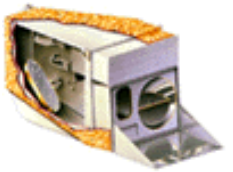

VIIRS and MODIS RSB Calibration Inter-comparison Using Vicarious Approaches

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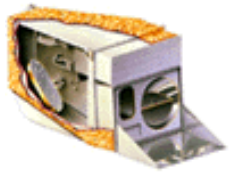
Outline

- Introduction
- Methodology
  - SNO & PICS (desert, Dome C)
- Results
  - NOAA20 VIIRS & Aqua MODIS
  - NOAA20 & SNPP VIIRS
- Summary

VIIRS and MODIS Sensor Overview



VIIRS RSB			MODIS RSB		
Band	CW (nm)	BW	Band	CW (nm)	BW
M1	412	20	B8	412	15
M2	445	18	B9	443	10
M3	488	20	B10	488	10
M4	555	20	B4	555	20
M5	672	20	B1	645	50
M6	746	15	B15	748	10
M7	865	39	B2	858	35
M8	1240	20	B5	1240	20
M9	1378	15	B26	1375	30
M10	1610	60	B6	1640	24
M11	2250	50	B7	2130	50
I1	640	80	B1	645	50
I2	865	39	B2	858	35
I3	1610	60	B6	1640	24

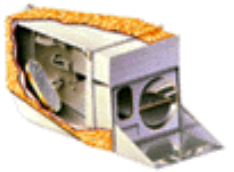
NOAA20/SNPP VIIRS

- Scanning radiometer
- 22 bands between 0.4 and 12 μm
- Afternoon polar orbit
- Swath distance of 3000 km
- Nadir resolutions: 0.375, 0.750 km
- Launched Nov 18, 2017 & Oct 28, 2011
- Aggregation, dual-gain, less xtalk impact

Terra/Aqua MODIS

- Scanning radiometer
- 36 bands between 0.4 and 14 μm
- Morning/afternoon polar orbits
- Swath distance of 2330 km
- Nadir resolutions: 0.25, 0.5, 1.0 km
- Launched Dec 1999 & May 2002

VIIRS and MODIS RSB Calibration



VIIRS:

- Reflectance based using an on-board SD
- SD BRF determined pre-launch and traceable to NIST
- On-orbit degradation in RSB is tracked by SD/SDSM
- Long-term degradation is further adjusted based on lunar roll measurements (same SD AOI)
- Calibration is performed for each band, detector, sub-sample, and HAM side

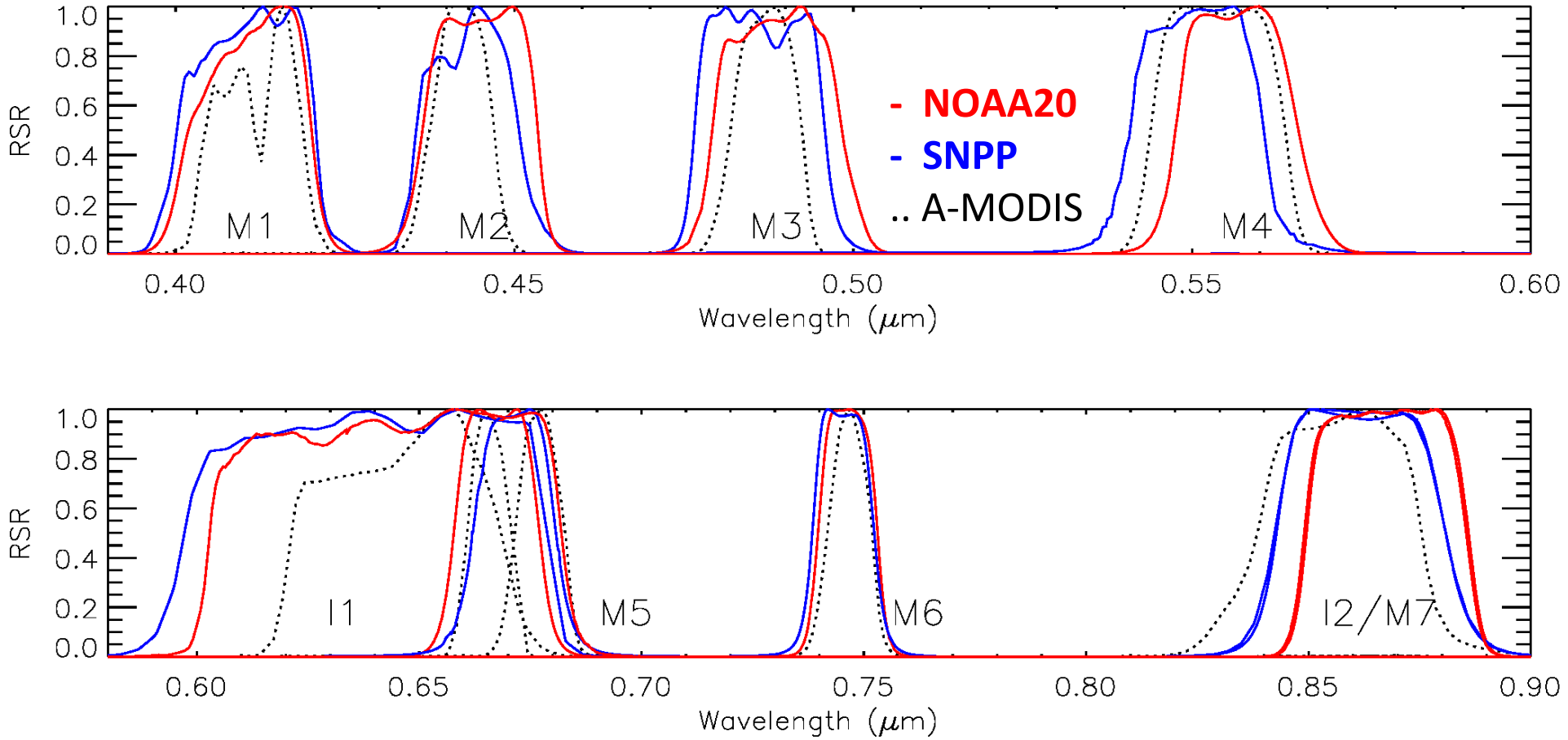
MODIS:

In addition to those listed above for VIIRS, on-orbit changes in RVS are tracked using lunar measurement (separate AOI from SD) and reflectances over pseudo-invariance calibration sites in north African desert

L1B data: NOAA20 VIIRS: NASA SIPS Collection 2 (C2), AS5200, **SNPP VIIRS:** C1, AS5000

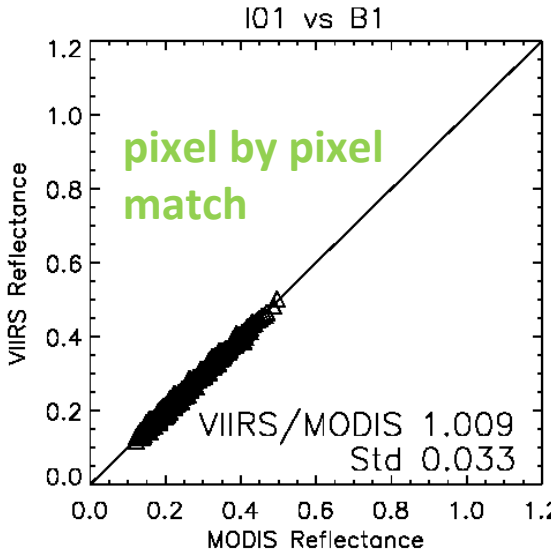
Aqua MODIS: Collection 6.1

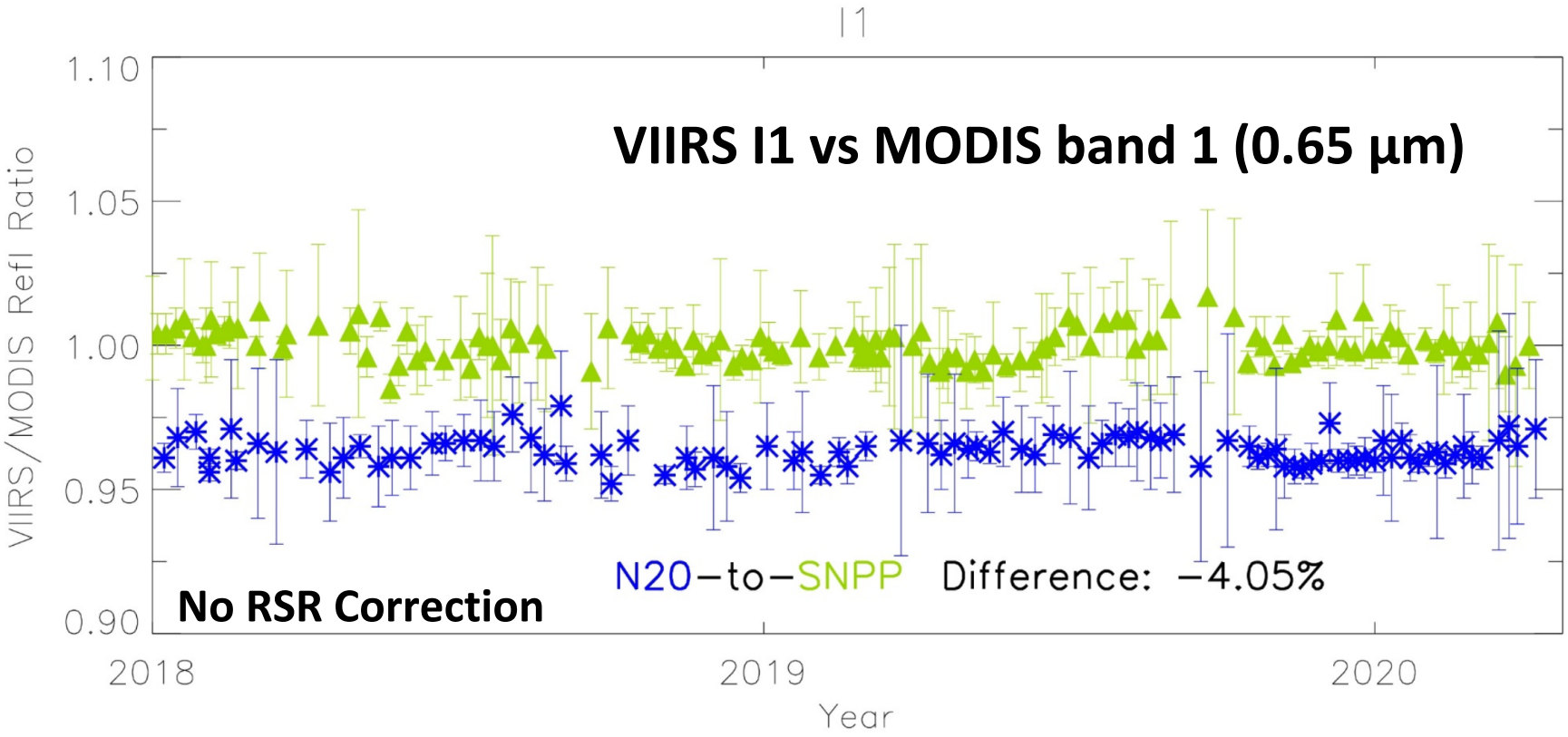
Relative Spectral Response (RSR)



- For RSB inter-comparison, RSR correction is necessary between NOAA20 and SNPP VIIRS and between VIIRS and MODIS.
- Correction is based on historic SCIAMACHY hyper-spectral measurements over typical surfaces (ocean, desert, snow and clouds), provided by the European Space Agency .

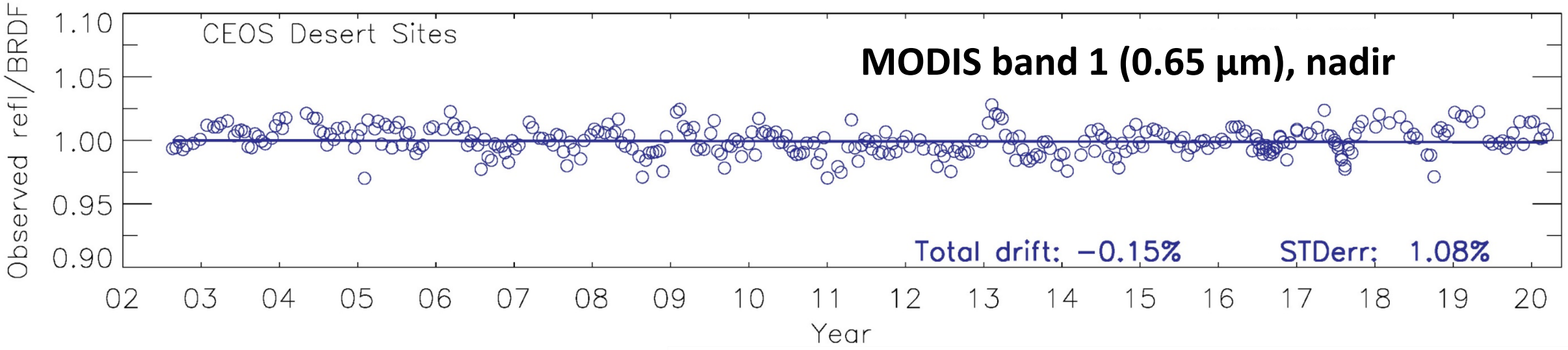
SNO (Simultaneous Nadir Overpasses)



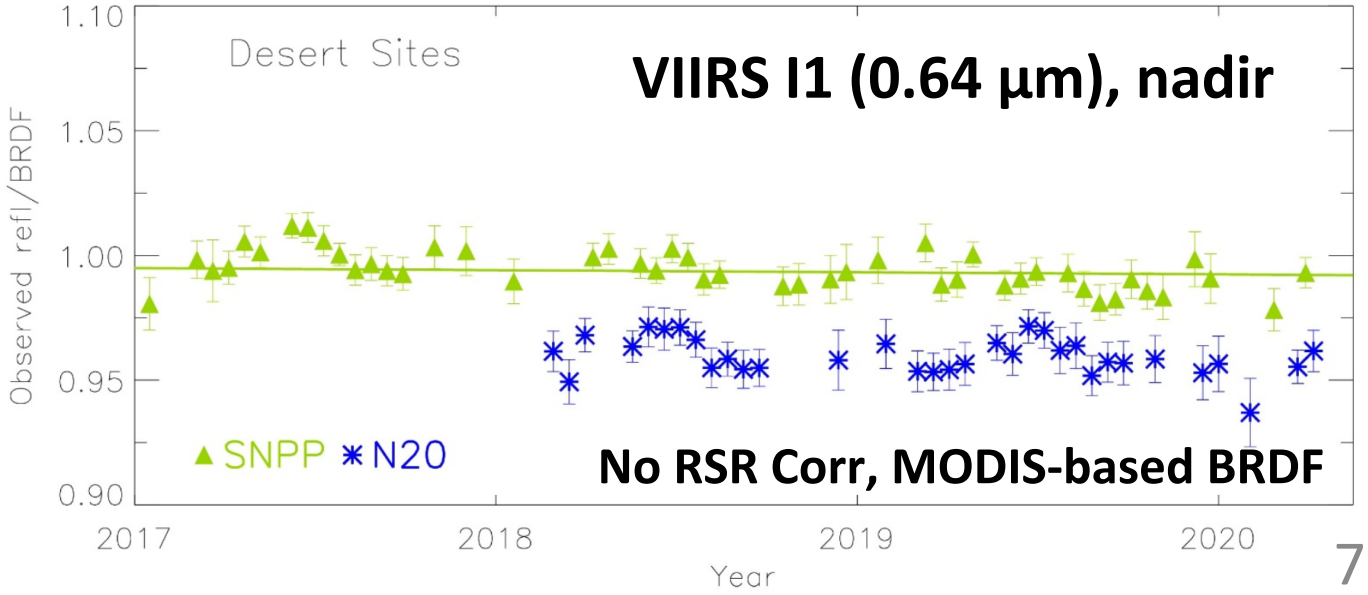


- Ratio approach between two sensors (SNPP/N20 VIIRS vs Aqua MODIS)
- Significantly reduce impacts of viewing and illumination angle differences and changing surface (< 30s)
- Different locations in high latitude, both RSB & TEB

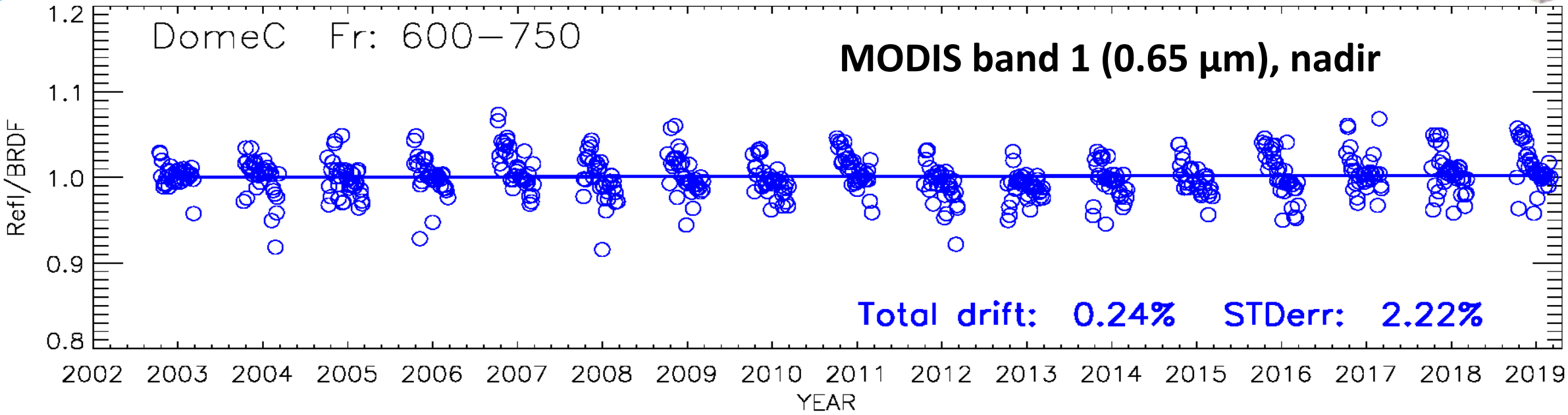
Pseudo Invariant Calibration Sites (PICS) over Desert



- Typical target area of 20 x 20 km
- Excellent radiometric stability for RSB
- 16-day repeatable orbits, nearly constant viewing angles to each site
- Need site-dependent BRDF correction to reduce seasonal fluctuations.

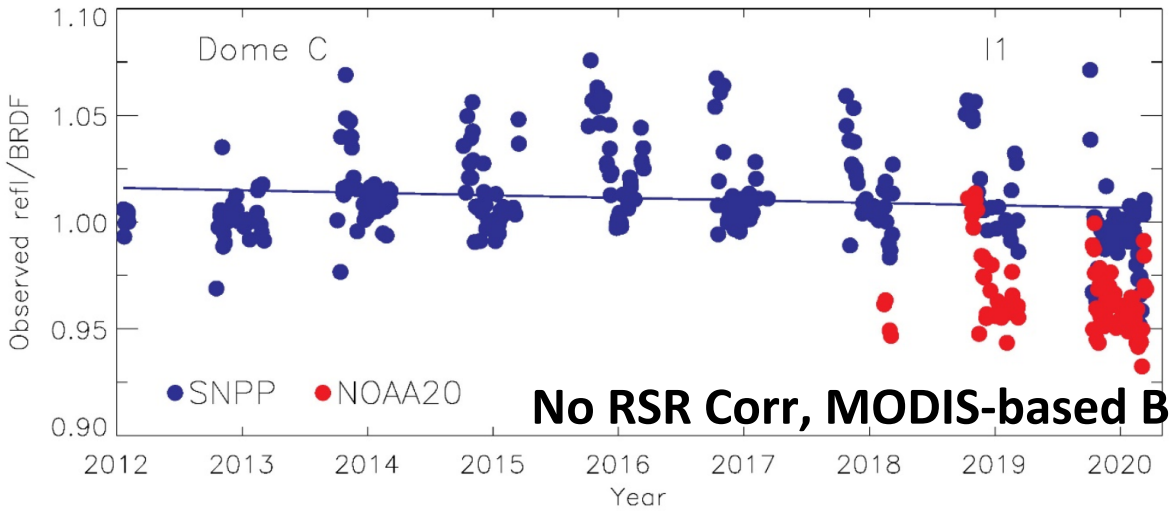


Pseudo Invariant Calibration Sites (PICS) over Dome C



- Typical target area of 20 x 20 km
- Excellent radiometric stability and less atmospheric influence
- RSB data available in Dome C summer
- Relatively large unc. after BRDF correction

VIIRS I1 (0.64 µm), nadir



NOAA20 VIIRS and Aqua MODIS RSB Inter-Comparison

	Vicarious Calibration Results						
Method	**M1 B8**	**M2 B9**	**M3 B3**	**M4 B4**	**M7 B2**	**I1 B1**	**I2 B2**
SNO	**-2.5 ±1.6**	**-3.5 ±1.5**	**0.5 ±1.6**	**-2.4 ±1.6**	**-3.1 ±1.8**	**-2.8 ±1.6**	**-3.0 ±1.8**
Desert	**-4.3 ±1.0**	**-5.5 ±0.8**	**2.5 ±1.0**	**-2.6 ±0.9**	**-0.7 ±0.5**	**-3.7 ±0.7**	**-1.0 ±0.7**
Dome C	**-3.9 ±0.9**		**-1.1 ±0.9**	**-2.6 ±1.8**	**-1.0 ±2.2**	**-2.9 ±1.8**	**-1.3 ±2.2**

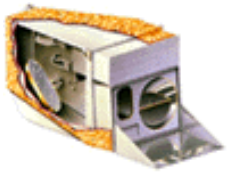
**Results are provided in percentage difference (NOAA20 – Aqua) (%) for RSB. RSR correction is based on SCIAMACHY. VIIRS L1B (C2 AS5200) from NASA SIPS and MODIS L1B from C6.1.*

NOAA20 and SNPP VIIRS RSB Inter-Comparison

	Vicarious Calibration Results						
Method	**M1 B8**	**M2 B9**	**M3 B3**	**M4 B4**	**M7 B2**	**I1 B1**	**I2 B2**
SNO	**-7.6 ±1.6**	**-5.5 ±1.5**	**-5.3 ±1.6**	**-3.2 ±1.6**	**-2.8 ±1.8**	**-3.3 ±1.6**	**-2.9 ±1.8**
Desert	**-7.8 ±1.0**	**-6.3 ±0.8**	**-4.4 ±1.0**	**-3.9 ±0.9**	**-3.0 ±0.7**	**-3.9 ±0.8**	**-3.3 ±0.8**
Dome C	**-7.8 ±0.9**		**-4.8 ±1.0**	**-5.4 ±2.2**	**-2.9 ±2.2**	**-3.8 ±2.1**	**-3.4 ±2.2**

**Results are provided in percentage difference (NOAA20 – SNPP) (%) for RSB. RSR correction is based on SCIAMACHY. VIIRS L1B (C2 AS5200 for NOAA20, C1 AS5000 for SNPP) from NASA SIPS and MODIS L1B from C6.1.*

Summary



- This study provides assessment of VIIRS and MODIS RSB calibration consistency using various vicarious approaches (SNO, desert, Dome C)
- For VIS/NIR bands, NOAA20 RSB reflectances are lower than Aqua MODIS by 2% for most bands (exception for M3, large RSR difference, from -1.0% to 2.5% depending on approach.
- SNPP VIIRS reflectances (based on NASA SIPS L1B) are significantly higher than NOAA20 by ~ 4.0% for the VIS/NIR bands, and 5.0 to 7.0% for the shortest wavelengths (M1 and M2).

Backup slides

SNPP VIIRS and Aqua MODIS RSB Inter-Comparison

	Vicarious Calibration Results						
Method	M1 B8	M2 B9	M3 B3	M4 B4	M7 B2	I1 B1	I2 B2
SNO	5.2 ±0.8	2.1 ±0.8	5.8 ±0.8	0.9 ±0.4	-0.2 ±0.6	0.5 ±0.5	-0.2 ±0.6
Desert	3.5 ±0.9	0.8 ±0.8	6.9 ±0.9	1.3 ±0.9	2.2 ±0.7	0.2 ±0.8	2.3 ±0.8
Dome C	3.7 ±0.9		3.6 ±1.0	2.6 ±2.0	1.7 ±1.8	0.8 ±1.9	1.8 ±1.9

**Results are provided in percentage difference (SNPP – Aqua) (%) for RSB. RSR correction is based on SCIAMACHY. VIIRS L1B (C1 AS5000) from NASA SIPS and MODIS L1B from C6.1.*