Lab1

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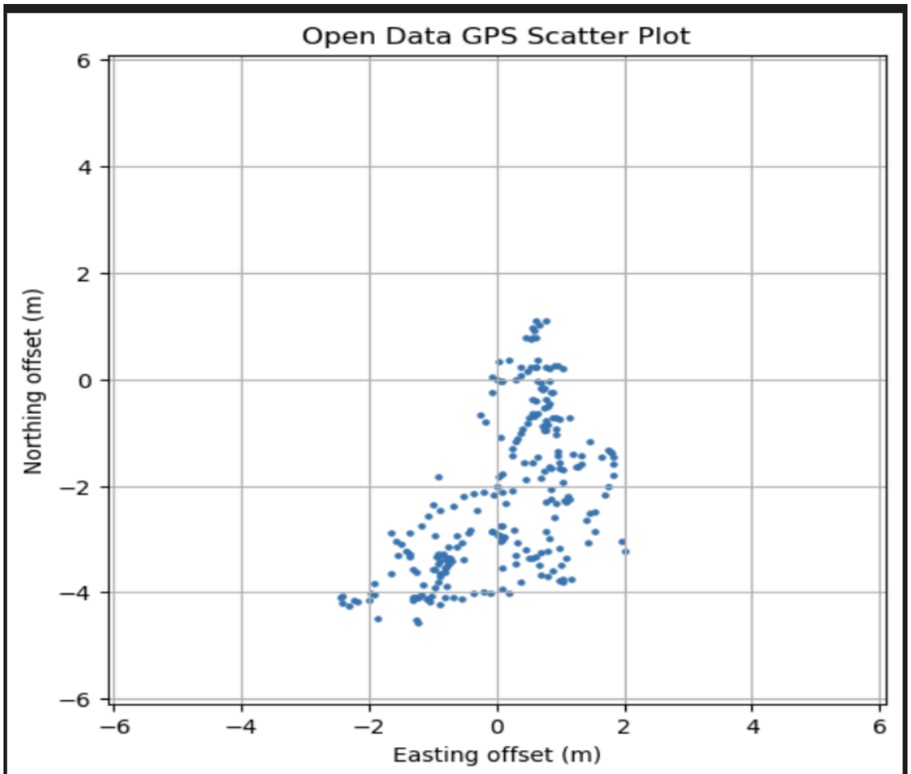
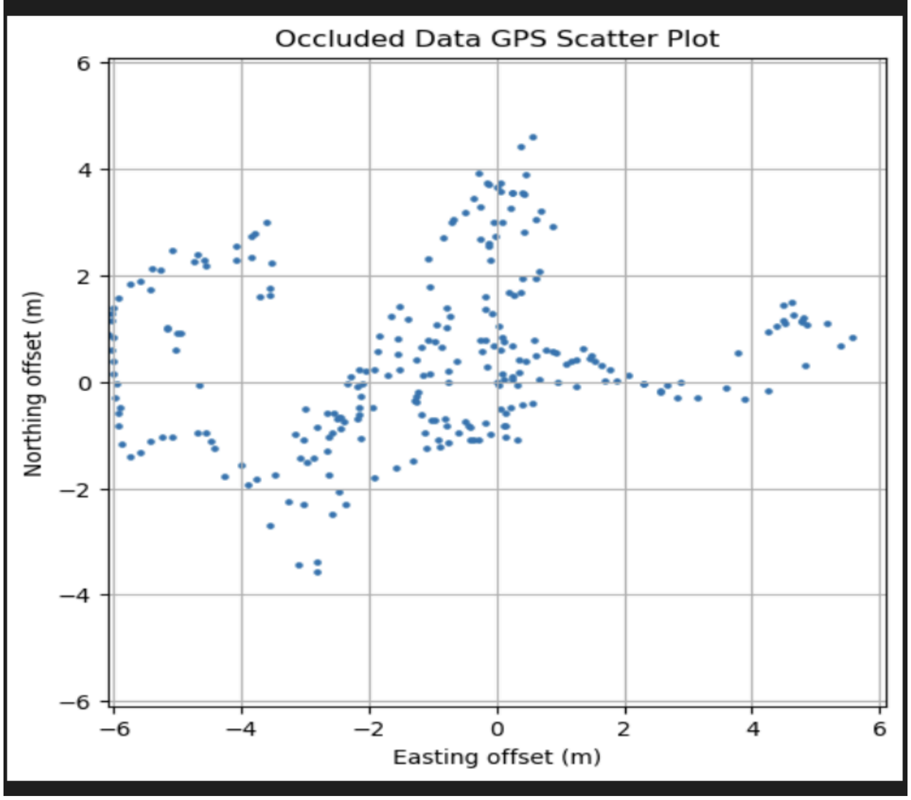
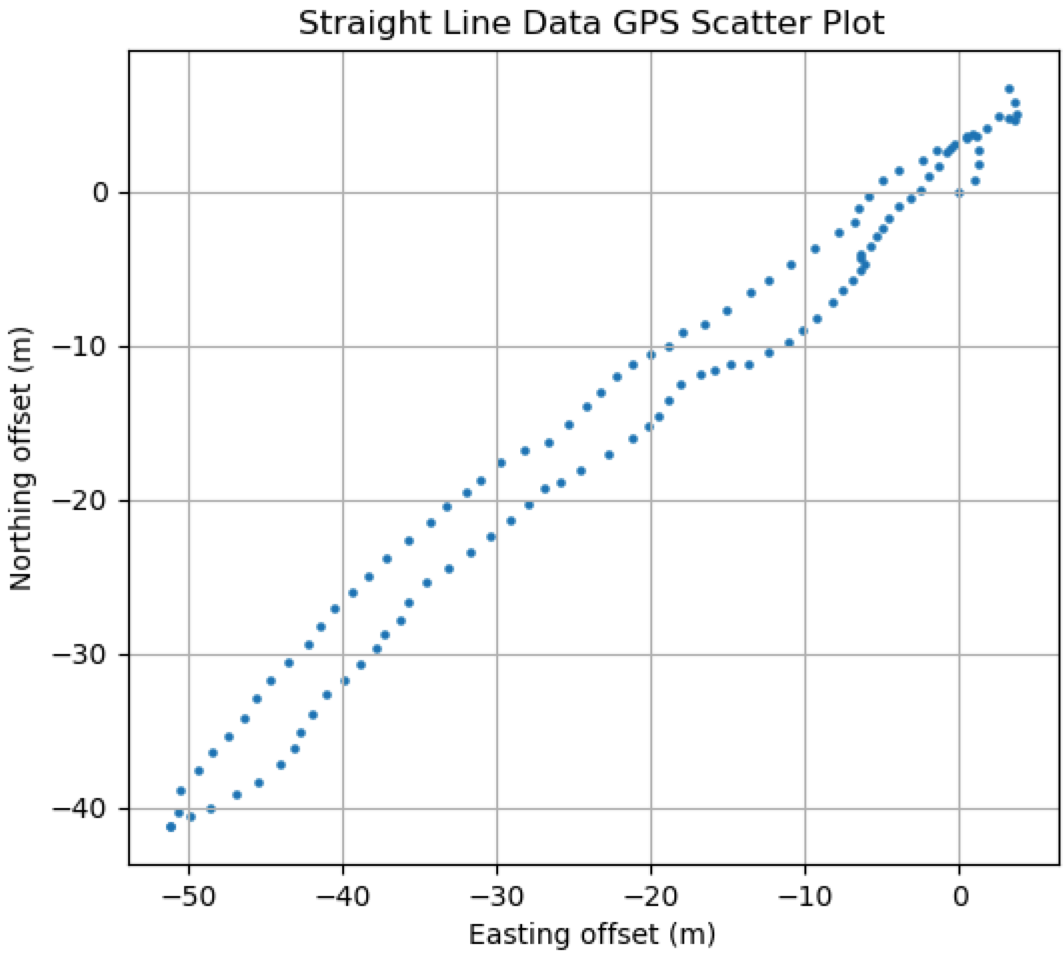
The purpose of this lab was to create a ROS based GPS driver for parsing and publishing GPGGA data and analyze the accuracy of the receiver by calculating position errors in both walking, stationary occluded, stationary open scenarios.

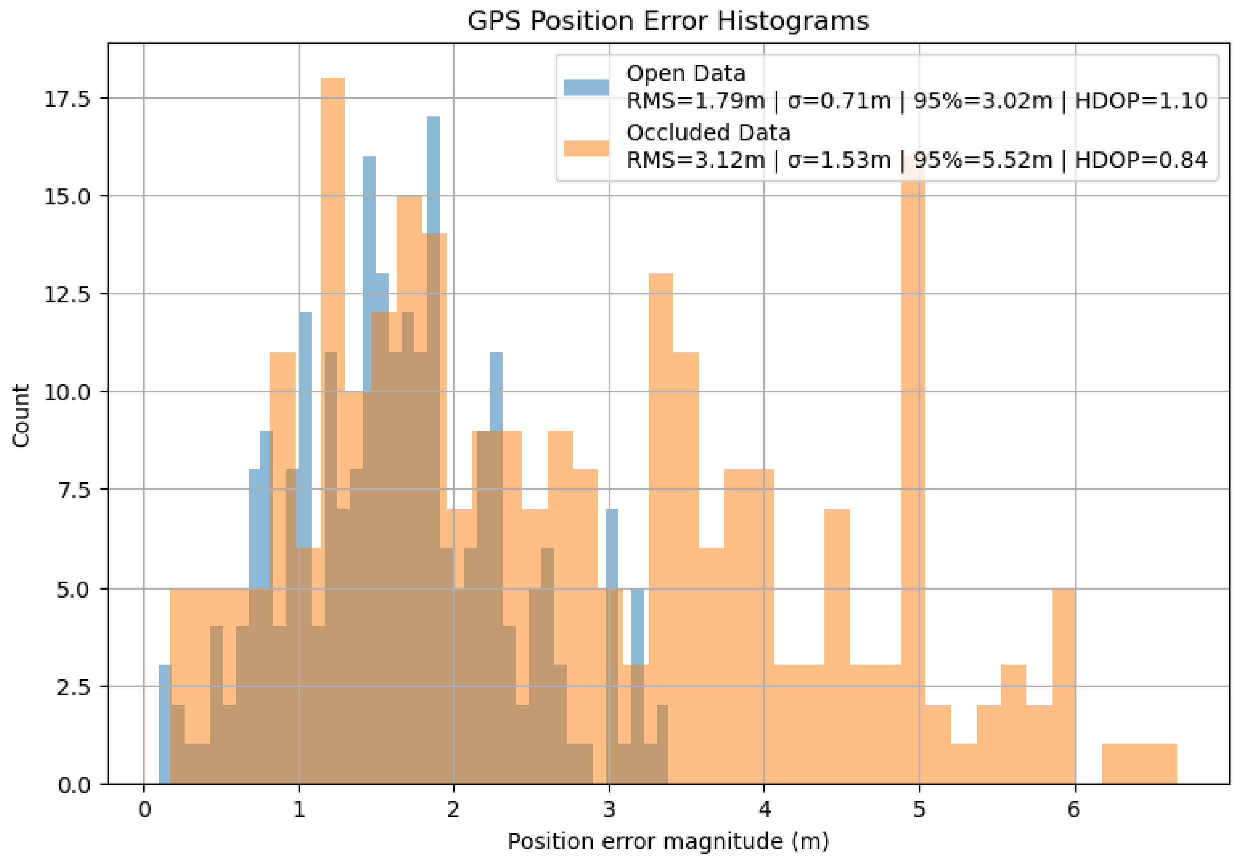
2. Make scatterplots of the Northing vs. Easting data (subtract 1st value to scale) with your stationary data sets. (next page)

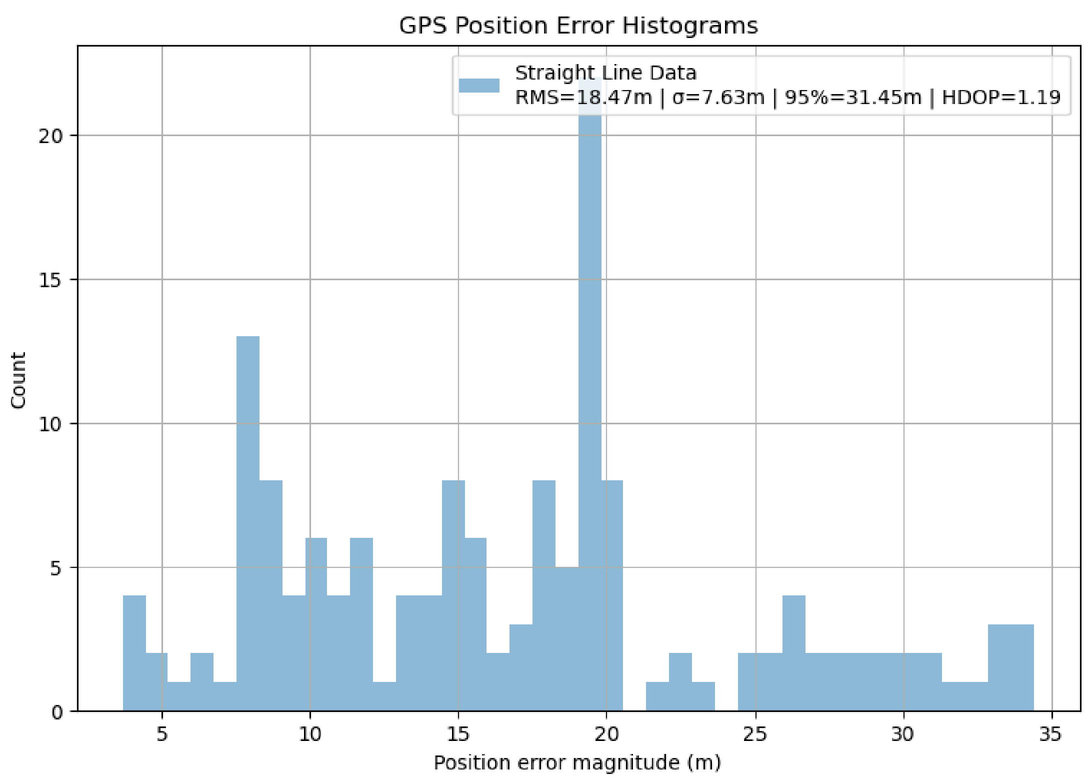






3. Make histograms of your error from your known position to your measured position.


GPS Position Error Histograms
Open Data
RMS=1.79m | σ=0.71m | 95%=3.02m | HDOP=1.10
Occluded Data
RMS=3.12m | σ=1.53m | 95%=5.52m | HDOP=0.84
Count
Position error magnitude (m)


GPS Position Error Histograms
Straight Line Data
RMS=18.47m | σ=7.63m | 95%=31.45m | HDOP=1.19
Count
Position error magnitude (m)

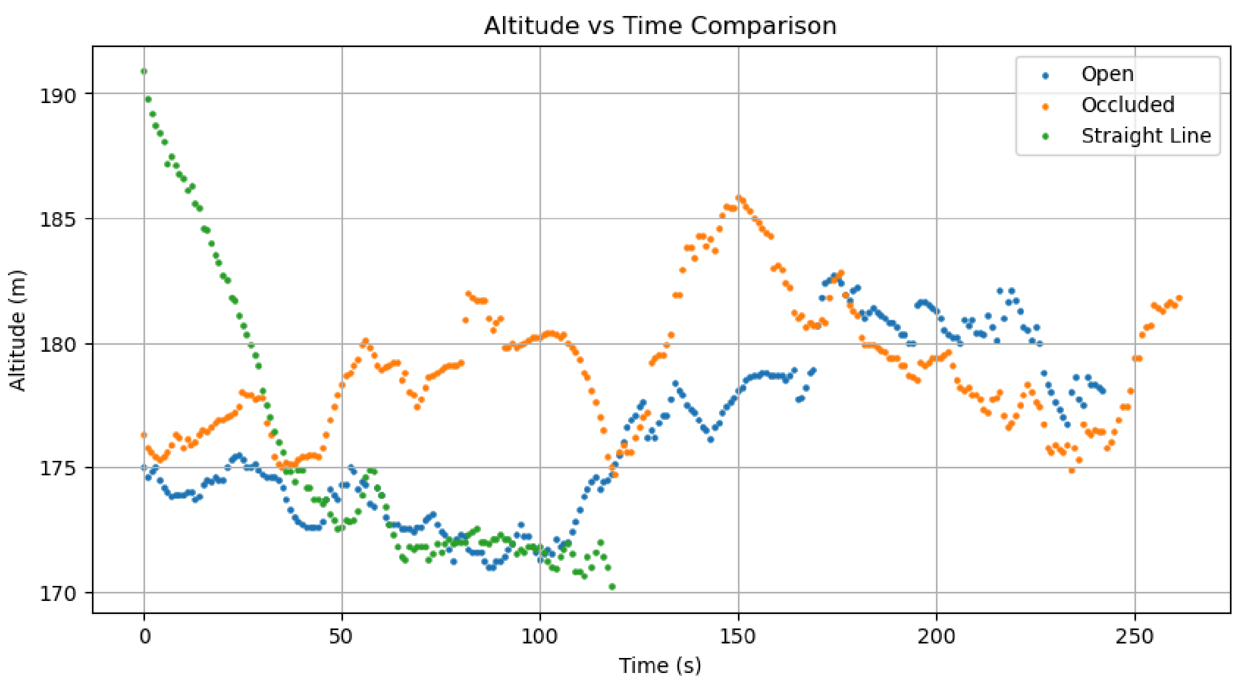
Question: What is your quantitative error estimate from your “known” position? (Remember, we discuss error in terms of position, not easting or northing. How do we get a single error value?)

For all the samples, I calculate a single horizontal position error value as the 2-D distance between the current UTM coordinate and a known stationary position, since this test was stationary I deduced that using the mean UTM position would be our known position. Then to obtain a single measurement we can calculate the root-mean-square position error across all samples. The open-sky dataset has a RMS error of 1.79 meters, while the occluded dataset has a RMS error of 3.12 meters. Showing the effect that being out in the open has on position error.

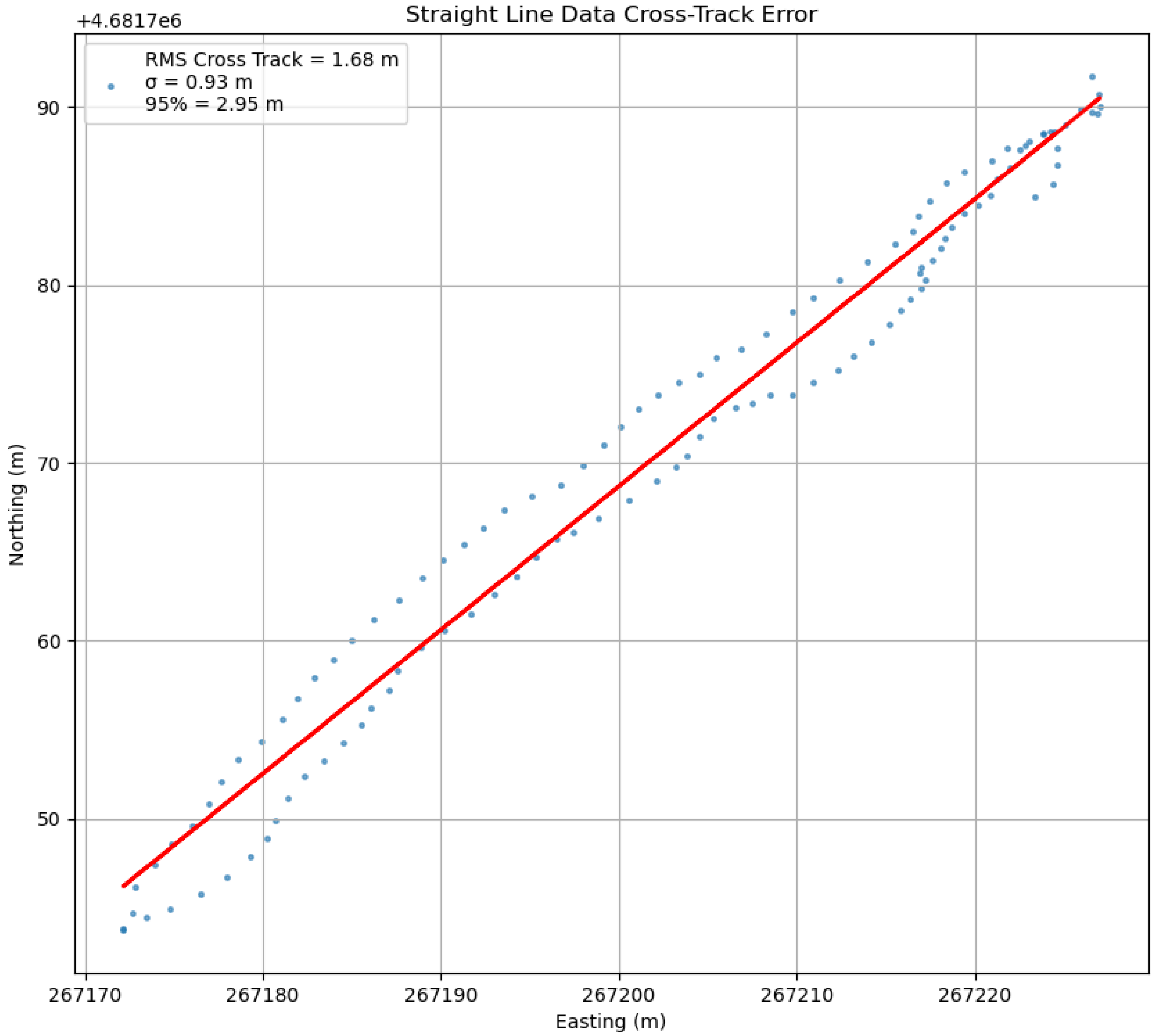
Question: Does this error value make sense given your hdop value and GPS error in general?

Yes, the error values do make sense given our results. In more open-sky conditions our RMS of 1.8 is a realistic error value for a consumer GPS. Meanwhile the occluded dataset confirms that trees/buildings can block and reflect signals causing increased noise and lower accuracy, shown through its RMS.

4. Make scatterplots of altitude vs. time.

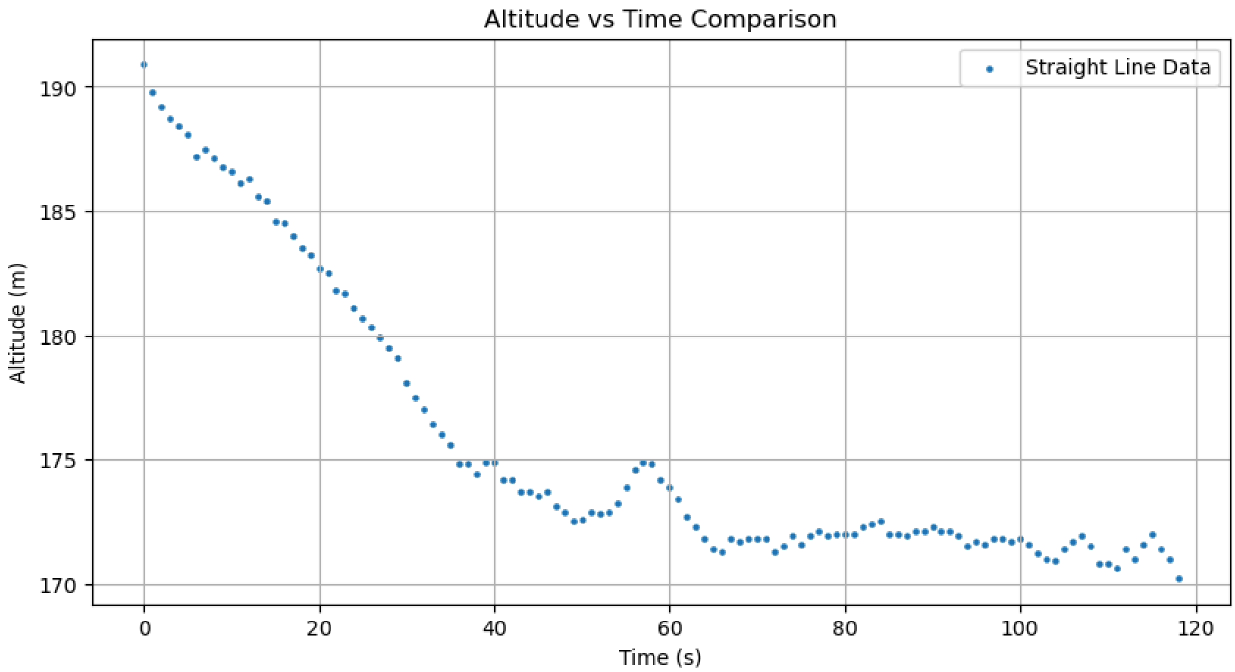


5. Make another scatterplot of northing vs. easting. What's the error from a line of best fit to your data?



To find a single error value the perpendicular distances from each measurement to the best fit line were computed. In this case the RMS cross track error was 2.95 meters. This is a very high value because when I was taking my data in Worcester there was a winter snowstorm so I could stay outside for a long time.

b)



General Questions:

a) **How do your estimated error values change for stationary vs. moving data?**

The open dataset produced the smallest position errors at a RMS of 1.79 meters. Meanwhile the occluded dataset had larger errors at a RMS of 3.12. Meanwhile the moving data had far larger error deviation from the ideal path compared to the open case with a RMS cross track error of 4.99.

b. Can you explain why this result is the case? What does this say about GPS navigation when moving for our receiver?

When stationary, measurement noise causes fluctuations around a single point which tend to average out over time leading to a smaller error value. When moving, each measurement contains its own independent noise that can't be averaged out. Instead, this noise accumulates along the trajectory, causing the estimated path to wander away from the true measurement. Hence this says that gps navigation is more accurate when stationary vs moving.

c. What are the physically likely source(s) of error in these data sets?

Sources of error can fall into a few different categories. The first is multipath reflections from buildings are other obstacles, which cause delayed signals and incorrect range estimates.

Second, poor satellite geometry, which can increase position uncertainty, and lastly atmospheric delays which can slow signals between the satellite and transmitter.