Satellite Intercomparison and Validation using the Radiometric Calibration Test Site (RadCaTS) at Railroad Valley, Nevada

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ARIZONA RadCaTS

Outline

- **Introduction to RadCaTS**
- **Instrumentation and methodology**
- Current projects
- Sample of current results
- Future work

Traditional Methods

- **Remote Sensing Group (RSG) has traditionally used the reflectance-based approach**
  - **Requires on-site personnel at time of interest**
  - **All equipment must be transported to site for in situ measurements**
  - **Travel to test site (7-10 hours)**
  - **Sites: Railroad Valley, NV, Ivanpah Playa, CA, Alkali Lake, NV, Red Lake, AZ**

Test Sites
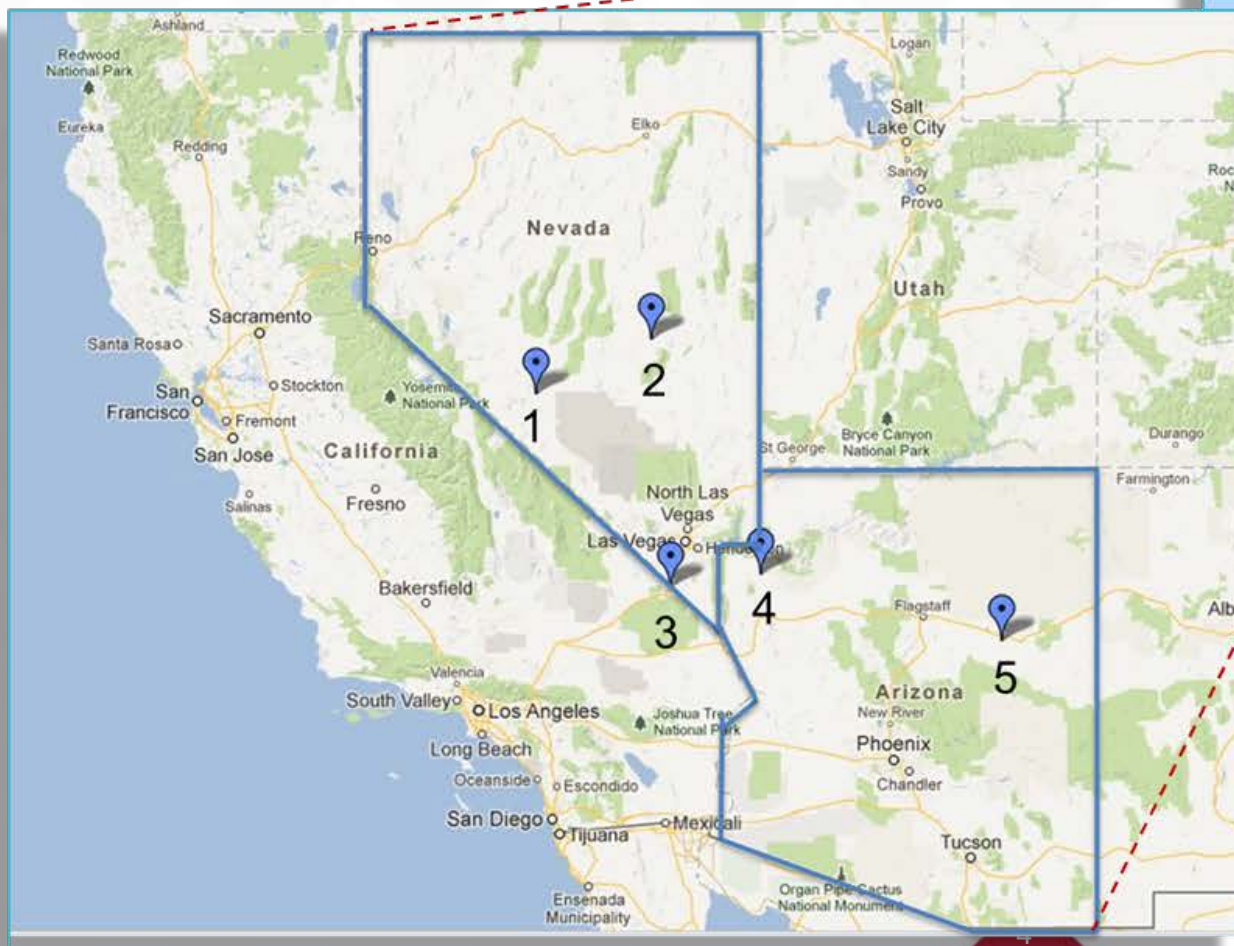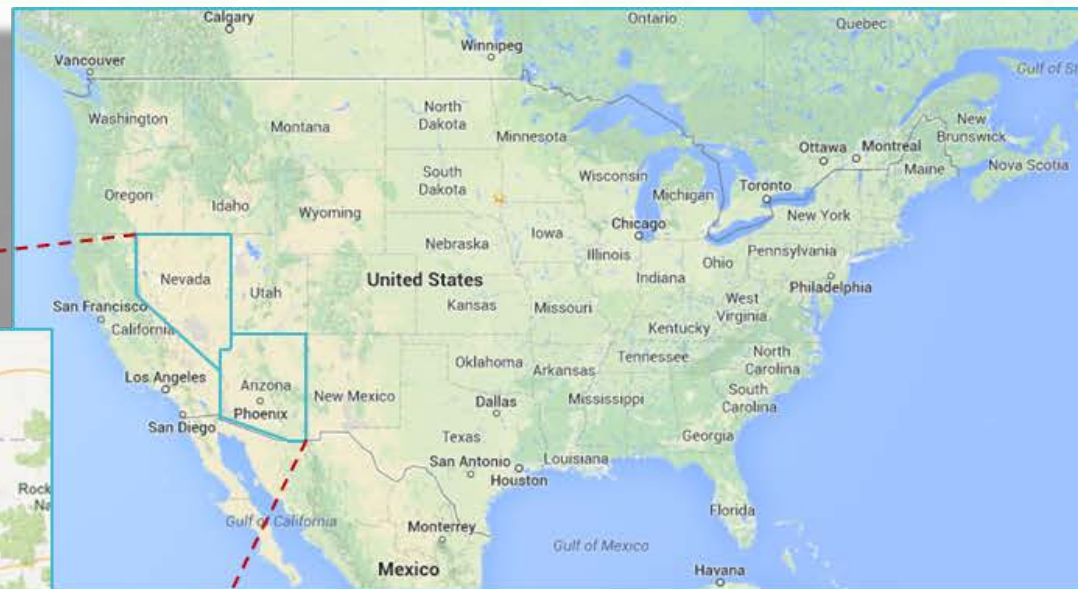
	WRS-2 path
1. Alkali Lake, Nevada	41
2. Railroad Valley, Nevada	40
3. Ivanpah, California	39
4. Red Lake, Arizona	38 and 39

RadCaTS

- **Recent efforts 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**

Introduction to RadCaTS

- **Railroad Valley, Nevada, chosen for RadCaTS**
  - **High surface reflectance** (BRF > 0.3 reduces path radiance effects)
  - **Spatially uniform** (minimizes misregistration)
  - **Spectrally flat** (reduces uncertainty in cross calibration)
  - **Near-lambertian surface** (reduces directional effects)
  - **High altitude** (reduces uncertainty due to aerosols)
  - **Large size** (reduces adjacency effects)
  - **Arid region** (less clouds, and less rain)

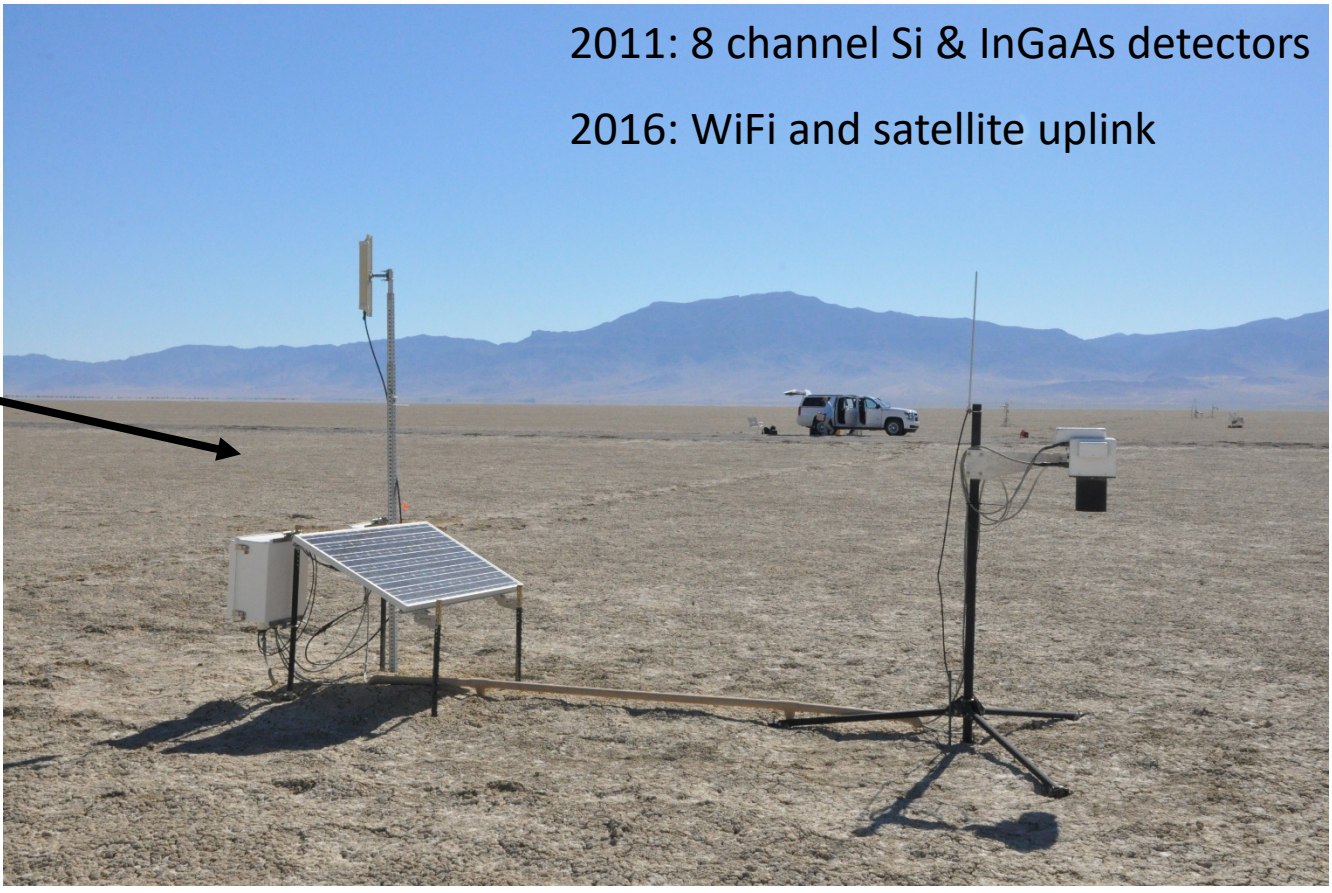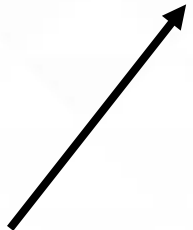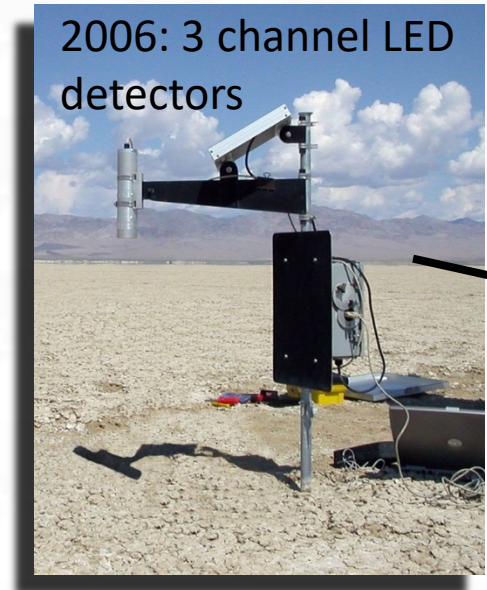**IEEE GSIS TC field collection tutorial: Jul–Aug 2017**

Evolution of Surface Reflectance Instrumentation: Ground-Viewing Radiometers (GVRs)

GLOBE Sun photometer

2011: 8 channel Si & InGaAs detectors

2016: WiFi and satellite uplink

2006: 3 channel LED detectors
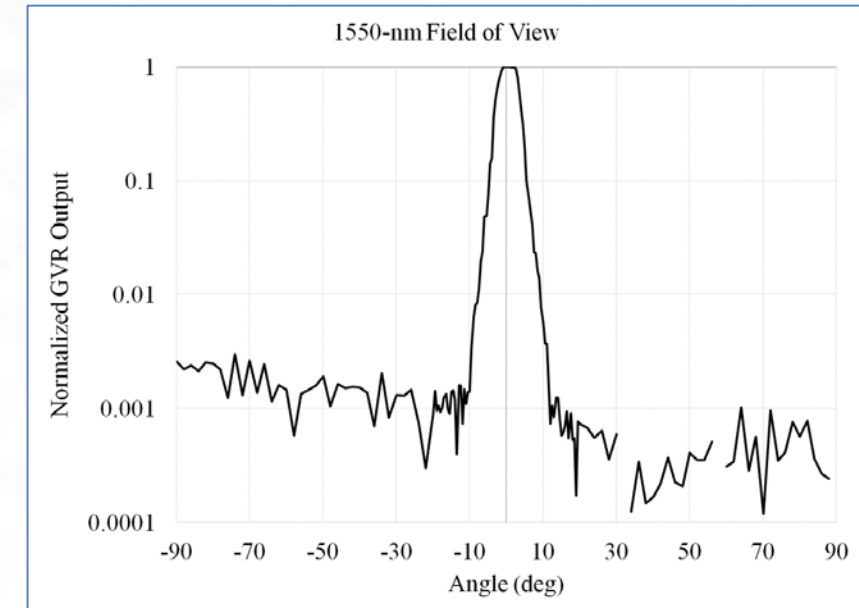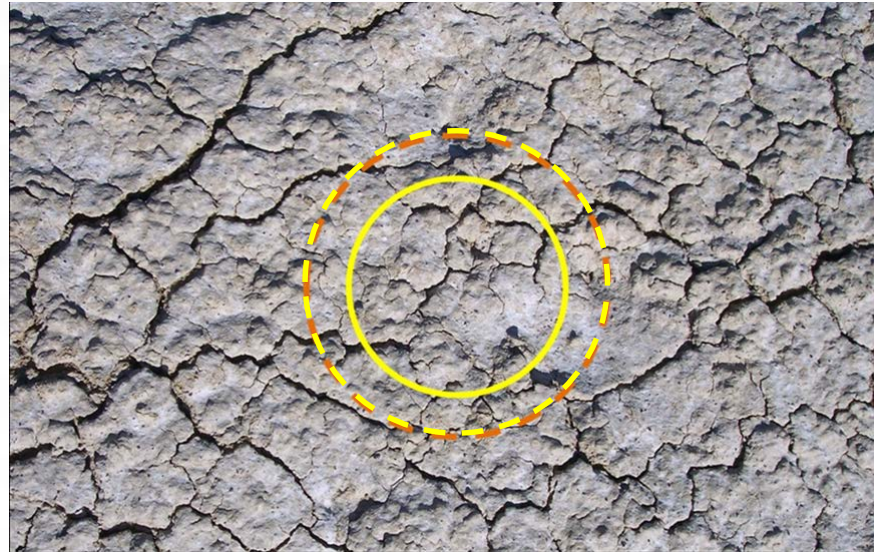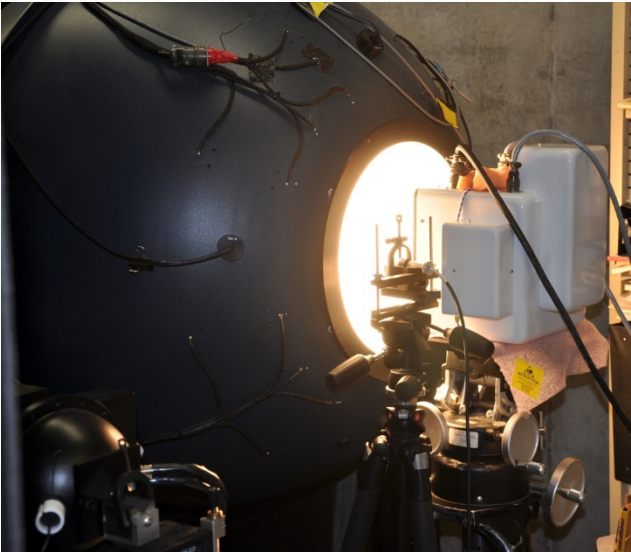
2002: 1 channel LED detector

Instrumentation

- **Laboratory calibration of GVRs before deployment**
  - **Radiometric (absolute and stability)**
  - **Spectral (in and out of band)**
  - **Field of view**

Instrumentation

- **Cimel CE-318T solar lunar photometer**

- **Meteorological station**

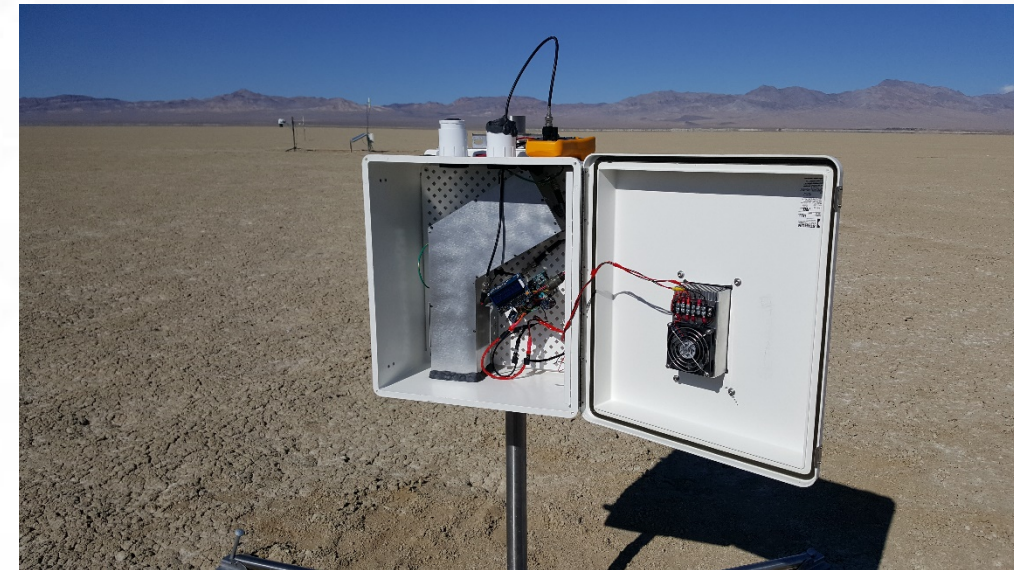- **Satellite uplink base station**

Other Instrumentation

- **GVR 23 at south end of site for GOES work**

- **Development of Calibration Test Site SI-Traceable Transfer Radiometer (CaTSSITTR-A and -G)**

- **Spectrometer Arduino Mega (SpAM) – student project**

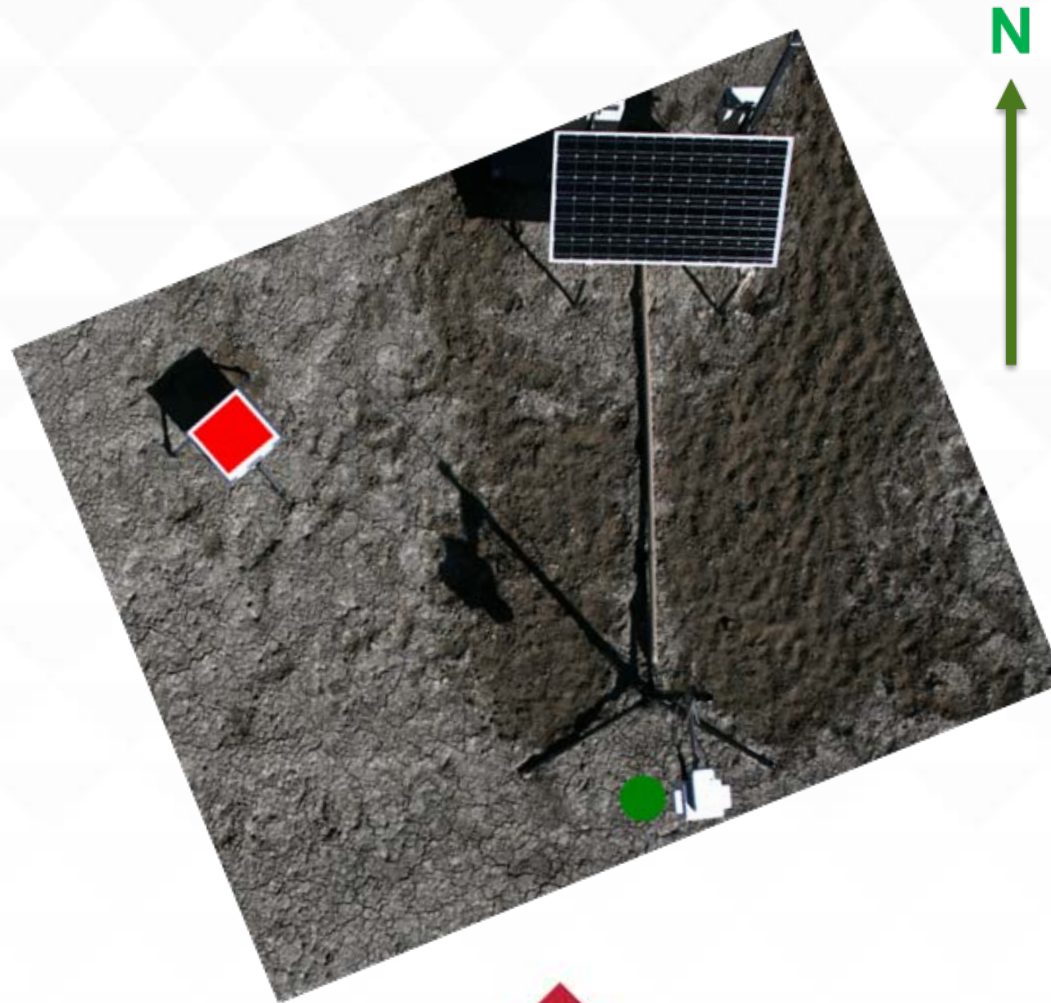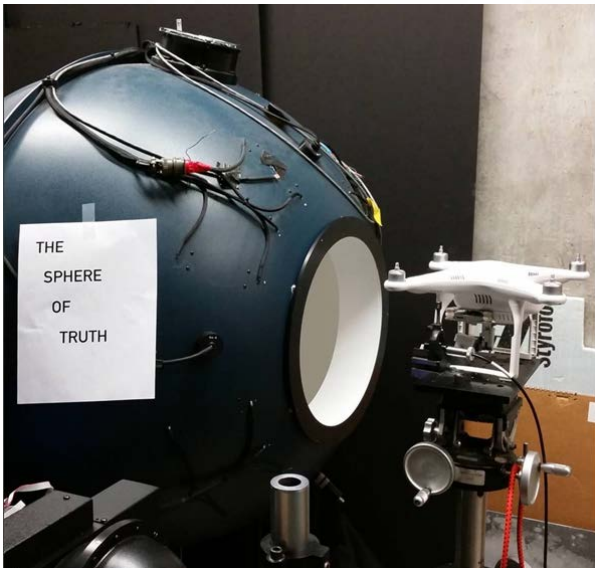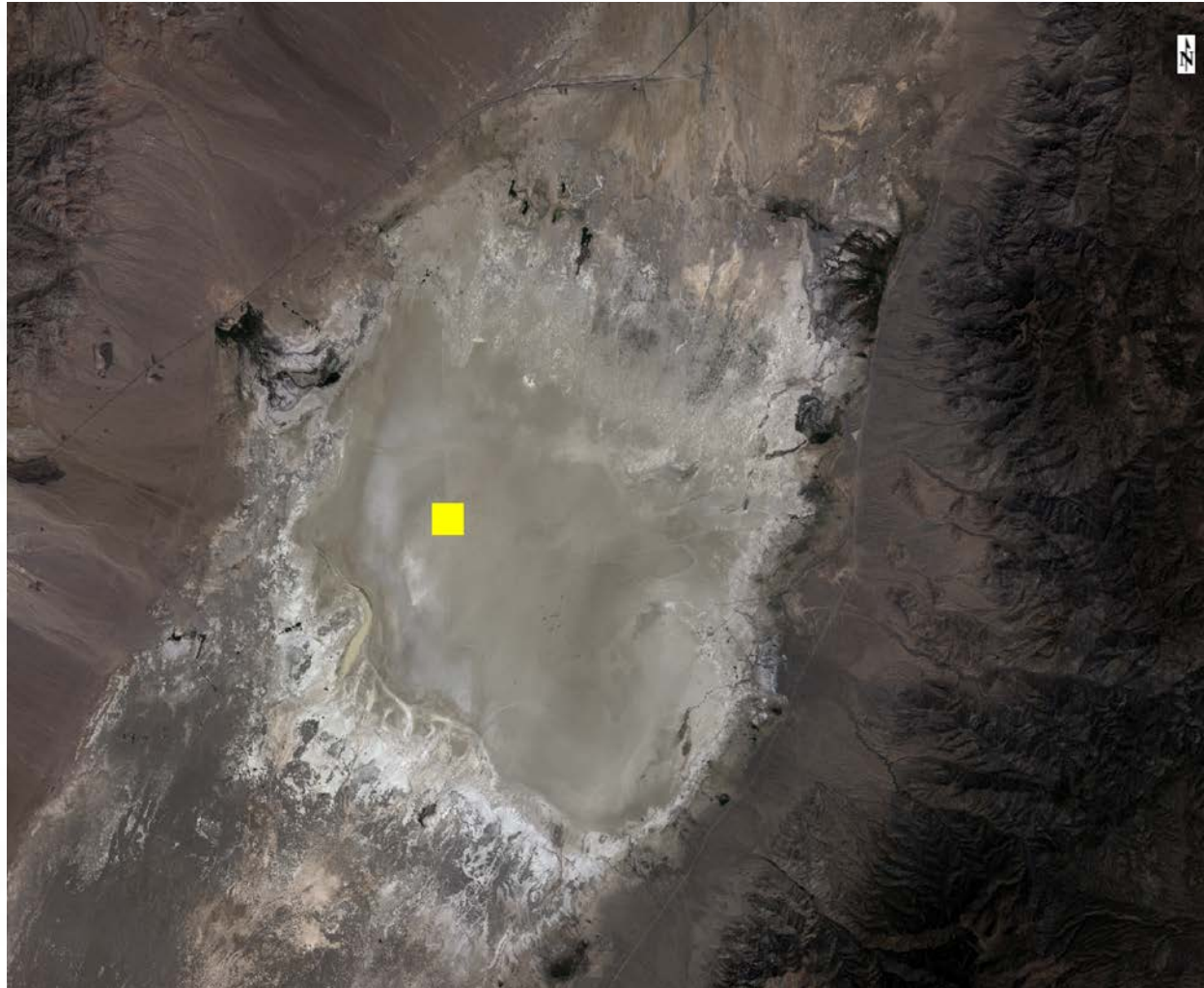- GVR 23 for GOES-16   CaTSSITTR-G   SpAM

Other Instrumentation

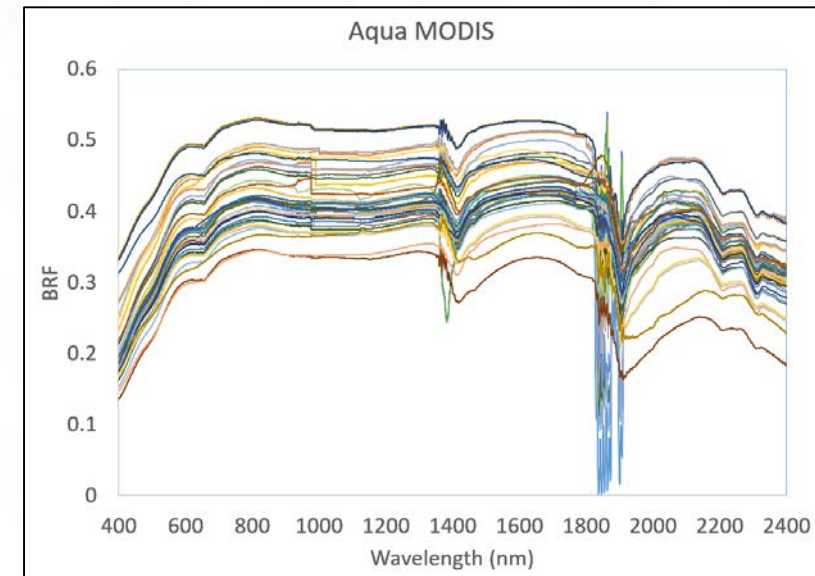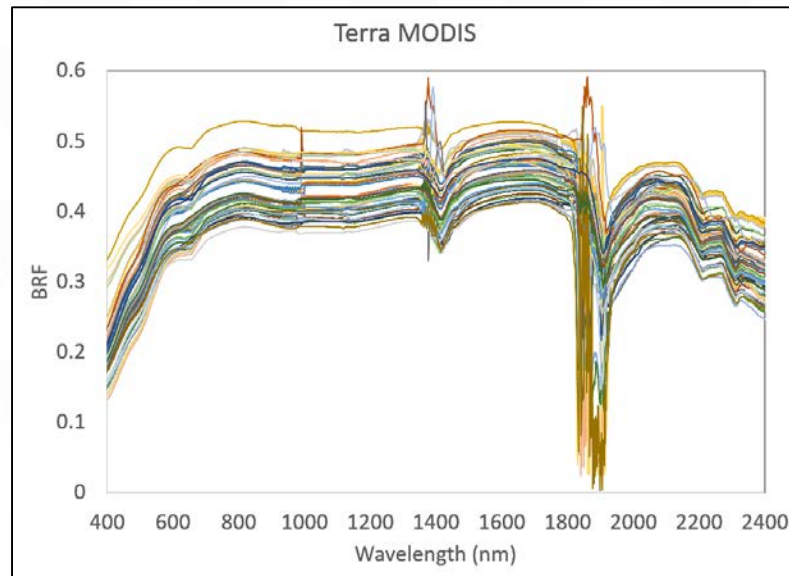- **Commercial sUAS for spatial uniformity analysis**

RadCaTS Layout

1 km

Methodology

- **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 (~85 data sets)**

Current Projects Using RadCaTS Data

- **Landsat 7 ETM+ and Landsat 8 OLI**

- **Terra and Aqua MODIS**

- **Suomi NPP VIIRS (radcats.gsfc.nasa.gov)**

- **Sentinel-2A and -2B MSI**

- **RapidEye**

- **GOES-16 ABI**

- **CEOS WGCV Radiometric Calibration Network (RadCalNet) (www.radcalnet.org)**

RadCaTS Involvement in CEOS WGCV RadCalNet

- **Currently one of four global sites**

- **RadCalNet is currently in beta testing mode**

- **Going live late 2017**

- **RadCaTS data uploaded daily to NASA GSFC for further processing**

- **Output:**
  - **TOA reflectance**
  - **400–2500 nm (10-nm intervals)**
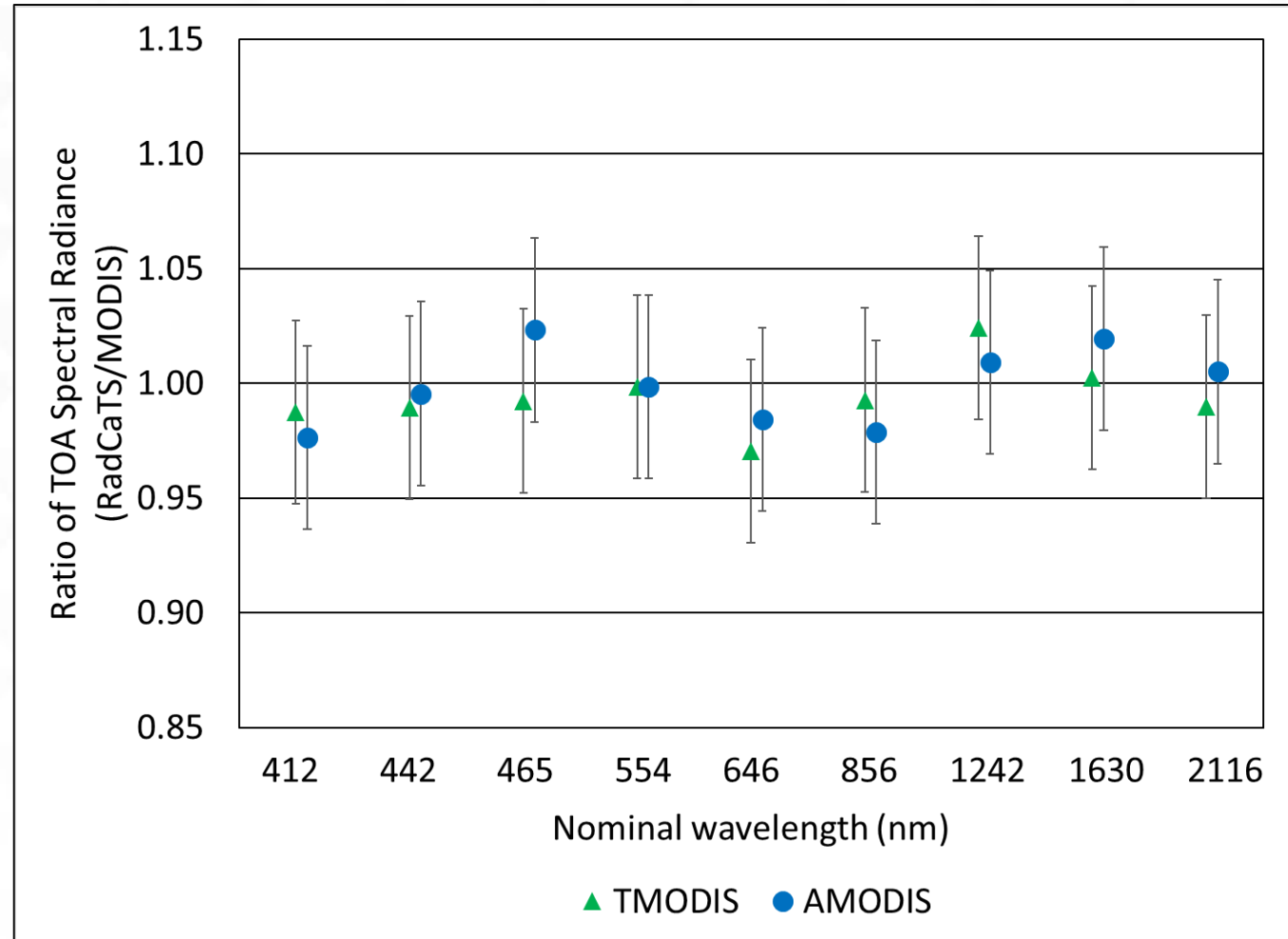 - **09:00–15:00 local time, every 30 min**
  - **Nadir view**

15
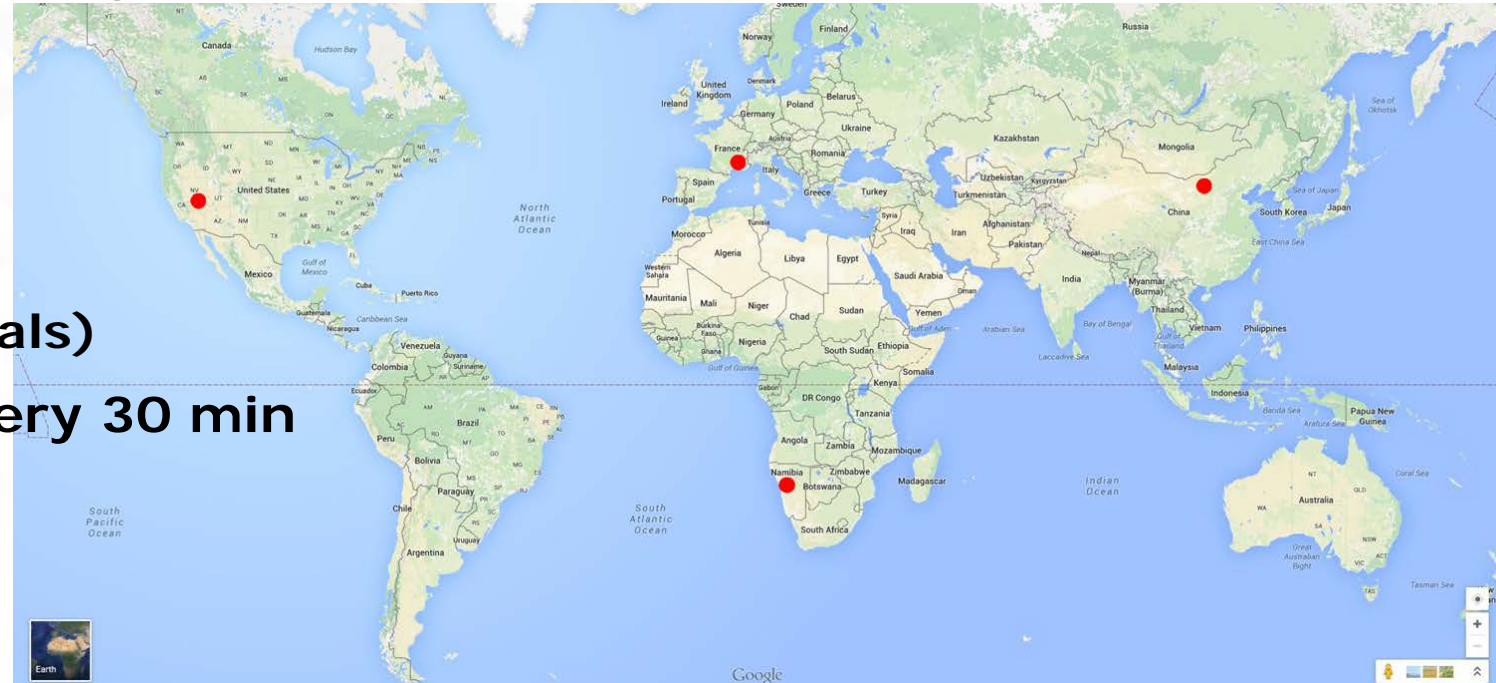
Typical Overpass Conditions

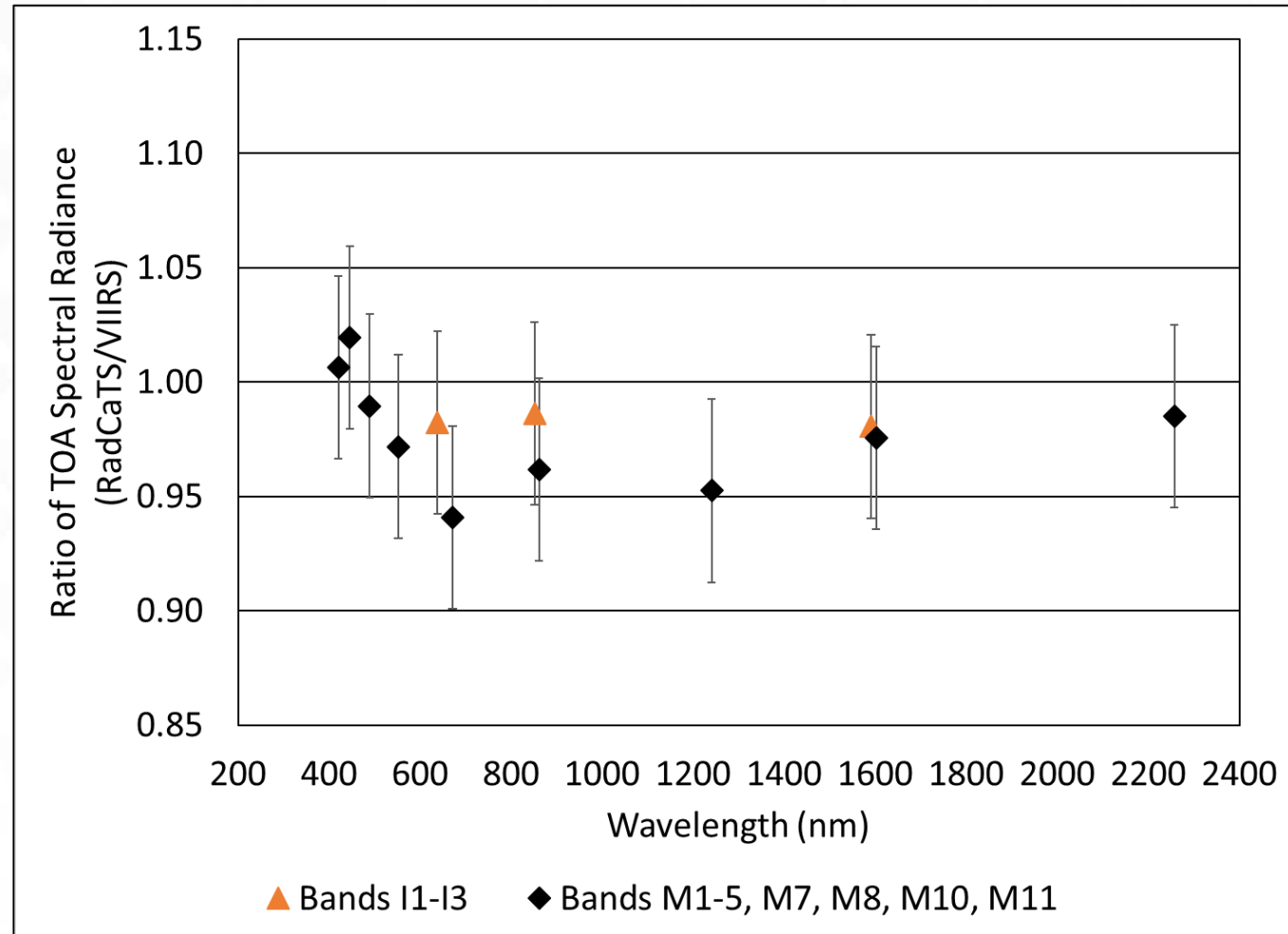|	Overpass time(s) UTC	View Angle(s)
• **Landsat 8**	18:21	Nadir
• **Terra**	18:32, 18:38, 18:44	12°, Nadir, 11°
• **Sentinel-2A**	18:34, 18:44	11°, 6°
• **Aqua**	20:48, 20:53	7°, 4°
• **SNPP**	20:33, 20:39, 20:46	11°, Nadir, 10°

Results

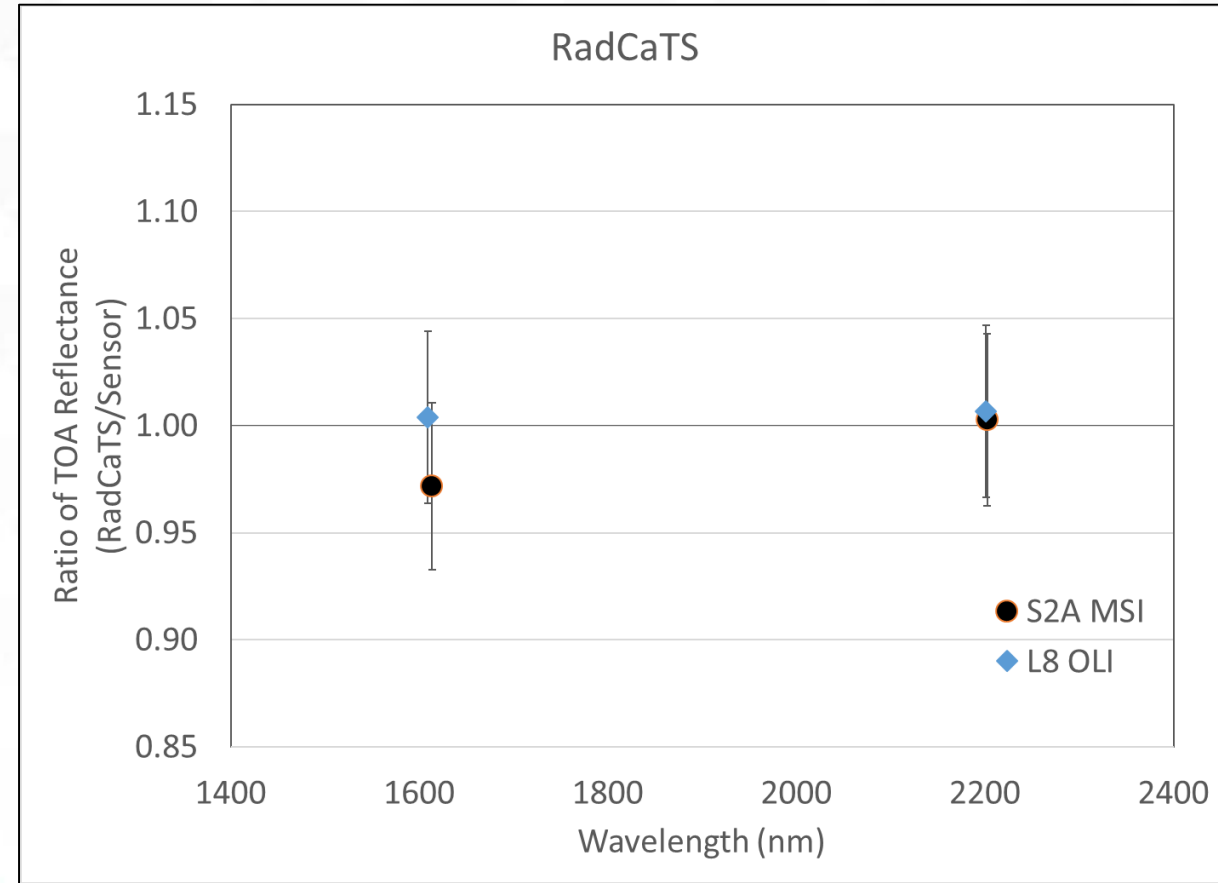- **Sample of results: MODIS (2012–2017)**
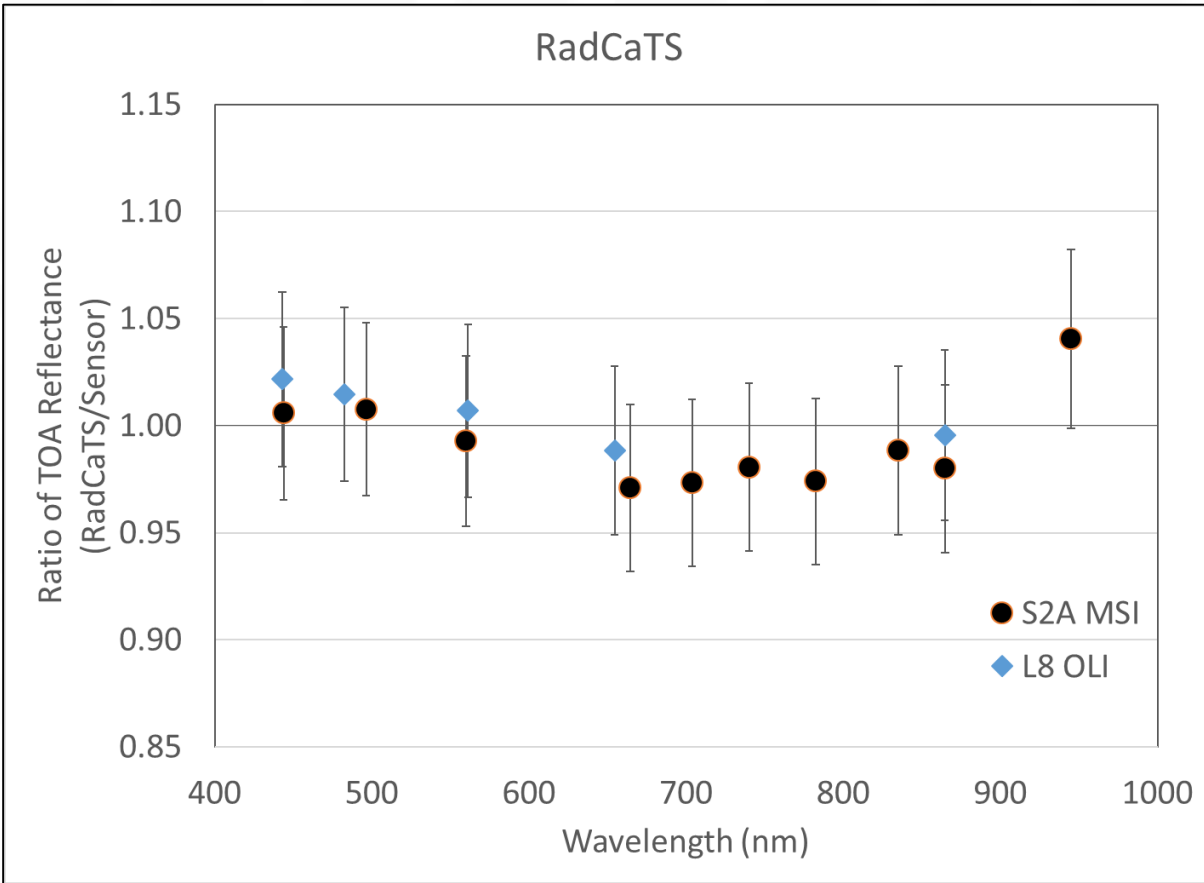
Results

- **Sample of results: SNPP VIIRS (2012–2016)**

Results

- **Sample of results: Landsat 8 OLI and Sentinel-2A MSI (launch–2017)**

Future Work

- **Continue to process specific overpasses**
  - **Current missions: Terra, Aqua, Landsat, SNPP, Sentinel-2, GOES-16**
  - **Future missions: Landsat-9, GOES-17, JPSS-1**
- **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!

- **Questions?**