AH2923 VT2022
Assignment 8

Post Processing of Geodetic GNSS Observations

In this assignment you will post process and analyze the data collected during assignment 5 as well as two additional static baselines. The coordinates must be determined in SWEREF 99 18 00. We use the Trimble Business Center (TBC) software to process the GNSS observations. Find the program under All Programs –>Trimble Office –>Trimble Business Center.

There are two tasks in this assignment:

- Create a terrain model and draw a map based on the RTK measurements.
- Compare the processing of short and long GNSS baselines.

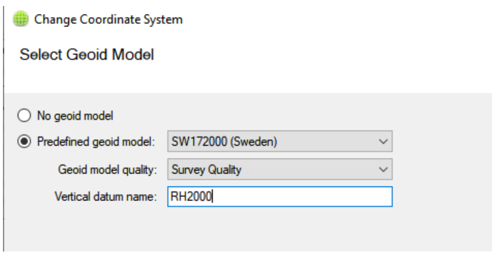
To get familiar with the software, see the following tutorials:

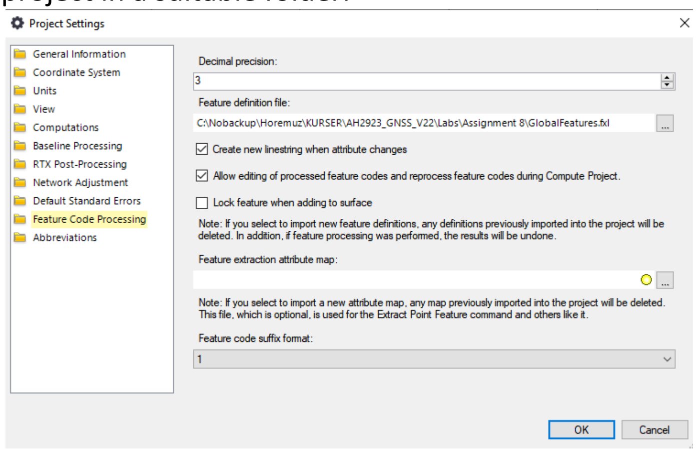
- Setting Up a New Project
- Importing GNSS Data
- Processing GNSS Baselines
- Processing Feature Codes

Task 1: Post processing of RTK-data

First you process and analyze the RTK-data collected in Assignment 5. Here are the main processing steps:

1. **Create a new project** using the Metric template. Click on *Project Setting* ( ) located on the top bar of the window –> *Change Coordinate System* select coordinate system SWEREF 99, zone 18 00, geoid model SW172000. Additionally, in the same window, -> *Feature Code Processing*, browse file *GlobalFeatures.fxl*, which is available in Canvas. Save the project in a suitable folder.





2. **Import data**. In *Home* tab click on *Import*. The files are available in Canvas and must be downloaded to the PC first. Navigate to the data folder and choose data for your group. Import file containing raw data (code + phase observations) from the reference receiver and from KTH Swepos station: 20931032.t02 and 0KTH1030.22o (2022-04-13) or 20931151.t02

and 0KTH1150.22o (2022-04-25) depending what date you measured. Import also your *.job file, which contains coordinates from the RTK survey. If you get a message about the project coordinate system, choose "*Keep existing project definition*" option. This means that if you defined some other system in the field, the coordinates will be transformed into SWEREF 99 18 00. After the import you can see all the points measured in the field including vectors to the reference station. To get a better overview of your points,you can turn off the visibility of the lines. Do so using *View Filter Manager* in *Home* tab and check off boxes *Baseline*, *PP Vector* and *RTK Vector*.

3. **Process the baseline between KTH_0 Swepos station and our reference receiver**. Since we set up our reference receiver freely, we must now determine its coordinates in SWEREF99. First, mark the coordinate quality of the point KTH as Control quality. In Project Explorer expand point KTH_0, click on Global, choose properties and click on the ? by the coordinates. KTH is now marked with a triangle in the Plan View. In the same way mark the coordinates for reference station as unknown quality. Process the baseline by clicking *Survey->Process baselines,* save the processing results.
4. **Process feature codes.** Use *Survey -> Process feature codes* to draw the lines and set the object symbols. If you see that some lines/symbols are missing, check and change the point codes. You can do it in Properties window (right click on the point in *Plan View -> Properties*) or in Point Spreadsheet (*Home->Points*). After you change the codes, update the view by F4 (Compute Project). Visualize the results in Google Earth choosing *Home -> View -> Google Earth*. You can select the objects to be exported to Google Earth by *Home -> Select by layer* (in *Selection* partition).
5. **Create digital terrain model**. Select all your measured points using the Project Explorer window (*Home* tab, *Data* partition), and choose *Surfaces -> Create Surface*. The software has now generated a TIN (Triangulated Irregular Network). Next step is to use the TIN to generate contour lines: select *Surfaces -> Quick Contours*, choose 0.5 m interval in *Contour interval* and You can also visualize the surface in 3D by selecting *3D View* in *Home* tab and then rotate the view by *View -> 3D View Settings*.

Task 2: Comparison of processing of short and long GNSS baselines

1. Create a new project as above. Do not forget to set proper coordinate system. Import the ephemerids file and data from the SWEPOS station KTH_0 and from the station called MOSE (for Mosebacka). The data from these stations is available in Canvas. Then mark the coordinate quality of the point MOSE_0 as Control quality as following. In *Project Explorer* expand point MOSE0, click right on Global and choose properties and click on the ***?*** by the coordinates. MOSE is now marked with a triangle in the PlanView.
2. Download and import precise ephemeris. Since we are going to process even long baseline (>100 km), it is necessary to use precise ephemeris. They can be used even for short baselines, but the results will be almost the same as with the broadcast ephemeris. In *Survey* tab click on Internet download, select IGS Rapid Orbits (final ones might not be available yet) and click on *Automatic* and then select time span *Project time span*. Three *.sp3 files will be then downloaded; click on Import to add these files to the project. *Project Settings* ( ) -> *Baseline Processing -> General -> Ephemeris type: Precise*.

3. Process the baseline from MOSE to KTH: Start the baseline processing from the *Project Explorer* window by right clicking on the session and choosing *Process Baselines*. In this way you process only the selected baseline. Generate a processing report by selecting the base line and then clicking on report in the right pane of the window. Evaluate the results.
4. Next, import data from the IGS station in Kiruna (KIRU). See description on the next page on how to find data from the IGS stations. When importing into TBC, ignore the warning about unknown receiver type.
5. Set the KIRU coordinates to Control quality before processing, indicating that this is the reference station. Process the baseline KIRU – KTH_0 similar to the previous step. Generate a processing report and evaluate the quality of the solution.
6. The known coordinates for the KTH point are available in the header of the RINEX file (as the approximate coordinates) from the SWEPOS data. Cartographic coordinates are given below.
7. Now compare the coordinates obtained for point KTH_0 computed with the MOSE and the KIRU reference stations with the KTH known coordinates and discuss the differences.

Write a report, which should include:

- Description of the surveying procedure, and description of the processing procedure
- Screen dump from Google Earth showing your detail measurements
- Screen dump from Trimble Business Center showing the terrain model in 3D view
- Description of the static processing of baselines MOSE-KTH and KIRU–KTH, coordinates from the processing, and a comparison of the coordinates and discussion of the results; which baseline yields more reliable results and why?

SWEREF99 18 00 coordinates (E,N,H)

KTH_.0	153946.679	6581651.252	52.216

Retrieving GNSS observations from IGS permanent GNSS stations

Generally, there are two sources of data from permanent GNSS stations: National geodetic networks and the International GNSS service (IGS). In Sweden there is a network of permanentGNSS stations called SWEPOS operated by Lantmäteriet, and data are available for subscribers only, i.e. this is a paid service. The KTH and MOSE-stations used above are SWEPOS stations.

The data from IGS permanent stations are available free of charge for teaching and research. A clickable map with all the IGS stations is available here: http://igs.org/network

Data can be obtained through different data centers, for example from the German Federal Agency for Cartography and Geodesy: https://igs.bkg.bund.de/root_ftp/IGS/obs/

Pick RINEX Type: Observation.

You need to download only the *KIRU00SWE_R_2022XXX0000_01D_30S_MO.crx.gz* file in which XXX shows the day of year for Lab 5. Use the GPS calendar to find the GPS week (Make sure that you look on the right year): http://www.ngs.noaa.gov/CORS/Gpscal.shtml