Compatibility of field campaign experiments and RadCaTS results on ASTER vicarious calibration

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(My name is displayed as "山本浩万" (KANJI) on MS Teams.)
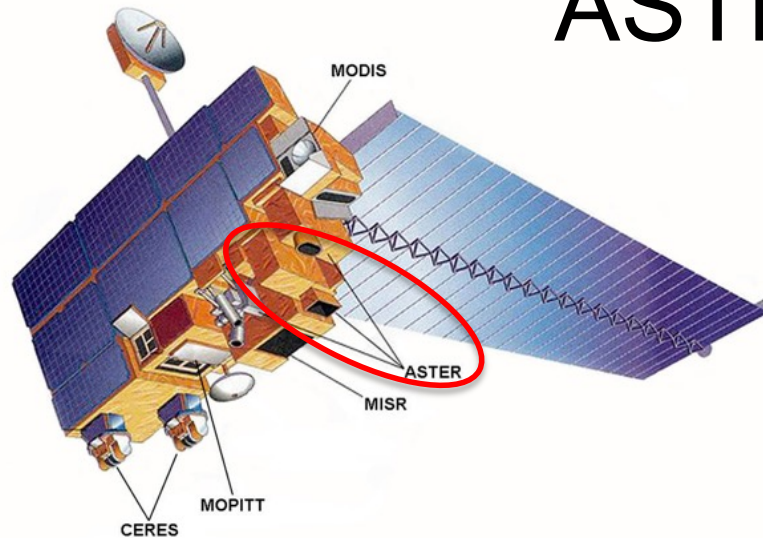
*1 Digital Architecture Research Center (DigiARC), AIST
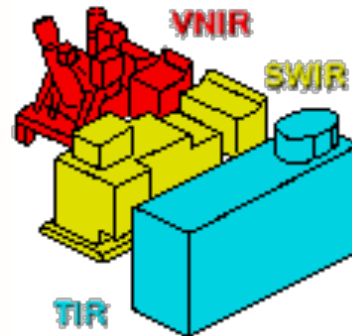
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(Contents in this material have been partially presented on IGARSS2022)

ASTER instrument

https://www.nasa.gov/mission_pages/terra/spacecraft/index.html

https://asterweb.jpl.nasa.gov/instrument.asp

●ASTER is a cooperative effort between NASA, Japan's Ministry of Economy, Trade and Industry (METI), and Japan Space Systems (JSS). AIST has been involved in ASTER project from the development stage.

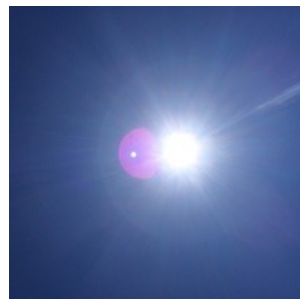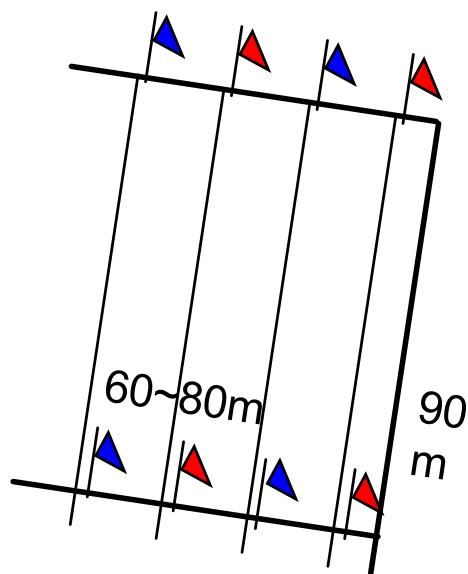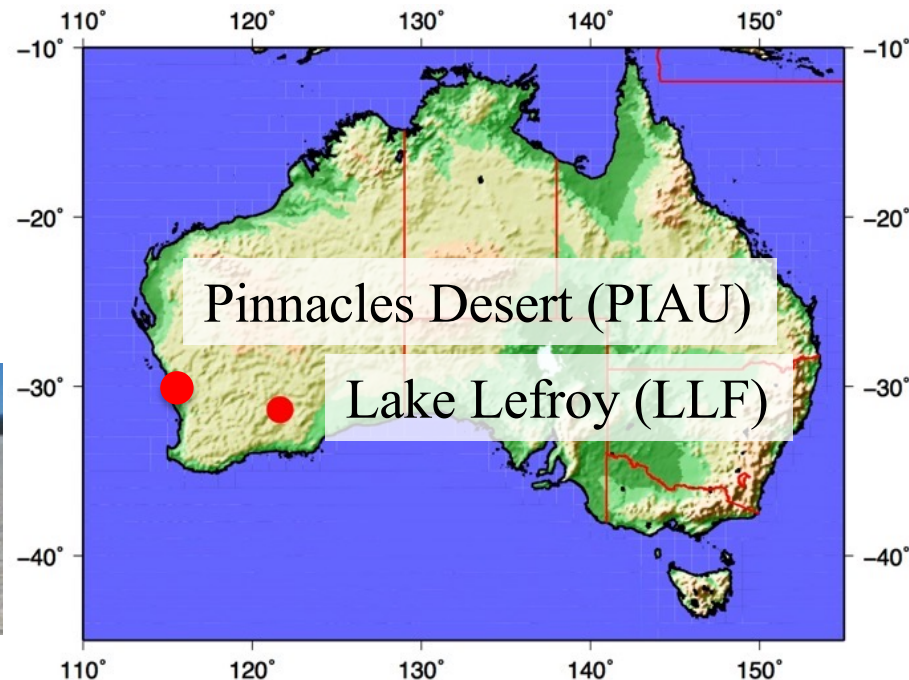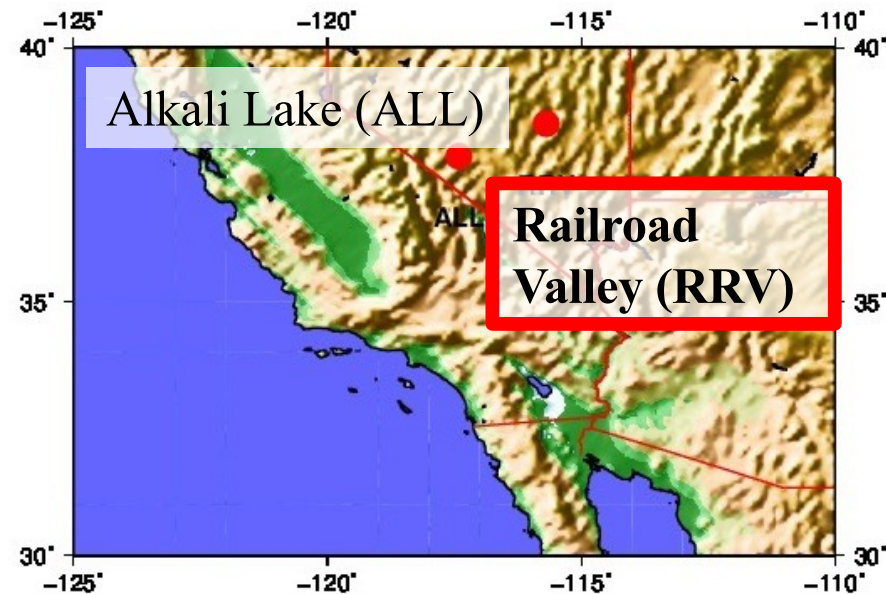●ASTER is the instrument aboard the NASA's Terra satellite, which was launched on Dec. 18 1999.

●The ASTER VNIR bands are evaluated radiometrically by reflectance-based various calibration methods for more than 20 years.

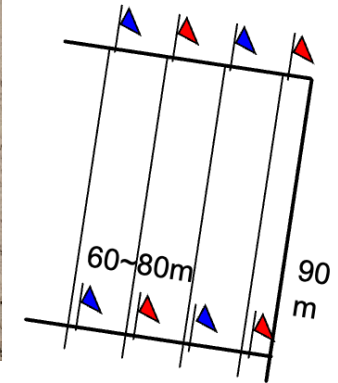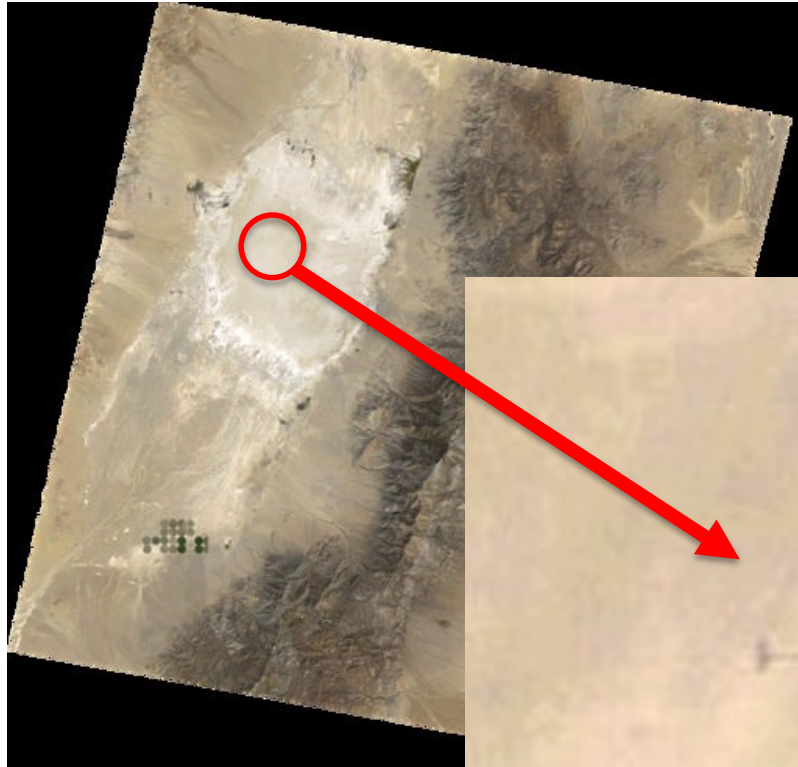| Subsystem	Band No.	Spectral Range (µm)	Spatial Resolution, m	Quantization Levels
VNIR	1	0.52-0.60	15	8 bits
	2	0.63-0.69		
	3N	0.78-0.86		
	3B	0.78-0.86		
SWIR	4	1.60-1.70	30	8 bits
	5	2.145-2.185		
	6	2.185-2.225		
	7	2.235-2.285		
	8	2.295-2.365		
	9	2.360-2.430		
TIR	10	8.125-8.475	90	12 bits
	11	8.475-8.825		
	12	8.925-9.275		
	13	10.25-10.95		
	14	10.95-11.65		

Vicarious Calibration for ASTER sensor

- ## **Sites**
  - **Alkali Lake (US)**
  - **Railroad Valley (US)**
  - **Ivanpah Playa (US)**
  - **Lake Lefroy (Australia)**
  - Coyote Lake (US)
  - Roach Lake (US)
  - Primm Valley (US)

60~80m 90 m

Alkali Lake (ALL)

Railroad Valley (RRV)

Pinnacles Desert (PIAU)

Lake Lefroy (LLF)

独立行政法人

AIST ASTER vicarious calibration area at Railroad Velley

OCO-GOSAT joint team
(JPL and JAXA)

ASTER imagery Captured on 8 Aug., 2021

Instruments

ASD FieldSpec FR, 3, 4

PREDE POM02
(or CE318-T)

MicroTops-II
(Model 540, 521)

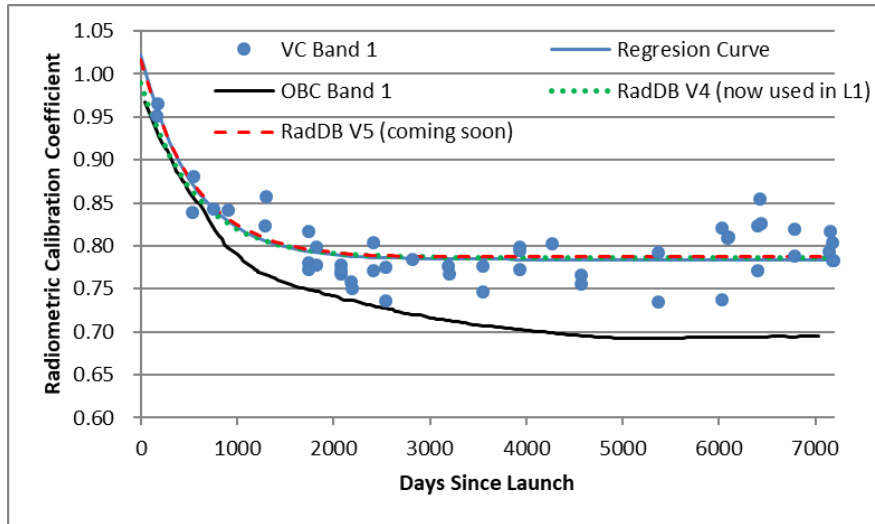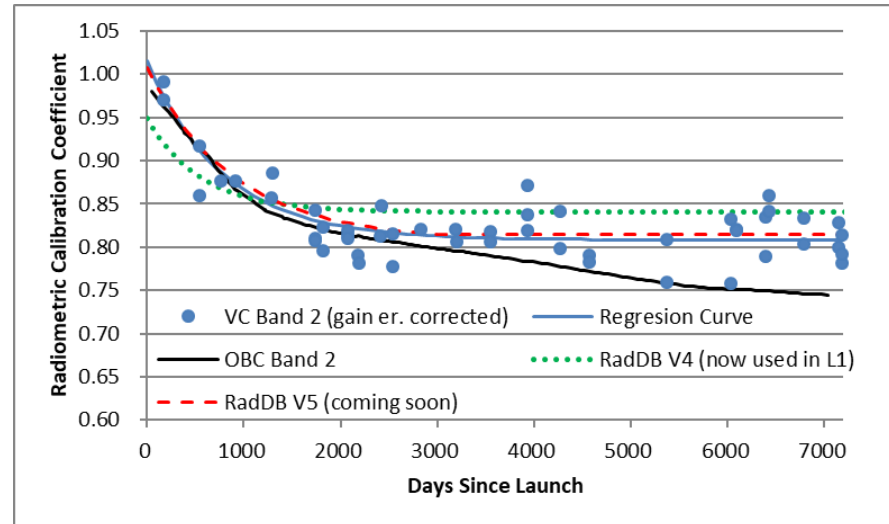Labsphere Spectralon
SRT-99-100

TR-73U

https://www.monotaro.com/

Nikon CP4300
RICOH THETA m15 etc.

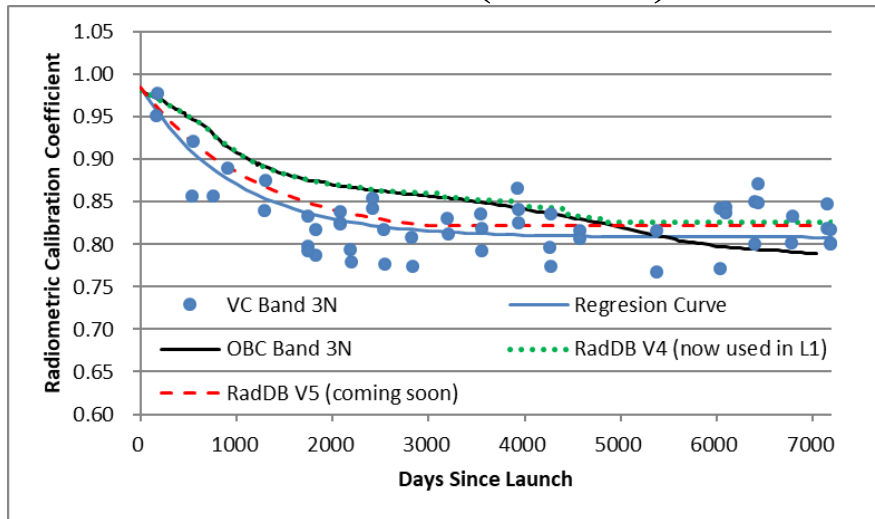https://dc.watch.impress.co.jp/img/dcw/docs/675/976/html/002.jpg.html
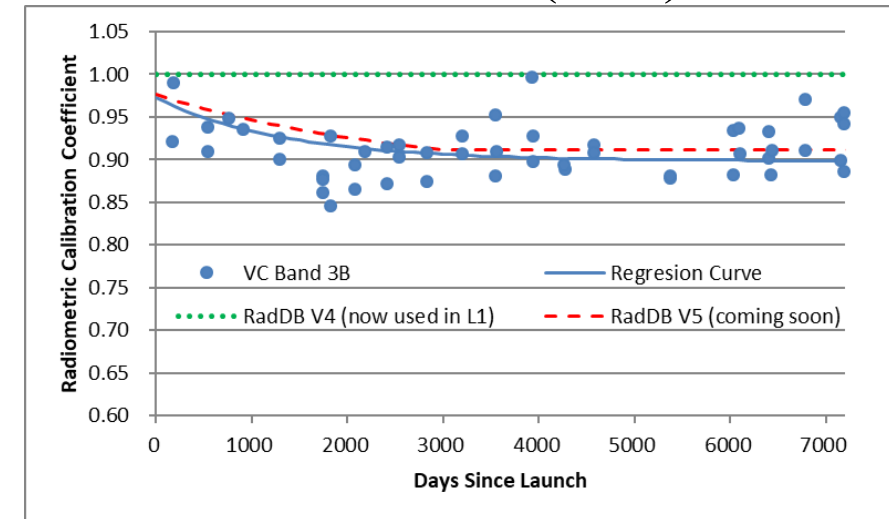
ASTER degradation curve (Dec, 1999 ~ Dec, 2019)

Band1 (Green)

Band2 (Red)

Band3N (NIR)

Band3B (NIR)

Article

Radiometric Degradation Curves for the ASTER VNIR Processing Using Vicarious and Lunar Calibrations

Satoshi Tsuchida [1],*, Hirokazu Yamamoto [1], Toru Kouyama [2], Kenta Obata [1,3], Fumihiro Sakuma [4], Tetsushi Tachikawa [4], Akihide Kamei [5], Kohei Arai [6], Jeffrey S. Czapla-Myers [7], Stuart F. Biggar [7] and Kurtis J. Thome [8]

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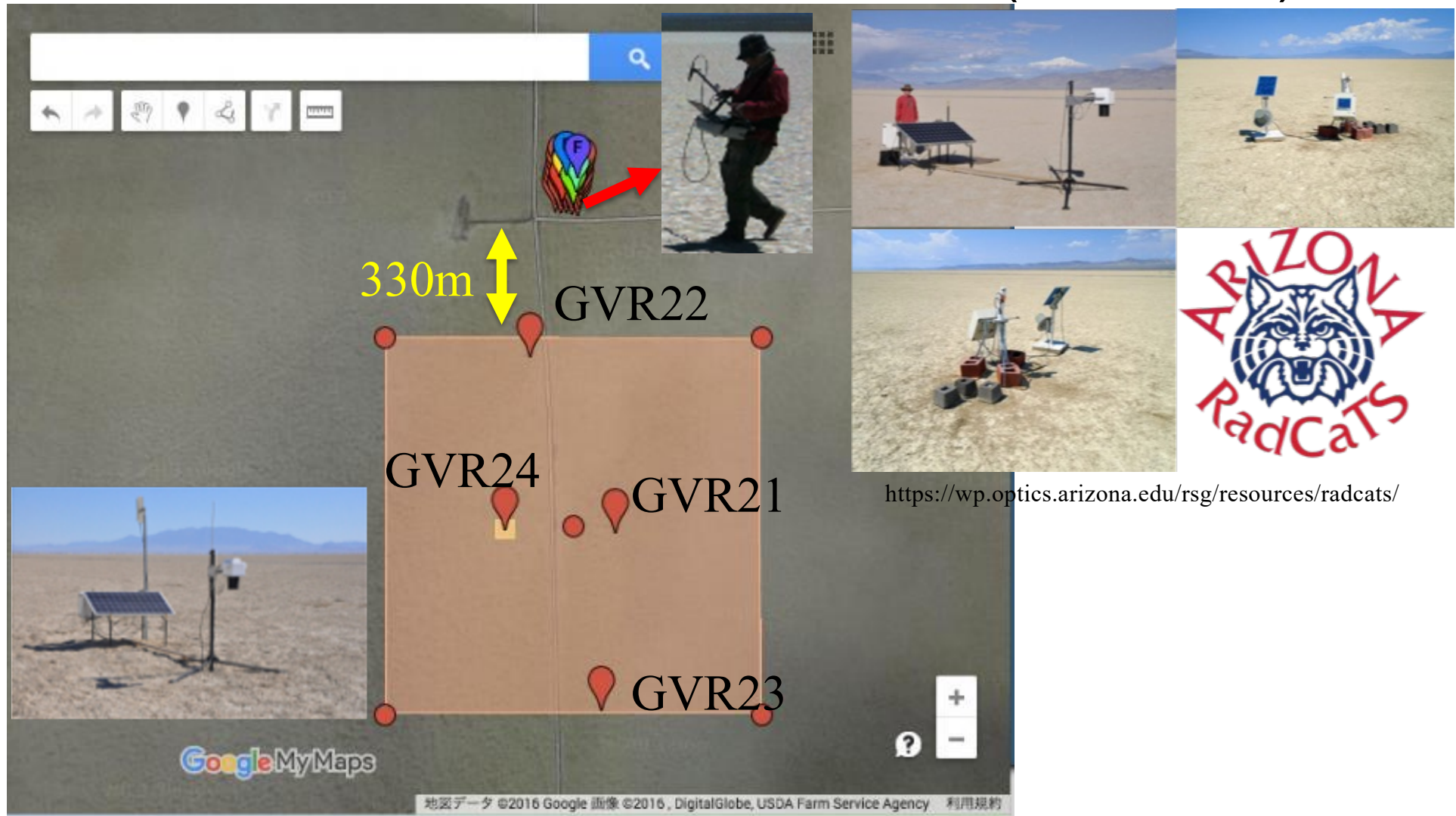
[7]   Remote Sensing Group, College of Optical Sciences, University of Arizona, Tucson, Arizona, 1630 E University Blvd, Tucson, AZ 85721, USA; jscm@optics.arizona.edu (J.S.C.-M.); biggar@optics.arizona.edu (S.F.B.)

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*   Correspondence: s.tsuchida@aist.go.jp; Tel.: +81-29-861-3947
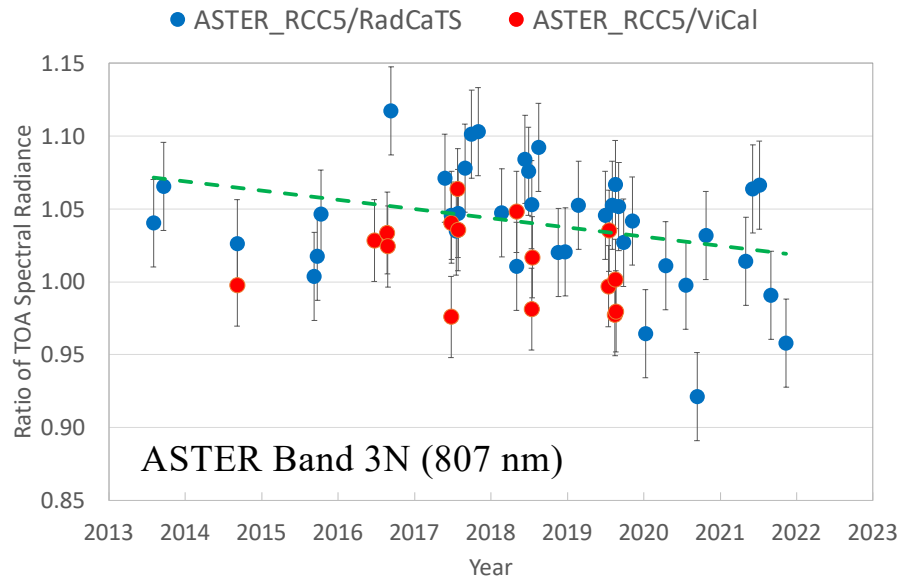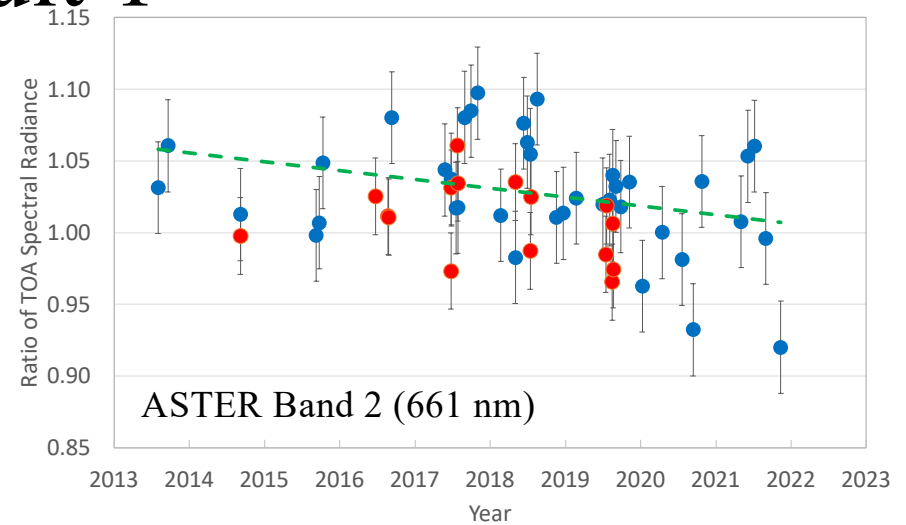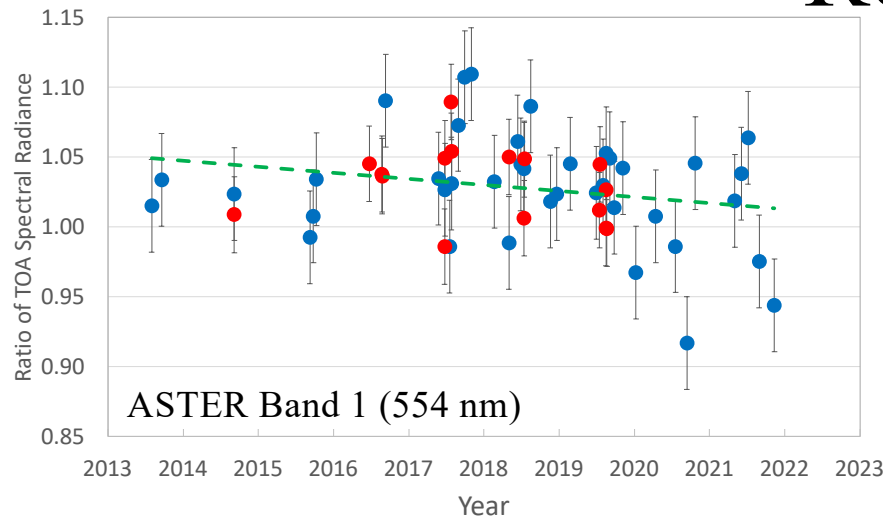
AIST ASTER measurement area at Railroad Valley and Radiometric Calibration Test Site (RadCaTS)

330m

GVR22

GVR24

GVR21

GVR23

https://wp.optics.arizona.edu/rsg/resources/radcats/

ground-viewing radiometer (GVR)

独立行政法人 産業技術総合研究所

Result 1

ASTER Band 1 (554 nm)

ASTER_RCC5/RadCaTS   ASTER_RCC5/ViCal

ASTER Band 2 (661 nm)

ASTER_RCC5/RadCATS   ASTER_RCC5/ViCal

ASTER Band 3N (807 nm)

ASTER_RCC5/RadCaTS   ASTER_RCC5/ViCal

RadCaTS data are available available from March 2013 to present, and ASTER ViCal experiments has not been conducted after 2020 due to the impact of COVID-19, so RadCaTS and ASTER ViCal data obtained from 2014 to 2019 are used in this research (There are no ASTER ViCal data in 2013).

Validation of ASTER VNIR radiometric performance using the reflectance-based vicarious calibration experiments and RadCaTS data (2013(2014) - 2021)

Result 2

Table. ASTER acquisition date, time, and VNIR pointing angle [deg] at the time of RadCaTS and AIST ViCal simultaneous measurements.

Date	Time (UTC)	VNIR pointing Angle [deg]
Sep 6, 2014	18:39:04	-0.019
Jun 26, 2017	18:38:41	-0.019
Jul 28, 2017	18:38:55	+0.019
May 3, 2018	18:45:42	+8.586
Jul 15, 2018	18:40:06	-0.017
Aug 19, 2019	18:38:28	-0.019

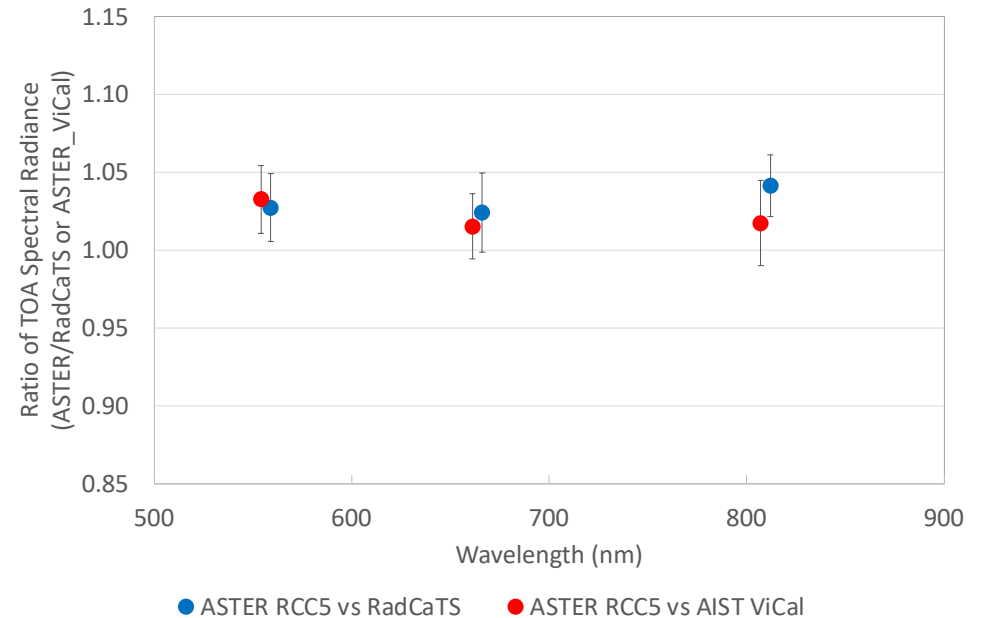● ASTER RCC5 vs RadCaTS   ● ASTER RCC5 vs AIST ViCal

Fig. A summary of the ASTER ViCal and RadCaTS simultaneous measurement results

Table. Mean and standard deviation results of ASTER TOA spectral radiance ratio

	ViCal (Mean)	ViCal (Standard Deviation)	RadCaTS (Mean)	RadCaTS (Standard Deviation)
Band1	1.03	0.02	1.04	0.01
Band2	1.01	0.02	1.03	0.02
Band3N	1.01	0.03	1.05	0.01

RadCalNet RVUS data results agree with our vicarious calibration results.

Conclusion

- The latest ASTER L1T radiometric performance was evaluated using ASTER ViCal and RadCaTS data.

- The results derived from RadCaTS data are mostly agree with ASTER ViCal experiments conducted for the period 2014 to 2019.

- ViCal results are closer to ASTER L1T TOA radiance processed by the latest radiometric DB Ver5 than RadCaTS results.

- This results make sense because the latest radiometric DB reflects AIST ViCal results.

- Evaluation of current ASTER radiometric DB (ver5) shows that ASTER Band1, Band2, and Band3N percent difference are within 5%.

- The results of this research indicate that RadCaTS data can be used instead of ASTER vicarious calibration experiments.