



GNSS Antenna Comparison -for Bistatic Application

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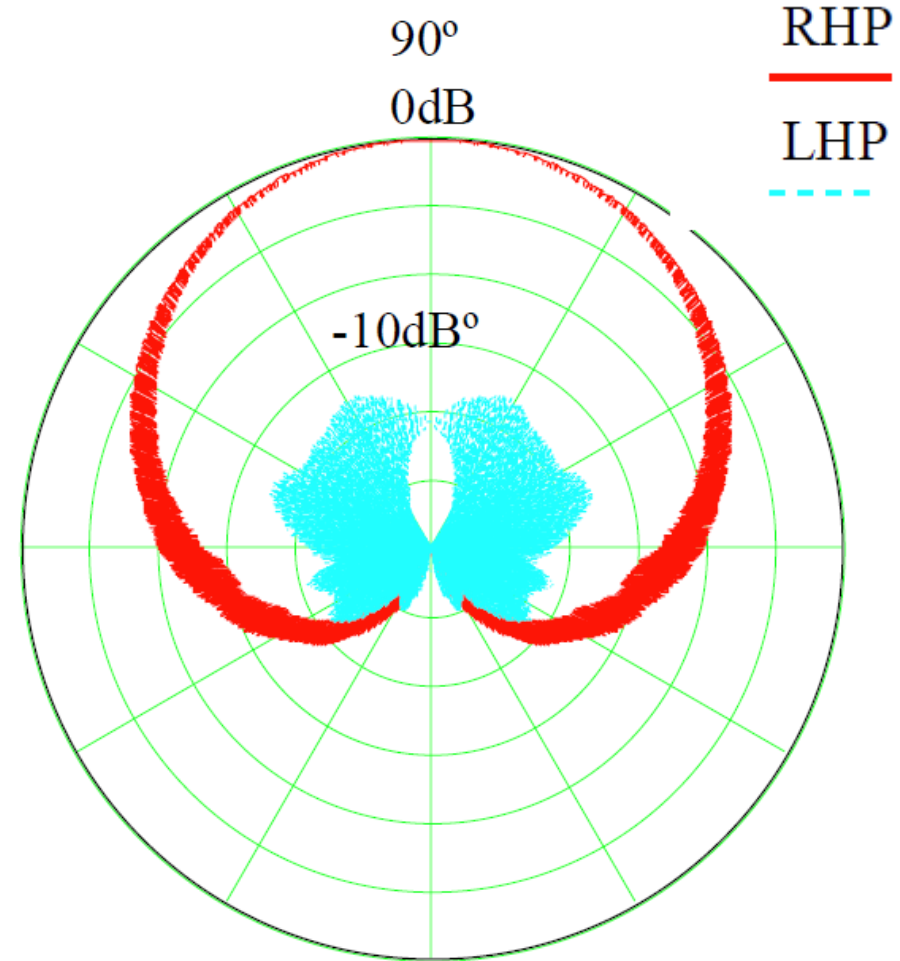
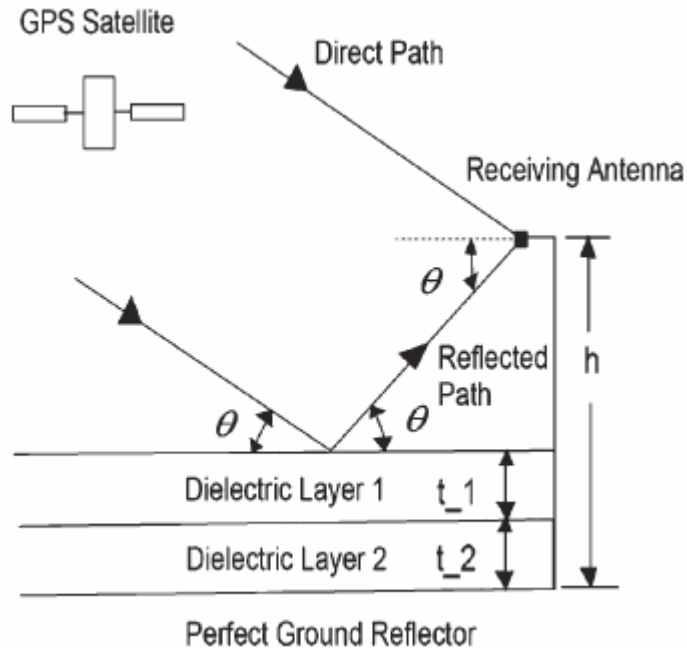
University of Colorado, USA

Presentation Outline



- L2 antenna introduction/overview
- DLC rooftop, 24h data collection with:
 - JN L2-horiz. antenna
 - Novatel Pinwheel antenna
 - Antcom L1L2L5 antenna
- SNR for two fix heights
- SDR Efforts
- Proposed future work

Theoretical Background



- Basic concept of a reflected signal
- Multiple layer possible (especially with snow/ice)

- Gain pattern for a NovAtel Pinwheel GPS antenna
- Suppresses the LHP



Commercial Antennas

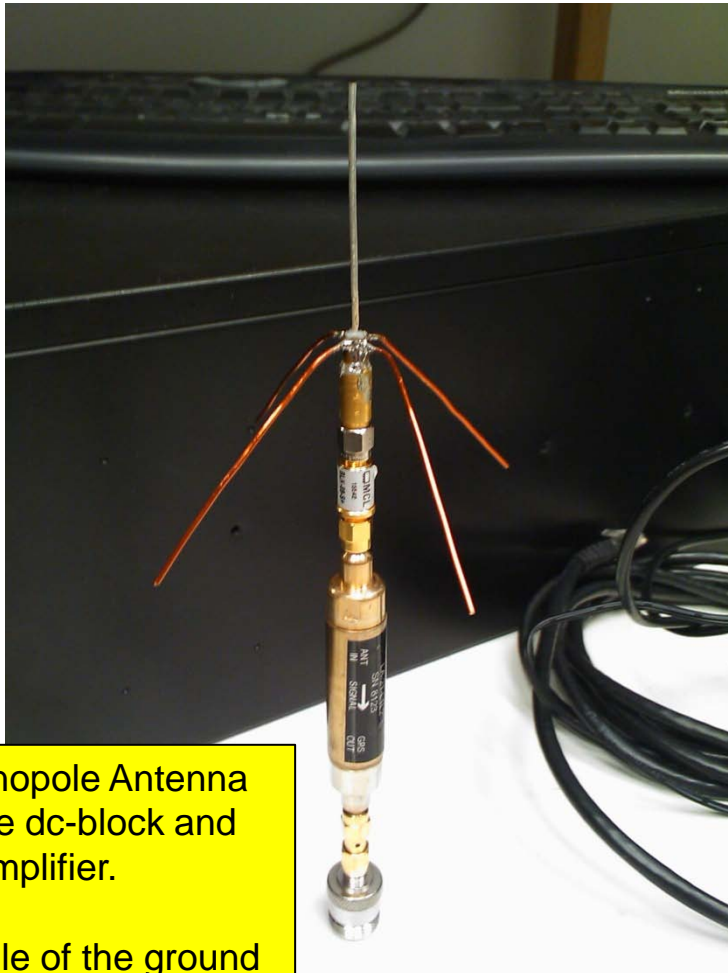
Novatel Pinwheel antenna



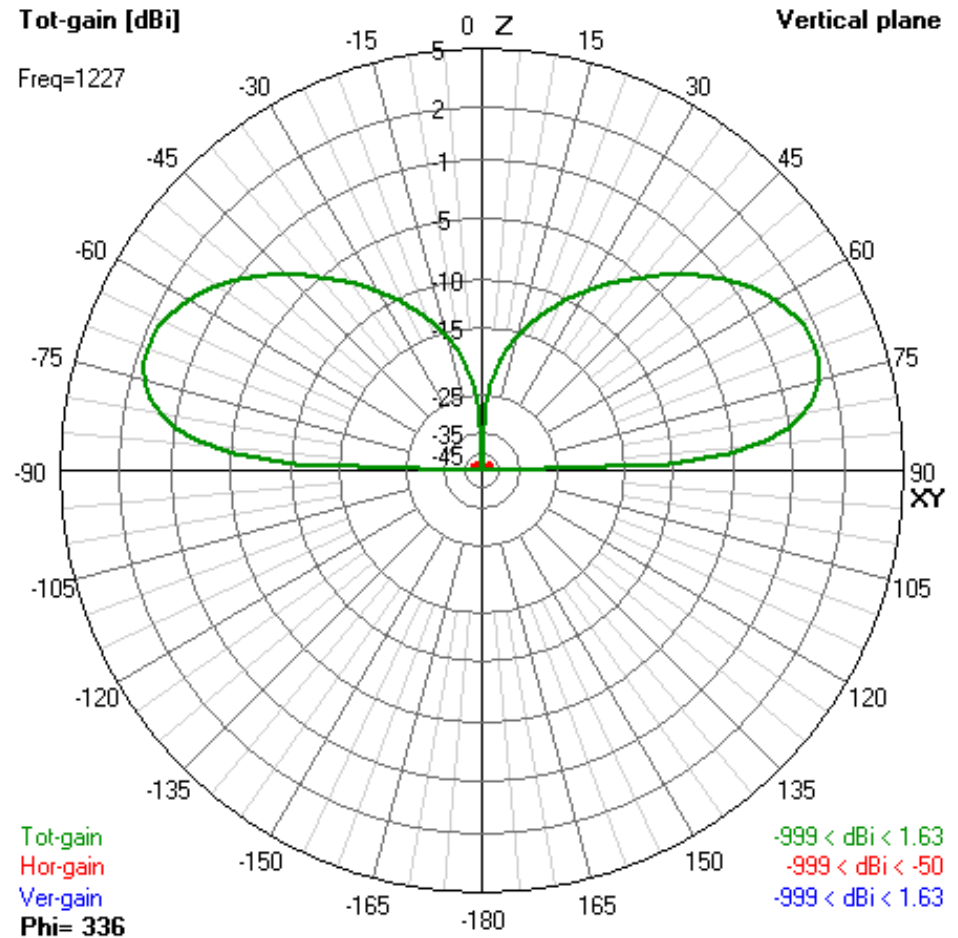
Antcom L1L2L5 antenna



L2 Monopole Antenna



- Monopole Antenna above dc-block and preamplifier.
- Angle of the ground sprouts determine the impedance of the antenna

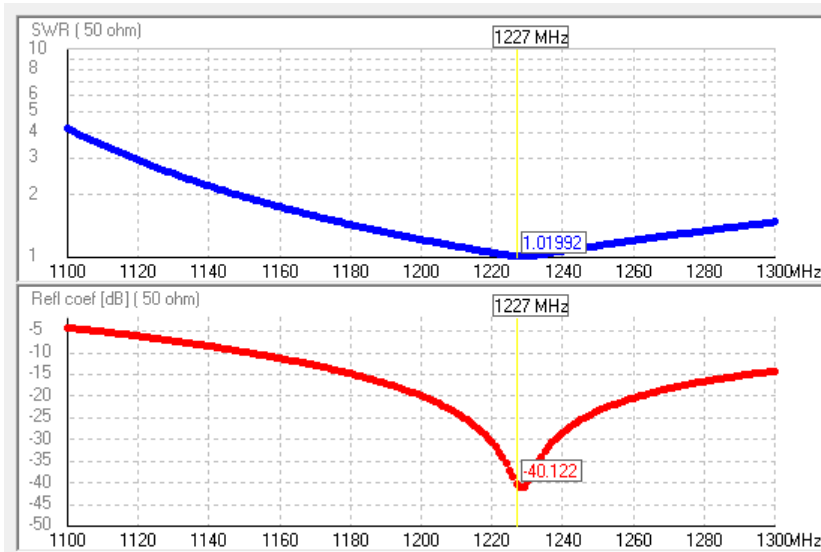


- Simulated gain pattern with idea ground plane
- Polarization not factored into simulation

Freq. Response for L2-Simulation

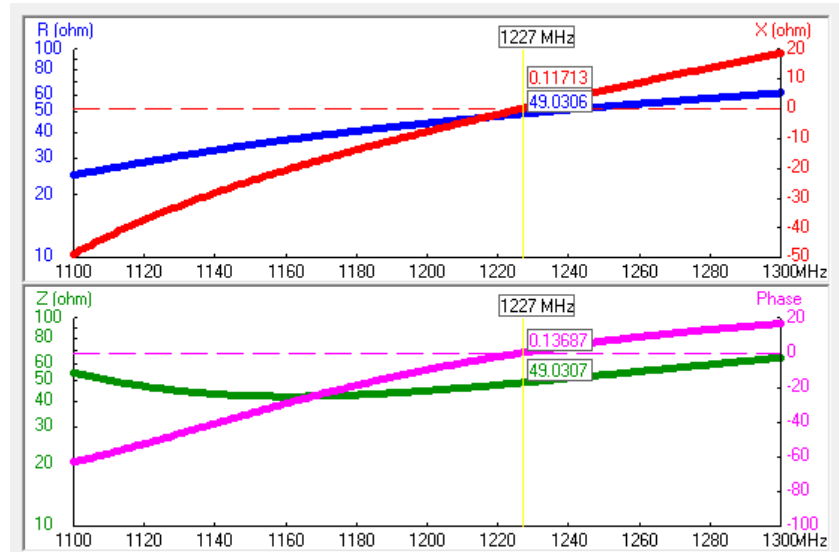


Freq. And SWR



- Standing wave ration ~ 1
- The reflection coefficient as low as -40 dB at L2

Phase and Impedance



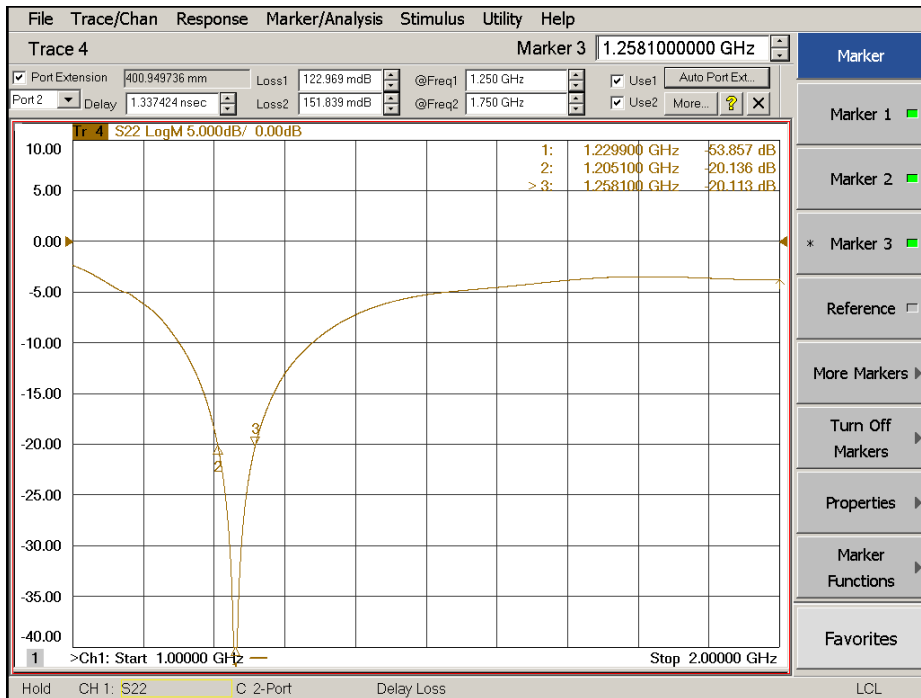
- The complex impedance is $\sim (49.0+0.1j)$
- The phase is ~ 0.1 deg



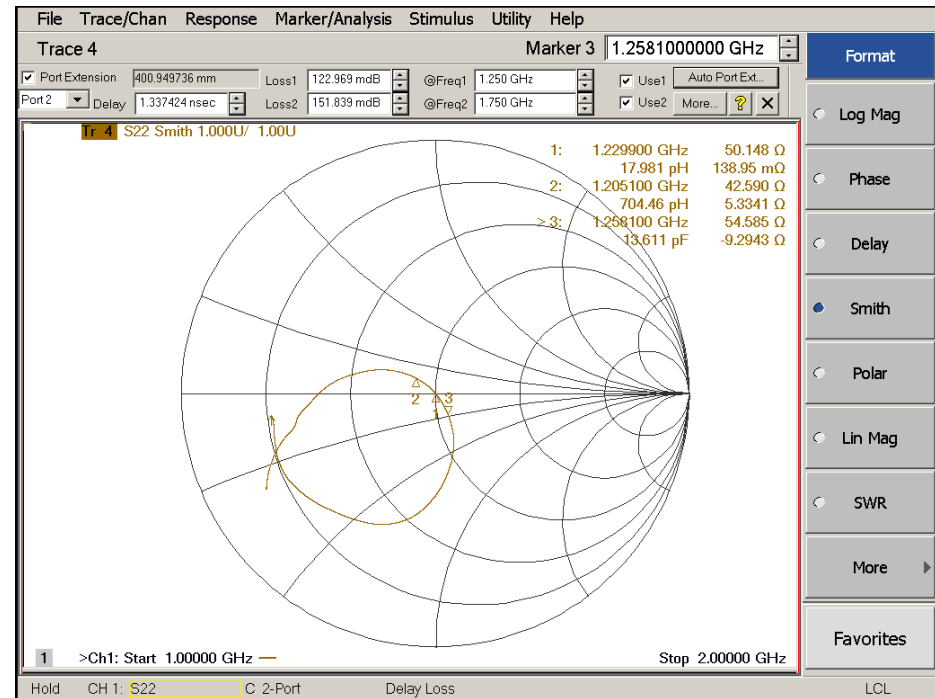
L2-Measurement

Frequency sweep

Impedance (Smith chart)



• The reflection coefficient as low as -54 dB for L2



• The Impedance is about 50 Ohm where the imaginary part is just a fraction

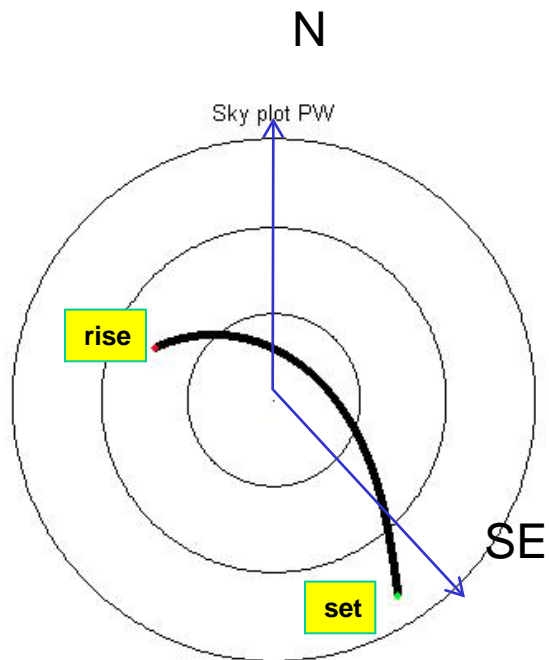
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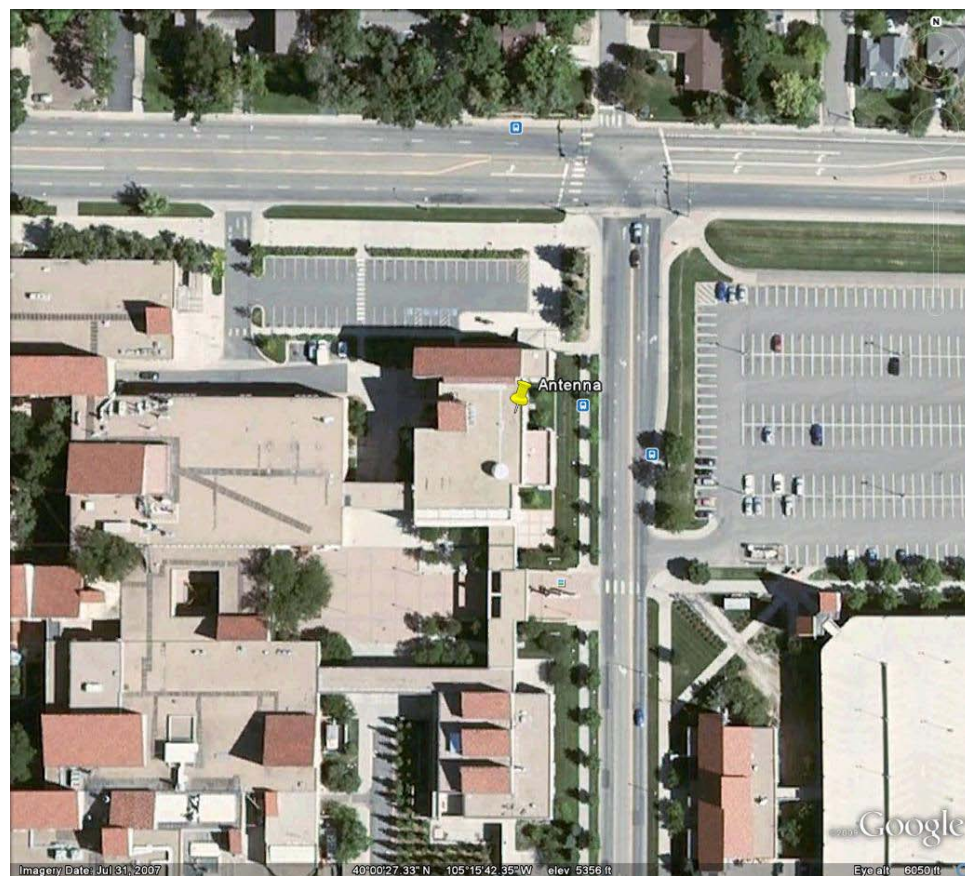
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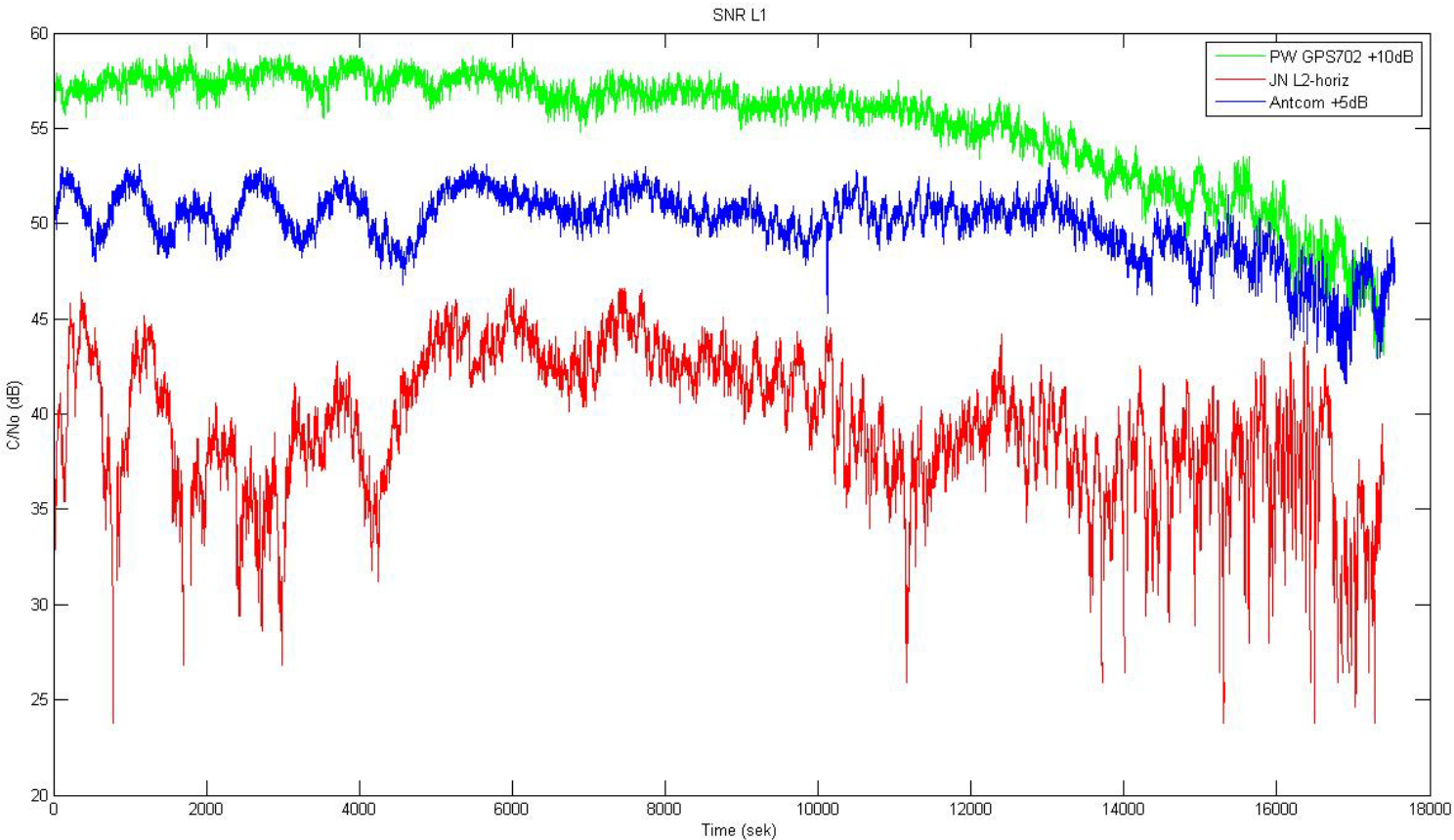
PRN 07 Sky-plot



•The location of the antenna (Univ of Colorado Engineering Building) and sky trace of satellite of interest (PRN07) are illustrated

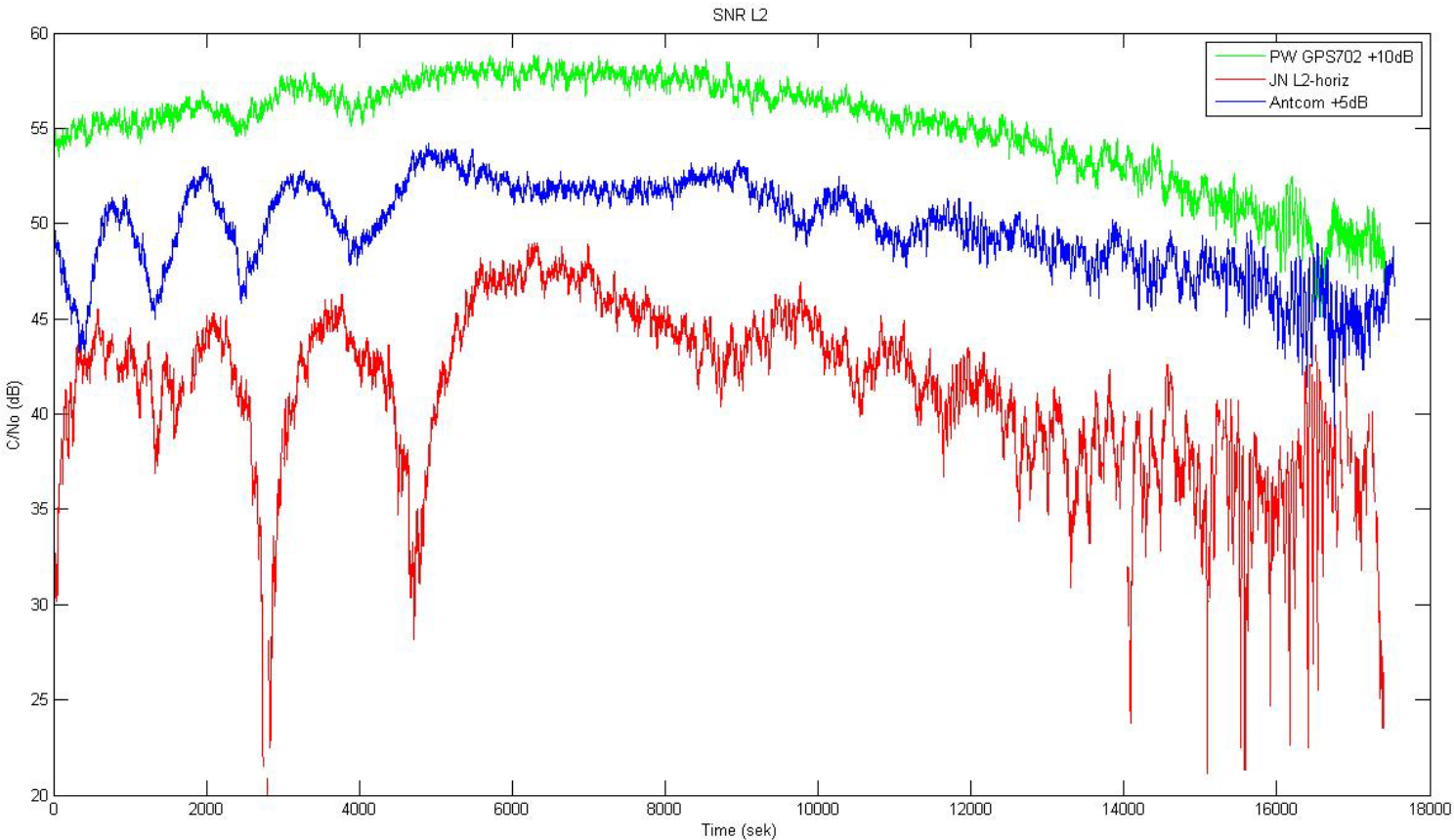


PRN 07- L1 Measurement



- Three L1 C/No traces for PRN07 (taken over three different days)
- Pinwheel is stable (except as PRN7 set)
- Antcom exhibits a “nice” pattern during rise
- Monopole has deeper fades but appears sporadic
- In summary, results are as expected

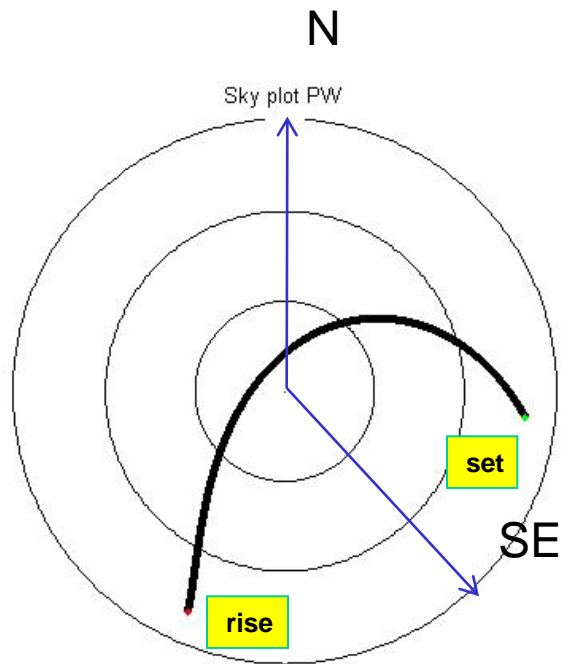
PRN 07 L2C CM+CL Measurement



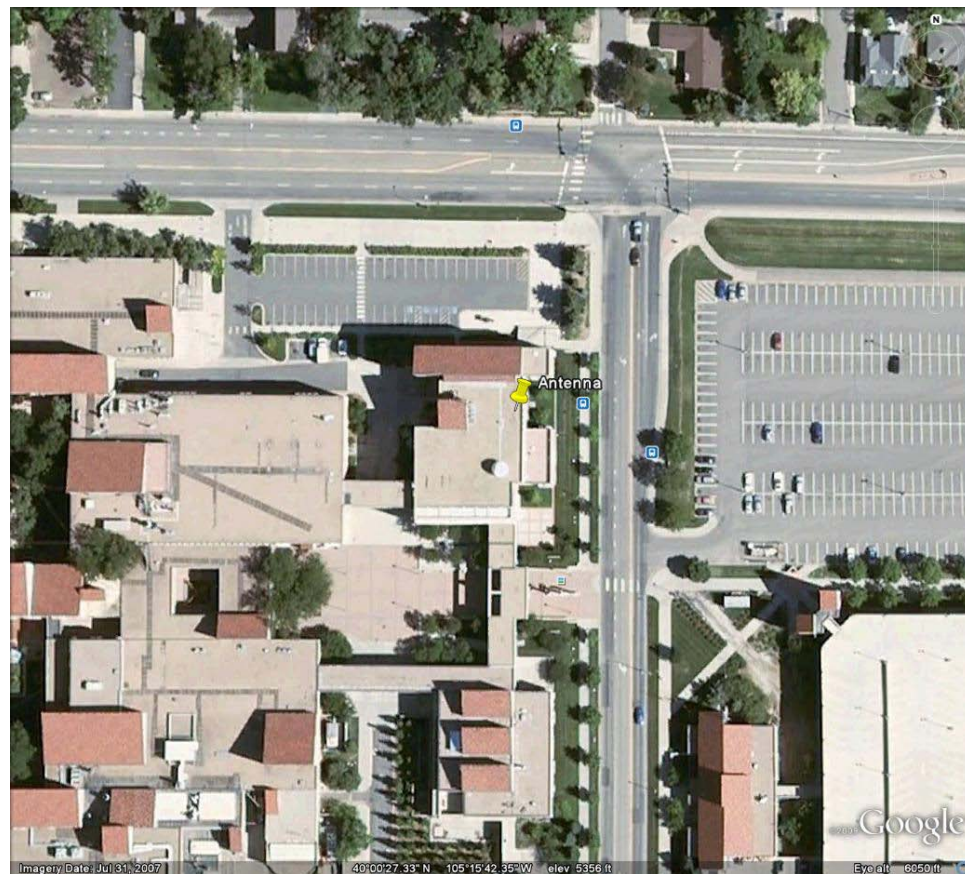
- Three L2 C/No traces for PRN07 (taken over three different days)
- Pinwheel is stable
- Antcom exhibits a “nice” pattern during rise
- Monopole has deeper fades but still appears sporadic
- In summary, smoother traces but more characteristic fluctuations than the L1 measurements



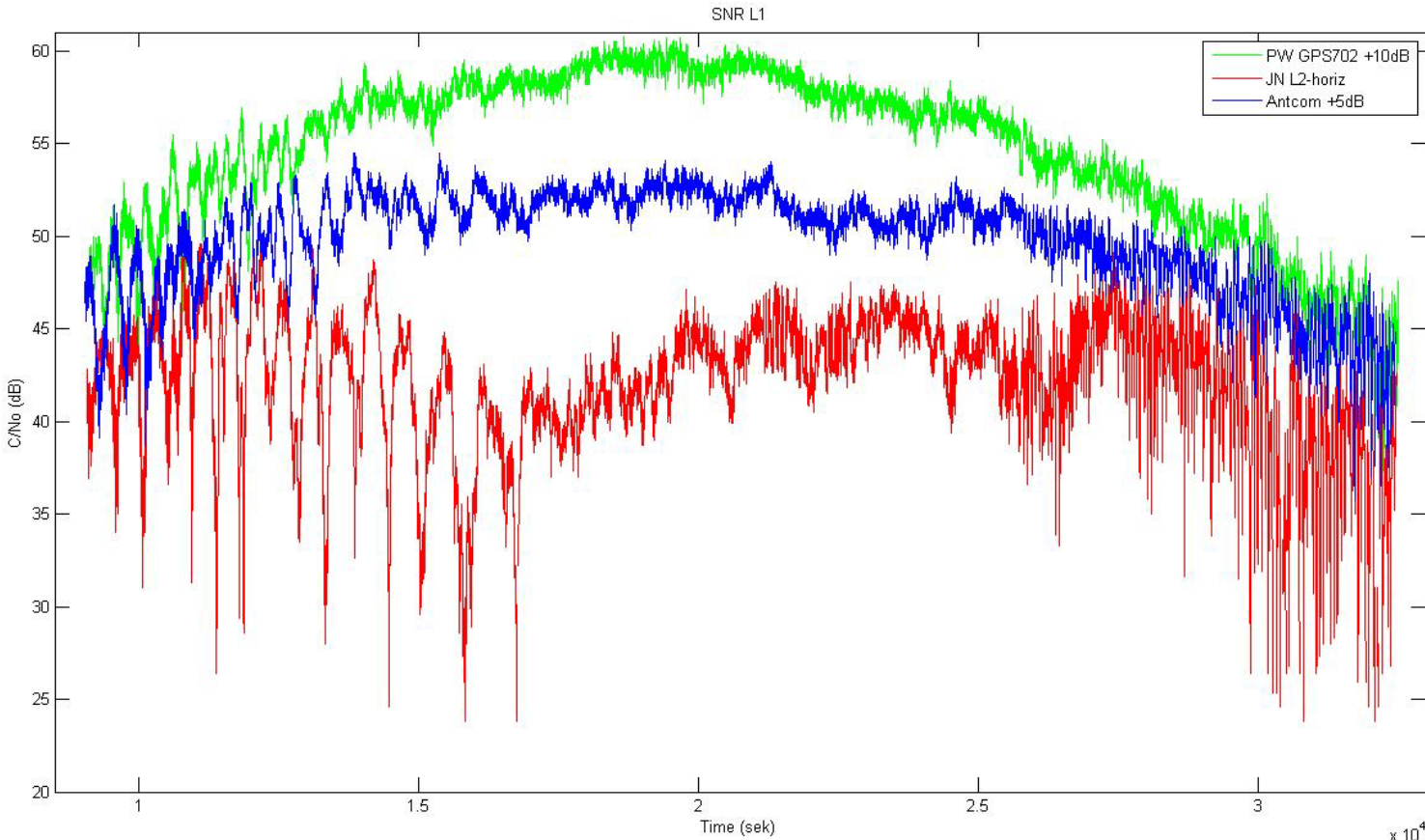
PRN 17 Sky-plot



•The location of the antenna (Univ of Colorado Engineering Building) and sky trace of satellite of interest (PRN17) are illustrated

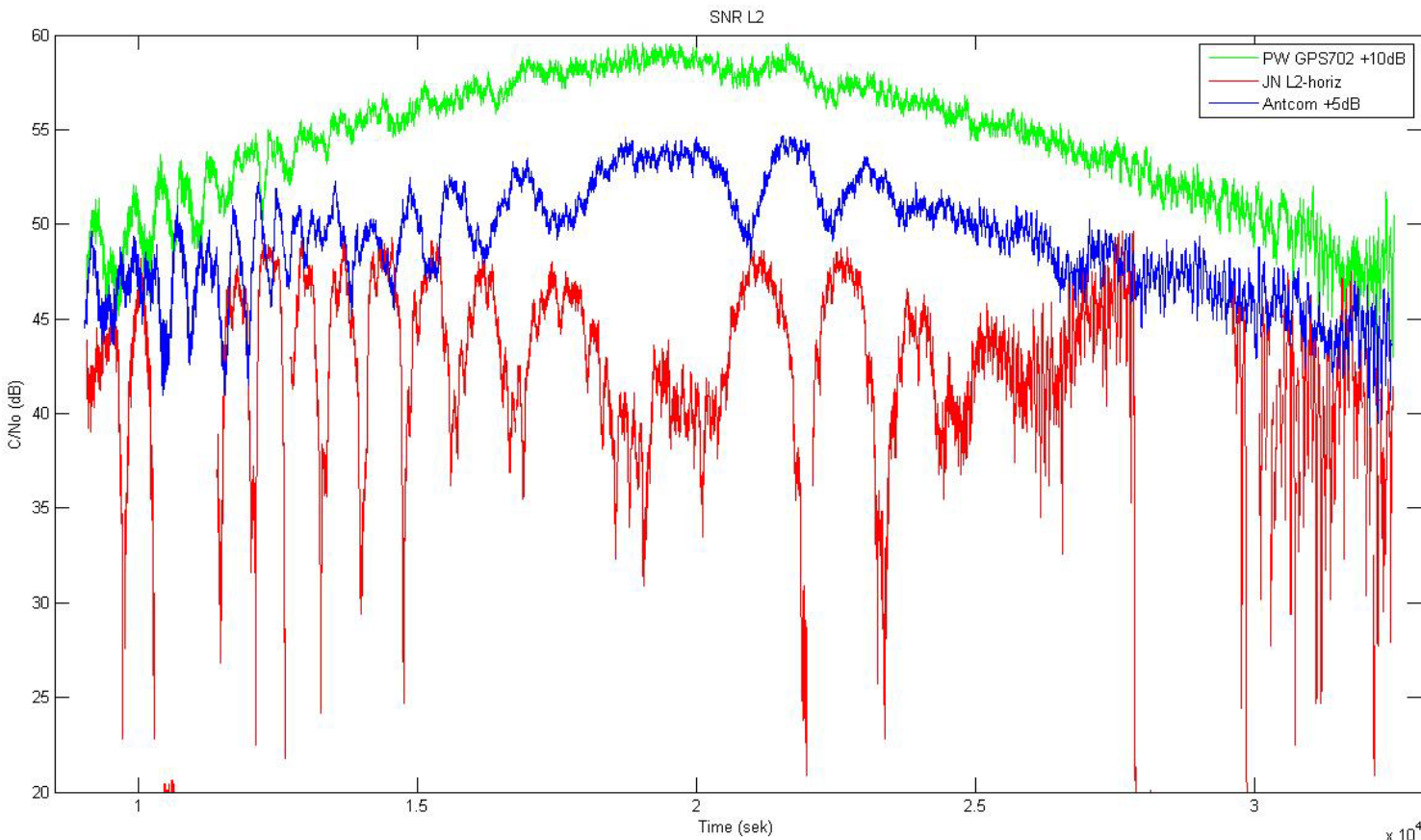


PRN 17 – L1 Measurement



- Three L1 C/N₀ traces for PRN17 - taken over three different days - sweet spot for the monopole
- Pinwheel provides strong expected arc
- Antcom has a “nice” far field reflection pattern during rise
- Monopole have a stronger fluctuation and is a bit sporadic as the satellite sets
- In summary, clearer far field reflection than PRN 7

PRN 17 L2C CM+CL Measurement



- Three L2 C/N₀ traces for PRN17 -taken over three different days - sweet spot for the monopole

- Pinwheel provides strong expected arc

- Antcom continues to show a “nice” far field reflection pattern during rise (limited LHCP rejection?)

- Monopole has the desired stronger fades and continues to be sporadic as the satellite sets

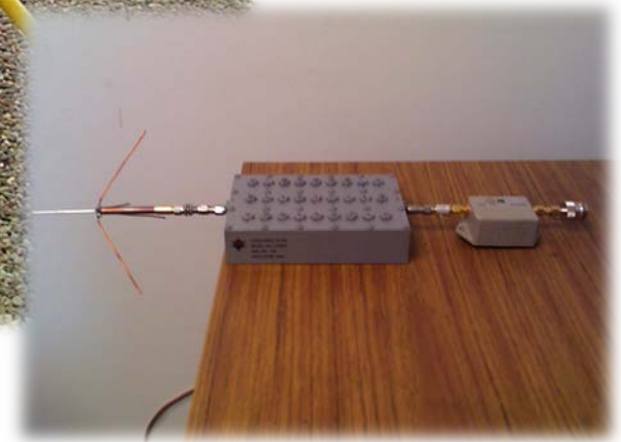
- In summary, more clarity for the desired/fluctuations than the L1 signal on PRN17 and both signals on PRN7

Presentation Outline

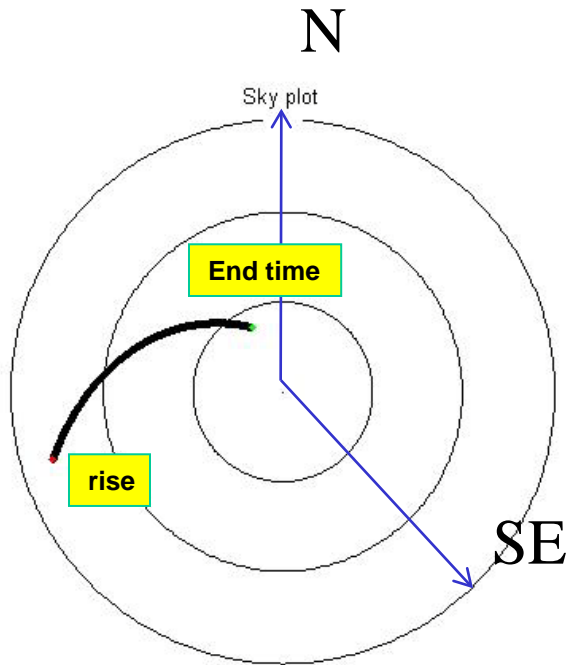


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SNR for two fix heights



PRN7 Sky-plot

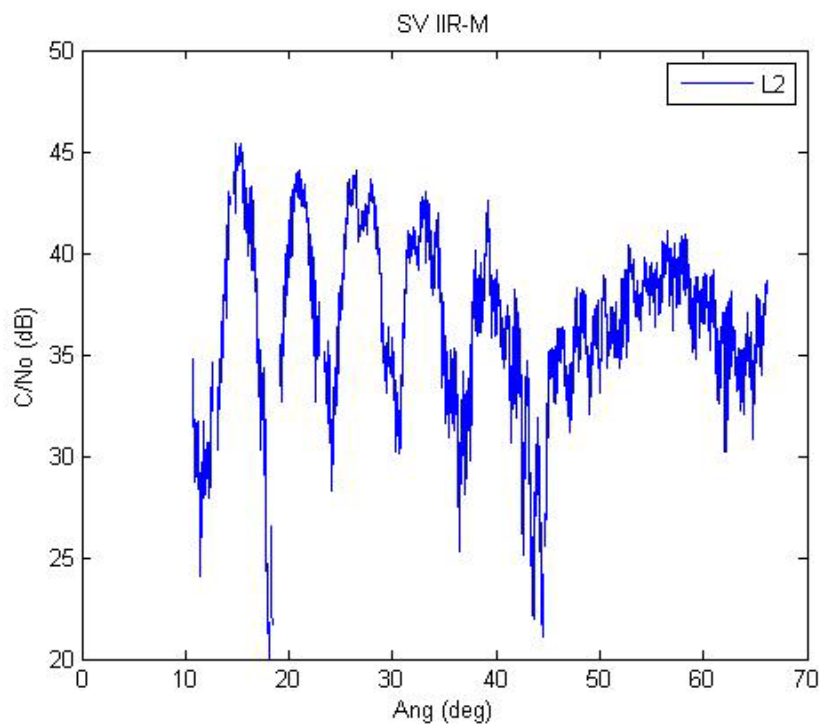


- The location of the antenna (Univ of Colorado Engineering Building) and sky trace of satellite of interest (PRN07) are illustrated

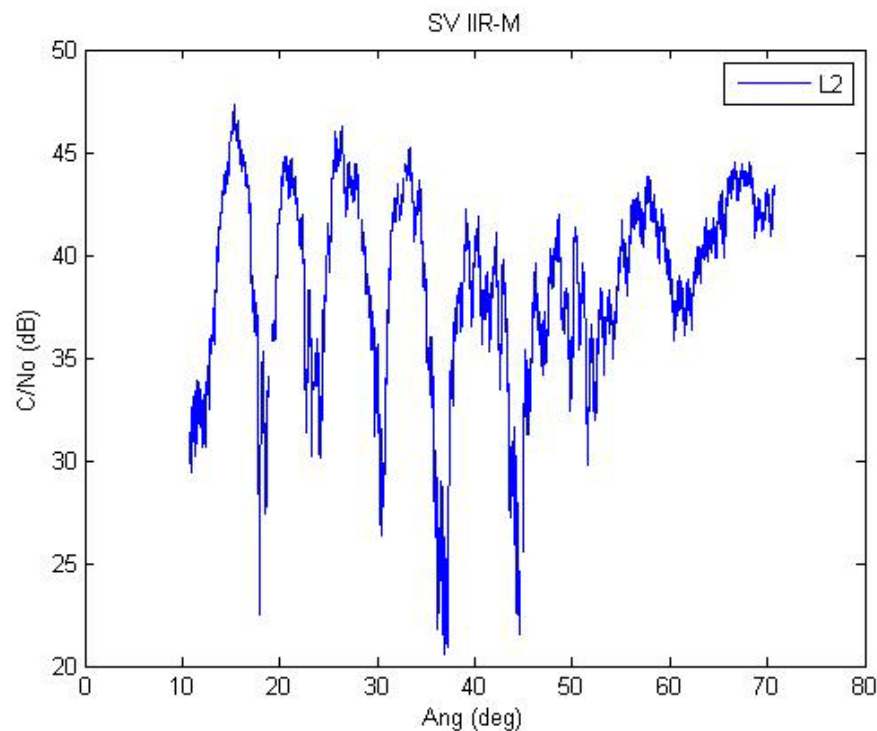


PRN 7

48,5in. dry



Rain, wet



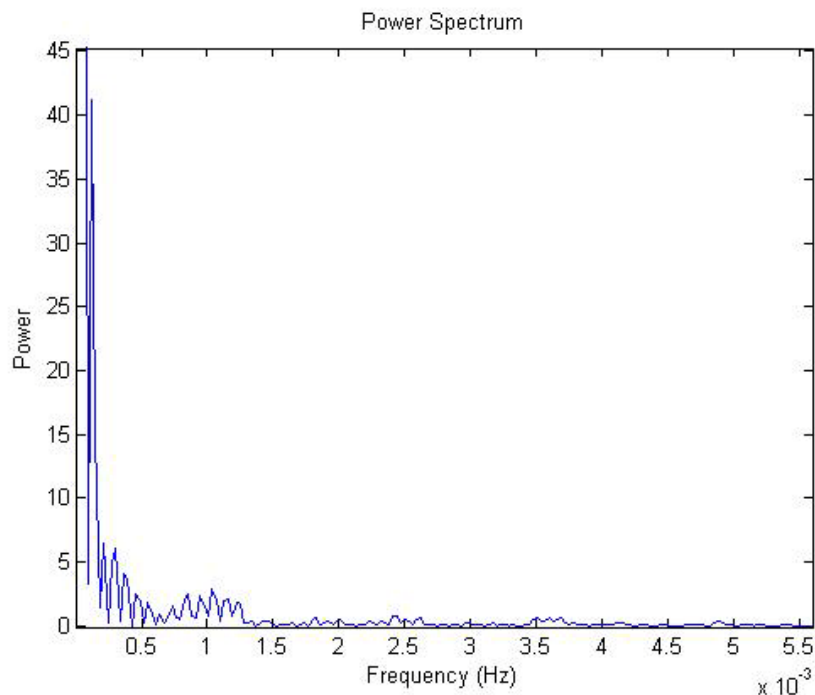
- At 1,2m height the monopole is getting a stronger effect (deeper fades) of the constructive and deconstructive interference when the surface is wet



PRN 7

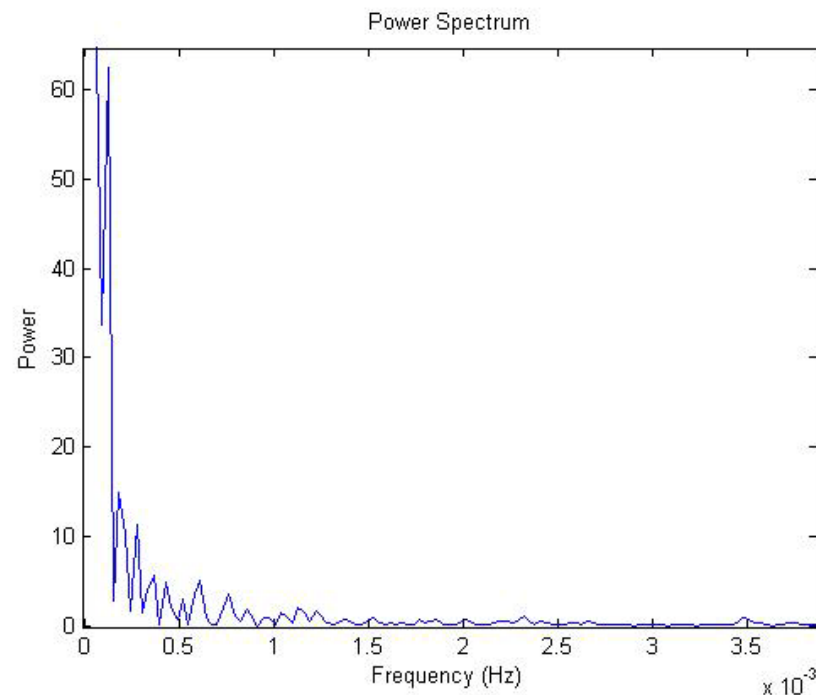
48,5in. Dry

**peak: 41.16power
at 0.0001221Hz**



Rain, wet

**peak: 62.43power
at 0.0001221Hz**



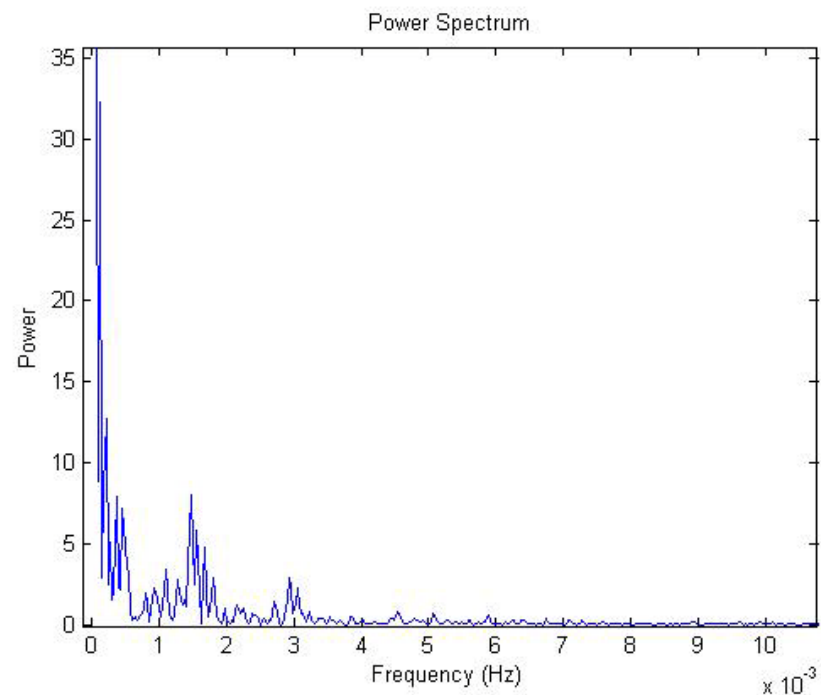
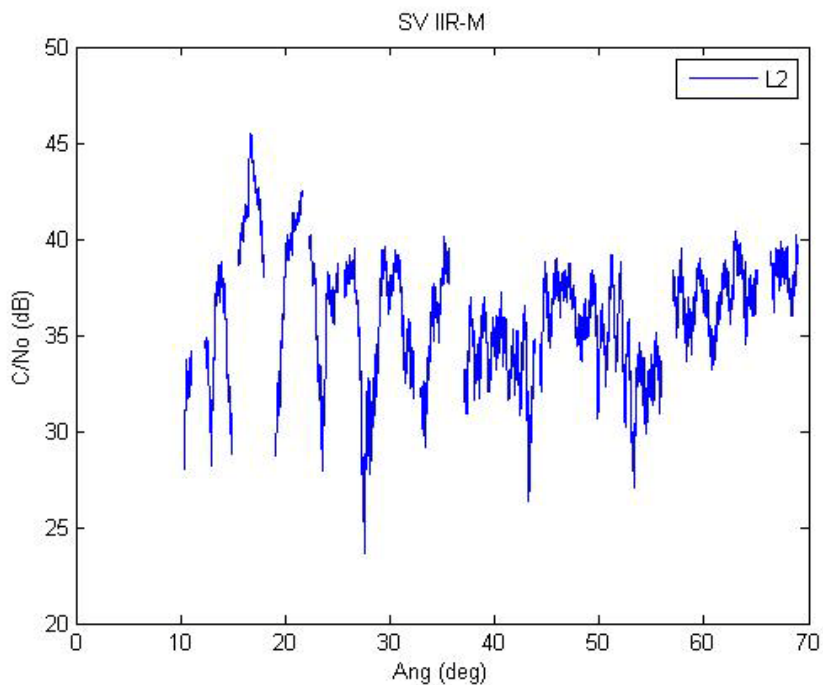
•The differs in the magnitude of the power spectrum also gives the wet surface the advantage



PRN 7

peak: 32.34power
at 0.0001221Hz

63,5in. dry



•While at 1,6m height the monopole is a more sporadic on the measurement and a weaker result compare with the lower height

Presentation Outline

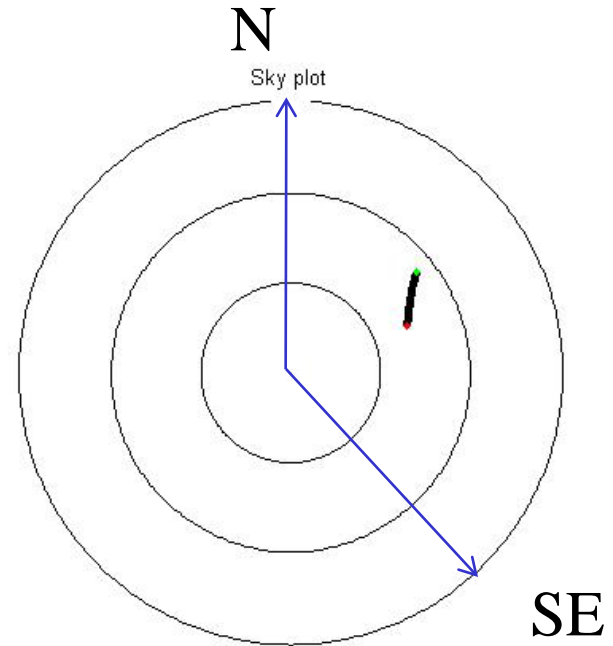
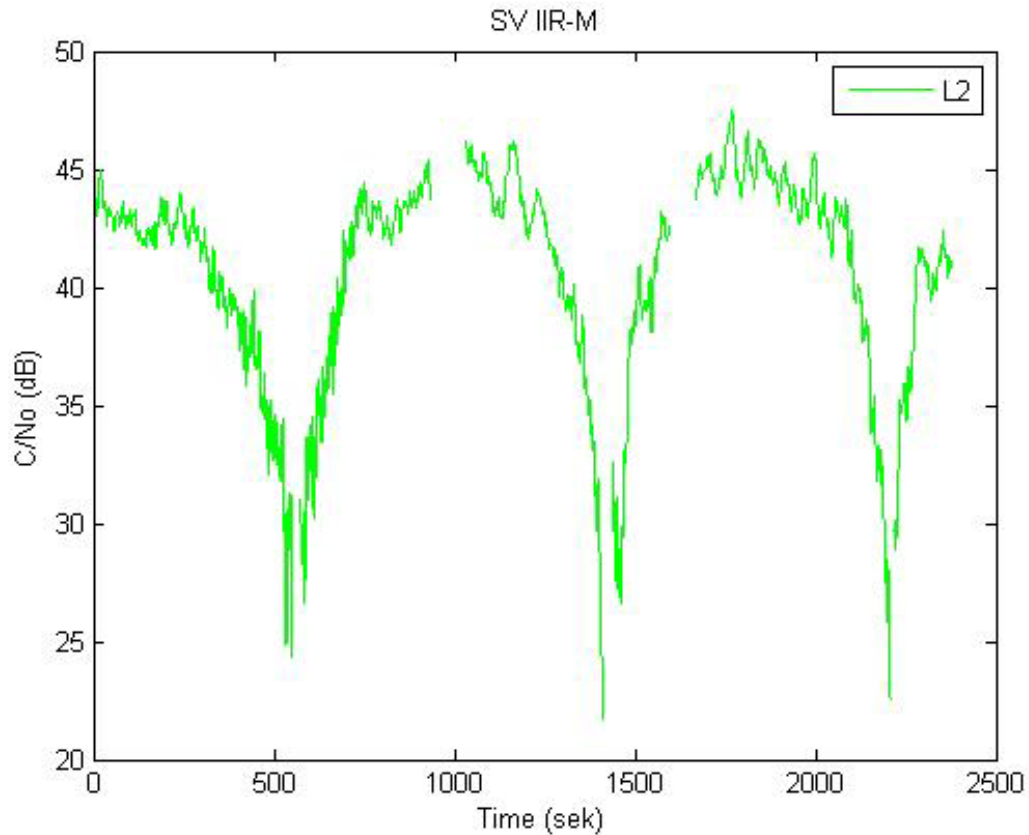


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SDR Comparison (40min data set)

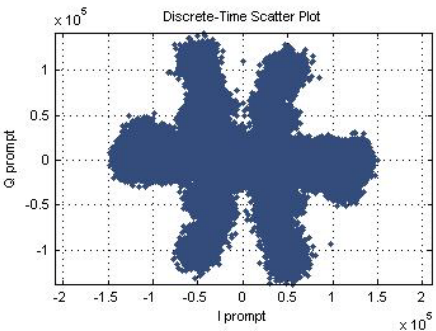
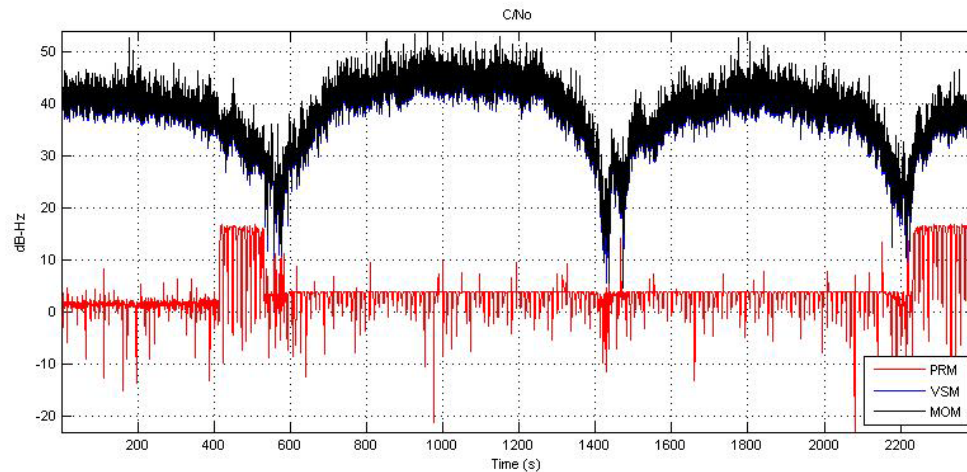
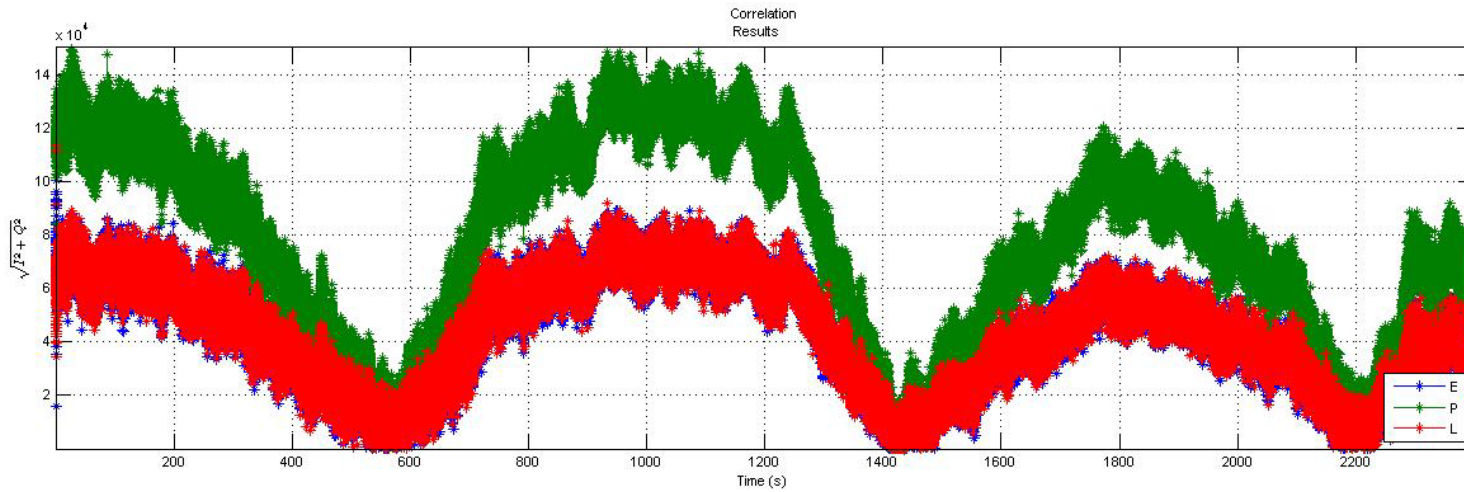


PRN 15 NetR8



- The logged RINEX file from NetR8 receiver follows a clear constructive/deconstructive interference under its constraints of the sensitivity software

PRN 15 SDR



- Matlab SDR processing shows the same C/No profile
- Fails to lock on the exact phase; either L2C quarter cycle problem or merged processing of the CM and CL codes
- In summary, the SDR for the L2C code is under development with promising preliminary results

Proposed Future Work



- Work on GPS SDR code for L2C and L5 measurement (including GIOVE measurements)
 - Phase lock/data bit issues
 - Sensitivity
 - C/No estimators
- Assess other antenna designs
- Real time L2C GPS SDR receiver implementation