University of Waterloo Geography and Environmental Management Geomatics Exercise

Intro:
Welcome to our Geomatics lab! Today we are going to run through different activities that will introduce you to Geomatics and show you how it is connected to our everyday lives. Geomatics is a discipline that is focused on the techniques and tools for the collection, storing, analyzing, processing, and sharing of geospatial information. That definition may sound intimidating, but the idea is to take geospatial data and transform it into information that everyone can use! This lab is divided into 3 sections that Geomatics is connected to: Human Geography, Spatial Geography, and Physical Geography.

Before starting each section of the lab, please watch the corresponding video that was provided.

Materials List:
Computer
Multicoloured pen/pencils
Blank Paper

Part 1: Human Geography (10 – 15 mins)
Geographic Information Systems, also known as GIS, is a mapping technology that allows the user to create and interact with a variety of maps and data sources. This activity is to show how GIS technology can transform data that has been collected into spatial information for marketers.

Follow along with the video tutorial for Part 1: https://youtu.be/WuTF3JRYiKk

Instructions:
1. Go to https://prizm.environicsanalytics.com/. This website gives you consumer insights by dividing neighbourhoods into 67 unique lifestyle types.

2. Scroll down to "Get to Know Canadians by Neighbourhood" and enter the postal code of your house or your school! This is what it should look like:

   If you get an error such as "The postal code provided is not assigned to a segment. Please enter a residential postal code.", just enter a postal code around your area or use one of the postal codes provided below.

3. Scroll down more and you will see what your postal code represents! For example, the postal code N2L 3B9 represents "New Asian Heights". The data that this website gives is very general and may not accurately represent you if you looked up the postal code of your neighbourhood.
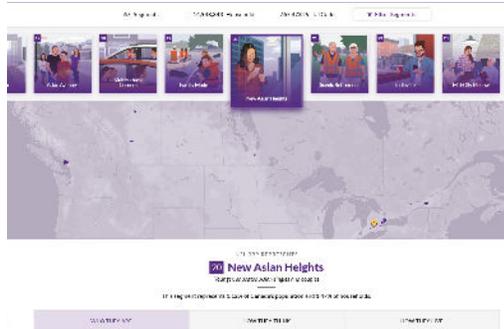
4. At the bottom of the above photo, you can see 3 tabs: "Who They Are", "How They Think", and "How They Live". The first tab gives a short paragraph describing the unique lifestyle of your postal code along with some other serious information on the right:

WHO THEY ARE	HOW THEY THINK	HOW THEY LIVE

One of four predominantly Asian segments, New Asian Heights reflects the emergence of younger, educated singles and couples living in the urban fringe of Toronto and Vancouver. Nearly three-quarters are foreign born, most having immigrated since 1990. Nearly 90 percent are condo owners or renters, typically in high-rise buildings. Still early in their careers, these young adults earn relatively modest salaries from entry-level jobs. But with few residents raising children, they have enough disposable income to enjoy a lively lifestyle close to downtown amenities. These fitness-conscious households score high for practicing yoga, jogging and working out at a health club. Many also lead busy online lives, logging on to websites for dating, shopping, finding jobs and connecting with friends.

AVERAGE HOUSEHOLD INCOME	**AVERAGE HOUSEHOLD NET WORTH**	**RESIDENCY**
$82,236	$510,228	Own & Rent
EDUCATION	**OCCUPATION**	**DIVERSITY**
University	White Collar / Service Sector	High
URBANITY	**FAMILY LIFE**	**HOME TYPE**
Urban Fringe	Younger Singles & Couples	Apartments

The second tab gives a few general assumptions for how a person in this lifestyle type may think:

WHO THEY ARE	HOW THEY THINK	HOW THEY LIVE

"I am willing to sacrifice my time with my family in order to get ahead"

"It is important to me that people admire the things I own"

"From time to time, I like to do things that are dangerous or forbidden, just for the sake of the risk and the sensation"

"I am comfortable sharing my personal information with social media sites"

The third tab gives you information about their activities and lifestyle choices:

WHO THEY ARE	HOW THEY THINK	HOW THEY LIVE

LEISURE ACTIVITIES	**SHOPPING**	**MEDIA**
Attend film festivals	Shop at Banana Republic	Watch late night TV talk shows
DIGITAL	**FINANCIAL**	**FOOD AND DRINK**
Use online dating apps	Bank at TD Canada Trust	Frequent coffee shops
RESTAURANTS	**HEALTH**	**AUTOMOTIVE**
Dine at Asian restaurants	Use store-bought orthotic insoles	Drive imported compact SUVs

Questions:
1. How accurate is the description of your neighborhood?
2. Look through the other tabs, does this reflect your family?
3. How might marketers benefit from this information?
4. **Optional Activity**: Go to google and look up your postal code. Zoom out. Look up the 'shopping' section from Prizm. Look up the shop on Google Maps. Does your area have more of these types of these shops in comparison to other shops? You can repeat this activity with restaurants as well.

The idea of this activity is how Prism managed to turn collected data into marketing information with the use of GIS! If you are interested in the data Prism used to create the marketing information, you can find the list of databases Prism uses along with the variables (different pieces of information) inside the databases here: https://environicsanalytics.com/data.

Part 2: Spatial Geography (30 - 45 mins)
When you think of the word 'map', do you think of a paper map or a digital map? The Global Positioning System, also known as GPS, is a global navigation satellite system that allows us to use digital maps and make our lives easier. However, what are the main uses of GPS and how does this affect spatial geography? The activities below are to show the abilities GPS and GIS have for solving spatial problems. *All questions in this section are bolded.*

Follow along with the video tutorial for Part 2: https://youtu.be/6LJnKCpdssg

Instructions:
1. Before we jump into the different uses of GPS, we are going to make a map! Using a blank sheet of paper, draw a map including the neighborhood where you live and the wider area including your school without using google maps or any other map. Draw it to the best of your abilities. Mark and label any landmarks, such as stores, your house, your school, parks, etc., and roads you can remember by creating a legend on the side of your map. Here is an example of what a legend looks like:
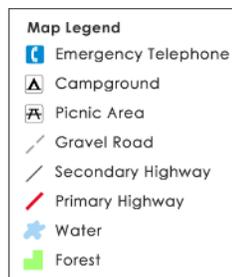
2. The map you produced is called a mental map! It differs for everyone, but it is a great way to show that even a hand drawn map can help someone else. If someone needed directions in your neighborhood, your mental map could be very helpful! We will refer back to your mental map later.

3. There are 4 main uses of GPS: first we have Location. Go to google maps (https://www.google.ca/maps) and look for your neighbourhood/school. Zoom out so you see your neighbourhood as well, and then search "fast-food restaurants". The results should look like this:
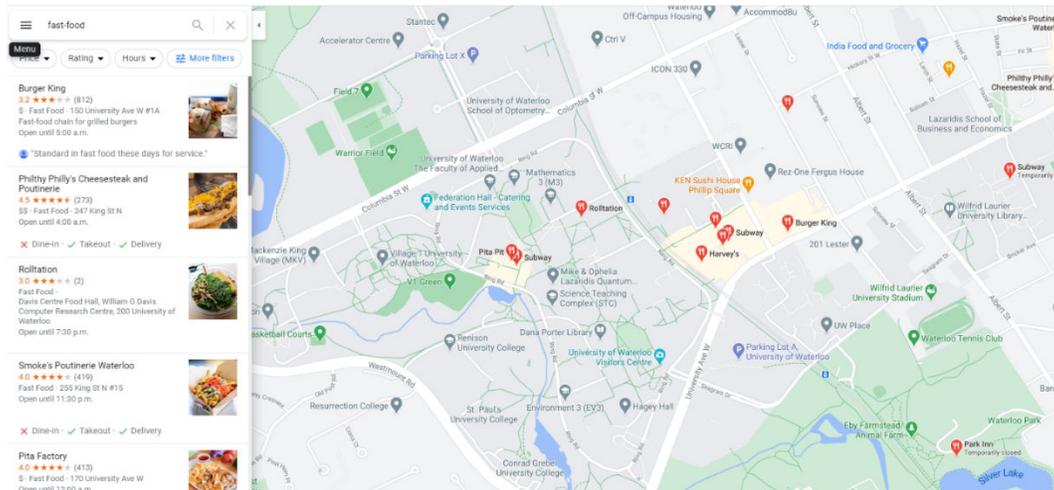
If when searching the map zooms out too far, you can zoom back in and hit the "Search this area" button that appears at the top middle of the webpage.

- **Question A: How many fast-food restaurants are in your neighborhood and did you know where they were before looking on google maps? Look back at your mental map and draw in any missing fast-food restaurants.**

4. Now click anywhere on the map. A gray circular location symbol should drop where you clicked, indicated by the red circle below, and a box containing coordinates should appear at the bottom middle. The box should look like this:


- **Question B: Find the coordinates of your school and jot it down.**
  This is the benefit of GPS, it can mark the exact position of a location on a map and with GIS, it allows for quick lookups and access spatial information about specific locations.

5. Using different coloured pens, draw 2 or more ways on your mental map to get from your house to your school.
- **Question C: Which route do you think is the fastest and why?**

6. The second use of GPS is navigation! Go onto Google Maps and look up directions from your house to your school. Google Maps should automatically give you the shortest route after considering multiple variables. It can calculate this thanks to a GIS analysis technique called shortest path. The algorithm takes into account variables to create the route for you, for example, the route distance, traffic, and speed limit.
    - **Question D: Compare the Google Maps Shortest Path result to your answer to Question E: Did you consider these variables as well? Did you consider more? Or was your answer completely different to how the Google algorithm computes the fastest route?**

7. This is the benefit of GIS as it can allow many spatial analyses to happen in order to provide solutions to our problems! In this example, it uses the shortest path analysis to solve our problem of getting to other locations faster.
    - **Question F: What other uses are there for this technology?**

8. The third use of GPS is Tracking. GPS has the ability to monitor the movement of objects very precisely, which is very useful when driving around using the navigation on Google Maps!

9. We can see how tracking can provide us with useful information, go to Google Maps and click on the top left button. Then go to Traffic:
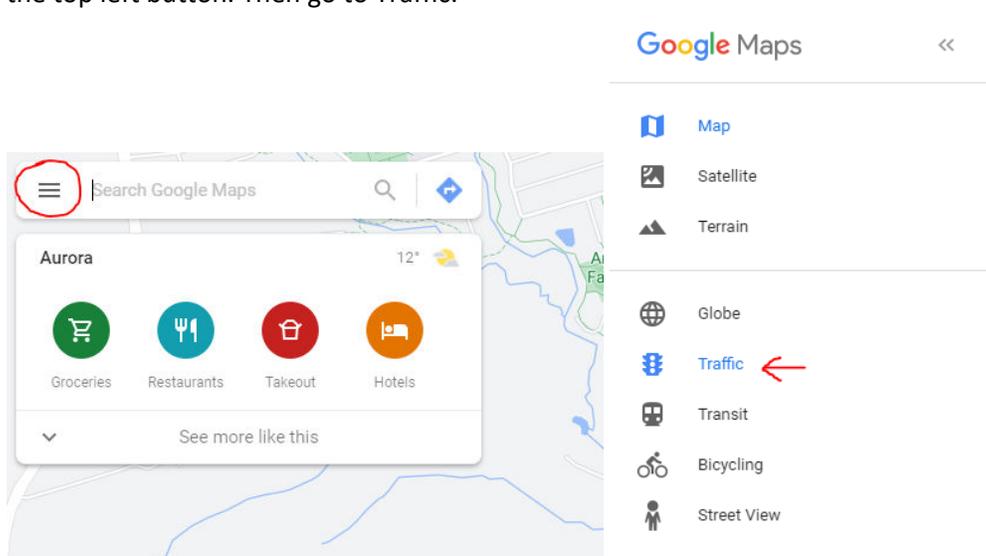
10. In this map, we can see the amount of traffic on each road. Green means no traffic, yellow means slight traffic, and red means heavy traffic. Google Maps actually uses the tracking ability of GPS to count how many "people" (more precisely how many phones) are on the road. Since they are tracking the amount of phones, there are ways to exploit this, for example this man with a wheelbarrow tricked google maps into thinking there was a traffic jam: https://www.wired.com/story/99-phones-fake-google-maps-traffic-jam/.

11. However, not everyone is like the legendary wheelbarrow man and holds 99 smartphones while they drive, therefore the traffic data that Google has collected is actually pretty accurate. They also allow you to view typical traffic and scroll throughout each day of the week to look at the traffic on a regular day. At the bottom, click the "Live Traffic" button and change it to "Typical traffic". The bottom widget should now look like this:
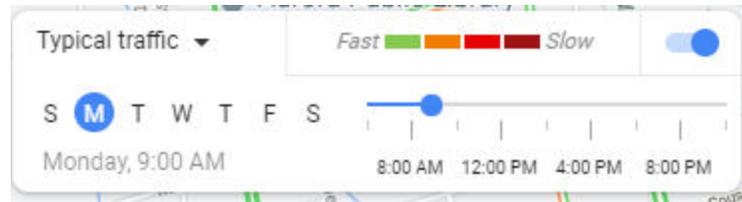
12. By clicking the letters of the week on the left, we can select a day to look at and change the time using the slider on the right. You can see the map changing when you click on different times in the day. Note that the map only changes when you let go of the slider for the time, do not hold and drag.

   - **Question G: Find the days and times that your neighbourhood has the most traffic. Hint: Good times to look around are lunch time, dinner time, and end of the school day.**

13. The last use of GPS is mapping. Mapping gives you the ability to solve problems in a different way! The map that you drew of your neighbourhood solves the problem: How do you get from your house to school? Without your map, it would be a lot harder to give proper instructions. With GPS and GIS mapping, we can solve even bigger problems.

14. Head over to https://www.google.com/maps/d/ and login to your google account. After you are logged in, you are going to click "+ Create A New Map" on the top left corner of the site.
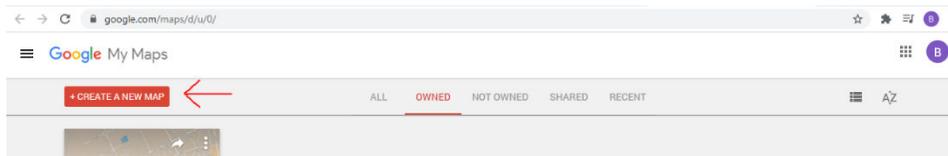

15. You should now be able to see a map of the world and on the left hand side we can see the title of the map is currently "Untitled Map. We are going to rename our map by clicking the "Untitled Map" text and rename it "Coffee Shops at UWaterloo". Click save.

16. Below the title, you will see an untitled layer. Here is where we are going to import all the coffee shop data we have of the University of Waterloo. The data we are using is taken from Open Street Maps, which is open source data collected by users around the world. Click "Import", and upload the KML file given to you named "Coffee Shops".
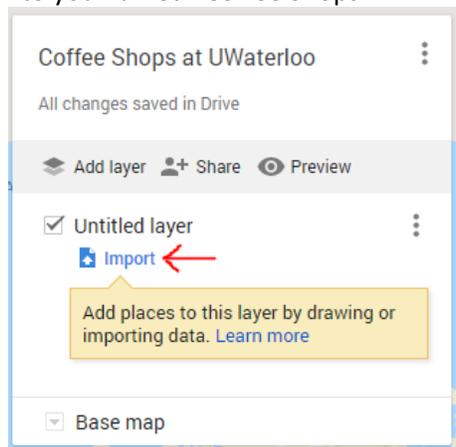
17. An error will show up saying 1 column was skipped, do not worry just click "Ok"

18. A blue location marker should now be on the map. Zoom into the blue marker and you can actually see that it is a bunch of location marked around the UWaterloo Campus! Your map should look like this:
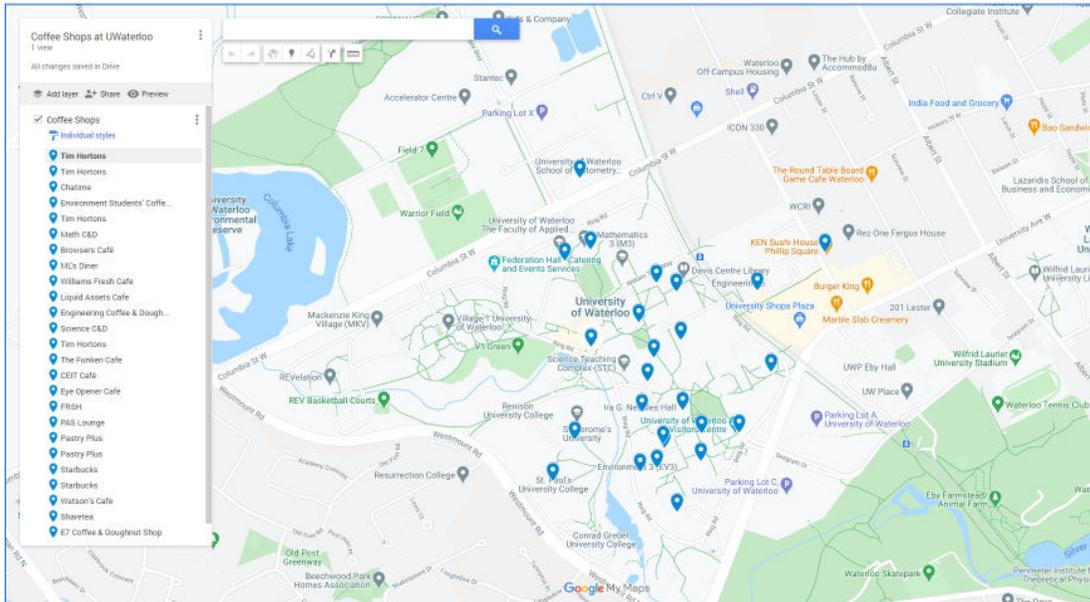
19. Right now the map looks a little cluttered. This is because the base map we have has other locations labeled, making it very hard to see our coffee shops on the map. To change the base map, scroll all the way down on the left and click on the little arrow beside the words "Base Map". 9 squares should show up and you can select each of them to see what the map looks like with each base map.
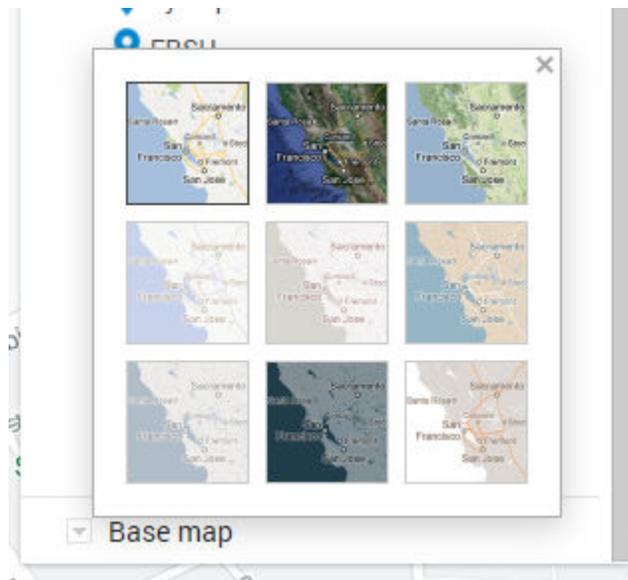
For my example, I chose the base map "Mono City", which is the center square above. I chose this base map because it is minimalistic, but if you zoom in you can see the building names and all the paths around campus. You can choose any base map you are comfortable with. This is how the map should look like now with "Mono City":
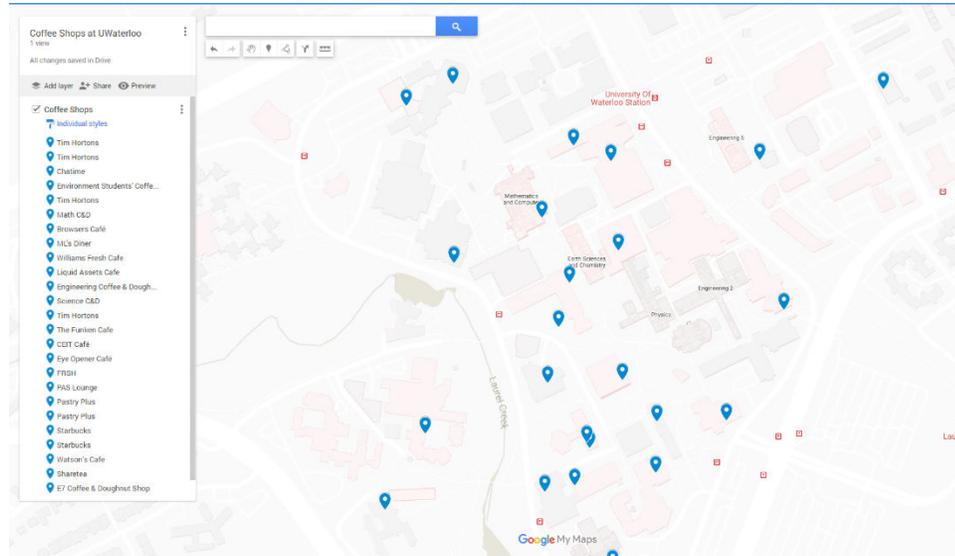

20. We now have a basic map, but what use is this map? We can use this map to determine where we want new coffee shops to go!

- **Question H: Using the map that you created, which building should UWaterloo build a new coffee shop in and why?** *Note: The name of the buildings are visible if you zoom in closer to the map.*

21. Using the same data, we can present the map in different ways to solve other problems. Here we are going to look at the different styles that you can use to display the data you are given. Click on the "individual style" at the top of your list at the left and under "set label" change it to name. This will show the name of each point on the map. If the name is not visible, zoom in and the names will show. This feature is in Google Maps to ensure that the labels are not too clustered and can be easily read.

22. Next, we are going to change how the points are grouped by. Currently the data is grouped individually and we can show it in another way. Click "Individual style" and change the "Group places by" to sequence of numbers. The map now labeled each shop from 1 to 24. This type of map would be great if the user is trying to find a specific store on the map. You can find it on the legend and just look for the number on the map! Another way to group the data is by similar attributes. This time we are going to change the "Group places by" to cuisine. This is what your legend should look like:
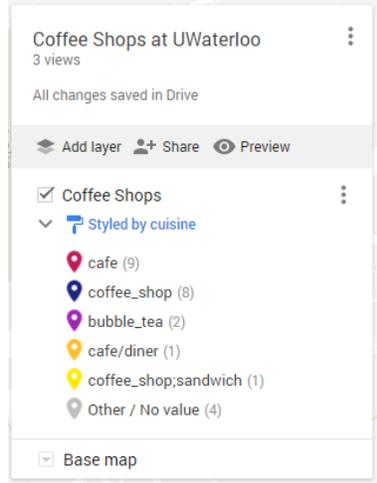
Your map is now sorted into different cuisine each shop is represented by.

- **Question I: What would be the use of the map you just created?**
- **Question J: Change how you display the data using the steps we just learned to create a new type of map and screenshot how the map looks like with the legend on the side. Explain why and when people would use your map.**

This section explained what uses there are to GPS and why digital mapping is so useful in solving spatial problems. During this activity, you turned the knowledge you have of your neighbourhood into a useful hand drawn map and you have created a wonderful digital map of the coffee shops around UWaterloo campus!

Another fun example of mapping is the shot charts that are available for each player in the NBA. These maps use shooting percentages to map out where the player is best at shooting and where they are the worst. To see the maps, go to https://www.nba.com/stats/ and scroll down to "Shotchart Search". There you can look for your favorite team or player!

## Part 3: Physical Geography (20 – 30 mins)

Remote Sensing is the acquisition of information about an object or phenomenon without making physical contact with the object. In Geomatics at UWaterloo, we take multiple courses that dive deeper into remote sensing, but the most basic version of remote sensing is taking aerial photos. These activities show the abilities of aerial photos and how they can help us describe physical phenomena around the world. *All questions in this section are bolded.*

Follow along with the video tutorial for Part 3: https://youtu.be/8iEUEe8Qn4k

Instructions:

1. Using Google Earth Engine: https://earthengine.google.com/timelapse/ look at the Columbia Glacier Retreat and start the time lapse. You can pause the time lapse using the pause button on the bottom left of the photos
   - **Question A**: **What do you see happening throughout these photos?**

2. Next we are going to find out where the Columbia glacier is on the map. Click the map on the top right and zoom out using the scroll wheel or the " - " button on the top right

3. Go to https://climate.nasa.gov/ and click on the "Global Temperature" tab at the bottom.
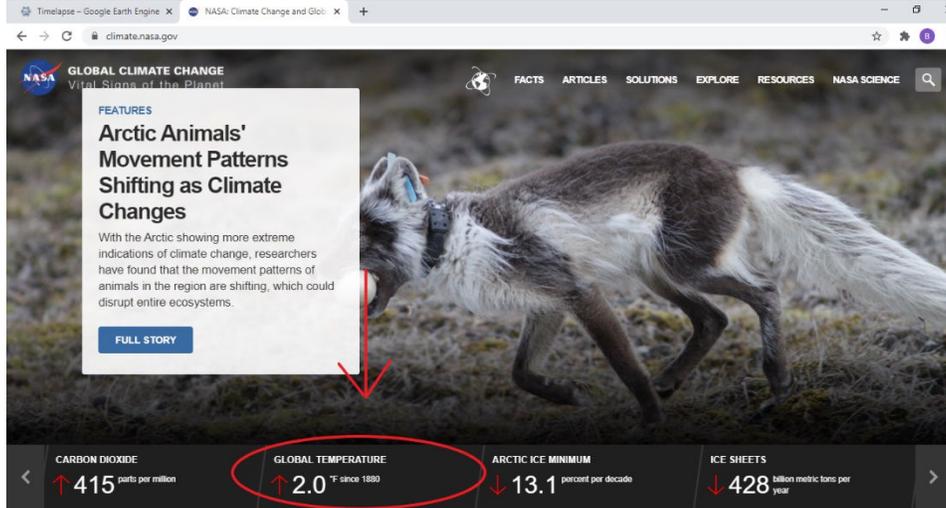
4. We are going to look at the map on the right. Using the slider on the right, move the slider to 1985 and note the temperature difference at the location of the glacier. Then, move the slider to 2018 and note the temperature difference at the location of the glacier.

5. Now we are going to look at the figure on the left side of the NASA page. Find the Temperature Anomaly on the graph of 1985 and 2018 by hovering over the graph. Note the 2 numbers.

6. *Next, go to https://www.co2levels.org/ and zoom in to find the CO2 levels from 1985 and 2018. If nothing is showing up on the site, refresh the page.*
   - **Question B: What do you think has caused the glacier to retreat?**

7. As you can see we can link the aerial photos to climate data to show the effects Climate Change has on the glaciers. It can also show the effects of other phenomena as well! We are going to do an activity that shows more examples of the processes that we study in physical geography.

8. First, we are going to break into 3 groups. Using the Google Earth timelapse, we are going to look at the aerial photos of these processes:
   - One group look at meandering river time-lapse: Kosi River, India
   - One group look at deforestation: Toliara and Saint Augustin, Madagascar
   - One group look at Drying of the Aral Sea: Kazakhstan and Uzbekistan
   You can find the timelapses on the left side of the website under "Timelapses around the World"

9. Present to the rest of the class answering these questions:
   - **Question C: Describe what do you think is happening in the time lapse?**
   - **Question D: Do you think human's play a significant role in the process that you are observing?**
   - **Question E: Does it surprise you how quickly these changes are occurring?**

This activity showed how we can link remote sensing to physical geography. We can also use 360 photos to create fun geography games! If you want, you can create an account on https://www.geoguessr.com and guess where in the world you are from the 360 photos!

Thank you for working through this exercise! Problems and exercises in this tutorial are based on a first year GIS course, GEOG181, that all Geography and Environmental Management students take.

Interested in learning more about Geomatics at Waterloo? Check out this introductory video on the program: https://www.youtube.com/watch?v=M_Rhgxp4JNI

If you have any questions, please feel free to reach out via email at roadshow@uwaterloo.ca or social media @uwaterloogeo on Facebook & Instagram and @GeogWaterloo on Twitter.