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# Assessment of Cross-sensor Vegetation Index Compatibility between VIIRS and MODIS Using Near-coincident Observations

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**(Miura et al., 2018, *Journal of Applied Remote Sensing*, 12(4), doi:10.1117/1.JRS.12.045004)**

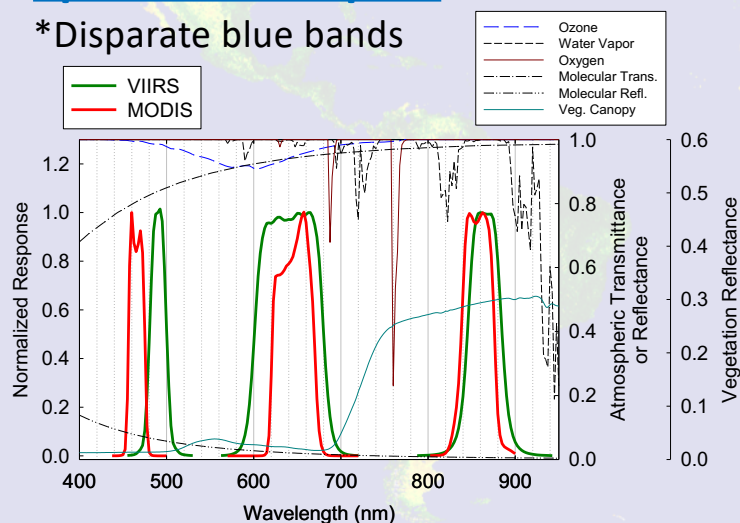
## Acknowledgements

- NOAA IDPS and NASA Land SIPS for their provisions of VIIRS and MODIS data
- Funding provided from the NOAA Joint Polar Satellite System (JPSS) program through a cooperative agreement with University of Hawaii at Manoa

# Comparison of MODIS and VIIRS

## Spectral Bandpass

\* Disparate blue bands



## Spatial Resolution

- \* **MODIS:** 250 m & 500 m @nadir  
0.5 km-by-1.2 km & 1 km-by-2.4 km @edge-of-scan
- \* **VIIRS:** 375 m & 750 m @nadir  
800 m-by-800 m & 1.6 km-by-1.6 km @edge-of-scan

## Algorithm Performance

- \* Cloud masks
- \* Atmospheric correction

## VI Products

- \* **MODIS:** Gridded, 16-day or monthly composites (CV-MVC)
- \* **VIIRS:** Granule, daily



# Objective



- To characterize radiometric compatibility of VIs between MODIS and VIIRS using 2015 global data
  - Used observation pairs along overlapped orbital tracks
  - Evaluated cross-sensor VI differences across dynamic range, seasons, and view zenith angles





# Data & Processing



- Suomi NPP VIIRS (IDPS) and Aqua MODIS (Collection 6)
  - Year 2015 @ monthly (32 days) intervals
  - 4 km grid spatially-aggregated
  - High quality pixels adopted by the JPSS program (no cloud, low aerosol loading, & solar zenith  $< 65^\circ$ )
- Subsamples from overlapped orbital tracks
  - $0^\circ - 7.5^\circ$ ,  $20^\circ - 27.5^\circ$ ,  $40^\circ - 47.5^\circ$ ,  $55^\circ - 62.5^\circ$  (backward & forward)
  - ~2,000 observation pairs randomly selected for each sun/view geometry per month
- Four VIs analyzed
  - “Top-of-Atmosphere (TOA)” NDVI, “Top-of-Canopy (TOC)” NDVI, TOC EVI, & TOC EVI2



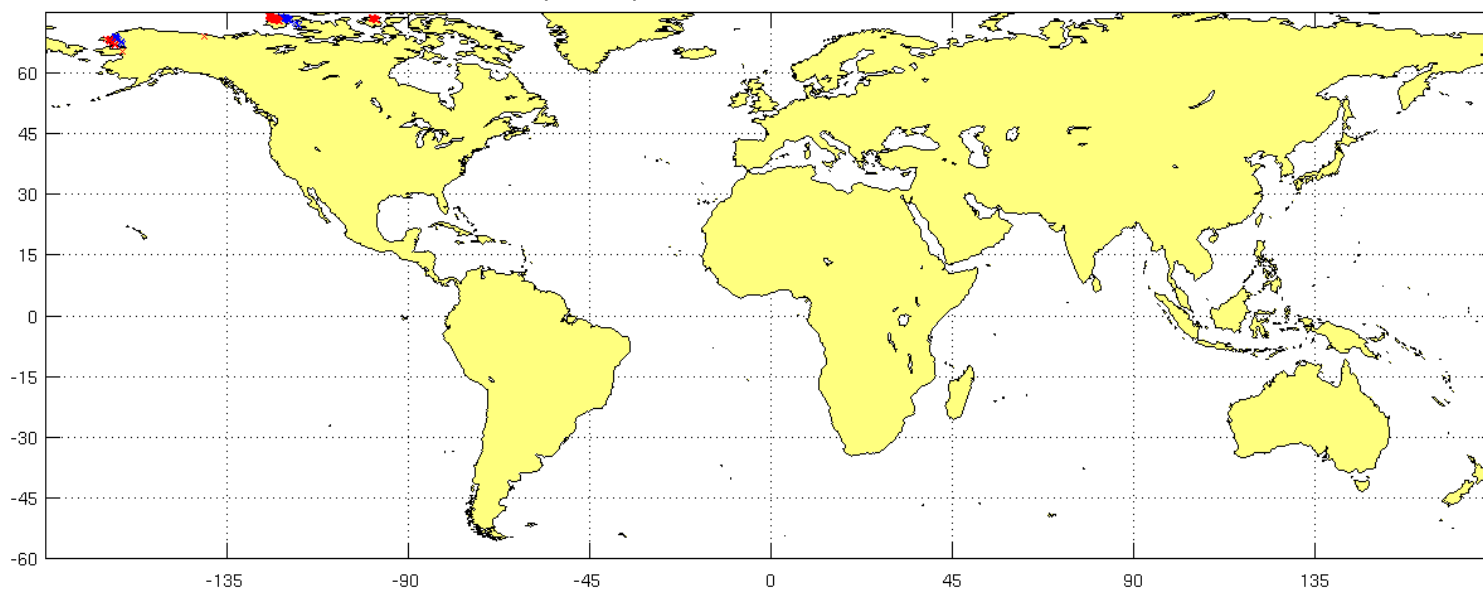
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# S-NPP & Aqua Orbital Tracks

- Ground tracks overlap on 3 days over a 8-day period

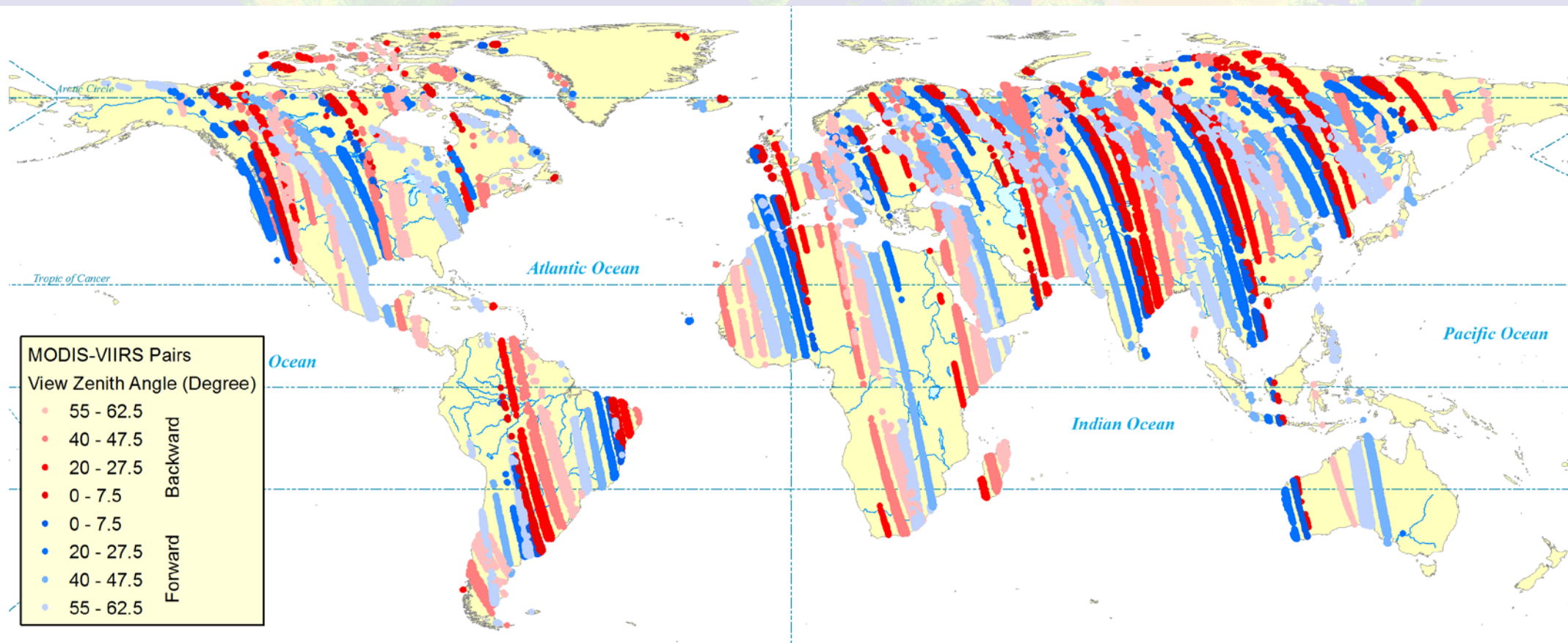
DOY: 250, View zenith: (0-7.5), Blue: Rel. Az. is 0-90, Red: Rel. Az. is 90-180.





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# Spatial Distribution of Near-Coincident Observation Pairs





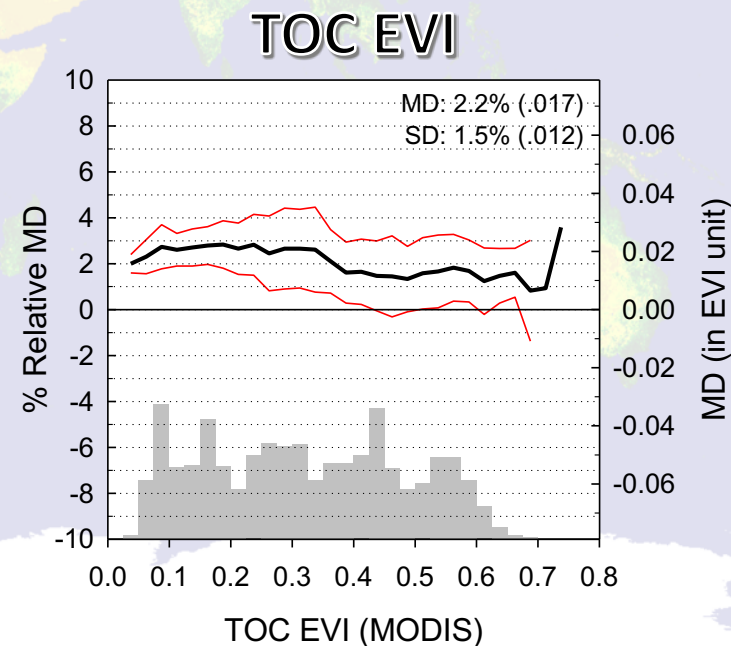
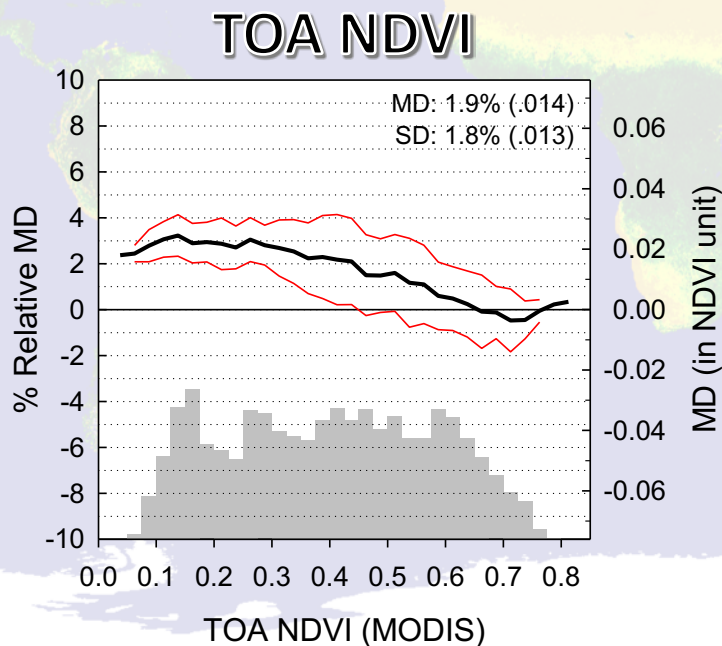
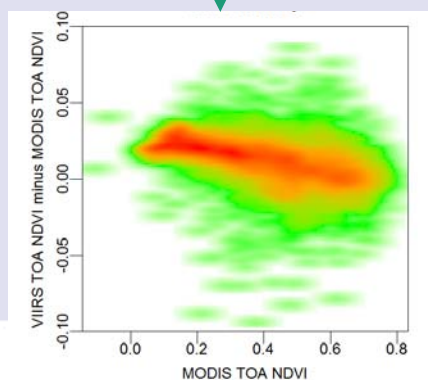
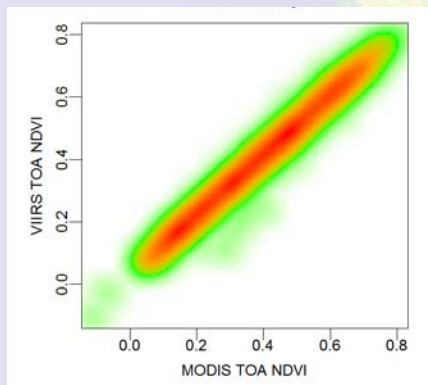


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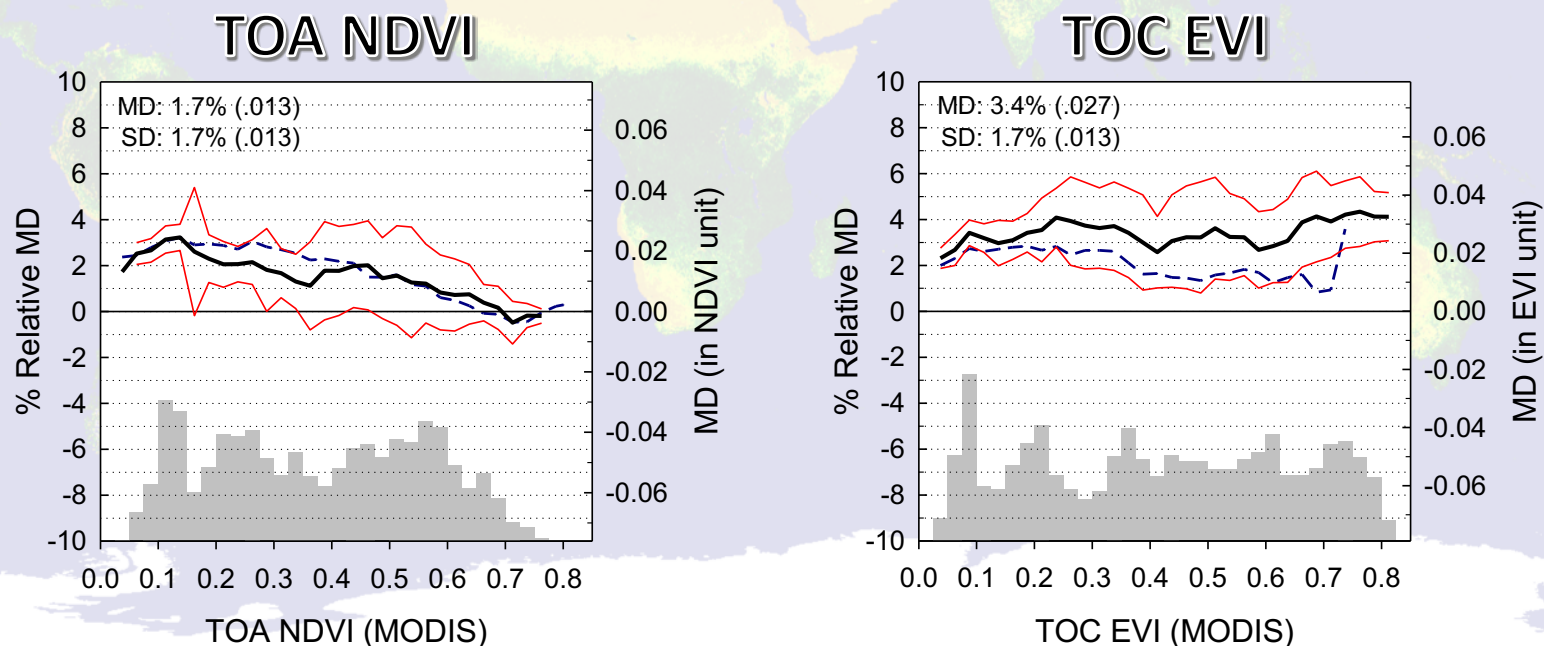
# Difference (VIIRS minus MODIS) Over Dynamic Range: TOA NDVI vs. TOC EVI

VZA: 0°-7.5°, August 2015



# Difference (VIIRS minus MODIS) Over Dynamic Range: TOA NDVI vs. TOC EVI

VZA: 55°-62.5°(backward), August 2015





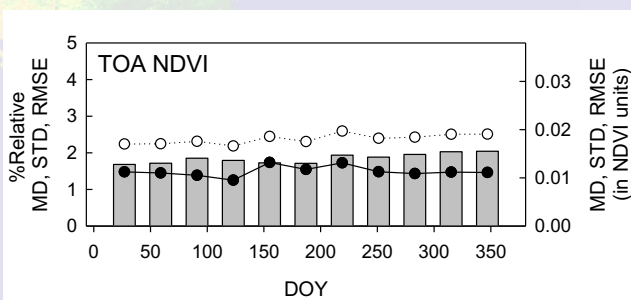


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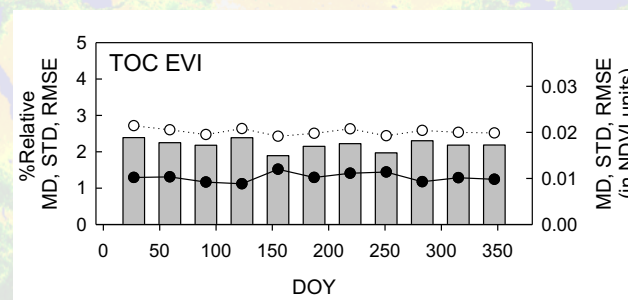
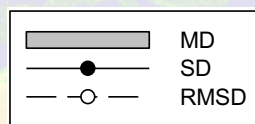
# Difference (VIIRS minus MODIS) Across Seasons: TOA NDVI vs. TOC EVI



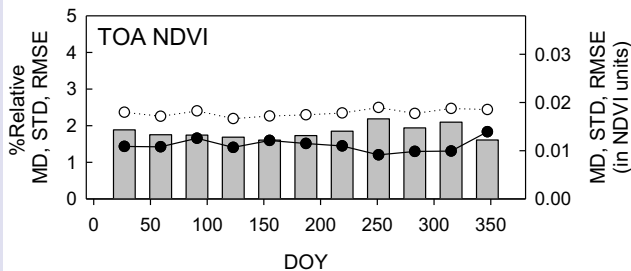
0° – 7.5°  
(Backward)



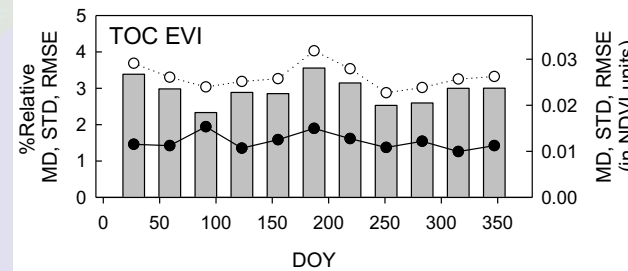
0° – 7.5°  
(Backward)



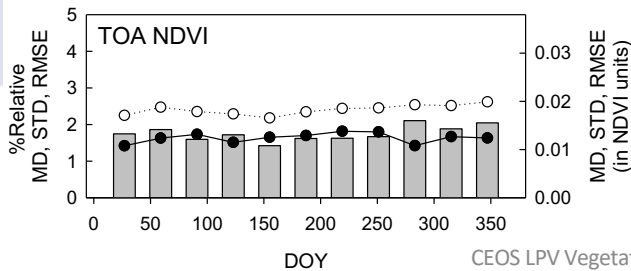
40° – 47.5°  
(Backward)



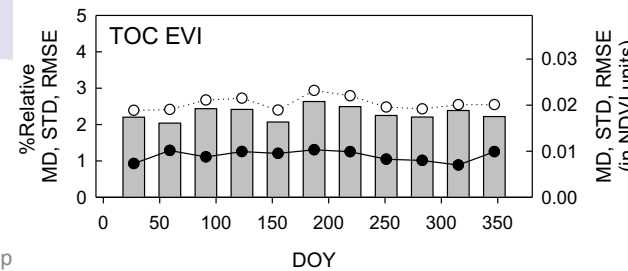
40° – 47.5°  
(Backward)



40° – 47.5°  
(Forward)



40° – 47.5°  
(Forward)

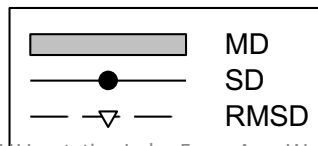
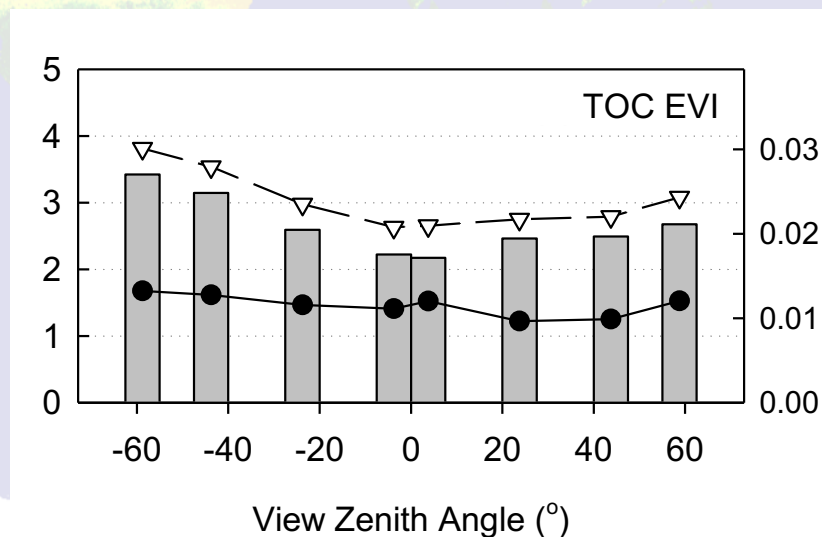
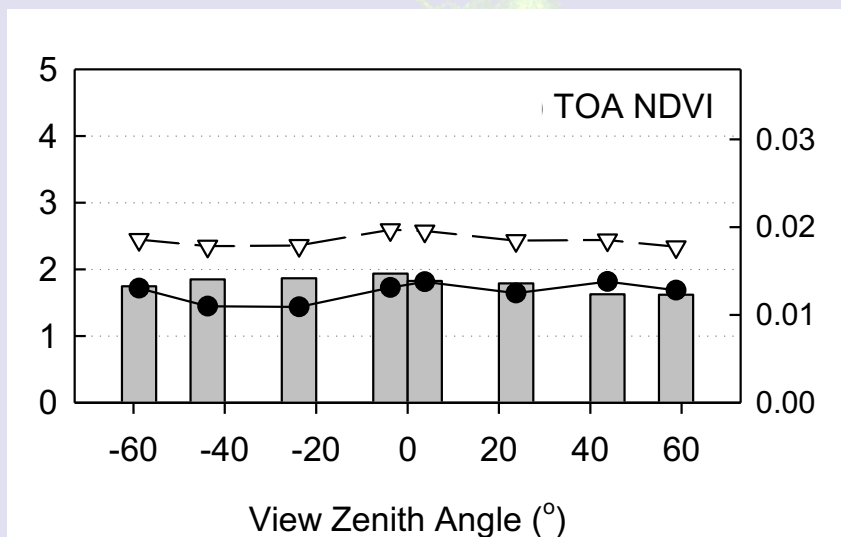


# Difference (VIIRS minus MODIS) Across View Angles: TOA NDVI vs. TOC EVI

August 2015

TOA NDVI

TOC EVI






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# Band Decomposition Analysis

- Employed an error propagation equation to investigate the mechanism by which each band contribute to overall VI differences

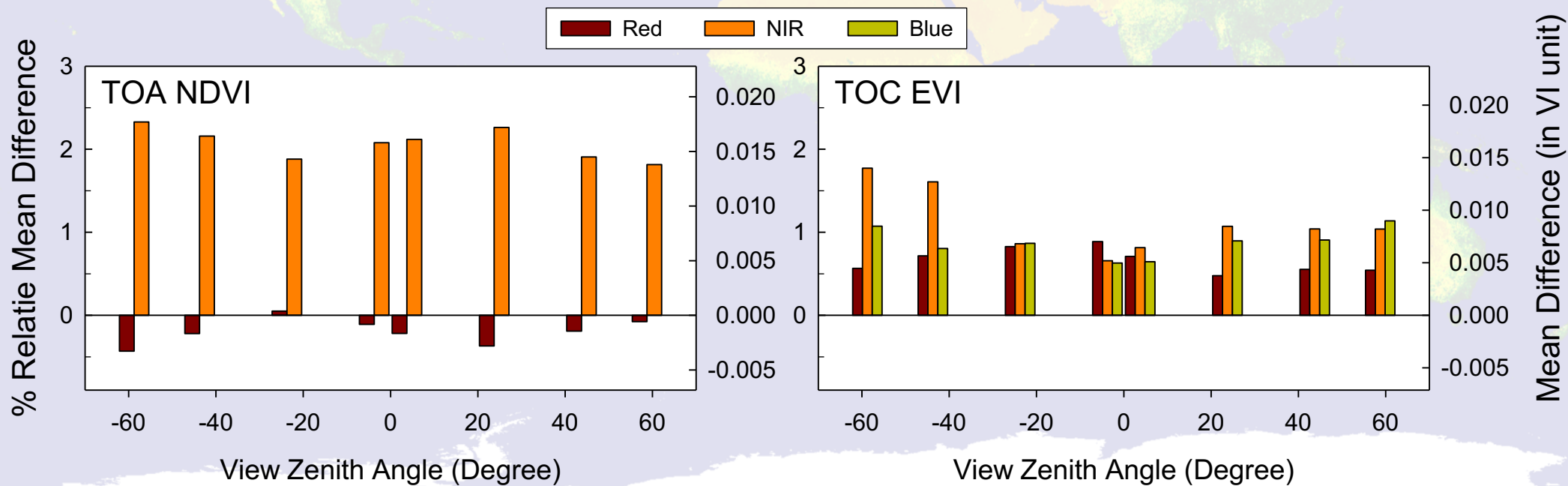
$$\Delta VI \approx \frac{\partial VI}{\partial \rho_{\text{red}}} \cdot \Delta \rho_{\text{red}} + \frac{\partial VI}{\partial \rho_{\text{NIR}}} \cdot \Delta \rho_{\text{NIR}} + \frac{\partial VI}{\partial \rho_{\text{blue}}} \cdot \Delta \rho_{\text{blue}}$$



Red Band Component      NIR Band Component      Blue Band Component



# Band Decomposition Analysis: TOA NDVI vs. TOC EVI



# Summary & Discussions

- Overall, VIIRS and MODIS VI differences were small (1.3% - 2.5% of its dynamic range)
  - Fairly constant across dynamic range and seasons
- However, TOC EVI and TOC EVI2 differences showed view zenith angle dependencies
  - Their differences larger for larger view zenith angles
- Observation geometries, including platform orbital differences, should be taken into account for a combined use of MODIS and VIIRS VI products
  - Nadir BRDF-adjusted reflectance

## VIIRS vs. MODIS VI Difference Summary

	MD	RMSD
<b>TOA NDVI</b>	0.013 (1.7%)	0.018 (2.4%)
<b>TOC NDVI</b>	0.012 (1.4%)	0.021 (2.4%)
<b>TOC EVI</b>	0.020 (2.5%)	0.023 (2.9%)
<b>TOC EVI2</b>	0.010 (1.3%)	0.016 (2.0%)