## **GPS PROCESSING**

The NGS Airport Survey Program is currently developing specific guidance for projects to be processed with OPUS Projects.

The RINEX files for the PACS & SACS are to be uploaded to OPUS using the project keyword and processed together resulting in one Bfile and one Gfile.

A Precise Ephemeris must be used in processing. This should be available 12 to 14 days after the last GPS Observation. When an OPUS solution returns, the ephemeris used will be shown in the header information. Verify the EPHEMERIS used is "[precise]"

- Two 4-hour simultaneous observation sessions on the PACS, HARN, and bench marks involved in the survey with a 30-60 minutes break between sessions is required. Observations must be simultaneous with the PACS.
- Two 2-hour observations on the SACS with a 30-60 minutes break between sessions is required. Observations must be simultaneous with the PACS.
- The operator must reset the tripod (take down set up) between the sessions and document same.
- Start times on subsequent days must be at least 2.5 hours different than the previous start times to incorporate a different satellite geometry.

• If the OPUS-S report is "bad" (low % obs or low % fixed or high overall RMS or any uncertainties > 4 cm) **reoccupy - no exceptions**. OPUS-Projects can, on occasion, "recover" data that OPUS-S could not process as successfully as we might like, but if OPUS-S struggles, chances are significantly higher that OPUS-Projects will too. OPUS-S is your first Quality Control stage: use it.

• Review the video: <u>https://www.youtube.com/watch?v=KLCDQ8yafY0</u> to Minimize Errors during GNSS Data Collection.

- Remember that OPUS-S will not allow less than 2 hrs of usable data.
- NGS recommends collecting and processing GPS data at a 10° elevation mask.
- Set OPUS-Projects TROPO INTERVAL to 7200 s for processing.

Once the project is created, edit the project preferences to the following:

Tropo Model: Piecewise Linear

Tropo Interval: 7200

Constraint Weights: Normal

Network Design: User

Prior to uploading to OPUS, edit (or verify) the Rinex file to follow the standard format of:

AAAADDDS.xxo where AAAA is the unique 4-character ID, DDD is the Julian Day (Day of Year), S is the session (letter or number is fine), and xx is the last two digits of the year of the observation. Ensure the correct information is shown in the RINEX header prior to uploading to OPUS.

As stations are uploaded to OPUS and the Project identifier is specified, the solutions will begin to appear in the OPUS Projects Manager Page. For each solution, verify the ARP heights, Antenna and Receiver information (Name and Serial Numbers), and 4-character IDs are correct.

Investigate any solutions that do not meet the OPUS Projects Quality Thresholds. Obstructed stations are not recommended, but if unavoidable, NGS advises extended observation times/multiple observations. The user's ability to manipulate processing settings are limited in OPUS Projects when compared to PAGE-NT.

Prior to session processing, verify that each CORS automatically selected by OPUS has data for every session in the project. If not, those CORS will need to be manually deselected by the user for each processing session.

In addition, lookup each CORS from the NGS CORS Page and verify that it has either formal Network Accuracy Values (sigmas) or has short term time series sigmas available. For CORS with short term time series sigmas, these are given as  $\pm$  standard deviation values in parentheses on the plots. A screen capture of the time series should be provided in the project report or in a directory aptly named. Exclude any CORS without either one of these values.

Once a CORS is added to OPUS Projects, the user does not have the option of deleting CORS from the CORS List at this time. Users will have to manually deselect CORS they wish to exclude from each processing session.

All processing sessions must include a distant CORS for tropo correction (about 1000 KM away). The same distant CORS should be used for all sessions. It helps to verify that data is available for the distant CORS from the NGS CORS Page prior to adding it to OPUS Projects.

Use a local CORS as a central Hub in each session (do not use the PACS as a Hubsite). Use the same Hub for all sessions.

After processing each session, verify that the Data Quality Thresholds are met. Investigate any solutions out of tolerance.

In addition to the required deliverables in Section 10 of the AC-16A, provide all OPUS-Projects output files in well-organized folders.

**OPUS Solutions** 

**OPUS Projects Session Processing output** 

123A

123B

124A...

**OPUS Projects Network Adjustment** 

Submitters must provide the OPUS Projects "Project ID" and the Manager's email address. The Manager's Keyword is also a requested deliverable.

Use the output Bfile, Gfile, and Serfil to create the Constrained Adjustment input files.

Only one set of adjustments are needed for PACS & SACS when using OPUS-Projects. The resulting Bfile and Gfile from OPUS Projects must be used as initial input files for the Constrained Adjustments.

The Gfile may require edits to the C Record, cc 59 and 69. To assign the appropriate Receiver Manufacturer Code, use the table in Annex N, pg. N-7 of the FGCS bluebook. Use **extreme caution** when editing the Gfile. Extra characters/deleted characters/mis-alignment can cause Adjust to not read the file properly.

It is very useful to complete all Dfile records for all stations (including CORS) in Windesc. For published control, you can select File > Import > From Internet > By List of PIDs > PUB to import all published control and CORS. Create descriptions for all new stations as well. Use the Serfil to match SSNs to each station.

The Afiles used in the Constrained Adjustments can be created by Windesc as well. To export these files, use File > Export >GPS Project Files. Follow the prompts to get all positions, ellipsoid heights, and network accuracies from the NGS IDB.

AfileHF - Follow the prompts to make the appropriate selections for control. Use the CORS selected as the Hub in processing as the constraint in the Horizontal Free Afile.

AfileHC - Constrain all CORS (except the distant CORS) and the HARN in the Horizontal Constrained Adjustment. (Note: when performing the Horizontal Free Adjustment, some non-CORS and non-HARN stations with published NAD83(2011) Lat/Lon, Ellipsoid Height, and Network Accuracies may be constrained if fitting well in the adjustment. Refer to the Constrained Adjustment Guidelines for specifics regarding each adjustment.

AfileVF – Constrain the orthometric height of only one NAVD88 1<sup>st</sup> or 2<sup>nd</sup> Order bench mark. Constrain the Lat/Lon of the Hub CORS.

AfileVC – Constrain the orthometric height for all NAVD88 1<sup>st</sup> or 2<sup>nd</sup> Order bench marks. Constrain any applicable Height Mod stations. Constrain the Lat/Lon of the Hub CORS.

Inspect each Afile to verify the correct SSNs, Positions, Ellipsoid Heights, orthometric Heights, and Network Accuracy Standard Deviations (sigmas) (Horizontal Afiles only) were written properly. For CORS with no formal network accuracies, the short term time series sigmas must be hand entered (take care to not misalign any columns)

The Bfile.86 file Windesc will create can be used to add the \*25\*, \*26\*, \*27\*, \*70\*, and \*72\* records from the OPUS Projects output Bfile. Use **extreme caution** when editing the Bfile. Extra characters/deleted characters/mis-alignment can cause Adjust to not read the file properly.

Move the Afiles, Bfile.86, Serfil, and Gfile to an ADJUST folder. Keep all input and output Adjust files in this folder. Do not rename or duplicate any of these files. Verify all edits to these file prior to performing the Constrained Adjustments.

Prior to performing the constrained adjustments, it is recommended to compare the Gfile vectors using the Adjust Utility "COMPVECS." This will compare redundant baselines and provide useful information on the repeatability of the vectors.