Supplementary Information

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1 Likert Plots

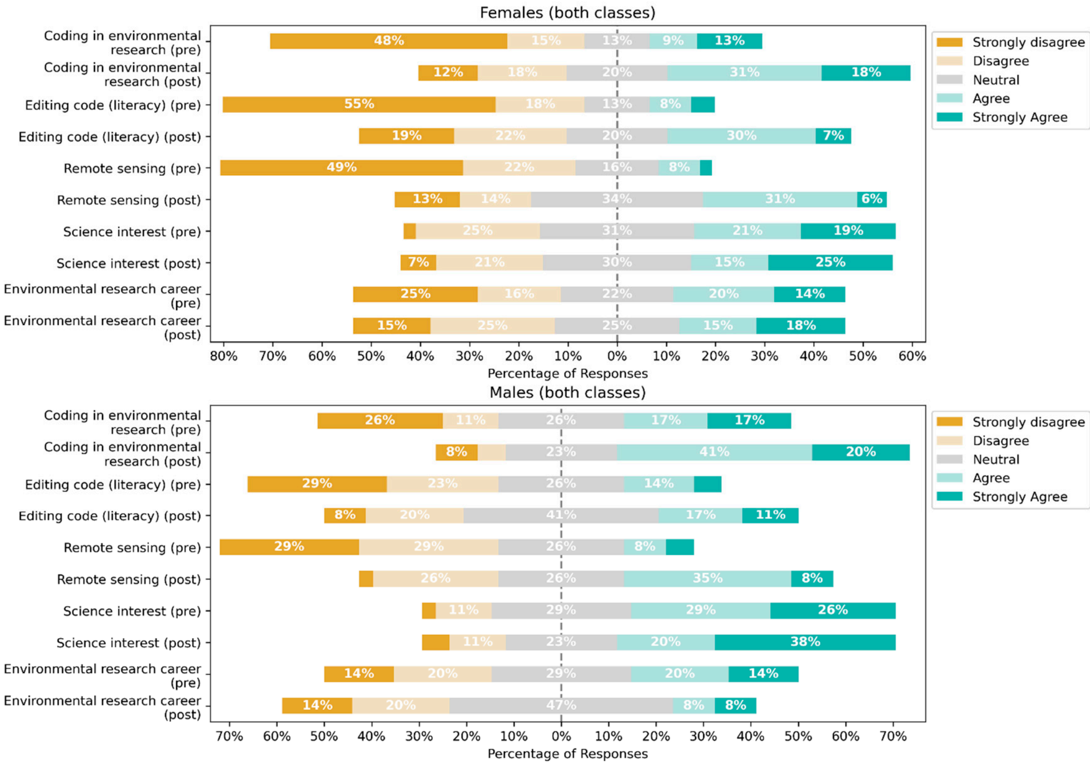


Figure S1. Likert plots for male and female students.

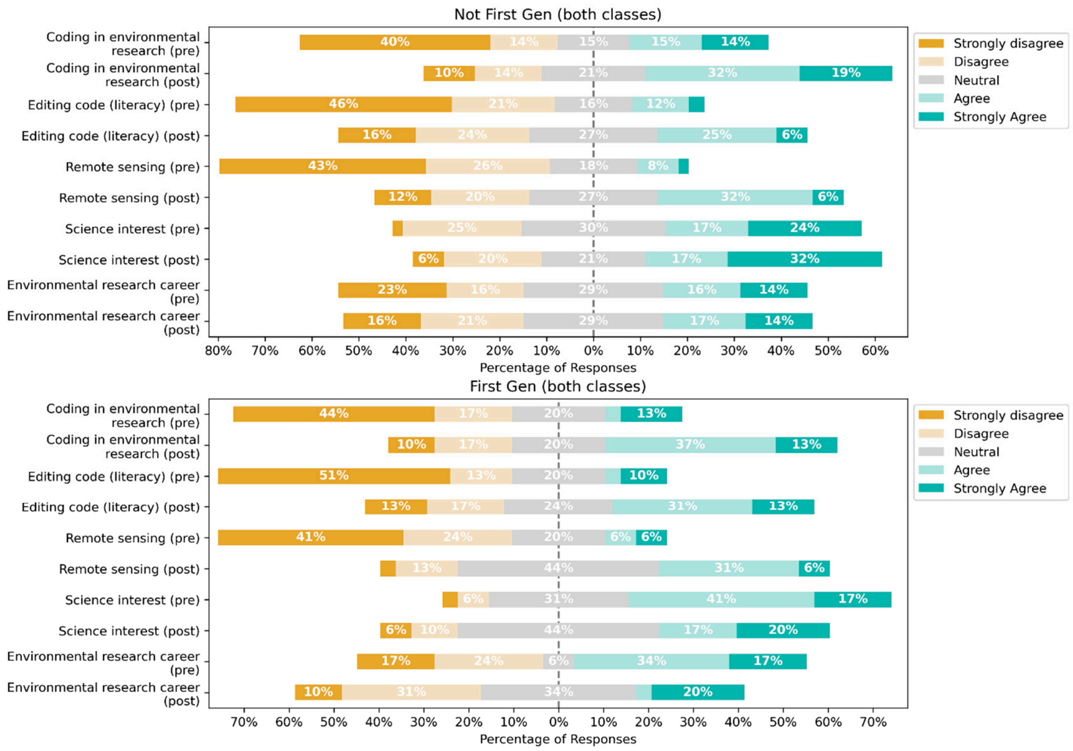


Figure S2. Likert plots for first-generation and non-first-generation students.

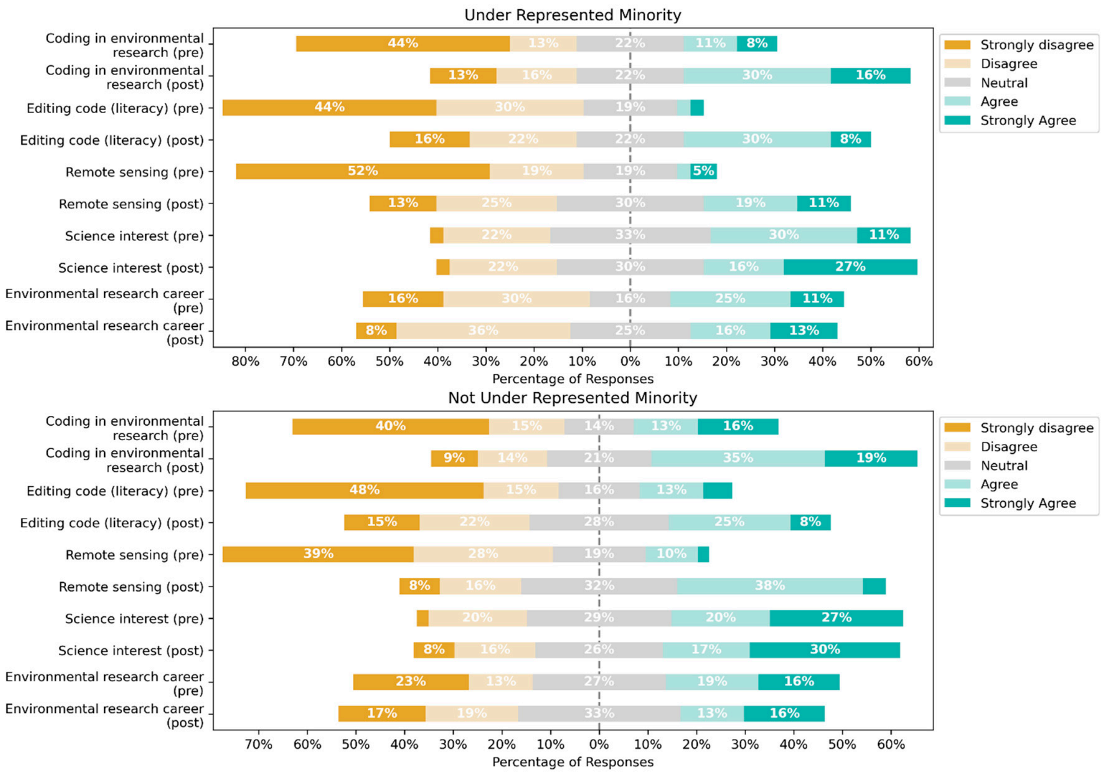


Figure S3. Likert plots for underrepresented minority (URM) students and non-URM students.

2 Pre and Post Surveys

Below are the pre and post surveys along with question type.

2.1 Pre-Survey

1. What is your favorite number? (Short answer)

2. What is the name of your first best friend? (Short answer)

3. What is the name of your first pet? (Short answer)

4. What gender do you identify with? (Multiple choice)

5. What is your major? (Short answer)

6. What year are you in? (Multiple choice)

7. With what group or groups do you identify? Please select any boxes that apply. (Checkboxes)

8. Are you a first-generation student (a student whose parent(s)/guardian(s) have no education experience past high school)? (Multiple choice)

9. I am confident in my ability to make small edits to code. (5-point likert)

10. I am confident in my ability to leverage current coding skills to investigate environmental change. (5-point likert)

11. I understand remote sensing for studying the environment. (5-point likert)

12. I have a strong interest in science. (5-point likert)

13. I would consider a career in environmental research. (5-point likert)

2.2 Post-Survey

1. What is your favorite number? (Short answer)

2. What is the name of your first best friend? (Short answer)

3. What is the name of your first pet? (Short answer)

4. I am confident in my ability to make small edits to code. (5-point likert)

5. I am confident in my ability to leverage current coding skills to investigate environmental change. (5-point likert)

6. I understand remote sensing for studying the environment. (5-point likert)

7. I have a strong interest in science. (5-point likert)

8. I would consider a career in environmental research. (5-point likert)

9. Has the COVID-19 pandemic impacted your search for research opportunities? (Short answer)

10. If answered yes above, how? (Short answer)

3 Remote Sensing Modules

3.1 Lab 1: Albedo, Sea Surface Temperature, and Sea Ice

Problem: Polar Bear Habitat is disappearing.

Learning Objectives:

After this exercise, you will be able to:

- Observe satellite-derived albedo data for land surfaces around the globe.
- Navigate through a map of the world to locations of your choice and call up data from time periods of your choice.
- Visualize sea surface temperature data for time periods and locations of your choice.
- Visualize sea ice cover for locations and time periods of your choice.
- Modify a visualization parameter in Google Earth Engine code.

Background:

As the Earth warms, we are losing the sea ice that serves as habitat for polar bears and other animals. As the sea ice melts and water takes its place, the reflectivity of the surface changes. Water will absorb more of the incoming solar radiation, which further contributes to the increased warming occurring from the greenhouse effect. Reduced snow cover on land can lead to a decrease in albedo. Both melting ice and reduced snow cover are examples of a positive feedback loop, in which change in one direction (warming) stimulates further change in the same direction. Positive feedback loops can be destabilizing.

See this NASA video on youtube for a time series of sea ice extent:

https://www.youtube.com/watch?v=qHE0n5c6-6g

We can characterize the reflectivity of the surface with the concept of albedo, which is defined as the ratio of upwelling to downwelling radiative flux at the surface. The downwelling flux has a direct component and a diffuse component. Albedo is studied as “Black Sky Albedo” and “White Sky Albedo”, which use different assumptions about the diffuse versus direct downward flux. Both are used to calculate an overall albedo.

Paste and Play Exercise 1: Albedo on land

Step 1.1: We can use the following prepared code to get a map of the Black Sky Albedo on land.

Paste the following code into your GEE code editor and press Run.

```
//********START OF CODE************

//This line creates a new variable named "dataset" that is a collection of images from MODIS,
//filtered for a certain date range.

var dataset = ee.ImageCollection('MODIS/006/MCD43A3')

                .filter(ee.Filter.date('2018-01-01', '2018-05-01'));

//This next line creates a new variable called "blackSkyAlbedo", which starts with "dataset" and
//selects the data that characterizes the Black Sky Albedo  from Band 1, which is
//Albedo_BSA_Band1.

var blackSkyAlbedo = dataset.select('Albedo_BSA_Band1');

//This next line sets the visualization parameters that we'd like to use.

var blackSkyAlbedoVis = {

  min: 0.0,

  max: 400.0,

};

//This lines set the coordinates for where we want to center the map.
```

```
Map.setCenter(6.746, 46.529, 6);

//This line adds a layer to the map that will show the data we called blackSkyAlbedo, with the //mix and max we set in blackSkyAlbedoVis, and with the name "Black-Sky Albedo"

Map.addLayer(blackSkyAlbedo, blackSkyAlbedoVis, 'Black-Sky Albedo');

//************END OF CODE*****************
```

After pasting, press Run.

(If you are curious or want to explore more later, the source of the code is:
https://developers.google.com/earth-engine/datasets/catalog/MODIS_006_MCD43A3

Comment lines were added here.)

Please read through the comment lines so that you can start to learn what the code does. It's fine if you have no coding experience at all.

Step 1.2:

Zoom out so you can see more of the world at a time, and scroll around. You can Zoom in and out using the + and - buttons at the upper left of your map.

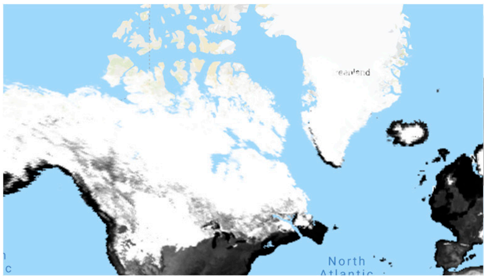
What areas have a high albedo? Why?

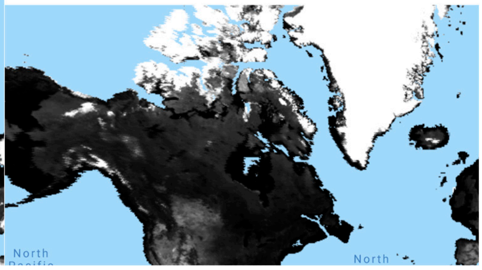
Click to the "Inspector" tab in the upper right box of the GEE window. Now you can go back to the map and click on a particular point. The Inspector will then tell you the exact values for albedo that are being plotted on the map at that point. What values do you get in the white areas? What about in the black areas?

What happens if you change the Max value of 400? Experiment with different values by modifying the line that says: max: 400.0,

Step 1.3:

Compare winter versus summer for any year you choose, for any location you choose. You may see dramatic differences! Take screen shots and label them. Here is an example:





2018 winter 2018 summer

Paste and Play Exercise 2 Sea Surface Temperature

Step 2.1:

Paste this code for Sea Surface Temperature:

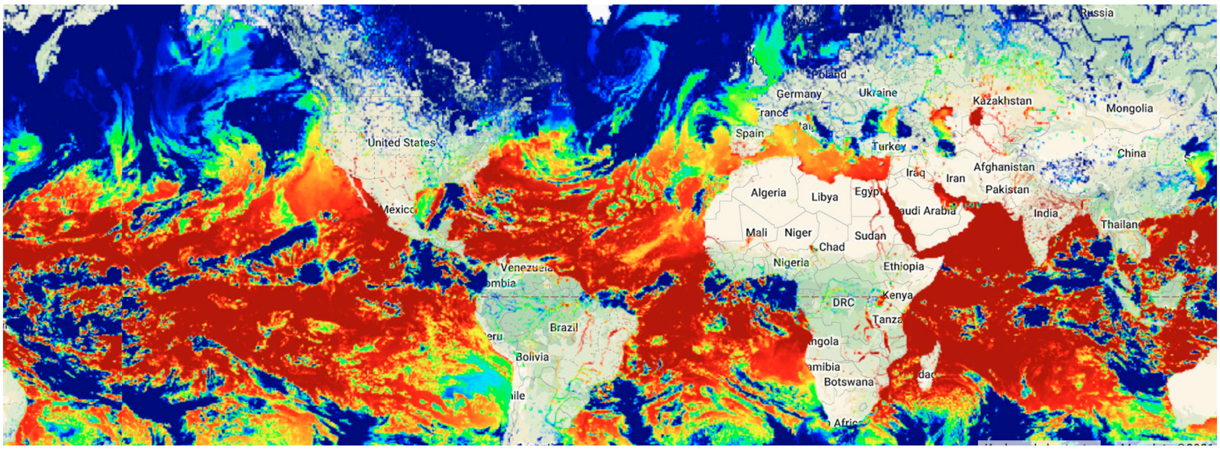
```
//********START OF CODE************
var dataset = ee.ImageCollection('NOAA/CDR/SST_PATHFINDER/V53')
                  .filter(ee.Filter.date('2014-05-01', '2014-05-14'));
var seaSurfaceTemperature = dataset.select('sea_surface_temperature');
var visParams = {
  min: 0.0,
  max: 2500.0,
  palette: [
    '030d81', '0519ff', '05e8ff', '11ff01', 'fbff01', 'ff9901', 'ff0000',
    'ad0000'
  ],
};
Map.setCenter(-121.99, -2.11, 2);
Map.addLayer(seaSurfaceTemperature, visParams, 'Sea Surface Temperature');
```

//************END OF CODE****************

Source: https://developers.google.com/earth-engine/datasets/catalog/NOAA_CDR_SST_PATHFINDER_V53?hl=en

Press Run to get a nice map of sea surface temperature.

Take a screenshot of your choice–it can be zoomed in or out. Here is an example.



Sea Surface temperature May 2014

You can play around with the timeframe and visualization parameters at some point if you'd like, but let's now modify that code to look at sea ice fraction with the same dataset.

Paste and Play Exercise 3 Sea Ice Coverage

<u>Step 3.1:</u>

Starting with the above code, we need to change which data are being requested, now it's "sea_ice_fraction", and we need to change the name of the variable. Also, if we plot with the same vis parameters, we will get red for higher numbers, which isn't intuitive since we are now talking about ice. So, we can reverse the codes given in the palette section.

The easiest way is to just paste the code below (it's already been modified in the ways described in the paragraph above).

//*******START OF CODE***********

```
var dataset = ee.ImageCollection('NOAA/CDR/SST_PATHFINDER/V53')
                .filter(ee.Filter.date('2014-01-01', '2014-01-14'));
var seaIceFraction = dataset.select('sea_ice_fraction');
var visParams = {
  min: 0.0,
  max: 100.0,
  palette: [
    'ad0000', 'ff0000', 'ff9901', 'fbff01', '11ff01', '05e8ff', '0519ff', '030d81',
     ],
};
Map.setCenter(-121.99, -2.11, 2);
Map.addLayer(seaIceFraction, visParams, 'Sea Ice Fraction');
//************END OF CODE*****************
```

Step 3.2:

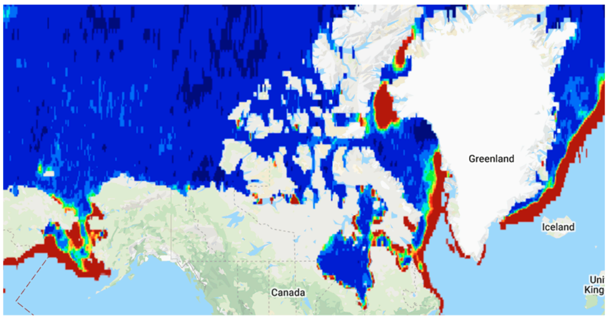
Scroll around the map and find a location you'd like to study that is currently polar bear habitat.

For a quick look at the habitat range, you can use this map showing the polar bear habitat in red. Map from https://animalfactguide.com/animal-facts/polar-bear/ (Greenland is to the lower left, at 7 or 8 o'clock.)

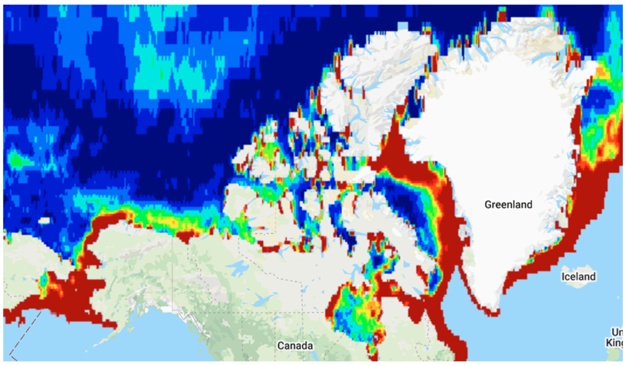
Alternatively, you can use the Map of Life to get the current habitat for polar bears. Change the coordinates in your map centering line of code so that your map will center on that location.

Note: The area you may choose to investigate may not show the trend of decreasing sea ice with time–this process is very complex, and while we know that the overall trend is decreasing, some areas may show an increase for some times.

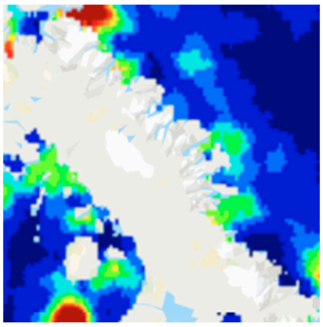
Here are some examples of the code modified for different time frames, and zoomed in to different locations.



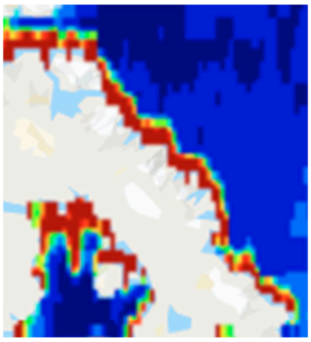
Ice Fraction Jan 2010



Ice Fraction Jan 2014



NE CA Jan-Mar 2001, vis 90-100



NE CA Jan-Mar 2020, vis 90-100

Note: These images had visualization min set to 90 so the pallet allows us to better distinguish higher values.

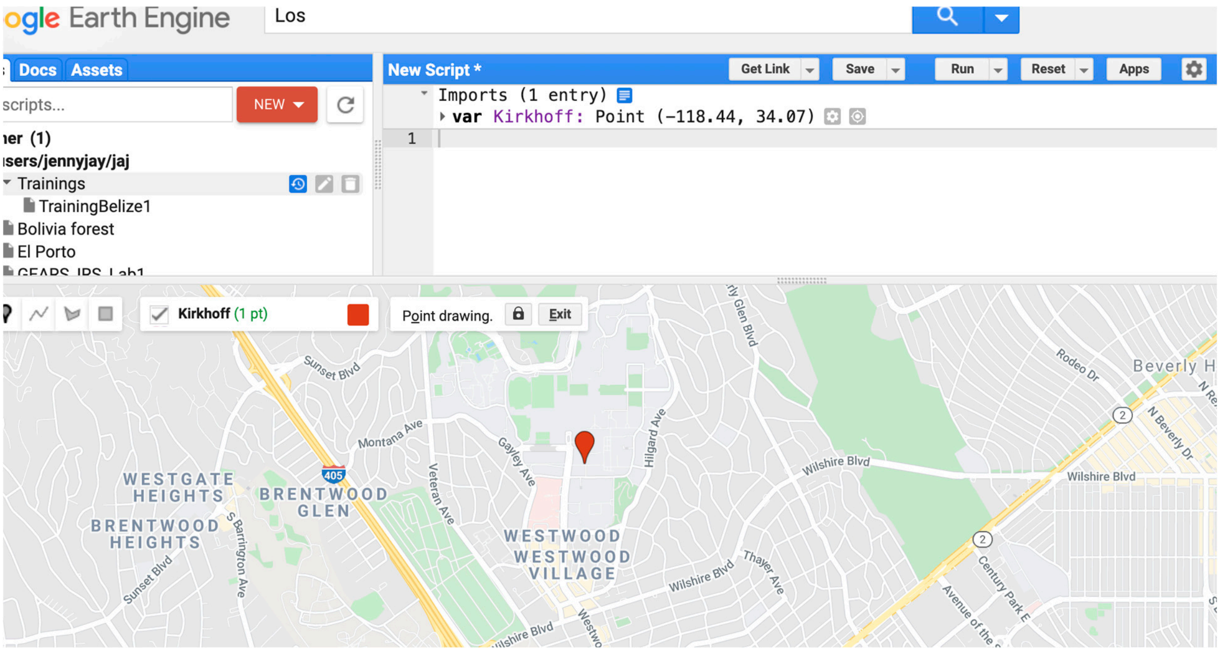
The top line in the Inspector will tell you the coordinates of where you are pointing.

3.2 Lab 2: Deforestation

This activity is a modified version of the Intro to Remote Sensing Lab 3 by Shaun R Levick. The original exercise can be found at: https://www.gears-lab.com/intro_rs_lab3/

1. Let's load an image to work with.

In the search bar (above the coding panel), enter Los Angeles. Navigate to a spot on campus, and mark this point with the geometry tools (located in the upper left of the map area). You do this by clicking on the symbol for a point, which looks like a little hot air balloon (just to the right of the little hand), in the upper left corner of the map. After you click on the symbol for a point, you can then click anywhere on your map. You'll see it appear as a variable in the coding panel, but it will be called "geometry". You can replace the word "geometry" with a name of your choice. I chose "Kirkhoff". The coordinates of the point are given after the word Point, in parentheses. To delete a point and start over, you just hover to the left of the word "var" in the coding area, and a little trash can will appear. Clicking on the trash can will get rid of that point and let you try again.



Skill: Marking and naming a specific point.

2. Search for 'Sentinel-2' in the search bar. In the results section you will see 'Sentinel-2: Multi-spectral Instrument (MSI), Level-1C' - click on it and then click the 'Import' button.

Skill: Importing and renaming a dataset.

3. After clicking import, Sentinel-2 will be added to our Imports in the Coding panel as a variable. It will be listed below our campus geometry point with the default name "imageCollection". Let's rename this to “sent2” by clicking on imageCollection and typing "sent2".

   It is important to understand that we have now added access to the full Sentinel-2 image collection (i.e. every image that has been collected to date) to our script. For this exercise we don't want to load all these images - we want a single cloud free image over UCLA. As such, we can now filter the image collection with a few criteria, such as time of acquisition, spatial location and cloud cover.

4. Let’s filter

Skill: Filtering for date

```
// This is our first line of code. Let’s define the image collection we are
working with by writing this command

    var image = ee.Image(sent2


    // We will then include a filter to get only images in the date range we are
interested in

    .filterDate("2019-07-01", "2020-09-30")


    // Next we include a geographic filter to narrow the search to images at the
location of our point.  Make sure to switch out the word Kirkhoff with whatever
you named your point.

    .filterBounds(Kirkhoff)


    // Next we will also sort the collection by a metadata property, in our case
cloud cover is a very useful one

    .sort("CLOUD_COVERAGE_ASSESSMENT")


    // Now lets select the first image out of this collection - i.e. the most
cloud free image in the date range

    .first());
```

```
// And let's print the image to the console.
print("A Sentinel-2 scene:", image);
```

Skill: Filter by date.

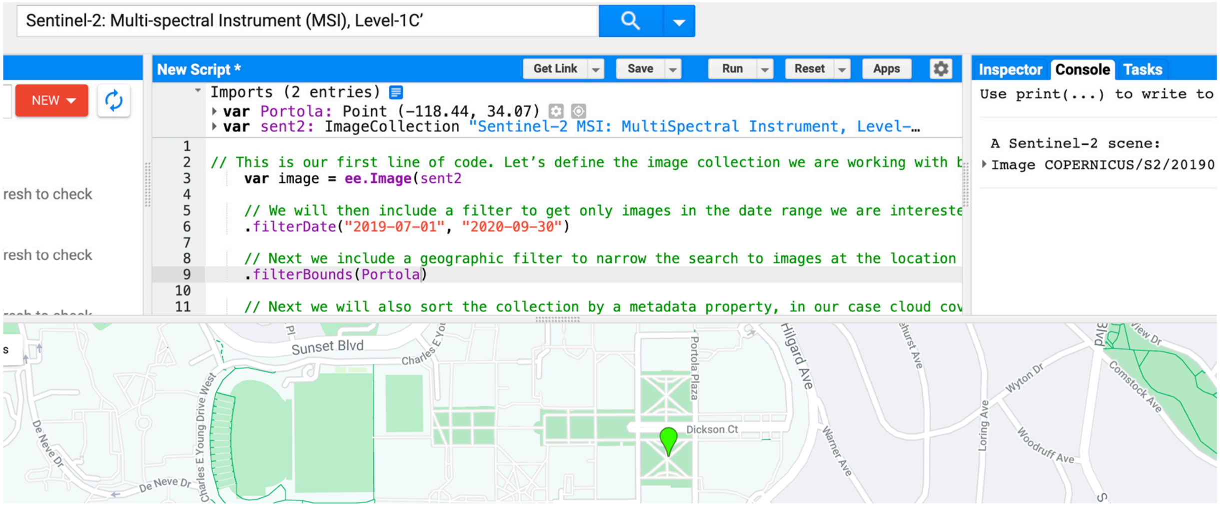
Skill: Filter by location.

Skill: Filter by cloud cover.

Skill: Choose the first image in a set.

You need to copy the entire piece of code above and paste it in the “New script” box of the GEE code editor. Then click the "Run" button and watch Google do its magic...... This piece of code will search the full Sentinel-2 archive, find images that are located over the point you identified, sort them according to percentage cloud cover, and then return the most recent cloud free image for us. Information relating to this image will be printed to the Console, where it is listed as "A Sentinel-2 scene" with some details about that scene.

With a point at Portola Plaza labelled “Portola”, after pressing run, the screen looks like:



Over in the console, in the upper right, you can see some information about the image that has been chosen.

This code yielded:

```
Image COPERNICUS/S2/20190921T183041_20190921T184213_T11SLT (16 bands)
```

The numbers right after s2/ tell us the date. We can tell this image is from Sept. 21, 2019. You can expand where it says Image, then Properties to see the Cloud Cover for this image (0 in this case.)

5. Now in order to actually have a look at this image, we need to add it to our mapping environment. Before doing that however, lets define how we want to display the image. Let's start with a true color representation by pasting the following lines below the ones you've already added, and click "Run".

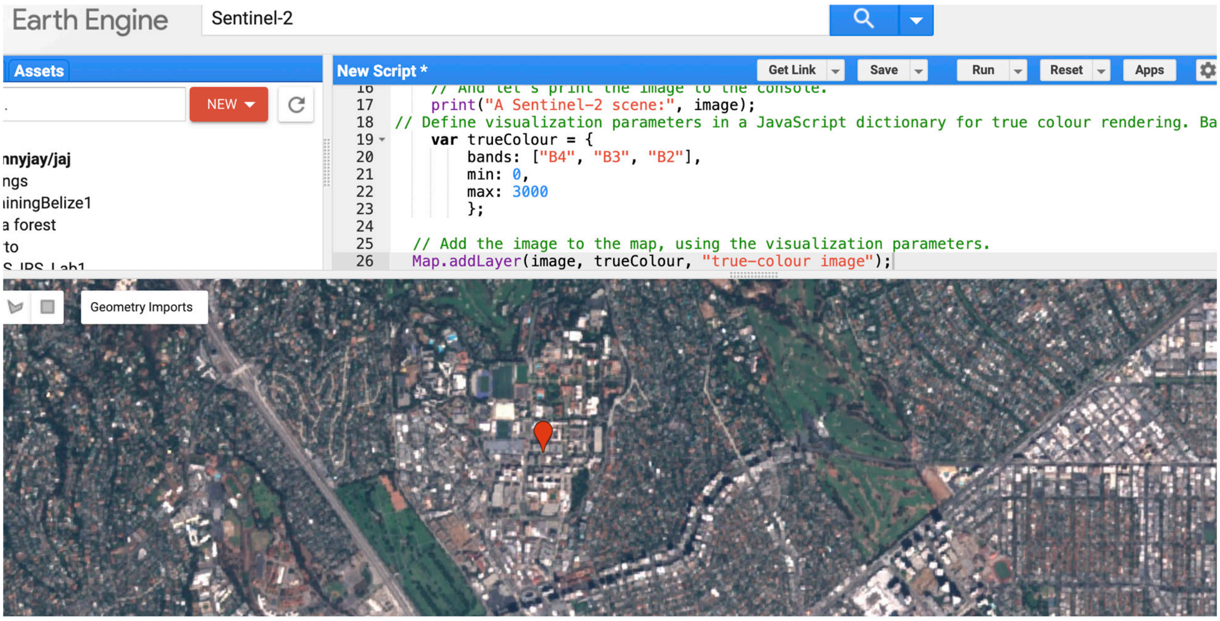
Skill: Choose to display the red, green, and blue bands in a layer called trueColour. In the brackets after bands, we need to tell GEE which band to depict as Red ("R"), then which band to use as green ("G"), and then finally what band to use for blue ("B").

```
// Define visualization parameters in a JavaScript dictionary for true colour
rendering. Bands 4,3 and 2 needed for RGB.

    var trueColour = {
```

```
        bands: ["B4", "B3", "B2"],
        min: 0,
        max: 3000
        };


    // Add the image to the map, using the visualization parameters.
    Map.addLayer(image, trueColour, "true-colour image");
```



Remember you can use the + and – in the left of the map to zoom in and out.

6. Optional: Using the search bar, re-open the dataset we're working with and click on bands. Confirm bands 4,3, and 2 are the red, green, and blue bands respectively.
7. This code specifies that for a true colour image, bands 4,3 and 2 should be used in the RGB composite. After the image appears in the map, you can zoom in and explore UCLA and Los Angeles. We see great detail in the Sentinel-2 image, which is at 10m resolution for the selected bands. The (+) and (-) symbols in the upper left corner of the map can be used for zooming in and out (also possible with the mouse scroll wheel/trackpad). A left click with the mouse brings up the "hand" for panning to move around the image. Moving your mouse over the "Layers" button in the top right-hand corner of the map panel shows you the available layers, and lets you adjust the opacity of different layers.
8. In order to find out more information at specific locations, we can use the Inspector tool which is located in the Console Panel - left hand tab. Click on the Inspector tab and then click on the image in the map view. Wherever you click on the image, the band values at

that point will be displayed in the Inspector window. Click over some different patch types (sports fields, ocean, beach, houses) to see how the spectral profile changes.

9. Now let's have a look at a false colour composite - we need to bring in the near-infrared band (band 8) for this. Paste the following lines below the ones you've already added, and click "Run".

```
//Define false-colour visualization parameters.
    var falseColour = {
        bands: ["B8", "B4", "B3"],
        min: 0,
        max: 3000
        };

    // Add the image to the map, using the visualization parameters.
    Map.addLayer(image, falseColour, "false-color composite");
```

Skill: Adding a false color layer with B8, near IR, depicted in red.

10. False-color composites place the near infra-red band in the red channel, and we see a strong response to the chlorophyll content in green leaves. Vegetation that appears dark green in true colour, appearing bright red in the false-color. Scroll to the Santa Monica moutains, to the west of UCLA. Note the variations in red that can be seen in the vegetation along the bottom of the valleys.

    Q1: Why might this be?

    You will also see that "false-colour composite" has been added to the Layers tab in the map view.

    We've asked GEE to add two different layers to the map, first the true color image and then the false color. Both layers still exist there. You can click either of them on or off using the layers box that's in the upper right of the mapping area. If you hover over it, it will expand and let you click or unclick boxes for each layer you've asked GEE to print.

11. Next, let's calculate the normalised-difference vegetation index (NDVI) for this image. NDVI is an index calculated from the RED and NIR bands, according to this equation:

NDVI = (NIR - RED)/(NIR + RED)

Paste the following lines below the ones you've already added, and click "Run". NDVI values range from 0 to 1, and the higher the value (depicted as white) the more "vigorous" the vegetation.

```
//Define variable NDVI from equation
    var NDVI = image.expression(
        "(NIR - RED) / (NIR + RED)",
        {
          RED: image.select("B4"),     //  RED
          NIR: image.select("B8"),     // NIR
          BLUE: image.select("B2")     // BLUE
        });

    Map.addLayer(NDVI, {min: 0, max: 1}, "NDVI");
```

Note how the valleys between the mountains that showed up bright red are now appearing white.

Healthy vegetation will appear as whiter in color.

Scroll around, and click layers on and off.

Q2: What do you notice as you scroll around? List two things that you notice that seem interesting to you. (This part is just graded for completion, so just list what you think is interesting!)

Skill: Calculating NDVI.

<u>**Activity:**</u>

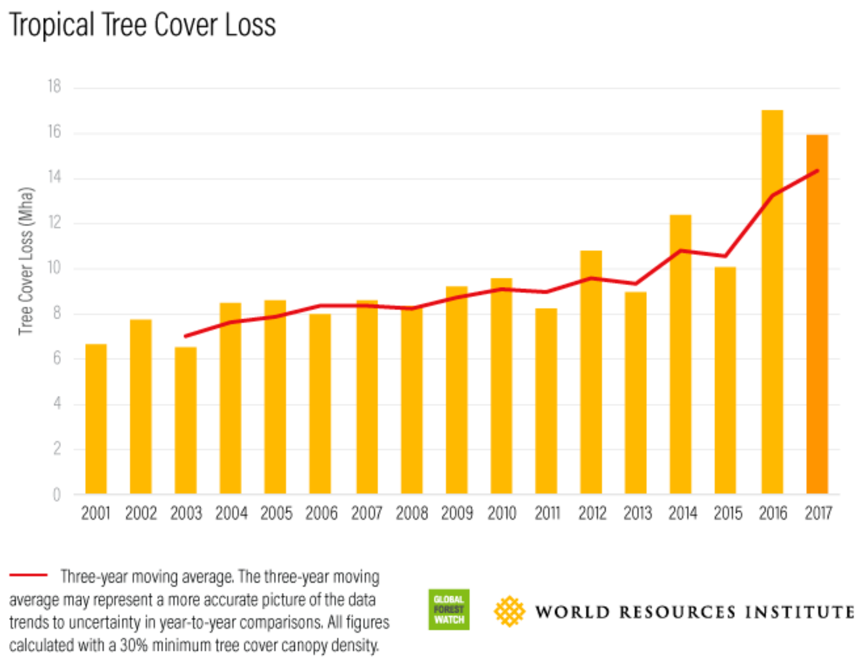
Let's see if we can observe what land use looks like in areas with high deforestation.

From blog.globalforestwatch.org

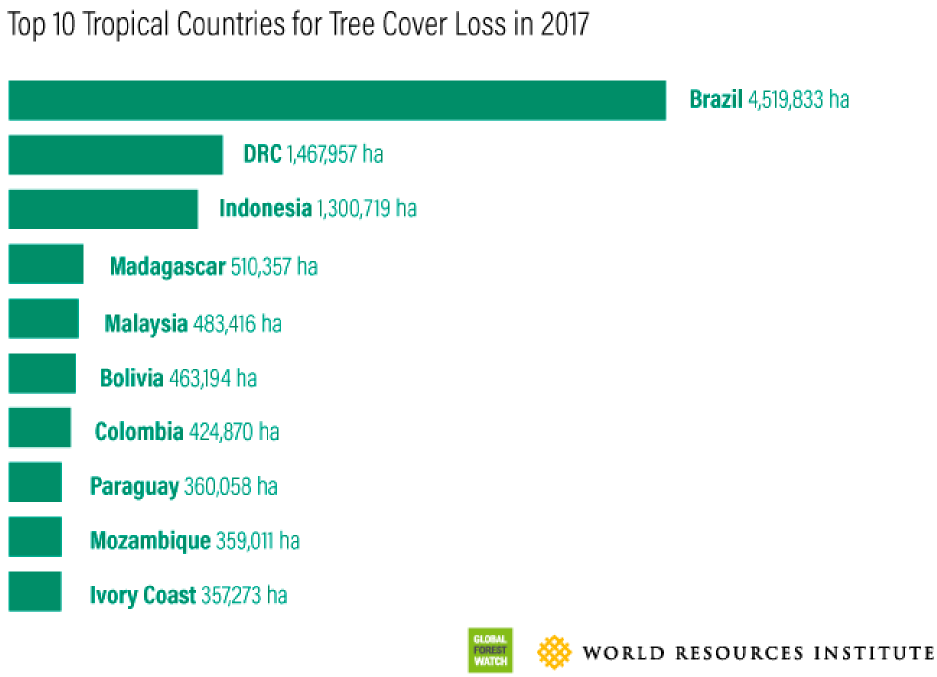
2017 Was the Second-Worst Year on Record for Tropical Tree Cover Loss

Last year was the second-worst on record for tropical tree cover loss, according to new data from the University of Maryland, released today on Global Forest Watch. In total, the tropics experienced 15.8 million hectares (39.0 million acres) of tree cover loss in 2017, an area the size of Bangladesh. That's the equivalent of losing 40 football fields of trees every minute for an entire year.

Here are two charts showing when and where deforestation is occurring:

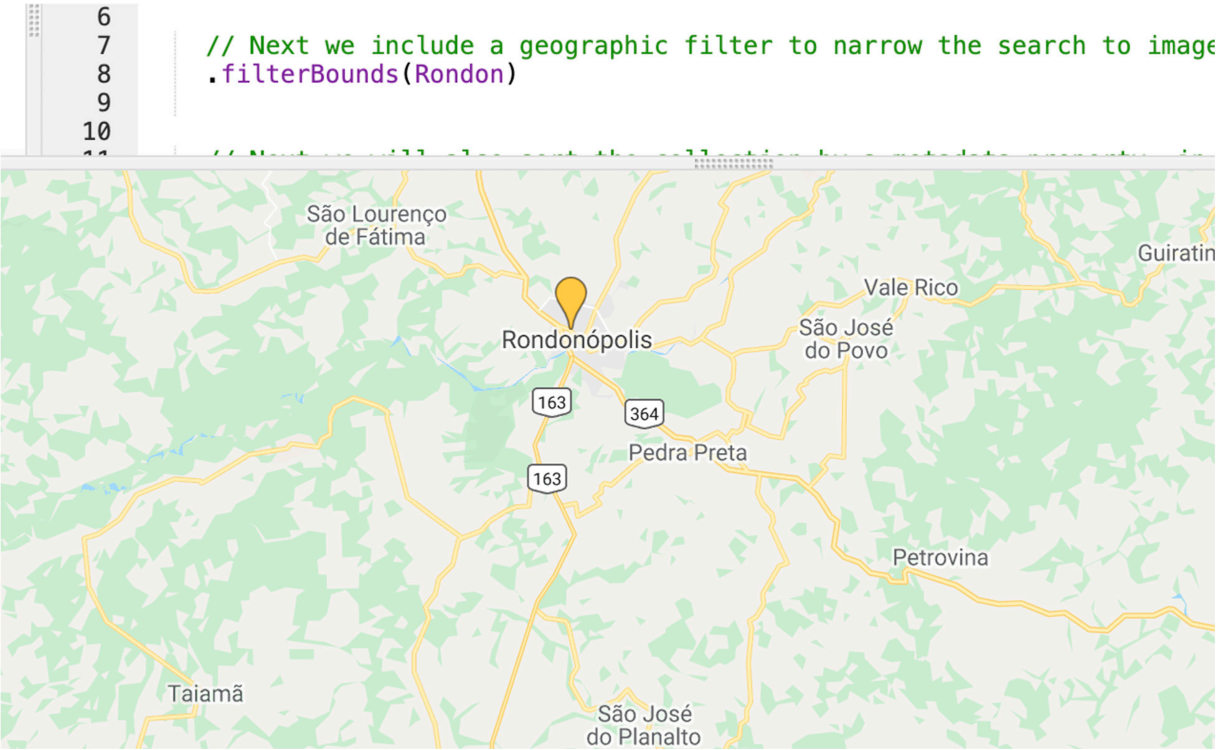


From blog.globalforestwatch.org



From blog.globalforestwatch.org

1. Mark a point you'd like to investigate and name it.
2. Paste the text from above and change the location filter to match your point.



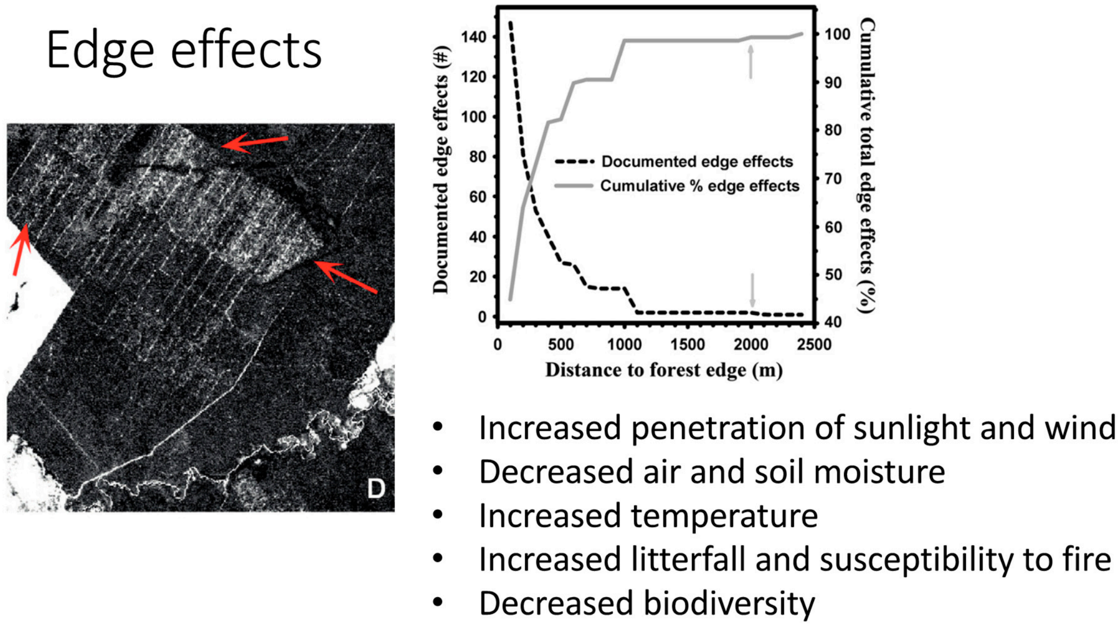
3. Adjust times to check a period near when Sentinel-2 started collecting data, June 2015. You can narrow the time range to a month or two, because if you end up comparing various years, you'll want to do if for the same time period.
4. Take a snapshot of the true color layer and the NDVI for that time period.

Q3: What point did you choose? You can give the location coordinates. You'll find them in the line of code where the point is identified.

Q4: What is your earlier time period? (As stated above, you'll want to narrow the time period to just a month or so, so you are not comparing different times of year. However, you may get only cloudy images for certain months. Try some months for the year 2016 or 2017 until you get a good image.)

Q5: Paste True color and NDVI screen shots for your earlier time point.

Q6: Do you see patterns that look like agricultural conversion of forest? It will potentially look like a fishbone type pattern (see images below). Consider whether the agricultural conversion you see would increase or decrease the amount of forest "edge". Edge effects from deforestation are really important, because the forest near an edge is different from a forest surrounded by forest (see the figure below). This means that the ecological impact of deforestation extends into the forest some distance.



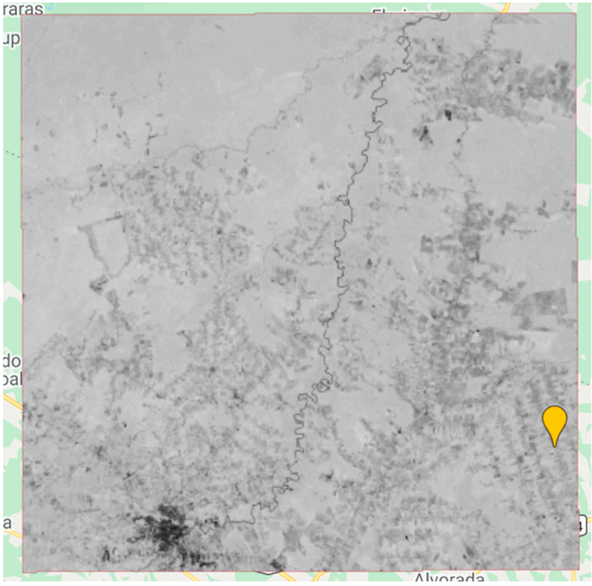
<u>Optional: If you have time:</u>

5. Do the same for a recent time period (same months, different year) and compare photos. The photos may be hard to match up because the point you chose may be at a very different point in the image from a different timepoint.
6. While you may want to try a few different locations to try and observe something interesting, it's totally okay if you are not able to find a location where deforestation is obvious. Just try the exercise to gain experience in getting images (and NDVI to indicate vegetation health) at different locations.

Q7: What is your later time period? You should choose the same month, for a different year.

Q8: Paste True color and NDVI screen shots for your later time point.

6/1/2017-6/30/2017



2020, same month

4 CURE Assignment

4.1 ORCAA Project Overview

Part 1: Exploration with ORCAA

Water Quality Project Description:

Background:

In class we've covered mechanisms and strategies to understand the fate and transport of chemicals in aquatic environments. One interesting research topic that's gained some attention is the impacts of the COVID-19 anthropause (or reduction in human activity) on the environment, namely water quality. During the pandemic, many places cited improvements in water quality hypothesizing that this is due to less travel, commerce, dumping into waterways, etc.

We've also learned how to use Google Earth Engine as a tool to monitor large-scale environmental changes over time. One of these tools is the shortened version of the Optical Reef and Coastal Area Assessment (ORCAA) Tool which can output multiple water quality parameters such as turbidity, chlorophyll-a, and color dissolved organic matter. The tool can be used to make maps of images and also time series plots.

Possible water quality parameters:

Sentinel-2 MSI	**Terra and Aqua MODIS**
Turbidity	Sea Surface Temperature (SST)
Normalized difference chlorophyll index (NDCI)	Kd(490)
Chlorophyll-a (Chl-a)	Chlorophyll-a (Chl-a)
Color Dissolved Organic Matter (CDOM)	Particulate Organic Carbon (POC)

In this project you will select a location of your choice through the COVID-19 pandemic (2020 and onward) and compare the water quality patterns before and during the pandemic. Keep in mind the Sentinel-2 and MODIS time ranges.

Learning outcomes:

- Apply coding and analysis skills from class to a real scientific research question
- Test a hypothesis using Google Earth Engine for impact of the anthropause on water quality
- Analyze data and maps
- Communicate findings and discuss potential reasons for results

COVID-19 Anthropause Project:

For background, please refer to Callejas et al.

Overall goal: We'd like to conduct a class research project to investigate coastal water quality impacts of the anthropause at a global scale. It will be important to set up a database of water quality data and other information for a set of locations in order to study the impacts of the anthropause. Also, the dataset will serve to set up a baseline so the recovery of marine ecosystems post-anthropause can also be investigated.

For this project, you will partner with 2-3 other students. For this project you will visualize differences in water quality using a location of your choice. Your investigation should focus on an appropriately sized area. For example, MODIS has a coarse resolution and thus is best used for large areas like coastlines. Sentinel-2 may be more appropriate for smaller water bodies such as lakes and smaller river mouths.

The final write up will contribute to a database to allow a global investigation of impacts of the anthropause. It will be posted online and you will be given credit for the database contribution. You'll be turning in short text in response to prompts (you will be given a template), maps, and time series for water quality parameters.

Overall outline of project:

1. Location of interest. Identify a coastal area that may reasonably have been impacted by covid. Describe the region–what country? Climate? Population? Commerce?

2. Potential sources for water pollutants. Is marine traffic important? If so, please round up the data. Are there significant discharges? Please find available information.

3. What happened at your location during the pandemic? What dates did shutdowns happen, if any?

4. Generate a hypothesis specific to your site that involves at least two locations within your general area of interest, Recall how Callejas et al. had high marine traffic areas and low marine traffic areas. The low traffic areas served as control sites for the variation in marine traffic that occurred at the high traffic areas. One may be more likely to have been impacted by the anthropause and one may be more remote.

5. Using ORCAA, investigate trends in the coastal water quality along the coast at atleast the two locations.

6. Observe and analyze maps and time series. Do your data support the hypothesis? Submit template with all data and your analysis.

4.2 ORCAA Tool Activity

ORCAA tool activity
Detecting turbidity as a function of time

To get started:

Search your inbox with: "Welcome to Google Earth Engine code editor" to find the email that GEE sent you when you registered. Click on the link for the code editor.

Paste this link into your browser:

https://code.earthengine.google.com/7290c6b7e1b840d4e72a49c10b2ec510

You'll only need to pay attention to a few parts of the code.

At the top you'll see there is a polygon with 4 vertices named "roi" for "region of interest." Right now the tool is aimed at Belize City, but you can change this.

In lines 5 and 6, the start and end dates for our analysis are given. You'll be changing these.

Lines 10-16 will gather all of the images within your time period to sort them by cloud cover. It will choose the first (the most cloud-free) and plot a true color image on your map.

1. **Comparing turbidity time series plots for the coastal region off Belize City for different time periods**

A. Run the code as is to get the data for 2018.

B. When you press run, you'll see several layers plotted on the map. See the Layers box in the upper right corner of the map. Click and unclick the boxes to see what the different layers look like. If you click on the gear to the right of the layer name, you'll see you can change visualization parameters. For example, when you shift the Opacity bar, you'll make the layer more or less opaque.

C. In the upper right box of your screen, to the right of the code editor, you'll see a time series graph of the turbidity for 2018. Export the graph using the arrow up in the right corner and paste into a document.

D. Now run 2020. Paste the graph in the same document so you can compare. How does the time series differ? This year was the covid shutdown. What do you think might be going on (refer to Callejas et al. 2021 posted paper)?

2. **Investigating another region of interest.**

A. To choose another area, delete the current roi by going to the very top of the code (above line 1) and deleting the line that says var = roi…. You can do this by clicking on the trash can that appears when you hover over that line.

B. Go back to the map and scroll/zoom around until you find another region you are interested in. Click on the square that is along the bar in the upper left of the map. That bar starts with a hand, then there is a point, line, and polygon before you see the square at the right. Once you click on the square, you can go to the map and define what square or rectangle you'd like. It will appear in a color, and its description will now appear at the top of the code where the previous line was.

C. Change the default of "geometry" to "roi". Your code will now work on this area.

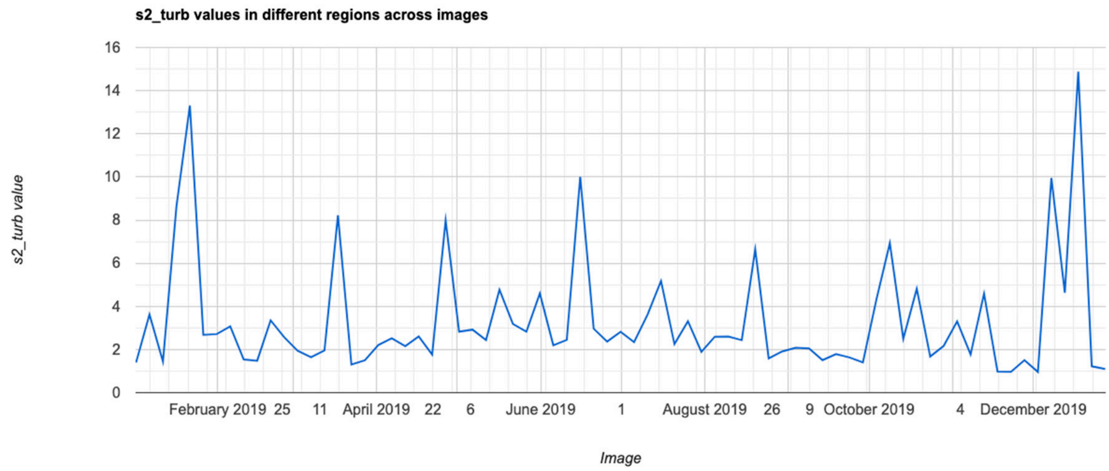
D. Press run to get the image and time series for a certain timeperiod of interest. Export the graph to the word document. (See below for Cancun.)

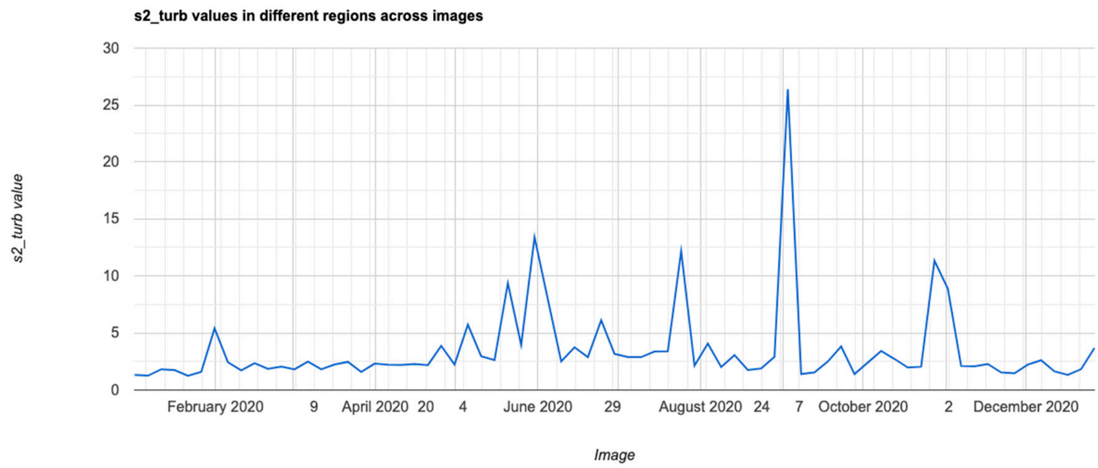
E. You'll see in the map that again you can click on and off the various layers, but you won't be able to get rid of the color of the shape that way. To do that, go back to the upper left, under Geometry Imports, and unclick. Pasted below as an example ares the most cloud free true color images for 2019 and 2020 near Cancun.

2019

2020

F. Run for another time period to get some data for comparison.





G. Did you see anything interesting? Do you have a hypothesis you can investigate by running more years? Locations? Have fun!

4.3 ORCAA Tool Project Template

Please use and fill out the following template for the project.

Group Members:

Country:

Coordinates of overall area (you'll be looking at three locations within this area):

Description of Area (1-2 paragraphs):

What happened at your area during the pandemic? What dates did shutdowns happen, if any?

Potential sources for water pollutants. (Is marine traffic important? If so, please round up the data. Are there significant discharges? Please find available information.)

Location 1:

Coordinates of the box you are studying:

Qualitative description:

Time ranges for True Color Image (Sentinel-2)-

Time Range format: YYYY-MM-DD to YYYY-MM-DD or YYYY-MM-DD for single day

Pre-COVID map:

COVID map:

Pre-COVID-19 Map, COVID-map (2 figures) :

Time ranges for Turbidity-

Pre-COVID map:

COVID map:

Time series:

Turbidity: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for NDCI (Sentinel-2)-

Pre-COVID map:

COVID map:

Time series:

NDCI: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for Chlorophyll-a (Sentinel-2)-

Pre-COVID map:

COVID map:

Time series:

Chl-a: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for CDOM (Sentinel-2)-

Pre-COVID map:

COVID map:

Time series:

CDOM: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for SST (MODIS)-

Pre-COVID map:

COVID map:

Time series:

SST: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for Kd(490) (MODIS)-

Pre-COVID map:

COVID map:

Time series:

Kd490: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for Chlorophyll-a (MODIS)-

Pre-COVID map:

COVID map:

Time series:

Chl-a: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for POC (MODIS)-

Pre-COVID map:

COVID map:

Time series:

POC: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Location 2:

Coordinates of the box you are studying:

Qualitative description:

Time ranges for True Color Image (Sentinel-2)-

Time Range format: YYYY-MM-DD to YYYY-MM-DD or YYYY-MM-DD for single day

Pre-COVID map:

COVID map:

Pre-COVID-19 Map, COVID-map (2 figures) :

Time ranges for Turbidity-

Pre-COVID map:

COVID map:

Time series:

Turbidity: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for NDCI (Sentinel-2)-

Pre-COVID map:

COVID map:

Time series:

NDCI: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for Chlorophyll-a (Sentinel-2)-

Pre-COVID map:

COVID map:

Time series:

Chl-a: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for CDOM (Sentinel-2)-

Pre-COVID map:

COVID map:

Time series:

CDOM: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for SST (MODIS)-

Pre-COVID map:

COVID map:

Time series:

SST: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for Kd(490) (MODIS)-

Pre-COVID map:

COVID map:

Time series:

Kd490: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for Chlorophyll-a (MODIS)-

Pre-COVID map:

COVID map:

Time series:

Chl-a: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Time ranges for POC (MODIS)-

Pre-COVID map:

COVID map:

Time series:

POC: Pre-COVID Map, COVID Map, Time series plot (3 figures)

Discussion

Please provide a one-page single-spaced discussion of what you observed. You can refer to your site descriptions, articles in the press about the pandemic for your location, and any other citations that may be relevant. If you didn't see any impact of the pandemic, you can discuss why this location may not have been as impacted as others.

Also submit to a Google Drive:

Compiled Google Sheets for each of your two locations containing time series data for all parameters. You'll have one sheet for MODIS and one for Sentinel. We will provide templates.