

About the Experiment

- S93 Rev232 T117 Titan Bistatic and Occultation Observations
 - Grazing occultation: 2-way/3-way mode
 - Bistatic outbound: 1-way mode
 - Telemetry OFF, Ranging OFF
 - Covered by Canberra

- Science Highlights (From Essam Marouf)

The RSS Titan observations on T117 include a grazing atmospheric occultation and an egress bistatic surface scattering experiment. The grazing atmospheric occultation will profile the thermal structure of the atmosphere at Ingress-egress latitudes of about 4.3S and 17.9N degrees, respectively. This is one of only few RSS Titan occultations to sound the near-equatorial region of the atmosphere. The experiment will also yield electron density profiles on both the ingress and egress sides. The T117 egress bistatic ground track grazes the northern shores of the Ligea Mare (sea), likely crossing narrow channels and/or small lakes of liquid hydrocarbons (mainly methane). The observation covers the region from about (72N, 230W) to about (79N, 190W) degrees, and captures near-grazing scattering angle decreasing from about 80 to 75 degrees. Measurements of the absolute power of the polarized components of mirror-like surface reflections (surface echoes), when detectable, yield information about surface reflectivity, dielectric constant, and roughness.

DSN Antennas

- DSN Coverage

	Pre	BOT	EOT	Post									
16 047	1700	2000	0345	0545	DSS-43	CAS	RS	T117	BSROC	L3	6717	1647	1A1
16 047	1900	2200	0345	0545	DSS-35	CAS	RS	T117	BSROC	L3	6717	0681	1A1

- Note different BOT
- First time using DSS-35
 - Has capability to simultaneously support X- and Ka-band RCP and LCP
- DSS-43 will provide uplink for the occultation
 - DSS-35 will be backup
- Receivers scheduled
 - 2 closed-loop receivers per antenna
 - Open-loop receivers (RSRs, WVSRs)
 - 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

S93 T117 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
35	Danny	rsops3	WVSR2	WVSR1A -> XRCP WVSR1B -> XLCP	1, 2, 3, 4 4, 5, 6 7, 8, 9 1, 2, 3	1, 16, 50, 100 1, 16, 50 (2-way) 1, 16, 50 (1-way) 1, 16, 50, 100
35	Danny	rsops5	WVSR2	WVSR2A -> KRCP WVSR2B -> KLCP	1, 2, 3, 4 4, 5, 6 7, 8, 9 1, 2, 3	1, 16, 50, 100 1, 16, 50 (2-way) 1, 16, 50 (1-way) 1, 16, 50, 100
43	Elias/ Dustin	rsops4	VSR1	VSR1A -> XRCP VSR1B -> XRCP	1, 2, 3 1, 2, 3	1, 16, 50 (2-way) 1, 16, 50 (1-way)
43	Danny	rsops5	PRSR1	PRSR1A* -> SRCP *(if available)	1, 2, 3 4, 5, 6	1, 16, 50 (2-way) 1, 16, 50 (1-way)

RSSG will be in Ops Room at 8:30 am on Tuesday, February 16th (047/1600)

Prime receivers. Monitor throughout experiment
Monitor during occultation to look for DST going out of lock

Aseel – VOCA

Elias – Ops Room Displays

Danny – Check WVSR/VSR/PRSR availability & RSR/WVSR/VSR/PRSR 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
 - Harder to plan for DSS-43 than in the past
 - Time windows were not long enough to completed RCP and LCP
 - Had to split. More later
 - SNT Measurements
 - Completed within 3-4 minutes
 - Post-Cal (antennas at stow)
 - 2-hr post-cal periods are scheduled
- Pre-cal calibrations are the longest
- Lu and Aseel will be making some changes to the bistatic procedure

ORTs

1. ORT on DOY 036 (Feb 5 PST) over DSS-35, X- and Ka-band

Completed

16 036 1430 1730 0230 0245 DSS-35 CAS TP RSS BISTATORT 6706 N750 1A1

- Also prime TP
- Station recent return from unplanned downtime
 - XKa LNA replaced
 - Asked station to try to calibrate the diodes before the support, but it was cloudy during the maintenance block
- Practiced bistatic calibrations during 3-hr pre-cal
 - Team A supporting
 - Followed procedure without problems
 - Asked for screenshots of diode calibration values

Ka-band

Diode Calibration Values		
0.25	0.008057	K
0.5	0.039114	K
1	0.102887	K
2	0.252757	K
4	0.582315	K
8	1.312727	K
12.5	2.269171	K
50	13.413794	K

X-band

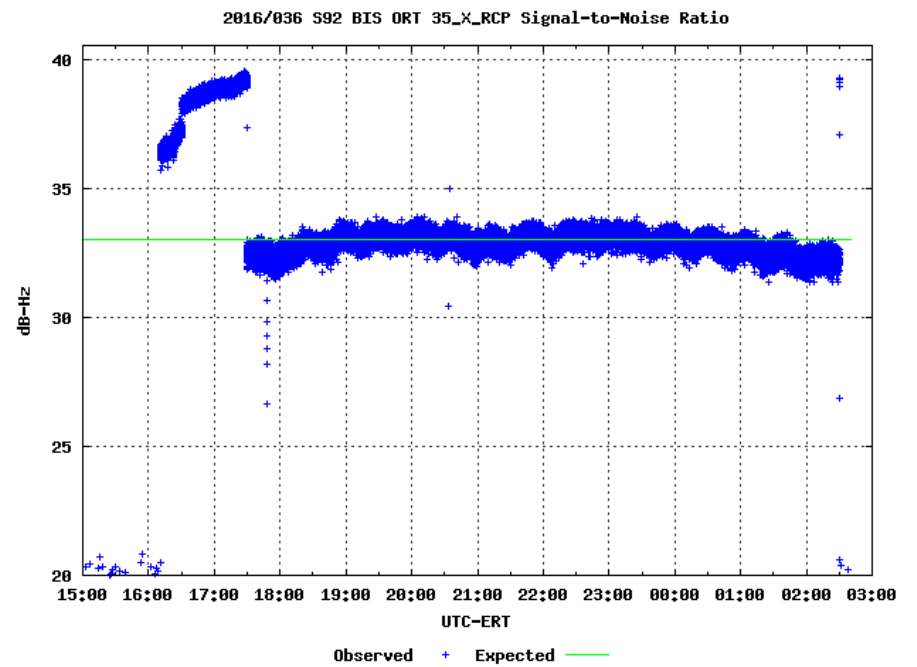
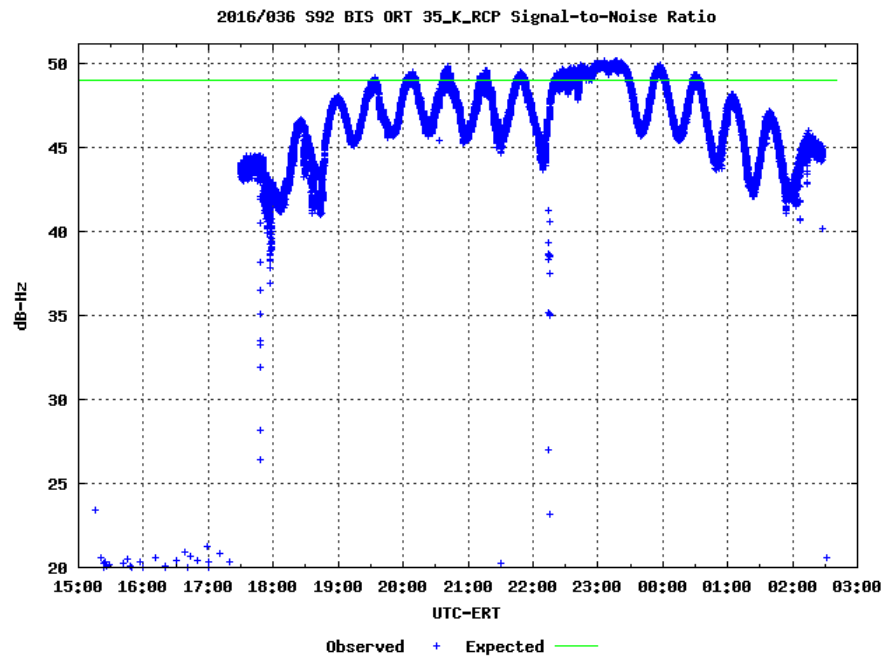
Diode Calibration Values		
0.25	0.207210	K
0.5	0.432560	K
1	0.881700	K
2	1.790955	K
4	3.718908	K
8	7.576698	K
12.5	16.222107	K
50	35.800442	K

- Station performed multiple Monopulse on-point phase cals in 1-way and 2-way modes
- Monopulse data acquired
- No Ka-LCP data acquired

ORTs cont'd

ORT on DOY 036 DSS-35, X- and Ka-band continued

Post-pass power plots



ORTs cont'd

2. ORT on DOY 037 (Feb 6 PST) over DSS-43, X- and S-band Completed

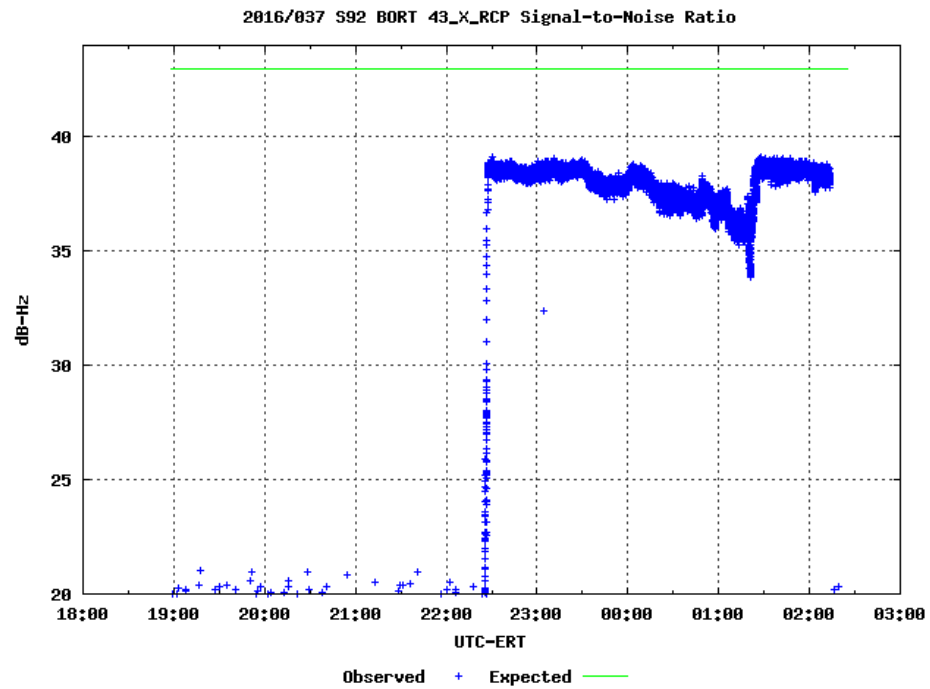
16 037 1930 2200 0215 0230 DSS-43 CAS TP RSS BISTATORT 6707 1647 1A1

- Also prime TP
- Practiced bistatic calibrations during 3-hr pre-cal
 - Team D supporting
 - Problems encountered – Five DRs opened!
 - Procedural problems
 - Trouble following the S-band bistatic procedure
 - Subreflector problems
 - Station reported during pre-cal that the preceding track had subreflector problems
 - Subreflector was orange at pre-cal
 - Delay in acquiring X-band after BOT
 - Engineer had to reset subreflector
 - Switch problems
 - Switch S2 not working
 - No S-band during track
 - Microwave misconfiguration
 - X-RCP and X-LCP the same
 - Did not ask the station to correct after BOT

ORTs cont'd

ORT on DOY 03 over DSS-43, X- and S-band continued

Post-pass power plots (X-band only. No S-band)



ORTs cont'd

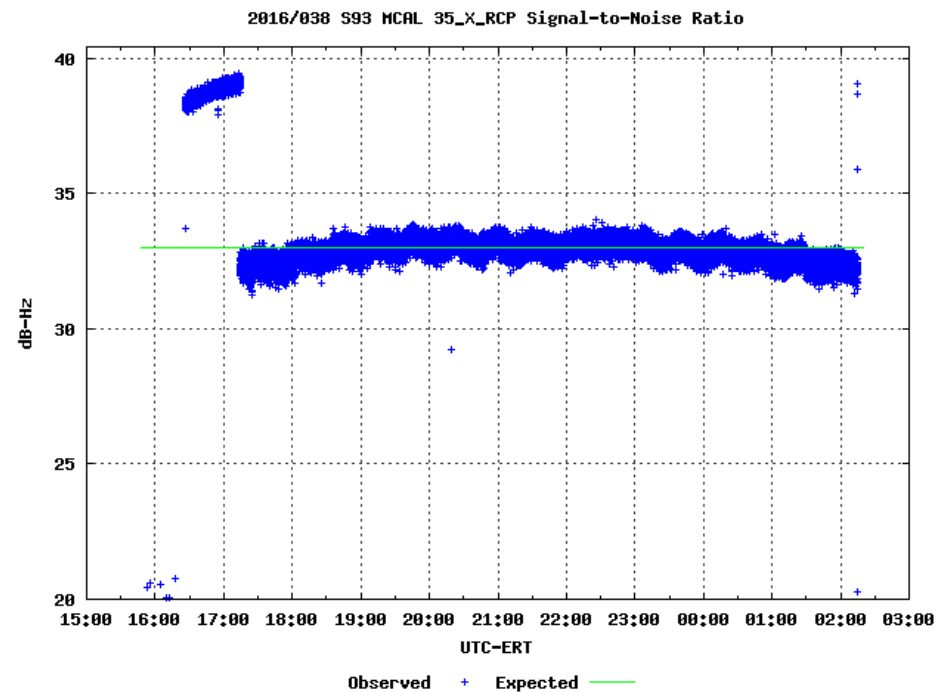
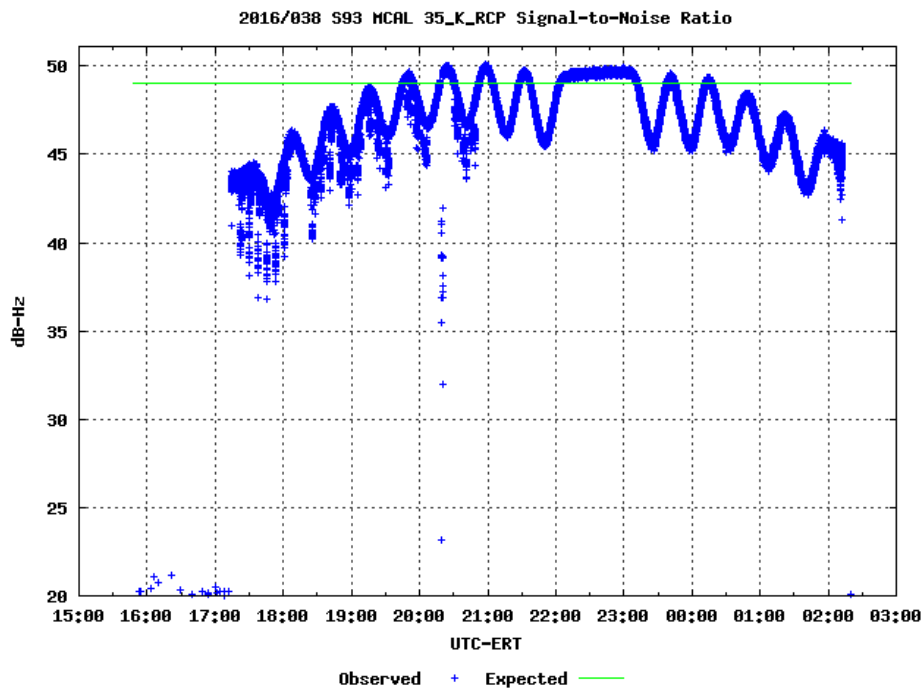
3. ORT on DOY 038 (Feb 7 PST) over DSS-35, X- and Ka-band

Completed

16 038 1545 1715 0215 0230 DSS-35 CAS TP RS OCCORT MC 6708 N750 1A1

- Also prime TP
- Acquired Monopulse pointing data
- Pass nominal

Post-pass power plots



ORTs cont'd

4. ORT on DOY 041 (Feb 10 PST) over DSS-35, X- and Ka-band

Completed

16 041 1400 1530 2330 0030 DSS-35 CAS TP RS BISTORT MC 6711 0681 1A1

- Also prime TP
- Station partially completed noise diodes calibrations
 - Successfully calibrated X-band diodes prior to the track
 - Intended to replace the Ka-band diodes and calibrate them, but weather forecast was for showers
 - Based on diode calibration values, Canberra's Engineering Team Leader suggested we used the 50K diode instead of the 12.5K diode
 - Injects about 12K of noise power
 - Agreed. Also used 4K instead of 0.5K for SNT measurement

Ka-band

LNA	K1
NDA	2A
LNA degK	9.1
Amb degK	296.4
Year	2016
DOY	38
0.25K	0.004
0.5K	0.033
1.0K	0.086
2.0K	0.208
4.0K	0.474
8.0K	1.070
12.5K	1.859
50.0K	11.078

X-band

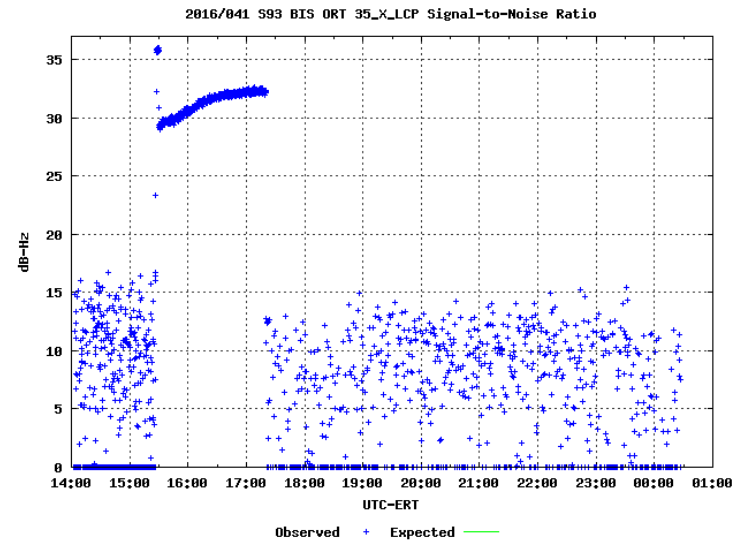
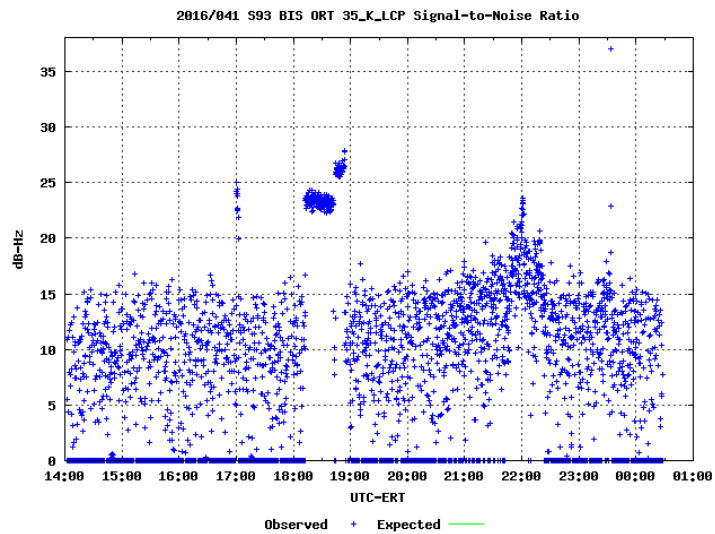
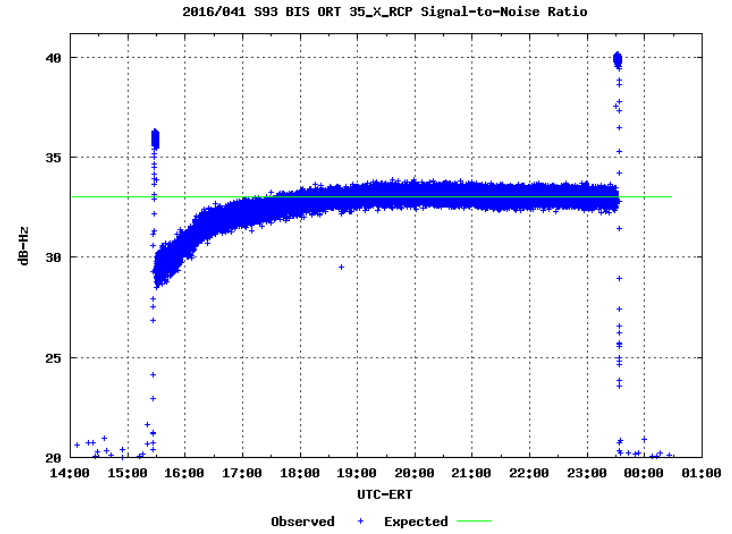
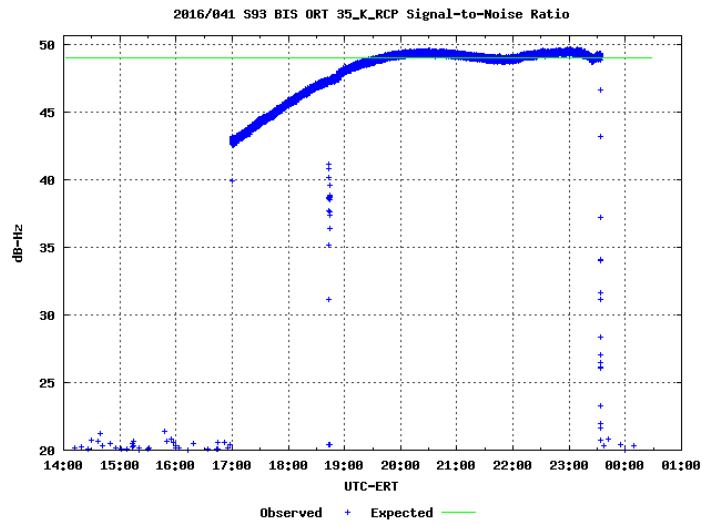
LNA	X1
NDA	1A
LNA degK	9.1
Amb degK	298.4
Year	2016
DOY	40
0.25K	0.208
0.5K	0.439
1.0K	0.897
2.0K	1.822
4.0K	3.773
8.0K	7.697
12.5K	16.440
50.0K	36.476

- Practiced bistatic calibrations during 1-hr post-cal
 - Team A supported
 - Station followed bistatic procedure without problems
 - Lu monitored
- Monopulse pointing data acquired. Ka-LCP verified

ORTs cont'd

ORT on DOY 041 DSS-35, X- and Ka-band continued

Post-pass power plots



ORTs cont'd

Upcoming

Added this week

5. ORT on DOY 045 (Feb 14 PST) over DSS-43, X- and S-band

16 045 1415 1645 0000 0015 DSS-43 CAS TP OTM-442 BU 6715 1645 1A1

- Also prime TP
- Increased pre-cal by 1.5 hours to practice bistatic calibrations
 - Took time from another project that was able to accommodate Cassini

6. ORT on DOY 046 (Feb 15 PST) over DSS-35, X- and Ka-band

16 046 1845 2015 2320 0020 DSS-35 CAS TP RS BISTORT MC 6716 N750 1A1

- Also prime TP
- Acquire Monopulse pointing data
- Practice bistatic calibrations during 1-hr post-cal

Predicts

- DSS-43 uplink (ETX) predicts should compensate for Doppler shift due to Titan's atmosphere
- Ideally, OTM-442 OD would've been best to use for predicts generation
 - OD delivered Friday afternoon
 - Monday is holiday
 - No time to complete predicts generation
- NAV's made special delivery to RSS on Wednesday, Feb 10
- Prior delivery (which RSS used for Live Update process) was Sunday, Feb 7
- Either could be used for predicts generation
 - One will be slightly better, but won't know until Friday (or maybe later today?)
- SPS provided products DSS-43 using Wed and last Sunday's OD
- RSS decided to use products based on last Sunday's OD
- RSS (Paul Schinder) applied the Doppler shifts to the ETX files
- Modified file was sent the NOAs earlier today
- Elias and Danny have started predicts work
- 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-35

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

RSS timeline is not yet finalized. An update will be sent soon

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

Noise Diodes

- DSS-43 noise diodes still need to be calibrated
- Consulted with Essam regarding DSS-35 noise diodes
 - Station offered to try to replace and calibrate them during this Friday's maintenance block, but risky if weather is bad
 - Will use 50K and 4K instead of 12.5K and 0.5K, respectively
 - Change bistatic procedure accordingly
 - Prefer that station focuses efforts on DSS-43

DSS-35 Cassini Specific 4th Order Pointing Model

- Crucial to have good pointing models since we can't utilize monopulse during the bistatic experiments
- David has data from DOY 036
- Dustin will send data from DOY 038 and 041 (completed) and DOY 046 when completed

Misc

Equipment Status

- NOAs?

Open-Loop Receivers

- Danny is checking with Sue Finley about availability of VSR
- PRSR was sent to Parkes to support Southern Hemisphere Radar observations in Nov-Dec, 2015
- It is now back at Canberra, but being report before installation
- May not be available for support on DOY 047