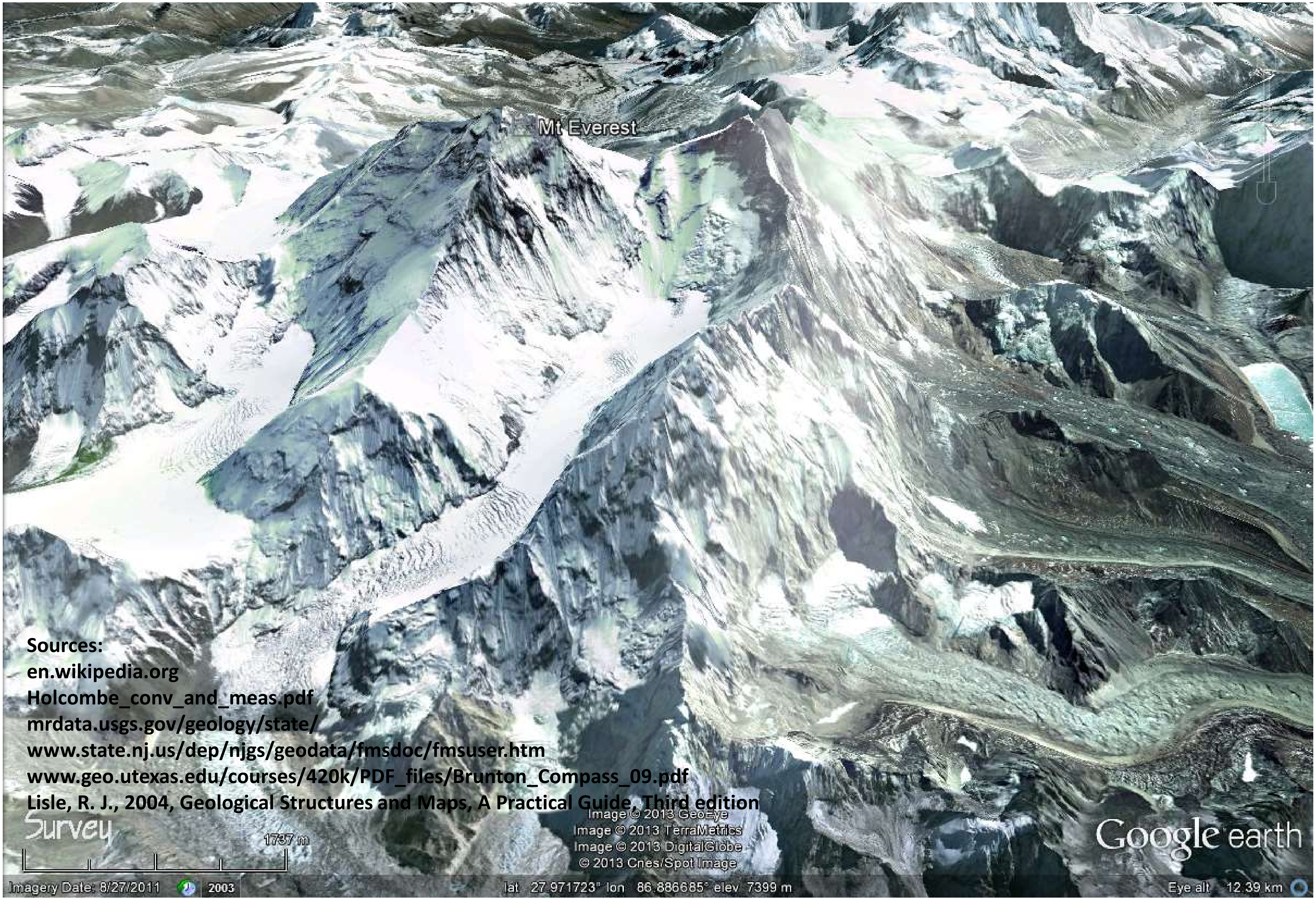
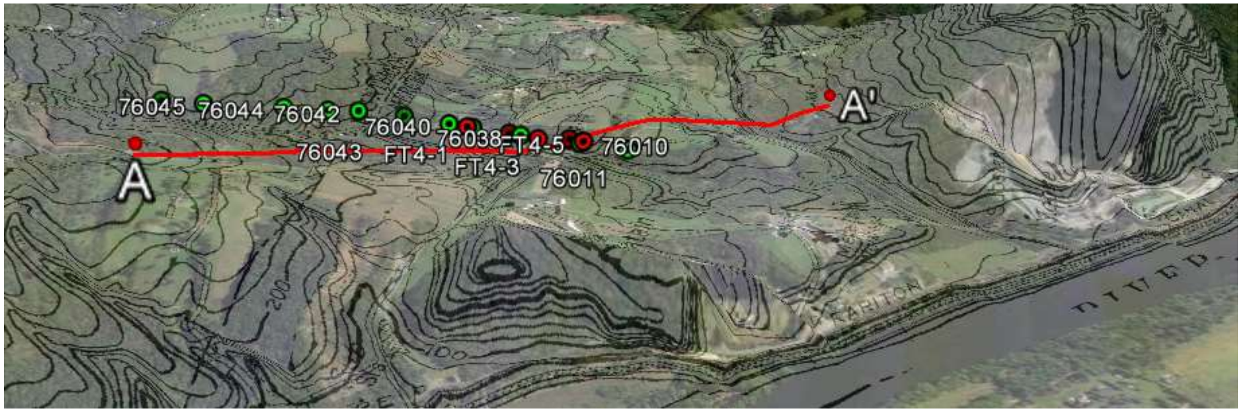
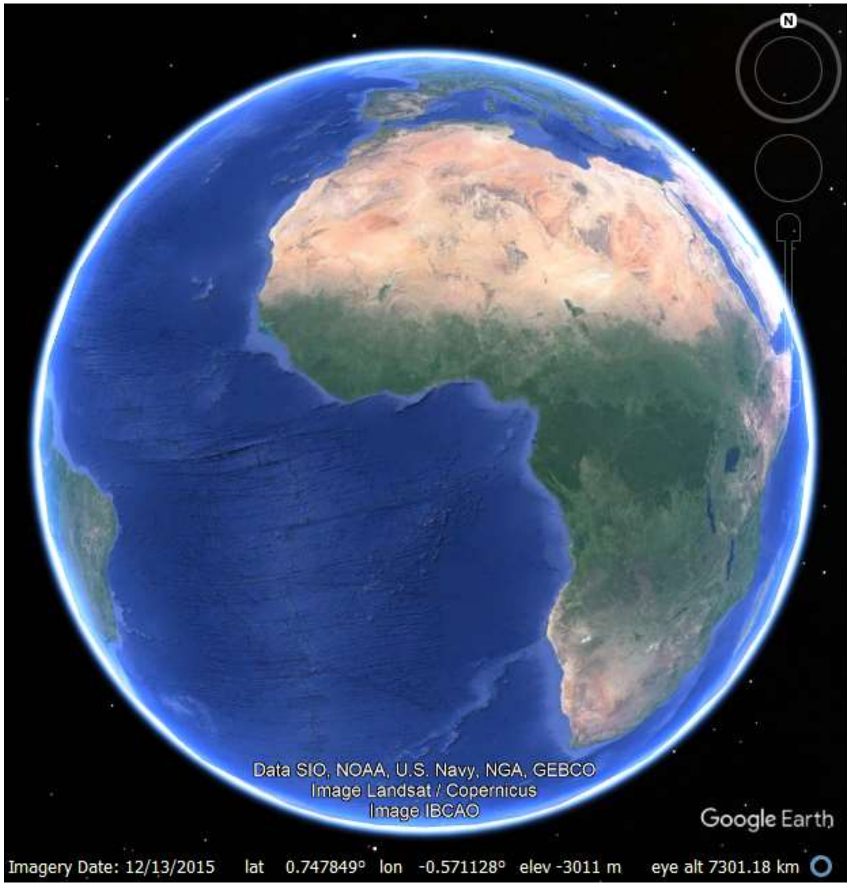
GEOL-157 LAB 4 Maps, Landforms, and Google Earth



Sources:
en.wikipedia.org
Holcombe_conv_and_meas.pdf
mrdata.usgs.gov/geology/state/
www.state.nj.us/dep/njgs/geodata/fmsdoc/fmsuser.htm
www.geo.utexas.edu/courses/420k/PDF_files/Brunton_Compass_09.pdf
Lisle, R. J., 2004, Geological Structures and Maps, A Practical Guide, Third edition

- **LANDFORMS**
- **MAPS**
- **MAP ELEMENTS**
- **MAP SCALES**
- **TOPOGRAPHY and HYPSOGRAPHY**
- **TOPOGRAPHY and DEMS**
- **GIS POINTS, LINES, and POLYGONS**
- **GIS TINS**
- **DEMS and HYPSOGRAPHY**
- **GEOLOGICAL PLANES and LINES**
- **GEOLOGIC POINTS**
- **USING GOOGLE EARTH**

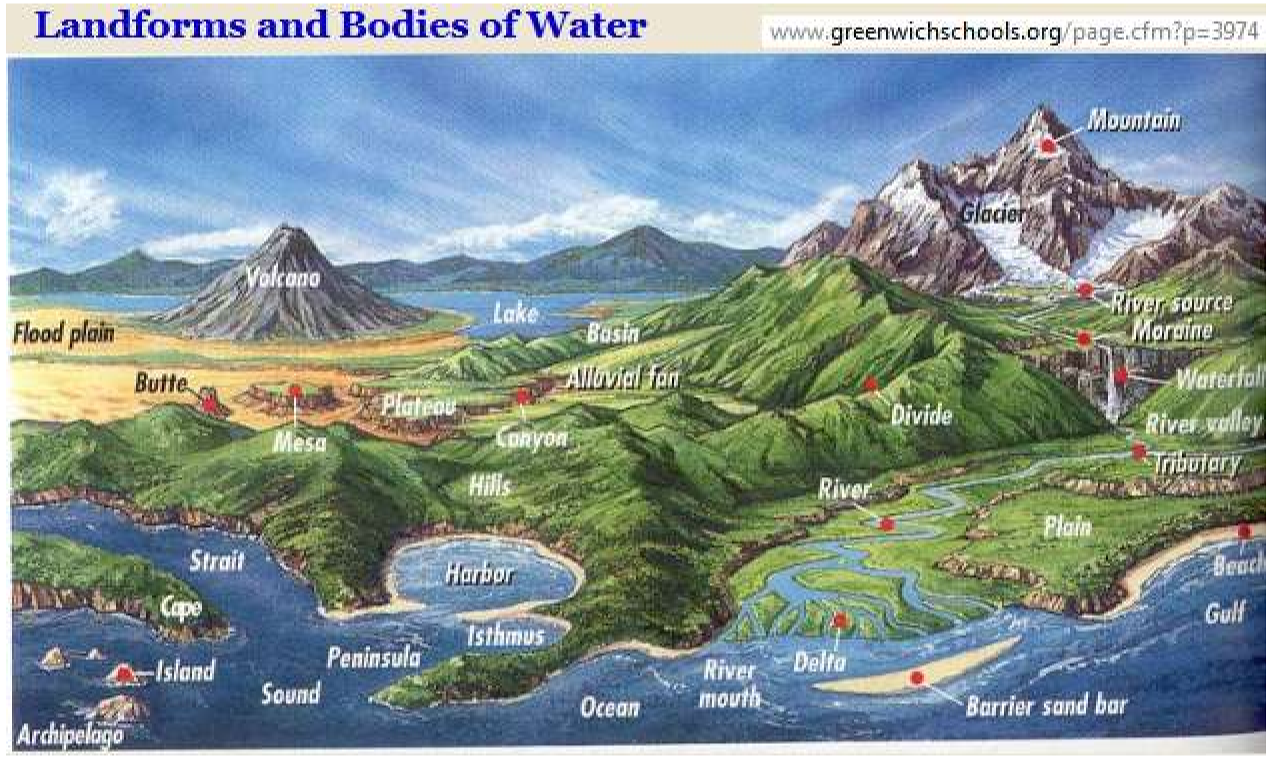




GC Herman 2013 rev. 2019

LANDFORMS

- Landform elements include seascape and oceanic water-body interface features such as bays, peninsulas, seas and so forth, including sub-aqueous terrain features such as mid-ocean ridges, volcanoes, and the great ocean basins.



- ***Topography*** - The expression of landscape forms and locations as part of a terrain

MAPS

1482 printed map depicting Ptolemy's description of the Oecumene, Johannes Schnitzer, engraver

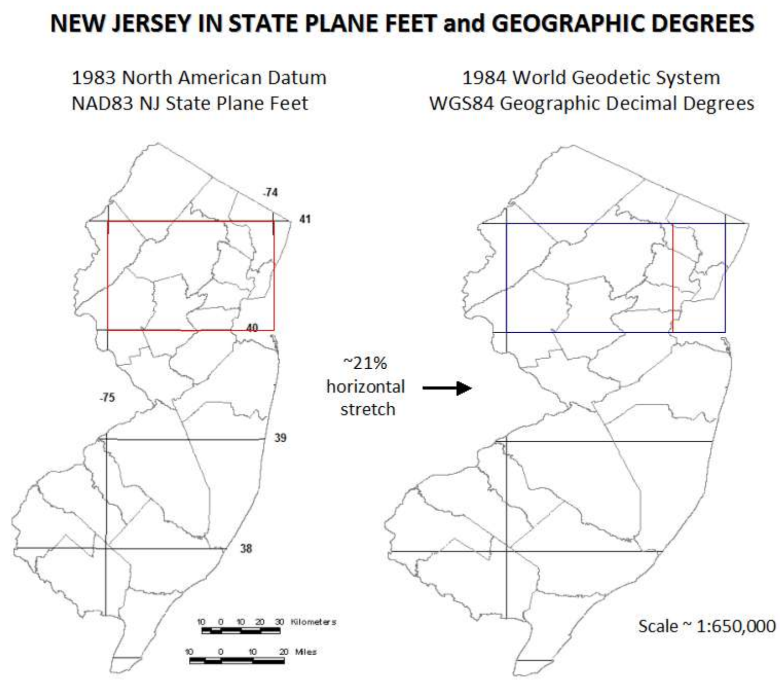
- **Cartography** (Greek *chartes* = map and *graphein* = to write) is the study and practice of making maps

- Maps in the traditional sense are depictions of the Earths terrain and associated objects represented on flat media.

- They combine science, technique, and cartographic elements in order to communicate spatial information effectively.

- Attempts are made to eliminate distortion in one or several aspects of the map.

- The map maker must choose which distortions are less important than the others.



MAPS

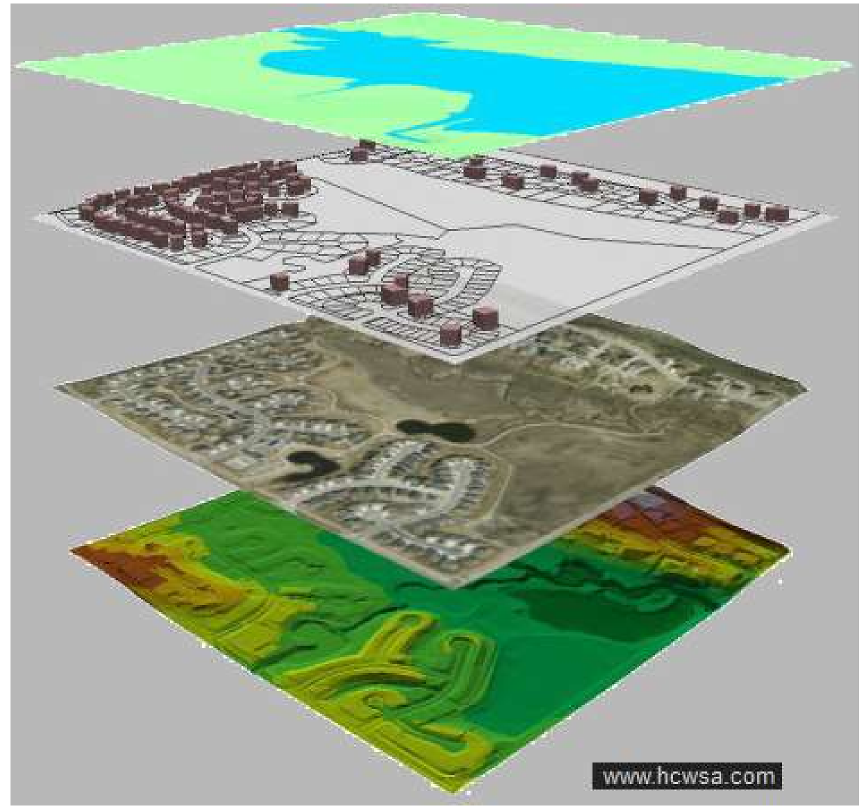
•They may choose to allow a little distortion in all four of the following aspects to produce the right type of map:

•**Conformality** - the shapes of places are accurate

• **Distance** - measured distances are accurate

• **Area/Equivalence** - the areas represented on the map are proportional to their area on the Earth (Scale)

• **Direction** - angles of direction are portrayed accurately



• Modern cartography is closely integrated with geographic information science and constitutes many theoretical and practical foundations of geographic information systems (GIS).

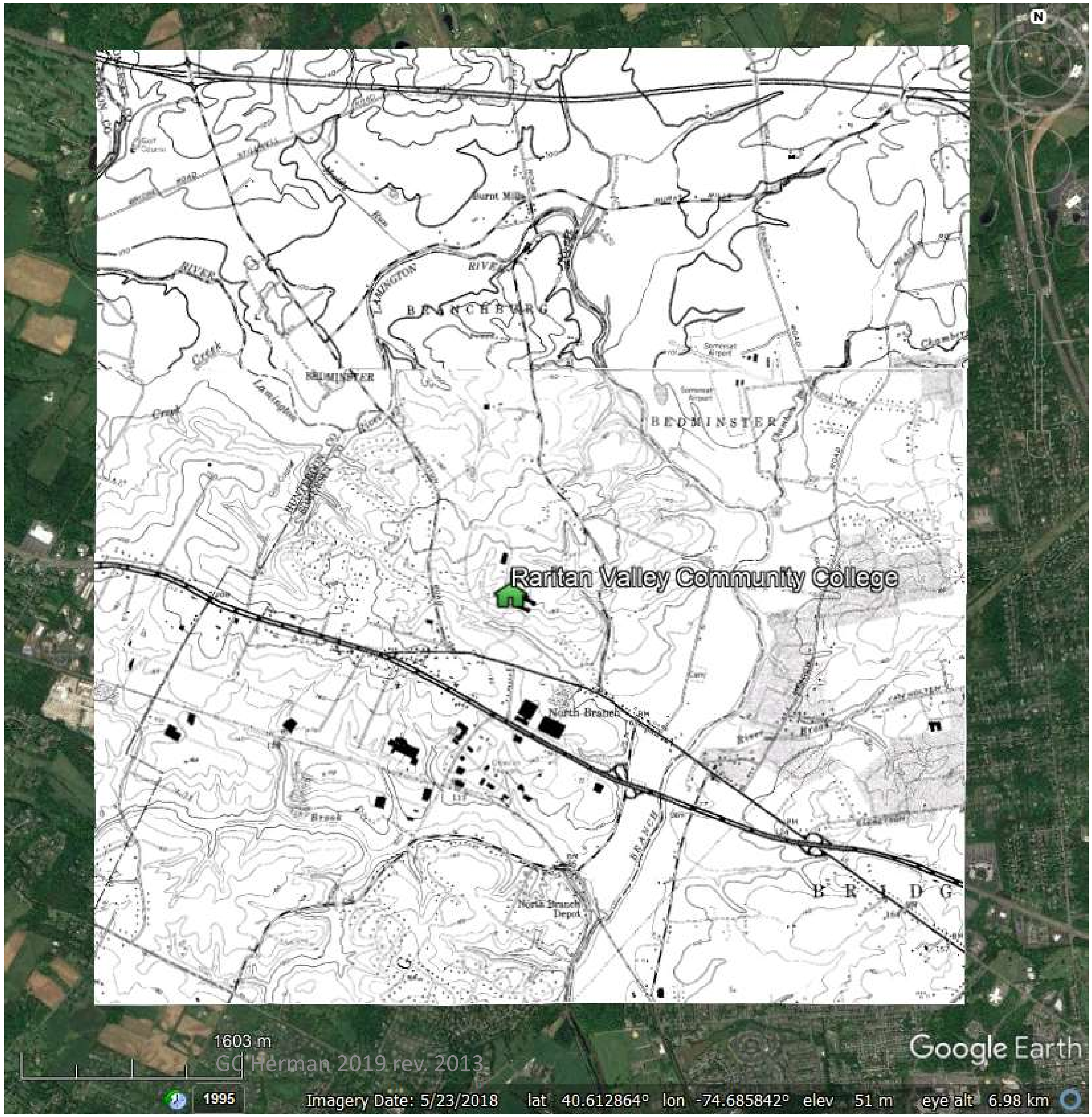
http://www.impacttectonics.org/GEO310/Labs/2A-Map_Projections_and_Scales.pdf

MAPS

Basic map elements that should be included in all maps:

1) Distance or Scale
2) Direction
3) Legend or explanation of map symbols
4) Sources of information

USGS 1:24,000 scale topographic maps are commonly used as base for geological maps in many parts of the US.



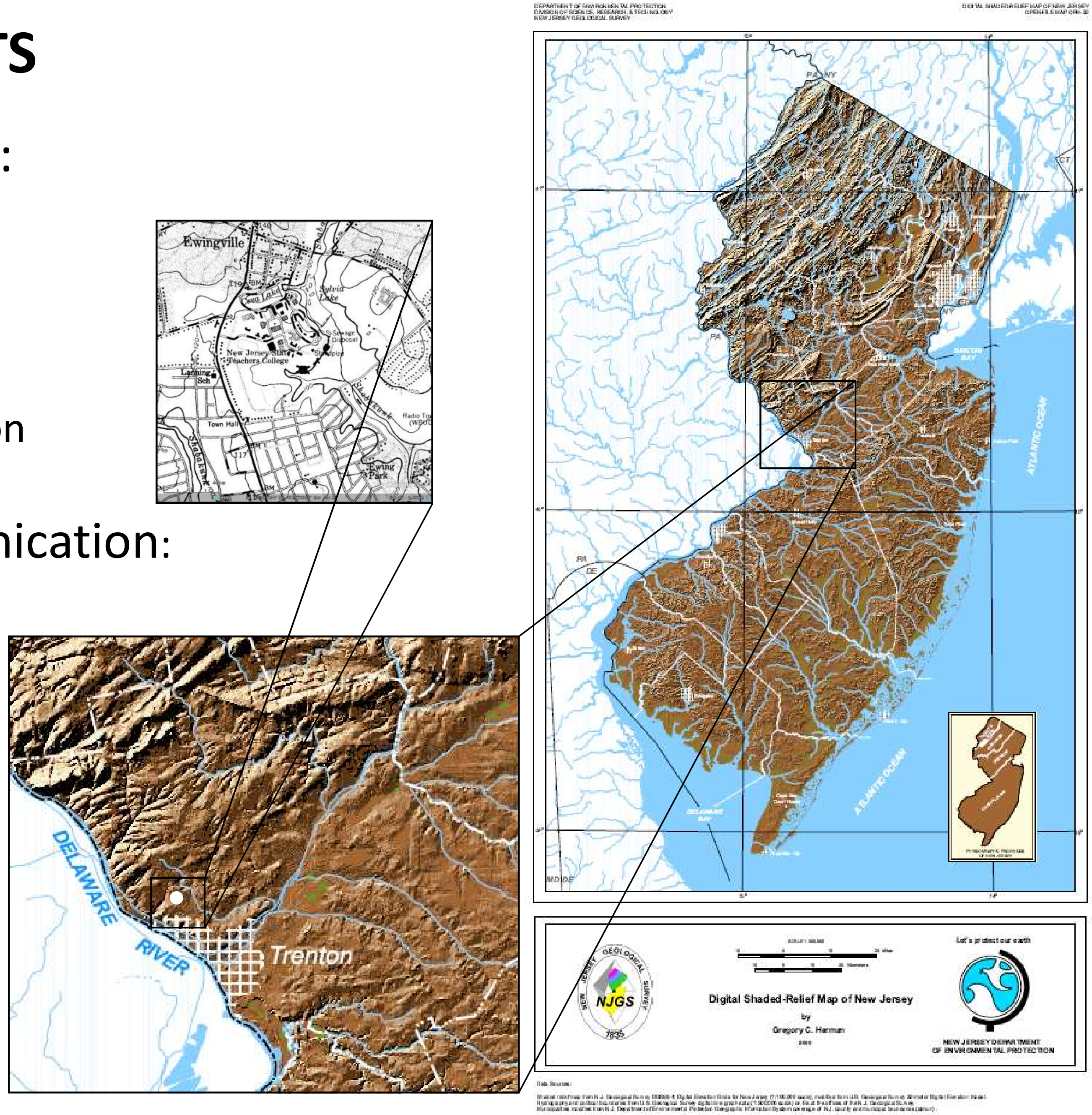
MAP ELEMENTS

Context-sensitive:

- Title
- Projection
- Cartographer
- Date of production

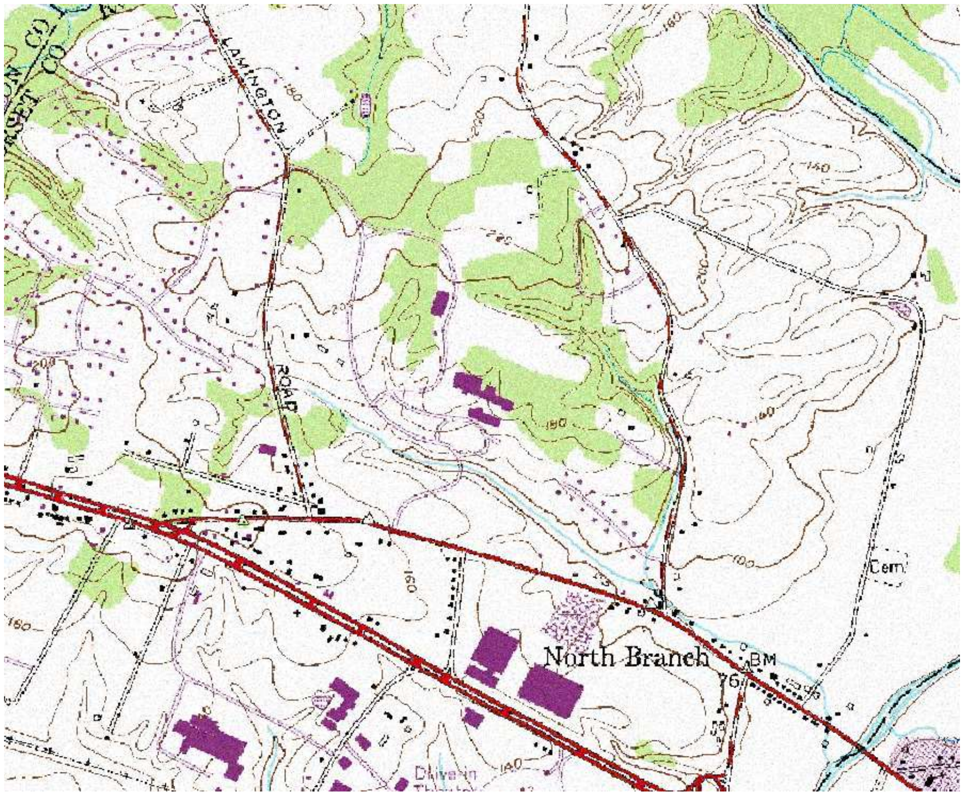
Effective communication:

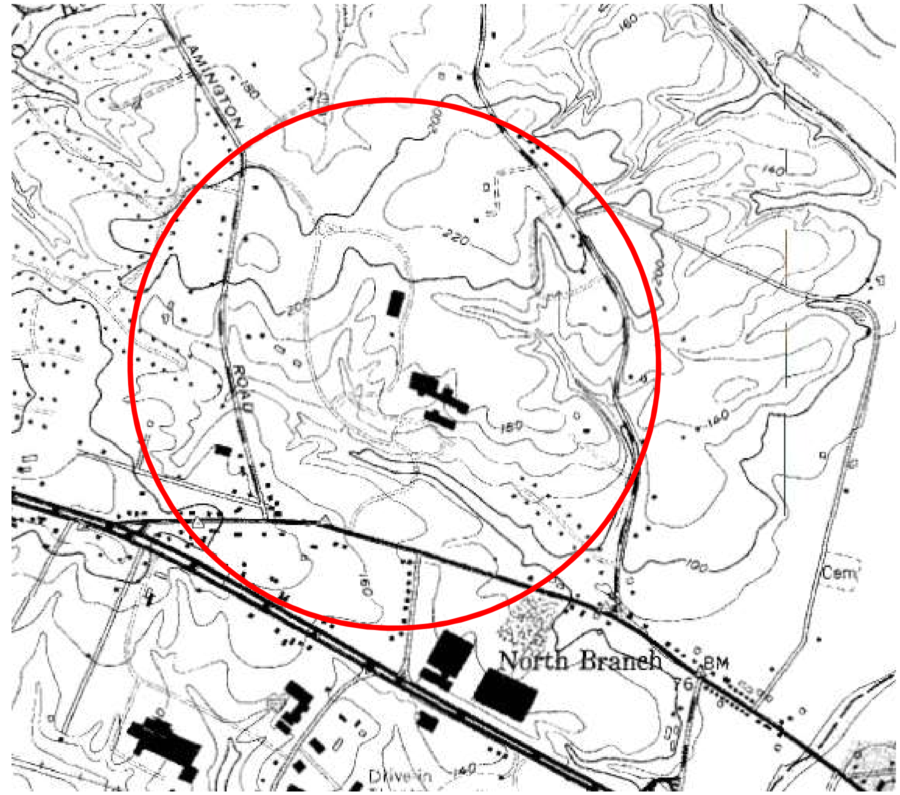
- Neatlines
- Locator maps
- Inset maps
- Index maps
- Component and color balance



MAP SCALES

13-color Topographic Map → Monochromatic Bit-map image (one- color and no color)





USGS 1:24,000 scale topographic maps are commonly used as base for geological maps in the US.

Raritan Valley Campus

MAP SCALES

A scale of 1:24,000 means 1 inch = 24,000 inches or 2000 ft. This is a convenient scale when using feet and inches, and provides a basis for other scales that are useful for measuring distances:

IMPERIAL UNITS

SCALE	1 inch =
1:63,360	1 mile
1:24,000	2000 ft
1:12,000	1000 ft
1:6,000	500 ft
1:4,800	400 ft
1:2,400	200 ft
1:1,200	100 ft
1:600	50 ft
1:240	20 ft

Converion to metric is underway, with 1:100,000 scale and 1:50,000 scale maps being the modern standard.

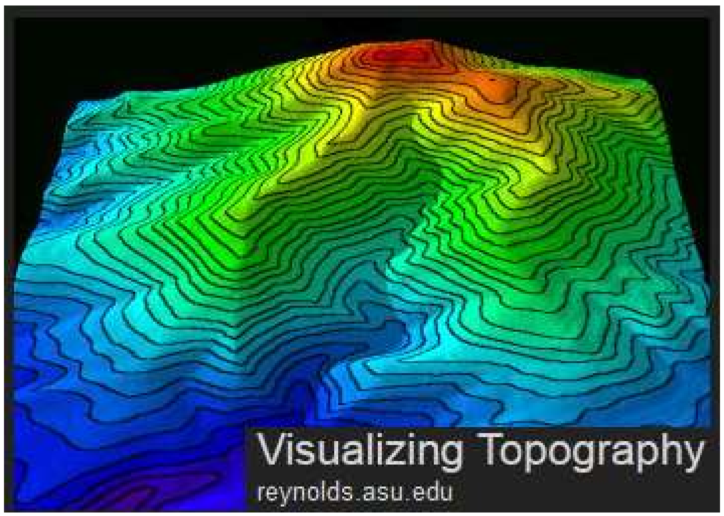
1:250,000 scale means 1 cm = 250,000 cm on the map, or

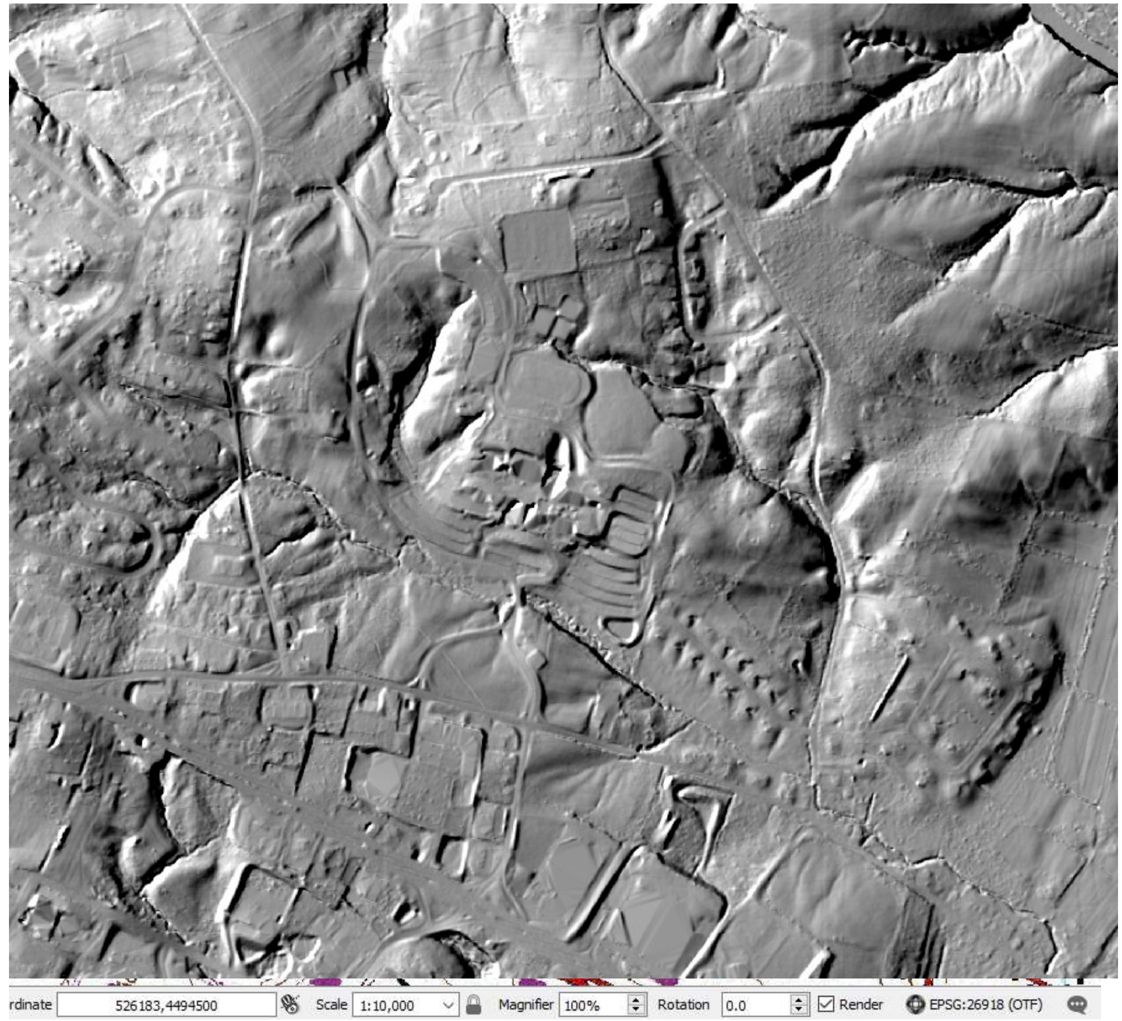
METRIC UNITS

SCALE	1 cm =
1:250,000	2.5 km
1:100,000	1 km
1:50,000	500 m
1:20,000	200 m
1:5,000	50 m
1:2,000	20 m
1:1000	10 m
1:500	5m
1:100	1m

TOPOGRAPHY & HYPSOGRAPHY

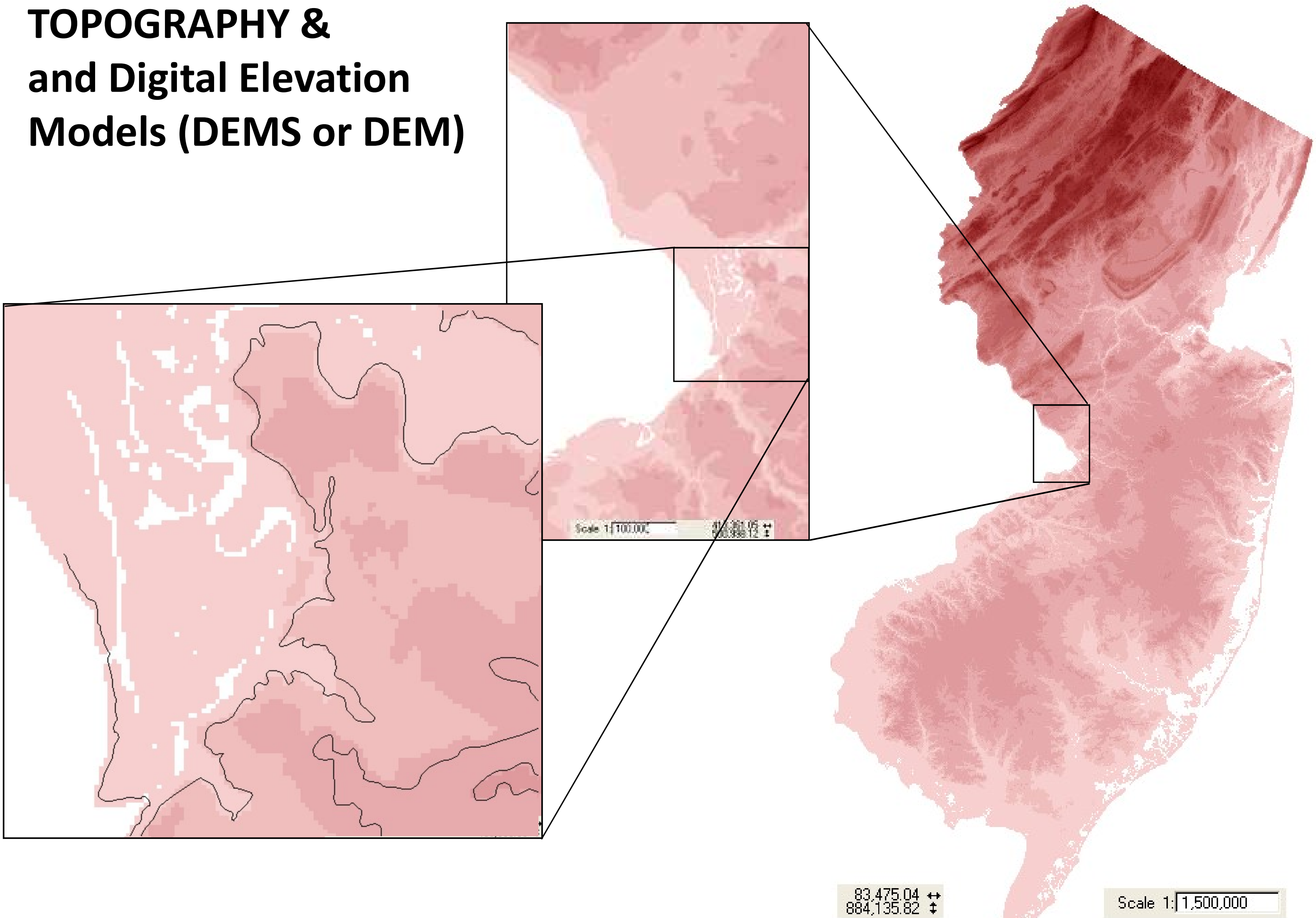
• Each brown line on a colored topographic map (right) represents the intersection trace between a **horizontal plane** at a certain elevation and the land surface.





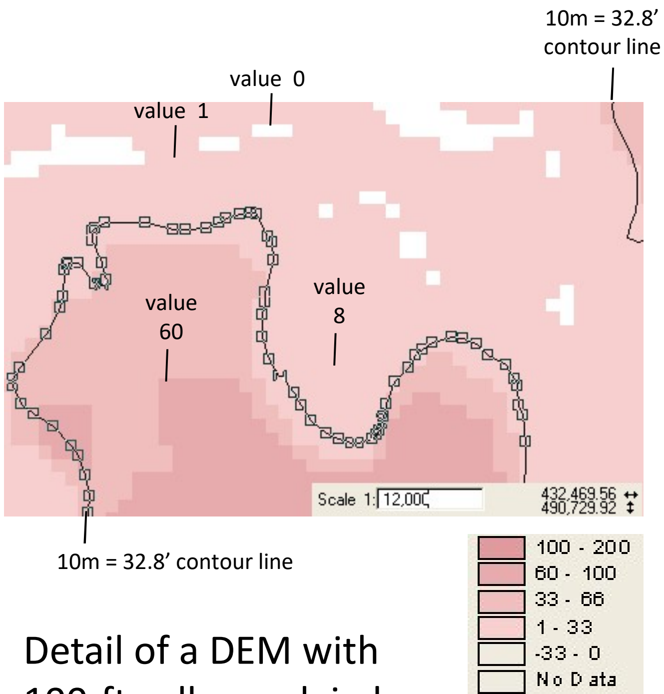
• ***The 2D lines tracing topography are called hypsography*** and represent a horizontal plane of specific elevation that intersects landforms relative to a datum, like sea level (0 feet (ft) or meters (m) . Hypsographic lines are graduated (e.g. 2 or 20 ft or/m).

TOPOGRAPHY & and Digital Elevation Models (DEMS or DEM)



GC Herman 2019 rev. 2013

DEMS and HYPSOGRAPHY

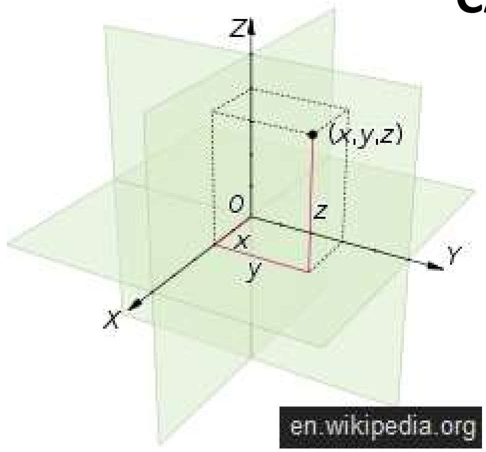


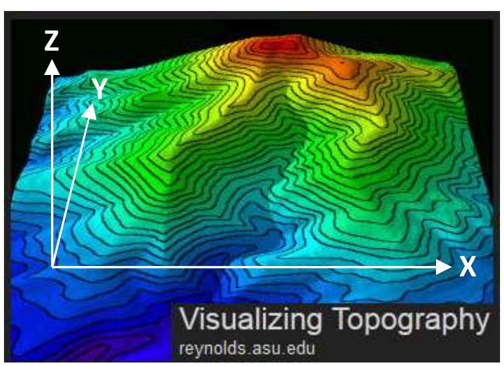
Detail of a DEM with 100-ft cells overlain by hypsography lines with one showing its vertices.

Hypsography consists of many *polylines*, sets of individual line segments connected end-to-end by *vertices*.

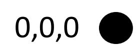
Digital-elevation-models (DEMs) are *raster* data, equivalent to a screen having equi-dimensional cells, each coded with an unique elevation value.

GIS POINTS, LINES, and POLYGONS



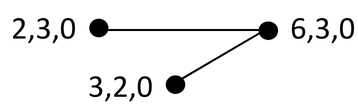


CARTESIAN COORDINATE SYSTEM uses X, Y, and Z coordinates

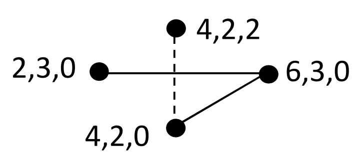


POINT ($X_nY_nZ_n$)

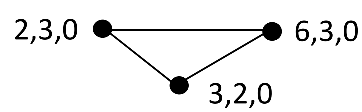
SIMPLE **LINE** ($X_1Y_1Z_0$, $X_2Y_2Z_0$)



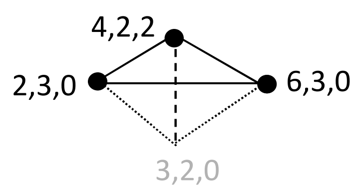
POLYLINE ($X_1Y_1Z_0$, $X_2Y_2Z_0$, $X_3Y_3Z_0$, $X_nY_nZ_n$)



POLYLINEZ ($X_1Y_1Z_0$, $X_2Y_2Z_0$, $X_3Y_3Z_0$, $X_4Y_4Z_1$, $X_nY_nZ_n$)



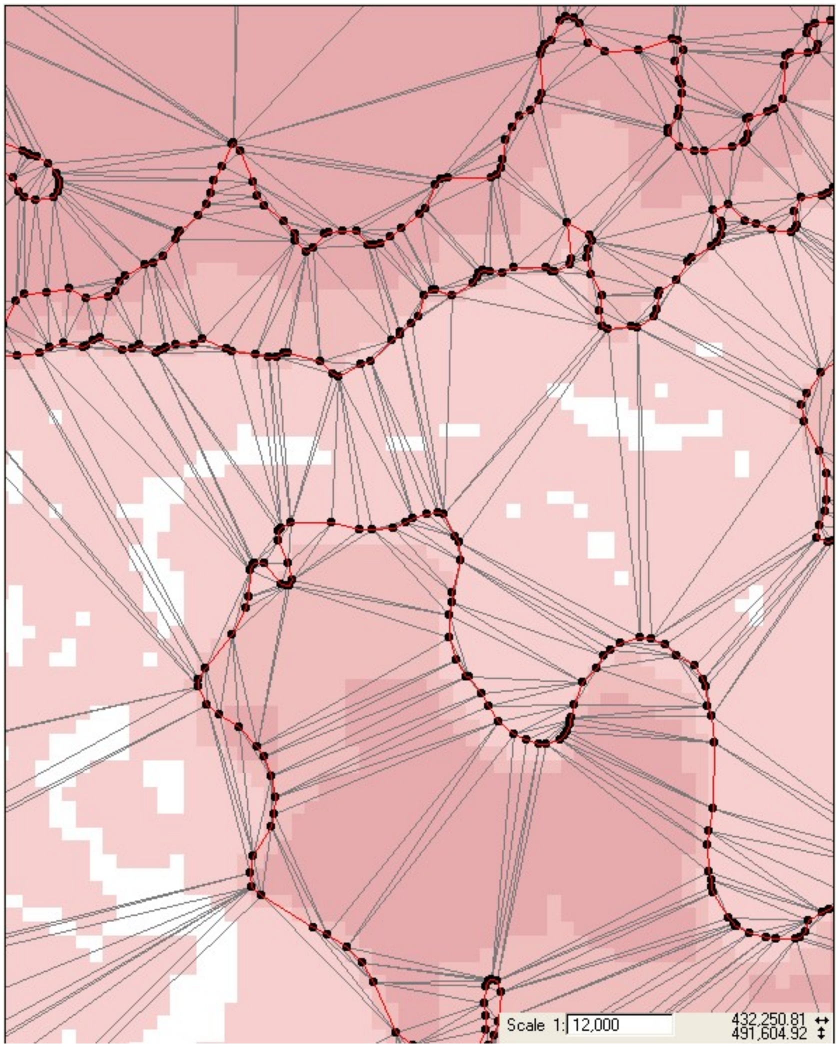
POLYGON ($X_1Y_1Z_0$, $X_2Y_2Z_0$, $X_3Y_3Z_3$, $X_nY_nZ_n$)

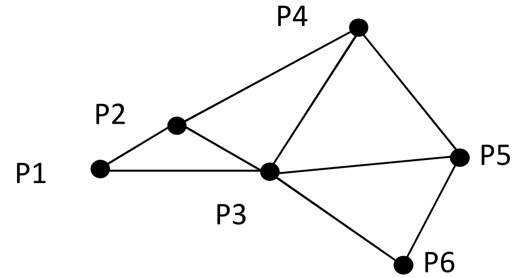


POLYGONZ ($X_1Y_1Z_0$, $X_2Y_2Z_0$, $X_3Y_3Z_1$, $X_nY_nZ_n$)

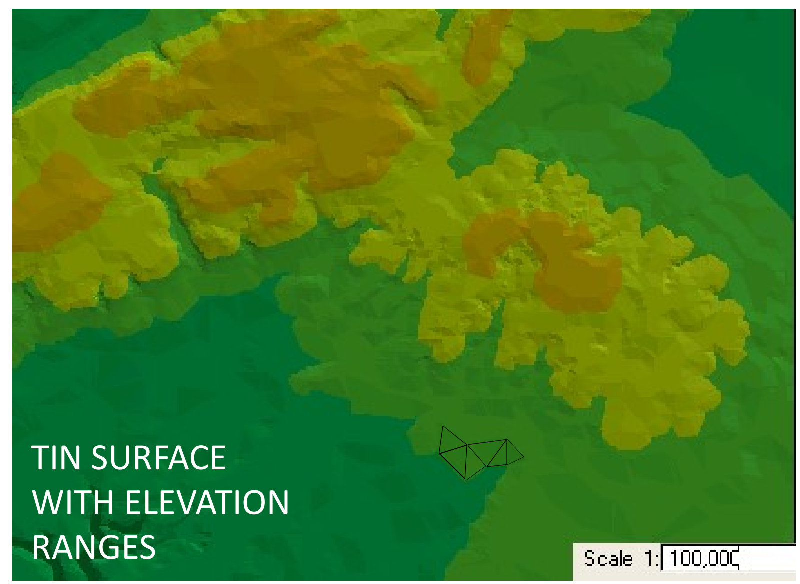
GIS TINS (Triangulated Integrated Networks)

Detail of a DEM with 100-ft cells overlain by a TIN showing it's components, points (vertices), lines, and polygons





POLYGONZ $(X_1Y_1Z_1 , X_2Y_2Z_2 , X_3Y_3Z_3)$ +
POLYGONZ $(X_2Y_2Z_2 , X_3Y_3Z_3 , X_4Y_4Z_4)$ +
POLYGONZ $(X_3Y_3Z_3 , X_4Y_4Z_4 , X_5Y_5Z_5)$ +
POLYGONZ $(X_4Y_4Z_4 , X_5Y_5Z_5 , X_5Y_5Z_5)$ +
POLYGONZ $(X_nY_nZ_n , X_{n+1}Y_{n+1}Z_{n+1} , X_{n+2}Y_{n+}Z_{n+2})$



GEOLOGICAL PLANES and LINES

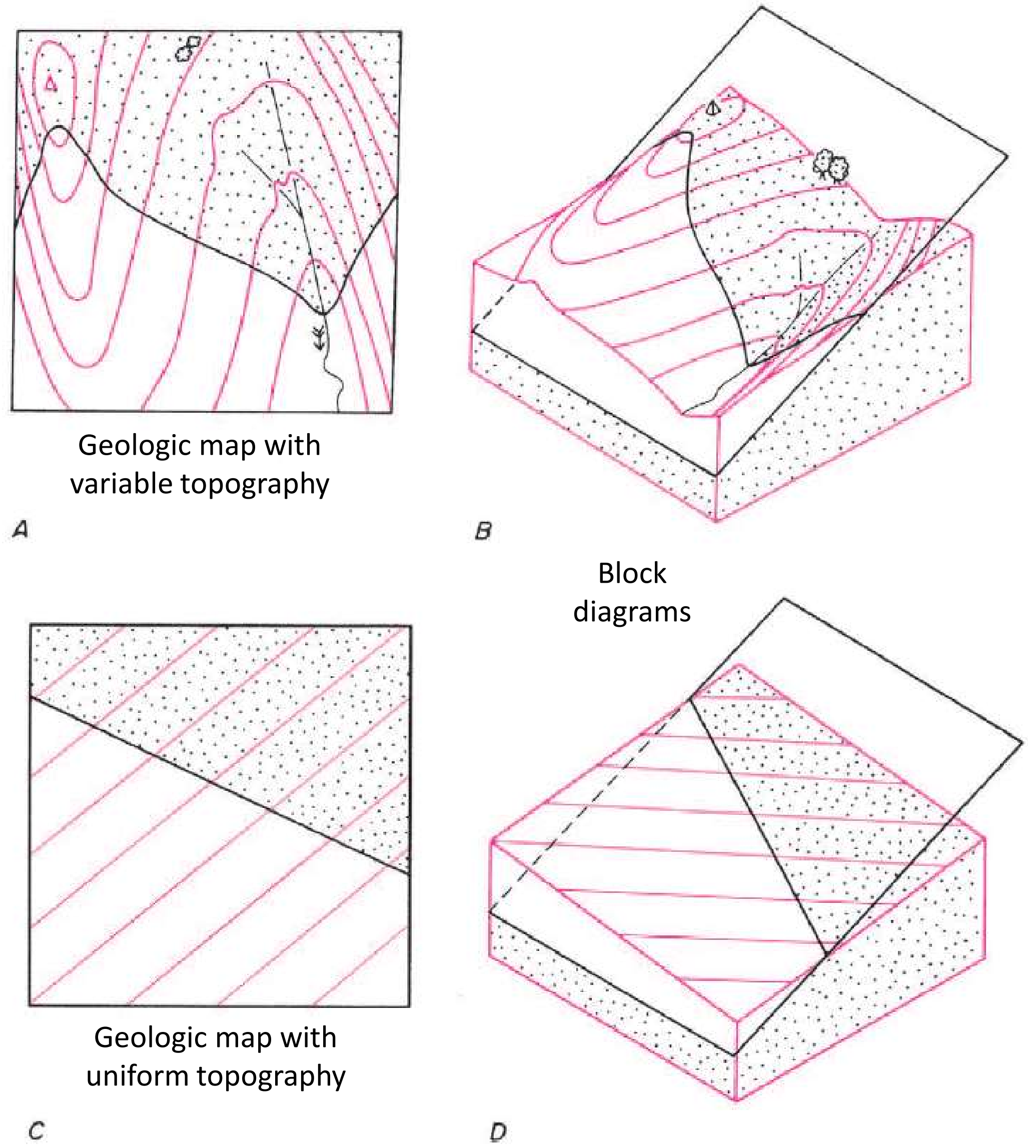
TOPOGRAPHY AND INCLINED PLANES

• The dark, irregular line on the geological map (fig. 2.9A) separates two rock formations even though the contact between the formations is a planar surface (fig. 2.9B). The lighter lines are hypsography.

• It is important to realize that this polyline represents the formational boundary ***produced by the 3D intersection of two surfaces***; 1) the planar, inclined '*geological surface'*, and 2) the irregular the surface of the ground, or the *'topographic surface'*.

• Unlike the geological surface, the topographic surface is not planar but has features such as hills, valleys and ridges. It is these topographic irregularities which produce the sinuous trace of geological contacts we observe on maps.

• If, for example, the ground surface were planar (fig. 2.9D), the contacts would run as straight lines on the map (fig. 2.9C).



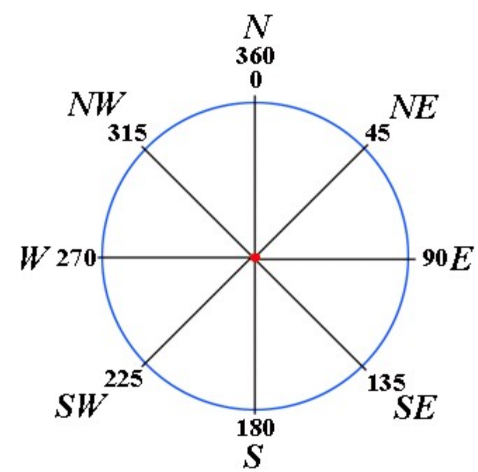
Adapted from Richard J Lisle, Geological Structures and Maps, A practical Guide.

GEOLOGICAL PLANES and LINES

• The word *azimuth* stems from an Arabic word meaning "direction“, and means an angular measurement in a spherical coordinate system.

Brunton Pocket Transit

• In geology, we primarily deal with land navigation and directional readings on two-dimensional maps of the Earth surface, and azimuth commonly refers to incremental measures in a circular (0- 360°) and horizontal reference frame relative to land surface.



A SIMPLE COMPASS ROSE

GEOLOGICAL PLANES and LINES

- **Plane Dip -** Bedding and other geological layers and planes that are not horizontal are said to dip.

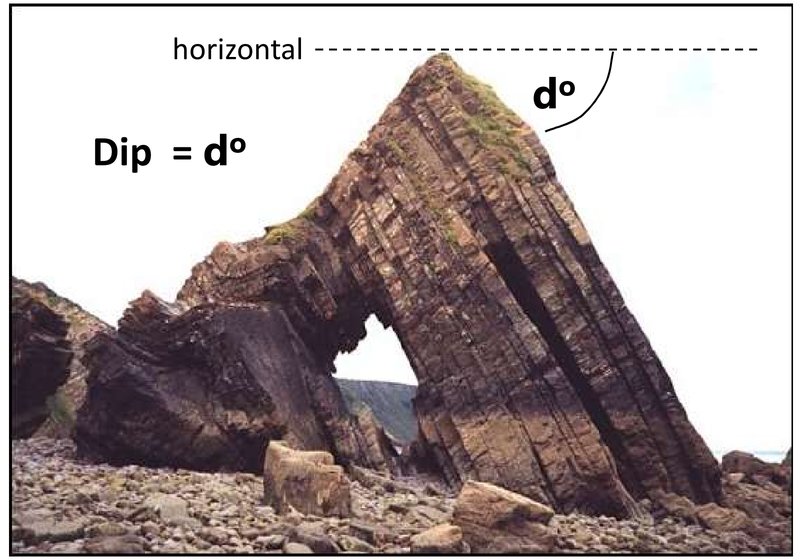
  - There are two aspects to the dip of a plane:

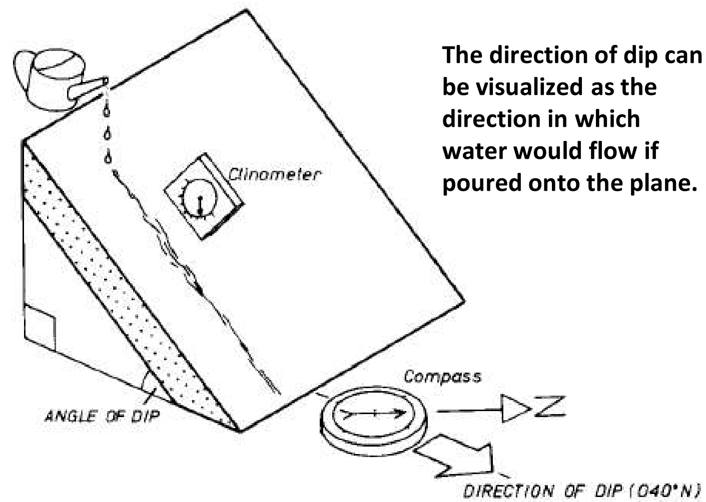
  (a) the direction of dip, or *dip azimuth*) which is the compass direction towards which the plane slopes; and

  (b) the *dip angle*, which is the angle that the plane makes with a horizontal plane (right).

  - The angle of dip = 0° for a horizontal plane, and 90° for the vertical plane.

  - To record the dip of a plane all that is needed are two numbers; the dip angle followed by the dip azimuth, e.g. 74/138 is a plane which dips 74° in the direction 138°.





The direction of dip can be visualized as the direction in which water would flow if poured onto the plane.

The concepts of direction of dip and angle of dip.

GEOLOGICAL PLANES and LINES

• Linear Plunge and Trend

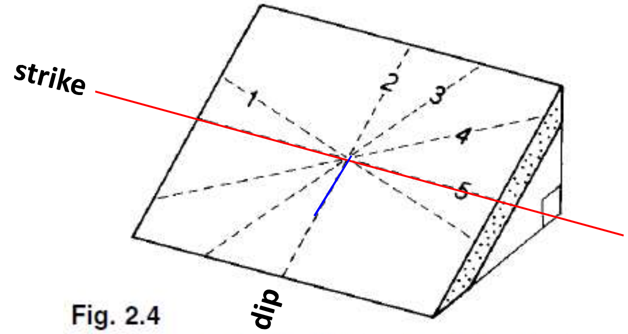
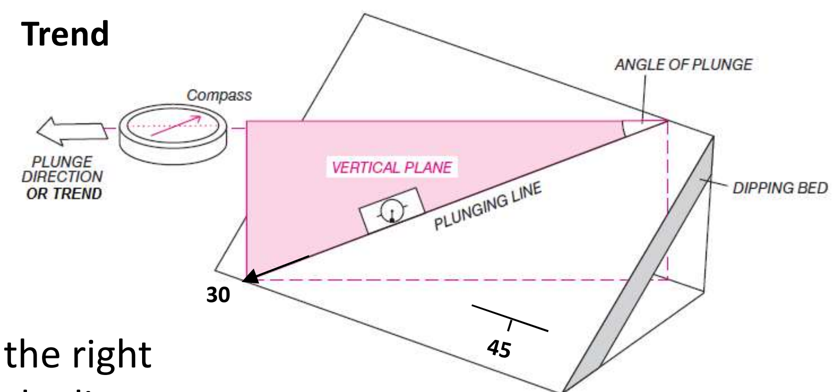


Fig. 2.4
Lines geometrically contained within a dipping plane.

- Any dipping plane can be thought of as containing a large number of lines of varying ***plunge*** (Fig. 2.4).
- The **strike** line is a horizontal (non-plunging) line within a dipping plane (e.g. line 5 is a strike line; it is not the only one but the other strike lines are all parallel to it.)
- *Think of the sloping roof of a house as a dipping plane, the line along the roof ridge is a strike line*



- ***Plunge*** describes the tilt of lines, and the word *dip* being reserved for planes.
- The plunge is 3D and includes both:

  (a) the plunge angle, and
  (b) the plunge azimuth or ***trend***.

- Consider the plunging line on the dipping plane to the right and an imaginary vertical plane (pink) containing the line. The ***trend*** is the horizontal azimuth which this vertical plane runs, and the direction towards which the line is tilted.
- The ***plunge*** is the amount the line is tilted with respect to the horizontal. The angle of plunge of a horizontal line is 0° and the angle of plunge of a vertical line is 90°.

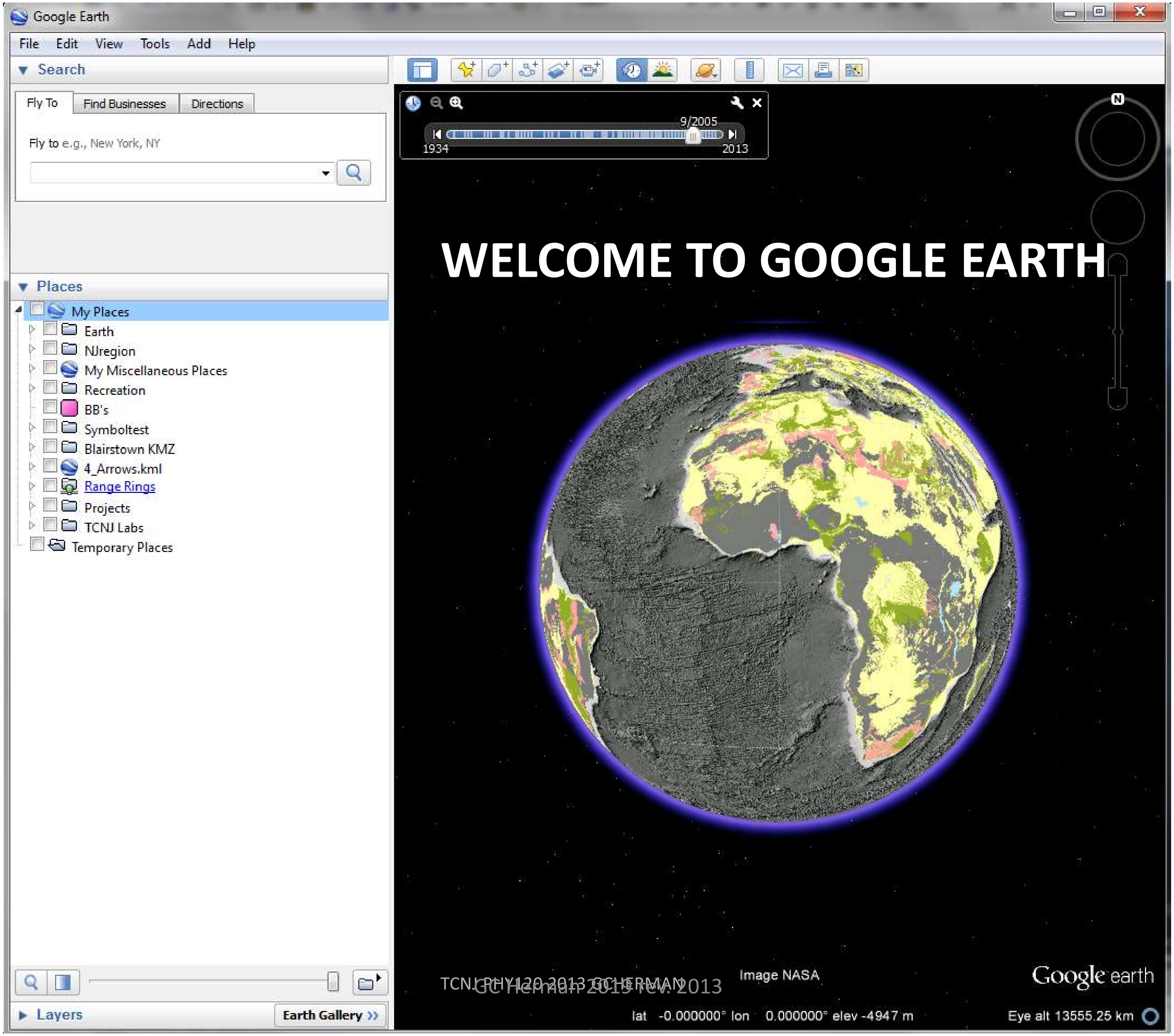

Google Earth
File Edit View Tools Add Help
Search
Fly To
Find Businesses
Directions
Fly to e.g., New York, NY
Places
My Places
Earth
NJregion
My Miscellaneous Places
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Image NASA
Google earth
lat -0.000000° lon 0.000000° elev -4947 m
Eye alt 13555.25 km

GOOGLE EARTH

Google Earth **SPEAK**

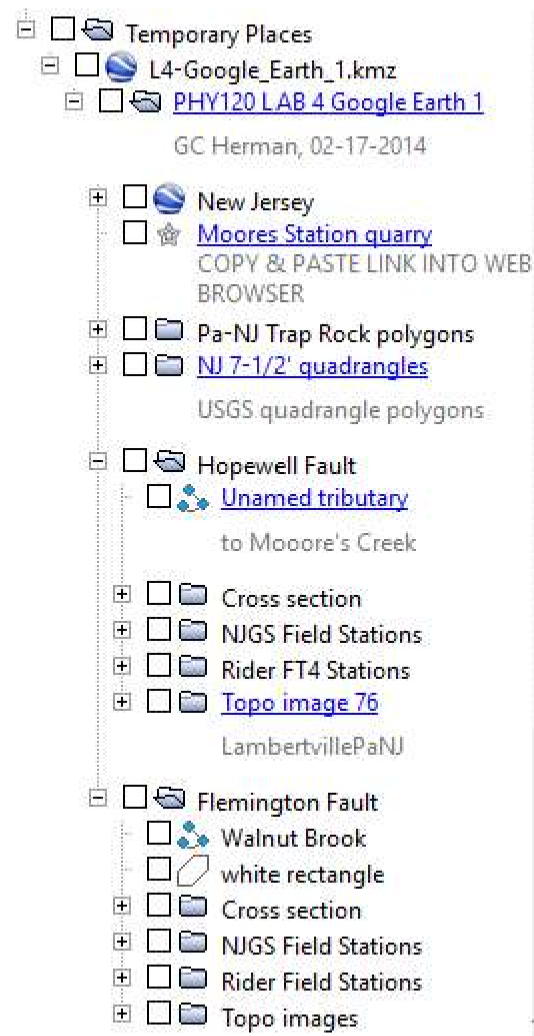
- **KML** stands for Keyhole Markup Language (KML), an XML notation for expressing geographic annotation and visualization within Internet-based, two dimensional maps and three-dimensional Earth browsers (Wikipedia, 2012).

- 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 Wordpad, common ASCII-text editing files for PCs.



- Go to http://www.impacttectonics.org/PHY120/Index.html

and download

Google_Earth_1.kmz file (~4 MB)

- Double click on it to Start Google Earth, or
- In Google Earth <File><Open >, navigate to the downloads folder and <Open>.

- The file will load into the Temporary folder. After it loads the legend on the left should reside in the file into the Temporary Places folder:

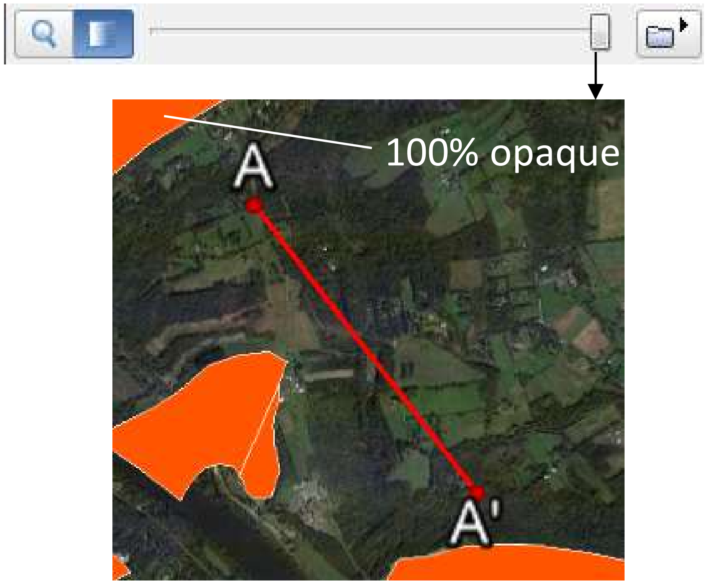
- **Before doing anything else**,

<right click> on the **TCNJ PHY120 GE Labs.kmz**

then **<Save Place As…>.** A pop-up menu will prompt you for a location to save the file.

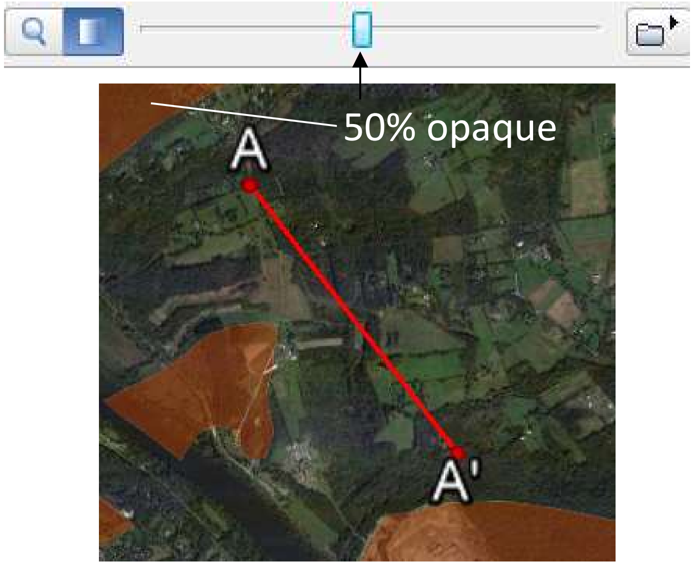
- Point it to your flashdrive or hard drive and **<Save>**

L4-TCNJ_Google_Earth_1.kmz (16.0MB)



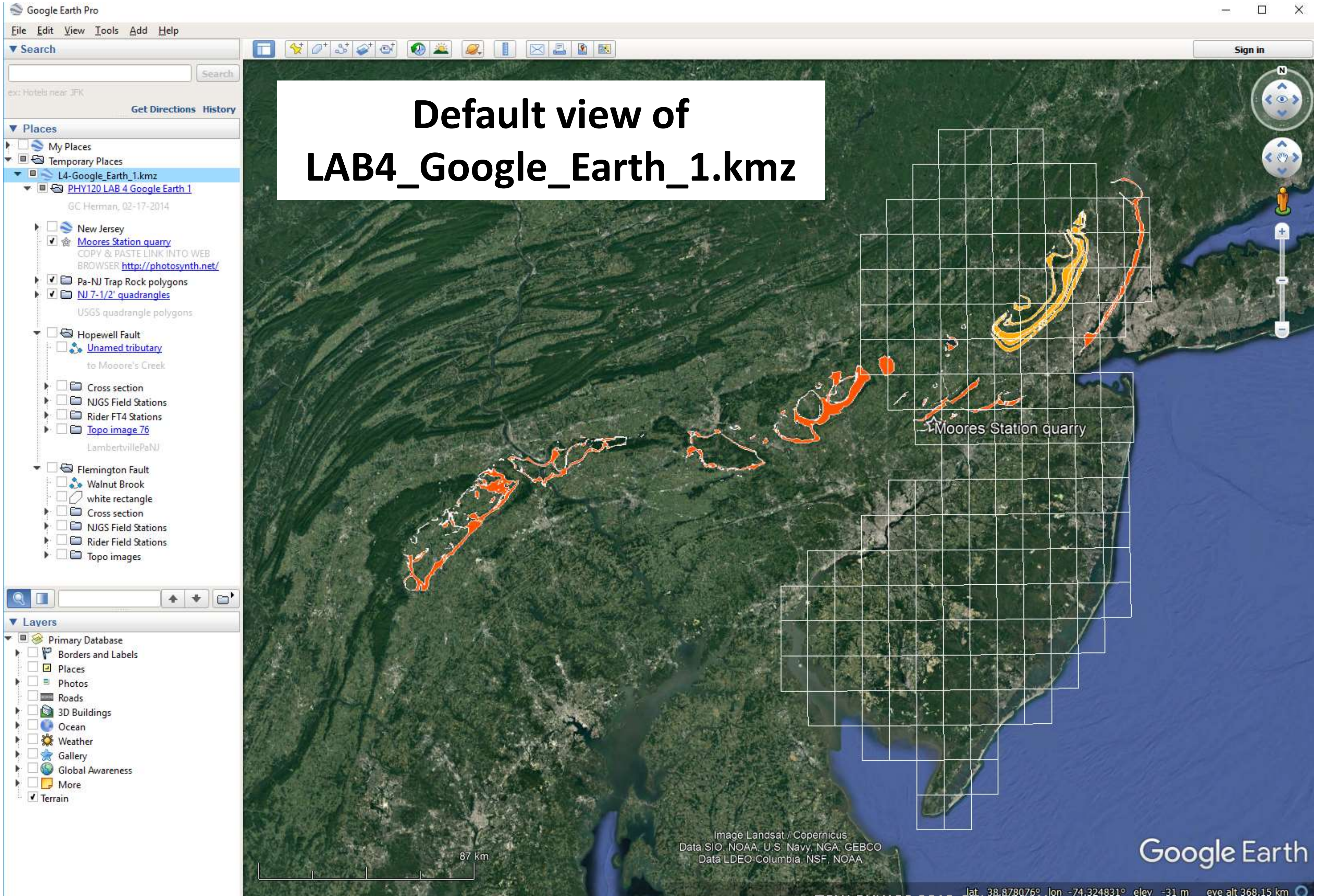
GE Legend controls

- •Expand the folder
- •Turn on/off layers
- • Object folder
- •Compiled KMZ file of objects

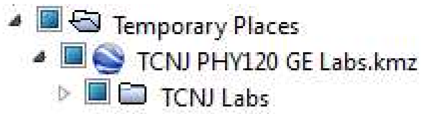


•DO NOT TURN ON ALL LAYERS BY CLICKING ON THE BUTTON FIRST

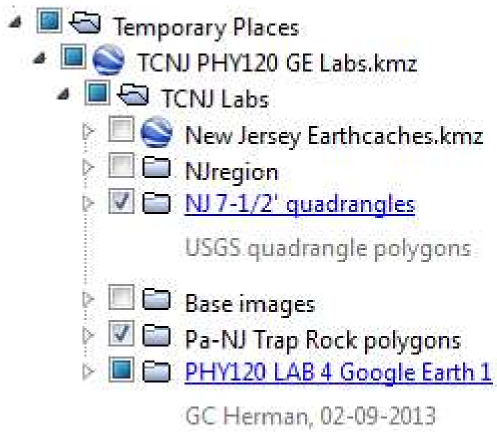
• INSTEAD, CLICK ON THE BUTTON TO EXPAND THE TREE TO SEE WHAT LAYERS ARE CURRENTLY ACTIVE (CHECKED)


Default view of LAB4_Google_Earth_1.kmz
Google Earth Pro
File Edit View Tools Add Help
Search
Get Directions History
Places
My Places
Temporary Places
L4-Google_Earth_1.kmz
PHY120 LAB 4 Google Earth 1
GC Herman, 02-17-2014
New Jersey
Moores Station quarry
COPY & PASTE LINK INTO WEB BROWSER http://photosynth.net/
Pa-NJ Trap Rock polygons
NJ 7-1/2' quadrangles
USGS quadrangle polygons
Hopewell Fault
Unamed tributary
to Mooore's Creek
Cross section
NJGS Field Stations
Rider FT4 Stations
Topo image 76
LambertvillePaNJ
Flemington Fault
Walnut Brook
white rectangle
Cross section
NJGS Field Stations
Rider Field Stations
Topo images
Layers
Primary Database
Borders and Labels
Places
Photos
Roads
3D Buildings
Ocean
Weather
Gallery
Global Awareness
More
Terrain
Sign in
Moores Station quarry
87 km
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data LDEO-Columbia, NSF, NOAA
Google Earth
lat 38.878076° lon -74.324831° elev -31 m eye alt 368.15 km

• First, the folder expands to show:

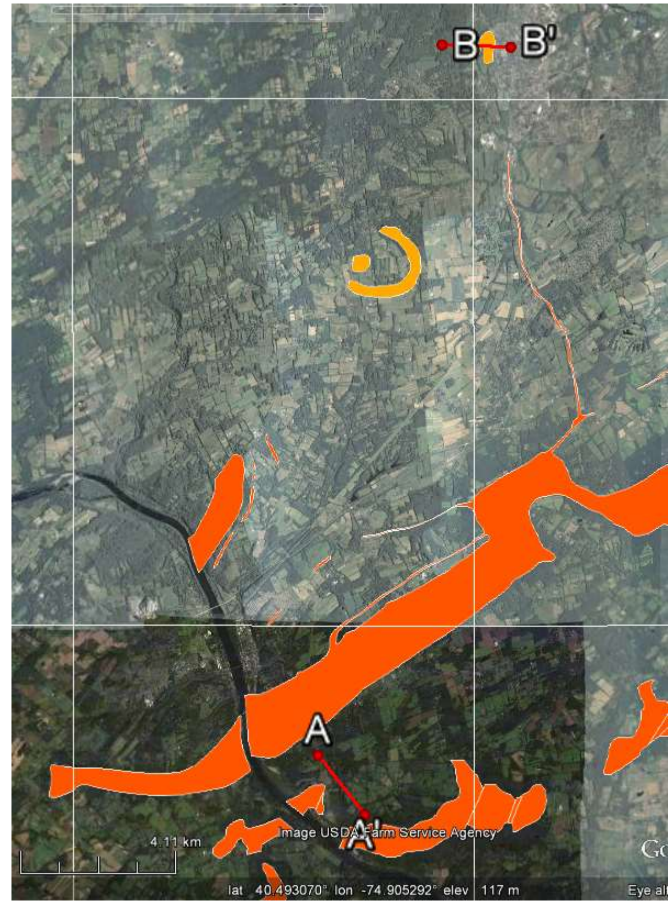


• Clicking ▷ next to TCNJ Labs expands to:



basalt

diabase

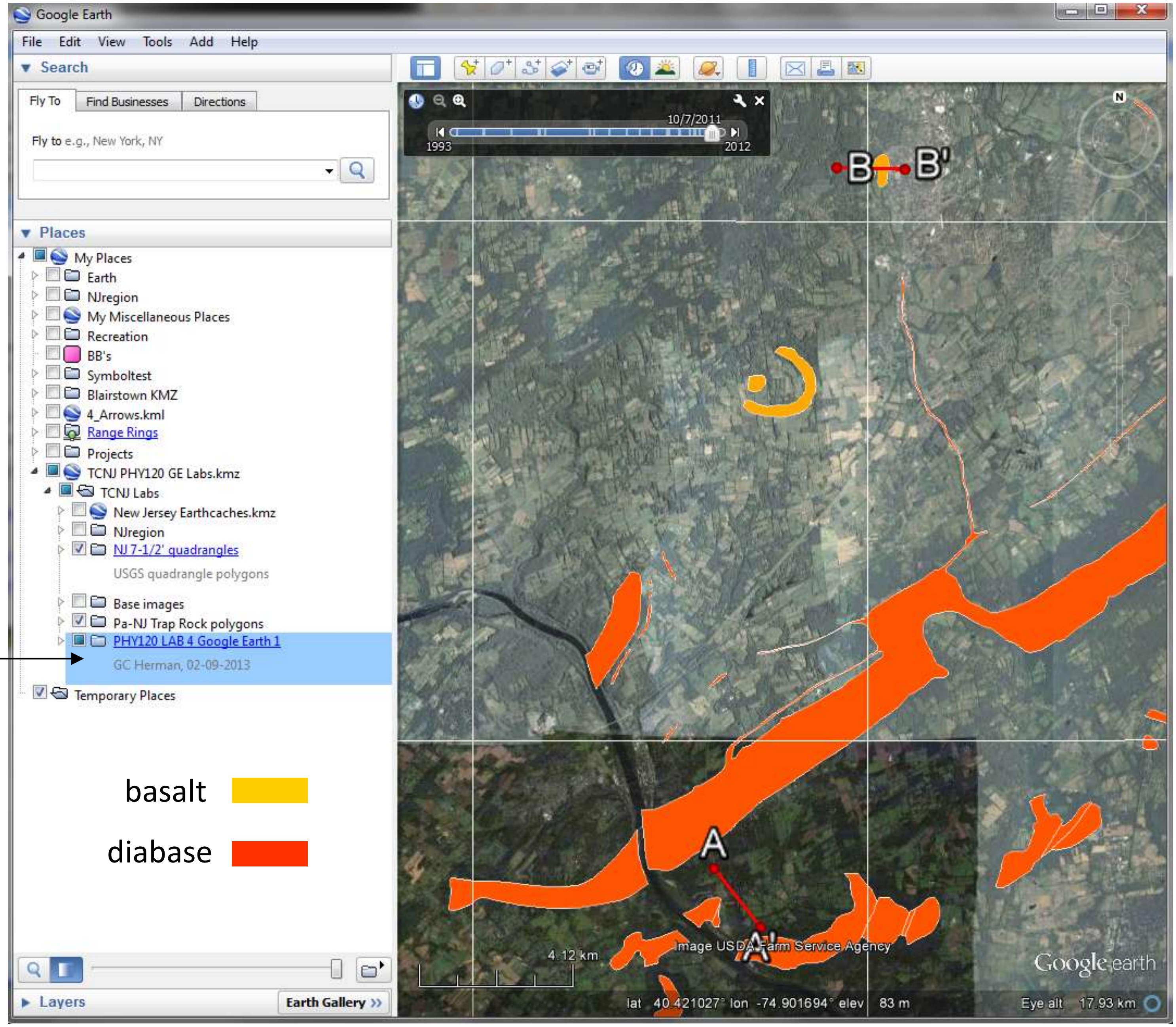


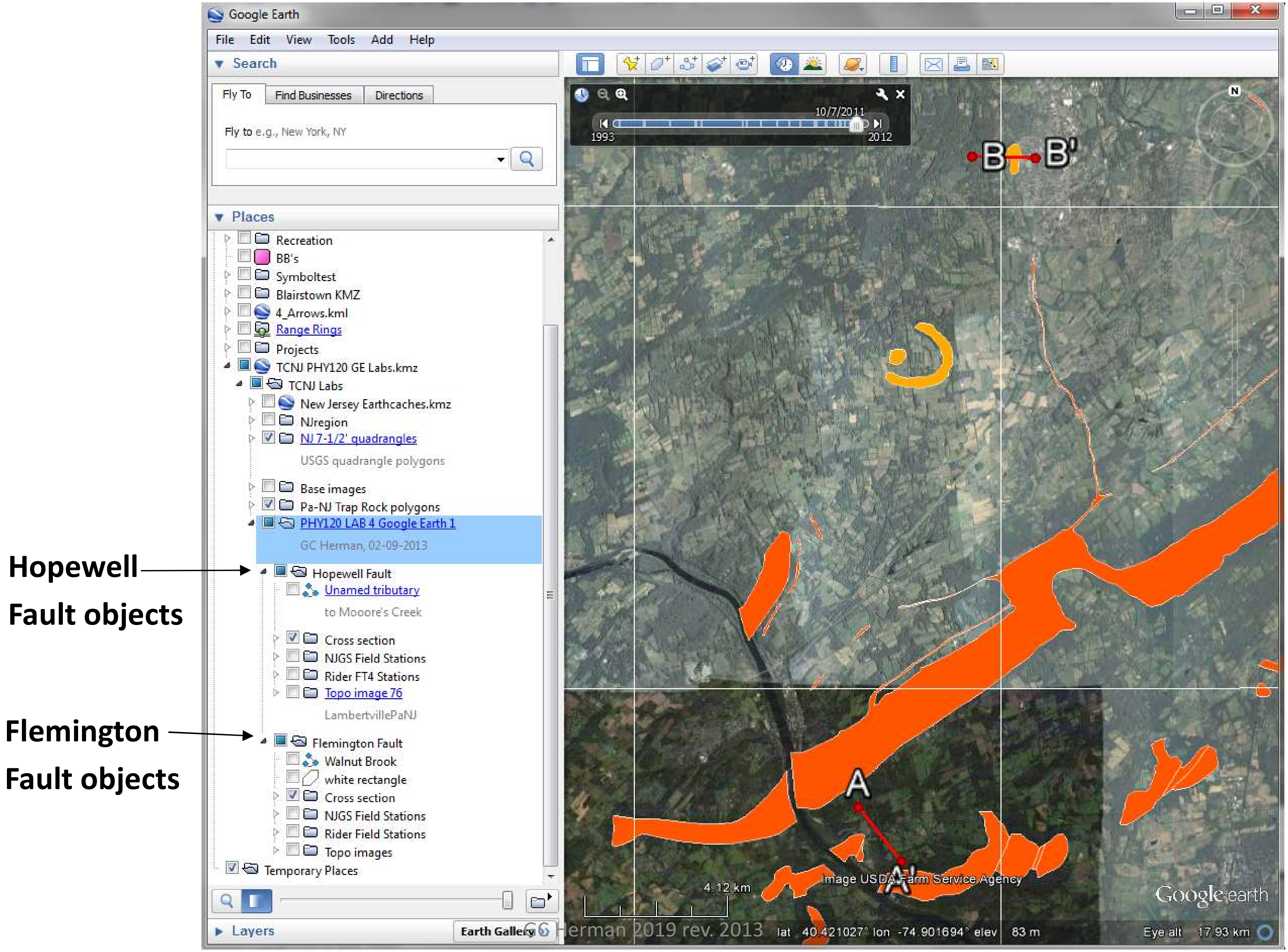
•The two active themes include the USGS 7-1/2' quadrangles covering New Jersey (NJ) and the trap rock (diabase and basalt) formations in Pennsylvania and NJ

mrdata.usgs.gov/geology/state/

Clicking on

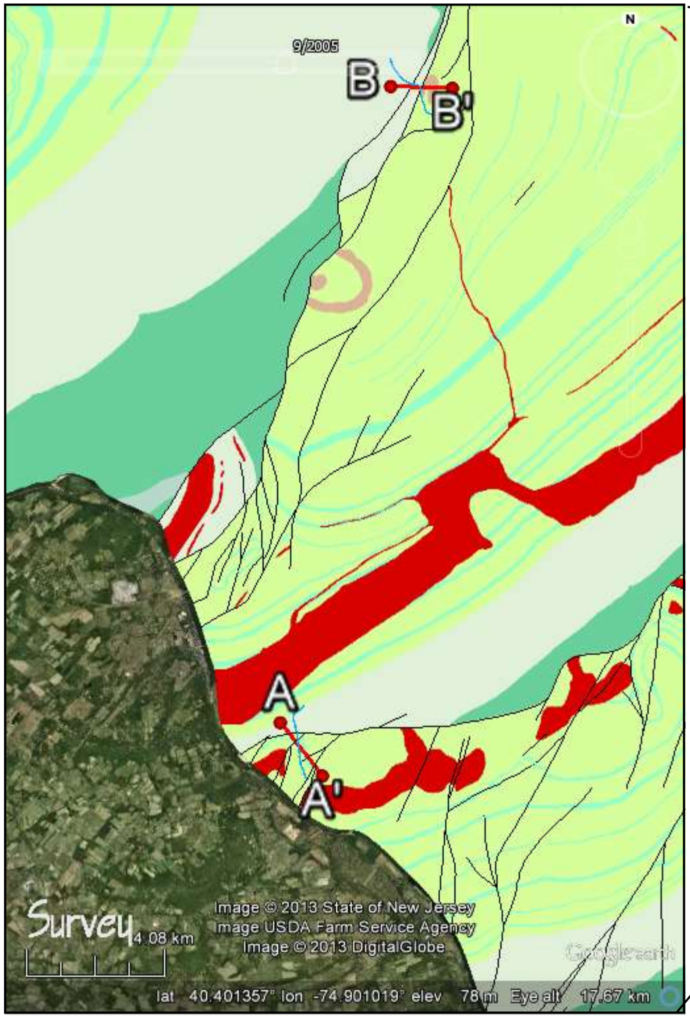
will result in this view

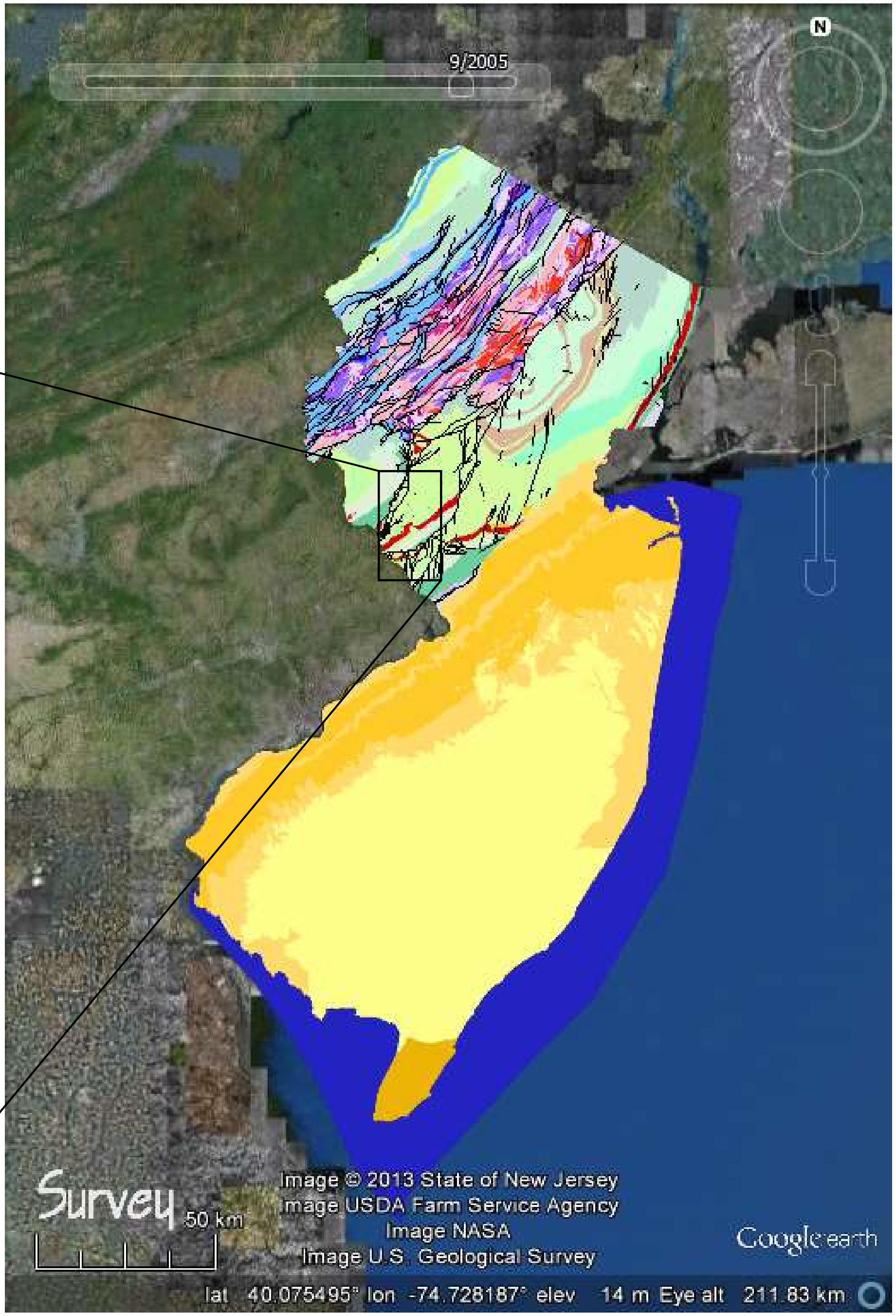



Hopewell
Fault objects
Flemington
Fault objects
Google Earth
File Edit View Tools Add Help
Search
Fly To
Find Businesses
Directions
Fly to e.g., New York, NY
Places
Recreation
BB's
Symboltest
Blairstown KMZ
4_Arrows.kml
Range Rings
Projects
TCNJ PHY120 GE Labs.kmz
TCNJ Labs
New Jersey Earthcaches.kmz
NJregion
NJ 7-1/2' quadrangles
USGS quadrangle polygons
Base images
Pa-NJ Trap Rock polygons
PHY120 LAB 4 Google Earth 1
GC Herman, 02-09-2013
Hopewell Fault
Unamed tributary
to Mooore's Creek
Cross section
NJGS Field Stations
Rider FT4 Stations
Topo image 76
LambertvillePaNJ
Flemington Fault
Walnut Brook
white rectangle
Cross section
NJGS Field Stations
Rider Field Stations
Topo images
Temporary Places
Layers
Earth Gallery
10/7/2011
1993
2012
B
B'
A
A'
Image USDA Farm Service Agency
4.12 km
GC Herman 2019 rev. 2013
lat 40.421027° lon -74.901694° elev 83 m
Eye alt 17.93 km
Google earth

GEOLOGICAL POINTS

• Now let's consider two geological traverses conducted by the NJGS and a Rider U. field trip down two streams that cross two normal fault in the Mesozoic Newark Basin, NJ





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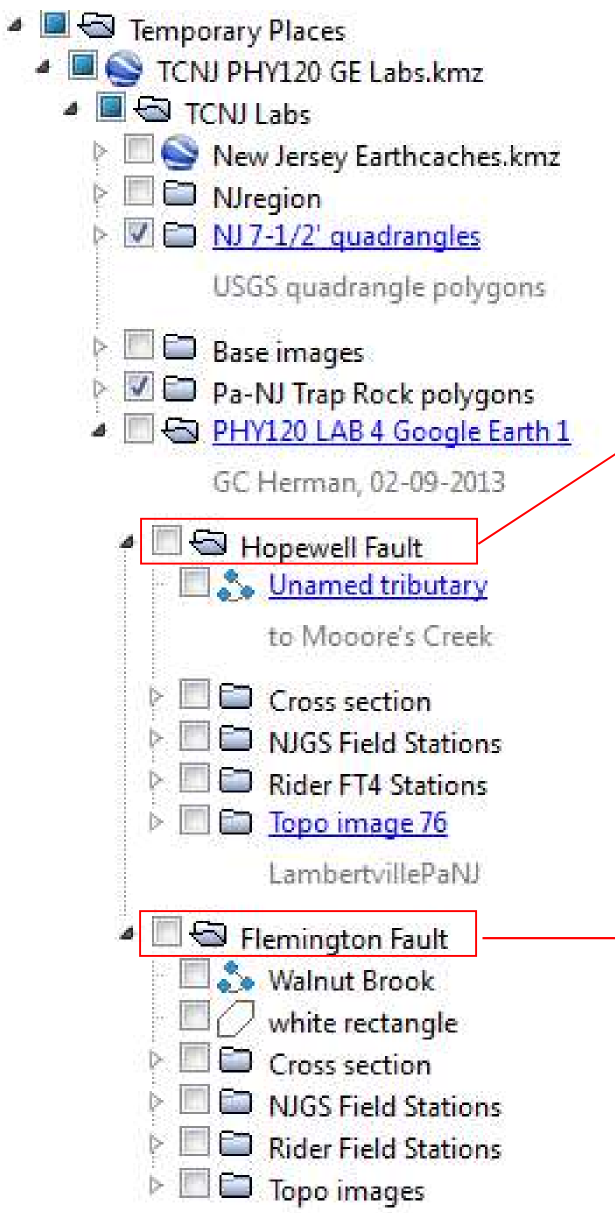
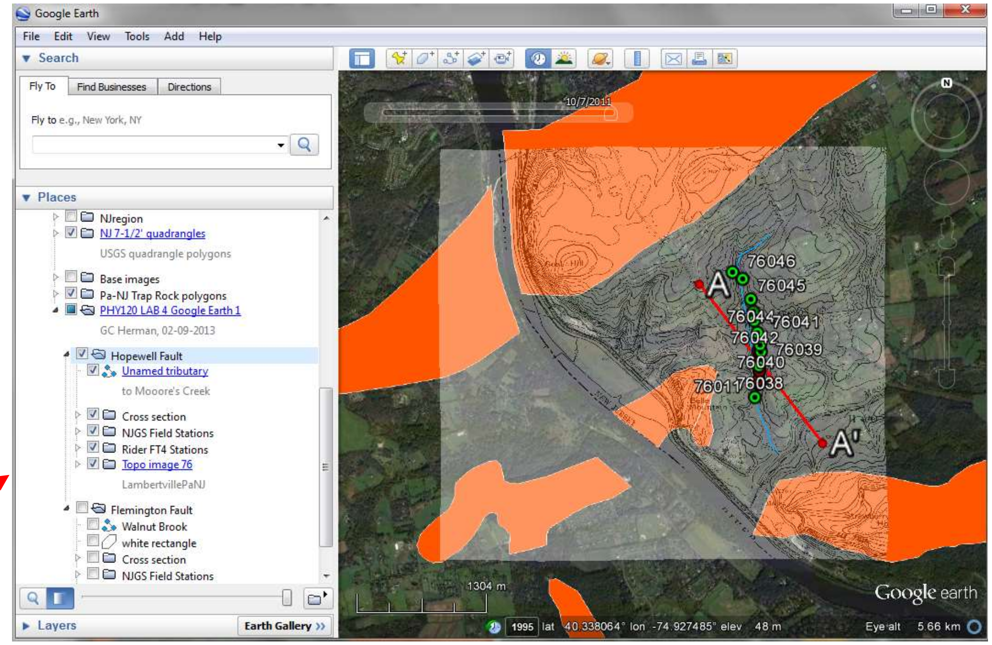
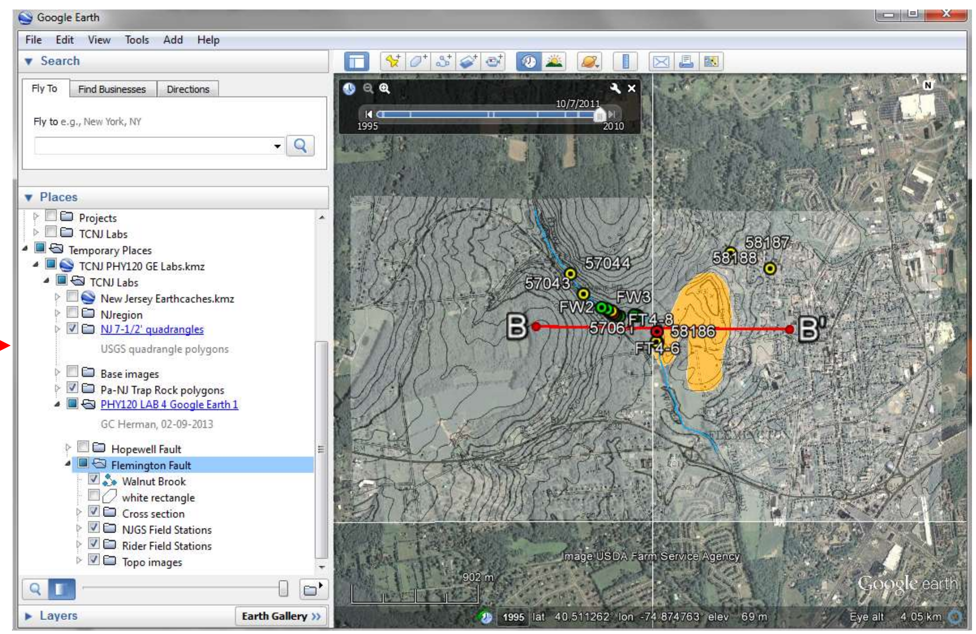
GEOLOGICAL POINTS







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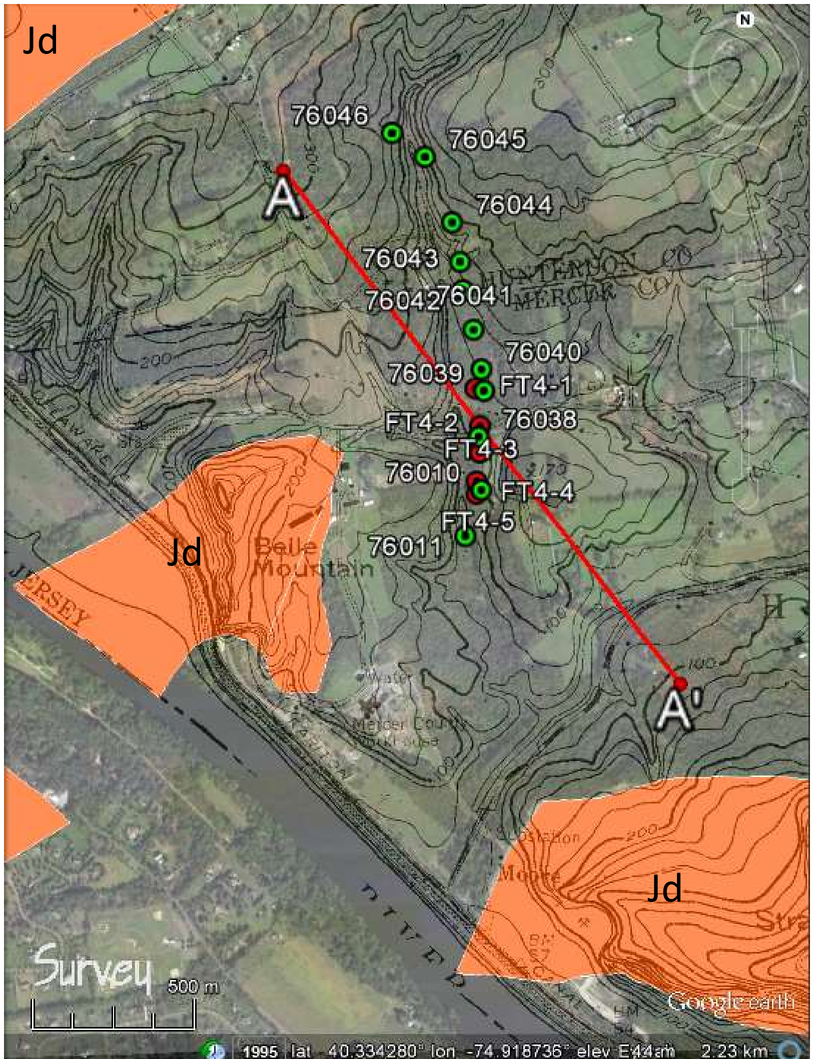
GEOLOGICAL POINTS

• Each traverse has a set of point-based field station where stratigraphic, structural, GPS locations, and multimedia have been collected during 4 or 5 different visits.

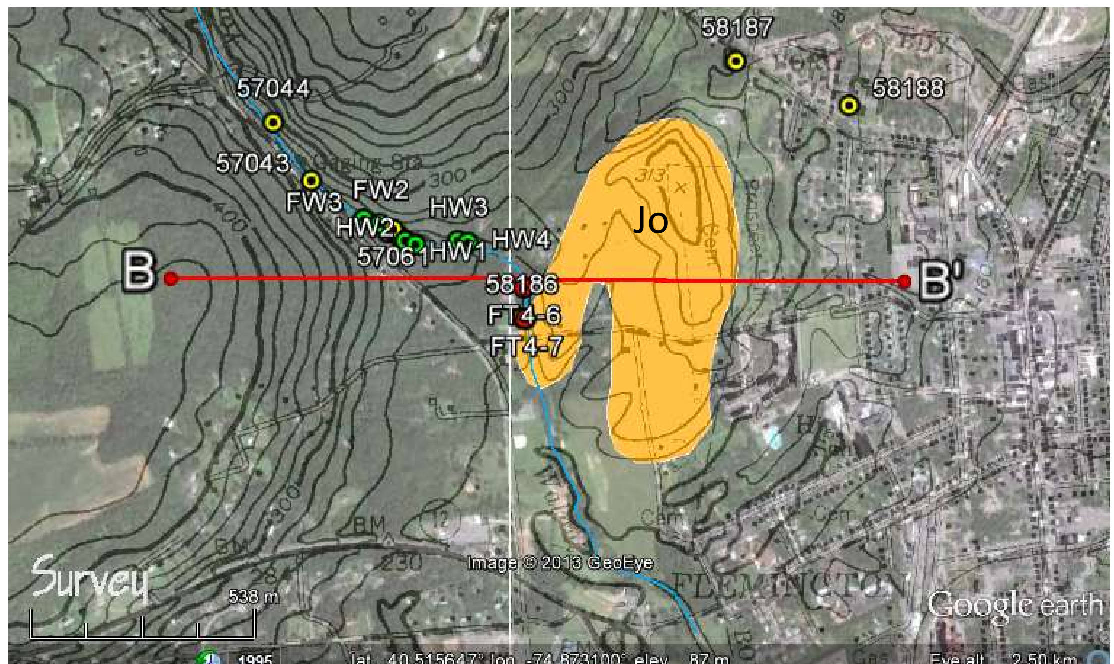


•Hopewell fault traverses along A-A'

Lambertville 7-1/2' quadrangle (quad)

•Flemington Fault traverses along B- B'

Flemington, NJ 7-1/2' quad



GEOLOGICAL POINTS in KML format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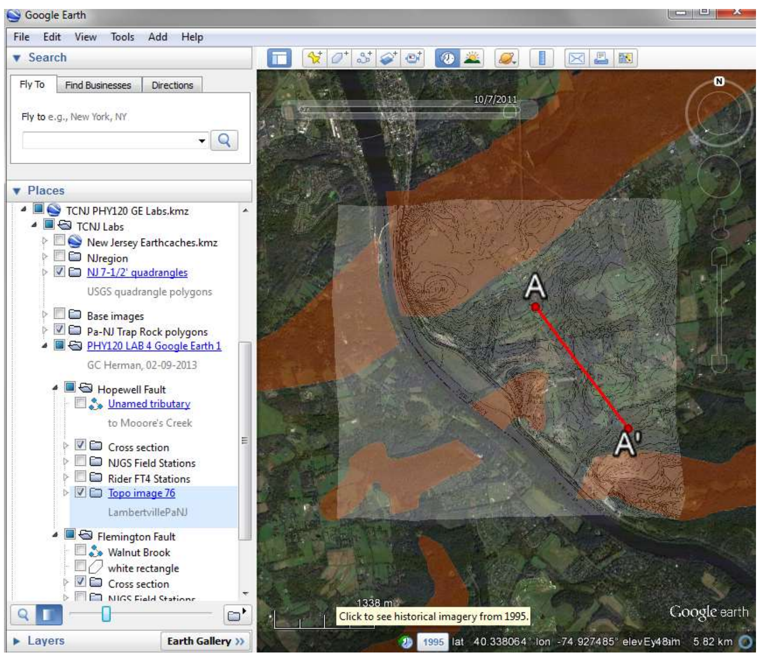
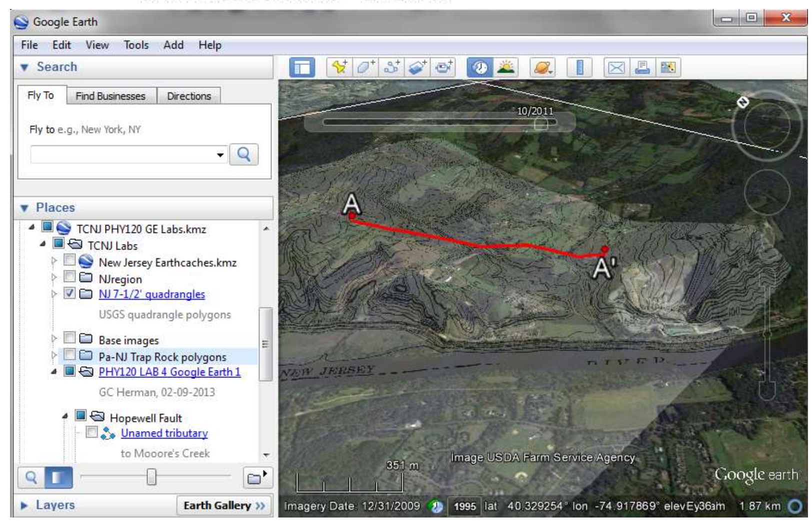
GE and middle mouse button interoperability

A key GE viewing tool is to use the mouse for interactive viewing by <Pressing><Holding> the middle button of your mouse after the cursor is positioned over the feature or area of interest, then moving the mouse while the middle button is depressed:

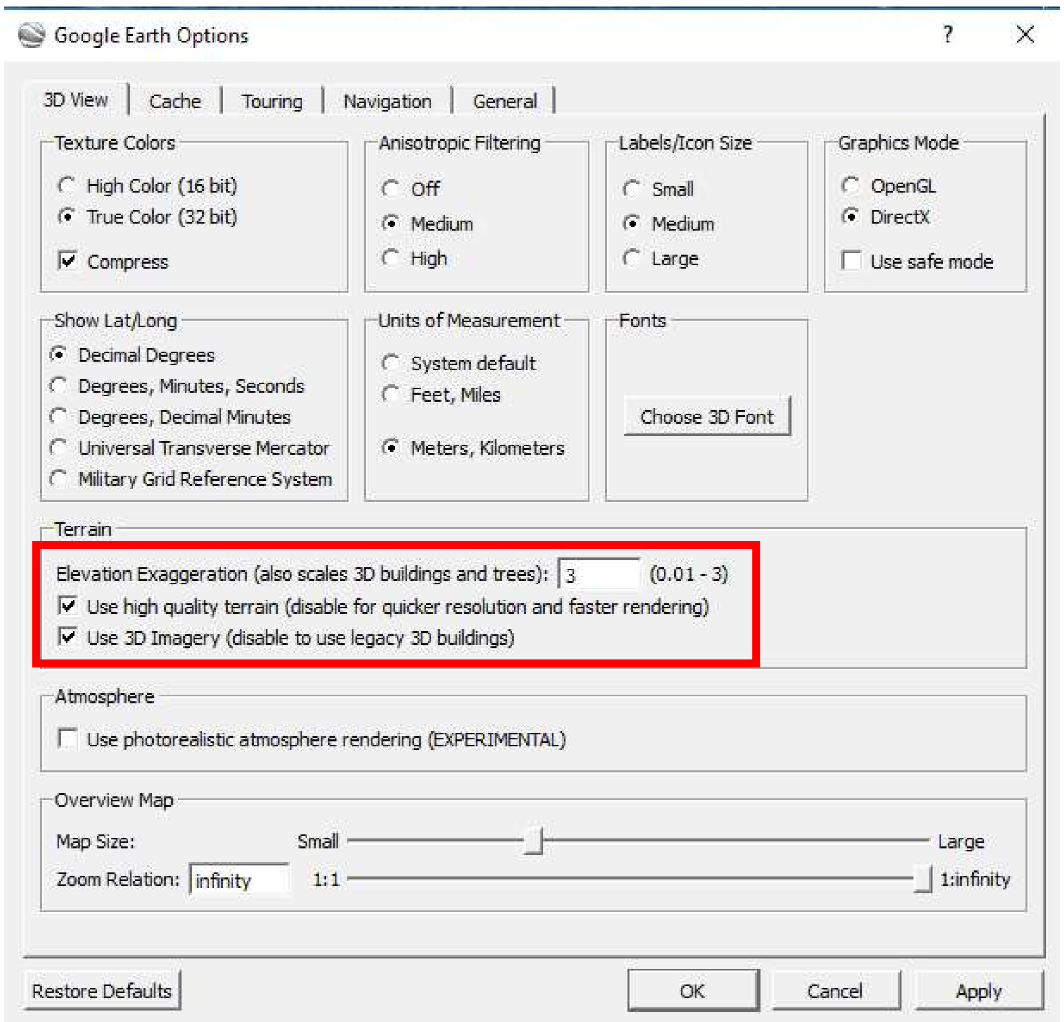
- Depressing and holding the middle mouse button while moving the cursor allows you tilt and rotate the view simultaneously





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.

3X Elevation exaggeration and oblique view of the Moore's, Station Trap Rock Quarry, Lambertville, NJ

3X Elevation exaggeration and oblique view of the Moore's, Station Trap Rock Quarry, Lambertville, NJ with part of the Lambertville, NJ-Pa USGS 7-1/' topographic quadrangle draped and set at 75% transparency (25% opaque)

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02/22/2012