Questionnaire for information regarding the CEOS WGCV IVOS subgroup Cal/Val test sites for land imager radiometric gain

QA4EO-WGCV-IVO-CSP-001

Name of site: Rail Road Valley Playa

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Summary of Changes since last issue:

Issue 1.0: Initial version

Issue 1.1: Template section (17 February, 2009)

Table of Contents

1. Abstract

This document provides the template to collect and present information to describe the characteristics of a Land based test site suitable for calibrating and validating the radiometric gain of an inflight satellite/aircraft imaging optical sensor. The template is structured as a series of questions to describe the sites, accessibility as well as its physical characteristics and their derivation. Test sites with varying characteristics have been used for many years for a variety of applications, however this template has been specifically designed for sites which are regularly instrumented and are or seek to be endorsed by the Committee on Earth Observation Satellites (CEOS) Working Group on Calibration and Validation (WGCV) as "reference standards". At present there are eight such sites but more are required to ensure a robust system to reliably underpin the needs of the Earth Observation (EO) community in the longer term. The template contained in this document should be completed by anyone seeking to have a site endorsed by CEOS to join this group. The current eight **CEOS instrumented reference standard test sites** are:

- **Railroad Valley Playa**, NV, USA, North America
- **Ivanpah**, NV/CA, USA, North America
- **Lspec Frenchman Flat**, NV, USA, North America
- **La Crau**, France, Europe
- **Dunhuang**, Gobi Desert, Gansu Province, China, Asia
- **Negev**, Southern Israel, Asia
- **Tuz Golu**, Central Anatolia, Turkey, Asia
- **Dome C**, Antarctica

2. Scope

The scope of the template is to fully describe the characteristics of a test site so that those referring to its use or those seeking to use it can assess its suitability for their application. Once the template is complete it should be sent to the Infrared and Visible Optical Sensors (IVOS) subgroup chair who will arrange its review against CEOS defined criteria, before it is allocated a formal reference number and published on the Cal/Val portal as an endorsed site. At the time of issue of this template the most critical of these criteria is that it is regularly instrumented. However, these criteria are in the process of review and refinement and are likely to include other characteristics in the future. The template is structured (see table 1) to collate information under a number of headings and whilst it is desirable to have all questions completed it is recognised that there may be some gaps in knowledge at the time of first submission.

It is also anticipated that as time progresses, data (particularly surface characterisation information) will increase and evolve, and may come from sources other than the nominal Point of Contact (POC). Provision is being made for this new information to be stored and linked to the template to improve the knowledge base. However, the POC should be made aware of such information as part of the submission process.

Table 1: Information content of questionnaires

Questionnaire Content Description
Site location
Logistic information
Site climatology
Site instrumentation
Measurement accuracy
Site usage
Contact information
Data availability
References

3. Process

The attached template (appendix 1) should be completed by an individual willing to serve as POC for a CEOS test site. In this role they are agreeing to ensure that the site is maintained to a level consistent with the data contained in the template or to change the data as appropriate. This confirmation will take place on an annual basis through an email exchange with CEOS WGCV IVOS chair and Quality Assurance Framework for Earth Observation (QA4EO) secretariat. Readers are directed to the view existing completed examples of the template for further guidance.

When the template is completed it should be returned to the CEOS IVOS chair (or other designated individual) to submit for review and to arrange for publication on the Cal/Val portal.

If approved, the template will then be assigned a reference number and placed on the Cal/Val portal (http://calvalportal.ceos.org/CalValPortal/welcome.do) and the information also incorporated into the test site catalogue currently under development for CEOS WGCV by USGS (http://calval.cr.usgs.gov/sites_catalog_map.php).

Similar templates exist for non-land sites and also for non-instrumented land sites.

Appendix 1: Template for CEOS reference standard test site

CEOS Reference standard test site for Land radiometric gain

CEOS Reference: QA4EO-WGCV-IVO-CSP-xxx[1]

Name of site: Rail Road Valley Playa

Point of contact:

Address:

Range of applications[1]:

[1] to be completed by QA4EO secretariat

1. Site location

1.1.Identification and characterisation

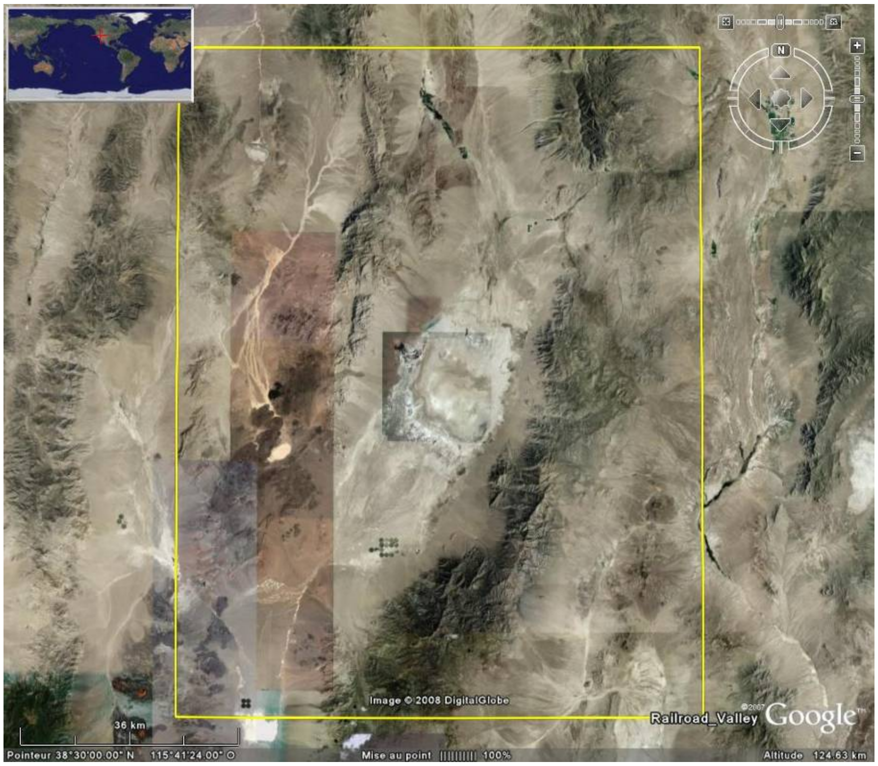
1.1.1. Site Name

Rail road Valley Playa

1.1.2. Location

Latitude :38.49703 N
Longitude : -1 15.6901 3 W

1.1.3. Google Earth Image (1x1 degree around the site center)



1.1.4. Altitude

1434 m

1.1.5. Description of the landscape

Railroad Valley is a large basin in east-central Nevada. Approximately 80 miles (130 km) in length and up to 20 miles (32 km) wide, it generally runs in a north-south direction, with some southern areas running southwest to northeast.

Railroad Valley Playa is a dry lakebed in Nevada spatially homogeneous with a composition consisting of compacted clay-rich lacustrine deposits forming a relatively smooth surface. The surface composition is comparable to those of Ivanpah and Lunar Lake; however, all three sites suffer from the presence of iron absorption (Fe^{3+}) in the visible part of the spectrum, characteristic of playas in this region

1.1.6. Environment

Strong linear road features and oil drilling structures (no lat/long. available)

1.1.7. Topography

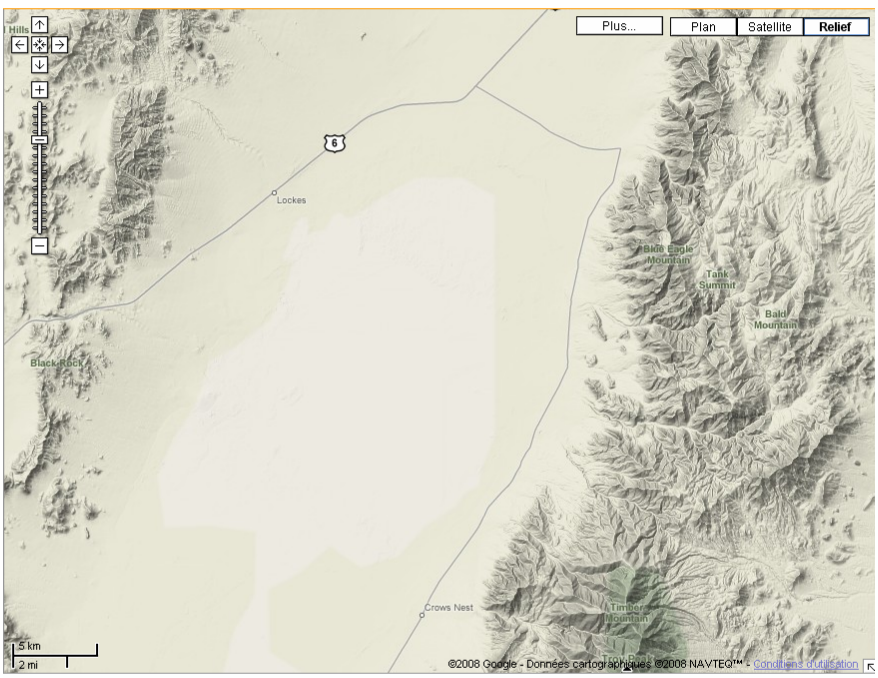


Figure 1: Topography of the site

1.2. Site view

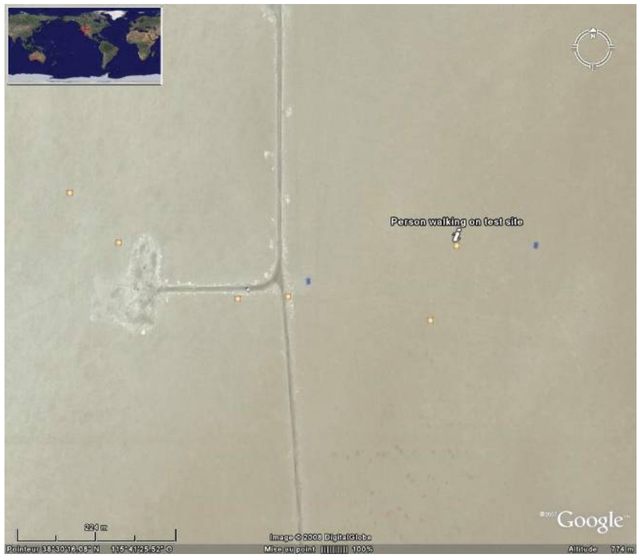


Figure 2: GoogleEarth site zoom

2. Logistic information

2.1. Site proximity from road

2.2. Access

By road (I-6)

2.3. Nearest town

Railroad Valley is in central Nevada, about 75 miles SW of Ely, and about 100 miles NW of Tonopah, just south of highway 6. The site is about 13 hours by car from the University of Arizona.

2.4. Distance from nearest town/port

- 50 miles from Lund
- 258 miles from Las Vegas (4h30)
- 75 miles from Ely

2.5. Logistics (Hotel, Restaurant, etc.)

Currant

2.6. Access to Communications

2.7. Owner

3. Site Climatology

3.1. General atmospheric conditions: Meteorological conditions

3.1.1. Annual pluviometry

CURRANT HWY STN, NEVADA

Period of Record Monthly Climate Summary 4/ 1/1963 to 6/30/1977

Precipitation and snow in inch

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Total Precipitation	0.97	0.88	0.79	0.89	0.88	1.21	0.70	0.76	0.83	0.97	0.58	1.11	10.59
Average Total Snow Fall	9.0	9.9	6.1	4.6	2.9	0.2	0.0	0.0	0.0	0.6	1.6	9.2	44.1
Average Snow Depth	2	2	1	0	0	0	0	0	0	0	0	2	1

LUND, NEVADA (264745)

Period of Record Monthly Climate Summary : 8/29/1957 to 12/31/2005

Precipitation and snow in inch

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Total Precipitation	0.78	0.83	1.07	1.00	0.98	0.88	0.66	0.93	0.81	0.89	0.73	0.69	10.26
Average Total Snow Fall	3.0	3.3	3.7	2.3	0.5	0.0	0.0	0.0	0.0	0.2	1.7	3.4	18.0
Average Snow Depth	0	0	0	0	0	0	0	0	0	0	0	0	0

3.1.2. Wind

3.1.3. Clear sky conditions

3.2. Atmosphere characterisation

3.2.1. Aerosol characteristics

3.2.1.1. Seasonal variation of the aerosol

3.2.1.2. AOT_550: Historical data

3.2.1.3. Data from AERONET CIMEL network

2253 Days [6.173 Years], Start Date: 25-JUN-2001; Latest Date: 03-JUN-2008

The principal investigator(s) of the 'Railroad_Valley' site: Kurt Thome

AERONET Climatology, Level 2.0 - Quality Assured Data

AERONET Algorithm: Version 2

Year: 2001, 2002, 2003, 2005

Channel (nm): 1020, 870, 670, 500, 440, 380, 340, 500 (not interpolated)

Aerosol optical depth at 500 nm (taua500), Angstrom exponent (alpha440-870), precipitable water (PW), the associated standard deviations (sigma), the number of days (N) and months (Month) in the observation periods.

Overall Averages of	Taua 500	sigma	Alpha 440-870	sigma	PW	sigma	N	Month
JAN	0.02	0.01	1.01	0.19	0.37	0.15	22	1
FEB	0.01	0.01	0.00	0.00	0.32	0.09	13	1
MAR	•••	•••	•••	•••	•••	•••	••	•••
APR	•••	•••	•••	•••	•••	•••	••	•••
MAY	•••	•••	•••	•••	•••	•••	••	•••
JUN	0.04	0.02	0.75	0.43	0.90	0.49	5	1
JUL	0.13	0.07	1.19	0.49	1.28	0.62	70	3

Overall Averages of	Taua 500	sigma	Alpha 440-870	sigma	PW	sigma	N	Month
AUG	0.12	0.07	1.40	0.54	1.22	0.49	98	4
SEP	0.05	0.03	1.55	0.49	0.92	0.38	87	3
OCT	0.04	0.03	1.41	0.41	0.70	0.26	72	3
NOV	0.03	0.02	1.30	0.52	0.63	0.27	46	2
DEC	0.02	0.01	1.21	0.63	0.51	0.18	14	2
YEAR	•••	•••	•••	•••	•••	•••	427	20

3.2.1.4. Nominal values of AOT at 450, 550, 650, 850 nm

3.2.1.5. Absolute error of AOT at 450, 550, 650, 850 nm

3.2.1.6. Model of aerosol used

3.2.1.6.1. Granulometry

3.2.1.6.2. Refraction index used

3.2.1.7. Alpha

3.2.2. Water vapour content characteristics

3.2.2.1. Water vapour content origin

3.2.2.2. Seasonal variation of the water vapour content

3.2.2.3. Mean and accuracy

3.3. Surface characterisation

3.3.1. Surface albedo characteristics

3.3.2. Surface reflectance characteristics

The surface reflectance of this site typically exceeds 0.4 at wavelengths longer than 500 nm. The surface is nearly lambertian for view angles less than 30 degrees from nadir and its location in the desert southwest part of the United States leads to typically low aerosol loading and a high expectancy of clear weather. While the spatial uniformity of Railroad Valley Playa is not as good as other test sites used by the RSG, its overall size of 15 km by 15 km makes it large enough for use with MODIS.(ref :Thome)

3.3.2.1. Instrumentation used for characterisation

The surface characterization makes use of three ASD FieldSpec FR spectroradiometers and one FieldSpec. There are two large-sized Spectralon panels that are used as field references as well as multiple other panels that are used as secondary references. Recent advances in field equipment have led to the deployment of a set of ground-looking radiometers built by RSG that are located at Railroad Valley to monitor surface changes throughout the year. The ASD radiometers are portable array-based spectrometers consisting of a spectrometer unit, computer interface, and 2-m long fiber optic probe inserted into a foreoptic (generally carried on a boom to insure that data collected are not shadowed by the user). Two of these radiometers are Full Range (FR) devices employing a silicon photodiode array and two fast scanning thermoelectrically cooled spectrometers capable of data collection from 350-2500 nm with a spectral resolution between 3-20 nm (depending on the detector). The third ASD instrument is a UV/VNIR-only system with a single silicon detector array, capable of data collection from 350-1050 nm. These systems may be operated in the field with 1°, 5°, or 8° full-field-of-view (FFOV) foreoptics, depending on the application.

3.3.2.2. Route of traceability

3.3.2.3. Mean reflectance at Nadir (full spectrum)

3.3.2.4. Uncertainty of reflectance (please give breakdown of uncertainty contributions)

3.3.2.5. Mean reflectance at Nadir at 450, 550, 650, 850 nm

3.3.2.6. Δρ at 450 nm, 550, 650, 850 nm

3.3.3. BRDF (or specific angles)

3.3.3.1. Instrument used

3.3.3.2. Relative error on BRDF correction at θs=45 degrees, θv=30 degrees

3.3.4. Surface reflectance – variability across site (uniformity) (%)

100 * 100 m =

500 * 500 m =

1000 * 1000 m =

4. Site instrumentation (Nominal)

4.1. Meteorological instrumentation (list)

4.1.1. Meteo station (Temperature, pressure, humidity)

4.1.2. Pluviometer

4.1.3. Anemometer

4.2. Atmospheric instrumentation

4.2.1. Instrument used for aerosol characterisation

4.2.1.1. Instrument used

4.2.1.2. Route of traceability

4.2.1.3. Measurement protocol

4.2.1.3.1. Scanning mode

4.2.1.3.2. Spectral characteristics

4.2.1.3.3. Frequency of measurements

4.2.2. Instrument used for surface irradiance characterisation

4.2.2.1. Instrument used

4.2.2.2. Route of traceability

4.2.2.3. Measurement protocol

4.2.3. Instrument used for water vapour content characterisation

4.2.3.1. Instrument used

4.2.3.2. Route of traceability

4.2.3.3. Measurement protocol

4.3. Surface instrumentation

4.3.1. Instrument used for reflectance/radiance characterisation

4.3.1.1. Instrument used

4.3.1.2. Route of traceability

4.3.1.3. Measurement protocol

4.3.1.3.1. Scanning mode

4.3.1.3.2. Spectral characteristics

4.3.1.3.3. Frequency of measurements

4.3.2. Instrument used for BRDF characterisation

4.3.2.1. Instrument used

4.3.2.2. Route of traceability

4.3.2.3. Measurement protocol

4.3.2.3.1. Scanning mode

4.3.2.3.2. Spectral characteristics

4.3.2.3.3. Frequency of measurements

5. Current status of the site

5.1.Instrumented

5.2.Maintained (source and commitment of funding)

5.3.Regularly visited (state frequency)

- Human ☐
- Satellite ☐
- Aircraft ☐
- Automated ☐

6. Site usage

6.1.Historical record of comparisons (ground, aircraft and satellite)

6.2.Date / sensor / location of results

2007-09-16: Field trip to Alkili Lake, Railroad Valley, and Ivanpah for TM, ETM+, ASTER, Terra MODIS and downloading of Ground-viewing radiometers. Collaboration with the Japanese science team for the ASTER collections.

2007-09-11: Field trip to Ivanpah for ASTER and ETM+. Collaboration with the Japanese science team for the ASTER collections.2007-08-17: Field Trip to Ivanpah and Railroad Valley for TM, ETM+, ASTER, MASTER and downloading of Ground-viewing radiometers. Collaboration with the Japanese science team for the ASTER collections.

2007-07-24: Field Trip to Ivanpah and Railroad Valley for TM, ETM+, ASTER and downloading of Ground-viewing radiometers.
2007-06-23 : Field Trip to Ivanpah and Railroad Valley for ETM+, ASTER, Aqua MODIS and NOAA-17.

6.3. Regularity of satellite data (if known)

6.4. Satellite and sensor ID

7. Contact information

7.1. Point of Contact (Name and address)

Kurt Thome

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Tucson AZ 85721-0094

Phone: +1 520.621.4535

Fax: +1 520.621.8292

Email: kurt.thome@opt-sci.arizona.edu

kurtis.thome@nasa.gov

7.2. Instrumentation maintenance

8. Dataset availability and owner

8.1. Dataset

8.2. Owner

8.3. Availability

9. References

9.1. Bibliography

9.1.1. Characterization of the site

Bannari, A., Omari, K., Teillet, P. M. and Fedosejes, G., 2004. Multi-sensor and multi-scale survey and characterization for radiometric spatial uniformity and temporal stability of Railroad Valley Playa (Nevada) test site used for optical sensor calibration. Proceedings of SPIE - The International Society for Optical Engineering 5234, 590-604.

K . Thome, J. Czapla-Myers, S. Biggar Railroad Valley Playa for use in vicarious calibration of large footprint sensors, IVOS, 2005.

9.1.2. Description of the methodology

Thome, K. J., Biggar, S. F., & Wisniewski, W. (2003a). Cross Comparison of EO-1 Sensors and Other Earth Resources Sensors to Landsat-7 ETM+ Using Railroad Valley Playa. IEEE Transactions on Geoscience and Remote Sensing, 41, 1180−1188.

9.1.3. Description of the instrumentation

RSG web site: http://www.optics.arizona.edu/rsg/index.php

9.1.4. Description of applications for vicarious calibration

Thome, K.J., Biggar, S.F., W. T. Wisniewski, Cross-comparison of EO-1 sensors and other Earth Resources Sensors to Landsat-7 ETM+ Using Railroad Valley Playa, IEEE Trans. On Geoscience and Remote Sensing, 41: 1180-1188, 2003.

Biggar, S.F., Thome, K. J., and W. T. Wisniewski, Vicarious radiometric calibration of EO-1 sensors by reference to high-reflectance ground targets, IEEE Trans. On Geoscience and Remote Sensing, 41: 1174-1179, 2003.

9.2.Site Web

RSG web site: http://www.optics.arizona.edu/rsg/index.php

9.3.General acknowledgement

9.3.1. Aeronet data

We thank Kurt Thome and his staff for establishing and maintaining the site used in this investigation.