GROUP ON EARTH OBSERVATIONS

CEOS

QA4EO

A QUALITY ASSURANCE FRAMEWORK FOR EARTH OBSERVATION

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

QA4EO-WGCV-IVO-CSP-002

Name of site: Dunhuang

IVOS test site questionnaire: QA4EO-WGCV-IVO-CSP-001

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IVOS test site questionnaire: QA4EO-WGCV-IVO-CSP-001

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

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Summary of Changes since last issue:

Issue 1.0: Initial version

Issue 1.1: Template section (17 February, 2009)

Issue 2.0: POC Input (20 April, 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: Dunhuang

Point of contact:

Xiuqing Hu

Associate Professor

National Satellite Meteorological Center

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Email: huxq@cma.gov.cn charmhu@163.com

[1] **to be completed by QA4EO secretariat**

1. Site location

1.1. Identification and characterisation

1.1.1. Site Name

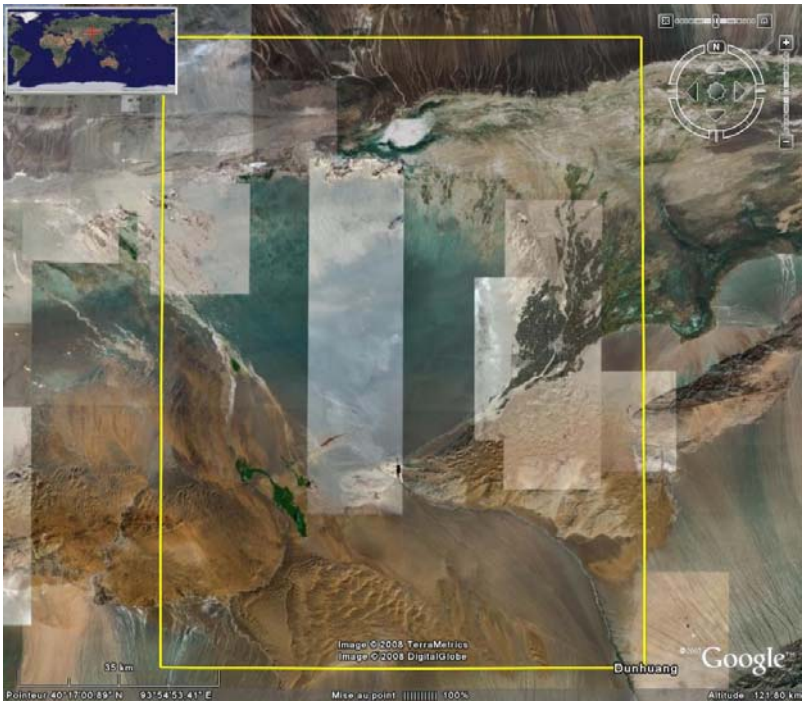
Dunhuang -China

1.1.2. Location

Latitude: 40.03838° North

Longitude: 94.79400° East

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



1.1.4. Altitude

1140.0 meters

1.1.5. Description of the landscape

This site was operational radiometric calibration and validation for Chinese satellite sensors in 2001, and located on the east edge of the Kumutage Penniform Desert in Gansu province, South-West China. It is a Gobi desert, and about 35 km west apart from

the city of Dunhuang . The whole target area for vicarious calibration is situated on a stabilised alluvial fan, 30 km x 30 km size. The area used for high spatial sensors (such as CBERS, TM etal) vicarious calibration measurements is approximately 400 m x 400 m in the centre of the fan and the surface comprises cemented gravels, and 15km×15km for low spatial sensors (Such as NOAA/AVHRR, FY-1/FY-3 optical imagers and EOS/MODIS etal)vicarious calibration with no vegetation. Sources of meteorological data for the site include the Dunhuang-PAM automated weather station, which is part of the Asian Automatic Weather Station Network. Atmospheric aerosols over the site are typical of a rural continental location, although some larger particles were observed, possibly influx from the sand dunes to the north-west. Sandstorms affect the site on around 8 days per annum and atmospheric dust is a significant factor on around 60 days per annum. (Source: Network for Calibration and Validation of Earth Observation (NCAVEO) web site, http://www.ncaveo.ac.uk/calibration/radiometry/in-flight/#dunhuang.) AERONET site.

1.1.6. Environment

There are the national road G315 on the south edge of this site and a village road on the west edge of it.

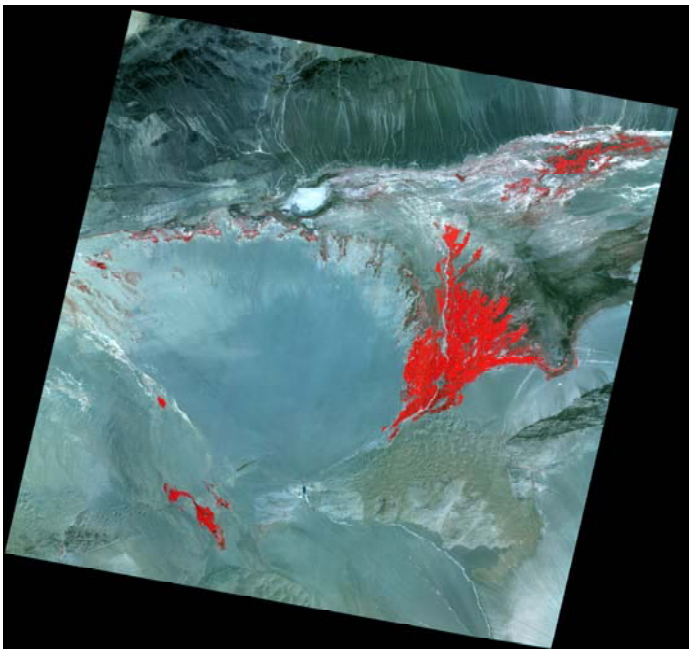


Figure 2: Image of CBERS-2 (2006.08.20)

1.1.7. Topography

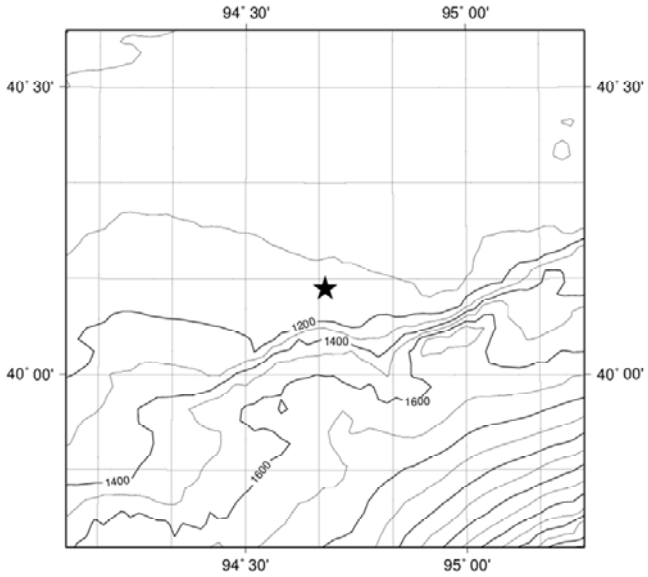


Figure 3: Topography of Dunhuang site

1.2.Site view

Figure 4: site overview and Field measurement pictures

2. Logistic information

2.1. Site proximity from road

The south edge of the Dunhuang site from the National road G315 is just several hundred meters. The central point of the site from the road is 6 Kilometers.

2.2. Access

Drive the Landrover up to conduct field measurement.

2.3. Nearest town

Qili Town of Dunhuang city is the nearest from the site. It is just 1 kilometer apart from its east edge.

2.4. Distance from nearest town/port

Its east edge is just 1 kilometer apart from Qili Town.

2.5. Logistics (Hotel, Restaurant, etc.)

The general logistics for field campaign is very convenient including living hotels ,eating and Transpartation.

2.6. Access to Communications

The communication in site mainly depends on the mobile-phone. The communication of the Dunhuang city is very nice.

2.7. Owner

3. Site Climatology

3.1. General atmospheric conditions: Meteorological conditions

3.1.1. Annual pluviometry

<300mm

3.1.2. Wind

wind season: Winter and Spring

3.1.3. Clear sky conditions

112 clear days per year, visibility>40km

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

55 Days of measurements

Start Date: 19-MAR-2001; Latest Date: 12-MAY-2001

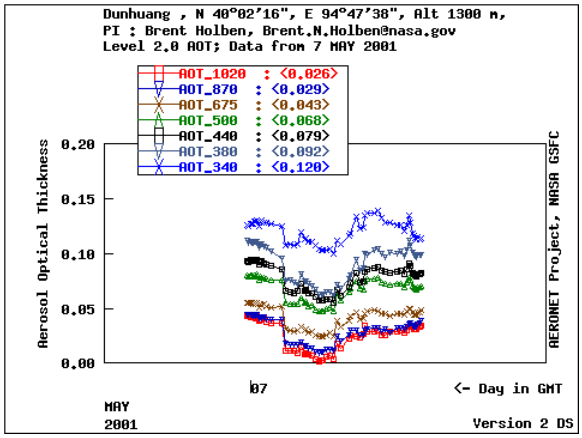
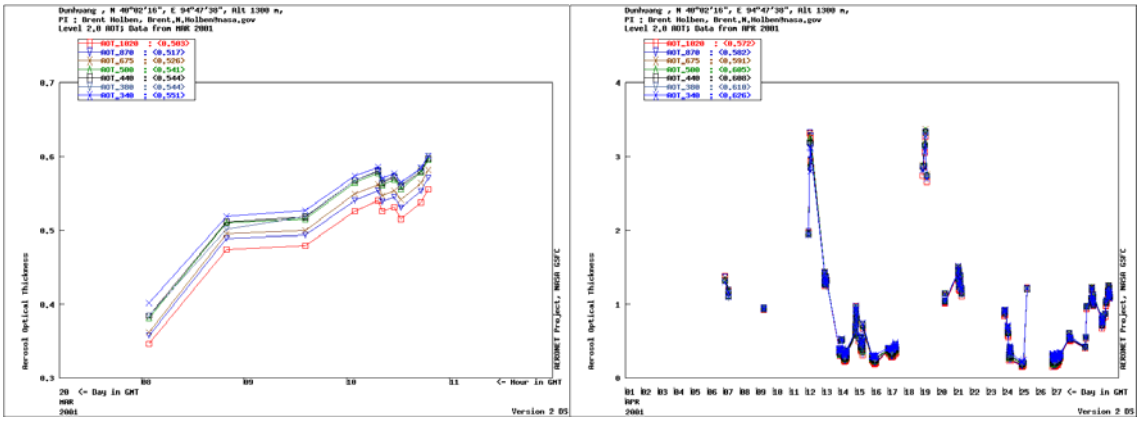


Figure 1: Variability of AOT on May, 7th, 2001



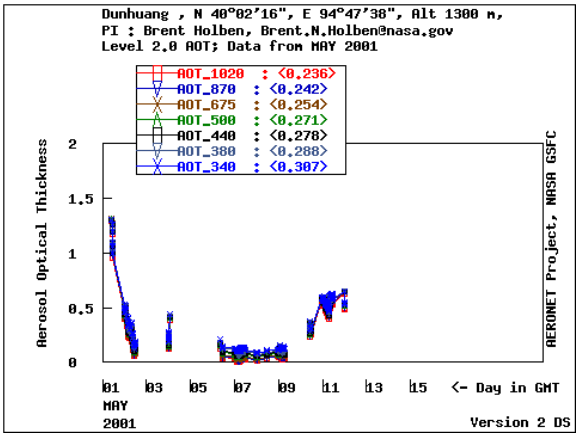


Figure 2: Monthly variability of AOT (March, April, May 2001)

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

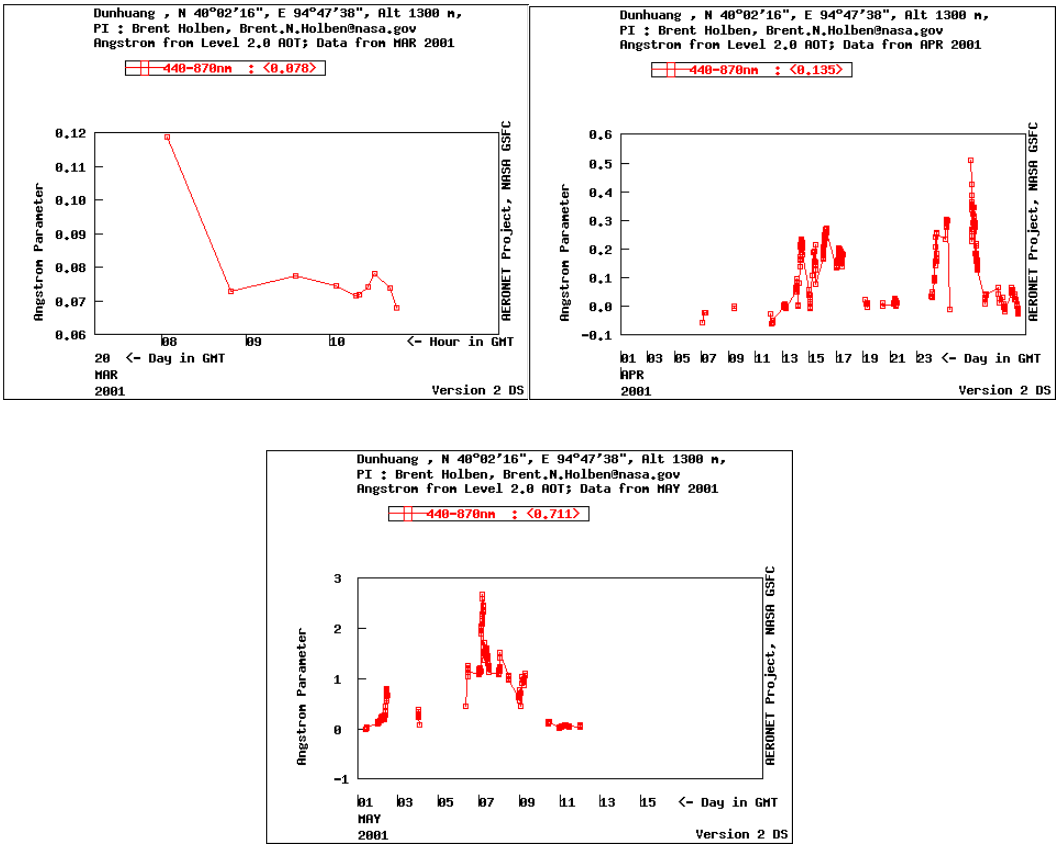


Figure 3: Monthly variability of Angstrom exponent (March, April, May 2001)

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

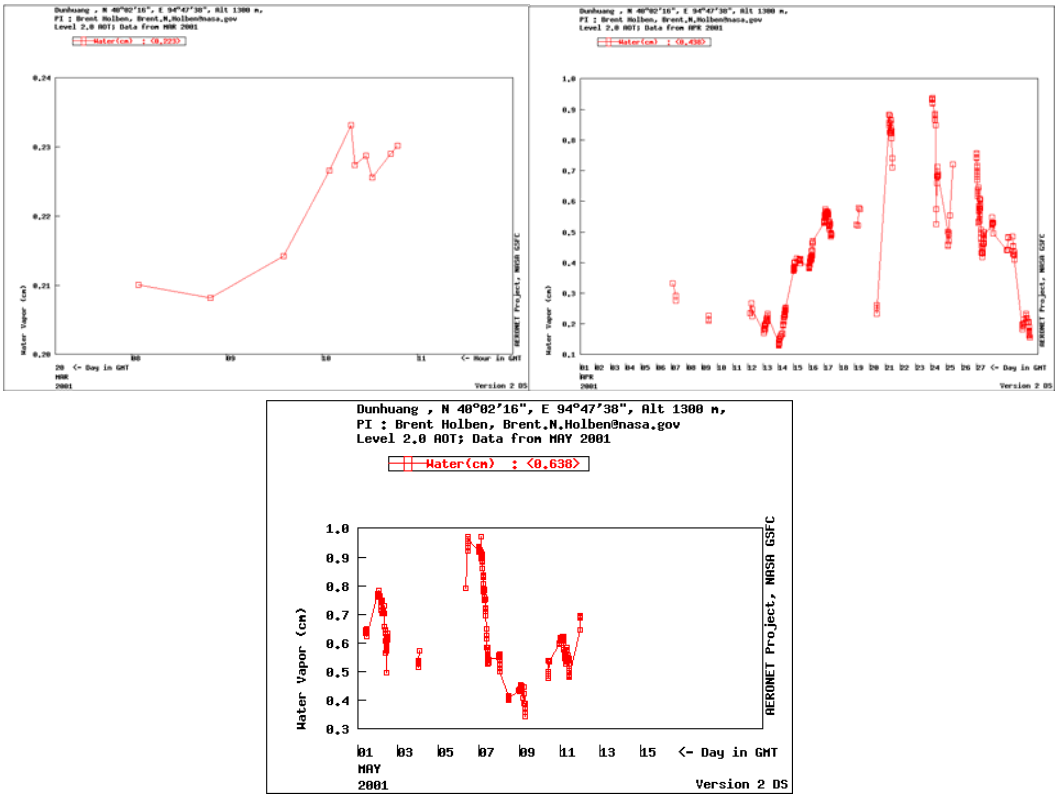


Figure 4: Monthly variability of water vapourcontent (March, April, May 2001)

3.2.2.3. Mean and accuracy

3.3. Surface characterisation

3.3.1. Surface albedo characteristics

3.3.2. Surface reflectance characteristics

3.3.2.1. Instrumentation used for characterisation

ASD field spectroradimeter (350-2500nm)

3.3.2.2. Route of traceability

3.3.2.3. Mean reflectance at Nadir (full spectrum)

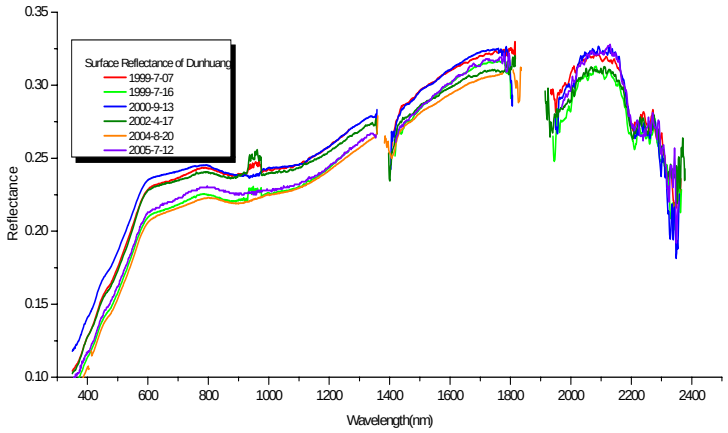


Figure: Reflectance of Dunhuang site from 1999 to 2005

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. $\Delta\rho$ at 450 nm, 550, 650, 850 nm

3.3.3. BRDF (or specific angles)

3.3.3.1. Instrument used

Figure : BRDF measurement system

3.3.3.2. Relative error on BRDF correction at θs=45 degreeș, 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)

Dunhuang Meteorological Station provide all the operational meteorological parameters measurement every day

4.1.2. Pluviometer

Same as above

4.1.3. Anemometer

Same as above

4.2. Atmospheric instrumentation

4.2.1. Instrument used for aerosol characterisation

4.2.1.1. Instrument used

CE318 sunphotometer located in Dunhuang Meteorological station

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

ASD field spectroradimeter (350-2500nm)

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)

There are several comparisons between ground-based measurement and FY series Satellite sensors' observation. This site measurements are also used to cal&val for Chinese CBERS and HY series satellite sensors several times.

6.2. Date / sensor / location of results

- 1996 Measurement of site's characteristics
- 1999 FY-1C MVISR
- 2000 FY-1C,FY-2B ,CBERS-01
- 2001 FY-1C, FY-2B
- 2002 FY-1D,FY-1C, FY-2B, HY-1, (using the aircraft measurent), SZ-3/CMODIS
- 2003 FY-1C/1D, FY-2B, HY-1
- 2004 FY-1C/1D, FY-2B, JB3
- 2005 FY-1C/1D, FY-2C, MODIS, AVHRR
- 2006 FY-1D, FY-2C, MODIS, AVHRR
- 2007 FY-1D,FY-2C/2D, FY-3/MERSI Simulator aircraft flight
- 2008 FY-2C/2D, FY-3A/VIRR/MERSI

6.3. Regularity of satellite data (if known)

FY-1C/1D MVISR data were collected during 1999 to 2007
FY-3A MERSI&VIRR data are being collected from July, 2008.

6.4. Satellite and sensor ID

FY-2C/2D/2E VISSR, FY-1C/1D MVISR, FY-3A MERSI&VIRR

7. Contact information

7.1. Point of Contact (Name and address)

Xiuqing Hu

Associate Professor

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China Meteorological Administration

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Beijing, China 100081

Tel:+86-10-68407463

Fax:+86-10-62172724

Mobile: +86-13661397179

Email: huxq@cma.gov.cn charmhu@163.com

7.2. Instrumentation maintenance

Dr. Yuan Li and Engineer Lijun Zhang

8. Dataset availability and owner

8.1. Dataset

China Radiometric Calibration Sites (CRCS) Database was established 2007.

8.2. Owner

National Satellite Meteorological Center (NSMC)

8.3. Availability

This database is Web-based Intranet available currently. It collected all the field compaign measurement data by NSMC's calibration research group.

9. References

9.1. Bibliography

9.1.1. Characterization of the site

Wu, D., Zhu, Y., Wang, Z., Ge, B. and Yin, Y., The building of radiometric calibration test site for satellite sensor in China. 1-4+figs.

Wu, D., Yin, Y., Wang, Z., Gu, X., Verbrugghe, M. and Guyot, G., 1997. Radiometric characterisation of Dunhuang satellite calibration test site (China). Physical measurements and signatures in remote sensing. Guyot, G. and Phulpin, T. Rotterdam, Balkema. Volume 1, 151-160.

Huxiuqing, Zhangyuxiang, Liuzhiquan, Zhangguangshun, Huangyibin , Qiukangmu, etal. Optical characteristics of China Radiometric Calibration Site for Remote Sensing Satellite Sensors (CRCSRSSS). SPIE Proceeding, 2000, Vol4151: 77—86.

Proceedings of China Remote Sensing Sensors Radiometric Calibration (in Chinese, Beijing: Ocean Press), Pages 344, 2001

9.1.2. Description of the methodology

9.1.3. Description of the instrumentation

9.1.4. Description of applications for vicarious calibration

9.2. Site Web

NSMC: http://www.nsmc.cma.gov.cn

CRCS: http:// www.crcisnet.org

9.3. General acknowledgement

We thank Brent Holben and his staff for establishing and maintaining the site used in this investigation.

IVOS test site questionnaire: QA4EO-WGCV-IVO-CSP-001