

The Geographic Coordinate System

What is a coordinate system?

Coordinate Systems are ways of splitting up the world in order to form transferable units (numbers) that relate to points on a map. They are very useful, as a set of coordinate values can be given to almost anyone in the world and they can relate the coordinate values to a real life place. Different coordinate systems have different methods of splitting up the earth. A coordinate system enables every location on the earth to be specified by a set of coordinates of known location on a grid. There are two major global coordinate systems, known as the “**Geographic Coordinate System**” (i.e. latitude and longitude) and the “**Universal Transverse Mercator System**” (i.e. UTM coordinates).

Our study uses the Geographic Coordinate System but there are other coordinate systems that divide the globe differently, like the Universal Transverse Mercator (or UTM) coordinate system, this system divides the Earth into 60 zones vertically, and 20 sections horizontally. They are reported numerically as ‘eastings’ and ‘northings’ (e.g. 630084m east, 4833438m north).

The most well known coordinate system is the **Geographic Coordinate System (GCS)**, which uses measures of **latitude** and **longitude** to determine your location. Lines of latitude run north and south parallel to the equator, with positive numbers representing the northern hemisphere, negative numbers representing the southern hemisphere, and the equator representing 0 degrees latitude. Lines of longitude run east and west parallel to the prime meridian, with positive numbers representing the eastern hemisphere and negative numbers representing the western hemisphere, with the prime meridian representing 0 degrees longitude. This may be understood by looking at this grid in relation to a map of the world (see figure 1).

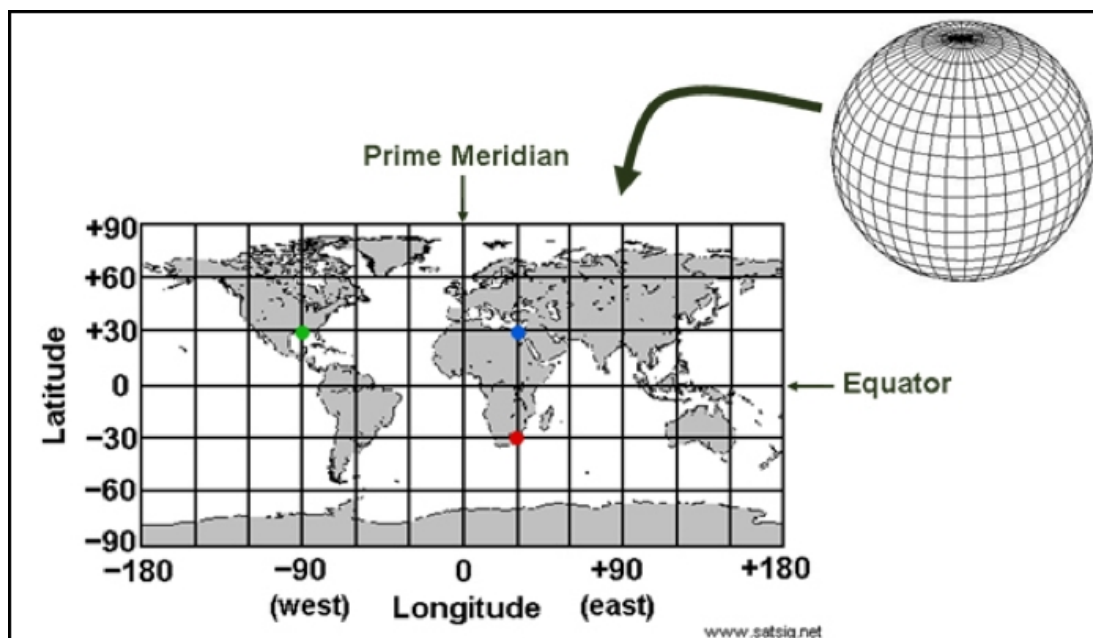


Figure 1. Geographic Coordinate System grid with example points.

In this image you can see the globe is divided into grid squares using lines of longitude and latitude. It is important that you understand the difference in longitude and latitude and how we write locations in

longitude and latitude form. There are three points on the grid map marked in red, blue and green. The points are all in very different locations but share either the same longitude or latitude with one of the other points. The green and blue points are on same **latitude**, +30 (horizontal line, **parallel to the equator**). The red and blue points are on the same **longitude**, +30 (vertical line, **parallel to the prime meridian**). As you can see, latitude and longitude can have the same numerical value (+30 in this case) but as these values in fact indicate very different points on the landscape and so, must be written in a universal format so we can know the difference between the two.

Coordinate Formats and Notation

Latitude and longitude units for the Geographic Coordinate System are represented in Degrees, Minutes, and Seconds where 1 Degree=60 nautical miles (69.09 miles); 1 Minute=1 nautical mile; and 1 Second=100.8 feet. For easy in modern data analysis (which likes single numbers), several other formats for reporting latitude and longitude have become popular.

Most organizations usually tell you which units they use, but if not, you can usually tell by the format in which the coordinates are written. If a location is given in **Decimal Degrees**, the coordinate is a whole number that will have 2 numbers before the decimal point, 5 or more after the decimal point and may be followed by the degrees symbol (i.e. 43.92741°). In other formats, the numbers are split up and the decimal and the degree symbol will appear inside the number. For example, **Degree Decimal-Minutes** has a number followed by the degree symbol and then another number with a decimal in it (i.e. 64° 68.445 latitude, 92° 42.367 longitude). **Degree, Minutes and Seconds**, has a number followed by the degree symbol, a second number followed by an accent symbol (') and then another number with a decimal in it (i.e. 44° 40' 16.75 latitude, 93° 37' 10.05 longitude).

To make sure that your GPS unit is set to the right formats for your study you will need to learn how to see what format your GPS unit is set in and change it if necessary. See the **'GPS Settings and Instructions'** section in **'Finding a Location Using a GPS Unit'**.

Common practice reports the latitude value first, then the longitude value, separated by a comma. For the latitude coordinate, you may also see an indication of the direction from the equator, using either the "-" symbols or S (degrees South); and for the longitude, the direction from the prime meridian, using the minus symbols or W (degrees West). For example, the blue point in the Figure 1 above has the latitude & longitude coordinates of "30,30", but can also be written as "30,30W" or "30, -30". If you find the system of writing coordinates confusing it may just be simplest to write 'latitude' and 'longitude' with their corresponding values. As you can see, most coordinates in North America have a positive number for the latitude and a negative number for the longitude.

If you'd like to practice, take a moment to work out the coordinates for green and red points in Figure 1 and then check your answers below (if you get them incorrect you may want to read over this section again).

Answers

- Green point = “30,-90” or 30 Latitude, -90 Longitude.
- Red point = “-30,30” or -30 Latitude, 30 Longitude.

What Is A “Datum” And Why Do We Care!?

Another important variable to consider when talking about location is the **datum**. The Earth is not a perfect sphere, in fact, it is a three dimensional oval shape (similar in shape to the Figure 2). This oval like shape makes mapping the earth a little more complicated as the Earth does not fit completely to our mapping grid systems (which was developed for perfect sphere). Datums are known geographic shapes of the Earth, which we can apply to maps so coordinate systems can still work perfectly. Datums can be classified into two broad categories: local referencing datums and global referencing datums. A local referencing datum is a datum that has been developed for a set local area often on a national level. A global-referencing datum best approximates the size and shape of the Earth as a whole (on an international level) but is not good at predicting accurate coordinates on a national scale.

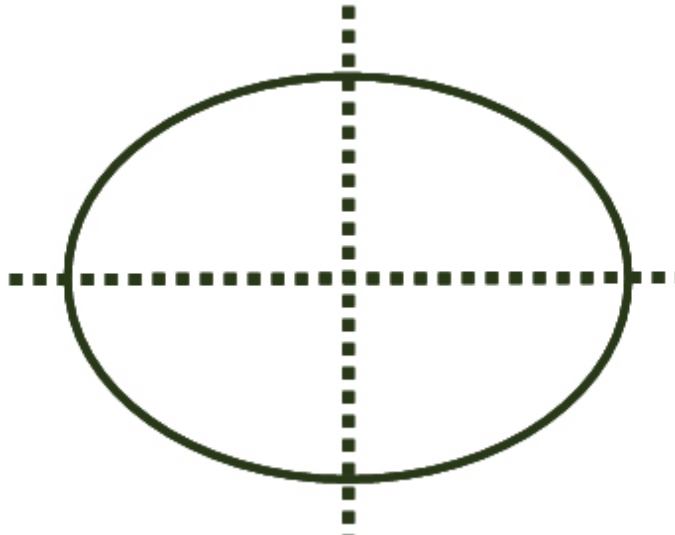


Figure 2. An approximation of the Earth's shape

The North American Datum (or NAD) is the specific datum for the US it is often followed by two numbers, which indicate the date this datum was developed e.g. NAD27 is the North American Datum of 1927. Different NADS correspond to different geographic shapes of the US, so it is useful to keep the NAD the same throughout your study otherwise your locations can be wrong.

GPS units have interchangeable NAD options in their settings. The GLWW study uses NAD83 for all its data entry, if your GPS is set to a different NAD setting you will need to change it to NAD83. See the **'GPS Settings and Instructions'** section in **'Finding a Location Using a GPS Unit'**. Different online mapping tools use different datums to generate the coordinates for a given location. The datum used by iTouchMap is NAD83. If you use a different online mapping tool to get your latitude and longitude coordinates it is difficult to know what datum they may be using (they almost never report it).

Want to read even MORE about coordinate systems?

Check out the link to a tutorial developed by “CitSci.org”, **Coordinate systems** <http://citsci.org/DH.php?WC=/WS/CitSci/Tutorials_Wisconsin/Tutorial2_Static.html>. You can find other interesting tutorials developed for citizen scientists there as well.