

An Improved GPS Geodetic Antenna

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Signal reflected from the antenna environment mixes with the direct sky signal to induce error in GPS positioning, especially in the vertical dimension. This multipath effect can be reduced by carefully selecting the antenna site and by reducing the gain of the antenna below the desired horizon. UNAVCO has experimented with a number of methods to diminish this gain, including microwave absorbing foam and absorbing ground planes. We find large choke rings to be most effective, and have utilized them in geodesy experiments wherein we obtained better than 1mm repeatability on all three axes on a 45 km baseline. These experiments also included water vapor radiometer (WVR) tropospheric corrections along the propagation path to each of the satellites in view.

A 1 meter choke ring was added to a Turbo Rogue antenna and the gain and phase center were mapped in the Ball Aerospace anechoic antenna test range. This choke enhancement is shown at left in a field installation. Because of the effectiveness of the chokes, the configuration was tapered downward 10 degrees to maintain gain at the horizon. The anechoic chamber L1 gain comparison is shown below. L2 results were slightly less dramatic.

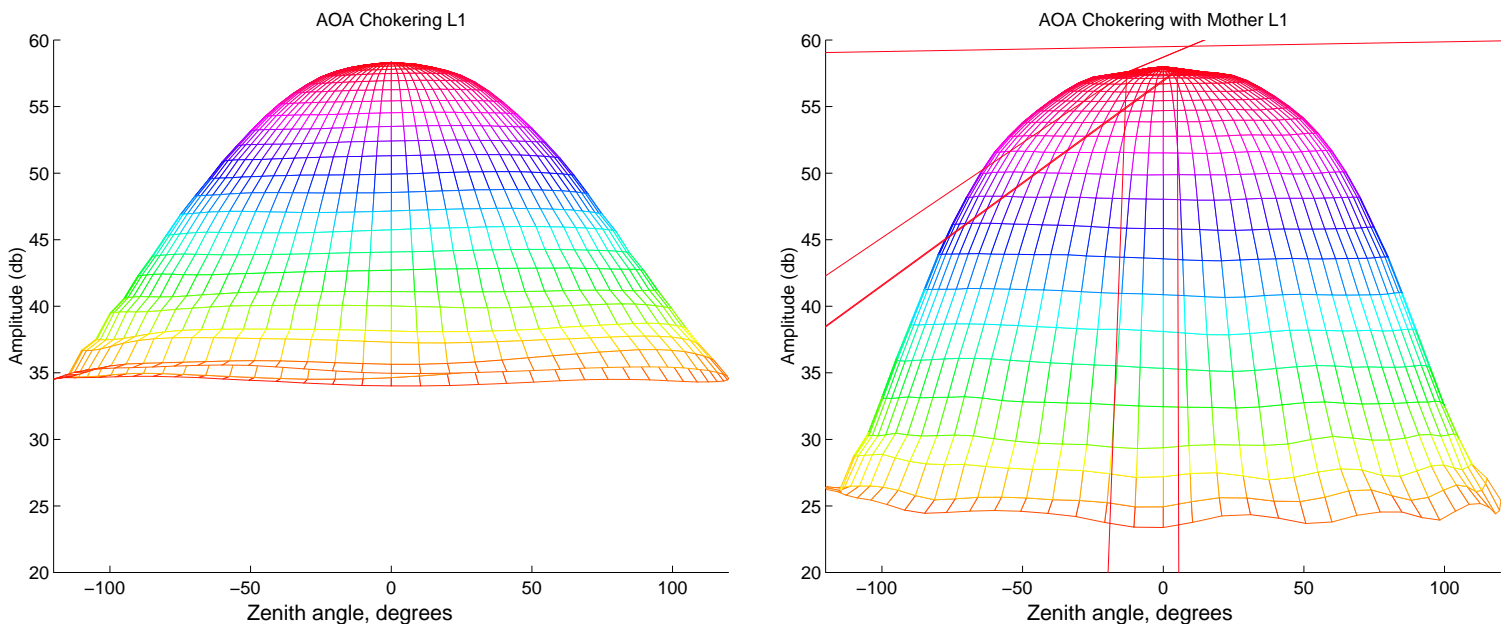


FIGURE 1. L1 Gain plots of Turbo Rogue Antenna (AOA) without (left) and with (right) 1 meter choke ring enhancement (called “Mother”). Note that the large choke enhancement increases gain at low to mid elevation angles above the horizon, while steepening the cutoff at and below the horizon.

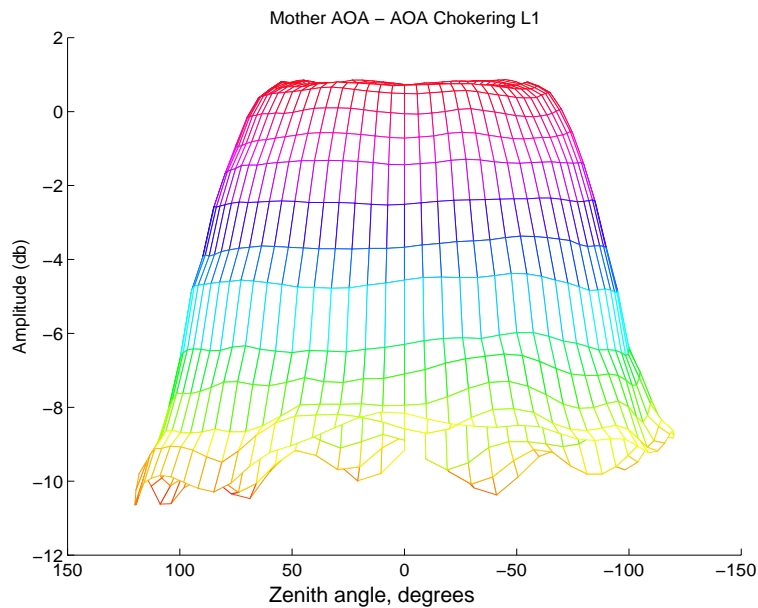
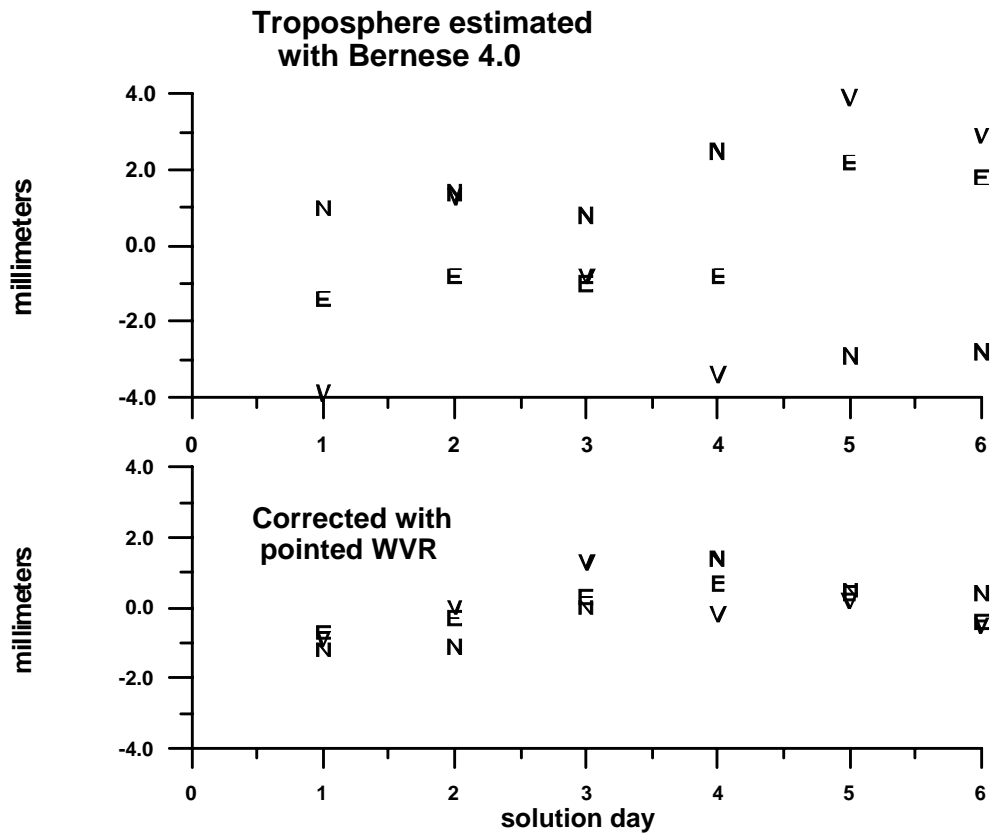


FIGURE 2. Difference in gain at L1, standard Turbo Rogue choke ring minus Turbo Rogue choke ring with 1 meter enhancement.

Phase center position as a function of source azimuth and elevation was also measured in the anechoic chamber. The enhanced antenna showed slightly less phase center motion than the standard AOA antenna. This is not a definitive test, however, because the anechoic chamber eliminates reflected (multipath) signal, which can be a major cause of phase center motion. A more dramatic improvement is expected in field applications due to better suppression of signal from behind the antenna.

In a separate test in the anechoic chamber, the choke ring enhancement was brought up to level on one side to determine the effect of severe field damage. Only insignificant changes were seen in the gain pattern.

The improvement in repeatability on a 45 km baseline with WVRs and large choke rings is shown below.



RMS repeatabilities (mm)	north	east	vert
Bernese 4.0 w/trop estimations (6 days)	2.3	1.6	3.4
Corrected with pointed WVR (6 days) (9 days, some bad (incomplete) data)	1.0 0.9	0.5 1.2	0.8 1.1