Introduction

- MODerate Resolution Imaging Spectroradiometer (MODIS) is a key instrument for NASA's Earth Observing System (EOS).
- MODIS is onboard both Terra spacecraft (launched on December 18, 1999) and Aqua spacecraft (launched on May 4, 2002).
- MODIS's 2-sided paddle wheel scan mirror provides a -55 to +55 degree scan of the Earth covering 10 km (at nadir) along track by 2330 km along scan swath.
- MODIS has 36 spectral bands, among which 20 are reflective solar bands (RSBs) ranging from 0.41 to 2.3 microns, with spatial resolution (at nadir) of 250 m (bands 1-2), 500 m (bands 3-7) and 1000 m (bands 8-19,26).
- RSBs are calibrated on-orbit by an onboard Solar Diffuser (SD) panel, the Moon, and an onboard Spectro-Radiometric Calibration Assembly (SRCA)

RSB On-orbit Calibration Algorithms

On-orbit Calibration Algorithms

### Reflectance

\[ \text{Reflectance} = \frac{I_{Ch} - m_{0}}{m_{1}} \text{dB} = \frac{I_{Ch}}{m_{1}} - \text{Earth-Sun Distance} \]

### Radiance

\[ L_{Ch} = m_{0} \cdot I_{Ch} \cdot \text{Earth-Sun Distance} \]

**SD On-orbit Calibration Schematic***

SD/SDM Calibration Algorithm

Scaling factors \( m_1 \) from SD

### SD (BRF) degradation from SDSM

\[ m_{SD} = \left( \frac{A_{BRF}(SDM) \cdot \text{Earth-Sun Distance}}{A_{SDM} \cdot \text{Earth-Sun Distance}} \right) \]

**VIS and NIR Focal Plane Assemblies Layout***

### VIS and NIR Focal Plane Assemblies Layout***

### SD BRF and SD Screen VF

- Prelaunch BRF is used (validated on-orbit)
- SDS VF is derived on-orbit
- On-orbit yaws for BRF and VF:
  - One set of Aqua yaws, 6/2002
- Each set of yaws 12 (or 6) SDS open (BRF, VF)
  12 (0r 6) SDS closed (VF)

**SD Degradation**

### Terra Out-of-band Thermal Leak Correction Example

<table>
<thead>
<tr>
<th>Time-Dependent RVS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative RVS is derived from SD, SRCA, and Moon data for Terra and from SD and Moon data for Aqua</td>
</tr>
</tbody>
</table>

**Special Calibrations and Challenging Issue**

- Algorithms:
  - Using a linear approach between the SWIR signals
    \[ d_{SNR}\text{ (BRF)} = d_{SNR}\text{ (VF)} - m_{\text{sd}} \cdot d_{\text{Earth-Sun Distance}} \]
  - \( d_{\text{Earth-Sun Distance}} \): uncorrected Earth view signal after background subtraction
  - \( d_{\text{Earth-Sun Distance}} \): corrected Earth view signal after OOB correction
  - \( m_{\text{sd}} \): linear correction coefficient
  - \( E_{\text{Earth-Sun Distance}} \): Earth-Sun distance

**RSB On-orbit Calibration Algorithms**

**On-Orbit Performance**

**Special Calibrations and Challenging Issue**

- Challenging Issues:
  - \( m_1 \) shows annual oscillation for the Ocean bands
    - 0.5% for B8, 0.4% for B9, and 0.3% or less for other bands
  - This might be true since it was also observed in Moon and SRCA scaling coefficients
  - \( m_1 \) shows daily oscillation
  - The oscillation is band and detector dependent and can be as large as 0.4% for some bands
  - Accuracy of time-dependent RVS
  - Striping