Cross-cutting geospatial and environmental STEAM instruments
for the new generation
(GOSTEAM) Project No: 2020-1-SE01-KA201-077972

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GOSTEAM Hands-on Activity Template *(Inquiry-based)*

Title:

Earth Observation & Satellite images in your classroom

Short Description (Max 500 words):

During this activity students will be introduced to a brief theoretical explanation of what remote sensing is followed by practical demonstrations of its potential including: land-use changes and urban sprawl, identification of fires, volcanic eruptions, floods, etc. Hence, numerous and varied case studies are used to show the possibilities of Remote Sensing in identifying natural and anthropogenic events at different spatio-temporal scales. Furthermore, explanations and technical guidelines are provided for the EO Browser tool so that students can learn how to search for and process satellite images through this online application.

Keywords (Up to 5):

Remote Sensing, Satellite Images, Environmental Monitoring, Disaster Risk Impact Assessment

Information about the Implementation

Age and language of the students:

	9-12	12-15	15-18	18+
Language: Greek — Age:	☐	☑	☑	☐

Number of Lessons – Duration (per lesson):

Number of Lessons: 1 Duration per Lesson: 45’

Subjects:

For which subject(s) the activity is usable, is it an interdisciplinary activity?

- Science ☑
  - Physics ☑ Chemistry ☐ Biology ☐ Geosciences ☑ Environmental ☑ Other ☐
- Technology ☑
- Engineering ☑
- Arts ☑
- Mathematics ☑

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Information about the Scenario

Curriculum and country:

Link of the current activity to the curriculum:

Country: Greece | Class: Secondary | Grade: 7 - 12

Topic: Environment, Geography, Physics

Objectives (Max 100 words):

Description of the learning objectives

Some of the key objectives to be addressed through this activity include:

1) The use of emerging technologies, such as Remote Sensing, to analyze real-time territorial changes and space-time processes at the Earth's surface,

2) The incorporation of a geographical point of view through remote sensing tools in order to analyze phenomena linked to global environmental changes and disaster risk management.

Materials (Max 100 words):

Which resources and materials (software, hardware) are needed?

Material: Search Engines, Satellite Images

Software: EO Browser (Online)

Spatial concepts, skills, and abilities:

Which spatial concepts and skills are covered by the activity?

Spatial concepts:

Primitives: Identity/Name ☐ Location ☑ Space/Time ☑

Simple: Distance ☐ Direction ☐ Connectivity ☐ Movement ☐

Boundary ☐ Shape/Area ☑ Adjacency ☐

Difficult: Overlay ☐ Buffer ☐ Topology ☐ Coordinate ☐

Map ☐ Scale ☐ Shortest Path ☐ Navigation ☐

Surface ☑ Slope/Gradient ☐ Aspect ☐ Contour ☐

Complex: Interpolation ☐ Map Projection ☐ Spatial Dependency ☑

Other:

Spatial skills:

- ☐ Map literacy
- ☐ Navigation/orientation
- ☐ Estimating distances and directions
- ☑ Recognizing and understanding patterns/Understand and identify models of spatial organization
- ☐ Select an ideal location based on the given spatial features
- ☑ Visualization
- ☑ Understand and identify spatial correlations/ dependencies
- ☐ Categorize spatial entities/ geographic features and identify hierarchies
- ☑ Compare spatial entities and draw analogies among them
- ☐ Identify/determine connections/relations
- ☐ Understanding scale in space and time
- ☐ Delineation of spatial regions/ zones based on given features/ properties

Short Description

Navigation/orientation: Finding one's way in unfamiliar environments, interpreting and giving walking and driving directions.
Estimating distances and directions: Measure paths, weighted distances, angles.
Map literacy: Using, interpreting/understanding, learning from, and communicating acquired spatial knowledge from maps, comprehension of geographic features represented as points, lines, or polygons.
Recognizing and understanding patterns/Understand and identify models of spatial organization. Delineation of spatial regions/zones based on given features/properties: Regionalization processes, pattern recognition and clustering identification in the 2d and/or the 3d world.
Select an ideal location based on the given spatial features: Single or multi-criteria siting and optimal areas identification.
Visualization: Visualizing spatial entities from written/oral verbal descriptions, from their 2d or graphical representations or through mental transformations; such as axis rotation or perspective taking.
Understand and identify spatial correlations/ dependencies: The ability to realize, identify and explain patterns, clusters and relevant spatial dependencies.
Categorize spatial entities/geographic features and identify hierarchies: Identify the hierarchical form of data and gradients between spatial entities.
Compare spatial entities and draw analogies among them: Calculate and compare different geometric objects' shapes, area and boundaries.
Identify/determine connections/relations: The ability to identify links and common characteristics among spatial entities and between humans and spatial entities.
Understanding scale in space and time: The understanding of changes/transitions through space and time for different spatio-temporal scales.

Geospatial concepts and spatial abilities documentation (see Section 3.2):
http://www.gosteam.eu/wp-content/uploads/2021/05/GOSTEAM_IO1_A1_final.pdf

Description of the activity in detail

Question Eliciting Activities

Provoke curiosity

Usually, the most effective way to provoke students' curiosity is by presenting an exciting video or a series of photos

Let's begin our journey:

https://pudding.cool/2017/10/satellites/ (Seeing Earth from outer space - Storytelling)

https://www.youtube.com/watch?v=28hImDyJXu0 (Monitoring the Earth)

Propose preliminary explanations or hypotheses

Formulate the scientifically oriented questions that teachers will present to the students to trigger their engagement in thinking about the topic investigated based on their existing knowledge. Make these questions digitally available and easily usable, e.g., by integrating them in the materials described in the previous step.

It is best to ask these questions in the context of a relative discussion.

Is it possible to understand the complex interactions determining our ecosystem and climate using satellites?

Can we build better models, algorithms, and simulations to predict future changes?

Visit the following page to demonstrate some dynamic phenomena monitoring using satellites, including vegetation, climate etc!

https://apps.sentinel-hub.com/digital_twin_sandbox/

You can also ask students:

Is it possible to understand and analyze dynamic "invisible" phenomena (i.e., COVID 19 impact, natural disasters impact and consequences)?

But, how? Using indirect measures!

Active Investigation

Plan and conduct simple investigation

Provide the teachers with a specific plan of the investigation that will take place. Offer instructions about the activities they students will need to perform and what kind of materials

they may need. Describe ways that the teachers can use to facilitate the students to focus on evidence.

This is the phase in which students are being prepared for the subsequent phase of evidence gathering during observation.

Topic selection:

You can focus on one topic, for example Land-use and Landcover changes and guide students to gather evidence on how we monitor changes and why?

Explanations on Monitoring Landcover Changes, in which research topics and how. **(Link)**

Alternatively, you can guide students to search for different environmental and disaster risk topics the want to focus on, explaining why it is important to tackle this topic!

Different environmental topics **(Link)**

Curriculum connection apart from the Environmental parts – Physics and Mathematics:

How satellites work:

https://www.restec.or.jp/en/knowledge/sensing/sensing-2.html

http://satellites4everyone.co.uk/?page_id=4402

https://www.sentinel-hub.com/docs/Custom_script_tutorial.pdf

Types of earth observation imagery:

https://business.esa.int/newcomers-earth-observation-guide

Satellites list and capabilities:

https://gisgeography.com/earth-satellite-list/

Different band combinations and applicability:

Landsat 4-5

Landsat 8

Sentinel 2

https://www.sentinel-hub.com/docs/Custom_script_tutorial.pdf

Different indicators to monitor different phenomena:

https://eos.com/make-an-analysis/natural-color/

Creation

Gather evidence from observation

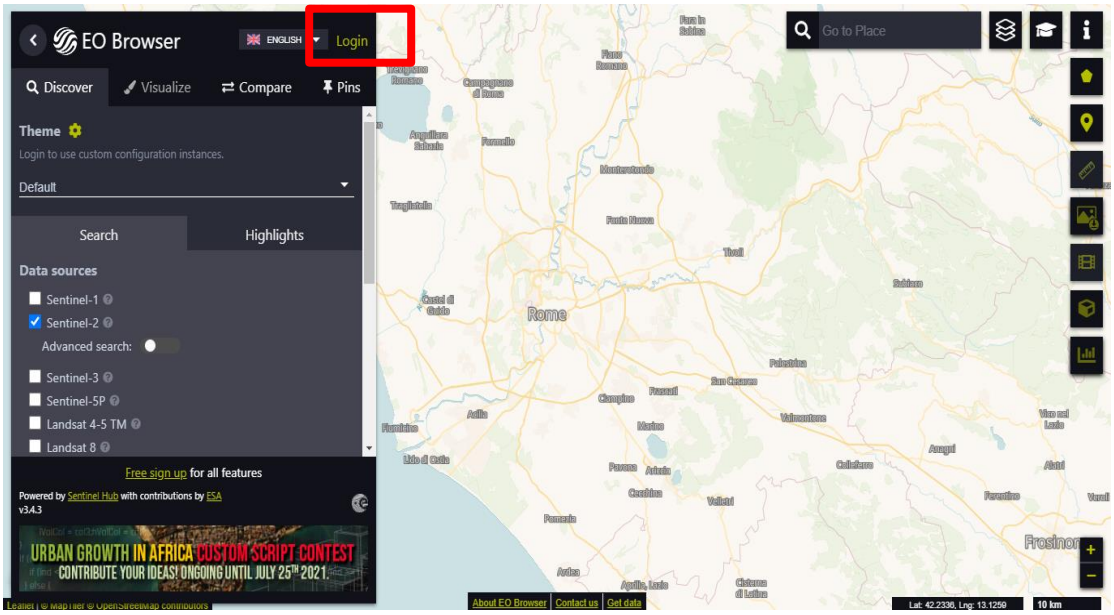
The selected resource (e.g., a simulation, an experiment, an animation, a graph, or other exhibit of similar nature) must provide students with an opportunity to collect evidence addressing the

scientific questions presented in previous stages through direct or indirect observation. Provide guidance to the teacher organize and manage the activity most effectively and efficiently.

Connect to:

Sign-up to the EO Browser platform:

1. Click on the login button and use your email info and a password to create an account and have full access to all available tools of EO Browser.
2. Verify your account through your email!



1. A simple demonstration:

Ever Given cargo ship which blocked Suez Canal

Sentinel 2 image (29/03/2021)

Timelapse: 29/02/2021 – 01/04/2021

2. Land-use change/Urban expansion:

No place on the Earth has had as drastic land cover change and urban sprawl over the past ten years as Dubai, United Arab Emirates (UAE). The creation of over 300 kilometers of coastline, the rapid expansion of urban land cover, and the intensification of urban development make

this one of the most rapidly and visibly changed land covers due to urbanization (**Source:** https://lcluc.umd.edu/).

Dubai 2000

Landsat 4-5

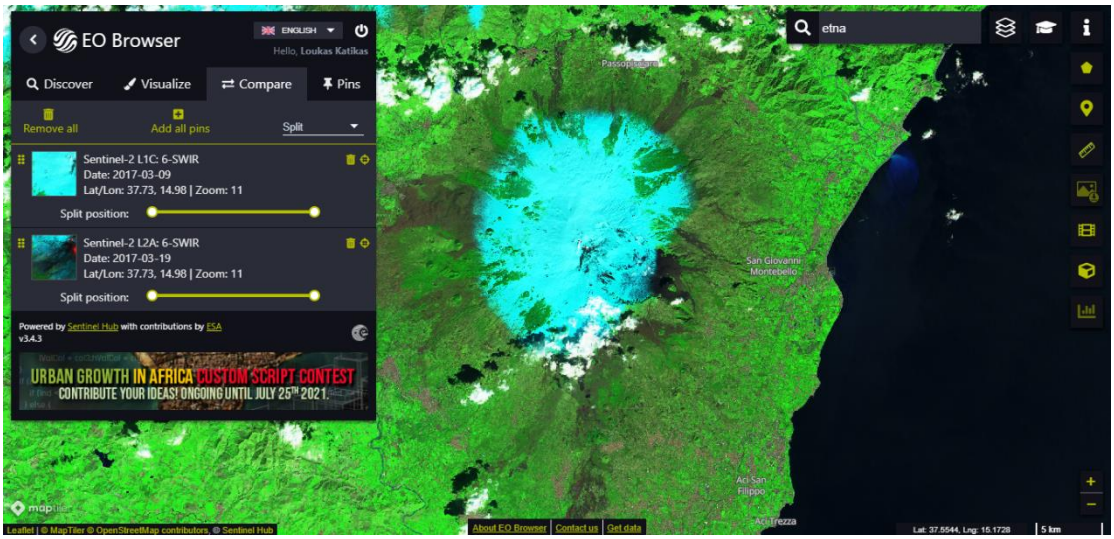
Dubai 2020

Sentinel 2

3. Volcanic eruption/Etna:

After one of the quietest years in decades, Etna has decided to make 2017 a little more exciting. On the 16th of March 2017, the volcano had a moderate strombolian eruption,

referred as a volcanic "paroxysm," that produced a lava fountain over the summit of the volcano (Source: wired.com).

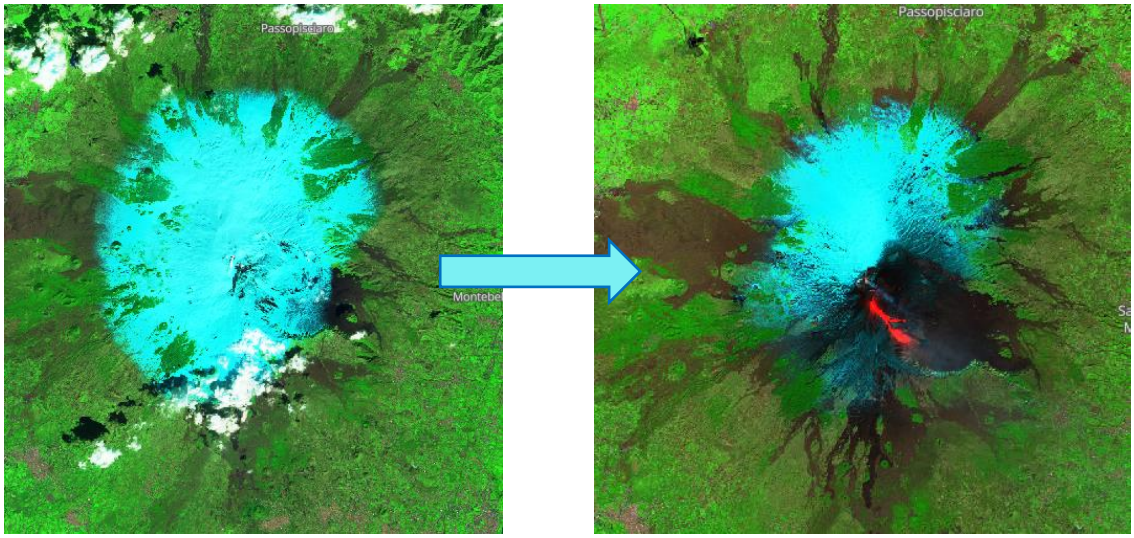


Etna 09/03/2017

Sentinel 2

Etna 19/03/2017

Sentinel 2



4. Forest fires – Bolivia:

- The 2019 Amazon rainforest wildfires season saw a year-to-year surge in fires occurring within Brazil, Bolivia, Paraguay, and Peru.
- The increased rates of fire events in 2019 led to international concern about the fate of the Amazon rainforest, which is the world's largest terrestrial carbon dioxide sink and plays a significant role in mitigating global warming (Source: Wikipedia).
- Trigger students' interest by demonstrating images of Amazon's rainforest fires from previous years.
- Use videos to highlight Amazon's importance in the Earth's climate stability.

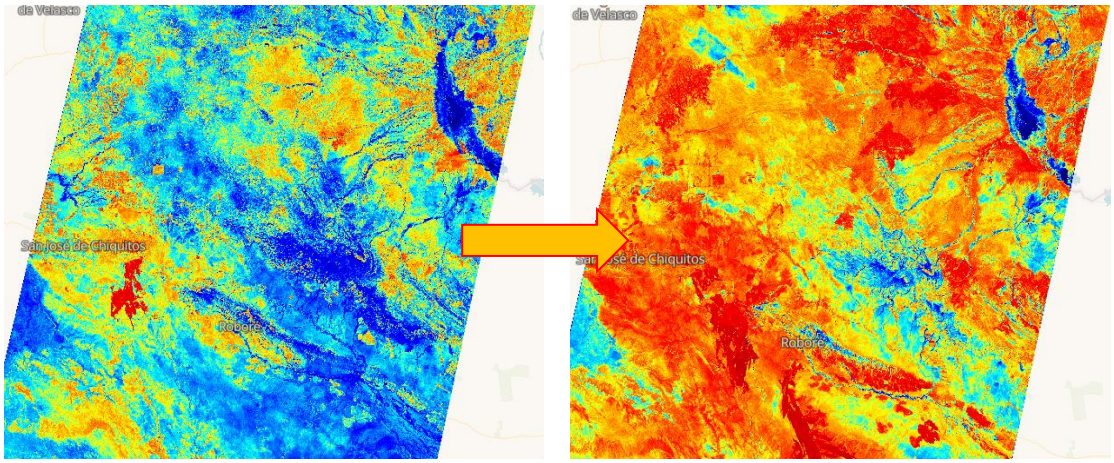
Bolivia 2016

Sentinel 2

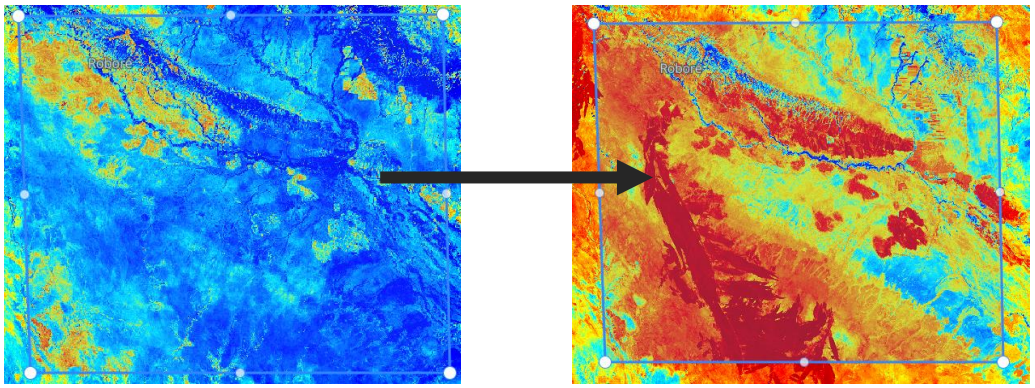
Bolivia 2019

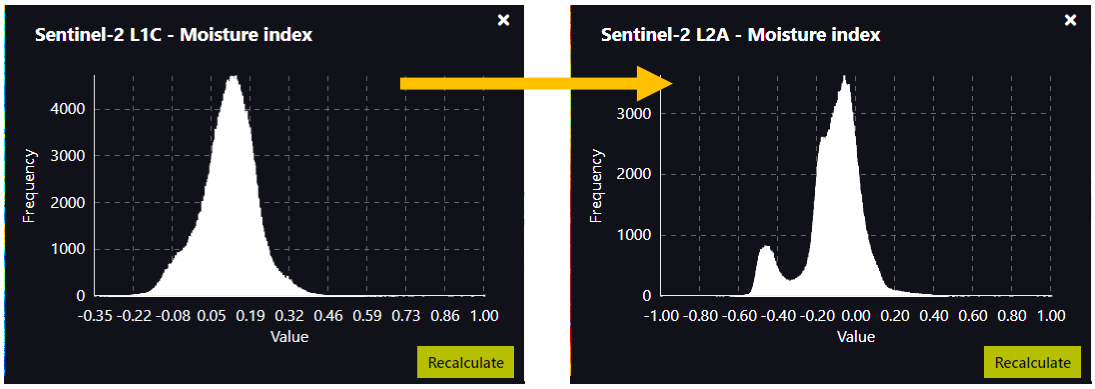
Sentinel 2

Use images of the same month!



Forest fires Moisture graphs using EO Browser – Bolivia:



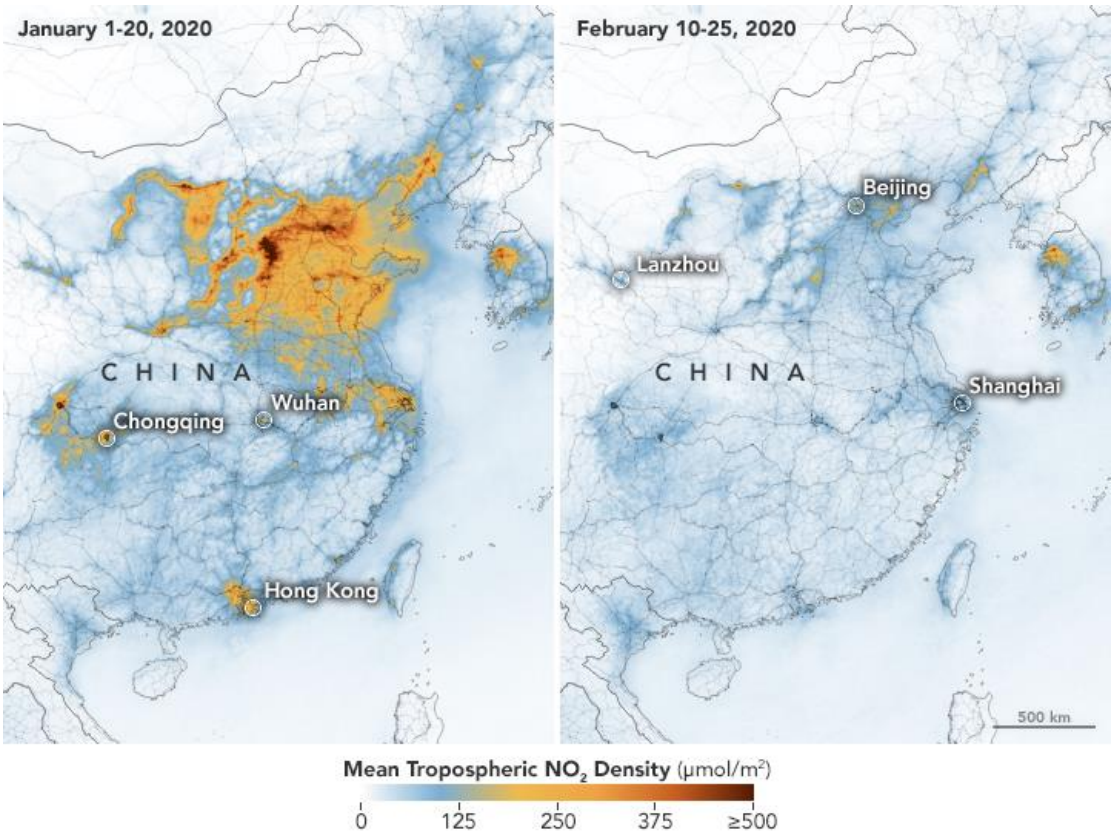


5. Air Pollution – COVID 19:

- Last year air quality data have shown a decline of air pollution over China with its lockdown to prevent the spread of the coronavirus (COVID-19).

- This map shows the variation of nitrogen dioxide concentrations over China from January to February 2020. (Source:https://earthobservatory.nasa.gov/)

Video from ESA
https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/COVID-19_nitrogen_dioxide_over_China



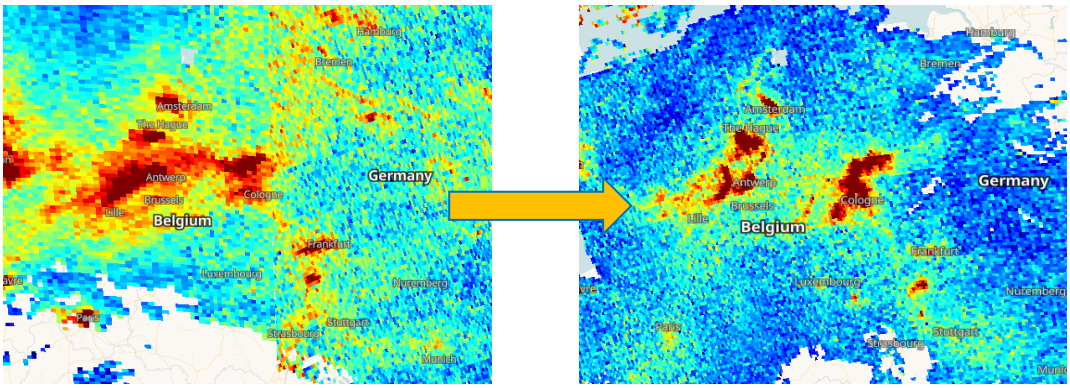
Europe 21/04/2019

Sentinel 5 (NO2)

Use images of the same month!

Europe 26/04/2020

Sentinel 5 (NO2)



6. Create your own timelapse:

https://apps.sentinel-hub.com/eo-browser/?zoom=14&lat=45.46919&lng=-73.51836&themeId=DEFAULT-THEME&visualizationUrl=https%3A%2F%2Fservices.sentinel-hub.com%2Fogc%2Fwms%2Fbd86bcc0-f318-402b-a145-015f85b9427e&datasetId=S2L2A&fromTime=2019-10-13T00%3A00%3A00.000Z&toTime=2019-10-13T23%3A59%3A59.999Z&layerId=1_TRUE_COLOR

Discussion

Explanation based on evidence

Guide the teachers to encourage their students to provide correct explanations for the topic(s) investigated.

Describe ways and they can use to this end and give them directions how to discover them.

- Look at other areas of change. Try to explain why these changes occurred. Are these changes because your satellite images are from different time periods (i.e. summer vs. winter, drought vs. rainy season), or was there human influence, or a major environmental event (i.e. fire, flood, etc.)?
- How can you use this change information to help your community?
- Communicate geographical information, ideas, issues, and arguments using appropriate written and/or oral, cartographic and graphic forms.

Consider other explanations

Direct teachers to facilitate the student groups to evaluate their own explanations in the light of alternative explanations, particularly those reflecting scientific understanding. Illustrate examples they can use and give them instructions how to locate them.

- Think about how we could use EO Browser and satellite data to monitor glaciers size changes. Which satellite we should use and what Bands combinations?
- Or maybe to create a timelapse that displays the striking Aral Sea water level reduction from 2005 to 2020?

Reflection

Communicate explanation

Guide teachers to facilitate each student group to reflect on the previous experiences and to produce a report with its findings, presenting and justifying the proposed explanations to the other groups and the teacher.

Provide content which the teacher can use to help the students to get familiarized and to become efficient in scientific writing.

- Applying generalizations to evaluate alternative responses to geographical environmental issues at a variety of scales (local, regional, national, global).
- Proposing individual and collective actions considering environmental, social and economic factors; Predict and evaluate the outcomes of the proposed actions.

Follow-up activities and materials

Describe and direct the user to any follow-up activities or materials that can be used to wrap-up the hands-on activity.

These could include appropriate learning assessment and/or reminder materials (e.g., quizzes, games, other user-friendly tests), hints for further activities etc.

1. https://medium.com/sentinel-hub/educational-role-of-eo-browser-and-new-features-5bc6ea8d8143 (Educational role of EO Browser)
2. https://www.sentinel-hub.com/explore/ (EO Browser overview)
3. https://www.sentinel-hub.com/explore/education/ (EO Browser for Education)
4. https://medium.com/sentinel-hub/there-is-never-enough-data-worldview-landsat-8-collection-2-and-more-f1d52159e7e0 (EO Browser examples)
5. https://medium.com/sentinel-hub/how-to-make-the-perfect-time-lapse-of-the-earth-351f214527f6 (Create amazing timelapses using Python – ADVANCED!)

Sustainable contact

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References (if any):

Assessment (if any):