

Deriving and Using Coordinates with Herp Data

By Chris McMartin, April 2013

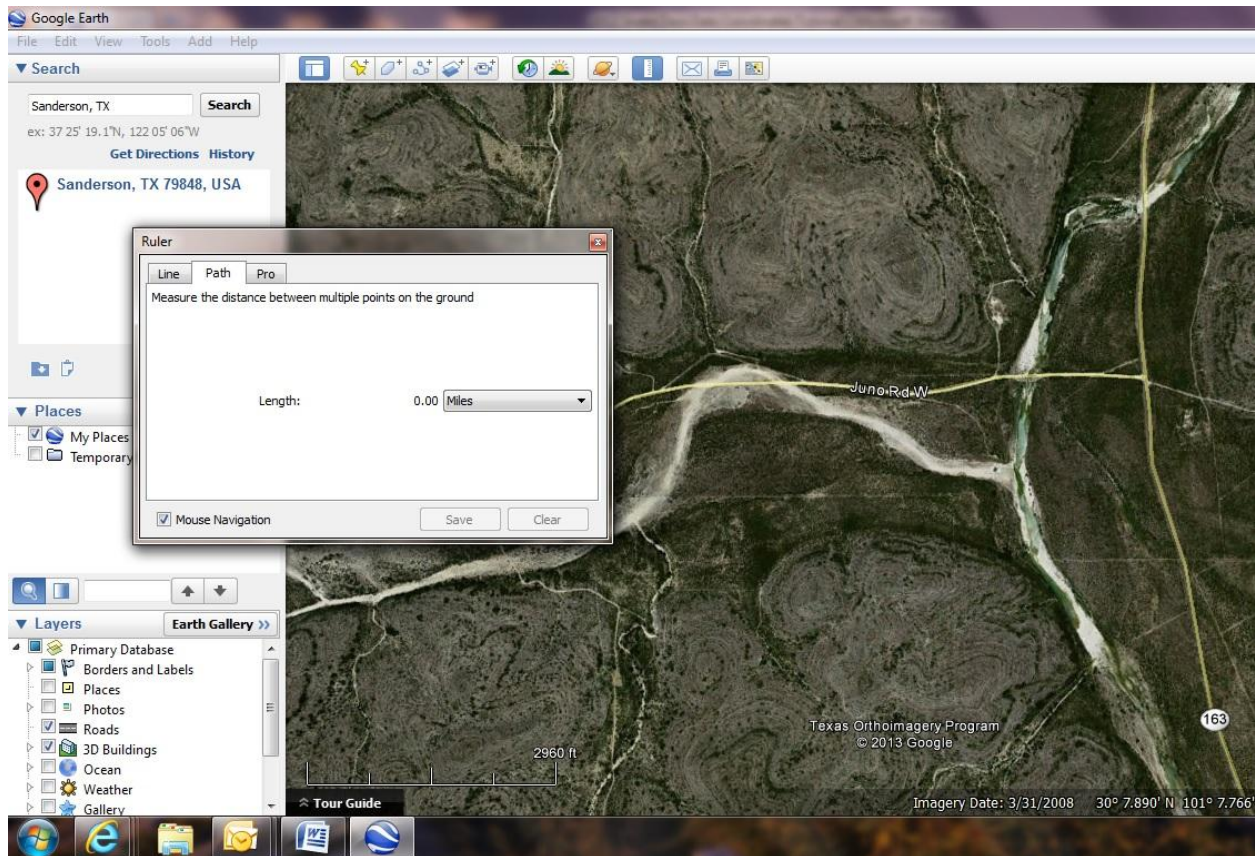
How can I determine latitude/longitude for a data record?

There are several means by which to accomplish this. The first, and most traditional, would be to use a paper chart. A chart is more than a map—all charts are maps, but not all maps are charts. In addition to standard geographic features commonly found on all maps, a chart will have latitude and longitude lines printed on it. Charts come in different scales (e.g. 1 inch = 50 miles, 1 inch = 1000 feet, etc.). It is best to use the largest-scale chart you can find (perhaps counterintuitively, a large *scale* represents a small *area* of the Earth). In other words, if you find a 1:24,000 scale chart (like many US Geological Survey charts), that will cover a very specific area (like a township) compared to a 1:100,000 scale chart (which may cover entire counties or even smaller states). A benefit to using a paper chart is that you can simply mark the spot an animal was found while in the field, and then figure the exact coordinates later.

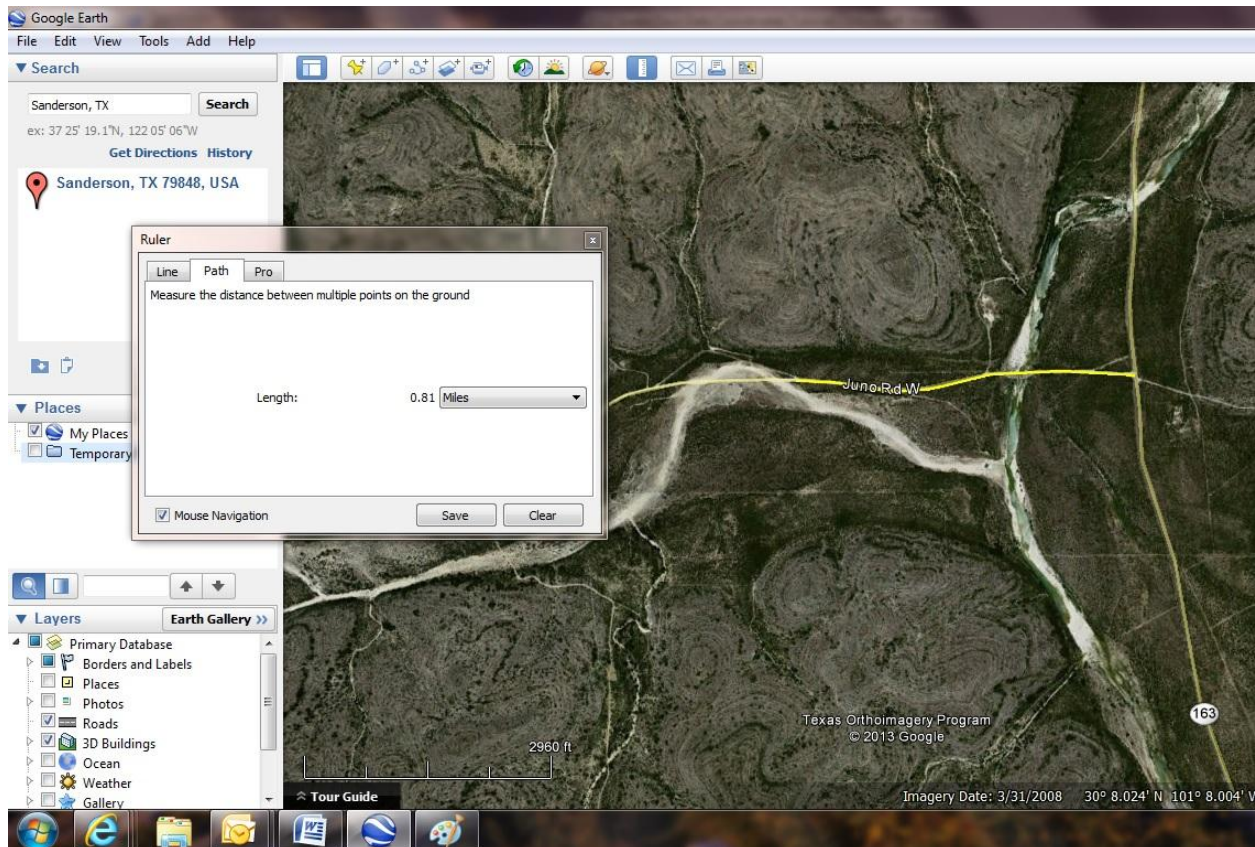
More common these days is to use a handheld GPS receiver. This doesn't have to be anything sophisticated; there are models made specifically for pedestrian use (e.g. hiking), but car units also work fine, as does an antenna hooked into a laptop with mapping software or some smart phones with GPS capability. Familiarize yourself with your particular equipment's operation; there should be a "page" which will display the unit's current latitude and longitude. For example, on Garmin vehicle GPS units, this is found by using the "Where Am I?" feature. I leave this page displayed while road-cruising, as it updates real-time and therefore allows me to record the coordinates on a data sheet when I stop to observe a herp.

If you have neither of these options available, but have knowledge of roads in the area you're road-cruising, you can use your car's trip odometer to assist in determining location. I use the "Trip B" setting for this purpose, as I reset "Trip A" each time I fill the gas tank. To use the trip odometer to find location, you simply reset it to zero at a known intersection, which you record (e.g. "Intersection of Hwy 163 and Juno Road W"). The next time you stop to observe a herp, you record the distance traveled (e.g. "Juno Road W, 0.8 mile W of Intersection with Hwy 163"). Since trip odometers only record to tenth-of-mile accuracy, your data will only be accurate to within 528 feet. Additionally, if you backtrack at all (such as turning around to examine a DOR), this will induce error, which will compound with every such occurrence. Don't worry about that *too* much—see the discussion on accuracy below.

If using the odometer method, Google Earth is your friend once you return to Internet access. On the menu, under "Tools," click "Ruler." This will bring up a dialog box wherein you can select "Line," "Path," or "Pro." Choose "Path" (see the screenshot on the next page).



Once you've selected "Path," the mouse pointer will change to a form of "crosshairs" when positioned over the imagery to assist in selecting points on the image. Click on the intersection you selected as your reference point (in this case, 163 and Juno Road W). From there, click points along the road you cruised, using the scale in the lower left of the satellite imagery display as a guide for how far you're "traveling" down the road. The "Path" window will display a running total in miles (or the units of your choosing). Click on points along the road such that you're not "cutting corners;" i.e. the path defined by your mouse clicks should closely follow the curves of the road. Once you get close to the desired distance (in the example, 0.8 mile), space your mouse clicks more closely so you don't overshoot. Positioning the mouse crosshairs over that final point will provide a coordinate readout in the lower right of the display. See the screenshot on the next page for the result.



You can see from the screenshot I slightly “overshot” my desired mileage (by a hundredth of a mile—53 feet). The coordinates for this point as displayed are N 30° 08.024′, W 101° 08.004′. I can do one of three things to correct the overshoot, understanding I probably induced error anyway by not tracing the path of the road *exactly*:

1. Accept this error and realize it’s still much more accurate than most of our historical predecessors’ measurements.
2. Delete this path and start over from Highway 163, hoping to be more accurate with my mouse clicks this time.
3. Provide a small correction to my coordinates. Since I’m in the Western Hemisphere, and using my example I would need to correct slightly to the east, I would need to *subtract* a small amount from the seconds of longitude. At continental US latitudes, a second of longitude is equal to roughly 85 feet. Since I overshoot by 53 feet almost due west, I’d be comfortable changing my longitude by one second, meaning my new coordinates for this data point would be N 30° 08.024′, W 101° 07.004′.

How accurate are my GPS unit's coordinates? How accurate do my coordinates need to be?

This is a highly subjective topic. I am amused when I hear people talking about the accuracy of a particular GPS unit, especially when they record separate coordinates for rocks two feet apart. The important thing to remember is that just because your GPS receiver *displays* ten decimal places, doesn't mean it's *accurate* to ten decimal places.

No matter the number of decimal places your receiver can display, bear in mind all units use the same signal from the satellites. The published, official accuracy of the GPS signal is around 10 feet, 95% of the time. In other words, you can be guaranteed to be within 10 feet of where the signal says you are 95% of the time. It could be better than that, but there's no real way to be certain (source: <http://www.gps.gov/technical/ps/2008-SPS-performance-standard.pdf>) . Therefore, any decimal places greater than those shown below are not really providing any more accuracy. You can take comfort in the fact that many historical records for plants and animals are lucky if they get the *county* correct!

Granted, there are some devices available which can enhance accuracy through the incorporation of ground-based signals in addition to the space-based GPS signals, but in many places herpers find themselves, these enhancements are not available so I do not address them here.

Given that the published GPS signal accuracy is around 10 feet, you should only need to record your coordinates with the following level of precision:

If your receiver displays decimal degrees (e.g. N 30.14683°, W 102.40925°), 3 decimal places (e.g. 30.146°) gets you within 365 feet. Four decimal places gets you within 36 feet. Five decimal places gets you within 4 feet, well within the published GPS signal accuracy.

If your receiver displays degrees-minutes-decimal minutes (e.g. N 30° 08.810', W 102° 24.555'), one decimal place (e.g. 30° 08.8') gets you within 608 feet. Two decimal places gets you within 61 feet. Three decimal places gets you within 7 feet, well within published GPS signal accuracy.

If your receiver displays degrees-minutes-seconds (e.g. N 30° 08' 48.6", W 102° 24' 33.3"), one decimal place gets you within 102 feet. Two decimal places gets you within 11 feet, right about the published GPS signal accuracy.

What format should my coordinates be?

The best answer is: whatever format is required by the database you're using! For example, the H.E.R.P. database at www.naherp.com is very forgiving and will accept any of the formats mentioned above. However, the "Herps of Texas" database at www.inaturalist.org requires coordinates in degrees-decimal degrees—see the next question below.

Formatting note: Some databases will use minus signs ("-") to denote "south" and "west" coordinates; e.g. N 30° 08.810', W 102° 24.555' must be input as 30° 08.810', -102° 24.555'. Otherwise, your location may display on the wrong side of the planet!

How can I convert between the different coordinate formats?

There are several web sites which can help, but it's easy enough to do it yourself. Minutes and seconds of latitude/longitude are "base-60," like minutes and seconds of time. Just as one hour has 60 minutes and one minute has 60 seconds, one degree has 60 minutes and one minute has 60 seconds.

To convert from degrees/decimal degrees to degrees-minutes-decimal minutes, take the "decimal" part of the number and multiply by 60. Example: To convert N 30.14683°, W 102.40925°, multiply ".14683" and ".40925" each by 60 to get 08.810' and 24.555' respectively. Tack these values onto your existing degree values (30° and 102°). Your coordinates are therefore N 30° 08.810', W 102° 24.555'.

Repeat the same process to convert degrees-minutes-decimal minutes to degrees-minutes-seconds. Example: To convert N 30° 08.810', W 102° 24.555', multiply ".810" and ".555" each by 60 to get 48.6" and 33.3" respectively. Tack these values onto your existing degree and minute values (30° 08' and 102° 24'). Your coordinates are therefore N 30° 08' 48.6", W 102° 24' 33.3".

To convert the other way (i.e. from degrees-minutes-seconds to degrees-minutes-decimal minutes), divide the seconds by 60. Example: To convert N 30° 08' 48.6", W 102° 24' 33.3", divide "48.6" and "33.3" each by 60 to get 0.810 and 0.555 respectively. Tack these values onto your existing degree and minute values (08' and 24'). Your coordinates are therefore N 30° 08.810', W 102° 24.555'.

Similarly, to convert from degrees-minutes-decimal minutes to degrees-decimal degrees, divide the minutes by 60. Example: To convert N 30° 08.810', W 102° 24.555', divide "8.810" and "24.555" each by 60 to get 0.14683 and 0.40925 respectively. Tack these values onto your existing degree values (30° and 102°). Your coordinates are therefore N 30.14683°, W 102.40925°.

The table below may help you understand how "base-60" (clock) math translates to standard "decimal" math. It's also a good way to quickly "error-check" your calculations. Think of it this way: half an hour

(or degree) is 30 minutes, or 0.5 hours (or degrees). Whole tenth values and their corresponding base-60 equivalents are in bold. See a pattern?

Minutes or Seconds (works for time as well as lat/long)	Decimal Equivalent	Minutes or Seconds (works for time as well as lat/long)	Decimal Equivalent	Minutes or Seconds (works for time as well as lat/long)	Decimal Equivalent
2	.033	22	.367	42	.700
4	.067	24	.400	44	.733
6	.100	26	.433	46	.767
8	.133	28	.467	48	.800
10	.167	30	.500	50	.833
12	.200	32	.533	52	.867
14	.233	34	.567	54	.900
16	.267	36	.600	56	.933
18	.300	38	.633	58	.967
20	.333	40	.667	60	Next whole minute

Why do my coordinates seem “off” when I plot them in Google Earth?

Latitude and longitude are defined in reference to a datum, which can be summarized as a way to superimpose coordinates on an imperfectly-shaped Earth. Historically, locally-oriented datums have been employed (such as the North American Datum 1927 or NAD 27), which provides greater accuracy; however, in recent years, the World Geodetic System 1984 (WGS 84) has been adopted due to its more widespread applicability (though sacrificing somewhat in accuracy).

Some GPS receivers allow the user to select a datum to display (though the default GPS reference is WGS 84, units may display coordinates using a different datum to facilitate using a paper chart with the unit). Google Earth uses WGS 84. Importing data into Google Earth *should* result in Google Earth “re-projecting” the information using WGS 84 (though you should confirm the resulting coordinates transformed properly).

I recommend setting your GPS unit to display in WGS 84, if that is an option. If you record coordinates from a GPS unit (or other program/web site) set to a different datum and then manually input them into Google earth, your location may appear displaced, in some cases by a few hundred yards. If this is the case, move the pointer to the desired location and use those coordinates.

I hope this information has been helpful. While I think I’ve covered the primary questions concerning latitude and longitude coordinates, if you have further questions don’t hesitate to contact me!

