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The role of National Mapping Organisations for PI Provision and ensuring PNT Integrity

D.R. Roman

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Bio

Daniel R. Roman is a graduate of the Ohio State University with a Master of Science in Geodetic Science and Surveying in 1993 and a Ph.D. in Geological Sciences (emphasis in geophysics/gravity & magnetism) in 1999. After graduation, he joined the National Geodetic Survey as a Research Geodesist. He is the team leader for Geoid Modelling and Research. He is also the Principal Investigator for the Gravity for Redefinition of the American Vertical Datum (GRAV-D) Project. He is currently serving as the acting Chief, Spatial Reference Systems Division at the U.S. National Geodetic Survey, responsible for maintain access to the geometric aspects of the National Spatial Reference System.

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Abstract

- CORS and OPUS solutions provide the basis for much of the current positioning in the U.S. NGS recently released OPUS-Projects to production, which provides even greater accuracy in positioning and, potentially, more consistency with coordinates in the National Spatial Reference System (NSRS). Positioning data will be obtained from all available GNSS to ensure a more robust solution than one based solely upon GPS. By 2022, NGS must have in place some system like this that will facilitate rapid positioning in the geometric frame and providing the access to the vertical height system through a geoid height model.
- NGS will also provide a mechanism for end-users to validate their access to the NSRS when using the services of private and public Real Time Kinematic Networks. This should be tested under varying conditions to ensure reliable and accurate solutions.

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References

- **Implementation Plan 2.1: NAD 83 Replacement**
– NAD-83-Report-05-16-2014
- **Implementation Plan 3.1: Validate RTN's**
- **Move to GNSS (GPS+GLONASS)**

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OUTLINE

- NAD 83 Replacement
- CORS Enhancements
- OPUS-Projects
- RTN Support
- Outlook

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NAD 83 Replacement

- Continental “plate-fixed” geodetic datum to be adopted in the United States
- More geocentric than the current NAD 83 reference frame
- Must coordinate with Mexico and Canada
- By 2022, reduce all definitional and access related errors in the geometric reference frame to 1 centimeter when using 15 minutes of GNSS data

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Two possible ways to align

- Using a newly defined NGS network such as the projected “foundation CORS.”
 - Must build a sufficient number prior to 2022 to establish a viable, independent national network
- Rely on stations currently in the IGS network located in the North American continent.
 - Presumes continued NGS participation in IGS (AC)

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Two Important Questions

- What will be the 14-parameter transformation between the redefined geodetic reference datum frame and the standard geocentrically assumed ITRFxxxx frame?
- What will be the adopted plate rotation models introduced to correct for the North America, Pacific, Mariana and Caribbean plate rotations?
- HTDP will be relied upon to propagate these transformations in a consistent manner

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CORS Networks Stations

- As of February 2014, all CORS stations provide extra signals beyond current GPS L1 and L2:
 - GPS's L2C and L5
 - Russia's GLONASS satellites L1 and L2
 - Over 40% of CORS sites will distribute these extra signals
 - These additional signals also enhance system robustness and better ensure PNT

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Satellite Orbital Processing

- NGS continues to serve as an Analysis Center (AC) for the IGS
- GPS satellite orbital processing is key to overall accuracy and contribution to future ITRF models
- NGS must expand to perform additional orbital analysis for other GNSS (e.g., GLONASS)
- Accuracy of orbits and data archived from the CORS Network stations are critical to success

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OPUS-Projects

- Utilizing the GNSS data from CORS and rovers
- Data are loaded through OPUS(-Static)
- Project name is tagged
- A series of adjustments are performed:
 - OPUS-S: for each observation set at a station
 - Session: for all points observed at the same time
 - Network: least squares combination of sessions
- Performs a network adjustment at the local level

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Network Components

- Think of project as having 2 components:
- Local network
 - Think precision - get best relative positions.
- Reference network
 - Think accuracy - multiple CORS tie the local network into NSRS.

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Local Network

- Think precision - get best relative positions:
 - Use common-mode errors to your advantage.
 - Use identical antennas when possible.
 - Keep baselines short maximizing simultaneous observations.
 - Use a single Hub per session.
 - Use the same Hub for all sessions when possible.
 - Include at least one distant CORS to stabilize tropo corrections.
 - Normal constraints.

Reference Network

- Think accuracy - multiple CORS tie the local network into NSRS:
 - Include the Hub(s) and distant CORS in all sessions.
 - Multiple CORS remove single reference mark bias.
 - Normal constraint weights allow for small variations in positions typical of CORS or any mark.

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Example 6: Single project Hub

Not too bad ...

... but much better

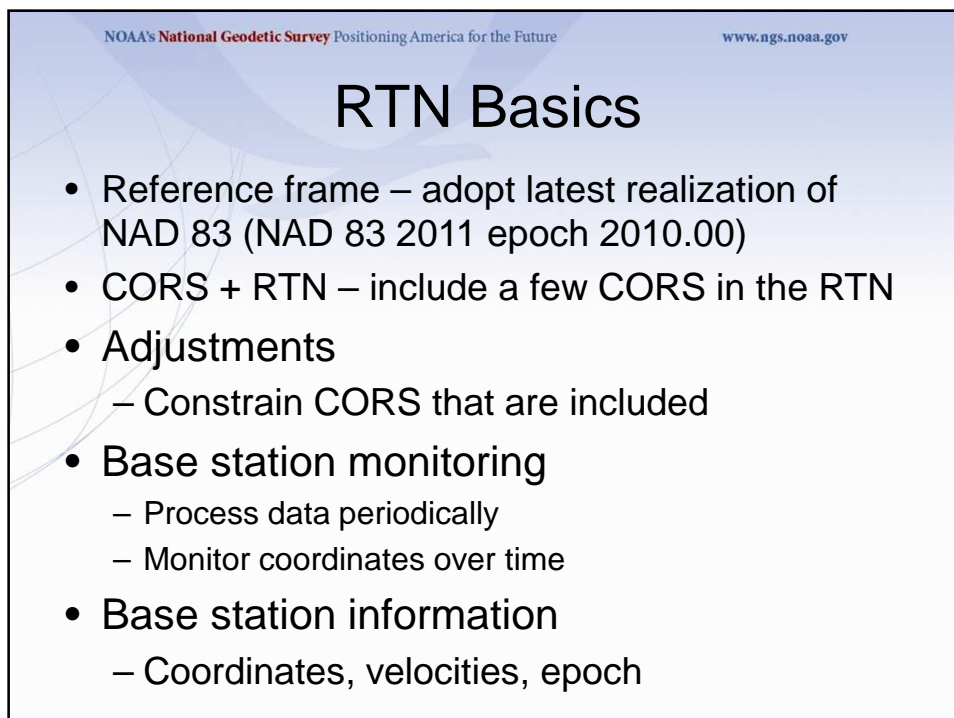
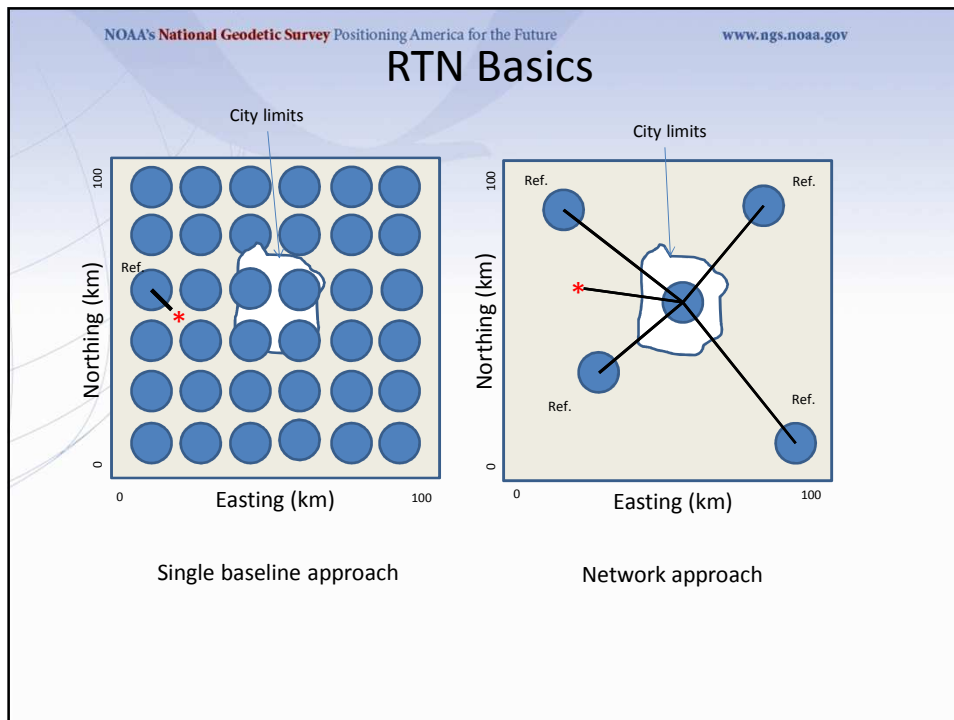
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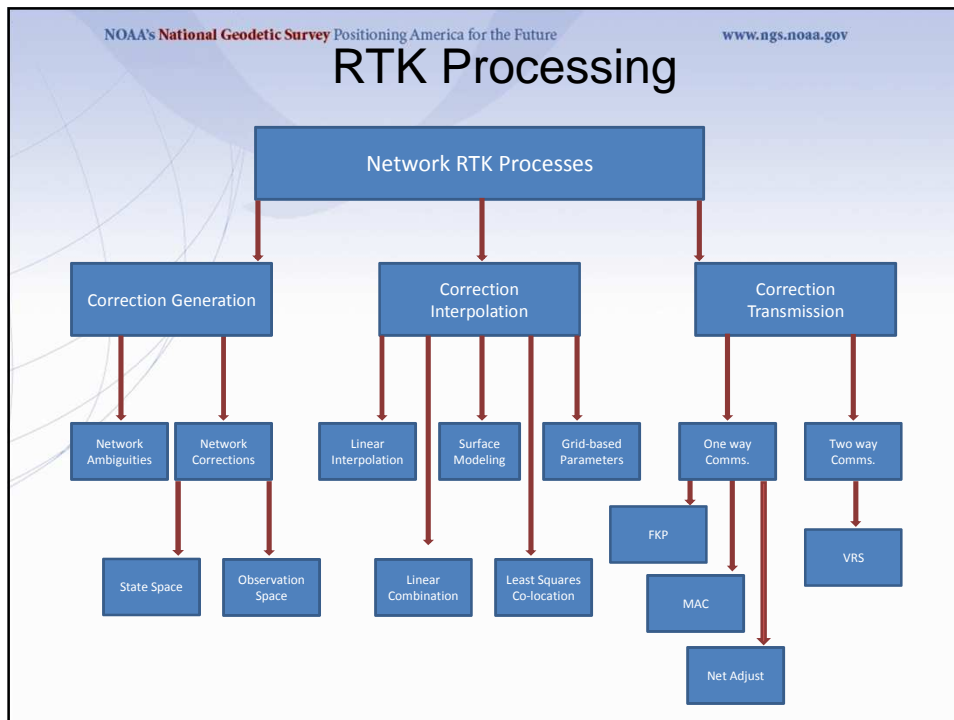
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RTN Validation

- NGS does *not* have regulatory authority over RTN's
- Provide, by 2015, a process for RTN operators to validate that their RTNs are aligned to the NSRS using NGS-acceptable standards.
- Make the tool available to RTN customers, too
- Use OPUS-Projects for State-wide systems
- Enhances robustness of solutions by providing alternative means for passing correction information to rover receivers (RTN/RTK)

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SUMMARY

- NAD 83 replacement will be more geocentric
 - Tied through 14-parameter transformation to ITRF
 - Goal by 2022: 15 minutes of GNSS for 1 cm accuracy
- CORS data already storing GLONASS+GPS
 - More to follow
 - Need orbits for all GNSS
- Access to the future NSRS will be by:
 - OPUS-Projects for geodetic control data
 - RTN's for real-time applications

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Contact Information

- Daniel R. Roman, National Geodetic Survey
Chief (acting) SRSD/GRAV-D P.I./Geoid Team Lead
- dan.roman@noaa.gov
- 301-713-3200 x103
- Relevant NGS webpages:
 - CORS: <http://www.ngs.noaa.gov/CORS/>
 - OPUS Page: <http://www.ngs.noaa.gov/OPUS/>
 - OPUS-Projects: <http://www.ngs.noaa.gov/OPUS-Projects/OpusProjects.shtml>