

Question and Answer Log
Best Practices for Real Time GNSS Network Administration, webinar
July 31, 2013

Q: By design VRS eliminates (or reduces) PPM errors due to ref station distance. Does MAC does the same?

A: Yes, the MAC approach does reduce errors by forming short baselines and selecting the appropriate algorithm for the final reduction.

Q: **Gary**, are you making any kind of corrections to your RTN base ellipsoid heights, based on your ties to NAVD88?

A: No, NCGS does not revise the ellipsoid height of a CORS ARP when we tie a CORS ARP to NAVD 88, because the ellipsoid height and NAVD 88 height are determined independently.

NCGS is working towards tying each NC CORS to NAVD 88 and submitting the survey work to NGS for publishing. So far, 91% of the NC CORS that are a National CORS have a published NAVD 88 elevation.

- If we perform 1st or 2nd Order geodetic leveling to a CORS ARP and submit this leveling to NGS in a project, the NAVD 88 elevation for that CORS ARP would be published in the NGS Integrated Data Base (IDB) as a 1st or 2nd Order benchmark.
- Conversely, if we include a CORS ARP in a height modernization (Height Mod) survey (NGS-58) and submit this work to NGS in a project, the NAVD 88 elevation for that CORS ARP would be published in the IDB as a Height Mod elevation.

Q: I'm not sure where or how they did those tests, but those are little looser than experienced in other tests; like those performed by the Ordnance Survey of the UK and even on our local RTN.

A: The example shown was purely selected for the presentation and not meant to be representative of ORGN network performance but rather to show the relationship between precision and accuracy. Rover performance within an RTN should be tested over the entire coverage area and must be a true rover antenna setup on marks on the ground and not an active station with choke ring antenna as performance and multipath are much different.

Q: For Mark Armstrong...Is this RTN precision done with a Network/VRS approach?

A: The ORGN network is a MAC network and RTN precisions were tested at various locations including an active station not in the network for comparison with typical rover setup on a mark. The solution is a network solution (MAX or iMAX) with corrector sent to the rover from the closest network reference station.

Q: Does NGS support the publishing of Trigonometric leveling? What is the significant advantage of having a NAVD 88 Height if it is not published, i.e., that height does not get used in the creation of the hybrid geoid?

A: No, per current policy NGS accepts only GPS, leveling, and gravity surveys. Trigonometric leveling was included in our test project so that we could compare the results of the three techniques (geodetic leveling, height modernization, and trigonometric leveling) used to obtain a NAVD88 height of a CORS ARP.

http://www.ngs.noaa.gov/INFO/Policy/files/062012_Data_Submission_Policy.pdf

The advantages of a CORS ARP having a published NAVD 88 elevation in the NGS IDB along with a published ellipsoid elevation are:

- Can be used in a Height Mod survey (NGS-58) as a published geodetic control monument that has a NAVD 88 elevation in the IDB.
- Users can connect to a CORS ARP for its benchmark or Height mod elevation without physically occupying the station.

The disadvantages of a CORS ARP having a published NAVD 88 elevation in the NGS IDB along with a published ellipsoid elevation are:

- NGS as a general rule discourages physically disturbing an operational CORS antenna. This would include touching the ARP for the purposes of leveling to it or removing the antenna to access the ARP.
- Unlike the ellipsoid height, the orthometric height cannot be monitored by re-observation (unless by trigonometric leveling)
NGS does guarantee inclusion of such data in its hybrid geoid models

Q: Can OPUS be used outside of US?

A: Yes, OPUS can be used outside the United States, but it is optimized for conditions within the U.S. e.g., coverage for OPUS rapid static is rare internationally due to insufficient density of base stations.

Q: What training is required to use OPUS Projects?

A: OPUS project manager training is required to create projects; we are in the process of planning several classes, and hope to have a webinar training option available this winter. Contact Erika.Little@noaa.gov to receive updates about training opportunities.

You may also contact your closest NGS Geodetic Advisor to see if OPUS Projects classes are planned for your area. <http://www.ngs.noaa.gov/ADVISORS/AdvisorsIndex.shtml>

Q: What are the plans to allow for NGS acceptance of an RTN? We are determining and monitoring our coordinates using Bernese, but have no easy way to use any of the provided NGS tools because of the scale of how we are operating.

A: NGS will only offer suggestions on how to administer RTNs. Bernese can be used to monitor reference station coordinates on a periodic basis. However, NGS will not provide assistance with Bernese. If your network is too large for NGS tools, consider uploading a subset of your base stations.

Q: **Ken** - how are the LDP coordinate systems working out for ODOT?

A: The Oregon Coordinate Reference System (OCRS), a system of low distortion map projections designed to match grid coordinates closely to ground measurements, was enacted into law in Oregon and has been enthusiastically accepted and used by private and public land surveyors in Oregon since January 1, 2012. For more information, see our OCRS web page at: <http://www.oregon.gov/ODOT/HWY/GEOMETRONICS/Pages/ocrs.aspx>

Q: **Question for Ken...**What was the purpose of the "high Pressure" days? I would think that the truth you were seeking must include "normal" atmospheric conditions?

A: The high pressure days were picked in order to have the best possible GPS signals when atmospheric conditions were stable. Our goal was to get the best possible positions for our GPS reference stations, not to emulate average conditions for a user of those stations. One might use an analogy to the historical establishment of triangulation stations in Oregon: they were established when conditions were good so they would have the best accuracy, even though a "normal" day in Oregon might not necessarily have such ideal conditions.

Q: **Ken,** Does Oregon have a certificate of sorts that states their network coordinates are "Verified" by NGS?

A: Mark Armstrong answering. Currently the NGS is investigating what the best process is for validating that RTN-provided coordinates are in agreement with the NSRS. Certificates are not available at this time but some form of acknowledgement for alignment with the NSRS may be provided in the future. NGS is very open to working with the RTN administrator community on designing a mutually agreeable process for such validation and/or certification.

Q: **Ken,** How do you deal with tectonic plate shift/drift over time - specifically DIFFERENTIAL movement within the RTN?

A: Of course we dealt with a long period of tectonic drift in Oregon when we transitioned our RTN network to NAD83(2011)epoch 2010.00 on 8 March 2013. We will perform periodic adjustments of our RTN in OPUS Projects and also set up site monitoring to produce time series plots for all of our GPS reference stations. We will use this information to gauge when a new set of positions may be dictated due to tectonic activity.

Q: Is there an NGS trainer for OPUS Projects in Louisiana?

A: No, there are no NGS employees in Louisiana. However the Mississippi State Advisor Denis Riordan may offer OPUS Projects training. Please contact him to be kept up to date on class offerings. Denis.Riordan@noaa.gov

Q: Please explain NGS's reasoning for the new 70KM rule for new CORS stations and if a station is destroyed, will you accept a new station that is closer than 70KM

A: NGS implemented the 70 km station spacing "rule" as a guideline. NGS selects stations based on NOAA Missions, applications, redundancy requirements, and updating of sites with legacy equipment. If a site is destroyed, NGS would be interested in a replacement if there are no nearby sites.

Q: What report from OPUS Projects is available to provide to users to communicate the accuracy of the coordinates?

A: A full least squares network adjustment solution report is provided by OPUS Projects for each mark and CORS within the project. Also, reports on the a priori OPUS solution for all marks and each session has a solution report as well. All of these results are also shown in graphs that may be viewed at optional sigmas (1-5). Contact me via email (Mark.L.Armstrong@noaa.gov) if you would like more information.

Q: Regarding private vendor operated RTNs, are they currently required or do they routinely consult with a licensed surveyor and or state associations?

A: There are no known federal requirements for surveyor consultation. The vendor operating the RTN should be able to provide information on station coordinates and perhaps RINEX files for each station and users may wish to verify NSRS alignment of the coordinates using OPUS.

Q: Do most RTN's broadcast NAD83 Base coordinates (instead of ITRF) - so that end users should NOT include non-null datum transformation parameters in their coordinate system definitions?

A: NGS encourages RTN operators in the United States to use the most recently adopted reference frame [NAD 83(2011), epoch 2010.00]. I would assume most, if not all, base stations in the U.S. use NAD 83.

Q: The Oregon Coordinate Reference System sounds a lot like County Coordinate systems employed in Minnesota and Wisconsin.

A: The OCRS is somewhat different in that each low distortion projection zone is optimized for a given area of topography instead of County boundaries. More information is available here: <http://www.oregon.gov/ODOT/hwy/geometronics/Pages/ocrs.aspx>

Q: NGS will accept L5 signal for OPUS PP?

A: OPUS will allow you to submit files containing L5, but use of that data is not yet implemented in any of the OPUS products. For the L5 signal to be meaningful from a positioning point of view, NGS, as well as other users of L5, would need the signal to be available from several satellites - at least two in view for double differencing. NGS does intend to introduce the use of L5 in the coming years as more satellites broadcast on that frequency.

Q: Is there going to be any discussion of providing data streams from CORS stations for use by RTNs or use as stand-alone sources of data?

A: For the foreseeable future, NGS will not be providing GNSS streaming data from any CORS.

Q: Any plans for Ntrip Caster RTK corrections from NGS?

A: For the foreseeable future, NGS will not be providing streaming correctors from any CORS.

Q: How many NGS CORS will be used for the next ITRF2013?

A: Generally the set stations in the GNSS part of ITRF is limited to those contributed by the IGS Analysis Centers (ACs). Each AC uses a set of stations that satisfies their own interests. In general, this results in many IGS stations plus some from regional networks, but never a full densification for a region. NGS is an AC for the IGS, and contributes several U.S. CORS to that effort. The densification of the global framework with the full U.S. CORS to obtain IGS08 coordinates at all CORS is done by NGS for our own purposes. Contributing too many of the U.S. CORS to the IGS would be a burden to those international efforts without adding anything significant to the solution. [J. Griffiths, jake.griffiths@noaa.gov]

Q: The 70 km distance between CORS also applies to outside the USA?

A: Yes. However, there may be additional restrictions. NGS is primarily focused on CORS in the United States and its territories.

Q: GNSS CORS are preferred to only GPS?

A: Yes, observations from multiple satellite systems (GNSS) are preferred.

Q: Why did NGS made the NAD83-2011 did not do a separate solution for Puerto Rico that it is located in the Caribbean Tectonic Plate instead of the NA plate?

A: This was adopted by convention for several reasons. The main reason was that introducing a separate plate model for Puerto Rico would complicate projects that tie to stations in CONUS. Another reason is that satisfactory plate motion models for the Caribbean are lacking. User experience and feedback from these kinds of issues will be beneficial to future NSRS realizations. So, please feel free to share future concerns with NGS. [J. Griffiths; jake.griffiths@noaa.gov]

Q: They are moving invertely (in opposing directions) the NA plate and the caribbean plate so Puerto Rico should have been a separate solution similar to Hawaii's

A: NGS appreciates this feedback, and would welcome others interested specifically in the treatment of Puerto Rico and the Virgin Islands in future realizations of the NSRS. However, for reasons mentioned above, the current policy is to treat the two plates in one common solution. This is not unlike the use of southern California data (on the Pacific Plate) being used in the North American Plate solutions. [J. Griffiths; jake.griffiths@noaa.gov]

Q: The Caribbean plate East velocities are overestimated by NGS HTDP specially the north larger islands

A: NGS would be pleased to see the actual values in question so that we may investigate this issue and resolve it. [J. Griffiths; jake.griffiths@noaa.gov]

Q: What is the individual tectonic displacement allowed in a site before computing a new solution?

A: In general, 2.0 cm horizontal, 4.0 cm vertical.

http://www.ngs.noaa.gov/INFO/Policy/files/042011_CORS_Coordinate_Policy.pdf

Q: How do network operators calculate velocities for reference stations?

A: NGS offers HTDP <http://geodesy.noaa.gov/TOOLS/Htdp/Htdp.shtml>, a horizontal velocity model based largely on surrounding CORS velocities. Our experience has shown that it takes several years of careful monitoring to develop reliable velocities.

Q: Will the RTN use NTRIP 2.x?

A: Which RTN? Not enough info to answer question.

Q: What frequency does NGS use for CORS velocities? Frequency of observations.

A: Currently, weekly, but we may shift to daily solutions.

Q: Why NGS doesn't force that all CORS indicated their version of WGS84 (latest WGS84 G1674) and ITRF08/ IGSb08 in their reference station coordinates pages?

A: The Federal Geodetic Control Subcommittee mandates the use of NAD 83 as the official federal civilian coordinate system of the NSRS. NGS, as the stewards of the NSRS, therefore abide by the mandate of the FGCS. WGS 84 is primarily used by the U.S. military agencies, and is maintained by the National Geospatial-Intelligence Agency (NGA).

Q: latest stats and plots time series on XYZ velocities and their residuals should appear in each CORS page

A: We have those in NEU. We also have a composite table:

http://geodesy.noaa.gov/CORS/coord_info/plots.shtml

Q: OPUS should allow the user to select the desired global geoid model for their post processing

A: -Because NGS does not create global geoid models, nor regional geoid models outside of the USA, the use of such models would require additional resources by NGS. As such, NGS only provides geoid support for geoid models we directly create.

Q: Are you looking at trying to have the RTN Symposium in the future?

A: NGS hopes to continue to have additional RTN Symposiums over the coming years, particularly as we move toward some form of validation/certification of NSRS-compliance for RTNs.

Q: Running a rover-monitor (e.g. a constantly running rover permanently mounted and resolving a network correction in real-time) and plotting this in a running time-series.

A: Yes, monitoring the time series (x,y,z) for all stations is possible using the network QC software. Note: A permanently monitored rover by definition should be a rover antenna on the ground setup over a known mark with true coordinates to compare the time series too. It should not be a choke-ring antenna as comparisons would not be valid to what rover user in the field experience.

Poll Responses

I am an:

RTN User: 79 (50%)

RTN Administrator: 41 (26%)

Other: 37 (24%)

157 responses

Our RTN uses which format(s)?

RTCM: 83

Open source: 36

Vendor specific: 29

Unknown: 19

124 people responded, many with multiple selections

As an RTN user, I prefer that RTN reference systems are:

A balance of accuracy and constancy: 78

Accurate, updated whenever distortions are found: 44

Constant, so my old and new survey values match: 17

123 people responded, many with multiple selections

To monitor RTN coordinates I would prefer the

Accuracy of OPUS Projects: 65

Simplicity of OPUS DB: 37

Undecided: 23

Other software: 16

No monitoring: 1

118 people responded, many with multiple selections

How do you establish your RTN base station coordinates?

Our base stations are CORS, we use CORS coordinates: 43

vendor-supplied processing software: 36

OPUS processing web application: 34

Unknown: 11

Other: 10

108 people responded, many with multiple selections

