

Intercomparison of Sentinel-2, Landsat-8, and others using the Radiometric Calibration Test Site



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Outline

- **Radiometric Calibration Test Site (RadCaTS) and current efforts**
- **Instrumentation and methodology**
- **Results and future work**

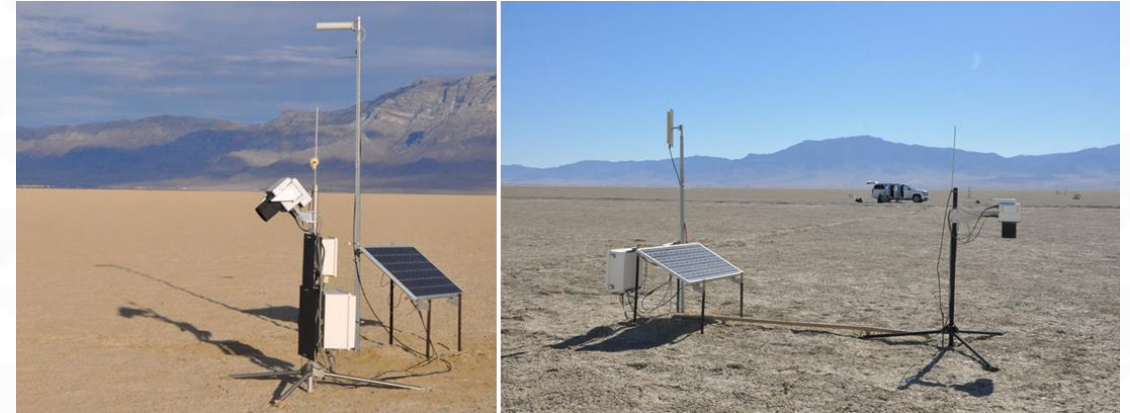


RadCaTS

- **Recent work focused on the Radiometric Calibration Test Site (RadCaTS)**
- **Similar to reflectance-based approach**
 - **Atmospheric measurements (automated solar radiometers)**
 - **Surface reflectance measurements (ASD and Spectralon panel)**
- **Yet different...**
 - **Absolutely-calibrated ground-viewing radiometers (GVRs)**
 - **Cimel CE-318T solar lunar photometer**
 - **On-site calibration of radiometers**
 - **Data logging**
 - **Infrastructure**
 - **Automated processing**

Current Status of RadCaTS: Instrumentation

- **5 Ground-viewing radiometers (GVRs)**
 - 4 in nadir-viewing configuration
 - 1 in GOES-East viewing configuration (60° zenith angle, 306° azimuth angle)
- **2 more GVRs in development**
 - 1 for nadir view
 - 1 for GOES-West view configuration
- **2 Cimel sun photometers**
 - #314 currently operating at Railroad Valley
 - #786 back to AERONET for repairs (May 2018 deployment)
- **Meteorological station**
 - Redundant temperature and pressure sensors
- **Satellite uplink station**
 - Daily upload of all data
- **Installation of web camera in May 2018**

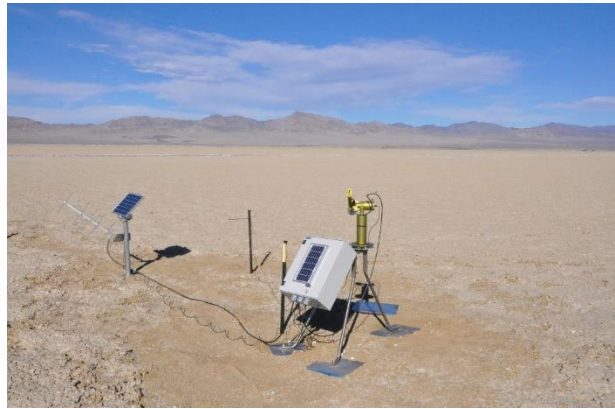




Current Status of RadCaTS: Instrumentation

- **Cimel CE-318T solar lunar photometer**
- **Meteorological station**
- **Satellite uplink base station**

CaTSSITTR





Surface Reflectance Studies: IEEE GSIS Vicarious Calibration Training Course

- **GSIS = Geoscientific Spaceborne Imaging Spectroscopy**
- **Part of a training series sponsored by IEEE GRSS**
- **Organized by Kurt Thome and Cindy Ong**
- **Occurred after IGARSS 2017 (28 Jul – 3 Aug 2017)**
- **Goal: demonstrate practical aspects of reflectance-based approach (lab to field)**
 - **Remote Sensing Group lab tour**
 - **Instructional field campaign at Railroad Valley and Lunar Lake**
 - **Collect field data, process to TOA**
- **Results in upcoming IGARSS 2018 Proceedings: Intercomparison of Field Methods for Acquiring Ground Reflectance at Railroad Valley Playa for Spectral Calibration of Satellite Data, Ian Lau, et. al., 2018**

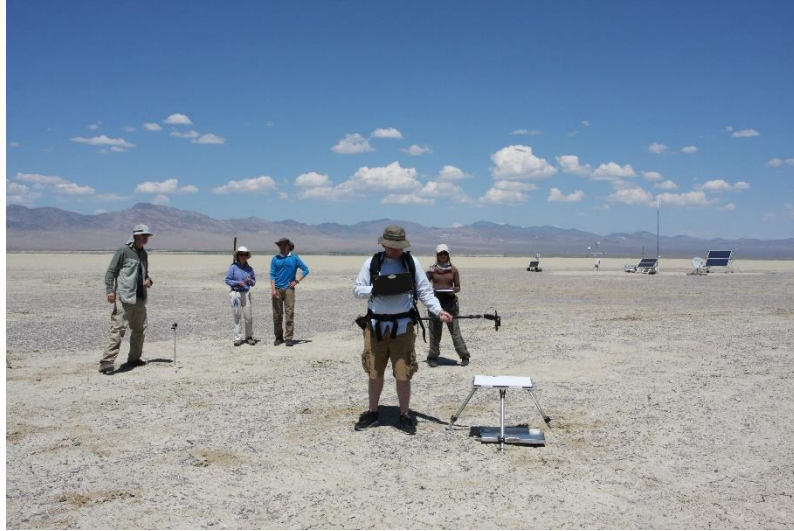


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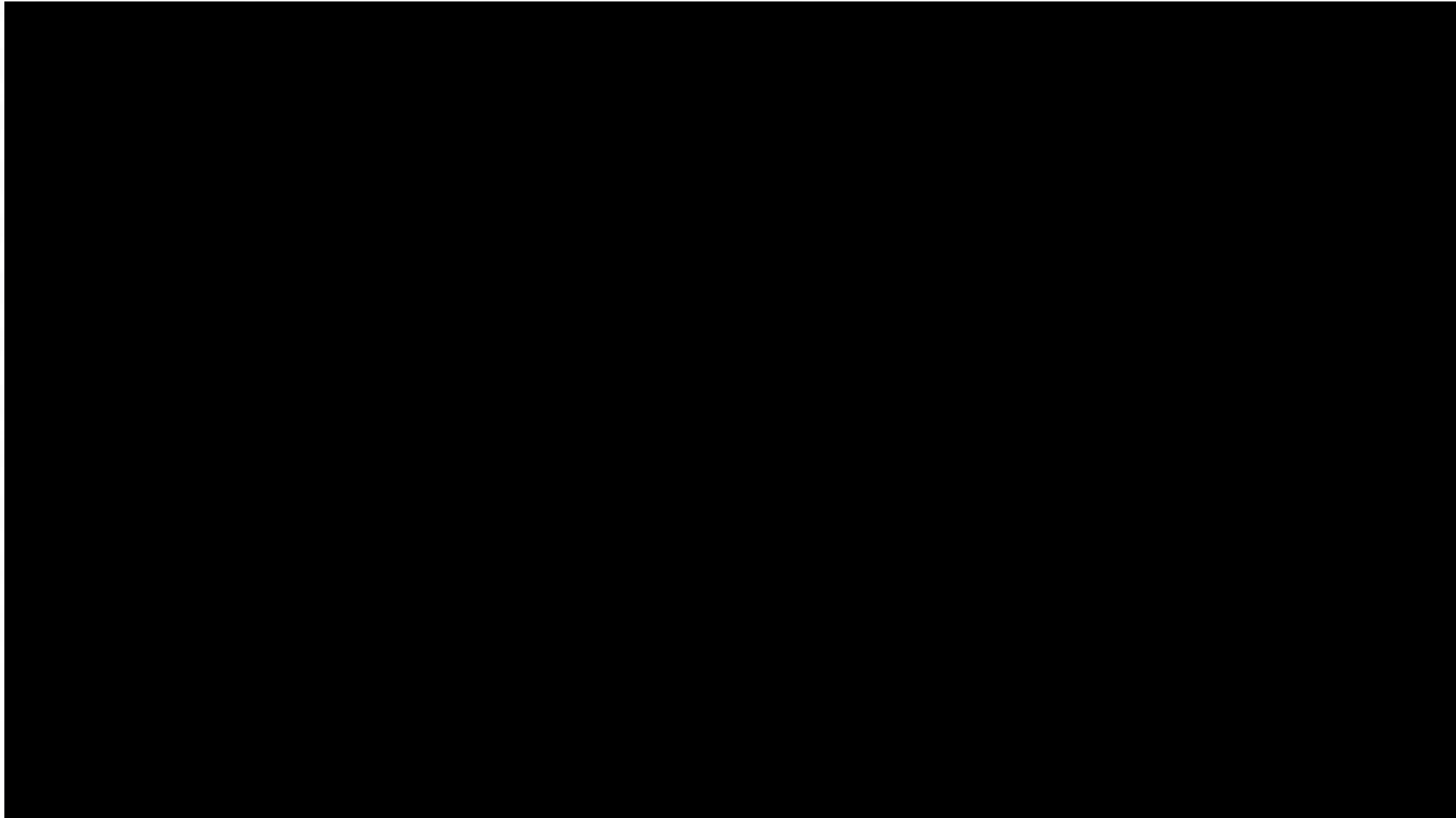


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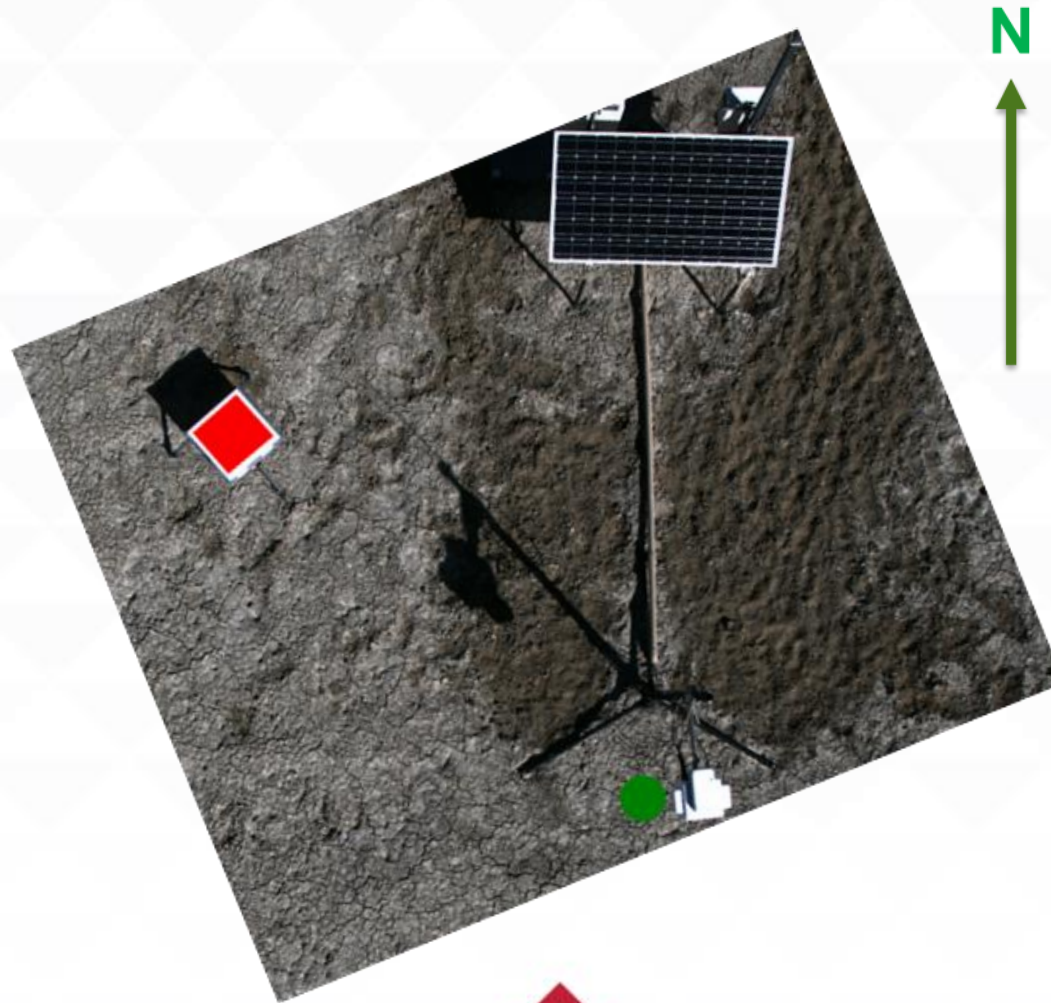
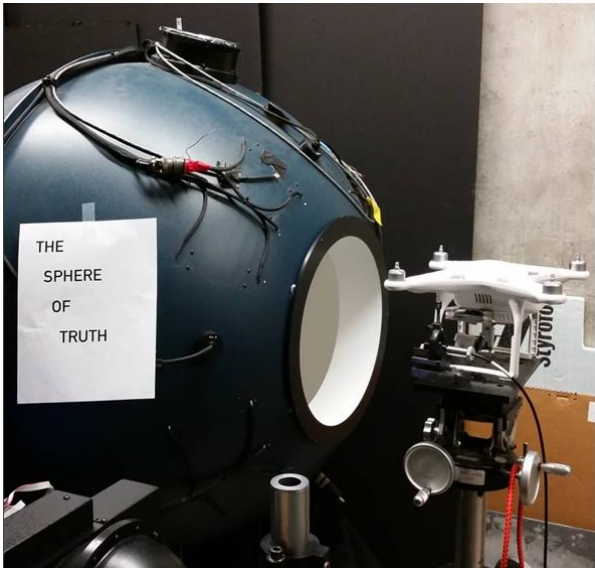
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Surface Reflectance Studies

- Commercial sUAS for spatial uniformity analysis





Current Status of RadCaTS

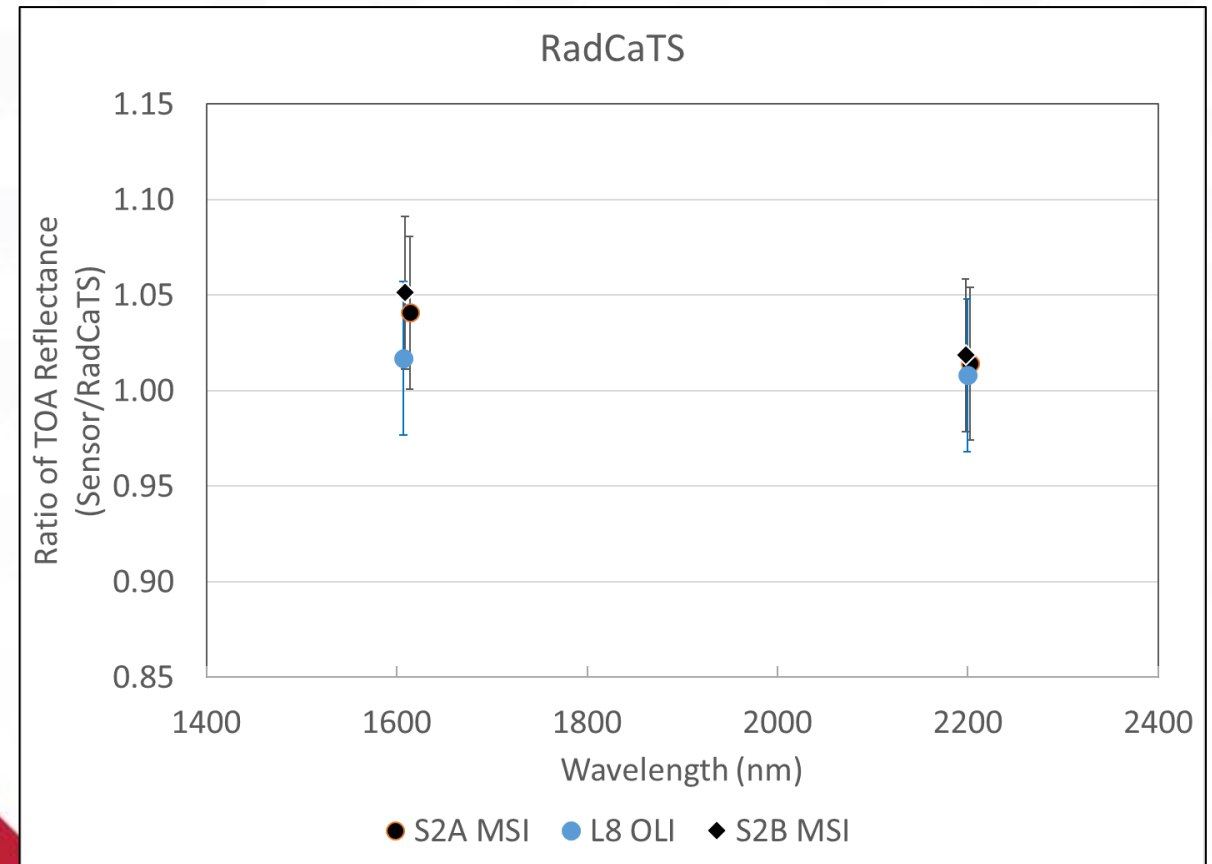
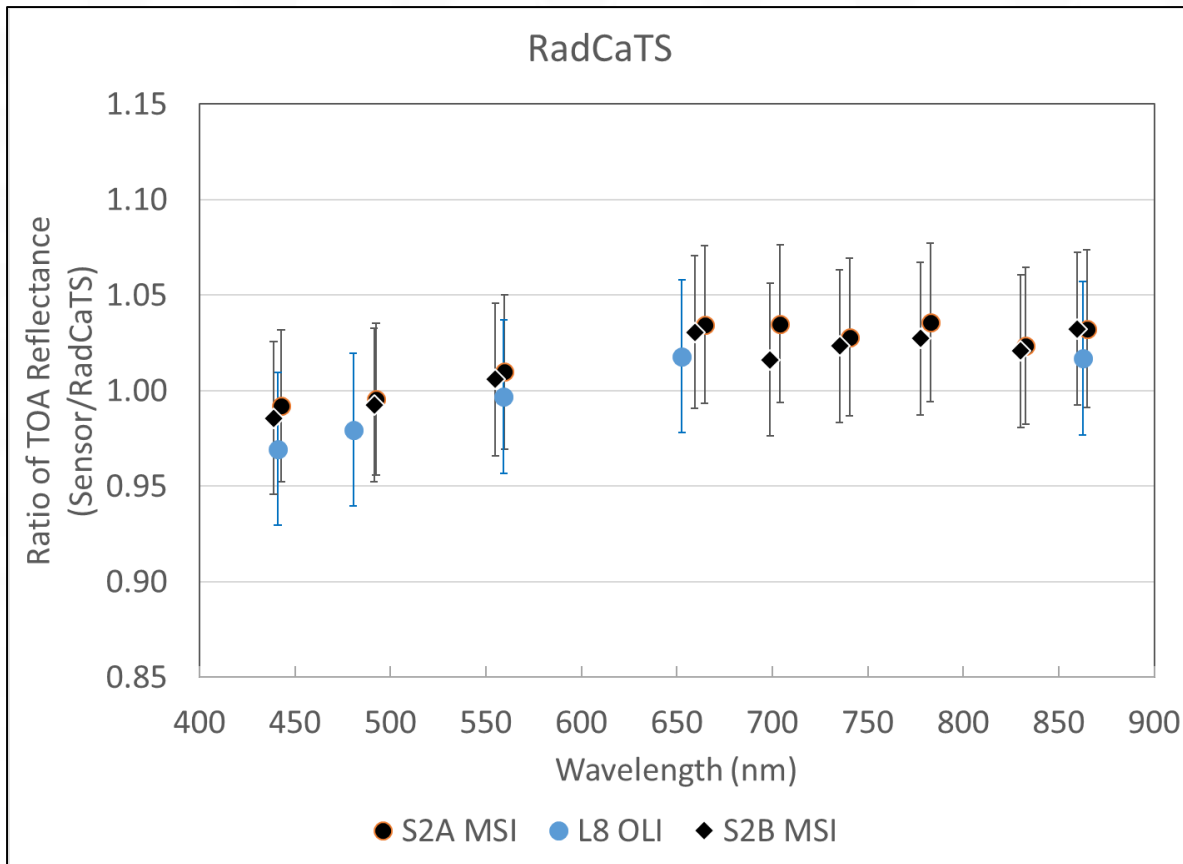
- **RadCaTS collection scheme**
 - **GVRs collect every 2 minutes (TE controller on when 850-nm channel signal reaches a threshold)**
 - **Met station measures every 2 minutes**
 - **Cimel operates on AERONET protocol**
 - **Data uploaded to Tucson once per day using satellite uplink**
 - **Excluding times when Angstrom exponent is outside range of 0.9–1.5**
 - **Surface reflectance determined using Thuillier 2003 E_{sun}**
 - **All new processing uses AERONET V3 aerosol optical depth data**
 - **Reference library of Railroad Valley data increased from ~ 85 to ~ 700**
- **Current RadCaTS processing for RadCalNet**
 - **Every 30 min from 09:00–15:00 Pacific Standard Time (UTC – 8 h)**
 - **No change for daylight savings time**
 - **Finished processing mid-2014 – 10 Mar 2018**



Sample of Current Results

- **L8 OLI (N=16), S2A MSI (N=26), S2B MSI(N=9)**
- **Uncertainty bars are $\pm 4\%$ (1σ)**

TOA Reflectance

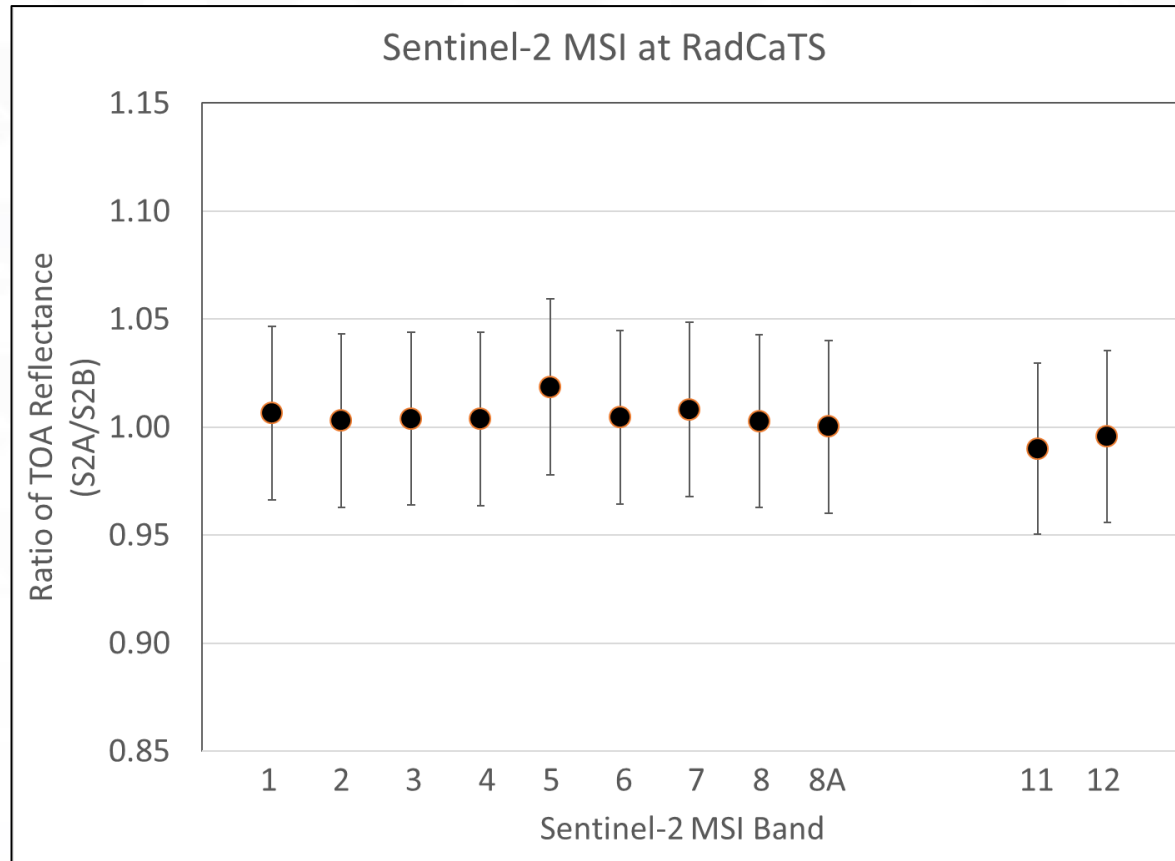




Sample of Current Results

- **Sentinel-2A and -2B MSI 'double ratio' (S2A/S2B)**
- **Uncertainty bars are $\pm 4\%$ (1σ)**

TOA Reflectance

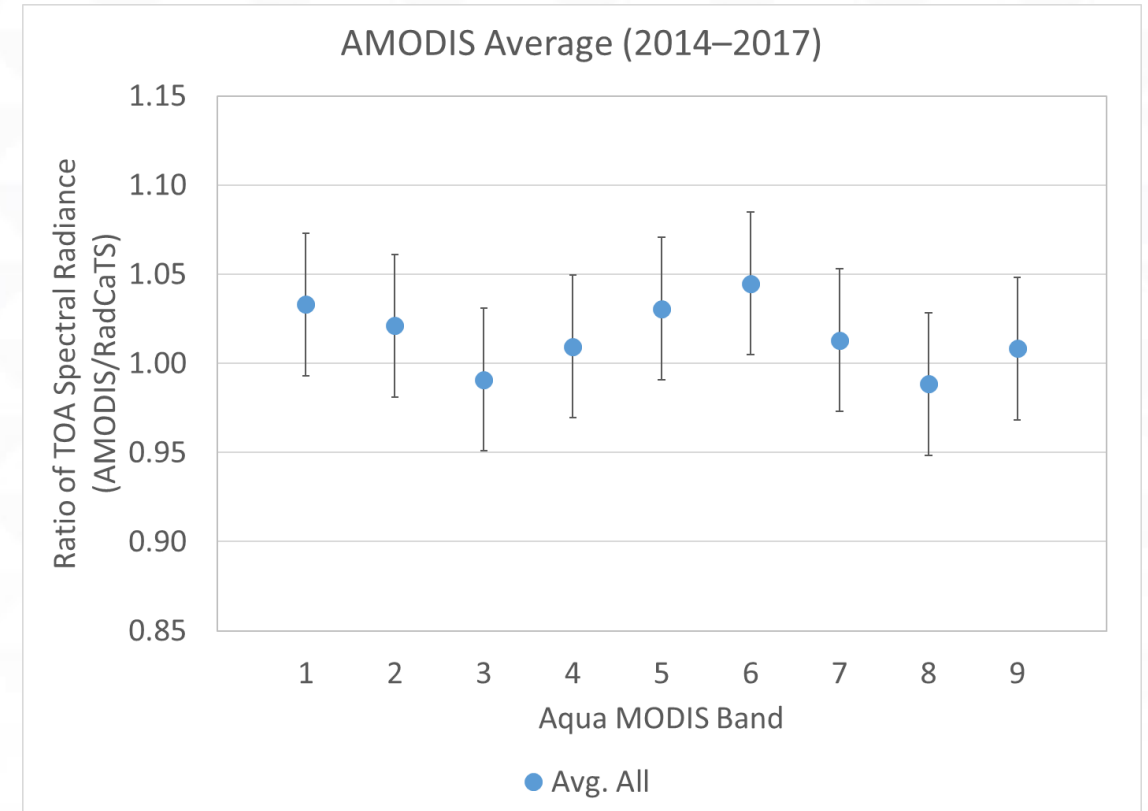
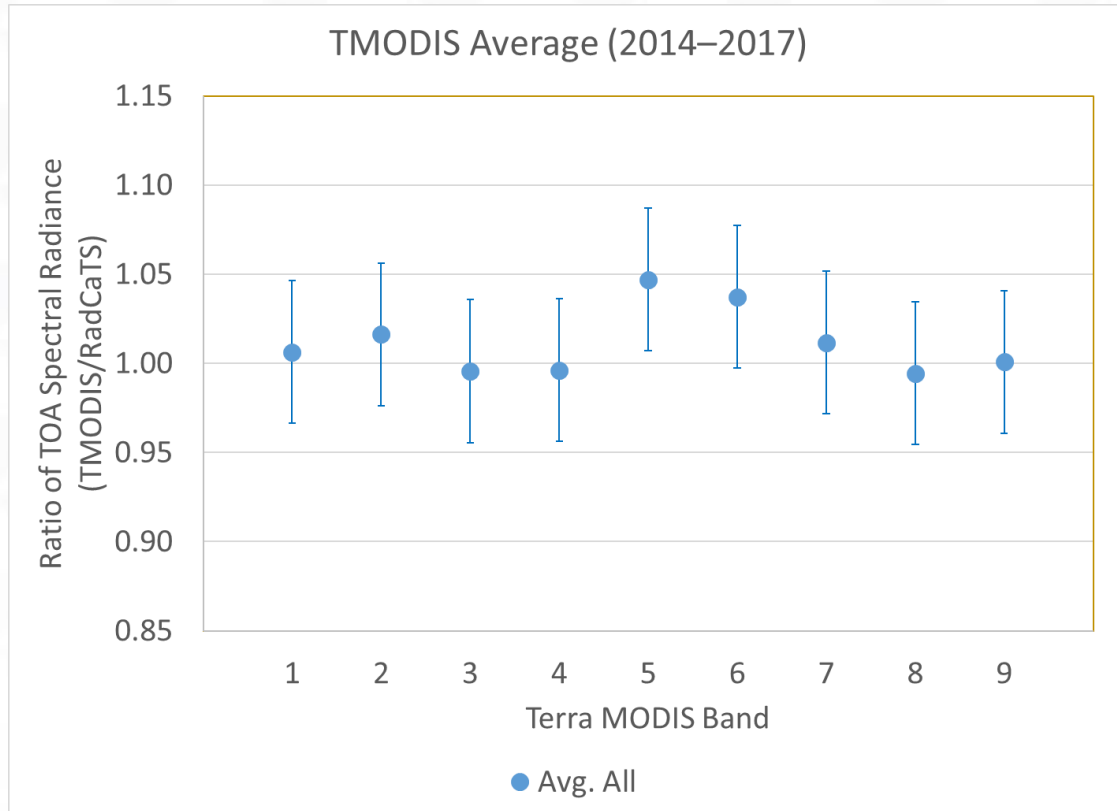




Sample of Current Results

- Terra and Aqua MODIS**

TOA Spectral Radiance

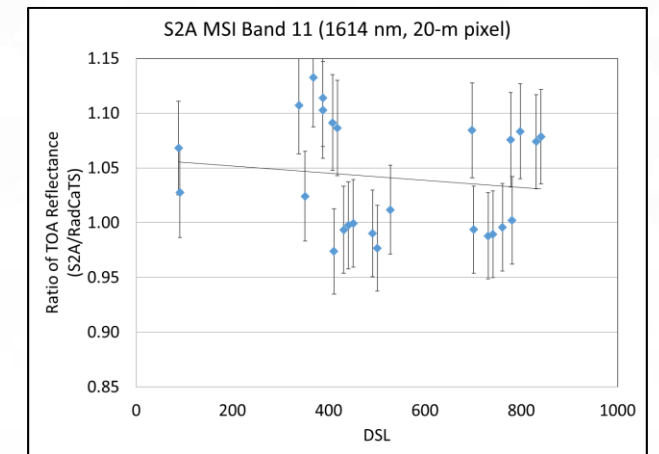
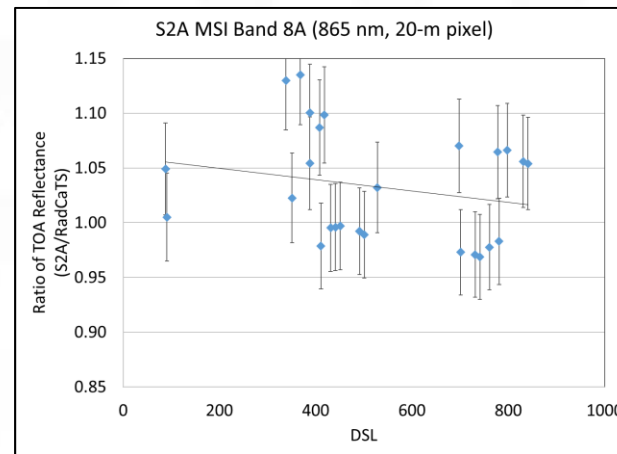
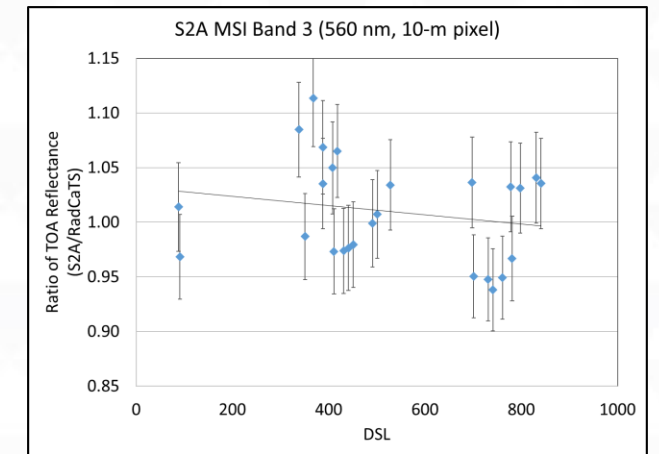
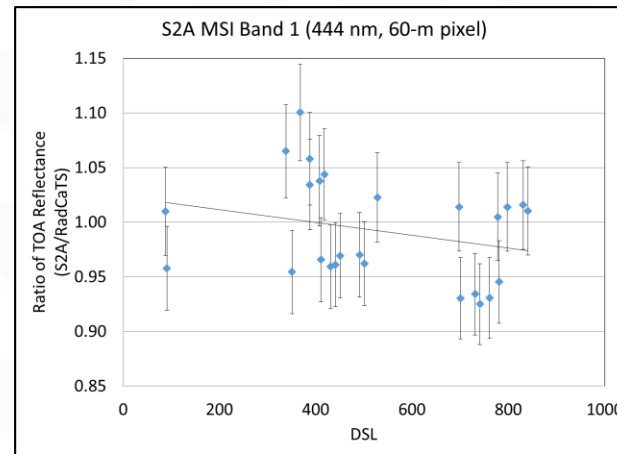
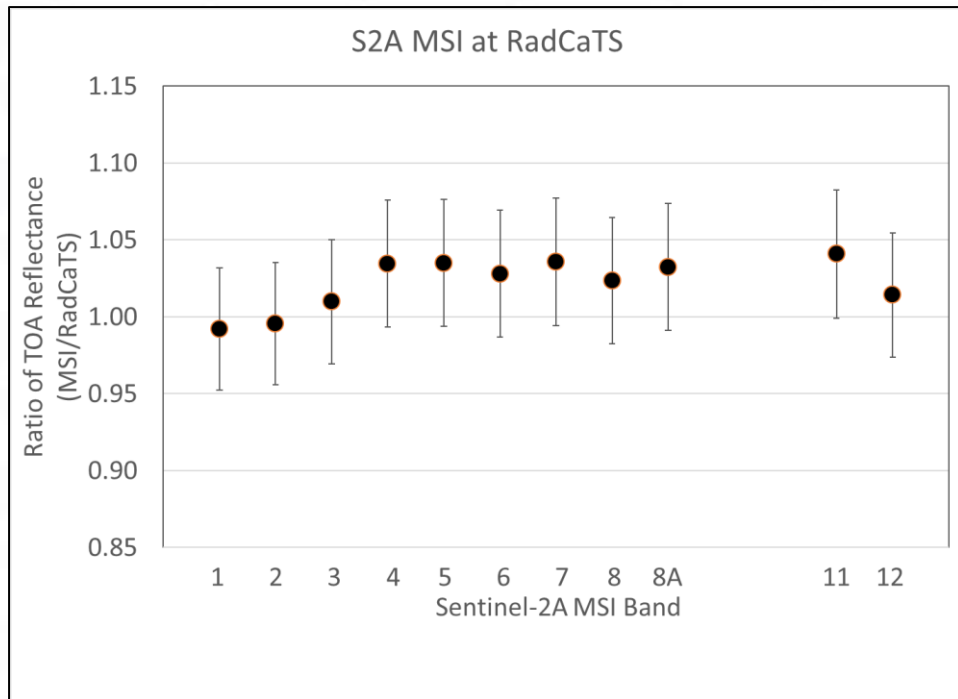




BRDF Effects

- **Directional reflectances observed for current S2 work**

S2A TOA Reflectance





BRDF Effects

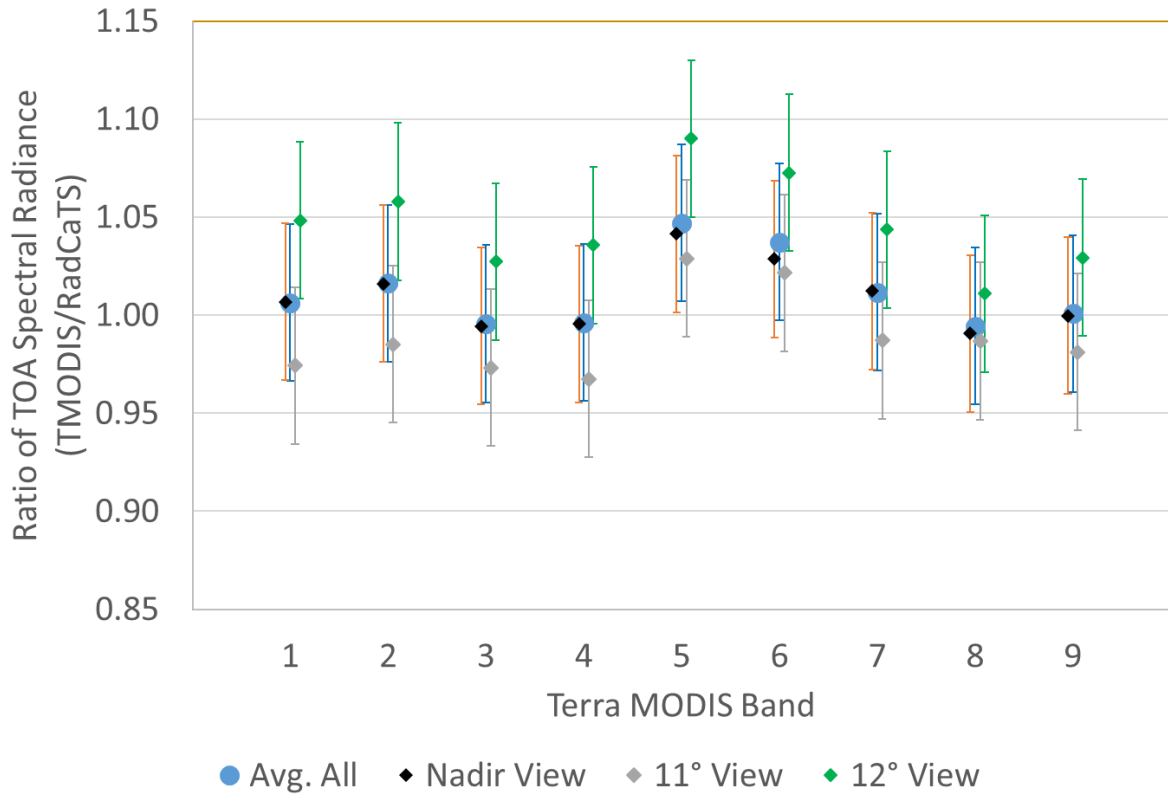
- Check with MODIS...

Terra MODIS (N = 36)

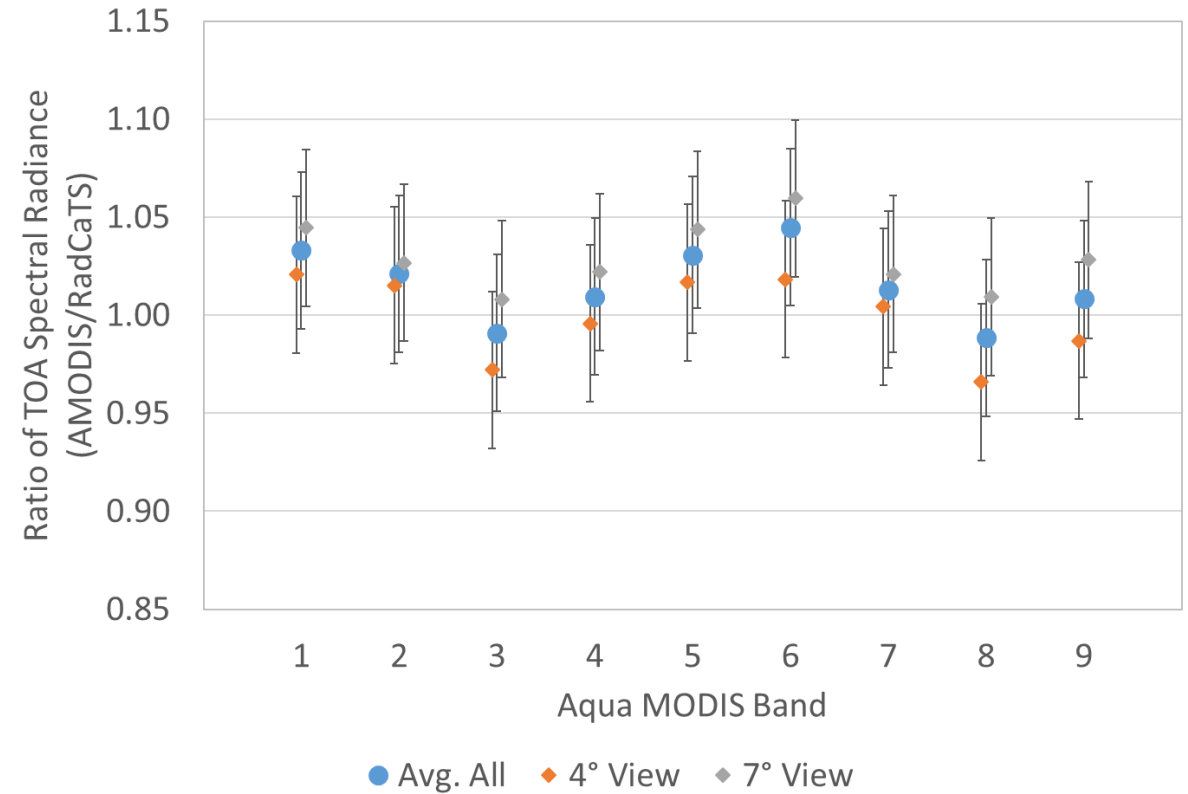
TOA Spectral Radiance

Aqua MODIS (N = 25)

TMODIS Average (2014–2017)



AMODIS Average (2014–2017)



Future Work

- **Create BRDF correction for off-nadir viewing configuration**
- **Continue to process specific overpasses**
 - **Current missions: Terra, Aqua, Landsat, SNPP, Sentinel-2, GOES-16, GOES-17**
 - **Future missions: Landsat-9**
- **Continue to process daily RadCalNet data and upload to NASA**
- **Routine maintenance and calibration of equipment**
- **Install web camera to monitor conditions**
- **Develop additional GVR for GOES-17 work**
- **Develop GVR head translation mechanism for additional spatial sampling (student project)**
- **Deploy SpAM (student project)**

Thanks!

- **Note:** Round robin field campaign at Railroad Valley in May 2018. Please contact Jeff or Kurt if interested in participating
- **Thanks!**

