JPSS-1 VIIRS V2 "At-Launch" RSR, Comparisons, Impacts, Etc.

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2016 STAR JPSS Science Teams Anuual Mtg

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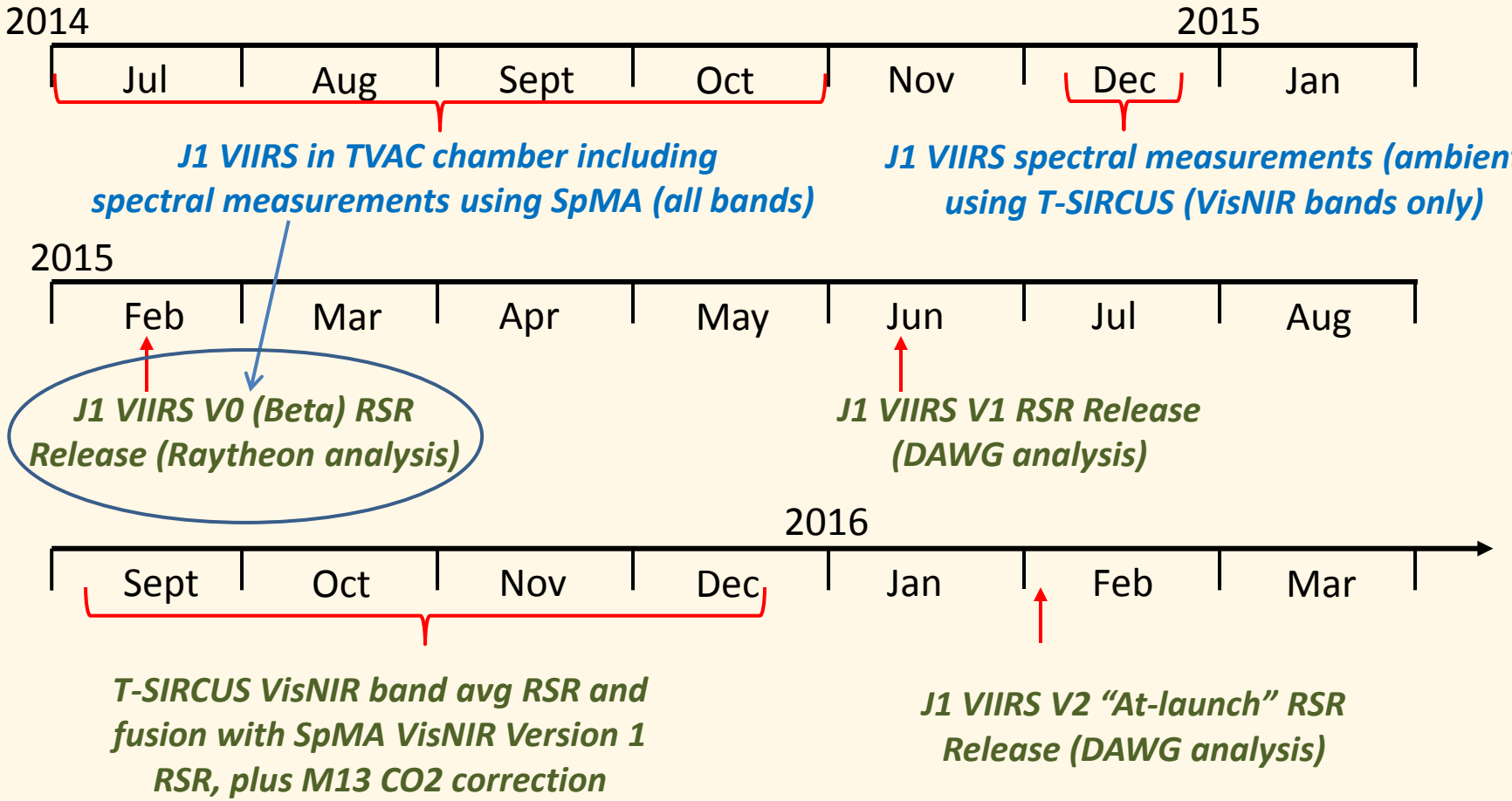
College Park , MD

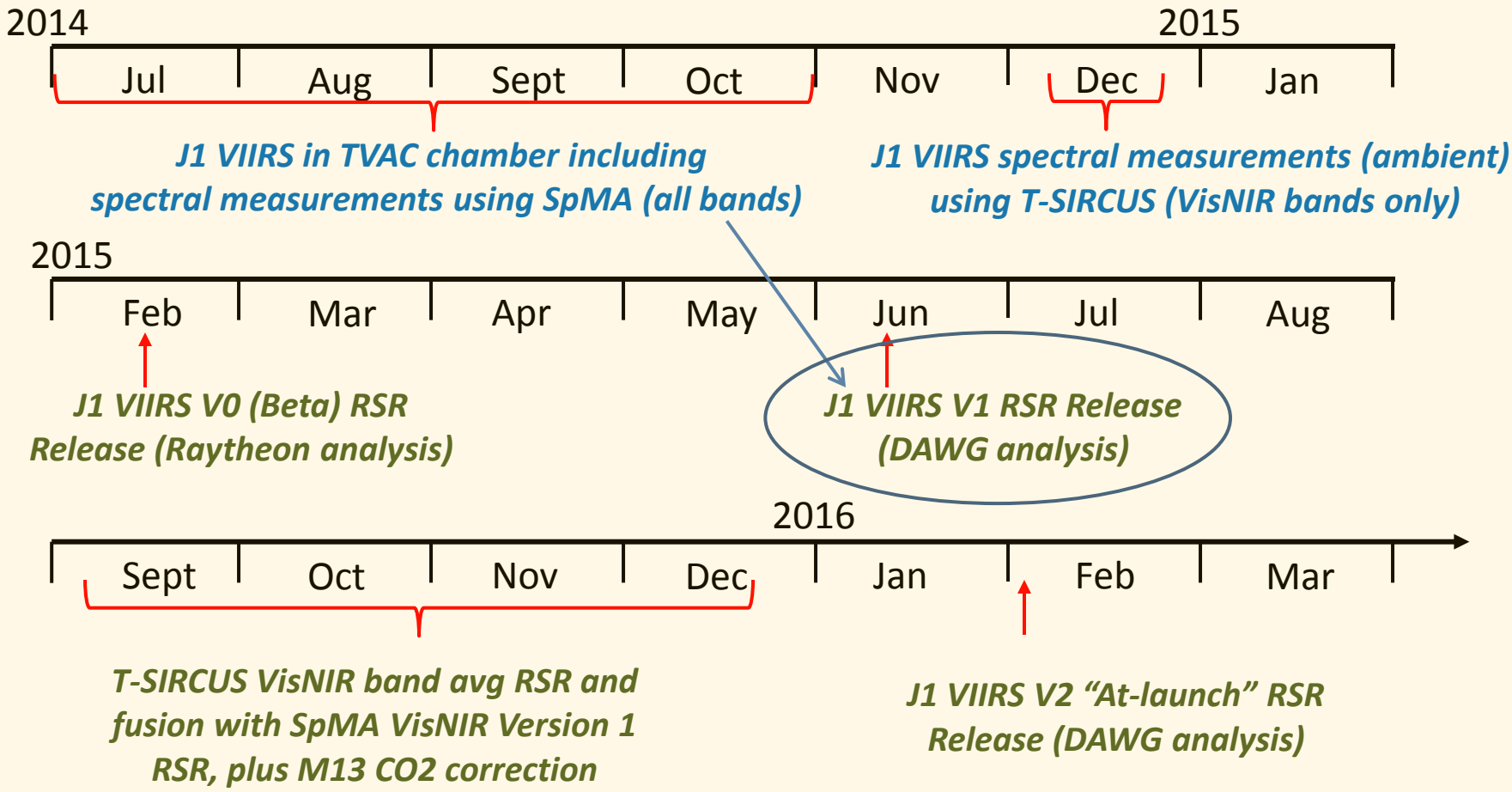
RSR, Comparisons, Impact

- JPSS-1 V2 RSR
  - Pedigree/Analysis
  - Product
- Influence of RSR on SDR
  - Comparisons with SNPP
  - Detector dependence

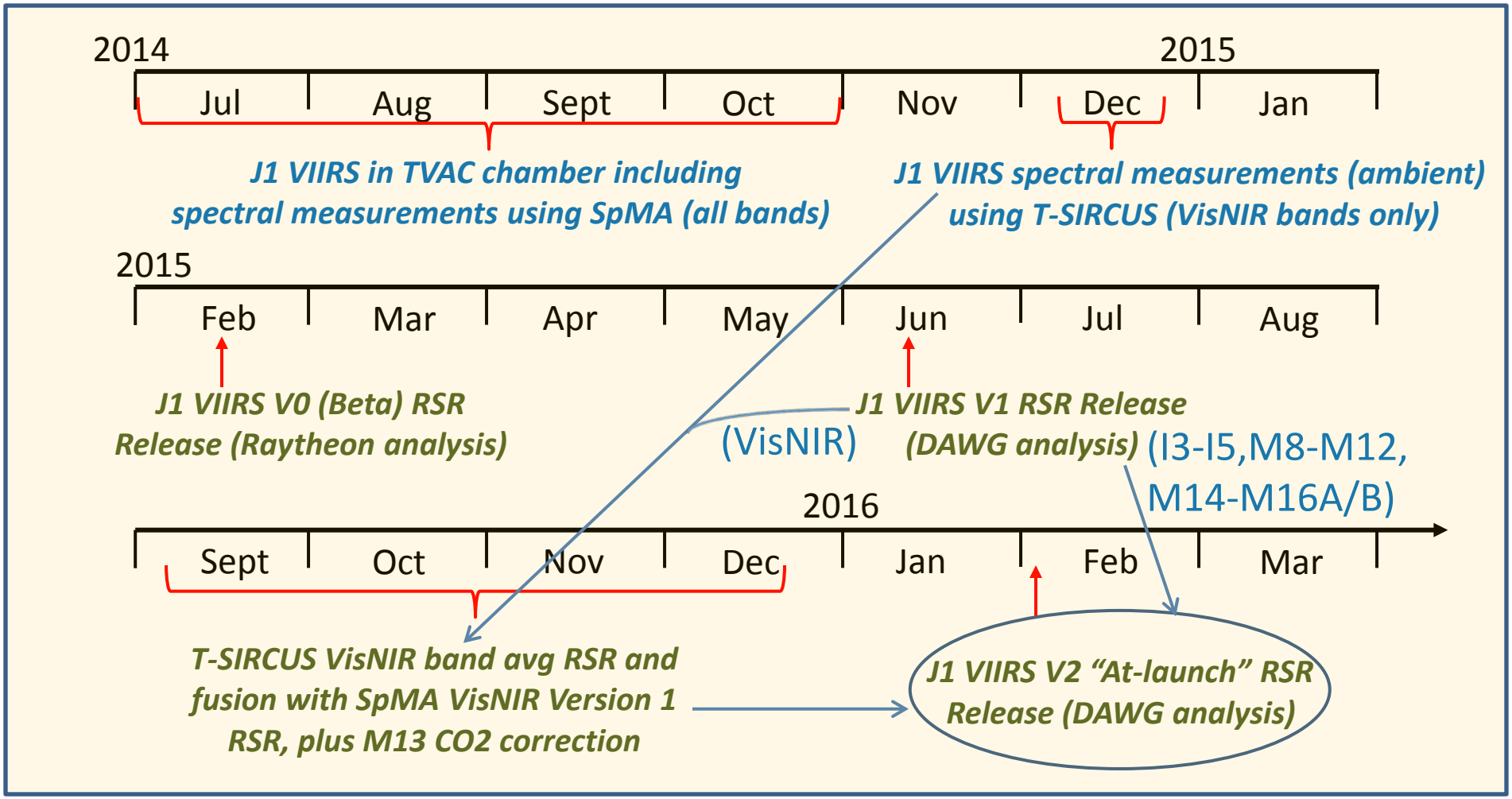
JPSS-1 VIIRS RSR Version History: Version 0 (Beta)



JPSS-1 VIIRS RSR Version History: Version 1



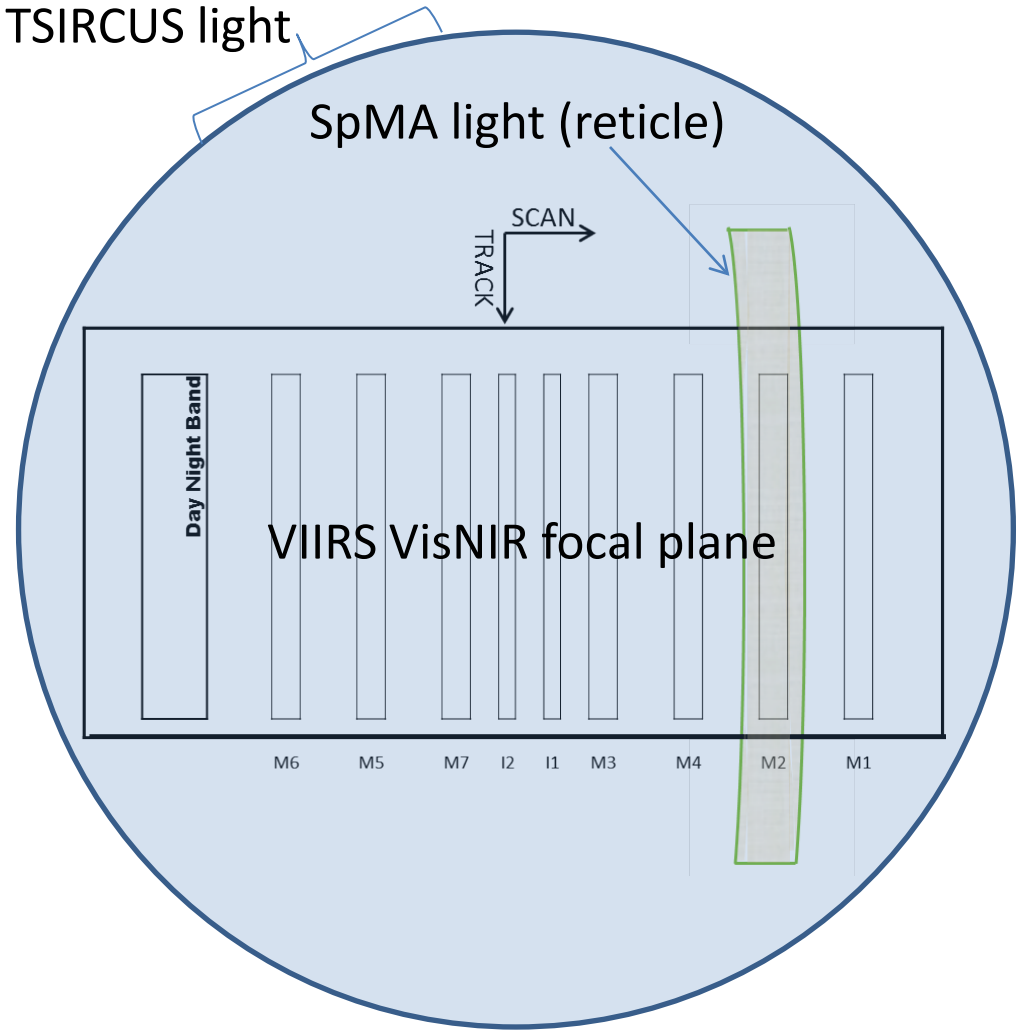
JPSS-1 VIIRS RSR Version History: Version 2 "At-Launch"



Measurements: Illumination Characteristics

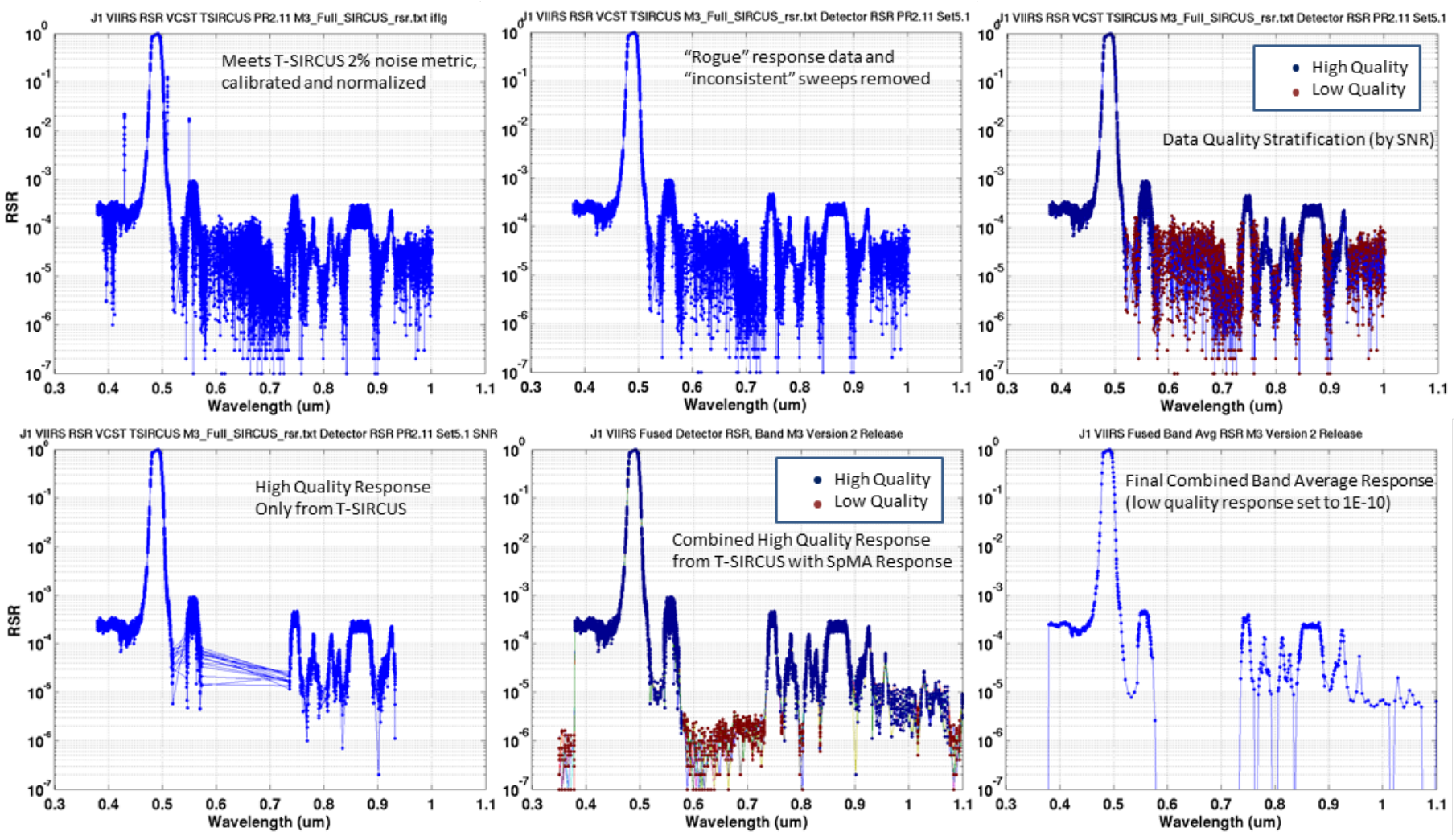
TSIRCUS sampling strategy at each wavelength

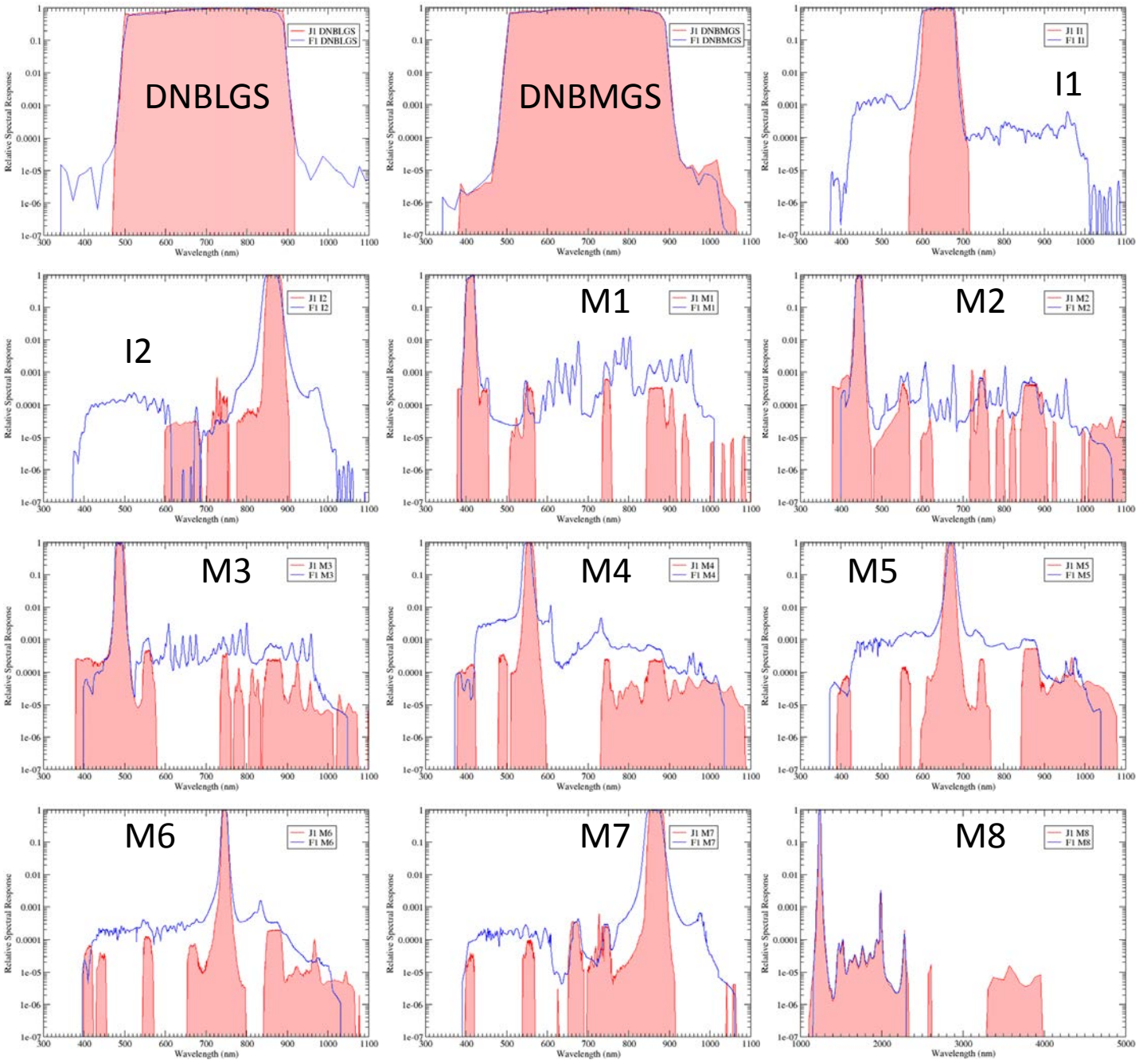
- Light on detectors for 8-28 seconds (Dn_{open})
- Shutter closed (dark) for 8-28 seconds (Dn_{closed})

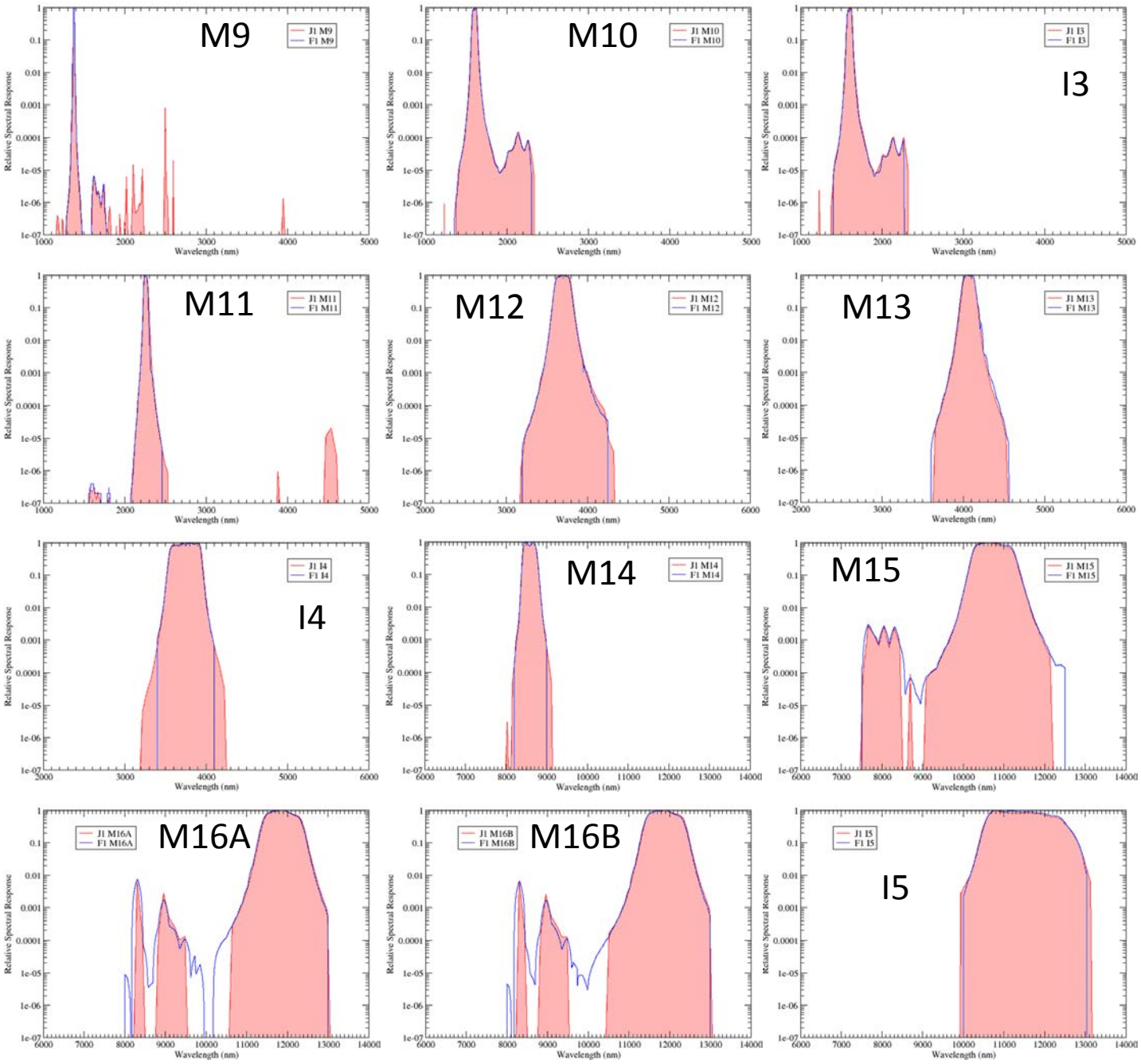


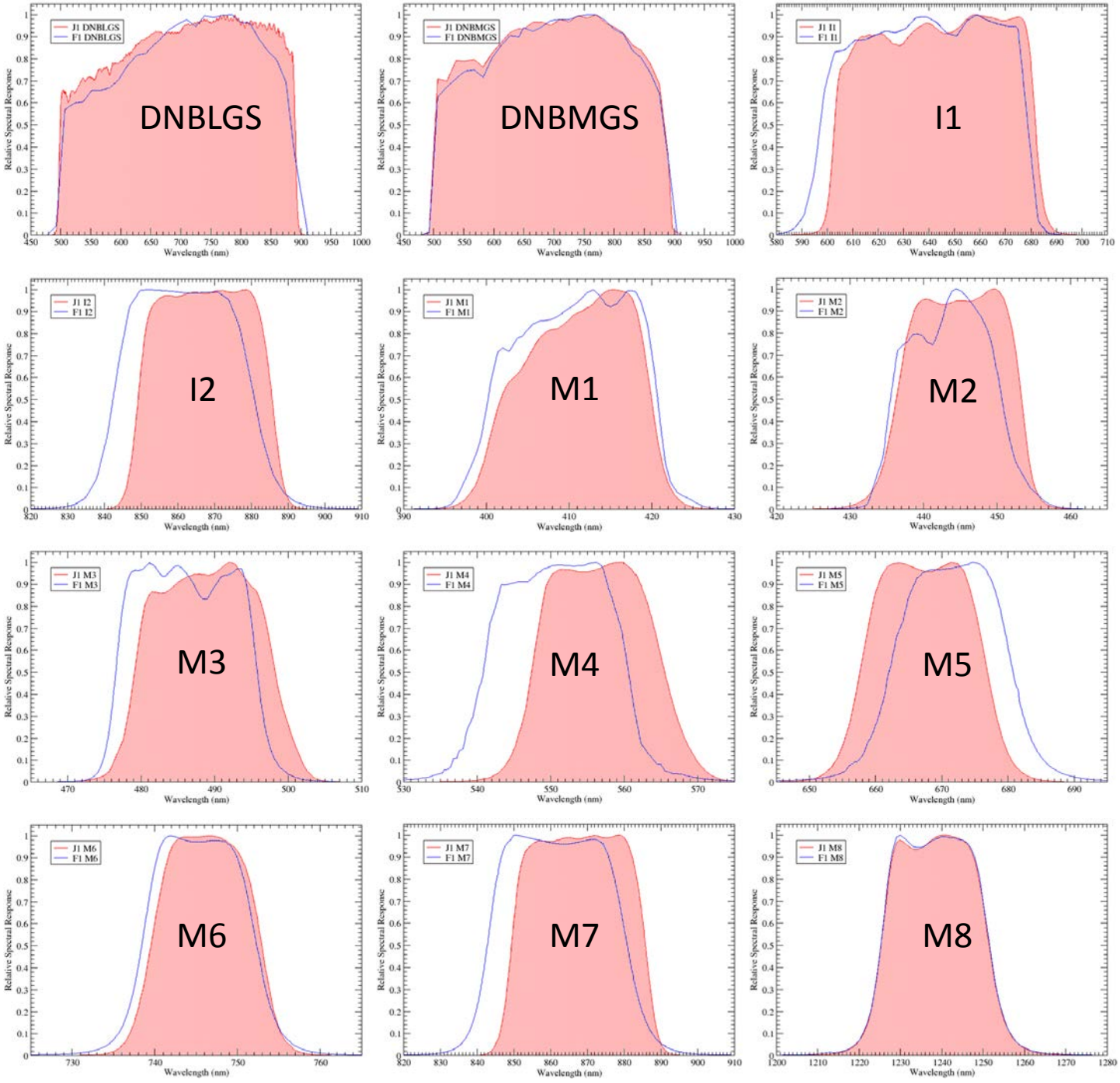
SpMA (V1 - All Bands)	TSIRCUS (V2 – VisNIR Bands)
• Slit illumination	• Flood illumination
• Polarized	• Unpolarized
• Spectral smile	• Spectrally flat
• >30% source non-uniformity along-track	• <10% source non-uniformity along-track
• Offline source monitoring	• Realtime source monitoring
• 5 to 6 decades of VisNIR response	• 4 to 5 decades of VisNIR response
• Contiguous spectral sampling	• “Picket-fence” spectral sampling

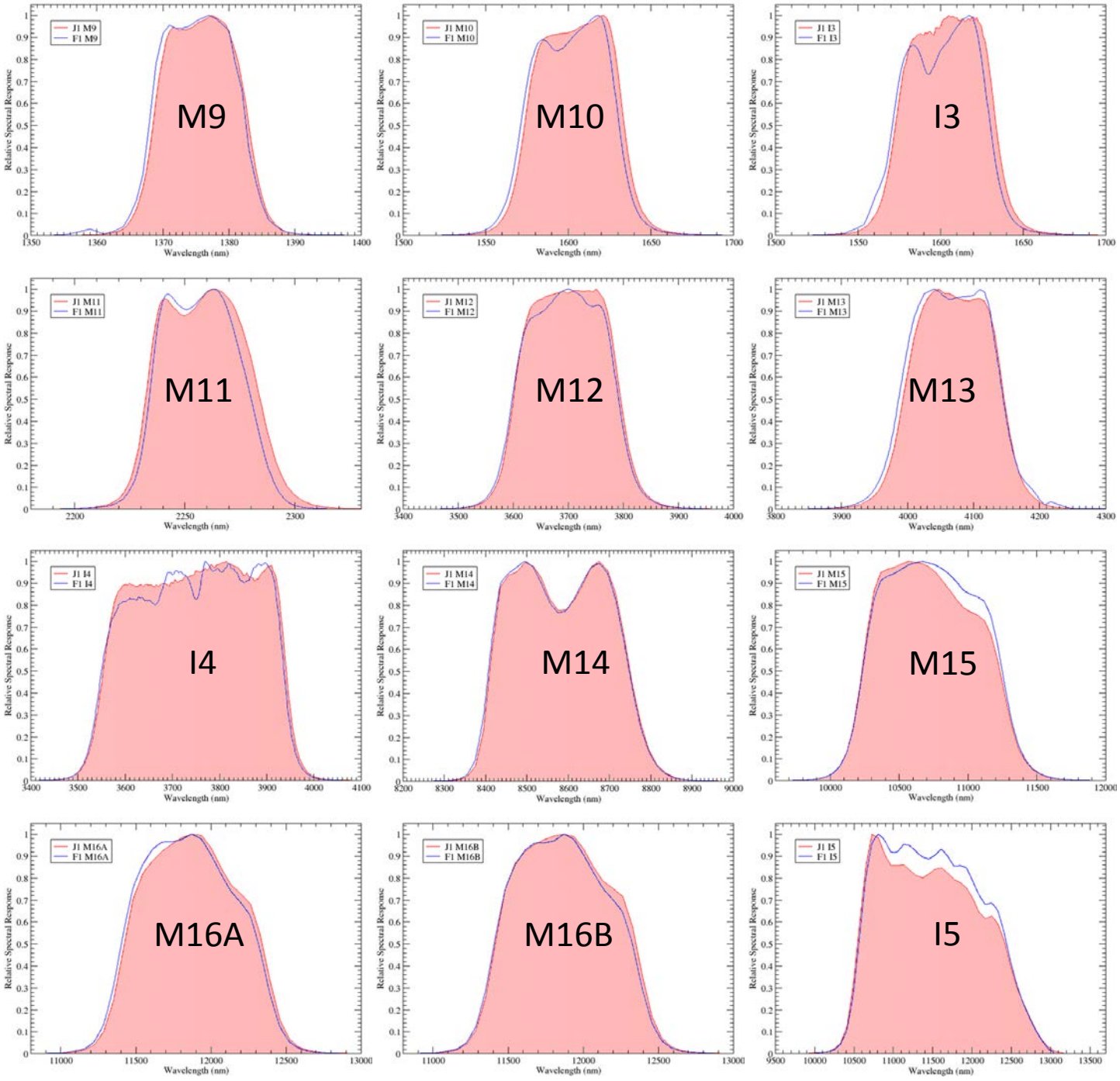
Analysis: 6 Steps to V2 Band Average "Fused" VisNIR RSR




DNBLGS
J1 DNBLGS
F1 DNBLGS
DNBMGS
J1 DNBMGS
F1 DNBMGS
I1
J1 I1
F1 I1
I2
J1 I2
F1 I2
M1
J1 M1
F1 M1
M2
J1 M2
F1 M2
M3
J1 M3
F1 M3
M4
J1 M4
F1 M4
M5
J1 M5
F1 M5
M6
J1 M6
F1 M6
M7
J1 M7
F1 M7
M8
J1 M8
F1 M8
Relative Spectral Response
Wavelength (nm)


M9
J1 M9
F1 M9
M10
J1 M10
F1 M10
I3
J1 I3
F1 I3
M11
J1 M11
F1 M11
M12
J1 M12
F1 M12
M13
J1 M13
F1 M13
I4
J1 I4
F1 I4
M14
J1 M14
F1 M14
M15
J1 M15
F1 M15
M16A
J1 M16A
F1 M16A
M16B
J1 M16B
F1 M16B
I5
J1 I5
F1 I5
Relative Spectral Response
Wavelength (nm)


J1 DNBLGS
F1 DNBLGS
DNBLGS
J1 DNBMGS
F1 DNBMGS
DNBMGS
J1 I1
F1 I1
I1
J1 I2
F1 I2
I2
J1 M1
F1 M1
M1
J1 M2
F1 M2
M2
J1 M3
F1 M3
M3
J1 M4
F1 M4
M4
J1 M5
F1 M5
M5
J1 M6
F1 M6
M6
J1 M7
F1 M7
M7
J1 M8
F1 M8
M8
Relative Spectral Response
Wavelength (nm)


J1 M9
F1 M9
M9
J1 M10
F1 M10
M10
J1 I3
F1 I3
I3
J1 M11
F1 M11
M11
J1 M12
F1 M12
M12
J1 M13
F1 M13
M13
J1 I4
F1 I4
I4
J1 M14
F1 M14
M14
J1 M15
F1 M15
M15
J1 M16A
F1 M16A
M16A
J1 M16B
F1 M16B
M16B
J1 I5
F1 I5
I5
Relative Spectral Response
Wavelength (nm)

Band Average RSR Performance Against Compliance Metrics

Band	Specified Center (nm)	Measured Center (nm)	Specified 50% Bandpass (nm)	Measured 50% Bandpass (nm)	Specified Lower 1% Limit (nm)	Measured Lower 1% Limit (nm)	Specified Upper 1% Limit (nm)	Measured Upper 1% Limit (nm)	Specified IOOB (%)	J1 Measured IOOB (%)	S-NPP Measured IOOB (%)
I1	640 ±6	642.3	80 ±6	78.9	≥565	594.4	≤715	691.5	0.5	0.11	0.39
I2	865 ±8	867.4	39 ±5	36.5	≥802	842.7	≤928	892.3	0.7	0.12	0.52
I3	1610 ±14	1603.2	60 ±9	60.7	≥1509	1544.3	≤1709	1667.7	0.7	0.44	0.48
I4	3740 ±40	3747.6	380 ±30	387.5	≥3340	3474.1	≤4140	4015.2	0.5	0.16	0.16
I5	11450 ±125	11483.1	1900 ±100	1875.1	≥9900	10170.8	≤12900	13090.6	0.4	0.08	0.06
M1	412 ±2	410.9	20 ±2	18.2	≥376	395.6	≤444	425.1	1.0	0.35	2.19
M2	445 ±3	444.8	18 ±2	17.0	≥417	429.2	≤473	457.7	1.0	0.52	0.93
M3	488 ±4	488.7	20 ±3	19.1	≥455	472.9	≤521	504.4	0.7	0.43	1.15
M4	555 ±4	556.5	20 ±3	18.1	≥523	540.2	589	573.7	0.7	0.37	3.65
M5	672 ±5	667.3	20 ±3	19.3	≥638	649.7	≤706	685.1	0.7	0.37	2.70
M6	746 ±2	746.2	15 ±2	13.4	≥721	734.2	≤771	758.2	0.8	0.40	1.64
M7	865 ±8	867.6	39 ±5	36.5	≥801	842.8	≤929	892.5	0.7	0.16	0.62
M8	1240 ±5	1238.4	20 ±4	26.1	≥1205	1214.0	≤1275	1264.9	0.8	0.48	0.49
M9	1378 ±4	1375.8	15 ±3	14.5	≥1351	1362.0	≤1405	1390.0	1.0	0.41	1.01
M10	1610 ±14	1603.8	60 ±9	60.2	≥1509	1545.7	≤1709	1667.6	0.7	0.43	0.46
M11	2250 ±13	2258.2	50 ±6	52.0	≥2167	2209.4	2333	2314.4	1.0	0.35	0.40
M12	3700 ±32	3697.9	180 ±20	194.8	≥3410	3519.1	≤3990	3893.8	1.1	0.33	0.34
M13	4050 ±34	4070.0	155 ±20	153.0	≥3790	3909.1	≤4310	4224.7	1.3	0.40	0.35
M14	8550 ±70	8580.3	300 ±40	340.1	≥8050	8336.3	≤9050	8879.3	0.9	0.19	0.21
M15	10763 ±113	10730.9	1000 ±100	1001.7	≥9700	9916.9	≤11740	11638.7	0.4	0.35	0.40
M16A	12013 ±88	11882.8	950 ±50	914.6	≥11060	11104.1	≤13050	12692.5	0.4	0.39	0.39
M16B	12013 ±88	11883.0	950 ±50	934.5	≥11060	11101.5	≤13050	12698.5	0.4	0.38	0.37
M16[1]	12013 ±88	11882.9	950 ±50	924.8	≥11060	11102.8	≤13050	12695.7	0.4	0.39	-
DNBMGS[2]	700 ±14	693.1	400 ±20	381.1	≥470	487.8	≤960	906.9	0.1	0.00	0.00
DNBLGS	700 ±14	694.8	400 ±20	391.4	≥470	491.0	≤960	900.1	0.1	0.02	0.00

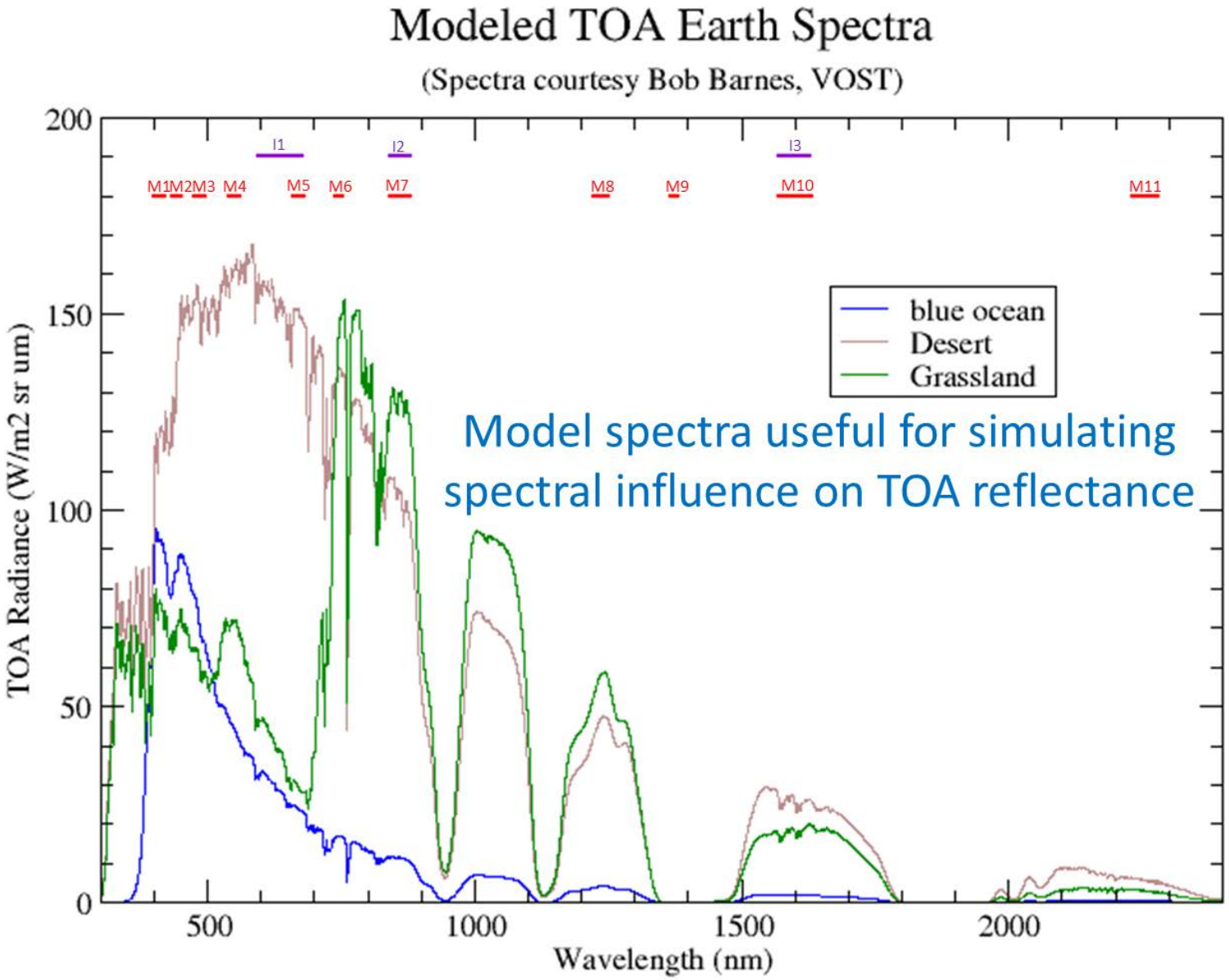
[1]M16 is an average of M16A and M16B.

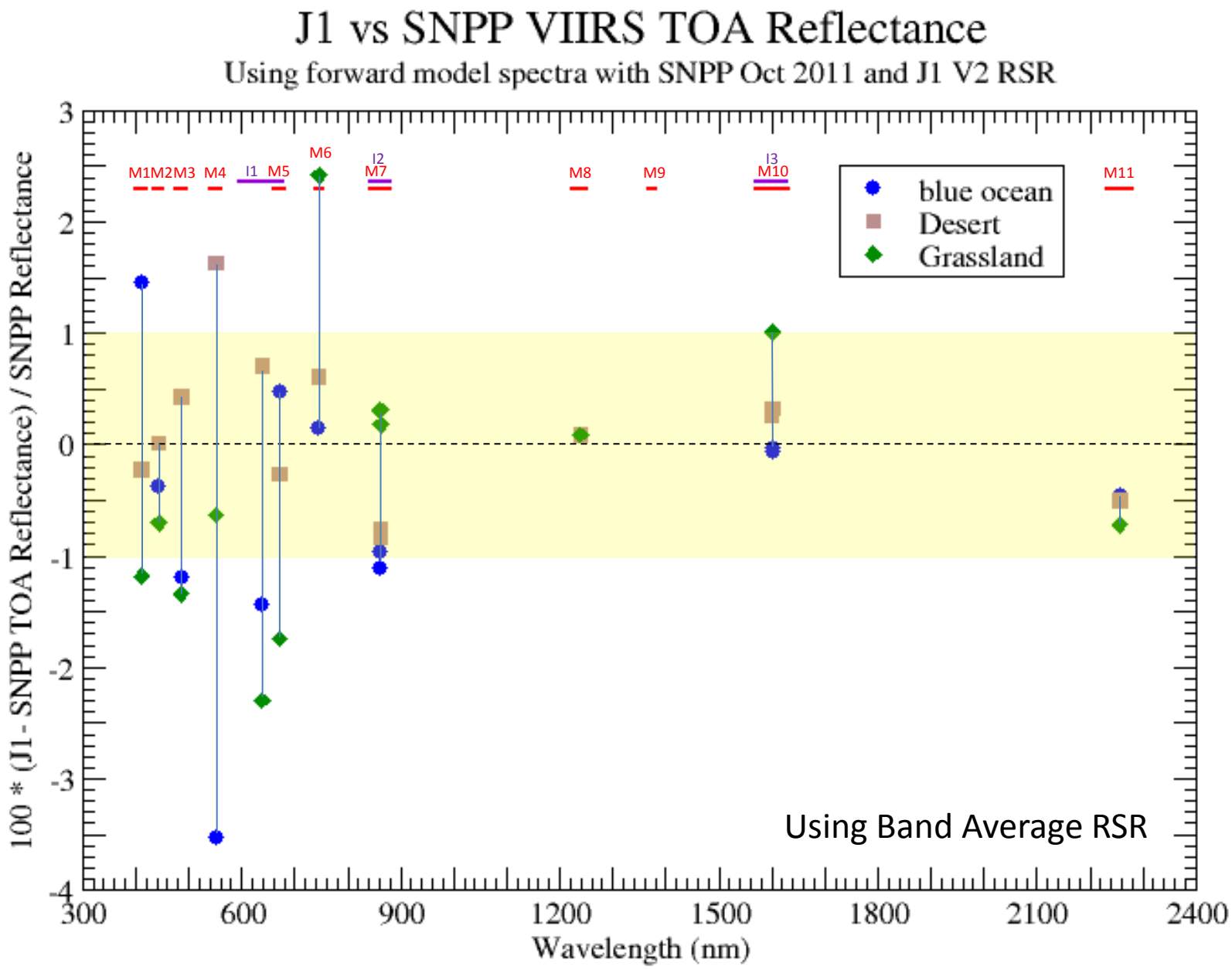
[1]DNBMGS spectral characterization represents DNBHGS. DNBHGS not directly measured due to its high gain.

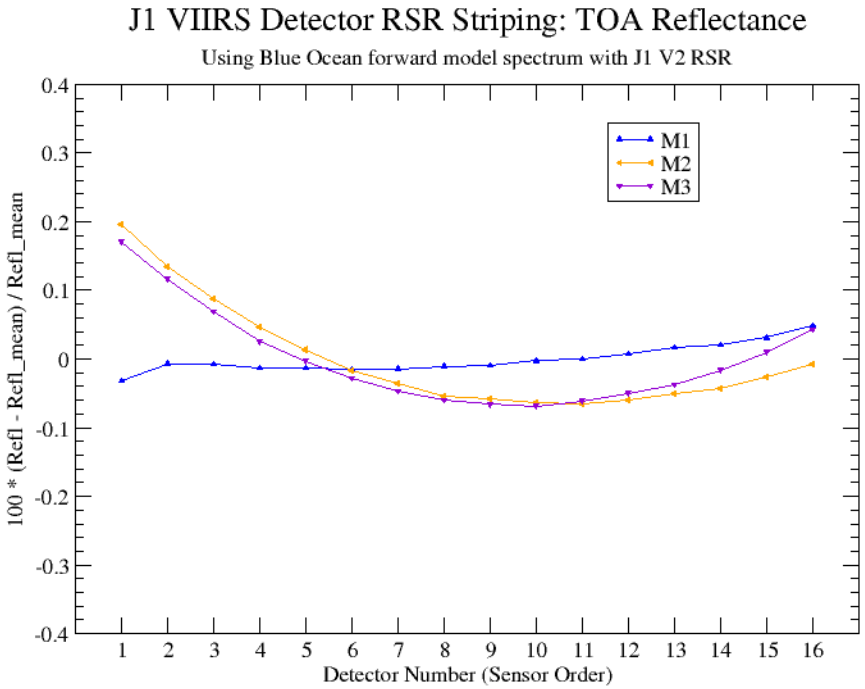
Summary: JPSS-1 VIIRS At-launch RSR

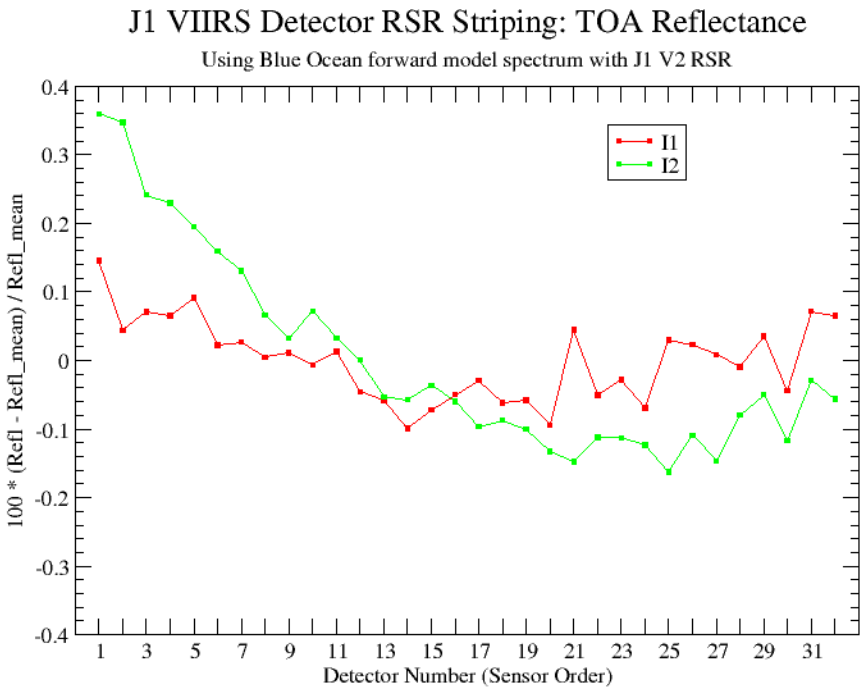
- JPSS-1 VIIRS RSR measurement and analysis program is complete, leading to the “at-launch” designation for the Version 2 (February 2016) release.
- Reductions in IOOB in VisNIR bands bring JPSS-1 VIIRS into compliance for these bands. Other minor non-compliances exist but are well characterized.
- Though the RSR are compliant on spectral position, there are differences in position/shape compared to SNPP.

V2 RSR Impact on SDR: RSB



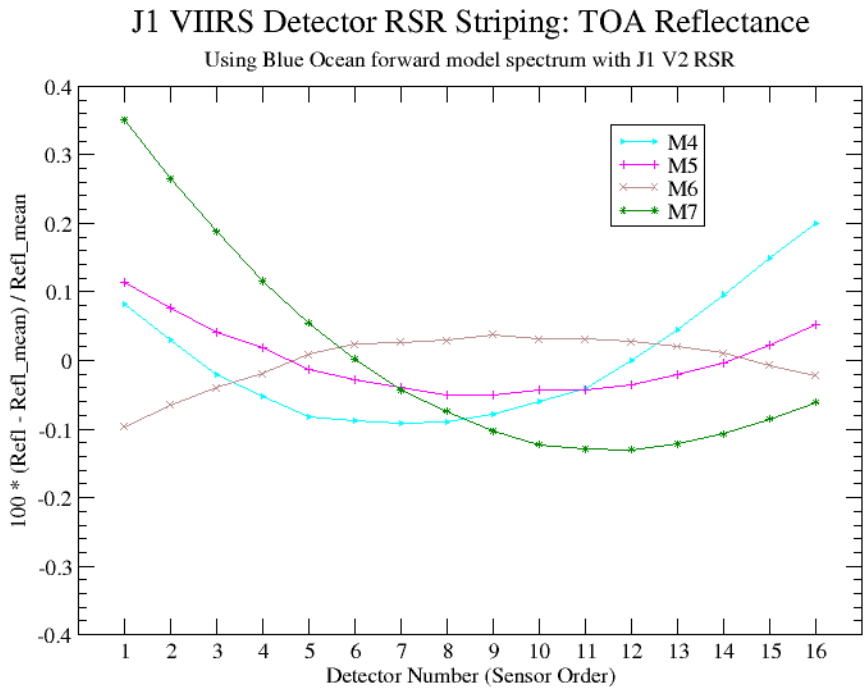

J1 vs SNPP VIIRS TOA Reflectance
Using forward model spectra with SNPP Oct 2011 and J1 V2 RSR
100 * (J1 - SNPP TOA Reflectance) / SNPP Reflectance
Wavelength (nm)
M1 M2 M3 M4 I1 M5 M6 I2 M7 M8 M9 I3 M10 M11
blue ocean
Desert
Grassland
Using Band Average RSR





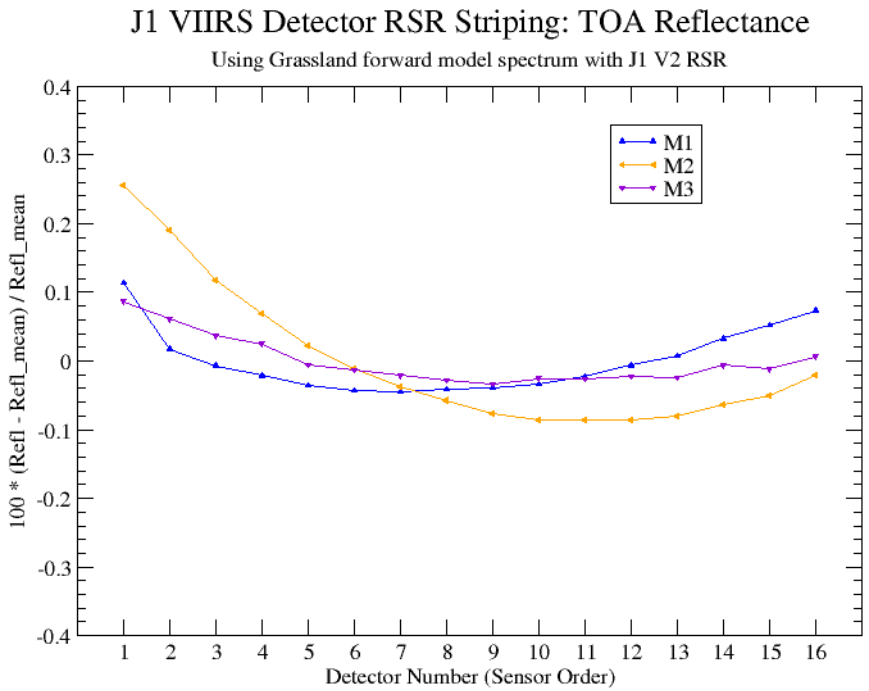
VIIRS Detector Dependence: Blue Ocean Model

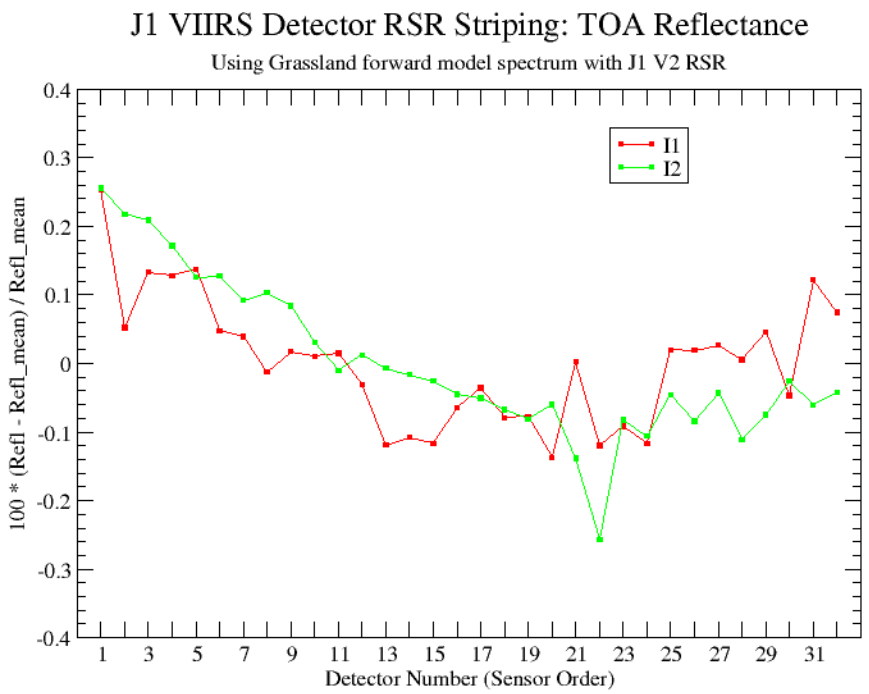
- Non-telecentric design causes variation in detector spectral coverage
- Simulated TOA reflectances show detector dependence

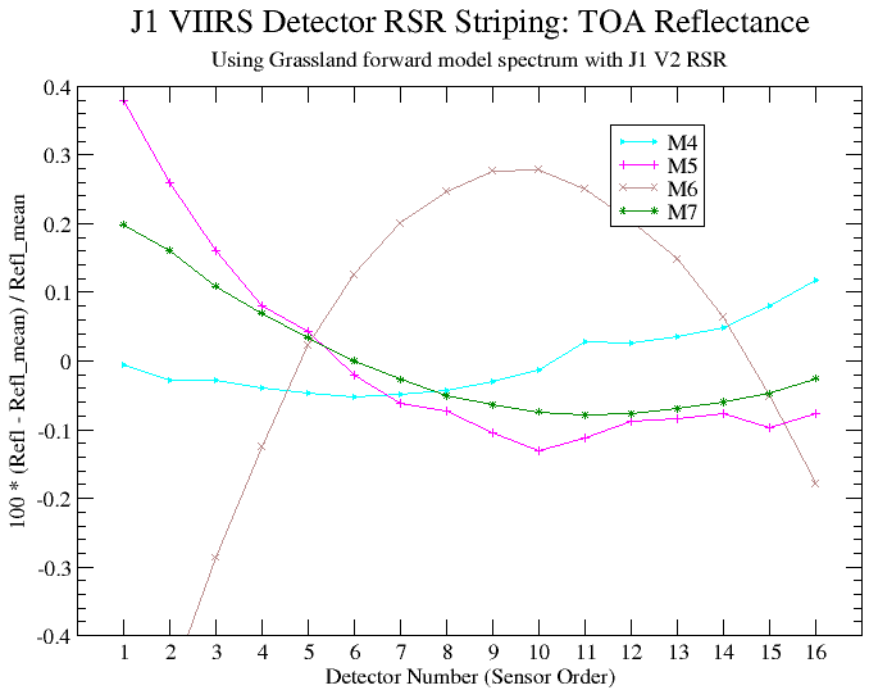


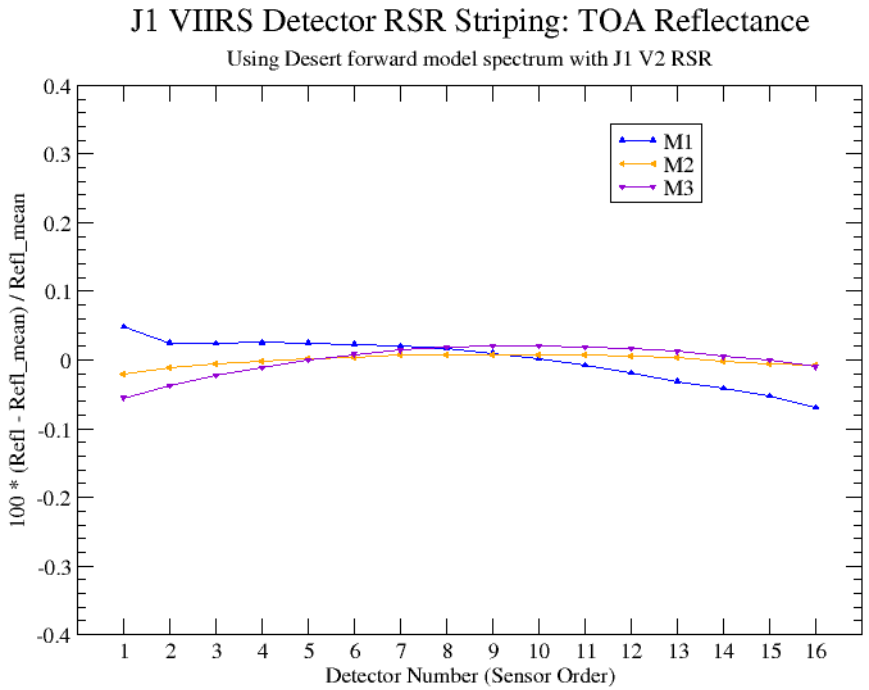
VIIRS Detector Dependence: Grassland Model

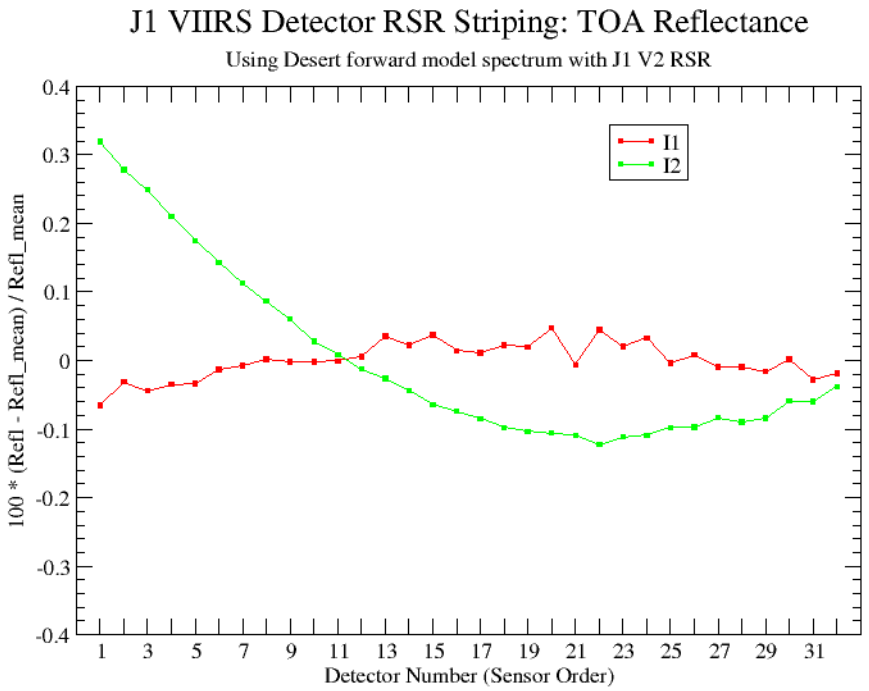
- Non-telecentric design causes variation in detector spectral coverage
- Simulated TOA reflectances show detector dependence





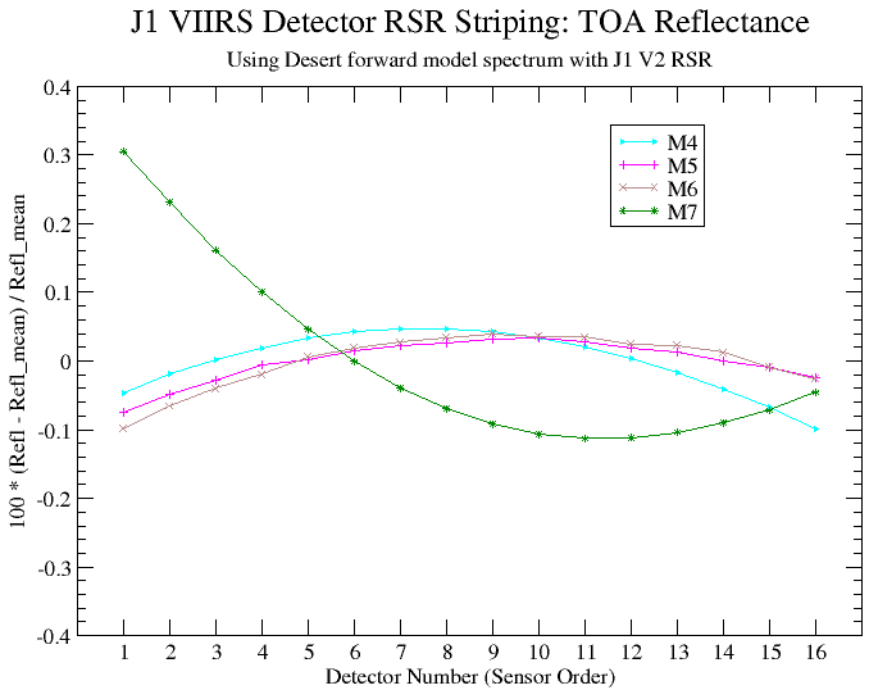




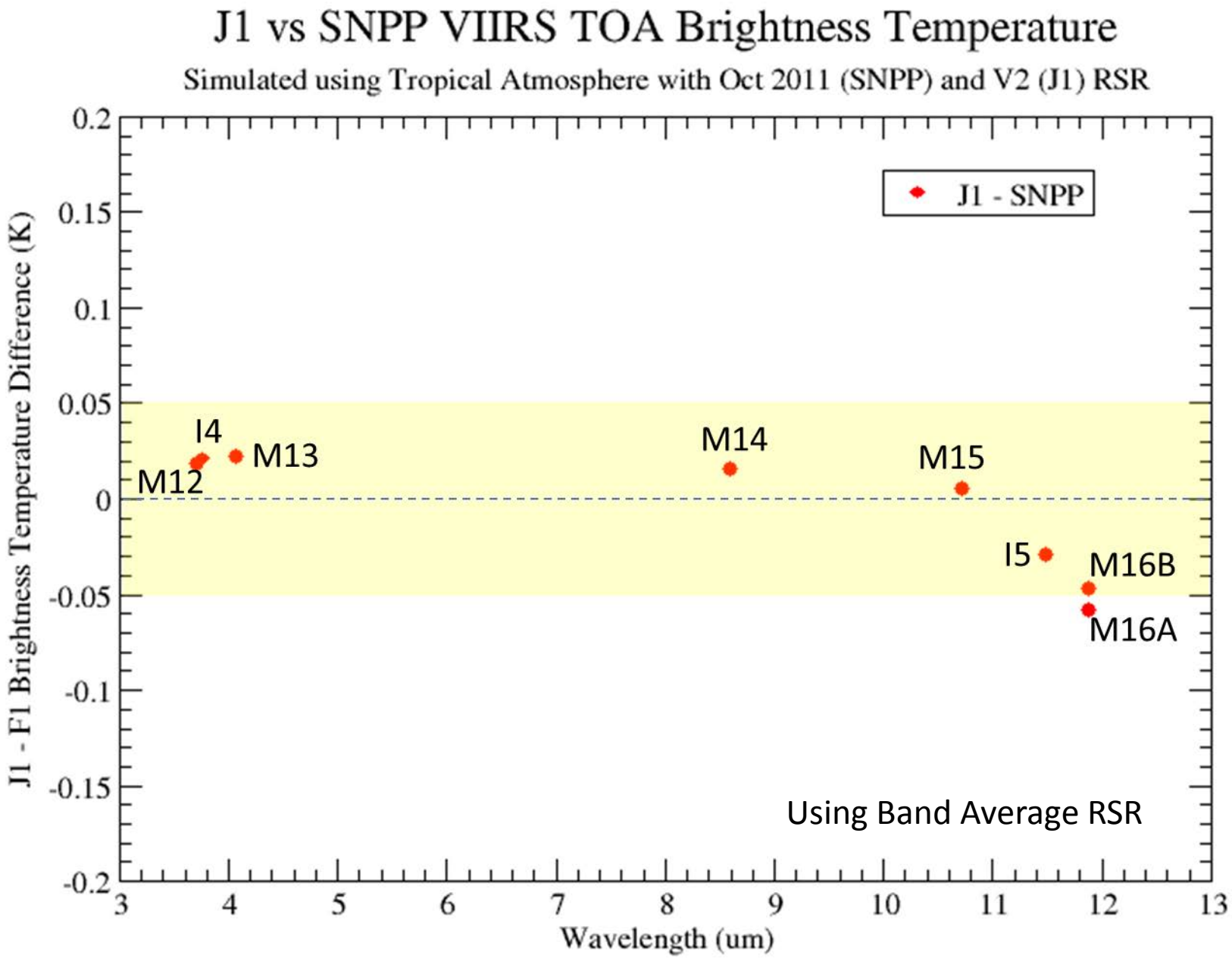


VIIRS Detector Dependence: Desert Model

- Non-telecentric design causes variation in detector spectral coverage
- Simulated TOA reflectances show detector dependence

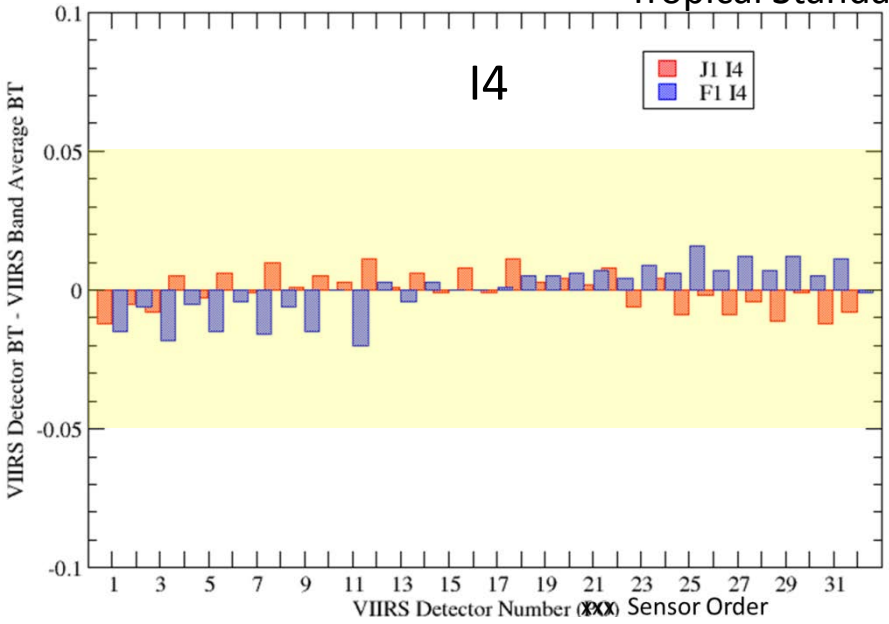


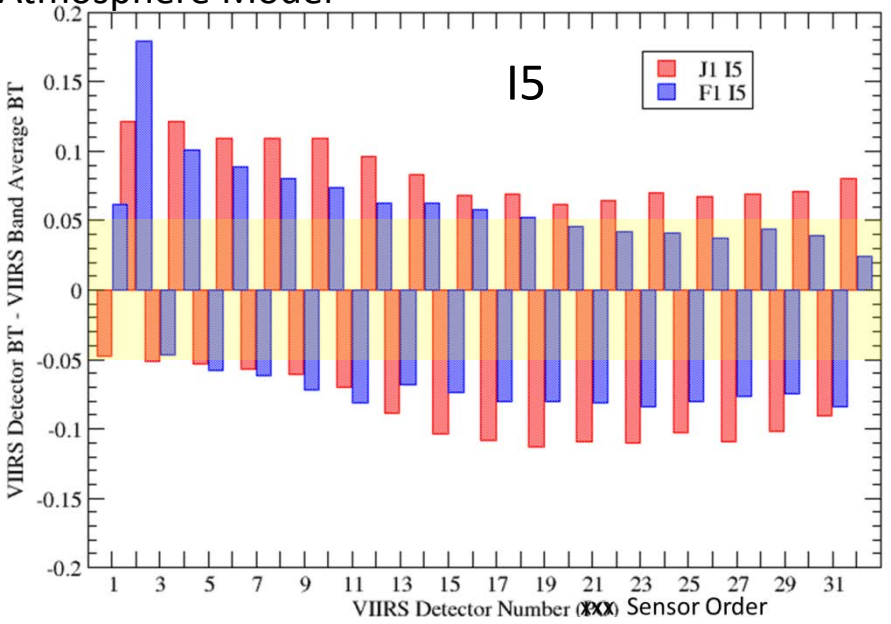
V2 RSR Impact on SDR: TEB

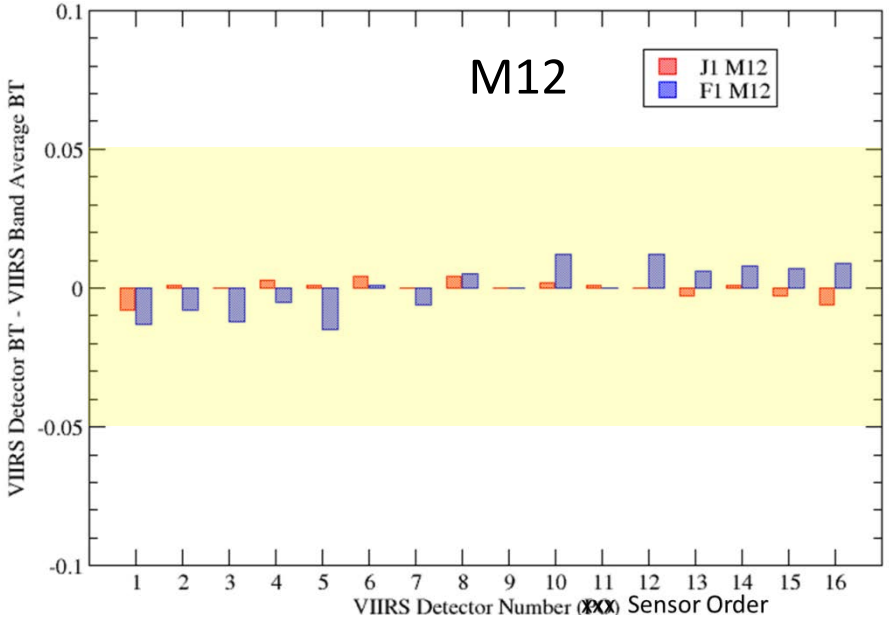


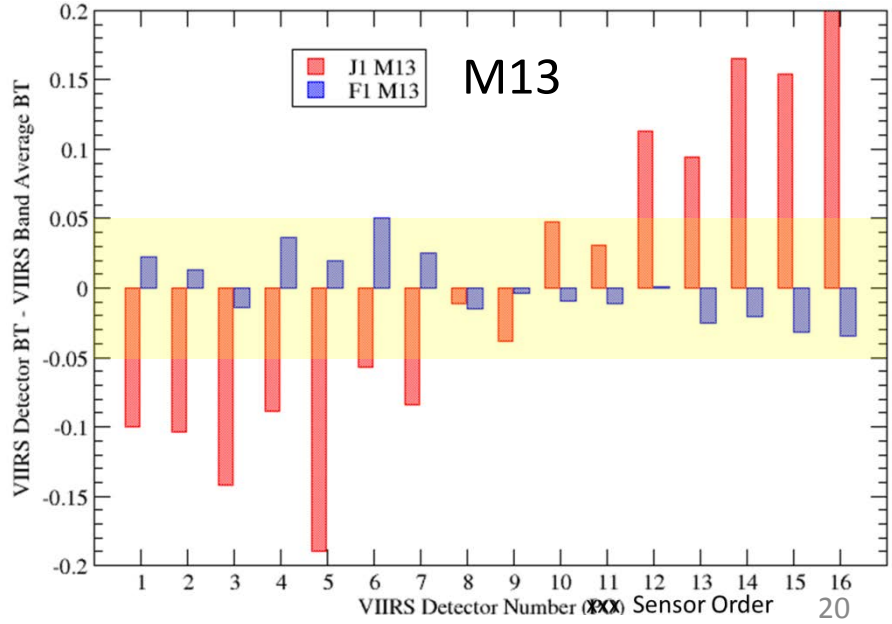
TEB Detector Dependence from RSR

Tropical Standard Atmosphere Model



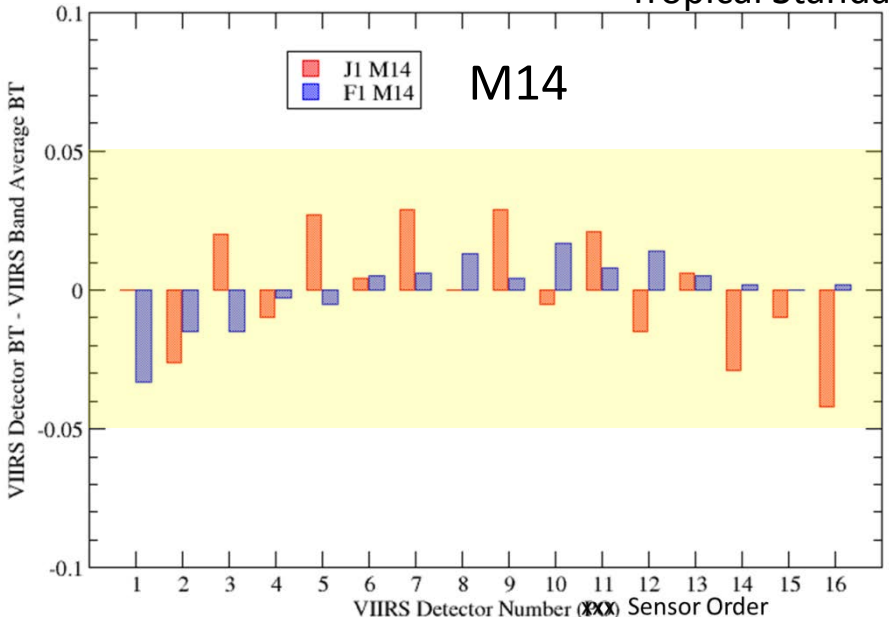


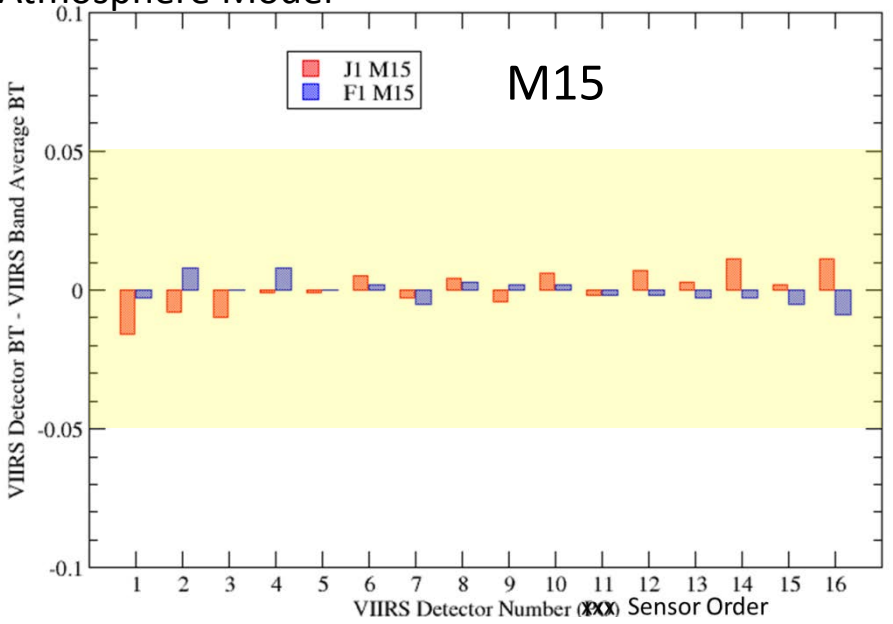


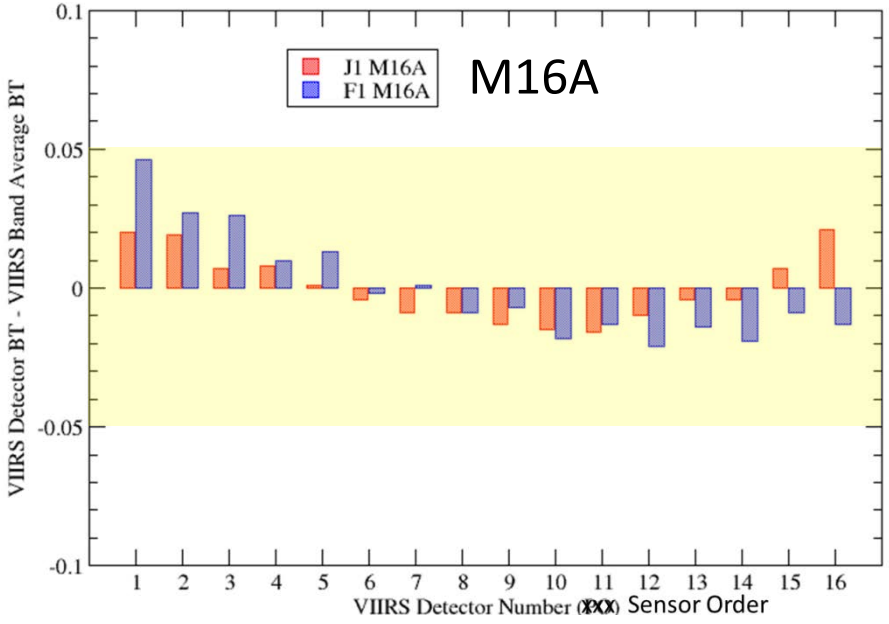


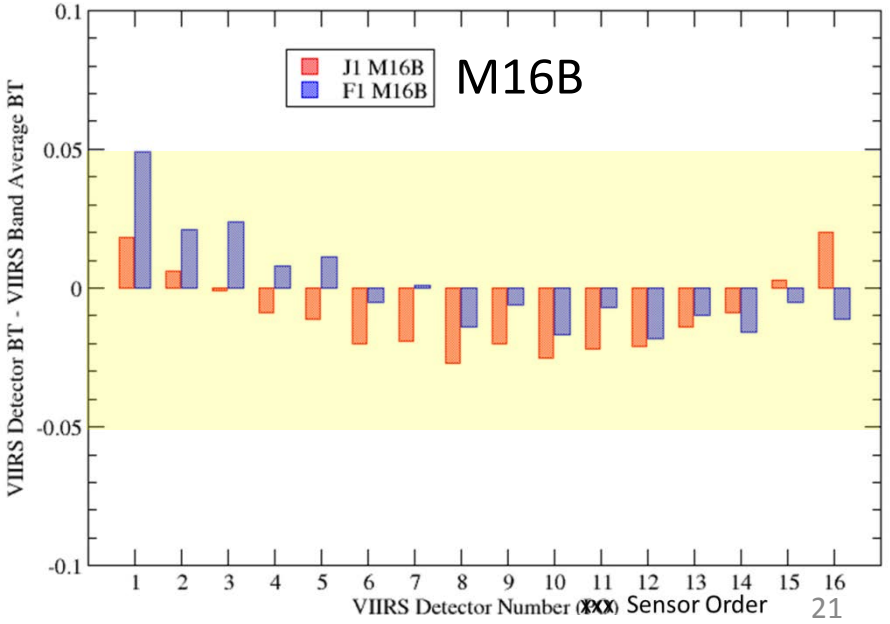
TEB Detector Dependence from RSR

Tropical Standard Atmosphere Model



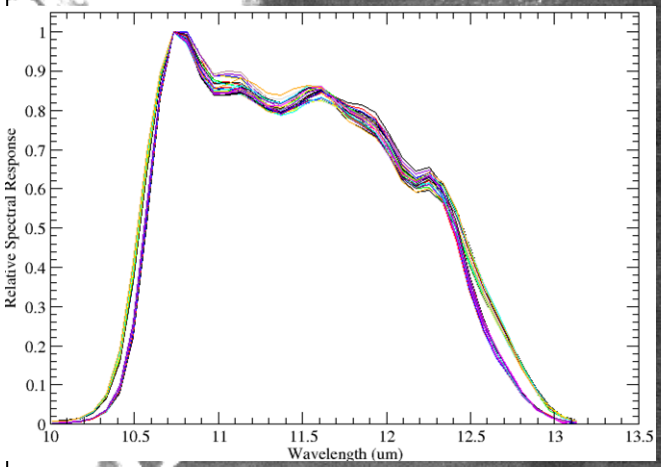


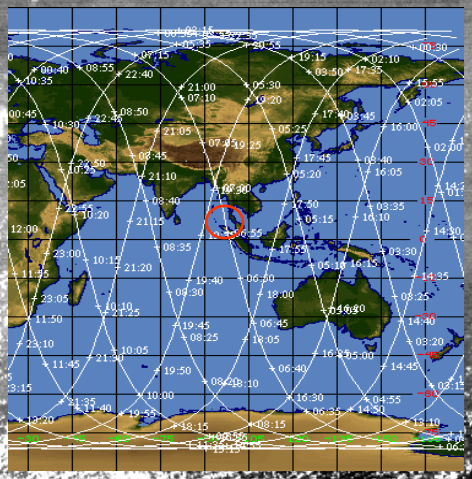


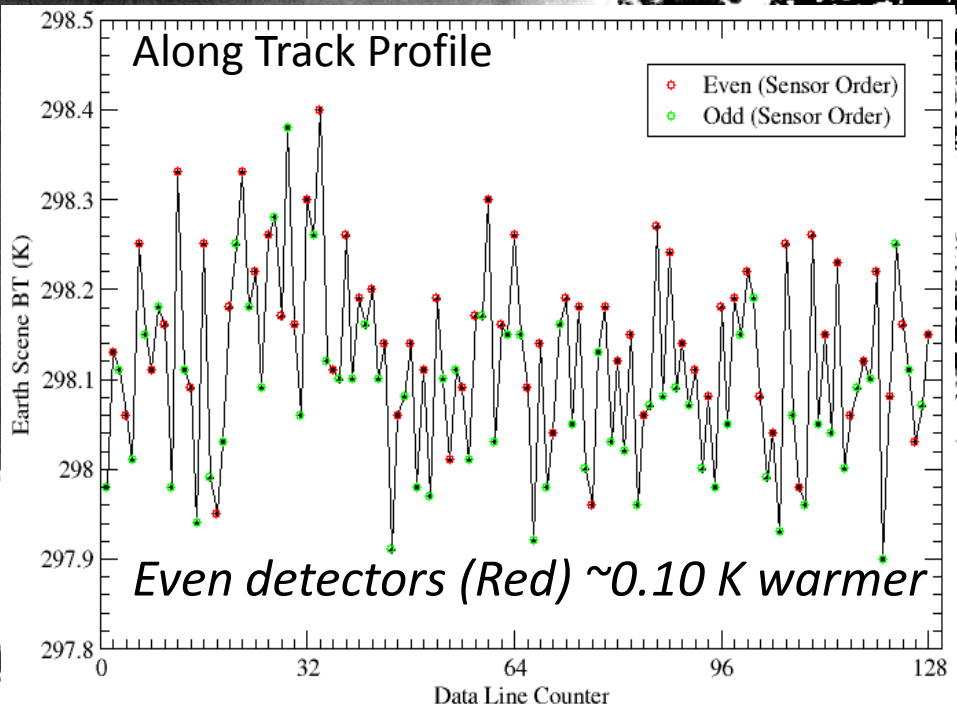


SNPP VIIRS Band I5 in the Indian Ocean

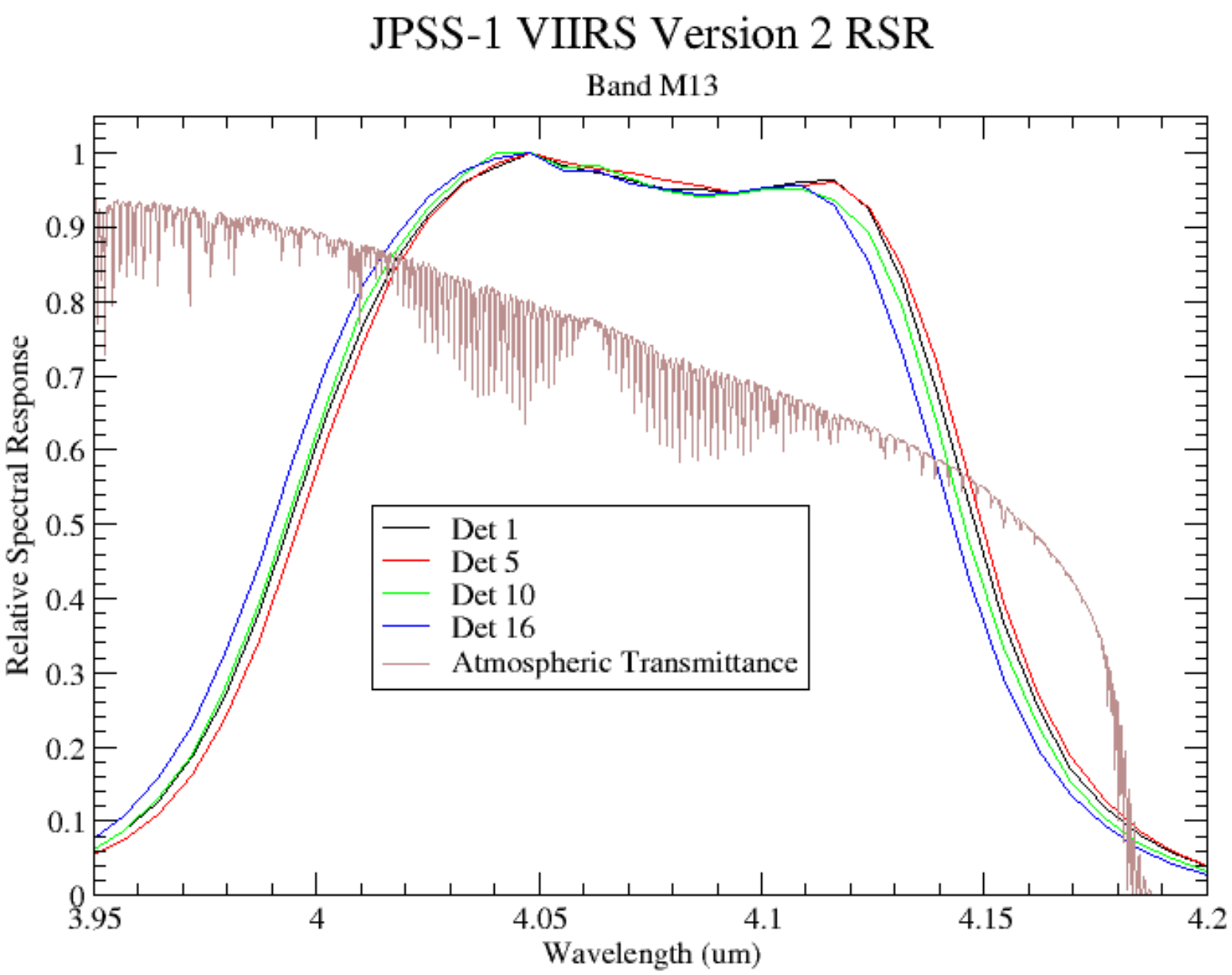
Day 2014080, 065522 UTC







Along track profile taken from position of green line in imagery


JPSS-1 VIIRS Version 2 RSR
Band M13
Relative Spectral Response
Wavelength (um)
Det 1
Det 5
Det 10
Det 16
Atmospheric Transmittance
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
3.95
4
4.05
4.1
4.15
4.2

Summary: JPSS-1 VIIRS RSR Influence on SDR

- Comparisons with SNPP
  - RSB TOA reflectance normalized difference mostly within 1% but as high as 4%
  - TEB TOA BT within about 50 mK
- Detector dependence
  - RSB TOA reflectance variation along focal plane up to 0.5% due to VIIRS non-telecentric optical design.
  - TEB detector striping similar to SNPP except M13 which appears larger.

JPSS-1 VIIRS RSR Availability

- JPSS-1 VIIRS At-launch RSR are awaiting approval for public release. Available now at password-protected NASA eRoom: https://jpss-erooms.ndc.nasa.gov/eRoom/JPSSInstruments/VIIRSF2_JPSS1/0_38007
- Band average and supporting detector RSR (Sensor order numbering), plus Readme and pptx with background information.