

About the Experiment

- S84 Rev205 T102 Titan Bistatic and Occultation Observations
 - Bistatic inbound and outbound: 1-way mode
 - Occultation: 2-way/3-way mode
 - Telemetry OFF, Ranging OFF
 - Covered by Canberra

Science Highlights

From Essam Marouf and RSS Team

The RSS Titan observations on T102 include ionospheric/atmospheric occultations and bistatic surface scattering on both the ingress and egress sides.

The ingress occultation probes 64.7S latitude and the egress occultation probes 63.2N latitude. The occultation will 1) determine seasonal changes in the high latitude atmosphere, specifically the temperature structure and formation and breakup of the winter polar vortex; 2) determine tropospheric winds from radio occultation measurements of tropospheric temperature profiles; 3) determine the atmospheric and ionospheric structure at all levels.

During the bistatic observation period, the Cassini HGA boresight is continuously maneuvered to point to the region on Titan's surface where mirror-like (specular) reflection can be observed at the NASA DSN ground receiving stations at Canberra. T102 is the second of two northern seas crossing bistatic opportunities implemented in association with RSS Titan occultations. The egress ground track barely misses the Ligeia Mare and probes the territory between it and the Kraken Mare (roughly 75N latitude, 260W to 320W longitude). The ground track then enters the northern region of the Kraken Mare and terminates well within it. The expected quasi-specular scattering captures incidence angles decreasing from ~80 to ~60 degrees. The ingress bistatic observation covers the region (lat, long) = (20S, 15W) to (50S, 25W). The corresponding incidence angle increases from ~45 to ~70 degrees. Measurements of the power and polarization properties of the echoes, when detectable, yield information about the surface status (liquid/solid), surface reflectivity, surface dielectric constant, implied composition, and surface roughness.

DSN Antennas

- DSN Coverage

	Pre	BOT	EOT	Post									
14 169	0705	1010	1730	1830	DSS-34	CAS	RS	T102	BIST/OCC	6107	N750	1A1	
14 169	0710	1010	1730	1830	DSS-43	CAS	RS	T102	BIST/OCC	6107	1647	1A1	

- DSS-43 will provide uplink for the occultation
 - DSS-34 will be backup

- Receivers scheduled

- 2 closed-loop receivers per antenna
- Open-loop receivers (RSRs, WVSRs, VSRs)
- Open-loop data are prime. Closed-loop data are backup
 - Will need ramp info in closed-loop data for processing
- RCP and LCP will be recorded
 - 1-way and 2-way/3-way modes

S84 T102 Open-Loop Receivers Assignment

DSS	Operator	Station	Open-loop Receiver	Channels	Subchannels	Bandwidths KHz
43	Dustin	rsops1	RSR1	RSR1A -> XRCP RSR1B -> XLCP	1, 2, 3, 4 1, 2, 3, 4	1, 16, 50, 100 1, 16, 50, 100
43	Elias	rsops2	RSR2	RSR2A -> SRCP RSR2B -> SLCP	1, 2, 3, 4 1, 2, 3, 4	1, 16, 50, 100 1, 16, 50, 100
34	Danny	rsops3	VSR1	VSR1A -> KRCP VSR1B -> KLCP	1, 2, 3, 4 1, 2, 3	1, 16, 50, 100 1, 16, 50
34	Danny	rsops5	WVSR1	WVSR1A -> XRCP WVSR1B -> KRCP	1, 2, 3, 4 1, 2, 3 4, 5, 6	1, 16, 50, 100 1, 16, 50 (2-way) 1, 16, 50 (1-way)
43	Elias/ Dustin	rsops4	WVSR2	WVSR2A -> XRCP WVSR2B -> XRCP	1, 2, 3 1, 2, 3	1, 16, 50 (2-way) 1, 16, 50 (1-way)
43	Danny	rsops5	PRSR1	PRSR1A -> SRCP	1, 2, 3 4, 5, 6	1, 16, 50 (2-way) 1, 16, 50 (1-way)

RSSG will be in Ops Room at 11:30 pm on Tuesday, June 17th (237/0915)

Prime receivers. Monitor throughout experiment

Monitor during occultation to look for DST going out of lock

Aseel – VOCA

Dustin - Ops Room Displays

Danny – Check WVSR/VSR availability & RSR/WVSR/VSR disk space

Bistatic Calibrations

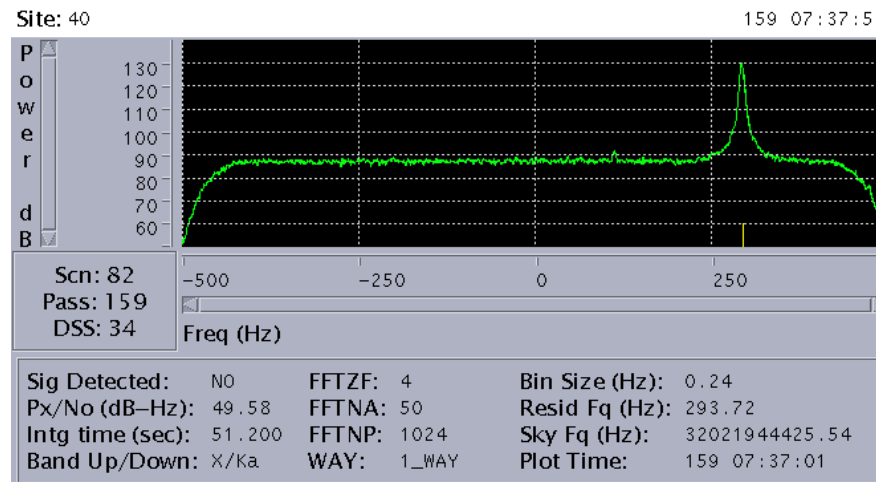
- Calibrations will be performed during
 - Pre-cal (antennas at stow)
 - 3-hr pre-cal periods are scheduled
 - Observation (mini-cals)
 - Pre-determined and carefully selected times (during turns)
 - Must be completed within 6-8 minutes
 - SNT Measurements
 - Completed within 3-4 minutes
 - Post-Cal (antennas at stow)
 - 1-hr post-cal periods are scheduled
- Pre-cal calibrations are the longest
- Lu and Aseel made slight changes to the bistatic procedure after T101
 - Current is Rev 6

ORTs

1. ORT on DOY 159 (June 8 PDT) over DSS-34, X- and Ka-band Completed

14 159 0600 0730 1630 1645 DSS-34 CAS TP RSS OCCORT MC 6097 N750 1A1

- Also prime TP
- Station performed Monopulse on-point phase cals in 1-way and 2-way modes
- Monopulse data acquired
- KRCP Spurs (DR C110269)
 - Visible in 1-way and 2-way mode
 - +/- 180 Hz from carrier. +/- 240 spurs visible after switch to 2-way
 - No visible X-band spurs

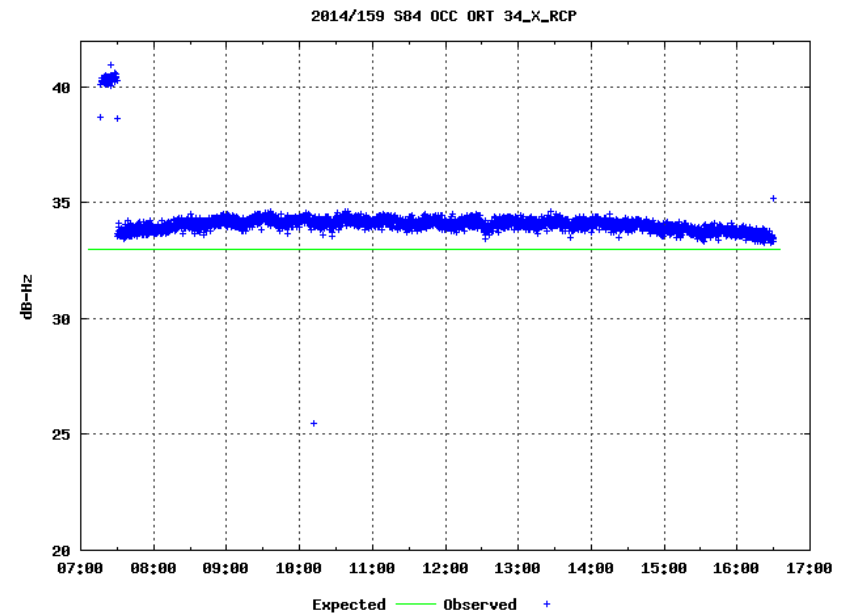
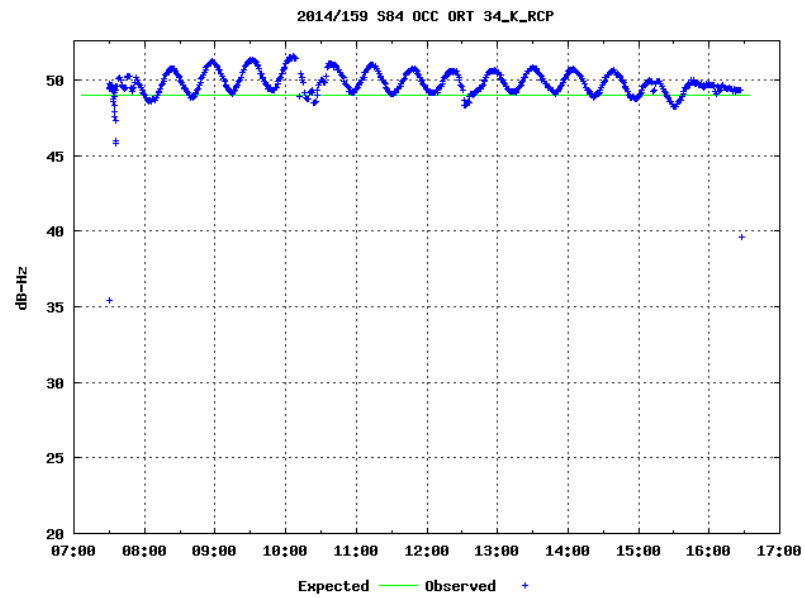


- DSS-35 was shadow tracking
 - Station asked RS to try to bring up RSR to look for spurs
 - Found predicts on SPS, but could not set IFS. Got error:
 - "Could not find 34_x_rcp cable"

ORTs cont'd

ORT on DOY 159 (June 8 PDT) over DSS-34, X- and Ka-band continued

Post-pass power plots



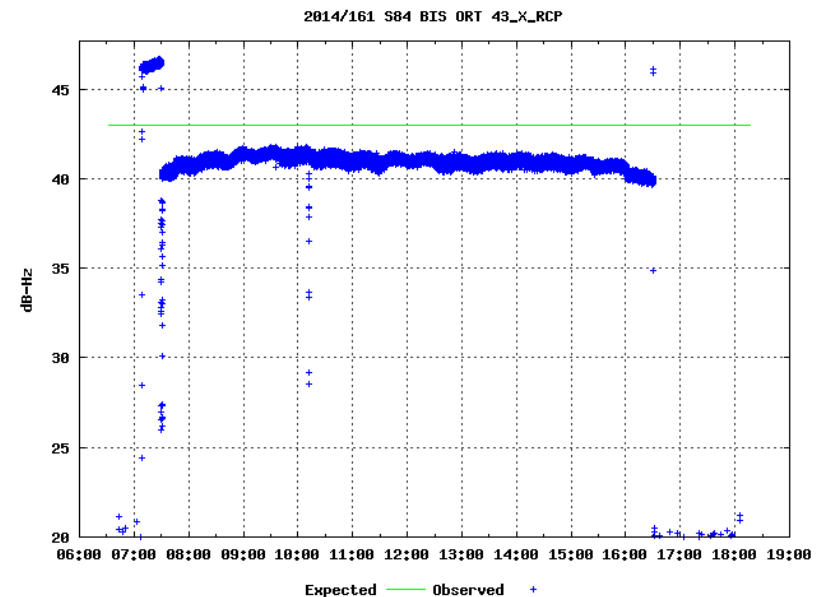
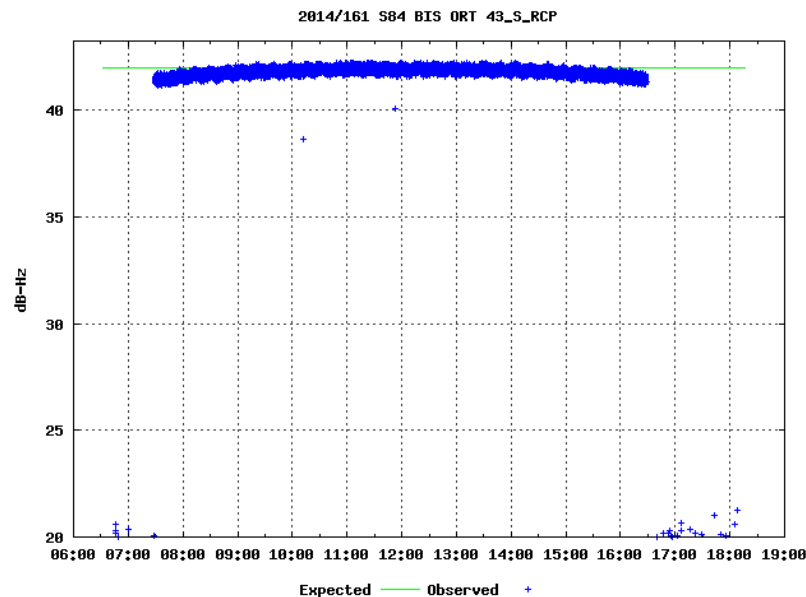
ORTs cont'd

2. ORT on DOY 161 (June 10 PDT) over DSS-43, X- and Ka-band Completed

14 161 0630 0730 1630 1830 DSS-43 CAS TP RSS BISTATORT 6099 1645 1A1

- Also prime TP
- Practiced bistatic calibrations during 2-hr post-cal
 - Team D supporting
 - Overall, station completed calibrations nominally
 - One minor problem when we requested SRCP in the ambient load. First we saw no change, so asked the station to verify. They put SLCP in the ambient load. Asked them to correct. Took a few minutes to get it right, but they eventually did
 - Mini Cal completed within 7 minutes

Post-pass power plots



ORTs cont'd

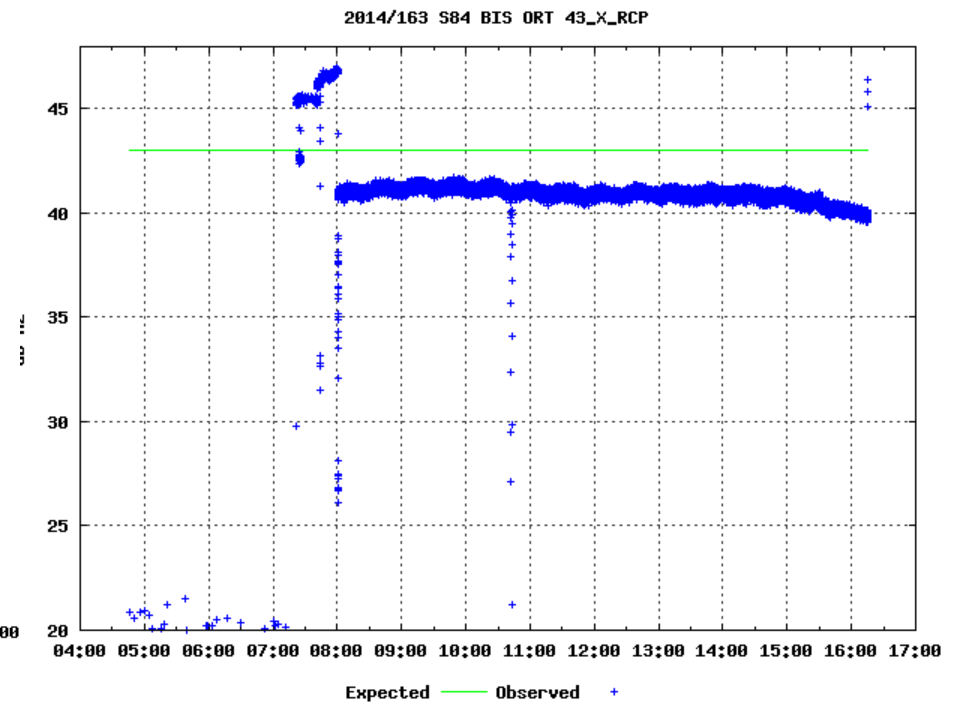
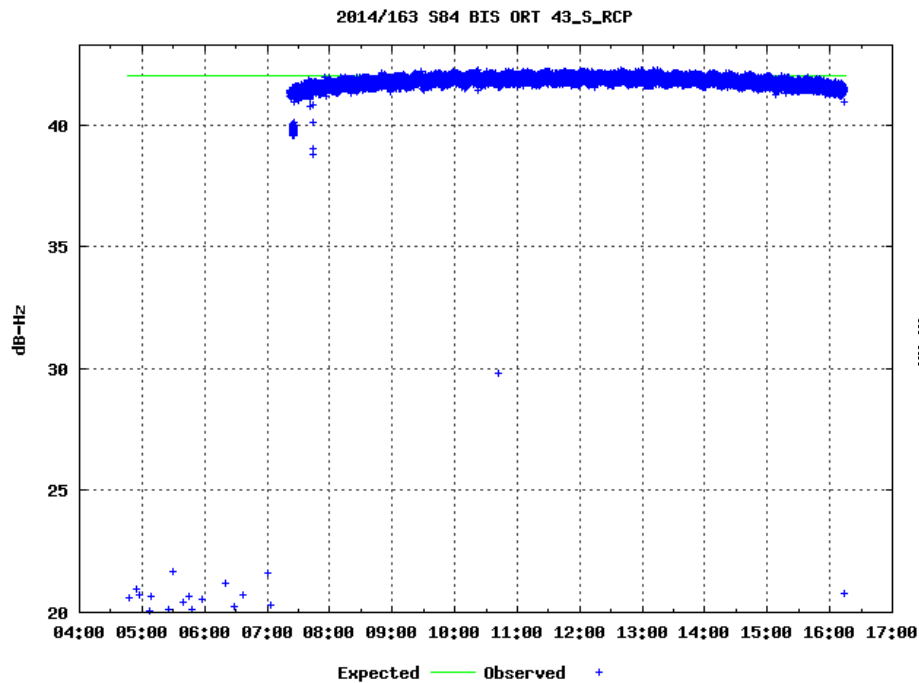
3. ORT on DOY 163 (June 12 PDT) over DSS-43, X- and S-band

Completed

14 163 0500 0800 1615 1630 DSS-43 CAS TP RSS BISTATORT 6101 1647 1A1

- Also prime TP
- Practiced bistatic calibrations during 3-hr pre-cal
 - Team A supporting
 - Station completed calibrations nominally without any problems

Post-pass power plots



ORTs cont'd

Upcoming

4. ORT on DOY 164 (June 13 PDT) over DSS-34, X- and Ka-band

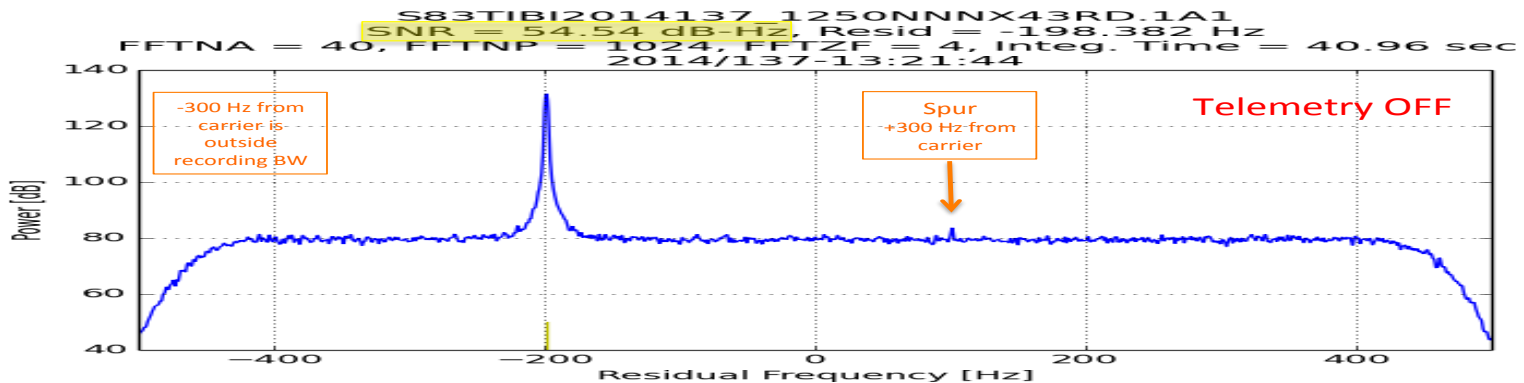
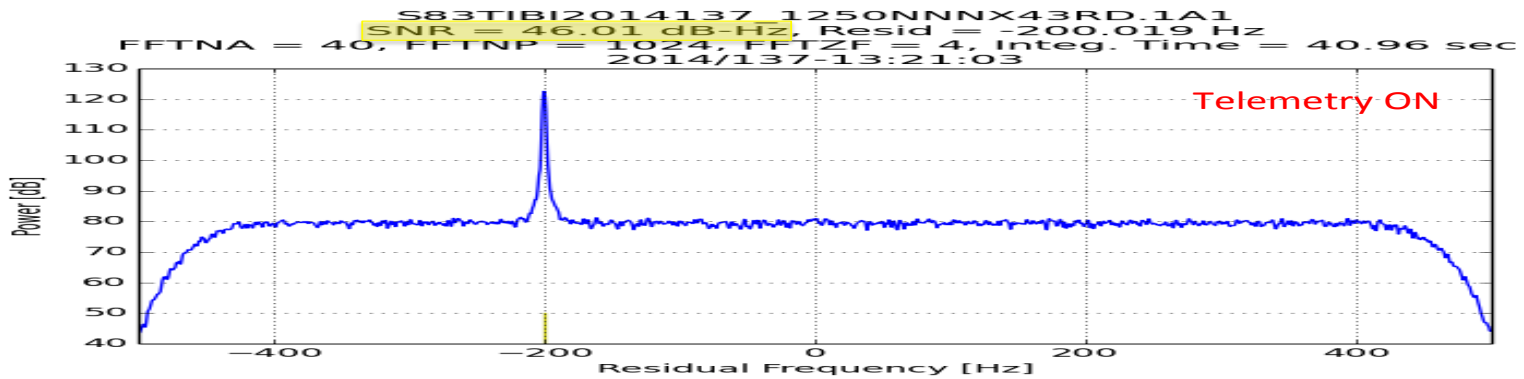
14 164 0415 0715 1615 1630 DSS-34 CAS TP RS BISTORT MC 6102 N750 1A1

- Also prime TP
- Will practice bistatic calibrations during 3-hr Pre-cal
- Acquire Monopulse data
- Verify KLCP signal

DSS-35 will be shadow tracking. Request to monitor Ka-band error channel signal (Ka-LCP with switch 43 in A position)

Spurs at Canberra

- DSS-34 Ka-band spurs have been present for a long time
 - Even during T99 gravity back in March (DOY 065-066)
 - Covered by BWGs at all complexes, but spurs observed at DSS-34 only
 - Sometimes missed when we monitor wider bandwidths
- DSS-43 X-band spurs (when telemetry is OFF)
 - First reported after T101 experiment on May 17 (DOY 137)



Predicts

- DSS-43 uplink (ETX) predicts should compensate for Doppler shift due to Titan's atmosphere
- NAV's last OD delivery prior to the occultation is on Saturday, June 14
 - Preliminary delivery to the project on Friday, June 13, which NAV expects will be the one that gets delivered on Friday
- SPS to provide DSS-43 and DSS-34 ETX files on Saturday afternoon?
- RSS (Paul Schinder) will apply the Doppler shifts to the ETX files. Danny will then check the files
- Modified files will be sent to the NOAs by Monday morning
- Elias will start preliminary predicts work on Saturday. Elias, Dustin and Danny will continue with the predicts work on Monday
- RSS usually uses three sets of downlink predicts in the open-loop receivers for occultations:
 - #1: Coherent with atmospheric compensation: generated using Nicole's PREDICTs software and SPS nominal (unmodified) ETX
 - #2: 1-way coherent: 1-way predicts generated using PREDICTs and the Doppler file produced by Paul, offset in real-time to coherent downlink frequency
 - #3: 1-way (no offset): For the times when the DST is not in lock on the uplink

Misc

Uplink Strategy

- DSS-43, 18 kW, ramped, sweep
- Backup: DSS-34

DKF – Does not have the correct uplink or AOS/LOS times. Use times in RSS timeline

Don't expect closed-loop receivers to lock up during bistatic experiments

Plan for DSS-34 Cassini Specific 4th Order Pointing Model?

- Crucial to have good pointing models since we can't utilize monopulse during the bistatic experiments
- Ka-band data were degraded at end of T101 DSS-34 track
 - Combination of known anomaly, weather (high humidity), low elevation angles?
- David has data from DOY 159
- Dustin will send data from DOY 164 soon after the ORT completes

Observation ends at ~13 degrees in elevation (165418z)

- Slightly better than T101, which ended at ~8 degrees in elevation

Misc cont'd

No Backup simultaneous XRCP and XLCP data

- No station currently has capability except for DSS-43
 - DSS-35 will have in October for T106
- DSS-43 will provide only data set

Problems with eDMD displays freezing

- Have workaround, but eDMD is most convenient

NOPE/NOAs - Equipment Status?

Open-loop receivers status?