

Geographic Coordinate Systems

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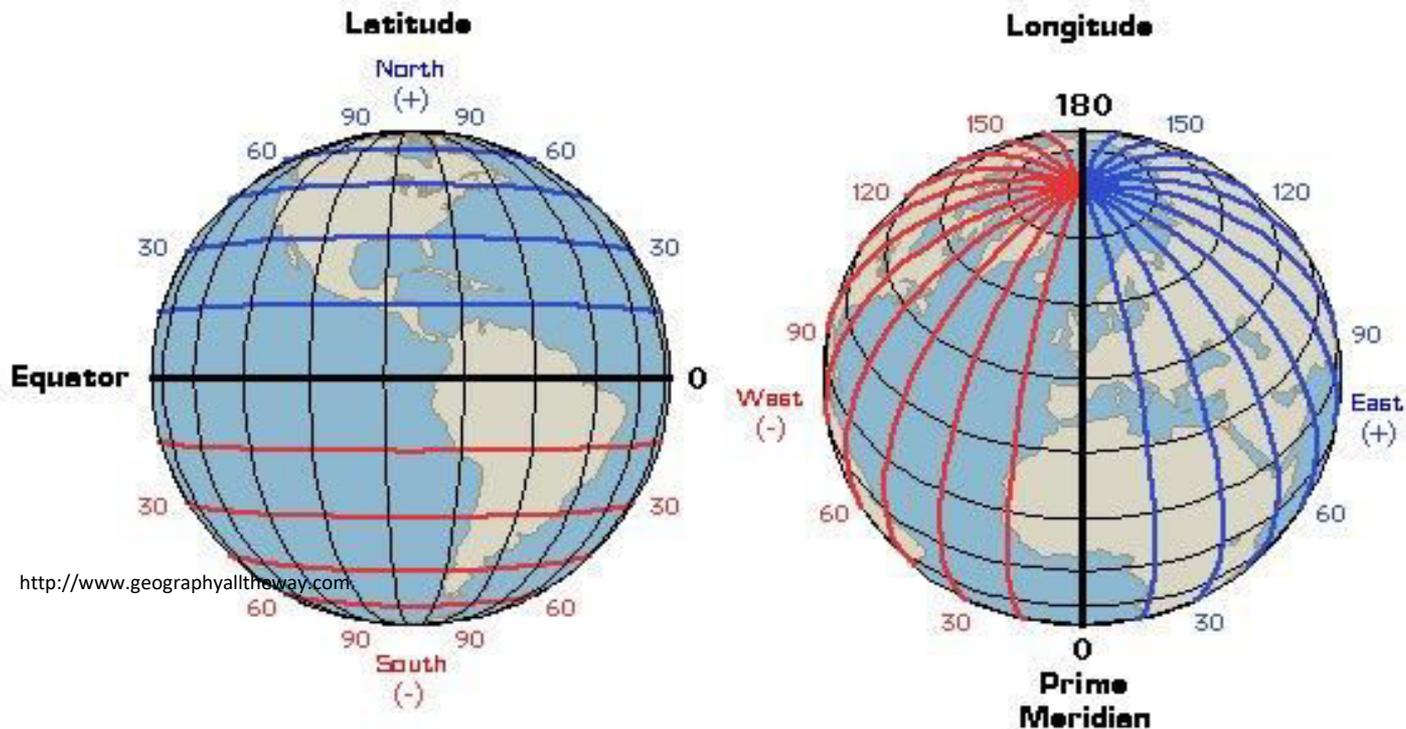
Associate Professor

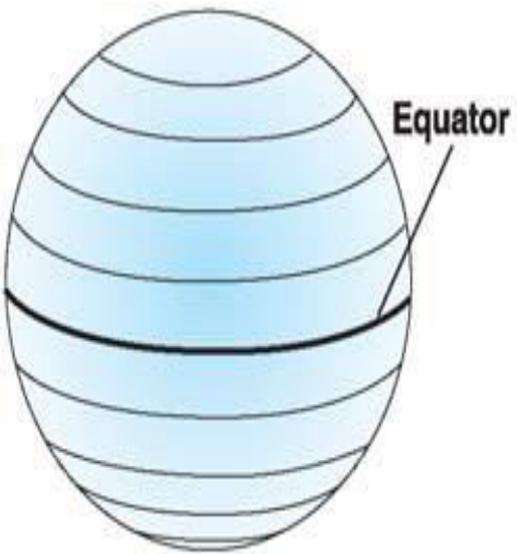
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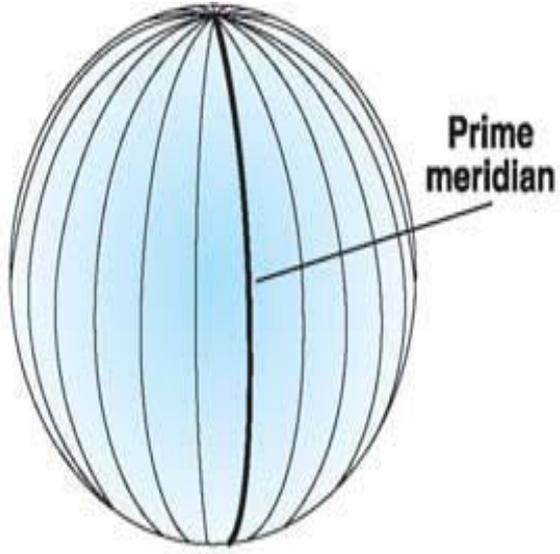
Geographic Coordinate Systems

A **geographic coordinate system (GCS)** uses a three-dimensional spherical surface to define locations on the earth. A point is referenced by its **longitude** and **latitude** values

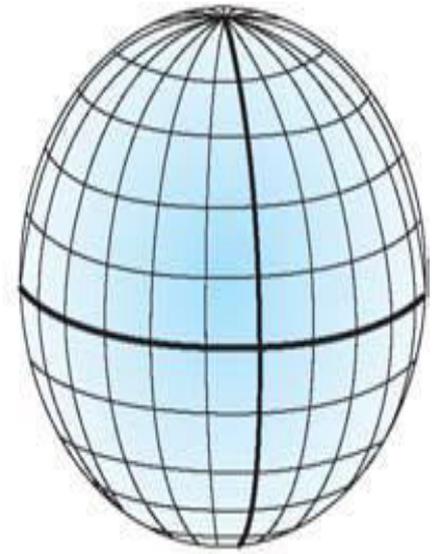




Parallels
(Lines of latitude)



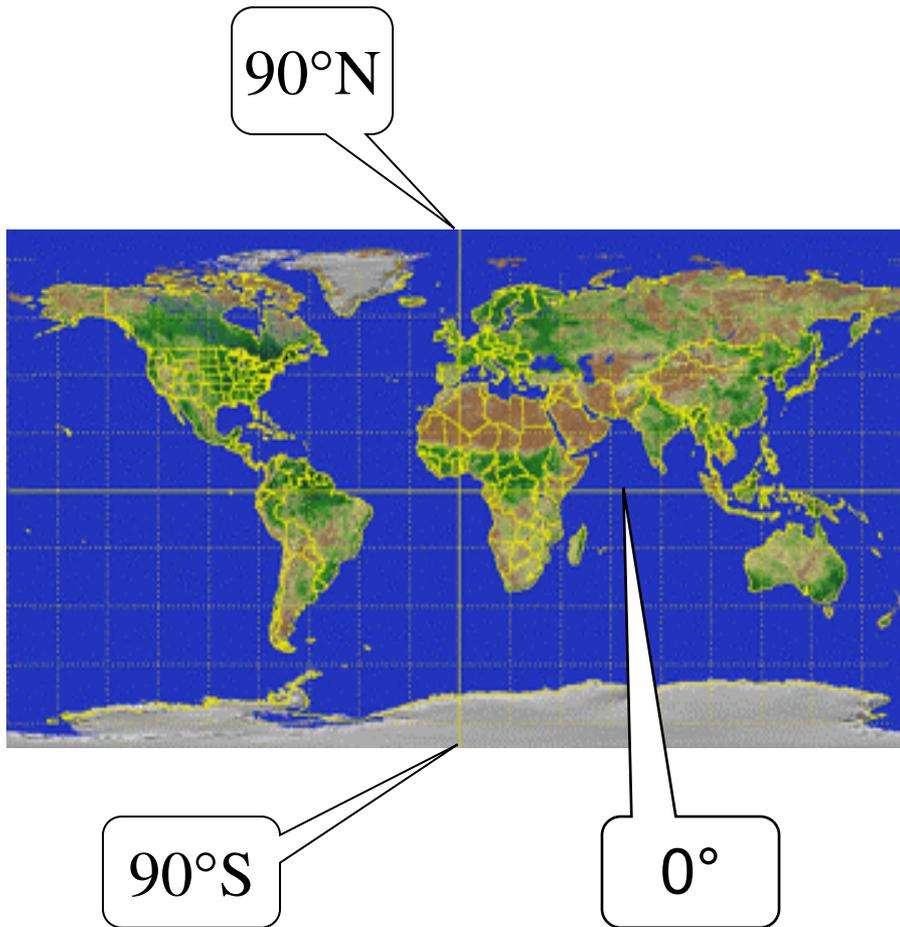
Meridians
(Lines of longitude)



Graticular
Network

Latitude and Longitude

- A **point** is referenced by its *longitude and latitude* values.
- Longitude and latitude are angles measured from the earth's center to a point on the earth's surface. The angles often are measured in degrees (or in grads)
- In the spherical system, 'horizontal lines', or east–west lines, are lines of equal latitude, or *parallels*.
- 'Vertical lines', or north–south lines, are lines of equal longitude, or *meridians*. *These lines* encompass the globe and form a gridded network called a **graticule**.



What is latitude?

Latitude is the distance from the equator along the Y axis.

It is expressed in degrees.

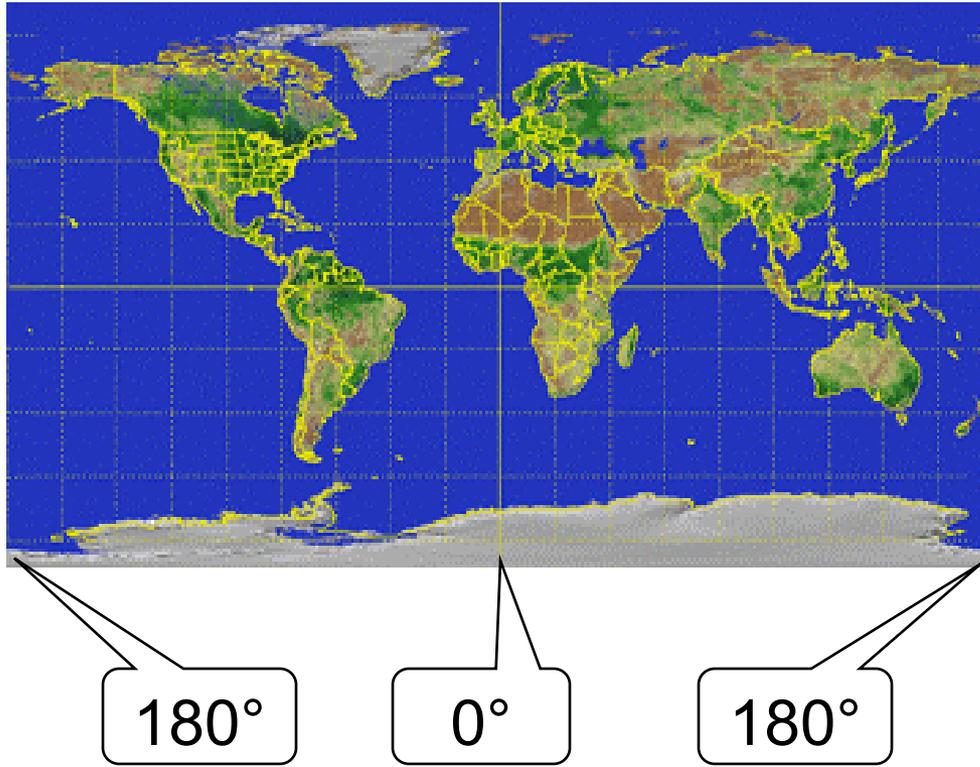
The north pole is 90° N

The south pole is 90° S

And remember that the equator is 0° latitude.

What is the maximum possible latitude on Earth?

90° is maximum. You could be at 90°N or 90°S but there is no greater latitude on Earth (or anywhere else)



What is longitude?

Longitude is the distance from the prime meridian along the X axis.

Just like latitude, longitude is measured in degrees.

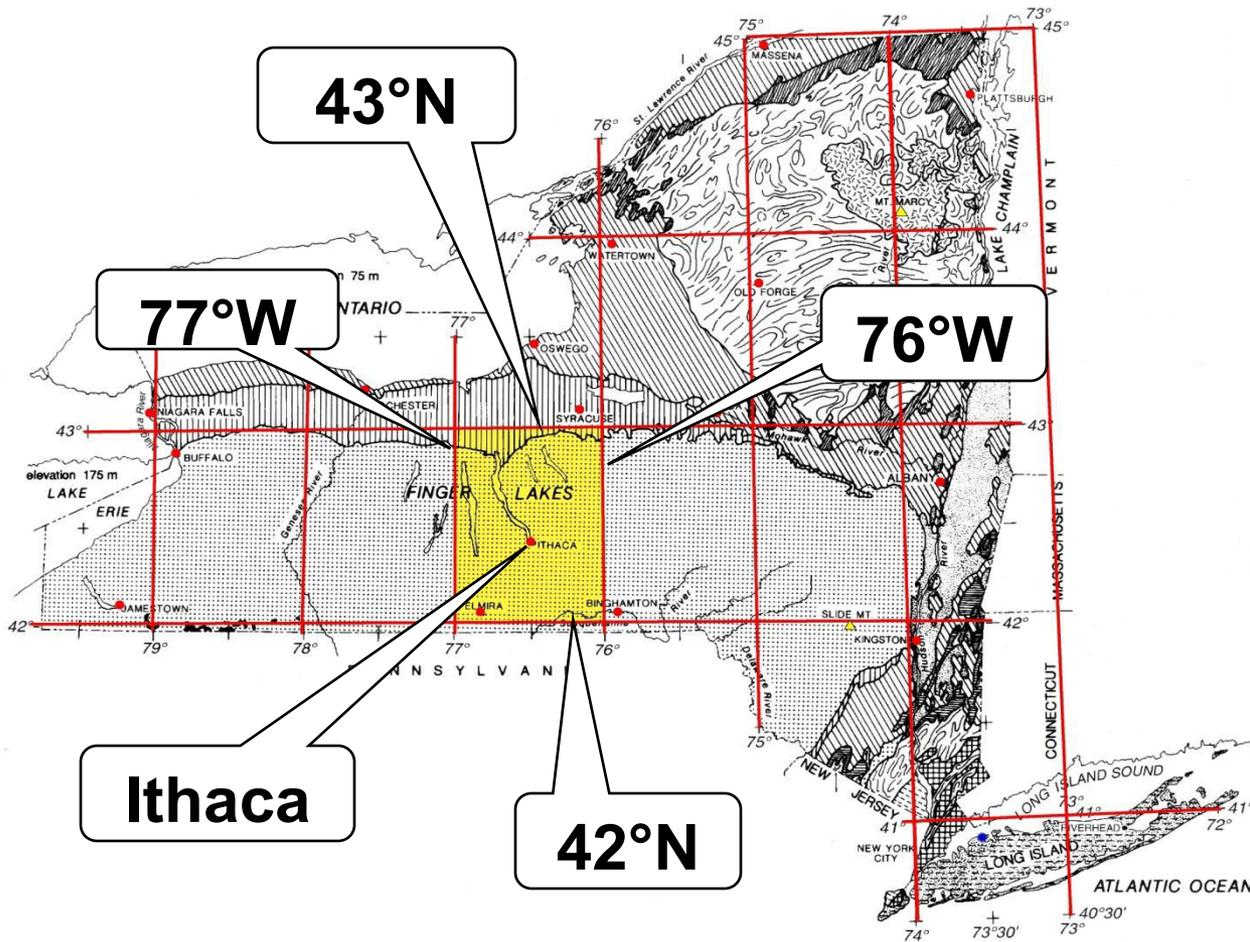
The prime meridian is 0°

And if you go half way around the world you will reach the 180° longitude line.

Understand that there aren't two 180° lines. On this FLAT map it just looks that way. It's the SAME line.

What is the maximum possible longitude on Earth?

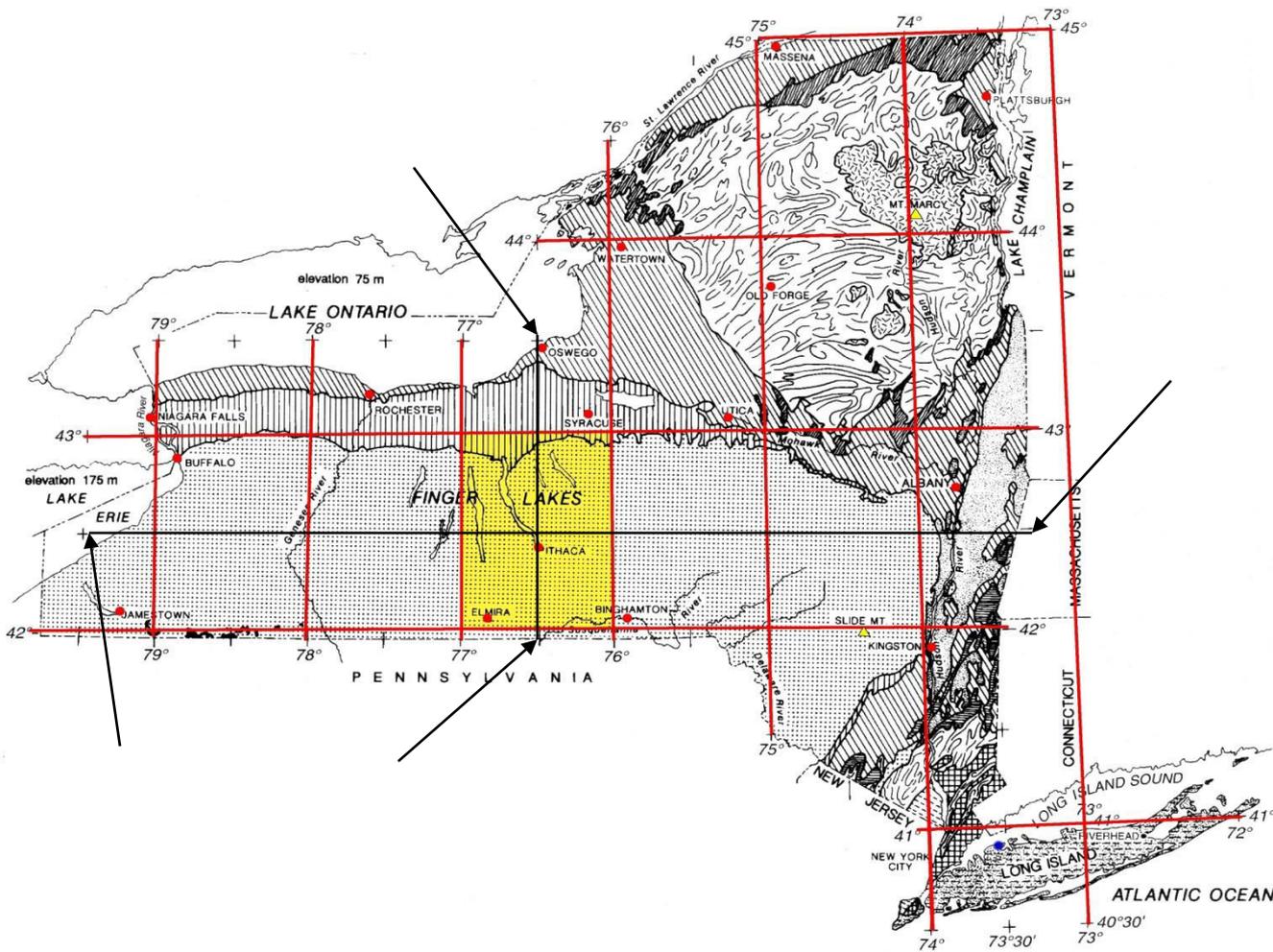
180° is the maximum possible longitude on Earth.



Let's use an example from the reference tables (page 3). Look at Ithaca, NY. The latitude is more than 42°N but less than 43°N and the longitude is more than 76°W but less than 77°W

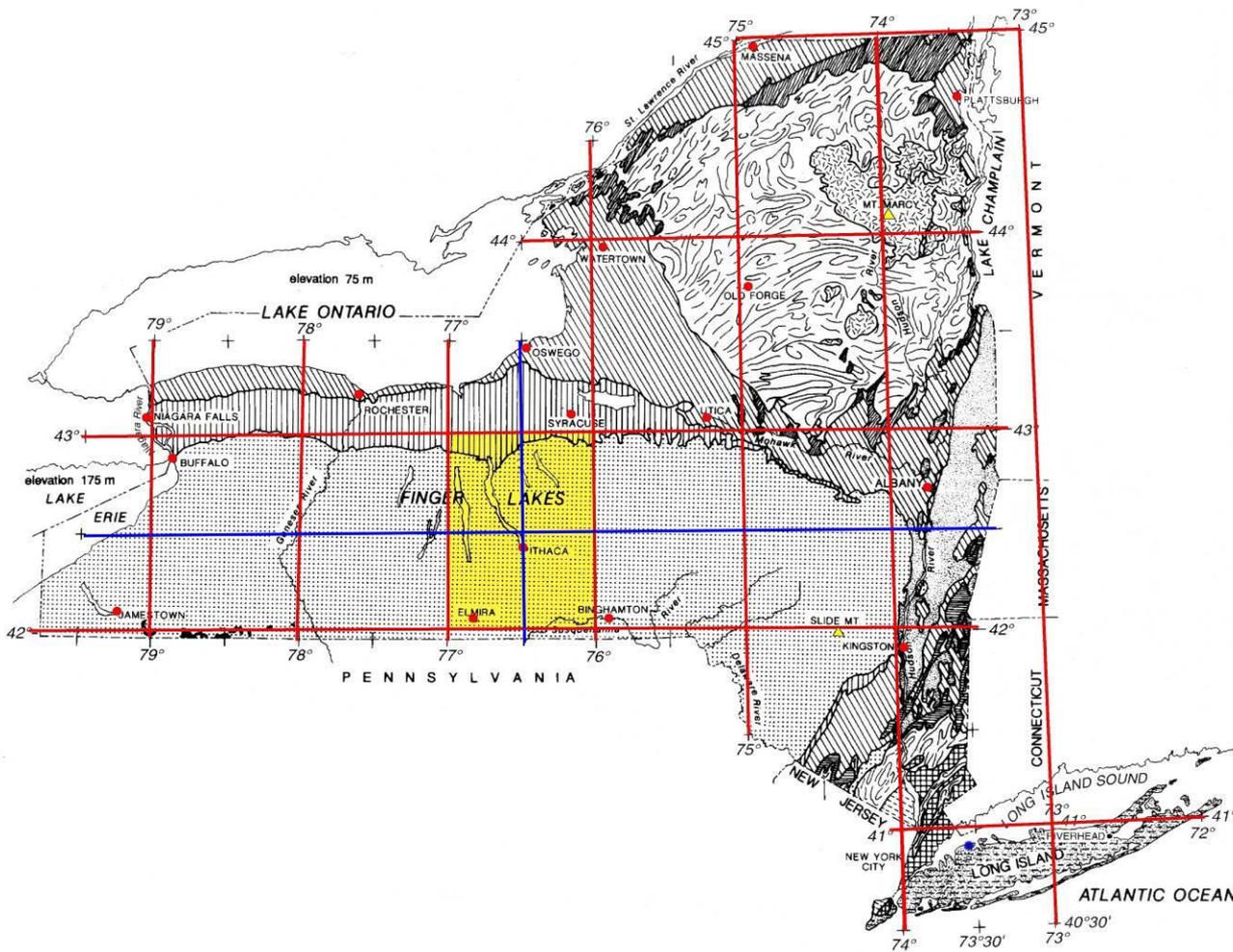
Each degree is about 111 kilometers so the yellow-shaded box ($1^{\circ} \times 1^{\circ}$) in which Ithaca is located covers over 12,000 square kilometers of land.

We need to be more precise. We can do that by subdividing each degree into **60** smaller units called **minutes**.



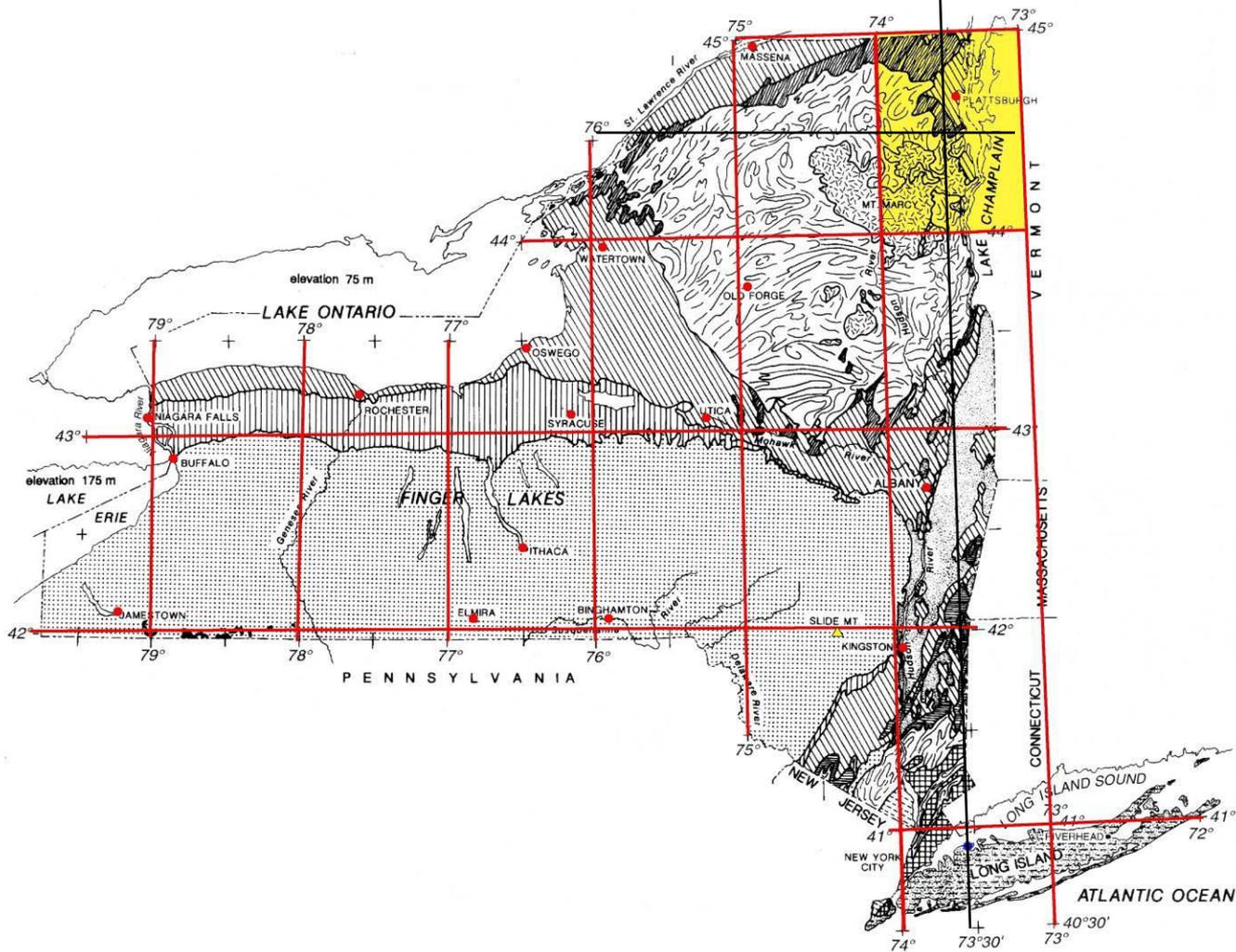
If there are 60 minutes in each degree then half a degree would be 30 minutes. Let's draw in the 30 minute (30') line. See these 2 marks? They are half way (30') between 42°N and 43°N. Using a ruler, connect them.

The line you just drew is 42°30'N. Now let's look at lines of longitude. See these 2 marks? They are half way (30') between 76°W and 77°W. Using a ruler, connect them. The line you just drew is 76°30'W. Now let's see if we can locate Ithaca more precisely.



First comes latitude. Notice that Ithaca is just south of the 42°30'N line. If it's not quite 30' then let's call it 25'. Ithaca is located 42°25'N.

Now we'll do longitude which, for Ithaca is easy since it's located right on the 76°30'W line. Ithaca's longitude is 76°30'W. Now we'll put latitude and longitude together to give a precise location: Ithaca is 42°25'N , 76°30'W. Let's try another.....



Let's find the location of Plattsburgh, NY to the nearest minute.

First draw the $44^{\circ}30'$ line

Then, the $73^{\circ}30'$ line.

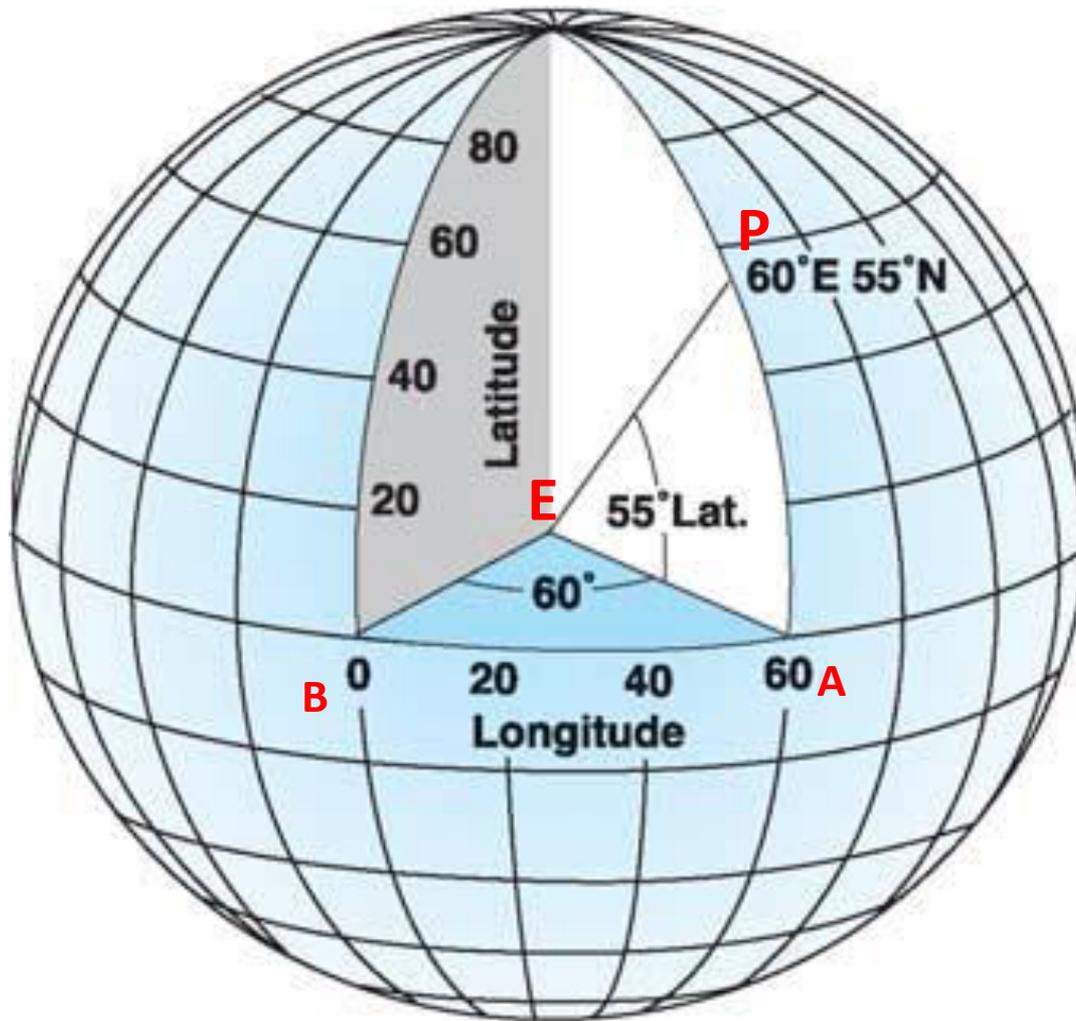
Now let's try to estimate the location.

Plattsburgh is more than $44^{\circ}30'N$ but less than $45^{\circ}N$. A good estimate would be $44^{\circ}40'N$.

Plattsburgh is more than $73^{\circ}W$ but less than $73^{\circ}30'W$. A good estimate would be $73^{\circ}25'W$

Putting the two together, Plattsburgh is about $44^{\circ}40'N$, $73^{\circ}25'W$.

- Latitude and longitude values are traditionally measured either in decimal degrees or in degrees, minutes, and seconds (DMS).
- Latitude values are measured relative to the equator and range from -90° at the South Pole to $+90^\circ$ at the North Pole.
- Longitude values are measured relative to the prime meridian. They range from -180° when traveling west to 180° when traveling east.
- If the prime meridian is at Greenwich, then Australia, which is south of the equator and east of Greenwich, has positive longitude values and negative latitude values.



Longitude:

Look for the deviation from 0 to 60 .

The shaded blue part is the angle which is hence made 60° E.

The longitude written on the horizontal surface is depicting the deviation

Latitude:

Look for the deviation from 0 to 55° N .

The shaded grey part is showing the plane surface of latitude It should not be confused with the vertical line.

E is the point extended from point **P (Position of object)** to the centre of earth which makes angle **BEA (longitude)** and angle **AEP (latitude)**

- The origin of the graticule (0,0) is defined by where the equator and prime meridian intersect.
- The globe is then divided into four geographical quadrants that are based on compass bearings from the origin.
- North and south are above and below the equator, and west and east are to the left and right of the prime meridian.

Here are some things to remember:

- > Latitude is written first and must always include N (north) or S (south) of the equator.
- > Longitude is written next and must always include E (east) or W (west) of the prime meridian.
- > All latitudes in New York State are N (north), and all NYS longitudes are W (west).
- > Each degree of latitude or longitude can be divided into 60 minutes.
- > A minute, as used here, is a unit of distance on the earth's surface. It is not a unit of time.