Status of ASTER/HISUI radiometric calibration
--- Vicarious calibration and cross-calibration ---

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ASTER instruments

- ASTER is a cooperative effort between NASA, Japan's Ministry of Economy, Trade and Industry (METI), and Japan Space Systems (J-spacesystems).
- ASTER is one of five Earth-observing instruments launched on Dec. 18 1999.

Instrument	VNIR	SWIR	TIR
Bands	1-3	4-9	10-14
Spatial Resolution	15m	30m	90m
Swath Width	60km	60km	60km
Cross Track Pointing	± 318km (± 24 deg)	± 116km (± 8.55 deg)	± 116km (± 8.55 deg)
Quantisation (bits)	8	8	12

HISUI instruments

- HISUI is a future spaceborne instrument suite which consists of hyperspectral and multispectral imagers, and being developed by Japanese Ministry of Economy, Trade, and Industry (METI).
- HISUI will be launched in 2016 or later …

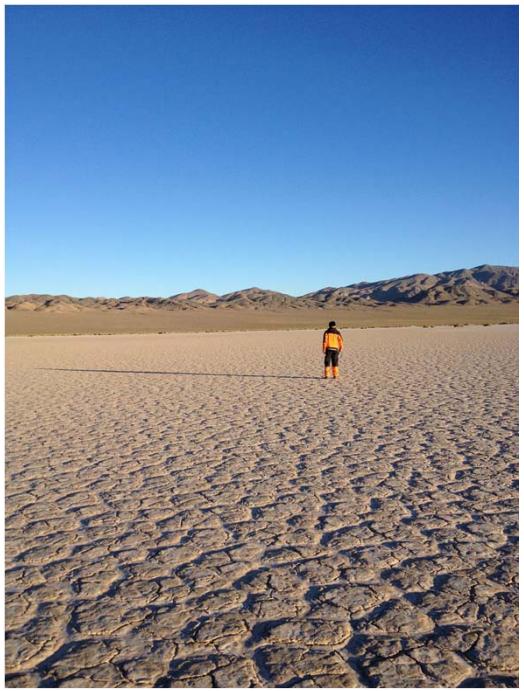
Parameter		Hyperspectral Imager	Multispectral Imager
Imaging Type		Pushbroom	Pushbroom
Spatial Resolution / Swath		30 m / 30 km	5 m / 90 km
Spectral	Bands	185	4
	Range	0.4 - 2.5 μm	0.45 -0.90 μm
	Resolution	10 – 12.5 nm	60 – 140 nm
SNR (30% albedo)		≥ 450 @620 nm ≥ 300 @2100 nm	≥ 200
MTF		≥ 0.2	≥ 0.3
Quantization		12 bits	12 bits
Data Compression		Lossless (70%)	Lossless (70%)
Pointing		Cross track, up to ± 3 ° (≈ ±30 km)	N/A

Vicarious calibration and cross-calibration for ASTER and HISUI

- ASTER
  - Vicarious calibration (Sites) : Ivanpah Praya, Alkali Like, Railroad Valley, Lake Lefroy, …
  - Cross-calibration (Sensors) : Terra MODIS, Landsat-8 OLI …
- HISUI
  - Vicarious calibration (Sites) : Ivanpah Praya, Alkali Like, Railroad Valley, Lake Lefroy, …
  - Cross-calibration (hyperspectral Sensors) : EnMAP, PRISMA, CLARREO, TRUTHS…
  - Cross-calibration (Multispectral Sensors) : VIIRS, Landsat-8 OLI, LDCM, Formosat-5 RSI…,

Sites for vicarious calibration

Ivanpah Praya

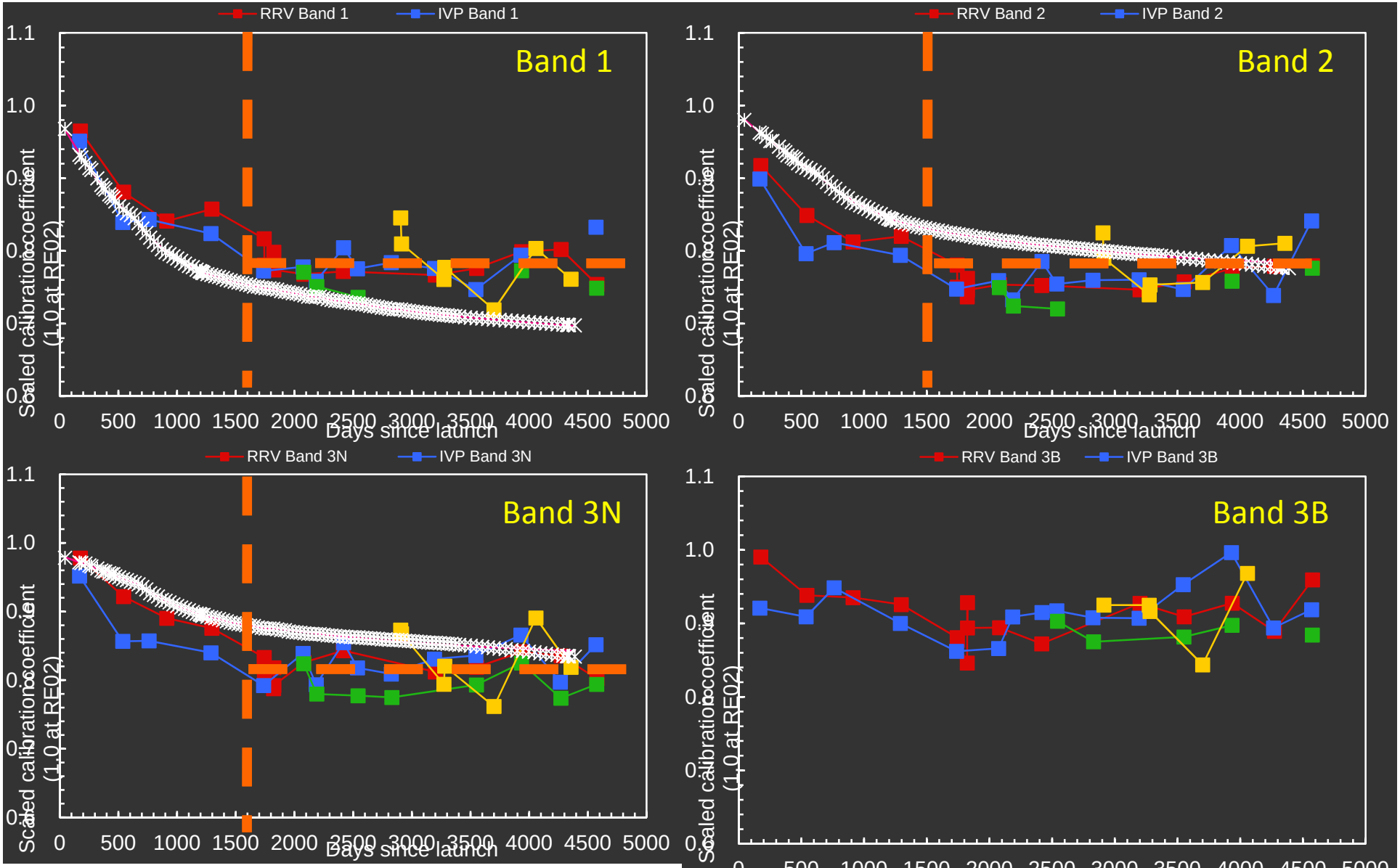


Alkali Lake

Railroad Valley


CSIRO
Australian Resources
Research Centre
(Perth)
Lake Lefroy, Australia
Aeronet
AIST
CSIRO

ASTER VNIR Results



Radiometric evaluation of long-term Terra ASTER/MODIS cross-calibration

Instrumented sites

Site Name	Longitude [deg]	Latitude [deg]	ASTER scenes (cloud : 0~100%)
Tuz Golu	E33.33	N38.83	31
RRV	W115.69	N38.50	126
Negev	E35.01	N30.11	61
La Crau	E4.86	N43.56	53
IVP	W115.40	N35.57	186
Frenchman Flat	W115.93	N36.81	93
Dunhuang	E94.34	N40.13	50
DOME-C	E123.0	S74.50	82

Apr., 2000 ~ Mar., 2013

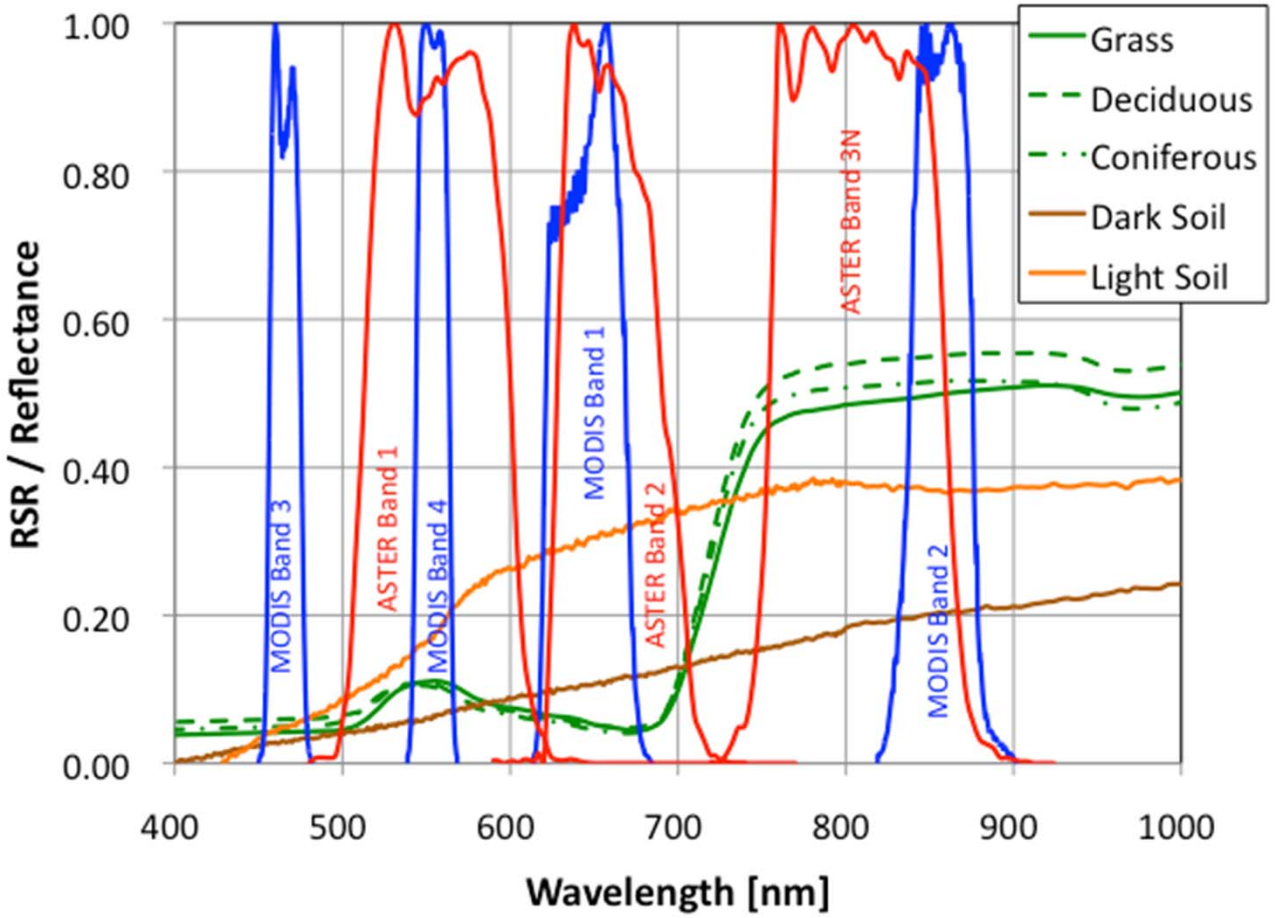
Pseudo-invariant desert sites

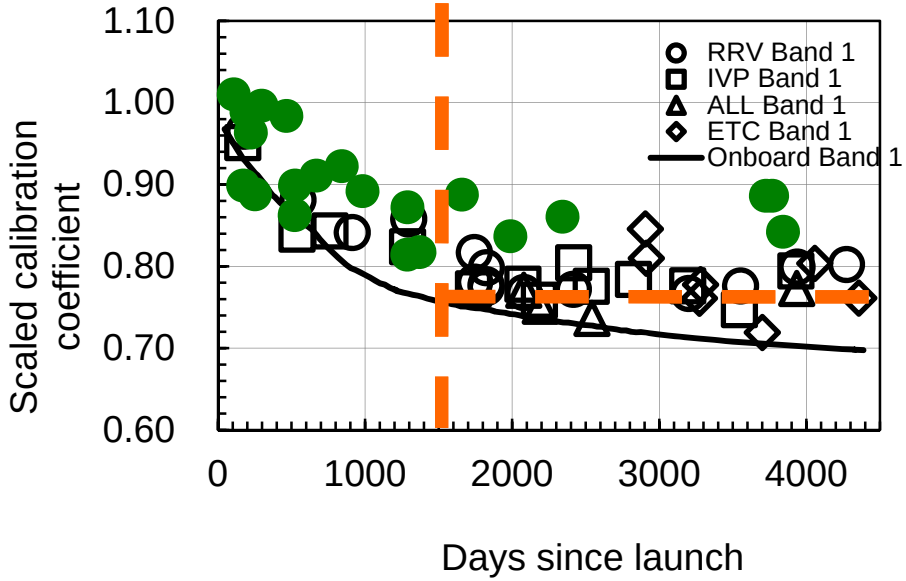
Site	Longitude [deg]	Latitude [deg]	ASTER scenes (cloud : 0~100%)
Libya1	E13.35	N24.42	15
Libya4	E23.39	N28.55	26
Mauritania1	W9.30	N19.40	12
Mauritania2	W8.78	N20.85	16
Algeria3	E7.66	N30.32	34
Algeria5	E2.23	N31.02	0

Apr., 2000 ~ Mar., 2013

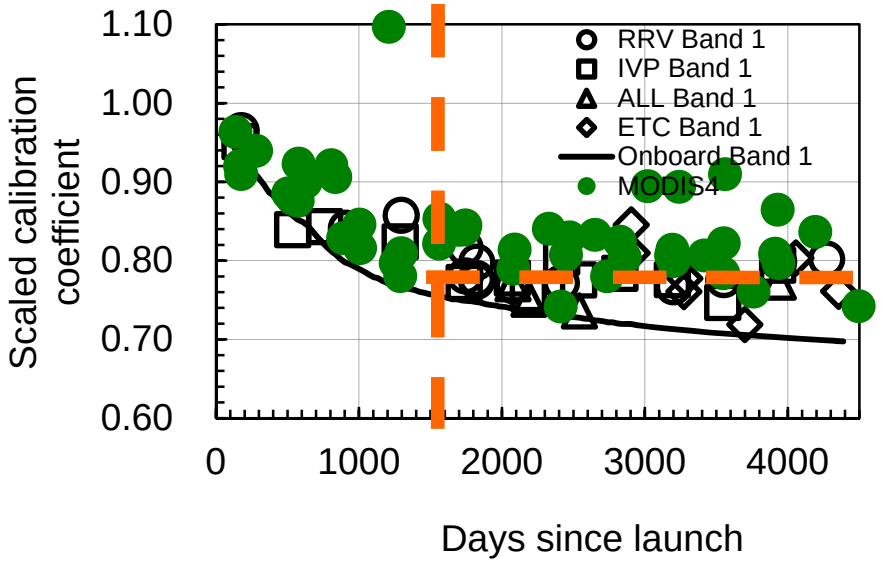
We selected 45deg>SZA for 8 CEOS instrumented sites and 6 pseudo-invariant desert sites , and removed cloudy scenes by using MODIS cloud mask (MOD35) products (Cloud fraction = 0).

Comparison between ASTER and MODIS relative spectral response

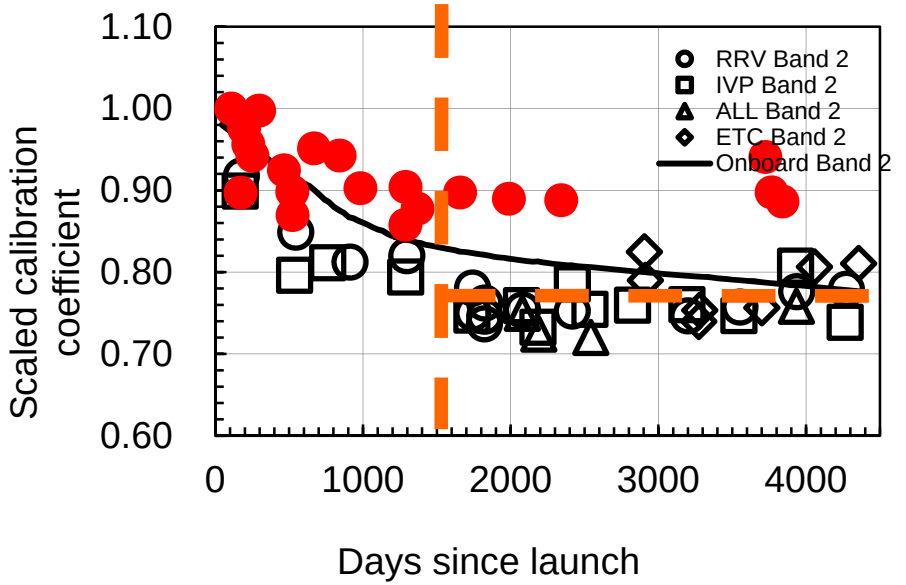




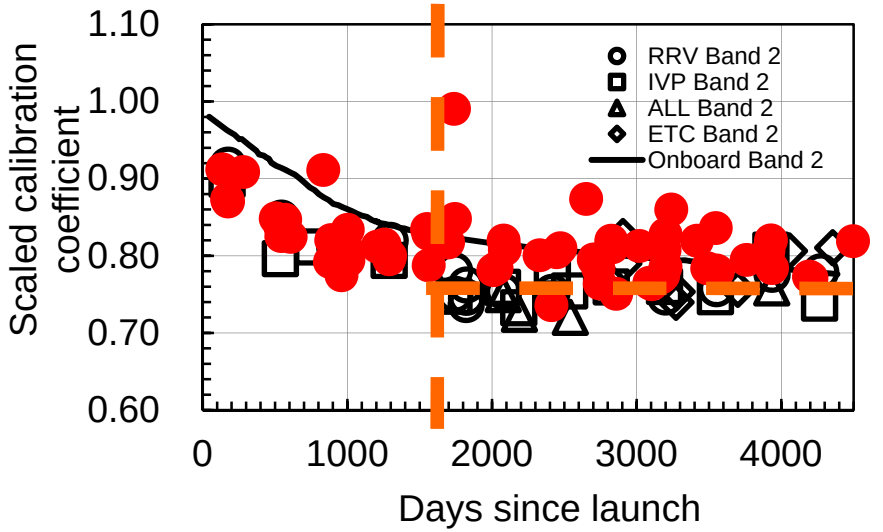
Band 1 (Normal gain)



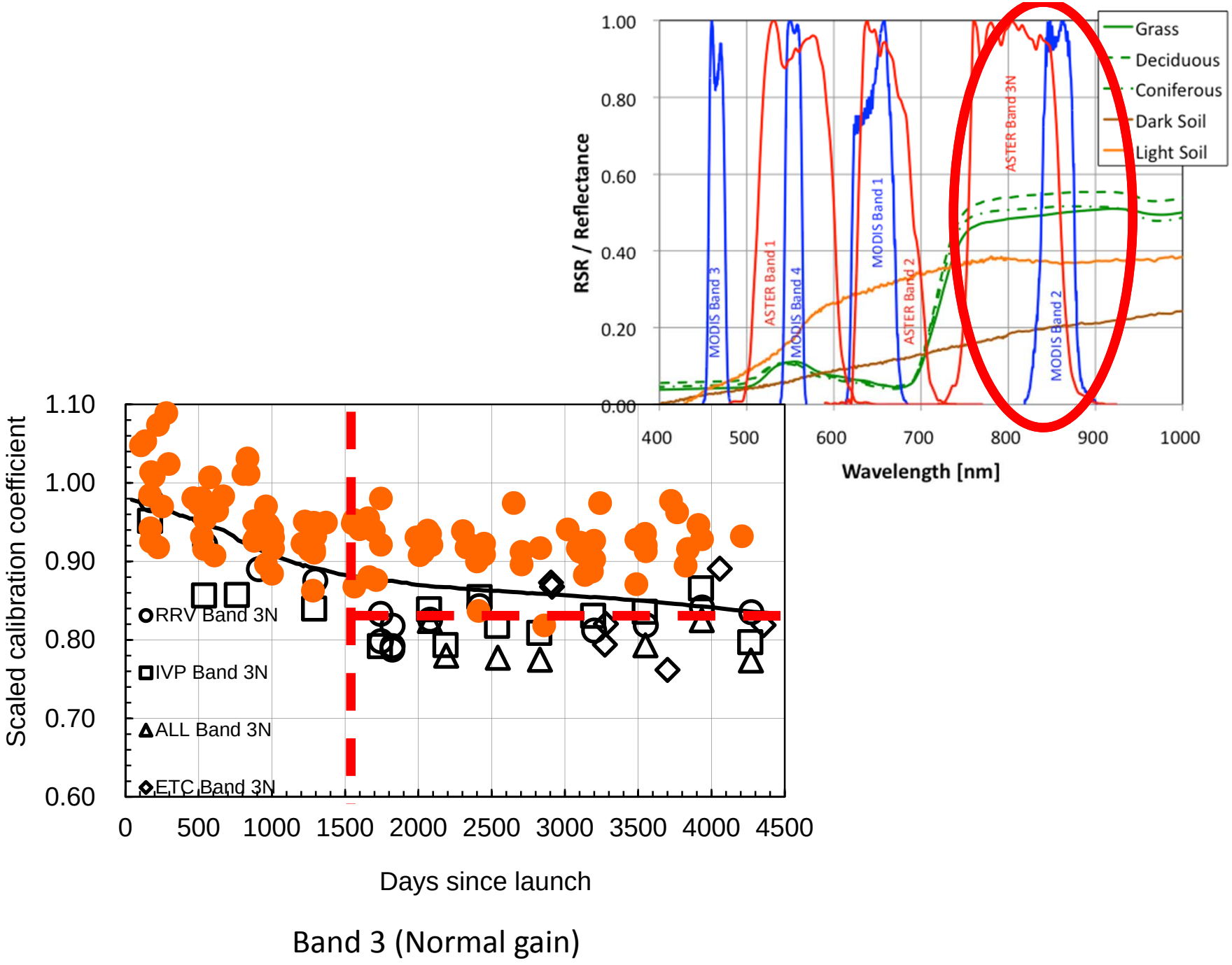
Band 1 (High gain)



Band 2 (Normal gain)



Band 2 (High gain)



Band 3 (Normal gain)

New ASTER VNIR Calibration coefficient

- RadioDB v3.13
- Calibration Coefficient =B*exp[A*DSL]+C

	A	B	C
Band 1	0	0	0.6938
Band 2	0	0	0.7686
Band 3N	0	0	0.8259
Band 3B	0	0	1

after Mar 4, 2013

ASTER/MODIS cross calibration with vicarious calibration helps us understanding the degradation trend.

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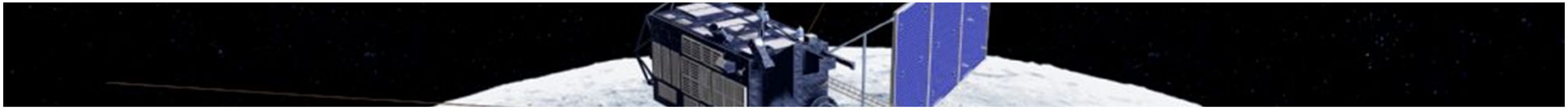
HISUI calibration and validation plan



Lunar Reflectance model developed from SELENE/SP data for Lunar Calibration

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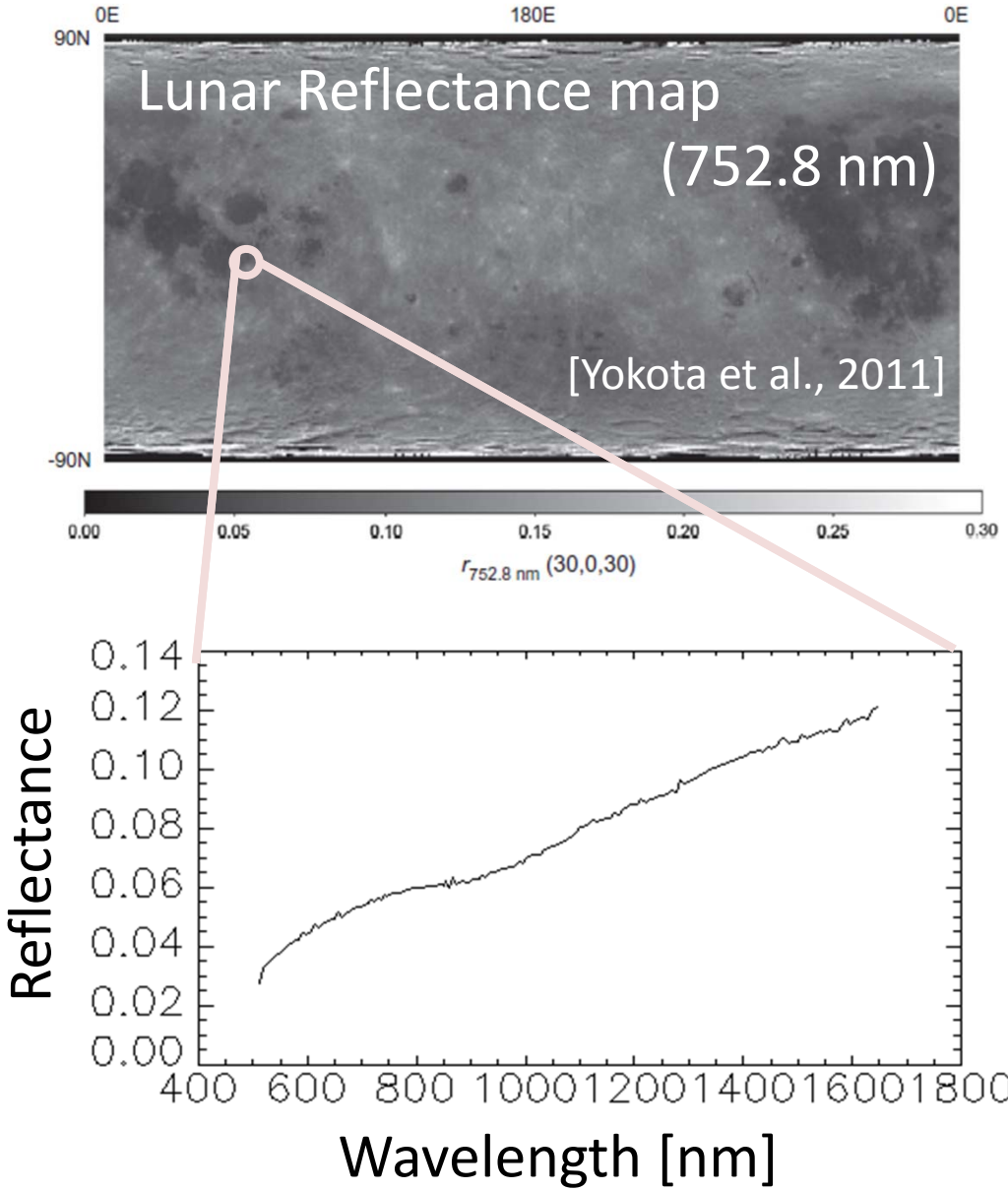
Ryosuke Nakamura (AIST, Japan)
+ HISUI Calibration WG

Lunar reflectance model



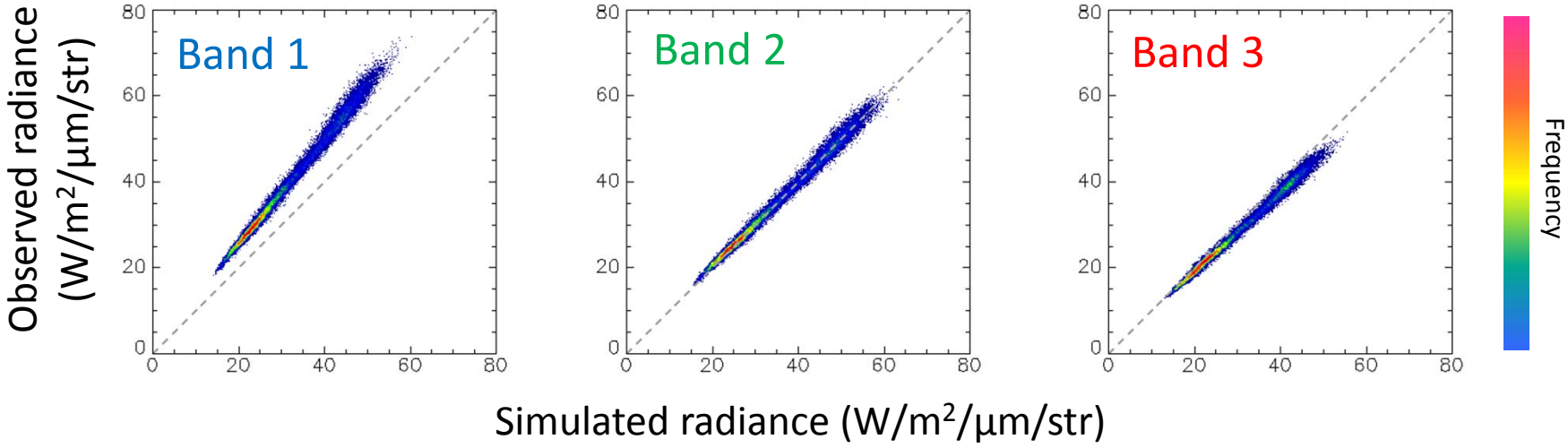
530 – 1800 nm (160 channels)
$\Delta\lambda$ = 6 - 10 nm
0.5˚ x 0.5˚ resolution
→ ~1 pixel size of HISUI/Hyper (30 m)

Including lunar surface photometric properties depending on incident, emission and phase angles.

Observed
ASTER/Band 2 (660 nm)
April 14, 2004

Simulated

Brightness Comparison



	Band 1	Band 2	Band 3
Correlation Coefficient between Observed & Simulated	0.992	0.993	0.993
Observed / Simulated	1.27±0.05	1.01±0.04	0.95±0.03

Simulating Moon observations

April 13, 2003

April 15

April 18

Summary

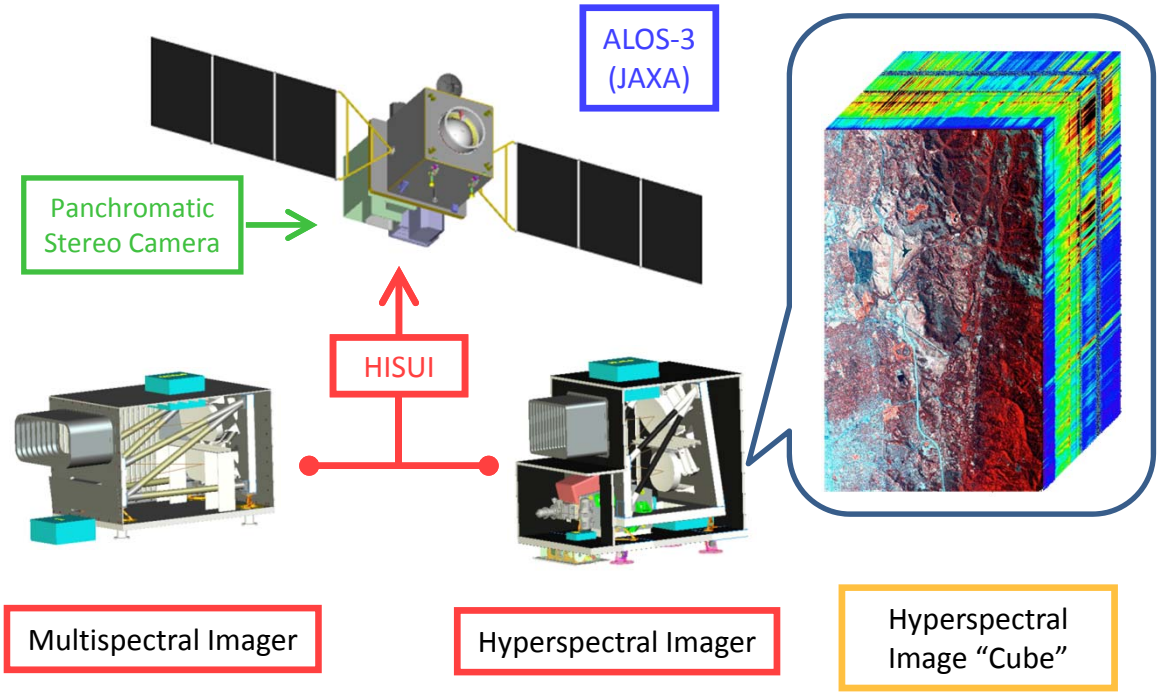
Lunar reflectance model based on SELENE/SP hyper-spectral data has been developed.

The model is, at least, useful to evaluate relative degradation of sensors because of high correlation coefficients.

By using the model, we can simulate/predict any moon observation.

SELENE/SP team is now preparing the model to be published.

Additional slides …



The hyperspectral imager:

Contiguous and high resolution spectral information from visible to short-wave IR

The multispectral imager:

4 Bands observation with a high spatial resolution by a wide swath

ASTER Unit Conversion Coefficients:UCC (W/m2/str/um/DN)

Band #	High	Normal	Low1	Low2
1	0.676	1.688	2.25	N/A
2	0.708	1.415	1.89	N/A
3N/3B	0.423	0.862	1.15	N/A
4	0.1087	0.2174	0.29	0.29
5	0.0348	0.0696	0.0925	0.409
6	0.0313	0.0625	0.083	0.39
7	0.0299	0.0597	0.0795	0.332
8	0.0209	0.0417	0.0556	0.245
9	0.0159	0.0318	0.0424	0.265
10	N/A	0.006822	N/A	N/A
11	N/A	0.00678	N/A	N/A
12	N/A	0.00659	N/A	N/A
13	N/A	0.005693	N/A	N/A
14	N/A	0.005225	N/A	N/A