Welcome to the NPP VIIRS: VIIRS Relative Spectral Response from the Gov't Team

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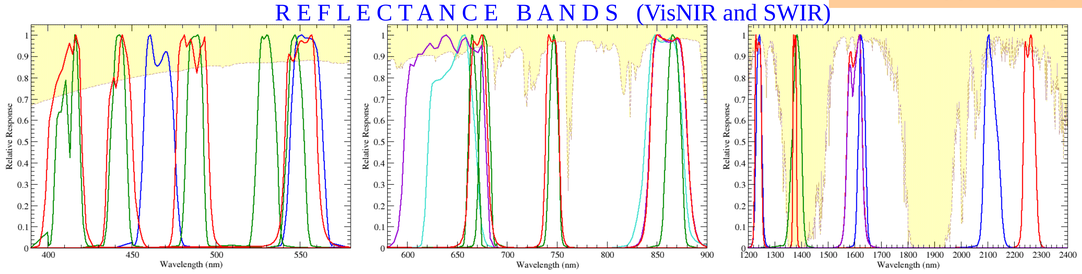
As the follow-on imaging radiometer to the highly successful MODIS on EOS Terra and Aqua, the NPP VIIRS will continue the legacy of global climate monitoring. This poster is intended to provide insight to the user community on VIIRS spectral characterization and how it compares with that of its predecessor, MODIS. The VIIRS instrument Government Team, consisting of NASA, Aerospace Corp., and MIT/Lincoln Lab elements, has completed an independent (from that of industry) relative spectral response (RSR) performance characterization analysis for NPP VIIRS Flight Unit 1 (F1). Pre-launch sensor level RSR measurements were made at the Raytheon El Segundo facility during the TVAC phase of the F1 test program in summer 2009. These measurements have been analyzed and reviewed by the RSR subgroup of the Gov't Team leading to the release of the Gov't Team "Best" RSR for F1 in Sept. 2010 (shown in panels below along with MODIS RSR). VIIRS spectral performance metrics for the Gov't Team "Best" RSR are also shown (bottom panel).

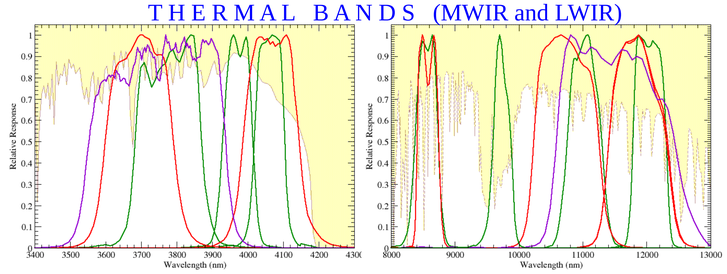
In-band RSR

VIIRS has 16 "M" (750m res, 16 detectors per band), 5 "I" (375m res, 32 detectors per band), and 1 Day-Night band (750m res, CCD). These bands have nearly equivalent spectral coverage for many but not all MODIS reflectance bands (exception of 900nm H2O bands); VIIRS thermal bands cover traditional atmospheric window regions but not atmospheric water vapor or CO2 absorption regions.

REFLECTANCE BANDS (VisNIR and SWIR)



THERMAL BANDS (MWIR and LWIR)



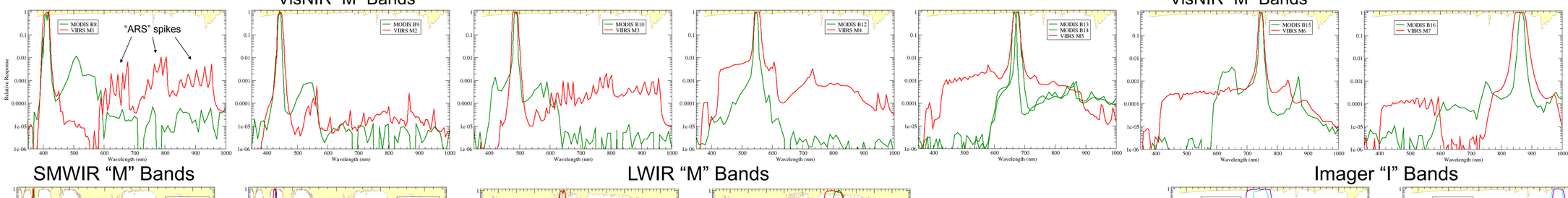
Color Legend for all RSR

- MODIS QKM (250m)
- MODIS HKM (500m)
- MODIS 1KM (1000m)
- VIIRS I Band (375m)
- VIIRS M Band (750m)

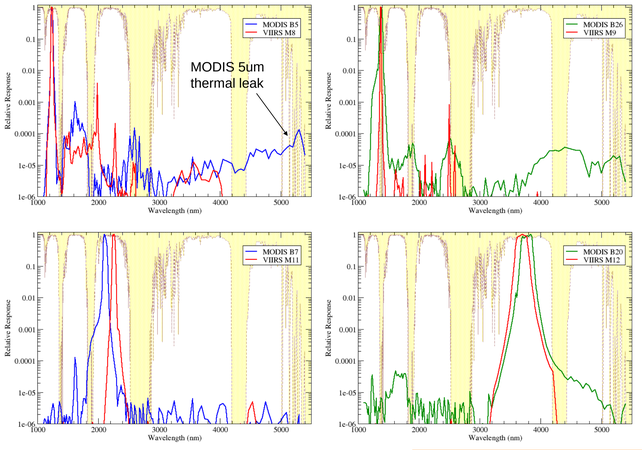
In-band + Out-of-Band RSR

The VIIRS F1 VisNIR integrated filter assembly (IFA) is known to contain large angle scattering resulting in out-of-band "ARS" light leaks. The F2 VisNIR IFA has been redesigned to mitigate this behavior. VIIRS SWIR and MWIR bands contain only small OOB features. LWIR bands M15 and M16 have OOB light leaks that have been well characterized to support compliant usage in the SST EDR.

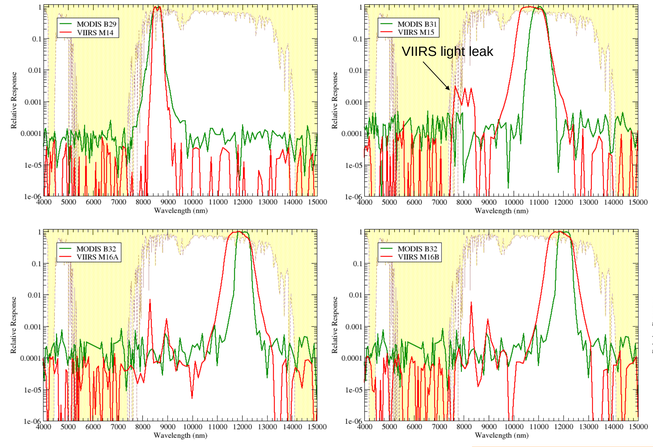
VisNIR "M" Bands



SMWIR "M" Bands

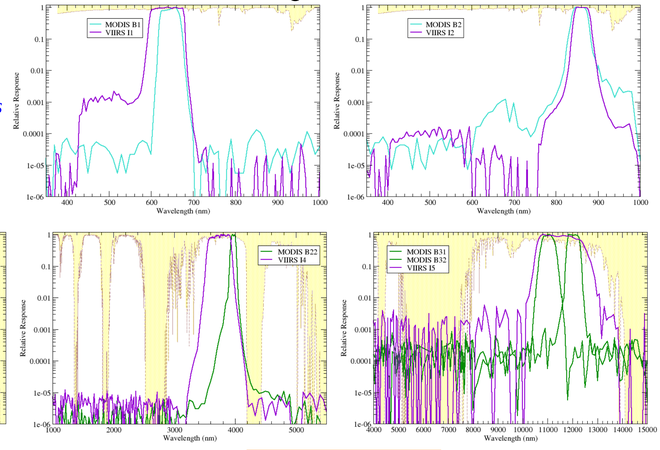


LWIR "M" Bands



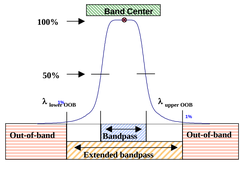
VIIRS contains imagery bands I1 and I2 (similar to 250m MODIS bands 1 and 2), and I3 (similar to 500m MODIS band 6), plus bands I4 (3.75um) and I5 (12.0um), providing 375m spatial resolution emissive band data.

Imager "I" Bands



VIIRS F1 Performance Metrics

VIIRS Performance Metrics Definition



The VIIRS F1 evaluation includes an assessment on the above spectral performance metrics for compliance with pre-launch specifications (right).

Non-compliant on all detectors

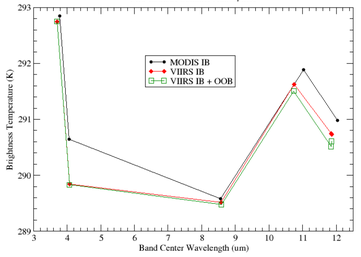
Non-compliant on some detectors

Band	Specified Center (nm)	Measured Center (nm)	Specified Bandwidth (nm)	Measured Bandwidth (nm)	Specified Lower 1% Limit (nm)	Specified Upper 1% Limit (nm)	Measured Lower 1% Limit (nm)	Measured Upper 1% Limit (nm)	Specified IOOB (%)	VIIRS Measured IOOB (%)	Equivalent MODIS (Band) and IOOB (%)
M1	412	410.5	20	20.2	376	444	394.6	426.8	1.0	2.40	(8) 0.62
M2	445	443.0	18	15.1	417	473	431.1	458.6	1.0	0.39	(9) 0.16
M3	488	486.0	20	19.4	455	521	472.1	502.8	0.7	0.76	(10) 0.22
M4	555	550.6	20	19.6	523	589	529.4	572.3	0.7	3.92	(12) 0.33
M5	672	671.4	20	18.8	638	706	649.5	693.9	0.7	2.99	(13) 0.22
M6	746	745.3	15	14.1	721	771	730.5	760.4	0.8	1.70	(15) 1.11
M7	865	861.8	39	38.0	801	929	829.6	897.8	0.7	0.46	(16) 0.25
M8	1240	1238.4	20	26.1	1205	1275	1213.5	1265.2	0.8	0.59	(5) 0.33
M9	1378	1375.3	15	13.9	1351	1405	1362.1	1390.0	1.0	0.42	(26) 0.63
M10	1610	1601.2	60	59.4	1509	1709	1542.6	1664.8	0.7	0.48	(6) 0.71
M11	2250	2257.1	50	46.4	2167	2333	2211.6	2303.0	1.0	0.42	(7) 0.54
M12	3700	3694.6	180	192.4	3410	3990	3516.2	3890.0	1.1	0.38	(20) 0.63
M13	4050	4065.8	155	158.0	3790	4310	3900.5	4213.7	1.3	0.88	(23) 1.03
M14	8550	8577.8	300	340.3	8050	9050	8333.5	8875.9	0.9	0.30	(29) 0.71
M15	10763	10743.6	1000	1014.4	9700	11740	9918.7	11649.9	0.4	0.42	(31) 0.54
M16A	12013	11861.4	950	1153	11060	13050	11095.1	12670.0	0.4	0.56	(32) 0.31
M16B	12013	11869.1	950	922.8	11060	13050	11098.3	12678.7	0.4	0.54	(32) 0.31
I1	640	637.8	80	81.6	565	715	583.2	686.6	0.5	0.33	(1) 0.08
I2	865	861.6	39	38.3	802	928	828.7	897.9	0.7	0.48	(2) 0.61
I3	1610	1601.2	60	58.9	1509	1709	1543.1	1664.1	0.7	0.51	(6) 0.71
I4	3740	3743.5	380	385.6	3340	4140	3473.0	4009.0	0.5	0.24	(22) 0.32
I5	11450	11507.9	1900	1881.7	9900	12900	10191.0	13081.3	0.4	0.65	(31) 0.54

The Gov't Team spectral performance assessment indicates that the VIIRS F1 sensor is spectrally performing as it was specified, with a few minor exceptions in band center, bandpass, and extended bandpass metrics. These are not considered to be important to EDR performance. Non-compliances on the IOOB metric in VisNIR and LWIR bands have been well measured, allowing downstream products (EDRs) to compensate for their influence. Aqua MODIS IOOB performance is better in the VisNIR, a little worse in the SWIR/MWIR, and close in the LWIR. Estimates of IOOB for MODIS and VIIRS LWIR bands are elevated in part by the high noise level of the measurement in those bands (see LWIR spectral response plots shown above).

Thermal Band Simulations

VIIRS/MODIS Forward Model Simulation
Mid-Latitude Summer Atmosphere



VIIRS and MODIS Simulated Thermal Band Data

- *VIIRS and MODIS compare closely (< 0.3K) for most of their common thermal bands.*
- *Largest difference between VIIRS M13 and MODIS B23; M13 spectral coverage has more CO2 absorption.*
- *OOB impact in VIIRS thermal bands is generally small (<0.2 K)*

Summary

- This poster introduces the NPP VIIRS Gov't Team "Best" Relative Spectral Response (RSR).
- VIIRS is spectrally performing largely as specified. The most notable exception is the integrated Out-of-band (IOOB) performance of VisNIR bands; however, IOOB anomalous performance has been well characterized.
- VIIRS and MODIS have many common bands, allowing VIIRS to continue much of the legacy of observations established by MODIS. VIIRS lacks H2O and CO2 bands in the thermal region but includes high spatial resolution imagery bands at 3.75 and 12 um.
- All VIIRS RSR are available in the public domain (https://cs.star.nesdis.noaa.gov/NCC/SpectralResponseVIIRS) for use by the Science Community to facilitate preparation for the launch of NPP, anticipated late in CY 2011.