Updates to the On-Orbit Calibration of SNPP and NOAA-20 VIIRS for Ocean Color Applications

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On-Orbit Calibration Updates

• Applying linear beta-angle corrections to solar f-factors:
  ‒ Removes residual beta-angle effects in solar observations.

• Using solar-derived f-factors to calibrate lunar observations:
  ‒ Fits to the calibrated lunar time series have smaller uncertainties than computed differences between the solar and lunar time series.

• Using long-period exponentials as basis vectors for radiometric fitting to the lunar time series:
  ‒ Simultaneous linear fits of lunar time series by exponentials and libration angles minimize any impact of libration on the radiometric fits.
  ‒ Lunar gains are the exponential component of the fits.
  ‒ Lunar gains applied to solar-derived F-factors for bands M1-M4, M8, M9

• Deriving modulated RSR gains from TOA ocean, lunar, and solar reference spectra for SNPP:
  ‒ Band-averaged radiances computed for reference spectra and mRSRs distributed over the mission.
  ‒ Gains derived from exponential fits to radiances, starting at first light.
  ‒ mRSR gains are ratios of ocean and lunar or solar gains.
NPP Solar Response Trending
Solar F-factors for Bands M1-M4
Solar F-factors for Bands M5-M7

SDSM Normalized BRDF Time Series

VIIRS Solar Calibration Time Series

VIIRS Solar Calibration Time Series
Solar F-factors for Bands M8-M11
SNPP Lunar Response Trending: Solar F-factors Applied

77 lunar cals
Jan 2012 through Dec 2020
Lunar Time Series Bands M1-M4
Lunar Time Series Bands M5-M7

SNPP VIIRS Lunar Calibration Time Series

SNPP VIIRS Lunar Calibration Time Series

SNPP VIIRS Lunar Calibration Time Series

SNPP VIIRS Lunar Libration Time Series

Sub-Spacecraft Longitude

Sub-Spacecraft Latitude
Lunar Time Series Bands M8-M11

SNPP VIIRS Lunar Calibration Time Series

(VIIRS Observations) / (ROLO Predictions)

Band M8

SNPP VIIRS Lunar Calibration Time Series

(VIIRS Observations) / (ROLO Predictions)

Band M9

SNPP VIIRS Lunar Calibration Time Series

(VIIRS Observations) / (ROLO Predictions)

Band M10

SNPP VIIRS Lunar Calibration Time Series

(VIIRS Observations) / (ROLO Predictions)

Band M11
SNPP Final F-factors: Lunar and mRSR Adjustments to Solar F-factors
SNPP Final F-Factors
JPSS1 Solar Response Trending
Solar F-factors for Bands M1-M4
Solar F-factors for Bands M5-M7

J1 VIIRS SDSM BRDF Time Series

J1 VIIRS Solar Calibration Time Series

J1 VIIRS Solar Calibration Time Series
Solar F-factors for Bands M8-M11

J1 VIIRS Solar Calibration Time Series

VIIRS Solar Beta Angle Time Series

J1 VIIRS Solar Calibration Time Series
JPSS1 Lunar Response Trending: No Solar F-factors Applied

25 lunar cal
Dec 2017 through Dec 2020
Lunar Time Series

J1 VIIRS Lunar Calibration Time Series

SNPP VIIRS Lunar Libration Time Series

Sub-Spacecraft Longitude

Sub-Spacecraft Latitude
JPSS1/SNPP Lunar Time Series Ratios

SNPP Observations w/ Time Corrections

JPSS1 Observations w/o Time Corrections

JPSS1 Lunar Observations Show No Significant Time Drift

Residual Libration Effects Cancel Out
SNPP / JPSS1: Ocean Color Comparisons
## JPSS1 / SNPP Ratios

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<tr>
<th>Band</th>
<th>OBPG Lunar Ratio</th>
<th>Vicarious Gain Ratio</th>
<th>VCST Desert Ratio</th>
<th>VCST SNO Ratio</th>
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<tr>
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<td>M7</td>
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<td>0.973</td>
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SNPP Ocean Color
Anomaly Comparisons

OBPG LUT: 2020160
VCST LUT: 20201223
Remote Sensing Reflectance Anomalies

Anomaly in VIIRS( VT86) Rrs(410) for Oligotrophic

Anomaly in VIIRS( VT88) Rrs(410) for Oligotrophic

Anomaly in VIIRS( VT86) Rrs(443) for Oligotrophic

Anomaly in VIIRS( VT88) Rrs(443) for Oligotrophic
Remote Sensing Reflectance Anomalies
Remote Sensing Reflectance Anomalies

Anomaly in VIIRS(VT86) Rrs(671) for Oligotrophic

Anomaly in VIIRS(VT88) Rrs(671) for Oligotrophic

Anomaly in VIIRS(VT86) Chla for Oligotrophic

Anomaly in VIIRS(VT88) Chla for Oligotrophic
JPSS1 Ocean Color Anomaly Comparisons

OBPG LUT: Static
VCST LUT: 20201210
Remote Sensing Reflectance Anomalies

Anomaly in VIIRS(J1VT02) Rrs(411) for Oligotrophic

Anomaly in VIIRS(J1VT03) Rrs(411) for Oligotrophic

Anomaly in VIIRS(J1VT02) Rrs(445) for Oligotrophic

Anomaly in VIIRS(J1VT03) Rrs(445) for Oligotrophic
Remote Sensing Reflectance Anomalies

Anomaly in VIIRS1(J1VT02) Rrs(489) for Oligotrophic

Anomaly in VIIRS1(J1VT03) Rrs(489) for Oligotrophic

Anomaly in VIIRS1(J1VT02) Rrs(556) for Oligotrophic

Anomaly in VIIRS1(J1VT03) Rrs(556) for Oligotrophic
Remote Sensing Reflectance Anomalies

Anomaly in VIIRS1(J1VT02) $R_{s}(667)$ for Oligotrophic

Anomaly in VIIRS1(J1VT03) $R_{s}(667)$ for Oligotrophic

Anomaly in VIIRS1(J1VT02) Chla for Oligotrophic

Anomaly in VIIRS1(J1VT03) Chla for Oligotrophic
On-Orbit Calibration Summary

• SNPP: 79 lunar observations over 9 years (75 lunar cals for LUT)
  - Lunar gain adjustments to bands M1-M4, M8, M9
    • 0.7 – 2.1 % adjustments
• JPSS1: 27 lunar observations over 3 years (no temporal corr):
  - Solar observations show possible time drifts
    • ~1.5% in band M1, up to 0.8% in other bands
  - Lunar observations show no significant time drift
• JPSS1 / SNPP Lunar Observation Comparisons:
  - Residual libration corrections are similar
  - Lunar calibration ratios:
    • Residual libration effects cancel
    • No time drift for JPSS1
• JPSS1 / SNPP Remote Sensing Reflectance Comparisons:
  - JPSS1 $R_{RS}$ are more stable over time than SNPP $R_{RS}$
Thank You