

An Overview of The May 2018 Railroad Valley (RRV) Field Campaign

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Brief's Outline

- Campaign Site - Railroad Valley (RRV) Playa – Un. of Arizona Radiometric Calibration Test Site (RadCaTS)
 - RadCaTS/ is part of Radiometric Calibration Network (RadCalNet)
 - Overview of both RadCaTS and RadCalNet
- Campaign Goals
 - Evaluate the bidirectional reflectance distribution function (BRDF) of RRV Site
 - Evaluate a common reference material
 - Determine the radiometric uncertainties of RRV
 - Intercompare the top of atmosphere (TOA) satellite sensor calibration for various NASA, USGS and commercial sensors
- NGA's Participation
- Summary



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RadCATS and RadCaINet

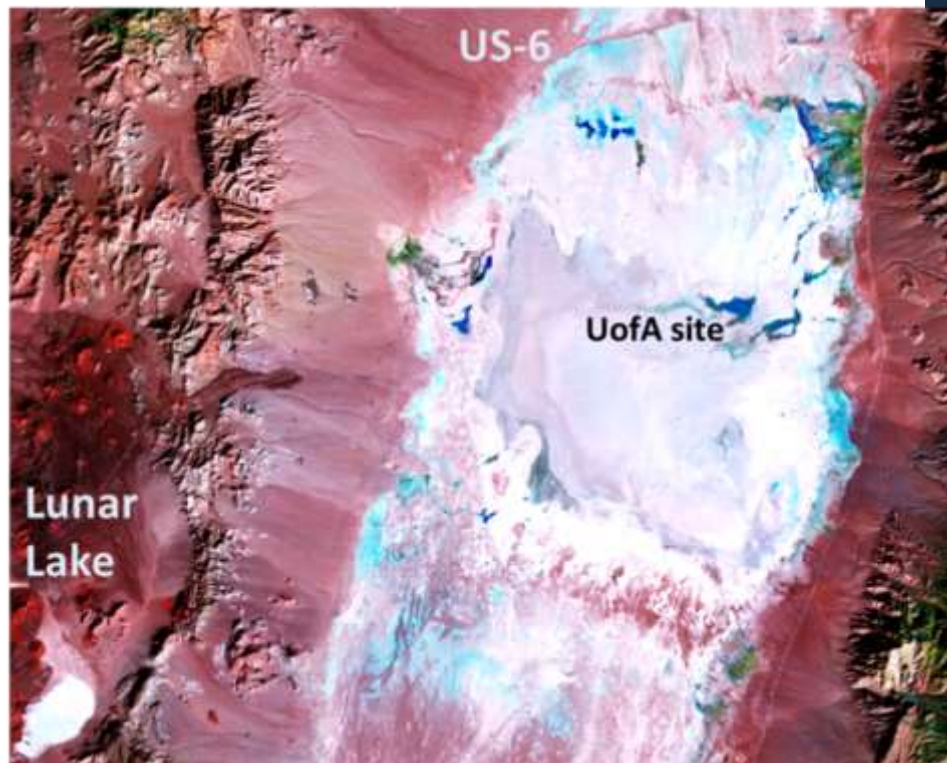
Railroad Valley Playa, Nevada – Un. of Arizona Radiometric Calibration Test Site (RadCaTS)

RRV Playa:

- Located in north-central NV
- BLM manages the Playa, and several groups have permission to use a small area for radiometric calibration investigations
- Part of the Radiometric Calibration Network (RadCalNet)

Playa is a suitable Calibration Site:

- **High surface reflectance** (BRF > 0.3 reduces path radiance effects)
- **Spatially uniform** (minimizes misregistration)
- **Spectrally flat** (reduces uncertainty in cross calibration)
- **Fairly high altitude** (reduces uncertainty due to aerosols)
- **Large size** (reduces adjacency effects)
- **Arid region** (less clouds/rain)

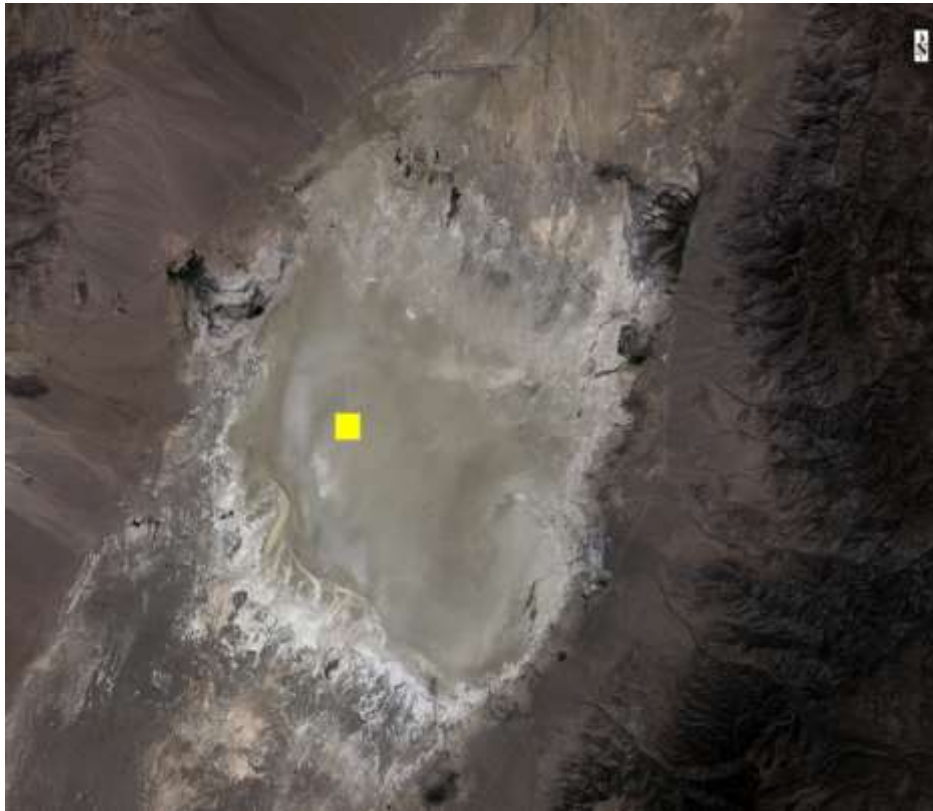


Source: ASTER Science Team

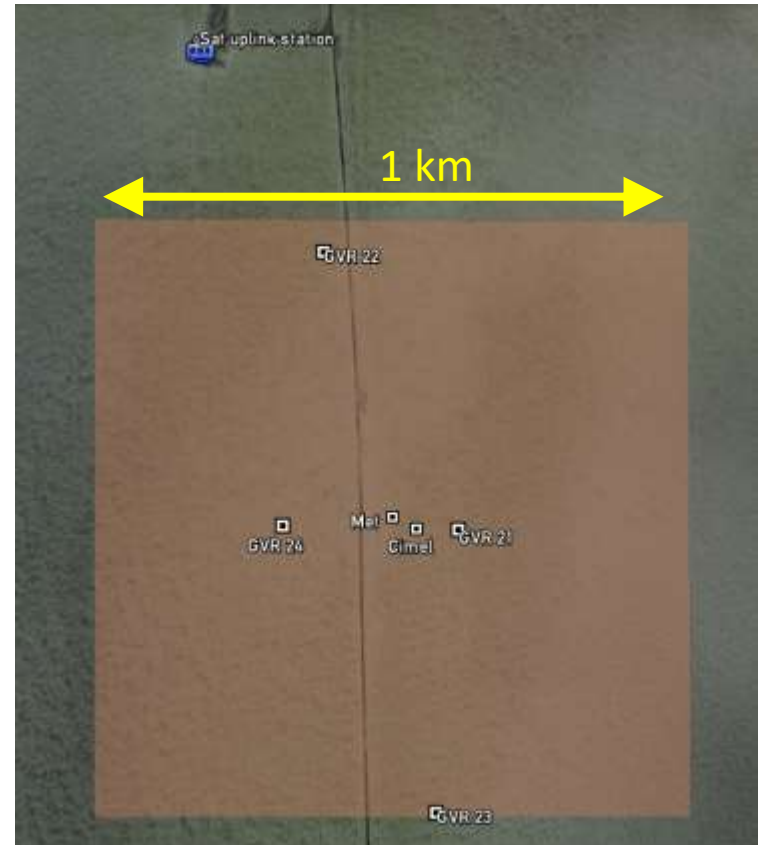


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RRV PLAYA and the Layout of RadCaTS



Source: ASTER Science Team



Source: ASTER Science Team

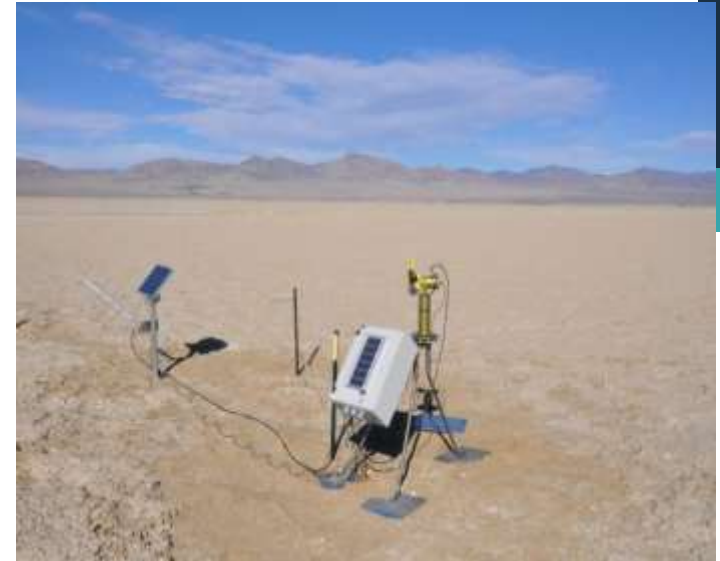


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Instruments of the RRV Site

2011: 8 channel Si & InGaAs detectors

2016: Wi-Fi and satellite uplink



Ground-viewing radiometer (GVR)

Cimel CE318 solar lunar photometer

Meteorological station

Satellite uplink, base station



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Routine RadCaTS Measurements Done Daily and Used to Supply Data to RadCalNet

- GVRs make point measurements every 2 min throughout day
- Cimel makes measurements based on AERONET protocol
- Data uploaded daily to Univ. of Arizona
- Multispectral BRF data converted to hyperspectral using library of data collected from 2000–2016 (~700 data sets)
- Spectral and temporal subset is supplied to RadCalNet

RadCaTS is One of the CEOS WGCV RadCalNet Sites

- RadCalNet is operational as of July 2018 (www.radcalnet.org)
- Currently four global sites
- RadCaTS bottom of atmosphere (BOA) data uploaded daily to NASA GSFC for further processing



Source: © OpenStreetMap/RadCalNet.Org



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RadCalNet Approach

- RadCalNet: Multiple automated in-situ measurement sites operated independently using same methodology and processing chain with known and documented uncertainties
 - ▶ Product provided to users:
 - TOA reflectance
 - 400-2500 nm (10 nm spectral sampling)
 - Defined for 50 m spatial area
 - Nadir view
 - 13 times per day: 9:00-15:00 local every 30 min
- CEOS Working Group on Calibration and Validation (CWCV) is managing this network from member's agencies



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Major Field Campaign Measurements

Surface BRDF Measurements

- Satellite Sensor data has shown there is a noticeable BRDF aspect to the Playa (see back up slide of MODIS data)
- For this field campaign, two instruments were used to measure the BRDF measurements

- A goniometer developed by a researcher from the University of Lethbridge, Canada (ULGS)
- NASA Jet Propulsion Laboratory's (JPL) PARABOLA Instrument



Characterization of Tarp Material/ Reference Panels – Attempting to Understand the Uncertainty of Arizona RadCaTS Daily Measurements

- Spectrometer measurements made of reference tarp sample (48% reflectance) using multiple spectrometers
- Measurements were done with up to six different radiometers/reference panels at different times during a single day
- One panel served as overall reference as did a very high reflectance panel (BaSO₄ panel)



Gray Tarp Comparison

- Goal: Tarp sample measurements will isolate differences caused by the instruments or the reference
 - ▶ Effects from from changing solar irradiance are limited because of short time between references and the gray sample
 - ▶ Short time between groups limits the BRDF effects of the sample
 - ▶ Limiting reflectance collection to a small sample area leads to teams measuring the same area
- Tarp is being evaluated as a traveling standard that would allow intercomparisons without the need for groups to gather in a single location
- One round of collections had all groups using the same reference standard



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Barium Sulfate Panel Measurements

- Barium sulfate (BaSO_4) panel has a reflectance similar to those of the reference standard
- Using the BaSO_4 panel reduces instrument effects such as those caused by non-linearity, lower SNR at lower reflectance, etc.
- Both BaSO_4 and gray tarp retrievals can be compared to laboratory-based predictions of reflectance allowing a check on the absolute uncertainty



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80 Meter (m) Transect Measurements

- Goal: Attempt to evaluate how much spatial sampling and collection methods affect retrieval of reflectance
- Transect approach limited the area that the groups were using to characterize (used a linear path approximately 80m in length)
- Equipment configuration, choice of reference, and sampling method for the 80m path was up to each group
 - ▶ Several groups walked while sampling the surface-leaving radiance
 - ▶ Others operated instruments in a stationary manner at several pre-determined spots along the path
- Should reduce differences caused by spatial heterogeneity of RRV



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NGA's Participation in the Field Campaign

- US government agencies and the international remote sensing community (e.g., NASA and CEOS) have extensive knowledge/experience in assessing radiometric calibration of EO Sensors
 - NGA is benefitting by learning the various techniques employed by these groups
 - Allows NGA scientists to understand the quality of the RadCaTS and RadCalNet Data
- NGA employs a variety of GEOINT sources to address its mission areas
 - It needs to be able to assess imagery quality of the various source material for non-literal exploitation

Summary

- A successful field campaign was done at the RRV Playa in May 2018
 - Extensive in situ spectral data was collected as well various satellite sensor data
 - This data should advance the knowledge about the uncertainty of the RadCalNet data publicly available
 - The field campaign lead believes results should be available in the first quarter of 2019



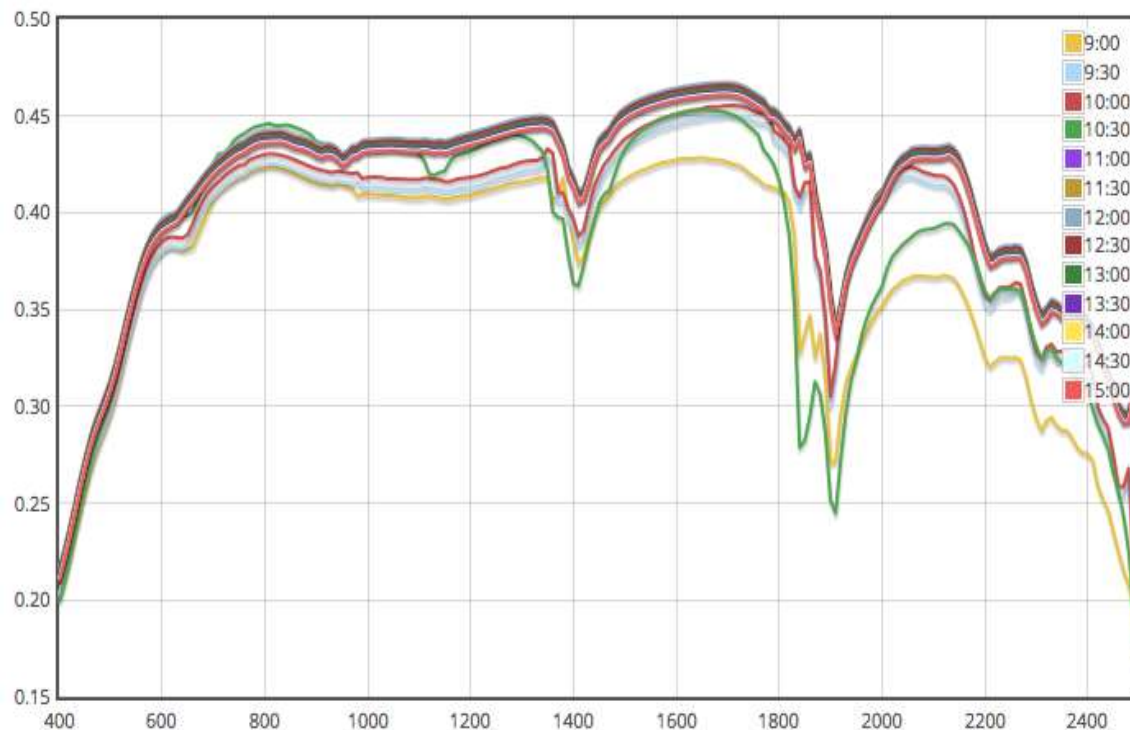
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Back Up Material

RadCalNet Input Data

- Surface Reflectance
 - 30 minute intervals
 - 9 am to 3 pm local standard time
 - Nadir view
 - 10 nm intervals from 400 nm to 2500 nm
- Atmospheric Data
 - Pressure
 - Temp
 - Aerosol
 - Water Vapor
 - Ozone
- Uncertainty
 - Provided by site operators and evaluated by RadCalNet WG



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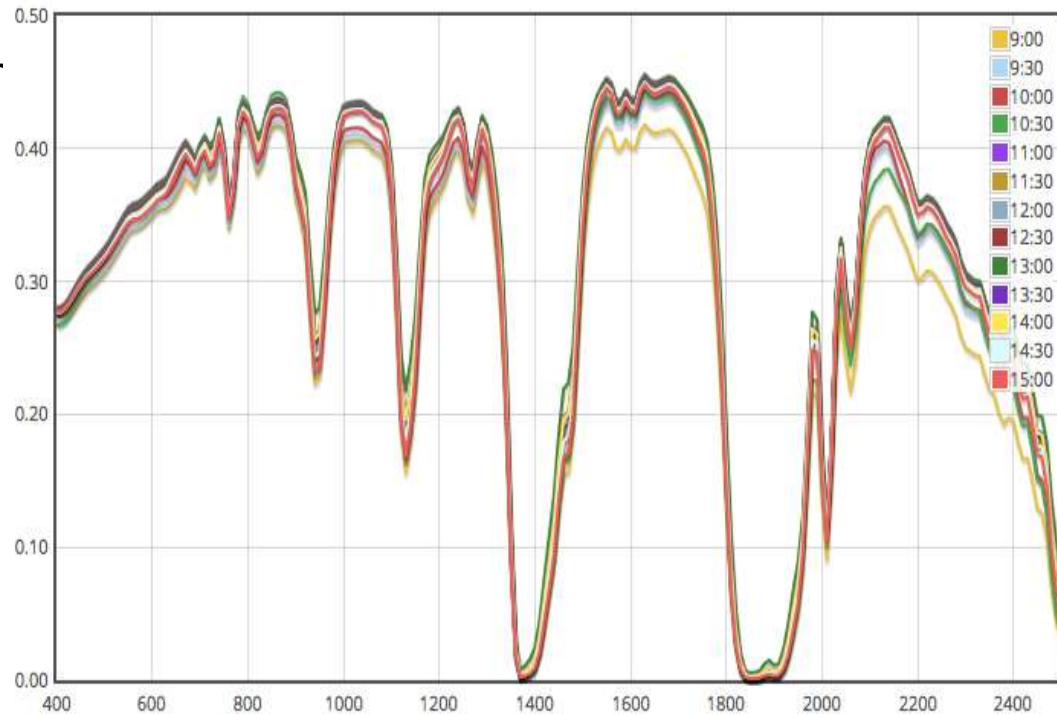
RadCalNet Output Data

- TOA Reflectance

- 30 minute intervals
- 9 am to 3 pm local standard time
- Nadir view
- 10 nm intervals from 400 nm to 2500 nm

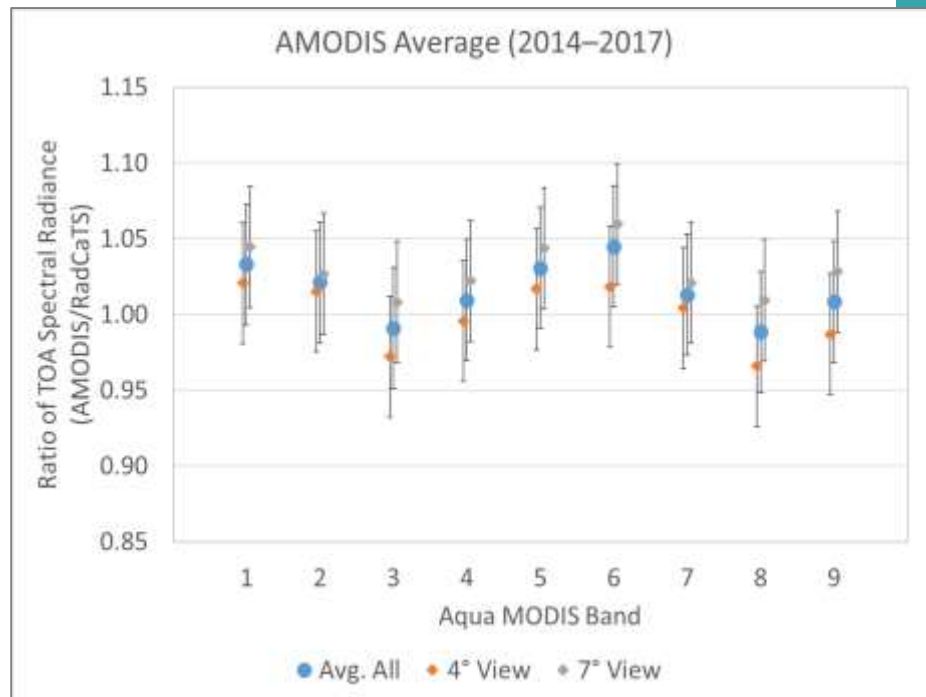
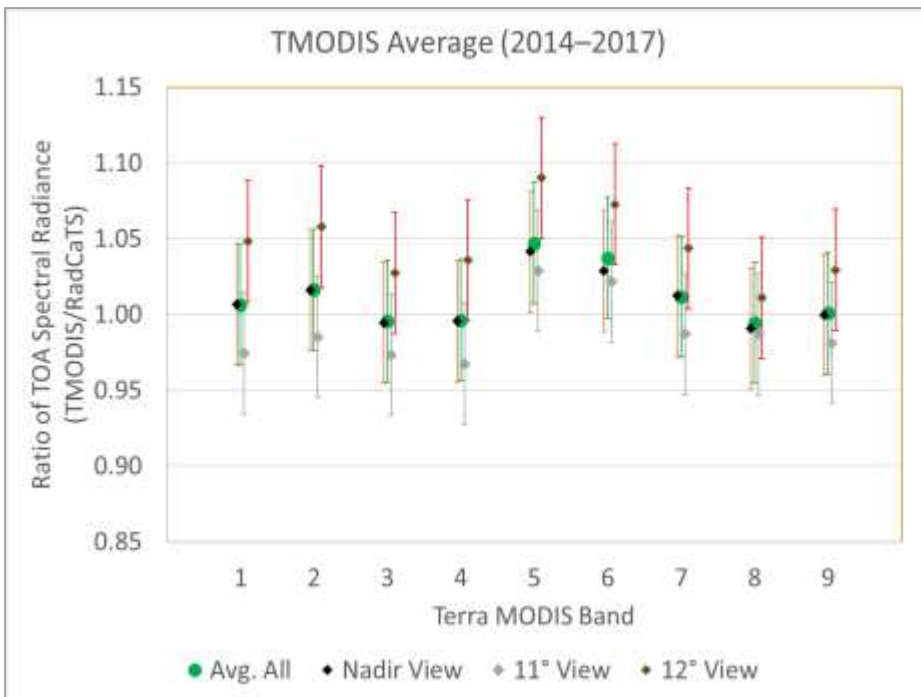
- Uncertainty Information

- Will be available with the individual data points by 1st quarter of 2019



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MODIS Data Showing a Potential BRDF Effect of the RRV Playa



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