Logged GPS Data Explanation

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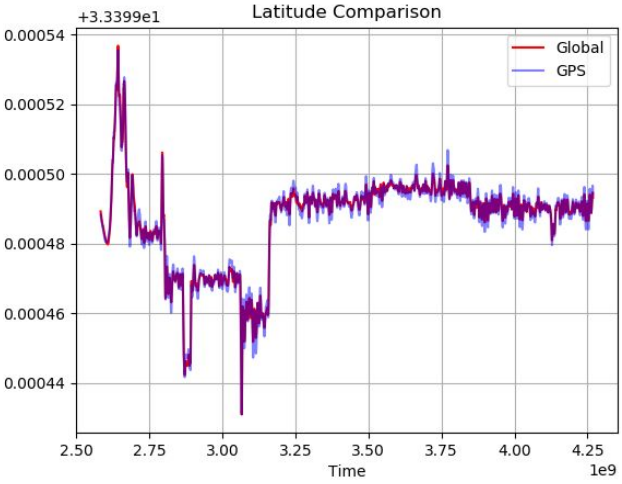
This document will describe the differences between the global, local, and gps position values that are logged in PX4. Logs are taken from the Chiropter's first test flight and converted into csv via the ulog2csv.py script from the pyulog Github repo.

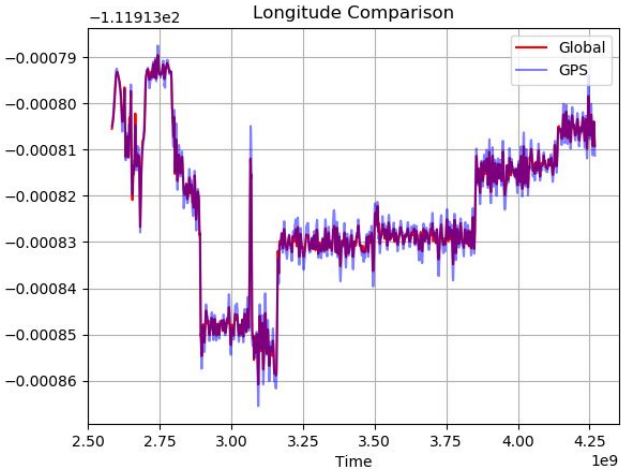
Flight log in question can be found under ECHO Drive > Flight Logs > Aug24 > log_27...
Here is the flight review for it:
https://review.px4.io/plot_app?log=583f267a-faba-4365-af3f-33033607a083

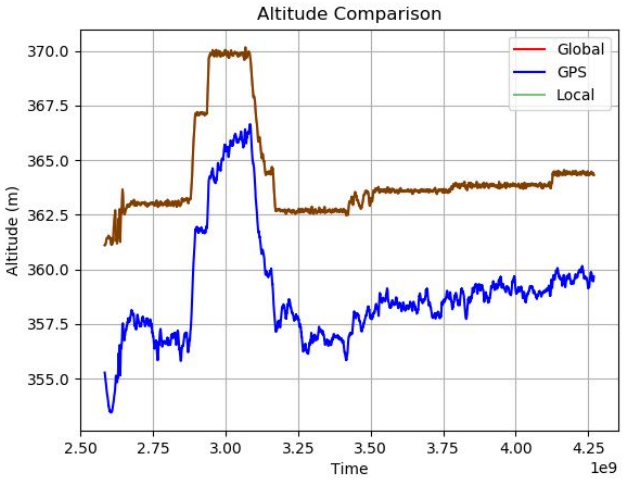
Running a log through the ulog2csv converter generates a multitude of csv files containing different sets of data.
Importantly, there are 3 different position files, referred to as Global, Local, and GPS.

Global contains *timestamp, lat, lon, alt, yaw, eph, epv*, and other irrelevant values.
Local contains *timestamp, ref_lat, ref_lon, x, y, z, yaw, ref_alt, eph, epv*, and other irrelevant values.
GPS contains *timestamp, lat, lon, alt, eph, epv*, and other irrelevant values.

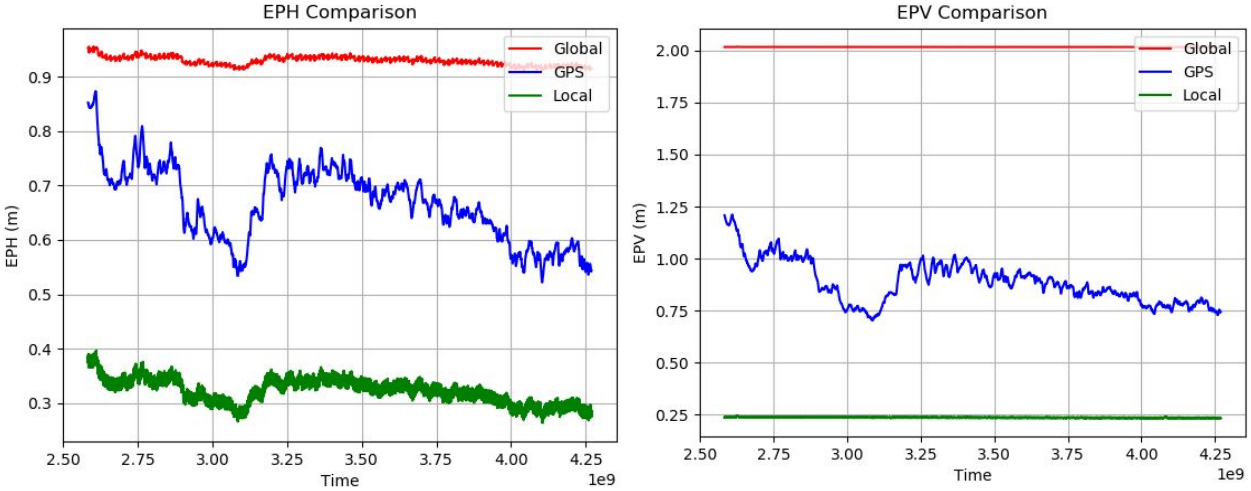
"Global" and "GPS" both provide latitude and longitude. They are similar, but "GPS" seems noisier. The "Local" file includes a reference lat/lon/alt, and x/y/z distance in meters from the reference point. I couldn't figure out how to convert this to an absolute lat/lon, but I was able to get an absolute altitude by taking ref_alt and subtracting z.





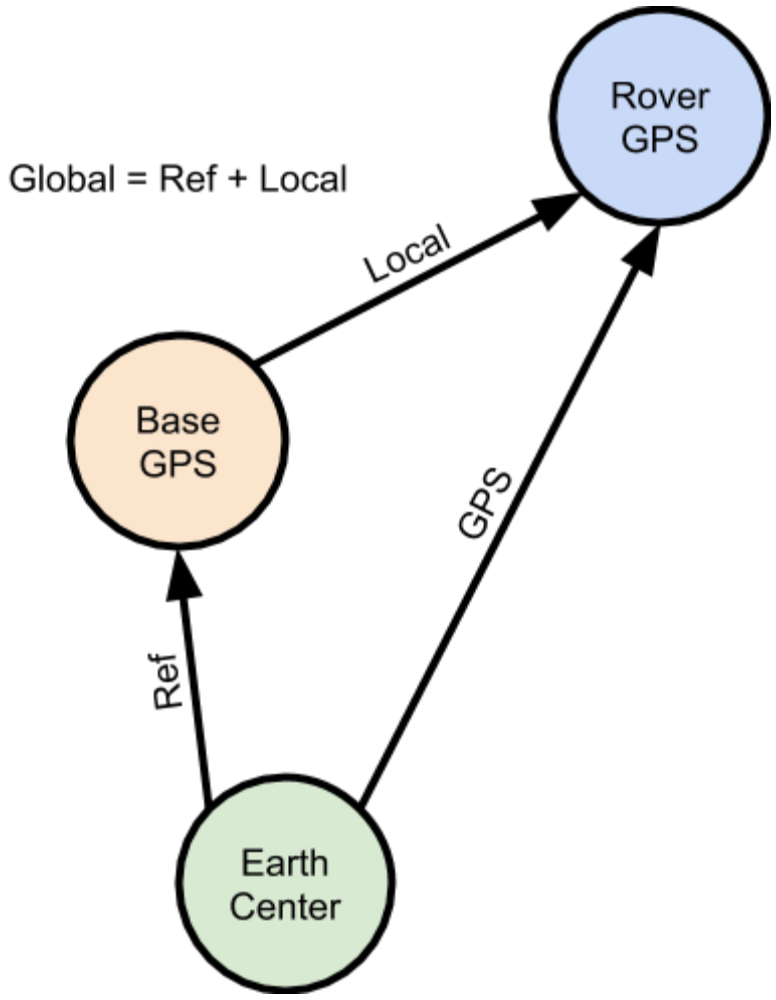


On the altitude plot, the Global and Local data are exactly the same! This suggests Global is probably Local XYZ transformed into latitude and longitude using the measured position of the reference base station. The GPS data is slightly lower than the Global/Local data, but follows the same trend and still has more variance.



EPH and EPV stand for the “standard deviation of the position error”, with H corresponding to horizontal, and V to vertical. This shows that the lowest error is on the Local data, followed by the GPS and then the Global. Once again, the GPS error varies more than the other two. It does correspond to the RTK accuracy values we saw on QGroundControl before flight, however. We may want to recheck this next test flight.

Summary:
GPS is the raw Rover GPS data in relation to the center of the earth. The Local data uses the Base GPS as the reference point, and x/y/z are the distance in meters from that reference point (via the RTK process). The Global data is just the absolute coordinates of the reference point + Local distance.



The “Global” measurement is the sum of the reference and local position vectors. In this case the error on the global position is the covariant error. This is somewhat difficult to predict for latitude and longitude considering they might have non-linear geometric corrections, but height seems to be a simple sum. Here the error might be reasonably expected to be the sum of squares. sigma(ref)^2 + sigma(local)^2 = sigma(Global)^2