

ACTIVITIES OF CALIBRATION AND VALIDATION FOR THE KOMPSAT-2 MSC DATA

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ABSTRACT:

KARI has prepared Calibration and Validation activities for the KOMPSAT-2 (Korea Multi-Purpose SATellite-2) MSC data that will be launched at the middle of this year. Firstly, we divided the Cal/Val activities of it to four parts, Spatial, Spectral, Radiometric and Geometric, and defined the detailed Cal/Val parameters from them. Secondly, Cal/Val targets have been defined and manufactured for the role of them. Thirdly, we have made the plan and the procedure for the Cal/Val parameters, developed the codes for them, studied more detailed method to do them, and trained the Cal/Val activities using the foreign satellite image data by ourselves. KARI has been now setting up the KOMPSAT-2 LEOP plan with the Cal/Val activities, and probably will finish the EOP Cal/Val activities for the KOMPSAT-2 MSC data by the end of this year.

1. INTRODUCTION

The Calibration and the Validation for KOMPSAT-2 MSC data has been prepared by KARI one by one so far, and the Cal/Val activities for KOMPSAT-2 will be carrying up for 4-5 months from KOMSPAT-2 launch to first release of MSC image data to Users. Because KARI has designed and developed the KOMPSAT-2, KARI has a responsibility for the Cal/Val of KOMPSAT-2. If KARI will get the good result of the Cal/Val activities during LEOP (Launch and Early Operation phase), the basic requirements of KOMPSAT-2 will be accomplished and Users will get the good quality of the MSC image data. This paper will present the overall Cal/Val activities for the KOMPSAT-2 MSC data.

2. ITEMS OF THE KOMPSAT-2 CAL/VAL

Table 1. Items of the KOMPSAT-2 Cal/Val

Group	Parameter	Method	Cal/Val target	Site	Who	Support	Phase		
							I	II	III
Spatial	GSD, FOV	GCP	Convex mirror	Portable	Cal 팀	PST	①	①	①
	SNR	Desert, Lake, Cal/Val target	Tarp, Dark Cal., OBRC	Portable	Cal 팀	PST	①	①	①
	MTF	Cal/Val target	Edge, Siemens, Convex mirror, Pulse	Portable	Cal 팀	PST	①	①	①
	Focusing	MTF		Portable	Cal 팀	PST	②	②	②
	TDI Yaw Steering	GCP			Cal 팀	PST	②	②	②
	TDI Line rate	MTF		Portable	Cal 팀	PST		②	②
	NIIRS	GSD, MTF, SNR			Cal 팀			⑤	⑤
Radiometric	Dynamic Range	MSC images			Cal 팀	PST	①	①	①
	TDI Level (Gain)	Dynamic range, MTF			Cal 팀	PST	②	②	②
	Linearity	Cal/Val target, MSC images	Tarp, Dark Cal., OBRC	Portable	Cal 팀	PST	①	①	①
	Relative (NUC table)	Desert, Lake, MSC images	Tarp, Dark Cal., OBRC	Portable	Cal 팀	PST	②	②	②
	Electric Gain/Offset	MSC images			Cal 팀	PST	②	②	②
	Absolute	Cal/Val target, MSC images	Tarp, Dark Cal., OBRC	Portable	Cal 팀	PST		⑤	⑤

Group	Parameter	Method	Cal/Val target	Site	Who	Support	Phase		
							I	II	III
Geo-metric	Pointing accuracy	GCP		Dae, Go	Cal 팀		①		
	UTC & OB T & MST Sync	'MGPSDEL TLM			FST	Cal 팀	②		②
	POD				FST	Cal 팀	③		③
	KPADS initialization	GCP DB		Dae/Go pass	FST	Cal 팀	②		②
	AOCS On-orbit Cal.	GCP DB		Dae/Go pass	FST	Cal 팀	③		③
	Pointing accuracy	GCP		Dae, Go	Cal 팀		①	①	
	Interior Orientation	GCP DB		Dae/Go pass	Cal 팀		②	②	
	Exterior Orientation	GCP DB		Dae/Go pass	Cal 팀		③	③	
Spectral	Pointing accuracy	GCP		Dae, Go	Cal 팀		⑤	⑤	
	Spectral Characteristics	?							

The KOMPSAT-2 Cal/Val is divided for 4 groups; Spatial, Spectral, Radiometric and Geometric, and each group has several items according to its property (Ryan 2003). 'Interior Orientation' of Geometric includes 'Optical Distortion' & 'Registration' of Spatial and 'CCD Geometry' of Geometric. In Table 1, the blue items are the parameters to initialize the KOMPSAT-2 with Telemetry Command, the green items are the parameters to upgrade the KOMPSAT-2 performance, the yellow items are the parameters to validate, and the white items are product parameters for the end-users.

3. CAL/VAL TARGETS

Table 2. Cal/Val Targets

Target	Cal/Val Parameter	Location
Siemens	MTF, Aliasing, IFOV	KARI, Goheung
Convex mirror	MTF, GCP	Portable
Tarp	Edge(MTF), Linearity, Radiometric, Dynamic Range	Portable
GCP target	CCD Geometric, CCD Distortion, Pointing Accuracy, KPADS S/W 초기화, AOCS On-orbit sensor calibration	Daejeon, Goheung, (Incheon ariport) Portable

For the KOMPSAT-2 Cal/Val activities, we need the Cal/Val targets that can be imaged by KOMPSAT-2 MSC, and has made Siemens, convex mirror, tarp and GCP target.

3.1 Siemens target

Siemens target located at Goheung has been designed to validate the MTF, Focusing, etc.

Table 3. Spec. of Siemens target

Angle (Deg.)	Radius (m)	Number	Arc length (m)	Total angle (Deg.)
4.2	68.1	27	5	113.4



Figure 1. Siemens target at Goheung

3.2 Tarp target

Tarp target, portable, has been designed to validate the MTF, Focusing, Linearity, Absolute radiometric cal., etc.

Table 4. Spec. of Tarp target

Reflectance	3.5%	23%	35%	53%
Number	8	8	8	8
Size	5m x 20m			



Figure 2. Deployed Tarp target

3.3 Convex mirror

Convex mirror, portable, has been designed to validate the MTF and GCP.

3.4 GCP DB

GCP DB for the KOMPSAT-2 Geometric Cal/Val has been establishing at Daejeon, Goheung, Seosan, Gwangyang and Kimje before LEOP to calibrate and validate the KPADS S/W initialization, AOCS on-orbit Cal., interior orientation, exterior orientation and pointing accuracy check. The basic requirement of KOMPSAT-2 GCP DB is the next;

- Accuracy: <0.1m (Horizon), < 0.2m (Height)
- Minimum number: >30 in 1 scene

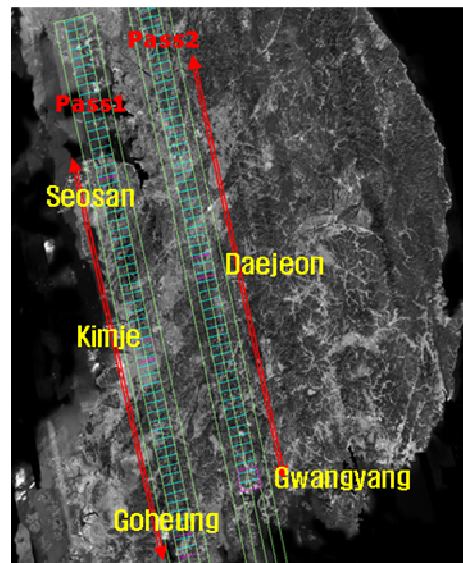


Figure 3. GCP DB Plan.

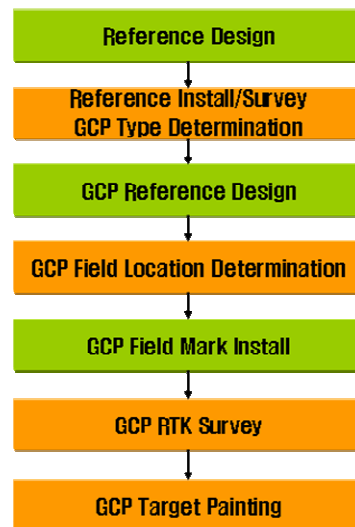


Figure 4. GCP DB procedure

6. CAL/VAL PLAN DURING LEOP

6.1 Cal/Val Phase

1. Cal/Val Phase I – with LEOP (about 1 month)

- Validation of the basic MSC image data quality parameters
 - MTF, SNR, GSD, Dynamic range, Linearity etc.
- Cal/Val of the MSC initial parameter values and Commanding to K2
 - Focus, TDI gain, NUC table, Electric gain/offset table etc.
- Cal/Val for basic requirement of K2 system mission
 - Time sync, AOCS, POD, KPAD, Pointing Accuracy, TDI Yaw steering

2. Cal/Val Phase II – after LEOP, before normal operation (about 3 months)

- Cal/Val for advancement of K2 system performance.
 - Interior & Exterior orientation etc.
- Cal/Val for advancement of K2 image data quality
 - MTF, SNR, GSD, Dynamic range, Linearity
- Cal/Val for Users
 - NIIRS, Absolute radiometric Cal., Pointing accuracy

3. Cal/Val Phase III – Normal operation

- Periodically Cal/Val for K2 system performance and image data quality

6.2 Cal/Val Flow

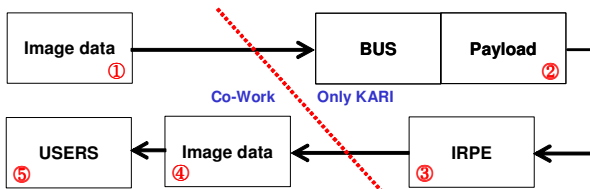


Figure 10. Cal/Val Flow

- ① Validate the basic K2 Cal/Val parameters
 - MTF, SNR, GSD, FOV, Linearity, Dynamic range
- ② Cal/Val the Payload and K2 parameters
 - Time sync, AOCS, POD, PAD, Interior & Exterior orientation
 - Focusing, NUC, TDI (Yaw steering, Line rate)
 - TDI gain, Electric gain/offset
- ③ Image restoration in IRPE (Low Fr. NUC, Sensor modeling)
- ④ Image enhancement (MTFC, DRA, Fusion)
- ⑤ Information for Users
 - Absolute radiometric Cal., Pointing accuracy, NIIRS

7. FUTURE WORK

KARI Cal/Val team has finished the basic readiness for the KOMPSAT-2 Cal/Val activities, and has to complete the GCP DB, the detailed procedure, the detailed plan of LEOP Cal/Val

and the algorithm of interior orientation, etc. If we get the good result from the KOMPSAT-2 Cal/Val activities, the result of it will be applied to the image restoration and the image enhancement in KOMPSAT-2 IRPE (Image Receiving & Processing Element), the end-users will get the good quality of the KOMPSAT-2 MSC image data.

8. REFERENCE

Ryan, R., 2003. Parameters Describing Earth Observing Remote Sensing Systems. In: *International workshop on Radiometric and Geometric Calibration*, USA