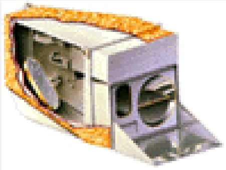

Transferring Aqua MODIS RSB Radiometric Calibration to SNPP VIIRS

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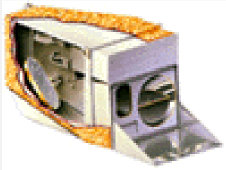


Outline

- Introduction
- Methodology

  - 1) SNO (simultaneous nadir overpasses), 2) Libya-4 desert, and 3) Dome C sites
- Results

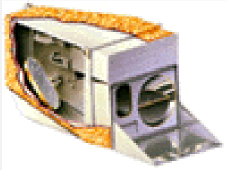
  - BRDF correction

  - Comparison of refl trends from the three approaches

  - MODTRAN simulated at-sensor refl ratios (VIIRS/MODIS)

  - Calibration differences between VIIRS & MODIS
- Summary

Introduction



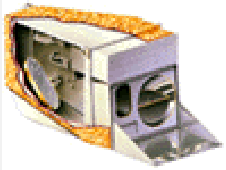
- Important to track VIIRS RSB calibration stability and performance

- NASA LandPeated provided reflectance time series over the first 3 years

- Comparison with a stable and well-calibrated MODIS sensor provides a quick and proper assessment

- The widely used pseudo-invariant sites (Libya-4 desert, Dome C snow) provide excellent opportunity to examine radiometric stability

Visible Infrared Imaging Radiometer Suite



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

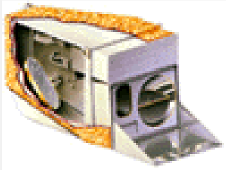
Suomi NPP VIIRS

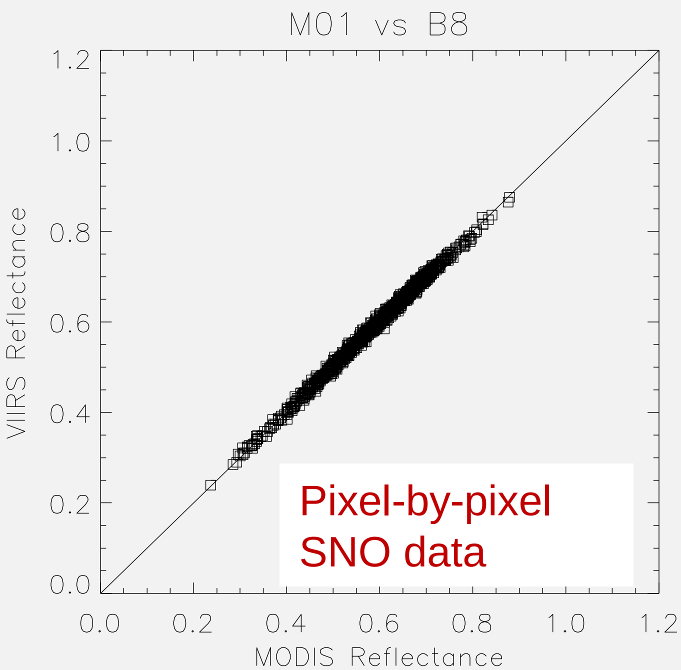
- **Scanning radiometer**
- **22 bands between 0.4 and 12 µm**
- **Afternoon polar orbit**
- **Swath distance of 3000 km**
- **Nadir resolutions: 0.37, 0.74 km**
- **Launched Oct 28, 2011**
- **Aggregation, dual-gain, xtalk**

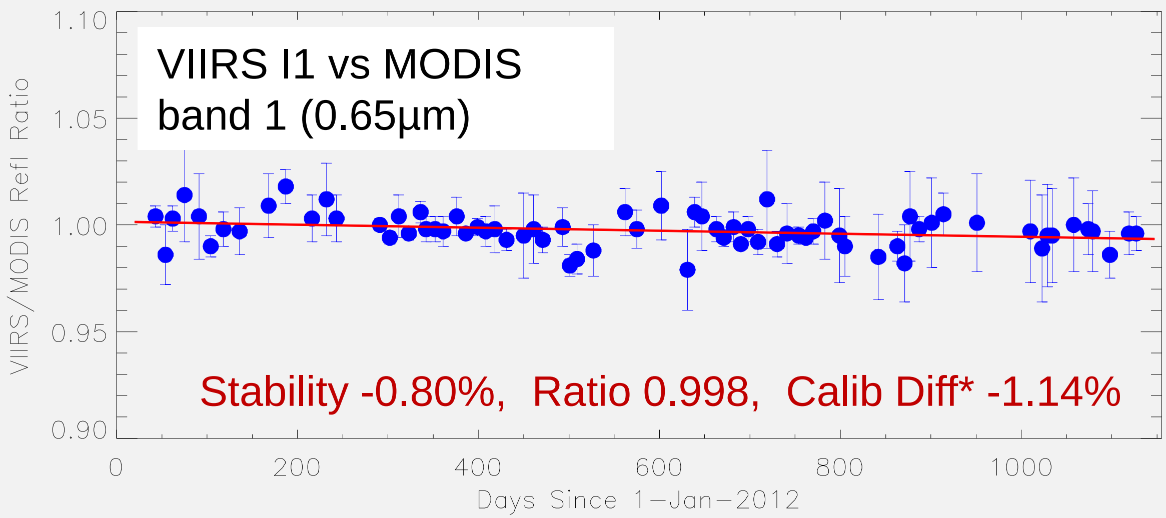
Terra/Aqua MODIS

- **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**

SNO (Simultaneous Nadir Overpasses)



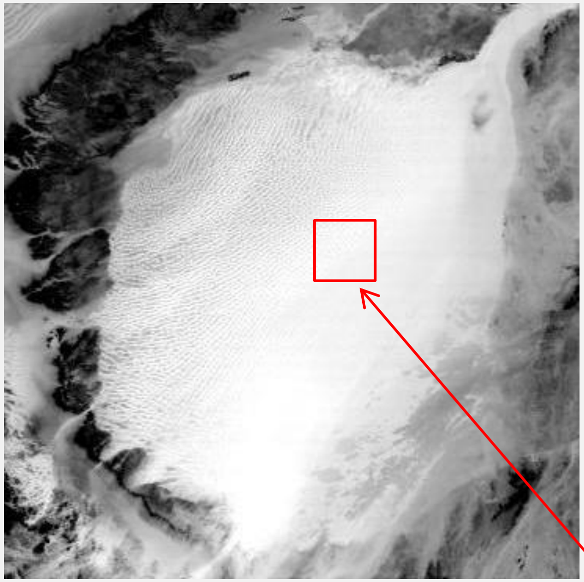




SNO Trends between Aqua MODIS and NPP VIIRS

- Reflectance ratio approach between two sensors (VIIRS & MODIS)
- Significantly reduce impacts of viewing and illumination angle differences and changing surface (< 30s)
- Always at different locations

Libya 4 desert site



Libya 4 Desert (2007/275)
(28.55^oN, 23.39^oE)

20 x 20 km

A semi-empirical bi-directional reflectance function (BRDF) consisting of two kernel-driven components (f_1 and f_2)

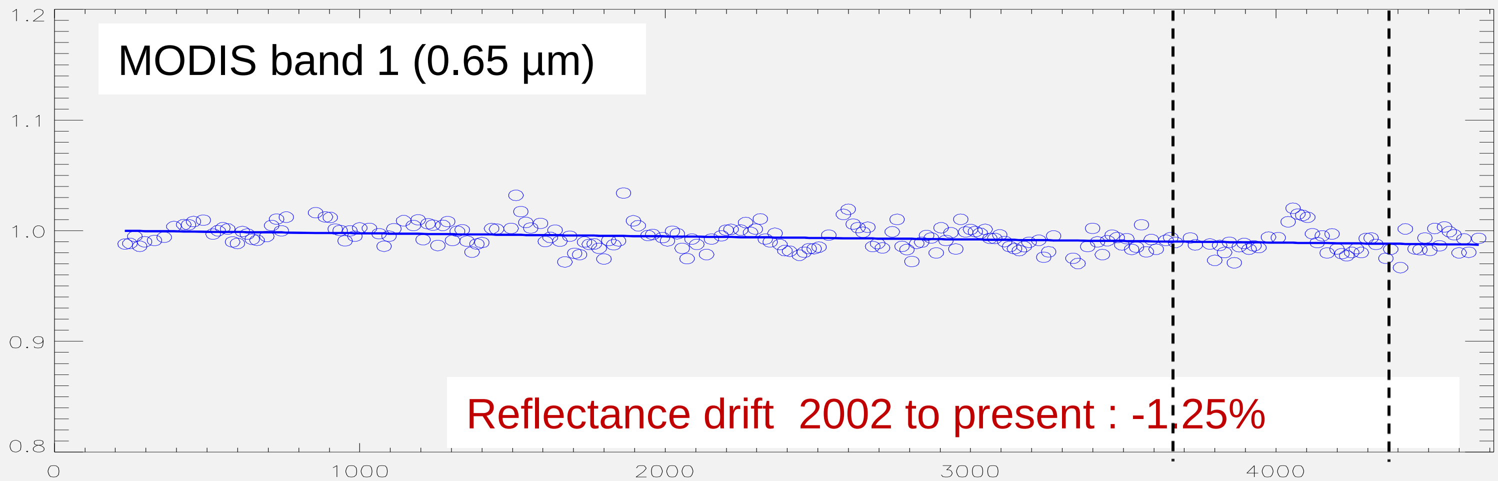
$$BRDF(\theta,\psi,\varphi) = K_0 + K_1 f_1(\theta,\psi,\varphi) + K_2 f_2(\theta,\psi,\varphi)$$

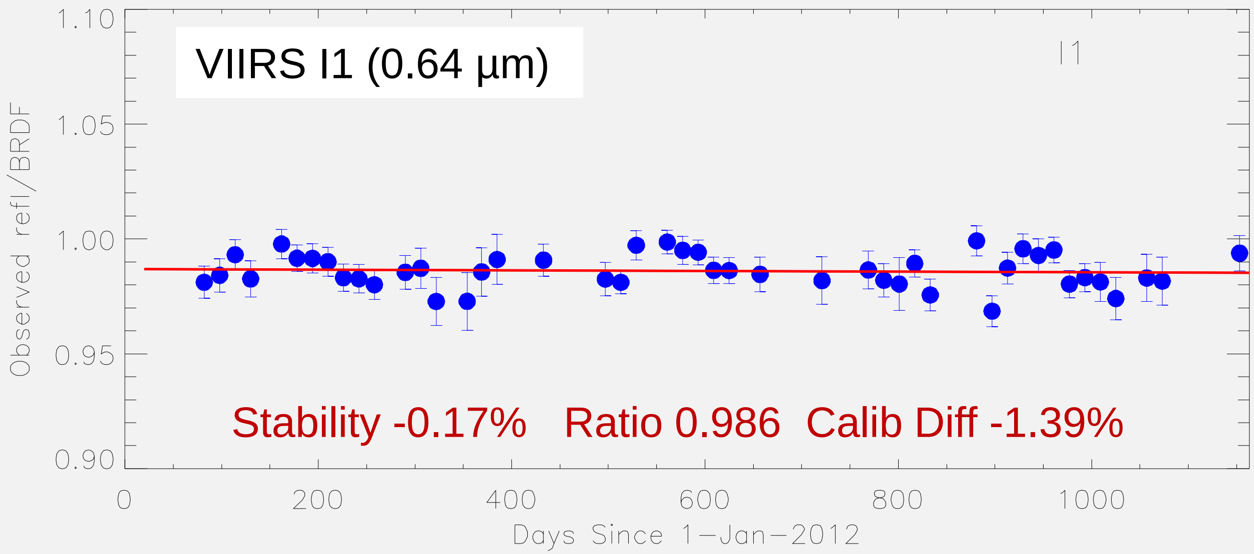
θ, ψ, φ - solar zenith, view zenith and relative azimuth angle

K_0, K_1 and K_2 – site-dependent coefficients

- Excellent radiometric stability
- Repeatable orbits (every 16 days) maintain constant viewing angles to each site
- need surface measurements and atmospheric correction to conduct absolute calibration

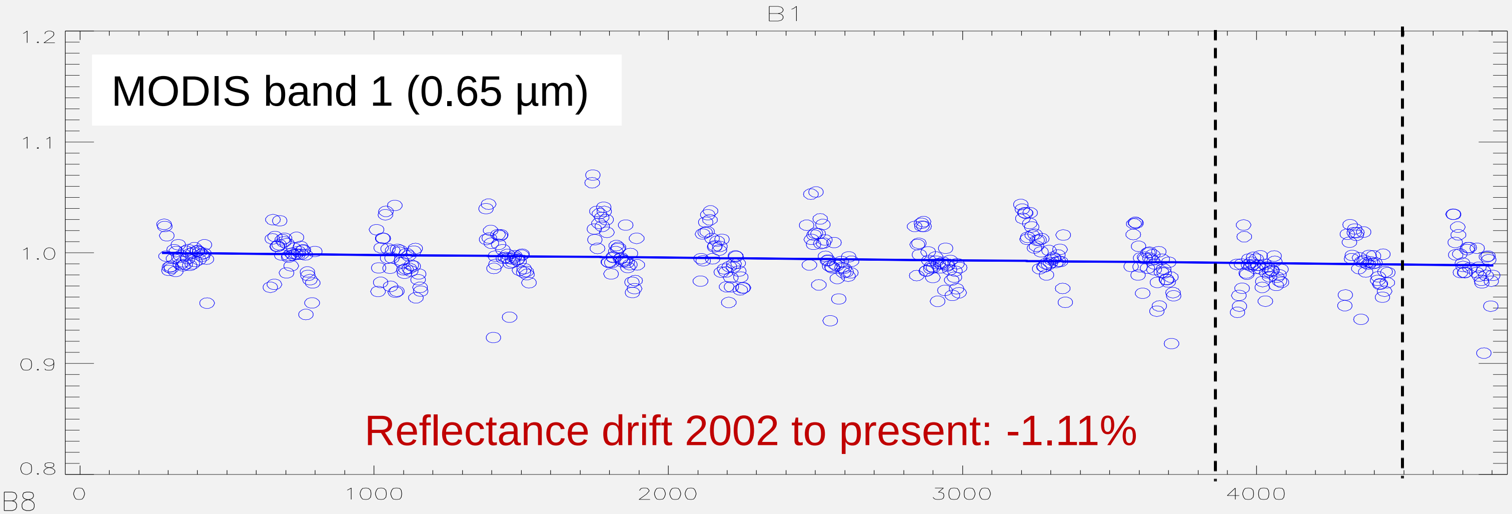
Reflectance trend over Libya-4 site

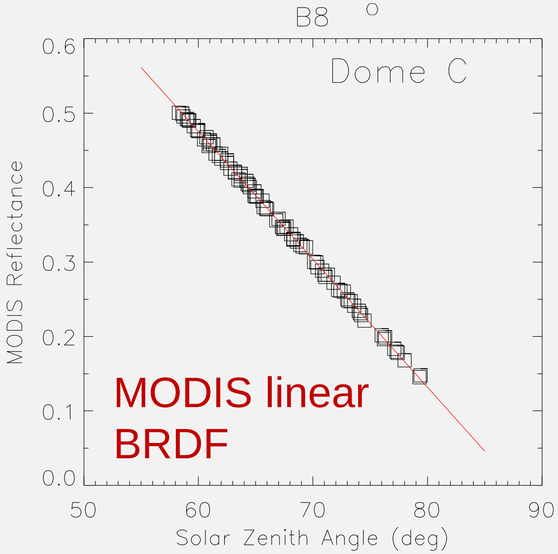


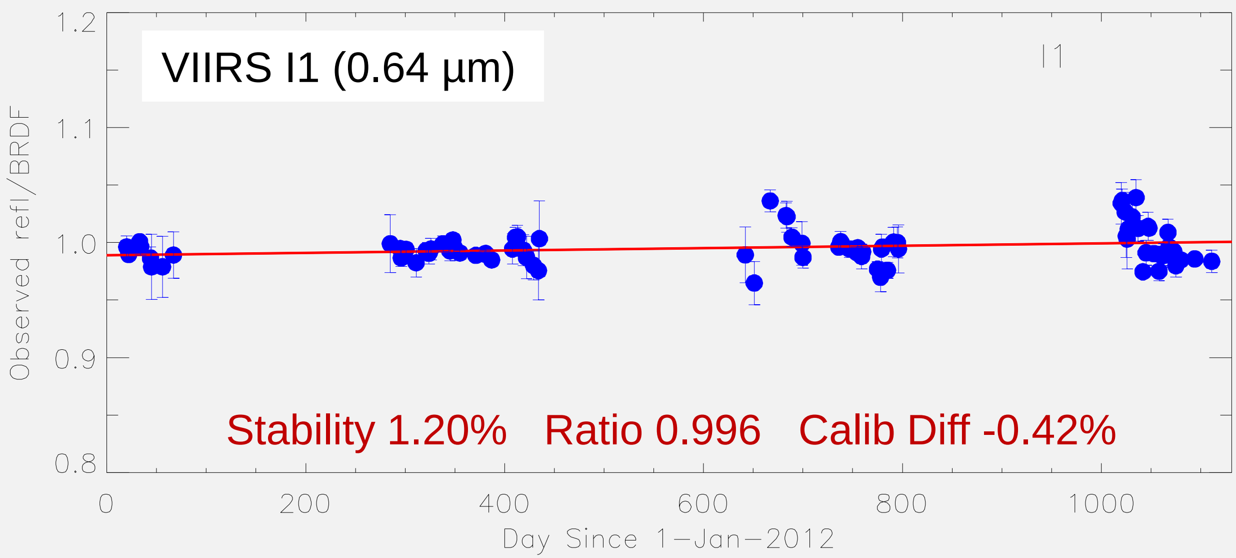


*Apply MODIS-based BRDF (2012-13) to VIIRS reflectances for their spectrally matched bands. For Libya-4 site, local crossing time difference is 15 minute between the two sensors.

Reflectance trend over Dome C site

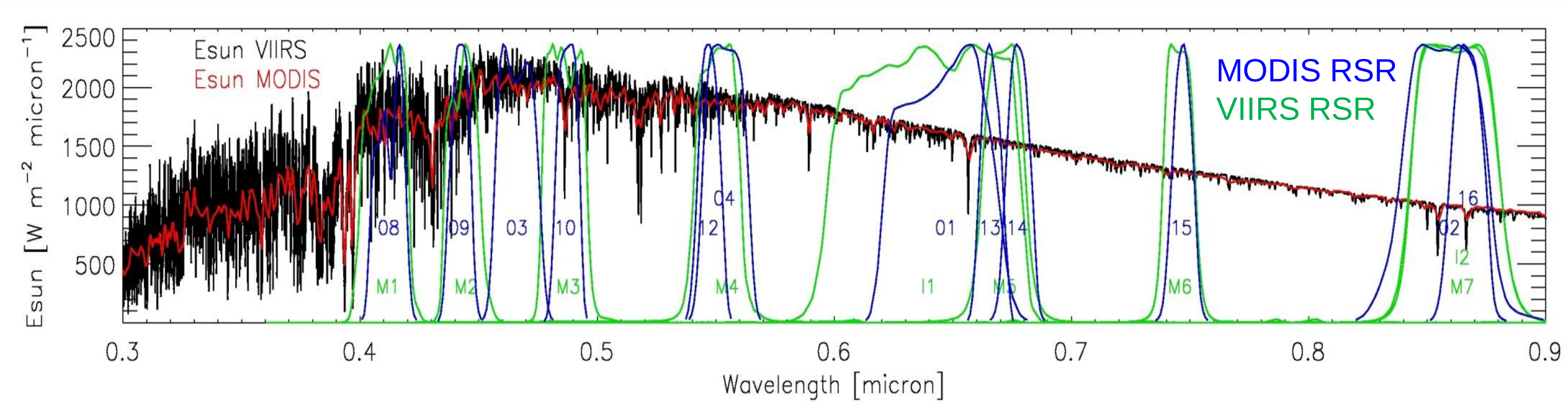


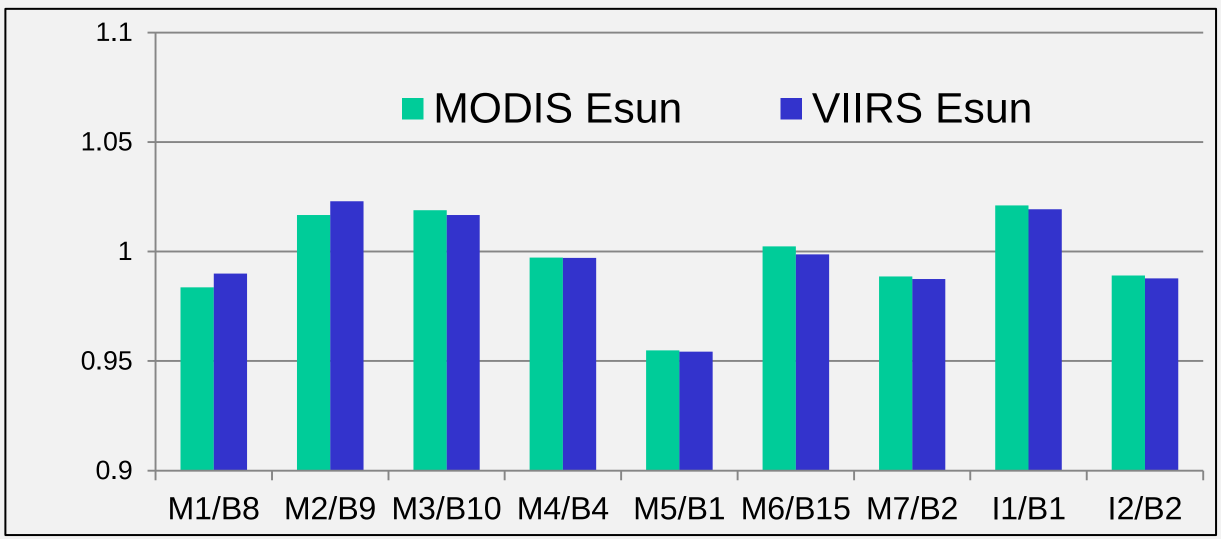




Apply MODIS-based Dome C linear BRDF (2012-13) to VIIRS reflectances

Solar Irradiance Models and RSR

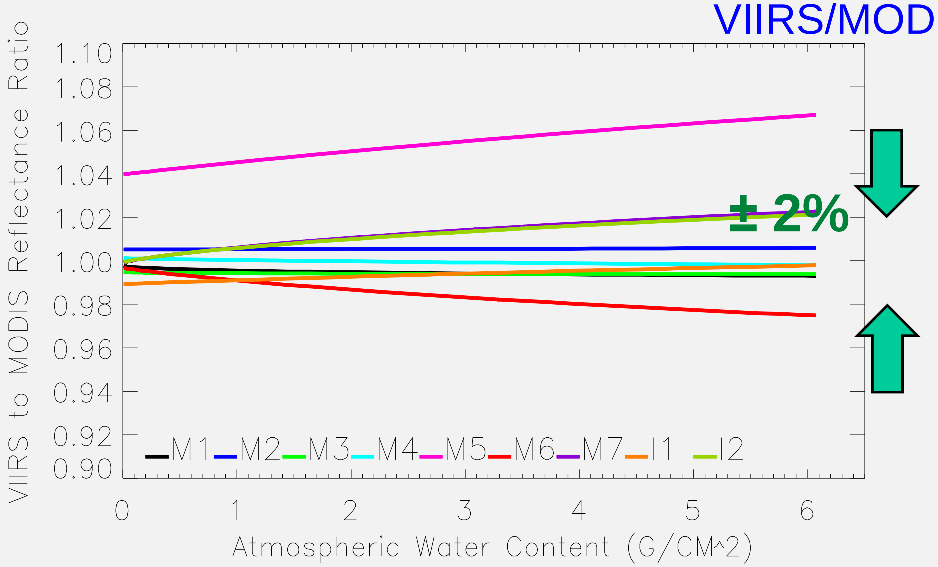


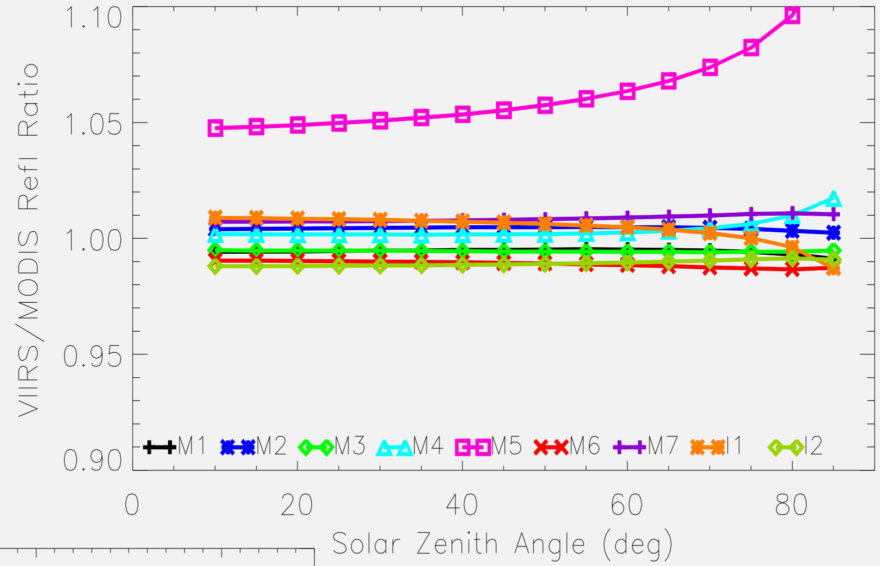


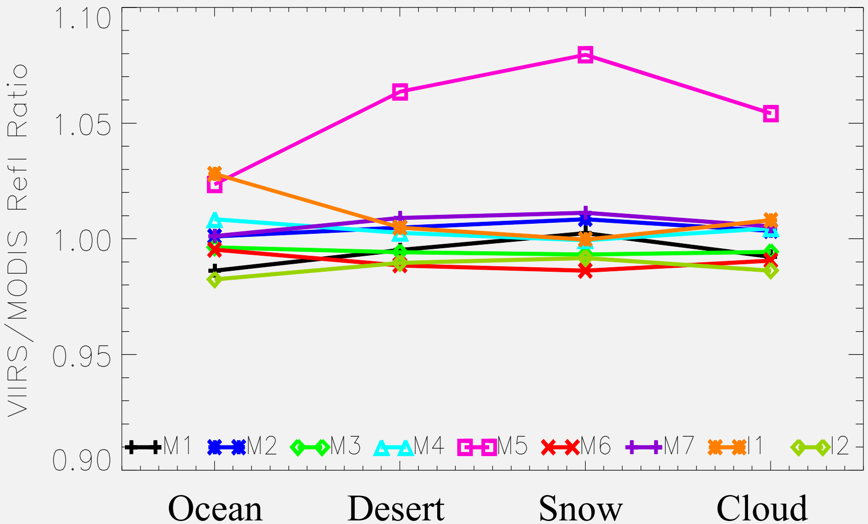
VIIRS to MODIS radiance ratios determined using sensor-based Esun models (MODIS and VIIRS) and RSR for their spectrally matched bands

MODTRAN5 Simulations

VIIRS/MODIS reflectance ratio

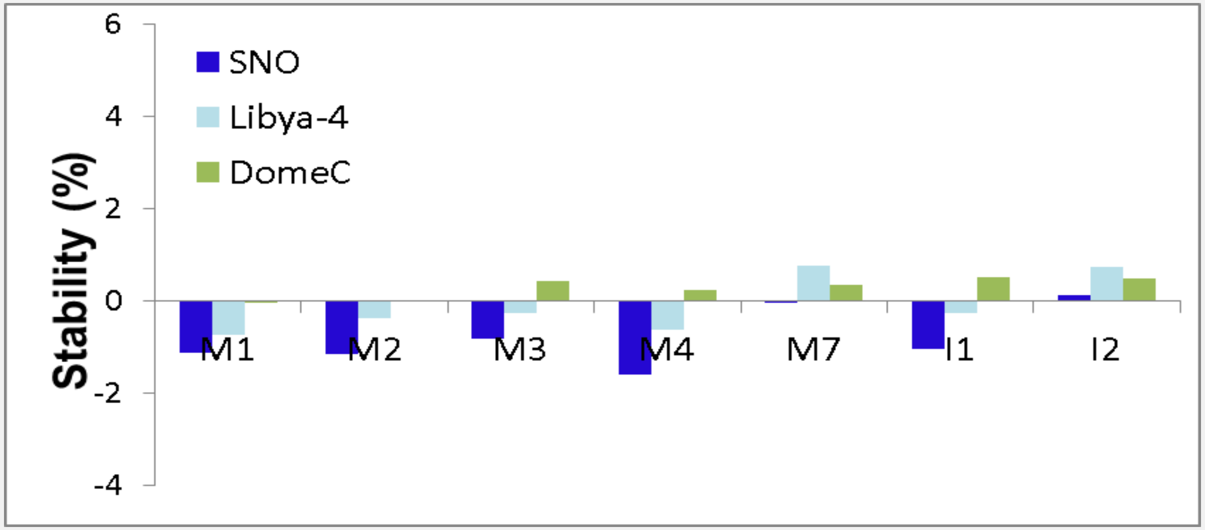


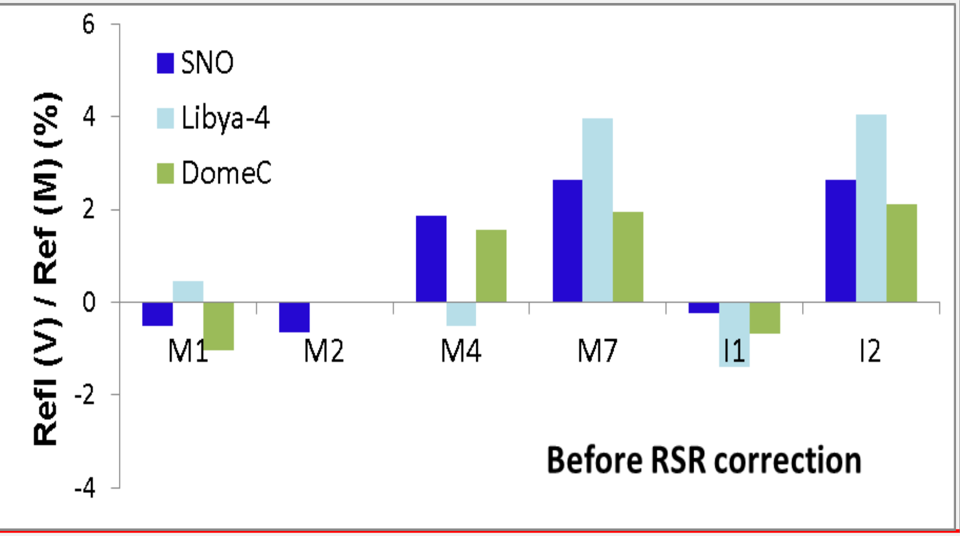


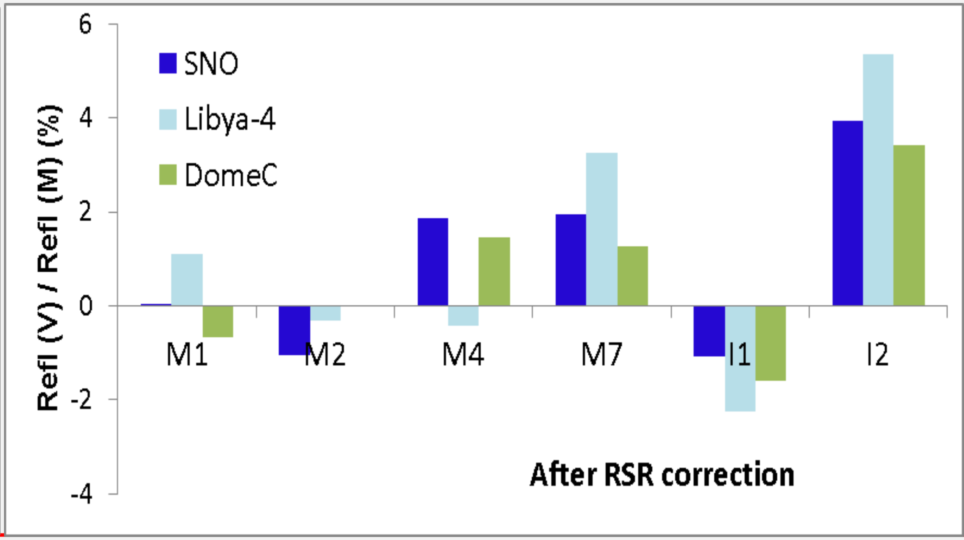


MODTRAN provided surface-specific spectral reflectances are used

VIIRS and MODIS calibration consistency







Summary

- Three vicarious approaches are used to evaluate the newly launched Suomi NPP VIIRS RSB SDR stability and performance: 1) well-calibrated Aqua MODIS, 2) Libya 4 desert site, 3) Dome C snow site
- NASA LandPeate VIIRS SDR RSB show a generally stable trend within 1% over the first three-year mission.
- With the help of MODTRAN simulated at-sensor radiances, the results of this study show that the relative calibration differences between the two sensors are within 2% for most RSB and 3% for I2.
- Comparison with results from three approaches shows that the trends have an agreement of within 2%.