Using RTN Data in OPUS Projects 5 for GPSonBM

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Question and Answer document

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Q: Will you explain the difference between MAX and iMAX?
A: Both the MAX and iMAX methods are used by Leica-based RTNs. Both provide full network corrections. Here is a link to Leica's website explaining the differences and their recommendations.

Q: Does this have anything to do with the random points created in my file "RTCM-Ref 1386"? the number changes.
A: There are different broadcast message formats within the Radio Technical Commission for Maritime Services (RTCM) standards, some of which restrict point names to certain standards. This appears to be one of those scenarios.

Q: If the server setup for my RTK, in my GNSS unit has several RTCM3, IMAX, MSM Near options for the MountPoint, how do I choose?
A: While we would love to give recommendations, this question truly would be best posed to your network provider. If you are unsure who that is, please reach out to your Regional Geodetic Advisor who will probably be able to help you determine that.

Q: What is a least squares adjustment?
A: Explaining the concept of a least squares adjustment of geodetic survey data is not a quick task. Please consult any existing resources you may have (textbooks, library resources, internet searches) to answer general questions such as this.

Q: When is M-PAGES available?
A: *Remember* that by using GVX file formats with your multi-constellation RTN/RTK observations, you can benefit from those other non-GPS constellations *right now* using OPUS-Projects 5. On M-PAGES, which is what OPUS-S will soon use for static baseline processing, we are hoping that in the next couple of months we will be announcing its move from our internal alpha testing to beta testing phase (note that beta tools are publicly available on our parallel beta website).

Q: What are the recommendations for areas where most of the NGS IDB marks are destroyed? I want to help with NGS on BM but there's not much out there around here.
A: On the GPSonBM Web map, click the Layer List icon at the bottom of the page, then zoom in on your map until the "Secondary Marks" layer can be selected (scroll down in the layer list to find it), then check the box to turn it on. This Secondary Marks layer contains ***all*** of the marks in each hexagon that will meet the GPSonBM requirements.

Q: What is the link that JJ provided on Slide ~7?
A: That is the NGS GVX File Format homepage, with information and samples.

Q: In the near future, will GVX have versions and support other GNSS constellations like RINEX?
A: Remember that GVX is the GNSS ***Vector*** eXchange format, thus there is no satellite constellation data in your GVX like there is in RINEX format. You can use whatever constellation(s) your GPS/GNSS receivers support to create the vectors in your GVX files. Vectors in GVX files can be based on all types of GNSS constellations, and such GVX files can be uploaded into OPUS-Projects 5.

Q: Are you saying one 24 hour file for each day that an observation occurred? and one file if all observations are on the same day?
A: Yes, we recommend downloading from the *non*-NCN stations the 24 hour file for the day(s) of the real-time survey. In addition, we recommend downloading at least 3 total days of data for a given project for uploading to OPUS Projects. If all real-time observations are on the same day, then download 24 hour files from the *non*-NCN stations for: the day before, the day of, and the day after observations to make up the 3 days.

Q: What if my network only offers RINEX files for CORS sites? Can that be uploaded, or does it need to be GVX format?
A: Remember that the RINEX file format contains *observations* from *non*-NCN CORS in the network you use, and RINEX are uploaded to OPUS Static to tie those *non*-NCN CORS to the NCN CORS in OPUS-Projects. The GVX file format contains *positions and vectors* from receivers/rovers **you use in the field**, is created by you in your office or field software, and ties your RTN rover points to the *non*-NCN CORS.

Q: On post-processing when using the GVX, are precise ephemeris applied?
A: GVX files contain *processed vectors and positions*. No additional post-processing of them is required inside of OPUS-Projects. The vectors in the GVX file will be based on whatever ephemeris was used to generate them, which most commonly will be the

broadcast ephemeris of your RTN/RTK survey. The broadcast ephemeris is sufficiently accurate when your rover vectors are less than 40 km in length. If you post-process data in commercial software and then export to GVX, the vectors will be based on whatever ephemeris was used in the commercial software during processing.

Q: Why do some non-NCN CORSs have a datasheet/PID in the first place? Does this mean that they will eventually be incorporated into the NCN in the future?
A: Some network owners/managers have submitted surveys to NGS to position some or all of their *non*-NCN CORS **relative to NCN CORS**. Once submitted to NGS and checked for compliance, they are issued a PID (which generates a Datasheet). ***No***, this does *not* mean that NGS or the network owner/manager intends to incorporate such *non*-NCN stations into the NCN in the future.

Q: How does the 3 hour separation compare/differ with the previously recommended 6 hour separation on collection on same point?
A: Note that the 3 hours minimum separation for RTN observations is what was discussed in the webinar. Previous discussions, *especially if regarding static observations*, are not applicable.

Q: What is the maximum size of the project area? What is the observation window for all data uploaded into a single project?
A: There is no maximum geographic size in OPUS-Projects, it's more practicality that plays a factor, along with your situation (tectonic motion, etc). We do recommend keeping the time between first observations and last observations to a maximum of about 30 days.

Q: Do all non-NCN base stations occupations require the same metadata as if it were a user mark (ie. Complete Serial Numbers for Receiver/Antenna) to Submit to NGS for Publication?
A: Yes. Remember that you will need to retrieve *observation* data, in the form of RINEX, for those *non*-NCN CORS. In most of the networks we have retrieved data from, the required metadata has been automatically populated to the RINEX file when downloaded from the network provider's website.

Q: This WinDesc workflow looks very preparatory. Are planning to develop in Open format like XML towards Open Standards?
A: We have been investigating ways to move away from the WinDesc formats and processes, and with the forthcoming modernization of the NSRS we will continue to do so, but as of now we must abide by the standards set forth in the FGCS Blue Book.

NGS is also developing web tools to streamline creating WinDesc files, and these tools will be presented at a later date.

Q: How many epoch is required?
A: If you intend to submit your project to NGS for publication, then for RTN positions we are requiring 5 minute occupations at the 1-second epoch/logging rate, which results in a total of 300 observations. Otherwise, GVX and OPUS-Projects 5 supports vectors at any duration and/or from any epoch rate.

Q: Is there any Validation on TOPCON GVX exports working in most current v7.3.0 (Tools) and v7.3.1 (Field). Last attempts in these Versions did "not" Export a valid GVX File that OPUS Projects v5.1 would read. Topcon Support Case was closed in late Nov. 2022 that issue resolved, yet to date (today) there is not been an update and remains pending till next updates. Like to confirm if any different known status.
A: No one on our team is aware of the current (as of January 2023) status of the GVX exports from Topcon MAGNET. Please follow up with anyone at NGS and Topcon that you originally communicated with, and we will do our best to assist our commercial partners (software developers) and our constituents (you).

Q:He said the tolerance between the 3 shots too fast. 3 cm horizontal and 5 cm vertical?
A: Correct, the 3 positions must all agree within 3 cm horizontal and 5 cm vertical (ellipsoid height). Consult our Requirements for Using OPUS-Projects 5 in the 2023 GPSonBM Campaign page for details such as those

Q: Do you need a log sheet and photos for each of the 3 observations on a mark?
A: For projects that you intend to submit to NGS for publication, you need a log sheet for each observation. You only need to submit one set of photos for each mark, but best practices would be to have your field personnel take photos of each occupation for QA/QC.

Q: Is it useful to collect observations on multiple eligible BMs within a 2km hexagon, or is data on one BM just as good?
A: One is adequate, but more is always better. Please reach out to your Regional Geodetic Advisor to discuss specifics of your area, they would be glad to assist you.

Q: What is the URL for taking/registering for the instructor-led OPUS training?

A: Navigate to the NGS homepage, hover over the Science & Education dropdown menu, then click Conferences/Training, finally click Upcoming Classes on the left, where you can register for our instructor-led classes both in-person and online.

Q: Is there a plan to migrate WinDesc functionality into OPUS projects?
A: Preliminary internal (aka 'alpha') testing is underway for a new function in OPUS Projects called "Start a Description File" which will streamline creating WinDesc files online that can then be uploaded to a project.

Q: Are there any options for those using a data collection software that does not currently support the export of a GVX file (Carlson) or are we limited to static observations for GPSonBM?
A: If your office or field software does not currently export GVX files, then you are limited to static observations for GPSonBM, via OPUS Share or OPUS-Projects. We encourage you to contact your vendor and request that they support exporting GVX files.

Q: In TBC view filter manager where did you elect to show the cor stations?
A: As Jeff explained in his demonstration, he downloaded the CORS Site List as KMZ (under the **NCN Lists** tab) from the NCN Data and Products page, then used Trimble Business Center tools to convert the KMZ to a "Points" layer in the project. ***Whichever software you work with***, he recommends doing this during your project planning phase to aid in identifying NCN CORS versus *non*-NCN CORS in your area.

Q: Will the NGS be willing to supplement local control points instead of marks requested at some point?
A: In order to be useful for creating the new transformation tools, the marks that you observe ***must* be marks that are in the NGS IDB** (Integrated DataBase), meaning they have a Datasheet.

Q: Would this be an example
Observation one 9:00am
Observation two 12:01 pm
Observation three 3:02 pm
A: Yes! If all three of the positional results agree within 3 cm horizontal and 5 cm vertical (ellipsoid height) then the field work would be complete for this mark.

Q: Could you utilize base-rover data instead of RTN data if you're utilizing the "NON-NCN" workflow and processing your base data in OPUS Projects?

A: Technically yes, this is possible, but that is *not the target workflow* of this GPSonBM webinar. Most importantly, we have ***not yet developed*** field requirements for that workflow so it **cannot** currently (as of January 2023) be submitted via OPUS Projects. However, this workflow will be supported eventually.

Q: why connect ground data at this this time? will this data be used to ground truth the new geoid?
A: No, this is *not* for ground truthing, or improvement, of any geoid models. This data is being used to create the future transformations tools that you will use to move your data between NAVD88 and NAPGD2022, as well as NAD 83 and NATRF2022.

Q: Is NGS still interested in static data from stations in the mountains of North Central Washington?
A: Please contact your Regional Geodetic Advisor to discuss specifics of your area, they would be glad to assist you.

Q: As a follow-up to the "are there 3rd-party" GVX convertors for my receiver & software that doesn't export GVX: What would it take, if someone is a good programmer, to create such a converter?
A: We are unaware of any 3rd party converters. You would need to be able to read/decipher the proprietary vector file from your GNSS receivers and convert that output to the GVX format. With that said, it ***may*** be that *not* all the required elements of the GVX format exist in the proprietary vector file, which would then require that the manufacturer of the receiver be involved in developing the converter. We recommend you talk to your equipment suppliers about your desire for GVX exports from the software you purchase from them. Another venue may be the customer support team for the software you use. If those contacts you make have questions about GVX, please connect them to us via your Regional Geodetic Advisor or other NGS contacts.

Q: Will the GPSonBM web map update after an OPUS Project for GPSonBM is completed and approved?
A: Yes, it will, but there may be slightly more lag time as compared to OPUS Share, due to the need to incorporate more steps into the map update workflow.

Q: Once MPages is released will we have to resubmit to OP for inclusion in the IDB?
A: No. The goal of M-PAGES is simply to add non-GPS constellations processing to OPUS.

Q: A few years ago the CORS sigmas used in the OPUS Projects adjustment were scaled up from the published values to alleviate problems with F-test and Constrain Ratio results. I noticed BETA OPUS Projects 5.1 still uses published values. Is this intentional?
A: This is a misinterpretation of what you are seeing in OPUS Projects; *neither* the current versions or the previous version use published sigmas. OPUS Projects uses the RMS of 90-days of OPUS-Net (an internal tool used by NGS) solutions for estimating the sigmas, to avoid using the optimistic values typically seen in the published sigmas.

Q:Do you have to take the OPUS Projects class taught by NGS to submit data using OPUS Projects 5.1
A: Yes, currently (January 2023). However, NGS is working very hard to create online videos and tutorials that will replace the mandatory training. ***Please note*** that we will continue to offer instructor-led training even after the online content is available.

Q: Not having a GVX converter available, I work for a DOT, how do I submit a OPUS Project using 2 hour sessions?
A: There is very little difference between submitting GVX and non-GVX projects. Detailed information can be found in the OPUS Projects User Guide and Quick Start Guide.

Q: Would you rather see 8 separate measurements on 3 separate days or would you rather see 8 separate measurements on one day.
A: Eight separate measurements spread out over three separate days would be preferred. Generally speaking, it is best to collect redundant observations under different conditions (e.g. different: days, times day, observers, equipment, etc).

Q: can some one use this technology in Africa? What is the estimate accuracy for test locations in Africa?
A: OPUS Projects can technically be used anywhere the user is able to get Solution Reports from OPUS Static, as it can tap into IGS (International GNSS Service) CORS data for processing your static data. Outside the US and Territories, we recommend the user conduct their own testing to determine if OPUS Projects meets their accuracy needs before planning to use it.

Q: Are there cut off times to consider for timing for the mark collecting. 30 days~ 45 days
A: There are no hard/definite cut off times for collecting real-time observations, other than the cutoff date of 30 September 2023 if you want your data to contribute to the

GPSonBM efforts. *However*, for best performance in and results from OPUS Projects, we do recommend keeping the time between first observations and last observations to a maximum of about 30 days.

Q: Still confused about times. I get need for three hour separation. I don't fully understand what three hour sep over different days means.
A: It means that collecting data on Monday@0800, Tuesday@0800, and Wednesday@0800, would *not* be acceptable. In other words: *even **if** data is collected on different days*, the redundant occupations must be shifted by >3 hours.

Q: I wish I knew more about who and why people use OPUS. Is it just for surveyors? I know, it's a really basic question. Thanks.
A: OPUS is for *anyone* with a compatible GPS receiver and internet access, and most users have a goal of tying their geospatial data to the National Spatial Reference System (NSRS). For more info, read through our about OPUS page, or take a look at this video from one of the OPUS Team.

Q: Can only Registered Land Surveyors participate in this work? I am not an RLS but I collect a lot of GPS points in the field.
A: *Anyone* who has taken the OPUS-Projects training can use it, and ***anyone*** with a compatible GPS receiver and internet access can participate in the GPSonBM program using OPUS Share.