" COORDINATE SYSTEM"

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Annotation:
This article provides information on coordinate system.

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A coordinate system defines a common set of conditions or rules that apply to all of the coordinates located within it. You could say a "Coordinate system systematically coordinates coordinates."

 But, it's not always simple. The thing is, the Earth is a really weird complex shape, not a smooth and perfect sphere. It's more like a lump of play dough shaped into a ball by the small, clumsy fingers of a toddler. Mountains, valleys, plains, fjords, canyons, and so much water. To top it off, it's not static. The gravity of the moon acts on the oceans, tectonic plates continue their slo-mo movements of nudging continents around, and even the poles shift.

 So you can imagine, when people took a look at this problem of locating places on the crazy-shaped-always-changing-Earth, they had a lot of different things to consider. Some looked at specific regions like a province, while others created systems that were oriented around tidal levels. Others ignored both of these things and chose something else entirely.

 This is why we have thousands of geographic coordinate systems — because there are a lot of right answers depending on what you need.

 These thousands of coordinate systems are able to co-exist because they are each defined by a common set of rules or properties. At a high level, geographic coordinate systems all have:

A datum – remember, the Earth is a playdough sphere. A datum is the mathematical frame of reference that approximates the 3D shape of the Earth for the purpose of measurement. This can be a perfect sphere like a classroom globe, or ellipsoidal and flattened, and is often shifted off the center of mass of the Earth in order to provide more accurate measurements.

Angular units – The measurement used to describe the angle of a point on the Earth's surface in relation to the center of the Earth. The most common angular units used are decimal degrees (DD), degree minutes seconds (DMS), and decimal minutes (DM).

Prime Meridian – the line running north-south along the Earth's surface indicating 0° longitude. The most commonly used prime meridian is the one running through Greenwich, England.Geographic Coordinate Systems

Now that you know that a geographic coordinate system (GCS) is made up of a datum, angular units, and a prime meridian, let's see how it actually works. It's a lot easier to understand if you look at a picture.

In this diagram, an ellipsoid is drawn. This loosely represents the surface of the Earth.

A centerpoint is located – this is where the X, Y, and Z axis cross.

The prime meridian is defined – this is the vertical measure of 0 degrees. This can be in a different location in different coordinate systems.

The directions of Up, North, East, South, and West are defined.

Now that orientations are set, you can see how the Earth is divided into quadrants. Moving away from the Equator and prime meridian gives you negative or positive values. These values are coordinates, and can be used to locate anything on the earth.One of the most commonly used GCS is the WGS 1984 (World Geodetic System 1984). This system is commonly used for sharing global locations particularly with a GPS.

While the information gained from a GPS can be extremely useful, solely relying on a geographic coordinate system isn't going to solve all your coordinate system problems.

We've all seen and managed that "Location" setting on our mobile devices, which enables your phone to measure GPS coordinates. That's great and all, but imagine just being given a string of numbers from a GPS and nothing else. You'd know exactly where you were, but how in the heck would you ever make it to dinner in time in rush hour traffic without all of those super-secret side street route options being revealed? That's why Google Maps and Apple Maps are pretty ubiquitous these days for navigating around.

Coordinate data becomes so much more accessible and meaningful to us when it's moved from a GCS to a Projected Coordinate System (PCS), which takes the where identified in a GCS, tells us how to draw that information to aflat surface (like your phone screen) using a projection method. I know that I would quite literally be lost without projected coordinate systems in my life.Projected Coordinate Systems

When it comes to a projected coordinate system (PCS), we first need to understand what a "projection" is.

 Basically, there's more than one way to peel an orange. You've got a nice, spherical orange, just asking to be eaten. You peel off the skin and pop a slice into your mouth. Yum. The orange peel, once wrapped around your orange, is now able to lie flat on the table because of the ways you ripped through the peel. That first orange was just so darn good, you gotta have another

one. Another orange peel lies flat on the table, this one with a different pattern of tears. Projection is just that – the method by which we "peel" the Earth and lay it out flat.

However, when it comes to maps, we aren't just "peeling and laying the Earth flat". We're trying to represent something that's spherical into 2D as a rectangle (or other shape), in a consistent way without tears to break up the image. There are a number of different projection methods used because moving from 3D space to 2D space will always result in distortion of some kind. Different projection algorithms are selected to preserve as many of the following qualities as possible to varying degrees, but note, all four can never be preserved in 2D:

Area – how accurate are the size of the landmasses compared to their reality?

Shape – how accurate are the shapes of features compared to their reality?

Distance – how accurate are the measurements between two points?

Direction – how accurately are two locations portrayed relative to each other?

As an example, check out how the Mercator projection works. To put everything on a flat, rectangular surface, countries closest to the poles see a distortion of the area where they end up being displayed larger than they are as they are stretched to fill the rectangle space.Take Greenland vs. Brazil for an extreme example of the Mercator projection. While Greenland appears to be larger than Brazil in the Mercator projection, in reality, the area of Greenland is 2,166,086 km², and Brazil is 8,515,767 km².

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