Exploring GNSS accuracy and precision

Modern GNSS hardware can obtain very accurate and precise positioning, so much so it is commonly used in surveying. Survey-grade GNSS is not the same as what is available in your phone, fitness or hiking GNSS device. This activity will demonstrate how much your consumer device can vary in the "real world". Your task is to take the most accurate measurement you can using whatever device(s) you have available on top of a nearby and accessible known surveyed point.

Resources:

- Trimble GPS Planning https://www.gnssplanning.com/
- WAAS status: http://www.nstb.tc.faa.gov/RT_NPACoverage.htm
- Ionosphere TEC: http://www.trimbleionoinfo.com/Images.svc/TEC
- Geodesy:
    - ITRF, WGS84 and NAD83 https://www.e-education.psu.edu/geog862/node/1804
    - CSRS https://www.nrcan.gc.ca/maps-tools-and-publications/tools/geodetic-reference-systems/canadian-spatial-reference-system-csrs/9052
    - Want CSRS in your ArcGIS Pro? https://github.com/shawnmflemingc/faq/blob/main/canadacsrs.md

Have access to a Survey-grade or RTK GNSS? You're welcome to use any device for this activity, the more accurate the better!

Step 1: Select a nearby Passive Control Station or Known Survey Point

You have choice in what you use for this portion of the project. You can find a passive control station and use that, or any known survey-grade position point. Whatever is easiest and closest for you. No points nearby? Talk with the professor to agree on an alternative location to use.

Passive Control Network database

There are a variety of passive control stations across Canada where a known position is provided.

https://webapp.geod.nrcan.gc.ca/geod/data-donnees/passive-passif.php?locale=en

Select (in order of preference) a point nearby and go find it! The CRS mapping website will provide coordinates to navigate to and a description of the marker (coordinates are in various reference frames and datums—be sure you select or convert to the best one for your device). Current GNSS (GPS) devices use WGS84 (G1762) (source https://www.e-education.psu.edu/geog862/node/1804).

Known Surveyed Point

Another option if no passive control is close by is to use any known documented survey point. Often these are derived during a survey using one of the passive control points already mentioned, so these derived ones might not be as accurate nor are updated the same way. ** Be sure to include WHEN, HOW and using WHAT TECHNIQUE the known point was last observed, as everything is moving! These known points might be as close as your own home's property boundary's "Standard Iron Bar"! If you have a surveyed plan for your or a nearby property, then look if any corners are marked with information and if the real-world coordinates can be calculated. If so, you have a point you can now use to test and don't even need to leave home!

Step 2: Plan your point collection

Consider how you will eliminate or reduce any of these errors introduced into your observations:

1. Atmospheric
2. Satellite geometry
3. Multi-path
4. Intended
5. Receiver Timing

Using the techniques discussed in the GNSS lecture, plan when best to go to (or return to) your known point and collect a new measurement using your own GNSS. Use the GNSS planning guide to avoid bad PDOPs, try and go when the TEC won't be bad, and avoid bad weather (because it's unpleasant!) and write down how you will best avoid and minimize the 5 error types.

Step 3: Collect a series or average number of points.

Observe the actual location and determine if you need to adjust your error budget. Make any notes about the location that might affect your error. Next take a photo of how you found your known point, monument, or SIB.

Now given your knowledge, ESTIMATE how accurate you think you can get given your hardware and conditions that will be present when collecting. This can be a range, but ideally should be as exact as you can be possible given the equipment and situation.

The goal is to as accurately collect a (series of) points using your device by placing it on the location with a clear view of the sky. Using the techniques discussed in lecture about collections, perform one or more observations to average them together. Spent at least 15 minutes collecting multiple observations of the same known point. Use either a photo of your device screen or screen captures of it showing at least some of the observation process and to include in the final map creation.

Step 4: Compare and Share!

Using any GIS mapping software, you wish (ideally something that can be shared online), spend about an hour or two to showcase your known point and how it compares to the observation points you took. Include your photos of the point, collection process and provide some baseline information about the collection environment like what was found on the GNSS, if PDOP could be obtained on your device, and any other meta information about your observations recorded in your survey book or log.

Hand in: A URL or PDF containing the following:

1. A professional quality map clearly showing the known and collected location(s). If it was possible to collect data in multiple ways include all types, including a 'stream' of data over the 15+ minutes during the collection.
2. Using map annotation or another appropriate method, include the meta information about the collection. Items like observed PDOP, conditions or sources of error.
3. Include at least a paragraph for each of the types of error describing how you minimized or eliminated them from your collection plan.
4. Your photos taken during the collection of your screen, the known point and anything else of interest.