

Experimental Results from “BigAnt”, a Large Format Antenna for High Quality Geodetic Ground Stations

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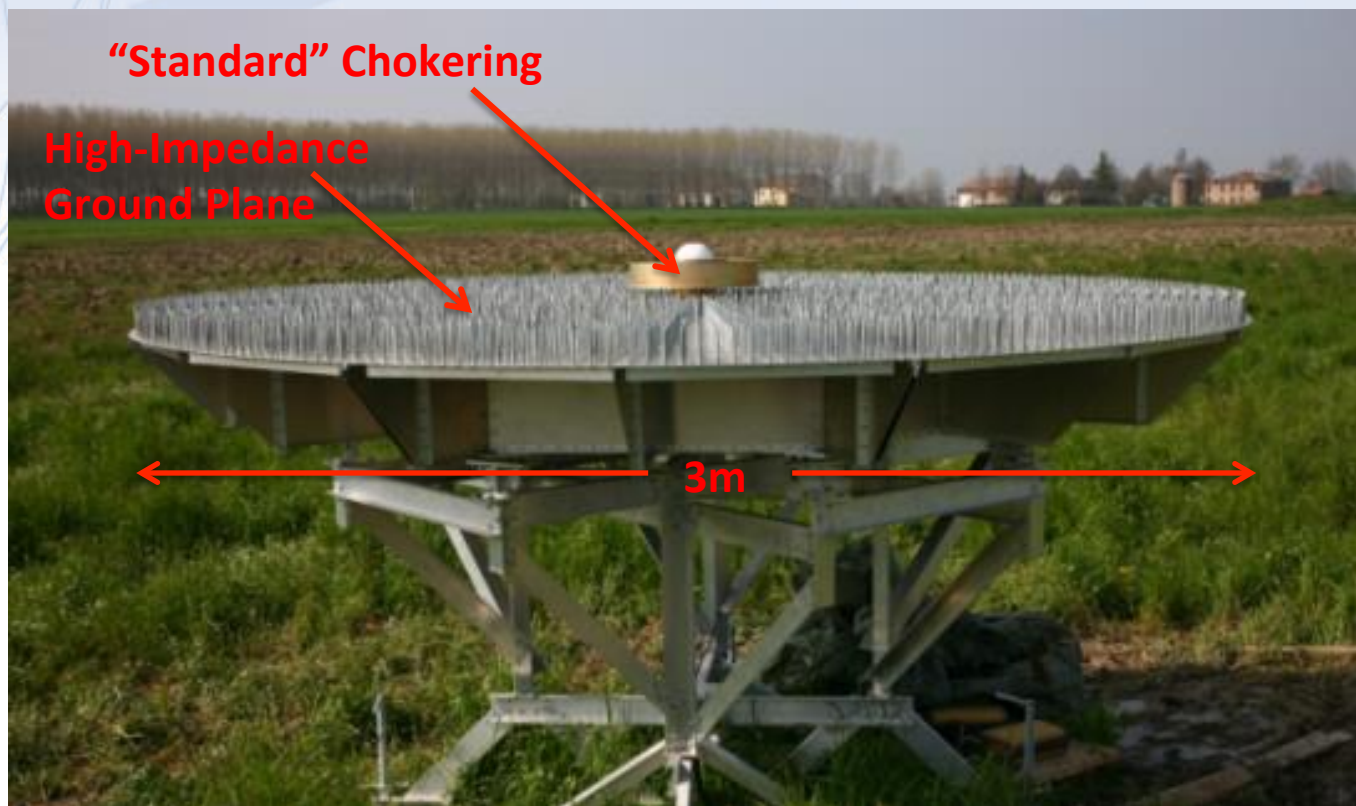
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Boulder, CO USA

Dmitry Tatarnikov
Topcon Positioning Systems
Moscow, Russia

Background

- All GNSS antennas sacrifice performance to be man-portable
- Permanent networks can use antennas optimized for performance without regard to size or weight (within reason)
- Thanks to Dmitry Tatarnikov & Topcon we have prototypes to test

BigAnt



BigAnt with Radome



Chokering & BigAnts



Another View

Chokering

BigAnt-2

BigAnt-1

44m

34m



Test Setup

Receivers:

- Septentrio AsteRx2eH (tracks both BigAnt-2 & chokering)
- Topcon Net-G3A on BigAnt-1 & BigAnt-2



Test Plan

- Antenna Calibration for BigAnt
- PPP solutions for Chokering & BigAnt
- Compare linear combinations & quality factors

Relative Antenna Calibration Summary



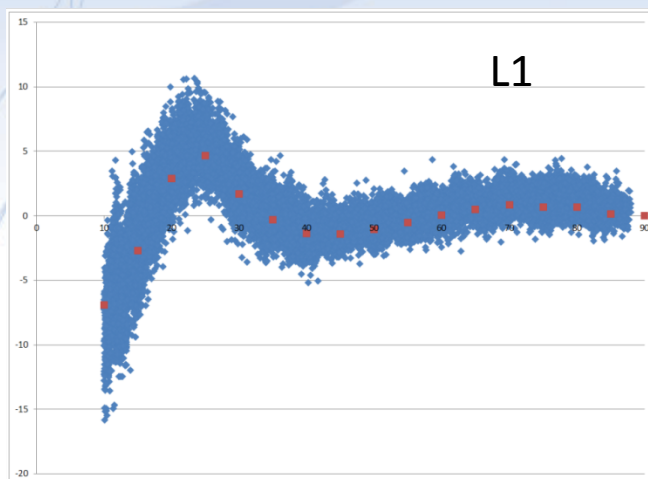
- Get L1 & L2 Phase Center Offsets (PCO) of test antenna with respect to reference
- From single differences solve for clock & Phase Center Variation (PCV)
- Use absolute calibration for reference to convert test antenna to absolute

Since: geometry removed
no troposphere
no ionosphere
no relative clock

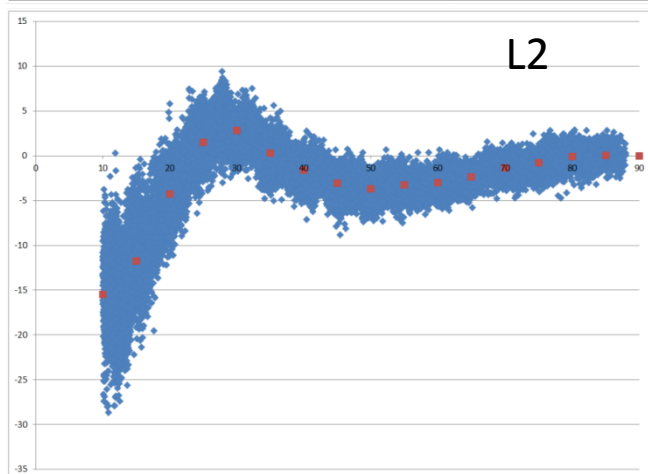
Problems: limited sky coverage
poor coverage at zenith
no azimuth solution
multipath

➡ Residuals show only remaining effect – PCV

Single Difference Phase Residuals vs. Elevation

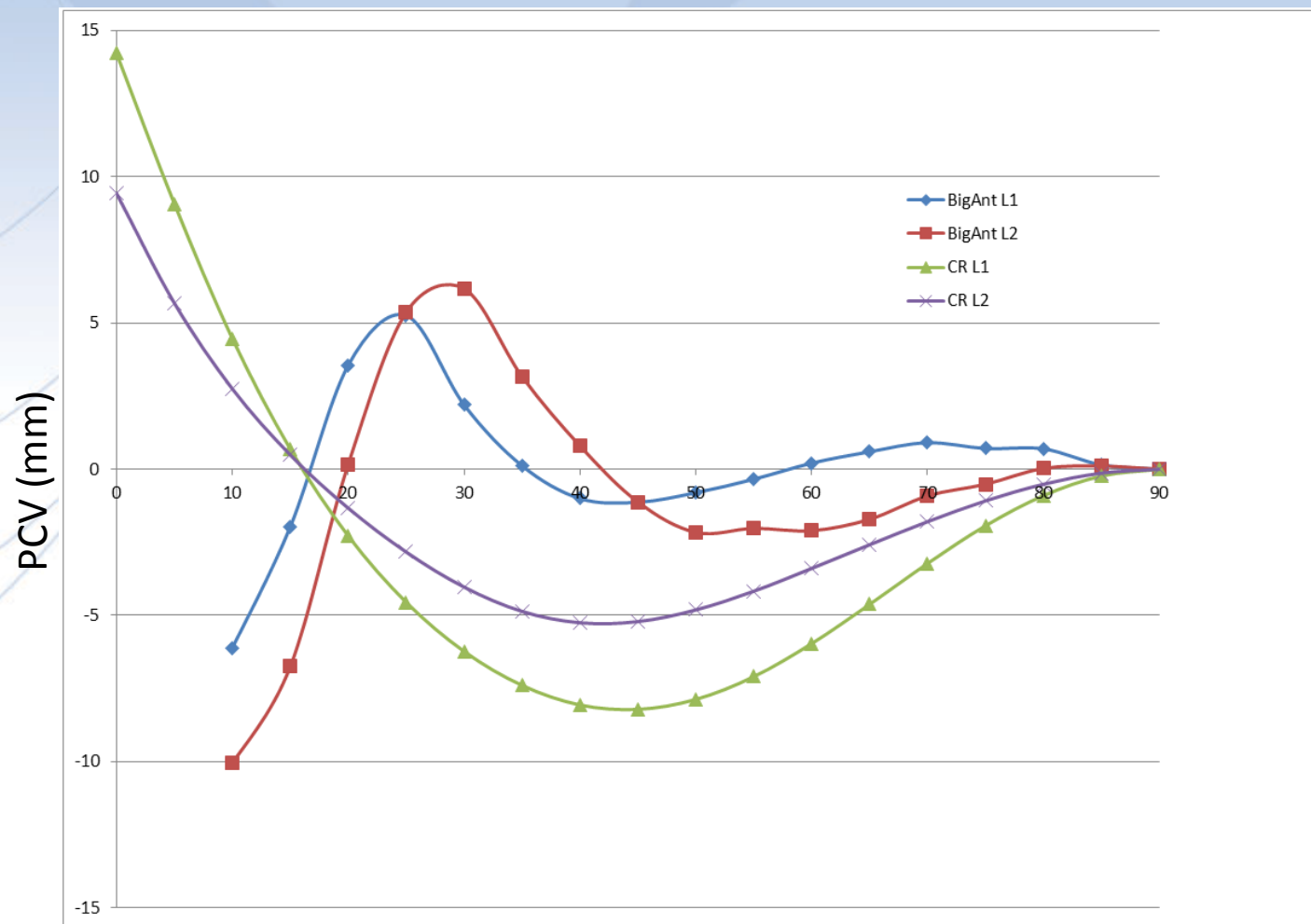


With the positions known, and the relative clocks removed, and with no propagation effects, the phase residuals clearly show the relative PCV as a function of elevation.



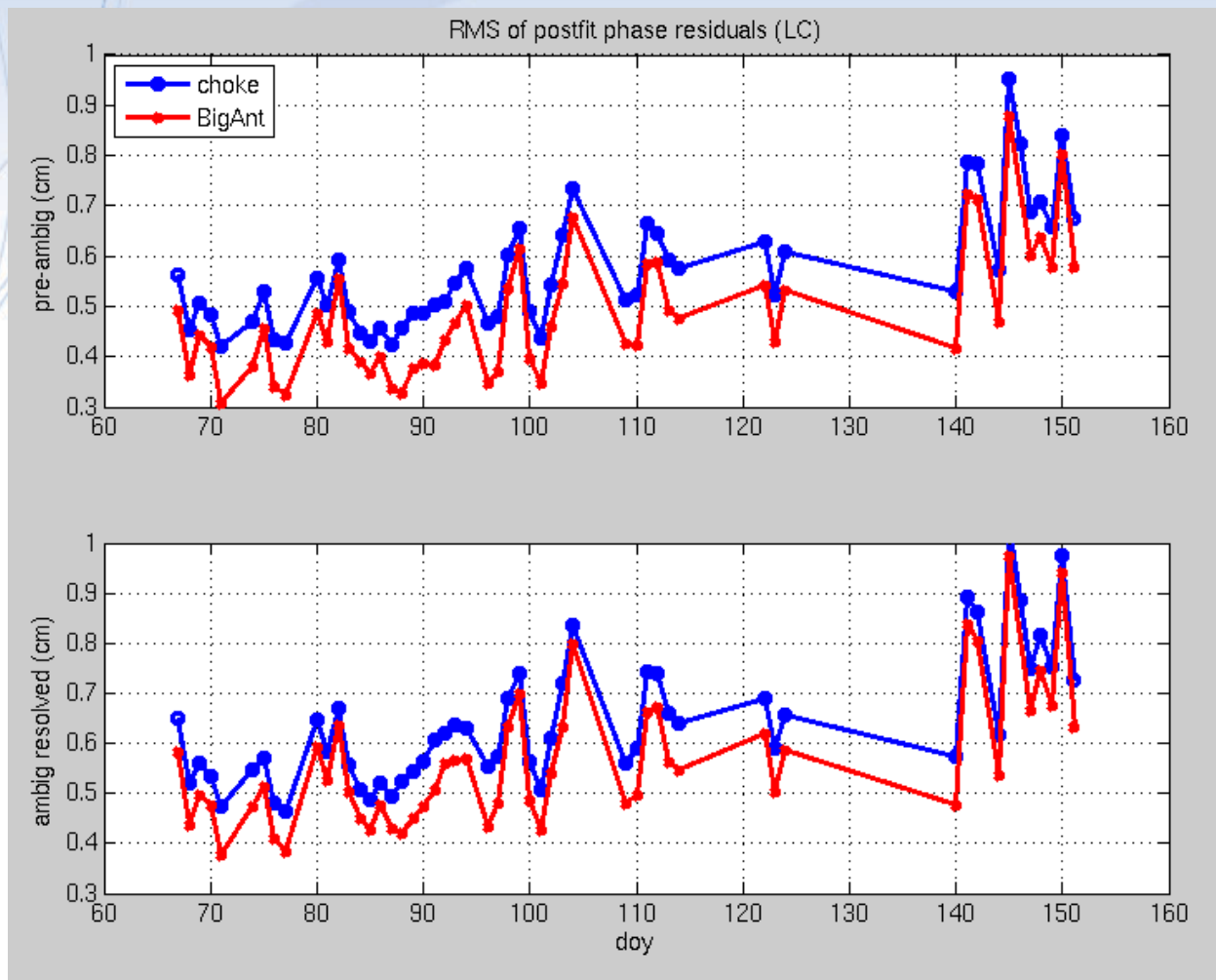
These residuals are averaged in 5° bins to produce the PCV that goes into the antenna calibration file.

Absolute Antenna Phase Center Variation (PCV) for BigAnt-1 & D/M_T Choke Ring

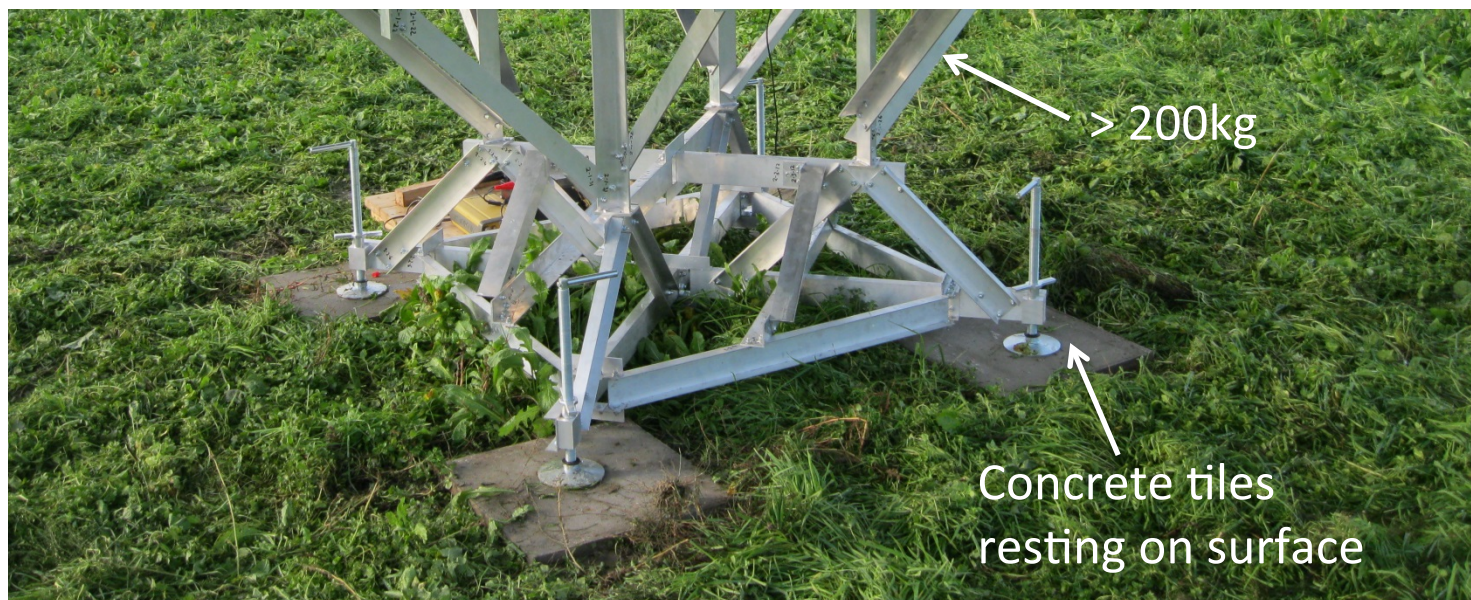
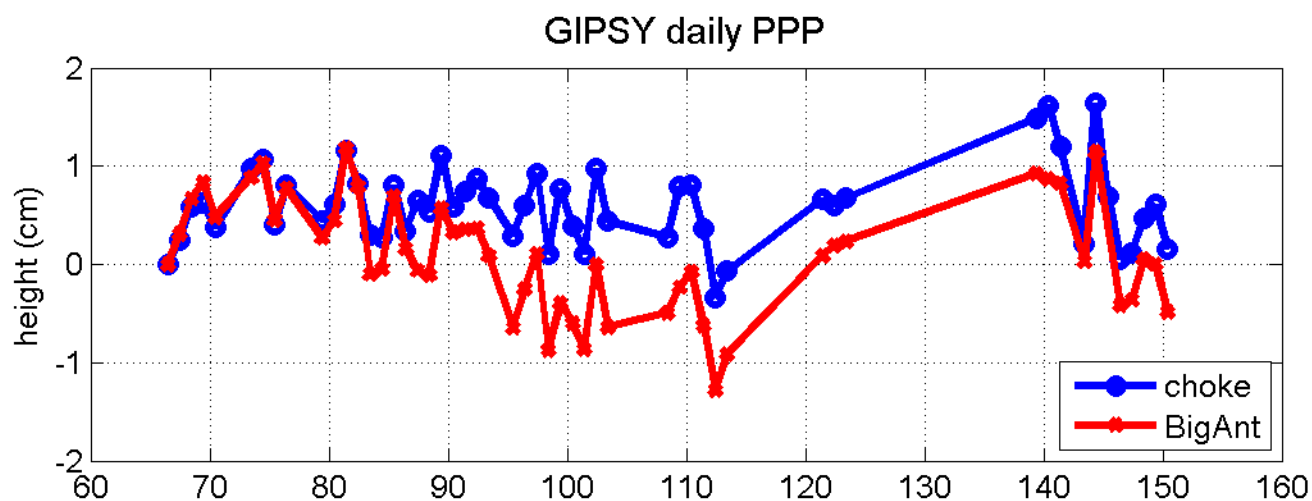


The absolute calibration of the choke ring antenna is used to convert the relative calibration of BigAnt into an absolute calibration. The PCVs & PCOs for the standard choke ring and BigAnt (standard choke ring + high impedance ground plane) are shown here.

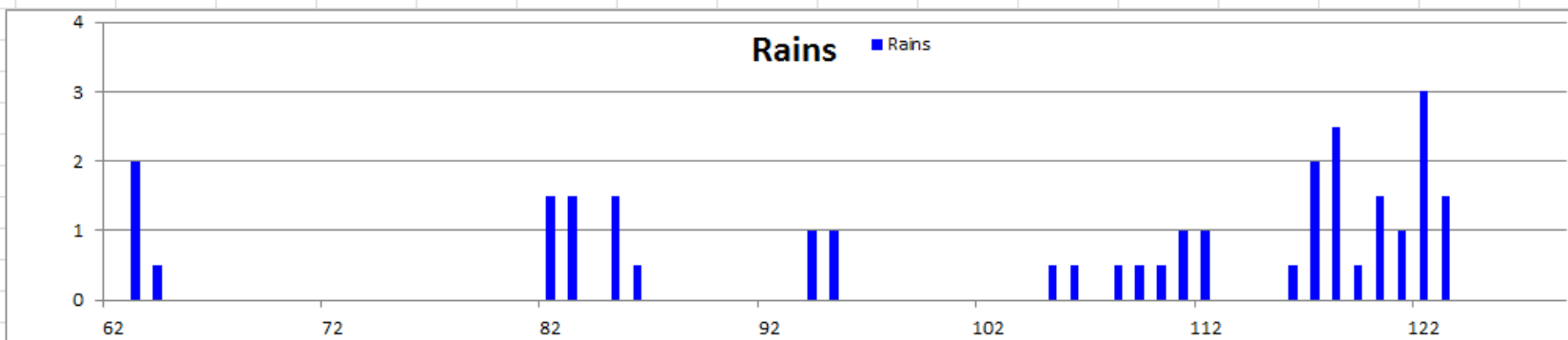
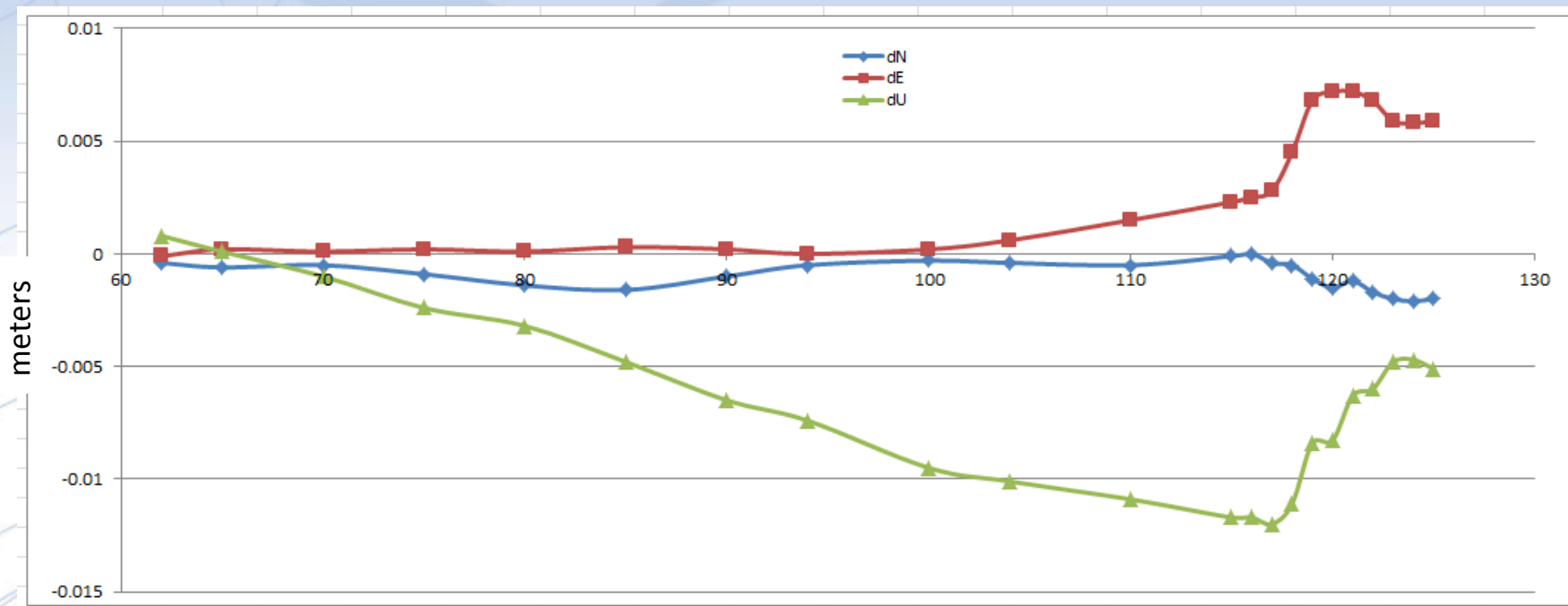
GIPSY PPP – phase residual σ



GIPSY PPP positions - vertical

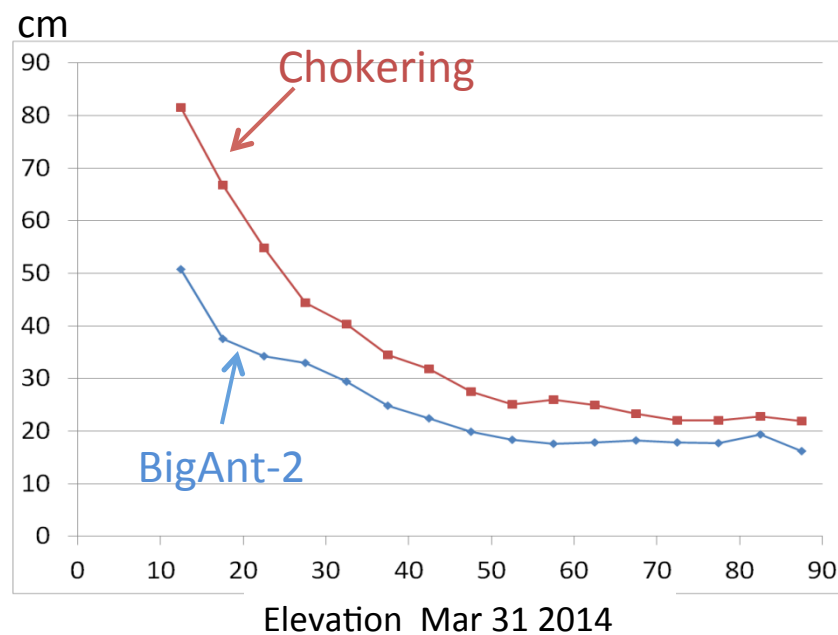
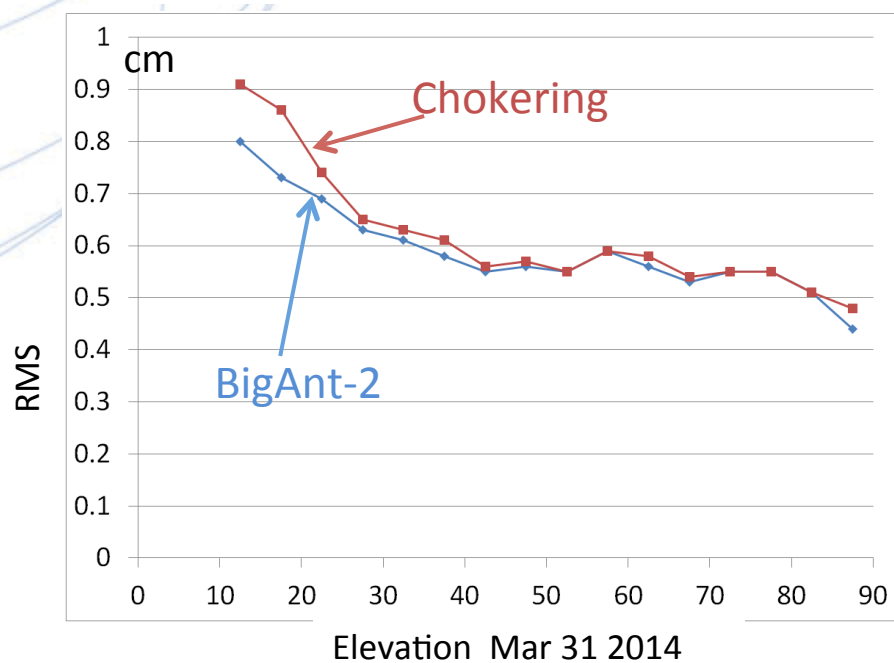
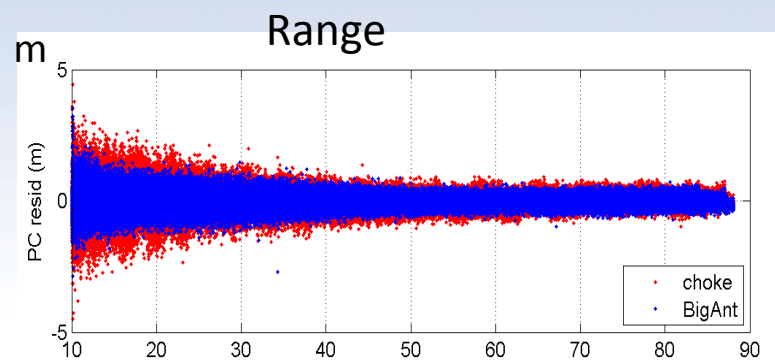
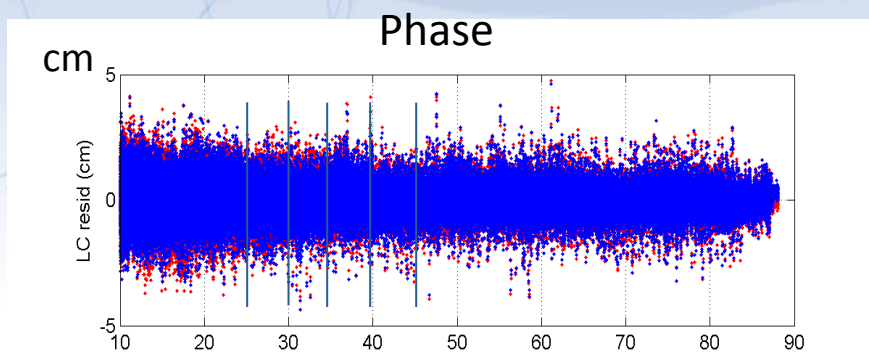


BigAnt Sinking

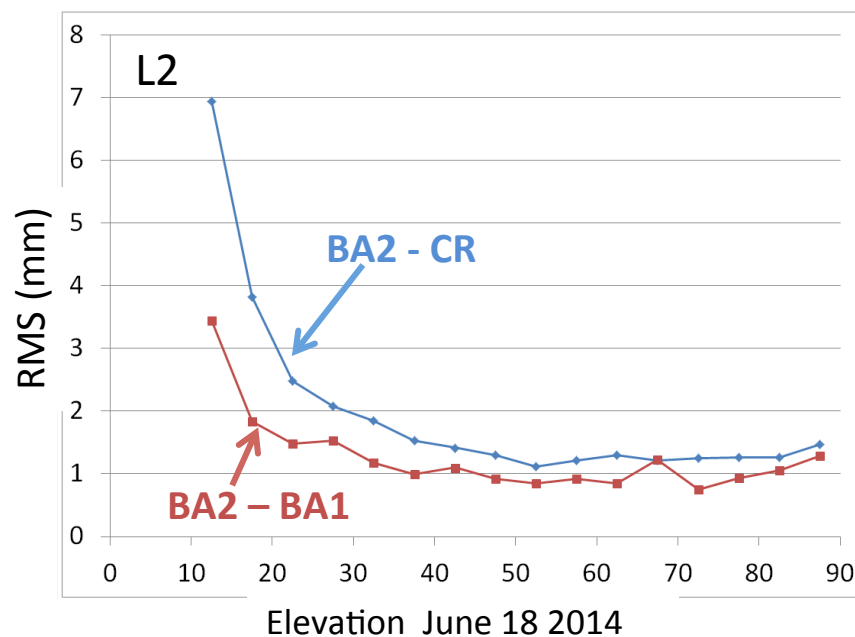
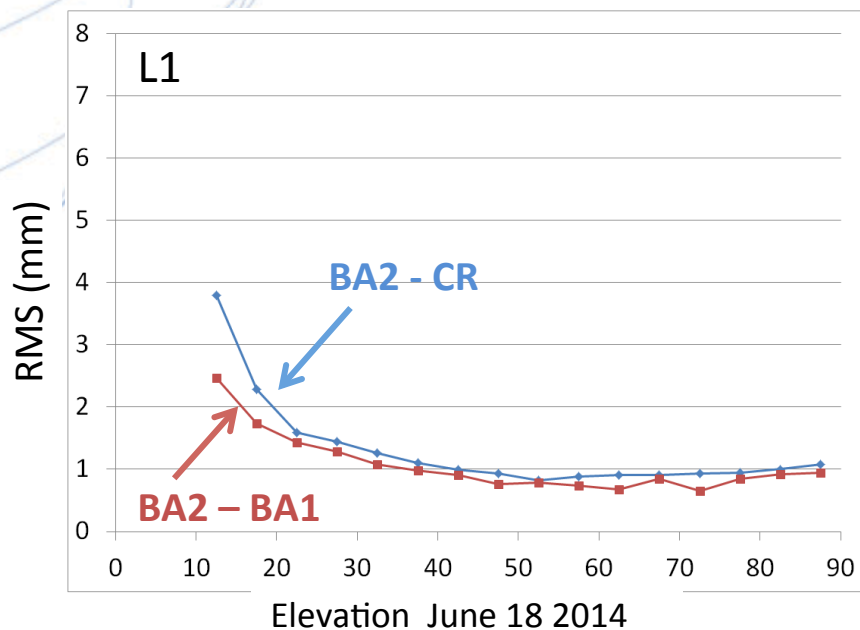
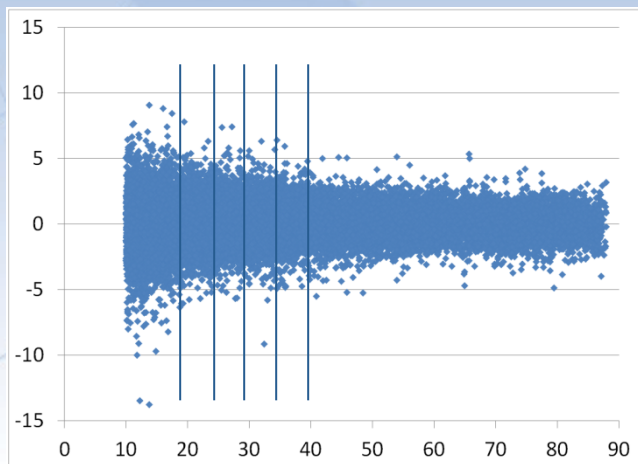


Day of year, 2014

GIPSY Phase & Range Residual RMS vs Elevation All Satellites

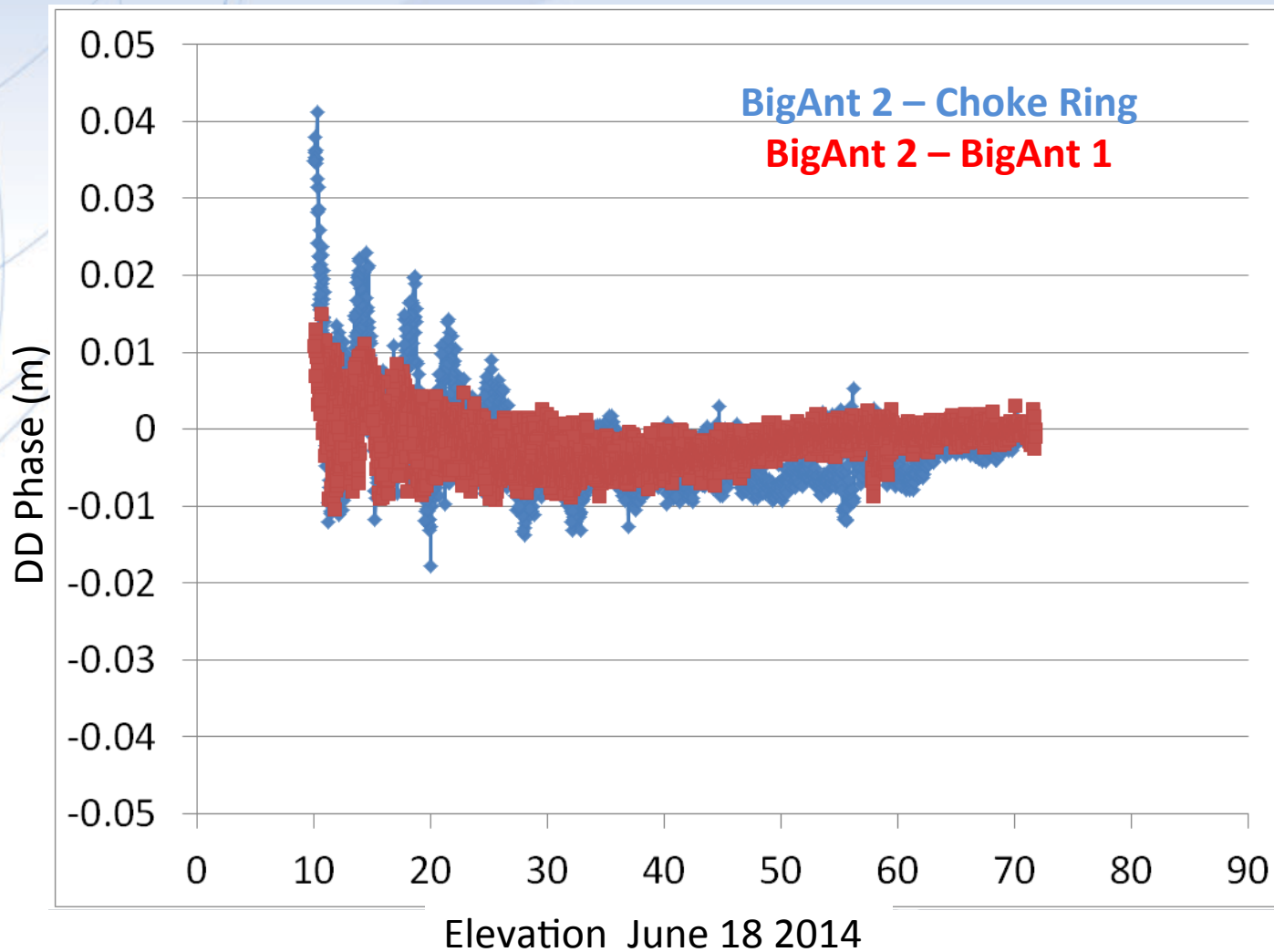


Single Difference Phase RMS vs Elevation All Satellites

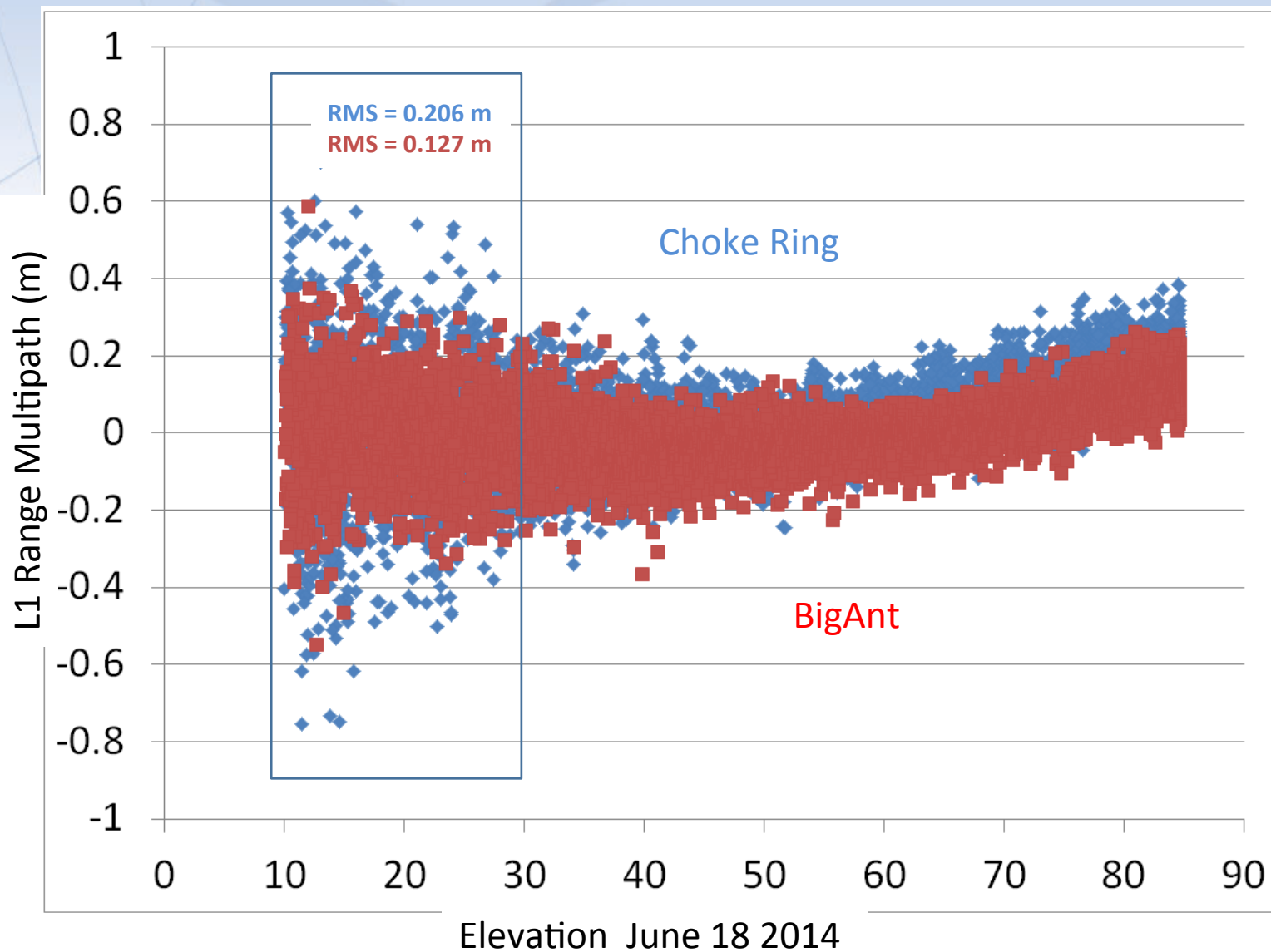


DD Phase – PRN 13

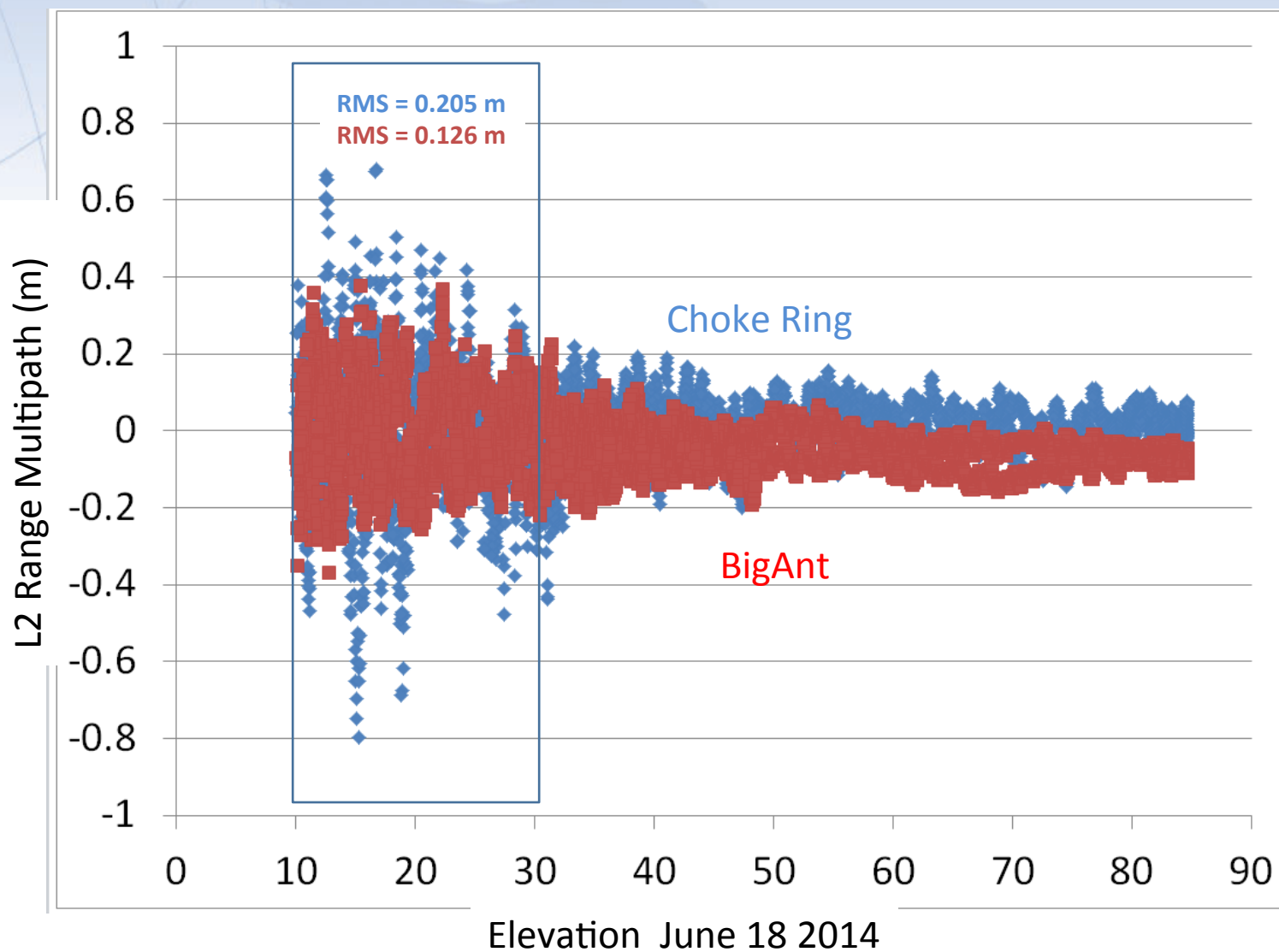
Ion-Free, Fixed-Integer, Various Reference Satellites



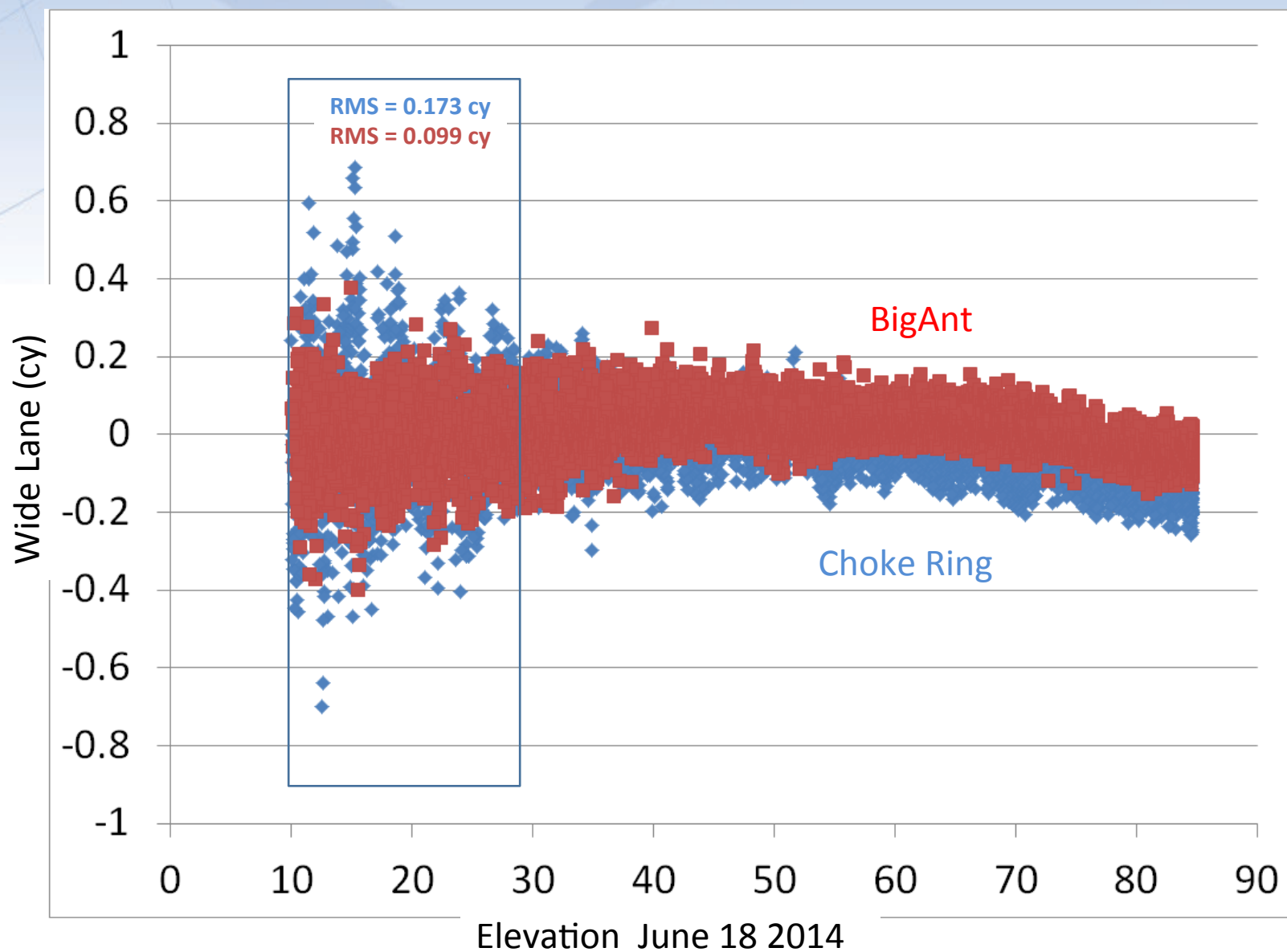
L1 Range Multipath - PRN 13



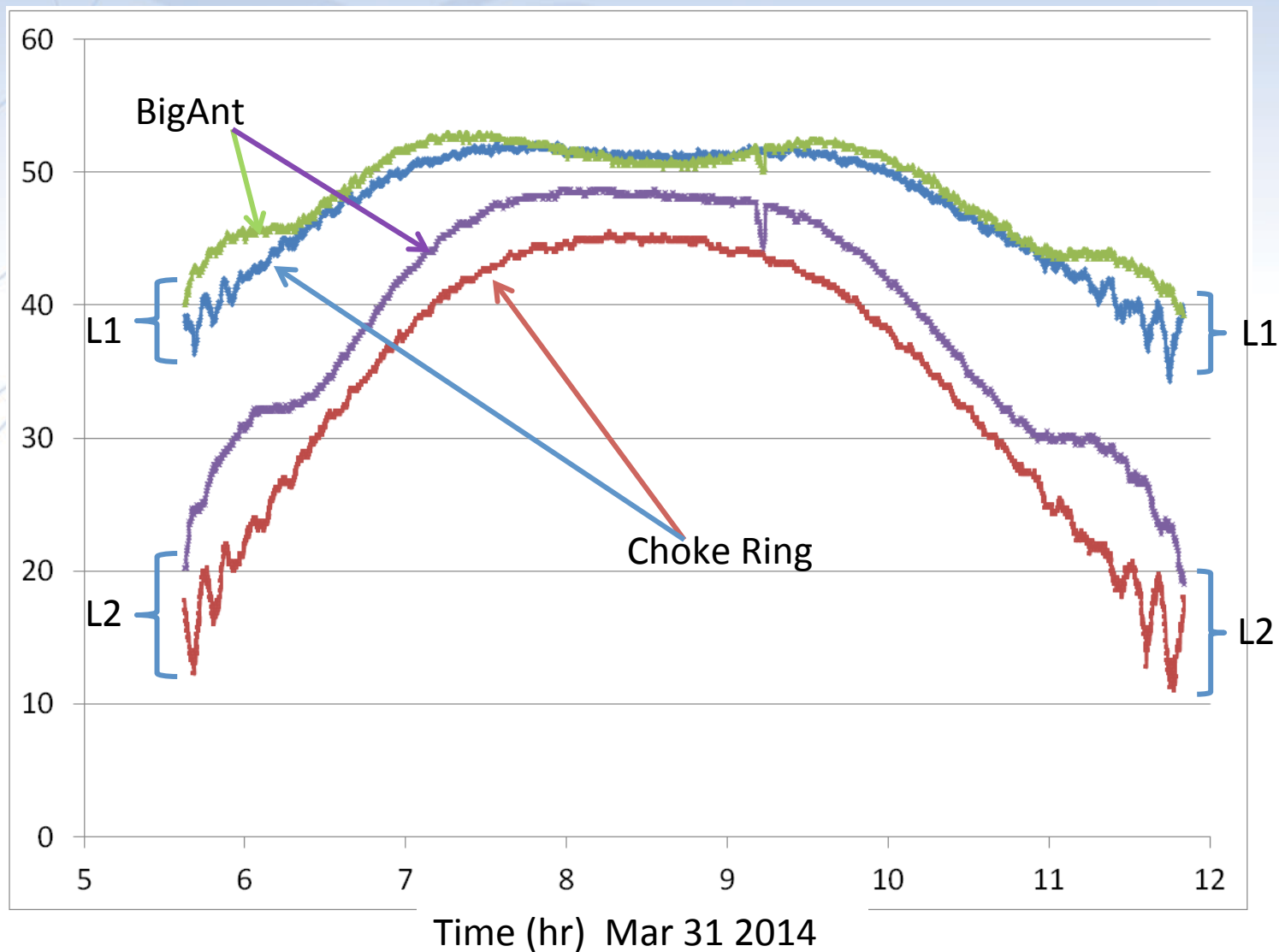
L2 Range Multipath - PRN 13



WIDE LANE - PRN 13

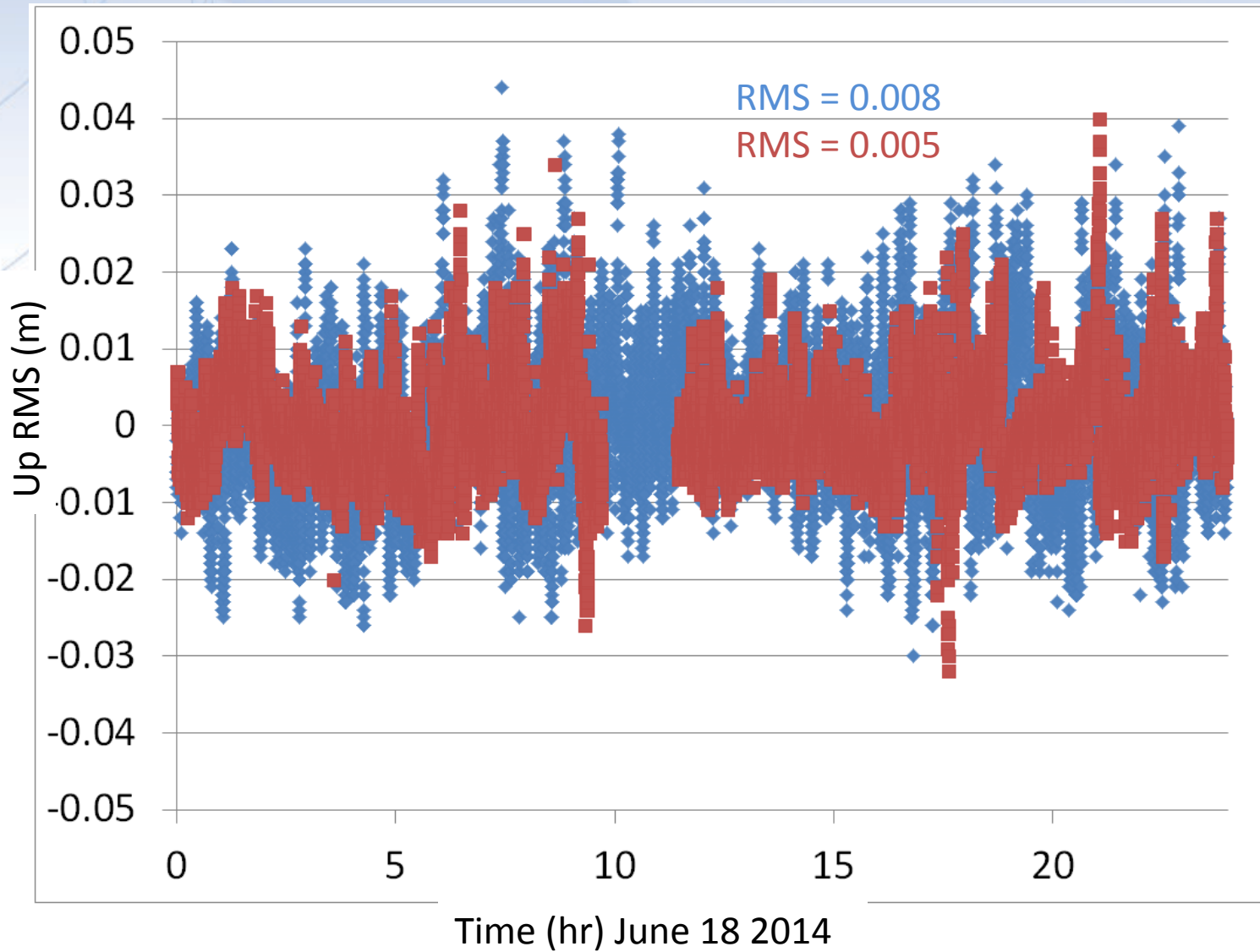


SIGNAL / NOISE RATIO - PRN 13



Kinematic Phase Solution – Up Component

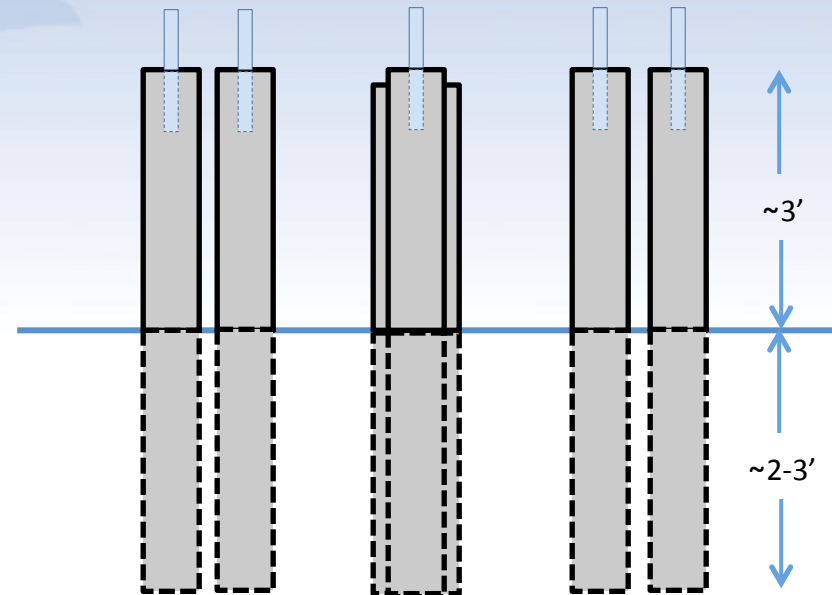
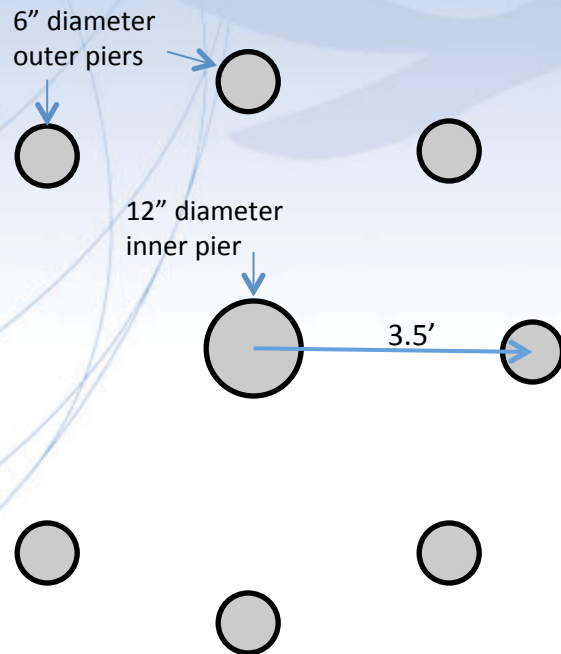
BigAnt-2 - Choke Ring & **BigAnt-2 – BigAnt-1** RMS = 0.008
RMS = 0.005



Possible Locations for NGS BigAnt



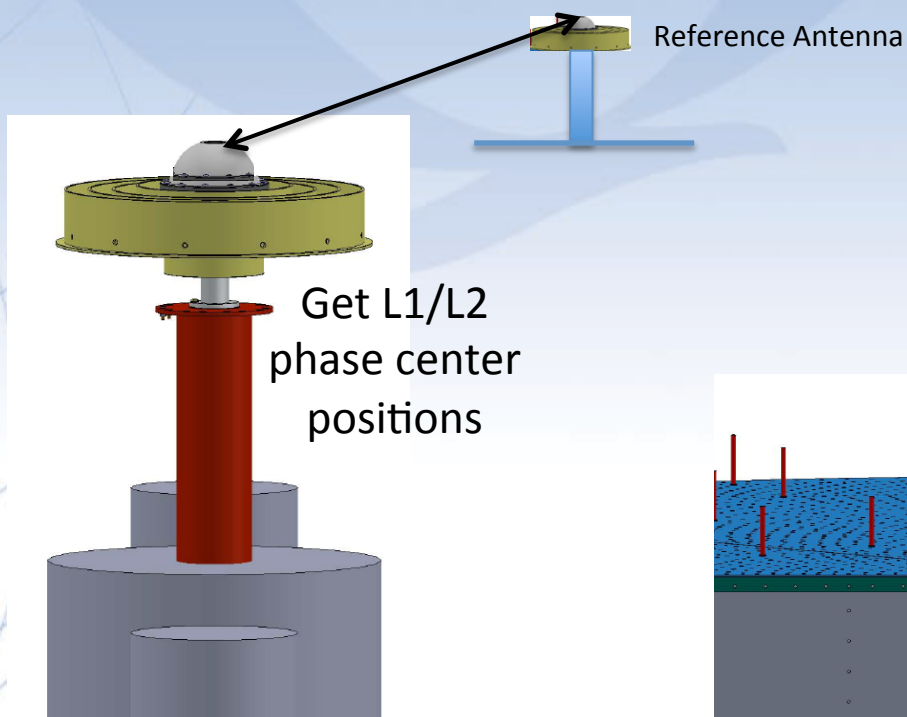
Mounting BigAnt



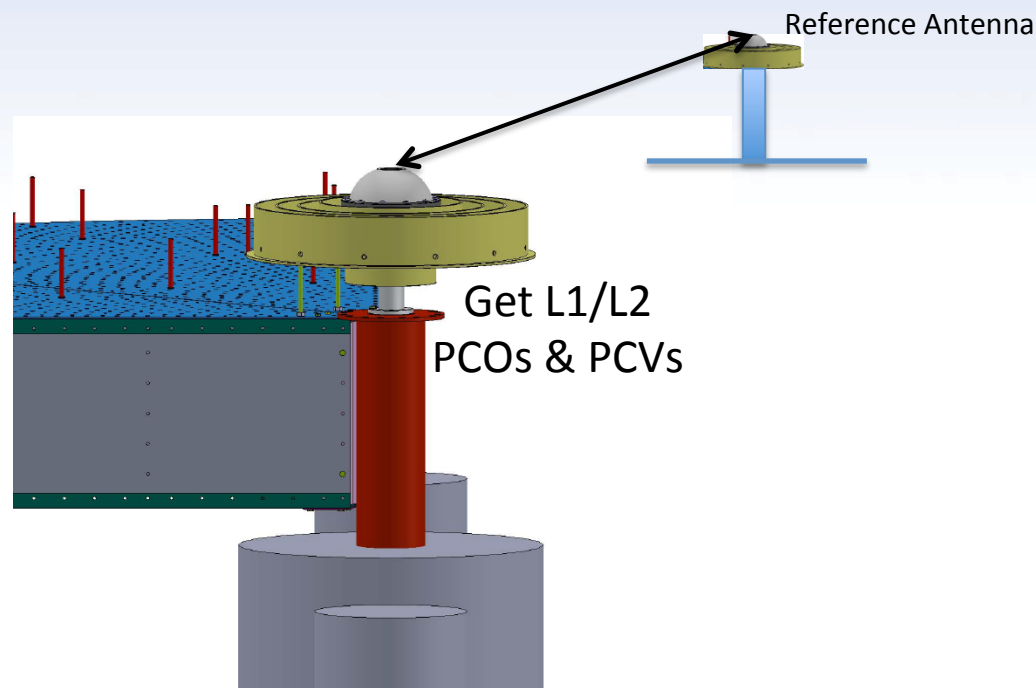
Antenna foundations consists of a single 12-in. diameter center pier (located in the center of a 3.5-ft. radius circle with 8 6-in. diameter support piers evenly spaced along the circumference. All piers are schedule 40 PVC pipe filled with concrete and anchored to subsurface coral.

The antenna foundation final pier heights are yet to be determined but should not exceed 3.0 ft. in height above the surrounding ground surface. The antenna will be fastened onto the foundation piers using 5/8-11-in. threaded rod imbedded in the top of each pier.

BigAnt Calibration



Step 1
Install Choking on
Central Pier. Take
sufficient data.



Step 2
Assemble High-
Impedance Ground
Plane around
Choking

Last Words

- Improved SNR
 - L1: $< 30^\circ$
 - L2: $10^\circ - 90^\circ$
- Phase & Range multipath significantly improved
- Implications
 - Down-weighting low elevation data
 - Tropospheric solutions (vertical)
 - Interchannel range bias
 - Ionosphere solutions
 - Clock solutions
- Further testing is planned
- Poster Paper – Wednesday 11:00

Thank You !



Time for comments / questions ?