Assessment of
HISUI Radiometric Performance
Using Vicarious Calibration and Cross-Calibration

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Outline

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• Vicarious calibration
• Cross-calibration
• Radiometric Database (DB)
• Calibration data archive system (CAS)
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Introduction

• The Hyperspectral Imager Suite (HISUI) is the Japanese next-generation Earth observation project, and is being developed by Japanese Ministry of Economy, Trade, and Industry (METI).

• HISUI Calibration Working Group considers the following calibration methods.
  – Onboard Calibration: Calibrated using the calibration device on satellite
  – **Vicarious Calibration:** Calibrated by simultaneous ground measurement
  – **Cross Calibration:** Calibrated using other satellite instruments
  – Lunar Calibration (TBD): Calibrated by viewing the moon (stable radiance)
Vicarious calibration sites for HISUI

- Alkali Lake (ALL)
- Railroad Valley (RRV)
- Lake Lefroy (LLF)

Summer in northern hemisphere

Summer in southern hemisphere

- Collaboration with CSIRO since 2009

We try to increase vicarious calibration frequency using both of northern hemisphere and southern hemisphere.
Clear Sky Ratio using MOD35_L2

Clear sky ratio (counted “Confident Clear” or “Probably Clear”) within 5 days from 2000 to 2011 is calculated.
Alkali Lake in US measured on Sep 4, 2014

ASTER@Alkali Lake (042-097, 8.5deg)

Alkali Lake in US measured on Sep 4, 2014
Railroad Valley in US measured on Sep 6, 2014

: ASTER@Railroad Valley (040-096, 0[deg])

Railroad Valley in US measured on Sep 6, 2014
CSIRO set up the CIMEL site, which is known as Aeronet (http://aeronet.gsfc.nasa.gov/) station close to Lake Lefroy, and ground-based atmospheric data can be downloaded from Aeronet since June, 2012.
ASTER @ Lake Lefroy (109-227, 0deg pointing)
Instruments

- Ozonometer and Sunphotometer
- Sunphotometer
- Sky Camera
- Thermo Recorder (Pressure/Temperature)
- White reference panel
- Spectroradiometer
Example of averaged surface reflectance factor

[Graph showing averaged surface reflectance factor over wavelength from 500 to 2500 nm for different numbers of measurements (1st, 2nd, 3rd, 4th).]

Railroad Valley

Lake lefroy
- The CEOS IVOS sub-group intends to define calibration reference test sites for land.
- The algorithm of cross-calibration for HISUI will be constructed.
Comparison of TOA radiance

Atmospheric condition and BRDF should be considered in case of different measurement date.
CEOS recommended solar irradiance spectrum (Thuillier 2002)

SUN01kurucz2005 irradiance model is included in MODTRAN5 code.

400-2384 [nm] : Thuillier 2002
2384 -2500[nm] : SUN01kurucz2005
Parameters obtained by pre-launch calibration:
- Pre-launch cal. parameters
- Other basic parameters from WGs
- File format satisfactory for Radiometric DB

Parameters obtained by in-flight calibration:
- Onboard cal.
- ViCal./Xcal.

Conversion to binary data:
- Calling files
  - Rad. DB creation software

Creating Radiometric DB and listing log of source data

Radiometric DB
Log of source data
Overview of HISUI calibration data archive system (CAS) and its surroundings (Planning)

- **LOB and L1 data request**
  - L1 data
  - L0B meta data
  - L0B data
  - Input data for L1 processing
  - Geo. DB, Rad. DB

**Ground Data System**

- **CAS**
  - Storage & Work Space: L1 data Cal. Data tools and etc.
  - L0B meta data
  - L0B data

- **L0B data storage**
- **L1 software**
- **Onboard calibration parameter storage**
- Geometric DB, Radiometric DB storage
- Uplink data storage

**Instrument Verification Segment (TBD)**

- Cal. WG
- L1 WG
- Instruct update of onboard calibration parameters

**Satellite**

- Onboard calibration parameters for uplink
- Instruct update of onboard calibration parameters

**Input data for L1 processing**

- Uplink data storage
- Onb. cal. parameters for uplink

**Instruct update of onboard calibration parameters**
HISUI calibration archive system (CAS) plan

LOB data storage

- L0B meta data
- L0B data
  - Cal(Lamp) YMMDDHHMM1
  - Cal(Dark signal) YMMDDHHMM2
  - Cal(Earth view)
  - HR mode
  - Normal mode

L1 software

Log information used for creating DBs

LOB data

- Geo. DB
- Rad. DB
- Geo. DB

Test DBs

- Geo. DB
- Rad. DB
- Log info

Source data

- Radiometric DB creation software
- Geometric DB creation software
- Source data

Storage and Workspace

- Rad. Cal.
- Spectral Cal.
- Geo. Cal.

Authorization of Cal./L1 WGs

Onboard calibration parameter storage

Uplink data storage

Geometric DB, Radiometric DB storage

Log info
Conclusions

• HISUI CalWG plans to conduct vicarious calibration in both of northern hemisphere and southern hemisphere. It is important to understand the characteristics between the NIST traceable reference panel and other panels used in the field experiments.

• Multispectral sensors data can be also used in cross-calibration of HISUI hyperspectral imager over the dry lake, salt lake, and CEOS reference test sites.

• HISUI CalWG is going to maintain the radiometric DB and CAS for renewing HISUI calibration parameters.

• EO-1 Hyperion and ALI, Landsat-7 ETM+, Landsat-8 OLI, and Terra MODIS and ASTER with ground-based data by vicarious calibration experiment is useful as HISUI vicarious calibration and cross- calibration in the pre-launch phase.