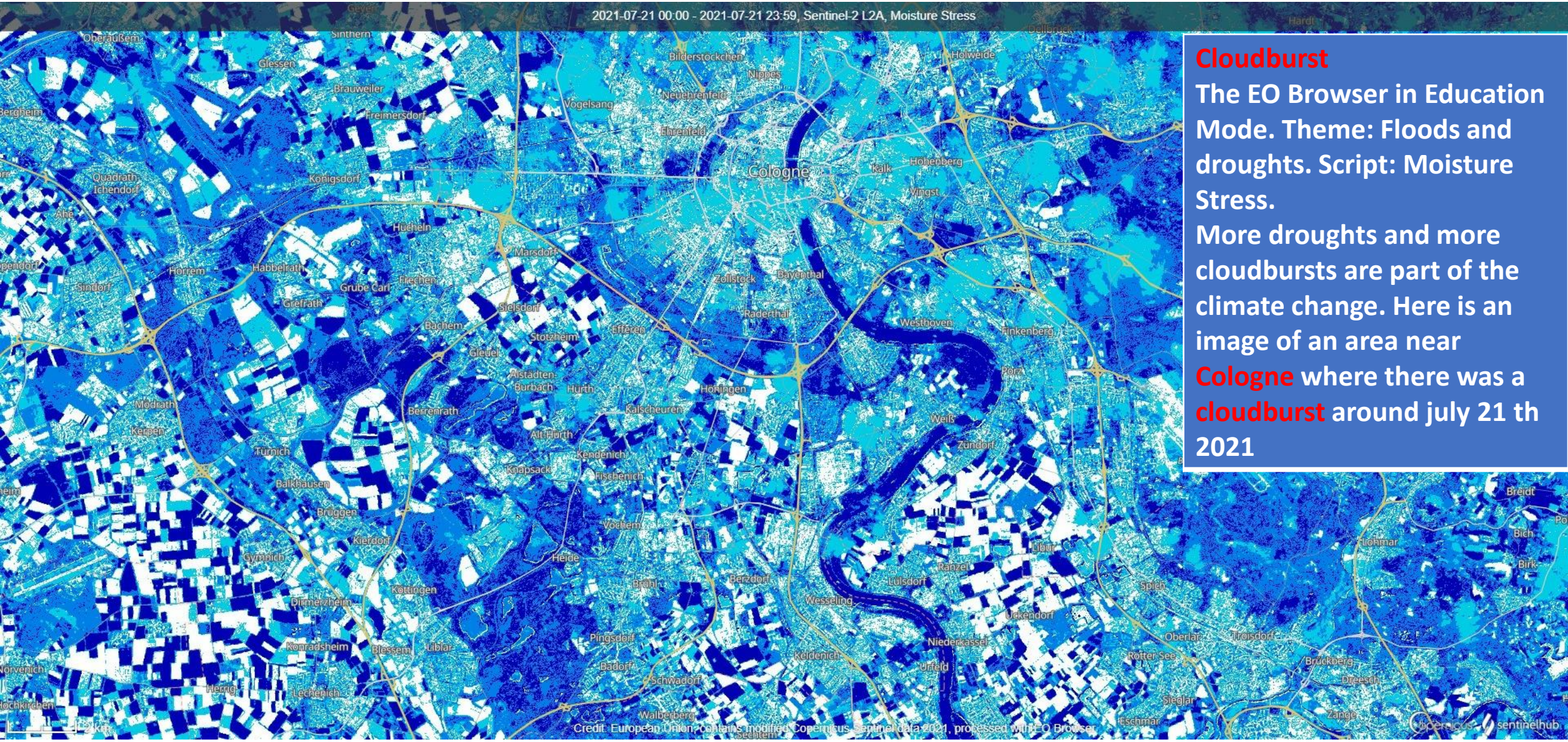

2021-08-10 00:00 - 2021-08-10 23:59, Sentinel-2 L2A, SWIR
Volcanoes
The EO Browser in Education Mode. Theme: Volcanoes
The volcano Fagradallsfjall at Reykjavik. SWIR based on band 12,8a og 4. The infrared waves highlights the warm lava. In True Color the lava is not so easy to spot.
Grindavik
1 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinel hub



Volcanoes

The EO Browser in Education Mode. Theme: Volcanoes. The volcano Cumbre Vieja in La Palma. In this theme the script Falce Color Urban if offered – band 12,8a,4. The lava is highlighted by band 12 and 11 with the waves SWIR being 3 times longer than red.

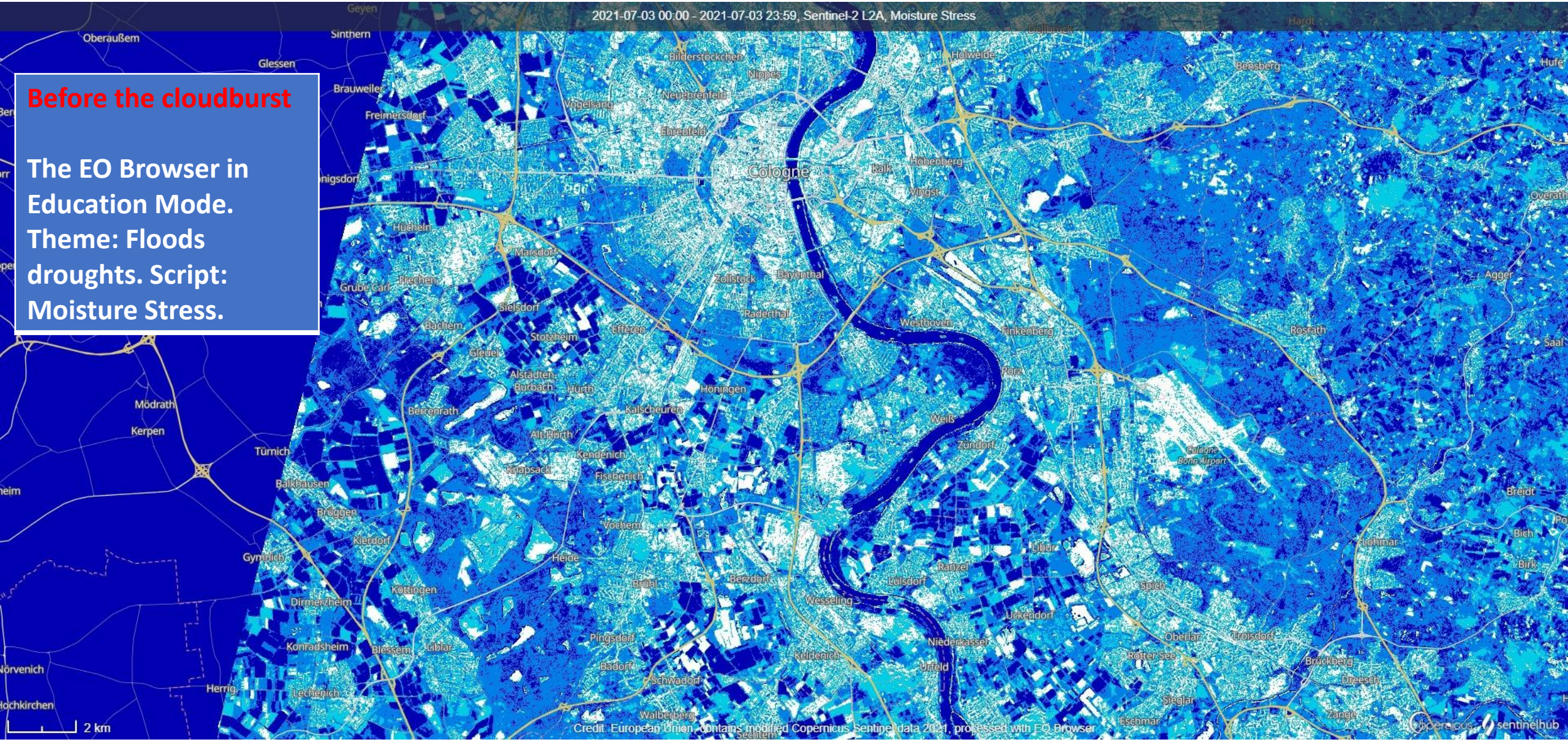

2021-09-25 00:00 - 2021-09-25 23:59, Sentinel-5 SO2, Sulfur Dioxide
Volcanoes
The EO Browser in Education Mode.
Theme: Athmosphere and Air Pollution. Here you measure molecules of SO_2 with the satellite Sentinel 5 P.
Elevated values of SO_2 from the volcano are shown with turquoise, yellow and red colors.
The wind direction is clear.
Poland
Germany
Belgium
Ukraine
Austria
France
Switzerland
Romania
Republic of Adygea
Italy
Bulgaria
Portugal
Spain
Greece
Turkey
Syria
Tunisia
Iraq
Jordan
Morocco
Algeria
Egypt
Libya
300 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
Copernicus
sentinelhub

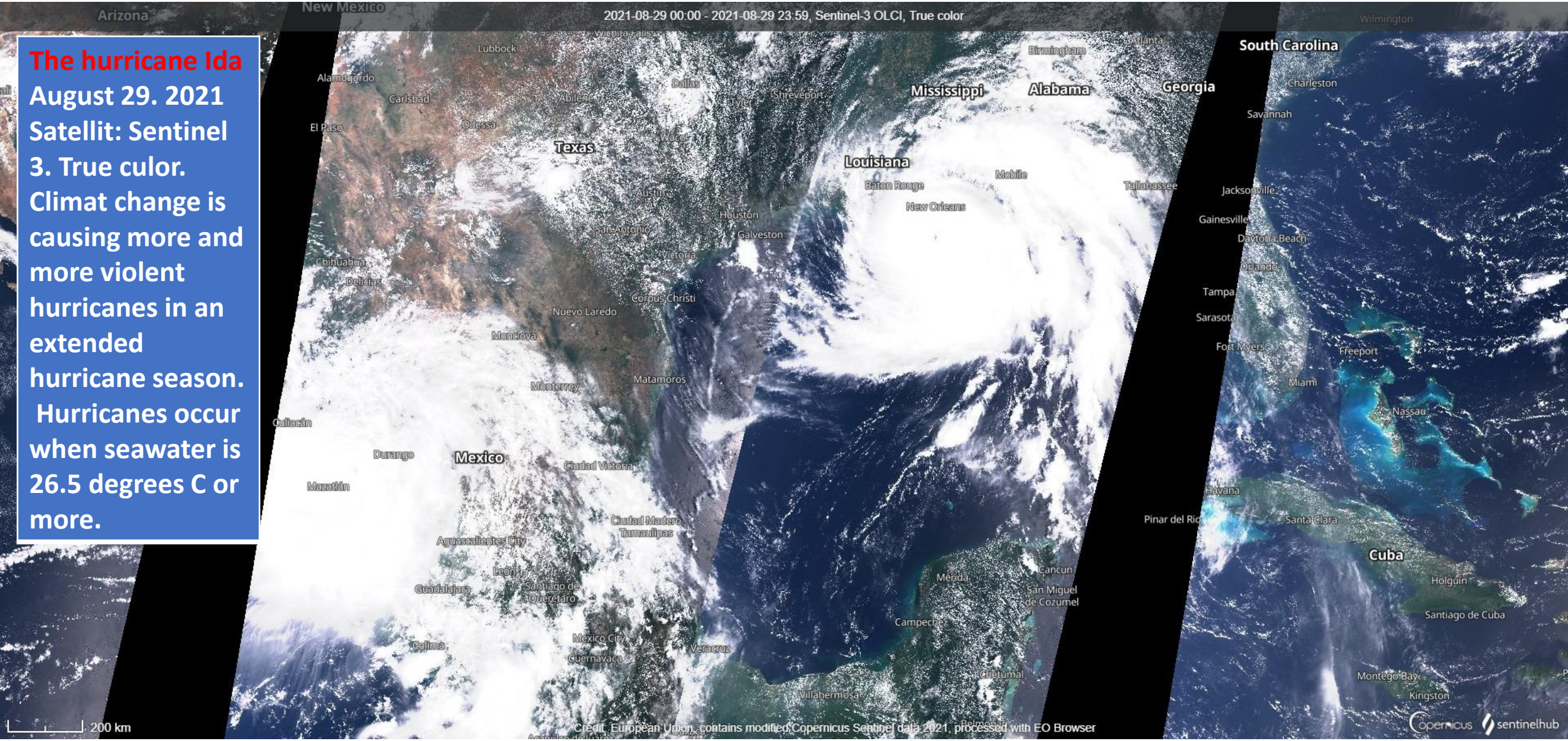


Cloudburst

The EO Browser in Education Mode. Theme: Floods and droughts. Script: Moisture Stress.

More droughts and more cloudbursts are part of the climate change. Here is an image of an area near Cologne where there was a cloudburst around july 21 th 2021


2021-07-03 00:00 - 2021-07-03 23:59, Sentinel-2 L2A, Moisture Stress
Before the cloudburst
The EO Browser in Education Mode. Theme: Floods droughts. Script: Moisture Stress.
Cologne
Oberaußem
Glessen
Sinthern
Brauweiler
Freimersdorf
Hücheln
Marsdorf
Grube Carl
Frechen
Sielsdorf
Bachem
Stotzheim
Efferen
Gleuel
Alstädten
Burbach
Hürth
Berrenrath
Kalscheuren
Honnigen
Alt Hürth
Kendenich
Knapsack
Fischenich
Vochem
Heide
Brühl
Berzdorf
Wesseling
Pingsdorf
Badorf
Schwadorf
Walberberg
Keldenich
Urfeld
Niederkassel
Uckendorf
Ranzel
Lülsdorf
Libur
Spich
Oberlar
Troisdorf
Rotter See
Bruckberg
Dreesch
Siegler
Eschmar
Zange
Lohmar
Bich
Birk
Breidt
Rosrath
Agger
Saal
Overath
Hufe
Bensberg
Holweide
Nippes
Neuehrenfeld
Vogelsang
Ehrenfeld
Kalk
Höhenberg
Vingst
Zollstock
Bayenthal
Raderthal
Westhoven
Finkenberg
Pörz
Weiß
Zündorf
Cologne Bonn Airport
Mödrath
Kerpen
Türnich
Balkhausen
Brüggen
Kierdorf
Gymnich
Kottingen
Dirmerzheim
Konradsheim
Blessem
Liblar
Herrig
Lechenich
Nörvenich
Hochkirchen
2 km
Credit: European Union, contains modified Copernicus Sentinel data 2021, processed with EO Browser
sentinelhub



The hurricane Ida
August 29. 2021
Satellit: Sentinel 3. True culor.
Climat change is causing more and more violent hurricanes in an extended hurricane season.
Hurricanes occur when seawater is 26.5 degrees C or more.

The UN Sustainable Development Goals

When you are confronted with a global problem, you can often investigate it with satellite imagery.

The UN Sustainable Devellopment Goals show ways to solve many global problems.

Here are 7 of these goals:

Goal 7: Affordable and clean energy

Goal 9: Industri, Innovation, and infrastructure

Goal 11: Sustanable cities and communities

Goal 12: Responsible consumption and production

Goal 13: Climate action

Goal 14: Life below water

Goal 15: Life on land

Examine how these sustainable devellopment goals relate to the global problems you have studied with satellite imagery.

https://sdgs.un.org/goals