

Exploring Our Planet With Open-Source Software



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Exploring Our Planet with Open-Source Software

Credits

This exercise was developed by:	In partnership with:
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This educational resource (and a broader collection of educational resources) is available for download (.pdf) from the VirginiaView and AmericaView Websites. An accompanying video tutorials of this document is also available through these websites:

<http://www.virginiaview.net/education>
<https://americaview.org/exploringourplanet>

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Credit for the cover photo:

101106-N-8863V-113 NORCO, Calif. (Nov. 6, 2010). Girl Scouts competed in the Mission Ocean Challenge during the USS California Science Experience at Naval Surface Warfare Center, (NSWC) Corona Division. This event intended to introduce students to real world STEM applications. (U.S. Navy photo by Greg Vojtko/Released).
http://www.navy.mil/gallery_search_results.asp

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Exploring Our Planet with Open-Source Software

This manual, and associated written tutorials, introduce instructors and students to open-source, on-line, software that supports student learning in cartography, image analysis, GIS, and map interpretation as they apply to Geography, Social Sciences, History, Current Events — basically, many of the topics that form subject matter for school curricula of our educational systems at several levels.

Introduction

Pages vi - viii

National Geographic Mapmaker Interactive. NGS Mapmaker Interactive offers users a capability for preparing individualized maps, measuring distances, adding place marks and layers. Users can select and switch base map layers. National Geographic Mapmaker Interactive allows students to add layers to represent environmental features, agriculture, human conditions, political boundaries, water, economy, and energy. Data is available for countries around the world. Together, these features provide opportunities for learning map skills, geographic concepts, and the context for historical reference features. Users can change scale, roam, and label features. Map displays can be created using data overlays representing food, energy, culture, environment, water, climate, and weather, among others. Mapmaker interactive is designed for use by students of all ages.

National Geographic Mapmaker Interactive

Pages 1 - 16

Google Earth. Most readers are likely already aware of *Google Earth*—a well-known open-access computer program that provides 3-D representations of the Earth's surface based on aerial imagery – aerial photography for finely-detailed views of landscapes and cities, and satellite imagery for broad-scale views of larger regions. Google Earth is not available in three forms – a desktop-version called Pro and a web-based version available through Chrome, and as a mobile app available for both android and Apple devices. .

Google Earth

Pages 17 – 107
and pages 126 -
163

OpenStreetMap (OSM) provides a free interactive map of the world depicting street patterns as compiled by volunteers. OSM is available without cost on computers, and mobile apps. Map data is collected directly from local observation by volunteers using GPS units, notebooks, and cameras. Data can be submitted into the OpenStreetMap database.

OpenStreetMap (OSM)

Pages 108 - 125

Introduction to this Manual

This manual, and associated written tutorials introduce instructors and students to open-source, on-line, software that supports student learning in cartography, image analysis, GIS, and map interpretation as they apply to Geography, Social Sciences, History, Current Events — basically, many of the topics that form subject matter for school curricula of our educational systems several levels. Most activities are prepared for use with computers, tablets, and iPads, and require internet access.

The accompanying videos will guide you in learning to work with these programs. They have applications in (for example) K-12 instruction, community colleges, and many introductory university courses, or in following your own individual interests.

Open-source software refers (in our present context) to software available to the public (typically through the internet) without cost to the user, require varying levels of expertise (from novice to expert), or equipment, and provides resources to guide learning and application of its capabilities. Here, we have selected a few of the many resources available, characterized by: (a) presentation of a range of important topics and skills; (b) created and maintained by established organizations; (c) together, cover deliver a spectrum of topics that prepare students with skills and perspectives that pertain to a range of subject matter.

At the end of this introduction, readers will find a link of YouTube videos that have been completed in conjunction with this written tutorial for ***National Geographic Mapmaker Interactive***, ***Google Earth Web*** and ***Google Earth Pro***. The YouTube videos do not cover every aspect of the written tutorials. Additionally, the tutorials do not cover every aspect of each of these open-source programs.

National Geographic Mapmaker Interactive. NGS Mapmaker Interactive offers users a capability for preparing individualized maps, measuring distances, adding place marks and layers. Users can select and switch base map layers. National Geographic Mapmaker Interactive allows students to add layers to represent environmental features, agriculture, human conditions, political boundaries, water, economy, and energy. Data is available countries around the world. Together, these features provide opportunities for learning map skills, geographic concepts, and the context for historical reference features. Users can change scale, roam, and label features. Map displays can created using date overlays representing food, energy, culture, environment, water, climate, and weather, among others. Chapter 1 of this tutorial covers National Geographic Mapmaker Interactive. Pages 1 – 16 in this tutorial.

Google Earth. Most readers are likely already aware of ***Google Earth***-- a well-known open-access computer program provides a 3D representations of the Earth's surface based on aerial imagery – aerial photography for finely-detailed views of landscapes and cities, and satellite imagery for broad-scale views of larger regions. The program represents the Earth by projecting satellite imagery, aerial photos, and GIS data onto a 3D representation of the globe, allowing users to see cities and landscapes from various perspectives. Users can navigate to explore the globe by entering addresses, coordinates, and place names, and by roaming using the computer mouse and zoom tools to change, location, scale, and orientation.

Google Earth is presently available in three forms – Google Earth Pro, Google Earth Web (sometimes called Google Earth for Chrome), and a mobile app. Each one of these versions provides different capabilities, although, some of the capabilities are very similar. It is very important that educators review the use terms in Google Earth before using the program in their classroom because of specific age limitations. *Google Earth Web* is covered in Chapter 2 (pages 17 – 39). *Google Earth Pro* in Chapter 3 (pages 40 – 107).

Google Earth provides a series of specific tools through the desktop application. *Google Earth Pro* provides suite of additional tools that allow users to compute distance and areas, manipulate, and export data, access historical data, and create new files and maps. It, additionally, provides capability to utilize existing GIS data to create individualized maps, annotate, outline, and prepare maps for use in other media.

An older version called **Google Earth Desktop**, is no longer available for download but, our final chapter – Chapter 5 (pages 126 -163), has details on using this application in case users still have this old program on their computer.

OpenStreetMap (OSM) provides a free interactive map of the world displaying street patterns as compiled by volunteer contributions (aka crowd sourcing). It is available on computers, and mobile apps without charge. Map data is collected from scratch by volunteers performing systematic ground surveys using tools such as a handheld GPS unit, a notebook, digital camera, or a voice recorder. The data is then entered into the OpenStreetMap database. OSM is covered in Chapter 4, and, again, we did not complete any accompanying YouTube videos for OSM. Pages 108 - 125.

YouTube Videos prepared for use with this tutorials

National Geographic Mapmaker Interactive

1. Introduction to National Geographic Mapmaker Interactive
<https://youtu.be/BWgUKRzWY4I>
2. Using Basemaps in National Geographic Mapmaker Interactive
<https://youtu.be/kVHzdKjiS0k>
3. Using Help, Bookmarks and Reset Map in National Geographic Mapmaker Interactive
https://youtu.be/1Z-C_4Tr4s
4. Drawing Tools in National Geographic Mapmaker Interactive
<https://youtu.be/-8yo-je347k>
5. Saving, Sharing, Printing in National Geographic Mapmaker Interactive
<https://youtu.be/uxM7x7PU2Oo>
6. Layers in National Geographic Mapmaker Interactive
<https://youtu.be/Yx8zWXkg6V0>
7. Country Flags and Latitude and Longitude in National Geographic Mapmaker Interactive
https://youtu.be/_MkTfFkLo5A

Google Earth

- 8. Introduction to Google Earth
<https://youtu.be/DaluBU8ZO3A>
- 9. Locating KML Files for Google Earth
<https://youtu.be/8bLweAYxQoM>

Google Earth Web

- 10. Introduction to Google Earth Web
<https://youtu.be/NjWJlt-jWF4>
- 11. Navigating in Google Earth Web
<https://youtu.be/1-SNUm58tc4>
- 12. My Places in Google Earth Web
<https://youtu.be/njzDD-t6TS0>
- 13. Map Styles in Google Earth Web
- 14. Sharing in Google Earth Web
<https://youtu.be/KkS8MVH8Me4>
- 15. Using a KML File in Google Earth Web
<https://youtu.be/G2uGOSbk6ns>

Google Earth Pro

- 16. Introduction to Google Earth Pro
<https://youtu.be/JStJz-AUYvQ>
- 17. Changing Settings in Google Earth Pro
<https://youtu.be/IXqzT4zUkE0>
- 18. My Places in Google Earth Pro
<https://youtu.be/EJPUY4QDGyI>
- 19. Default Table of Contents, Part 1 in Google Earth Pro
<https://youtu.be/KyjRgT2icME>
- 20. Default Table of Contents, Part 2 in Google Earth Pro
<https://youtu.be/ykILDv3A2TA>
- 21. Measuring in Google Earth Pro
<https://youtu.be/qsCxOsOL5SM>
- 22. Exploring Historical Imagery in Google Earth Pro
<https://youtu.be/7r1ETosfKmU>
- 23. Adding GPS Data to Google Earth Pro
<https://youtu.be/x6Ijzbi0iIo>
- 24. Using a KML File in Google Earth Pro
<https://youtu.be/p2KI-8Gyyh0>
- 25. Finding GIS Shapefiles to use Google Earth Pro
<https://youtu.be/gH20ARsLixA>
- 26. Using GIS Shapefiles in Google Earth Pro, without a Style Template
<https://youtu.be/4GXWB3JDMxA>
- 27. Using GIS Shapefiles in Google Earth Pro, with a Style Template
<https://youtu.be/wG0WyxqielY>
- 28. Using Regionate in Google Earth Pro
https://youtu.be/p84BgO1ro_w

Exploring Our Planet with Open-Source Software

1. National Geographic Mapmaker Interactive

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This set of tutorials introduces you to National Geographic's Mapmaker Interactive (<http://mapmaker.nationalgeographic.org/>). Please note that we recommend using Chrome as your web browser when working in this on-line program, some features don't work well in Firefox or in Internet Explorer.

1.1. Introduction

National Geographic Mapmaker Interactive is an online mapping program. (Our YouTube video introducing you to this program is found at: <https://youtu.be/BWgUKRzWY4I>.) Designed for educational purposes, this site is easy to use and maps can be customized to a specific region and for specific stories/themes. Students who are technologically savvy can master this mapping program in under ½ hour. For those students who are not technologically savvy, the *Help* videos can be played over and over again for clarification.

National Geographic Mapmaker Interactive is powered by ESRI, the world's leading producer of GIS software. National Geographic Society has provided different Base Maps and several layers (themes) for uploading into the on-line GIS program for mapping projects.

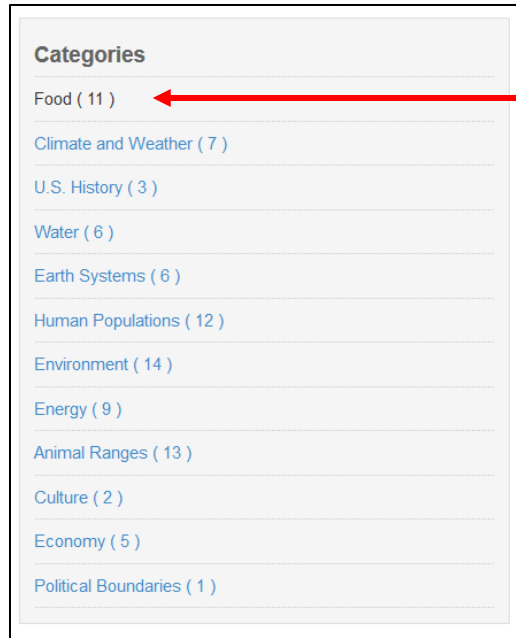
The screenshot on the right shows the Base Maps available (the YouTube video on specifics of these different basemaps: <https://youtu.be/kVHzdKjiS0k>):

National Geographic Mapmaker Interactive has themes already available for you to use! Thus, you do not have to search for data. You can use one theme (actually these are called Layers) or multiple themes in one map. (Again, don't worry about finding these right now, we are just showing you the possibilities for this program)

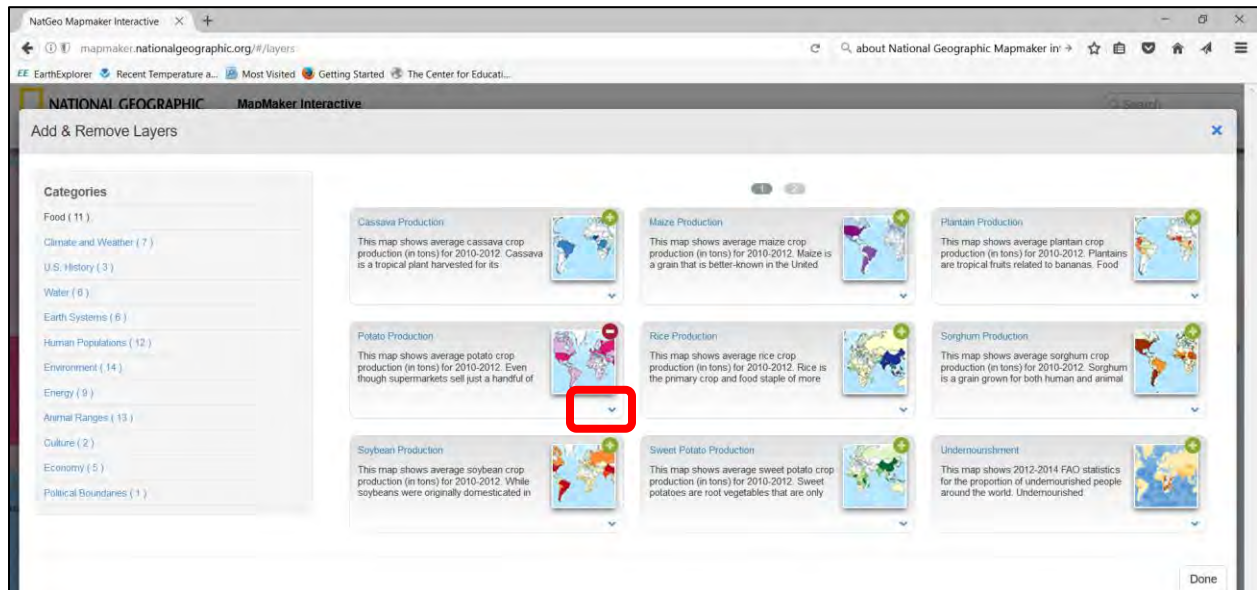
The following screenshot shows the categories for the layers available (as of the writing of this tutorial) for display in your map:



Exploring Our Planet with Open-Source Software

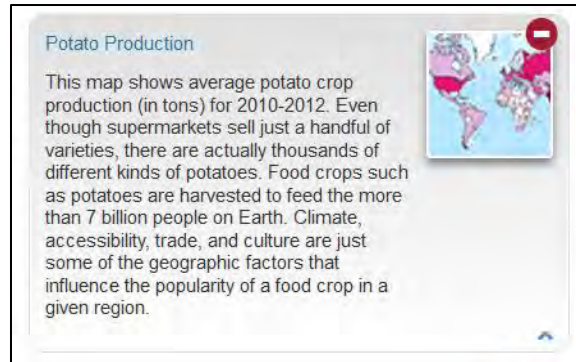


If you click on any one of these categories (in this case, we clicked on Food with 11 themes available), you find the list of themes to add to a base map:



Additionally, the program also provides metadata for each of the themes. For example, for the Potato Production theme, we clicked on the down arrow (red box – in the above screenshot) you receive the following metadata:

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You can add more than one theme to a map, change how the themes are displayed, and add typographical data, video and image links to the map produced. All of these possibilities are covered in individual video tutorials within the National Geographic Mapmaker Program.

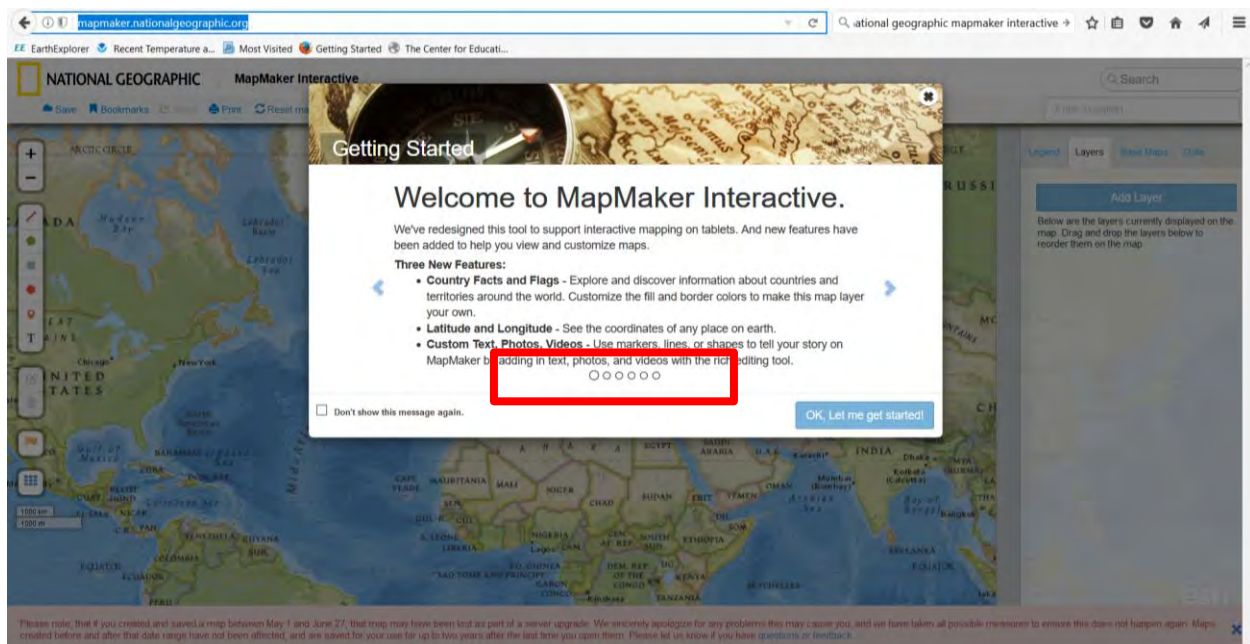
You do not need a subscription to National Geographic Magazine nor to the National Geographic Society to use this program.

The program works best in the Google Chrome web browser. You can also use the program on tablets.

1.2 Let's Get Started

Go National Geographic Mapmaker Interactive at <http://mapmaker.nationalgeographic.org/>

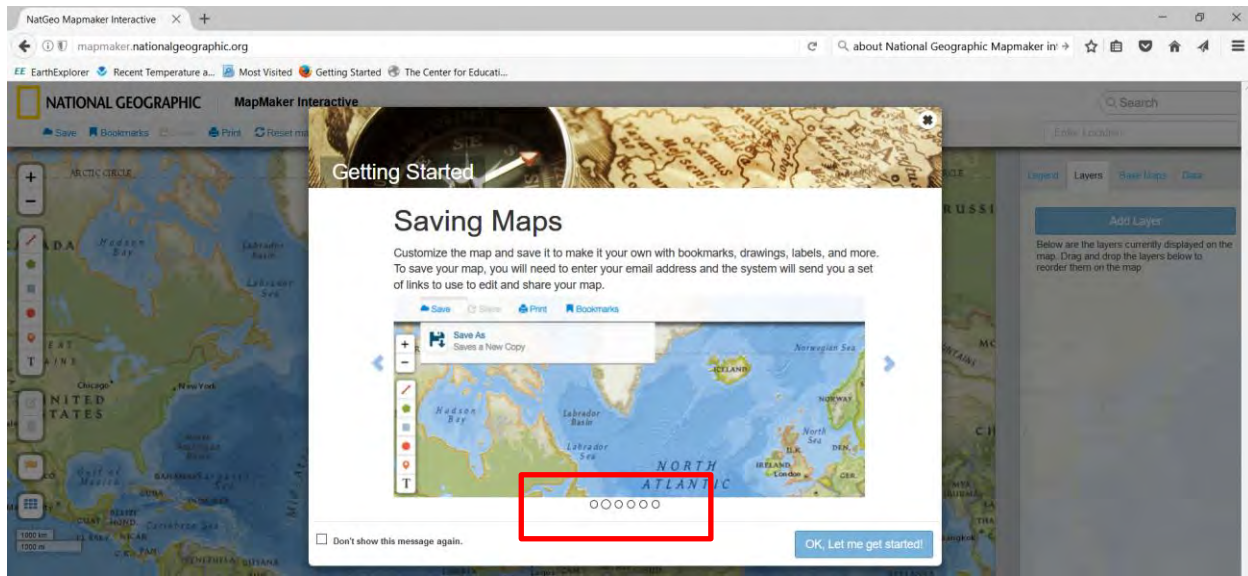
When you first open the program you will get the *Getting Started* window:



Exploring Our Planet with Open-Source Software

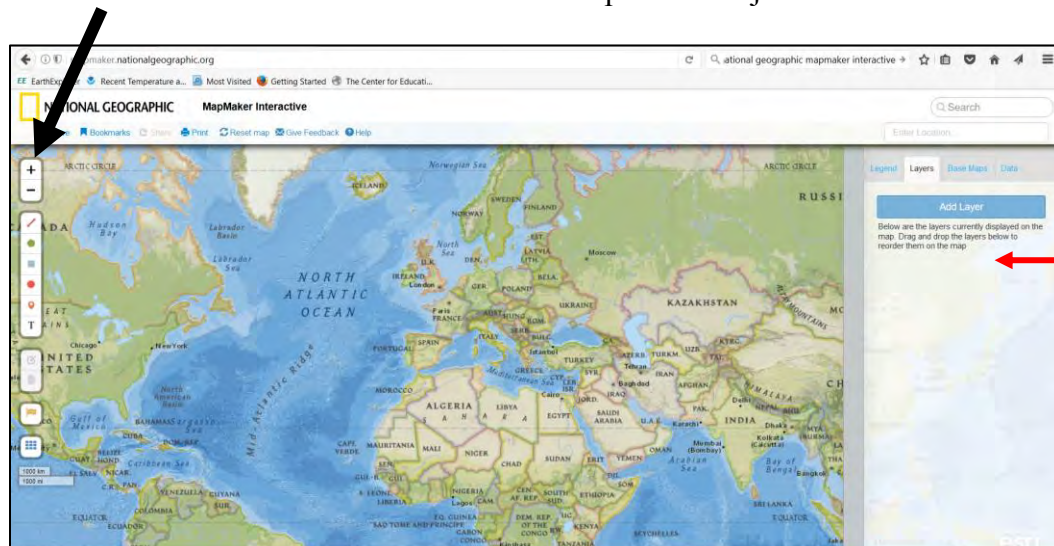
We do not recommend that you check the box – *Don't show this message again*, because this is how the National Geographic Society communicates changes to the on-line program. We recommend that you read this each time you enter the on-line program.

In addition, you can click on the open circles at the bottom of the window (red rectangle in above screenshot) and page through additional information. For example, we clicked on the next open circle and received this information about Saving Maps.



You can page through each one. They do not give you specific details on how to accomplish each task, but just tells you features of the program. However National Geographic Mapmaker Interactive does have video tutorials with detailed instructions.

For now, click on Ok, Let me get started! The window closes and you see the following screen – a base map of the entire world. On the right side of the window is your Table of Contents. On the left side are some tools to use. We will explore these just a bit.



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You can zoom into a specific region, if you want. To zoom in and out, you can use your mouse wheel – forward zooms in, backwards zooms out – or you can use the + (zoom in) and – (zoom out) signs in the upper left corner.

For now, we will leave the entire world visible as some themes are easier to see when zoomed out.

The next set of tools on the bar are drawing and text tools (green rectangle). How to use each individual tool is covered in the Mapmaker Interactive Video Tutorials and YouTube video that we created (<https://youtu.be/-8yo-je347k>).

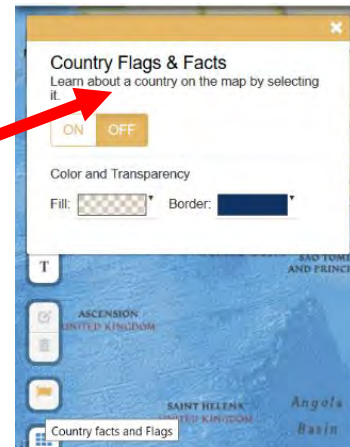
The next two tools are related to layers (black box). They are not activated on this screen because we have not added any layers.



1.3 Country Flags and Facts

The next tool (looks like a flag) is for Country Flags and Facts. (We also cover this in YouTube Video: https://youtu.be/_MkTffkLo5A).

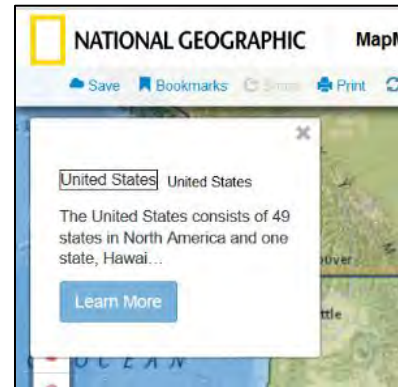
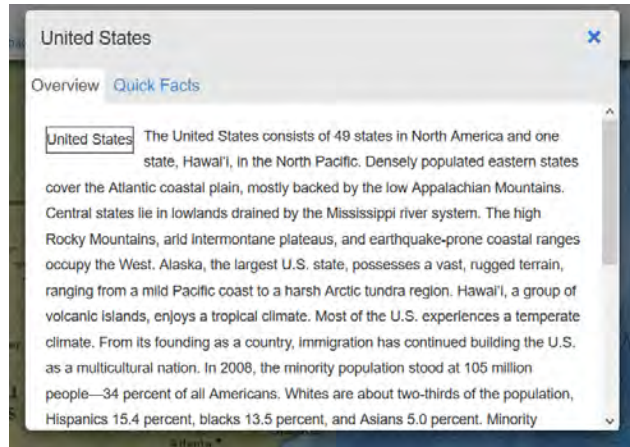
In the screen on the right, it is turned off. Just click *ON* and it will turn it on. Once on, you can change the fill and border colors. In the screenshot below, click on the checkered box to bring up the color window.



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In the screenshot on the right, turn on the Country Flags & Facts and then click on the United States in the map document window.

Here, click on *Learn More*:



Here, click on the *Quick Facts* tab:

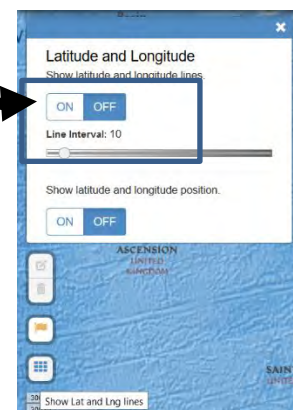


1.4 Using Latitude and Longitude Tools

The final tool on the right side of the screen is Show Latitude and Longitude Lines. (This topic is covered in YouTube video: https://youtu.be/_MkTffkLo5A.)

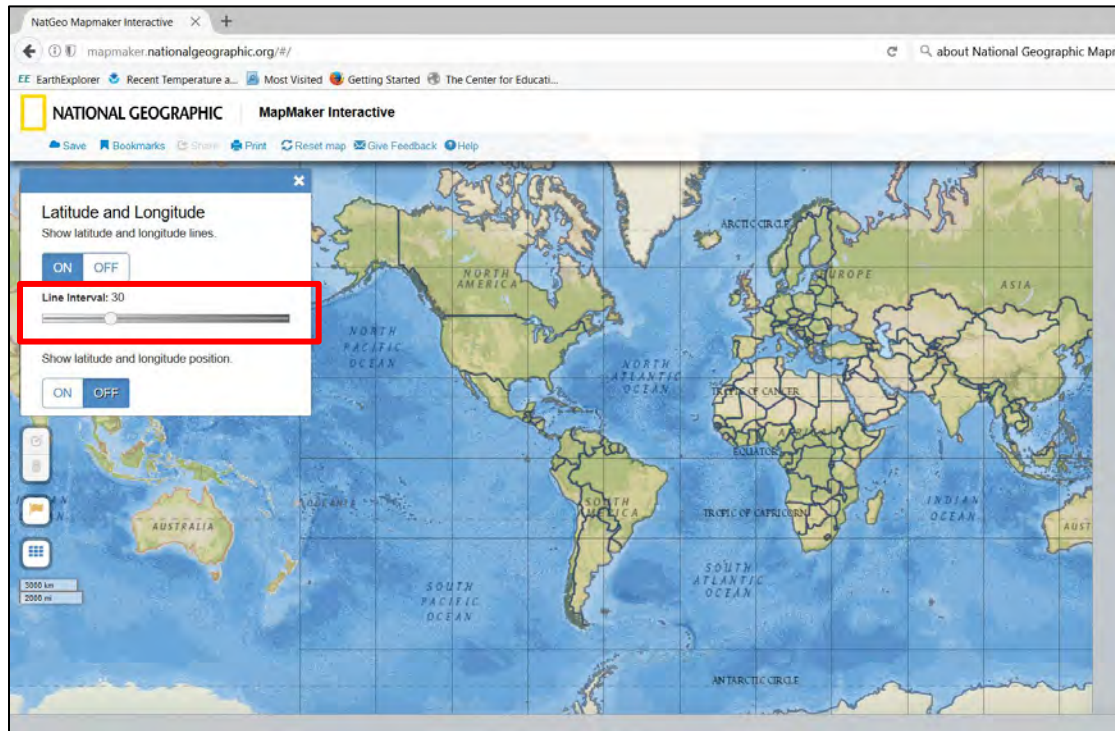
Again, these show OFF (blue rectangle). But if you turn it on, then the lines of latitude and longitude will display in your map. You can also change the line interval by using the sliding bar.

Additionally, you can turn ON latitude and longitude position for a specific location.



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As per the screenshot below, turn on the *Latitude and Longitude* and change the *Line interval* to 30 (red box).



How will you remember all of this? Don't worry, under **Help**, you have video tutorials for each of these tools.

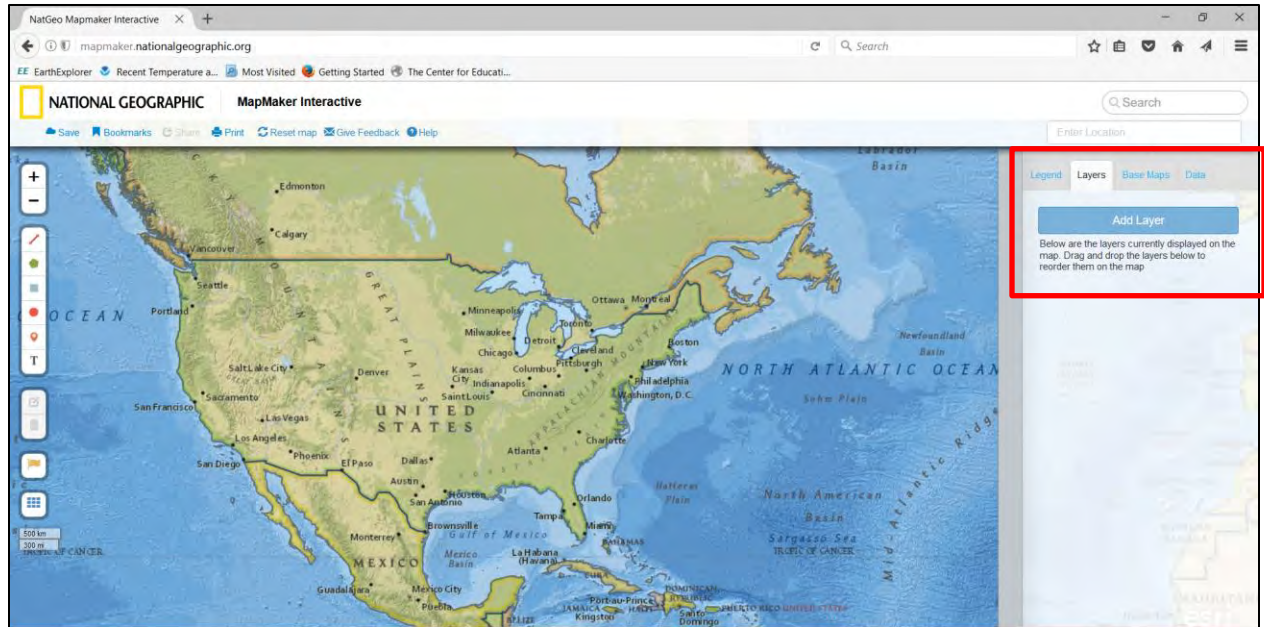
1.5 Using Layers

So, how do you add layers? (This topic is also covered in YouTube Video: <https://youtu.be/Yx8zWXkg6V0>.)

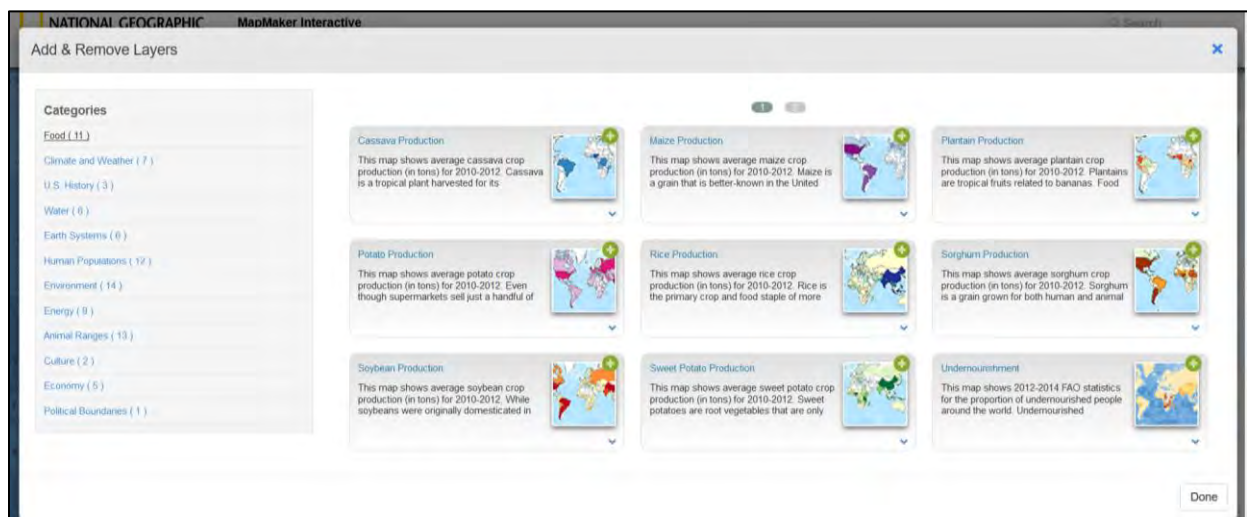
Let's experiment and add the *Potato Production* Layer.

Click on *Add Layer* (red box in the screenshot below) on the right side of the map.

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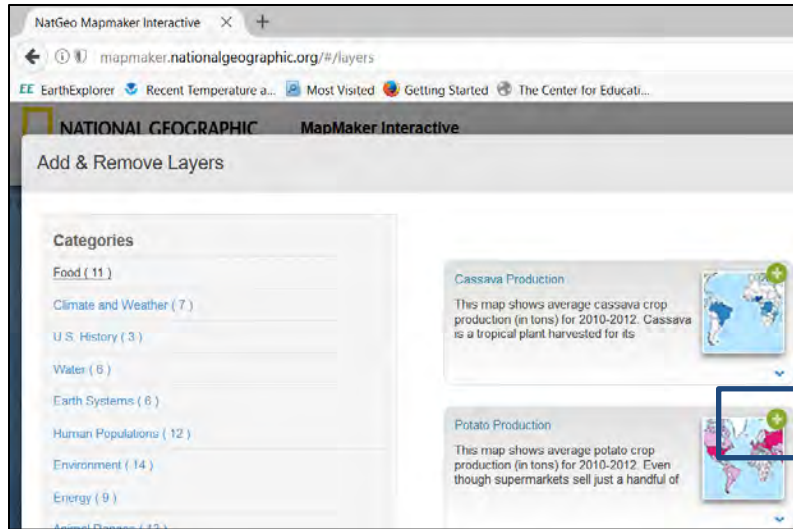


You get this window. Click on the *Food (11)* category and you see the following themes:

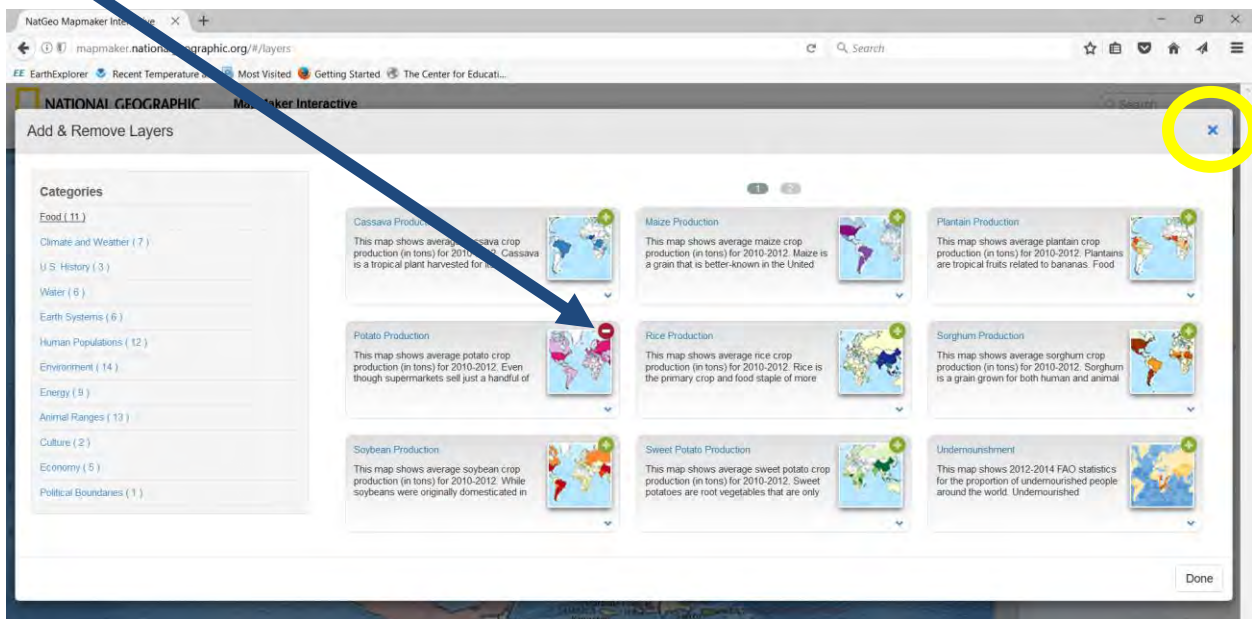


Find *Potato Production* and click on the + sign (blue box in the screenshot below).

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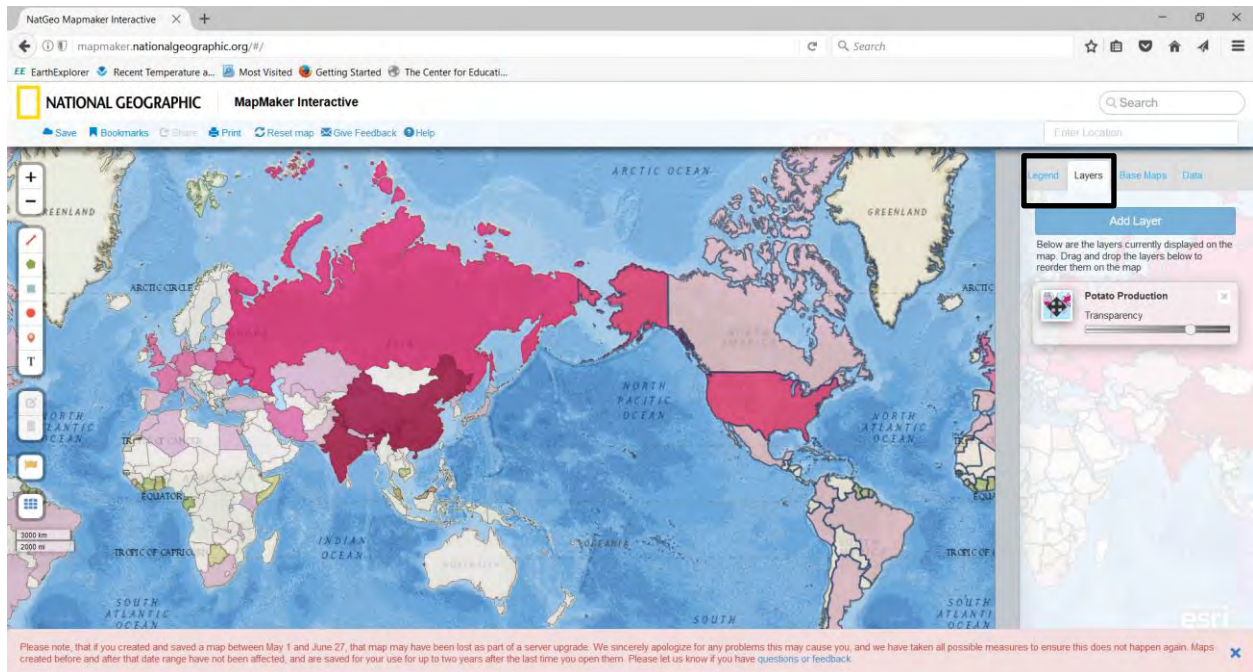


It does not look like anything happened, but look the + sign, it is now a – sign (inside a fuchsia circle). Let's close the window using the X in the upper right corner (yellow circle).



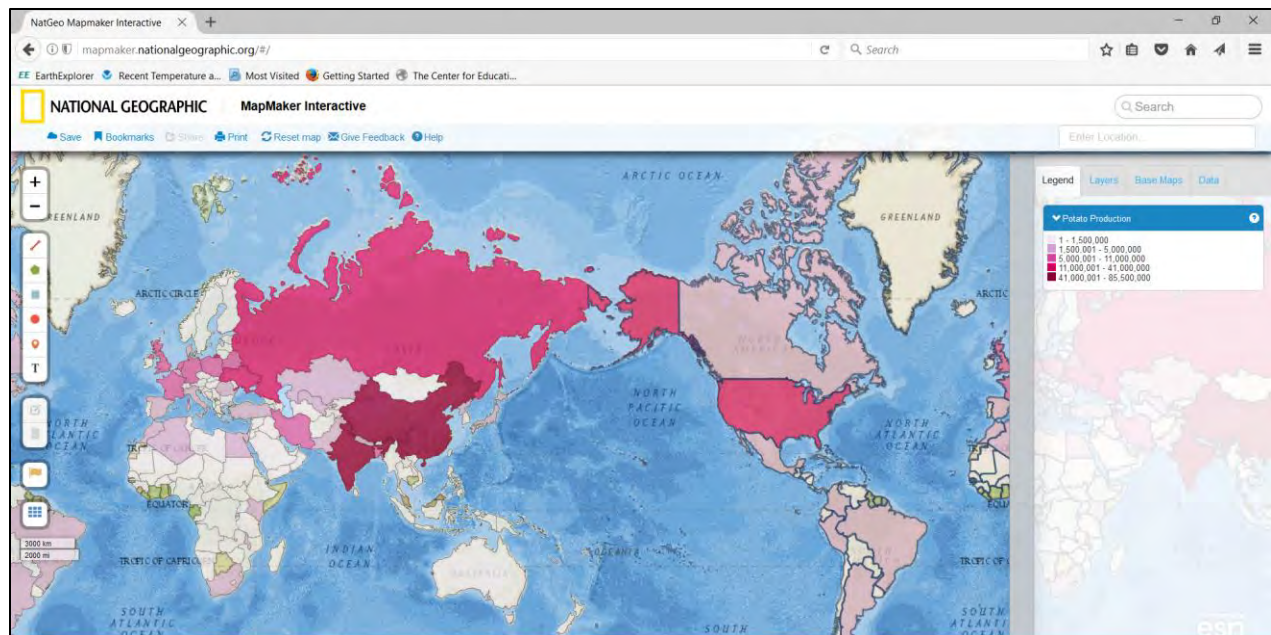
Now look at your map. If you don't see the colored theme, as shown in the screenshot below, you might be zoomed in too far. The theme is by country, so you have to be zoomed out far enough to see at least two countries (in whole or in part).

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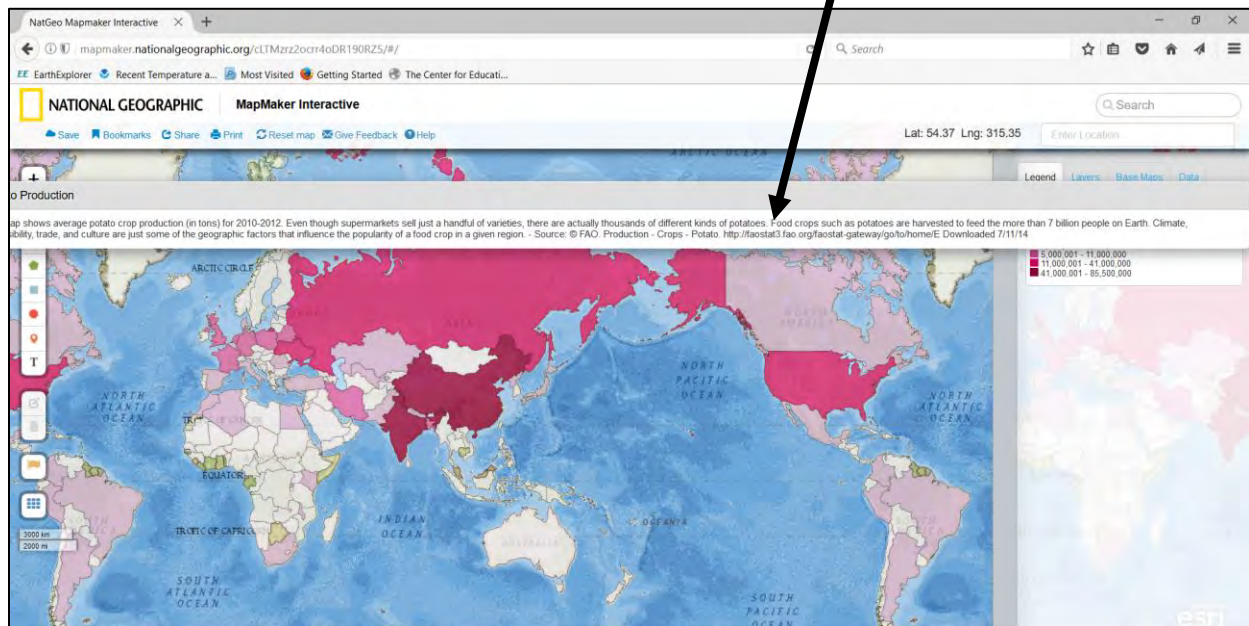
On the right in the Table of Contents, it shows a layer for Potato Production and at the bottom of the layer box is a Transparency bar. You can slide this setting back and forth to increase transparency, which you may want to do if you add a second theme or to see the country names.

For now, click on the *Legend* tab (black box next to the word *Layer*). It provides the legend and the categories for each production level.



If you don't remember what the metadata said about the production level, you can click on the question mark at the end of the blue bar and it will display the metadata at the top of the map.

Exploring Our Planet with Open-Source Software

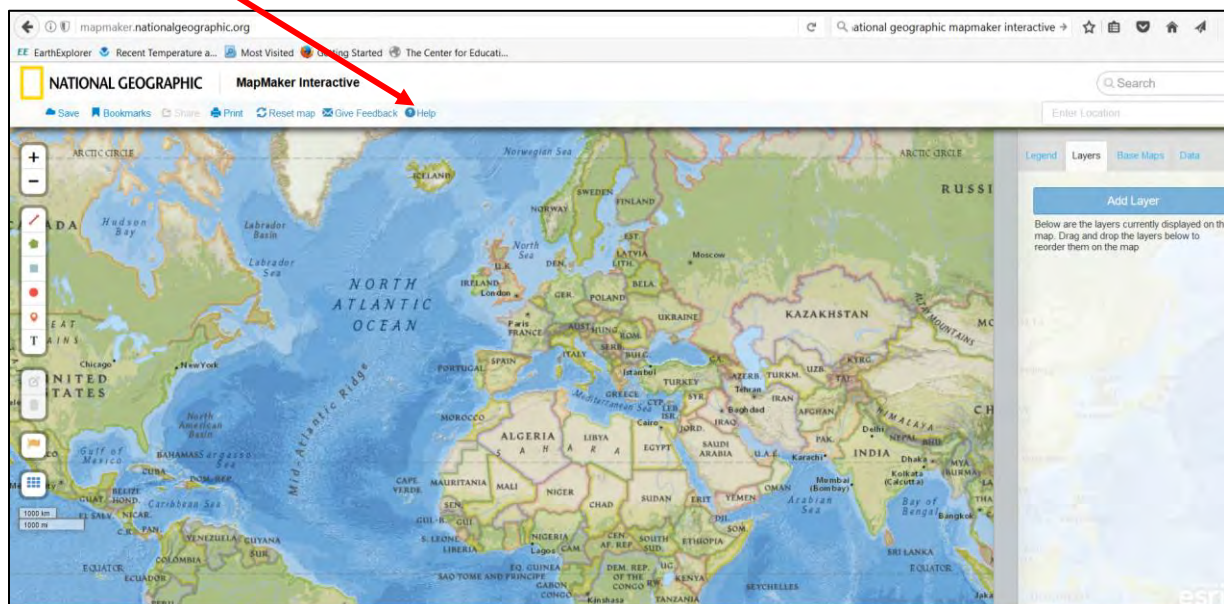


This is a lot to remember, but, again, National Geographic Mapmaker Interactive has short (1 – 3 minutes) video tutorials to show you how to work with the program.

Let's look at those now. Some of you are likely ready to move on.

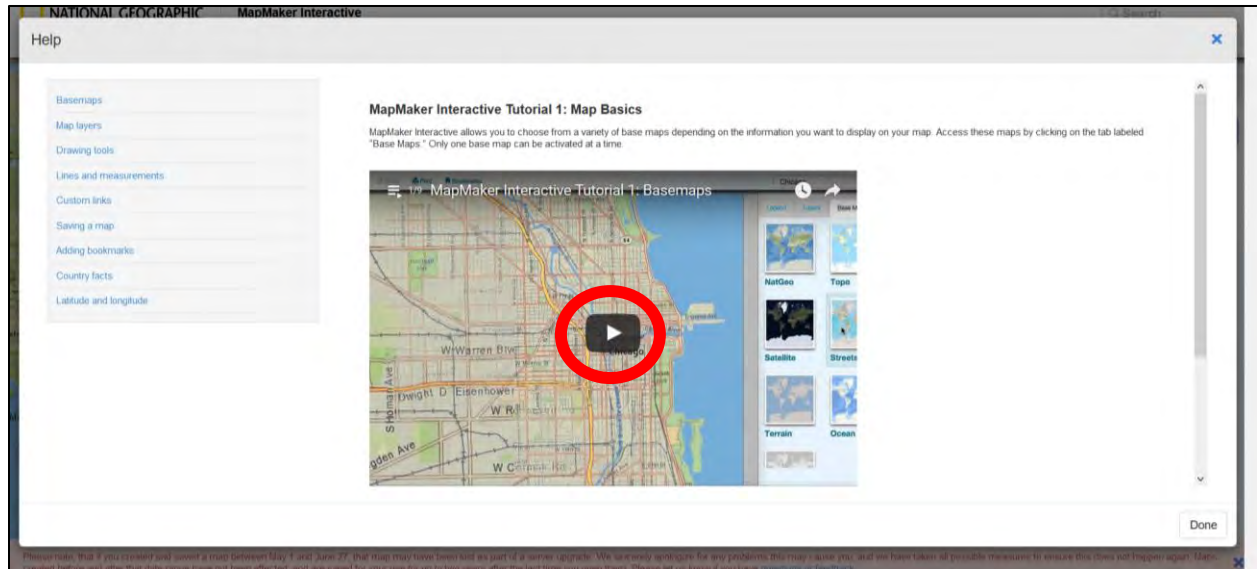
1.6 Using Help and the Video Tutorials

Click on **Help** in the toolbar. (The YouTube video for this topic: https://youtu.be/1Z-C_4Tr4s.)



Exploring Our Planet with Open-Source Software

This takes you to the **Help** window, as seen below. On the left is the list of **Help** topics. Each one of these topics is a video tutorial. In the screen below, *Tutorial 1: Map Basics* is already loaded. You just click on the play button (red oval) and this tutorial provides basic operations like zooming in and out or searching for a specific location. Go ahead and play this video now.

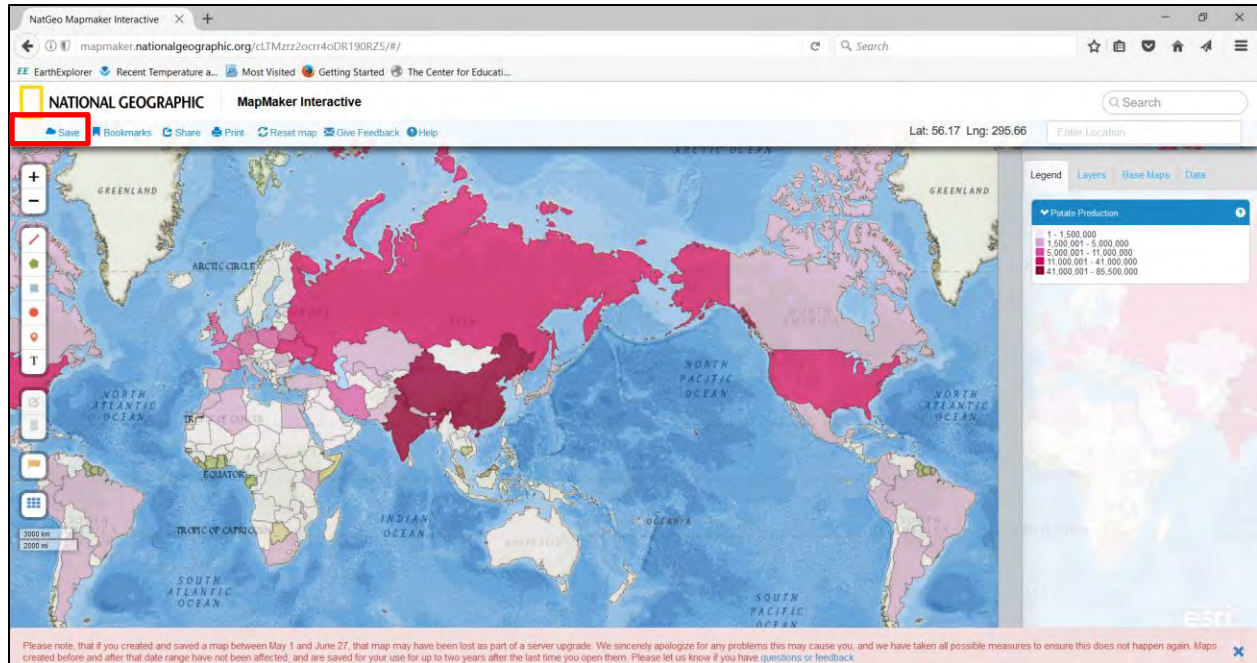


This particular video is only a little over one minute long. But at the end of the video, it automatically loads *Tutorial 2: Working with Map Layers* (about 1 ½ minutes long). You can let the videos run, one by one, automatically, to familiarize yourself with the entire program. Or you can click on the appropriate video link on the left if you want to just view one video at a time, or refresh your memory after watching all the videos.

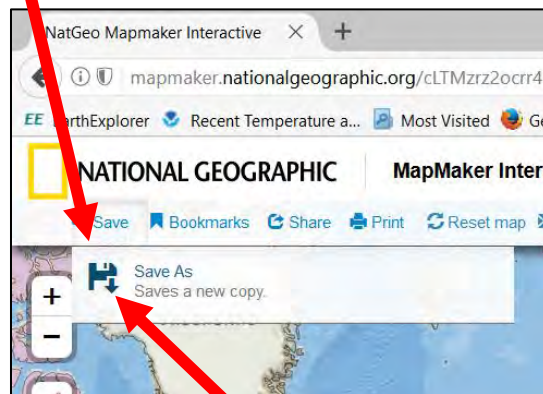
1.7 Saving Your Map

We will cover one final issue - Saving your map. In the upper right hand corner, click on **Save** (red box in the screenshot below). (The YouTube video: <https://youtu.be/uxM7x7PU2Oo>.)

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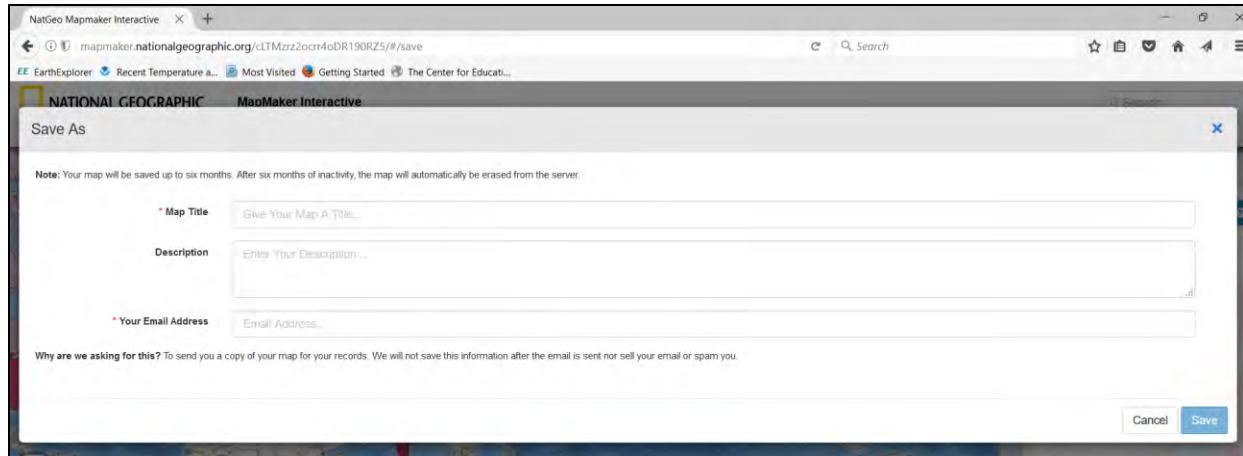
You will see the following icon in a pop down menu:



Click on the floppy disc with the down arrow.

The following window opens. You will not be saving the map to your computer -- it saves online with the National Geographic. Once you click on **Save**, you will get a link (a url) to your map. Please note in the message at the top of the screen, your map is only saved for up to six months. You need to save this url, so you can access your map at another time.

Exploring Our Planet with Open-Source Software



We will not cover each of the individual videos in this tutorial. This tutorial is to help get you started.

Additional Information

Additionally, we have created YouTube videos to help with the items discussed above and additional tools within National Geographic Mapmaker Interactive (the links to these videos are below). As a reminder, the National Geographic Mapmaker Interactive **Help** videos also provide knowledge on using National Geographic Mapmaker Interactive.

One of the authors of this tutorial has used National Geographic Mapmaker Interactive on a regular basis in two university-level geography courses. In one course, the students are required to make a story map using the themes of their choice. In the other course, the students use two themes to create a comparative map quiz. In all semesters, the students have found using this on-line GIS program easy to use and beneficial to reading and interpreting maps.

For more information on National Geographic Mapmaker Interactive, go to the National Geographic Society's Education blogs, for example:

<https://blog.education.nationalgeographic.com/2013/03/01/create-and-share-with-mapmaker-interactive/>

<https://blog.education.nationalgeographic.com/2015/04/01/harness-the-power-of-mapmaker-interactive/>

<https://blog.education.nationalgeographic.com/2014/04/21/mapping-monday-mapmaker-interactive-tutorials/>

Or their online tutorial:

<http://ngep.fieldscope.org/>

Exploring Our Planet with Open-Source Software

Or on History Tech:

<https://historytech.wordpress.com/2016/09/28/national-geographic-mapmaker-interactive-just-got-better/>

The YouTube Videos that accompany this chapter are found at:

1. Introduction to National Geographic Mapmaker Interactive
<https://youtu.be/BWgUKRzWY4I>
2. Using Basemaps in National Geographic Mapmaker Interactive
<https://youtu.be/kVHzdKjiS0k>
3. Using Help, Bookmarks and Reset Map in National Geographic Mapmaker Interactive
https://youtu.be/1Z-C__4Tr4s
4. Drawing Tools in National Geographic Mapmaker Interactive
<https://youtu.be/-8yo-je347k>
5. Saving, Sharing, Printing in National Geographic Mapmaker Interactive
<https://youtu.be/uxM7x7PU2Oo>
6. Layers in National Geographic Mapmaker Interactive
<https://youtu.be/Yx8zWXkg6V0>
7. Country Flags and Latitude and Longitude in National Geographic Mapmaker Interactive
https://youtu.be/_MkTffkLo5A

Exploring Our Planet with Open Source Software

2. Google Earth Web (or Google Earth for Chrome)

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This set of tutorials introduces you to Google Earth Web (not Google Earth Desktop or Google Earth Pro, which are covered in a different tutorials). The browser - Google Chrome - is now required to download Google Earth, or run Google Earth Web, so if you do not have Google Chrome, you can download it by clicking this link:

<https://www.google.com/chrome/browser/desktop/index.html>

2.1 Introduction

Google Earth has 3 formats, a desktop version, on-line web version and a mobile device version). We start with a discussion of the web version in this tutorial because if you don't have the desktop version, you must go through the web version to download it to your desktop. Google Earth Desktop and Pro are discussed in other chapters. Google Earth Web is on-line GIS software, it has the display features of a GIS and allows some personal mapping. For our YouTube video introducing you to the Google Earth produces, go to:
<https://youtu.be/DaluBU8ZO3A>.

Please note, if you are a K-12 Educator, please read the Google Earth Acknowledgement and Use Agreement form as restrictions do exist depending on the age of your student. The Google Earth Agreement and Use Terms can be found at:

<https://www.google.com/earth/download/gep/agree.html>

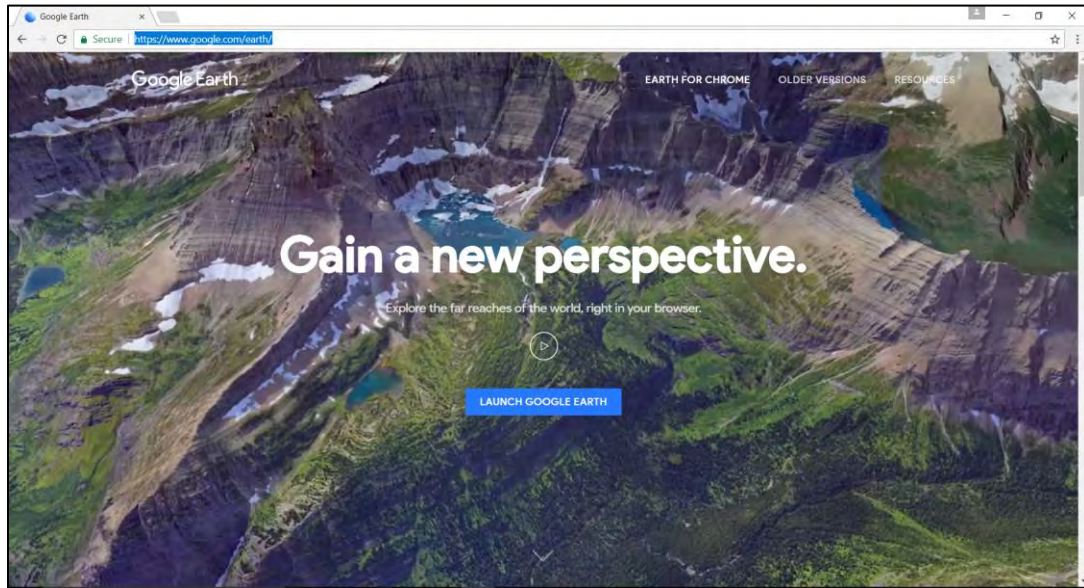
2.2 Let's Get Started

Enter <https://www.google.com/earth/> into your Google Chrome web browser.

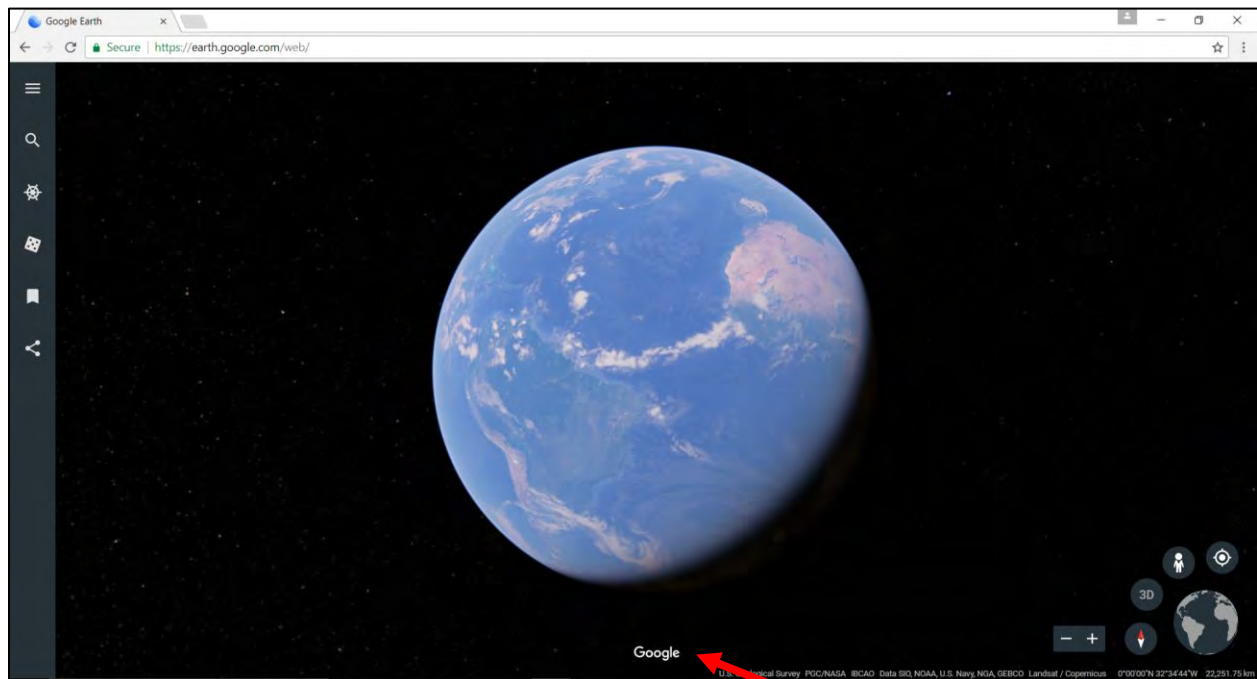
For our YouTube video introducing you to Google Earth Web, go to:
<https://youtu.be/NjWJlt-jWF4>

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You see the following window:



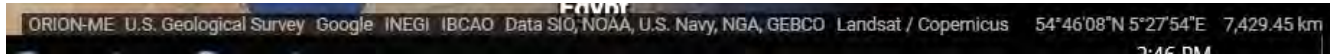
Click on *LAUNCH GOOGLE EARTH*. This window opens (the first time you do this, it might take a minute). When you launch Google Earth web, you will see “*This is the new Google Earth.*” It takes you through a video tutorial or you can click “Skip” and x out of the video.



Let's first point you to metadata on the above screen. You see Google in the bottom middle – if you plan on using any images from Google Earth, please refer to the use agreements at: <https://www.google.com/permissions/trademark/>.

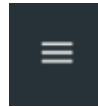
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Second, look at the bottom right of the page where Google Earth provides information as to where it obtained the images displayed.

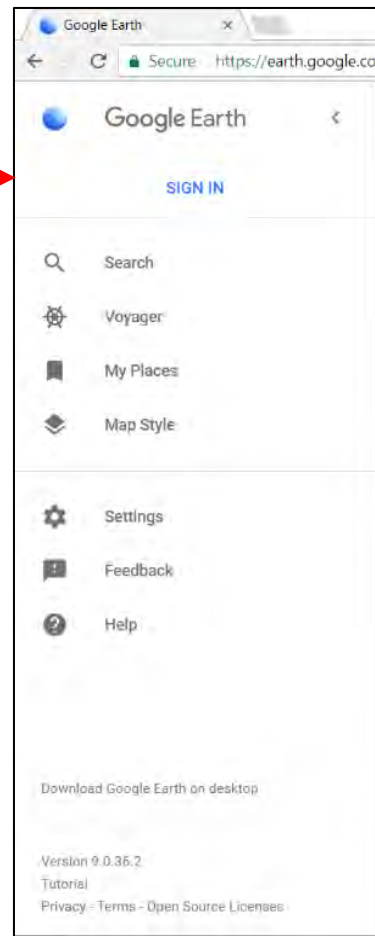


This information will change as you zoom in and out. If you have questions as to the reliability of these images, you can search for the individual information on the web. For example, Landsat – a systems of United States land observation satellites is found at <https://landsat.usgs.gov/>, also a U.S. Geological Survey site; NGA is the National Geospatial Agency; Copernicus is found at <http://www.copernicus.eu/>.

Now let's explore the tool bar on the left side of the screen. Click on the Menu button in the upper left corner:

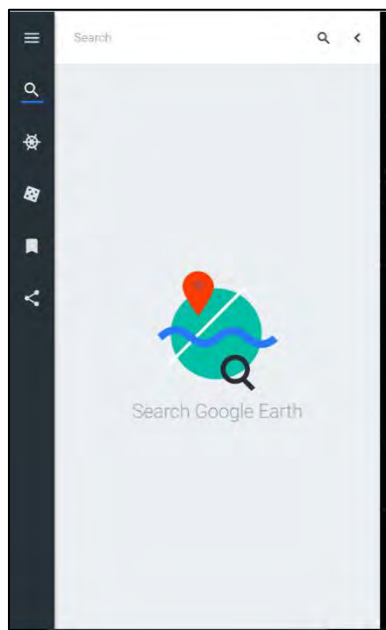


You get the pop up window on the right.



Click on **SIGN IN** – you use your Google Account or your Gmail sign in. If you have a Google Educational Account, use that.

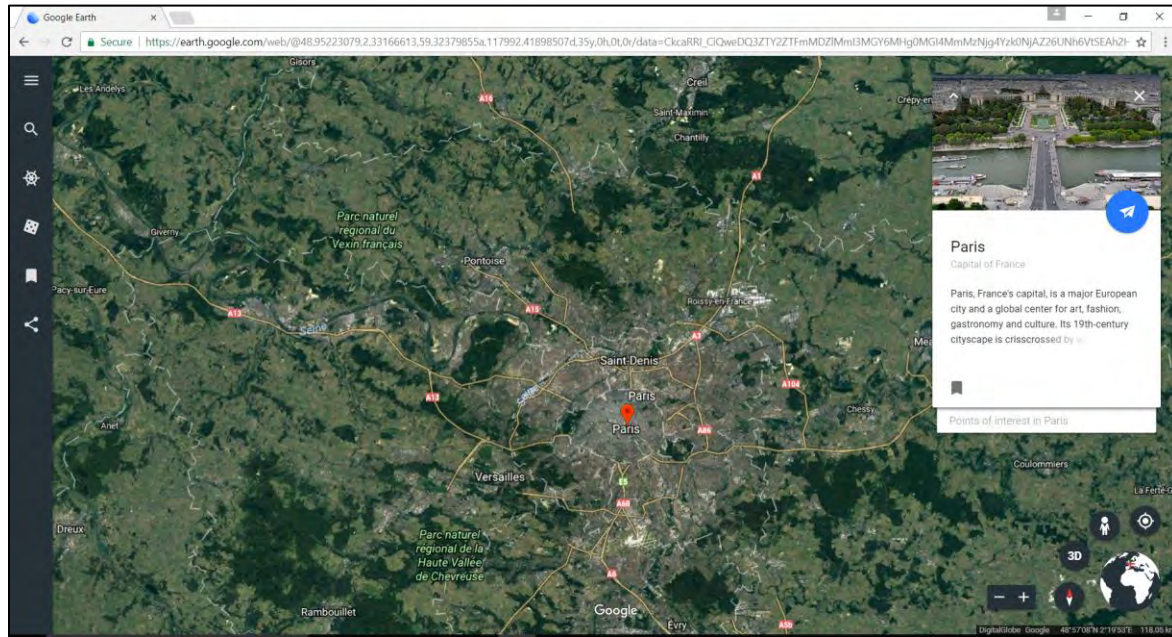
The next button, below, is Search. You use it to navigate to a specific location. You can enter the location by name, such as Paris, France or with latitude and longitude (for Paris in decimal degrees, this is 48.8566° N, 2.3522° E, but you can enter using degrees and decimal minutes or degrees, minutes, seconds). We do not recommend that you use the – sign instead of south latitude or west longitude; enter S or W.



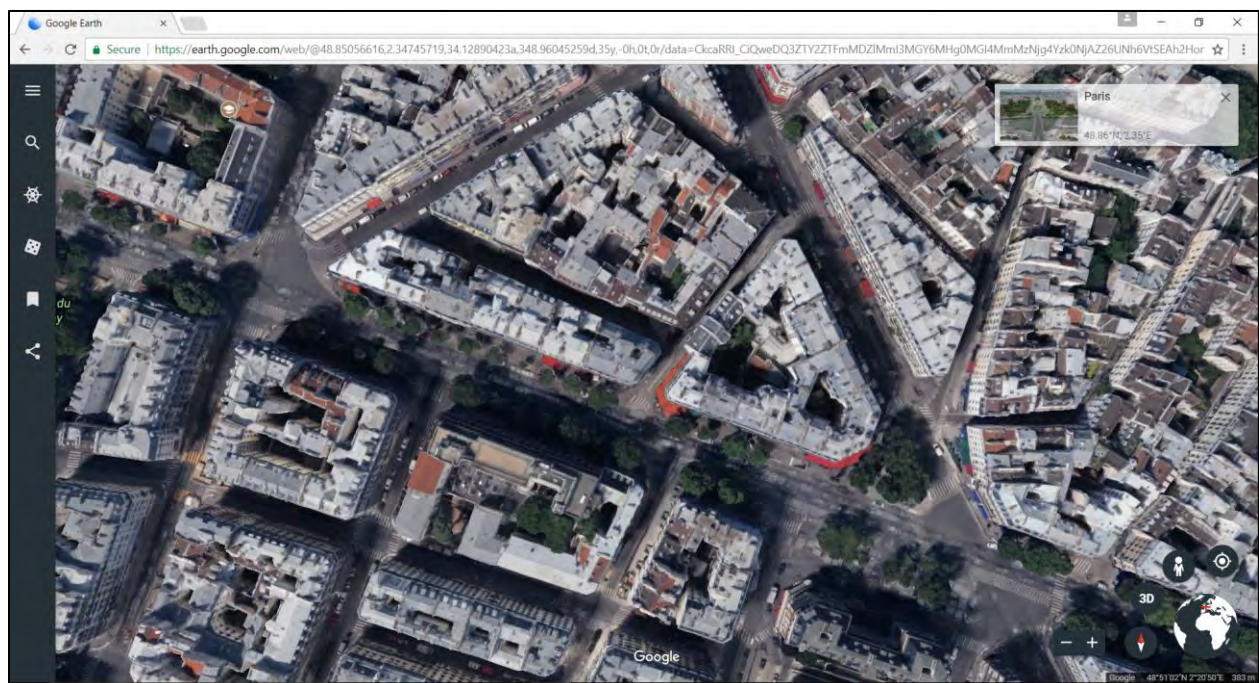
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Go ahead and search for Paris France and see how the screen and metadata changes.

At the following extent, we see Digital Globe and Copernicus, but Google Earth Web is also displaying some physical features, has placed a point on Paris, and provided a pop up window (a Knowledge Card) with some basic information on Paris.

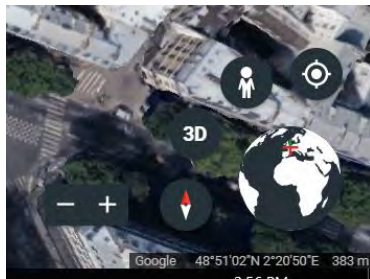


As you zoom further in, Google Earth Web provides the details in 3-D.



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Let's further explore the information in the bottom right corner (these are Navigation tools, for the YouTube video, go to <https://youtu.be/1-SNUm58tc4>).



This area provides information that the images at this level are from Google, gives the latitude and longitude of the reference point on the larger map and the elevation of that point in meters, notes that the images are in 3D, and provides a reference point (actually in red) on the world icon. The reference point identifies that Paris France is located on the European continent.

Click on the icon of a person and drag it to a specific street, you will enter street view on that specific street. You are in 2D view at street level.

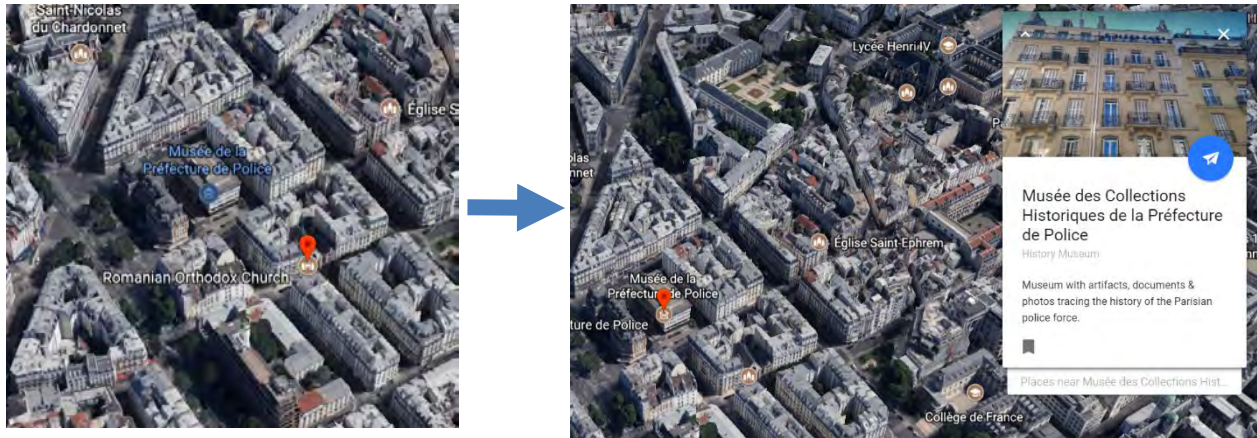


The other icons in the bottom right are zoom in and out (you can also use your mouse wheel) and fly to your location (Google will need to access locational information on your device).

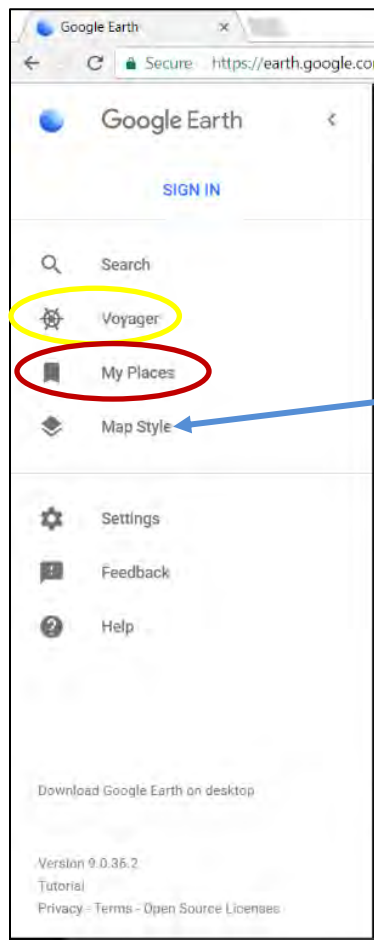
The icon within the white circle is navigate, if you hold it down, you can navigate around in street view or in Earth view.

Zoom out so you can see all of Paris, but only far enough that you can still see some labeled features. If you hover your mouse on one of these features, it turns blue. If you click on the blue words, you zoom to that feature and will get some information about it with a *Knowledge Card* that popped open:

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Let's go back to Menu and explore one other feature. We will review the others later.

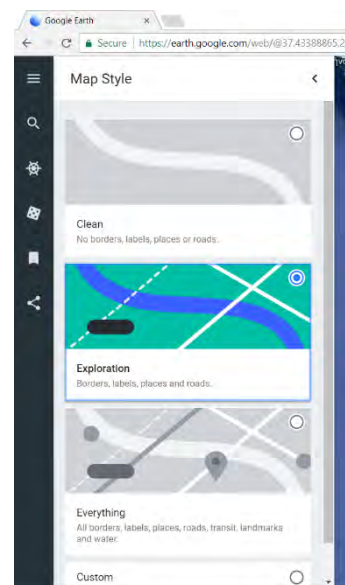


The next icon is *Voyager* (yellow oval). If you click on this icon, you can access difference types of information about various places on Earth. We will not go into any detail on *Voyager*. For My Places (maroon oval), we will discuss it in more detail below.

2.3 Map Style

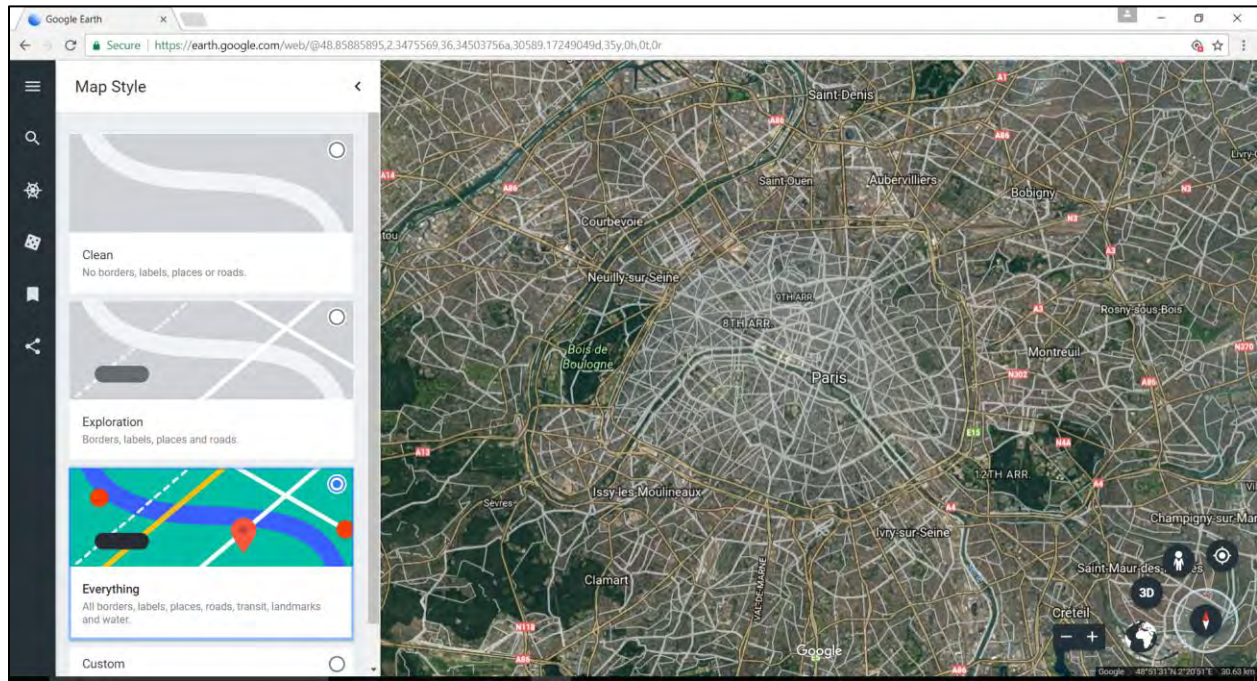
Let's look at Map Style. Click on it. (The YouTube video on Map Style is <https://youtu.be/rN1aBhNt7Tc>.)

This allows you to customize how you see the map when you are zoomed in at a location. The one that is in color is how it will be displayed on the map.



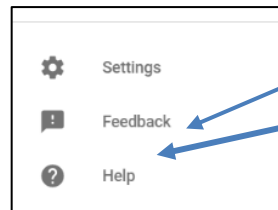
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As an example, change it to the 3rd map style – *Everything* - and the display of Paris France changed, as seen below.

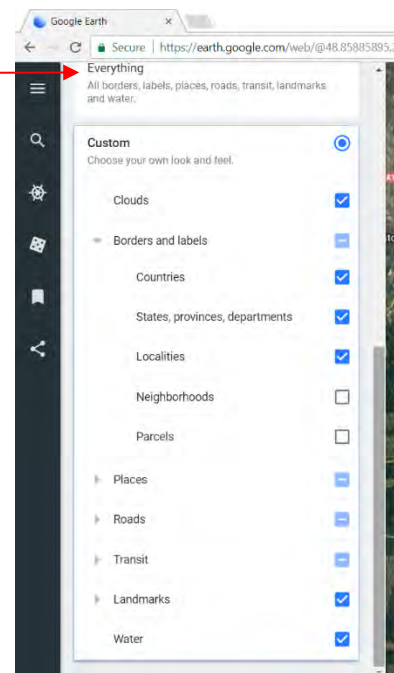


The last one – *Custom*, gives you many more options. We will not explore each one of these, you can do that on your own.

Now, back to the Menu icons.

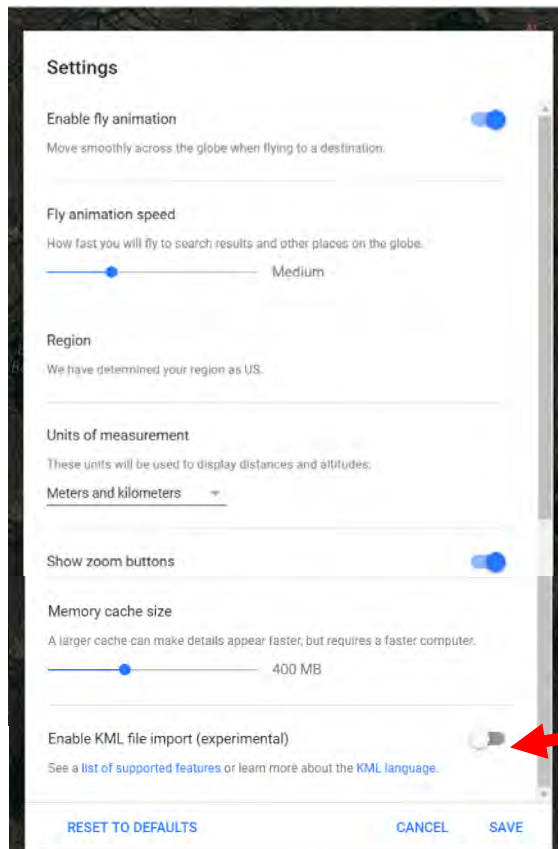


The *Feedback* icon allows you to communicate with Google. *Help* takes you to the **Google Earth Help Center**. (For the YouTube video on these items, see the Introduction to Google Earth Web video - <https://youtu.be/NjWJlt-jWF4>).



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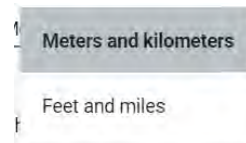
Now click on *Settings* and you get the following screen:



Here, you can turn on and off the *Fly Animation* and change the *Fly Animation Speed*.

Google has accessed our location and noted our region as US.

You can change the *Units of Measurement*, you only have two options:



You can turn on and off the *zoom buttons*.

You can change the Memory cache size. You would only need to do this if you are working with a very large class.

The last one – Enable KML*¹ file import (experimental). This button is turned off. Turn it on here, we will explore it later in this Chapter on Google Earth Web, and we will use it extensively in the Google Earth Pro tutorial (this ability is not experimental in Google Earth Pro).

Once that is turned on, you can close out the *Settings* window by clicking on *Save* in the bottom right corner.

Now, let's go back to the original toolbar on the left side of the screen. We have discussed the first two icons - *Menu* and *Search*.

¹ What is KML? KML stands for Keyhole Markup Language, which is a file type supported in Google Earth. See <https://developers.google.com/kml/> for more information.

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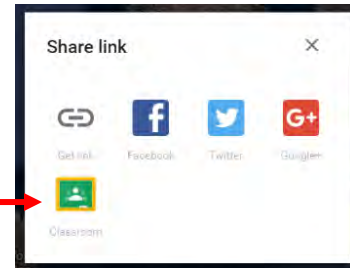


The next icon is *Voyager* again (yellow circle). Clicking on it here, takes you to the same information as when you accessed it under menu.

The next icon is called *I'm feeling Lucky* (green circle). If you click this icon, Google Earth does a random search and choose what it thinks might interest you.

We skip to the last icon – *Share* (red circle). If you click on this icon, you get the following pop up: This has a *Classroom* icon, which we will discuss in more detail later.

For now, just close the window.



2.4 My Places

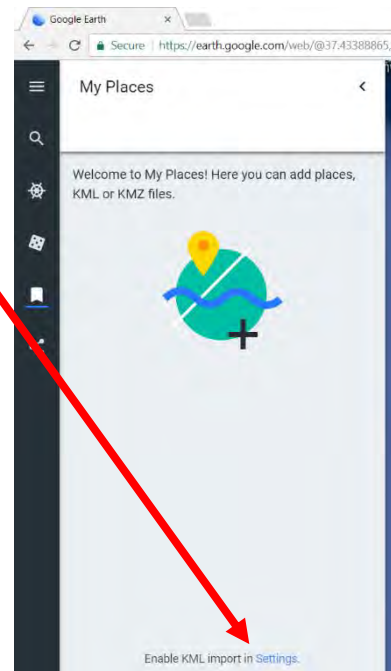
Let's now discuss the last icon – My Places (white circle). This is where Google Earth Web becomes interactive.

If you still see *Enable KML import* in *Settings* at the bottom of the window on the right, you did not enable the KML button. Go back to the previous page and do the steps again.

2.5 KML Files

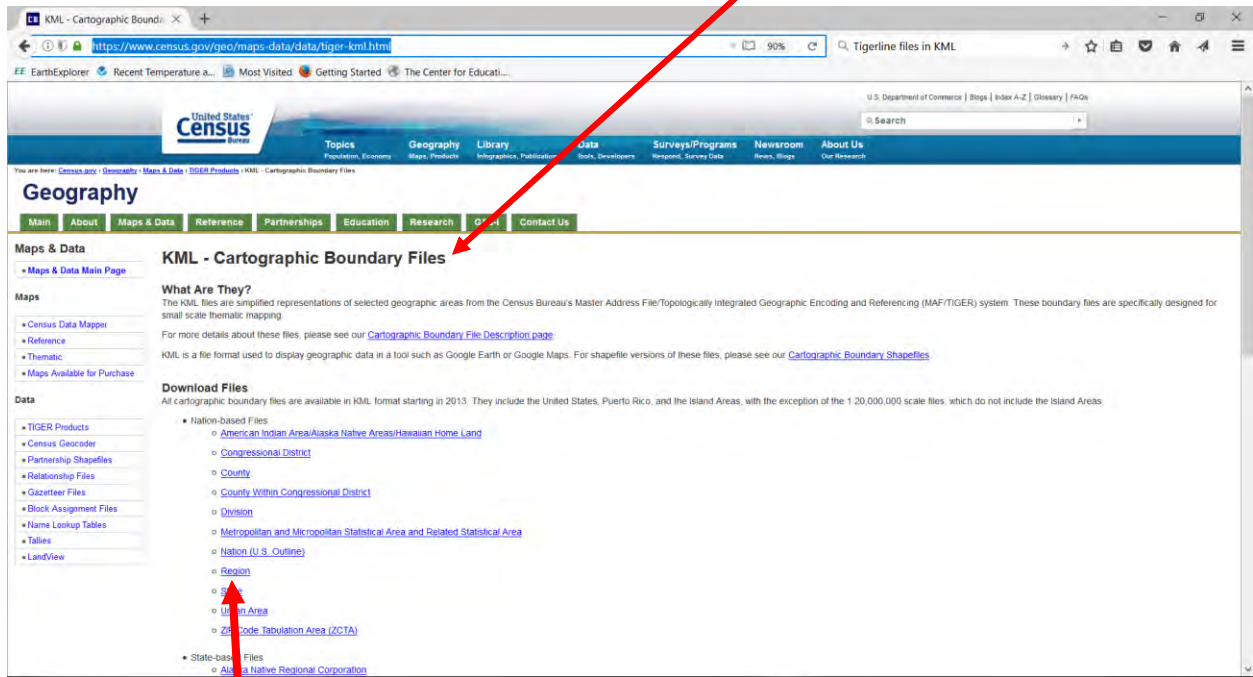
Now, we need to take a little side trip, because we are going to need a KML file to import as an example. (YouTube video on finding KML files: <https://youtu.be/8bLweAYxQoM>).

Go to <https://www.census.gov/geo/maps-data/data/tiger-kml.html> and we can get a KML file for your use.

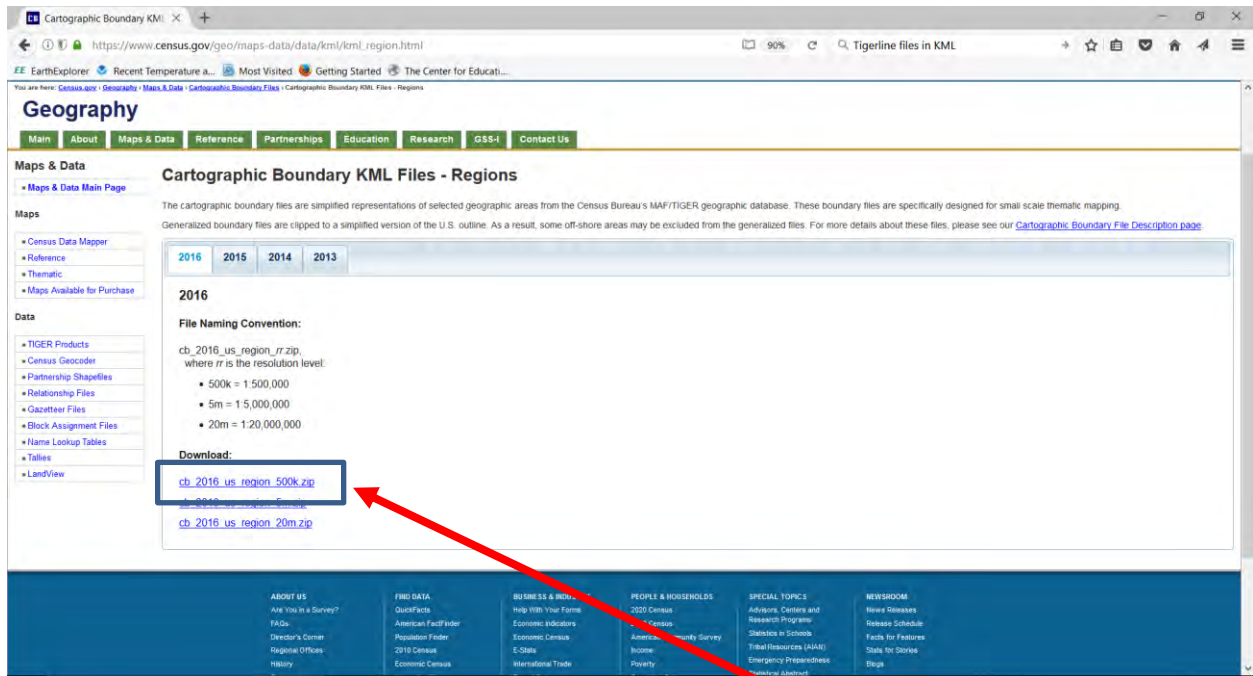


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You get this website – the US Census Bureau has files with boundaries at many different scales.



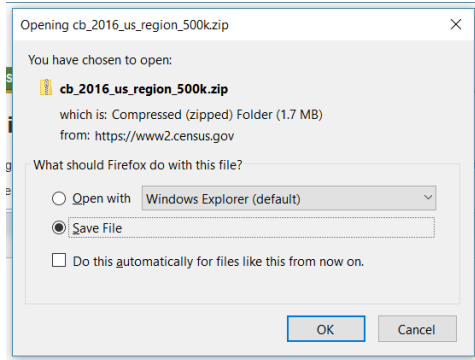
Click on *Region*.




Then, click on *cb_2016_us_region_500K.zip* under **Download**.

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You are downloading this file to your computer. You get the following pop up:

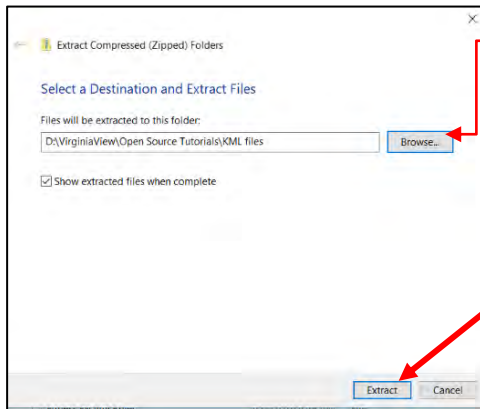
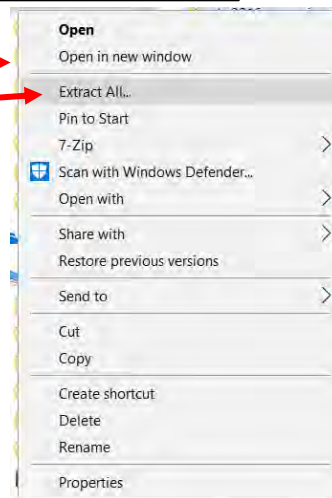


Make sure the *Save File* button is chosen and then click *OK* to download it to your download folder. Once downloaded, go to your download folder and you will see the following zipped file.

Name	Date modified	Type	Size
 cb_2016_us_region_500k	7/7/2017 4:14 PM	Compressed (zipp...	1,736 KB

Right click on the file and you will see this window.





Click on *Extract All...*



Use *Browse* to navigate to the folder where you want to unzip the files.

Once you have chosen the correct folder, click on *Extract* at the bottom

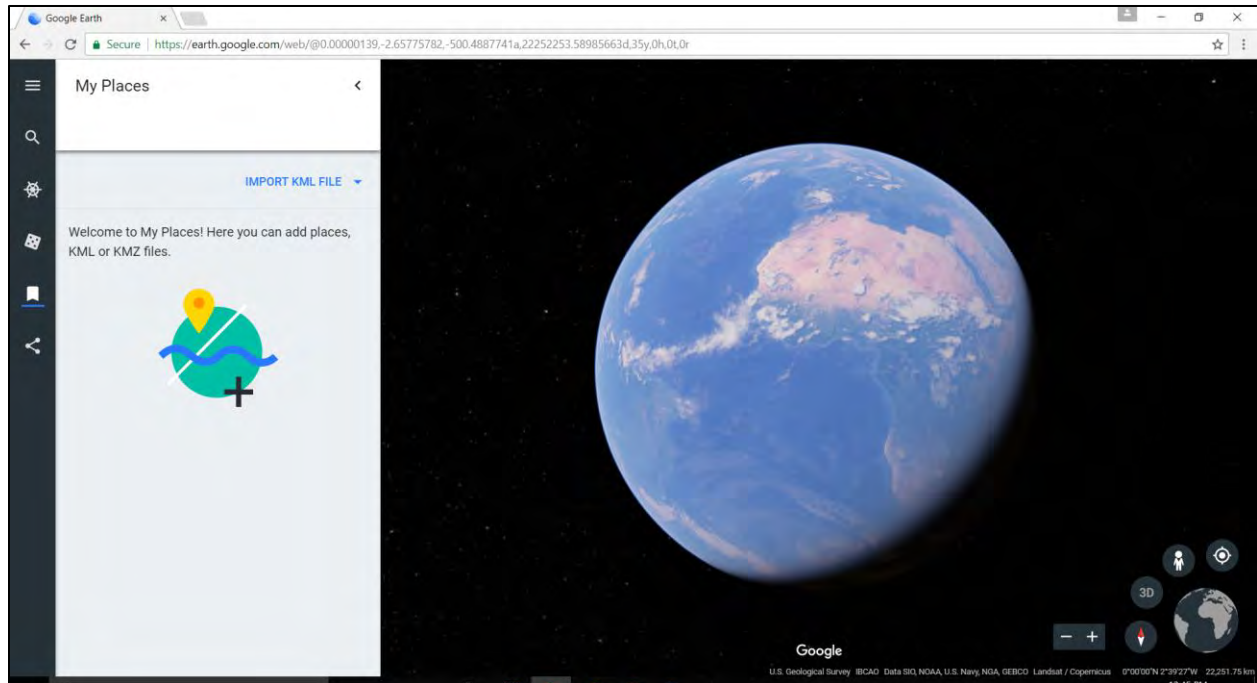
and the following files will be displayed in your file folder:

Name	Date modified	Type	Size
 cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	KML File	5,744 KB
 cb_2016_us_region_500k.kml.ea.iso	7/8/2017 12:42 PM	XML File	14 KB
 cb_2016_us_region_500k.kml.iso	7/8/2017 12:42 PM	XML File	34 KB
 cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	XML File	17 KB

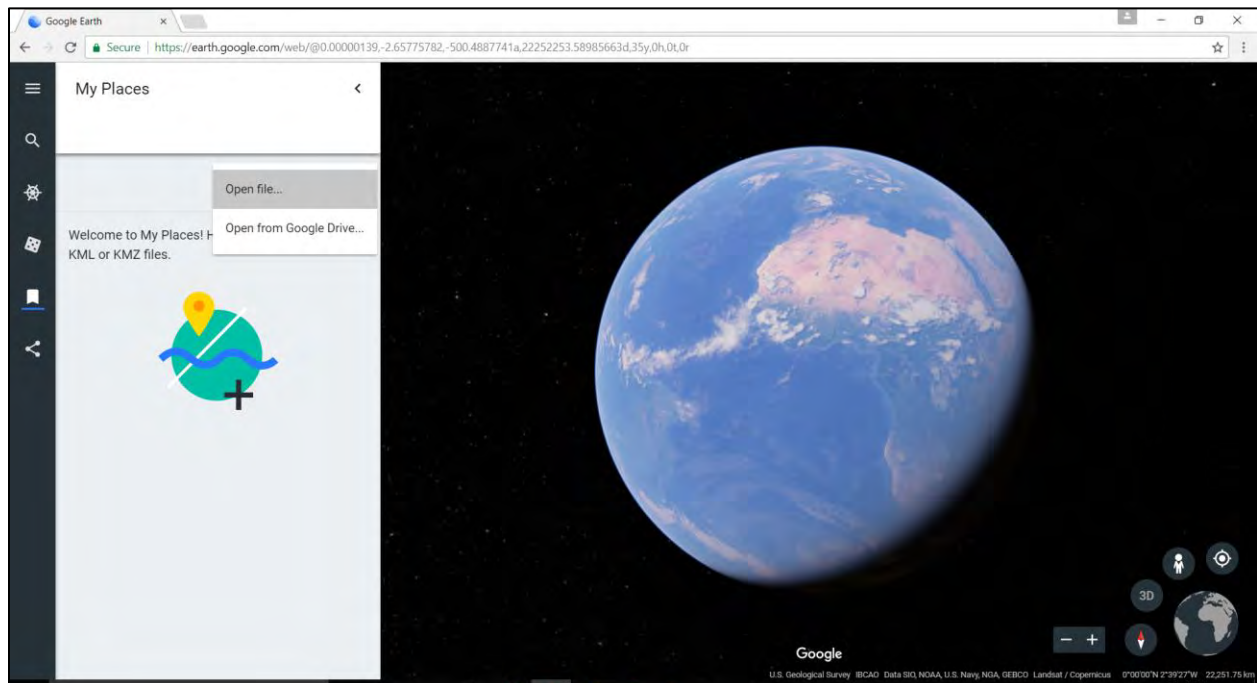
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Now go back to Google Earth Web and open the *My Places* window.

Click on *Import KML File* (for the YouTube video on Using KML in Google Earth Web go to <https://youtu.be/G2uGOSbk6ns>).

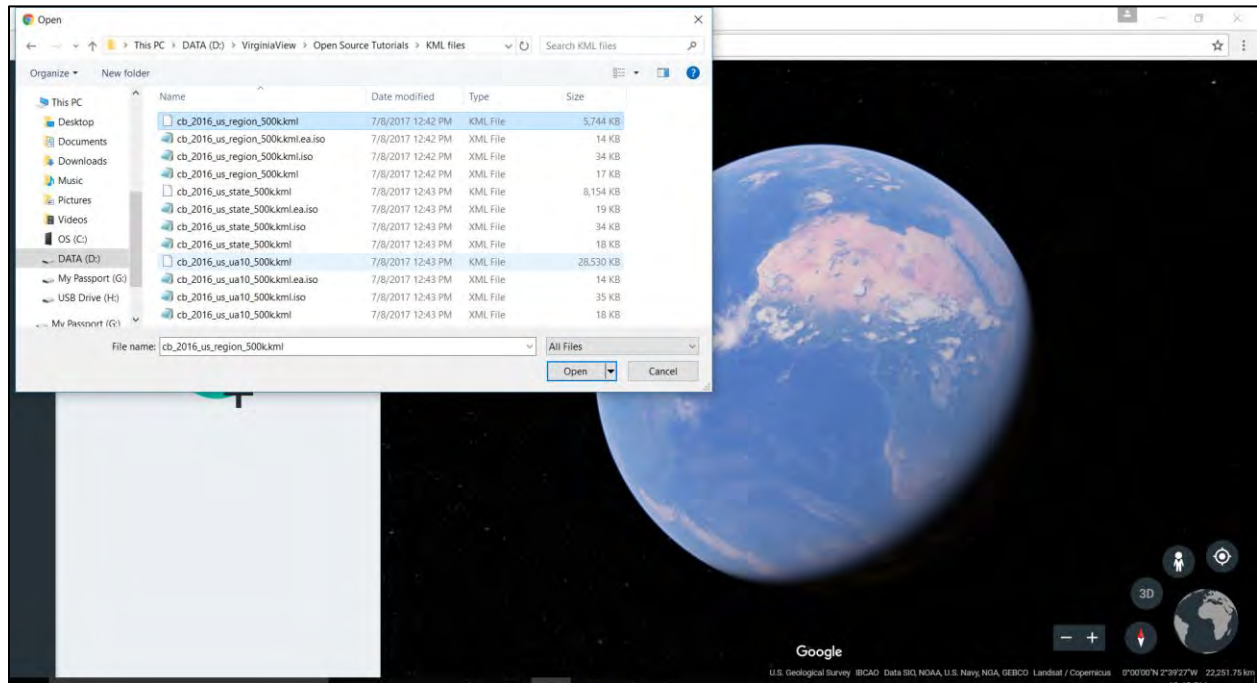


Then click on *Open file...*

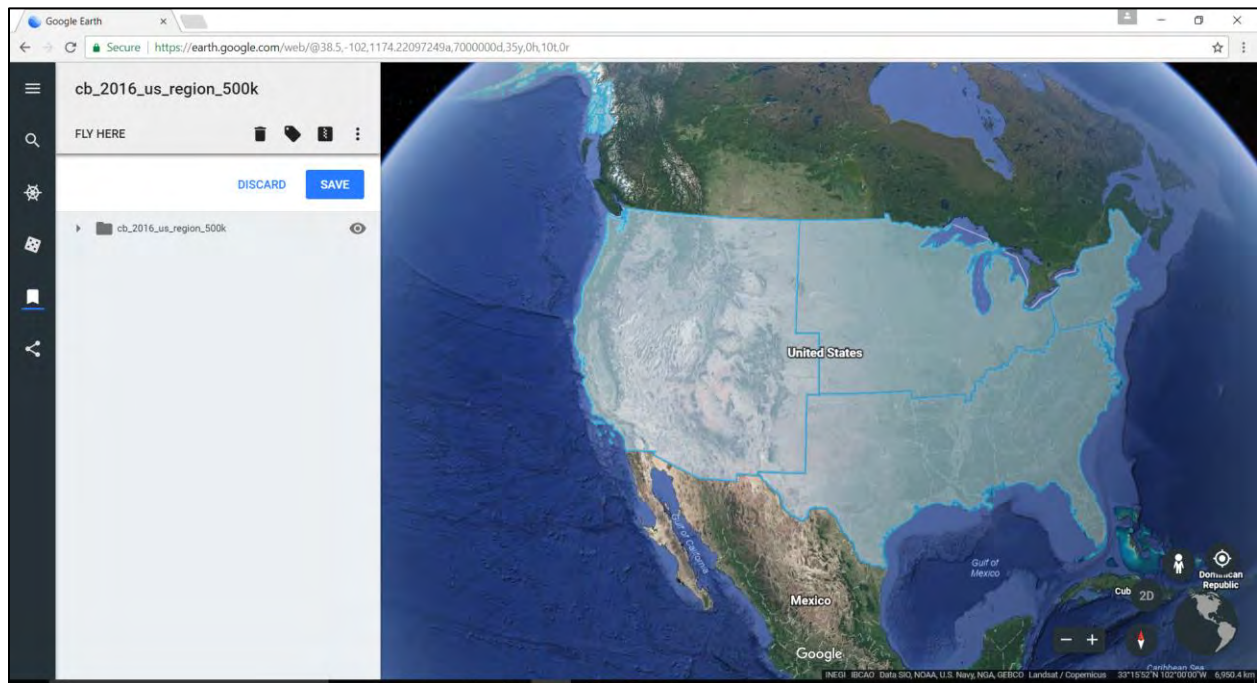


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Navigate to the folder where you unzipped the KML file, highlight the file that shows type KML and then click *Open*. Be patient, a file with many features may take a minute or more to load.

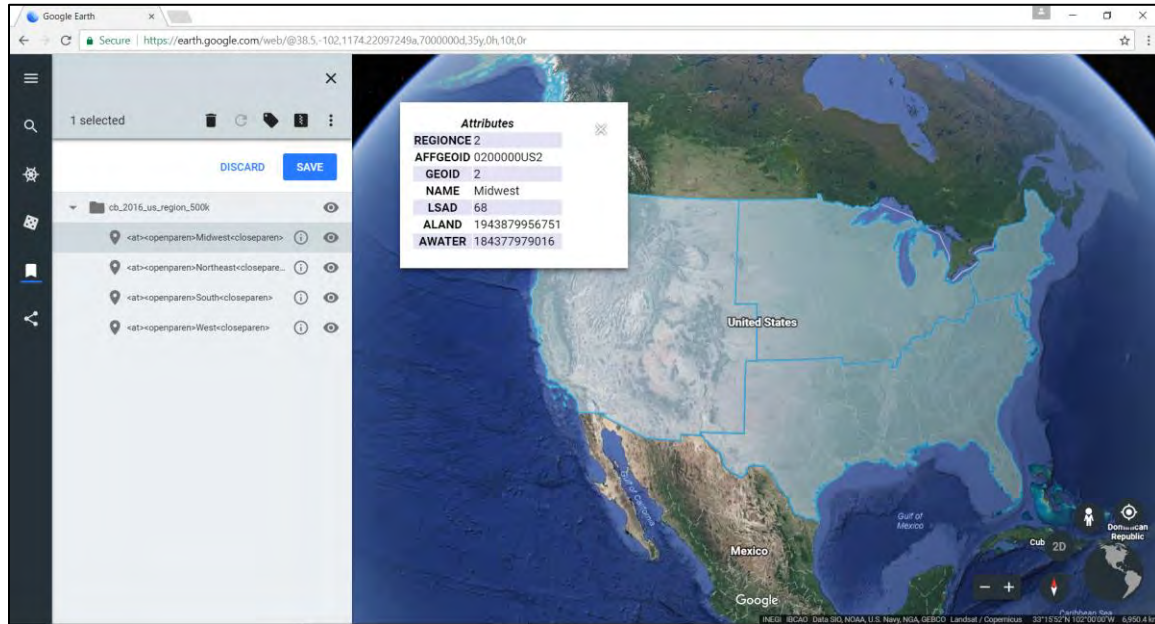


If you choose the same file, the file will display in Google Earth Web and is listed in the Table of Contents on the left. The US is divided into 4 regions – Northeast, South, Midwest and West - the boundary for each is medium blue.

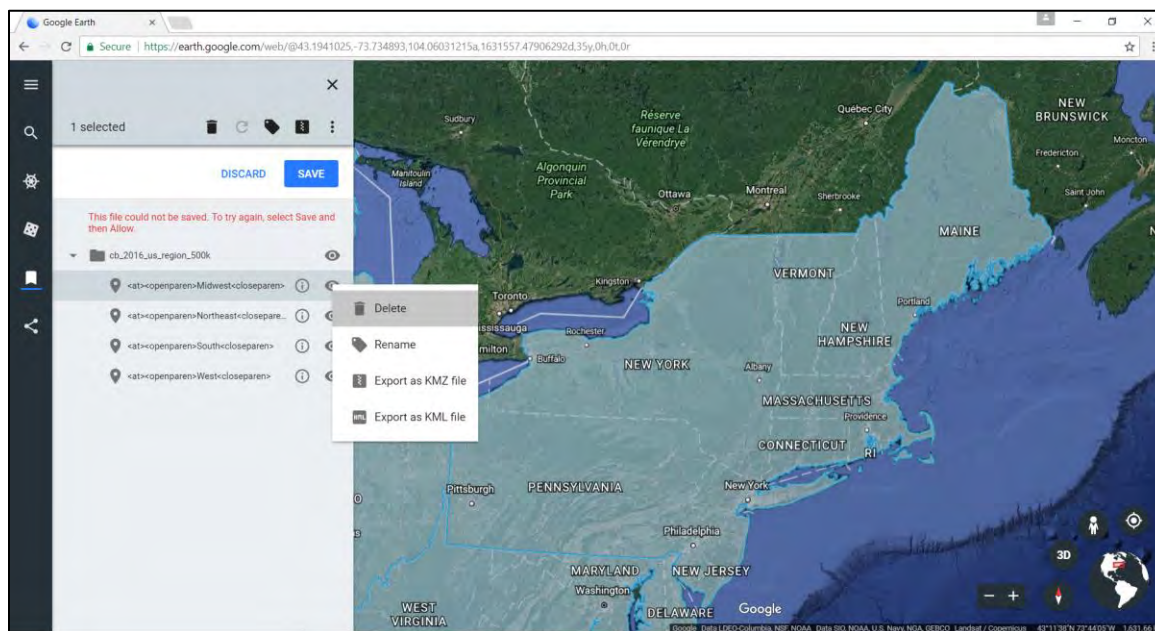


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Click on the down arrow (aka carrot) at the beginning of the file name and each region is listed. If you click on the name of any region, a dialog box opens and provides you information about the region (information from the US Census Bureau. If you are familiar with shapefiles, this is metadata in the Attribute Table). You can get this same information if you click on that particular region in the map document window.

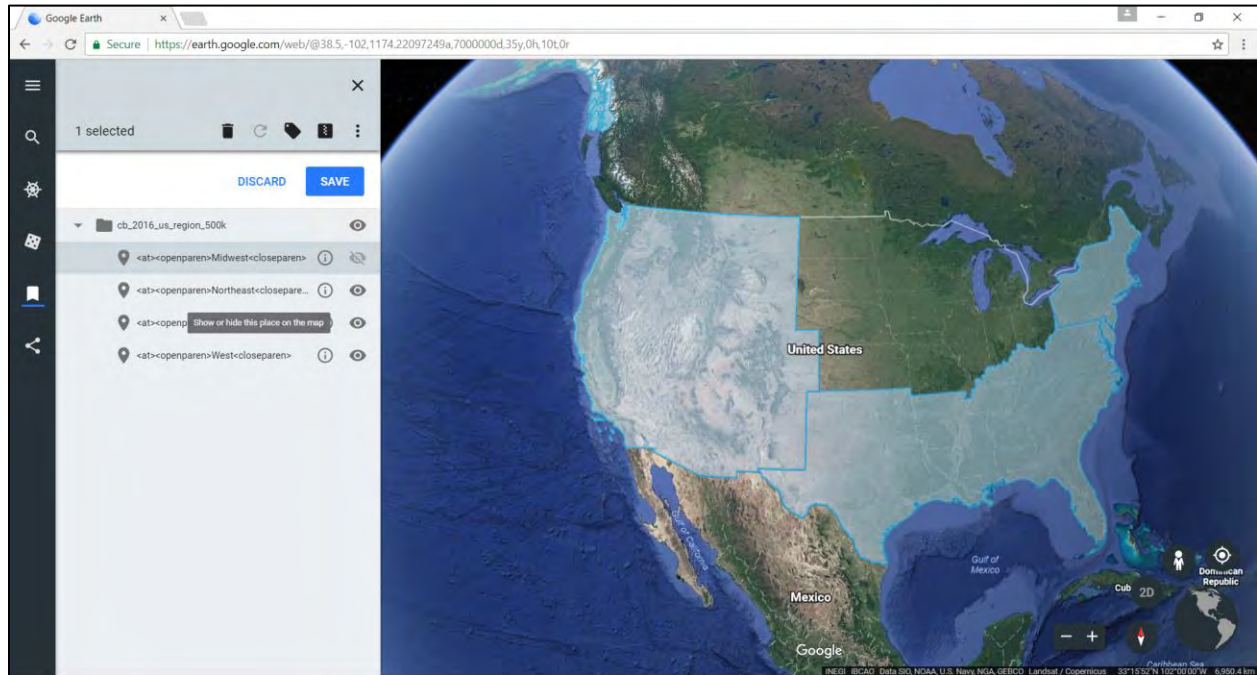


You can remove the file from Google Earth by clicking on *Discard*, the trash can or by right clicking on the file name and choosing delete. Clicking on Rename, you can rename the file to something simpler – like Midwest.

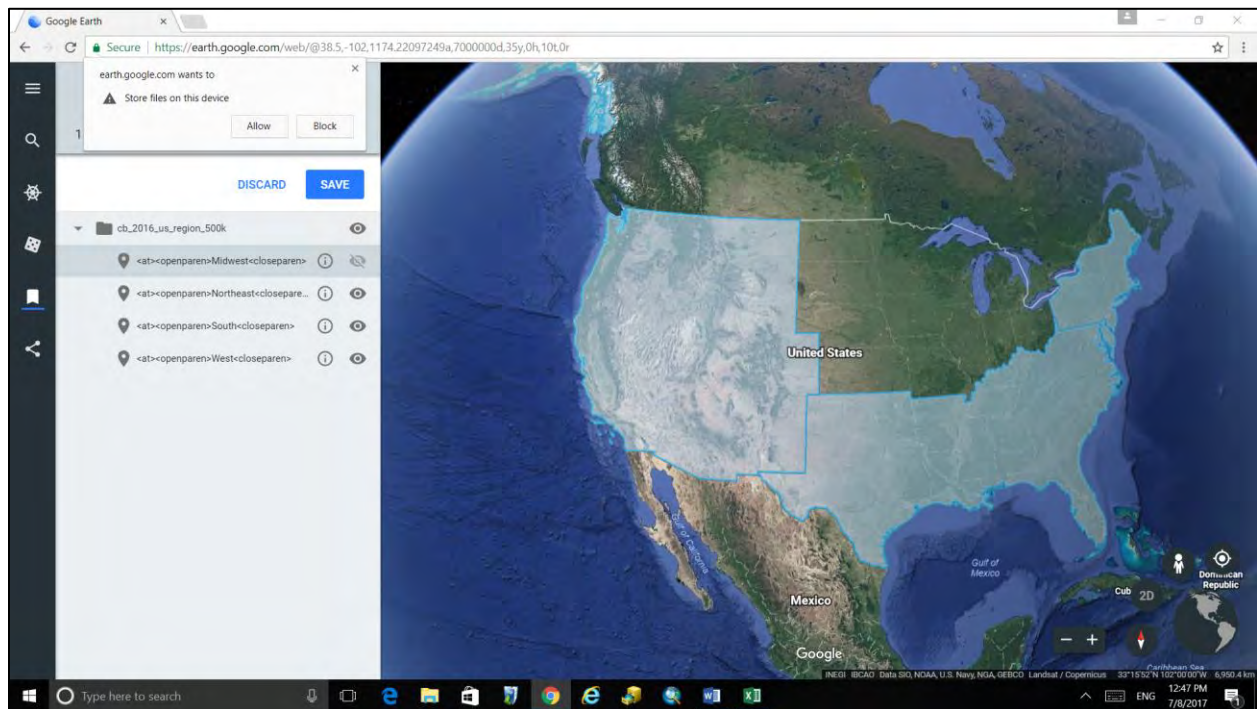


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If you click on the eyeball, it removes that individual region from the map display.



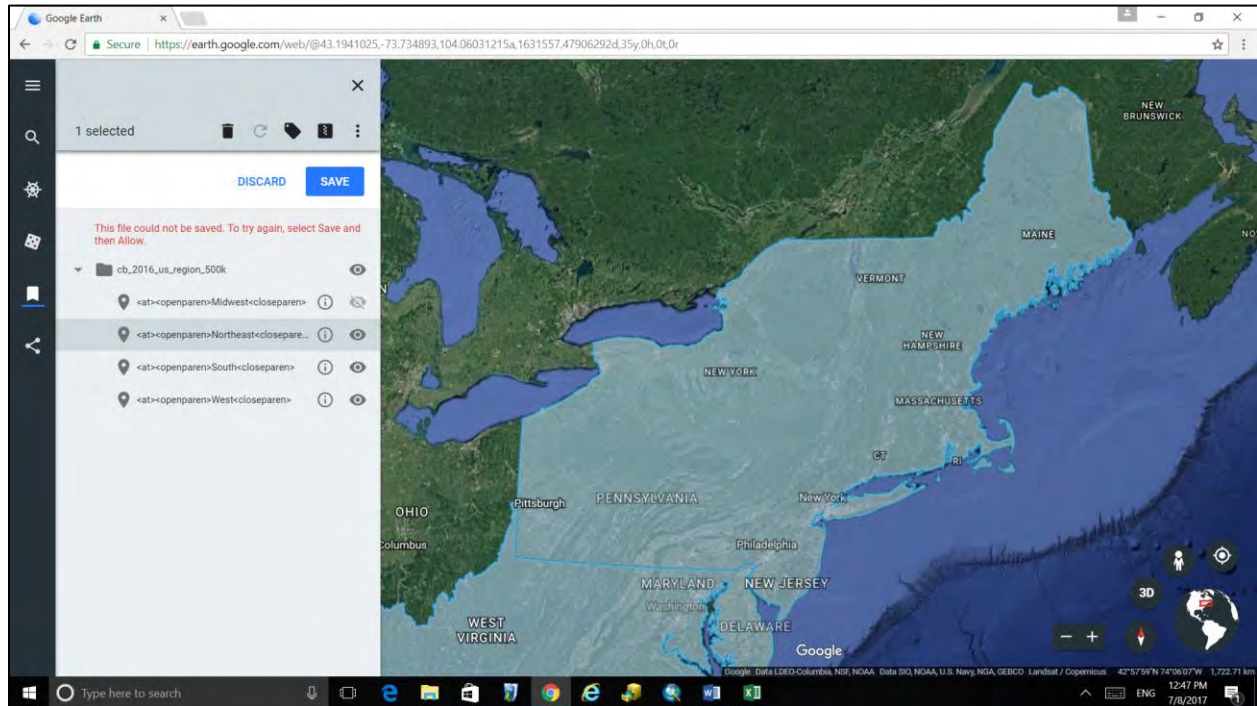
If you click Save, you can save the map to your device. Then when you go back into Google Earth Web and sign in, you can reopen the file.



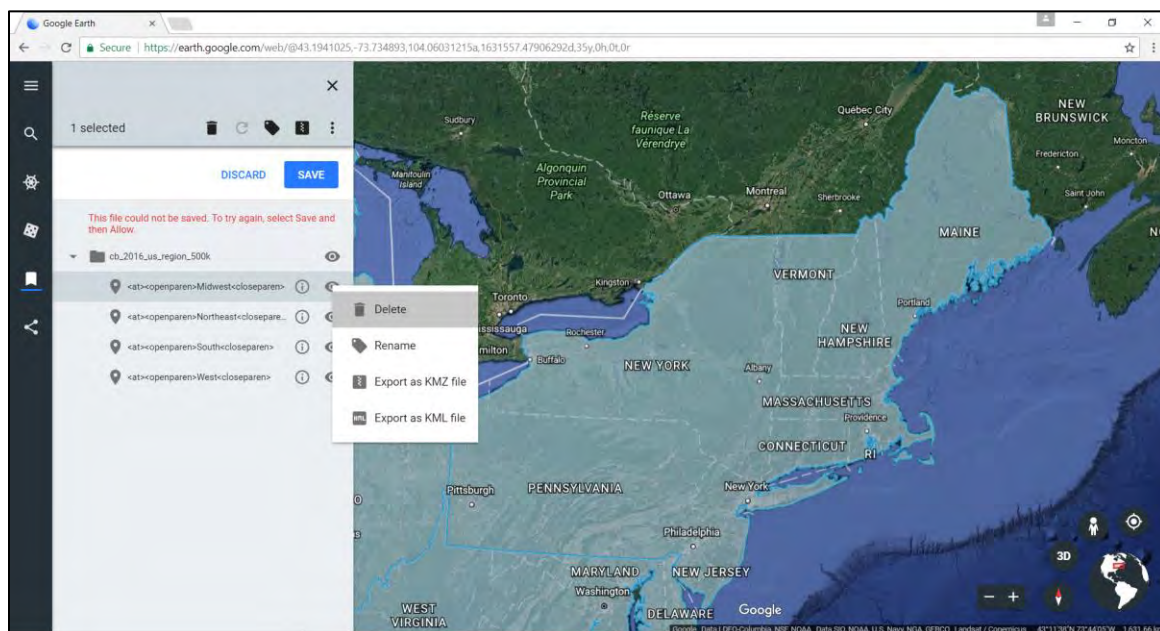
You can also zoom into one particular feature.

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Double click on Northeast and it zoomed to the Northeast Region as seen below

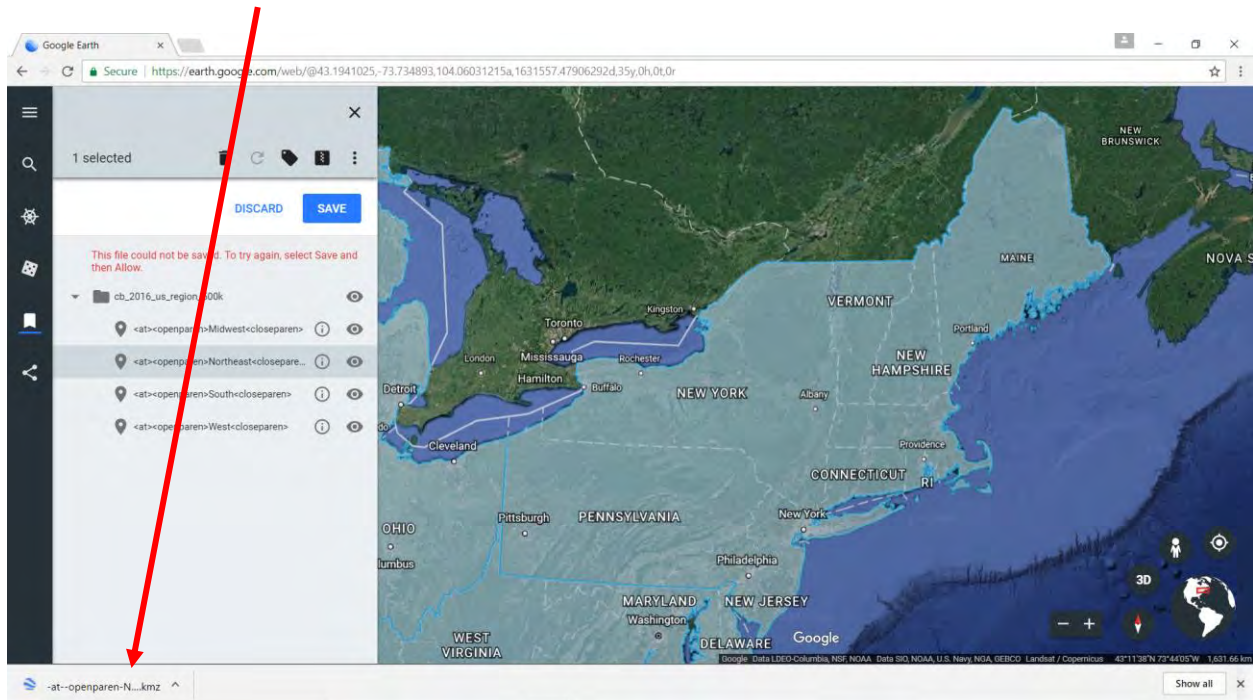


If you click on *Export as KMZ file*, it will save the map so that you can just click on the title in your file folder and it will open as it. If you have clicked on just one of the regions, only that feature will be saved. Please note that the file will open in Google Earth Pro, if it is on your computer.

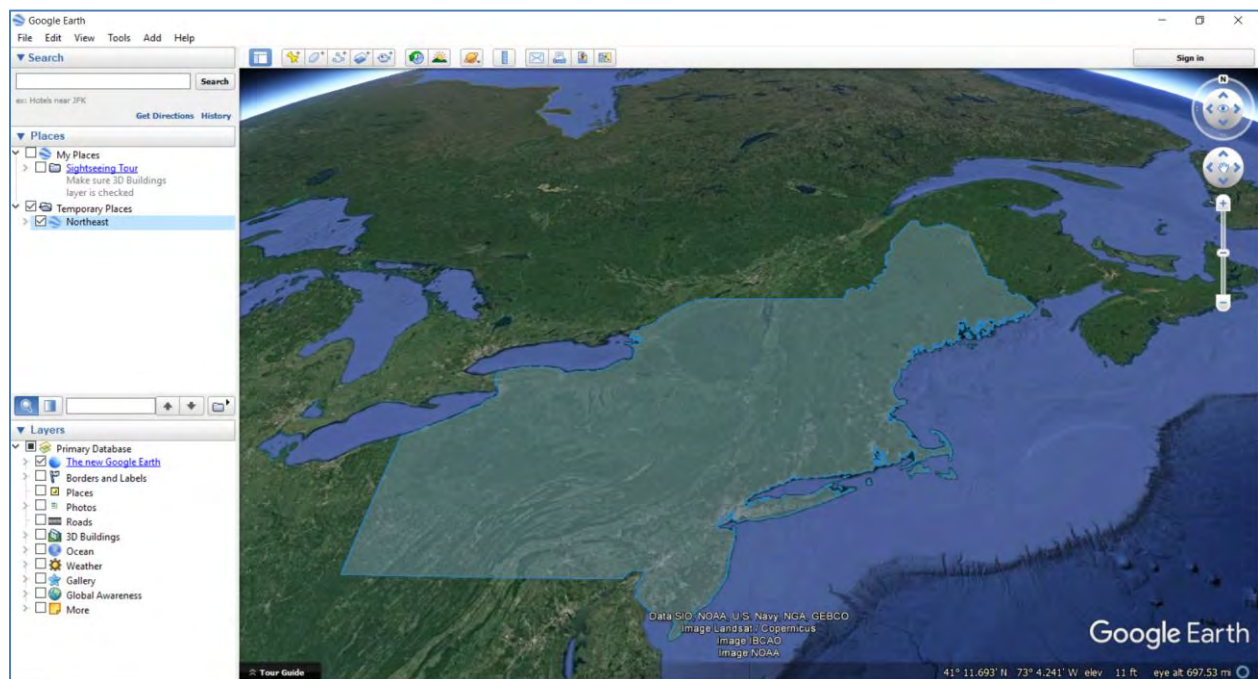


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Look at the bottom left of the window, you can see the exported file there - just saving the one feature, not the entire Region file.



Double click on the file name, it opened in a new window. I have Google Earth Pro, so that is the program that opened below:

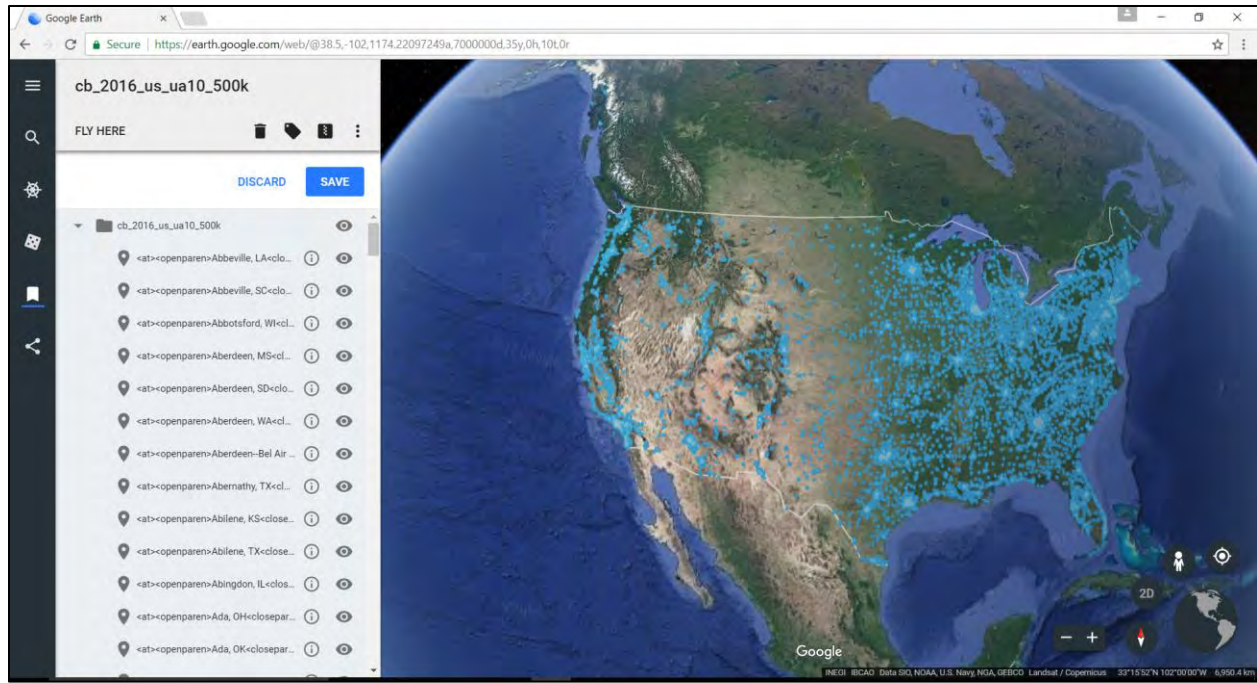


Can you add multiple KML files? Yes, but it slows down Google Earth Web tremendously. If you want to work with multiple KML files, we recommend using Google Earth Pro.

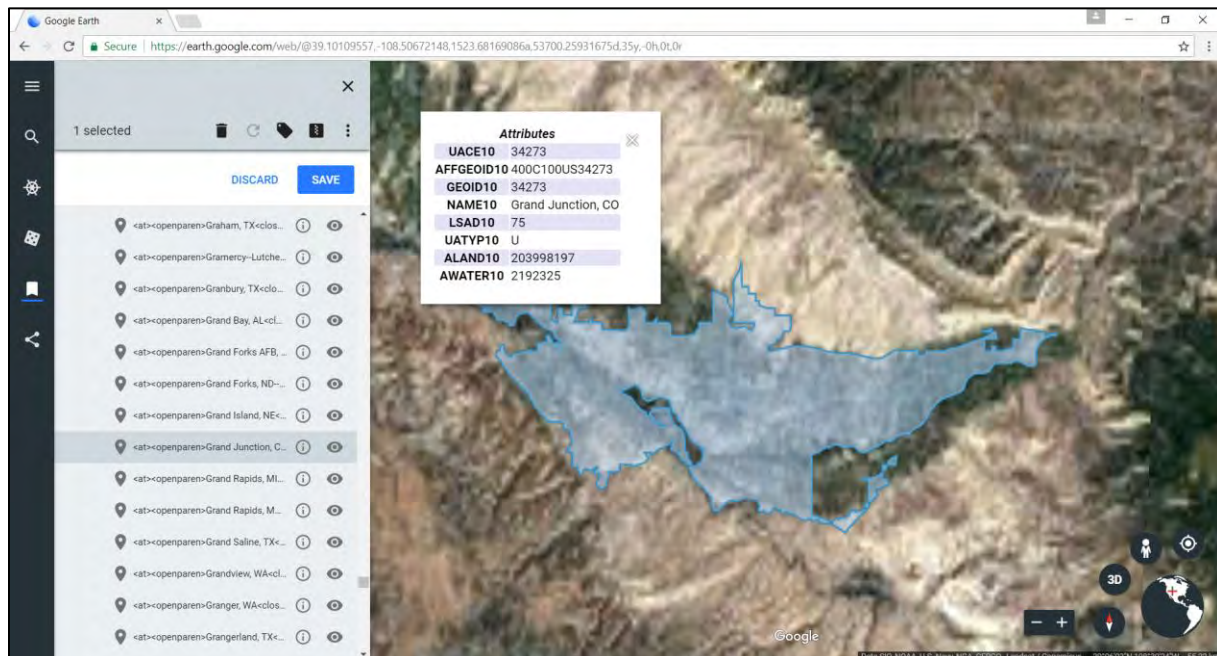
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Additional examples are included below, so you can work with different KML files.

All urban areas in the United States, listed in alphabetical order in the Table of Contents (again a file downloaded from the US Census Bureau website):

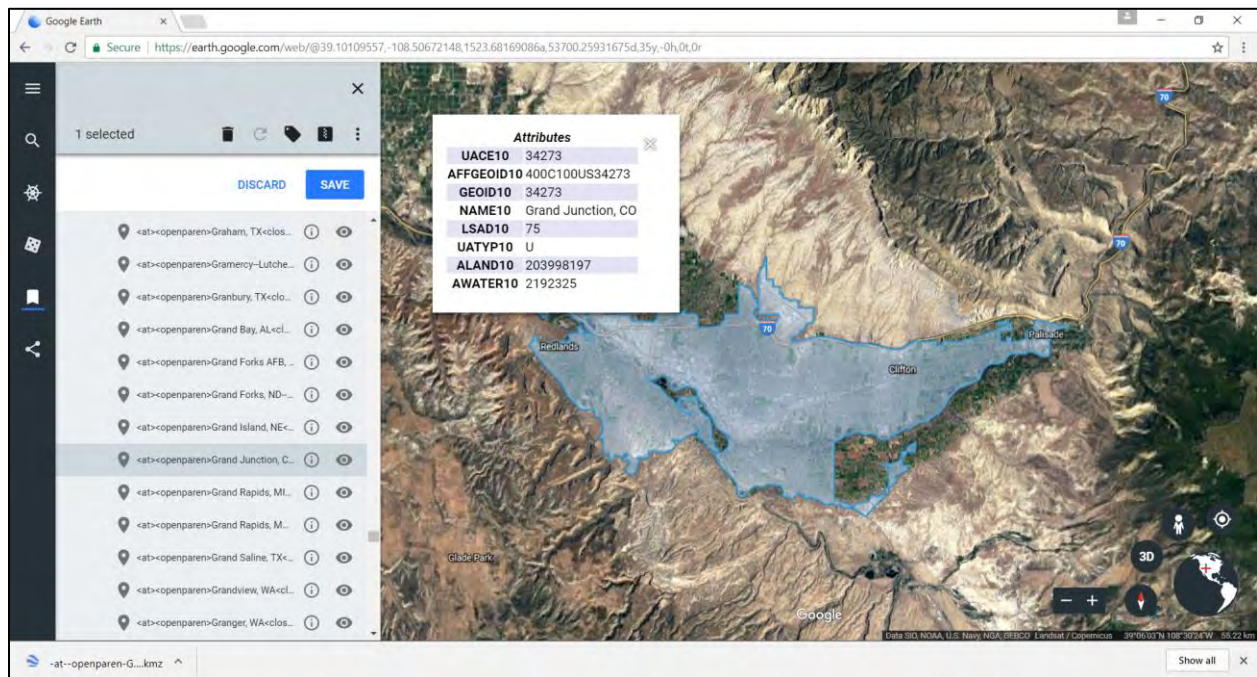


Zoomed into Grand Junction, Colorado.

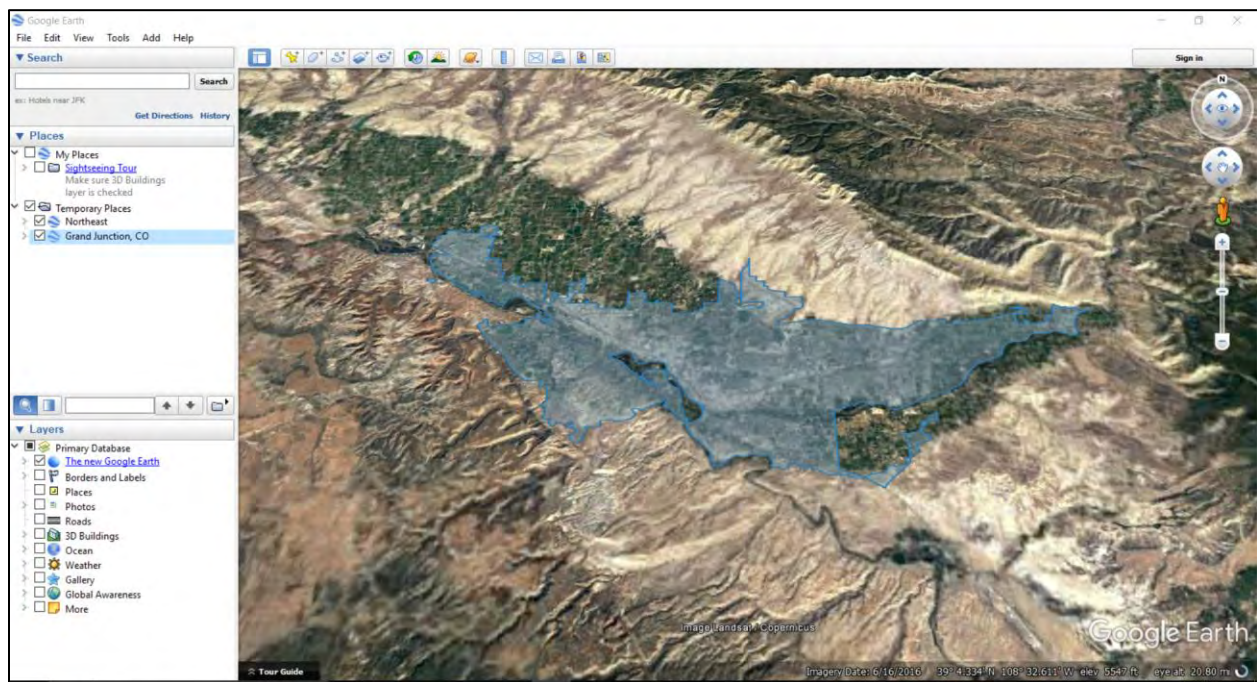


Exported as a KMZ for that specific feature.

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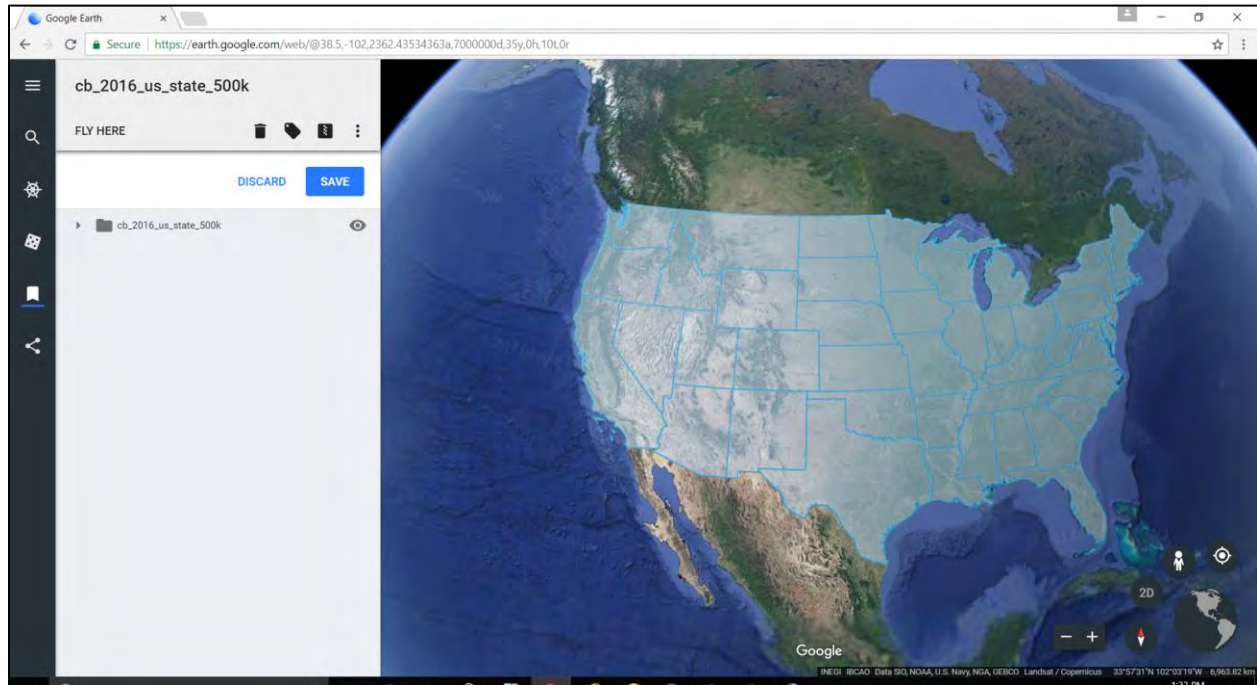


Opened as its own file in Google Earth Pro:

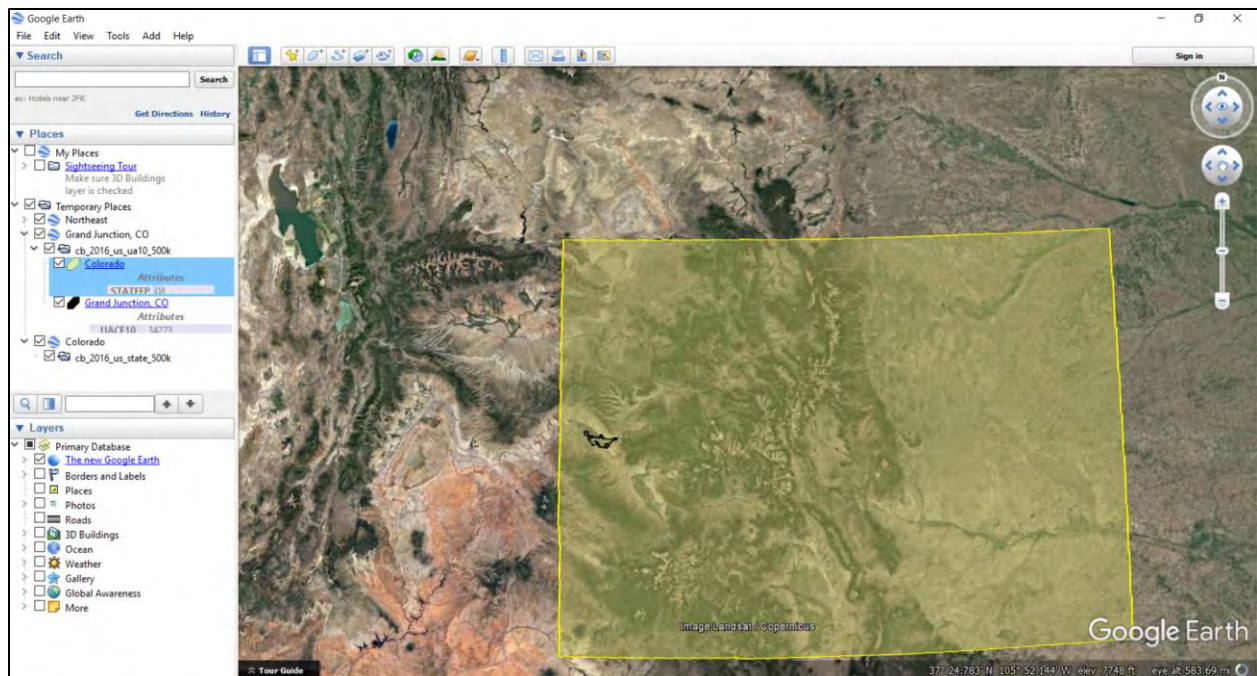


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The individual states of the United States.



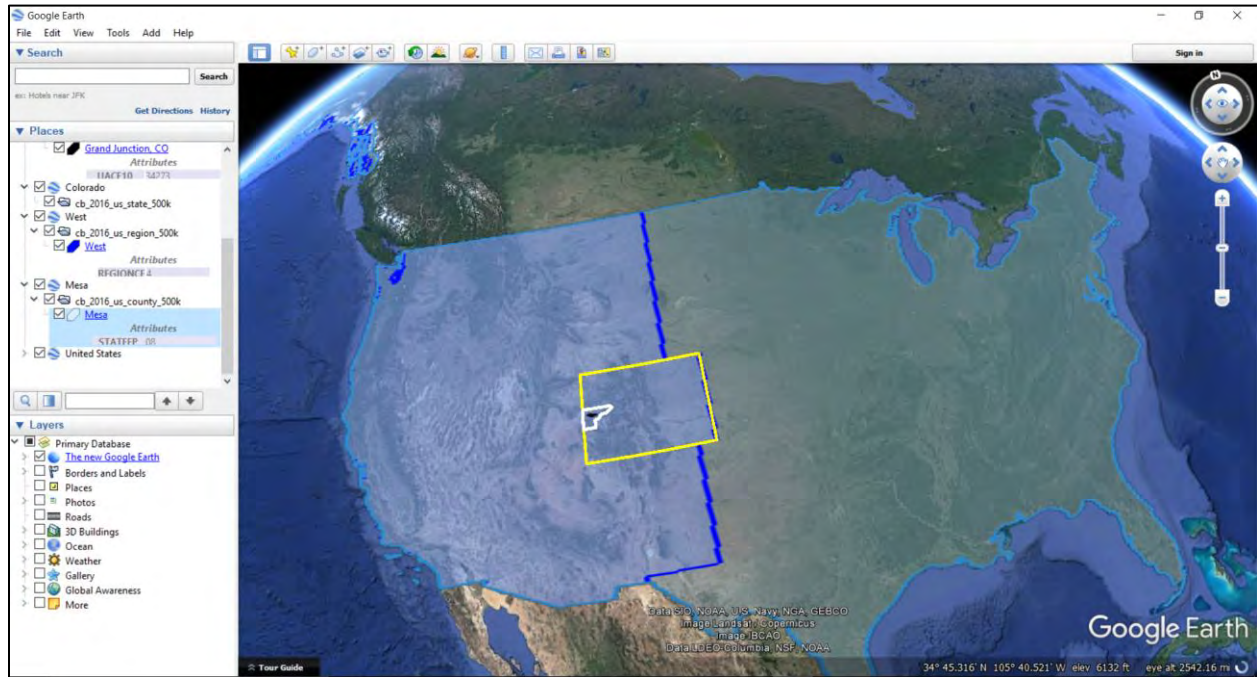
Performing the same functions -- Colorado as a separate file and displayed in Google Earth Pro.



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In the next screenshot, the files for Mesa County, Colorado, the Western Region of the United States (from the region file), and the boundary for the US were added.

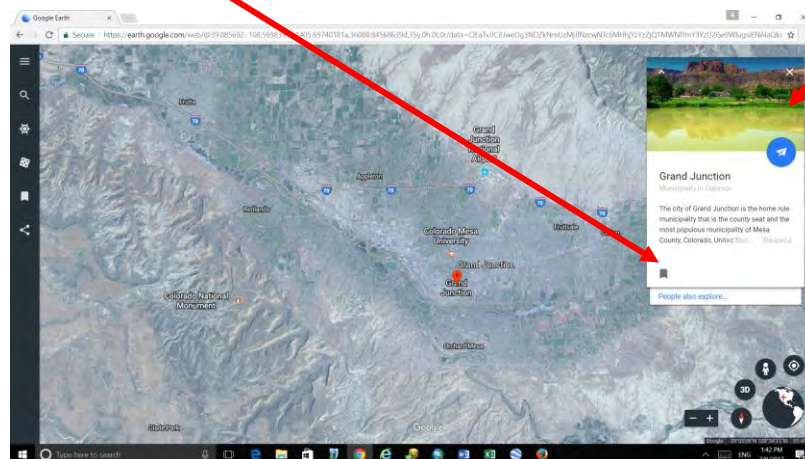
Grand Junction is in Mesa County, the State of Colorado, and the Western Region of the United States of America. These are all displayed in Google Earth Pro and the theme colors selected individually.



2.6 Using Placemark in My Places

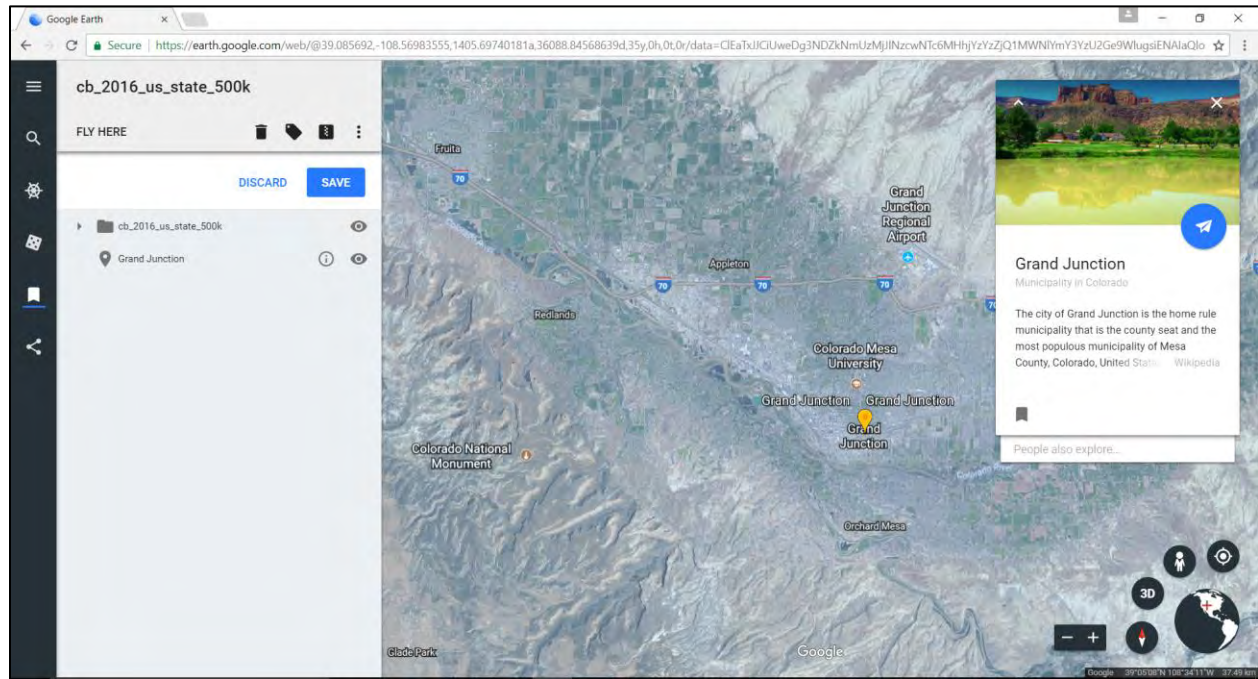
So what if all you want to do is search for a place and add it to *My Places*? (For the accompanying YouTube video, go to <https://youtu.be/njzDD-t6TS0>).

Use *Search* to locate your place. A balloon will be located on the map and the *Knowledge Card* will show up. Click on the Add button at the bottom of the *Knowledge Card*.



Exploring Our Planet with Open Source Software

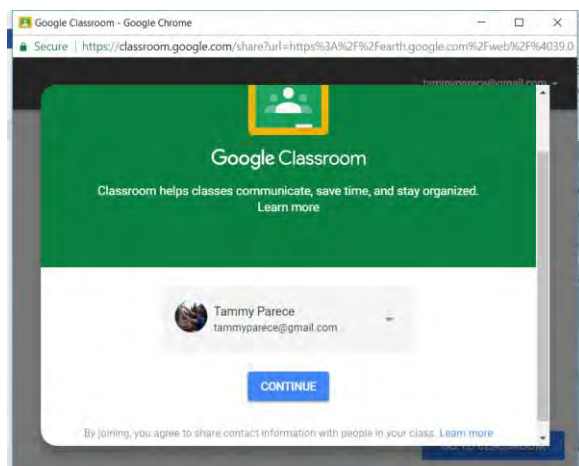
Google Earth will add it to your My Places Table of Contents. Yes, you can add places even when you already have a KML file on display!



2.8 Sharing

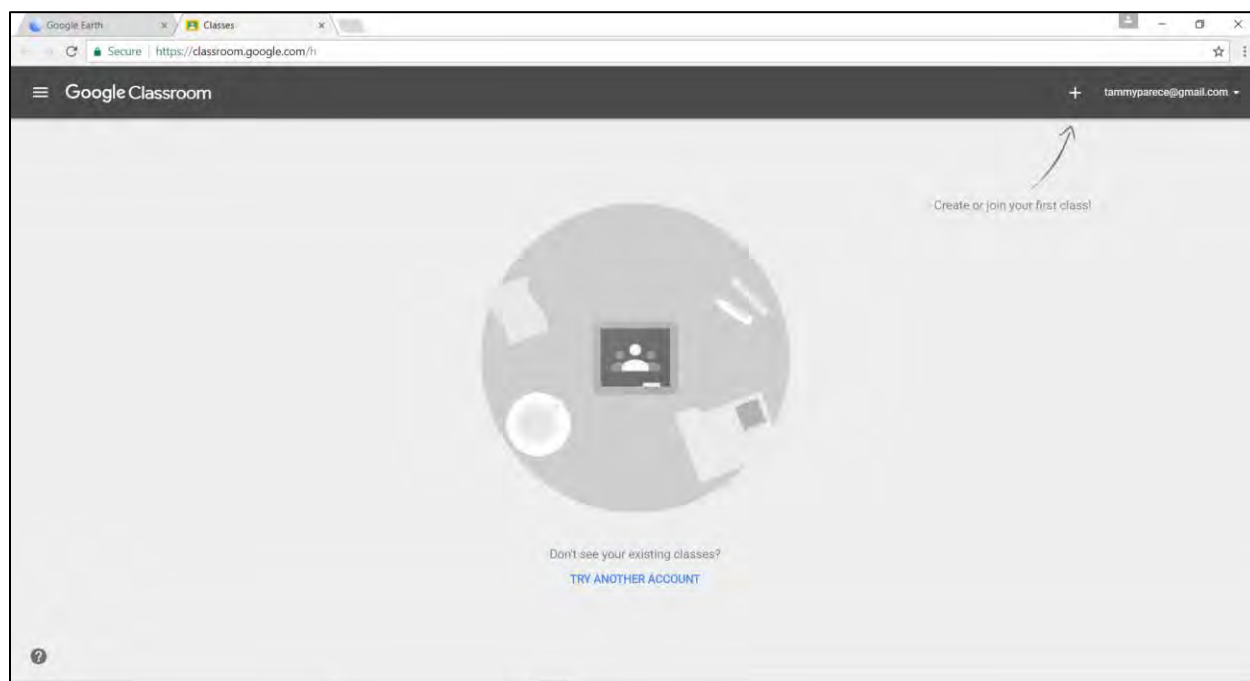
You need a Google Educational Account if you wish to Share to a classroom. If you do not, check with your school's resource or technology officer to obtain the information. (For our YouTube video on Sharing, go to <https://youtu.be/KkS8MVH8Me4>.)

Go to the *Share* button and then click on *Classroom*. You get the following window. Click continue.



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When you sign in, if you signed in using your education account, it will take you to your Classrooms. Additionally, after you select your class, you choose to add it as an assignment, announcement or question. If you have not joined a classroom, you can also do that here.



This concludes our tutorial on Google Earth Web. Please see the tutorials Google Earth Pro (Chapter 3) or Google Earth Desktop (Chapter 5) for additional features.

The YouTube Videos that accompany this chapter are found at:

1. Introduction to Google Earth
<https://youtu.be/DaluBU8ZO3A>
2. Introduction to Google Earth Web
<https://youtu.be/NjWJlt-jWF4>
3. Locating KML Files for Google Earth
<https://youtu.be/8bLweAYxQoM>
4. Navigating in Google Earth Web
<https://youtu.be/1-SNUm58tc4>
5. My Places in Google Earth Web
<https://youtu.be/njzDD-t6TS0>
6. Map Styles in Google Earth Web
<https://youtu.be/rN1aBhNt7Tc>
7. Sharing in Google Earth Web
<https://youtu.be/KkS8MVH8Me4>
8. Using a KML File in Google Earth Web
<https://youtu.be/G2uGOSbk6ns>

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3. Google Earth Pro

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This set of tutorials introduces you to Google Earth Pro (**not** Google Earth Web or Google Earth Desktop, which are covered in different tutorials). Google Earth Pro is recommended for use at the high school level. The browser - Google Chrome - is now required to download Google Earth, so, if you do not already have Google Chrome, you can download it by clicking this link:

<https://www.google.com/chrome/browser/desktop/index.html>

3.1 Introduction

Google Earth has three formats—(a) an on-line web version, (b) a mobile version, and (c) a version called Pro. In this tutorial, we explore the Pro version. Google Earth Pro, like the other two versions, is a GIS because it provides a map display and Table of Contents which permits layering multiple files on top of the map document. Further, it has some basic features of a GIS that allows some personal mapping. An older version was just called Google Earth Desktop and was replaced by Google Earth Pro. In most instances, if you had Google Earth Desktop during the update, it was replaced by Pro. For a YouTube video introducing you to the Google Earth suite of products, go to <https://youtu.be/DaluBU8ZO3A>.

We will not cover all features and abilities within Google Earth Pro. We will cover the basics - navigating, metadata, historical imagery, properties, dual Table of Contents and a few enhancements in Google Earth Pro that are not found in the other two Google Earth versions.

3.2 Let's Get Started – Downloading Google Earth Pro

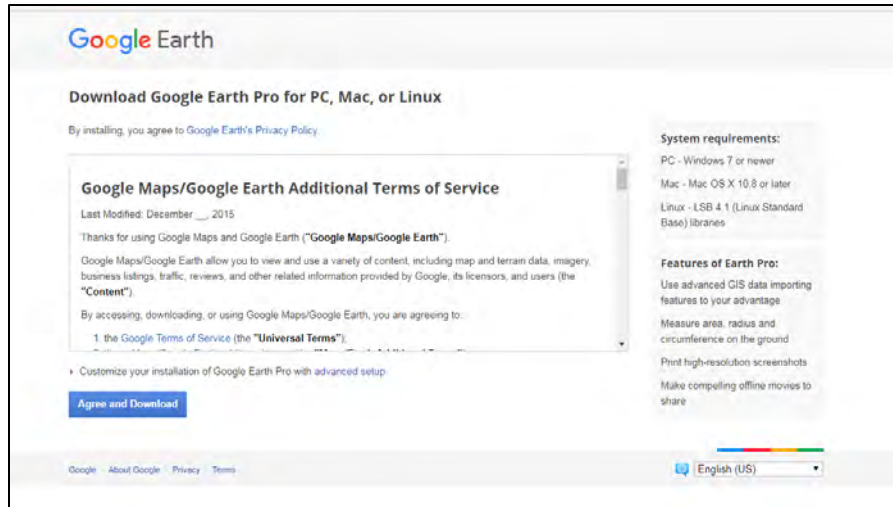
Our YouTube video introduction Google Earth Pro is found at: <https://youtu.be/JStJz-AUYvQ>.

Please note, if you are a K-12 Educator, please read the Google Earth Acknowledgement and Use Agreement form as restrictions do exist depending on ages of your students. The Google Earth Agreement and Use Terms can be found at:

<https://www.google.com/earth/download/gep/agree.html>

Once you have read this document, and if you have agreed to it, you will receive a prompt to download Google Earth Pro.

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Once you have downloaded, follow the instructions to run and add the program to your computer. Once you have completed the install, you can add a short cut to your desktop by right-clicking on the program and adding to desktop. Please note that you must have administrator capability on your computer to install Google Earth Pro. If you are working on an educational institution's computer, contact your IT Department about downloading Google Earth Pro. If you are working from a mobile device, see the tutorial on Google Earth Web, which is available for mobile devices.

You will see this icon:

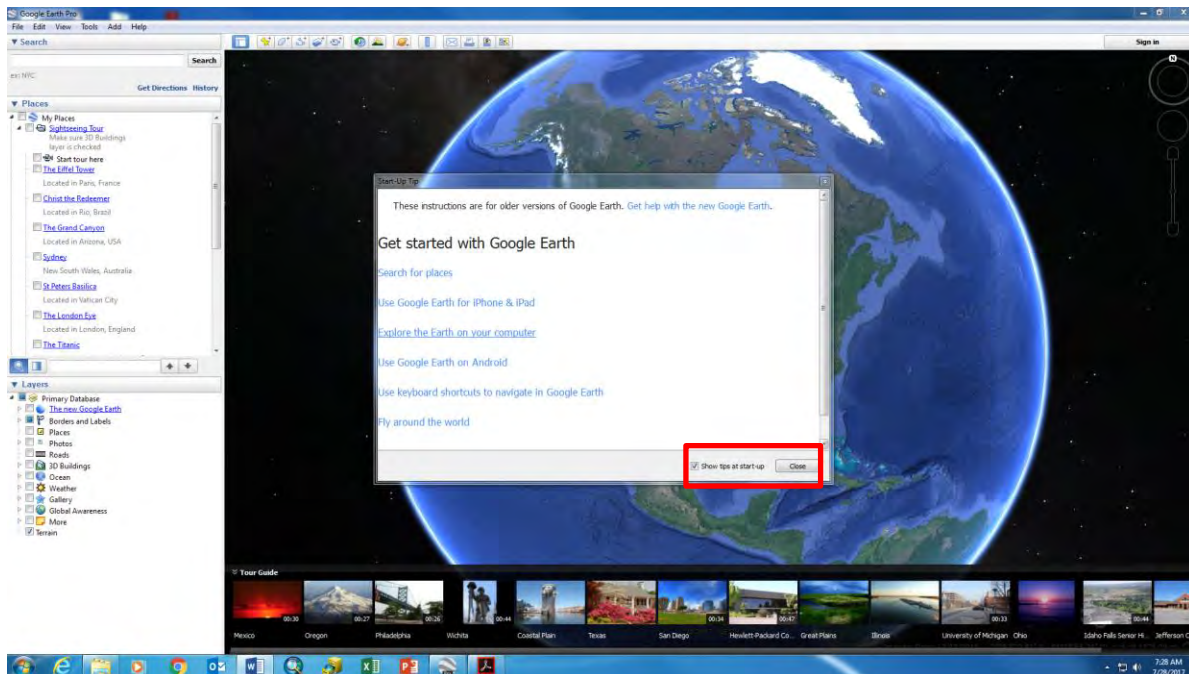


Now that you have downloaded and installed it, let's get started.

3.3 Google Earth Pro Basics

Open Google Earth Pro by doubling clicking on the icon. You will see the following:

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Start-up tips is enabled. We recommend that you leave this enabled until you are familiar with using Google Earth. If you don't want it enabled, unclick the box at the bottom that says *Show tips at start-up* (red rectangle above). Once you have finished reading this information, click *Close* and the following will show:



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We are going to explore this window for a bit. On the left is the Table of Contents (actually two different ones -- we will discuss these later). On the right is the Map Window.

Within the Map Window, you see the lines for the Geographic Grid (in this display, lines of latitude and longitude). At this extent, it is only showing major divisions. You can turn Geographic Grid on and off-- we will cover that under *settings*.



In the upper right hand corner are the *navigation tools*.

You can:

Rotate the Earth, north and south or east and west, with either of the two icons.

Zoom in and out with the slider bar (you can also zoom in and out with your mouse wheel).

Play with these icons. Can you get the Earth to turn upside down (south on the top and north on the bottom)?

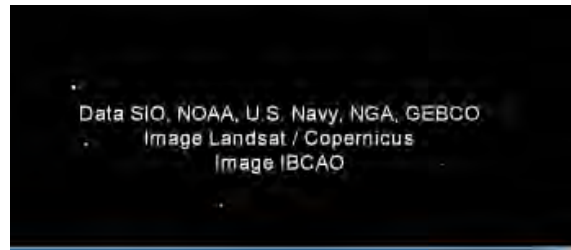
3.4 Metadata

Metadata is an important topic to understand. Go to the lower left hand corner for your first set of metadata. From right to left, you find altitude, latitude and longitude and the imagery date. Because we are in space right now looking at the Earth, the altitude is quite high, and measured in miles. As you zoom in, this will change. How do you know what spot on the Earth this figure represents – it is where your mouse pointer is located. The latitude and longitude is also for the location of your mouse pointer. In this display, latitude and longitude read as degree minutes and decimal seconds. Later, we will discuss how you can change these settings. At this extent, if you were to put your mouse in space, that reading will disappear. Finally, the image date – for this extent, this map of the Earth is a composite of the images, so the date displayed here represents the latest date for the composite images. As you zoom in and out, this date will change to the latest date that Google has of an image for that specific location on the Earth. This date also changes when viewing historical imagery, which will we cover later.



The other metadata information is extremely important – the source of the image displayed in the Map Window. This is located in the center, at the bottom. When you are zoomed out to this extent, you see many sources because, again, this extent is a composite of images.

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If you were to zoom into one specific locale, you would get more specific information, for example, Grand Junction, Colorado – here, we see an aerial photo (USDA) instead of a satellite image.



If you continue to zoom in and go to the extent of Street View, you will get © 2018 Google. Most street view images are acquired by Google.

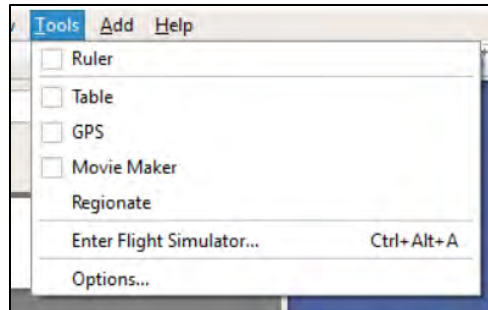
Other metadata can be found throughout Google Earth, especially when adding files under My Places or look at the Layers already displayed in Google Earth. We will discuss those as we proceed.

3.5 Changing the Default Settings in Google Earth Pro

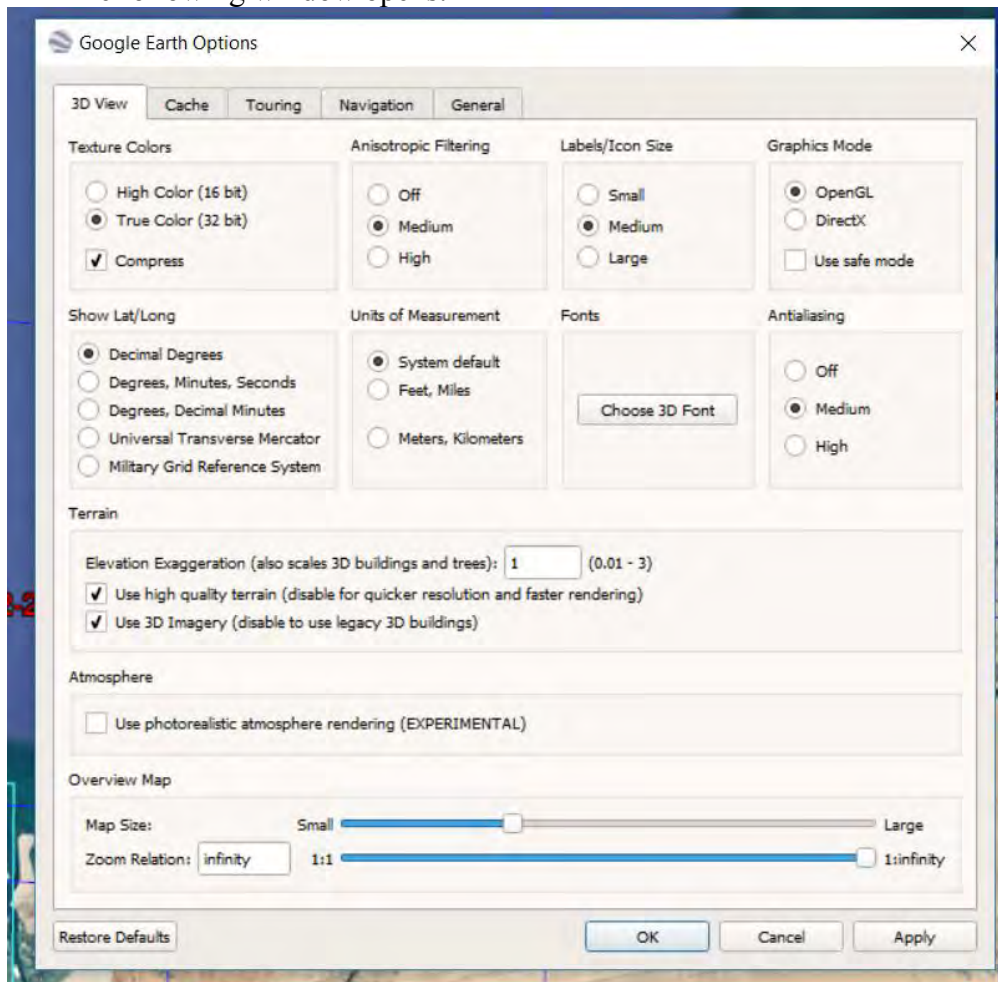
For the YouTube video related to this section, go to: <https://youtu.be/IXqzT4zUkE0>.

Google Earth loads with many default settings, which you can change. On the Toolbar, go to *Tools, Options*.

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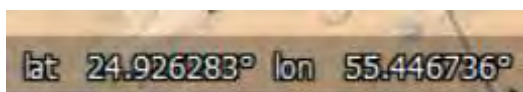


The following window opens:



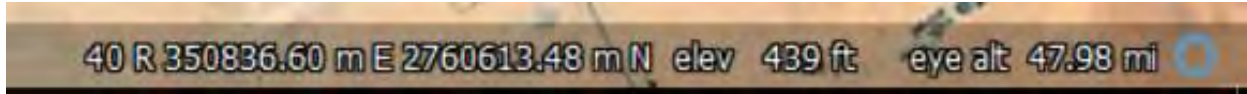
We will not discuss each of these. For example, the first row of boxes – Texture Colors, Anisotropic Filtering, and Graphics Mode – if you need more information about these capabilities, contact your IT Departments.

The second row, 1st box – *Show Lat/Long*, here is where you can change the display of your Latitude and Longitude. Decimal Degrees would look like:



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And, Universal Transverse Mercator (UTM) location data look like this:



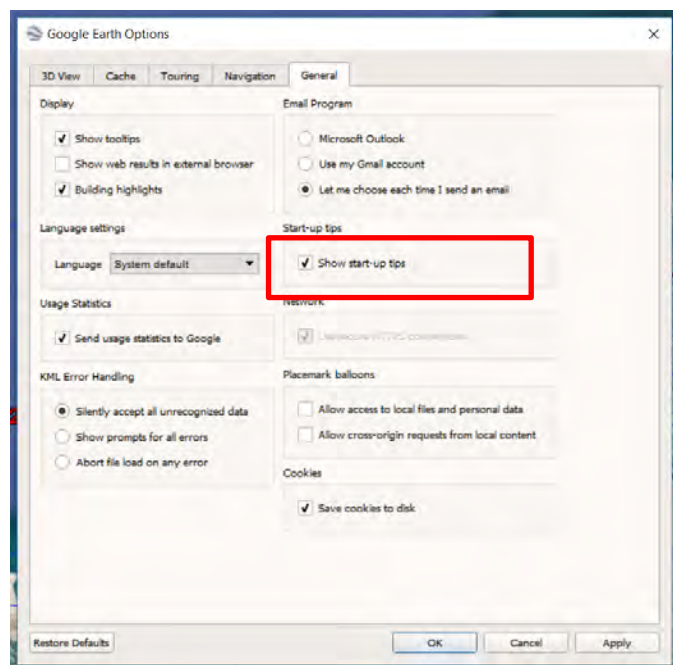
UTM Zone – 40R and the coordinates in meters, East and North of the zone’s origin. You have only changed the coordinate system, so the elevation and altitude are still showing in the default settings of feet and miles.

If you change the *Unit of Measurement* (the next box), the values will display now as meters. You can also change other options in this specific window to help with faster rendering. We briefly will look at some of the other tabs.

Cache – is related to memory, check with your IT Department on any changes.

Touring and *Navigation* tabs are setting specific to zooming in and out, flying around in Google Earth, etc.

The *General* tab contains settings that might be helpful with regard to changing language displayed for a non-English speaking student, emailing, tooltips, how errors are displayed, etc. If you are new to Google Earth Desktop, enabling *Show start-up tips* is recommended (red box).



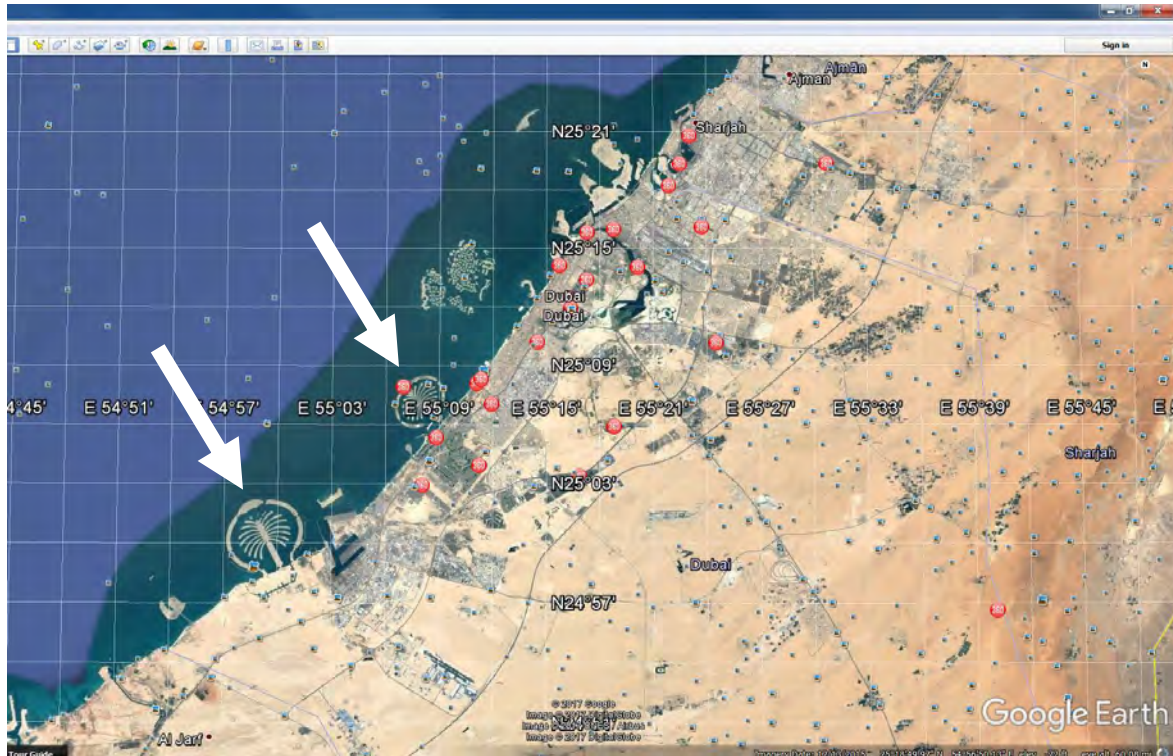
We won’t discuss these as they are each an individual choice as to how you want to receive information, or how your IT Department feels your emails, or access to local drives should be handled. The best thing about *Options* is the button on the bottom left, *Restore Defaults*. You don’t need to remember what they were, just hit the button and click *OK* or *Apply*.

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3.6 Exploring the Historical Imagery Option

For the YouTube Video for this section, go to: <https://youtu.be/7r1ETosfKmU>.

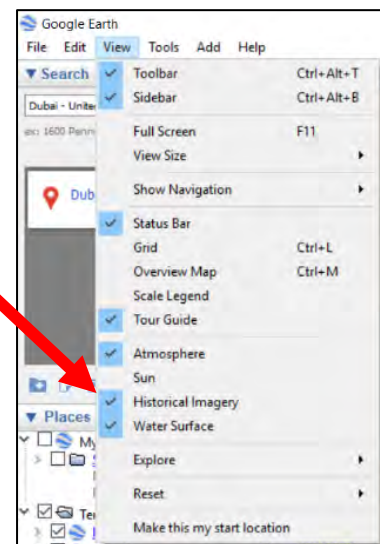
For this next section, go back to Dubai and then zoom in on the coastal area as shown below (no, the white arrows are not present on your screen):



We are going to examine changes to the coastal area using Historical Imagery within Google Earth. Most specifically, human changes which added the Palm Islands (white arrows).

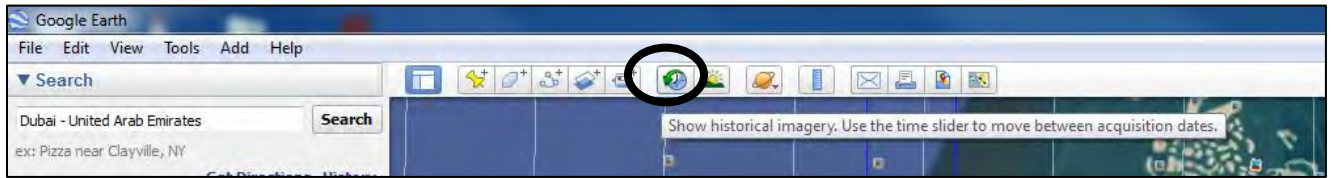
You can access the *Historical Imagery* option in two areas.

1st- on the toolbar, go to *View* and check *Historical Imagery*.

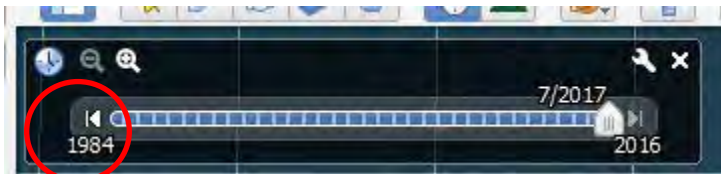


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Or, on the toolbar with icons, click on the icon within the black circle below:

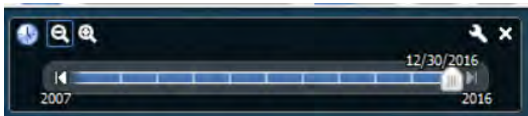


Both options turn on the *Historical Imagery* sliding bar, which will pop up in the upper left of the Map Window.



As you can see, Google Earth has Historical Imagery for Dubai extending back to 1984 (red circle above). You can either grab the slider with your mouse and slide it back and forth, or use the arrows at each end of the line – going to the left, the imagery gets older, and, to the right, more recent imagery is displayed.

Before we talk more about what happens in the Map Window, let's look at the sliding bar a bit closer. In the upper left corner of the pop-up window are two zooms – these zoom in and out on the divisions in the sliding bar. As you can see below, one click on the *Zoom In* changed the display to go back only to 2007, but each white division line represents one historical image.

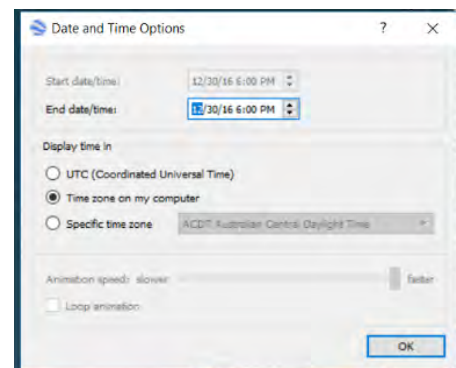


In accordance with the screenshot below, move the sliding bar to the left to 1984 and placed your mouse on one of the white lines. It shows the dates that each white bar represents.



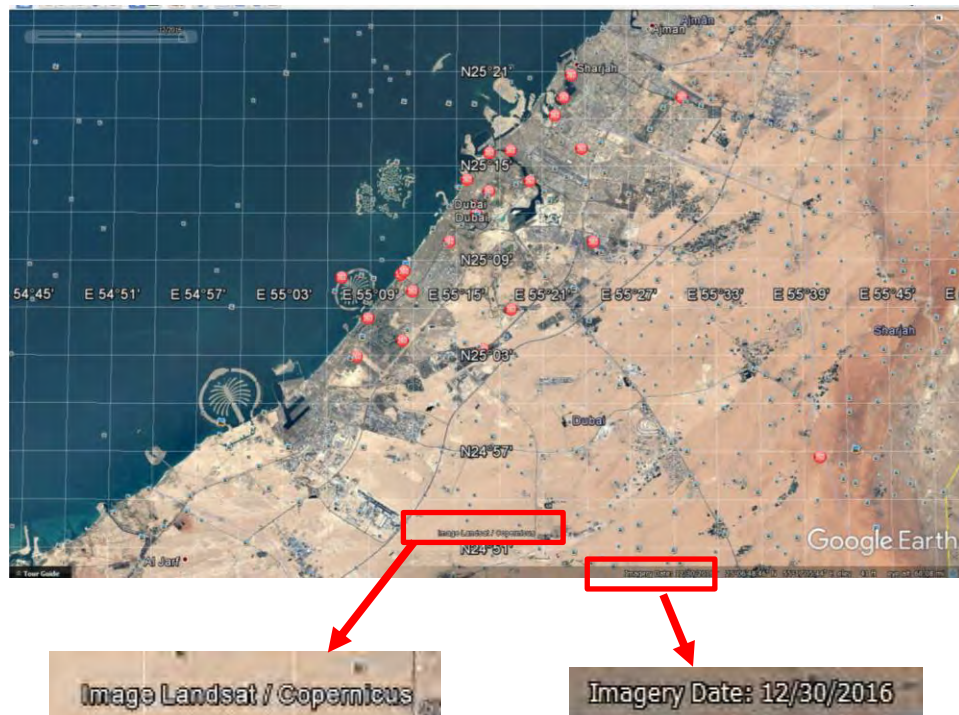
Clicking on zoom out, you can change the sliding bar back to the original time line.

The setting button (red circle above) allows you to change the Date and Time Options for Historical Imagery.



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Let's now look at what happens in your Map Window when using the sliding Historical Imagery bar. When you first click on the slider, the screen changes, and the date of the image is placed on the lower information bar on your screen and the image source in the bottom middle.



Remember, the image source also changes when you zoom in and out.

Now either slide the slider to the left or click once on the left arrow. Look at the bottom, the image source is the same but the image date is now 12/30/2015. Keep clicking and watch how the features (called Palm Islands) in the Persian Gulf have changed, most specifically watch the areas indicated by the white arrows. The screenshot below is 12/30/2004.

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12/30/2002, only one of the three Palm Islands is even partially present:



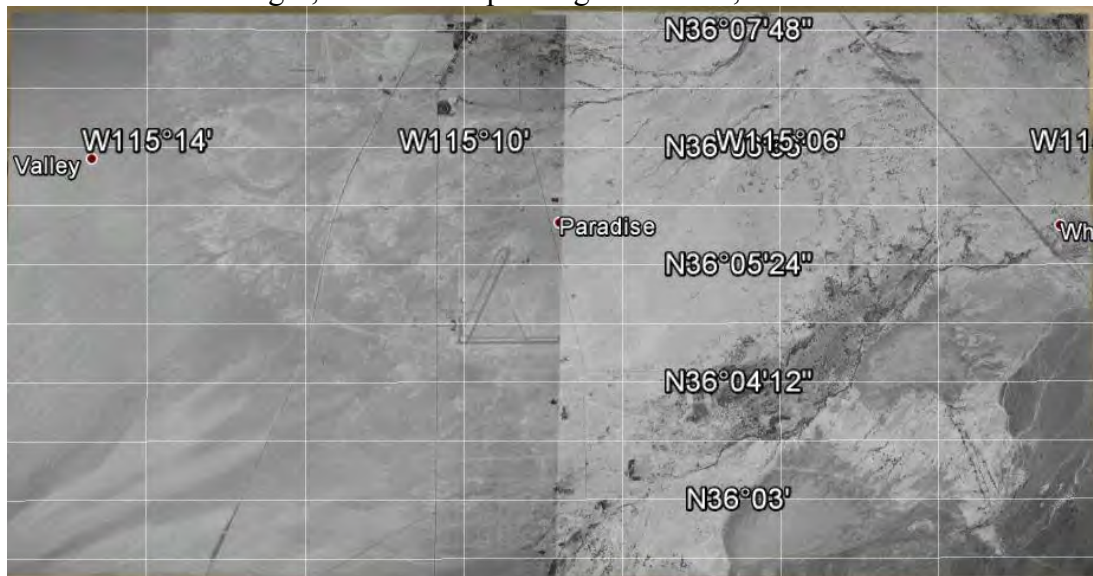
12/30/1984 below – not only are the Palm Islands not present, but look at the change in the extent of the urban area. You can use the historical imagery to show changes over time.

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Additional Examples of Changes Over Time

Las Vegas, Nevada – expanding urban area, 1950 to 2017.



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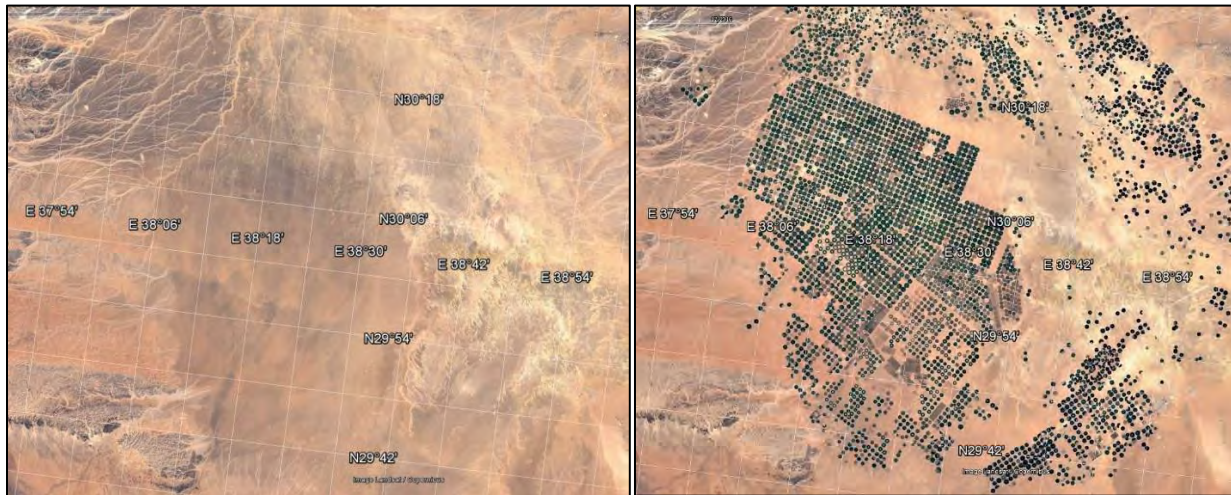
Question – what is the source of the 1950 image of Las Vegas? (Answer – NASA, obtained from the U.S. Geological Survey – do you remember how we found this metadata?)

Loss of water from the Aral Sea, 1972 to 2016



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1984 to 2016, desert to irrigated agriculture in Saudi Arabia

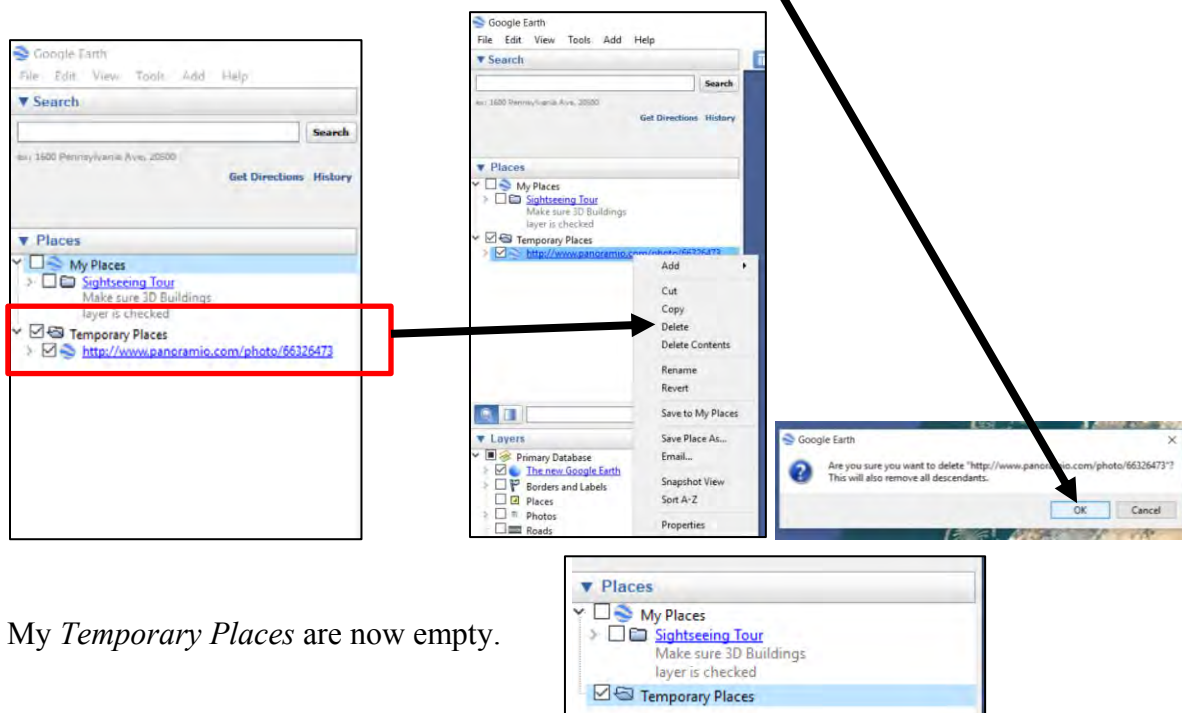


3.7 Exploring the Table of Contents – My Places

For the YouTube video related to this section, go to: <https://youtu.be/EJPUY4QDGyI>.

We are now going to discuss the top Table of Contents – *My Places*. This is where Google Earth records your activity as *Temporary Places*, but you do have a saving option. You could see it recorded when we clicked on the individual photo (red box). You can remove these – right-click on the file name and hit *delete*.

Google Earth will ask you if you are sure. click *OK*.

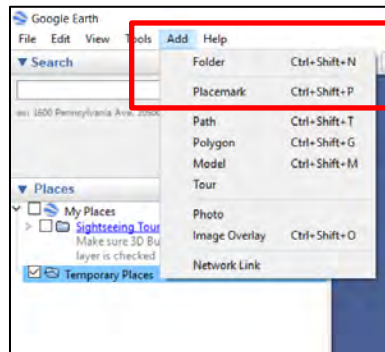


My *Temporary Places* are now empty.

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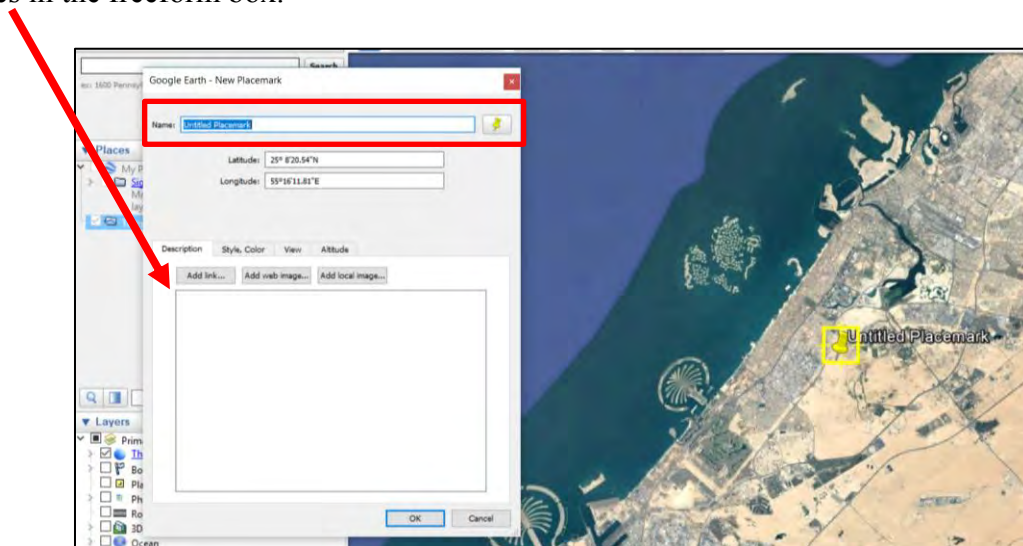
Adding a *Placemark*

You can add placemarks for places of your choice. To add a placemark, search for the location you wish to add a mark. Once you have found that location, and it appears in the Map Window. Now go to *Add, Placemark* (red rectangle below).



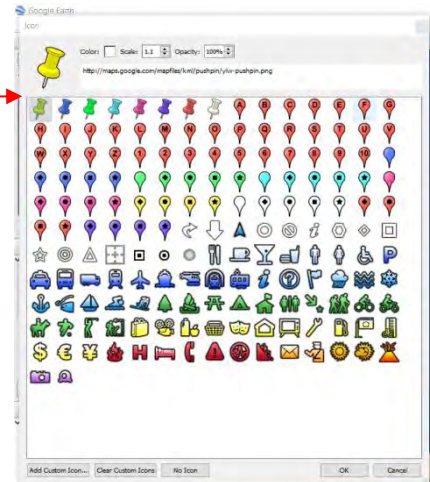
This adds a placemark in your map window, the yellow pushpin and opens the *New Placemark* window. If the placemark is not in the exact location you want it, you can move the Earth view around to put your placemark exactly where you want it. The latitude and longitude showing in the *New Placemark* window will change as you move it.

In the screenshot below, we are under the *Description* tab and the *Name* bar is highlighted (red rectangle). You can name your placemark anything you want. You can also add text, links, or images in the freeform box.



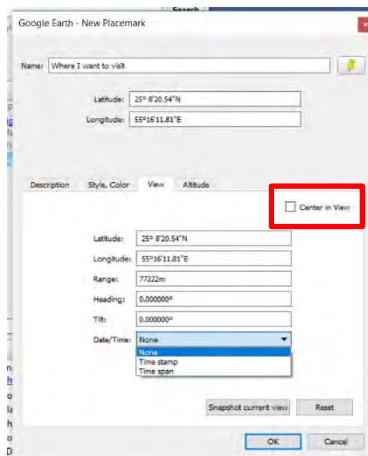
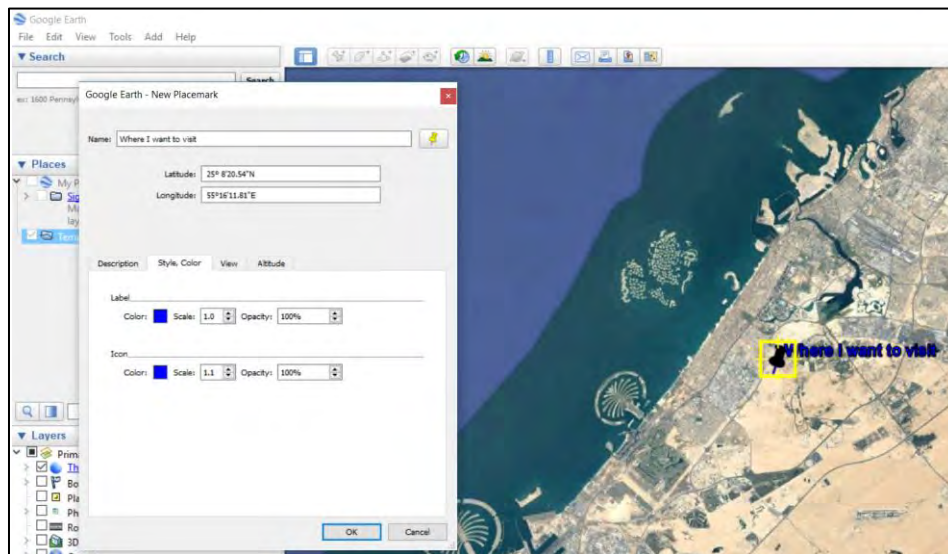
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You can also change the icon from a pushpin. In the red box in the screenshot above, click on the button that has the yellow pushpin and you get an icon window. You can choose any of these, or click on *Add Custom Icon* at the bottom to get a browse window and choose another type of icon. For our purposes, we are just leaving it as a pushpin.



Below, the placemark was named “Where I want to visit”, and it also changed the name in the Map Window.

The color was originally yellow (prior screenshot), but look it is now blue. Click on the *Style, Color* tab and you can change the label and icon colors. You can also change the scale (size) and opacity. Go ahead and experiment to see what best suits your purposes.

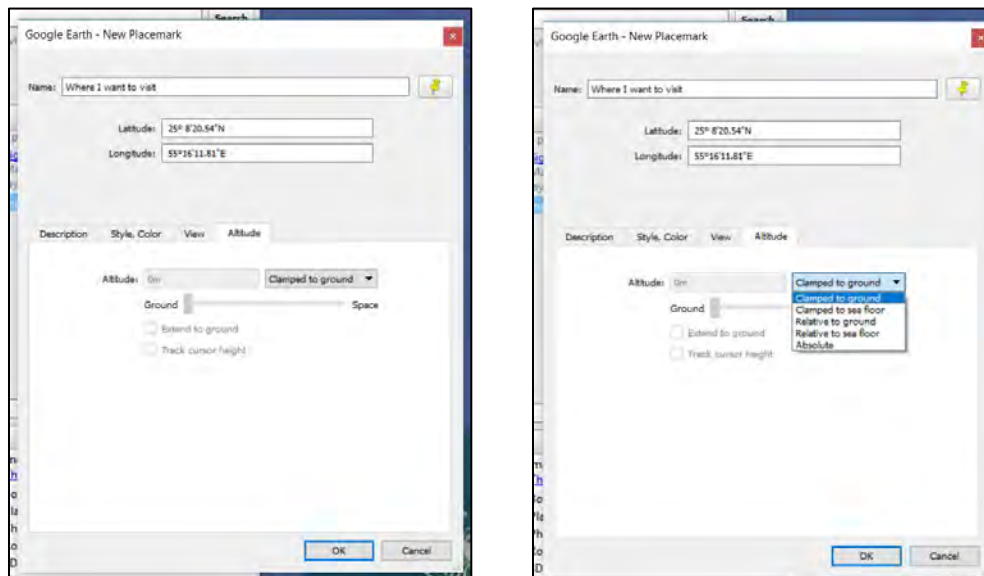


Click on the text tab – View. Here is an additional setting for the Map Window that you can change. For example, checking the box next to Center in View (red rectangle) will move the icon into the center of the Map Window. Note – it won't place your location in the center of the Map Window, it moves the placemark icon into the center, so be careful that is exactly where you want your placemark.

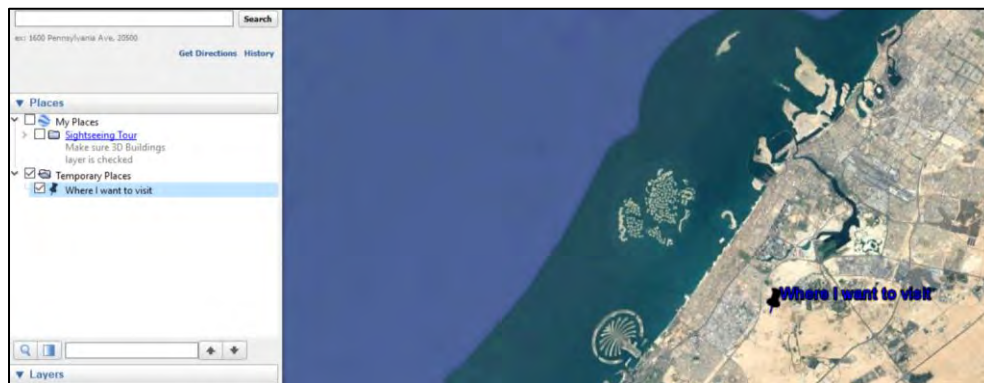
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Click on the last tab – *Altitude*. Normally, we want our placemark *Clamped to the ground*, but as you can see, we have additional setting, if you want to view the differences or are interested in distances to or above the sea floor (of course, this likely only makes sense for coastal areas). *Please note that we do not recommend that you use Google Earth for calculating distances for rock climbing, snorkeling, scuba diving or any other activity that could results in injury or loss of life.*

Depending on which setting you choose, you will enable the *Ground to Space* sliding bar (as you slide to the right towards the word *Space*, you zoom out and the altitude measurement is added), the *Extend to ground* (lengthens the height of the cursor above ground) or the *Track cursor height* (tells you the length of the cursor above the ground) options.



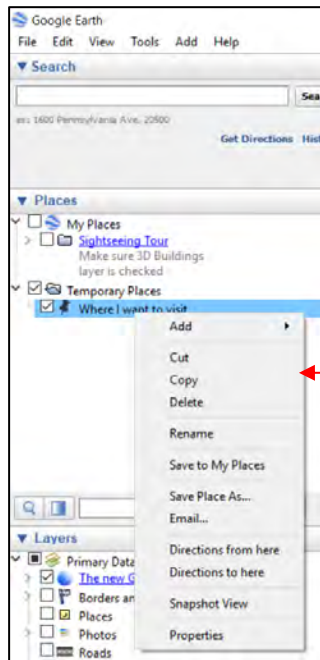
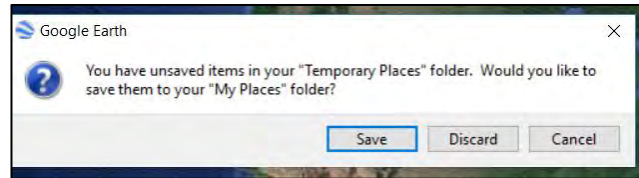
When you have completed and are happy with your settings, click *OK* and it will add your placemark to your *Temporary Places*.



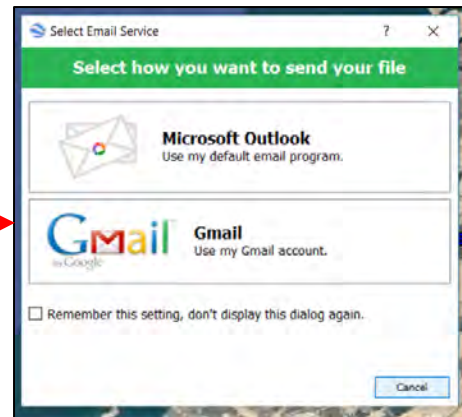
If you now close Google Earth (without taking any additional steps), you will get a dialog box asking if you want to save your placemark in your “*Temporary Places*” folder to your *My Places*

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folder or discard. If you save to *My Places*, it will show up next time you open Google Earth. You can also save it before you close Google Earth. See below.

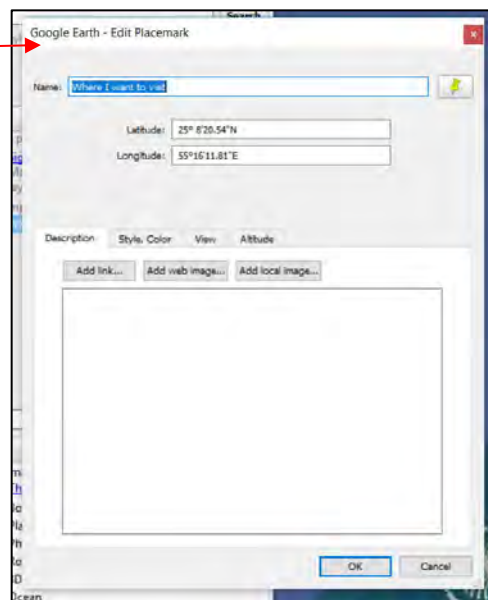


As you can see from this dialog box, you also have many other options. You can copy your placemark, you can delete it, rename it, email it. If you have not set your email (remember from Google Earth settings discussed above, you need to set your email), you will get the dialog box on the right.



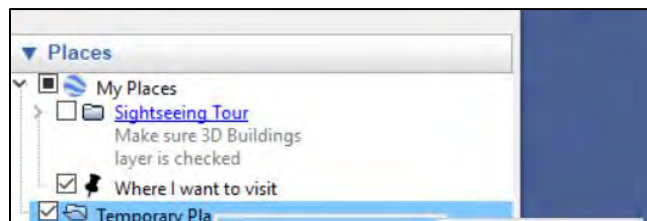
From the dialog box on the left, you also can get directions, and there is also a Properties link.

If you click on Properties, it takes you to *Edit Placemark*, where you have the same tabs



discussed above for *Description*, *Style*, *Color*, *View* and *Altitude*. So, if you don't like what you set when you added your placemark, here is where you can make changes.

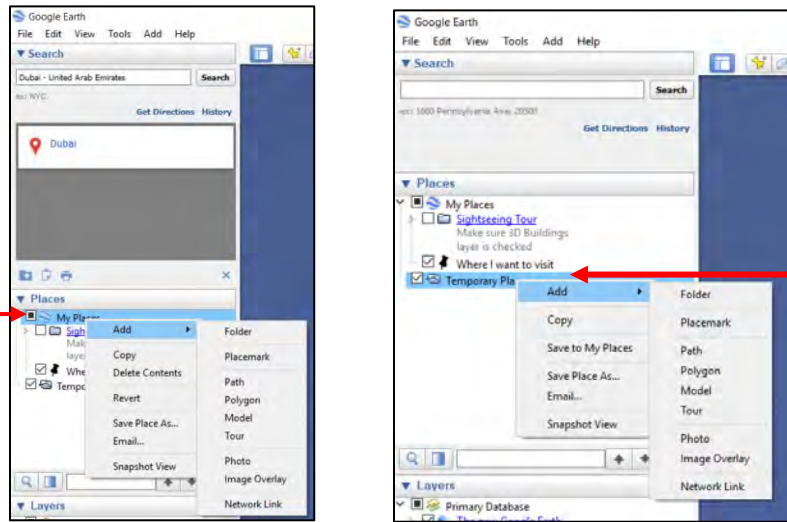
To save any placemarks before closing Google Earth, right click on the name of your placemark in the Table of Contents, then click on *Save to My Places*. If you have a specific folder where you want to save it-- for example, a folder for a specific class project which you are using Google Earth, click on *Save Place As* and then navigate to the file folder where you want to save². Once you have saved your placemark, it moves to *My Places*.



² If you don't already have a file folder set up, you can right click on My Places to create one.

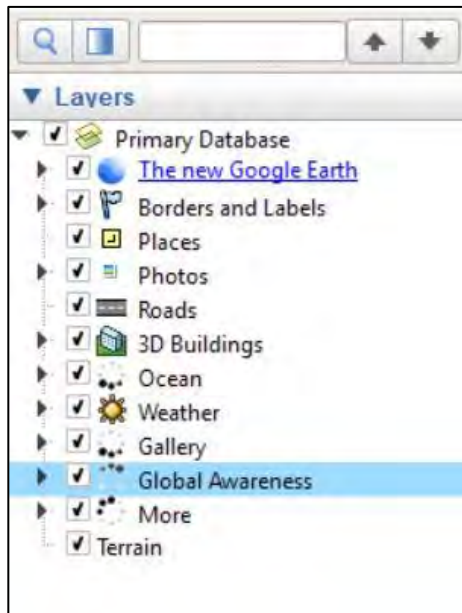
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There are multiple ways to add placemarks. You can right-click on the words *My Places* and add a placemark directly there, or you can right click on the words *Temporary Places* and add a placemark.



3.8 Table of Contents – Google Earth Default

Two YouTube videos are available on the Default Table of Contents. The first video, covers those layers listed before *More* (<https://youtu.be/KyjRgT2icME>) and the 2nd one covers those layers found under *More* (<https://youtu.be/ykILdv3A2TA>).

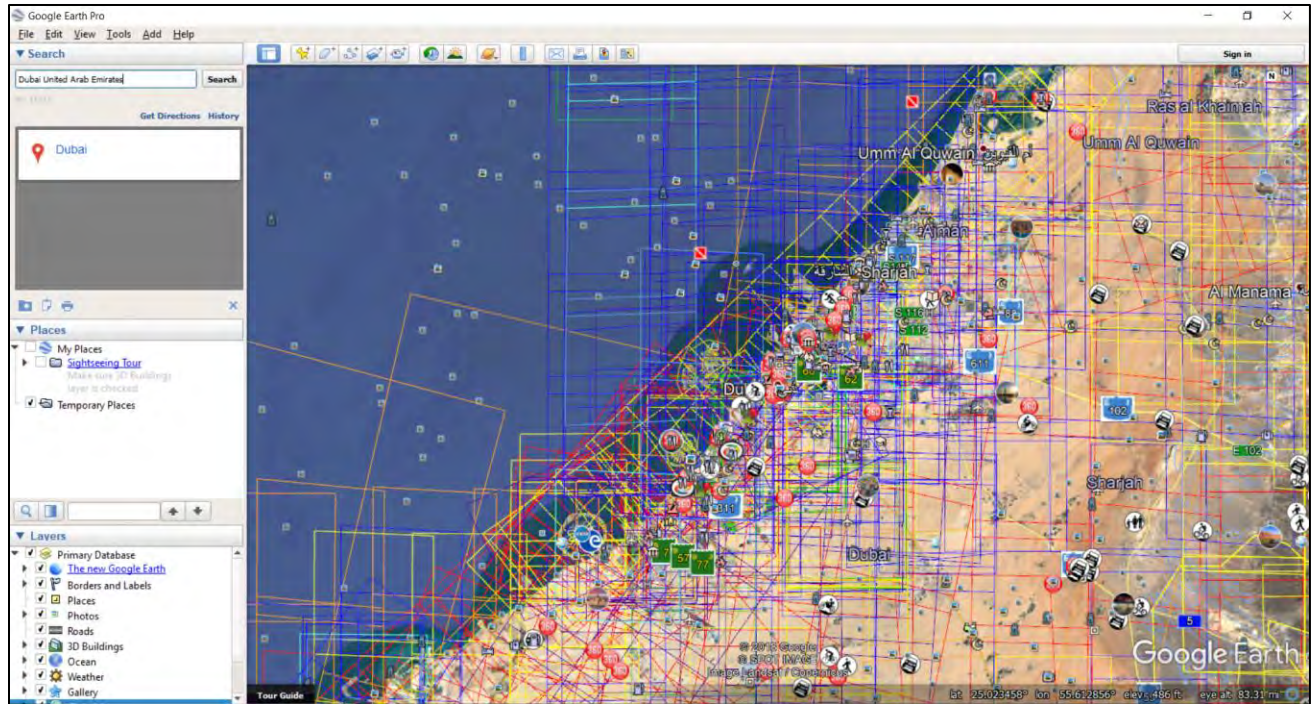


On the left-hand side are two Table of Contents. The one on the top is called *My Places* (as discussed earlier) and this is where you will see any new files (layers) that you add to Google Earth.

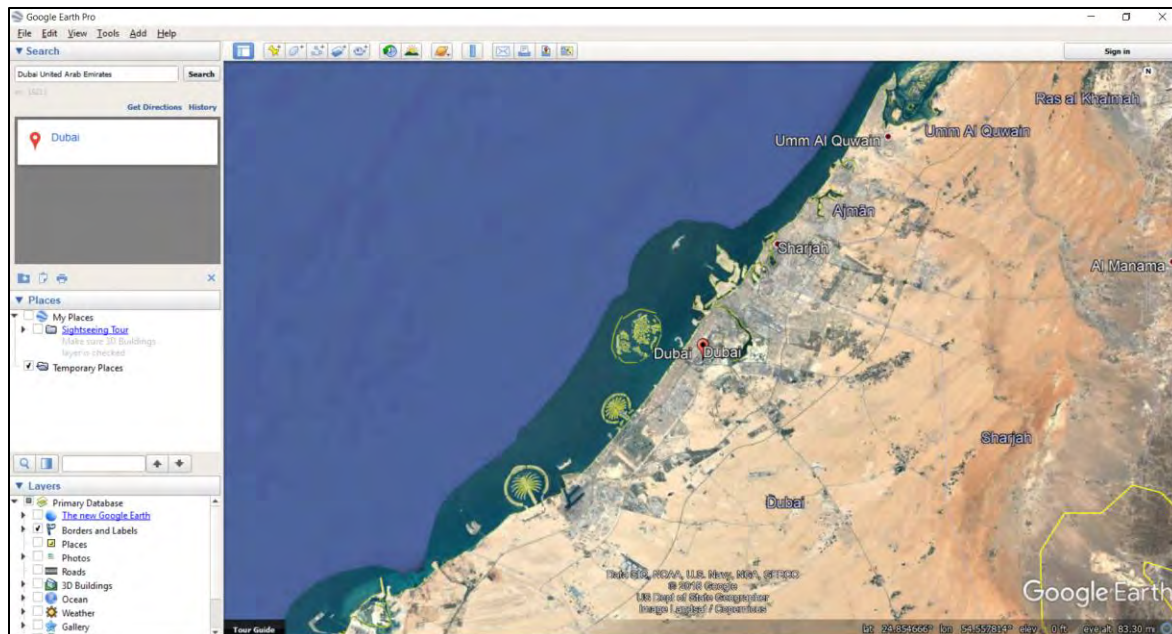
The bottom Table of Contents automatically comes with default content. Yours may look just a bit different – all layers have check marks, which means all of these layers are turned on. You can turn layers on and off by checking or unchecking. (The same applies when you start adding your own layers to *My Places*.) Go ahead and check them all.

Let's see how some of these work. First go to the top of the Table of Contents and search for Dubai, United Arab Emirates. You will see this:

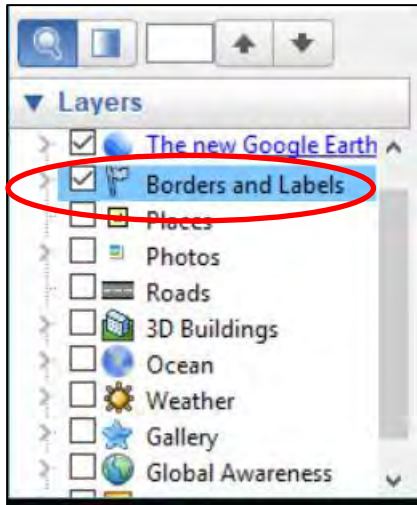
Exploring Our Planet with Open Source Software



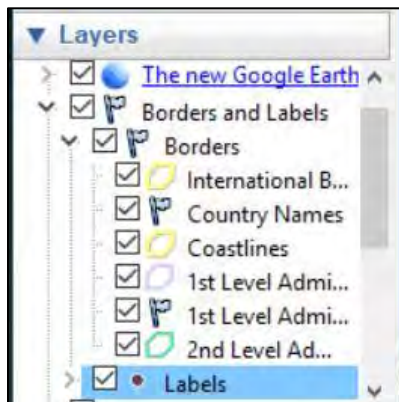
It's a bit messy. That is because we have all the layers turned on. Uncheck all layers except *Borders and Labels*. Your image should now look similar to this, much cleaner. But what is the symbology?



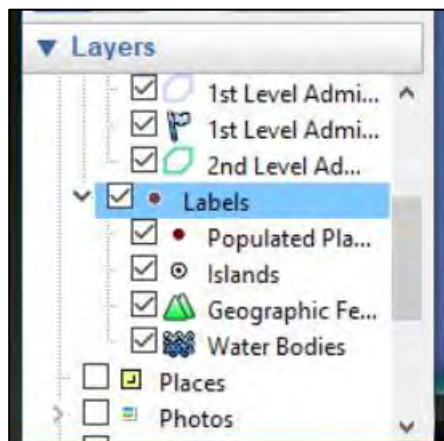
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In the Table of Contents, click on the > next to *Borders and Labels* (red circle to the left) to expand it. It expands into two more categories – *Borders* (polygons) and *Labels* (points). But notice, we have two (2) more >, one next to each category. Click on each of these to expand further.



First, look under *Borders*, we now have 6 different layers. Yellow polygons, hollow inside, are *International Borders and Coastlines*; light blue are *1st Level Administrative Borders (States/Provinces)* and cyan is *2nd Level Administrative Borders (Counties)*. The Flags are layers including *Country Names* and *1st Level Administrative Names (States/Provinces)*. We only see *International Borders* and *Coastlines* in Dubai because United Arab Emirates does not have the same Administrative levels as found in other countries.



Now look under *Labels*.

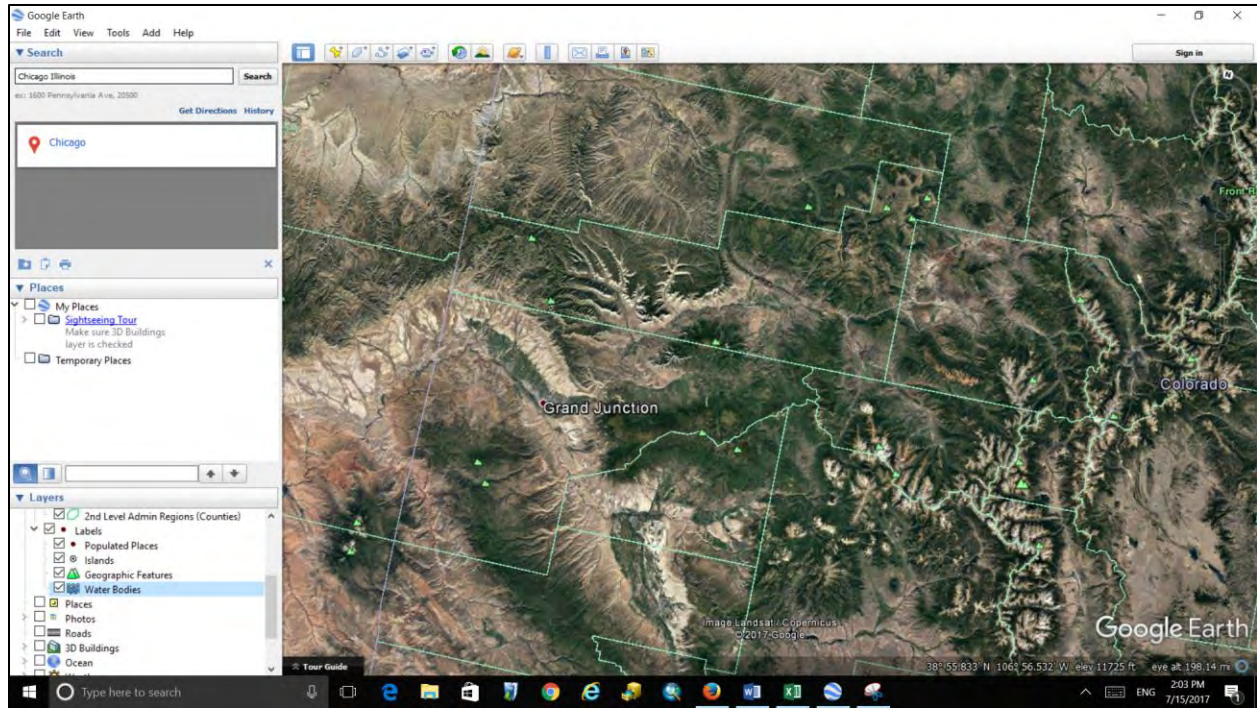
We have red points for *Populated Places*, a point surrounded by a circle for *Islands*, green triangles for *Geographic Features* and waves for *Water bodies*.

We only see some red points in the extent for Dubai because the other features are not present.

If you want to see what some of these other features look like in your Map Window, zoom into the state of Colorado, United States. We now have both *Administrative Levels* and some *Geographic Features*. You see only *1st Level Administrative Names* because we are not zoomed in close enough to see the county names.

In this Table of Contents, the symbology is set by Google, you can only turn it on and off, you cannot change the colors or the icon.

Exploring Our Planet with Open Source Software



Let's explore another layer. Please now go back to Dubai.

Check *Photos* and you will see little images of jpegs but also a red circle with 360 on it. (If you don't see any 360 photos, you may need to zoom in a bit.) Click on one of the red 360 circles. It provided a pop-up with additional information – more metadata. Go ahead and close the pop-up.



Now, click on any of the photo icons. You get a photo that has been uploaded by an individual person (image on the left below). In this case, the person uploaded two. If you have photos of a specific location, you can upload them to Google Earth. However, if you do so, you lose the rights to the photos, they become public domain—thus, a screen shot, as seen below, can be done. If you click on *Click on this image to fly...* (underneath the image), if Google has a *Street View*, you will get that (it does not for this location). Otherwise, you will might get a blurry

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image (middle image below). You can click on the *Street View* icon and if a *Street View* image is not available, you will see *ground view*, noted in the upper right hand corner of the Map Window (image below on the right).



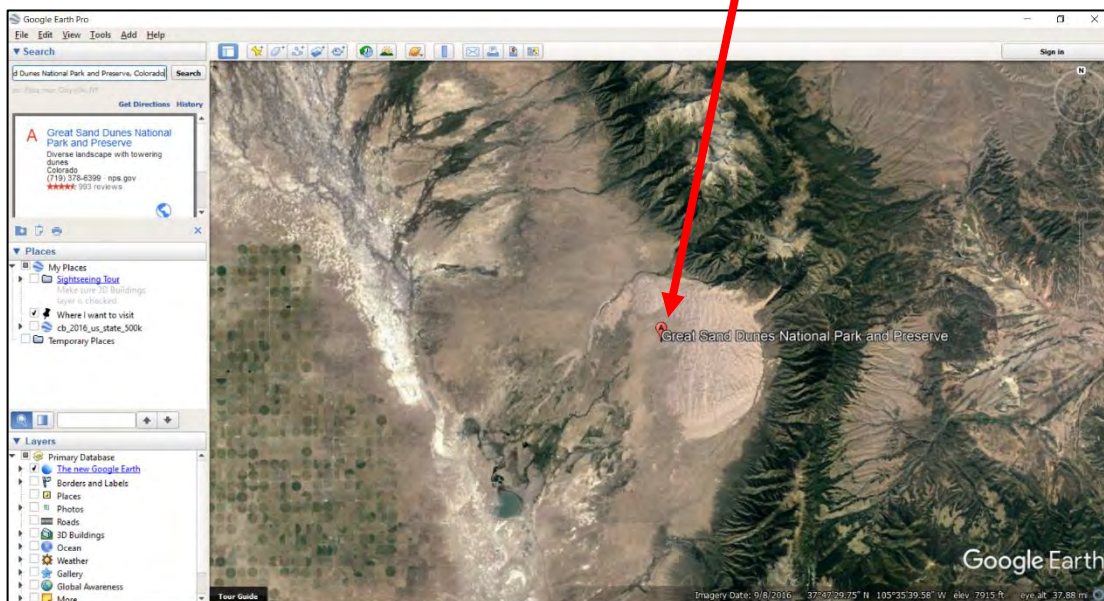
Terrain Layer



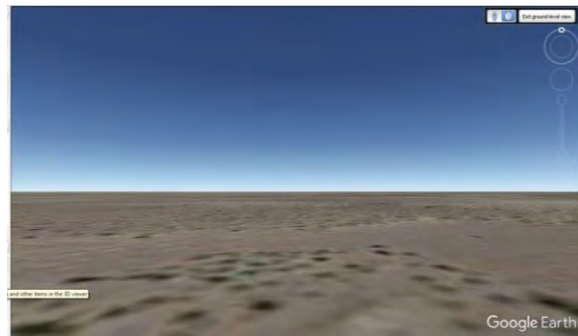
What is terrain?

Do a search for Great Sand Dunes National Park and Preserve, Colorado.

Now zoom into ground view level – right into the balloon labeled *Great Sand Dunes National Park and Preserve*. Once you have ground view level, uncheck (right image below) and check the *Terrain* layer (left image below). *Terrain* gives you the 3D view.



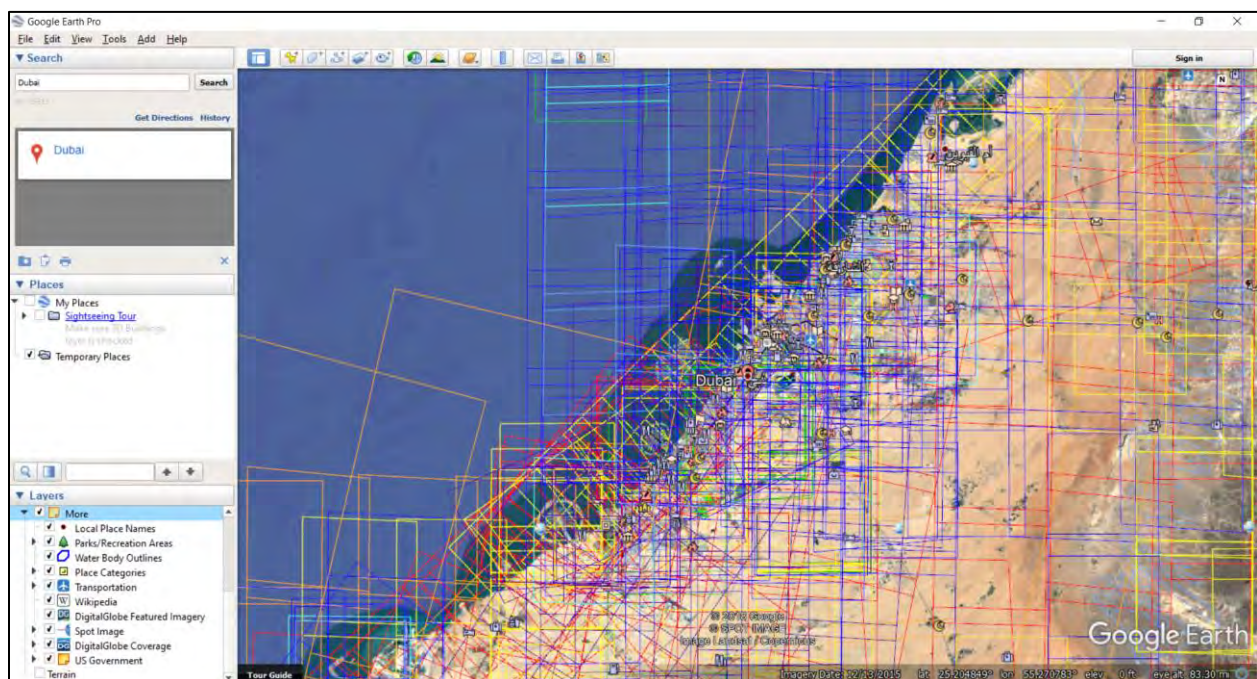
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Go ahead and turn others on and off to familiarize yourself with the data provided. Most of these are self-explanatory.

Satellite Imagery

The messiest layer is *More*-- we will discuss that just a bit. If you click on the > in front of the word *More*, it extends the number of layers. Now you can see why *More* is messiest – it is adding at least 9 more layers. Many of these, again, you can explore on your own and are self-explanatory.

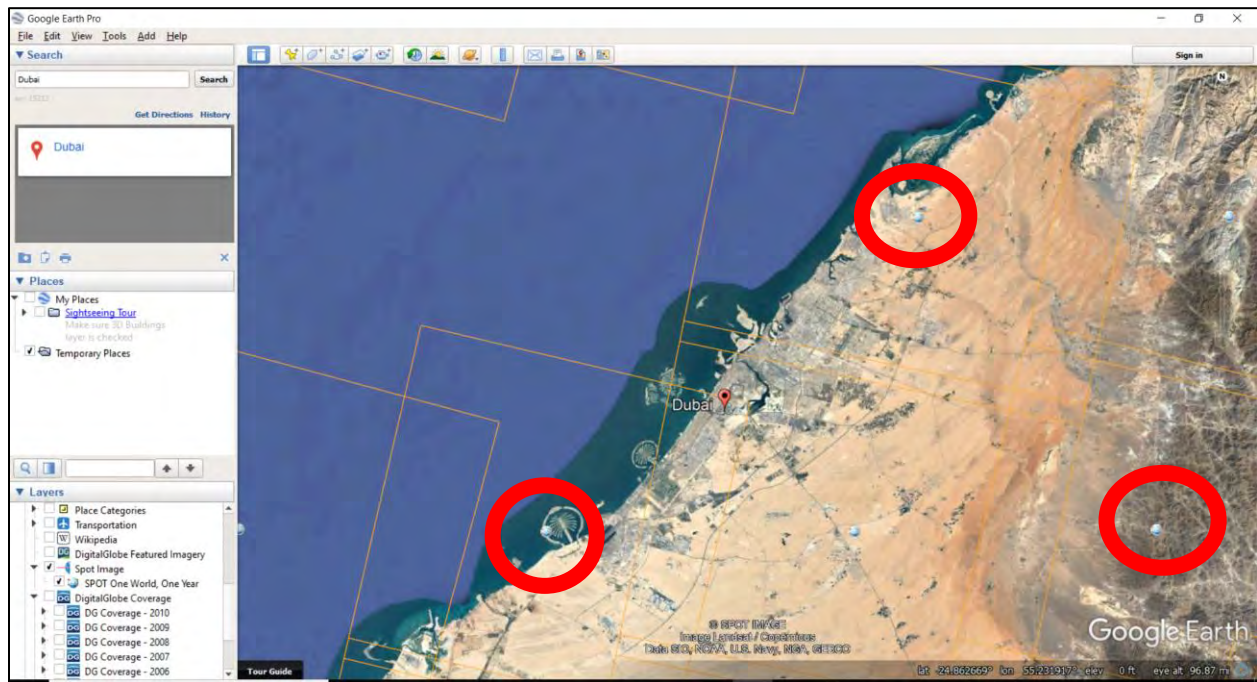


Two of these layers require additional discussion – *Spot Image* and *DigitalGlobe Coverage*. Turn off all but Spot Image. You don't see much, except some lines. Spot is a satellite system and the lines represent the boundary of the satellite scene³ covering the area. Let's take a closer

³ A Spot Scene boundary is the area covered by one Spot Satellite image. For more information on Spot, and Spot One World, One Year go to <http://www.intelligence-airbusds.com/en/143-spot-satellite-imagery> or

Exploring Our Planet with Open Source Software

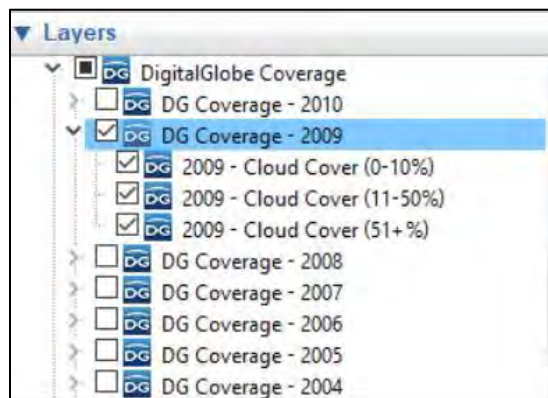
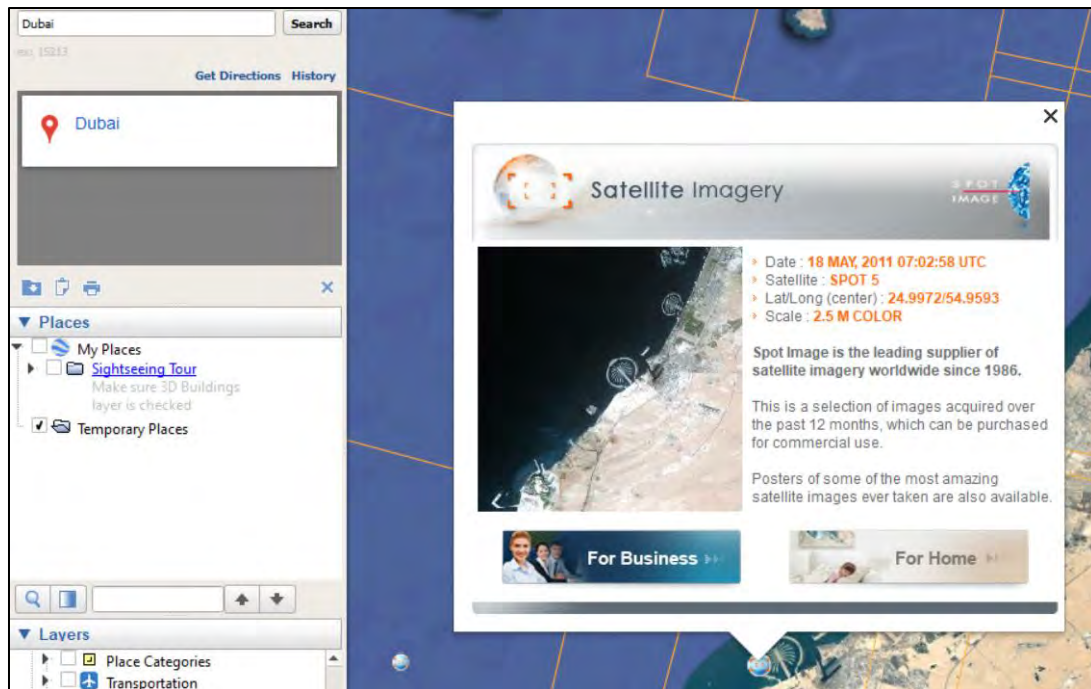
look. Turn off all the layers except *Spot Image*, *Spot One World, One Year*. Zoom out just a little bit so your Map Window looks like the following screenshot (we need to be able to see the boundaries of one Spot scene):



Click on any one of the round circle icons (inside the red circles). This pop-up provides additional metadata for the satellite image contained within the boundaries shown. An image acquired by Spot 5 on 18 MAY, 2011 07:02:58 UTC (Coordinated Universal Time, formerly Greenwich Mean Time).

<https://www.gim-international.com/content/news/spot-image-launches-one-world-one-year-imagery-layer-on-google-earth>

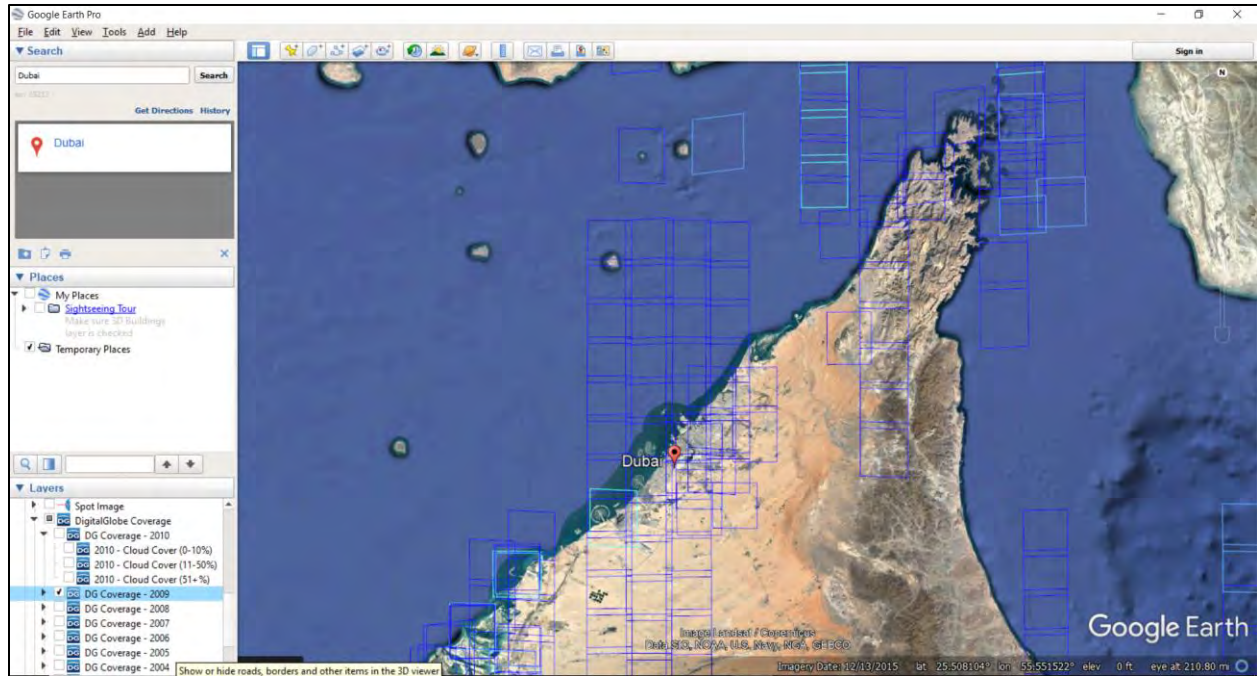
Exploring Our Planet with Open Source Software



Now, turn off *Spot* and turn on *DigitalGlobe*⁴ Coverage. This is the messiest of them all. If you expand the layer, you have multiple years of *DG Coverage*. You can turn these, individually, on and off. In the screenshot on the left, 2009 is turned on 2009 and the layer expanded. You have different levels of cloud cover. The blue boxes are actually the boundaries of the individual scene.

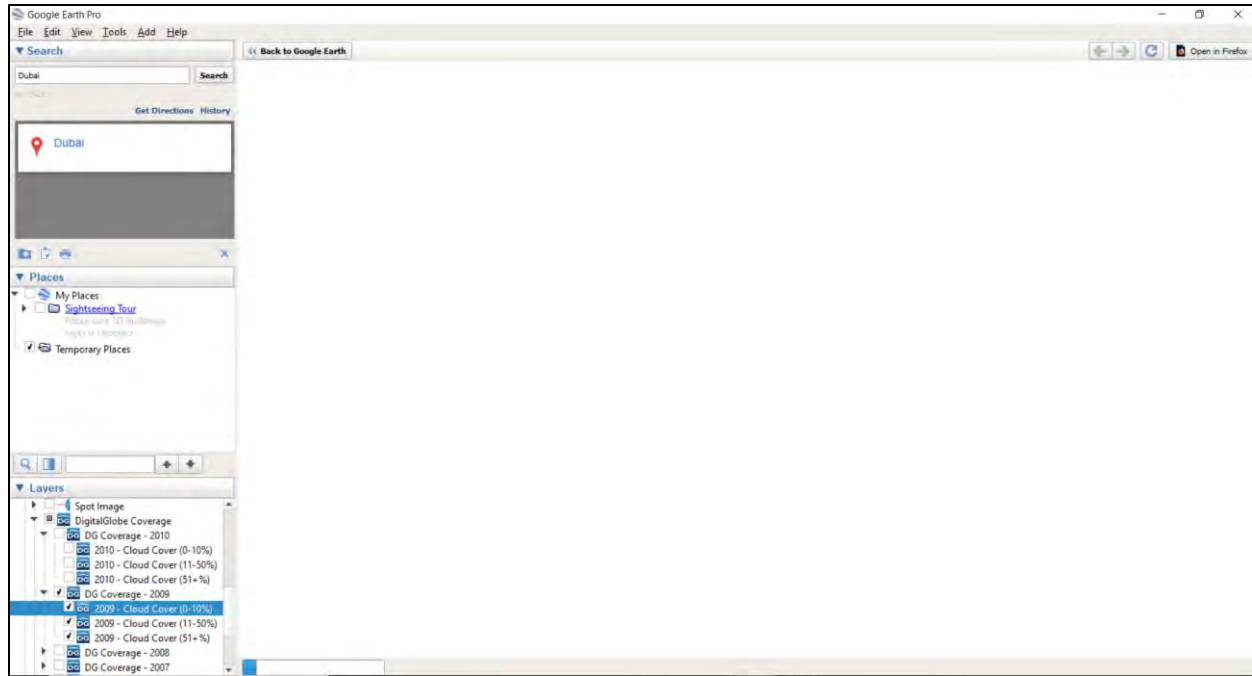
⁴ For more information on DigitalGlobe Satellite systems, go to: <https://www.digitalglobe.com/content>

Exploring Our Planet with Open Source Software

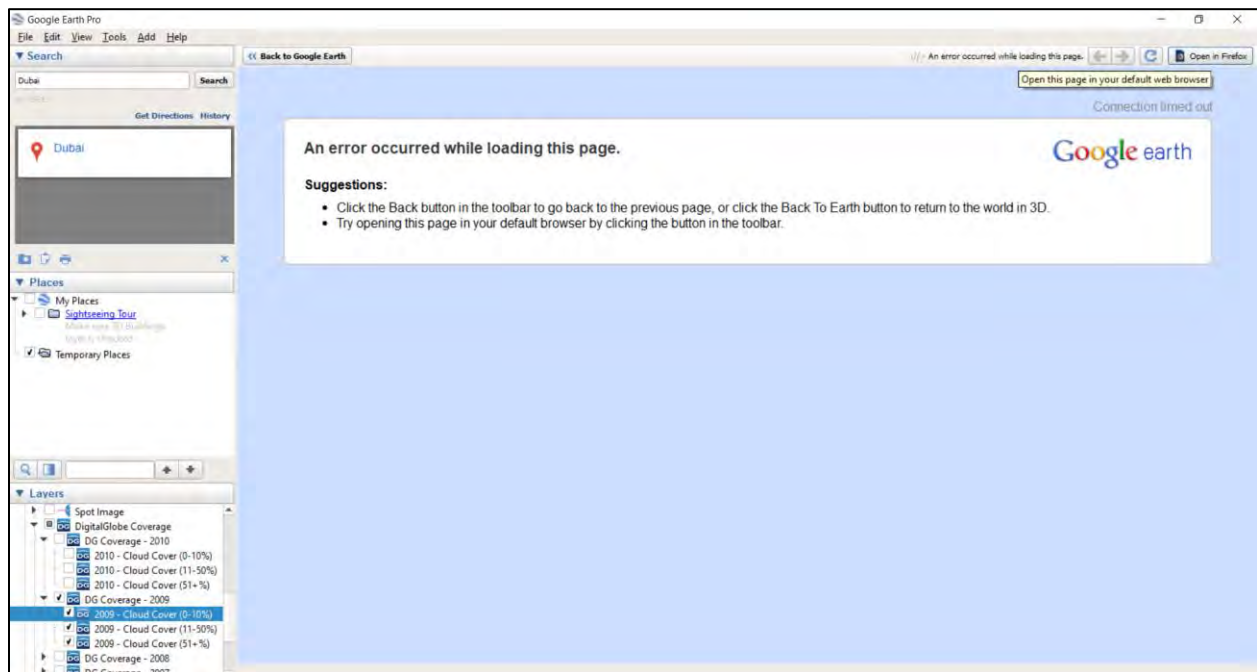


Look at the Map Window-- you see lots of lines and DG in a blue box with a date underneath in red (metadata). The date tells you the date of the Digital Globe Image (again, you may need to zoom in or out to see these). If you click on the blue box – it provides some metadata on the image – including the Digital Globe ID No., the Cloud Cover and Quality data. It also has the word [preview](#). You can click on that word and then you have to be patient while it loads the Digital Globe image. You have to be very patient, it takes time to load.

Exploring Our Planet with Open Source Software



You might also have the page expire, depending on your internet connection. You may need to click on Open in Firefox button in the upper right hand corner.



We are going to end our exploration of the Google Earth Pro provided Table of Contents, here. Again, you can further explore on your own.

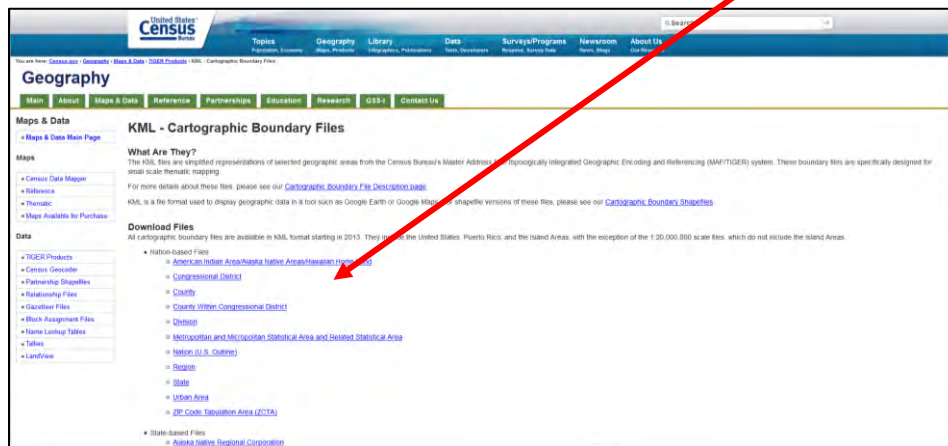
Exploring Our Planet with Open Source Software

3.9 Adding external files to Google Earth Pro

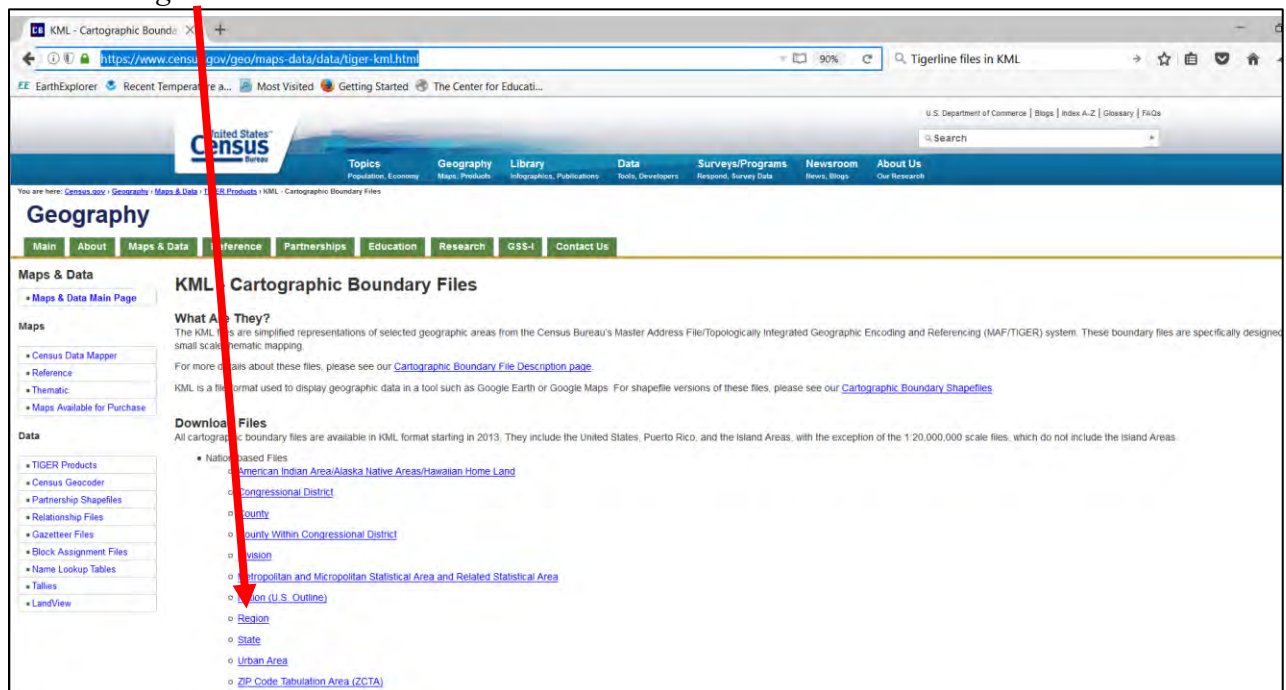
3.9.1 KML Files⁵

First, we need KML files. Go to <https://www.census.gov/geo/maps-data/data/tiger-kml.html> and we can get a KML files for your use. For the YouTube video on finding KML files, go to: <https://youtu.be/8bLweAYxQoM>.

You get this website – the US Census Bureau has files with boundaries at many different scales that you can download.

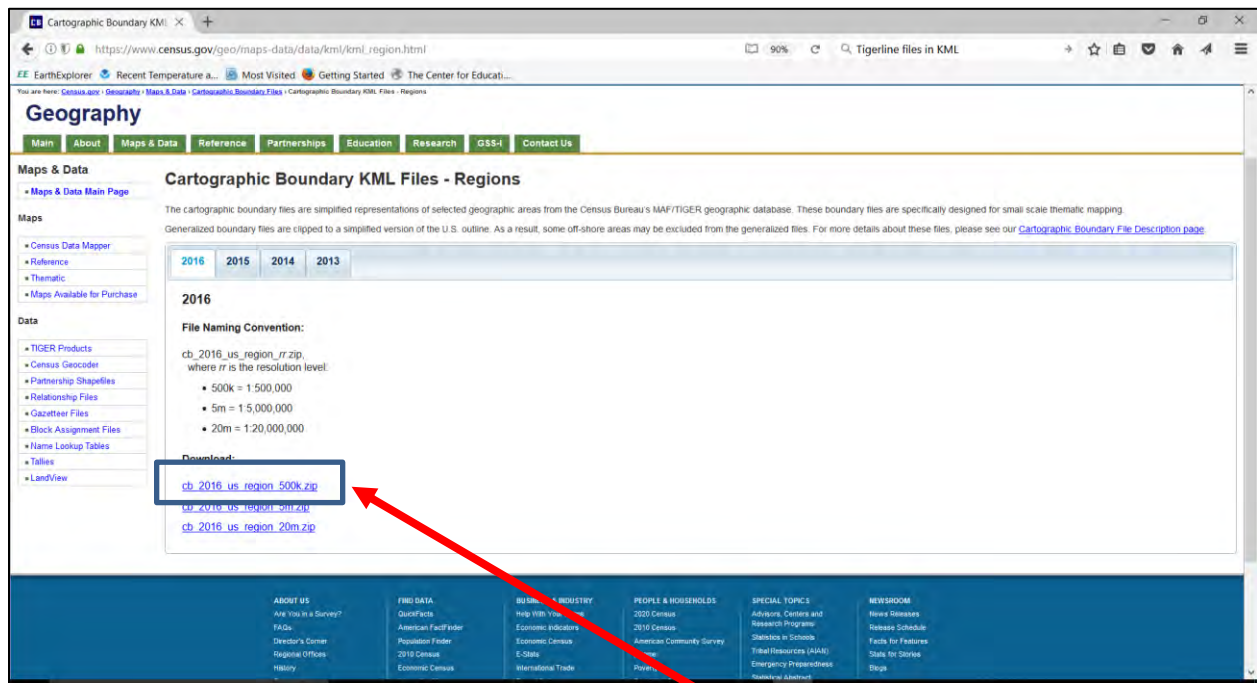


Click on *Region*.



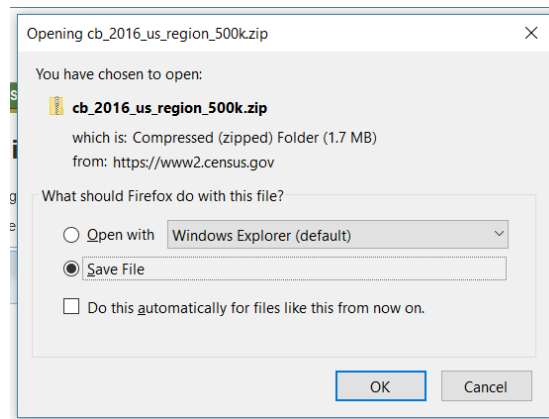
⁵ What is KML? KML stands for *Keyhole Markup Language*, which is a file type supported in Google Earth. See <https://developers.google.com/kml/> for more information.

Exploring Our Planet with Open Source Software




Then, click on `cb_2016_us_region_500K.zip` under **Download**.

You are downloading this file to your computer. You get the following pop-up:



Make sure the *Save File* button is chosen and then click *OK* to download it to your download folder. Once downloaded, go to your download folder and you will see the following zipped file.

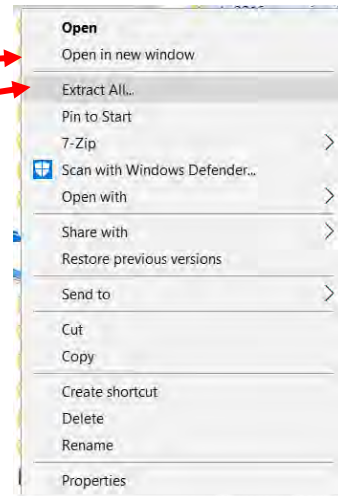
Name	Date modified	Type	Size
 cb_2016_us_region_500k	7/7/2017 4:14 PM	Compressed (zipp...	1,736 KB

Go back to the US Census Bureau KML Cartographic Boundary Files website (the first one) and also download the files for *Nation (US Outline)*, *States*, *Counties* and *Urban Areas*. We can use

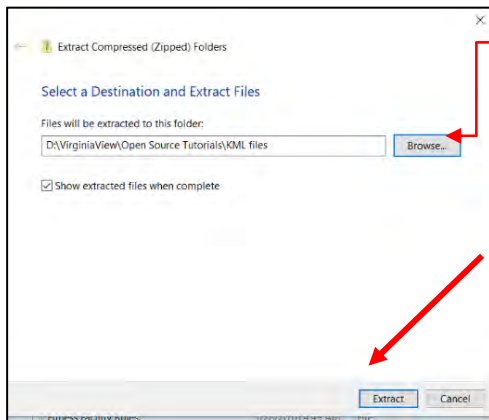
Exploring Our Planet with Open Source Software

all five (or more) in Google Earth Pro. Once all five files are downloaded, proceed in this tutorial about unzipping the files.

Right-click on the file and you will see this window:



Click on *Extract All...*



Use *Browse* to navigate to the folder where you want to unzip the files.

Once you have chosen the correct folder, click on *Extract* at the bottom and the following files will be displayed in your file folder:

A screenshot of a Windows File Explorer window showing the contents of the folder 'D:\VirginiaView\Open Source Tutorials\KML files'. The files are listed in a table with columns for Name, Date modified, Type, and Size. A red arrow points from the text 'the following files will be displayed in your file folder:' to the first row of the table.

Name	Date modified	Type	Size
cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	KML File	5,744 KB
cb_2016_us_region_500k.kml.ea.iso	7/8/2017 12:42 PM	XML File	14 KB
cb_2016_us_region_500k.kml.iso	7/8/2017 12:42 PM	XML File	34 KB
cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	XML File	17 KB

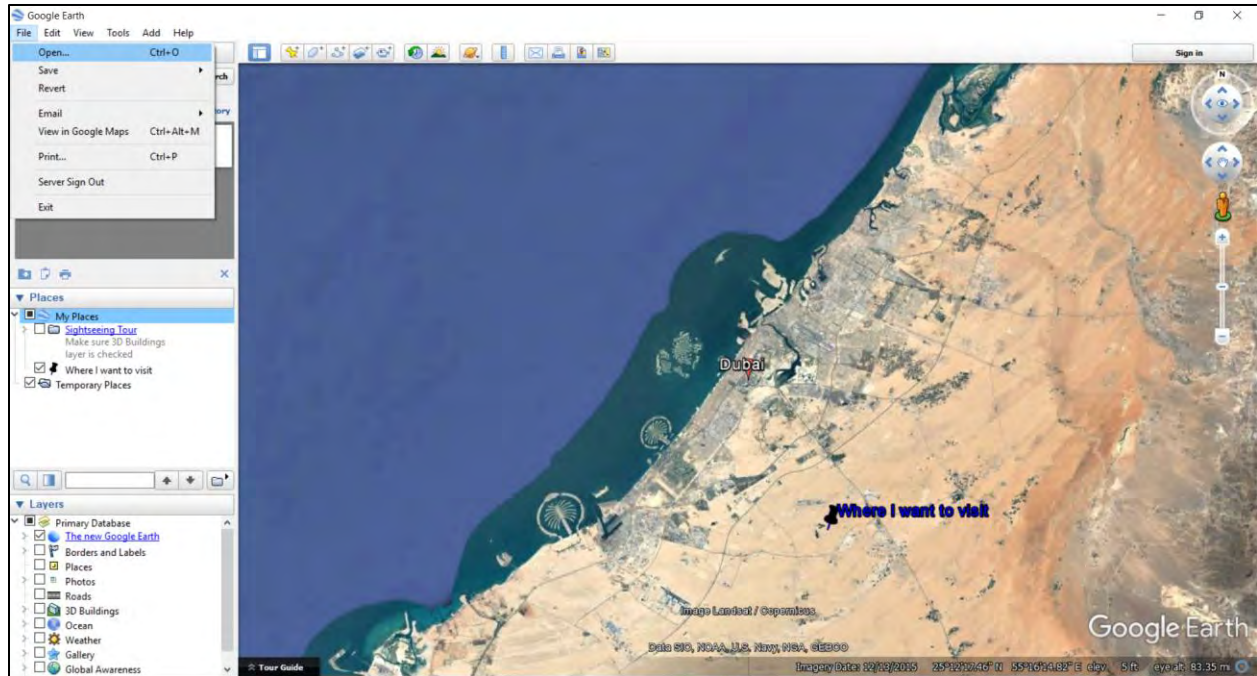
Perform these unzipping operations for all five downloaded files. Your file folder will look like this once all are unzipped:

A screenshot of a Windows File Explorer window showing the contents of the folder 'D:\VirginiaView\Open Source Tutorials\KML files' after all five files have been unzipped. The files are listed in a table with columns for Name, Date modified, Type, and Size.

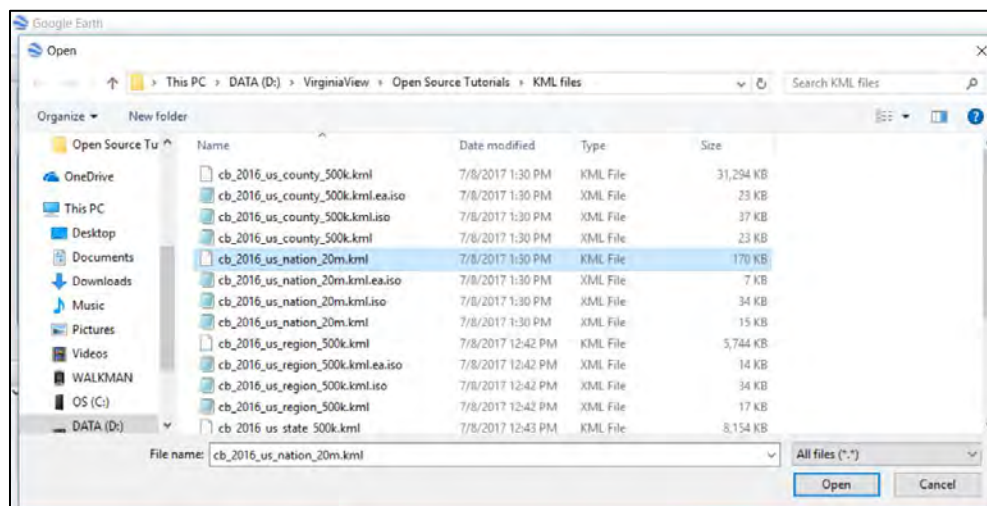
Name	Date modified	Type	Size
cb_2016_us_county_500k.kml	7/8/2017 1:30 PM	KML File	31,294 KB
cb_2016_us_county_500k.kml.ea.iso	7/8/2017 1:30 PM	XML File	23 KB
cb_2016_us_county_500k.kml.iso	7/8/2017 1:30 PM	XML File	37 KB
cb_2016_us_county_500k.kml	7/8/2017 1:30 PM	XML File	23 KB
cb_2016_us_nation_20m.kml	7/8/2017 1:30 PM	KML File	170 KB
cb_2016_us_nation_20m.kml.ea.iso	7/8/2017 1:30 PM	XML File	7 KB
cb_2016_us_nation_20m.kml.iso	7/8/2017 1:30 PM	XML File	34 KB
cb_2016_us_nation_20m.kml	7/8/2017 1:30 PM	XML File	15 KB
cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	KML File	5,744 KB
cb_2016_us_region_500k.kml.ea.iso	7/8/2017 12:42 PM	XML File	14 KB
cb_2016_us_region_500k.kml.iso	7/8/2017 12:42 PM	XML File	34 KB
cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	XML File	17 KB
cb_2016_us_state_500k.kml	7/8/2017 12:43 PM	KML File	8,154 KB
cb_2016_us_state_500k.kml.ea.iso	7/8/2017 12:43 PM	XML File	19 KB
cb_2016_us_state_500k.kml.iso	7/8/2017 12:43 PM	XML File	34 KB
cb_2016_us_state_500k.kml	7/8/2017 12:43 PM	XML File	18 KB
cb_2016_us_ua10_500k.kml	7/8/2017 12:43 PM	KML File	28,530 KB
cb_2016_us_ua10_500k.kml.ea.iso	7/8/2017 12:43 PM	XML File	14 KB
cb_2016_us_ua10_500k.kml.iso	7/8/2017 12:43 PM	XML File	35 KB
cb_2016_us_ua10_500k.kml	7/8/2017 12:43 PM	XML File	18 KB

Now go back to Google Earth and in the tool bar, click on *Open*.

Exploring Our Planet with Open Source Software

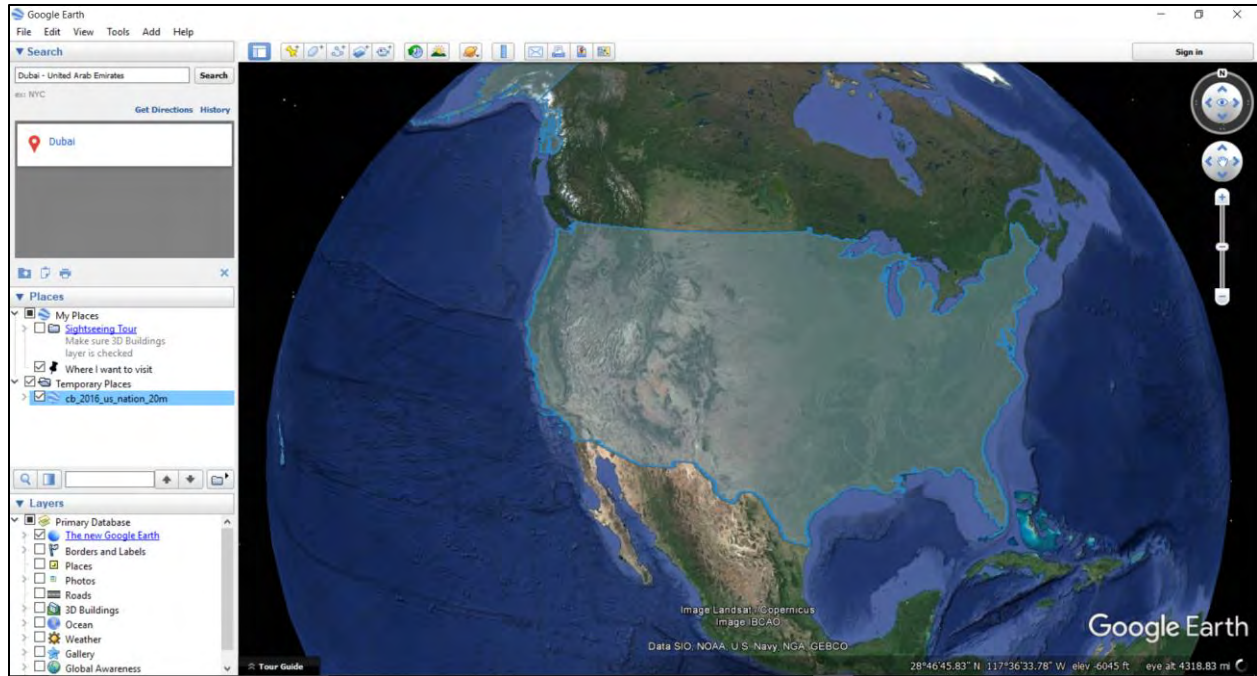


Then navigate to where you saved your unzipped files. We are only going to add one KML file right now, so highlight the one for the US Nation, which is the United States outline. Be sure you have highlighted the file type – KML as see below. Once you have highlighted the correct file, click *Open*.

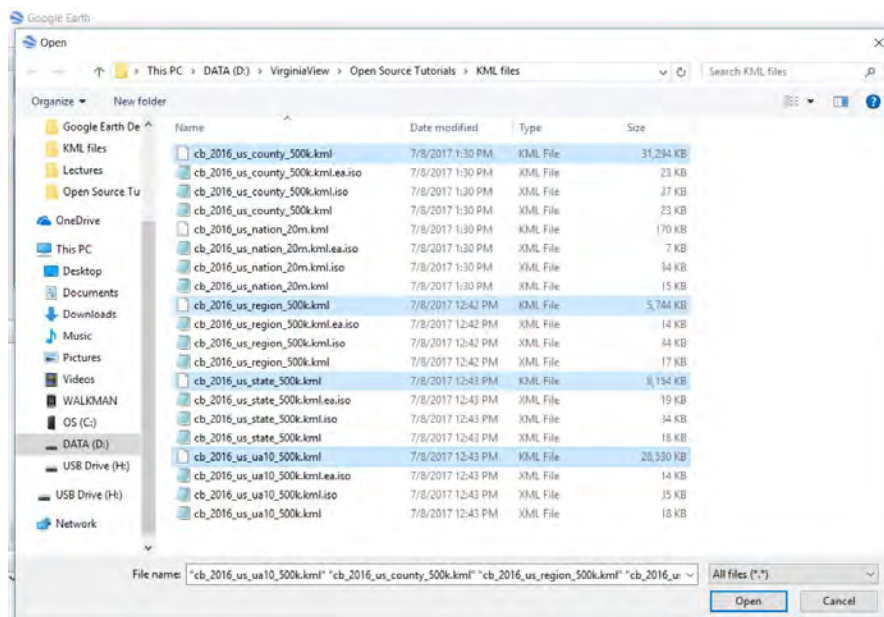


Once you have opened it, it will add to Google Earth in the *Temporary Places* Table of Contents and in the Map Window, zooming to the entire US (not just the continental US – see Hawaii in the west and Puerto Rico in the east?). Be patient, it might take a few seconds.

Exploring Our Planet with Open Source Software

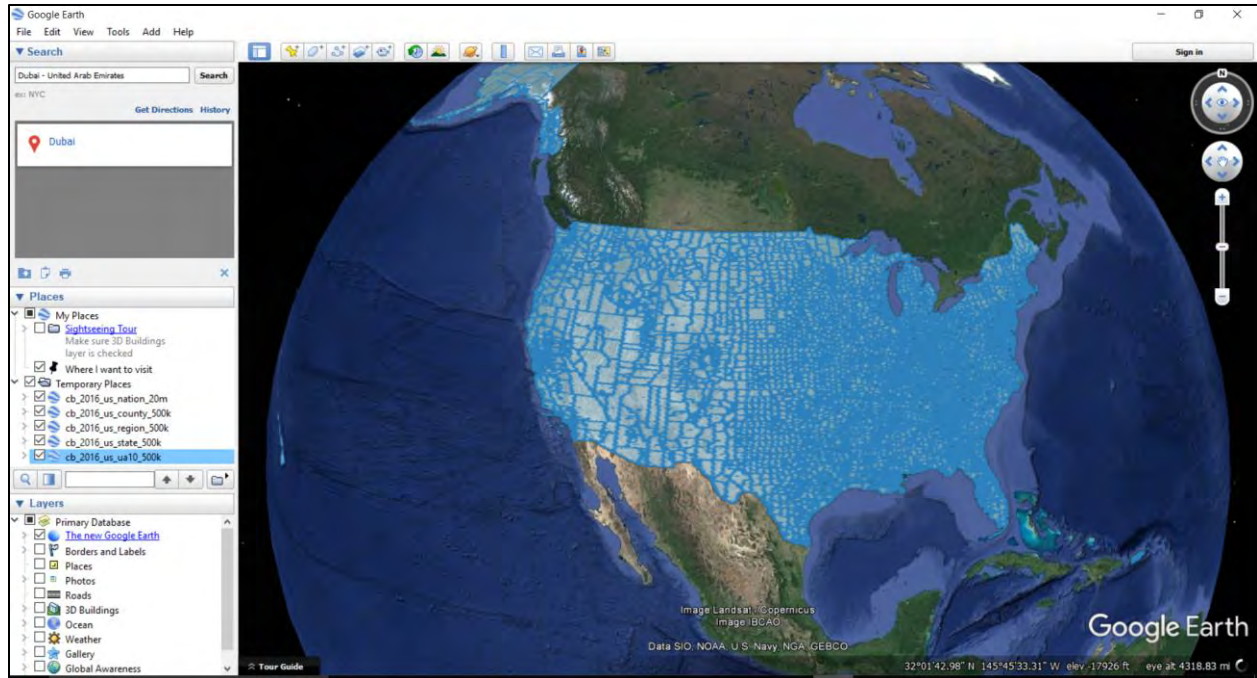


You can add multiple KML files at one time. Go back to *File, Open* and then navigate back to your folder containing your unzipped files. Highlight each of the other KML files (just the KML type) but holding down *ctrl* on your keyboard and click on each one to highlight, then click *Open*.



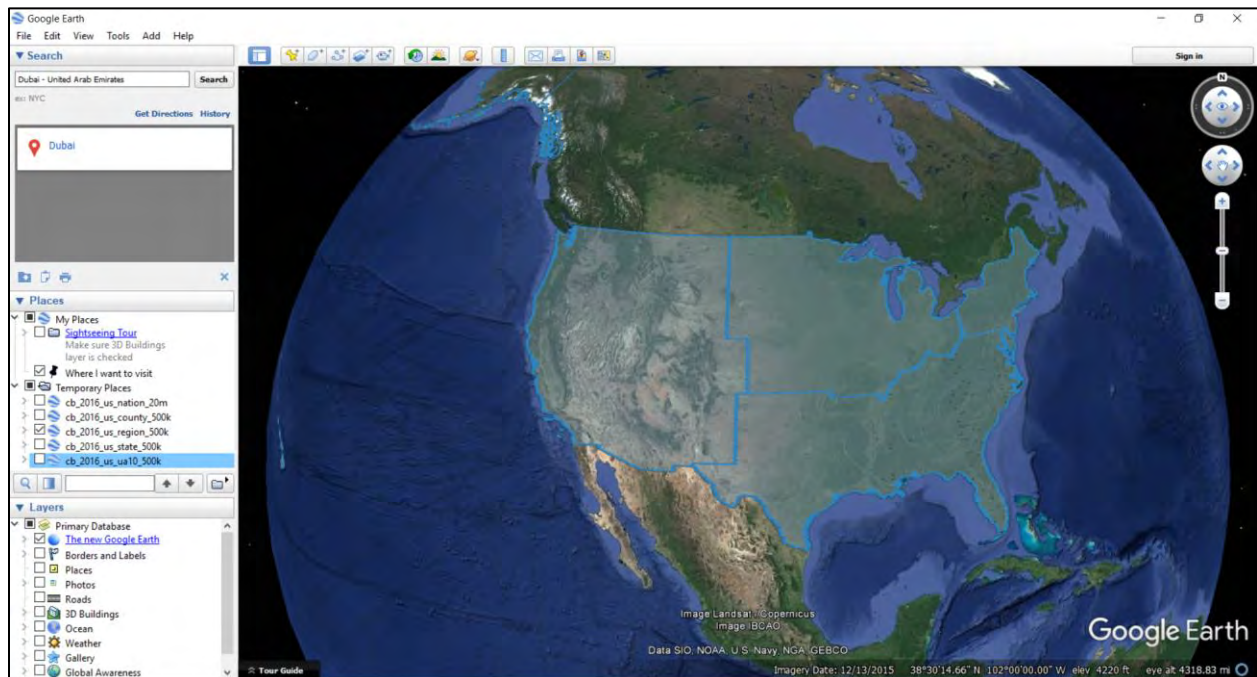
All the KML files are now added. You can see them listed in your *Temporary Places*.

Exploring Our Planet with Open Source Software



You cannot see all of them, but you can turn them on and off by unchecking or checking the box next to the layer name, just as we did under the Google Earth Table of Contents below.

You can also change the symbology for each of your layers. Turn off all the layers except the *US Regions*. The US is divided by the Census Bureau into 4 regions – West, Northeast, Midwest and South. You can see them displayed in the Map Window -- How do I know the names?



Exploring Our Planet with Open Source Software

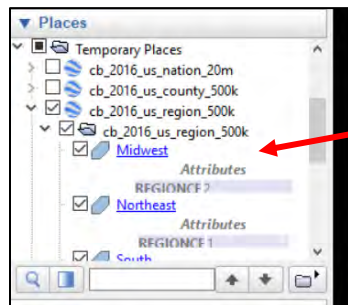
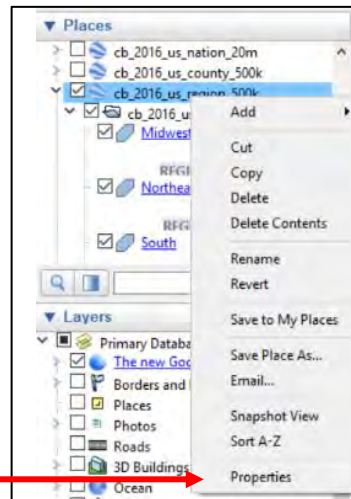
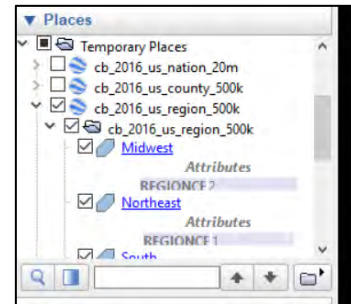
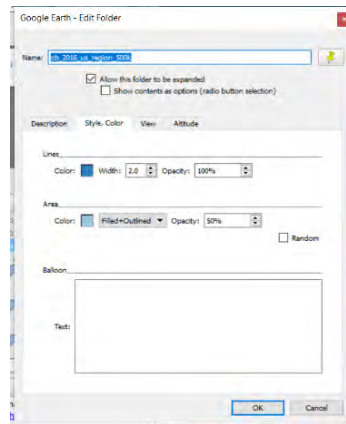
Now click on > in front of the name 'cb_2016_us_region_500k', just like you did with the layers under the Google Earth Table of Contents.

It expanded the layer to show the individual features. You can change the symbology for all the features so they are the same or change the symbology for each individual one.

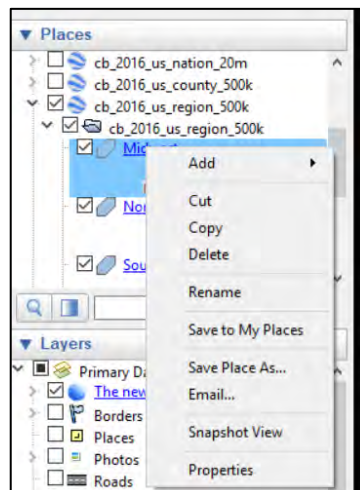
To change the symbology so it is the same for all of features, right-click on the name 'cb_2016_us_region_500k' and then click on *Properties*.

You get the dialog box like we have seen before, except it is titled *Edit Folder*. Click on *Style, Color* and you can change the symbology here, but it will be the same for all 4 regions.

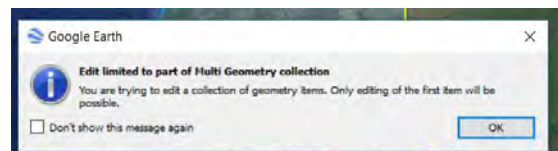
So let's do them individually.



First, be sure that the features are expanded so you can see each one of the regions listed.

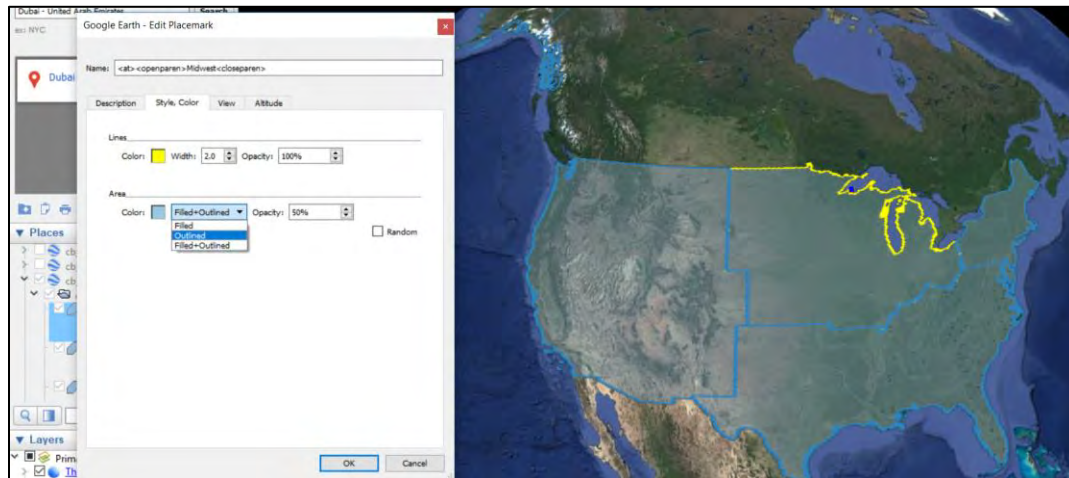


The right click on any Midwest and click on *Properties*, you will get a warning message, just click OK.



Go to *Style, Color* and change the *Line* color to yellow (click on the blue box to get a color palette) and then under area, click on the drop down menu and click *Outlined* (we don't want a fill color, just the outline). Click *OK*.

Exploring Our Planet with Open Source Software



The Midwest region will look like this:

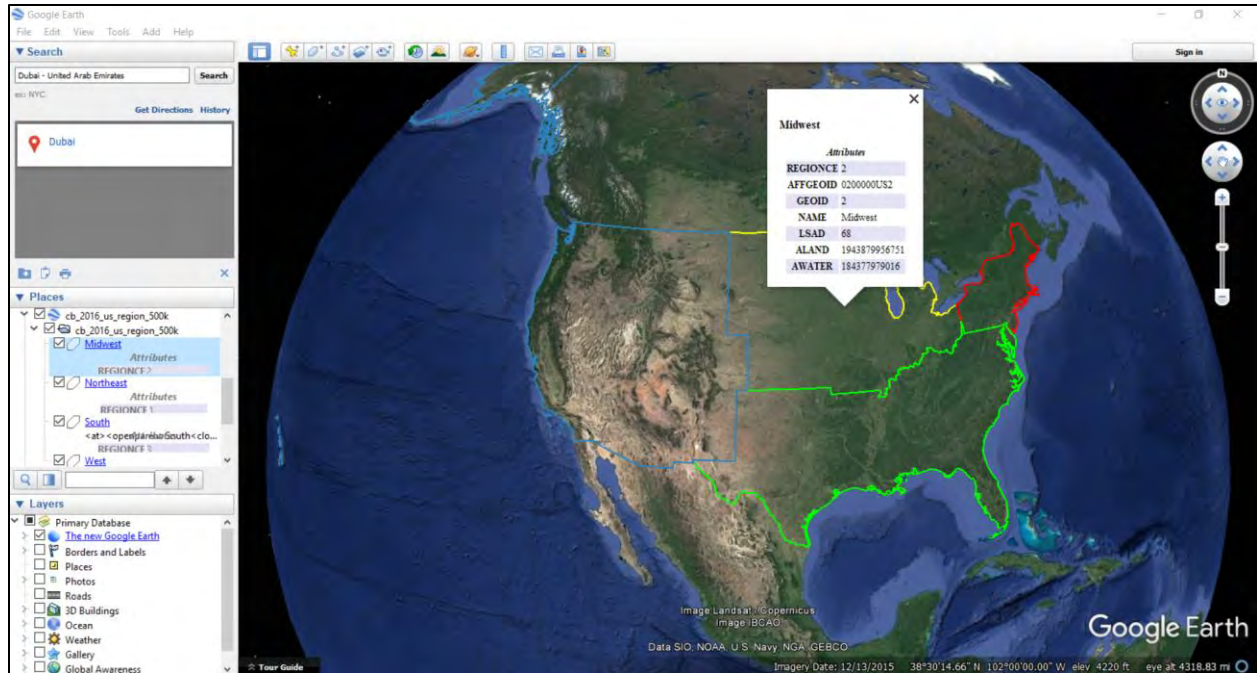


Now go back and do the other 3 regions, so your final map looks like this:



One other item to show you and we will go back to the other layers. These layers have metadata. To access the metadata, left-click on any of the feature names and the metadata window opens. Click on Midwest and information shows as follows. The Region CE, AFFGEOID, GEOID, NAME, LSAD are designated by the Federal Government. The other two ALAND and AWATER are the total area of land and water in the region.

Exploring Our Planet with Open Source Software

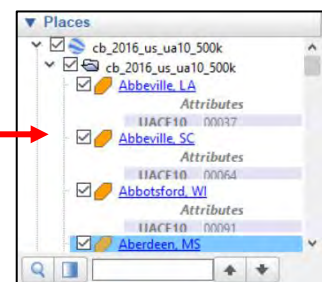


Go back and turn off the Region layer and turn on States and Urban Area (UA) layers and make your Map Window, look like this:



One more thing to show you. Expand the layer for Urban Areas. It should look like this:

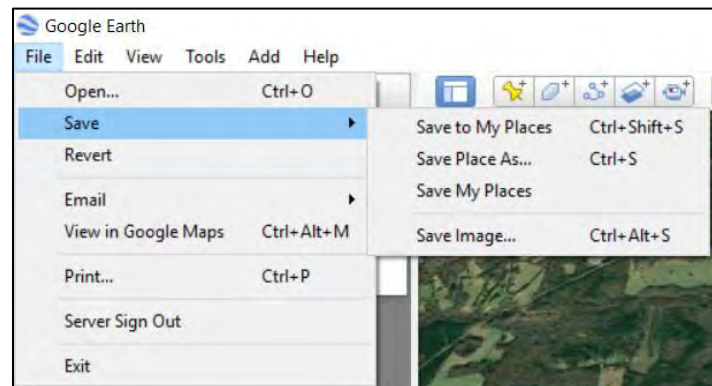
They are in alphabetical order. There are thousands of features. Left-double-click on Aberdeen MS, it will zoom to Aberdeen and also give you the attributes (metadata) for that urban area. Yes, you could change the individual symbology, but it would take a very long time.



Exploring Our Planet with Open Source Software



You can save your maps, just like you did with adding a placemark. Go to *File, Save* and then choose what you want to save:



Before proceeding to the next section, turn off all of your layers in *Temporary Places* and *My Places*.

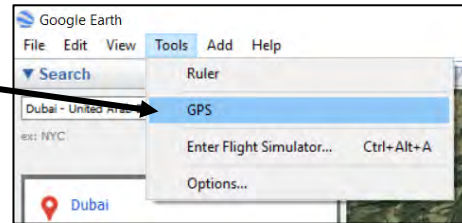
3.9.2 Adding Data from a GPS Unit

For the YouTube video related to this section, go to: <https://youtu.be/x6Ijzbi0iIo>.

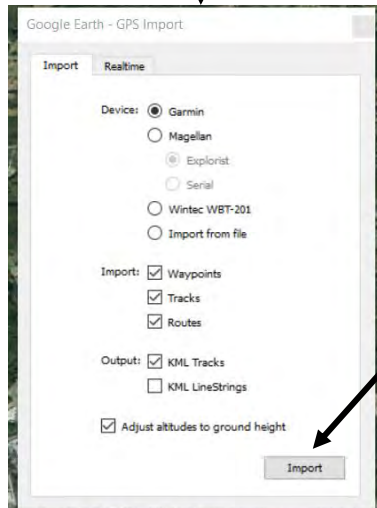
If you have a GPS receiver with a USB cord, you can download data directly from that unit into Google Earth Pro. Your GPS receiver must be turned off before you plug the USB cord into the computer. When you plug it in, your computer will turn it on (you do not need a specific program on your computer to load into Google Earth, just follow these steps).

Exploring Our Planet with Open Source Software

Go to *Tools, GPS*



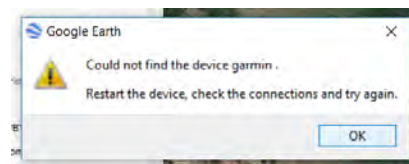
You get this window.



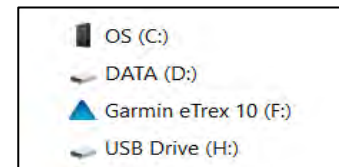
Choose the appropriate receiver, in our case it is Garmin.

Then click *Import*.

If you get this message:

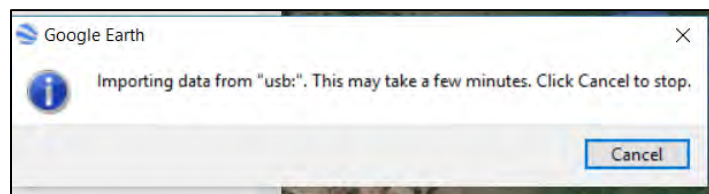


Look at the GPS receiver and make sure it is on and that it shows as an external drive on your computer. If it is not showing, give your computer a minute to recognize it.

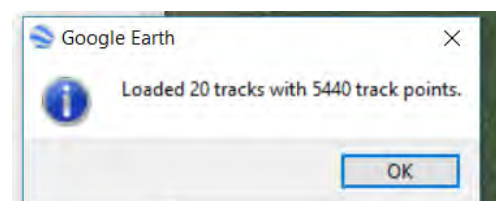


Then try *Import* again. If you are still having problems, contact your IT Department.

But when Google Earth finds your GPS received, which in most cases, only takes a minute or less, you will see this message:

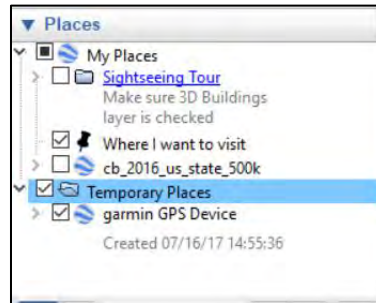


Once the data from your GPS receiver is loaded into Google Earth, you will get this message and Google Earth will zoom to the location of your data. Of course, the number of tracks and track points will vary depending on what you collected on the GPS received. It is highly recommended that you make sure that your GPS has any old information deleted before adding new information.

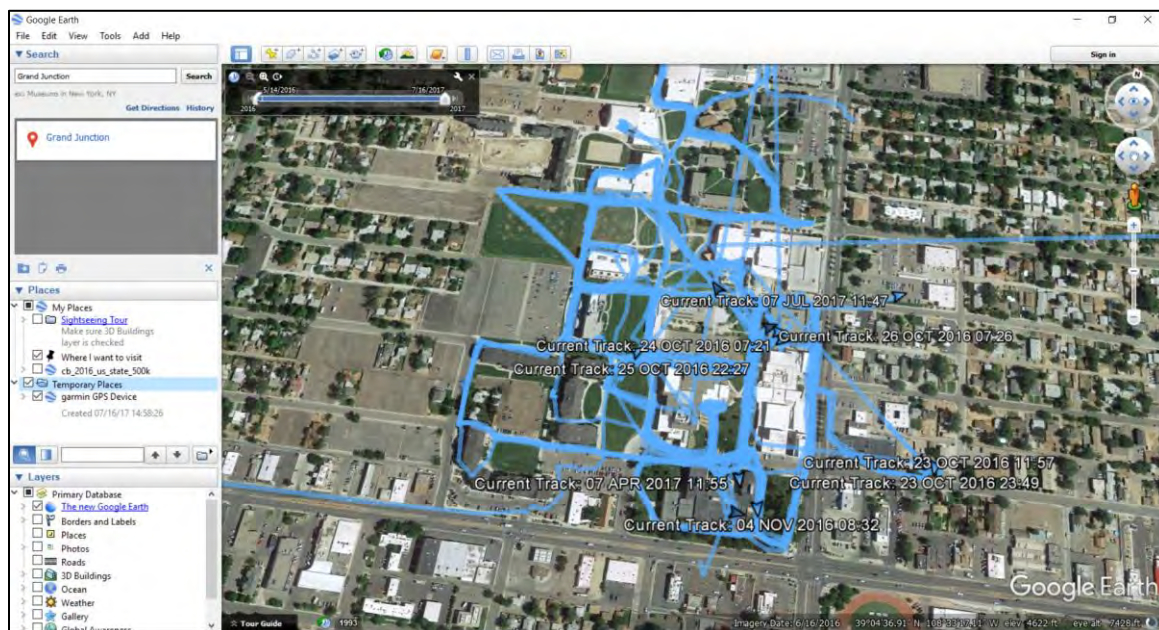


Exploring Our Planet with Open Source Software

Your GPS receiver will also show in your Table of Contents, under *Temporary Places*.

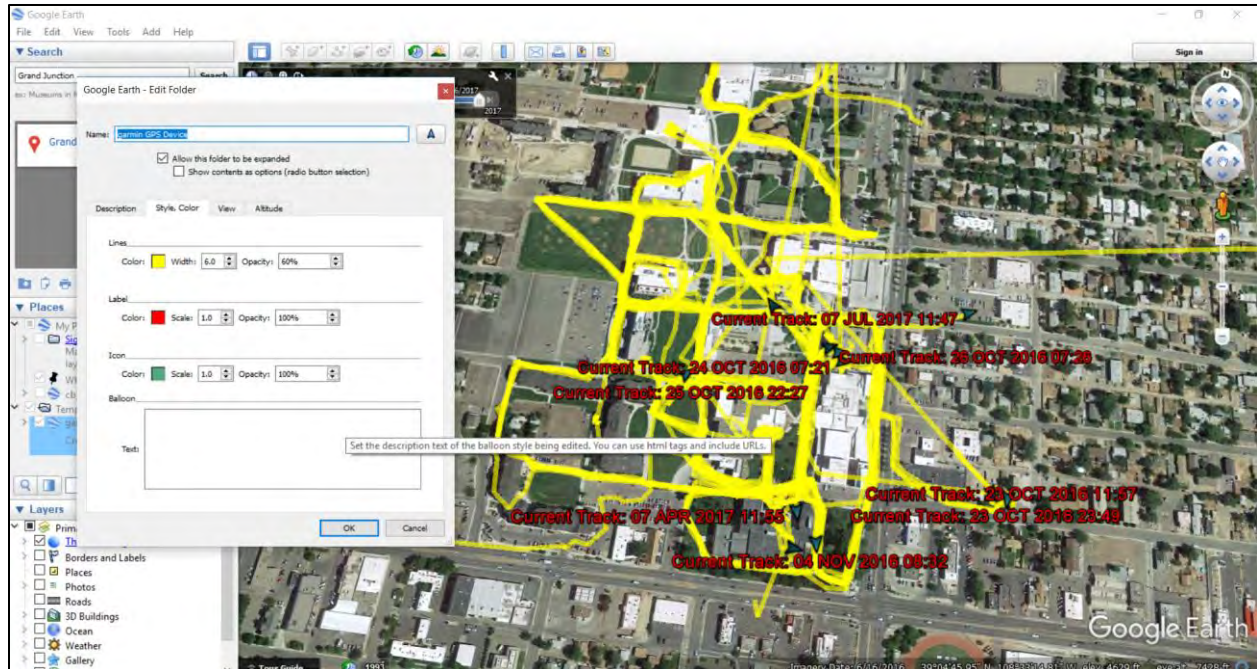


And the tracks and points will show in the Map Window. The display includes the date of acquisition for data.



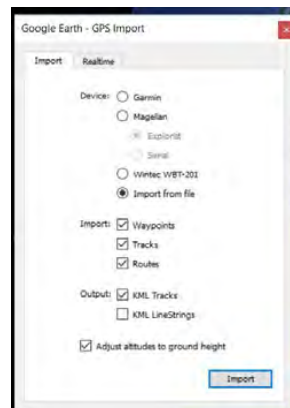
You can change symbology, just like you have done with other layers-- the only difference is that you are now working with 3 themes – track, points and labels:

Exploring Our Planet with Open Source Software



You can also save, just as we have described under previous sections.

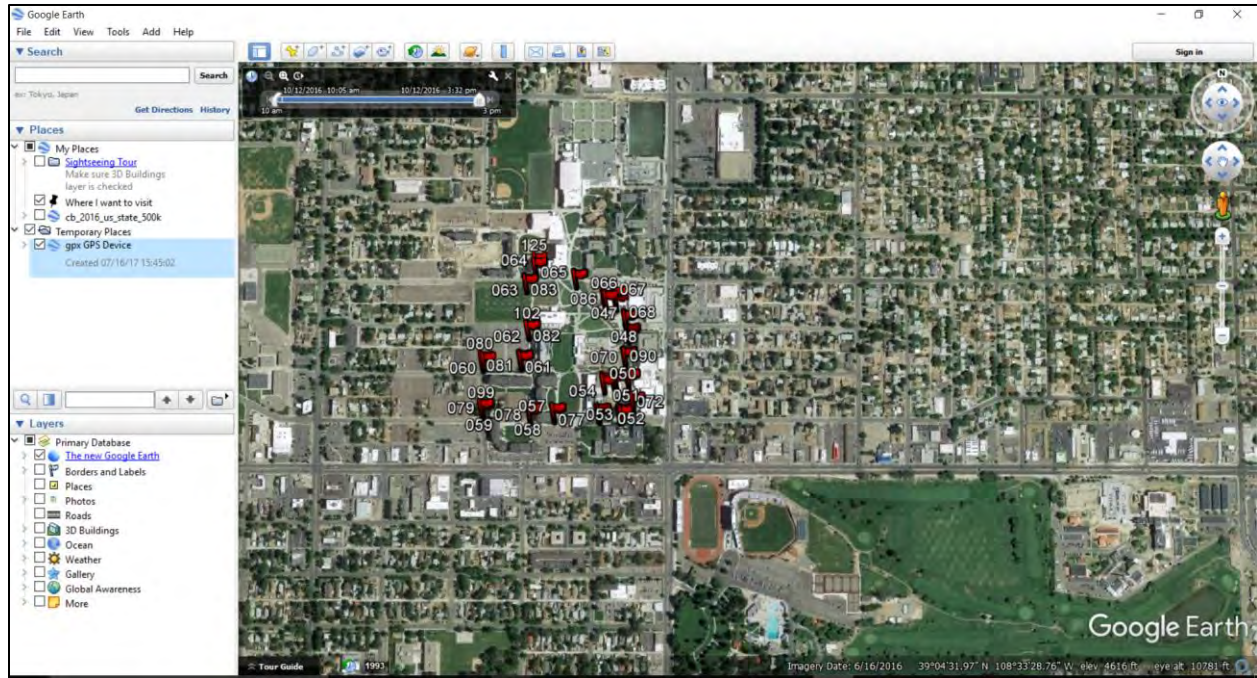
So, if you already have GPS data saved to your computer, you don't need to go find the received data and hope the data is still there. You just *Import from file*:



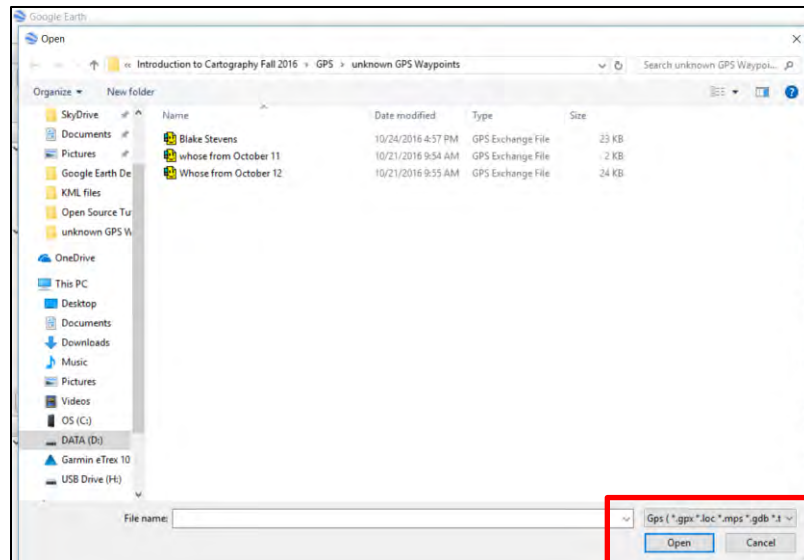
which will allow you to navigate to the file folder on your computer where you saved the GPS data (in all likelihood, it was saved as a GPS Exchange file (GPX)).

 whose from October 11	10/21/2016 9:54 AM	GPS Exchange File	2 KB
 Whose from October 12	10/21/2016 9:55 AM	GPS Exchange File	24 KB

Exploring Our Planet with Open Source Software



You can also add saved GPX files by going to *File, Open* and navigating to the file folder where you have the files. The only difference is that you have to change file type in the bottom of the *Open* window (red rectangle below) so Google Earth knows to look for a file type other than KML.



Again, you can save it just like we discussed previously.

Exploring Our Planet with Open Source Software

3.9.3 GIS Vector Shapefiles

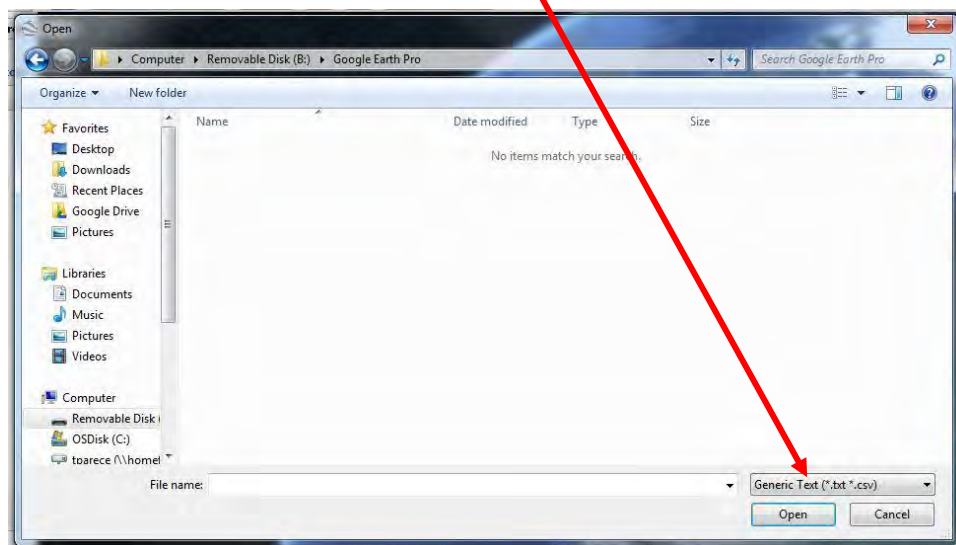
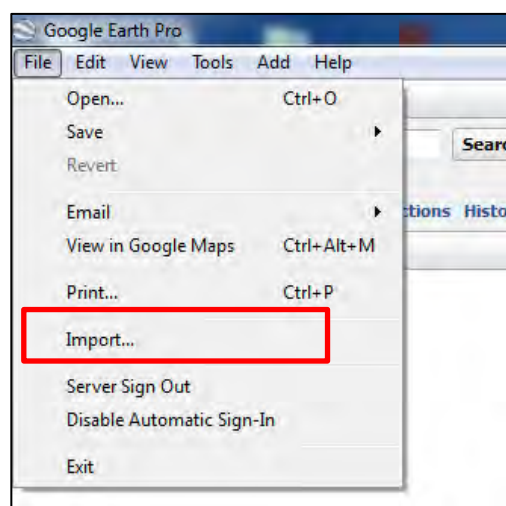
One of the features available in Google Earth Pro is the ability to import standard GIS files – raster (or grid) files and shapefiles. If you don't have access to a raster or shapefile, go to <https://www.google.com/earth/outreach/learn/importing-geographic-information-systems-gis-data-in-google-earth/>. This site contains a link to two sample files – *Rivers in Southeast Asia* and *Land Cover in Southeast Asia* that you can download and use.⁶

For the YouTube video related to finding GIS Shapefiles to use, go to: <https://youtu.be/gH20ARsLixA>.

Adding a Shapefile

Go to File > *Import* ...

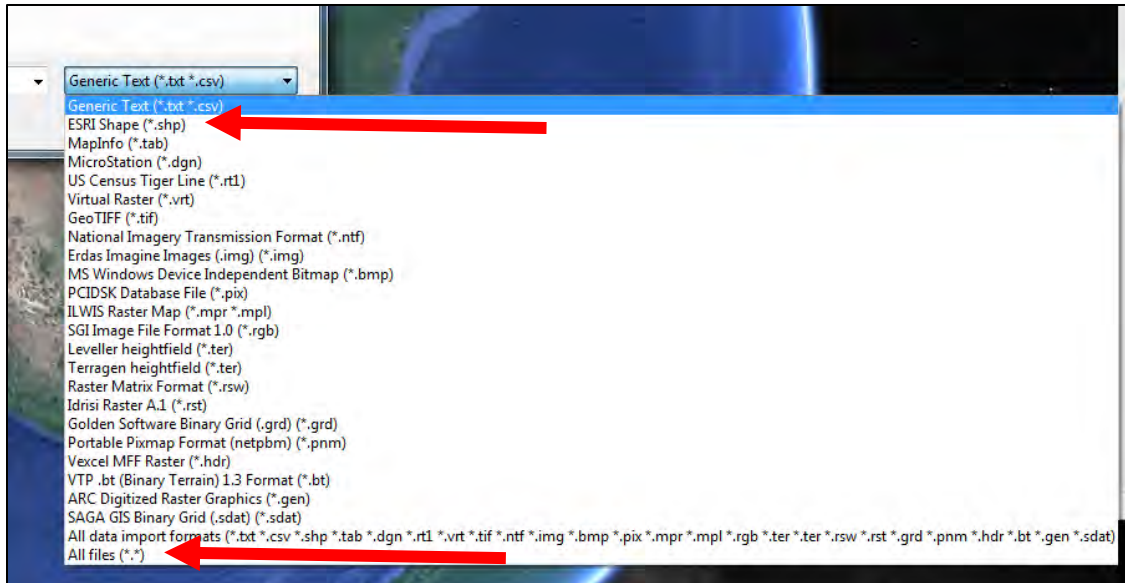
Navigate to the folder where you have unzipped the files. You may not initially see them, so you will need to change the file type.



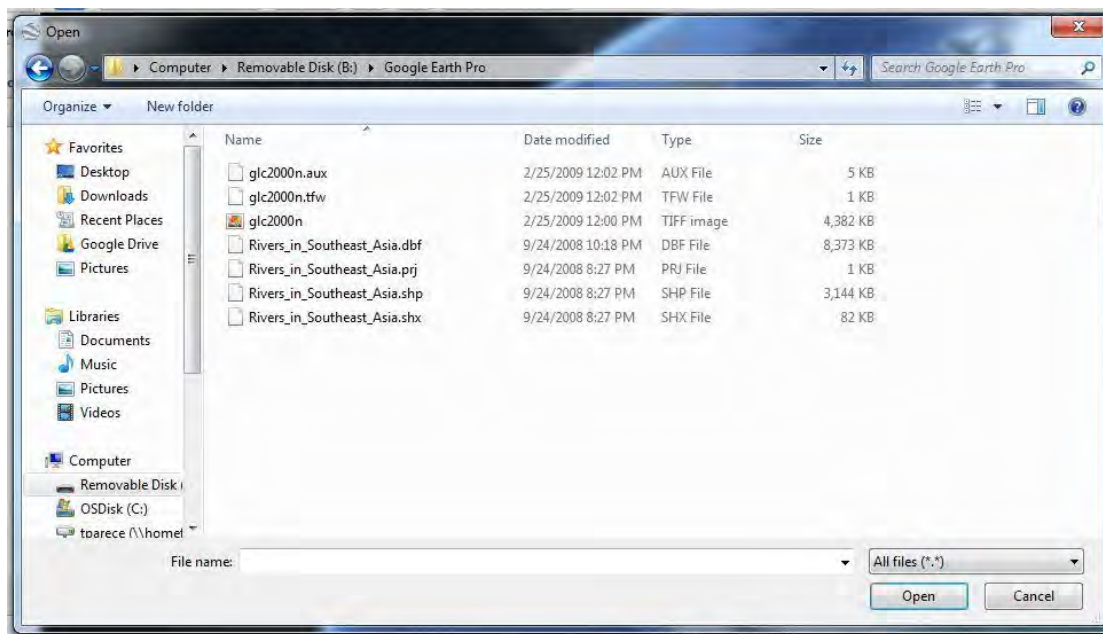
You can identify an *ESRI shapefile* or just choose *All* (see next screenshot).

⁶ If you would rather use shapefiles for US locations, you can access them from the US Census Bureau at their ftp site: <ftp://ftp2.census.gov/geo/tiger/TIGER2016/>. Most of the shapefile names are self-explanatory, but if you need clarification, click on up to higher level directory.

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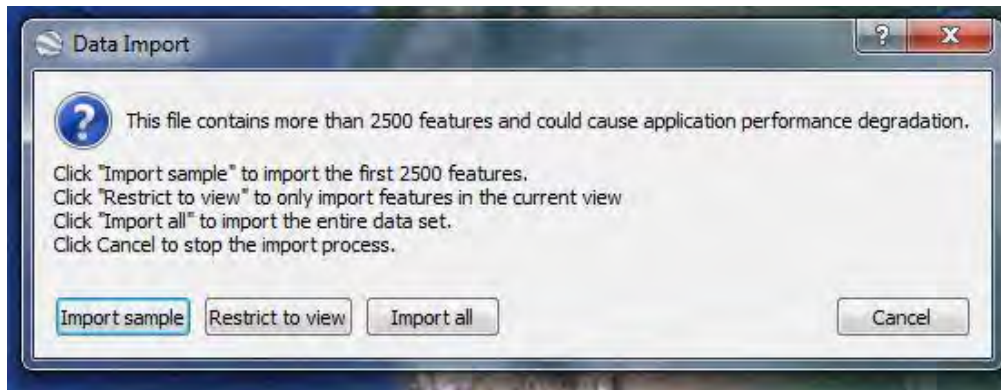
If you choose *All*, you will see the following in your Window:



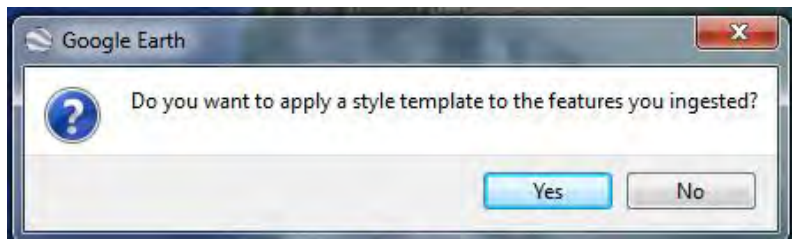
We are going to start with *Rivers in Southeast Asia*, so add all the files – do it all at one time but clicking on the first file (.dbf) and then hold shift and click on the last file .shx). Click on *Open*.

You will get the following dialog box. We will explore each option. Start with *Import Sample*. (Why do a sample? If you have a large number of features, this likely would be better for viewing purposes. Additionally, if you have a large number of features, we can use *Regionate*, which is discussed later in this tutorial).

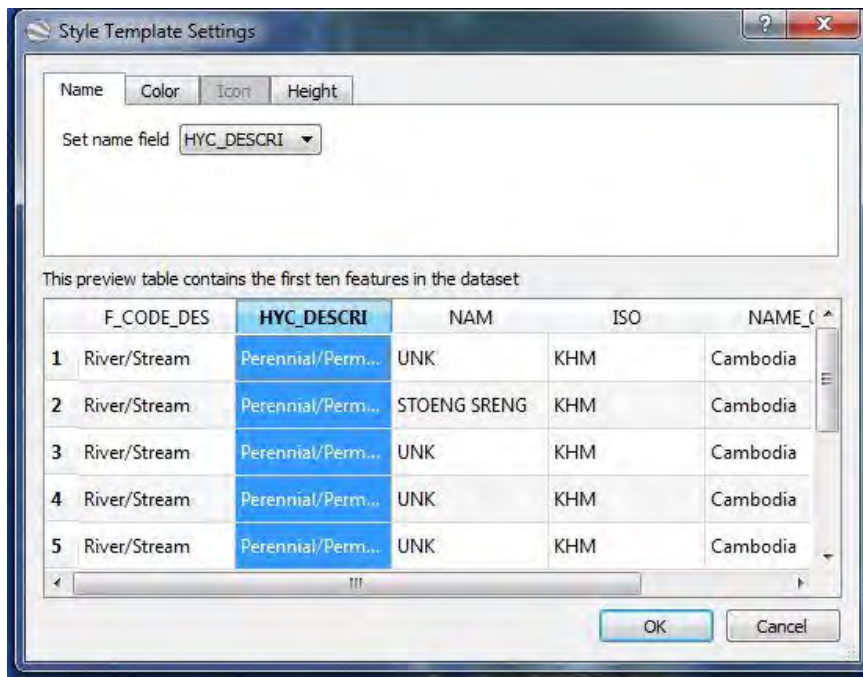
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You will get the next message. Click on *Yes*. This allows us to set symbology. For the YouTube video on Using GIS Shapefiles with a Style Template, go to: <https://youtu.be/wG0WyxqielY>. We also have a video on Using GIS Shapefiles without a Style Template: <https://youtu.be/4GXWB3JDMxA>.

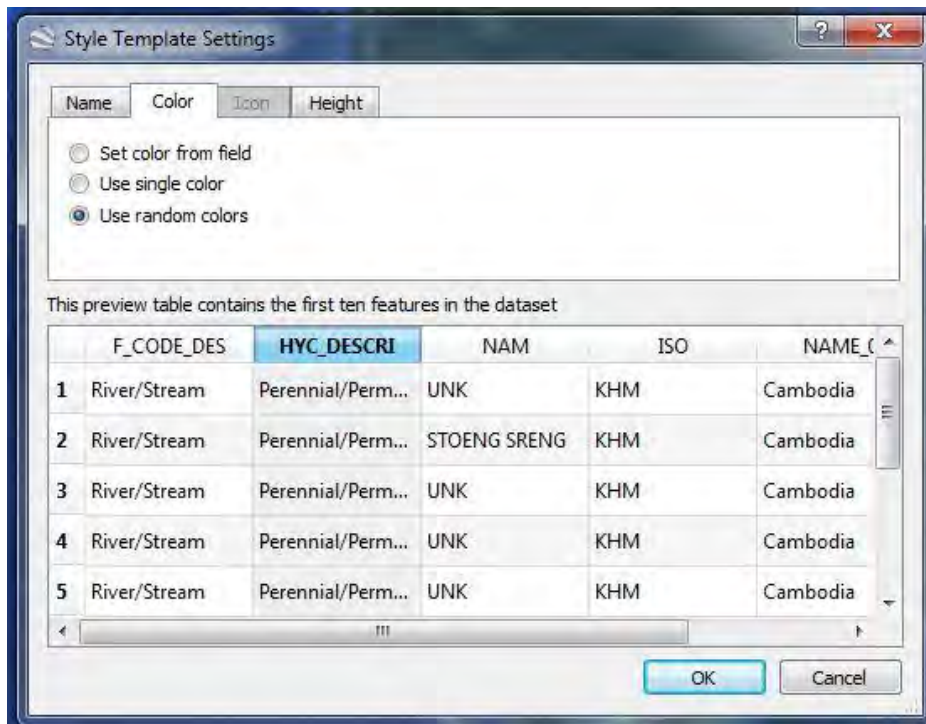


You now get the following dialog box.

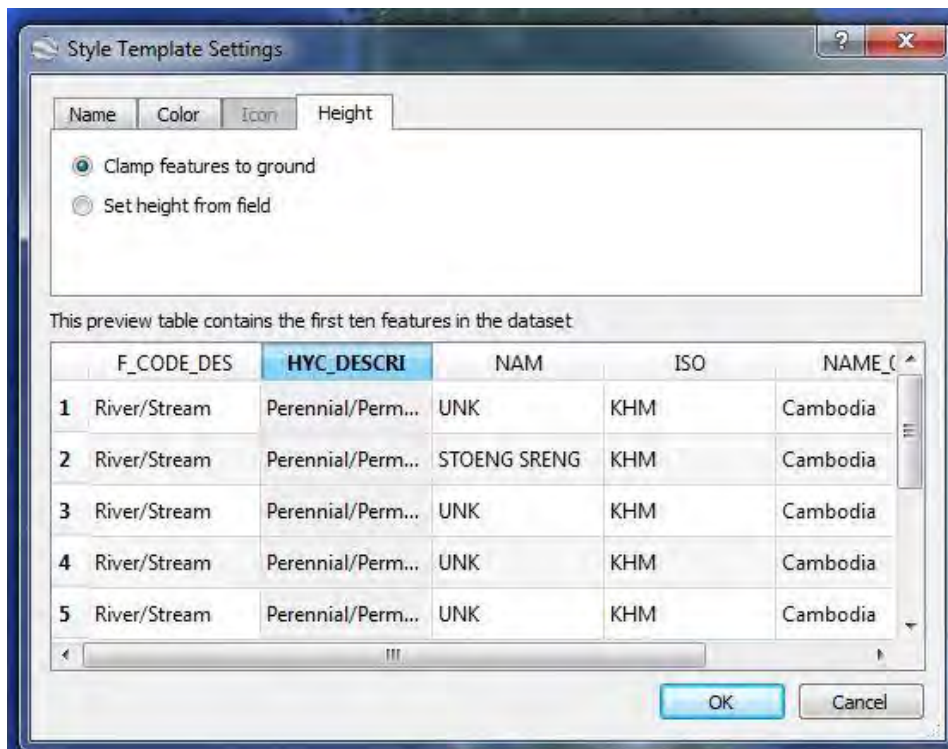


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You can click on a field in the table or choose it from the drop down menu – *Set name field*. This will set the field that will show in the Table of Contents. Next click on *Color*. For now, choose *Use random colors*. This will assign a different color to each feature.

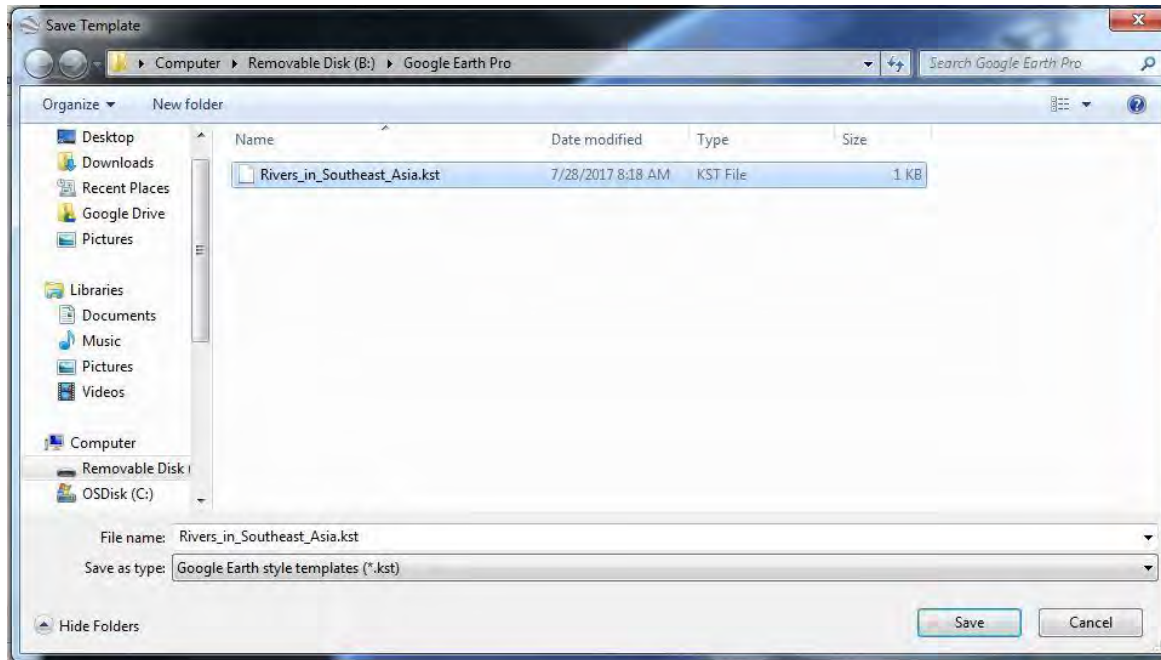


Under *Height*, leave the default – *Clamp features to the ground*.

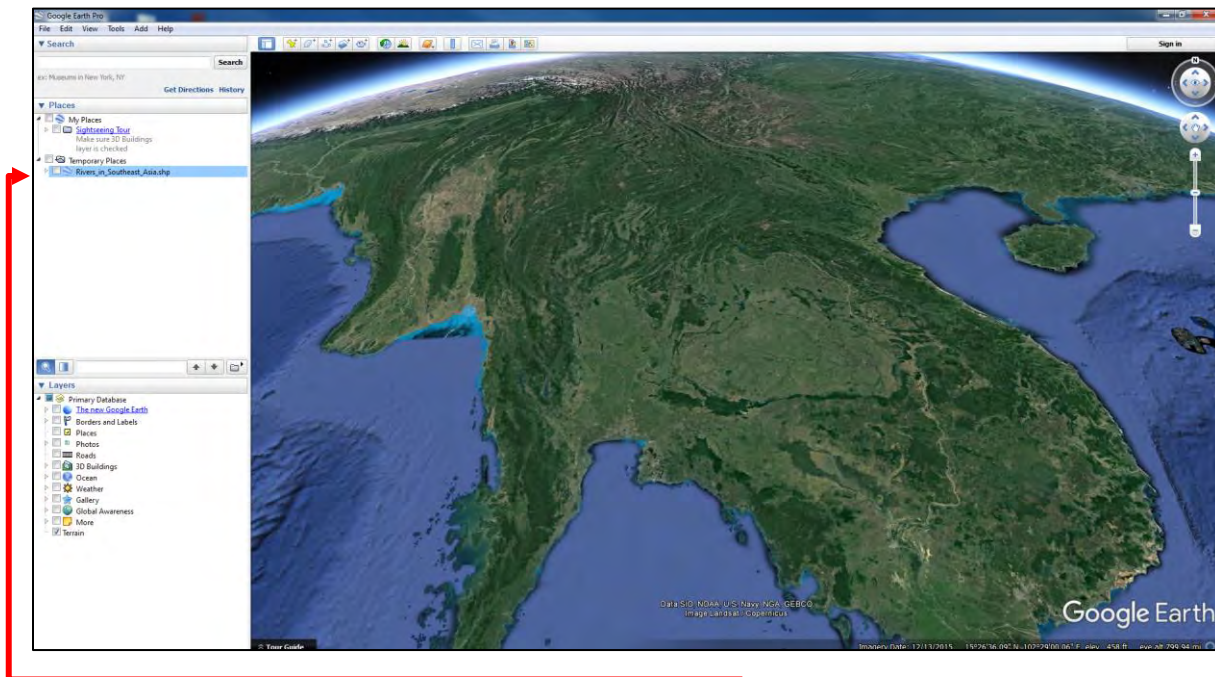


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Then click *OK*. You will get a window to save your *Style template*. Save it because you may want to use the same symbology on another occasion.

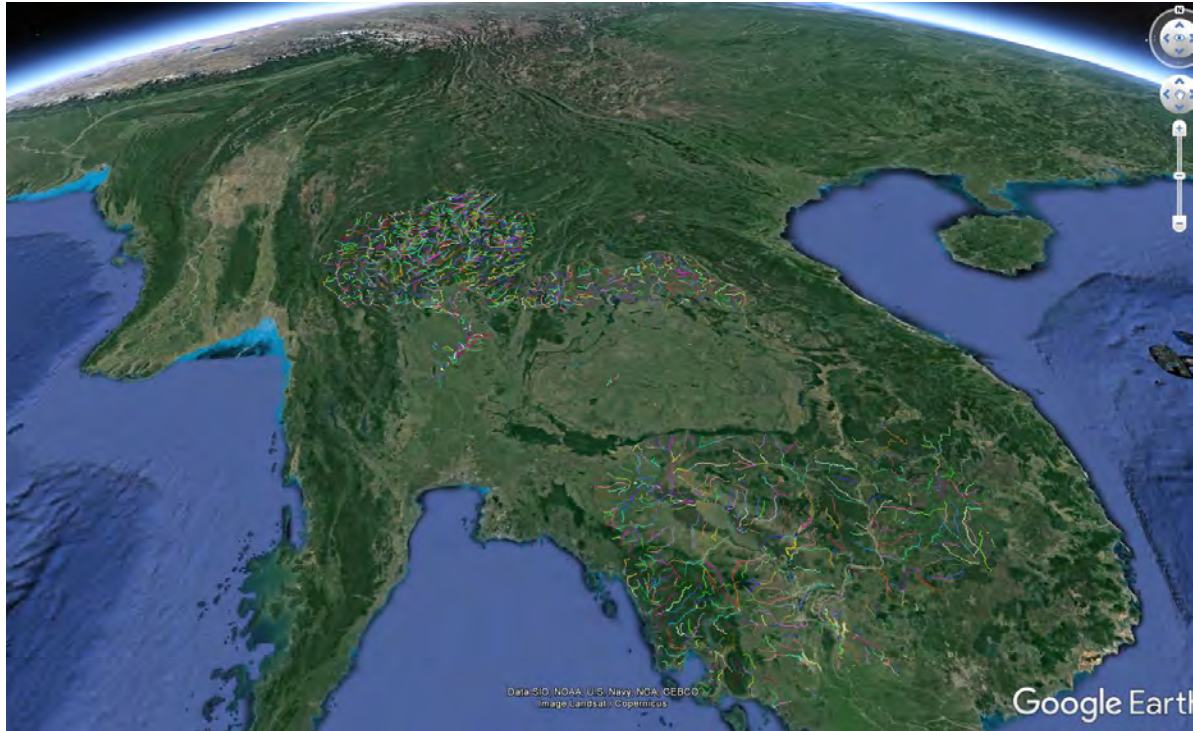


Click on *Save*. You will see the file in your Table of Contents, but not in the map window. Google Earth Pro zoomed to the area but no rivers are shown. Why?



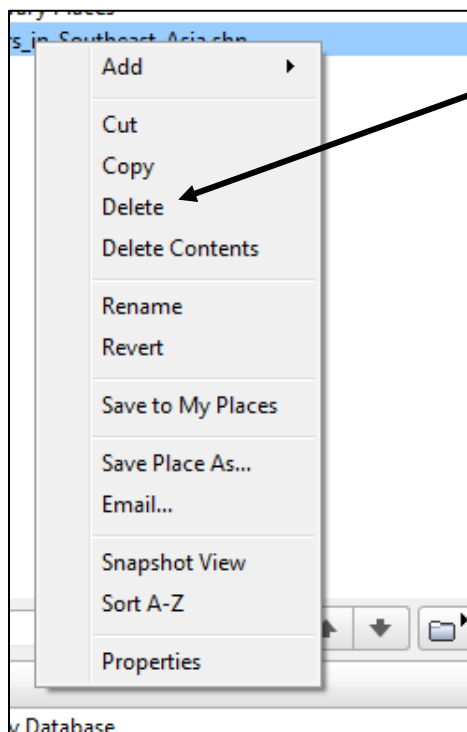
The *Rivers in Southeast Asia* file in the table of Contents is not checked. So check it.

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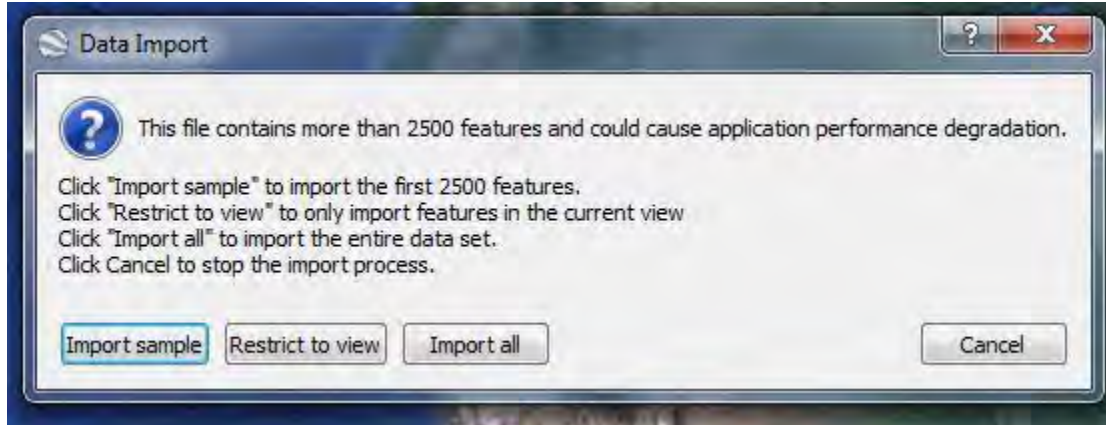
Only some rivers are showing, because we clicked on Random Sample. Let's see what happens when we choose a different setting.

Remove the file by right-clicking on the file name and select *Delete*.

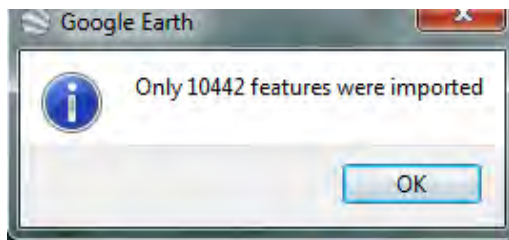


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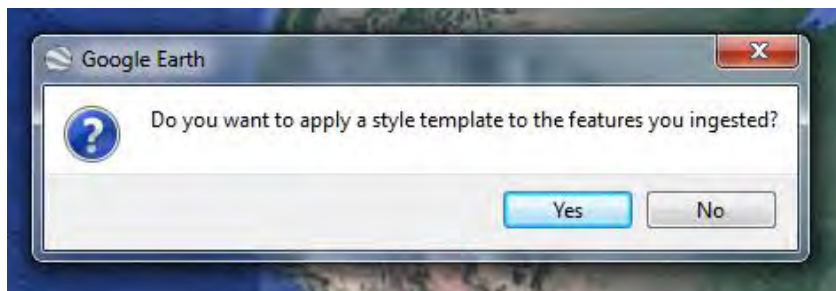
Import the file again and this time when you get the following message, click on *Restrict to view*.



You will get the following dialog box. Depending on how zoomed in you are, you may see a different number in this box.

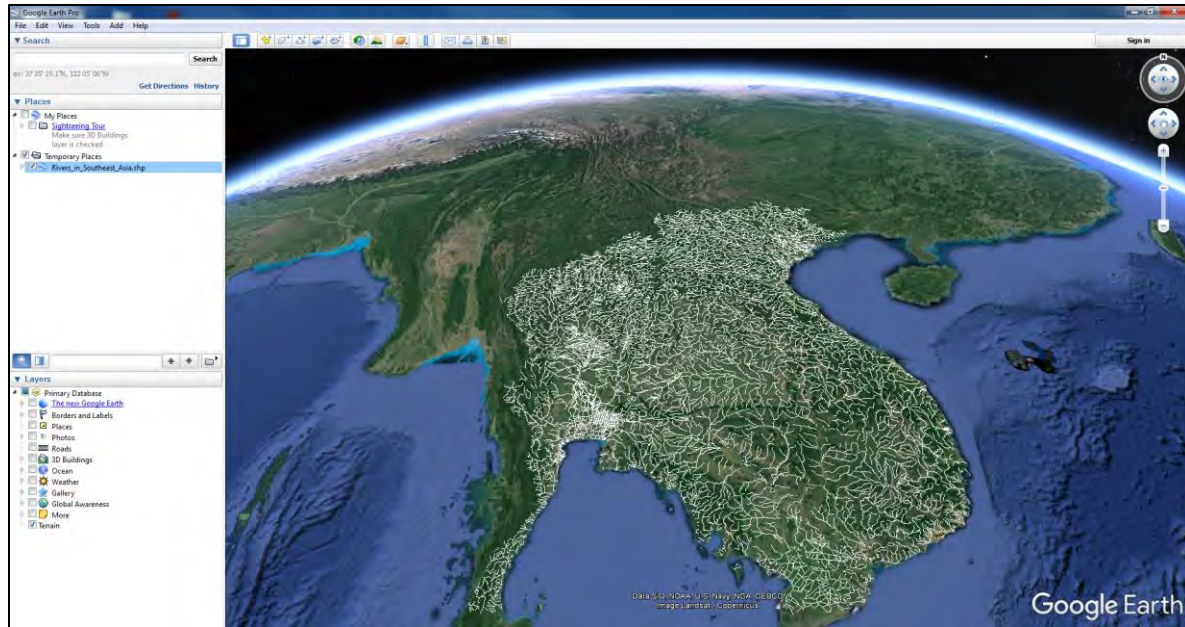


You will get this message again. You already created a *Style template*. You can reuse the previous one or create one, as we did before, but this time just click *No*.

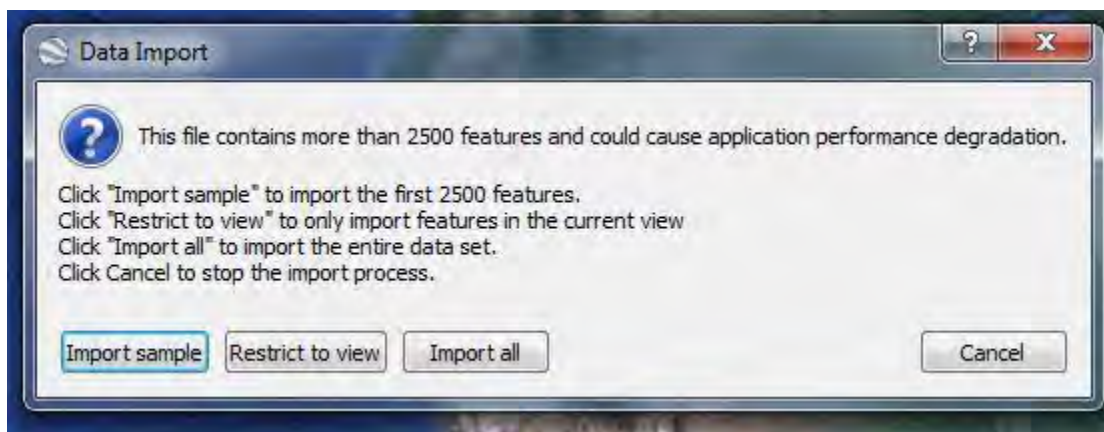


Again, the file added but it is not displayed – again, it is not checked in the table of Contents, so check it. Since we did not do a *Style template*, it assigned one color scheme to all rivers.

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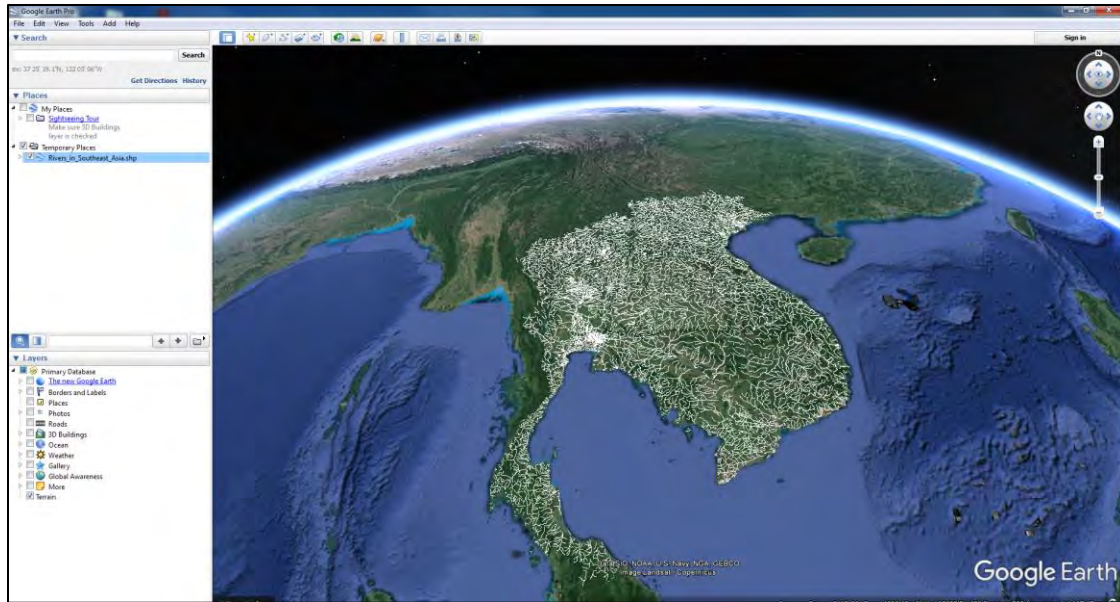


Let's delete it again, add it back in and look at the last option - *Import All*



We leave it up to you if you want to add a style template or not. In the following screenshot, a style template was not used, so all features are symbolized with color. We will experiment with other symbolization later.

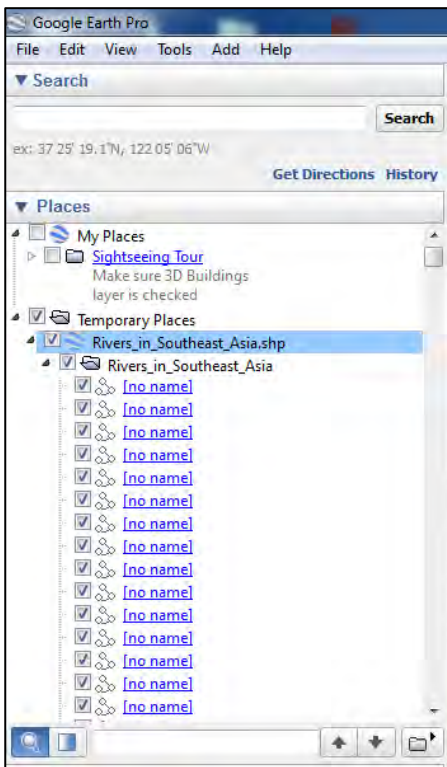
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Now that you know how to Import a shapefile, let's look at some things we can do with the shapefile.

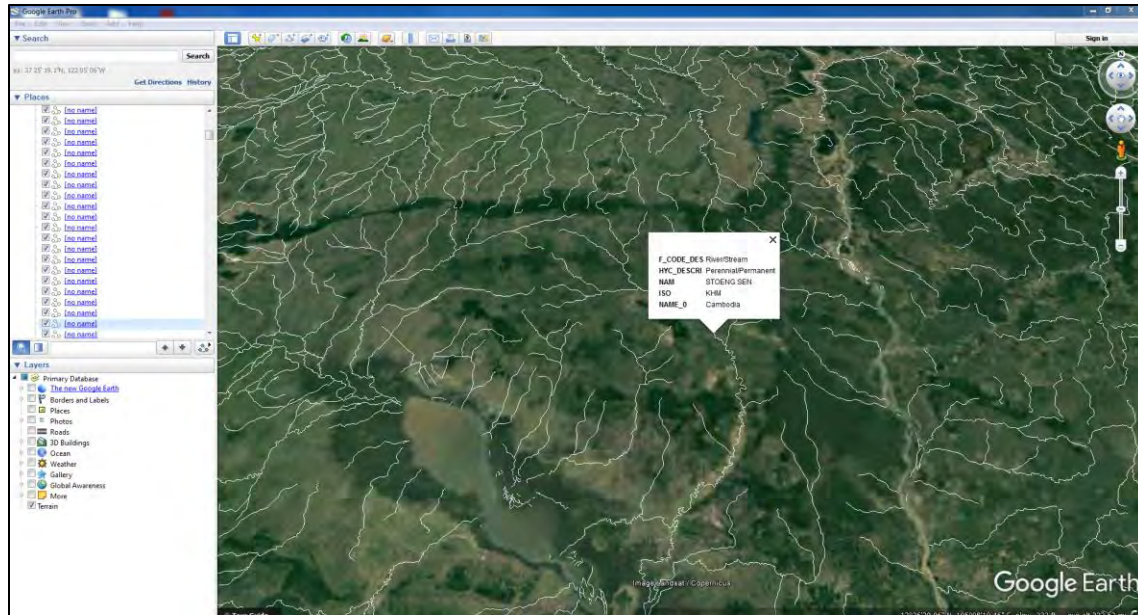
You can turn individual rivers on and off by checking and unchecking them.

(Remember since we did not do a *Style template*, when you expanded the file – 'no name' shows in the table of contents for each feature).

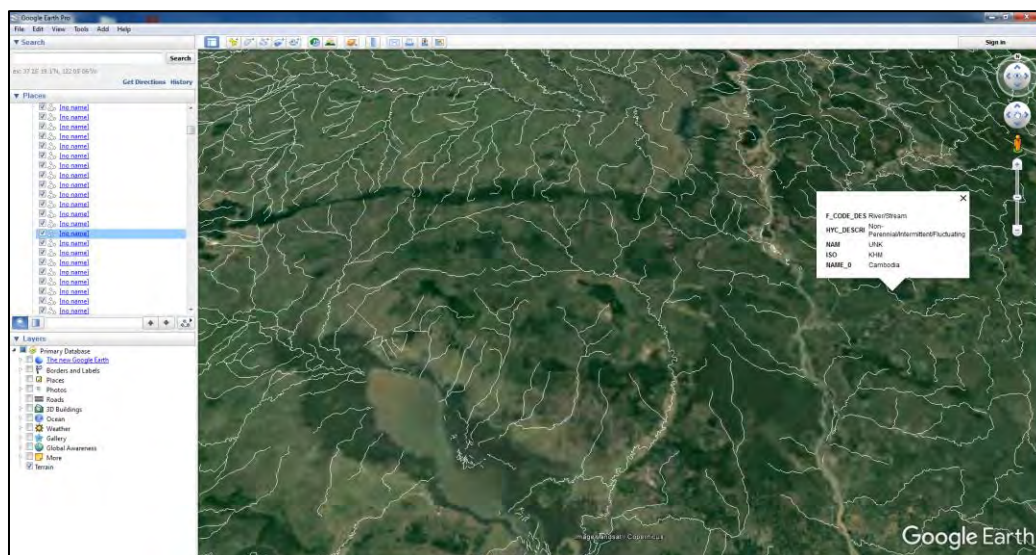


Clicking on any feature in the map document window brings up information that is in the attribute table for that specific feature:

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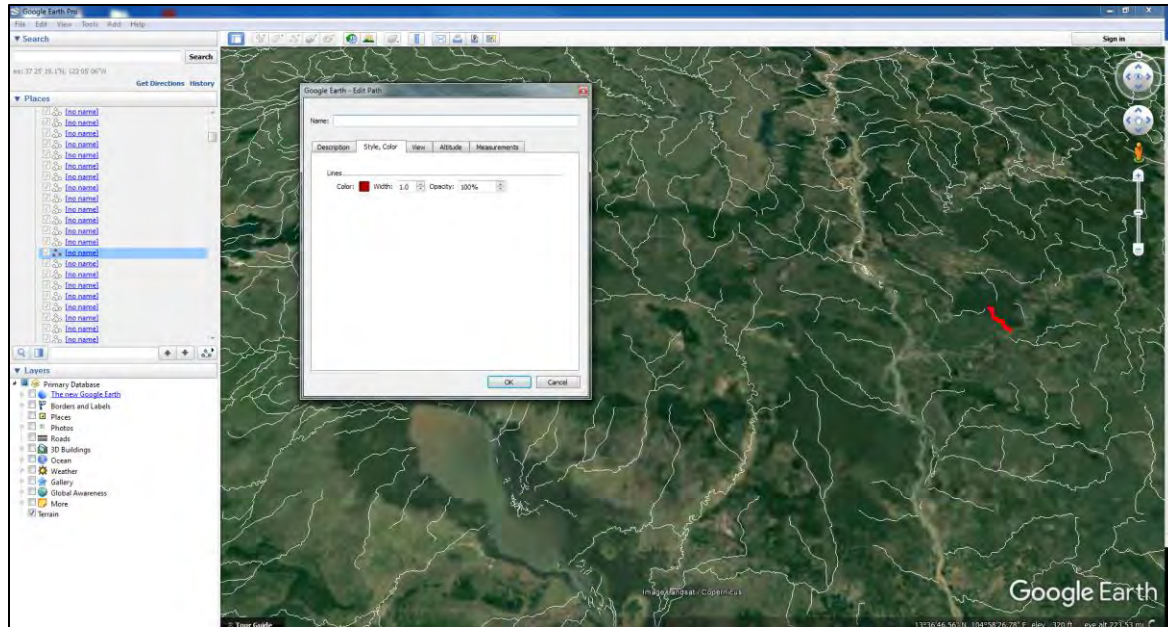


Clicking on a feature in the Table of Contents will zoom you to that feature and bring up the information from the attribute table.



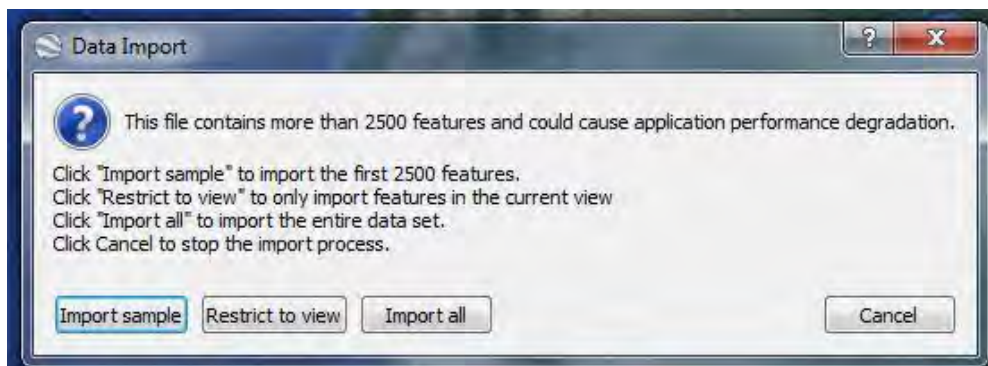
Right-clicking on one of the features in the attribute table, you can go to Properties (just like in Google Earth Desktop) and change the symbology for that individual feature. Since we have well over 10,000 individual features (river segments), that would take a very long time!

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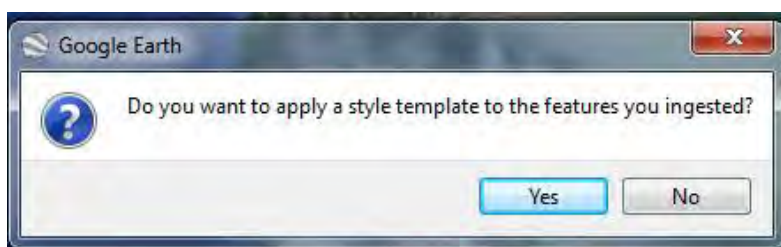


So, let's get a bit more detailed in setting our symbology. Remove the file again by deleting it. Then add the file back in. Why do we keep repeating these steps? Repetition allows you to learn the process very well.

When you get the following dialog box – choose *Import all*:

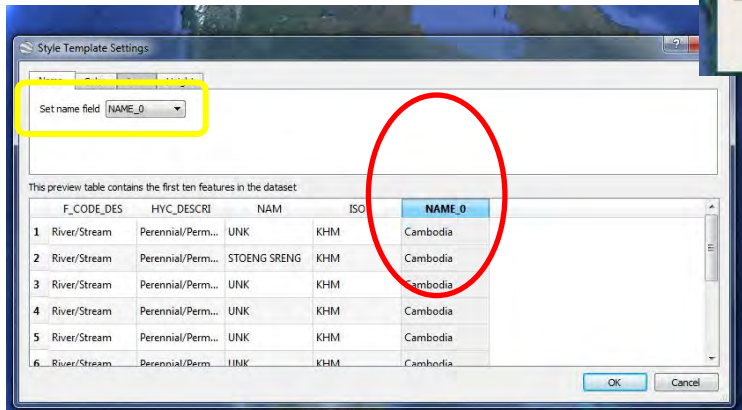
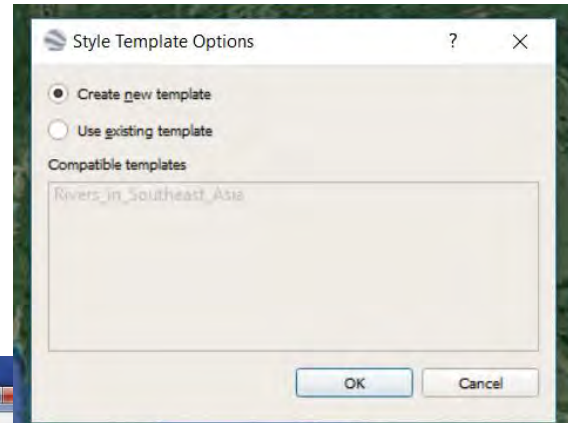


Yes to a setting a *Style template*.



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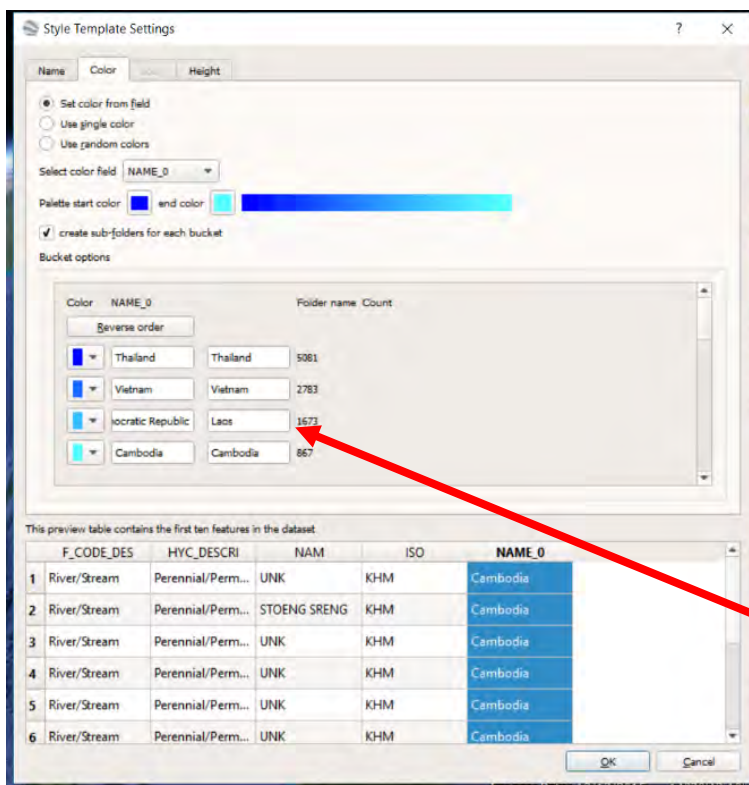
When the *Style Template Options* opens, click *Create new template* (if you did not save your prior style template, this dialog box might display). Then Ok.



Let's choose the country name (field *Name_0* – red oval) to symbolize the rivers (so be sure it shows in the *Set name field* (yellow box)).

Then go to the *Colors* tab.

Fill in this dialog box as shown to the left.



Check *Set color from field*

Select color field – make sure *Name_0* *Palette start color* – if you click on the box, you can select the specific color shown and then click on end color and you, again, can select the color. Once you do this, the range of colors shows in the bar.

Then click on *create sub-folders for each bucket*. And then *Bucket options* will open, it shows the range of colors that will be assigned for each river feature that is in the specific country listed – we have 4 countries.

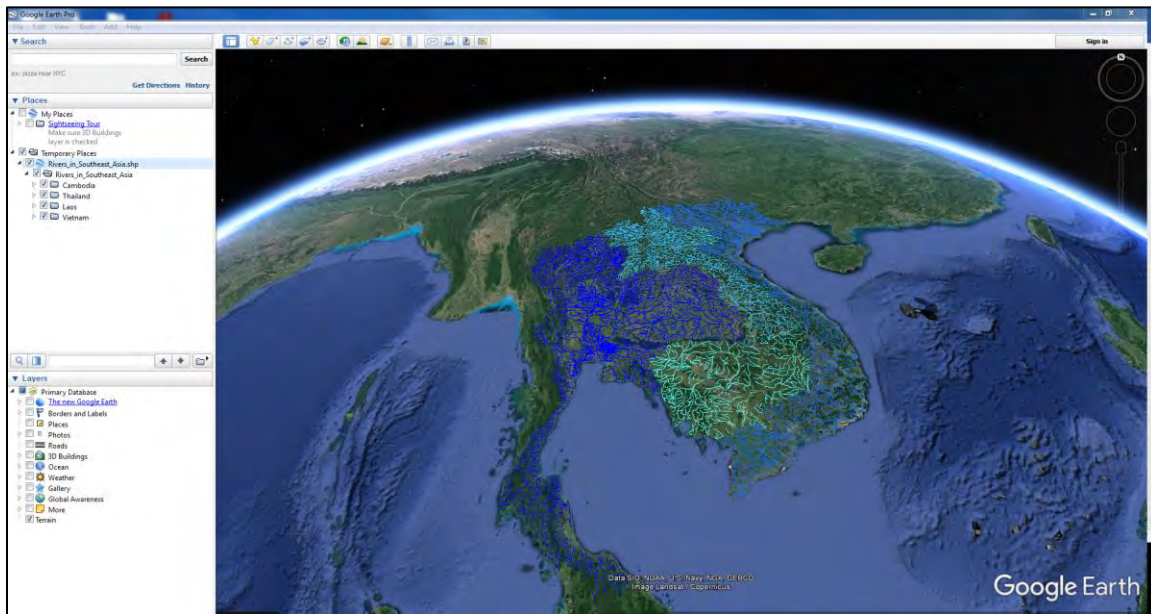
These boxes will be blank and you will need to type names of the countries in these boxes, so they are displayed in the Table of Contents.

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Feel free to change or play with these options. But, you might want to wait until you see what happens with these settings.

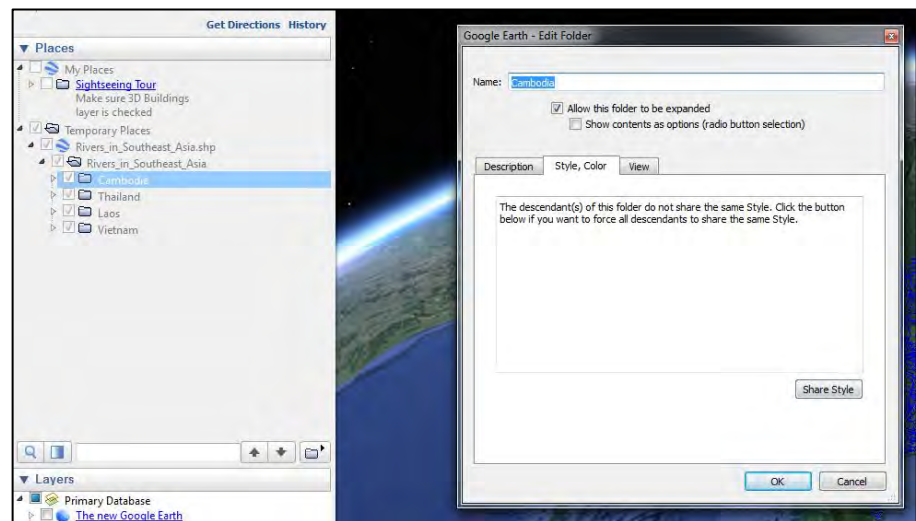
Click *OK* at the bottom.

If your map window does not display the features, again make sure *Rivers in Southeast Asia* is checked in the Table of Contents.

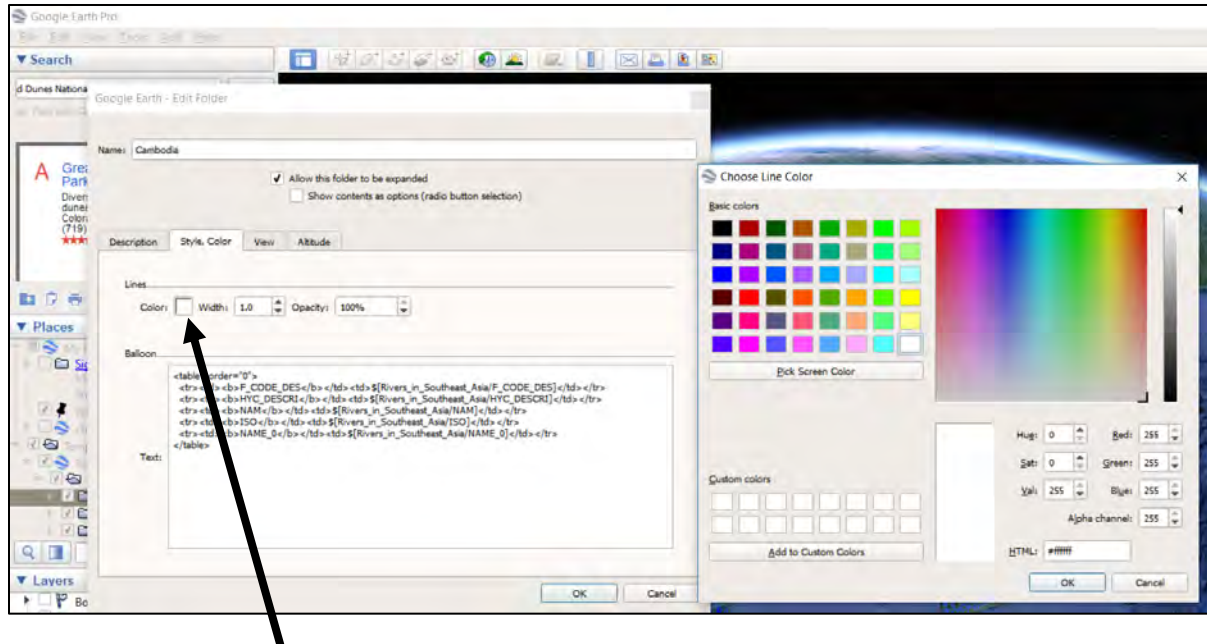


Please note – you have not changed the shapefile. You have only symbolized it and Google Earth Pro allowed you to save the *Style template*. You can create multiple different style templates if you want to experiment with what is displayed. Perhaps you are discussing with your students differences in permanent versus fluctuating (ephemeral) streams (**HYC_DESCRI**), so you symbolize based on that field.

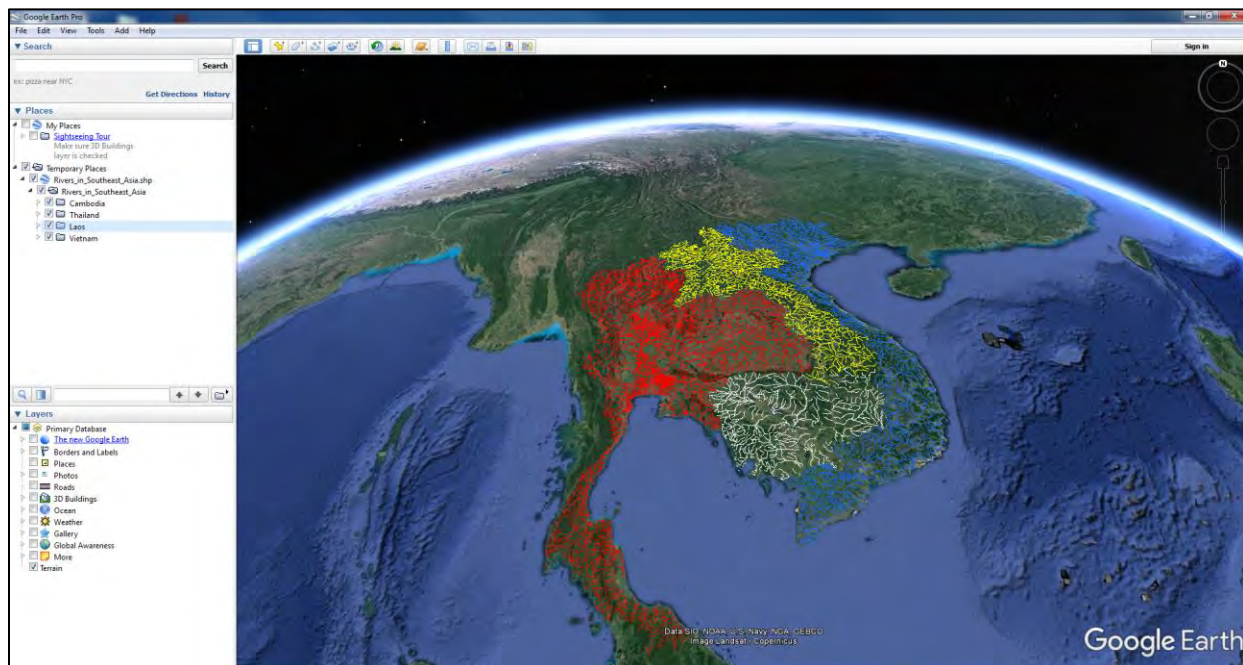
But perhaps, you are just unhappy with the symbology being all shades of blue. You can, again, change the symbology for one of the countries under the Properties. Right-click on the country name and click on Properties. You will get the *Edit Folder* box. Go to *Style, Color* and then click on *Share Style*.



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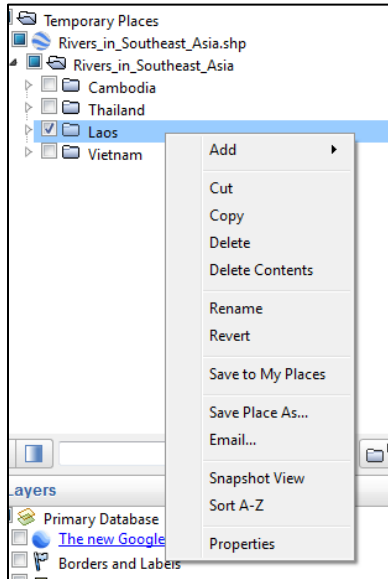


Then choose the color for that country. See screenshot below for suggestions for each country.



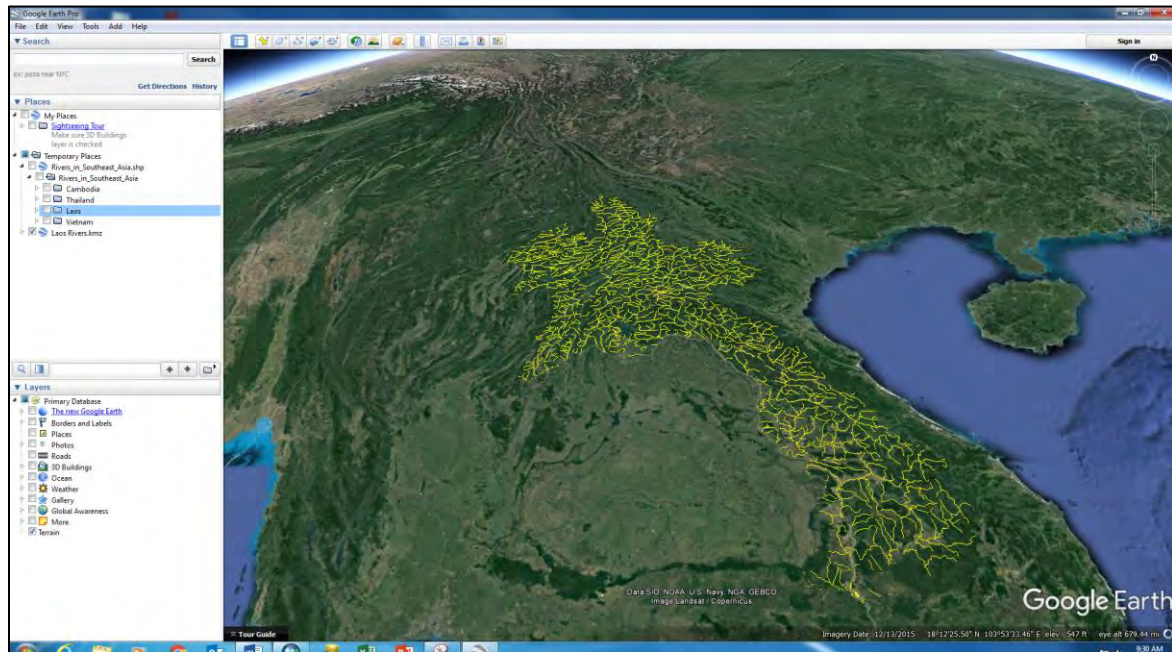
You now can turn on and off the rivers for an individual country by unchecking the box next to the country name. Yes, you can expand under the country and see all the features listed, but again, we have over 10,000.

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Suppose you would like a file for just one country. Right-click on the name – *Laos*, then click on *Save Place As*. You will be taken to a window where you can navigate and save it. You do not need to uncheck all the other layers as seen in this screenshot because you right clicked on the name Laos. Save your file – name it as you wish, here named as *Laos Rivers*. (Be sure to save it as a .kml, not a .kmz. Both can be added in to Google Earth Pro, but we are going to use the file again later, so it is important to save it as .kml.) It will save as a .kml file, not a shapefile. Once you have saved it, the window closes. No, it is not automatically added to your map.

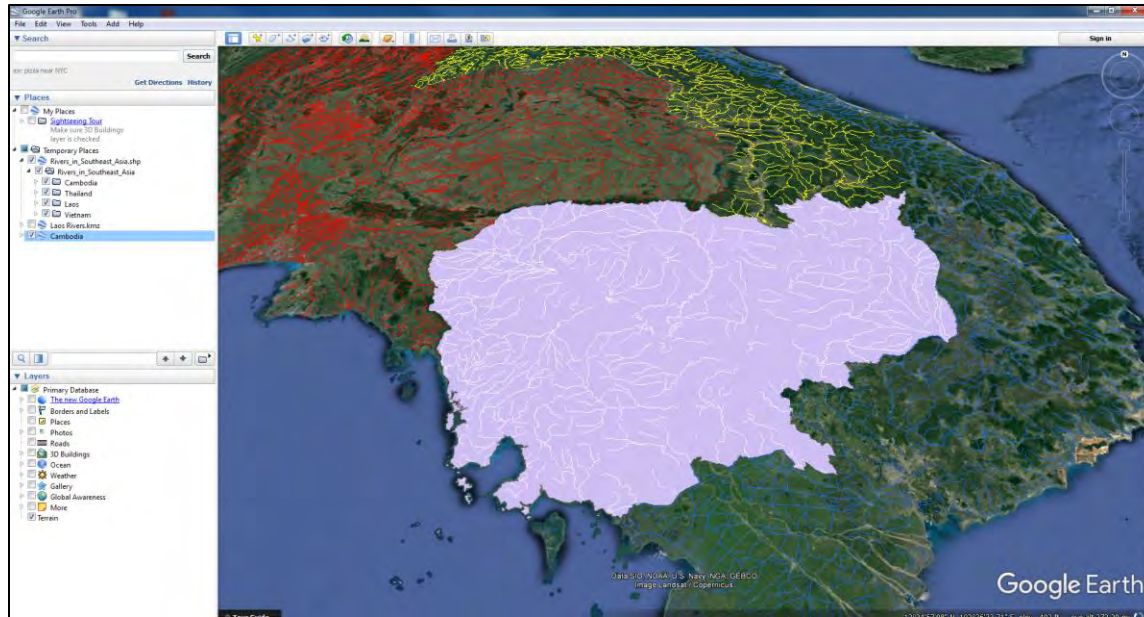
Now uncheck the Rivers in Southeast Asia file. Then either File > Import or File > Open and add your Laos Rivers files. The symbology is the same because it uses the symbology set before you saved it.



Now turn all the *Rivers* back on by checking *Rivers* in Southeast Asia. Like Google Earth Desktop, you have multiple files, .kml, .shp or even raster files in your Temporary Places.

For example, in the following screenshot, the boundary for Cambodia was added as a KML file, but you can add it as a shapefile. Shapefiles for all world countries can be found by searching on the internet, but be careful as to which site to use. If you are unsure if the site is safe, check with your IT Administrator.

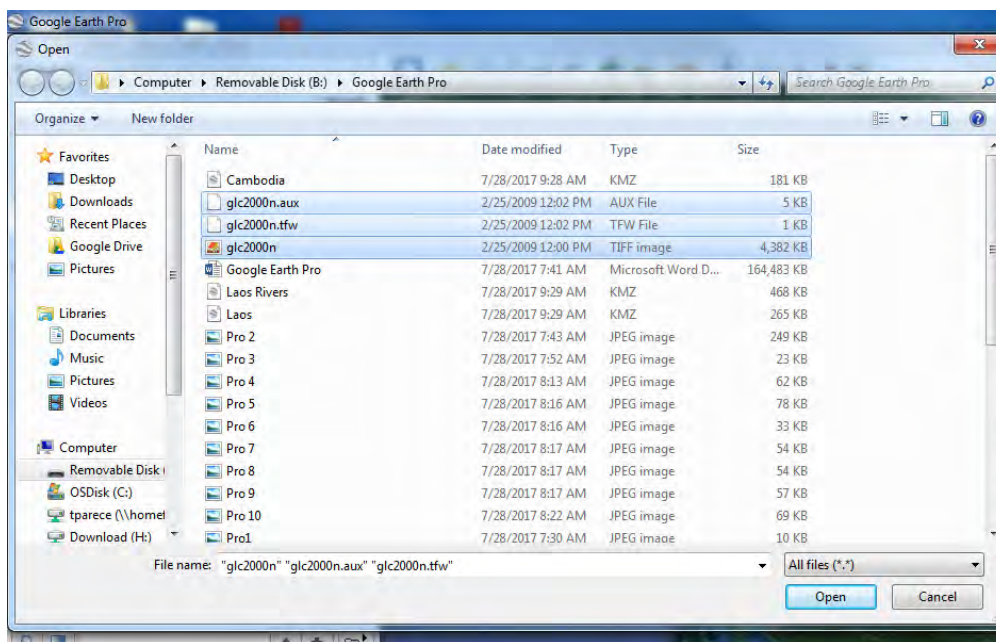
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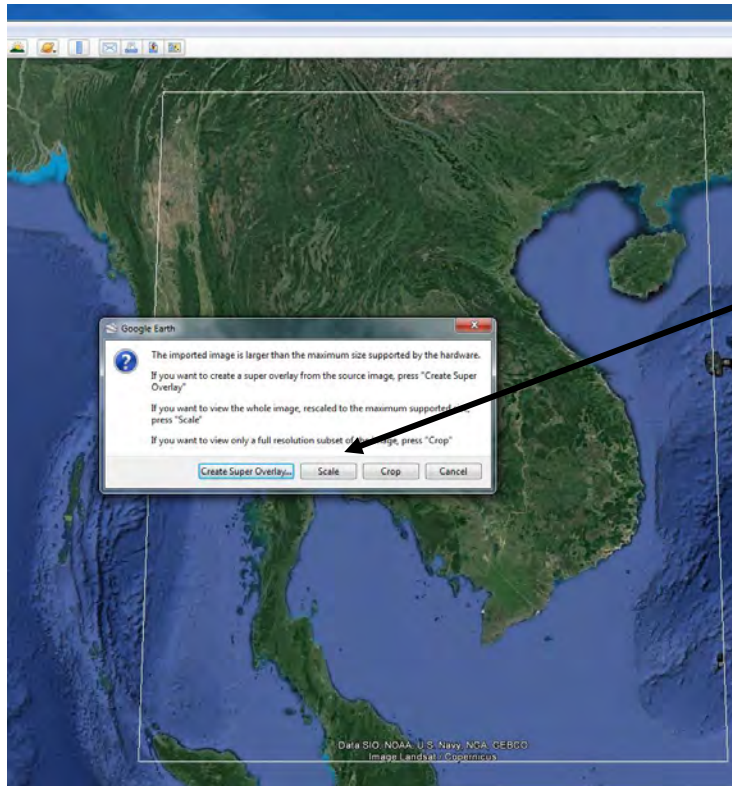
3.9.4 Adding a Raster File

You add a raster, or grid file, in the same manner as a shapefile. First, turn off all the files currently in your *My Places* table of contents.

Now go to *Import* and import the raster file you downloaded earlier – Southeast Asia Land Cover.

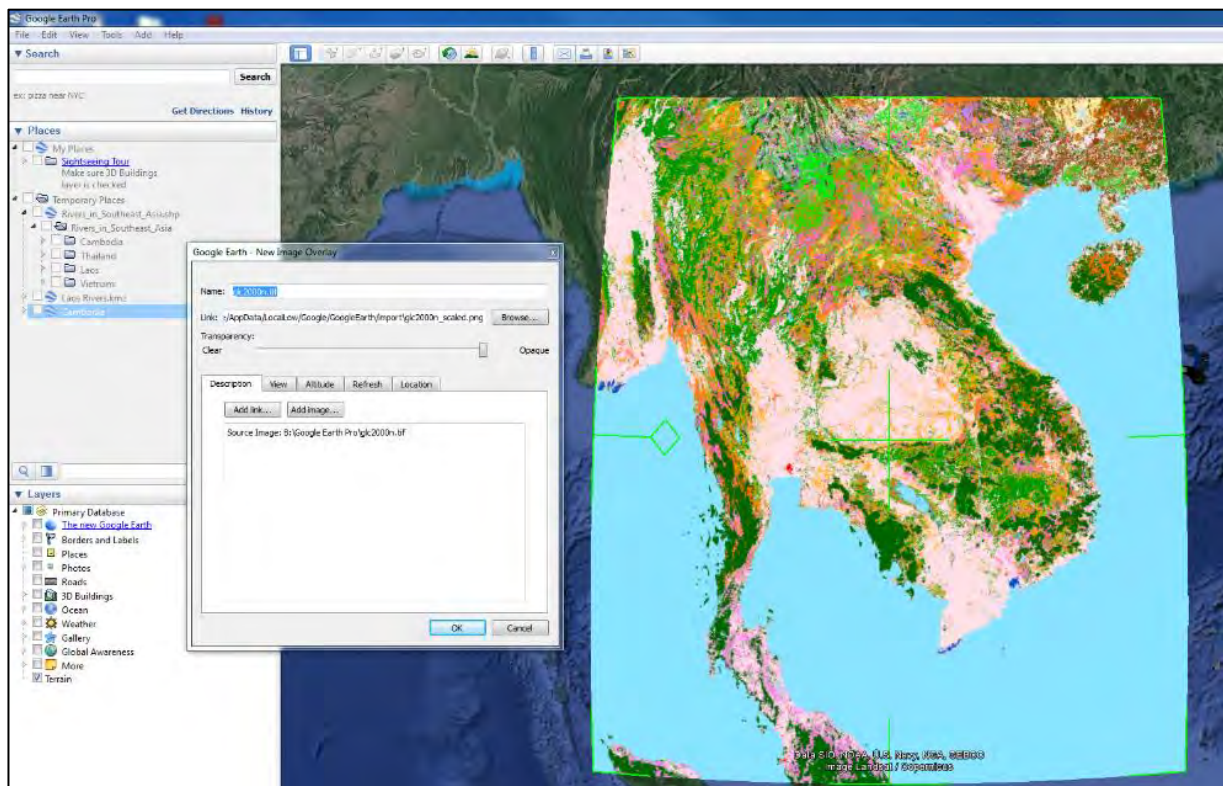


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You will get this dialog box. Raster files are very large files, so you don't necessarily want to add all like we did with the rivers' vector file. Let's start with *Scale*.

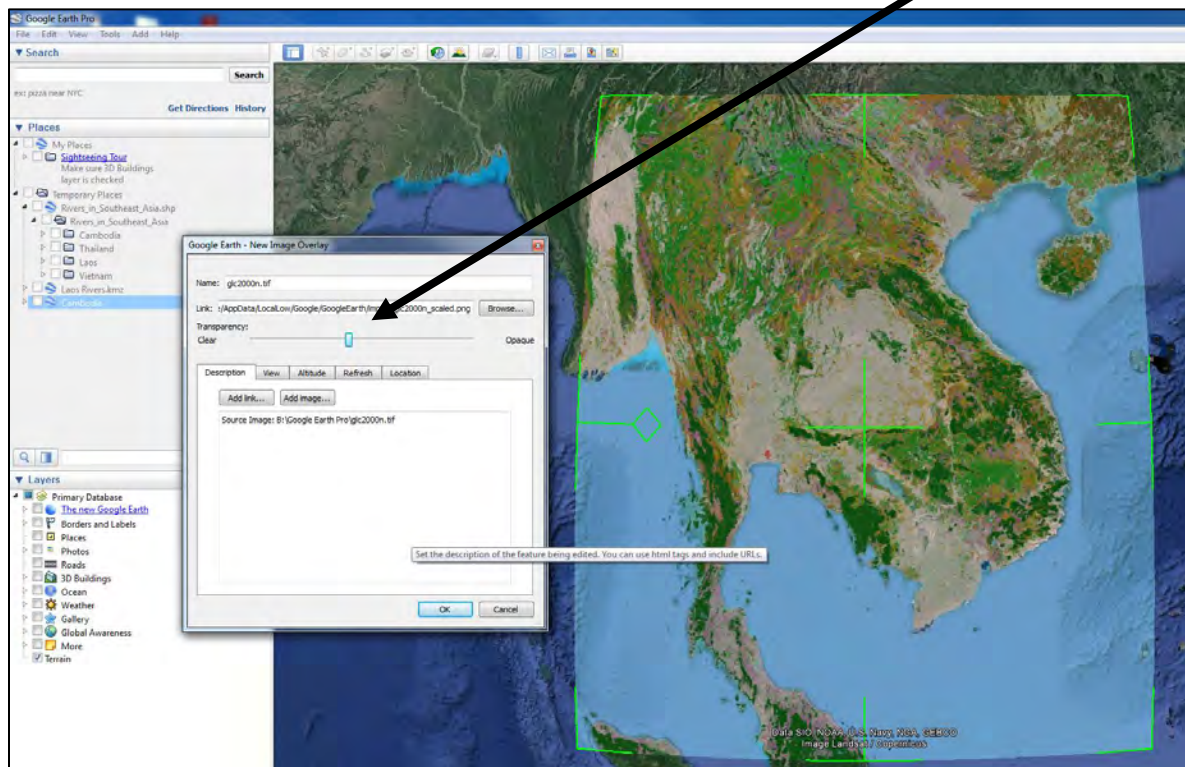
You get the following results:



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You did receive the properties dialog box (called *New Image Overlay*). You can change some of the default settings. We will not review them here.

But notice, you also have a *Transparency* – so you can see features below. We do not have a color/style option, with land cover those usually come with a default color scheme. Go ahead and set your transparency so you can see some features through the layer. Here, we have it midlevel:



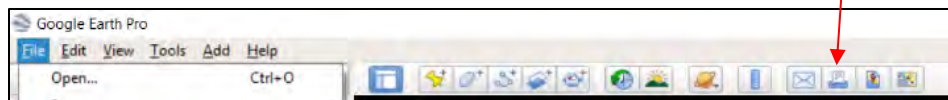
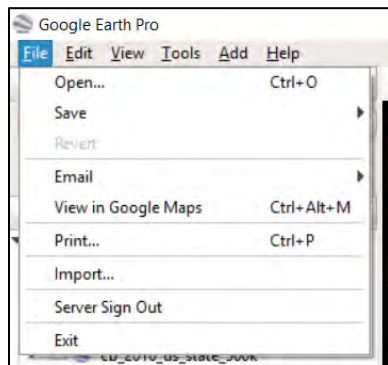
If you find you don't like the looks, just right click and go to Properties to reopen the dialog box. If you turn your rivers layer back on, you can see the rivers. Although the land cover layer is showing on top in the Table of Contents, in a GIS, raster layers are always displayed underneath vector files.

We will not review the other two options for displaying raster files – *Crop* and *Create Super Overlay*. *Crop* will clip the file to a specific area – for this dataset, it does not crop because it covers a relatively small area. You may explore these on your own.

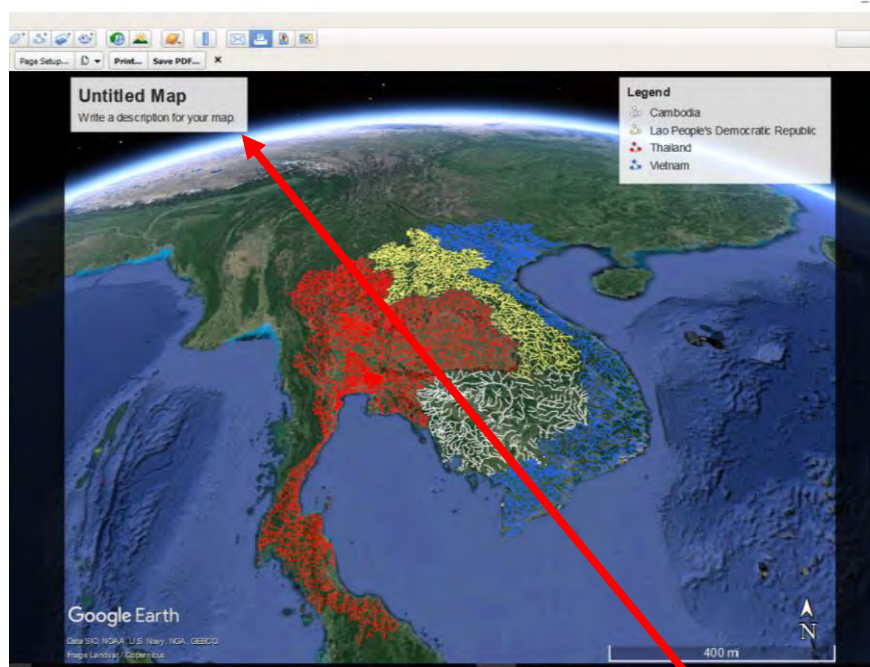
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3.10 Printing a Map from Google Earth Pro

You can print a map in two ways. *File > Print* or clicking on the print icon.



You will see this in your map document window:

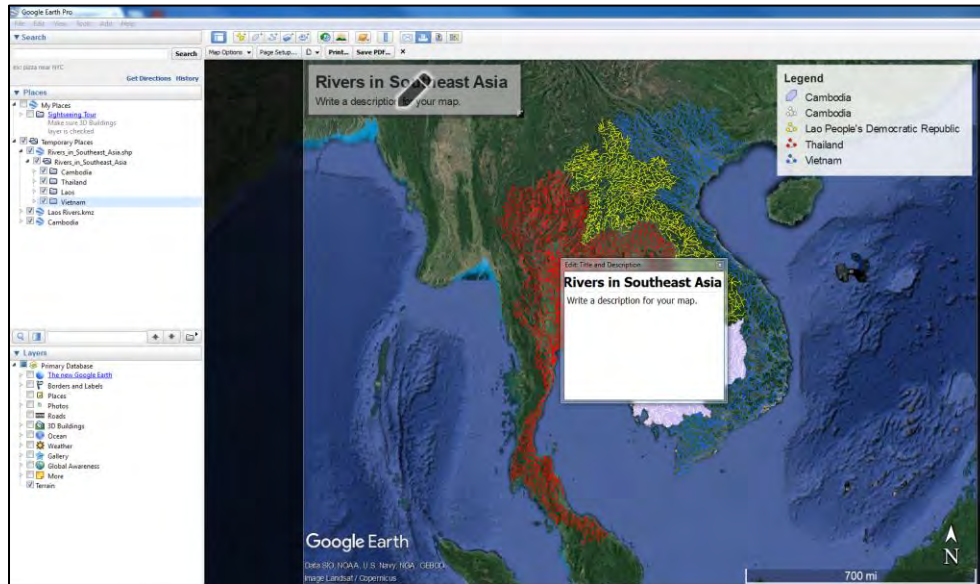


The legend carries over from your Table of Contents.

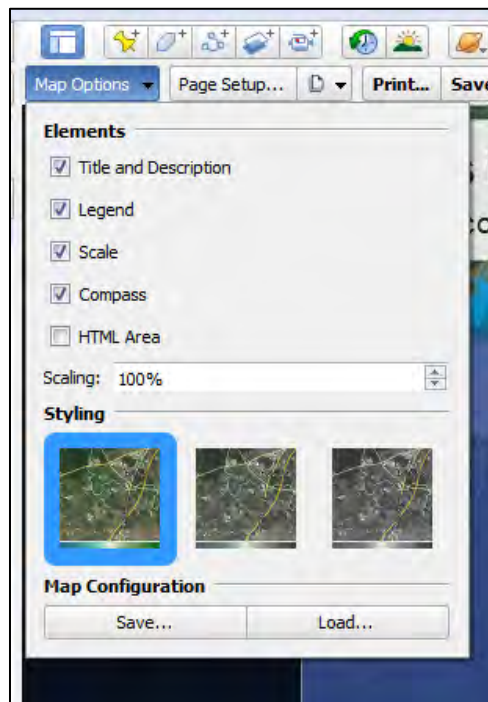
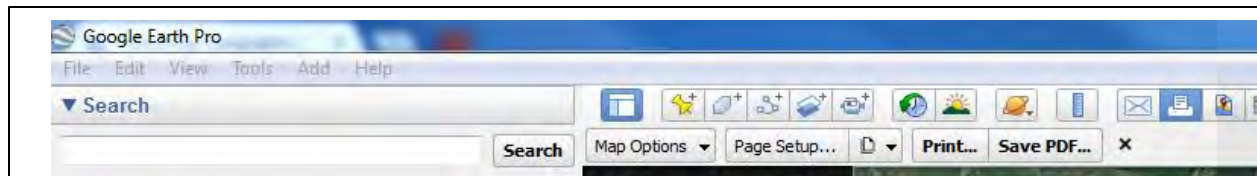
If you hover your mouse over *Untitled Map* box, you get a pencil in order to edit it.

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You get a pop up box in which you can edit your map name and add a description.

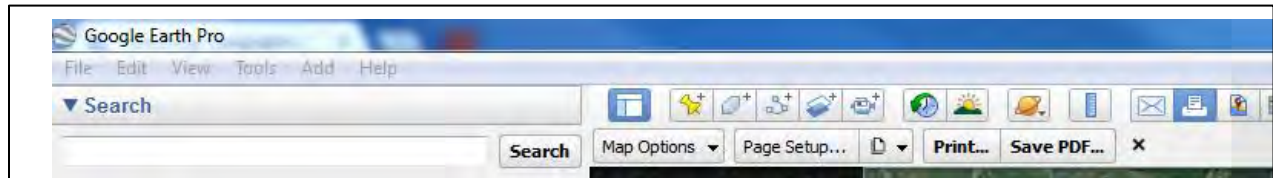


You can change options by clicking on *Map Options*.

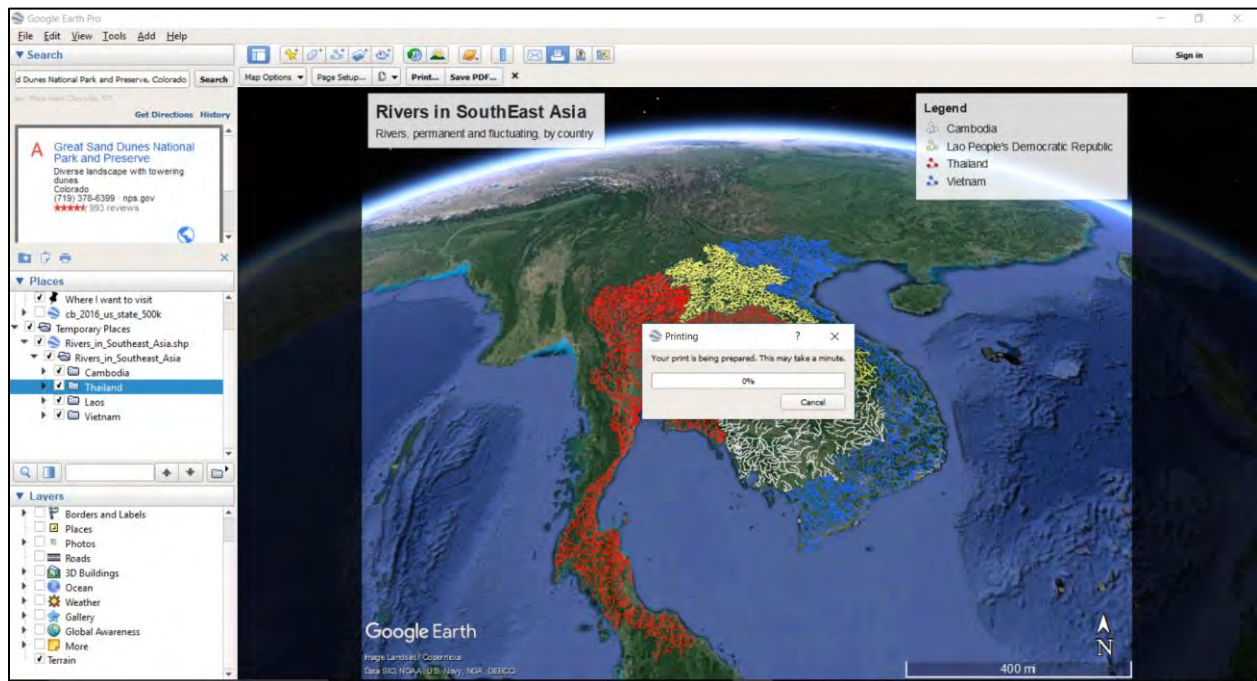


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Once you are happy with the way it looks, click on *Print* or *Save PDF*.



If you clicked on Save PDF, you will get the following pop-up. Once it is done, you will have a pdf saved to your working folder (where you saved your other items as we worked through this tutorial).



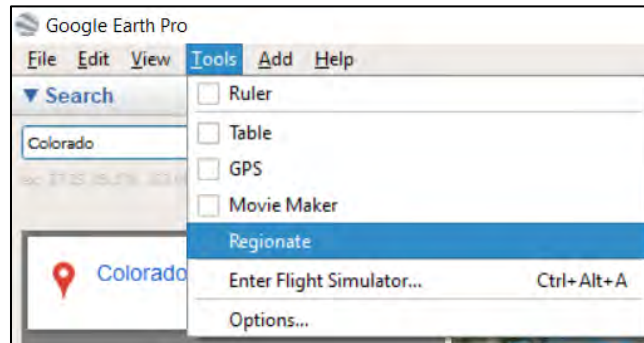
3.11 Regionate

For the YouTube video related to this section, go to: https://youtu.be/p84BgO1ro_w.

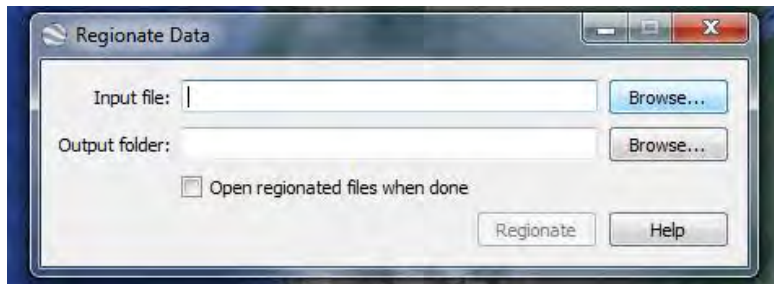
For this tool, we are using the kml file that was downloaded -- counties file for all US States. *Regionate* takes a large dataset and will display detailed features when you are zoomed in on a particular area. This is a memory-saving display mechanism in Google Earth Pro. You do not need to add any files to Google Earth Pro at this point, the *Regionate* tool will do that after it finishes.

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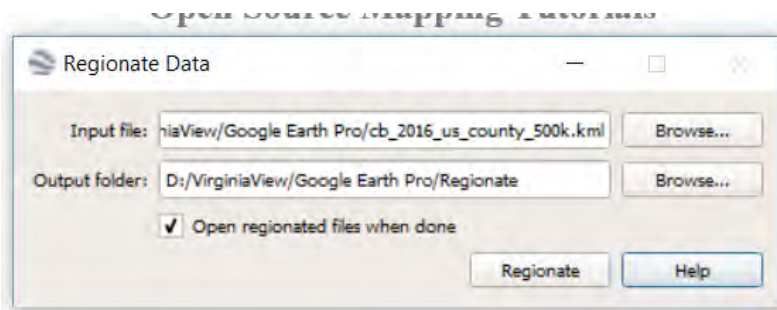
Go to *Tools > Regionate*



You get the following dialog box. Click on *Browse* and go to the file folder where you saved the *US Counties KML* file to add it as the Input file.



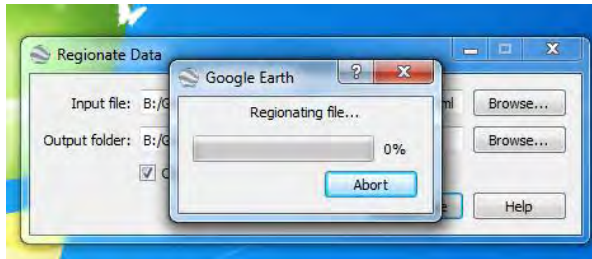
Then for the Output folder, a separate folder called Regionate was created (the tool will create a separate .kml file for each county).



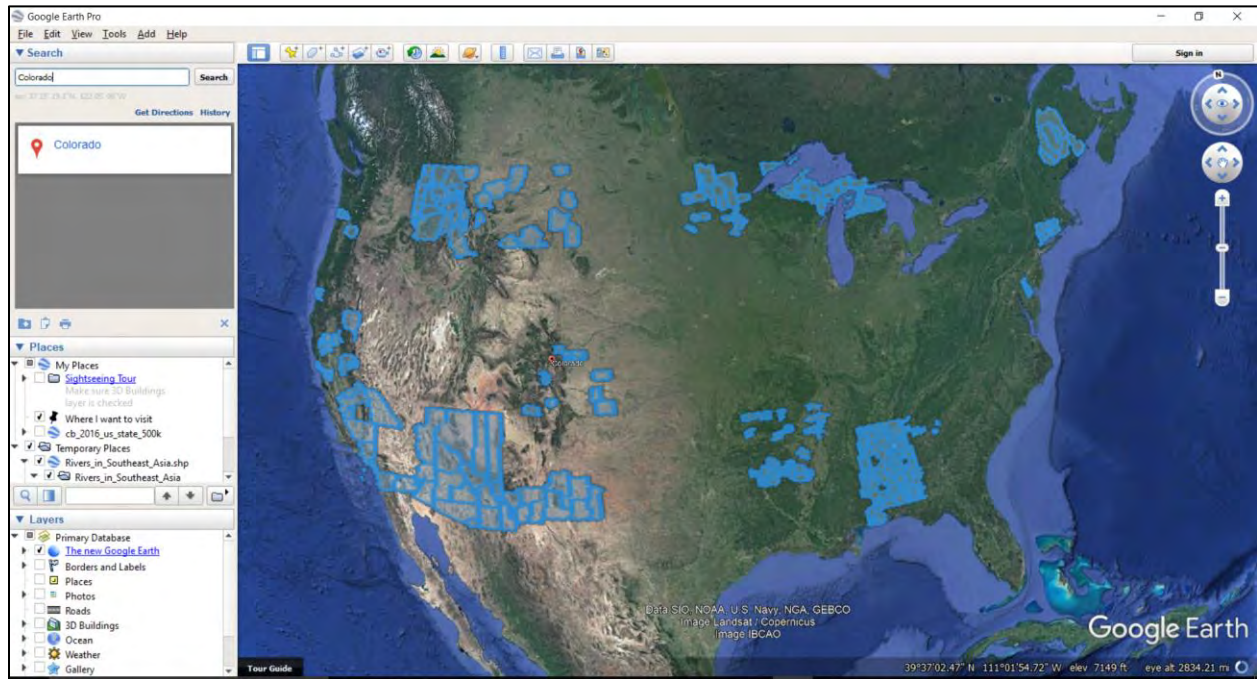
Be sure that you have checked – *Open regionated files when done*. Then click on *Regionate*.

You will get a status dialog box.

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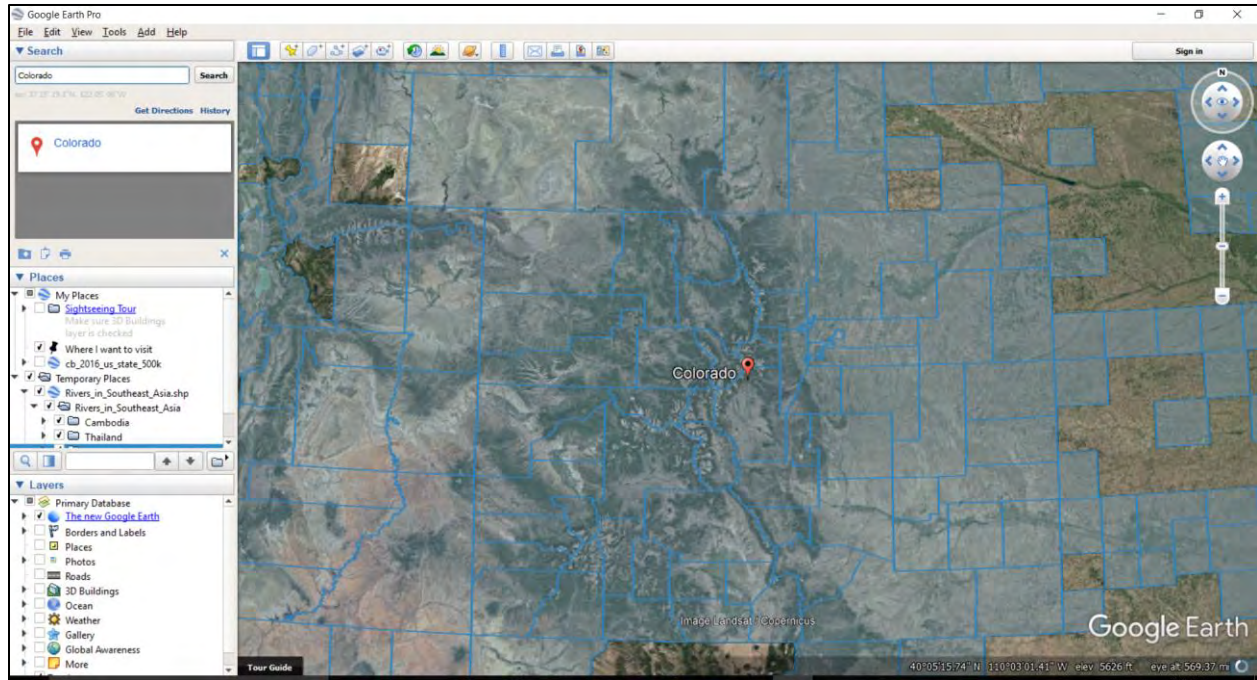


When it is finished, it will look like this:



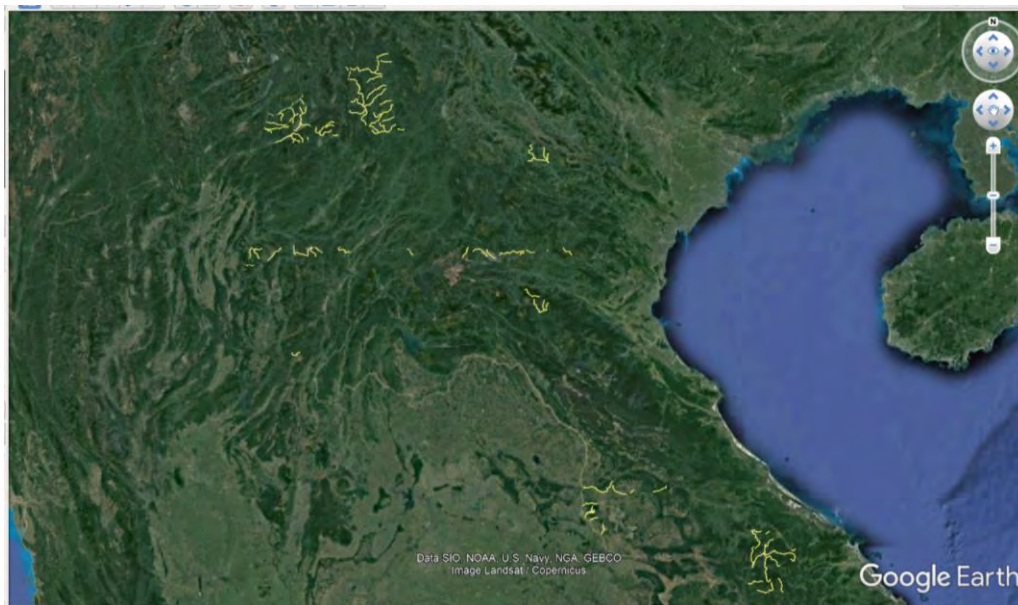
Zoom into a specific area. Below, search for Colorado and it populates all the counties for Colorado.

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Google also has a youtube video to help if you have questions -
<https://www.youtube.com/watch?v=ZIfPDFgx79I>

Now, try the *Regionate* tool with the Laos Rivers .kml file. Once the tool ran, mine looked like:



Zooming in:

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Thus, a very useful tool for discussing only specific regions and not needing to worry about clipping your data.

This ends the Google Earth Pro tutorial. Google Earth Pro has many other options not covered in this tutorial.

Additional Information:

You can find Google Earth Pro tutorials at this link:

<https://www.google.com/earth/outreach/learn/>

<https://www.google.com/earth/outreach/tutorials/>

If you are interested in staying up to date on Google Earth, the following blog monitors changes on a regular basis:

<http://www.portalsig.org/aggregator/sources/13>

We have created many YouTube Videos for this chapter, and some of the videos do cover information not covered in this chapter:

1. Introduction to Google Earth
<https://youtu.be/DaluBU8ZO3A>
2. Locating KML Files for Google Earth
<https://youtu.be/8bLweAYxQoM>
3. Introduction to Google Earth Pro
<https://youtu.be/JStJz-AUYvQ>

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4. Changing Settings in Google Earth Pro
<https://youtu.be/IXqzT4zUkE0>
5. My Places in Google Earth Pro
<https://youtu.be/EJPUY4QDGyI>
6. Default Table of Contents, Part 1 in Google Earth Pro
<https://youtu.be/KyjRgT2icME>
7. Default Table of Contents, Part 2 in Google Earth Pro
<https://youtu.be/ykILDv3A2TA>
8. Measuring in Google Earth Pro
<https://youtu.be/qsCxOsOL5SM>
9. Exploring Historical Imagery in Google Earth Pro
<https://youtu.be/7r1ETosfKmU>
10. Adding GPS Data to Google Earth Pro
<https://youtu.be/x6Ijzbi0iIo>
11. Using a KML File in Google Earth Pro
<https://youtu.be/p2KI-8Gyyh0>
12. Finding GIS Shapefiles to use Google Earth Pro
<https://youtu.be/gH20ARsLixA>
13. Using GIS Shapefiles in Google Earth Pro, without a Style Template
<https://youtu.be/4GXWB3JDMxA>
14. Using GIS Shapefiles in Google Earth Pro, with a Style Template
<https://youtu.be/wG0WyxqielY>
15. Using Regionate in Google Earth Pro
https://youtu.be/p84BgO1ro_w

Exploring Our Planet with Open Source Software

4. Open Street Map

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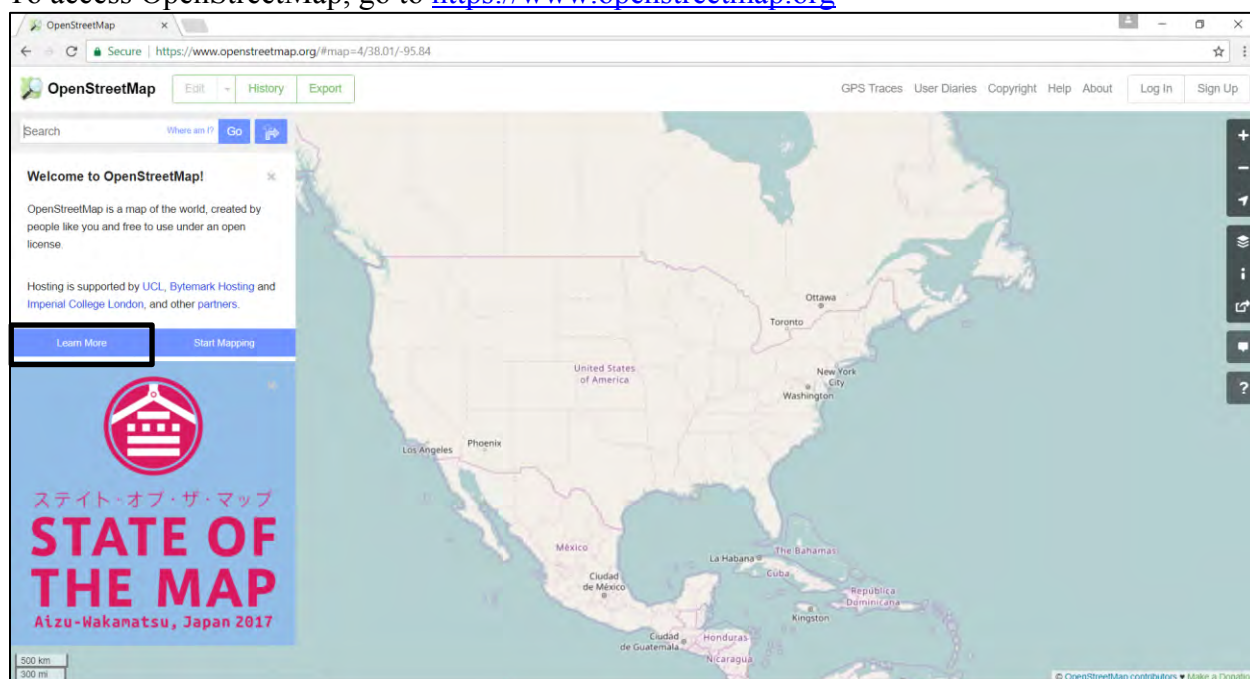
4.1 Introduction

OpenStreetMap is open source GIS mapping software developed and constructed by volunteers. It covers the entire world and maps have an open content license. Most maps and data are free to the public; mapping and data are accomplished by local people in their own community. The map is not complete and is being updated on an ongoing basis. In this tutorial, we will explain the basics on how to use OpenStreetMap, with screenshots as we progress.

You can use OpenStreetMap for basic navigation and locating features within your community. Or for more advanced students and higher grade levels, OpenStreetMap is an editable map that can be used in your local community to expand features available to users worldwide. We will discuss OpenStreetMap basics and some initial editing capabilities. We will not provide complete details on all OpenStreetMap features and abilities.

We recommend this on-line mapping program for High School level and above. For additional information on OpenStreetMap, see the links at the end of this tutorial.

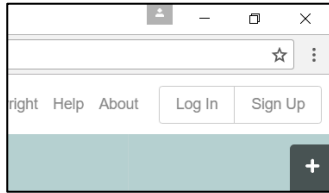
To access OpenStreetMap, go to <https://www.openstreetmap.org>



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If you click on Learn More (inside the black rectangle above), you will be taken to a website with more information on the OpenStreetMap Foundation and project.

4.2 Registering to use OpenStreetMap



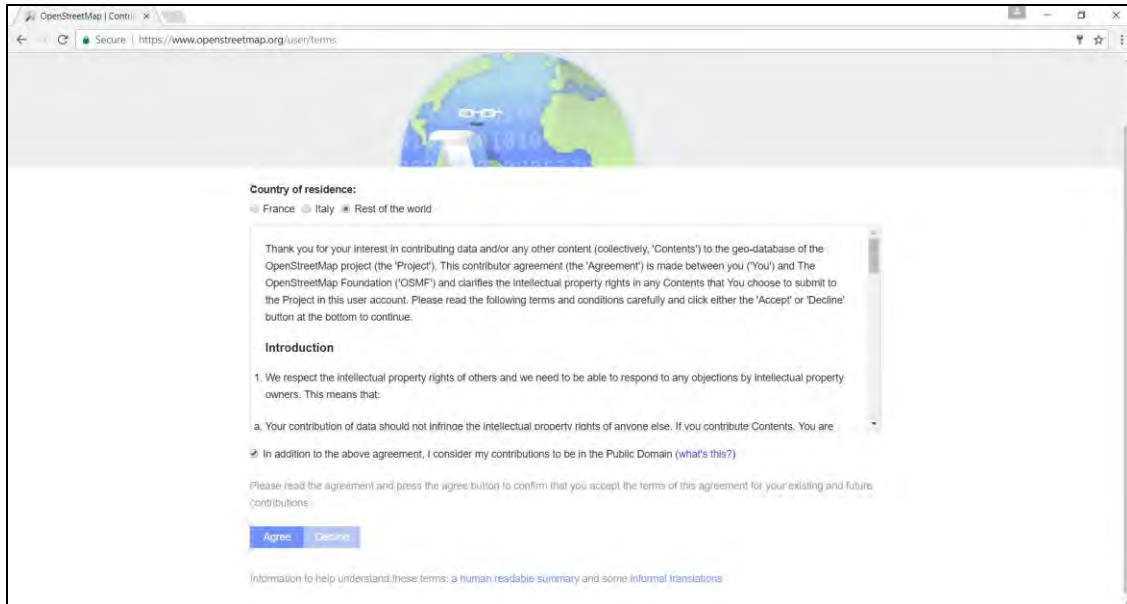
In the upper right corner, click on Sign Up.

You are taken to this page where you can sign up. Signing up allows you to see what volunteers have contributed to OpenStreetMap and also allows you to contribute to the program. Fill in the required information.

A screenshot of the OpenStreetMap 'Sign Up' page. The page has a header with the OpenStreetMap logo and navigation links. The main content area features a large illustration of a globe with a person's arm reaching out to it. Below the illustration, there are several form fields: 'Email Address', 'Confirm Email Address', 'Display Name', 'Password', and 'Confirm Password'. To the right of the form fields, there is a section titled 'Free and editable' with text explaining that OpenStreetMap is created by people like you and is free for anyone to fix, update, download, and use. It also mentions that signing up allows you to get started contributing and that an email will be sent to confirm the account.

You will then get this screen, please read the agreement in full. If you agree, then click agree.

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The screenshot shows the 'OpenStreetMap | Contributor Agreement' page. At the top, there's a header with the OpenStreetMap logo and a globe. Below the header, there's a section titled 'Country of residence:' with radio buttons for 'France', 'Italy', and 'Rest of the world'. The main content area contains a scrollable text box with the following text:

Thank you for your interest in contributing data and/or any other content (collectively, 'Contents') to the geo-database of the OpenStreetMap project (the 'Project'). This contributor agreement (the 'Agreement') is made between you ('You') and The OpenStreetMap Foundation ('OSMF') and clarifies the intellectual property rights in any Contents that You choose to submit to the Project in this user account. Please read the following terms and conditions carefully and click either the 'Accept' or 'Decline' button at the bottom to continue.

Introduction

1. We respect the intellectual property rights of others and we need to be able to respond to any objections by intellectual property owners. This means that:

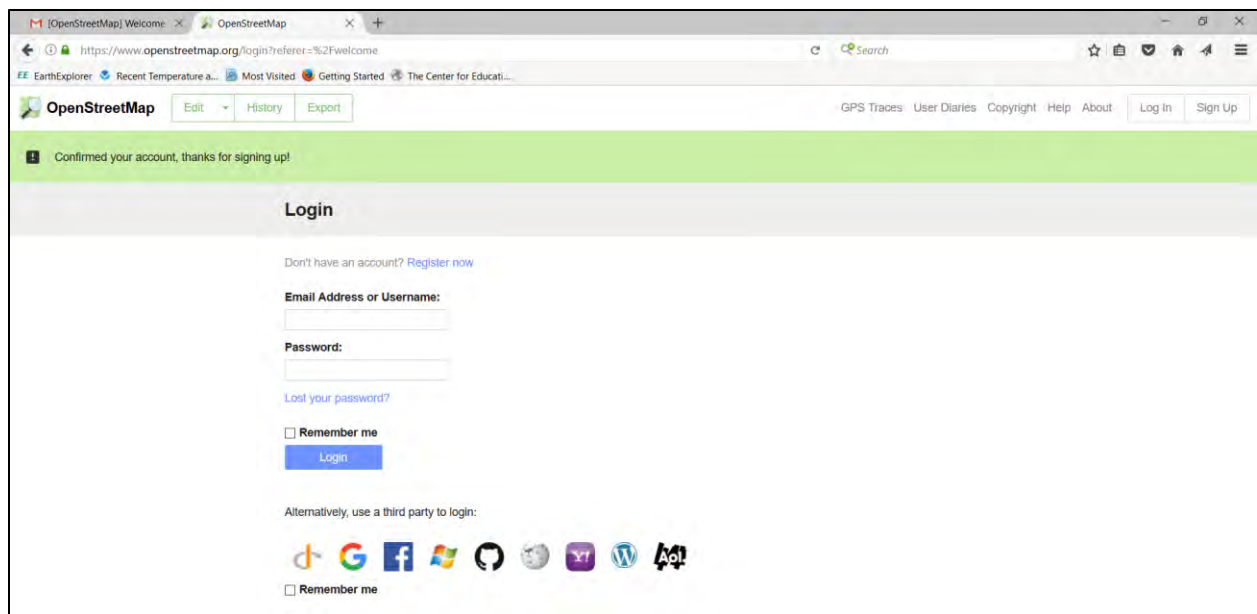
a. Your contribution of data should not infringe the intellectual property rights of anyone else. If you contribute Contents, You are:

☒ In addition to the above agreement, I consider my contributions to be in the Public Domain ([what's this?](#))

Please read the agreement and press the agree button to confirm that you accept the terms of this agreement for your existing and future contributions.

[Information to help understand these terms: a human readable summary and some informal translations](#)

You will get an email asking you to confirm that you have registered. Click on the provided link, and you will receive a confirmation, it takes you to a *Welcome Page* with basic terms for mapping. Click on *Start Mapping* to log in the first time.



The screenshot shows the 'OpenStreetMap | Welcome' page. At the top, there's a header with the OpenStreetMap logo and navigation links: 'Edit', 'History', 'Export', 'GPS Traces', 'User Diaries', 'Copyright', 'Help', 'About', 'Log In', and 'Sign Up'. Below the header, there's a green banner with the message: 'Confirmed your account, thanks for signing up!'. The main content area is titled 'Login' and contains the following text:

Don't have an account? [Register now](#)

Email Address or Username:

Password:

[Lost your password?](#)

☐ Remember me

Alternatively, use a third party to login:

☐ Remember me

Below the login form, there are icons for various third-party login providers: Google, Facebook, Windows, GitHub, and others.

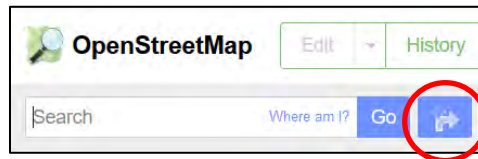
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4.3 Navigating in OpenStreetMap

You navigate in OpenStreetMap in many ways. Just like most other open-source GIS software. You can scroll in and out with your mouse wheel. You can also move east, west, north or south by left clicking on your mouse when your cursor is on the map and just dragging. Or you can use the navigation tools in the upper right corner.



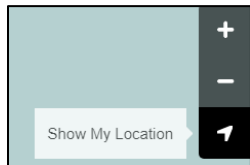
To navigate to a specific location, you can use the zoom tools, or the search engine in the upper left of the window:



You can also get direction from one location to another by clicking on the curve arrow at the end of the Search line (red circle above).

We will discuss the Edit, History and Export buttons in another section of this tutorial.

4.4 Understanding the Toolbar on the Right Side of the Screen

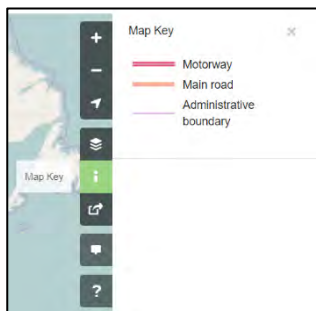
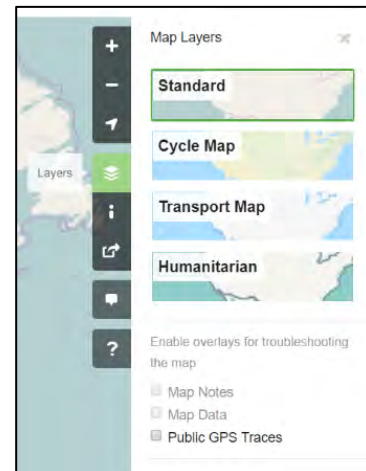


We have already discussed the first two buttons, zoom in and zoom out.

The next button is Show My Location. If you click on this button, you will get a message that this website wants to access your computer's location.

You will need to decide if you want that to occur, or check with your school's resource or technology officer for instructions.

In the next section, the first button is Layers. When you click on this button, it turns green and the Map Layers' table of contents opens. Remember, we are at the extent of CONUS, so you see some very general layers. Go ahead and click on each one to see how the map changes at this extent. Don't zoom in anywhere just yet, we will cover that below.

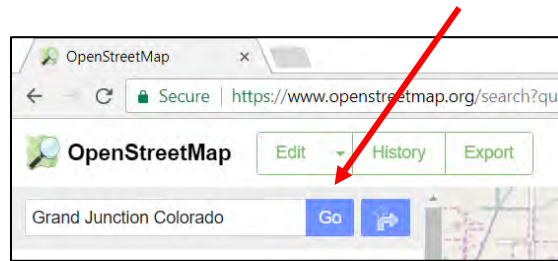


Next is called Map Key, what we normally think as the map legend. At this extent, only a few things are shown – Motorways, Main Roads and Administrative Boundaries. For this extent, Administrative Boundaries includes a solid purple line for country borders and dotted purple lines for states and provinces within each country.

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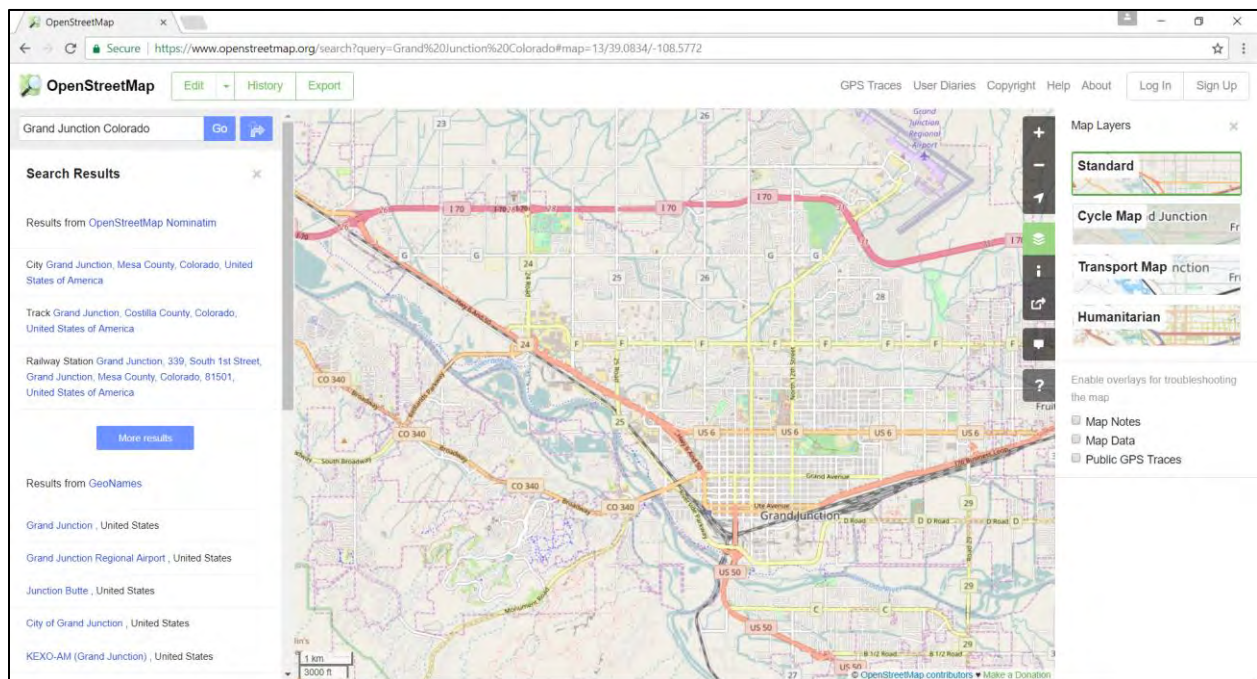
Now let's search for a location and see how the map, available layers, and map key change.

Search for Grand Junction, Colorado, don't forget to click on GO.



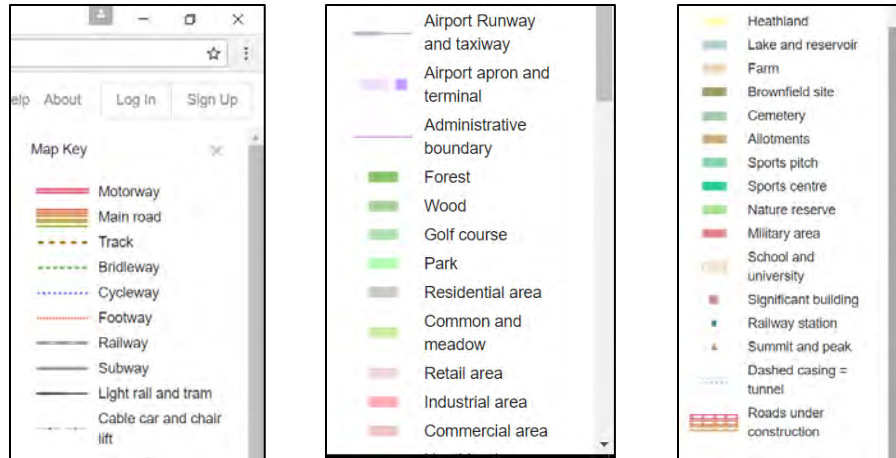
As you can see, many layers are now present in the map document – layers that were not present when we first entered OpenStreetMap and were zoomed to the extent of CONUS.

Click on Layers and Map Key to see what has changed.

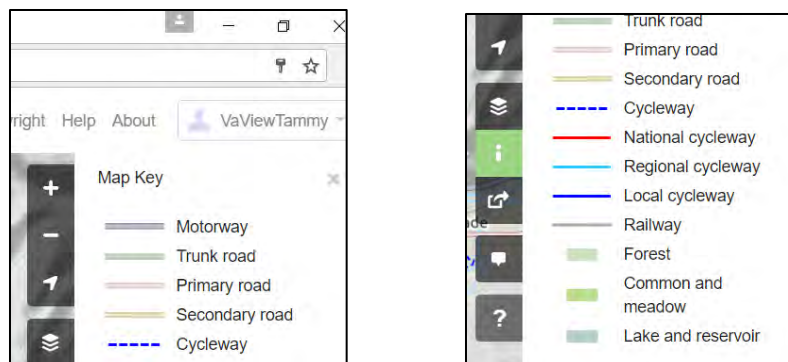
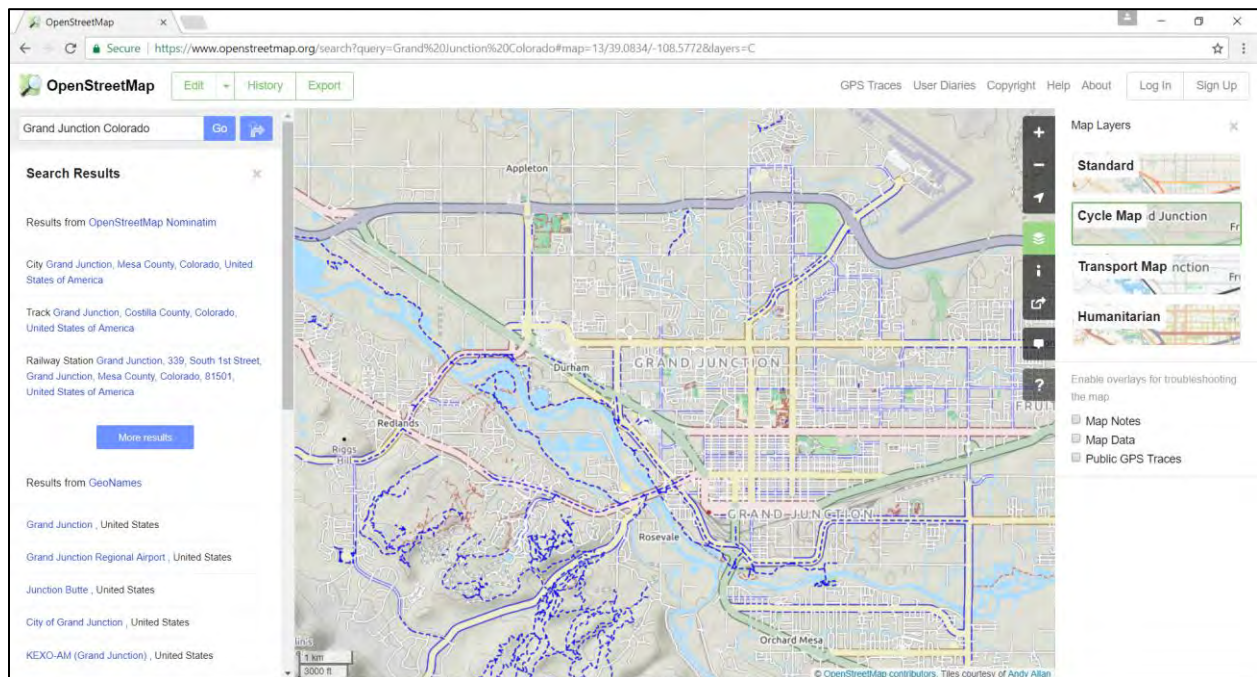


The Map Key has become quite extensive (note the screenshots below are from using the scrollbar on the right side of the Map Key):

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You may have noticed when you clicked on Cycle Map at the extent of CONUS, nothing really showed up. Go ahead and do it now that we are zoomed in. We see features and a Map Key.



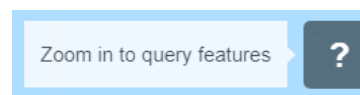
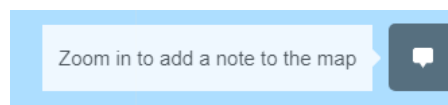
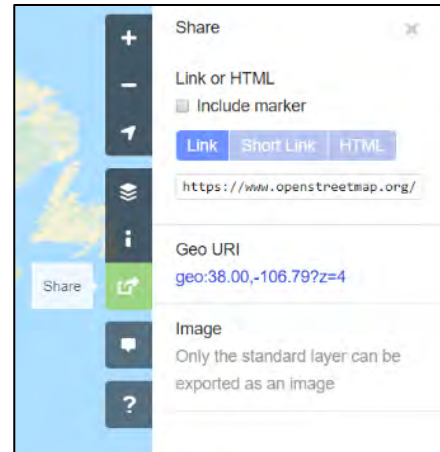
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Let's continue with the buttons on the right side of the screen.

Our next button is Share. If you click on this, you get a url link to copy and share.

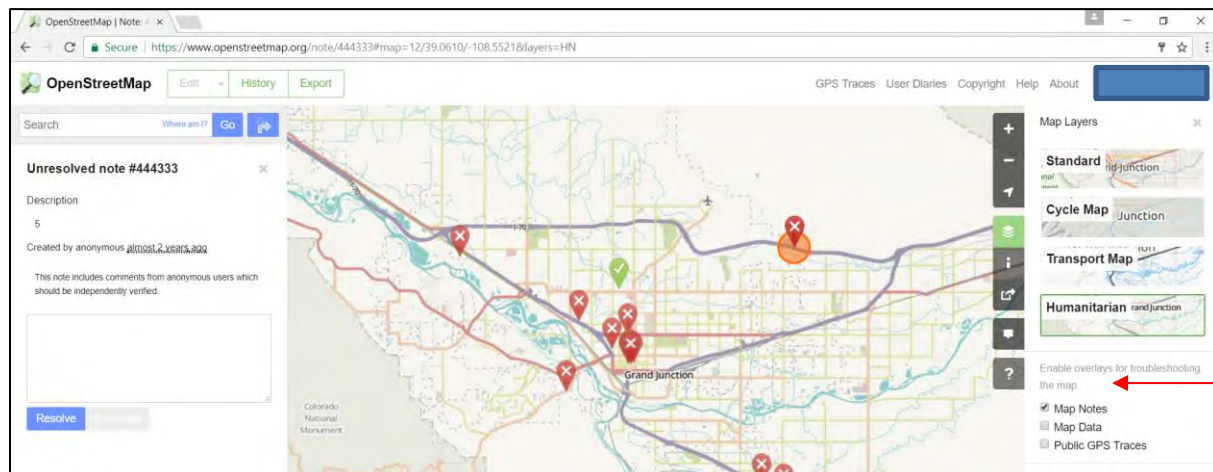
The last two buttons are Zoom in to add a note to the map and Zoom in to query features. If you are not logged in, neither will be active buttons.

In the following two screenshots, we are not zoomed in far enough to query features. That changes as we zoom in.



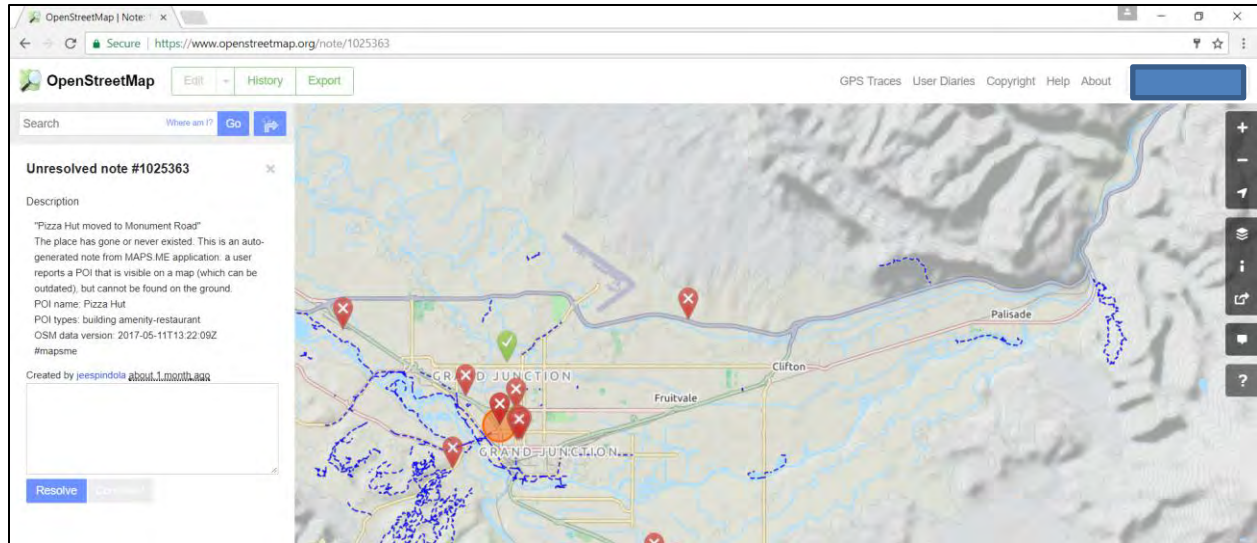
But, let's look at Map Notes first. Click on Map Layers and then underneath Layers, place a check mark under Map Notes.

This displays notes on the map where a problem may exist with data that a volunteer mapped. Yes, this is a volunteer project, but map information is verified and if it cannot be verified, a map note is added. In the below screenshot, click on the map note indicated with the orange circle. As you can see, whoever mapped it, only described it as 5. If you know what the feature is, you can add it in the description box to resolve it. This one would be a difficult one to resolve, so let's look at another.



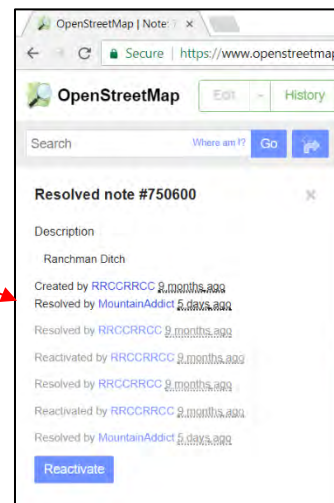
Now click on another one, one of the red balloons with an X. Click on the one shown below with the orange circle below it. A problem with this mapping project, a Pizza Hut was noted here, but as you can see from someone's notes, never was located here. You can type a message in the open box to help resolve this issue. You could also move the X to the correct location.

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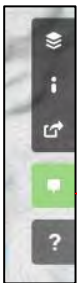


Now, let's look at one that is resolved. Click on the Green Balloon with the check mark:

As you can see, this is a resolved note. OpenStreetMap noted a problem with this volunteer mapping and others were able to resolve it.




So what do you do if you find a problem with features that have been mapped by volunteers?



First, uncheck the Map Notes in Layers and close the Layers table of contents.

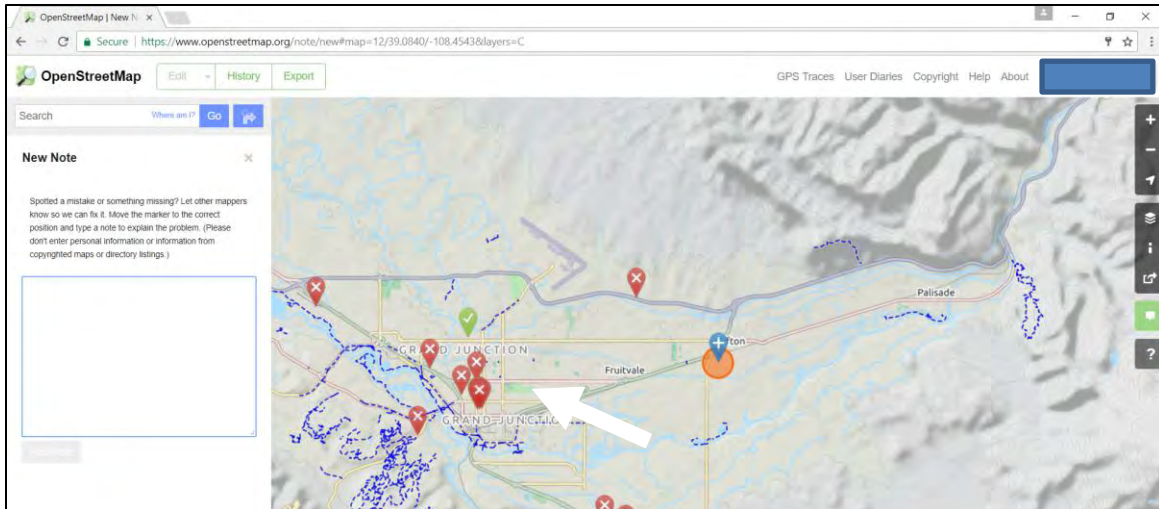
If you find a mistake in the map, click the little note on the right toolbar, it turns green.

It adds a blank note box on the left and puts a Blue Balloon with a + and an orange circle underneath on the map. In the box, you type the message indicating the problem with the feature mapped. To put the Blue Balloon on the right place, you place your mouse

cursor on the Blue Balloon, when you see the crosshairs , hold your left mouse button down and you can move the Blue Balloon to the correct location.

You may need to zoom in to find the exact location.

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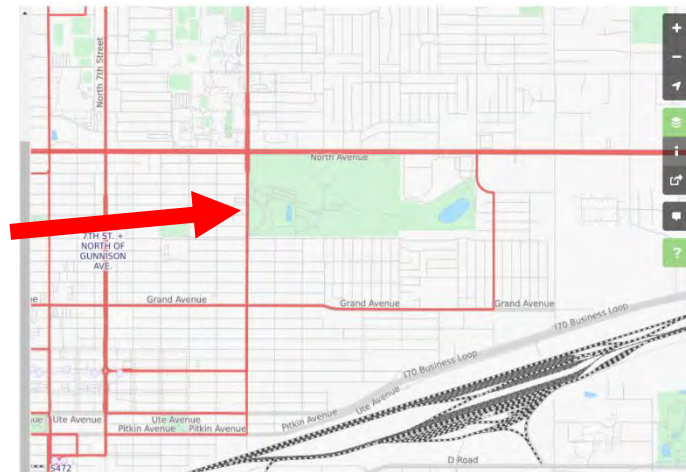
Why would you be interested in such a project? This could be a mapping project for your students, adding things to the map and resolving issues that the OpenStreetMap has found, or a project involving getting to know your city and navigating around the city from reality to a representation of your city in a map.

4.5 Query Features



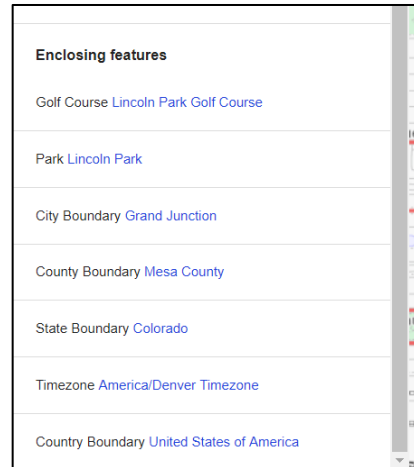
Click on the Question mark and it turns green. This is Query Features. You can then left click on any feature and it provides information.

First zoom in on the green rectangle (indicated by the white arrow in the screenshot on the bottom of the previous page). Once it is a bit larger, click on it.



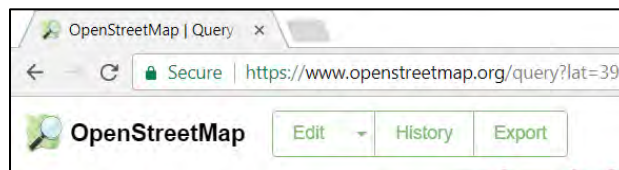
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Then look on the left side of the map. It provides details that have been mapped – Enclosing features. Why isn't there more information? Remember, this is a volunteer open-source mapping project. If Grand Junction, Colorado is the location of your school, perhaps a mapping project for your class would be to add additional features to the map. Within Grand Junction, we have several roadside sculptures that are permanent features. Such things can be added and might be useful to visitors in the city. Perhaps your city does not even have the streets named. Start with your school location and work outwards.

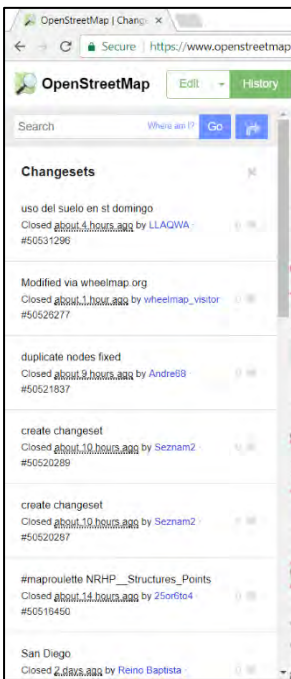


Let's talk about two additional buttons, then we can start talking about how to do mapping.

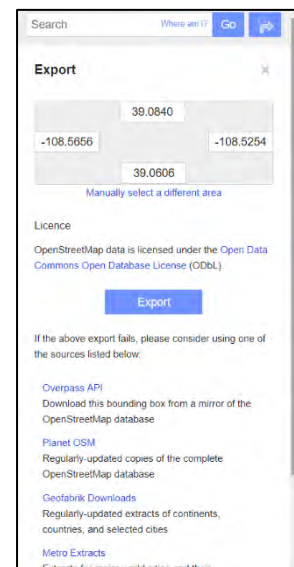
Look at the top of your map – three buttons – Edit, History and Export.



History provides details on mapping within this extent. Clicking on it for this extent of Grand Junction – we have a very active mapping community – some were completed just a few hours ago. It shows who did it (your user name that was set when you signed up, so we don't know the individual people's identity). Please note that you can join your local group, or form a local group if one does not exist, to help update the map.



Let's look at Export – just what it sounds. It allows you to export the map. You can export it in the extent showing in the map window (which automatically populates in decimal degrees), you can manually change the extent - one or all four of the boundary lines. You can also choose what map sources to export. Once you are happy with the choices for your export, you click on Export in the blue box.

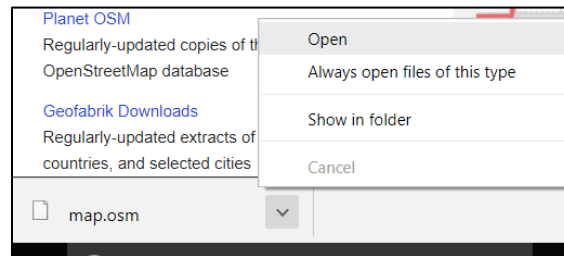


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Once the export is complete, you will see the following at the bottom of your map document window:

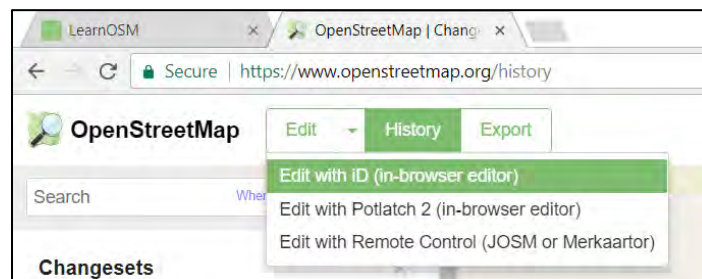


Click on the ^, then click on open. If you have any difficulty with opening this type of file, please see your IT administration for assistance.

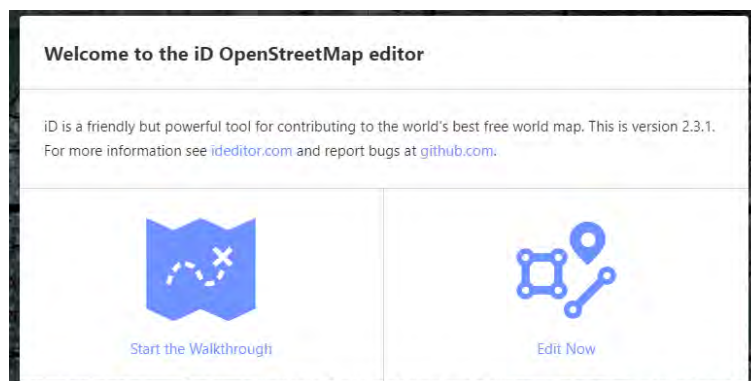


4.6 Editing in OpenStreetMap

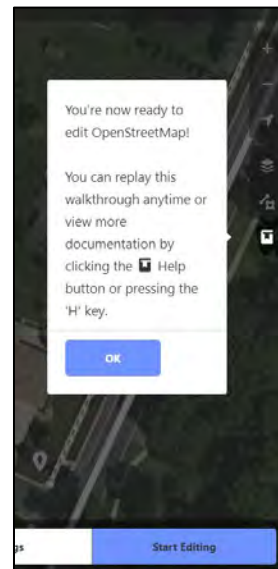
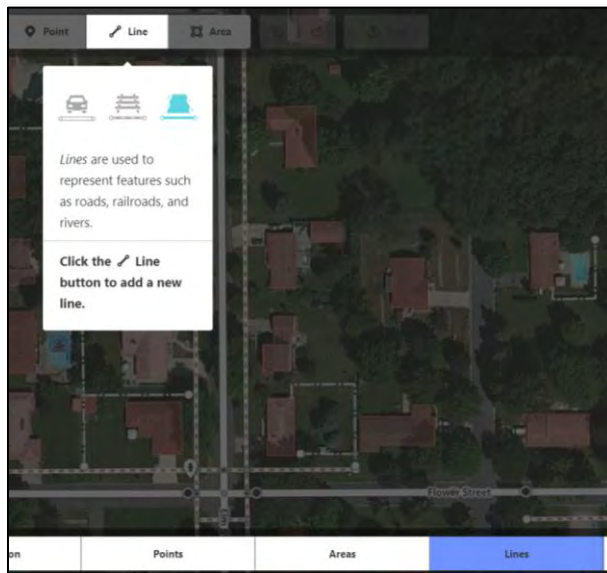
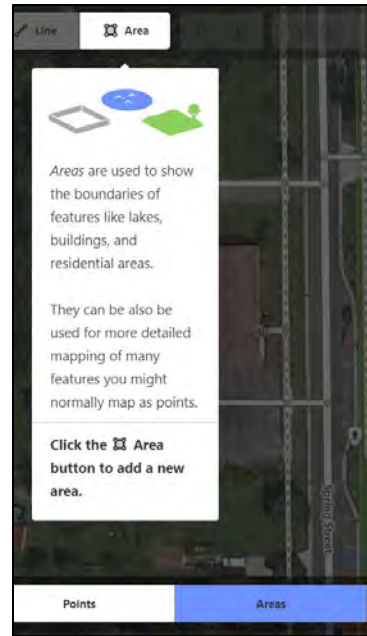
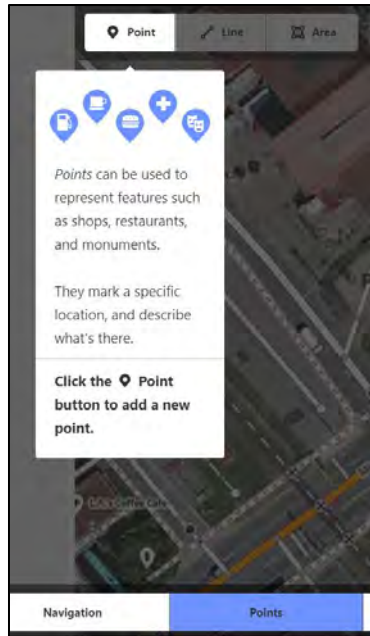
You have to be signed in to edit a map. You want to navigate to the area you want to edit and zoom in. OpenStreetMap gives you a step-by-step instruction on editing. Once you click on the down arrow next to Edit, choose Edit with iD.



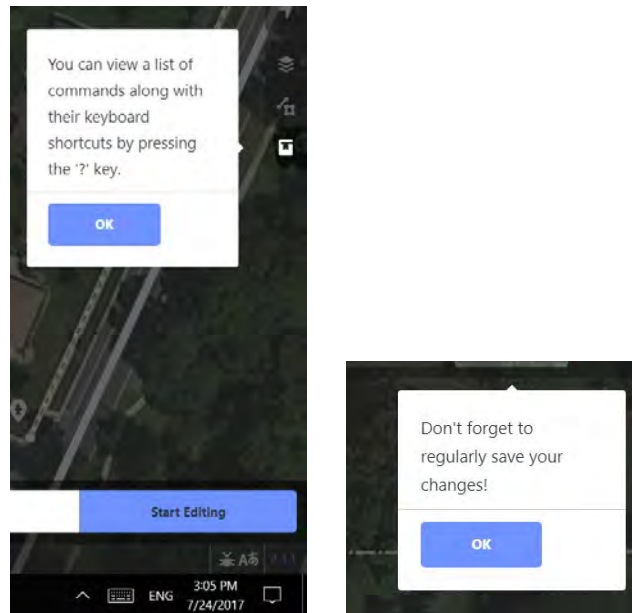
You will get the following message. You can proceed to Edit Now or Start the Walkthrough. The following screenshots provides the walkthrough.



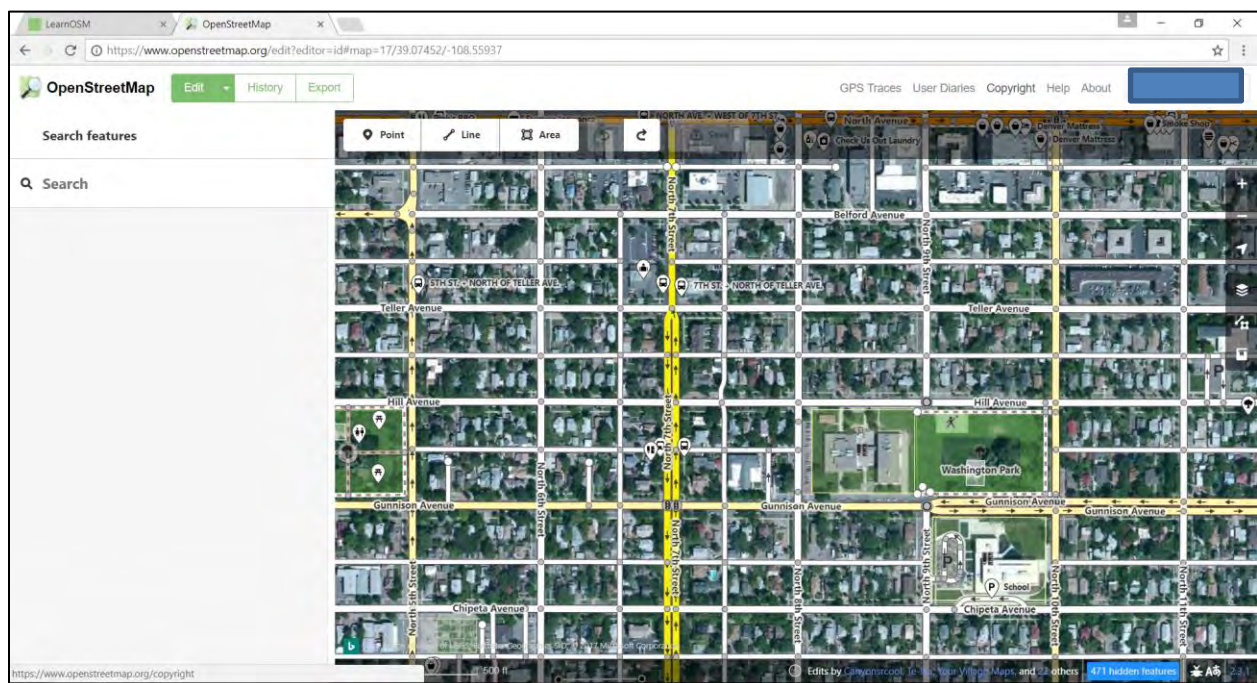
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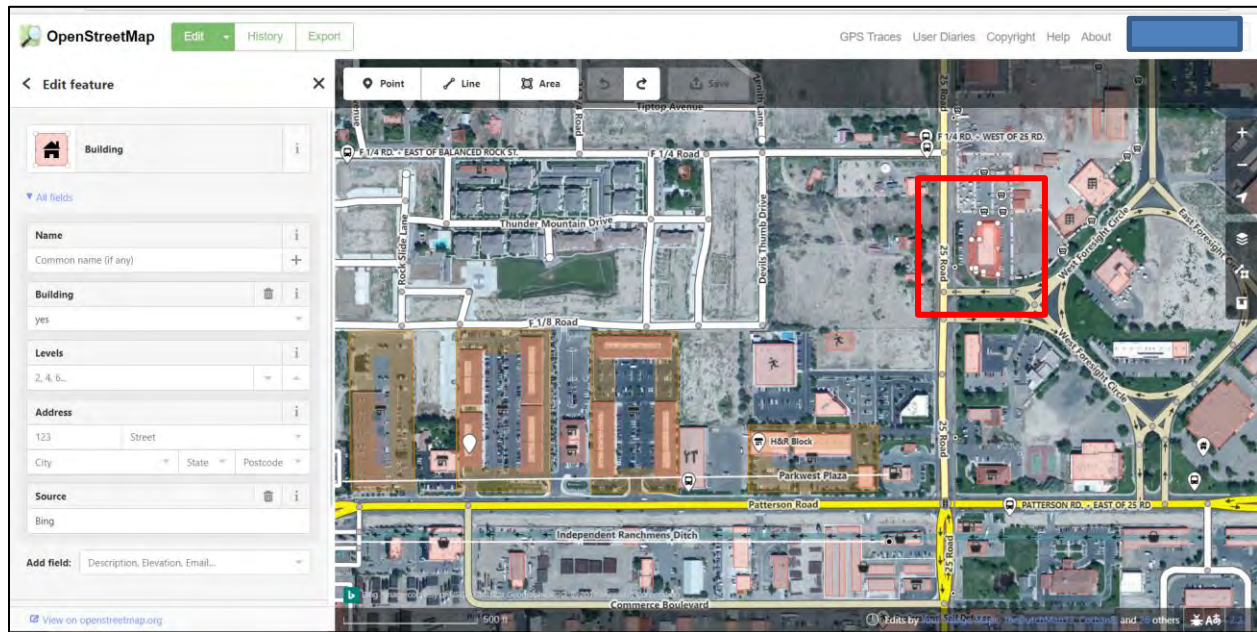
Once you have finished the walkthrough, or if you went straight to start editing, you will see the following -- an aerial photo as your base layer and those features already mapped by volunteers.



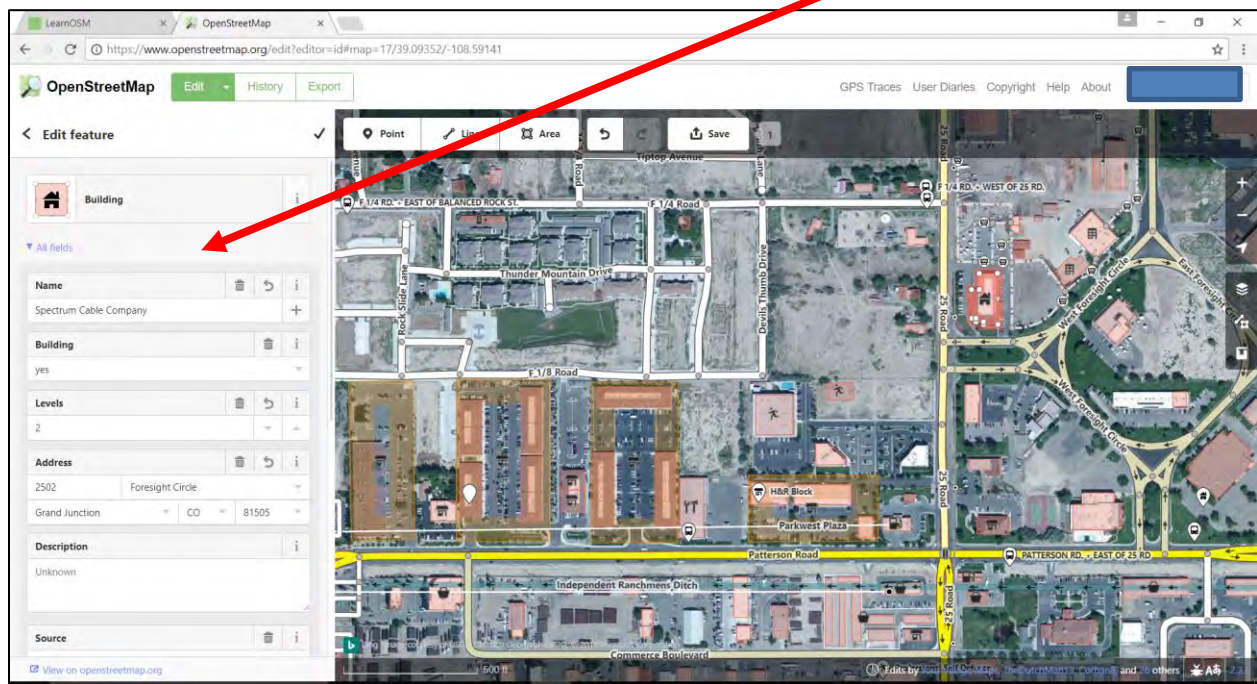
Now you need to navigate to the specific place you want to edit. In the following screenshot, I have navigated to the local cable company. The building is on the map (red rectangle) but it has not been identified.

Click on the building to highlight it (the nodes were added) and a window on the left pops up, so you can add the detail.

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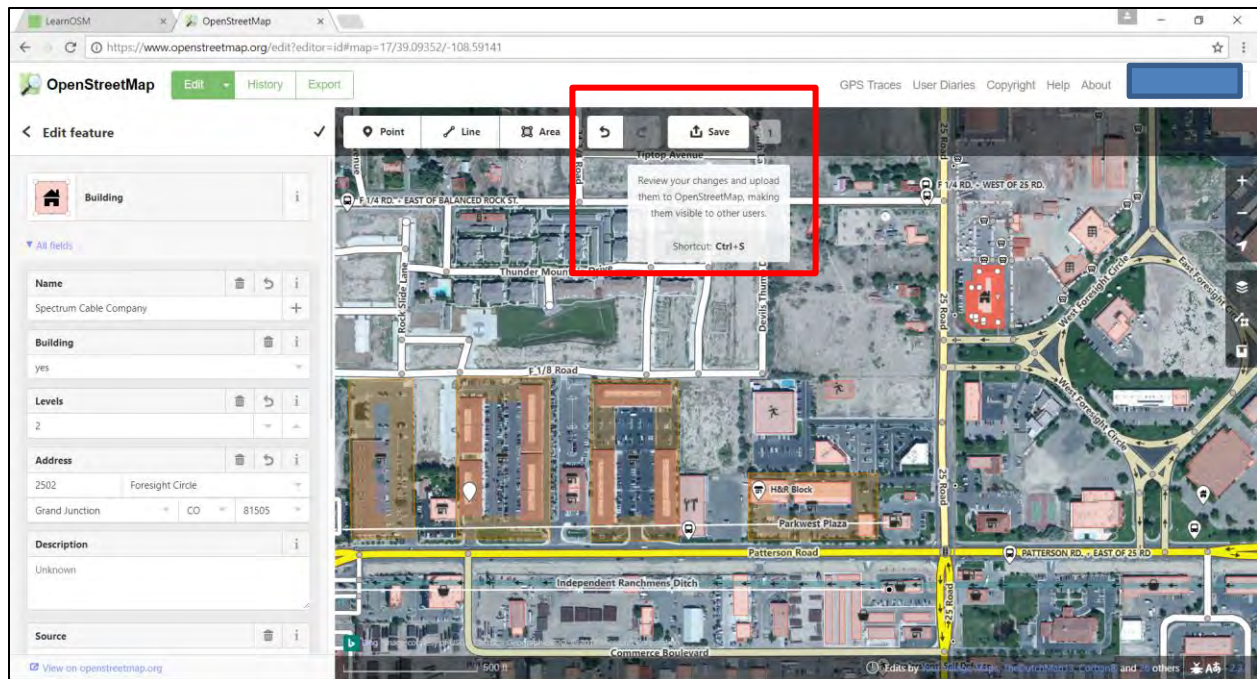


In this screenshot, detail for the building was added.



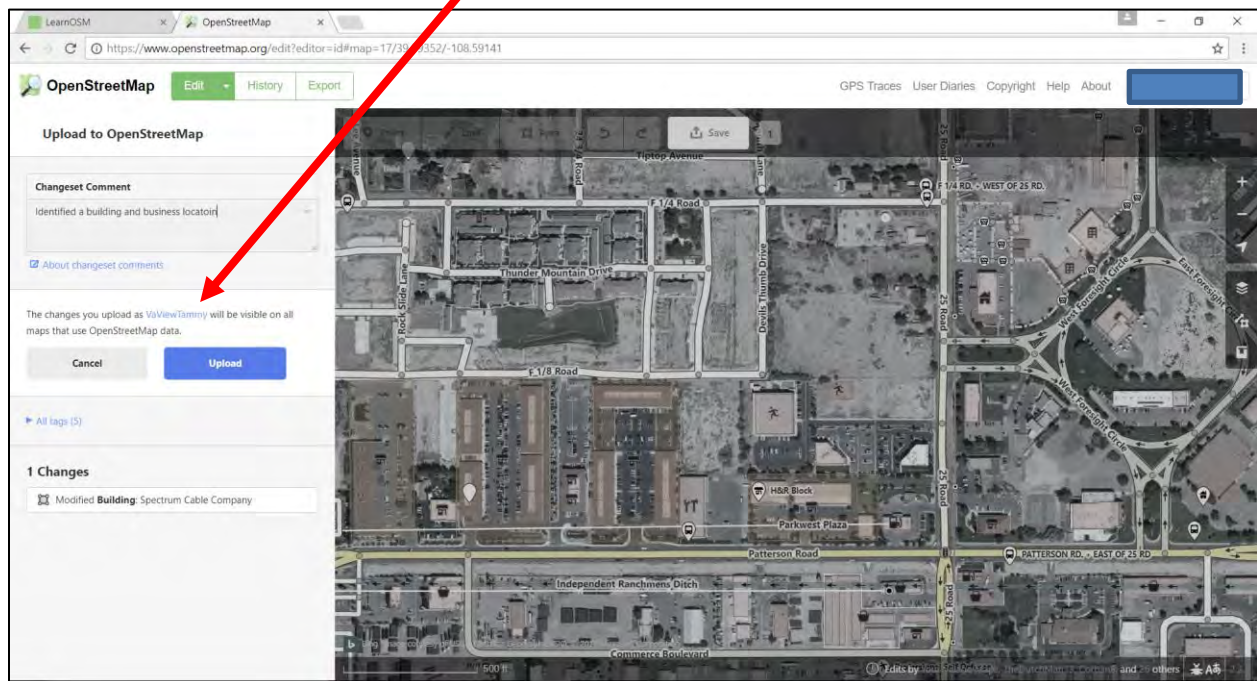
Then click on Save (red rectangle) and receive a message to review the changes.

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Once received, you will be required to add a Changeset Comment (this is what shows up in History as outlined above). You can review before uploading to make sure your comment is correct, and spelled correctly.

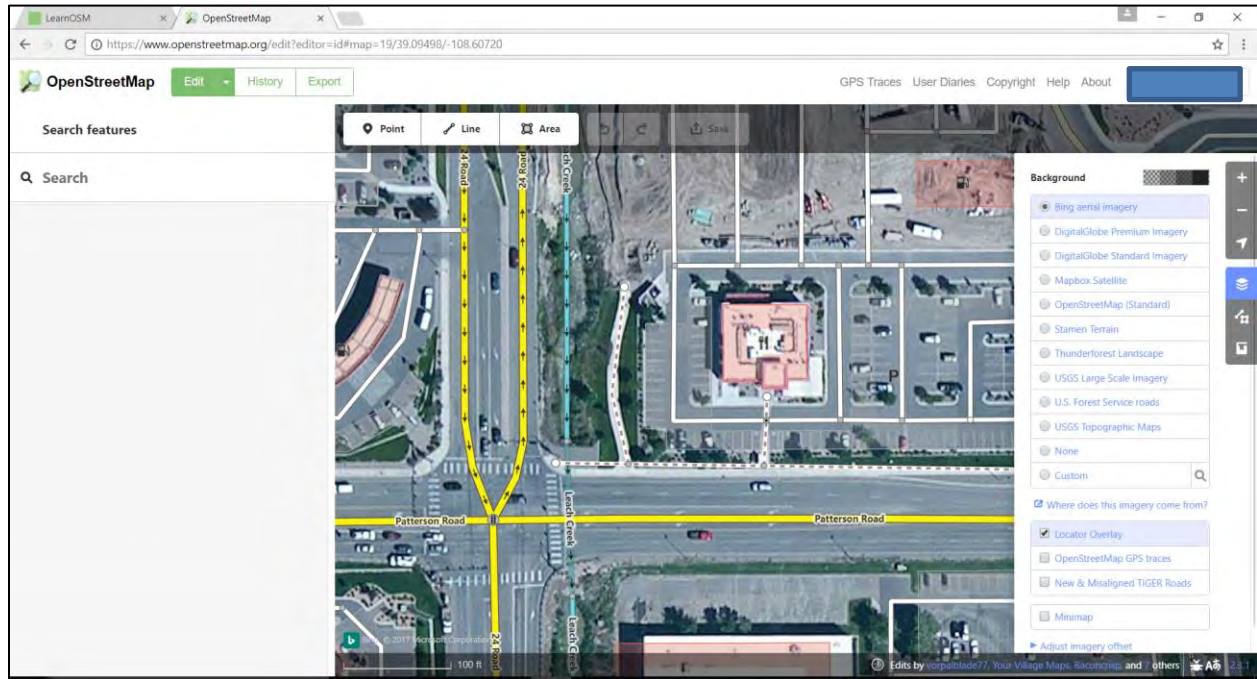
Once you are satisfied, click Upload.



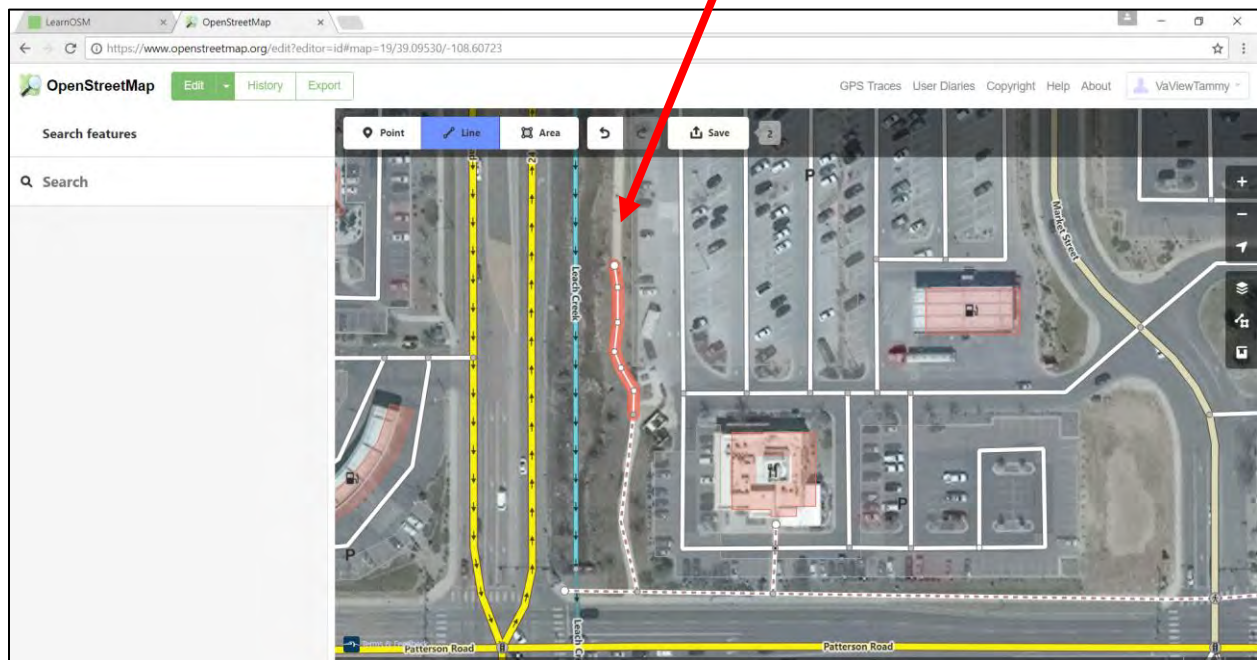
You can also change the aerial imagery that shows as your reference information.

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Click on Layers and you can see the optional list of available imagery.



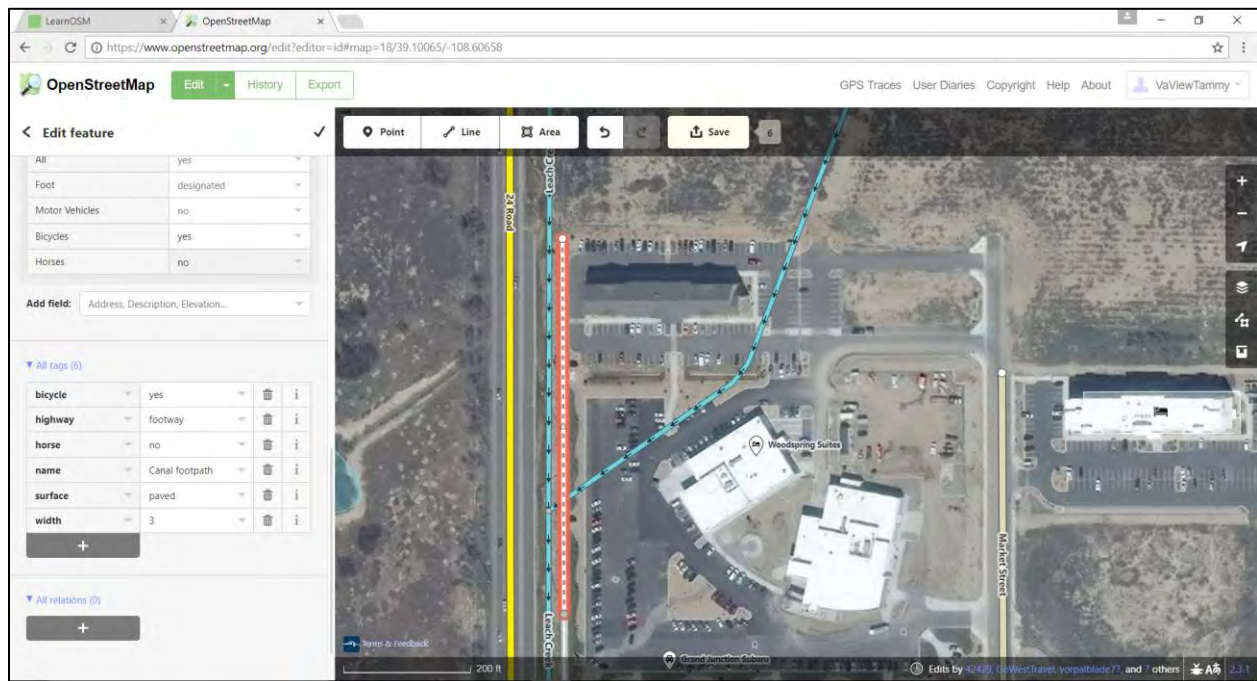
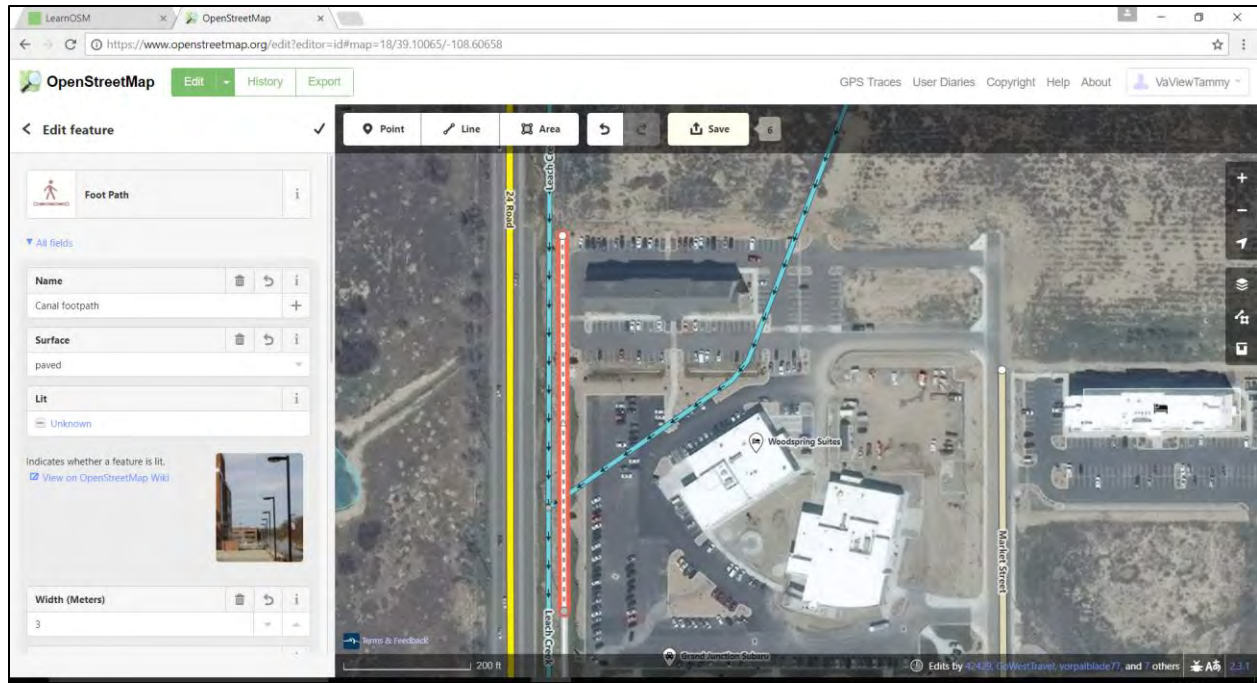
Click on DigitalGlobe Standard Imagery and you receive a much more detailed base image. In this case, add a line feature to extend a footpath that is located along a canal, which can be seen clearly with this imagery.



Click on Line (the button turned blue in the above screenshot), then click on the last node to activate the connection -- following the footpath in the base imagery, adding a node each time

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the footpath curved, following the footpath exactly. Once you followed the footpath to the end, double click to stop editing. The next two screenshots shows the detailed information added for the footpath on the left -- metadata. When complete and satisfied with the change, click on Save and once satisfied with your review of the information, click on Upload, as before.



Editing a map is an excellent exercise for students to identify features, understand addresses related to features, understand what type of features are found adjacent to others, and their

Exploring Our Planet with Open Source Software

relationship. It also allows students to learn and navigate around their local area. Please note that you are contributing to a mapping community, so be sure that your students are of sufficient knowledge and educational level to add accurate information to this open source mapping community.

This concludes this tutorial. You can do many other activities with OpenStreetMap, and this tutorial was just an introduction to get you started.

4.7 For more information and guides to using OpenStreetMap

If you are interested in going a local group or a local chapter, hosting a mapping party or joining the OpenStreetMap Foundation, go to: http://wiki.openstreetmap.org/wiki/How_to_contribute

For more information about OpenStreetMap Foundation, see:
http://wiki.osmfoundation.org/wiki/Main_Page

The beginners guide to OpenStreetMap can be found at:
<http://learnosm.org/en/beginner/introduction/>

When using Open Street Map, please be sure to follow all copy right laws. Copyright information for Open Street Map: <https://www.openstreetmap.org/copyright>

All screenshots within this tutorial are credited to: © OpenStreetMap contributors

If you wish to obtain further information about the DigitalGlobe imagery seen in OpenStreetMap: http://blog.digitalglobe.com/news/digitalglobe-satellite-imagery-launch-for-openstreetmap/?utm_source=gplus&utm_medium=social&utm_campaign=OSM

Please note that we have not yet completed any YouTube videos related to this chapter.

5 Google Earth Desktop

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This tutorial introduces you to Google Earth Desktop (not Google Earth Web or Google Earth Pro, which are covered in different tutorials). This version of Google Earth is no longer available, but we include this chapter for those who have this old version.

5.1 Introduction

Google Earth has 3 formats - (a) a mobile device version, (b) an on-line web version, and (c) a version called Pro (a prior version was just called Google Earth Desktop and was replaced by Google Earth Pro). In this tutorial, we explore the old Desktop version. In many instances, if you had administrative control on your computer, you will find that it was replaced by Google Earth Pro during an update. Google Earth Desktop is a GIS because it provides a map display and Table of Contents where you can layer multiple files on top of the map document, and it has some basic features of a GIS and allows some personal mapping.

We will not be covering all features and abilities within Google Earth Desktop. We will cover some basics about settings, historical imagery, layers already present, and how to add data from a KML file and a GPS unit. We will also cover some basic editing of features and drawing.

If you are using Google Earth Pro, we recommend that you complete this tutorial. All capabilities within Google Earth Desktop are available in Google Earth Pro. With the exception of the name – Google Earth vs. Google Earth Pro at the top of the program page, all screenshots should be the same or very similar.

Please note, if you are a K-12 Educator, please read the Google Earth Acknowledgement and Use Agreement form as restrictions do exist depending on the age of your student. The Google Earth terms of service are located at <https://www.google.com/earth/download/ge/agree.html>

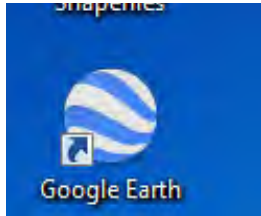
5.2 Let's Get Started – Downloading Google Earth Desktop?

You can no longer download Google Earth Desktop. If you wish to have a desktop version, you will need to download Google Earth Pro, directly from Google Earth Web at <https://www.google.com/earth/>. Once you have launched Google Earth Web, click on the Menu button and at the bottom of the Menu pop-up window, you see a link to download Google Earth Pro.

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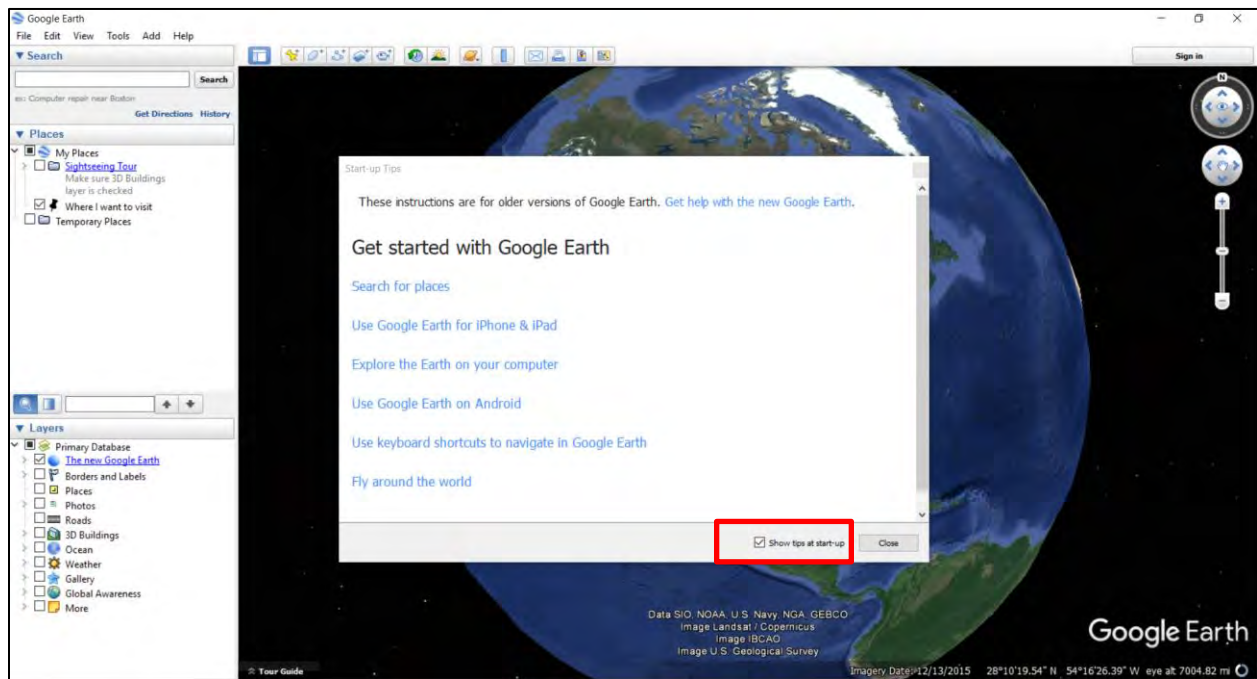
How do you know if you have Google Earth Desktop (older version) or Google Earth Pro?

You will see the following icon for Google Earth Desktop:



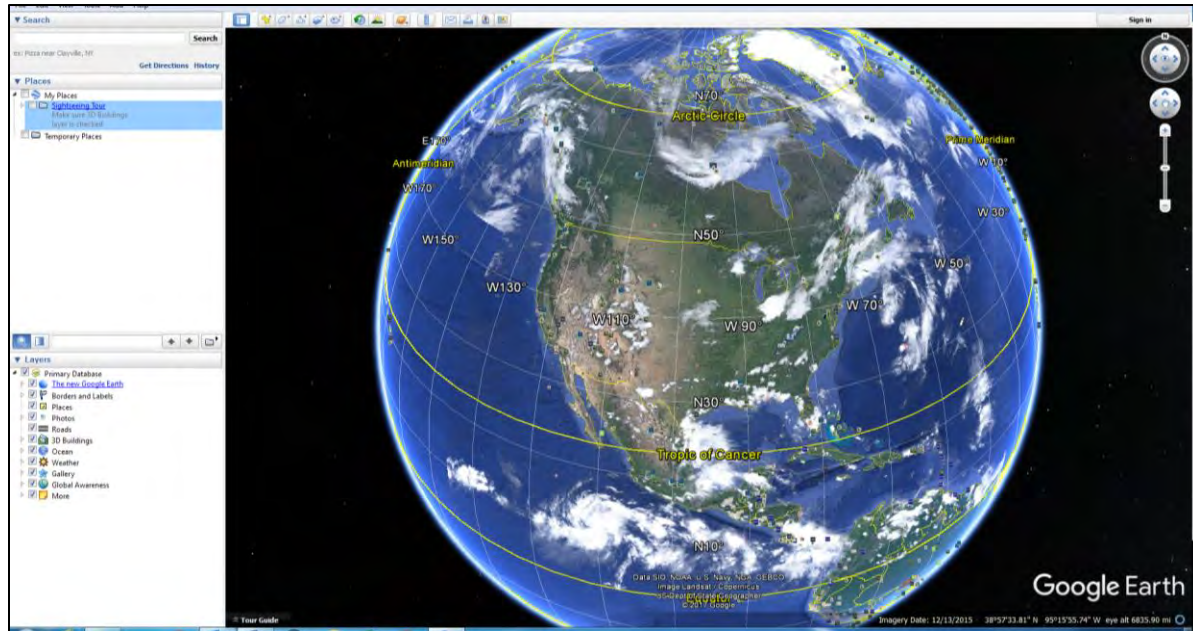
5.3 Using Google Earth Basics

Open Google Earth Desktop by doubling clicking on the icon. You will see the following:



Start-up tips is enabled. We recommend that you leave this enabled until you get used to using Google Earth. If you don't want it enabled, unclick the box at the bottom that says *Show tips at start-up* (red rectangle above). Once you have finished reading this information, click *Close* and the follow will show:

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We are going to explore this window for a bit. On the left is the Table of Contents (actually two different ones-- we will discuss these later). On the right is the Map Window.

Within the Map Window, you see the lines for the Geographic Grid, in this display, lines of latitude and longitude. At this extent, it is only showing major divisions. You can turn on and off the Geographic Grid and we will cover that under settings.



In the upper right hand corner are the navigation tools.

You can:

Rotate the Earth, north and south or east and west, with either of the two icons.

Zoom in and out with the slider bar (you can also zoom in and out with your mouse wheel).

Play with these icons. Can you get the Earth to turn upside down (south on the top and north on the bottom)?

5.4 Metadata

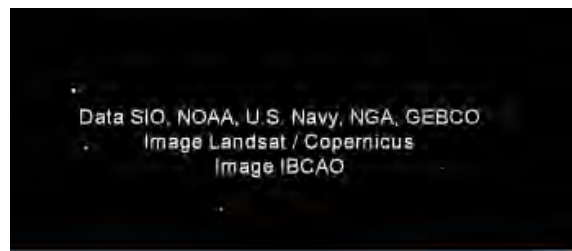
Metadata is an important topic to understand. Go to the lower left hand corner for your first set of metadata. From right to left, you find altitude, latitude and longitude and the imagery date. Because we are in space right now looking at the Earth, the altitude is quite high, and measured in miles. As you zoom in, this will change. How do you know what spot on the Earth this figure represents? It is where your mouse pointer is located. The latitude and longitude are also for the location of your mouse pointer. In this display, latitude and longitude read as degree minutes and decimal seconds-- you can change these settings as we will discuss later. At this extent, if

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you were to put your mouse in space, that reading will disappear. Finally, the image date – for this extent, this map of the Earth is a composite of the images, so the date represents the latest date for the composite of images. As you zoom in and out, the display date will change to the latest date that Google has for the image for that specific location on the Earth. This date also changes when viewing historical imagery, which will we cover later.



The other metadata information is extremely important – the source of the image displayed in the Map Window, located in the center at the bottom. When you are zoomed out to this extent, you see many sources because, again, this extent shows a composite of images.



If you were to zoom into one specific locale, you would get more specific information, for example Grand Junction, Colorado – is an aerial photo instead of satellite imagery and from the USDA (United States Department of Agriculture).



If you continue to zoom in and go to the extent of Street View, you will get © 2017 Google. Most Street View images are acquired by Google.

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Other metadata can be found throughout Google Earth, especially when adding files under My Places, or look at the Layers already displayed in Google Earth. We will discuss these as we proceed.

5.5 Table of Contents – Google Earth Default

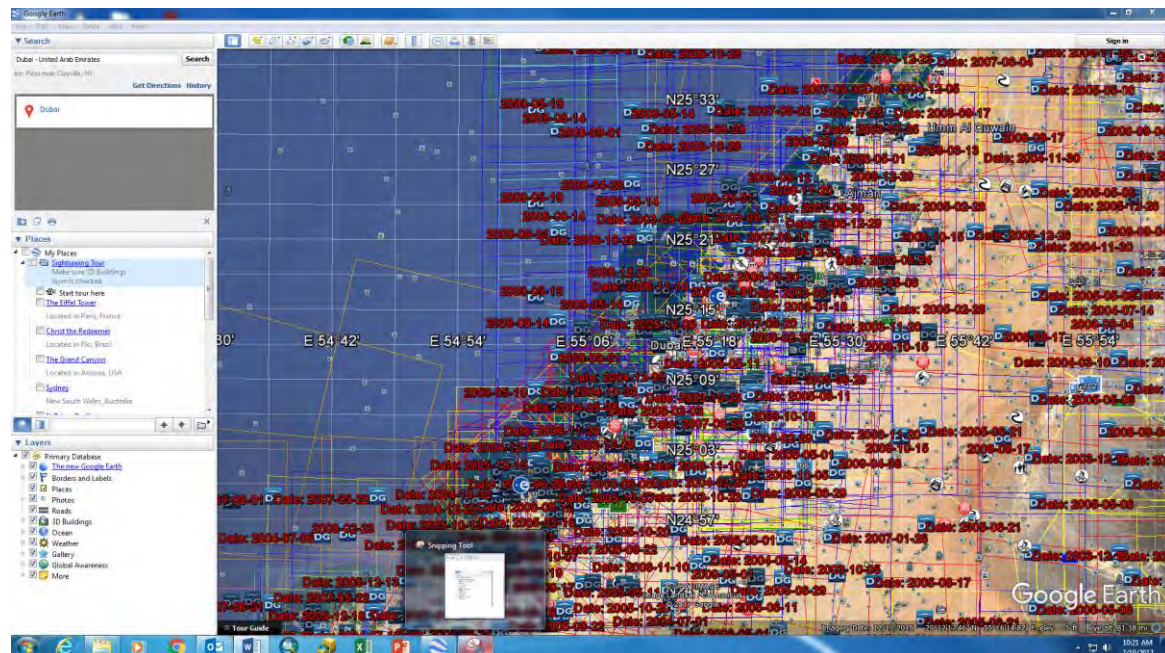
On the left hand side are two Table of Contents. The one on the top is called *Places* and this is where you will see any new files (layers) that you add to Google Earth. We will discuss this later.



The bottom Table of Contents automatically comes with Google Earth. Yours may look just a bit differently (check marks are present on all layers, which means all of these layers are turned on). You can turn layers on and off by checking or unchecking. (The same applies when you start adding your own layers to *My Places*.) Go ahead and check them all.

Let's see how some of these work. First go to the top of the Table of Contents and search for Dubai, United Arab Emirates.

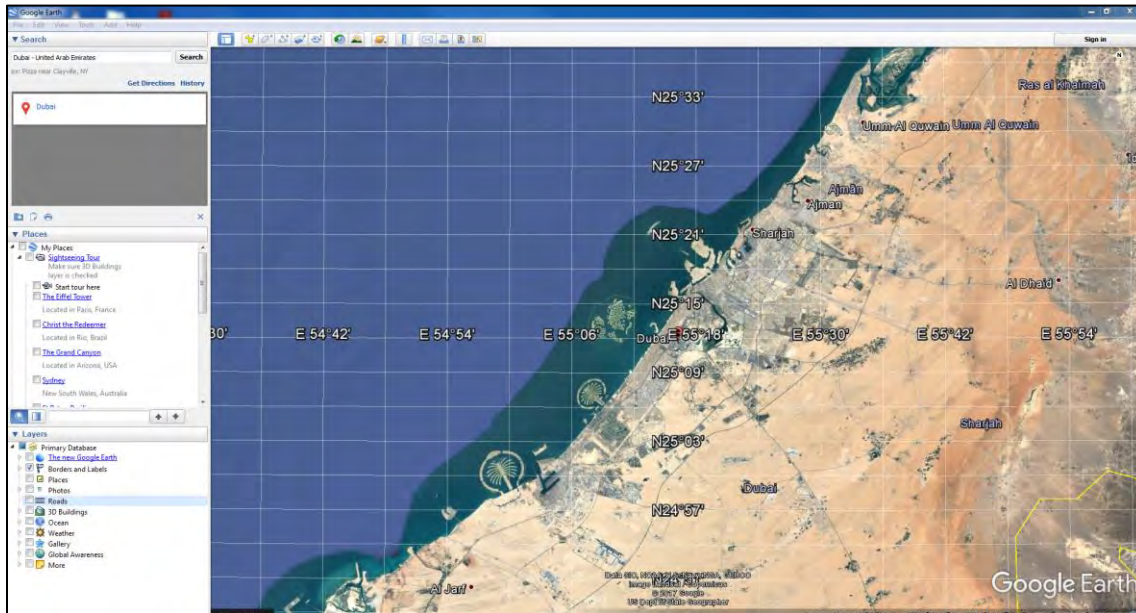
You will see this:



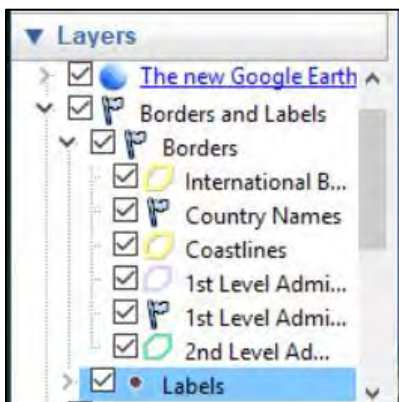
It's a bit messy. That is because we have all the layers turned on. Uncheck all layers except *Borders and Labels*.

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Your image should now look similar to this, much cleaner. But what is the symbology?

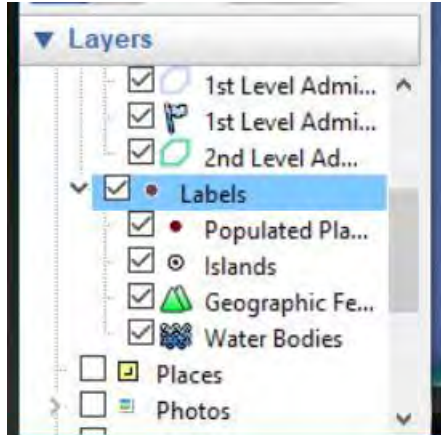


In the Table of Contents, click on the > next to *Borders and Labels* (red circle to the left) to expand it. It expands into two more categories – *Borders* (polygons) and *Labels* (points). But notice, we have two (2) more >, one next to each category. Click on each of these to expand further.



First, look under *Borders*-- we now have 6 different layers. Yellow polygons, hollow inside, are *International Borders* and *Coastlines*; light blue are *1st Level Administrative Borders* (*States/Provinces*) and cyan is *2nd Level Administrative Borders* (*Counties*). The Flags are layers including *Country Names* and *1st Level Administrative Names* (*States/Provinces*). We only see *International Borders* and *Coastlines* in Dubai because United Arab Emirates does not have those Administrative levels as we find in other countries.

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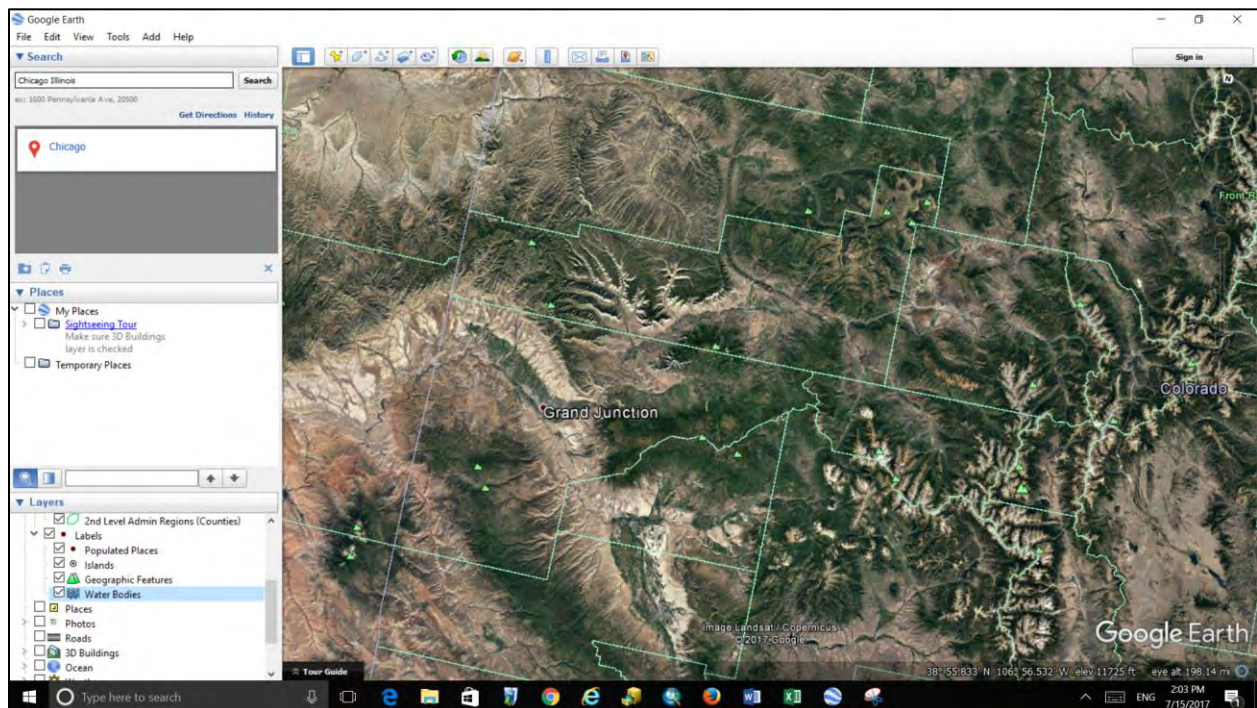
Now look under *Labels*.

We have red points for *Populated Places*, a point surrounded by a circle for *Islands*, green triangles for *Geographic Features* and waves for *Water bodies*.

We only see some red points in the extent for Dubai because the other features are not present.

If you want to see what some of these other features look like in your Map Window, zoom into the state of Colorado, United States. We now have both *Administrative Levels* and some *Geographic Features*. You see only *1st Level Administrative Names* because we are not zoomed in close enough to see the county names.

In this Table of Contents, the symbology is set by Google, so you can only turn it on and off, you cannot change the colors or the icon.



Let's explore another layer. Please now go back to Dubai.

Check Photos and you will see little images of jpegs but also a red circle with 360 on it (If you don't see any 360 photos, you may need to zoom in a bit.) Click on one of the red 360 circles. It provided a pop-up with additional information – more metadata. Go ahead and close the pop-up.



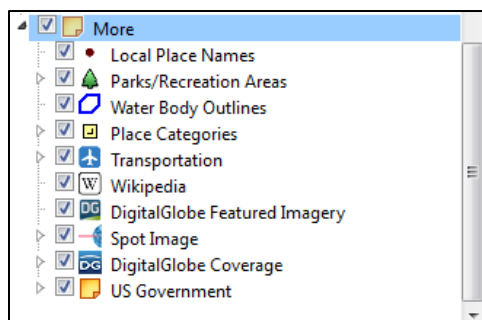
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Now click on any of the photo icons. You get a photo that has been uploaded by an individual person (image on the left below). In this case, the person uploaded two. If you have photos of a specific location, you can upload them to Google Earth. However, if you do so, you lose your rights to the photos, they then enter public domain. Thus, a screen shot, as seen below, can be posted. If you click on *Fly to this photo's location*, if Google has a *Street View*, you will get that (although it does not for this location). Otherwise, you will might get a blurry image (middle image below). You can click on the *Street View* icon and if a *Street View* image is not available, you will see *ground view*, noted in the upper right hand corner of the Map Window (image below on the right).



Go ahead and turn others on and off to familiarize yourself with the data provided. The messiest one is *More* (we will discuss that topic just a bit. If you click on the > in front of the word *More*, it extends the number of layers. Now you can see why *More* is the messiest – it is adding at least 9 more layers.

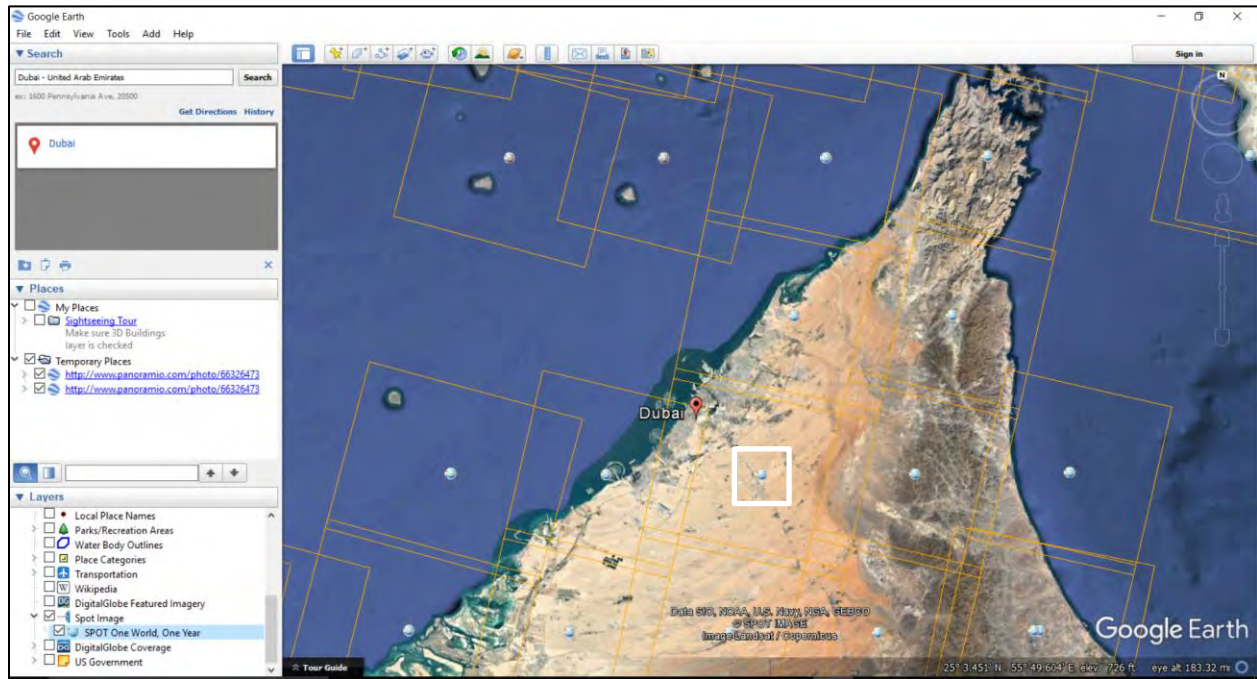


Two of these layers require additional discussion – *Spot Image* and *DigitalGlobe Coverage*. Turn on *Spot Image*. You don't see much, except some lines. *Spot* is a satellite system-- the lines represent the boundary of the satellite scene⁷ covering the area. Let's take a closer look. Turn off all the layers except *Spot Image*, *Spot One*

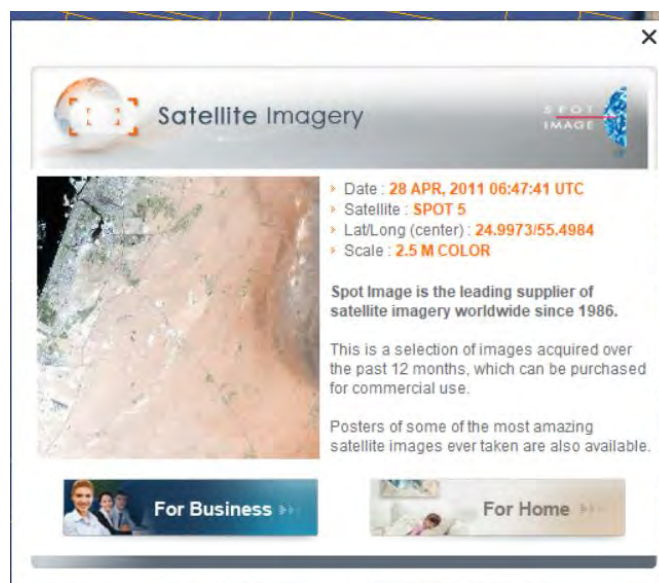
⁷ A Spot Scene boundary is the area covered by one Spot Satellite image. For more information on Spot, and Spot One World, One Year go to <http://www.intelligence-airbusds.com/en/143-spot-satellite-imagery> or <https://www.gim-international.com/content/news/spot-image-launches-one-world-one-year-imagery-layer-on-google-earth>

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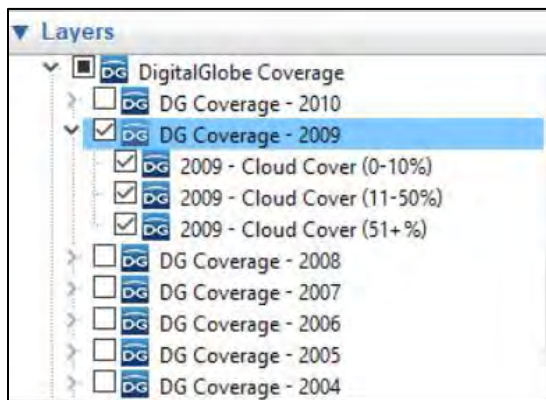
World, One Year. Zoom out just a little bit so your Map Window looks like the following screenshot (we need to be able to see the boundaries of one Spot scene):



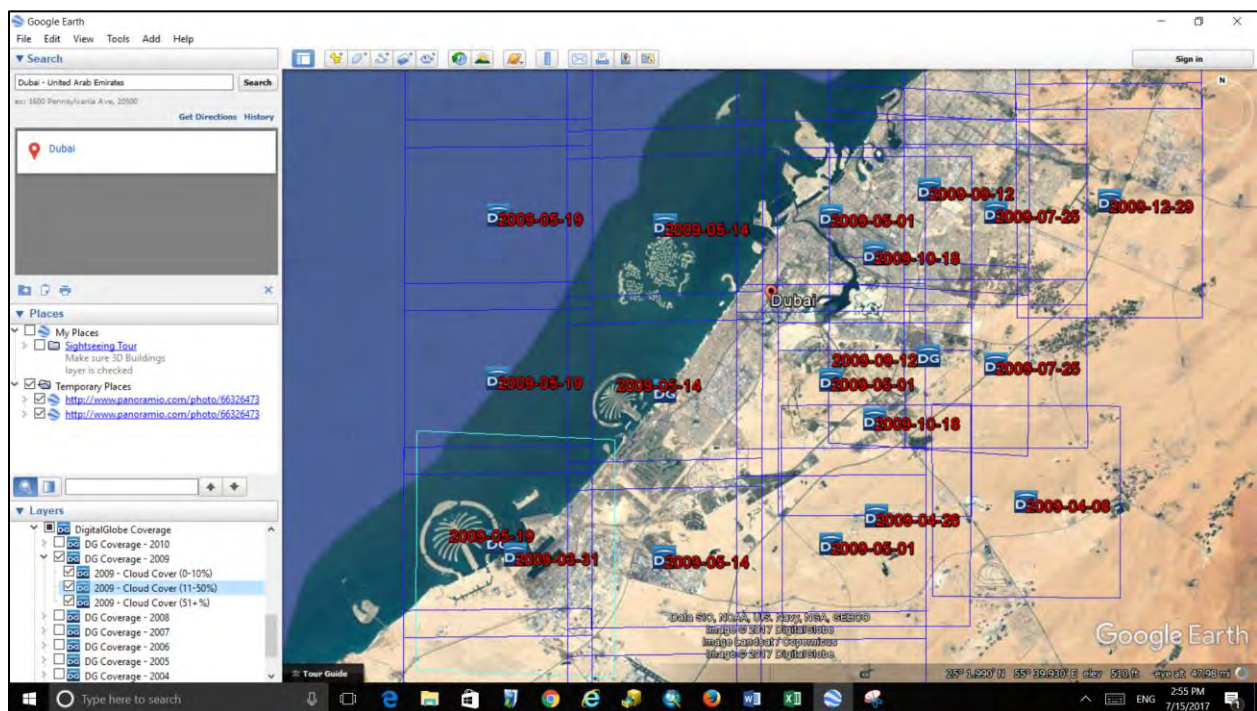
Click on any one of the round circle icons (white box indicates that one is clicked for this tutorial). This pop-up provides additional metadata for the satellite image contained within the boundaries shown thus-- an image was acquired by Spot 5 on the 28th of April, 2011 at 6:47:41 UTC (Coordinated Universal Time, formerly Greenwich Mean Time).



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Now, turn off *Spot* and turn on *DigitalGlobe⁸ Coverage*. This is the messiest of them all. If you expand the layer, you encounter multiple years of *DG Coverage*. You can turn these, individually, on and off. In the screenshot on the left, turn on the year 2009 and expand the layer. You have different levels of cloud cover. The blue boxes are actually the boundaries of the individual scene.



Look at the Map Window, you see lots of lines and DG in a blue box with a date underneath in red (metadata). The date tells you the date of the Digital Globe Image (again you may need to zoom in or out to see these). If you click on the blue box, it will display some metadata on the image – including the Digital Globe ID No., the Cloud Cover and Quality data. It also has the word [preview](#). You can click on that word, and then you have to be patient while it loads the Digital Globe image – look at the bottom and you see a green status bar. You have to be very patient, it takes time to load. You might also have the page expire, depending on your internet connection. You may need to click on Open in Internet Explorer button in the upper right hand corner.

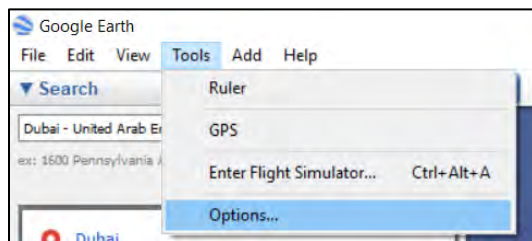
⁸ For more information on DigitalGlobe Satellite systems, go to: <https://www.digitalglobe.com/content>

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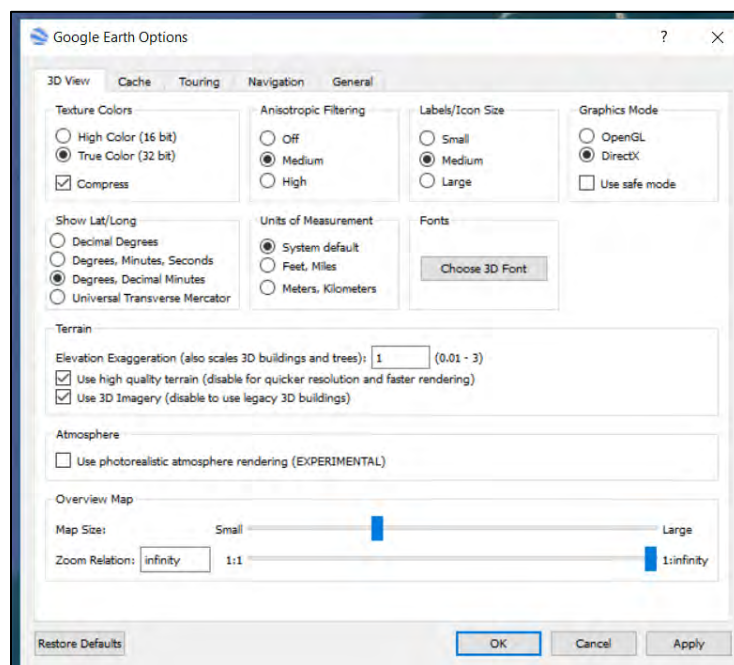
We are now ending our exploration of the Google Earth provided here by the Table of Contents. Again -- you can further explore on your own.

5.6 Changing the Default Settings in Google Earth Desktop

Google Earth loads with many default settings, which you can change. On the Toolbar, go to *Tools, Options*.

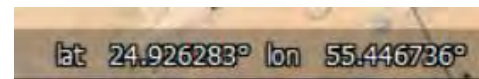


The following window opens:

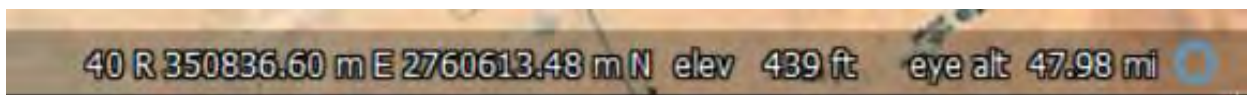


We will not discuss each of these. For example, the first row of boxes – Texture Colors, Anisotropic Filtering, and Graphics Mode – if you need more information, contact your IT Departments.

The second row, 1st box – *Show Lat/Long*, here is where you can change the display of your Latitude and Longitude. Decimal Degrees would look like:



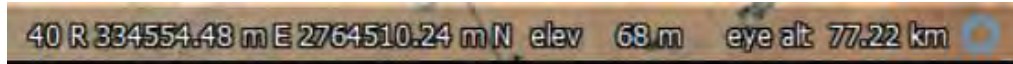
Universal Transverse Mercator (UTM):



UTM Zone – 40R and the coordinates in meters, East and North of the zone's origin. You have only changed the coordinate system, so elevation and altitude are still showing in the default settings of feet and miles.

Change the *Unit of Measurement* (the next box)— now, everything is displayed as metric units:

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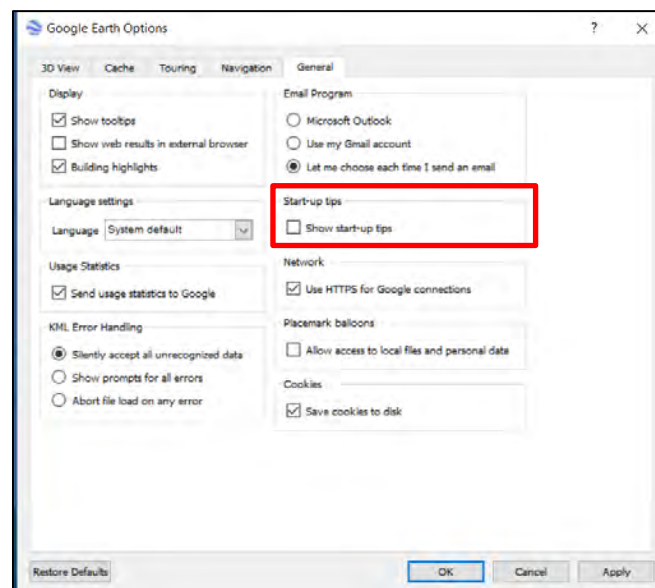
You can change the 3D Font. (We won't do that here.) You can also change other options in this specific window to help with faster rendering. We briefly will look at some of the other tabs.

Cache – is related to memory, check with your IT Department on any changes.

Touring and *Navigation* tabs are settings specific to zooming in and out, flying around in Google Earth, etc.

The *General* tab contains settings that might be helpful with regard to changing the language displayed for a non-English speaking students, emailing, tooltips, how errors are displayed, etc. If you are new to Google Earth Desktop, enabling *Show start-up tips* is recommended (red box).

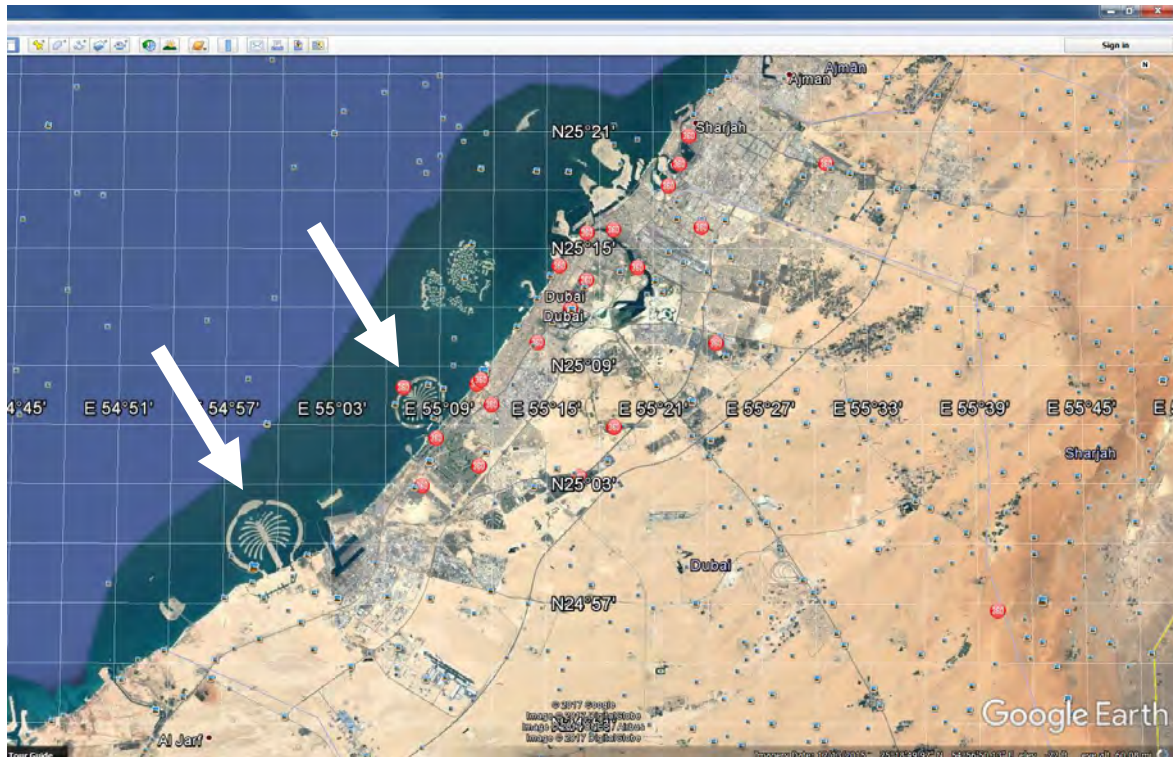
We won't discuss these, as they are each an individual choice as to how you want to receive information, or how your IT Department feels your emails or access to local drives should be handled. The best thing about *Options* is the button on the bottom left, *Restore Defaults*. You don't need to remember what they were, just hit the button and click *OK* or *Apply*.



5.7 Exploring the Historical Imagery Option

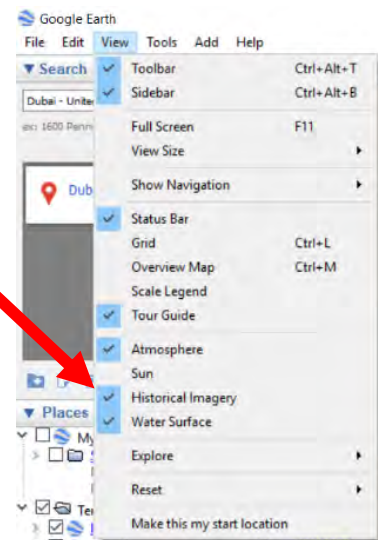
For this next section, go back to Dubai and then zoom in on the coastal area as shown below (no, the white arrows are not present on your screen):

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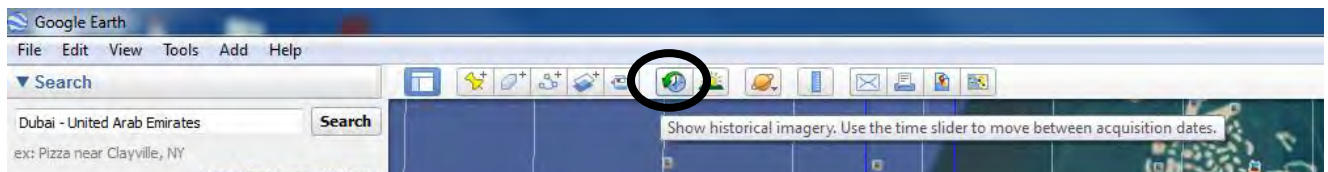


We are going to examine the changes to the coastal area using Historical Imagery within Google Earth. Most specifically, the human changes which added the Palm Islands (white arrows).

You can access the *Historical Imagery* option in two areas.
1st- on the toolbar, go to *View* and check *Historical Imagery*.



Or on the toolbar with icons, click on the icon within the black circle below:



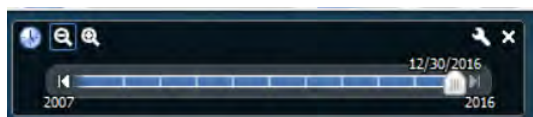
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Both options turn on the *Historical Imagery* sliding bar, which will pop up in the upper left of the Map Window.

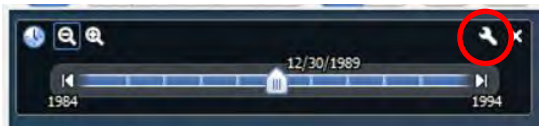


As you can see, Google Earth has Historical Imagery for Dubai back to 1984 (red circle above). You can either grab the slider with your mouse and slide it back and forth, or use the arrows at each end of the line – going to the left, the imagery gets older and to the right is more recent imagery.

Before we talk more about what happens in the Map Window, let's look at the sliding bar a bit closer. In the upper left corner of the pop up window are two zooms – these zoom in and out on the divisions in the sliding bar. As you can see below, one click on the Zoom in changed the display to go back only to 2007, but each white division line represents one historical image.

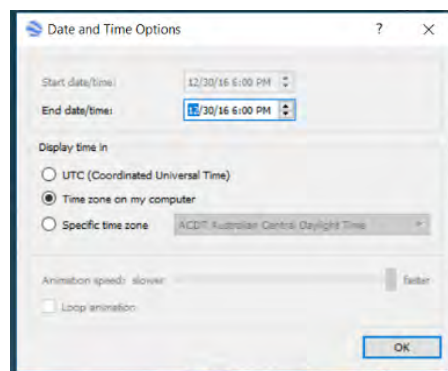


In the below screenshot, move the sliding bar to the left to 1984 and placed your mouse on one of the white lines. It shows the dates that each white bar represents.



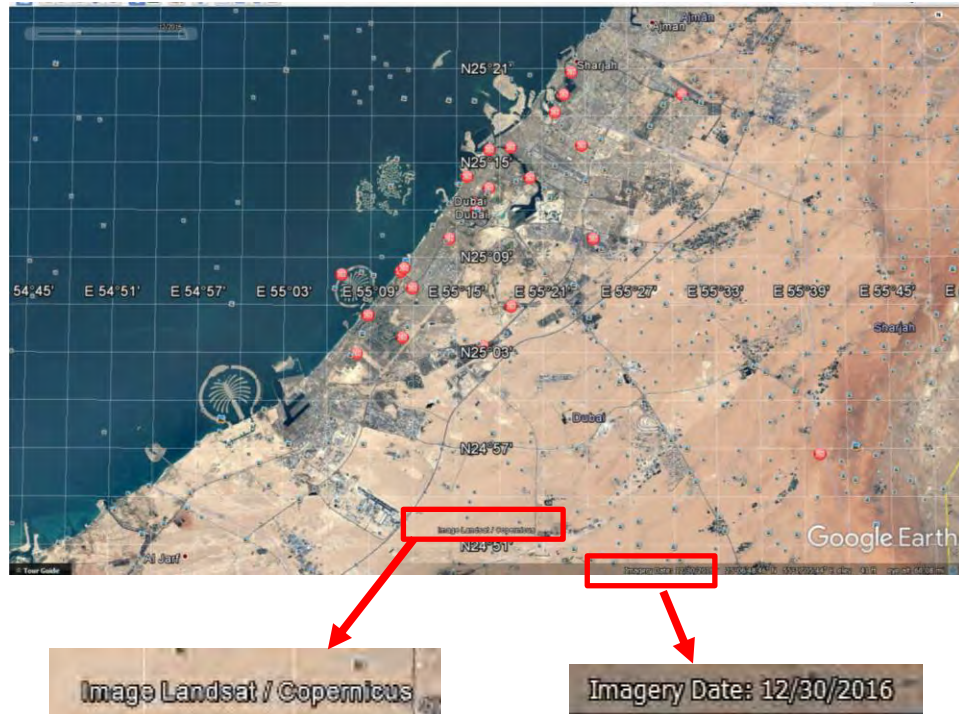
Clicking on *zoom out*, you can change the sliding bar back to the original time line.

The setting button (red circle above) allows you to change the Date and Time Options for Historical Imagery.



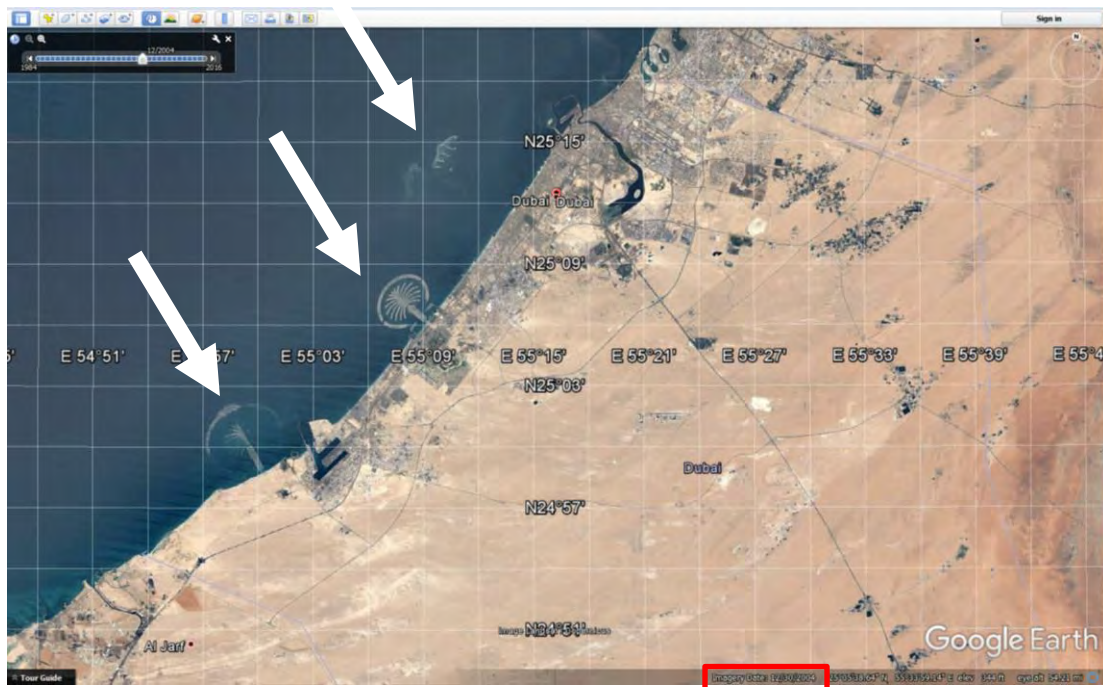
Let's now look at what happens in your Map Window when using the sliding Historical Imagery bar. When you first click on the slider, the screen changes and the date of the image is placed on the lower information bar on your screen and the image source in the bottom middle.

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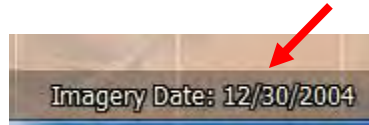


Remember, the image source also changes when you zoom in and out.

Now, either slide the slider to the left or click once on the left arrow. Look at the bottom- the image source is the same but the image date is now 12/30/2015. Keep clicking and watch how the features (called Palm Islands) in the Persian Gulf have changed, most specifically watch the areas indicated by the white arrows. The screenshot below is 12/30/2004.



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For 12/30/2002, only one of the three Palm Islands is even partially present:



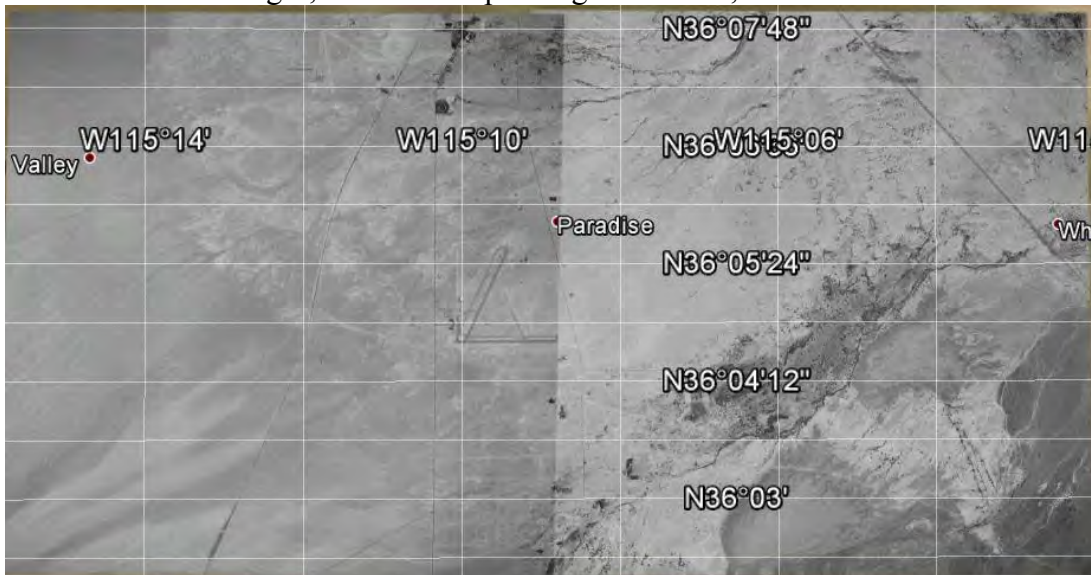
12/30/1984 below – not only are the Palm Islands not present, look at the change in the extent of the urban area. You can use the historical imagery to show changes over time.



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Additional Examples of Changes Overtime

Las Vegas, Nevada – expanding urban area, 1950 to 2017.



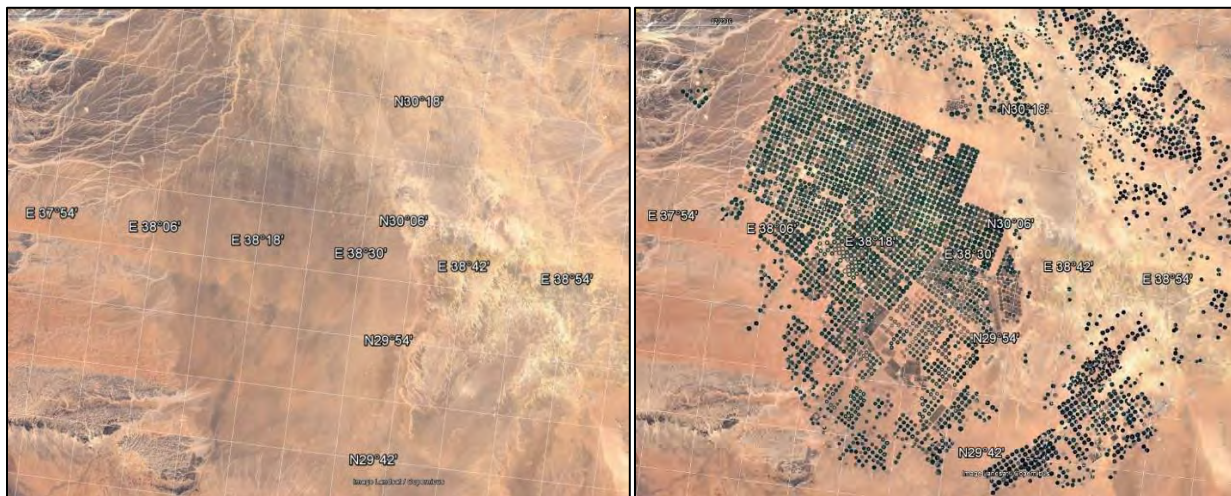
Question – what is the source of the 1950 image of Las Vegas? (Answer – NASA, obtained from the U.S. Geological Survey – do you remember how we found this metadata?)

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The loss of water from the Aral Sea, 1972 to 2016



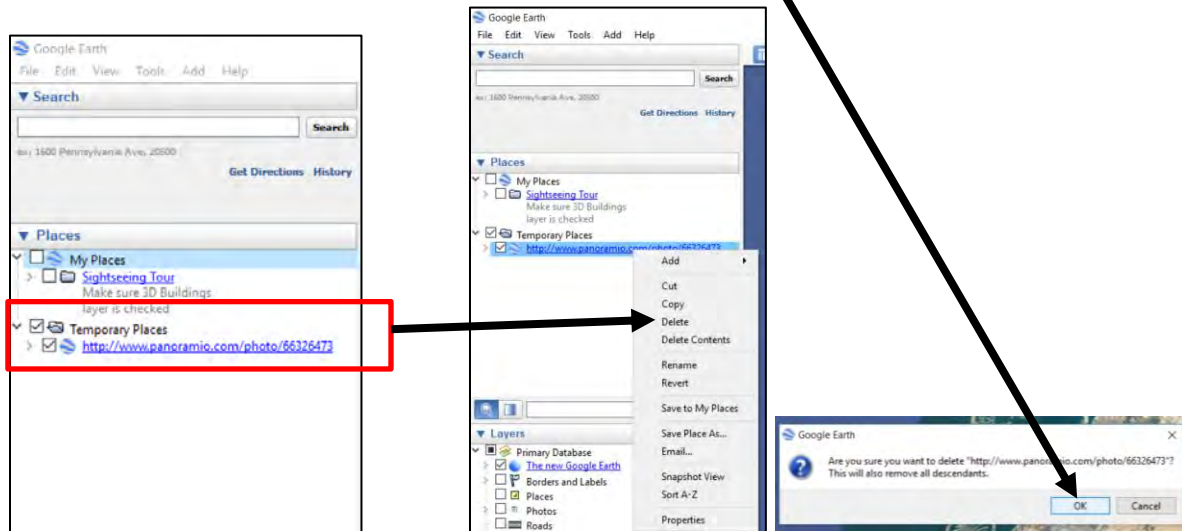
1984 to 2016, desert to irrigated agriculture in Saudi Arabia



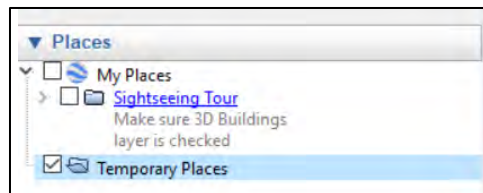
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5.8 Exploring the Table of Contents - Places

We are now going to discuss the top Table of Contents – *Places*. This is where Google Earth records your activity as Temporary Places. You can see it recorded when we clicked on the individual photo (red box). You can remove these – right click on the file name and hit delete. Google Earth will ask you if you are sure. Click *OK*.

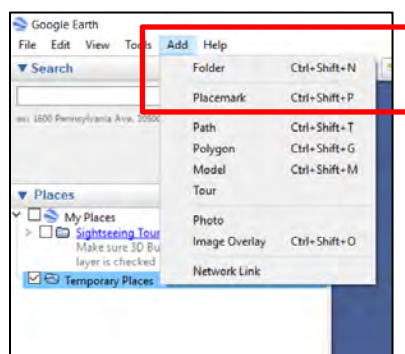


My *Temporary Places* are now empty.



5.9 Adding a Placemark

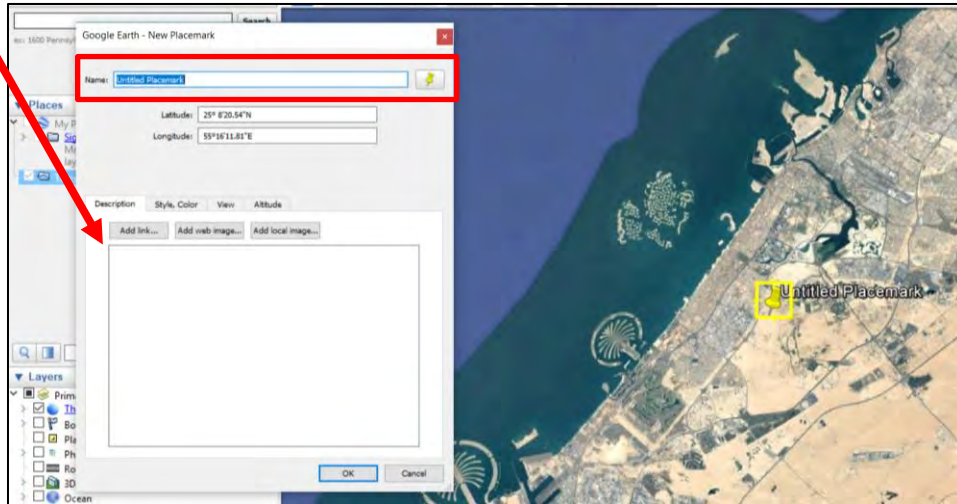
You can add placemarks for places of your choice. To add a placemark, search for the location you wish to add a mark. Once you have found that location and it appears in the Map Window, go to *Add, Placemark* (red rectangle below).



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This adds a placemark in your map window, the yellow pushpin and opens the *New Placemark* window. If the placemark is not in the exact location you want it, you can move the Earth view around to put your placemark exactly where you want it. The latitude and longitude showing in the *New Placemark* window will change as you move it.

In the screenshot below, we are under the *Description* tab and the *Name* bar is highlighted (red rectangle). You can name your placemark anything you want. You can also add text, links, or images in the freeform box.



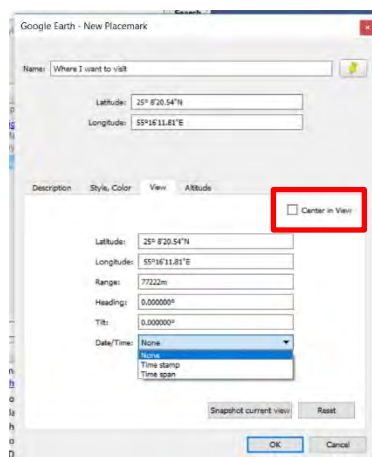
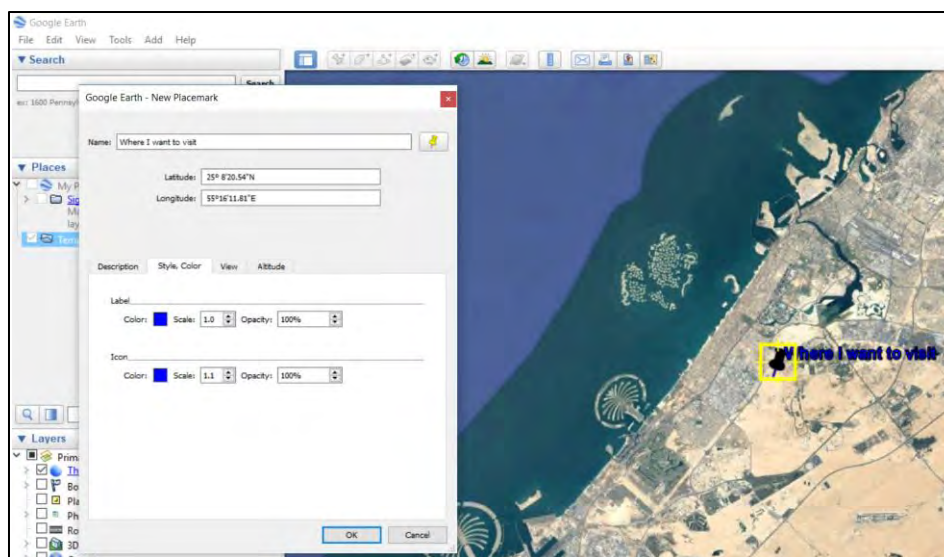
You can also change the icon from a pushpin. In the red box in the screenshot above, click on the button that has the yellow pushpin and you get an icon window. You can choose any of these, or click on *Add Custom Icon* at the bottom to get a browse window and choose another type of icon. For our purposes, we are just leaving it as a pushpin.



Below, placemark was named “Where I want to visit”, and you can see it also changed the name in the Map Window.

The color was originally yellow (prior screenshot), but look it is now blue. Click on the *Style, Color* tab and you can change the label and icon colors. You can also change the scale (size) and opacity. Go ahead and experiment to see what best suits your purposes.

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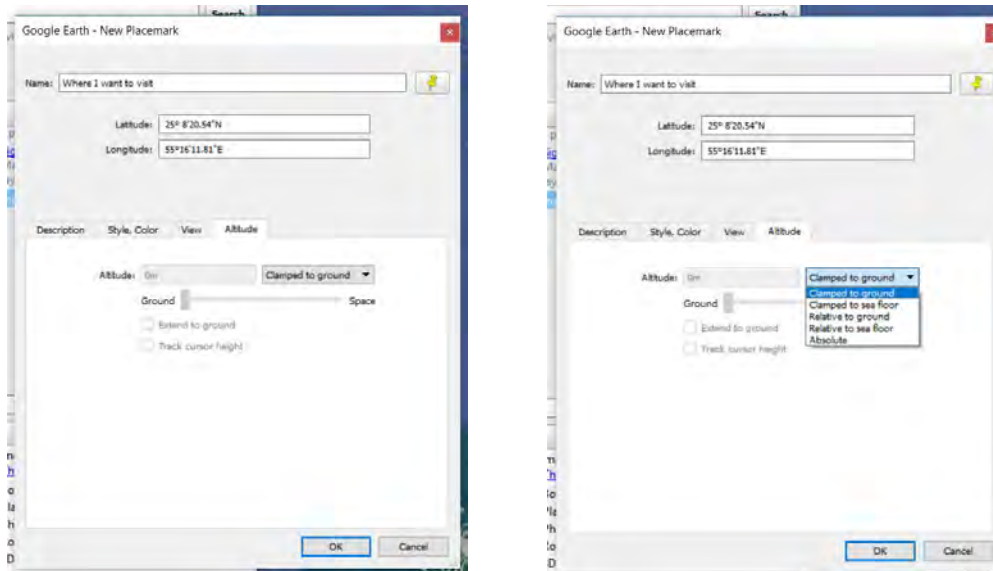


Click on the text tab – View – to see additional settings for the Map Window that you can change. For example, checking the box next to Center in View (red rectangle) will move the icon into the center of the Map Window. Note – it won't place your location in the center of the Map Window, it moves the placemark icon into the center, so be careful that is exactly where you want your placemark.

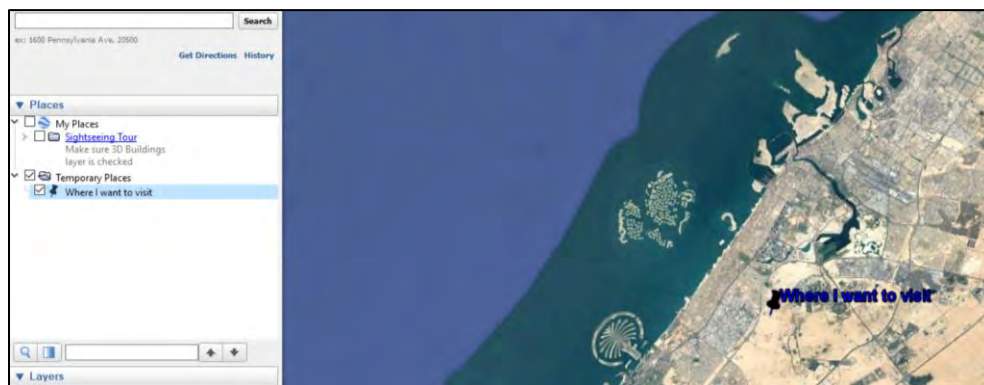
Click on the last tab – Altitude. Normally, we want our placemark *Clamped to the ground*, but as you can see, we have additional setting, if you want to view the differences or are interested in distances to or above the sea floor (of course, this likely only makes sense for coastal areas). *Please note that we do not recommend that you use Google Earth for calculating distances for rock climbing, snorkeling, scuba diving or any other activity that could results in injury or loss of life.*

Depending on which setting you choose, you will enable the *Ground to Space* sliding bar (as you slide to the right towards the word *Space*, you zoom out and the altitude measurement is added), the *Extend to ground* (lengthens the height of the cursor above ground) or the *Track cursor height* (tells you the length of the cursor above the ground) options.

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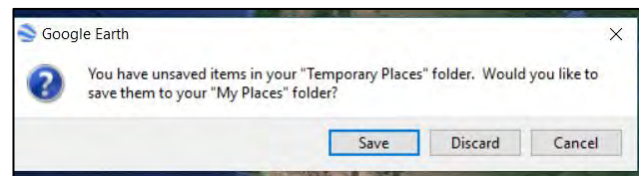


When you have completed and are happy with your settings, click *OK* and it will add your placemark to your *Temporary Places*.

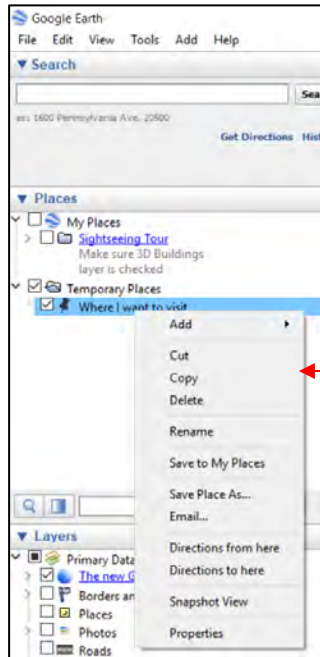


If you now close Google Earth (without taking any additional steps), you will get a dialog box asking if you want to save your placemark in your “*Temporary Places*” folder to your *My Places* folder or discard.

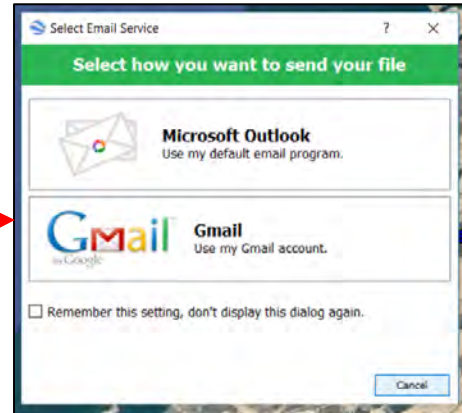
If you save to *My Places*, it will show up next time you open Google Earth. You can also save it before you close Google Earth. See below.



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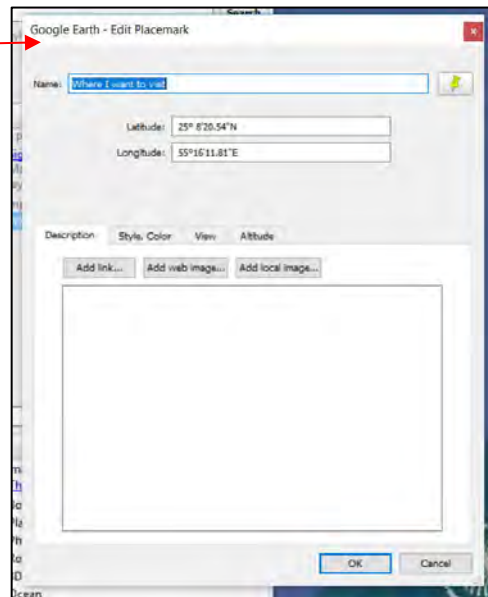


As you can see from this dialog box, you also have many other options. You can copy your placemark, you can delete it, rename it, or email it. If you have not set your email (remember from Google Earth settings discussed above, you need to set your email), you will get the dialog box on the right.



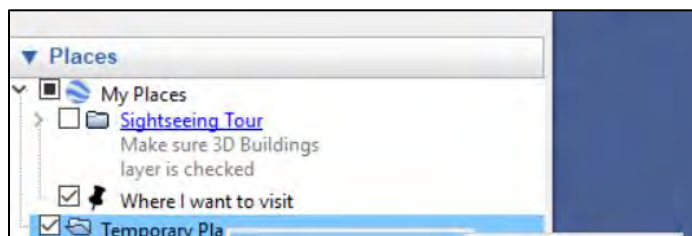
From the dialog box on the left, you also can get directions, and there is also a Properties link.

If you click on Properties, it takes you to *Edit Placemark*, where you have the same tabs



discussed above for *Description*, *Style*, *Color*, *View* and *Altitude*. So if you don't like what you set when you added your placemark, here is where you can make changes.

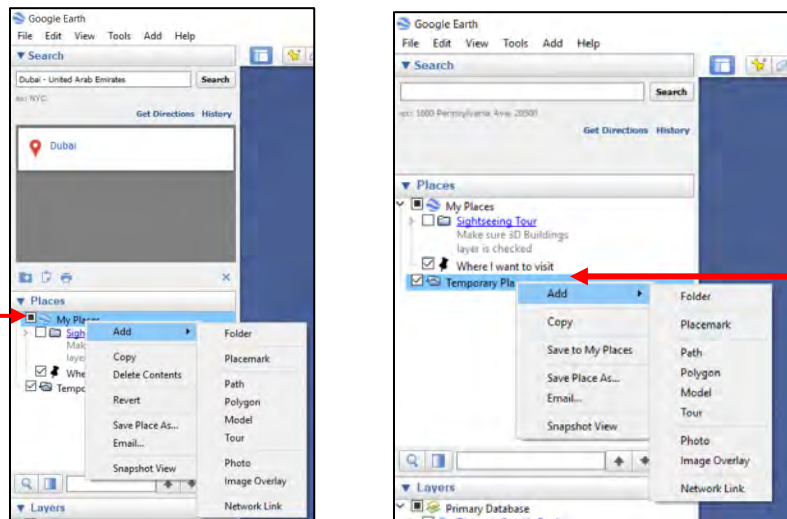
To save any placemarks before closing Google Earth, right click on the name of your placemark in the Table of Contents, then click on *Save to My Places*. If you have a specific folder where you want to save it, for example, a folder for a specific class project for which you are using Google Earth, click on *Save Place As* and then navigate to the file folder where you want to save⁹. Once you have saved your placemark, it moves to *My Places*.



⁹ If you don't already have a file folder set up, you can right click on *My Places* to create one.

Exploring Our Planet with Open Source Software

There are multiple ways to add placemarks. You can right click on the words *My Places* and add a placemark directly there, or you can right-click on the words *Temporary Places* and add a placemark.

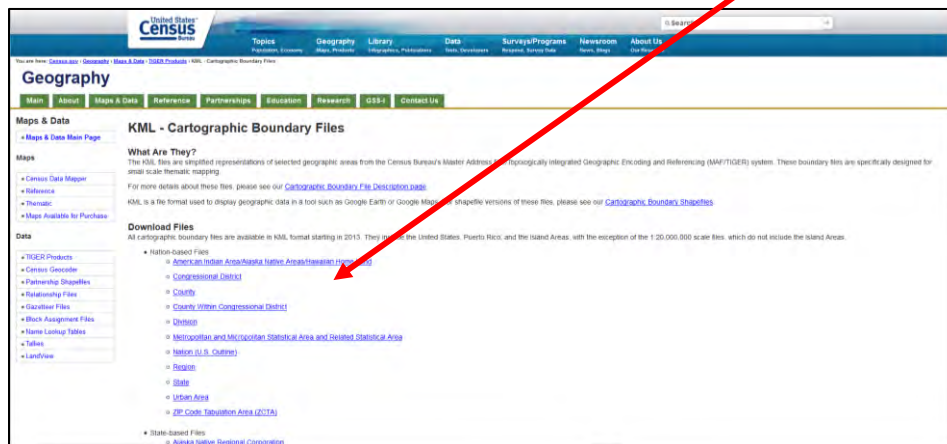


5.10 Adding external files to Google Earth Desktop

5.10.1 KML Files¹⁰

First, we need KML files. Go to <https://www.census.gov/geo/maps-data/data/tiger-kml.html> and we can get a KML files for your use.

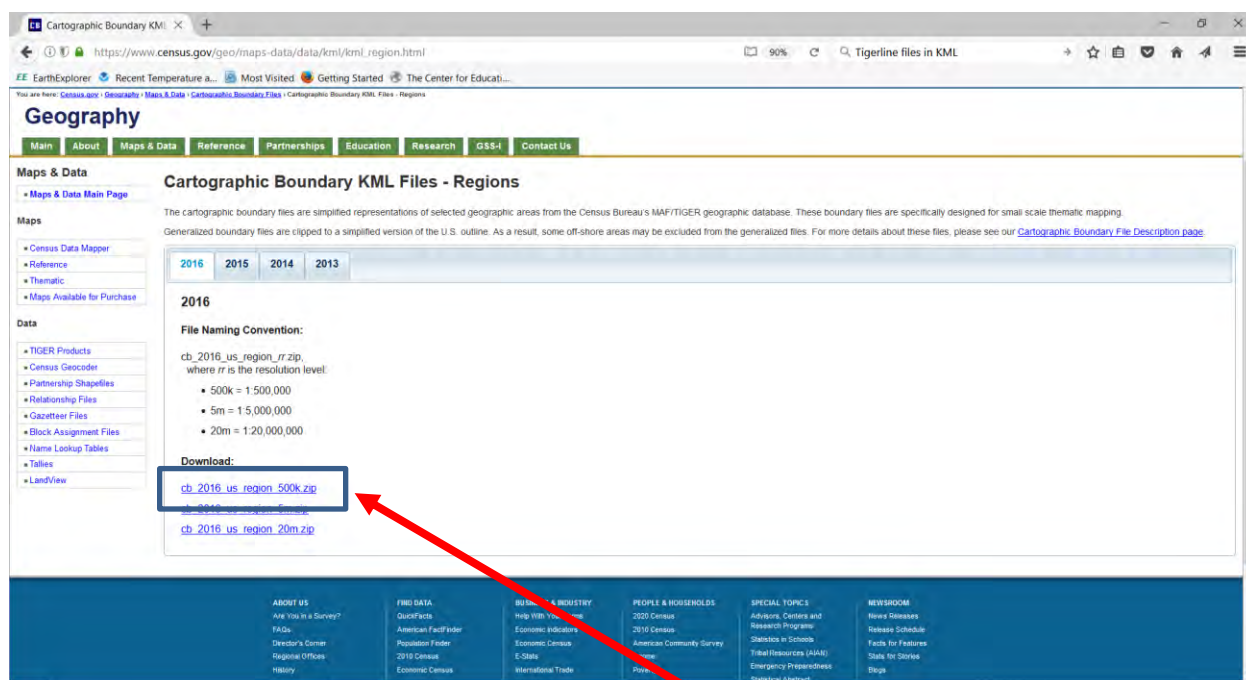
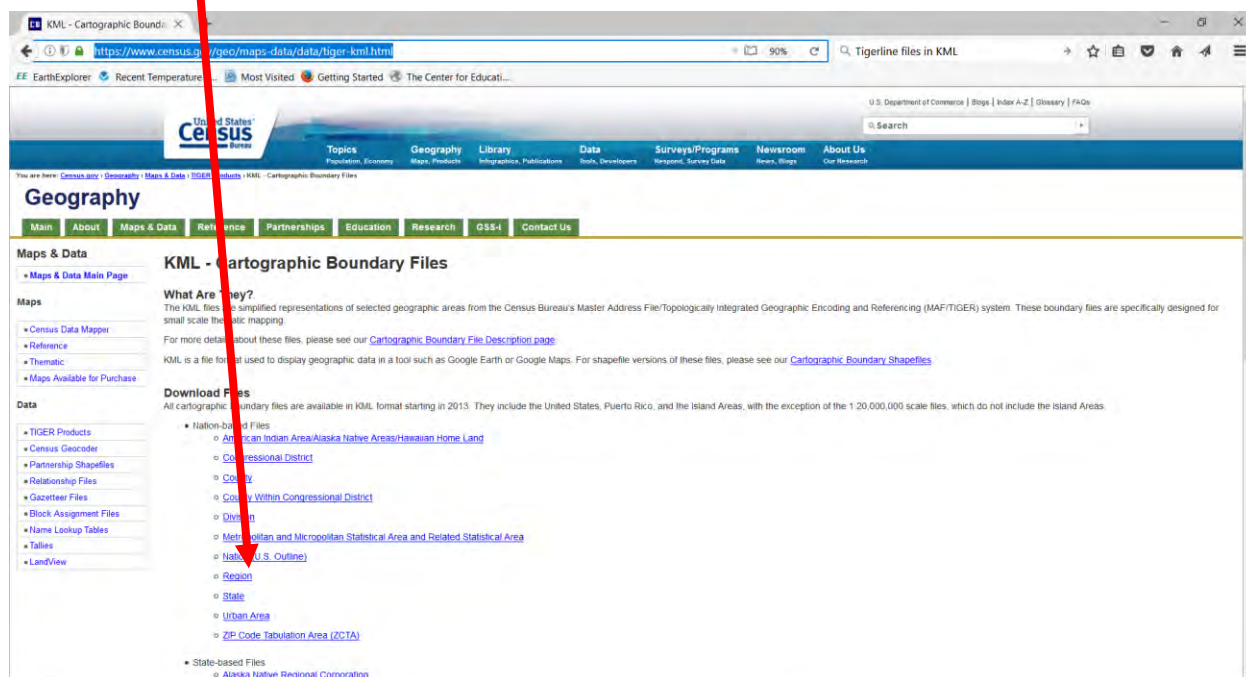
You get this website – the US Census Bureau has files with boundaries at many different scales that you can download.



¹⁰ What is KML? KML stands for Keyhole Markup Language, which is a file type supported in Google Earth. See <https://developers.google.com/kml/> for more information.

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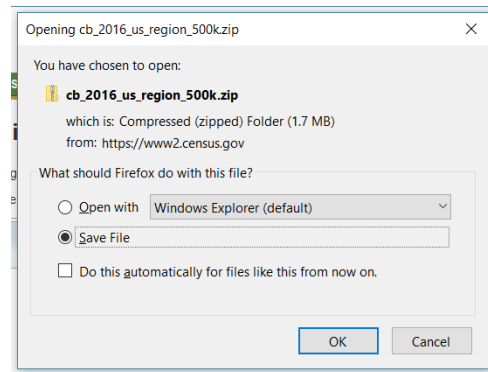
Click on *Region*.



Then, click on *cb_2016_us_region_500K.zip* under **Download**.

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You are downloading this file to your computer. You get the following pop-up:

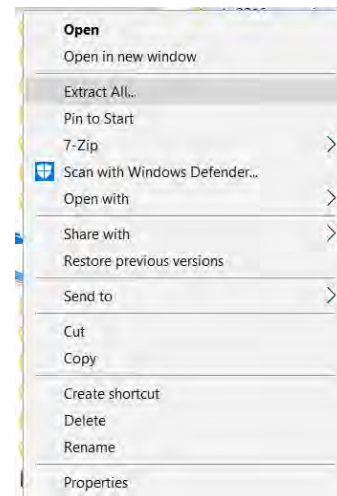


Make sure the *Save File* button is chosen and then click *OK* to download it to your download folder. Once downloaded, go to your download folder and you will see the following zipped file.

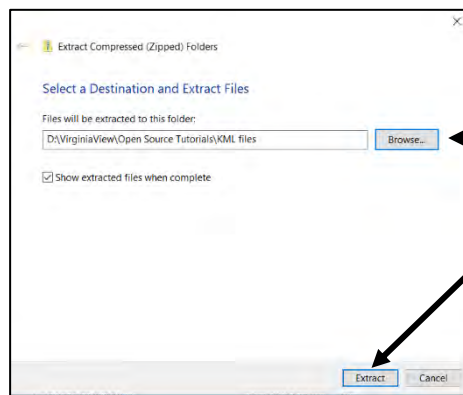
Name	Date modified	Type	Size
cb_2016_us_region_500k	7/7/2017 4:14 PM	Compressed (zipp...	1,736 KB

Go back to the US Census Bureau KML Cartographic Boundary Files website (the first one) and also download the files for *Nation (US Outline)*, *States*, *Counties* and *Urban Areas*. We can use all five (or more) in Google Earth Desktop. Once all five files are downloaded, then proceed in this tutorial about unzipping the files.

Right click on the file and you will see the following window:



Click on *Extract All...*



Use *Browse* to navigate to the folder where you want to unzip the files.

Once you have chosen the correct folder, click on *Extract* at the bottom and the following files will be displayed in your file folder:

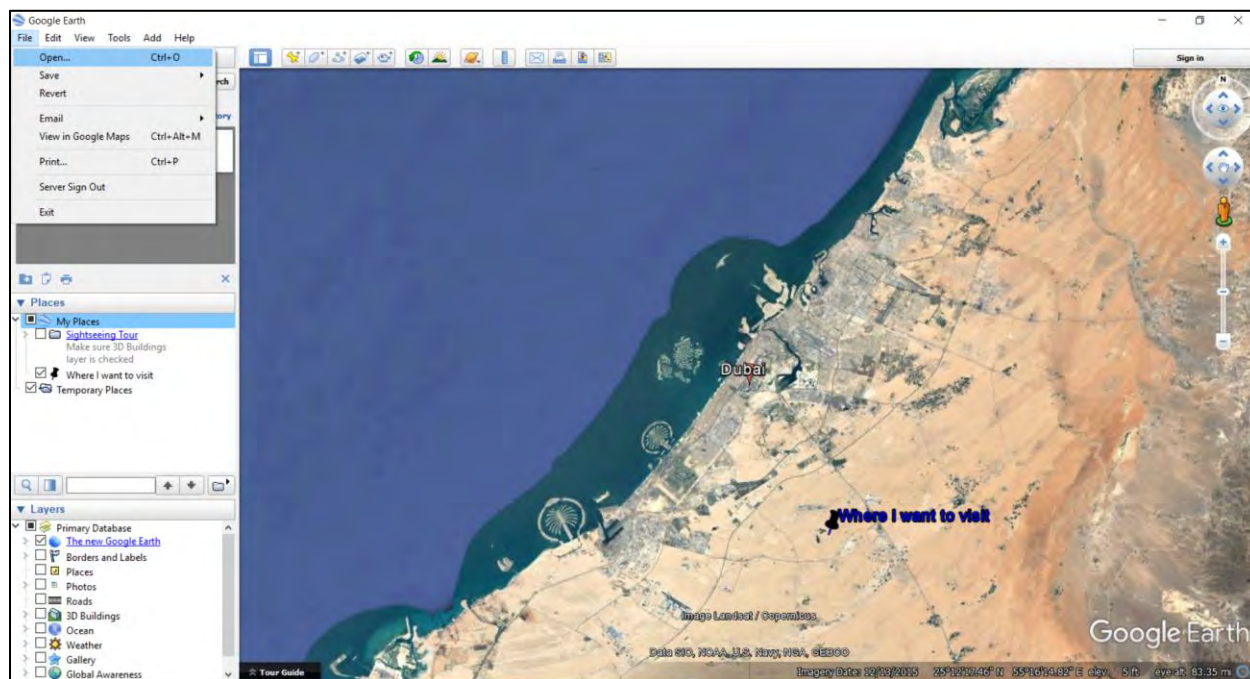
Name	Date modified	Type	Size
cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	KML File	5,744 KB
cb_2016_us_region_500k.kml.ea.iso	7/8/2017 12:42 PM	XML File	14 KB
cb_2016_us_region_500k.kml.iso	7/8/2017 12:42 PM	XML File	34 KB
cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	XML File	17 KB

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Perform these unzipping operations for all five downloaded files. Your file folder will look like this once all are unzipped:

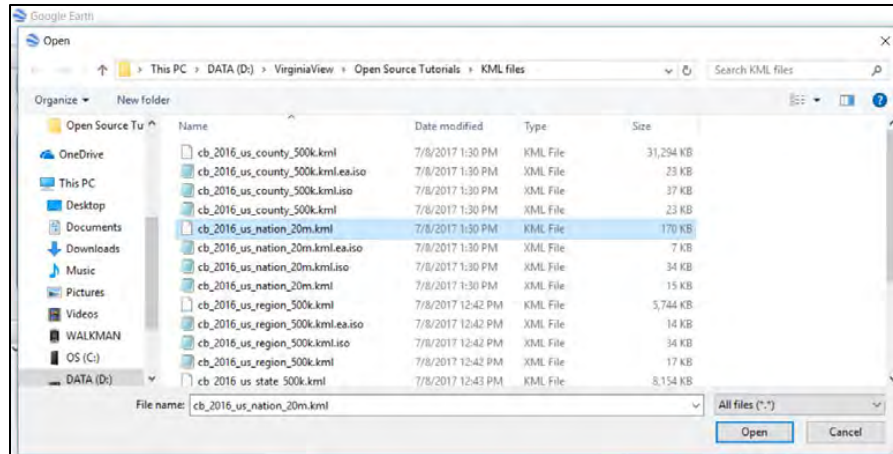
Name	Date modified	Type	Size
cb_2016_us_county_500k.kml	7/8/2017 1:30 PM	KML File	31,294 KB
cb_2016_us_county_500k.kml.ea.iso	7/8/2017 1:30 PM	XML File	23 KB
cb_2016_us_county_500k.kml.iso	7/8/2017 1:30 PM	XML File	37 KB
cb_2016_us_county_500k.kml	7/8/2017 1:30 PM	XML File	23 KB
cb_2016_us_nation_20m.kml	7/8/2017 1:30 PM	KML File	170 KB
cb_2016_us_nation_20m.kml.ea.iso	7/8/2017 1:30 PM	XML File	7 KB
cb_2016_us_nation_20m.kml.iso	7/8/2017 1:30 PM	XML File	34 KB
cb_2016_us_nation_20m.kml	7/8/2017 1:30 PM	XML File	15 KB
cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	KML File	5,744 KB
cb_2016_us_region_500k.kml.ea.iso	7/8/2017 12:42 PM	XML File	14 KB
cb_2016_us_region_500k.kml.iso	7/8/2017 12:42 PM	XML File	34 KB
cb_2016_us_region_500k.kml	7/8/2017 12:42 PM	XML File	17 KB
cb_2016_us_state_500k.kml	7/8/2017 12:43 PM	KML File	8,154 KB
cb_2016_us_state_500k.kml.ea.iso	7/8/2017 12:43 PM	XML File	19 KB
cb_2016_us_state_500k.kml.iso	7/8/2017 12:43 PM	XML File	34 KB
cb_2016_us_state_500k.kml	7/8/2017 12:43 PM	XML File	18 KB
cb_2016_us_ua10_500k.kml	7/8/2017 12:43 PM	KML File	28,530 KB
cb_2016_us_ua10_500k.kml.ea.iso	7/8/2017 12:43 PM	XML File	14 KB
cb_2016_us_ua10_500k.kml.iso	7/8/2017 12:43 PM	XML File	35 KB
cb_2016_us_ua10_500k.kml	7/8/2017 12:43 PM	XML File	18 KB

Now go back to Google Earth and in the tool bar, click on *Open*.

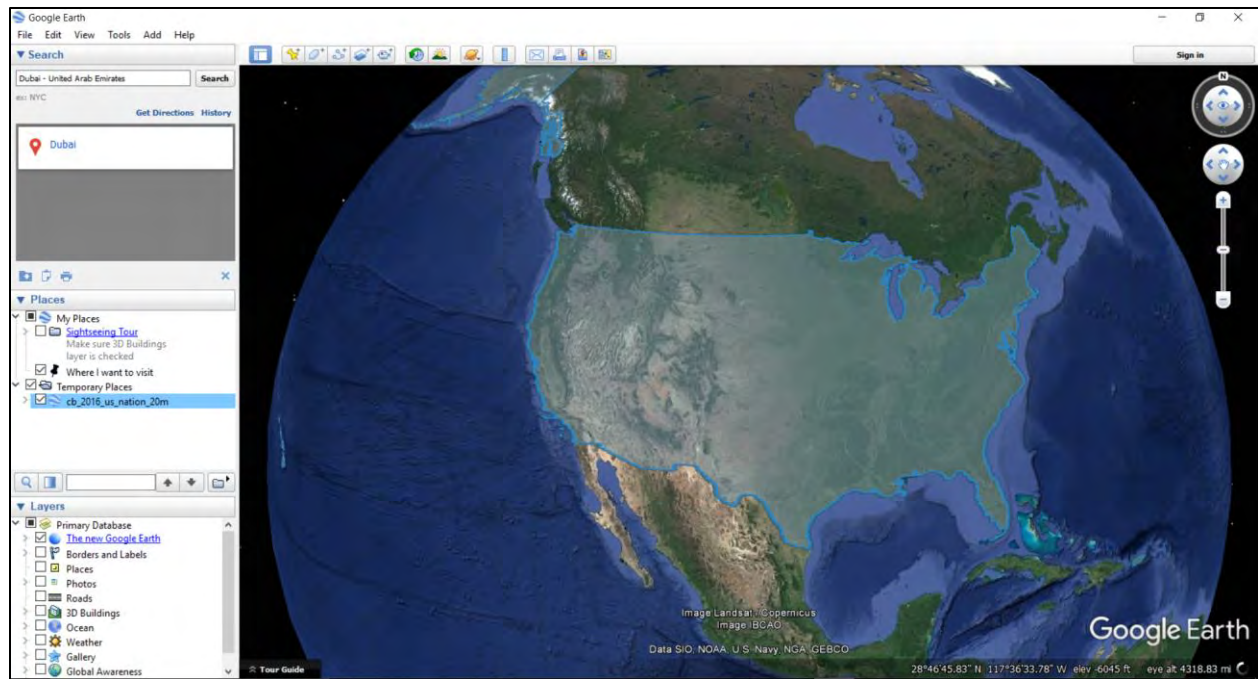


Then, navigate to where you saved your unzipped files. We are only going to add one KML file right now, so highlight the one for the US Nation, which is the United States outline. Be sure you have highlighted the file type – KML as seen below. Once you have highlighted the correct file, click *Open*.

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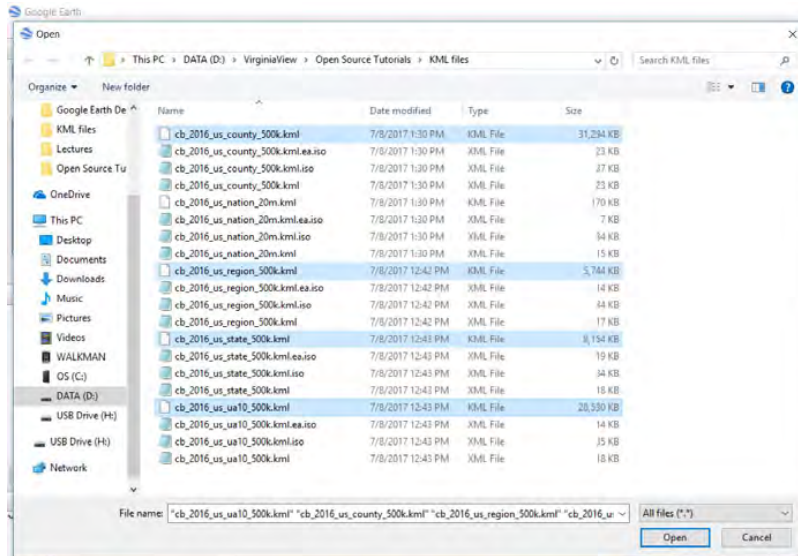


Once you have opened it, it will add to Google Earth in the *Temporary Places* Table of Contents and in the Map Window, zooming to the entire US (not just the continental US – see Hawaii in the west and Puerto Rico in the east?). Be patient, it might take a few seconds.

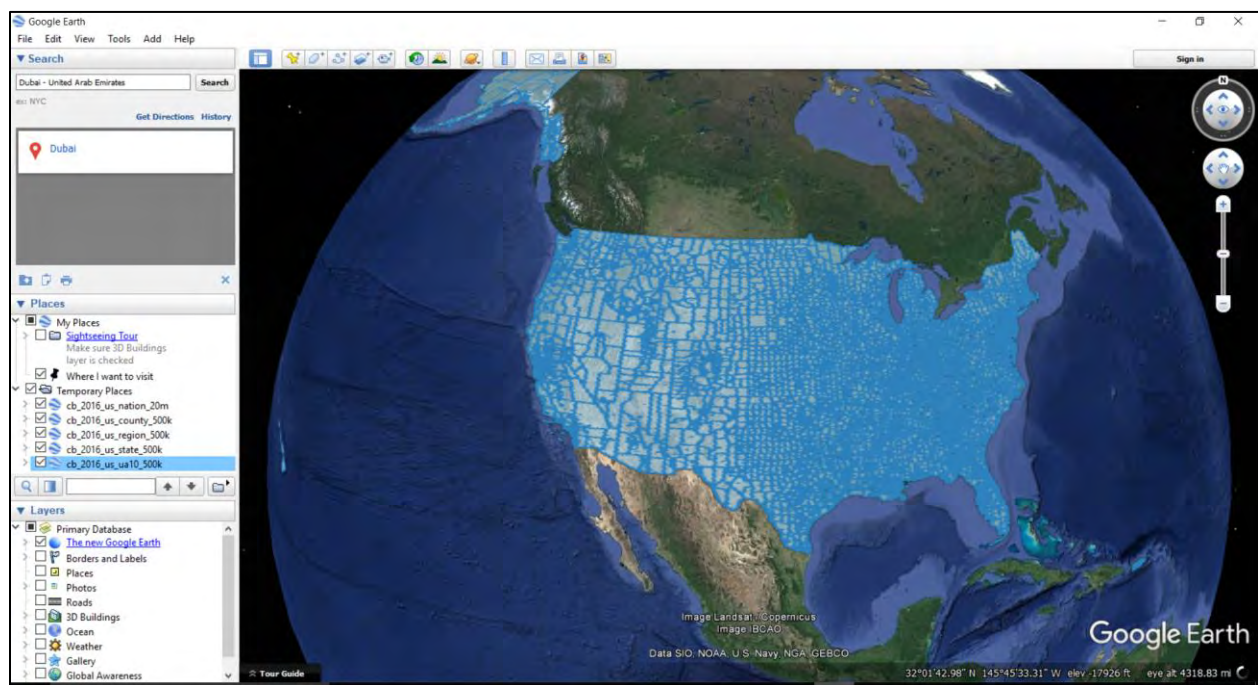


You can add multiple KML files at one time. Go back to *File, Open* and then navigate back to your folder containing your unzipped files. Highlight each of the other KML files (just the KML type) but holding down *ctrl* on your keyboard and click on each one to highlight, then click *Open*.

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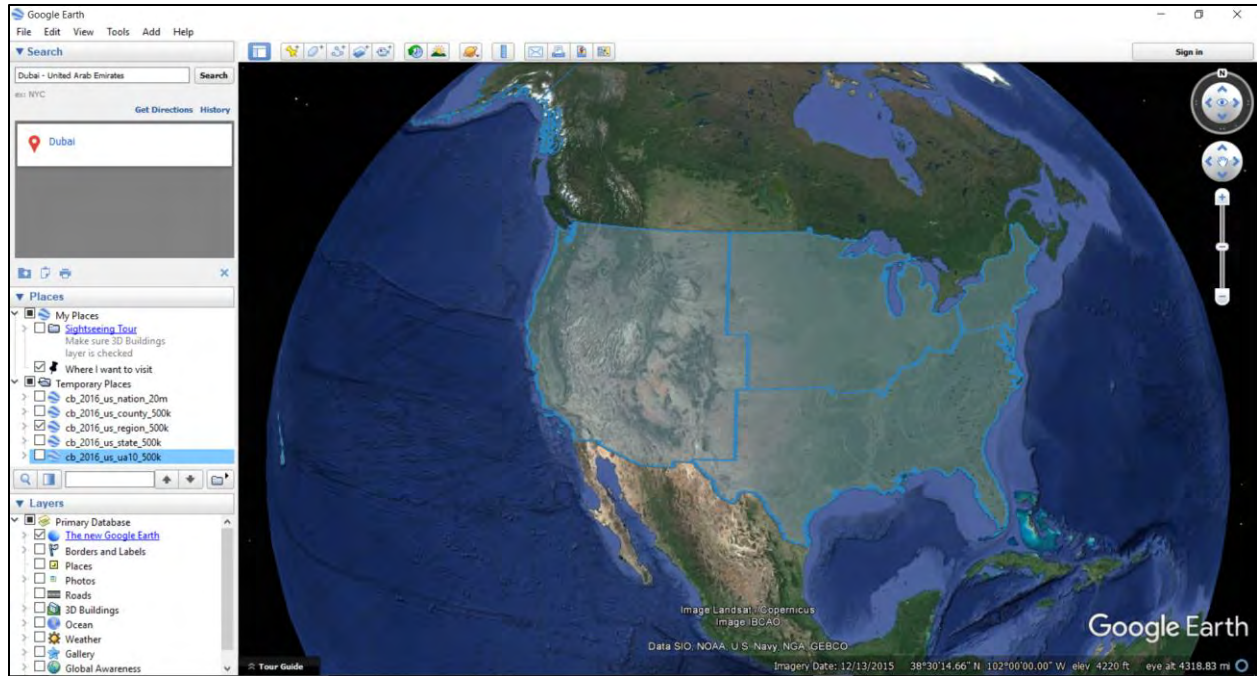
All the KML files are now added. You can see them listed in your *Temporary Places*.



You cannot see all of them, but you can turn them on and off by unchecking or checking the box next to the layer name, just as we did under the Google Earth Table of Contents below.

You can also change the symbology for each of your layers. Turn off all the layers except the US Regions. The US is divided by the Census Bureau into 4 regions – West, Northeast, Midwest and South. You can see them displayed in the Map Window. How can you find their names?

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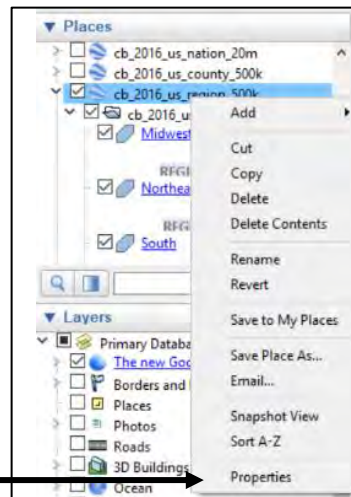
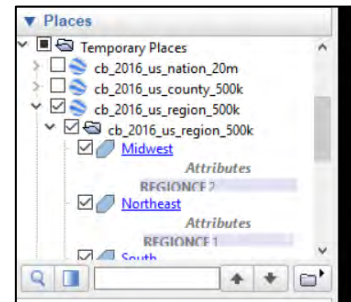
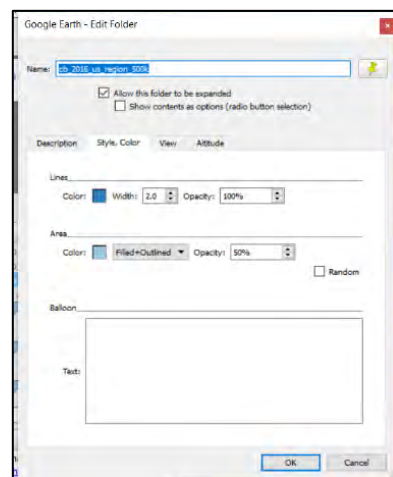
Now click on > in front of the name 'cb_2016_us_region_500k', just like you did with the layers under the Google Earth Table of Contents.

It expanded the layer to show the individual features. You can change the symbology for all the features so they are the same or change the symbology for each individual one.

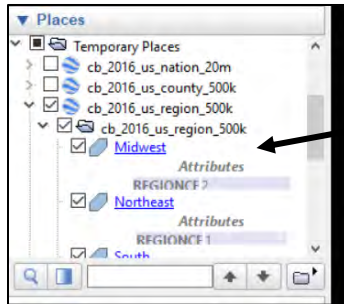
To change the symbology so it is the same for all of the features, right click on the name 'cb_2016_us_region_500k' and then click on *Properties*.

You get the dialog box like we have seen before, except it is titled *Edit Folder*. Click on *Style*, *Color* and you can change the symbology here, but it will be the same for all 4 regions.

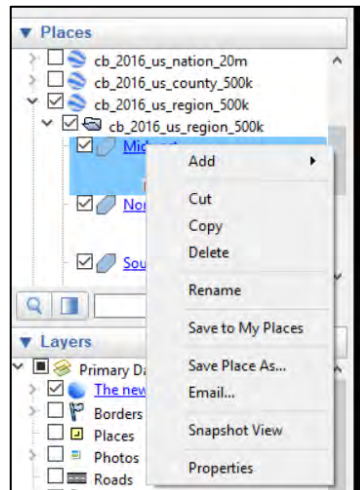
So let's do them individually.



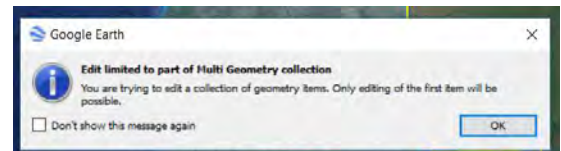
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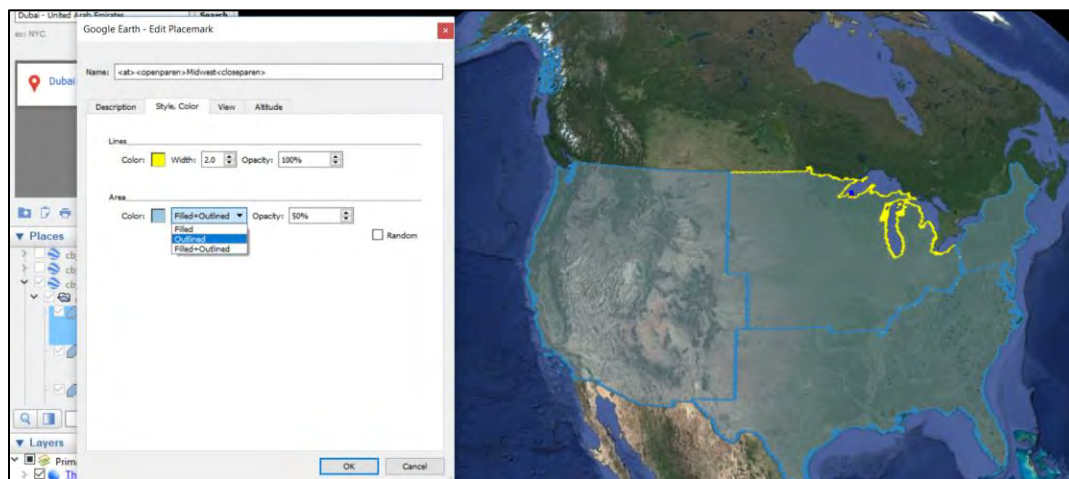
First, be sure that the features are expanded so you can see each one of the regions listed.



The right click on any Midwest and click on *Properties*, you will get a warning message, just click *OK*.



Go to *Style, Color* and change the *Line* color to yellow (click on the blue box to get a color palette) and then under area, click on the drop down menu and click *Outlined* (we don't want a fill color, just the outline). Click *OK*.



Midwest region will look like this:

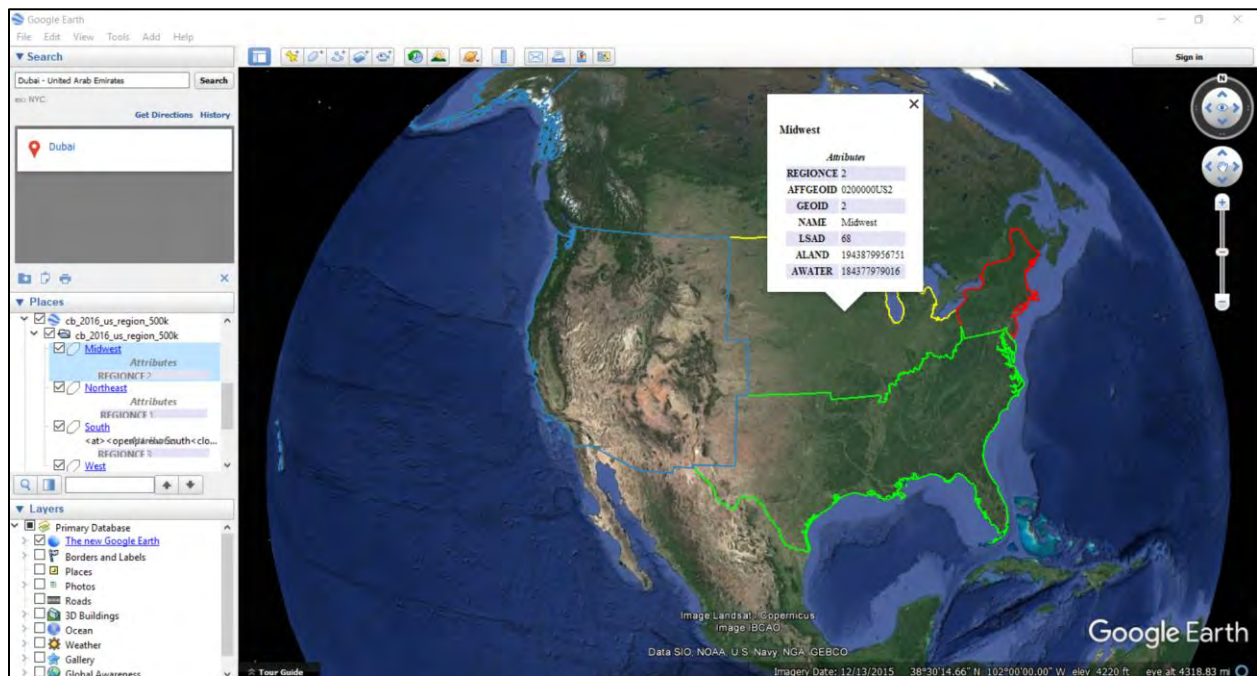


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Now go back and do the other 3 regions, so your final map looks like this:



There is one other item to show you before we return to the other layers. These layers have metadata. To access the metadata, left-click on any of the feature names and the metadata window opens. Click on Midwest and we have information as follows. The RegionCE, AFFGEOID, GEOID, NAME, LSAD are designated by the Federal Government. The other two ALAND and AWATER are the total area of land and water in the region.



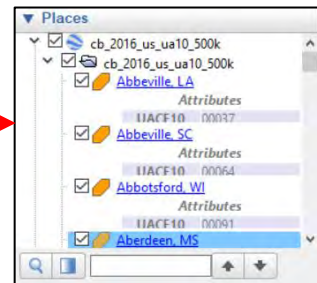
Go back and turn off the Region layer and turn on States and Urban Area (UA) layers and make your Map Window, look like this:

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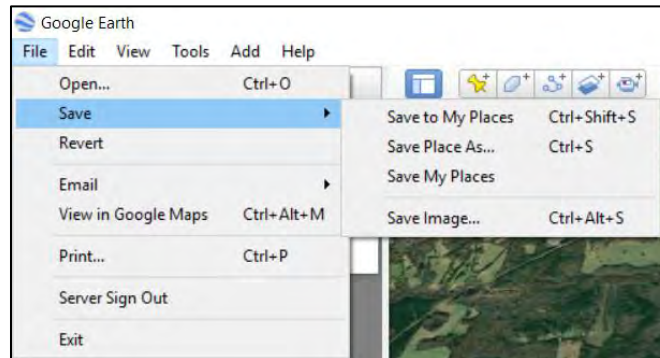
One more thing to show you. Expand the layer for Urban Areas. It should look like this:

They are in alphabetical order. There are thousands of features. Left double click on Aberdeen MS, it will zoom to Aberdeen and also give you the attributes (metadata) for that urban area. Yes, you could change the individual symbology, but it would take a very long time.



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Like what you did? You can save your maps, just like you did by adding a placemark. Go to *File, Save* and then choose what you want to save:

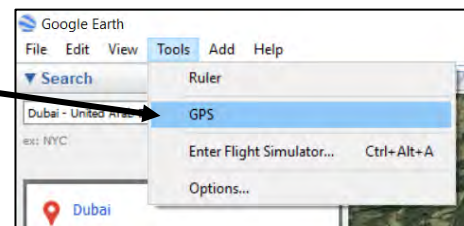


Before proceeding to the next section, turn off all of your layers in *Temporary Places* and *My Places*.

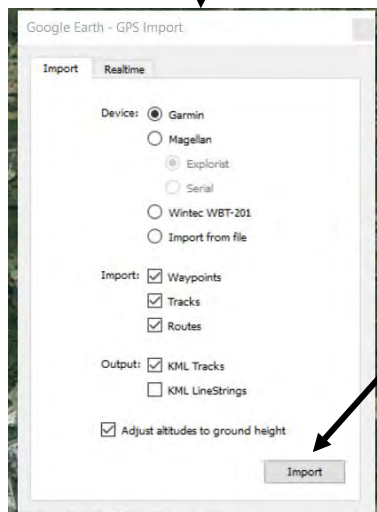
5.11 Adding Data from a GPS Unit

If you have a GPS receiver with a USB cord, you can download data directly from that unit into Google Earth Desktop. Your GPS receiver must be turned off before you plug the USB cord into the computer. When you plug it in, your computer will turn it on (you do not need a specific program on your computer to load into Google Earth, just follow these steps).

Go to *Tools, GPS*



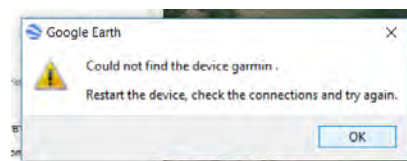
You get this window.



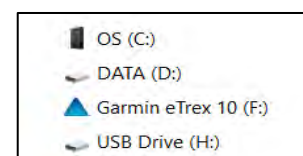
Choose the appropriate receiver, in our case it is Garmin.

Then click *Import*.

If you get this message:



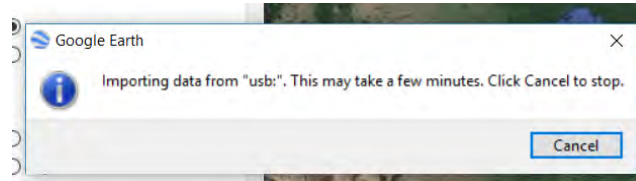
Look at the GPS receiver and make sure it is on, and that it shows as an external drive on your computer. If it is not showing, give your computer a minute to recognize it.



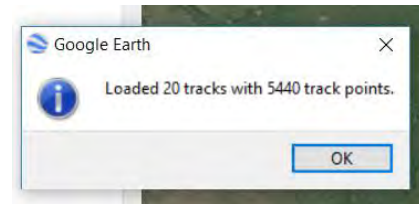
Exploring Our Planet with Open Source Software

Then try *Import* again. If you are still having problems, contact your IT Department.

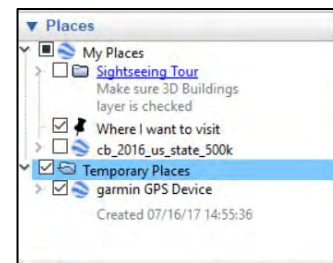
But when Google Earth finds your GPS receiver, which in most cases, only takes a minute or less, you will see this message:



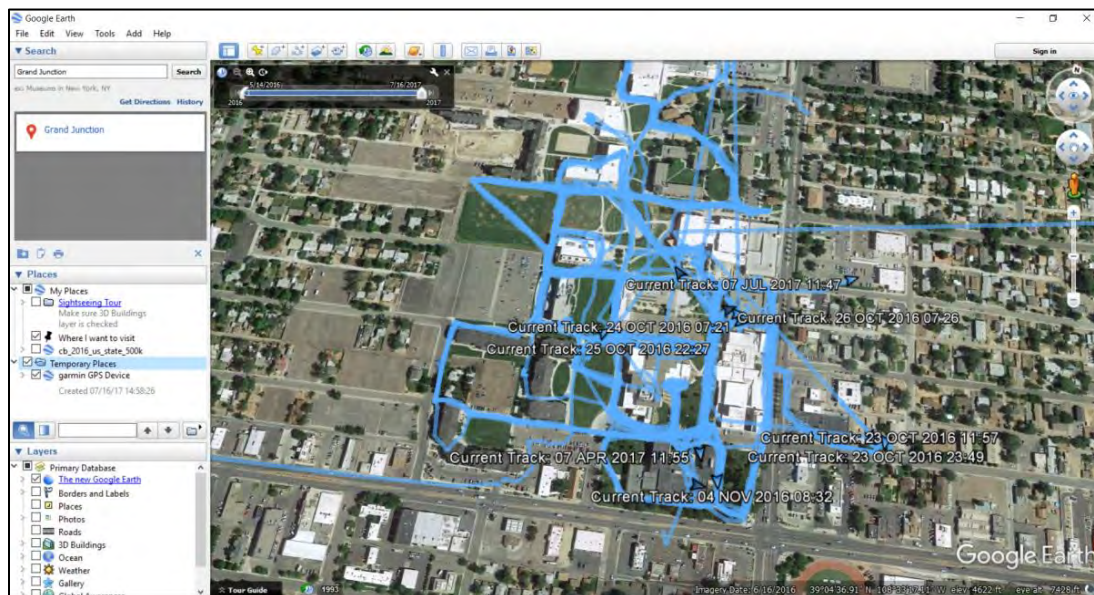
Once the data from your GPS receiver is loaded into Google Earth, you will get this message, and Google Earth will zoom to the location of your data. Of course, the number of tracks and track points will vary depending on what you collected on the GPS receiver. It is highly recommended that you delete any old information from your GPS before adding any new information.



Your GPS receiver will also show in your Table of Contents, under *Temporary Places*.

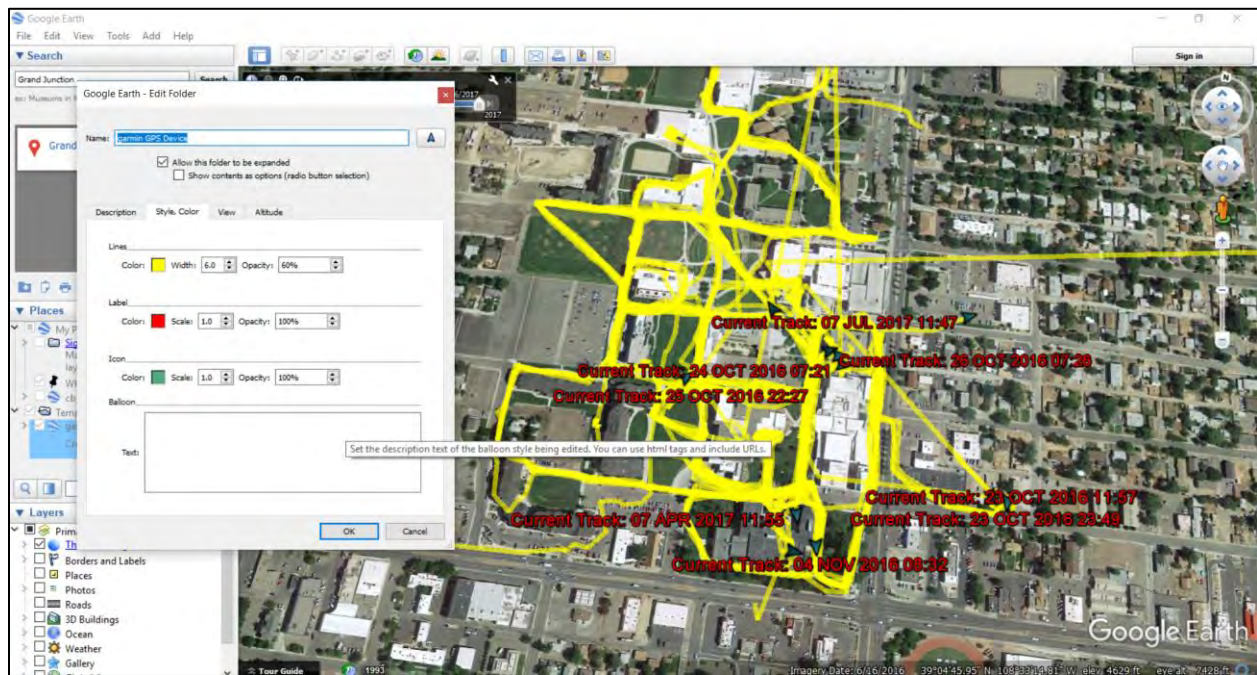


And the tracks and points will show in the Map Window. The display includes the date of data acquisition.



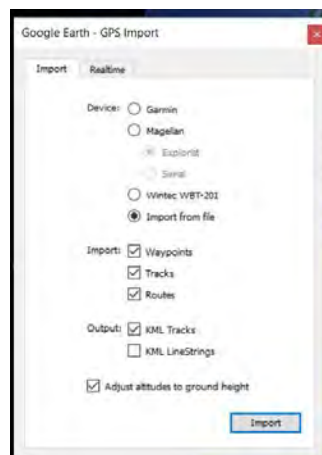
You can change symbology, just like you have done with other layers, the only difference is that you are working with 3 themes – track, points and labels:

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You can also save, just as we have described under previous sections.

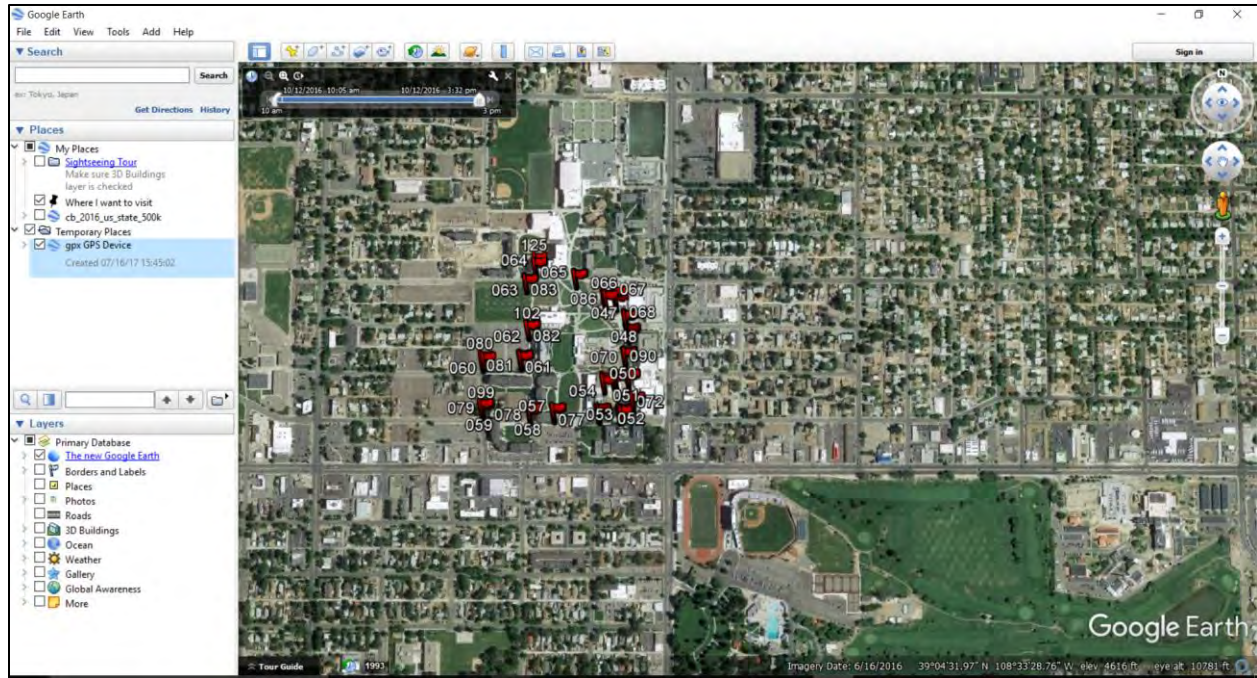
So, if you already have GPS data saved to your computer, you don't need to go find the receiver and hope the data is still there. You just Import from file:



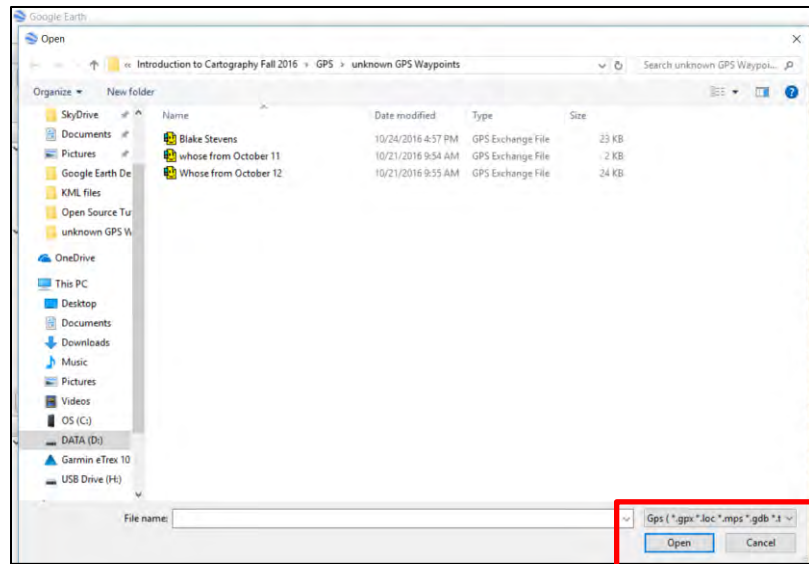
which allows you to navigate to the file folder on your computer where you saved the GPS data (in all likelihood, it was saved as a GPS Exchange file (GPX)).

 whose from October 11	10/21/2016 9:54 AM	GPS Exchange File	2 KB
 Whose from October 12	10/21/2016 9:55 AM	GPS Exchange File	24 KB

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You can also add saved GPX files by going to *File, Open* and navigating to the file folder where you have the files. The only difference is that you have to change the file type in the bottom of the *Open* window (red rectangle below) so Google Earth knows to look for a file type other than KML.



Again, you can save it just like we discussed previously.

This concludes our tutorial on Google Earth Desktop. Google Earth Desktop can also perform many other functions. We did not complete any YouTube videos specifically to Google Earth Desktop but many of the Pro videos can assist with some of these functions.

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Additional Information:

You can find Google Earth Outreach tutorials at this link:

<https://www.google.com/earth/outreach/tutorials/>

If you are interested in staying up to date on Google Earth, the following blog monitors changes on a regular basis:

<http://www.portalsig.org/aggregator/sources/13>