CGMS

CGMS-37, CMA-WP-05
Prepared by CMA
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Discussed in WG II

UPDATE ON GSICS ACTIVITIES IN NSMC

Summary of the Working Paper: This working paper explains the actions taken by the GPRC in CMA in response to recommendations from the CGMS-36 concerning GSICS. The progress of CMA GPRC the last year includes the establishment of computer hardware system, operational inter-calibration for FY-2 satellites, and the GSICS website. GSICS GEO-LEO inter-calibration for FY-2 is running operationally at CMA, and the result is displayed on the website now. Effort is spent on real-time monitoring of the performance of FY satellites sensors, and the test for LEO-LEO inter-calibration for FY-3A optical sensors such as MERSI, VIRR, and IRAS based on AIRS, IASI, and MODIS.

Update on GISCS Activities in NSMC

1 Introduction

The CMA GSICS Processing and Research Center (GPRC) in NSMC is being constructed since June, 2008. Actions have been taken In response to the recommendations of CGMS-36.

Recommendation 35.02: Satellite operators are requested to provide near real-time monitoring of instrument performance on easily accessible websites and to archive the information. Deadline: CGMS-36

Recommendation 35.04: Satellite operators to explain significant discrepancies in satellite inter-calibration as part of their contribution to GSICS. Pertinent reports should be delivered to the GCC. Deadline: CGMS-36

Recommendation 35.06: CGMS encourages continuation of the generation of long term satellite-based climatology.

In 2009, some progresses have gained relevant to the calibration of Fengyun satellite sensors and implementation of GSICS actions from CGMS-36. Table 1 lists our responses to the actions.

Table 1: CMA Implementation of GSICS-related actions (as of Oct. 1, 2009)

Action	Target date	Status
Realize FY-2C/2D GSICS into routine operation	12/31/08	Aug, 09 done
Create CMA GISICS web site	06/15/09	Oct, 09 done
Establish calibration data platform for FY serial sensors	12/15/09	Being Constructed
Establish a near real-time monitoring system of instrument performance of FY serial sensors	12/15/09	Being Developed for partial FY sensors
Recalibration for the FY-1C/1D retrospectively	06/31/10	Ongoing
FY-3A/VIRR/MERSI inter-calibration operational processing platform	New plan	algorithm being developed

2 CMA Progress on GSICS

2.1 CMA GSICS GPRC

After GSICS meeting in Feb, 2009, Tokyo, NSMC sped up establishing the CMA GPRC operational system in three aspects, including:

- Computer system design
- Operational GEO-LEO inter-calibration development for FY-2, and
- Establishing the GSICS CMA website (the English version).

The computer hardware system design for GSICS Processing and Data Management is shown in Figure 1.

GEO-LEO inter-calibration for FY-2X has operationally run since August, 2009. Developing the English version of CMA GPRC website started in April, 2009 and finished by now. It will open in Oct. 2009.

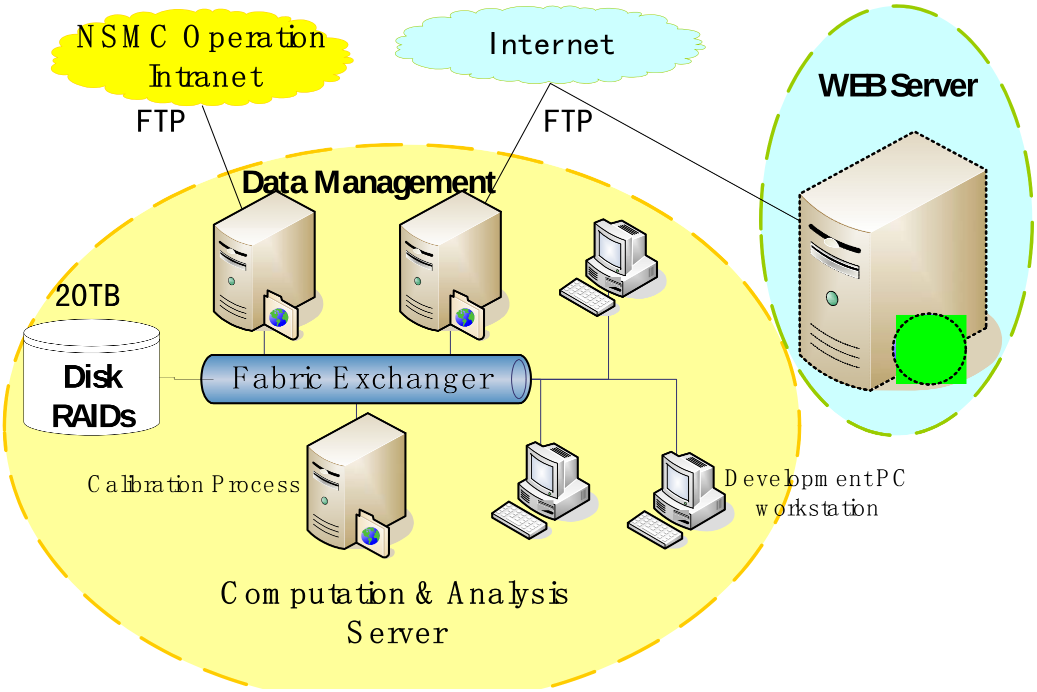

Figure 1. Design of CMA GPRC operational processing system

2.2 FY-2 GSICS Calibration

FY-2C/2D, JMA's GSICS GEO-LEO algorithm was modified by changing the reading interface to fit the FY-2 L1B HDF files, geo-location data of FY-2 normal disk image, and the spectral response function (SRF) of IR bands. JMA's gap filling algorithm was also used to AIRS radiance simulation of FY-2 bands successfully. We order from the websites all the AIRS and IASI Collocated data near the nadir of FY-2C/2D (IASI from http://www.nsof.class.noaa.gov/saa/products/ , AIRS from http://daac.gsfc.nasa.gov/). Inter-calibration was conducted for the past data received during the lifetime of FY-2C (from Mar, 2005 to now) and FY-2D (from February, 2007 to now).

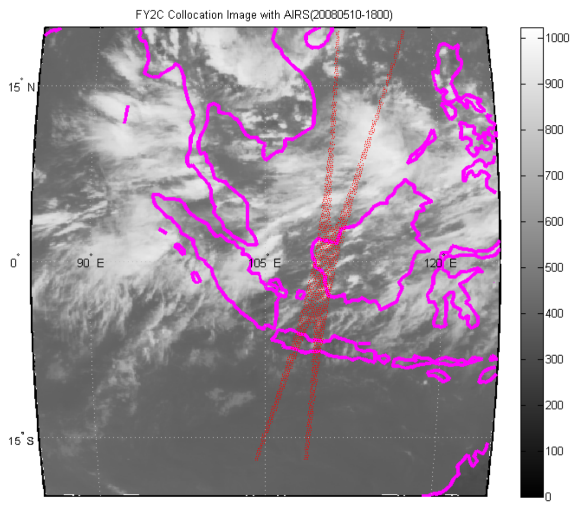

Figure 2. FY-2C and AIRS collocation map

All the inter-calibration results for FY-2C/2D are displayed on the website which is updated everyday. Other information such as the FY's sensors and instrument SRF, and FY-3A calibration can also made available on the web.

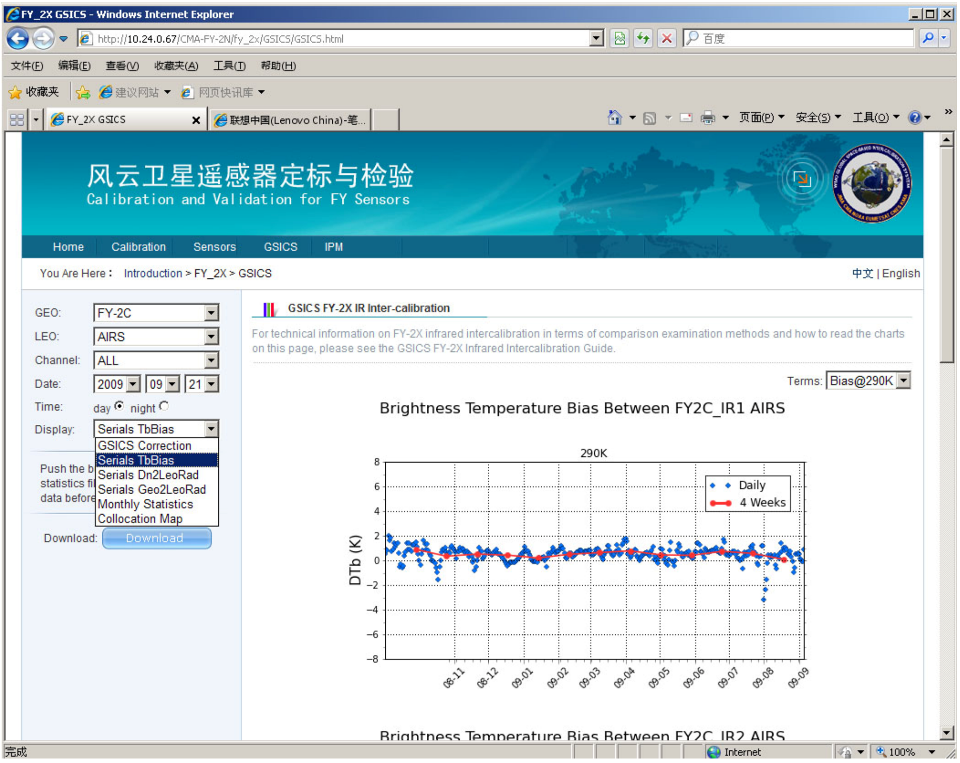

Figure 3. CMA GPRC Website

Current operational calibration at NSMC for the FY-2 is based on weekly inter-calibration with AVHRR and HIRS. Plan is made to replace the current operational calibration with the inter-calibration based on IASI, and validation of it using the result from inter-calibration with AIRS.

2.3 FY-2 onboard calibration model

FY-2 calibration segment consists of one warm black body viewed by an inserted mirror into the optical path between the front optics and the cold assembly that contains infrared detectors. The black body is kept at ambient temperature. When performing the black body calibration, the black body is moved into the optical path between the front optics and the cold detector assembly. A black body calibration sequence starts with taking the space view (hence mainly observing the self- emission of the front optical system), to be followed by viewing the black body. The deep space view is used as zero radiance reference, the known temperature difference between space and blackbody and the observed digital counts can be related to each other by the black body calibration coefficient. Unfortunately, the influence of the front optics can not be neglected by the calibration mechanism. Hence, a front optics model has been developed that takes into account the various transmission functions of the mirrors and the relevant viewing angles.

We are planning that the GSICS calibration of infrared channels is used to tune the black body calibration. So the black body calibration gives a stable relative calibration of the infrared channels, while the tuning towards the GSICS calibration gives the absolute calibration level for both channels.

We are trying to establish FY-2 onboard BB calibration algorithm using GSICS collocated radiance. We hope to establish the relationship between FY-2 onboard BB calibration and the GSICS long-term collocated radiance Optical structure about FY-2 series. There are two optical paths in FY-2 satellite: (1) Signals from the earth and space travel through the fore- and aft-optics to reach the detectors; (2) Signals from onboard blackbody go through the cal- and aft-optics to reach the detectors. So they do not have full-optics onboard blackbody calibration. Using the GSICS radiance from AIRS/IASI and the onboard blackbody radiance as two known sources for two different optics: fore-optics and full cal-optics.

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      --------------Detectors
                  |
                  |  R3
                  |
                  |------------------- BB radiance
                  |          R2
                  |  R1
                  |
                  |
  GSICS AIRS/IASI Radiance
```

Figure 4 FY-2 onboard black body calibration schematic diagram

GSICS Correction for FY-2C/2D IR onboard BB calibration:

- For GSICS radiance (R_g): a_{full}=(R1+R3+R_g)/(DN_g-DN_{space})
- For blackbody radiance (R_{bb}): a_{bb}=(R2+R3+R_{bb})/(DN_{bb}-DN_{space})
- Then, we can make the optics details as a black boxes. So, the correction factor can be found between a_{full} and a_{bb}.
- We can use this correction factor to correct a_{bb} when using onboard blackbody radiance to calibrate sensor.

This method can only be effective during the stable period of radiant cooler temperature of the detector. For the radiant cooler adjustment period, big error will be introduced because of the unstable status of the satellite body. From telemetry data of satellite, we have real-time temperatures of some key mirrors in fore- aft- and cal-optics and all of these mirrors characteristic factors, such as size, solid angle, transmittance/reflectance and emissivity etc. can be obtained from fabricants. So, the full-optics onboard blackbody calibration signals can be simulated by these characteristic factors of each key mirrors.

- R1=f(m1,m2,m3,⋯), R2=f(m5,m6,⋯), R3=f(m9,m10,⋯), Rbkg=f(m12,m13,⋯). Key work is to determine empirical relationship between Rx and mirrors' characteristic factors.

This work is in progress now…

2.3 FY-3A/MERSI/VIRR Inter-calibration

Another work is to run GSICS GEO-LEO algorithm for FY-2C/2D. This algorithm is also tested for LEO-LEO infrared bands on FY-3A's MERSI, VIRR and IRAS with the AIRS and IASI in July, 2009.

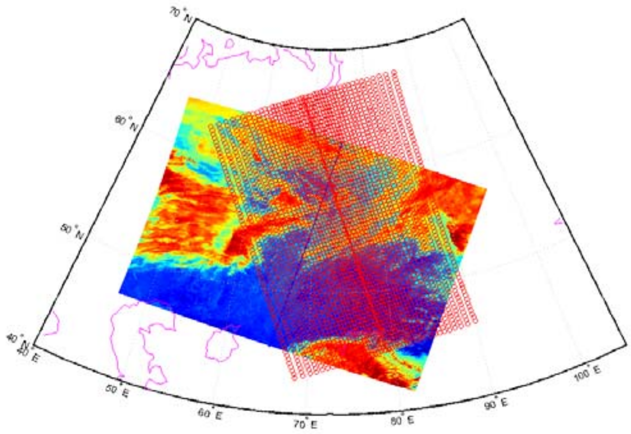

Figure 5 Collocation map of VIRR(bottom image) and AIRS (overlay Grid)

We collected some L1 data of AIRS, IASI, and the FY-3A MERSI and VIRR simultaneous nadir observation (SNO). (see Figure 5). It found that the radiance of band 5 of MERSI is larger than collocated radiance of AIRS, and than IASI. The result of VIRR IR bands shown that band 4 was perfectly consistent with AIRS, and with IASI, but band 5 radiance was a little lower in comparison. This comparison will be done operationally after it is tested successfully.

2.4 FY-1C/1D historical Data Recalibration

To improve the data accuracy and predictive usefulness of satellite observations, NSMC is reprocessing the archive FY-1C/1D data.

Database of several field measurements is already established and it contains all the historical data from Cal/Val experiments in fields of Dunhuang and Qinghai Lake. These measurements are important to calibrate and validate the L1B radiance and L2 retrieval products of satellite data.

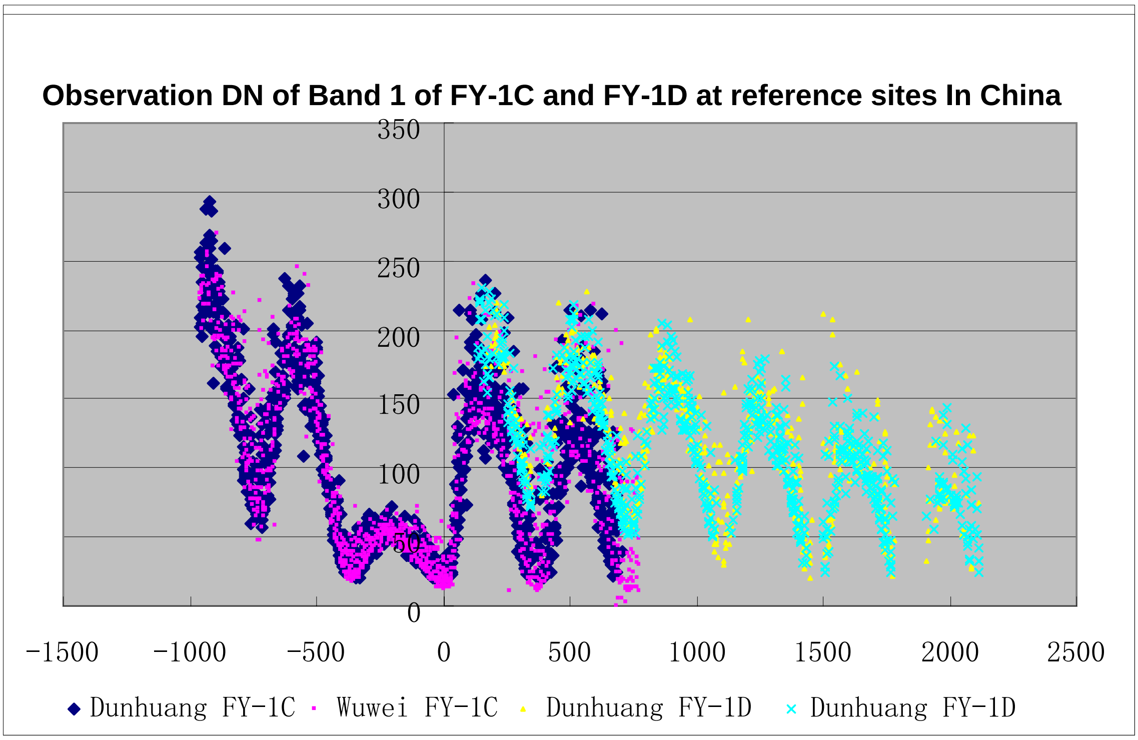

Figure 6. Digital count trend of FY-1C/FY-1D at Dunhuang and Wuwei sites

3 Action Plan in the near future

After work for FY-2 operational GSICS correction is done, we will move to realize in the operational FY-3A optical instruments GSICS, and the real - time assessment of these instruments. NSMC GPRC will keep its GISICS web pages updated to provide more information about FY's sensors.

A calibration data platform is planned including the OBC engineering and telemetry data, reference sensors' SNO observation and global reference sites image of FY serial sensors.