Introduction to Google Earth (GE)

The following exercises and methods are designed to have a user become familiar with the physical expression of land surface using the Google Earth (GE) virtual globe, and how GE works with raster (cell-based) and vector (point-based) geospatial themes. Please note that this workshop guide is designed for use with Windows PCs. Apple notebooks will have a slightly different user interface but in general, at this time, Windows and MAC products are very similar.

Part 1 is covered in person during LAB3, the first Google Earth LAB in Room SC-219. If you missed that one, but study this material and demonstrate proficiency, then you will gain partial credit for LAB 3. Also note that if you are having difficulty with this material please contact me to arrange either a Zoom or MS Teams session in which we can cover the material in more detail virtually.

For this exercise to be successful as a take-home assignment, you must download and install Google Earth Pro on your personal laptop. Alternatively, you can attend one of the two face-to-face (F2F) sessions as scheduled on our web page. You will have the opportunity to use a school laptop to conduct the lesson in one of these sessions. More instructions will be forthcoming for those to use the school's resources. First, we'll see how many can do the exercise on their own at home.

Google Earth KML Terminology:

• KML stands for Keyhole Markup Language (KML), an XML notation for expressing geographic annotation and visualization within Internet-based, two dimensional maps and three-dimensional (3D) Earth browsers (Wikipedia, 2012).

• KML is an international standard of the Open Geospatial Consortium. XML (Extensible Markup Language) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable (Wikipedia, 2012).

• KMZ is a compiled KML file, meaning that it has been encrypted in machine language and is not readily open or read in ordinary language or ASCII text editors.

• You can <File><Save> or <File Save As> from going to KMZ to a KML or vice versa.

• But if you want to manually edit the GE file, <Save As> a KML, then <Open> it using Microsoft (MS) Notepad or any ASCII text editors for PCs.

Google Earth (GE) and mouse-wheel button interoperability

• A key GE viewing tool is to use the mouse for interactive viewing by **<Pressing down>and <Holding>** the **middle button of your mouse** after the cursor is positioned over the feature or area of interest, then moving the mouse with the zoom wheel depressed.

• Depressing and holding the mouse wheel down allows you tilt and rotate the view interactively.

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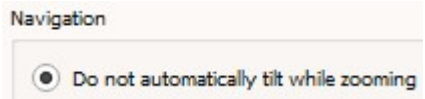
Desktop Management

There are a few steps that I ask students to do when starting GE so that we begin on common ground.

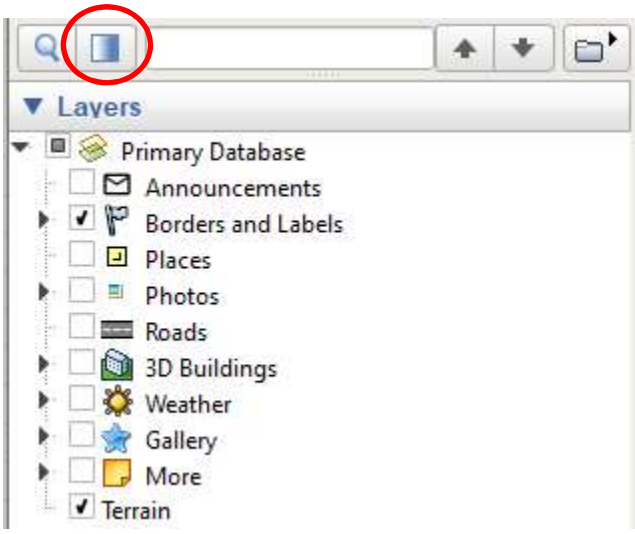


• Disable **<Tools> <Options> Navigation>**
<Do not automatically tilt while zooming> function

• Enable only
<Borders and Labels> and
<Terrain> in the Layers pane.

• Also note that immediately above the **<Layers>** pane is where the opacity slider is accessed.

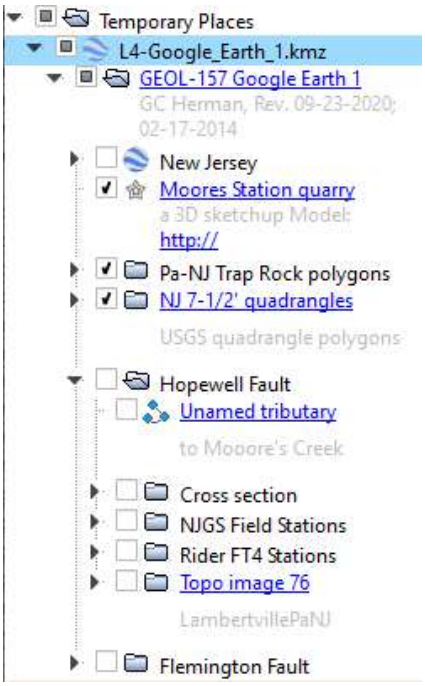
Opacity slider button



GE PART 1: Explore geospatial themes for New Jersey using Google Earth

Copy and paste the following URL into your browser and **<Enter>**

http://www.impacttectonics.org/GEOL157/GEOL157_Google_Earth_1.kmz



This will download a KMZ containing some New Jersey geologic and topographic data that we will open for the introductory exercise.

You can start the session either by **<double-clicking>** on the download button upon completion of the download, or start Google Earth, click on the **<File><Open >** sequence in the Menu Bar (fig. 1), and open the KMZ in you **<Downloads>** folder.

•The file will load into the GE Temporary folder:

• **Upon loading the theme DO NOT TURN ON ALL LAYERS.**

•Be sure to minimize the Tour Guide at the bottom of the GE view and slide the Legend pane downward in order to maximize the space available in which to expand theme folders.

• With the newly loaded theme highlighted and active, grab it by clicking on it once with the mouse, and physically drag it upward into <**My Places>** in the Legend pane.

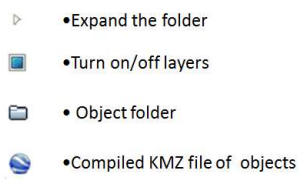
• Then **<Right click>** on the theme in the Legend pane and specify **<Save><Save My Places>** or **<Save Place As>** if you want to save it externally.

• A pop-up menu will prompt you for a location to **<Save>** the file for future use.

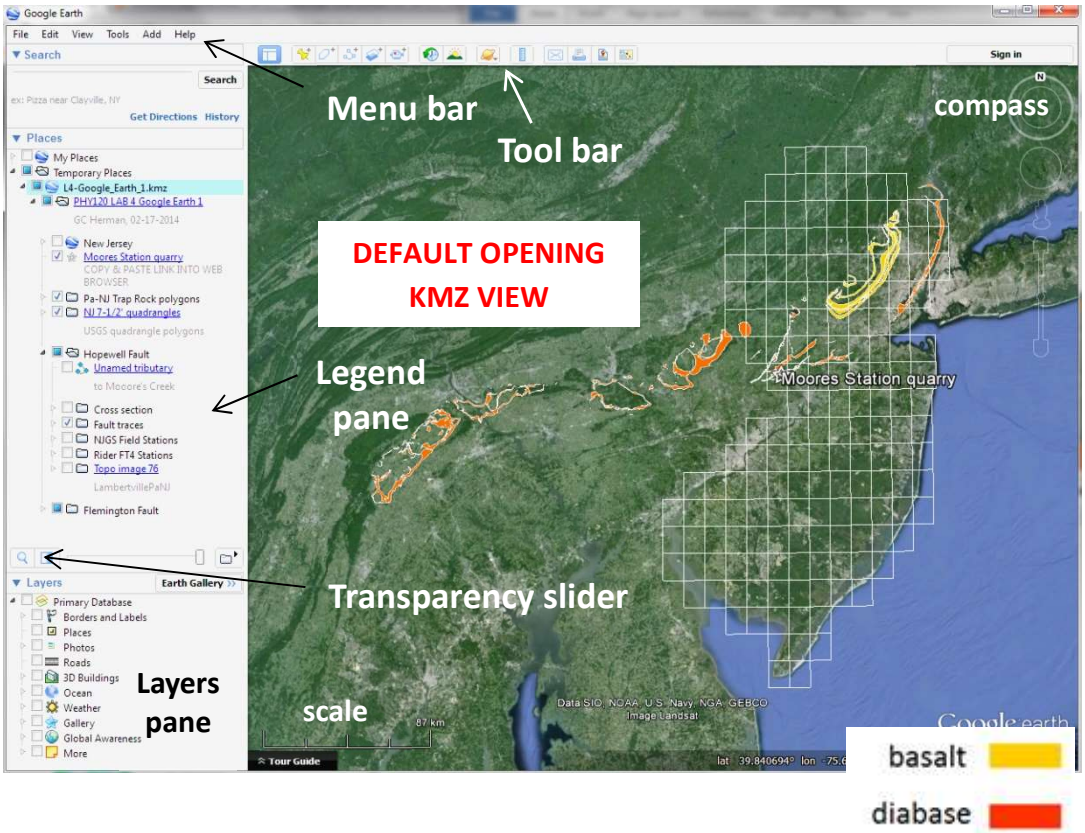
• Expand the theme folder by clicking on the *triangles* to view the theme content before deciding on an approach for *turning layers on and off (making them visible – see right).*

• This is a safe approach when downloading and using a file exceeding a couple megabytes size.

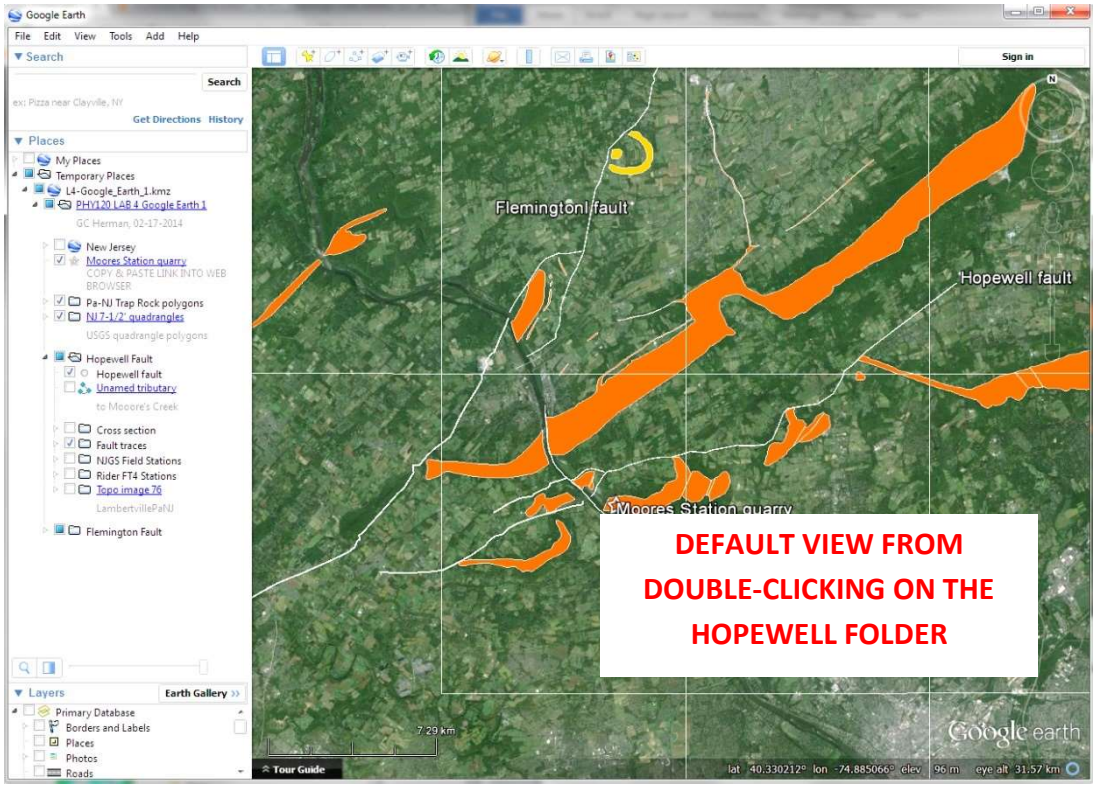
GE Legend controls



• Take note on the figure below where the different GE toolbars and functions are labeled and what their names are.



• Next, **<double-click>** on the **Hopewell Fault** folder and GE will zoom to that shown below zoom into focus.

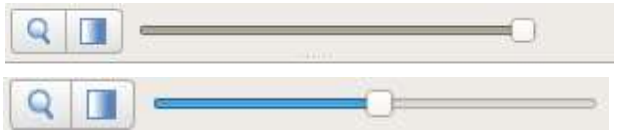


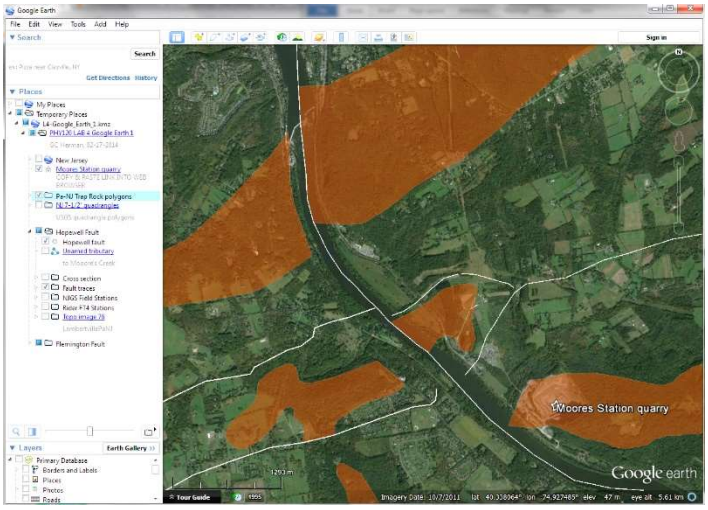
• Note that the ***Layers pane*** has now been restored, but slid down and minimized so that only the ***Borders*** through ***Roads*** is visible. This maximizes the Places pane availability for displaying a theme's component folders while providing quick access to the built-in GE reference themes such as *Borders and Labels,* and *Roads.*

• <**Single-left click**> on the view to move it into the center of the view, and use the mouse wheel to zoom in to the quarry.

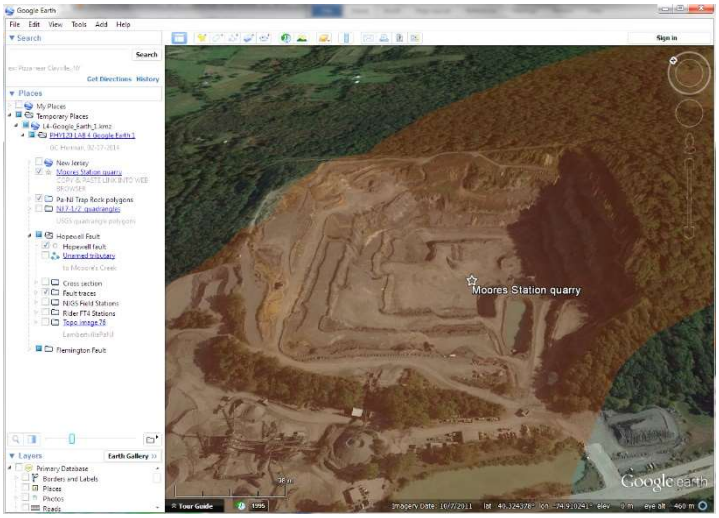
• Depress the mouse wheel and hold it down as you drag the mouse backward toward you to begin dynamically viewing the topography and geology polygon. Release the mouse wheel, **<Left click>** on the display again and drag it into a desired perspective.

• Next adjust the transparency slider to the left to adjust the active theme's opacity (opposite of transparency)



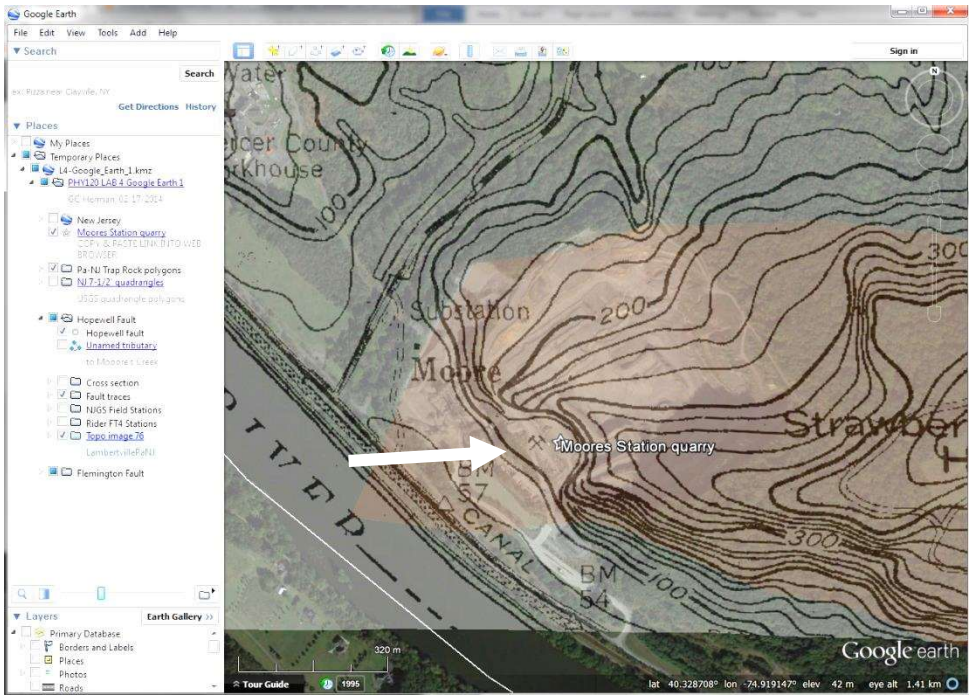


GE zooms to this view **after <double-clicking>** on the ***<Moores Station quarry>*** placemark. Note that the Pa-NJ Trap Rock polygons folder is active (highlighted blue) in the <Places> pane and that the opacity is set at ~50%, making it so that you can see the quarry when thetrap-rock layer is



Oblique North-Northeast view of the Moores Station quarry after repositioning and setting the Pa-NJ Trap Rock polygons theme to about 30% opacity (70% transparent).

Bird's-eye view of the Moores Station quarry with part of the U.S. Geological Survey, Pa-NJ Lambertville 7-1/2' topographic quadrangle map registered as an image overlay and set at about 30% opacity. The arrow points to the perspective



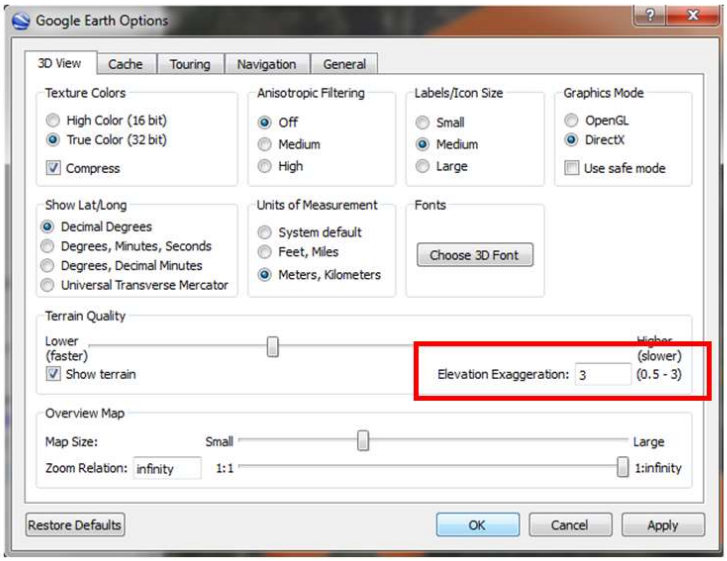
Photograph of quarry benches looking ESE along the viewpoint indicated above.

Adjusting the vertical exaggeration in GE

• Access the **<Tools><Options>** menu to change the vertical exaggeration of the ground surface to 3 as much as 3 times its value in order to accentuate topographic features.

GE and Vertical topographic exaggeration

The command **<Tools><Options…>** take you to the following menu:

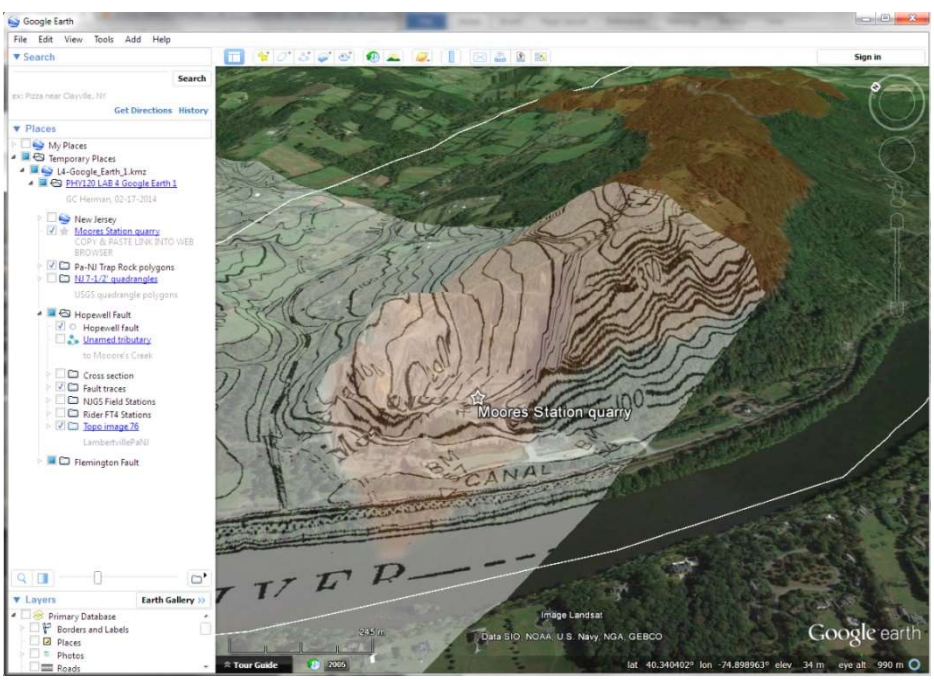


The elevation exaggeration will multiply the height of the topography by the factor entered (up to a maximum 3X)

This function should be used in areas of muted topographic relief, and not for mountain ranges or areas of drastic relief.

This GE Options window allows you to set the vertical exaggeration to anyone range of values from a minimum 0.5 and a miximum 3.0.

• The resulting display will look something like this:



Oblique, 3X vertically exaggerated view of the Moores Station quarry.

Compare this with the view on the preceding page

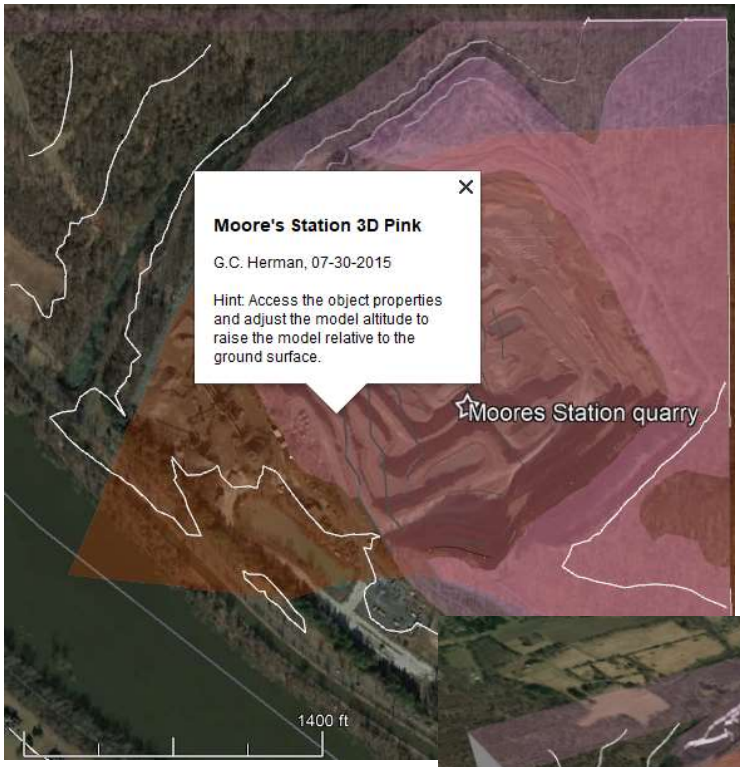
• Next we will see how vector-based object models like 3D buildings are brought into GE.

Single-left click on this legend entry:

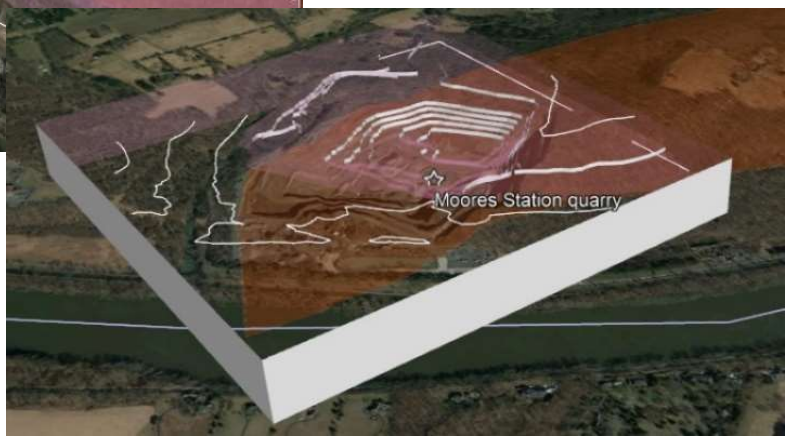
• In the viewing pane, a balloon pops up in the view with a link to a SketchUp Model of the quarry that was used in estimating the holding capacity when the quarry operations are stopped and it will be considered for use as a reservoir with about 1-billion gallon holding capacity.

• <Left-click> on the URL and the model will download. Click on it to open it and manipulate the 3D model by accessing its properties which places it in interactive mode for interactive manipulation of the model.

3D models like this can be built using Trimble's SketchUp computer-aided drafting (CAD) program that is free for use to learn. A subscription is required for professional use.



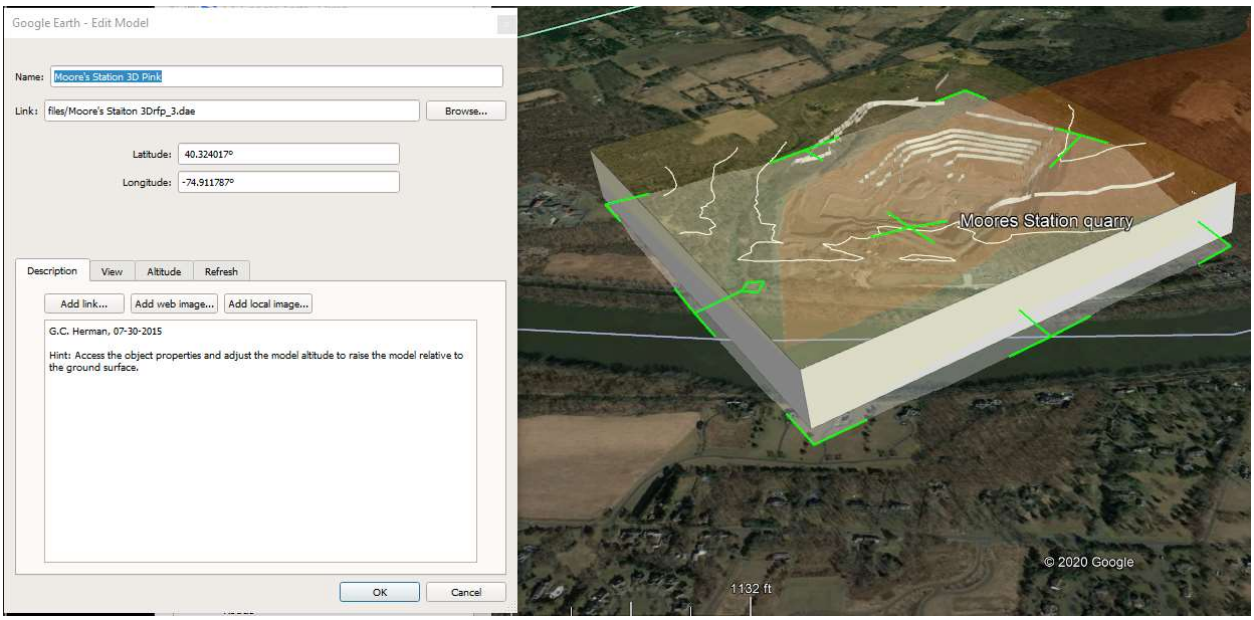
Map left) and oblique views (lower right) views of the quarry after loading the KMZ model, then repositioning for a tilted view. Note that the model loads as a semi-transparent theme and the GE transpareny won't operate on object models. The transparency of an vector-based model is saved and exported as such from the CAD program.



The next figure show how to access the model proerties and explore what options GE provides for registering and manipulating 3d (or 4D) object models.

• By making the Moore's Station model the active theme, then (Right-clicking> on it, the object's property-dialog (or information) pane opens to allow objection manipulation and naming.

• Spend time adjusting and playing with the model to see how 3D objects can also be register and manipulated in an interactive mode.



Registering a raster image that is accessed on the Internet into GE

This next exercise teaches you how to import and register custom raster imagery into GE for conducting studies of interest.

• STEP 1: Access this URL for LAB3 from our website

http://www.impacttectonics.org/GEOL157/NJGWS_OFM-30.png

This is a DEM-based, raster, hill-shaded image of NJ that we are going to register onto New Jersey in GE.

• STEP 2: In GE Pro Search for and fly to New Jersey.

Be sure to have <Borders and Layers> activated in the <Layers> Pane

• STEP 3: Click on the **<Add Image overlay>** button on the tool bar 

This will open a dialog window and a set of green 'handles' on your display screen that will be used for geo-registering the PNG image into GE.

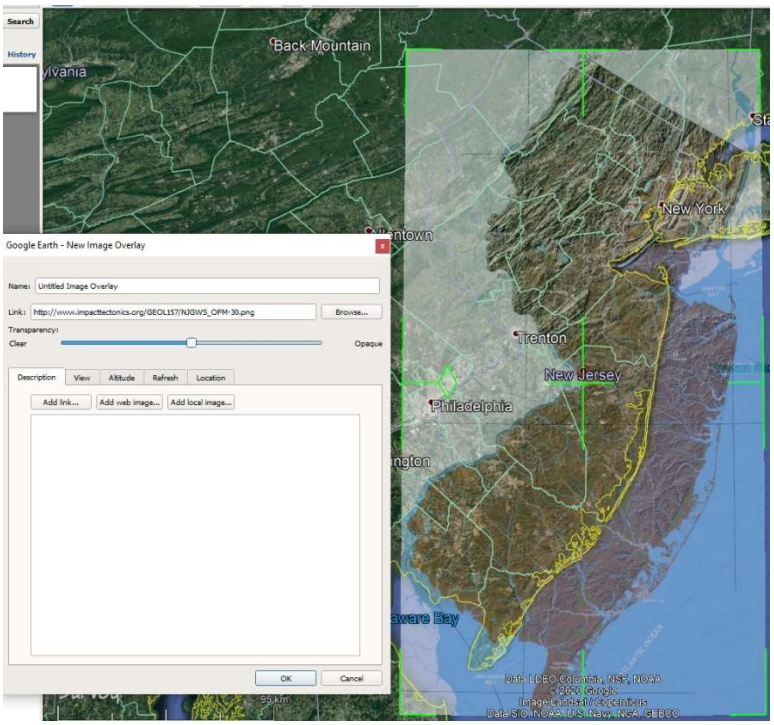
• STEP 4: Highlight and copy the image URL (the internet address) of the PNG image and **<Paste>** it into the **<Link>** box shown above, then press the **<Tab>** key on your PC's keyboard.

• STEP 5: After the image loads, adjust the transparency so that you can see GE's <Border and Lables> layer in order to place the image into its proper alignment.

In order to do this, explore how the Green handles work with respect to sizing and rotating the image.

Please Note:

1) This particular image doesn't need to be rotated
2) Once you get the image positioned correctly, click <Ok> and the image is 'locked in' or georegistered to your liking and with the transparency saved as set in editing mode. If you would rather adjust its opacity and have it fully opaque after your registration, simply remember to adjust the transparency slider to <Opaque> before exiting the properties window.

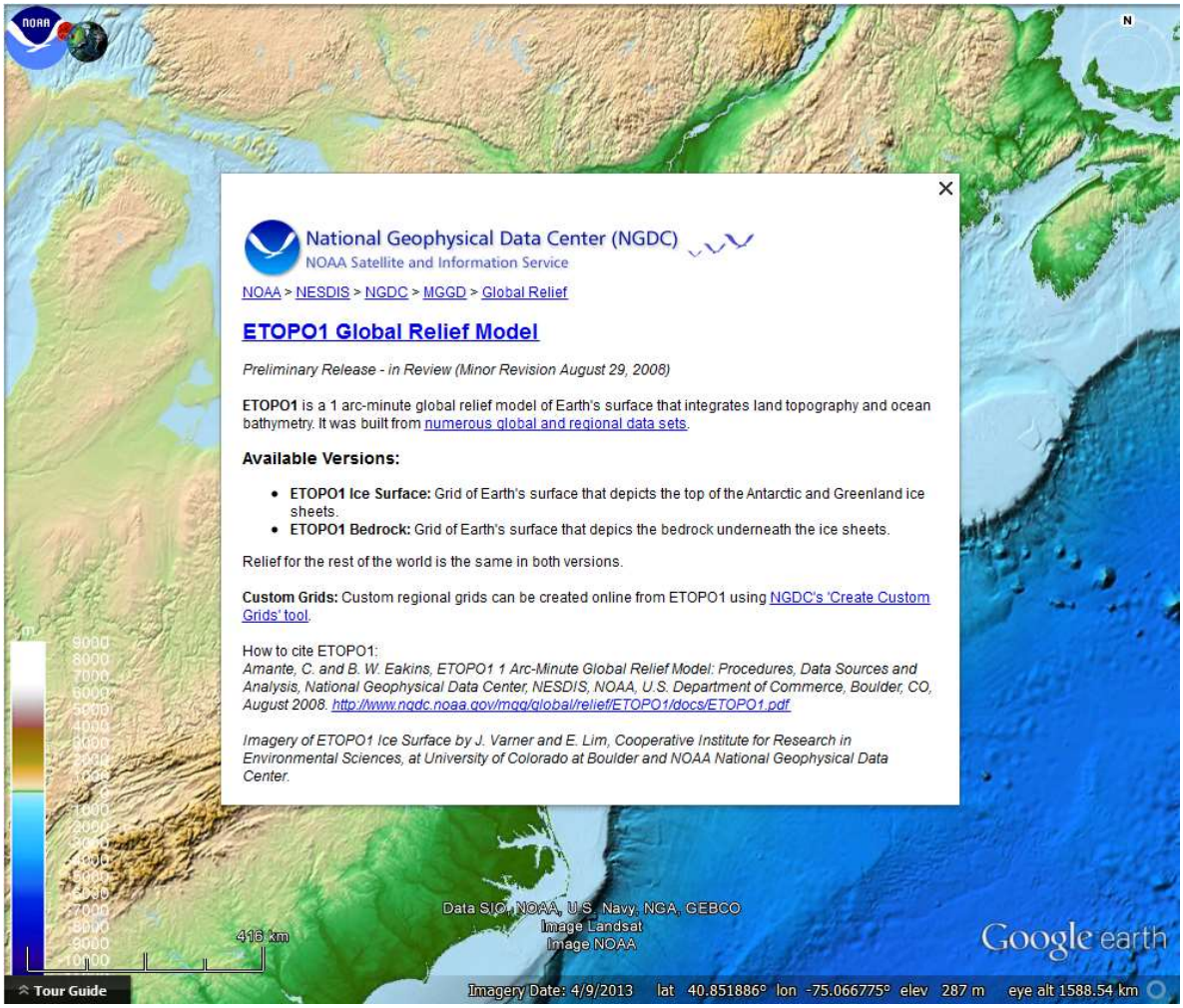


Next, download and open the ETOPO1 Global Relief Model

Go to the Internet and access this URL:

http://www.ngdc.noaa.gov/mgg/global/relief/ETOPO1/tiled/ice_surface/etopo1_ice_surface.kmz

• This opens the colored physiographic theme of the Earth pictured below:



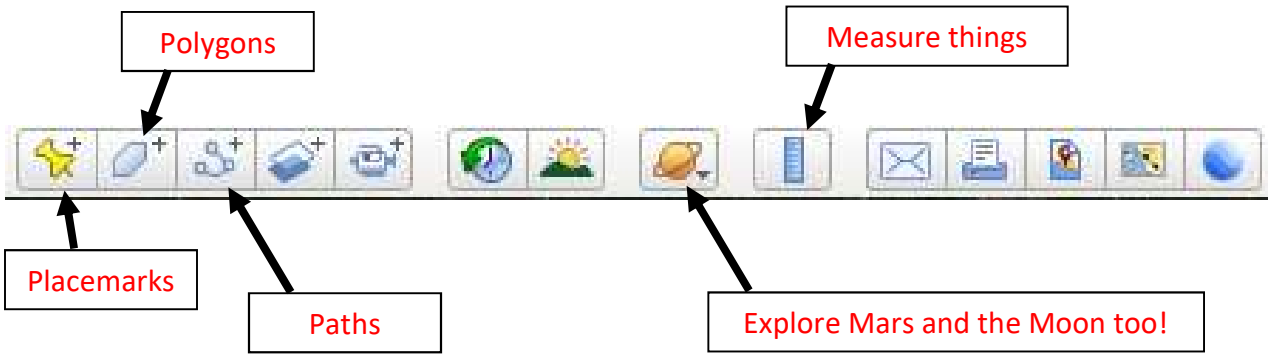
The ETOPO1 Global Relief Model balloon is displayed above

<Left click> on the newly added 

to activate it and adjust its tranparency.

• Use this theme to explore in semi-transparent mode to explore the Andes and the Himalayas, Japan, or wherever on Earth.

For the last part of LAB3, practice making placemarks (points), paths (polylines), and polygons in GE.



For making paths and polygons, practice adding vertices (points) with the mouse <left click> button and deleting vertices using the mouse <right click>. Take time to explore the various options when constructing vector entities and note how to name them.

TAKE-HOME GE EXERCISE 1: (526 KB)

At this time, you should have a working familiarity with raster imagery and coordinate-referenced points, lines, polygons and object models, and this lab functions to develop their skills in registering raster imagery for the purpose of extracting polyline-based geoscience themes. For this exercise, three images are provided in a KMZ file that provide continuous base representation of the Pleistocene terminal moraines covering eastern Pennsylvania and western New Jersey (fig. 13). The opening view includes the three maps showing line traces of glacial morainic deposits or thickness isolines of glacial sediments in the New Jersey region. The maps include work by Witte and Germanoski, 2012; Stanford, 2010; and the USGS Geological Survey for Long Island (http://pubs.usgs.gov/of/2000/of00-243/pdf/fig1.pdf).

According to Stone and others (2002), Earth's glacial record shows that the Laurentide ice sheet reached New Jersey at least three times over the last two million years. The limits of these respective events are characterized by Witte and Germanoski (2012) from youngest to oldest:

Pleistocene glacial stages and approximate ages in the NY Recess

Moraines (Marine isotope age)	*estimated glacial-culmination age of terminal deposits*
Holocene	11,700 years - present (11.7 Kya)
Late Wisconsinan (MIS 2)	~26 - 17.8 Kya
Late Illinoian or pre-Illinoian B (MIS 6 or 12)	~ 160 - 180 Kya
Two older pre-Illinoian (MIS 16 – 22)	~850 Kya - 2.01 Mya

According to Witte and Germanoski (2012), "Similar to New Jersey's oldest glacial deposits, those in Pennsylvania may represent more than one glaciation. There is some disagreement concerning the age of the older glaciations and number of pre-Illinoian glaciations, but there is a remarkable congruency between the glacial limits mapped on either side of the Delaware River. The youngest glacial deposits laid down during the Late Wisconsinan substage provide the clearest record of glaciation. The glacial record, indicated by the Illinoian and especially the pre-Illinoian deposits, is much less clear due to an extensive and complex periglacial and weathering history".

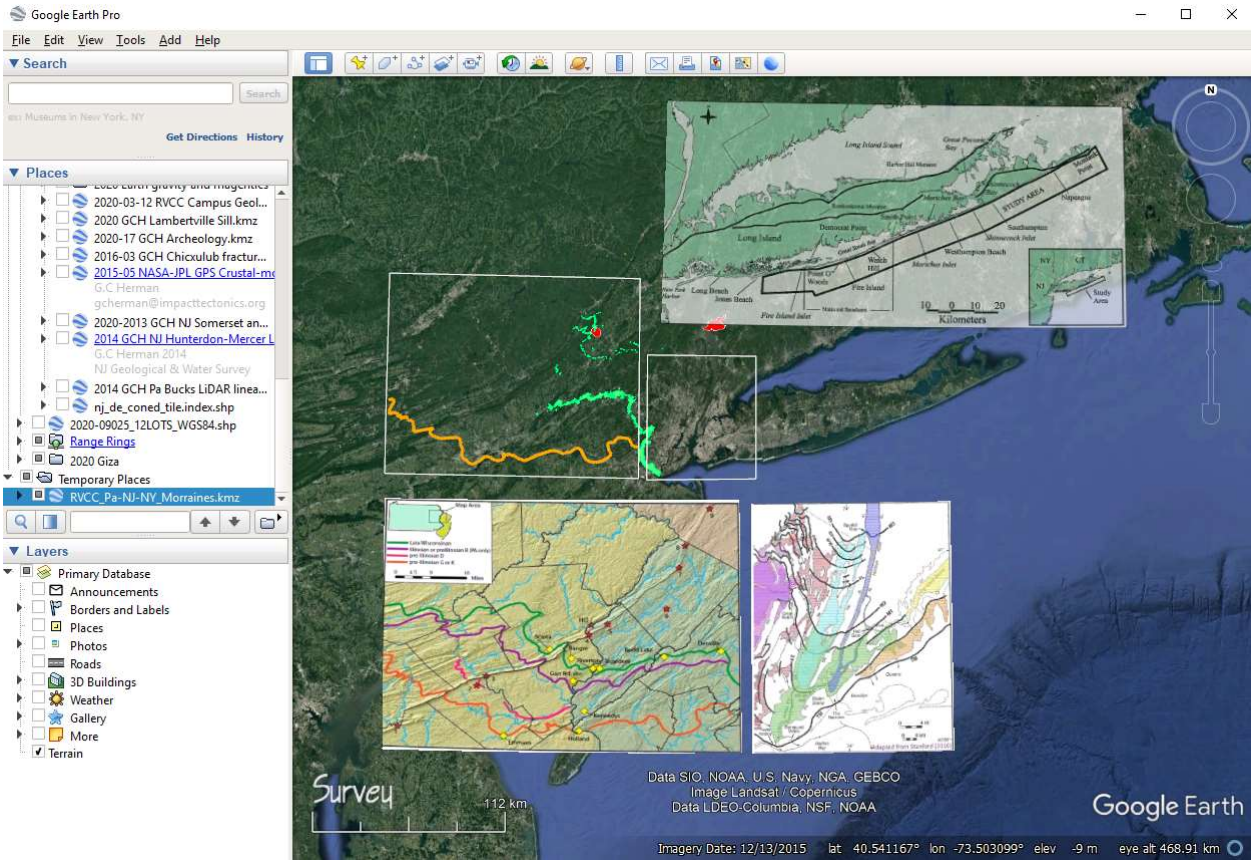
EXERCISE FIRST STEP: Access the on-line KMZ file and manage the KMZ folders

A) Copy and paste the following URL into your Internet browser and **<Enter>**

http://www.impacttectonics.org/GEOL157/2020_RVCC_GCH_Pa-NJ-NY_Glacial_Moraines.kmz

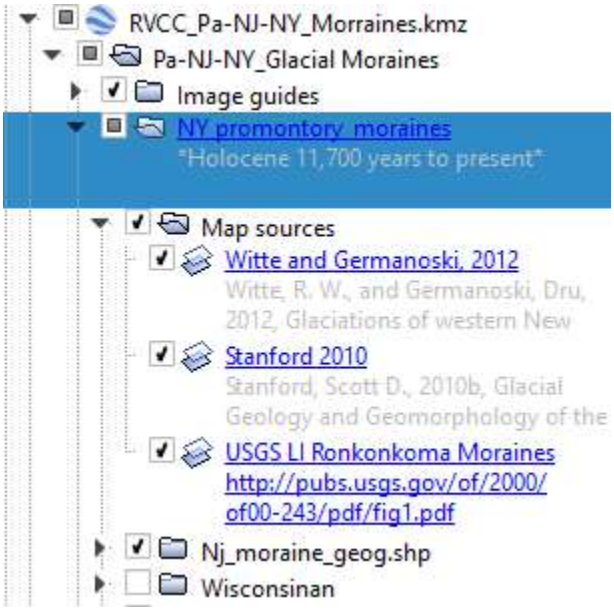
This will download the KMZ file to use for this assignment to your PCs' <Downloads> folder.

B) Next open the file using Google Earth Pro. The following is your opening view:



C) Note that the file loads into **<Temporary Places>** and that you need to grab it using the left mouse button and drag it upward into **<My Places>** then **<File><Save My Paces>** so that if your PC crashed during the session or you close and reopen GE, it is saved and available when starting GE.

D) Next expand the KMZ content file folders to see the subfolders.

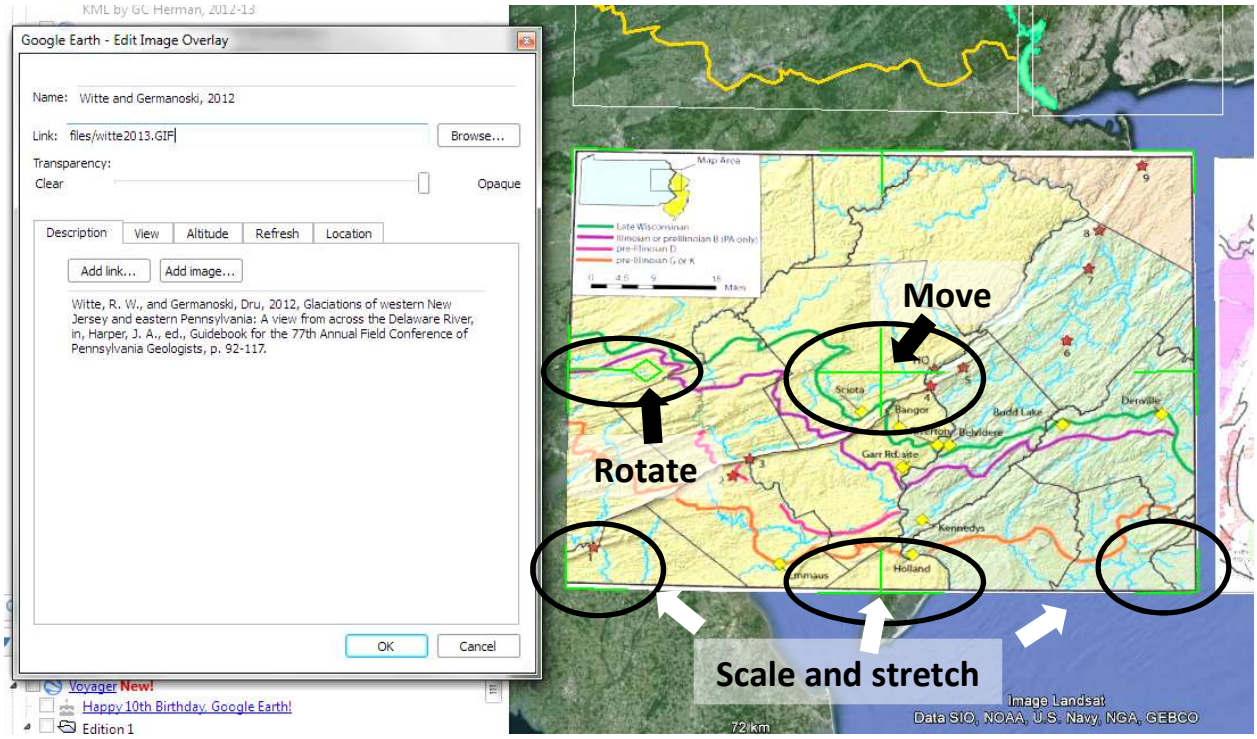


The opening view includes three raster images that are preloaded in the KMZ along with two white boxes that the two lower images fit in. A third, upper image of Long Island requires manual matching of the coastline to geo-register it. The Green polygon shapes included in the KMZ are NJ morainic deposits digitized by Stanford and others (2007) that were imported as GIS shapefiles into the KMZ theme.

EXERCISE SECOND STEP: Georegister all three (3) custom images

A) Once the KMZ subfolders are expanded and you see those labeled ***NY promontory moraines*** and ***Map sources,*** **<Left click>** on one of the images (like for Witte and Germanoski, 2020 shown below) to activate it then **<Right-click>** on the **<Properties>** menu option (bottom choice). This will place the image in editing mode and activate green handles to manipulate and register the image as demonstrated for in the preceding section. The different types of handles can be used to resize, stretch, rotate, or drag the image into position.

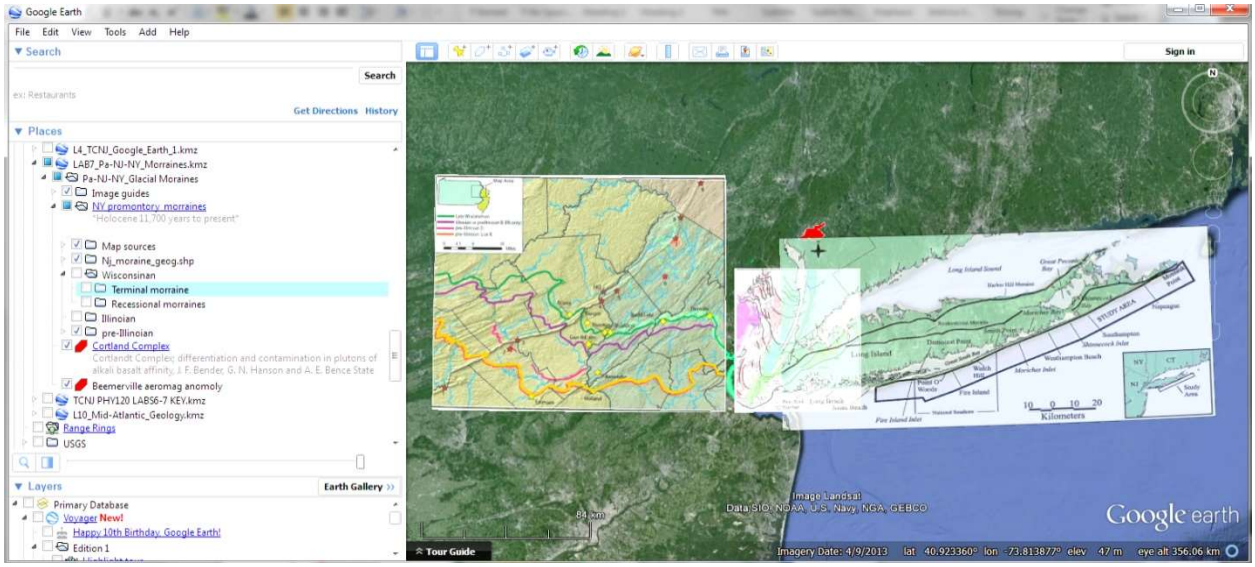
B) Once the correct position is attained, **<Left click> <OK>** in the Edit Image Overlay window



GE view of an image property-dialog box with the image in editing mode. Note the green handles that are used to manipulate the image, and the Trasparency slider on the <Properties>< Edit Image Overlay> menu.

C) When registering the Long Island image, use the transparency slider to make the image semi-transparent in order to match the coastline on the image with that in GE.

Once each image is positioned, then the next step is to digitize the traces of the glacial moraines.



GE view of the correctly georegistered imagery before digitizing the glacial moraines .

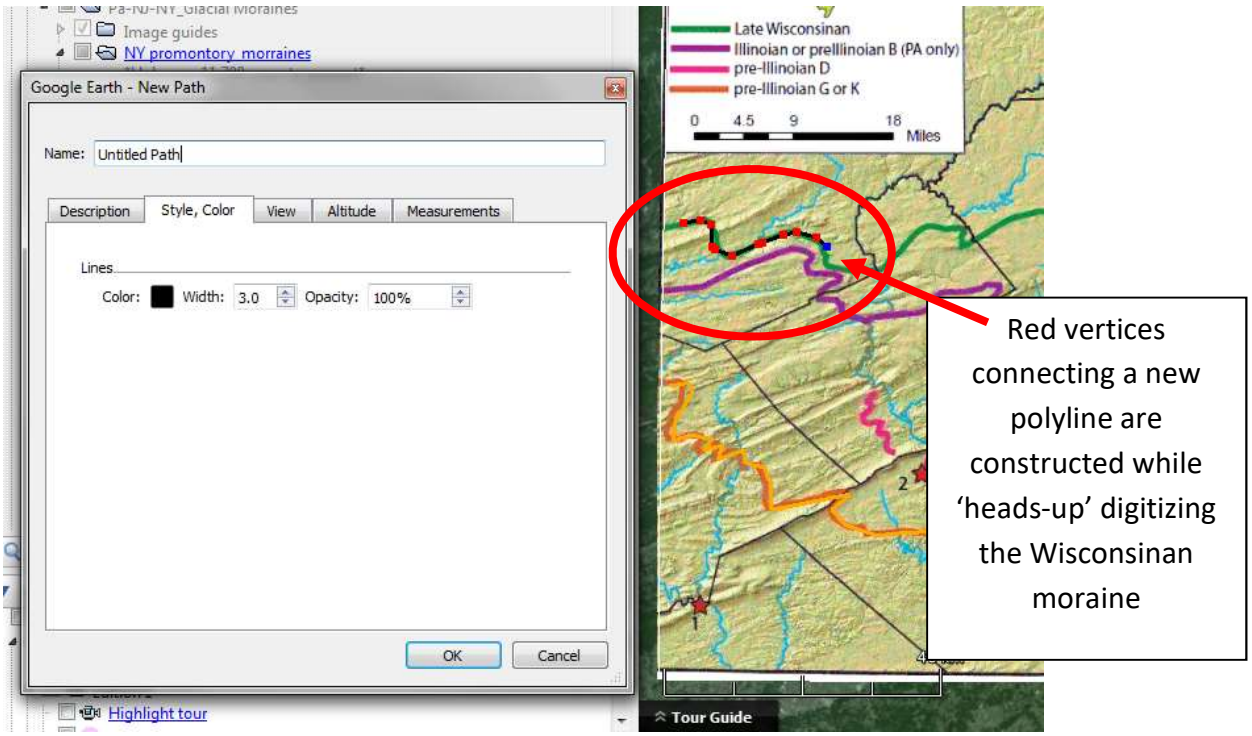
EXERCISE THIRD STEP: Digitize polyline traces of the moraines using the GE polyline tool

As seen in the opening image (p. 14) the pre-Illinoian moraine has already been digitized for you as a colored (orange) polyline that is useful for checking the alignment of *the Witte and Germanoski* image. Also, the Wisconsinan terminal moraine in New Jersey (the southernmost green polygon) serves as a reference for continuing the trace of the Wisconsinan from eastern Pennsylvania through New Jersey.

To digitize a feature trace,

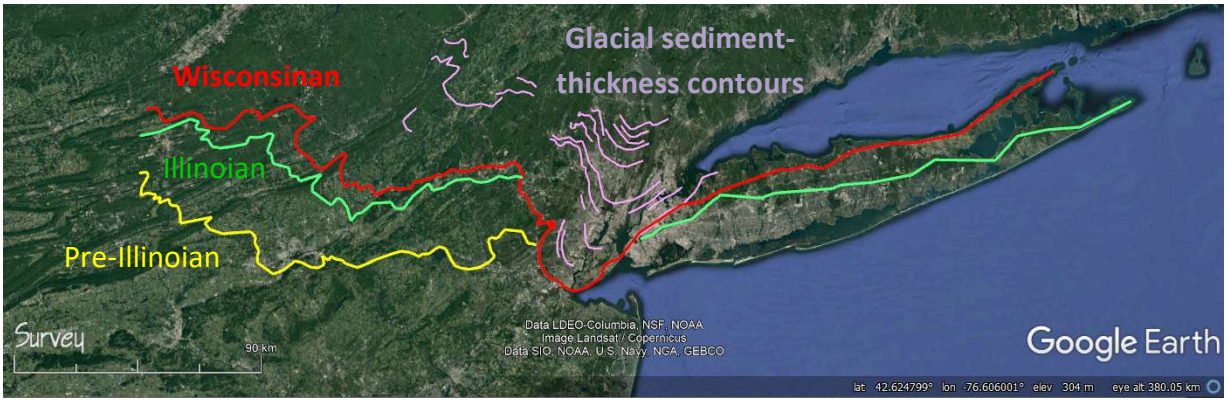
1) Activate the folder that is to receive a digital polyline, for example, before tracing the terminal moraine of Wisconsinan age, use the mouse to **<Left click>** the folder and highlight it before proceeding (like that in figure 14).
2) Next, **<Left click>** the polyline tool icon in the toolbar: 
   The mouse cursor becomes a symbol like this: 
3) Next, position the mouse cursor over the starting point, then repeatedly **<Left click>** the mouse button as you move along the trace, clicking to place a vertex on the image representation of the moraine:

GE view of an image property-dialog box with the polyline in editing mode. Note the black line of Width 3.0 that is being digitzied along the Wisconsinan moraine (beginning on the left and progressing to the right). Each small, red square is a polyline vertex that can be moved (using the left-mouse button) or deleted (using the right-mouse button)



4) Once the digitizing environment is active, a feature-dialogue box opens with an **<Untitled Path>** reference name in the title box shown above. Please type in the name of the feature that you will be digitizing. As long as this dialogue box remains open, you will be in the editing mode and can use the mouse as a digitizing tool to trace the feature line.
5) **<Right click>** on a vertex will delete it as you want to refine the line**.**
6) There are two modes of digitizing, by holding the left mouse-button down as you drag the mouse along, you can generate a smoot, continuous line that is densely populated with vertices. On the other hand, single clicking between mouse movements allows you to generate a polyline trace adding a single vertex at a time in controlled manner. The choice is yours, experiment using both approaches.
7) At any time, the dialog box for editing a polyline can be closed by clicking **<OK>**. To continue digitizing it, or to further edit it, simply **<Right click>** on the theme in the Legend pane, and continue editing it. Once the vertices are visible, you can select one with a **<Right click>** to move it (drag it when holding he mouse's left button, or delete it using the right button.)

The goal is to digitize a feature trace representing each of the terminal moraines, and a few of the sediment-thickness lines as part of a new KMZ file. The final product should look like this once the image sources are switched off and the digitized lines are displayed:



The colored lines above summarize how the final product should appear once all of the terminal moraines are digitized and organized in the respective folders. Note how the Illinoian gets overridden by the Wisconsinan and segmented into two parts. The pink lines are optional.

Some additional useful tips:

1) Please **<File><Save>** your work periodically. GE crashes, and when it does, you will regret it if you didn't save your work and you will need to start over.

2) To save your work, **<Left click>** on the folder at its root (highest) level, then in the **Menu Bar, <Left click> <File><Save><Save Place As**> to save your work to a local hard drive, zip drive, or the cloud.

   Alternatively, after highlighting the top-level folder, use the mouse button to use this shortcut: **<Right click> <Save Place As**>

3) *How it appears when you saved it last is how it will look when you open it next.*

4) It is also important to repeatedly save your work environment if you prefer by using this sequence of commands:

Menu Bar, <Left click> <File><Save><Save My Place> to save your current work environment.

To gain credit for this lab, capture an image of your final product or save your KMZ file and email it to me.

References

Stone, B.D., Stanford, S. D., and Witte, R.W., 2002, Surficial geologic map of northern New Jersey. U.S. Geological Survey Miscellaneous Investigation Series Map, scale 1:100,000.

Stanford, S. D., Pristas, R. S., Witte, R. W., 2007, Surficial geology of New Jersey: N. J. Geological Survey Digital Geodata Series DGS 07-2, scale 1:100,000.

Witte, R. W., and Germanoski, D., 2012, Glaciations of western New Jersey and eastern Pennsylvania: A view from across the Delaware River, *in*, Harper, J. A., ed., Guidebook for the 77th Annual Field Conference of Pennsylvania Geologists, p. 92-117.