



**Federal Aviation
Administration**

***WAAS Technical Report
William J. Hughes Technical Center
Atlantic City International Airport,
New Jersey***

12/2/13

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DR #118: PRN 2 Anomaly

***GPS Week/Day: Week 1764 Day 4 (October 31, 2013) to
Week 1765 Day 1 (November 4, 2013)***

Presented to: WAAS WIPP

Notes

- **PRN-2 experienced degraded signal quality starting on 10/31/13, ending with maintenance on 11/3/13**
- **The degraded signal quality caused:**
 - Degraded C/No
 - Periods of increased carrier phase standard deviation
 - Periods of elevated SQM DM relative to threshold
 - Periods of large amounts of SQM data being rejected by pre-screening of Accumulator values against prior 10 second median
 - Increased noise/threshold
 - Caused UDRE bumping on 11/3
 - May have contributed to some 3 sigma threshold screening
 - May have contributed to the elevated SQM DM / threshold
- **Maintenance period was relatively long**
 - Ephemeris health was good before Almanac health
 - WAAS reacquisition delayed because only some WRE-C's acquired while Almanac health was bad
- **Slightly different nominal bias upon return to healthy**
 - Different hardware on SV



PRN 2 SQM Data Analysis

- **10/30 (w1764d3): Baseline day**
- **10/31 (w1764d4): Very noisy SQM data from 14 – 18 utc. A lot of noisy measurements were excluded in the pre-screening. DM 2 is the most sensitive.**
 - DM 2 max noise/threshold ratio increased from 0.117 to 0.64.
 - DM 4 max noise/threshold ratio increased from 0.21 to 0.65.
 - DM 1 and DM 3 only experienced slight increases in noise/threshold ratio
- **11/1 (w1764d5): No tracking issue and measurements are within normal range**
- **11/2 (w1764d6): No tracking issue, but observed a bias on all 4 DMs.**
 - DM 1 measurements experienced ~.002 bias jump
 - DM 2 is the most sensitive, noise/threshold ratio increased to the max of 0.84
- **11/3 (w1765d0): Noisy SQM measurements from 14 – 18 utc.**
 - Most noisy measurements were excluded from the pre-screening.
 - Ratios on all DMs were elevated. DM 2 max ratio of 0.84



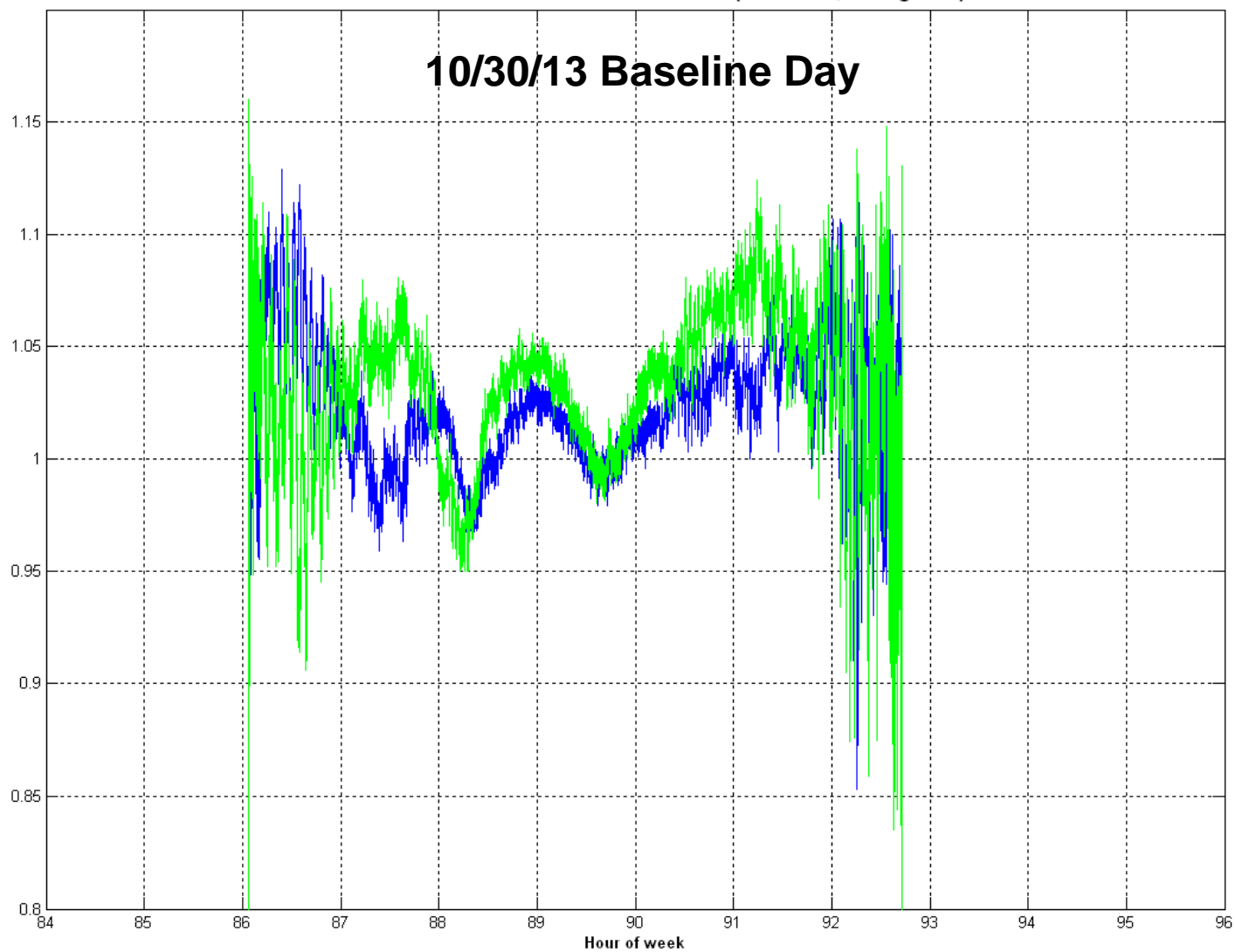
Max Ratios and Bias

Max Ratio (DM/Th)	10/30/13 1764d3	10/31/13 1764d4	11/1/13 1764d5	11/2/13 1764d6	11/3/13 1765d0	11/4/13 1765d1	11/5/13 1765d2	11/6/13 1765d3
DM1	0.2185595	0.2400833	0.3035402	0.7928548	0.7890802	offline	0.3801010	0.333
DM2	0.1179878	0.6409734	0.1969619	0.8463307	0.8434304	offline	0.1432725	0.137
DM3	0.2175192	0.2206496	0.1546688	0.4305080	0.8388435	offline	0.2614835	0.237
DM4	0.2069128	0.6517356	0.2610687	0.4576331	0.5786343	offline	0.2442931	0.1816

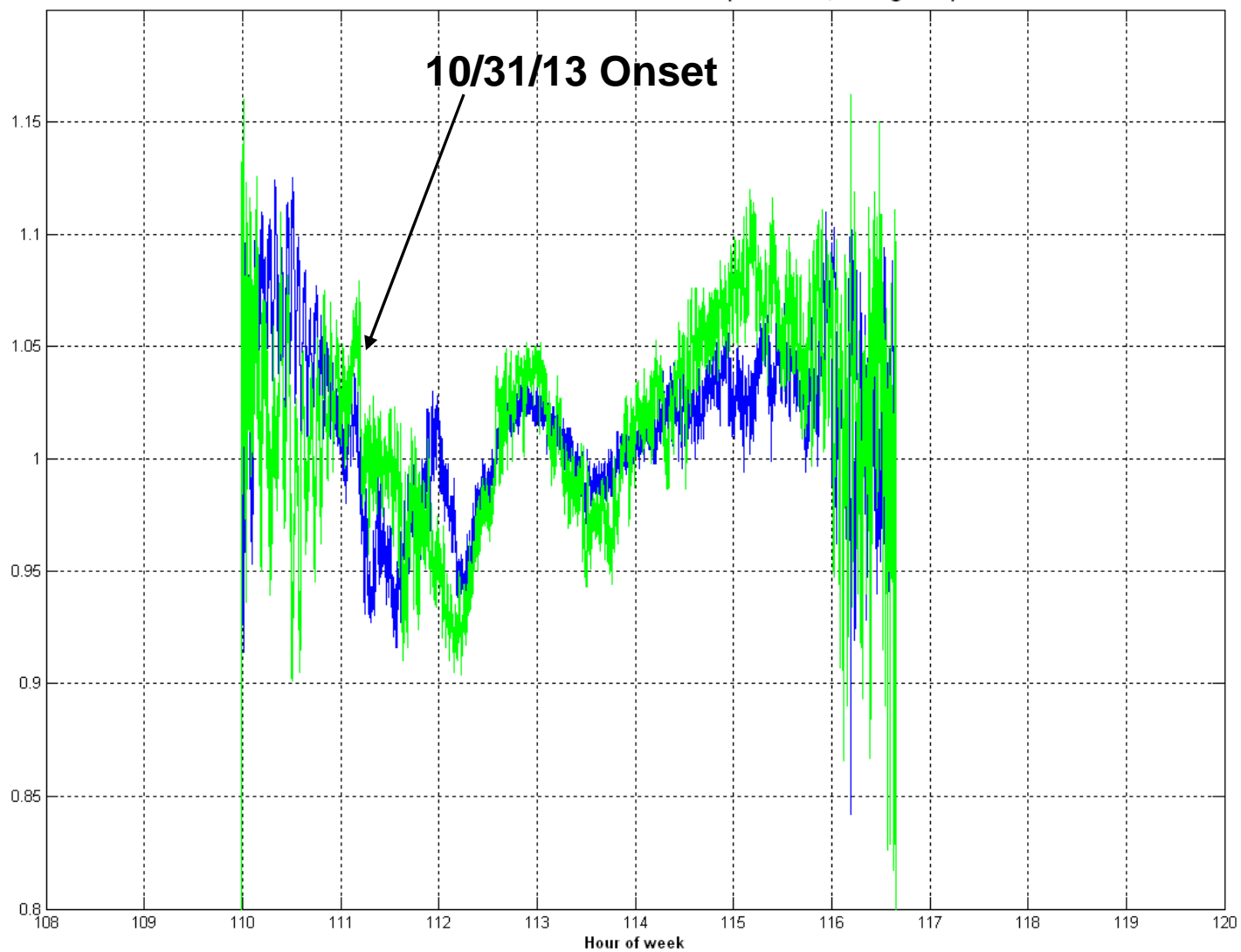
Max PRN Bias	10/30/13 1764d3	10/31/13 1764d4	11/1/13 1764d5	11/2/13 1764d6	11/3/13 1765d0	11/4/13 1765d1	11/5/13 1765d2	11/6/13 1765d3
DM1	0.0016227	0.0018080	0.0019836	0.0030688	0.0031989	offline	0.0012991	0.00172
DM2	0.0004950	0.0005135	0.0007969	0.0018349	0.0019234	offline	0.0003756	0.00052
DM3	0.0004215	0.0003616	0.0003777	0.0006130	0.0007254	offline	0.0002503	0.00012
DM4	0.0008723	0.0012873	0.0010591	0.0016555	0.0013528	offline	0.0006350	0.00021



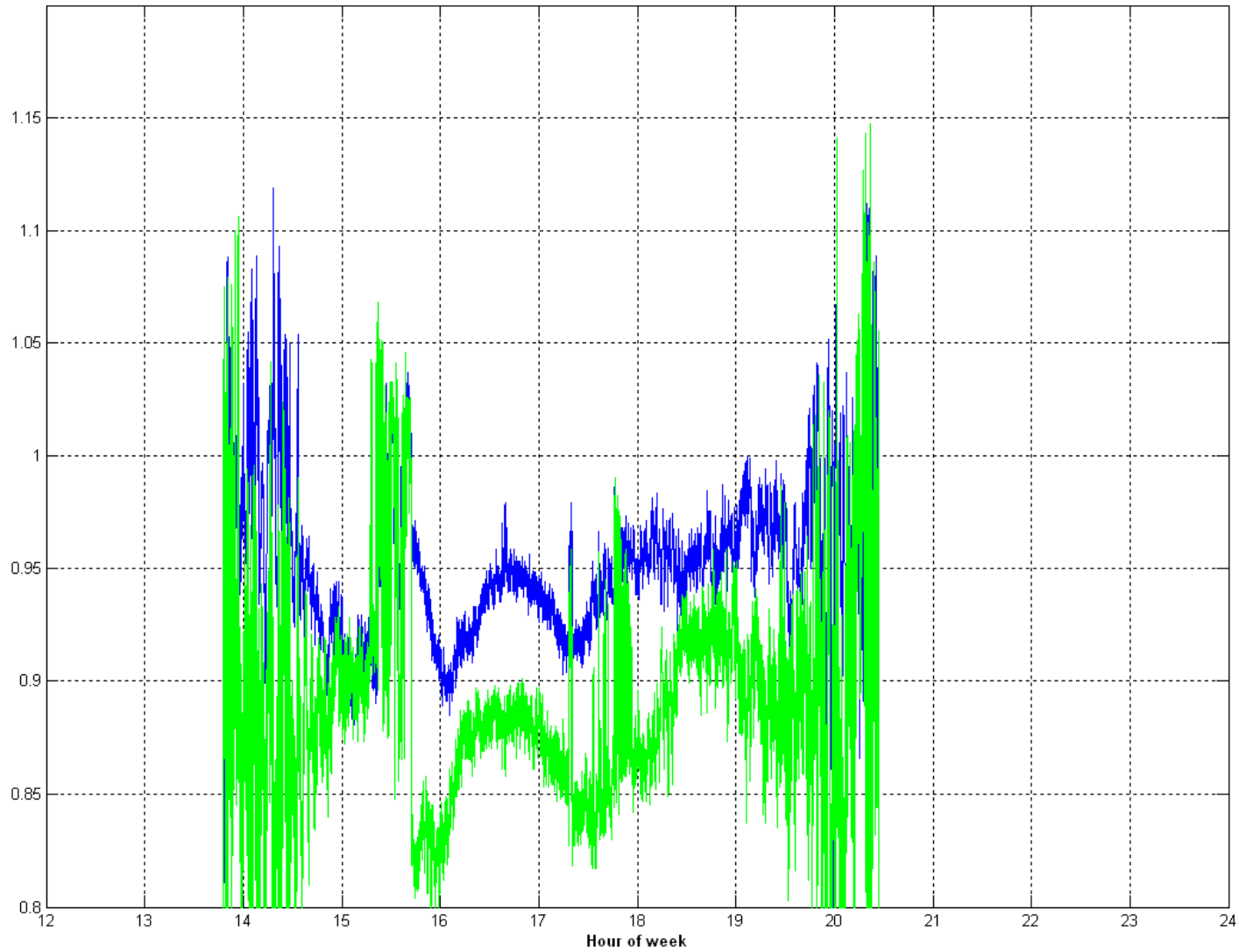
ZLA1 10/30/13 PRN-2 Normalized C/No (L1 = blue, L2 = green)

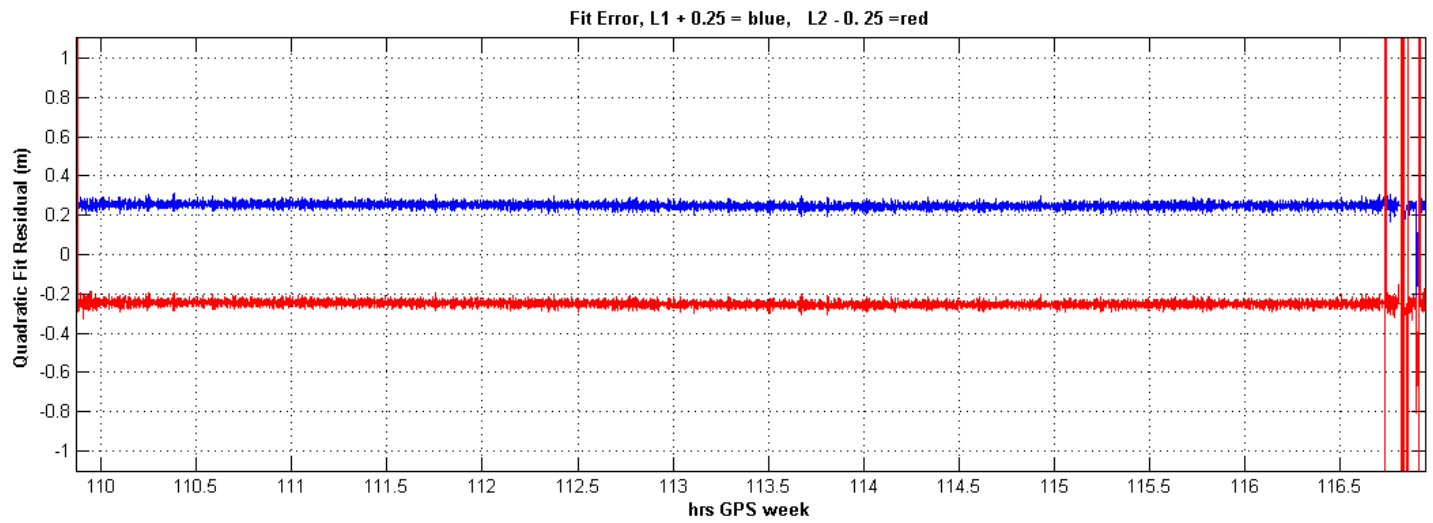
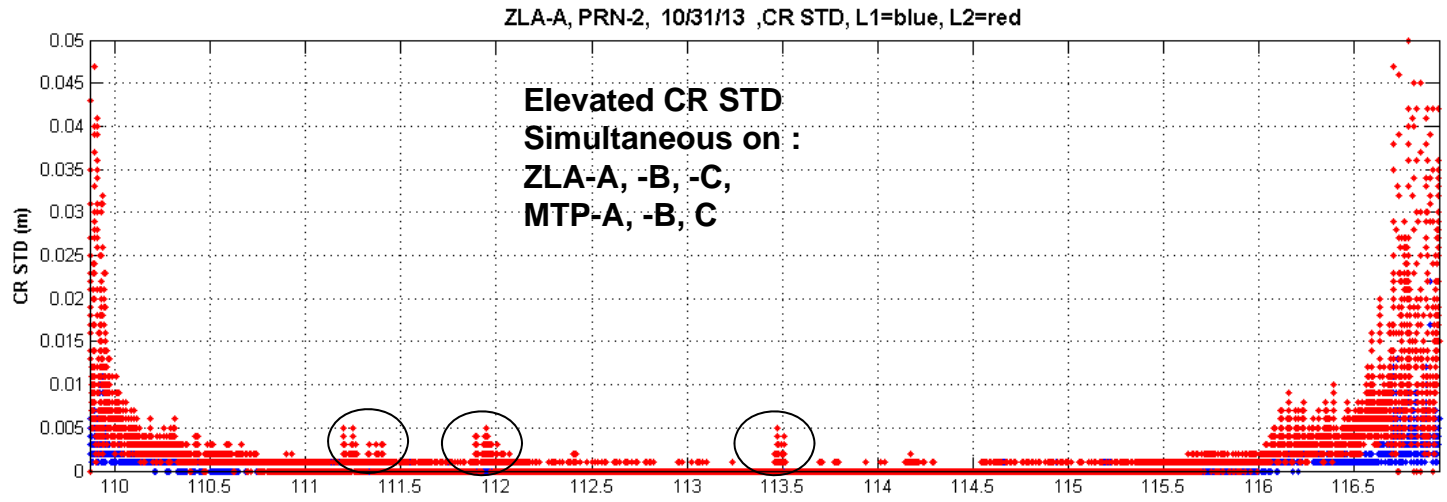


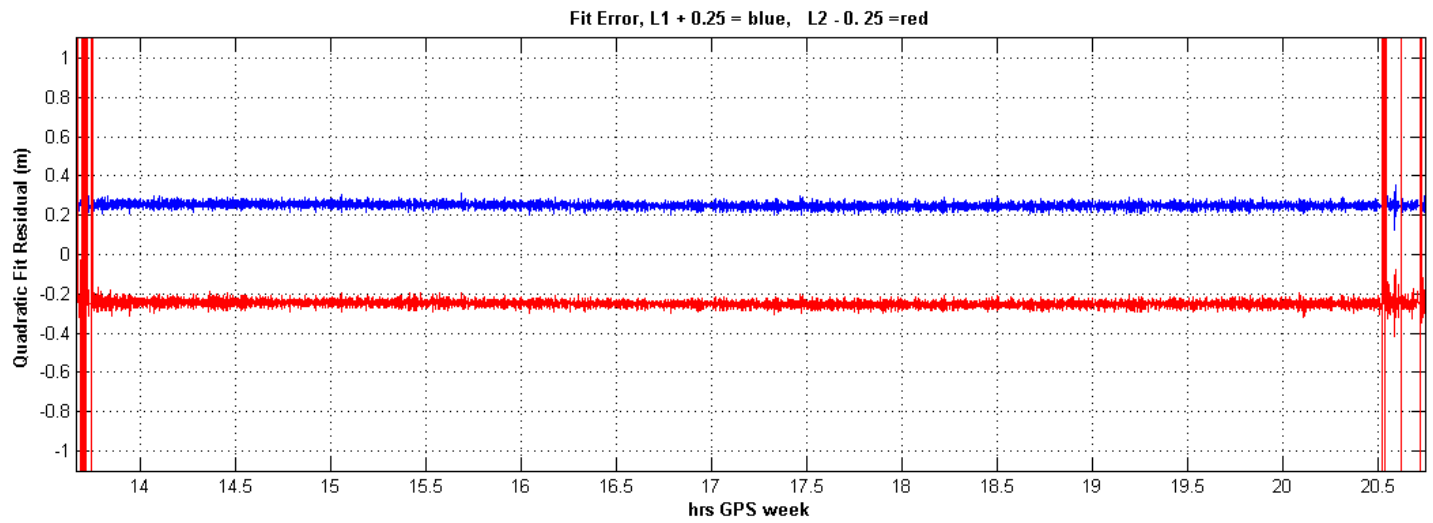
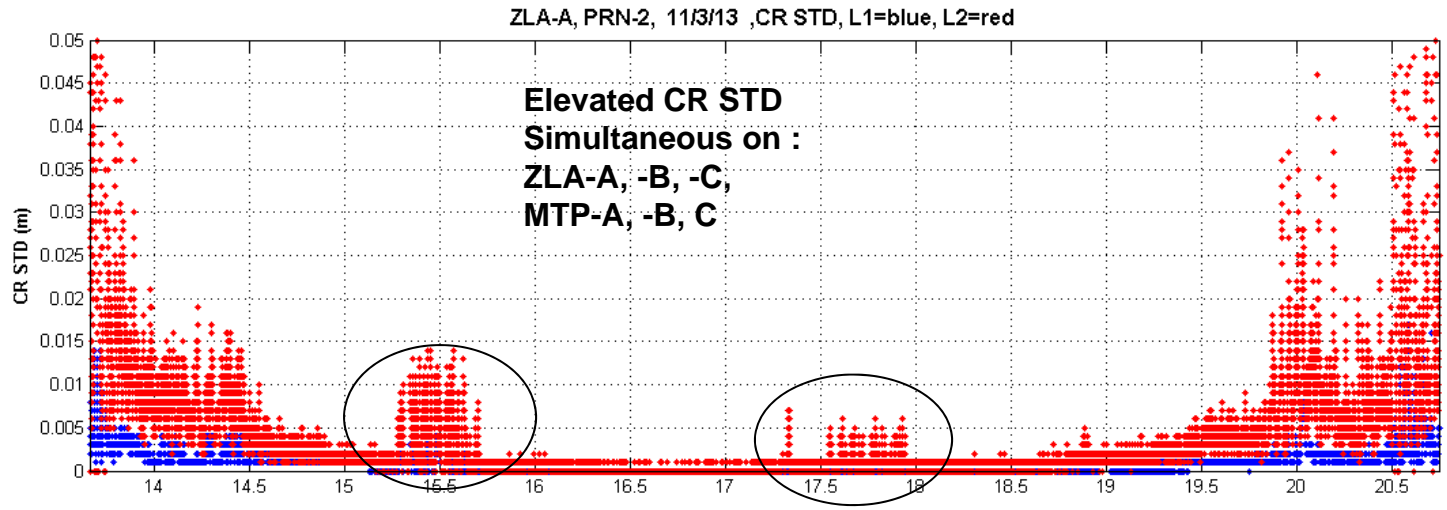
ZLA1 10/31/13 PRN-2 Normalized C/No (L1 = blue, L2 = green)



ZLA1 11/3/13 PRN-2 Normalized C/No (L1 = blue, L2 = green)



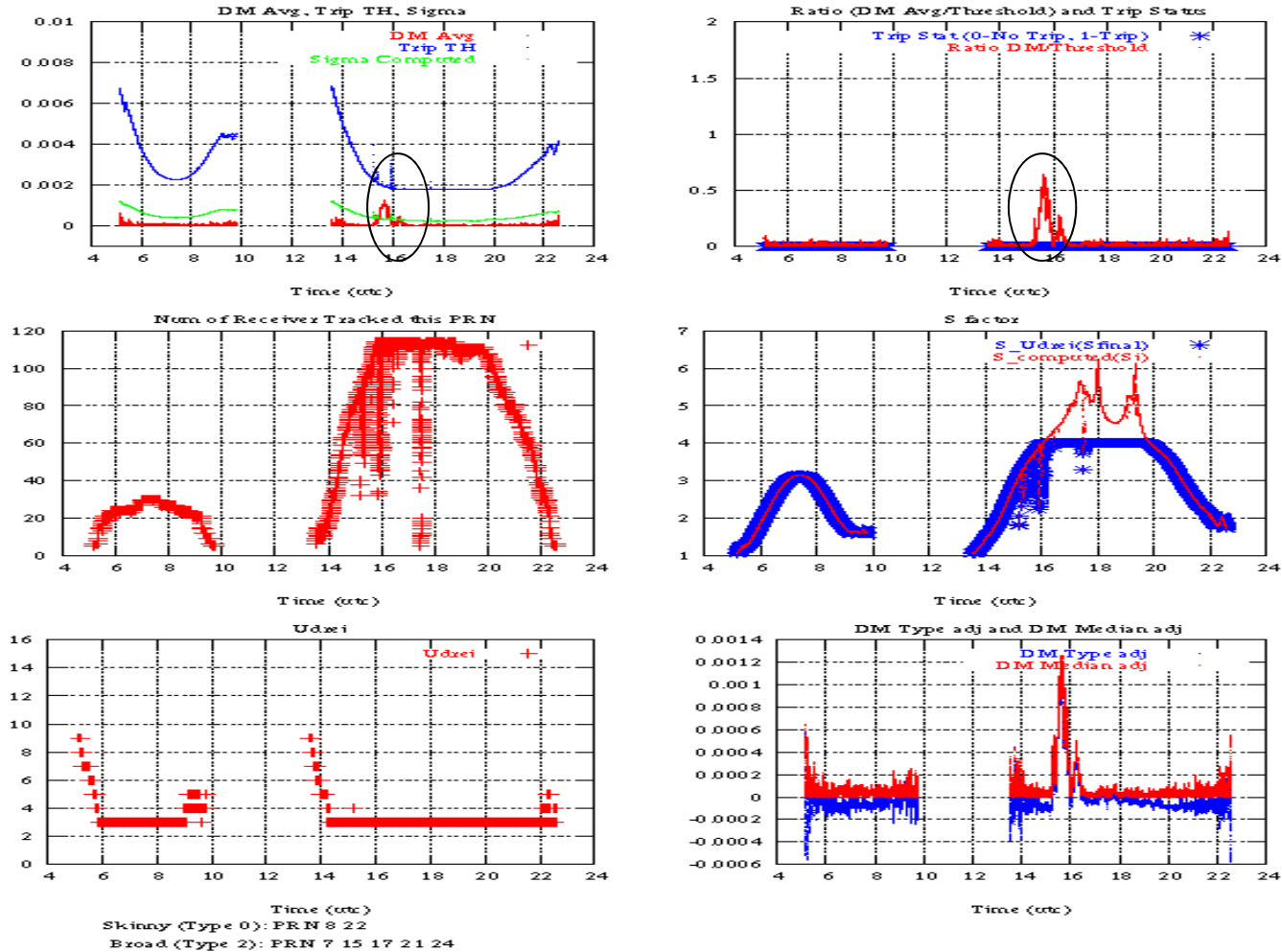




DM 2 PRN 2 1764 Day 4 (10/31/2013)

DM2 Elevated DM/T

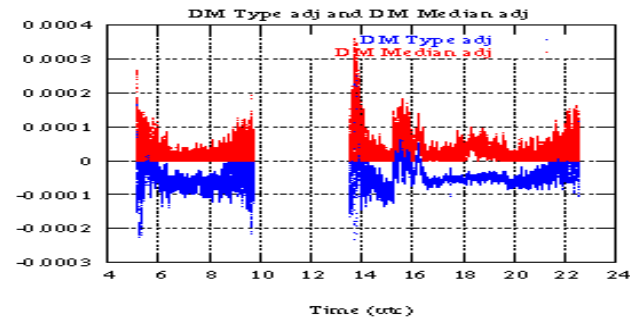
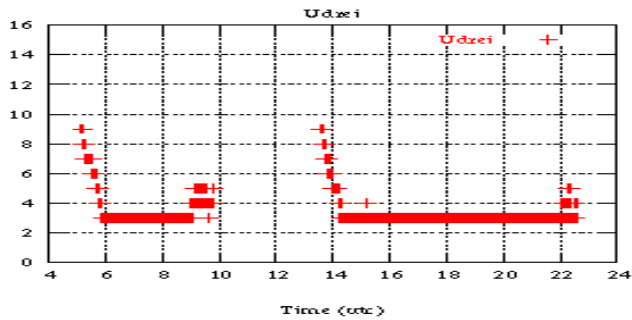
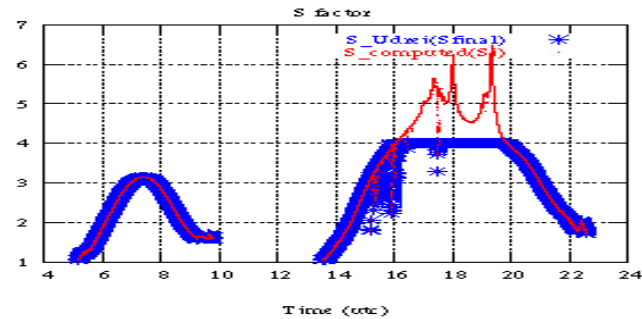
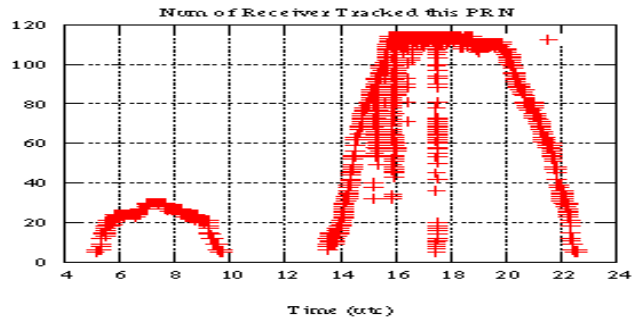
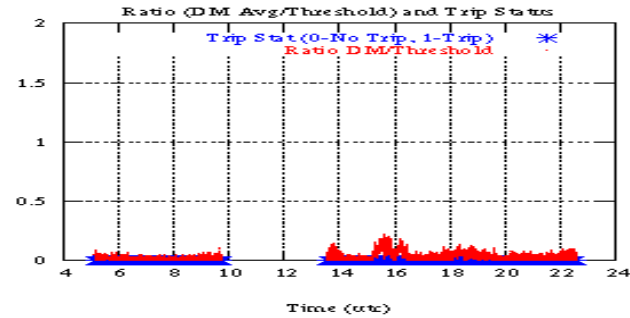
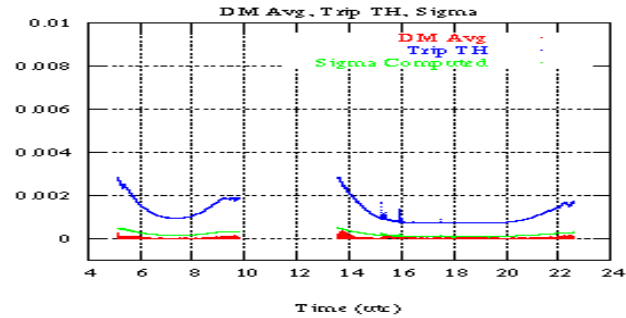
PRN 2 DM1 Across Receivers (IRB removed and above 5 deg)
GpsWeek 1764 Day 4



DM 3 PRN 2 1764 Day 4 (10/31/2013)

PRN 2 DM3 Across Receivers (IRB removed and above 5 deg)

GpsWeek 1764 Day 4



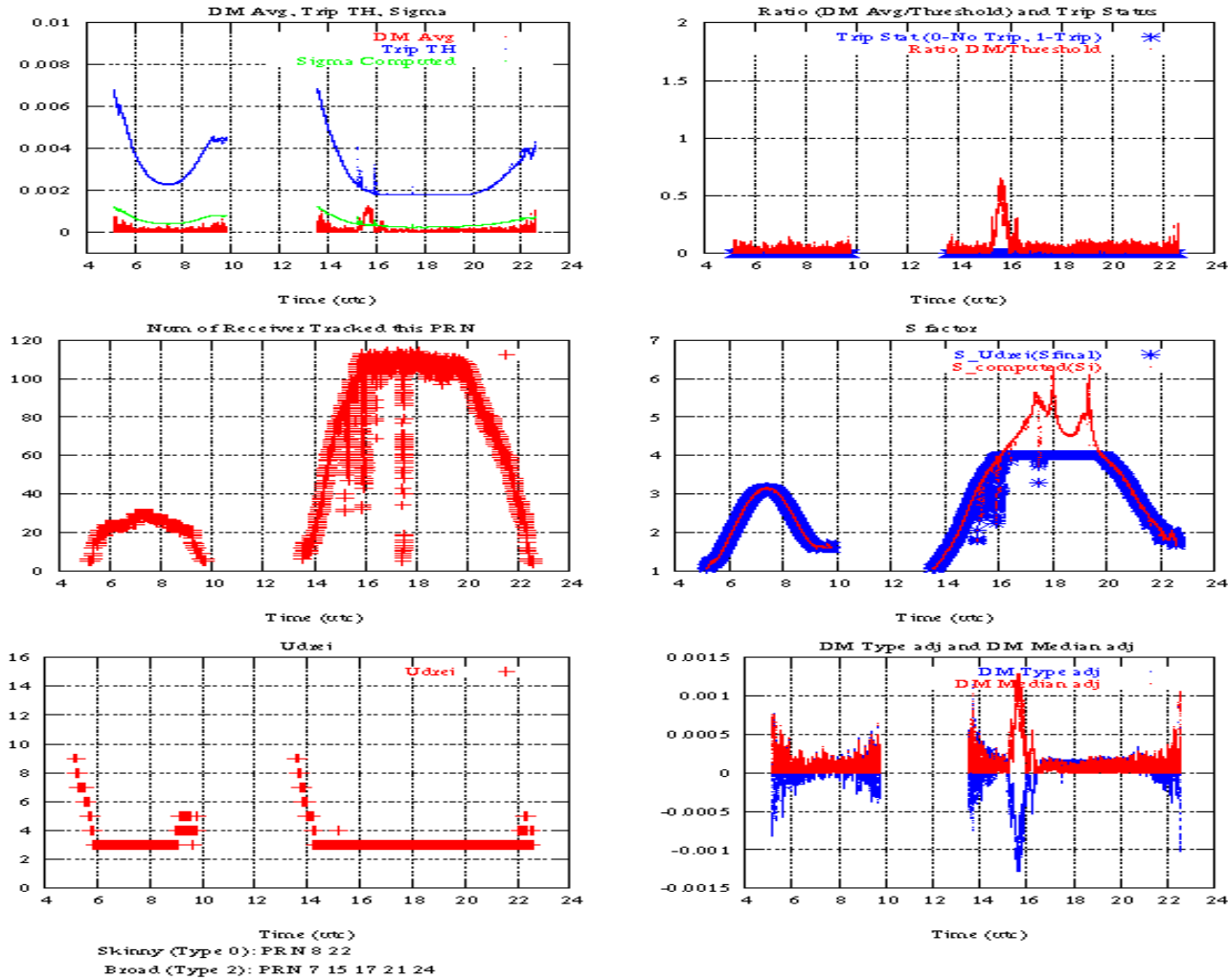
Skinny (Type 0): PRN 8 22
Broad (Type 2): PRN 7 15 17 21 24



DM 4 PRN 2 1764 Day 4 (10/31/2013)

PRN 2 DM4 Across Receivers (IRB removed and above 5 deg)

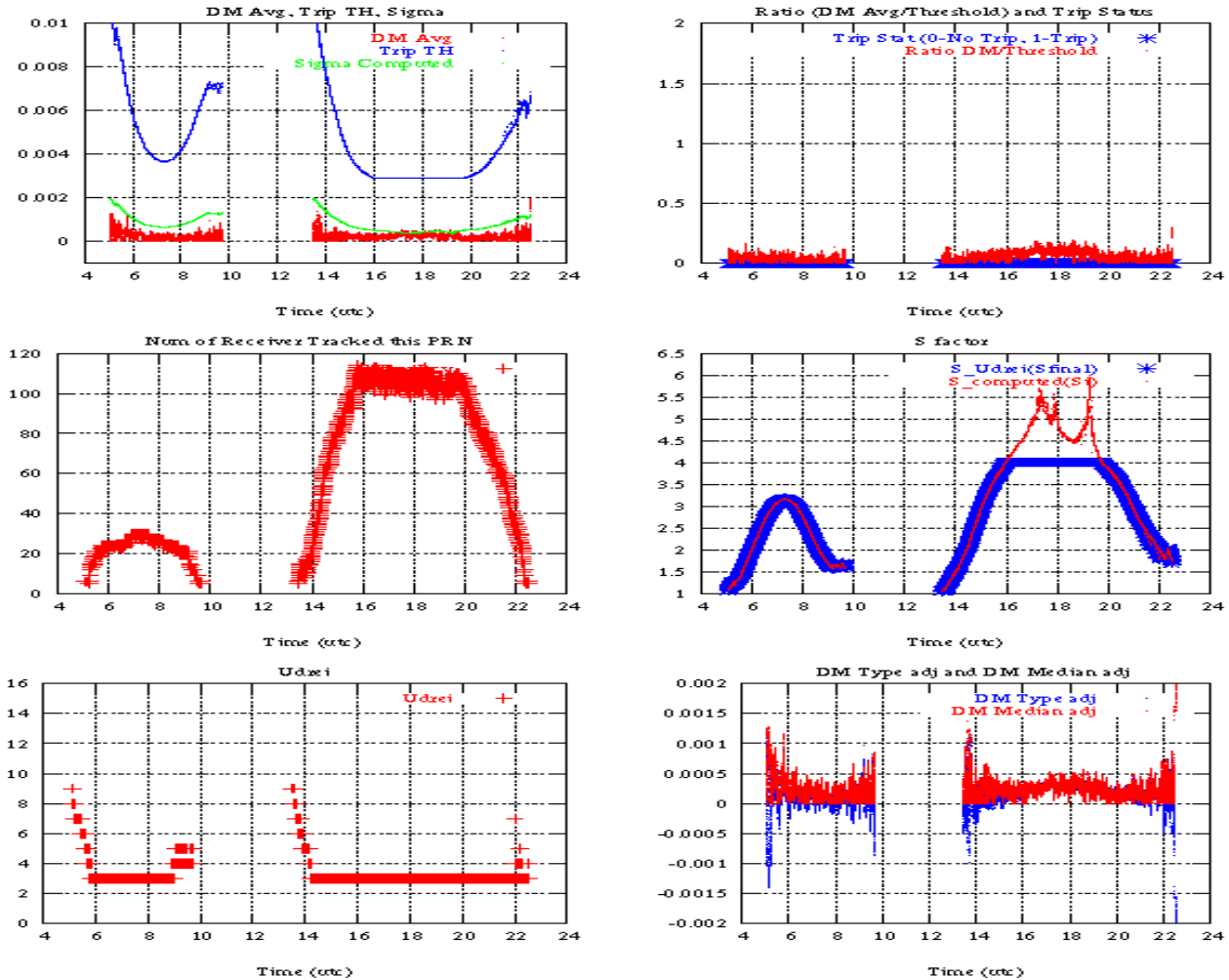
GpsWeek 1764 Day 4



DM 1 PRN 2 1764 Day 5 (11/1/2013)

PRN 2 DM0 Across Receivers (IRB removed and above 5 deg)

GpsWeek 1764 Day 5



Skinny (Type 0): PRN 8 22
Broad (Type 2): PRN 7 15 17 21 24

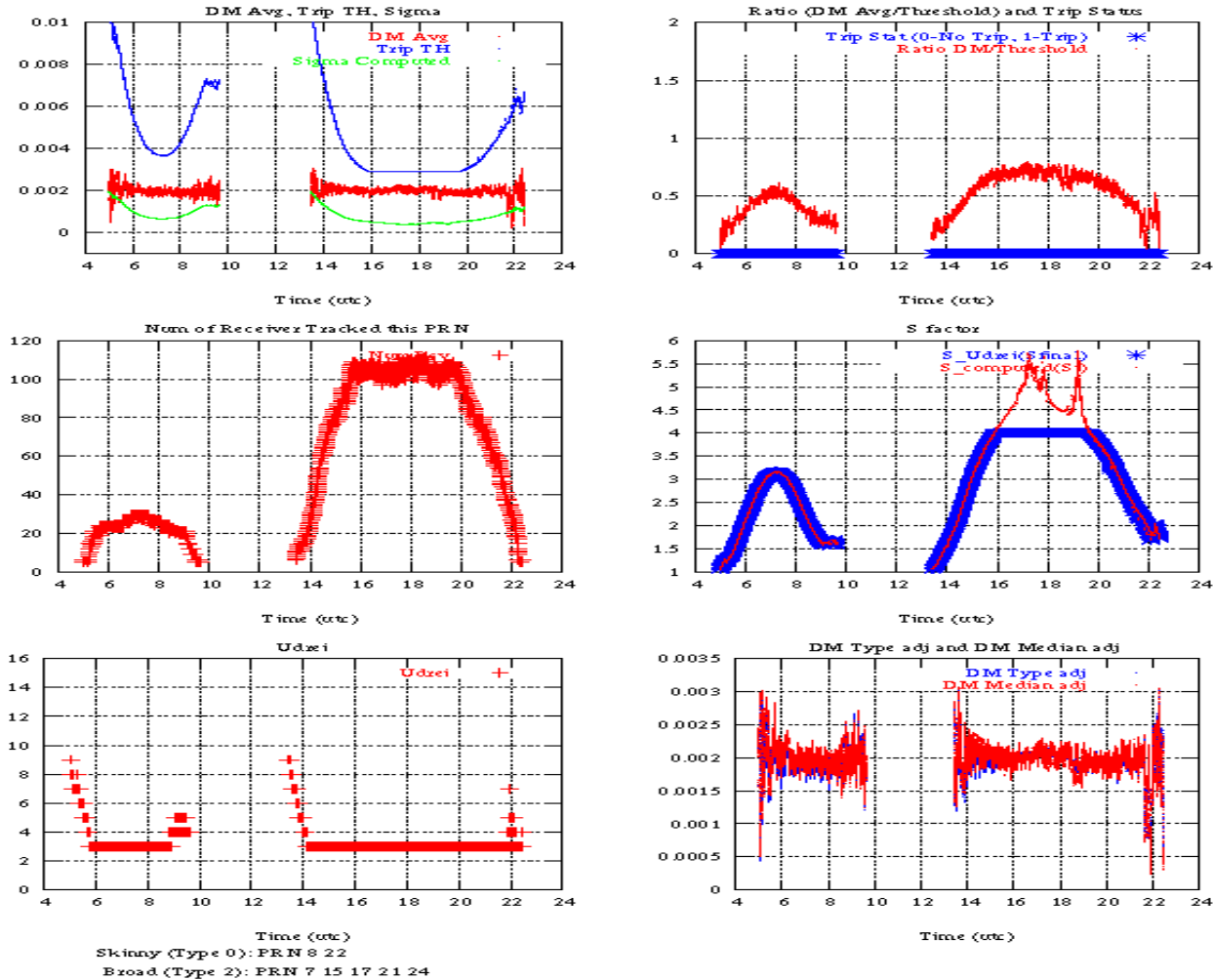


DM 1 PRN 2 1764 Day 6 (11/2/2013)

DM1 bias elevated from baseline

PRN 2 DM0 Across Receivers (IRB removed and above 5 deg)

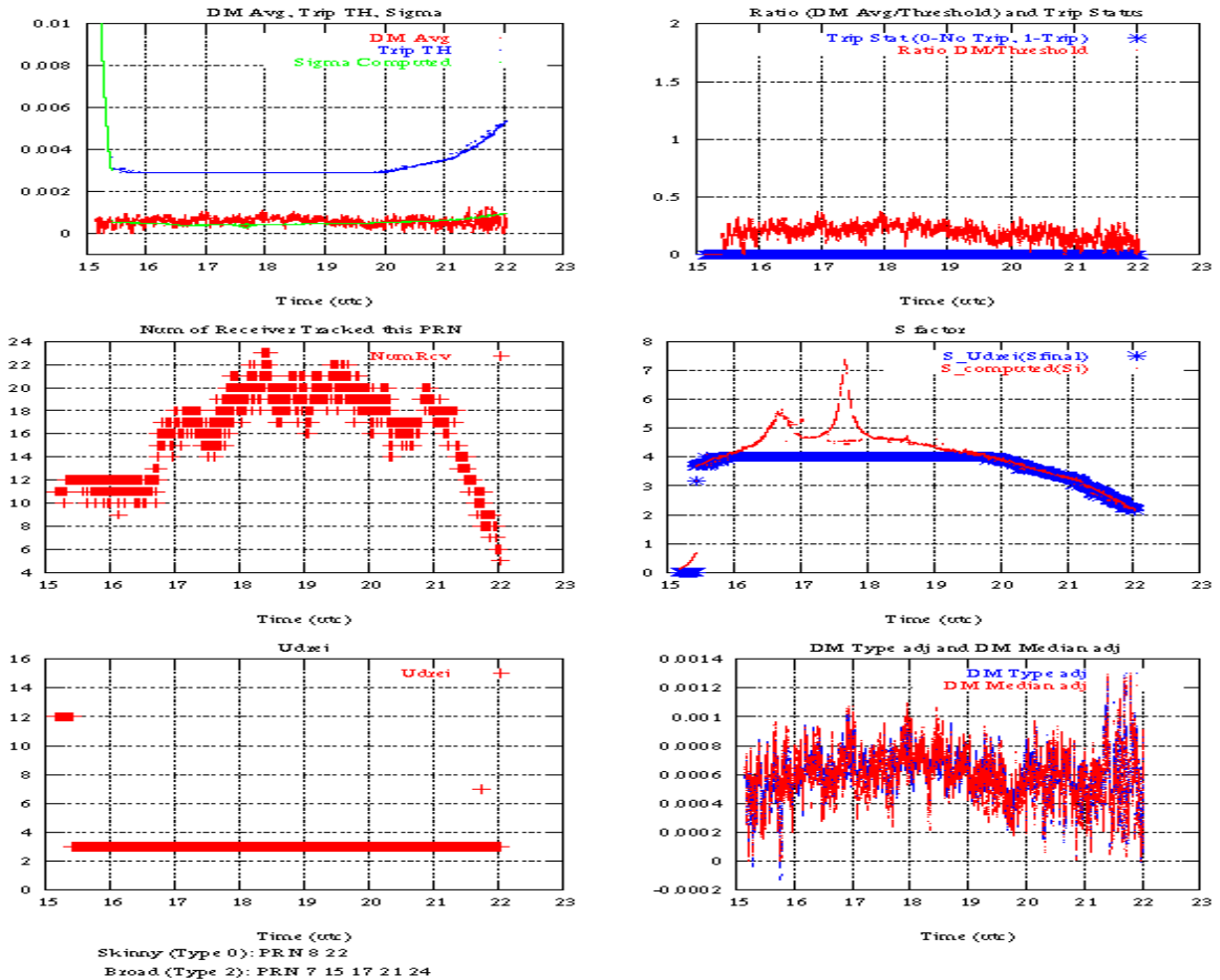
GpsWeek 1764 Day 6



DM 1 PRN 2 1765 Day 2 (11/5/2013)

PRN 2 DM0 Across Receivers (IRB removed and above 5 deg)

GpsWeek 1765 Day 2

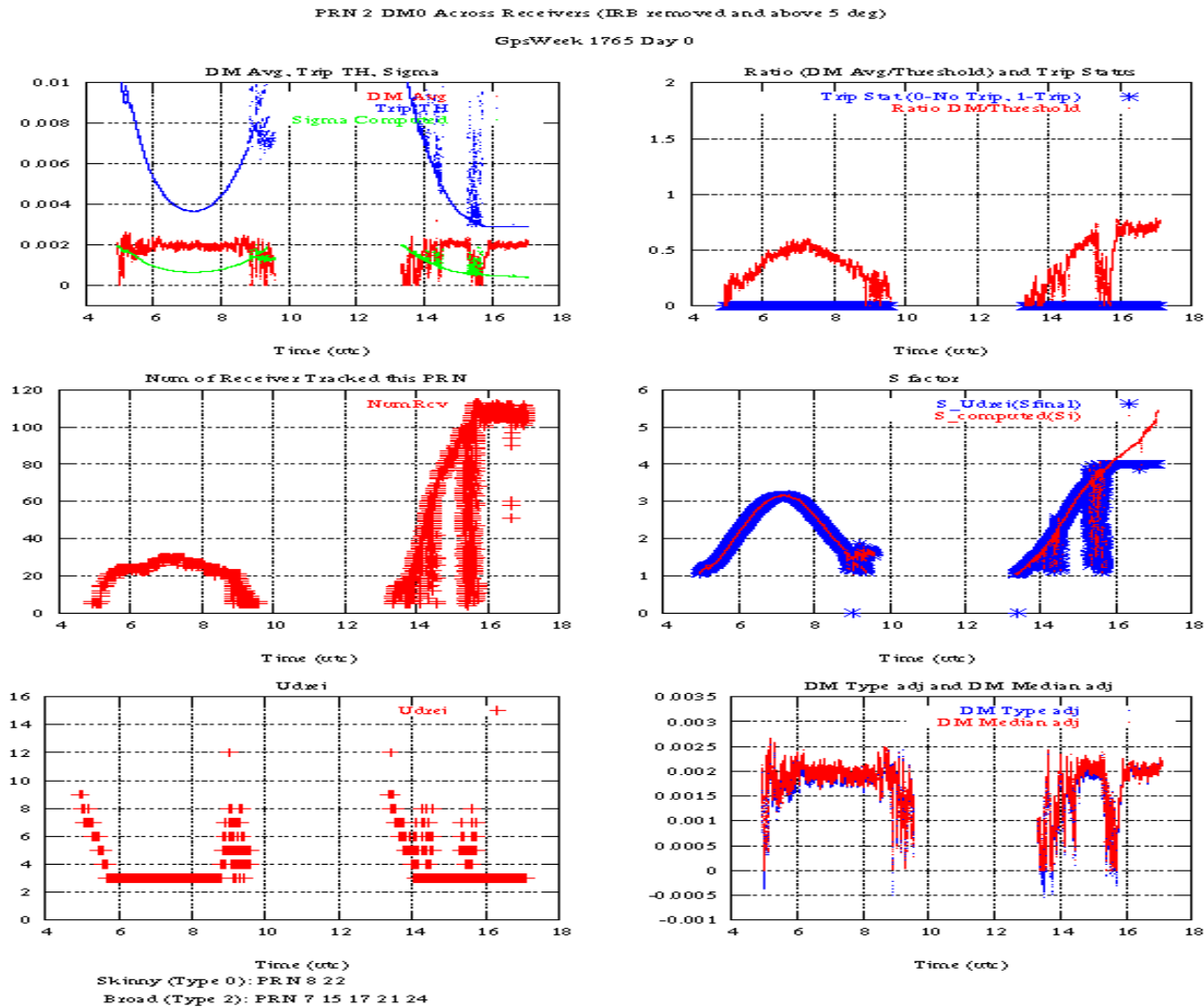


Skinny (Type 0): PRN 8 22
 Broad (Type 2): PRN 7 15 17 21 24



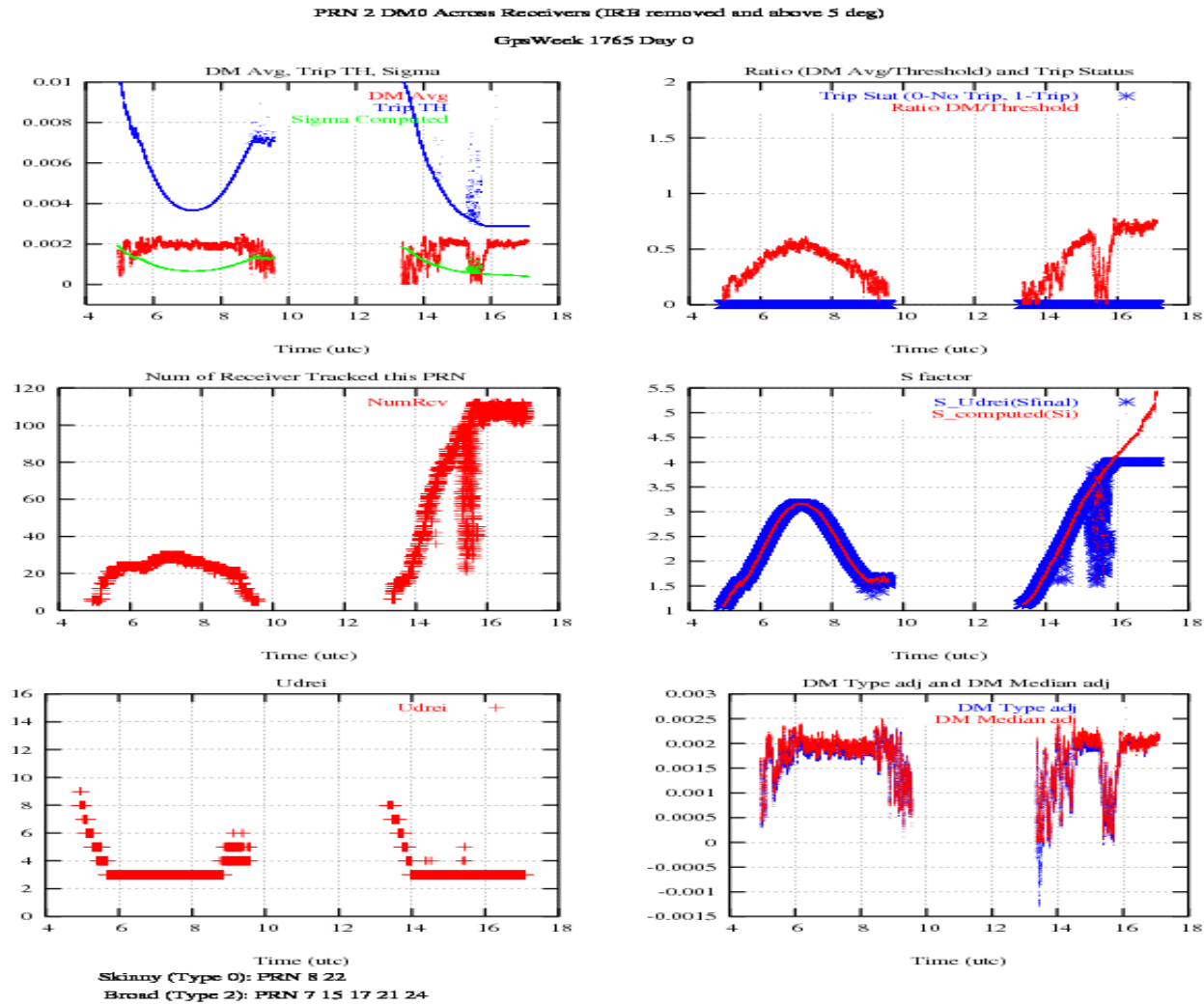
DM PRN 2 1765 Day 0 (11/3/2013)

Realtime (Threshold ACCUM < 1E6, i.e. ADD value)



DM 0 PRN 2 1765 Day 0 (11/3/2013)

Post Process (Threshold ACCUM < 2E6, i.e. 2 x ADD value)

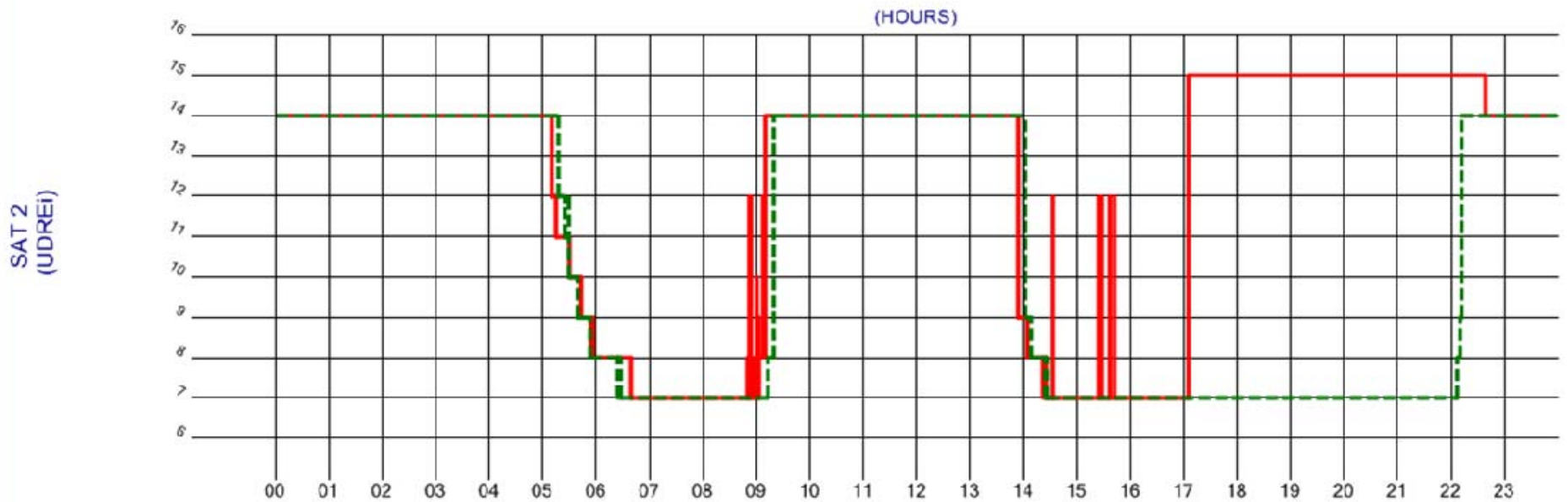


11/3/13 Pre-screening Examples

- All 9 accumulator counts must be nonzero and $> 1E6$
- Delta of new prompt accumulator count and 10-sec median accumulator counts must be within range $[0, 1E6]$
- 11/3/13 - UDRE bumped because there was not enough measurements left after pre-screening



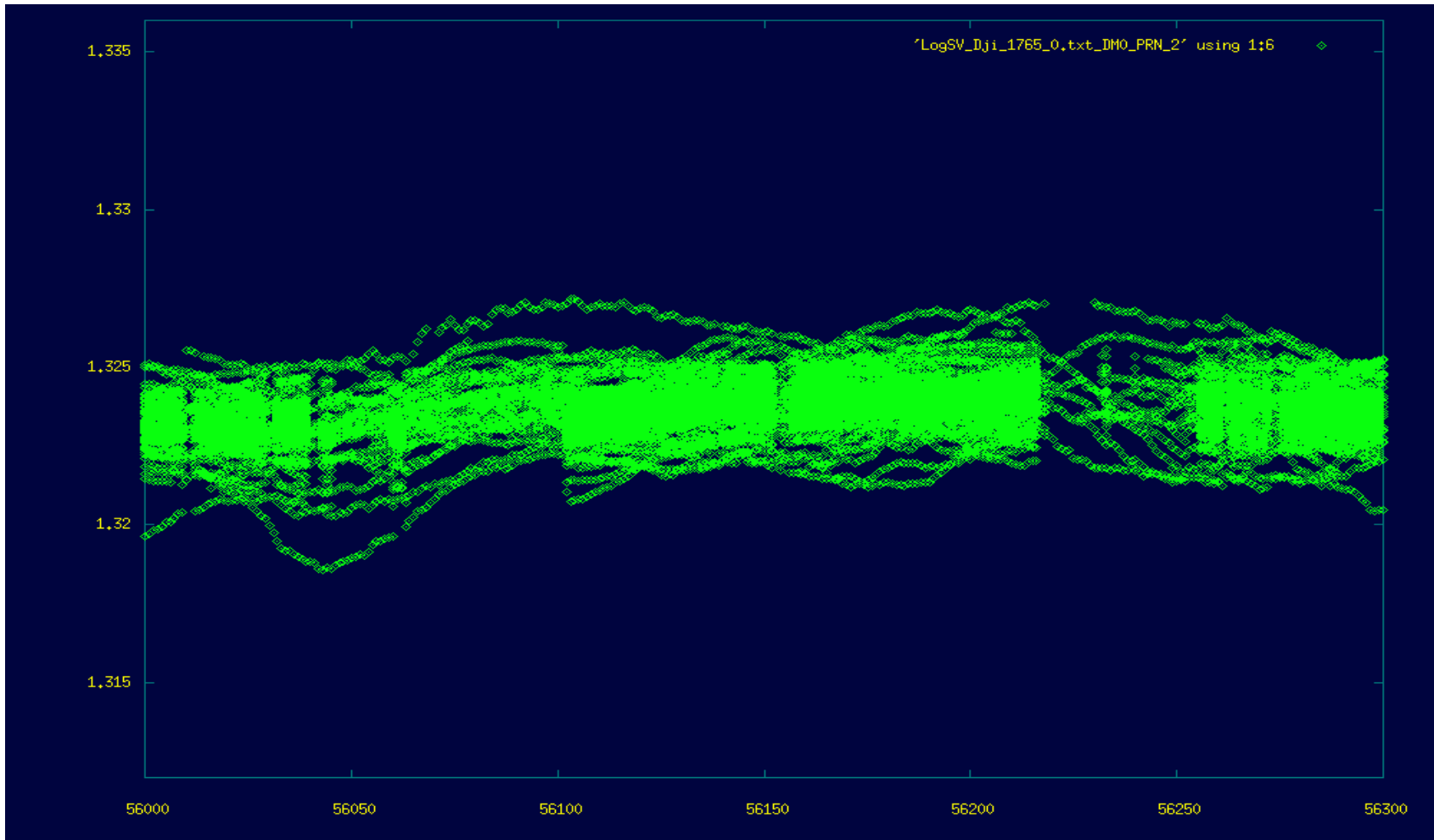
PRN-2 UDREi Bumping 11/3/13



Warning - plot has an artificial floor at UDREi = 7



11/3/13 Pre-screening 15:33-15:38

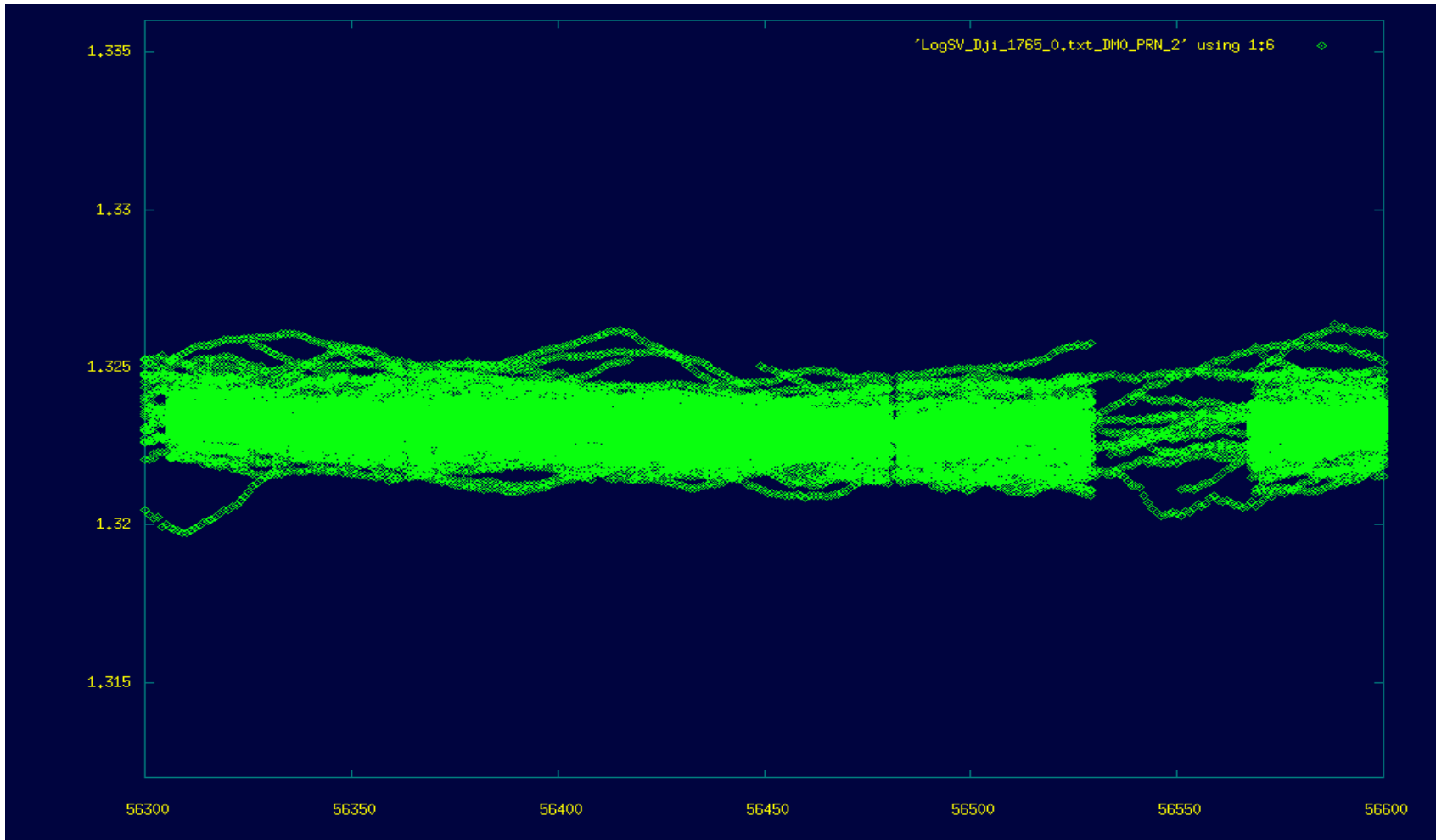


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11/3/13 Pre-screening 15:38-15:41



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