Korea Aerospace Research Institute
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Calibration and Validation for KOMPSAT in KARI

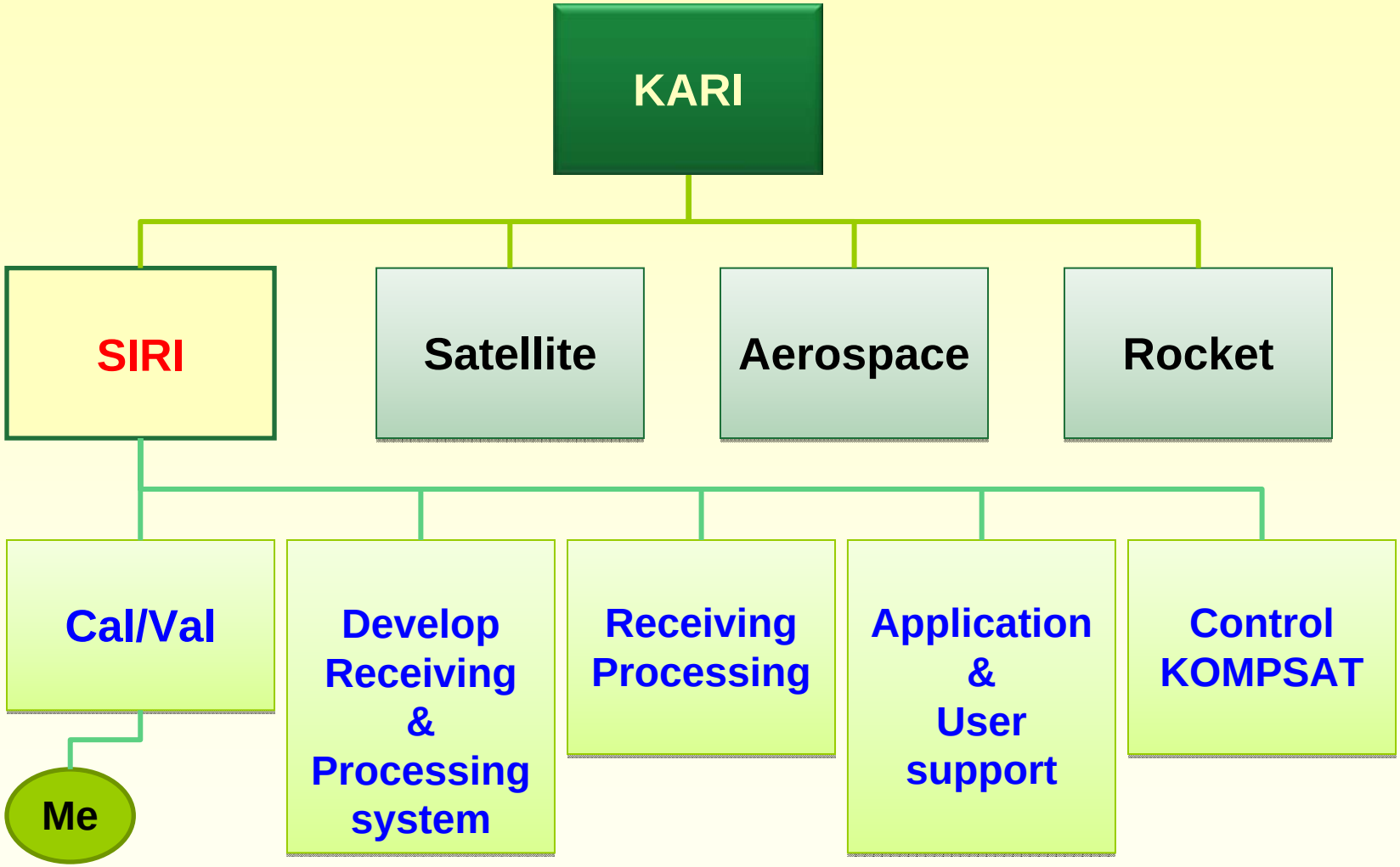
September 30, 2009

Korea Aerospace Research Institute
Satellite Information Research Institute

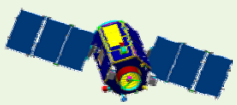
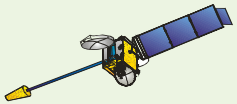
Introduction to KARI

- **Government Funded Space Research Institute**
  - **Established in 1989 by the government based on the special law**
  - **KARI with its 800 engineers/scientists plays the central role in the space development in Korea**

Introduction to KARI



Space Program in KARI

	KOMPSAT-1	KOMPSAT-2	KOMPSAT-3	KOMPSAT-5	COMS	KOMPSAT-3A
						
Payload	EOC, OSMI	MSC	AEISS	COSI	MI, GOCI	KISS
	Visual	Visual	Visual	SAR-X	Meteorology	Visual+IR
Launch	1999~2008	2006~	2011	2010	2010	2013
Performance	6.6m (EOC) 1km (OSMI)	1m, 4m 10bit	0.7m, 2.4m 14bit	1m, 3m X-band	500m	0.5m, 2m 14bit
Image mode	Strip	Strip	Spot, Strip, Wide	Spot, Strip, Wide		Spot, Strip, Wide
Swath	15km	15km	15km	15km	2,500km	15km
Orbit	Geo-sync	Geo-sync	Geo-sync	Geo-sync	Geo-Station	Geo-Sync

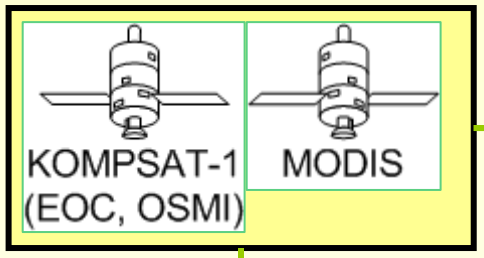
KOMPSAT-6 (SAR) & 7 (Visual) will be developed by KARI after KOMPSAT-5 & 3

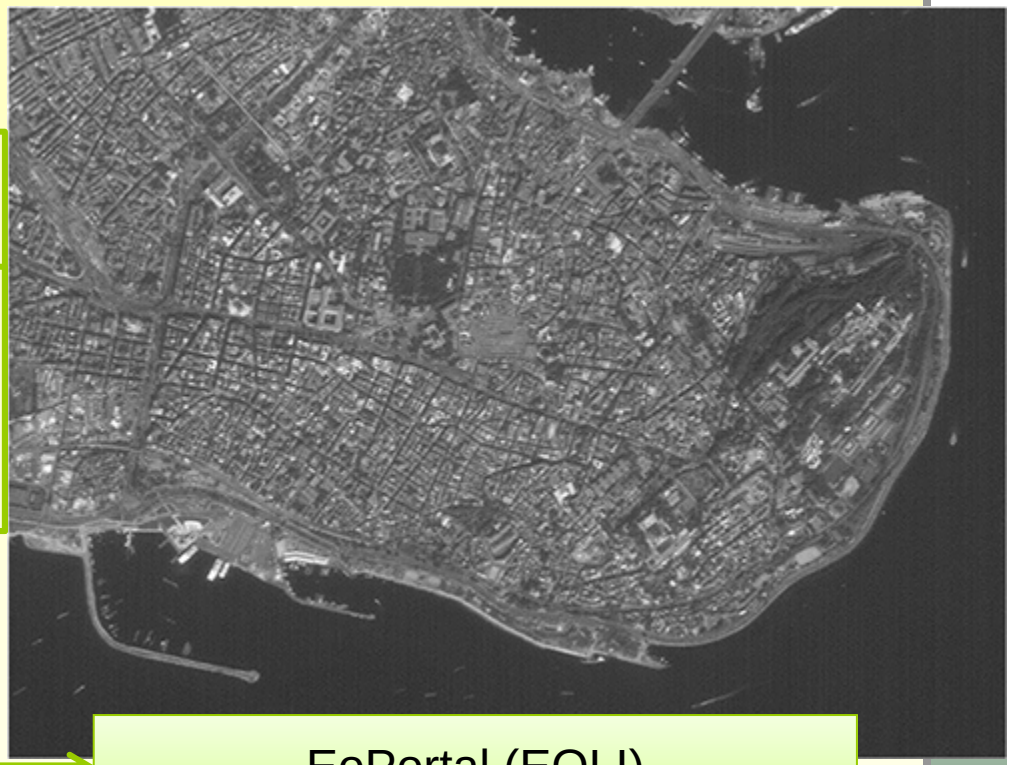
KARI & SIRI until 2009

ISO19115 XML Schema by KARI

Web service by KARI (EoDB)

http://eodb.kari.re.kr





EoPortal (EOLI)

ASEAN+3 DB system

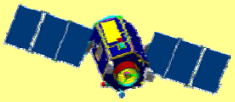
Sentinel ASIA DB system

KARI & SIRI until 2009

RPC + NITF + DIMAP

Web service - Space Capture 2

http://www.spacecapture.kr



KOMPSAT-2
(MSC)

SPOT Images Inc.

UAE, Taiwan

KAI Images Inc.

KARI & SIRI from 2009

KOMPSAT-5 from 2010

KOMPSAT-3 from 2011

KOMPSAT-3
AEISS

KOMPSAT-5
COSI

Cal/Val by KARI

Mongolian Cal. site with NRSC

AU Cal. site with CSIRO (TBD)

International Standardization in KARI

- **International Standardization Activities for Remote Sensing Satellite image data & Cal/Val**
  - **ISO19115 – Metadata (QA4EO-QAEO-GEN-DPK-002)**
  - **ISO19130 – Sensor and data models for imagery and gridded data**
  - **ISO19138 – Data quality measures**
  - **CEOS WGCV & ISPRS Commission**
    - **International Workshop on Radiometric and Geometric Calibration at Gulport, 2003**

- **In KARI**
  - **Has developed the XML Schema for ISO19115 by KARI**
    - **KOMPSAT-1 EOC, OSMI & MODIS data has already been serviced with ISO19115 in Web.**
  - **NITF for Remote sensing satellite image data**
    - **has already been serviced from KOMPSAT-2 MSC image data.**
  - **DIMAP(XML) for SPOT image inc.**
    - **has already been serviced from KOMPSAT-2 MSC image data.**
  - **NIIRS**
    - **Has been developed to get the NIIRS value from KOMPSAT-3 image data automatically.**
    - **KOMPSAT-3 AEISS image data = NIIRS 6**

Image data Quality for Users in KARI

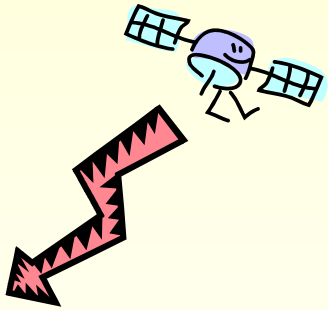
- **Image data Quality for Users**
  - There is a technical gap between the requirement for manufacturing the satellite and the requirement for the image data quality for Users.
  - Need & Define the quantitative value for the image data quality for Users
    - Almost Users have a eye without the concept of the quantitative image data quality~!
    - Spatial: GSD, MTF
    - Radiometric: Radiometric resolution, Noise (SNR), Absolute radiometric Cal.
    - Geometric: Pointing, Geo-location, Planimetric accuracy, Registration
- **KARI has plans of..**
  - Periodic Cal/Val of KOMPSAT
  - Workshop, Conference, Seminar
  - Beta User group

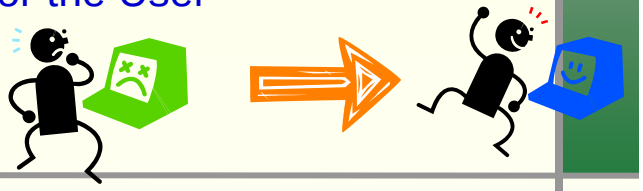
Calibration & Validation in KARI

- If no Cal/Val, NO guarantee the basic requirement of a Satellite.
- If basic Cal/Val, you can guarantee the ONLY basic requirement of the Satellite.
- If Cal/Val, you can get the full compliance of the satellite image data quality for Users.

- A Space agency(KARI) that is just developing a Satellite
  - MUST validate and verify the satellite and the satellite image data.
  - MUST calibrate the satellite and satellite image data.
  - MUST show up the status of the satellite image data for Users
- A Space agency(KARI) that is just developing a Satellite
  - MUST guarantee the Satellite image data quality for Users

- Impossible 'Full(Real)' test before Launch
  - After Launch, the final status of satellite will be known.
- Only manufacturing satellite cannot get the image quality for the User
  - Cal/Val will fill up the gap between them

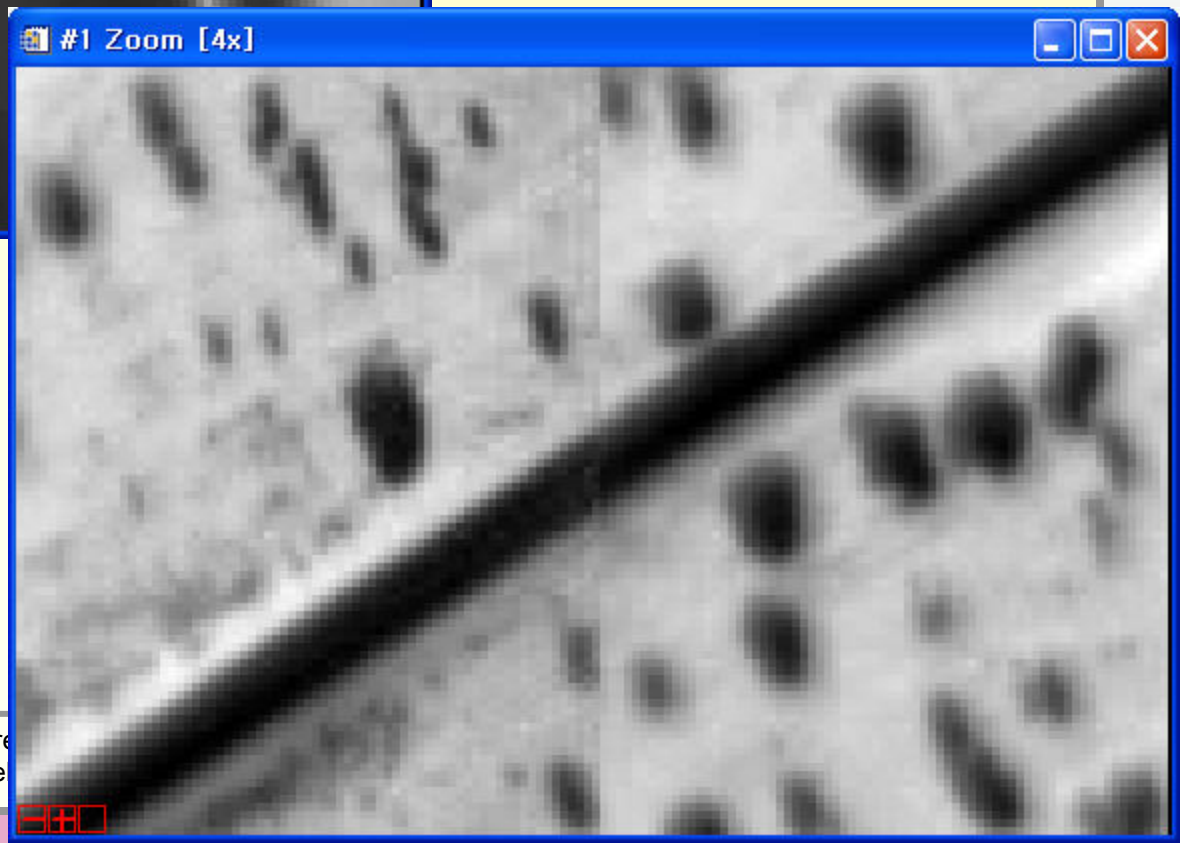


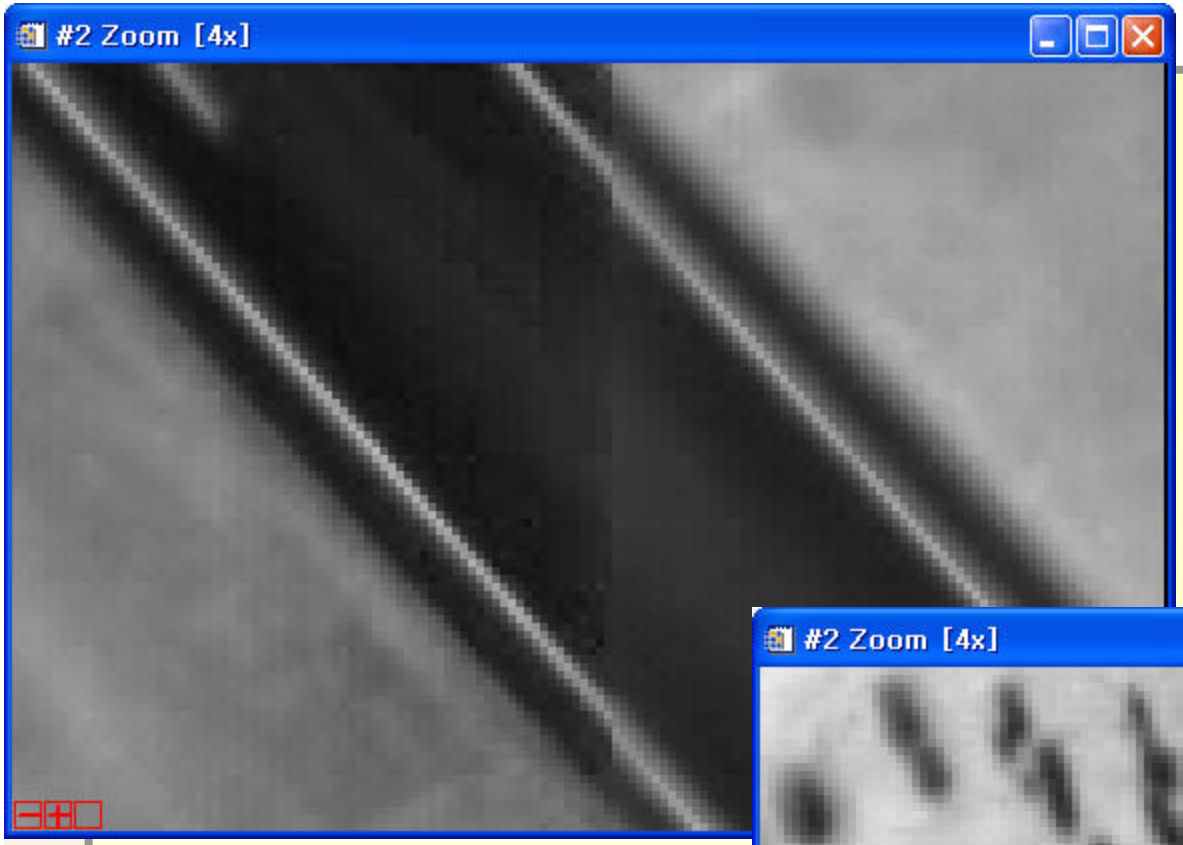


Calibration & Validation in KARI

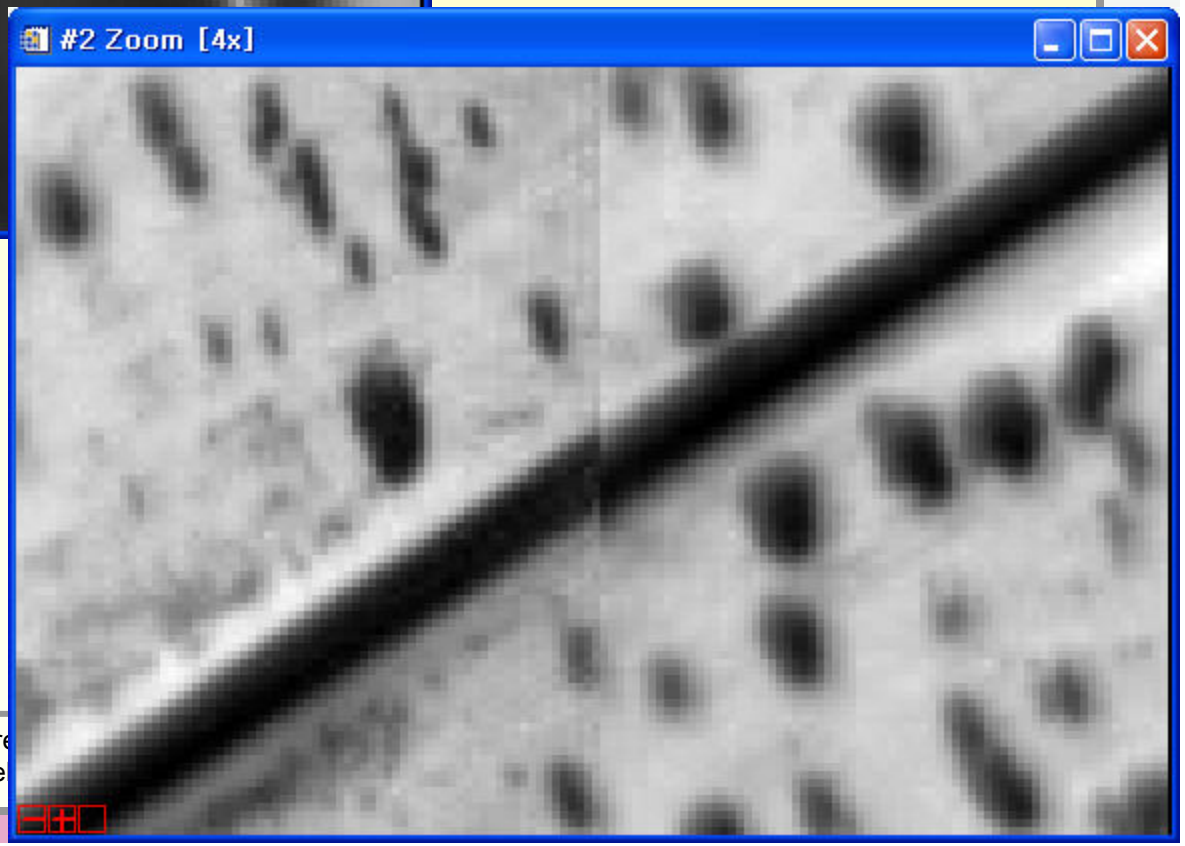
- **Cal/Val Requirements**
  - Requirements in KOMPSAT System Specification
  - Requirements from Users
- **Work Scope**
  - Characterization & Calibration & Validation & Image data Restoration
    - Cal/Val work scope in KARI
  - Image Enhancement
    - User's work scope
- **Activities**
  - Before KOMPSAT Launch
  - After KOMPSAT Launch (during LEOP)
  - In normal operation

-31(p2)-42(p4) pixels remove
-default



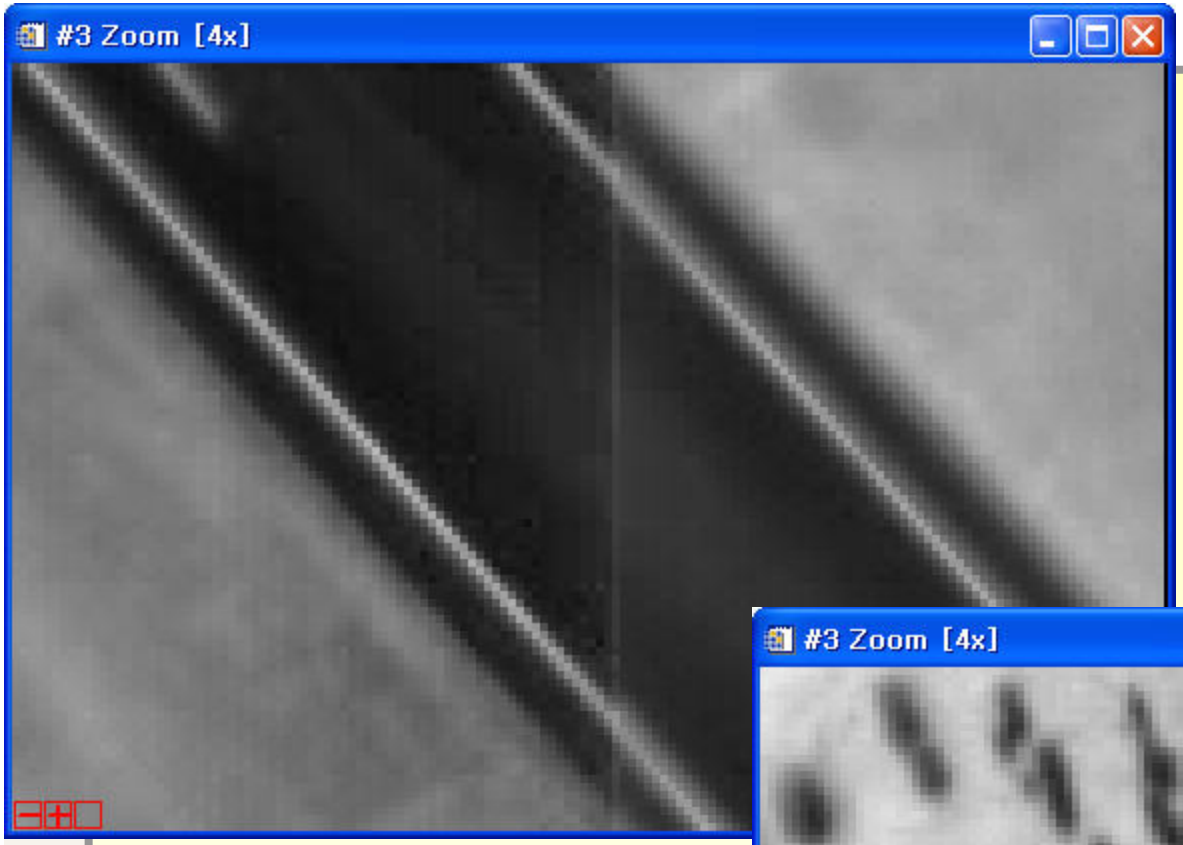


-31(p2)-40(p4) pixels remove
-2 pixels added

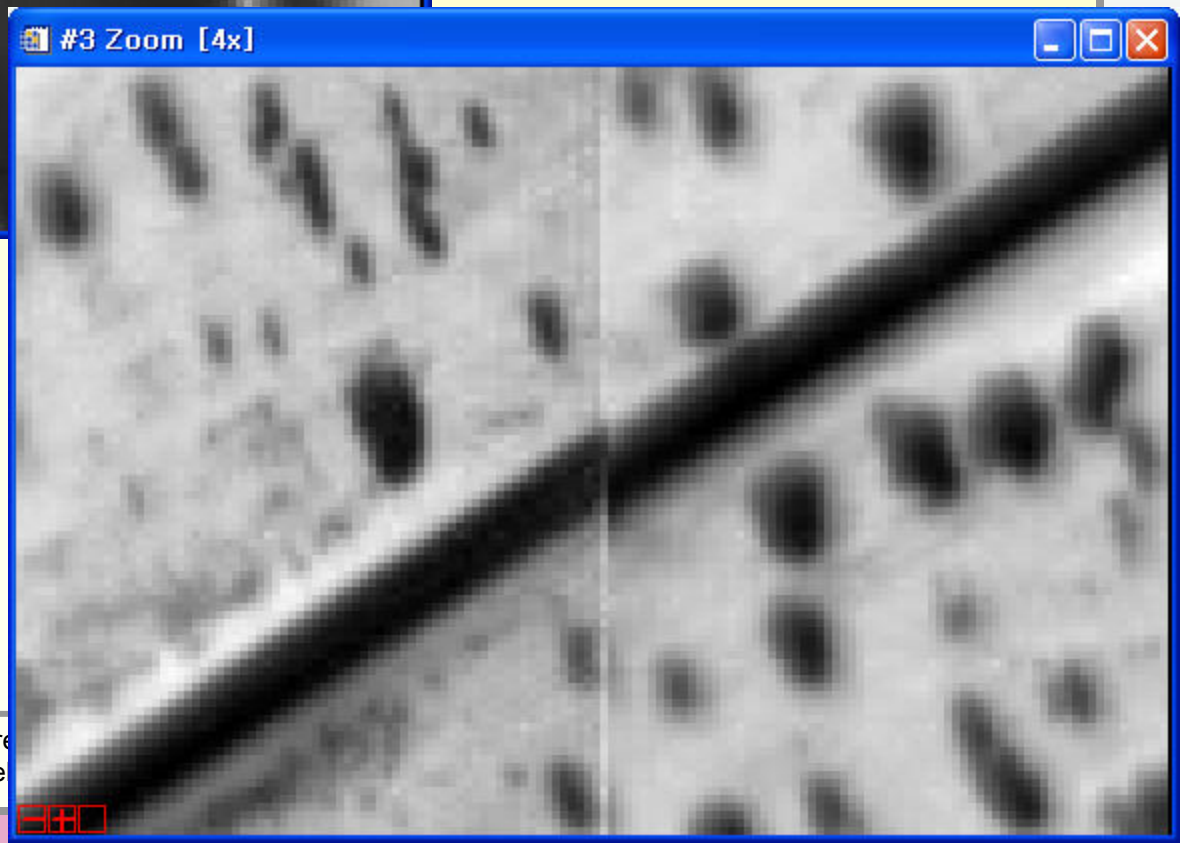


QA4EO
Sep. 30, 2009

Kore
Satel



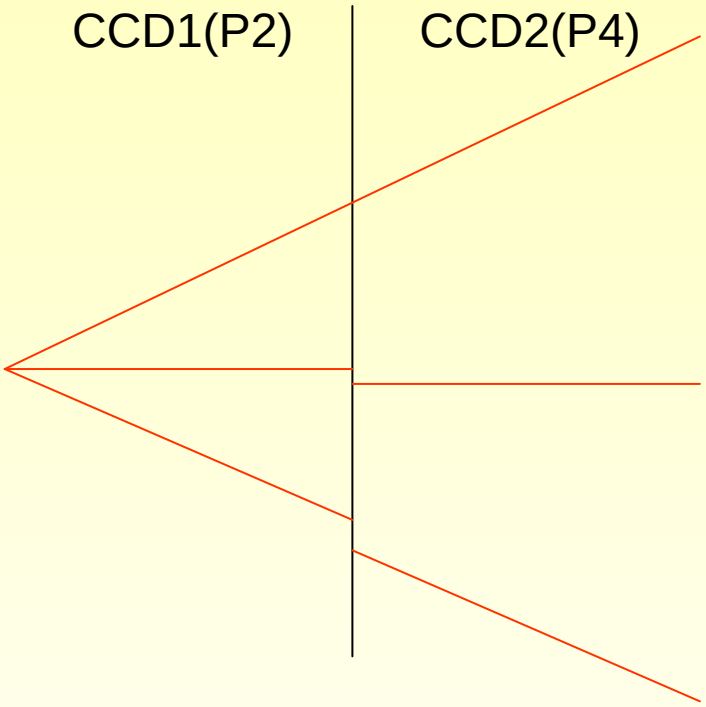
-30(p2)-40(p4) pixels remove
-3 pixels added



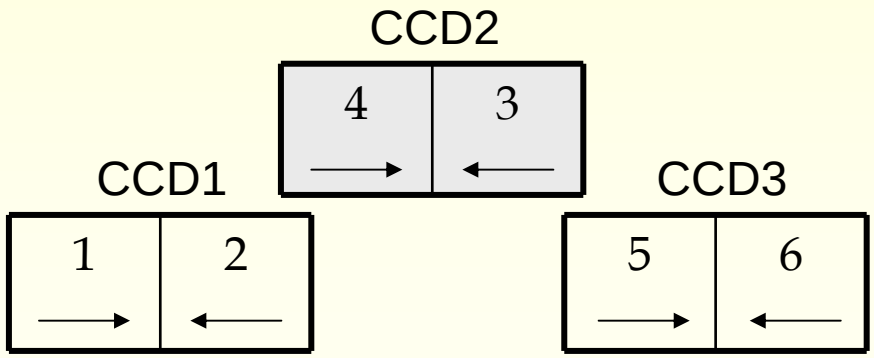
QA4EO
Sep. 30, 2009

Kore
Sate

X-man (?) in KOMPSAT-2

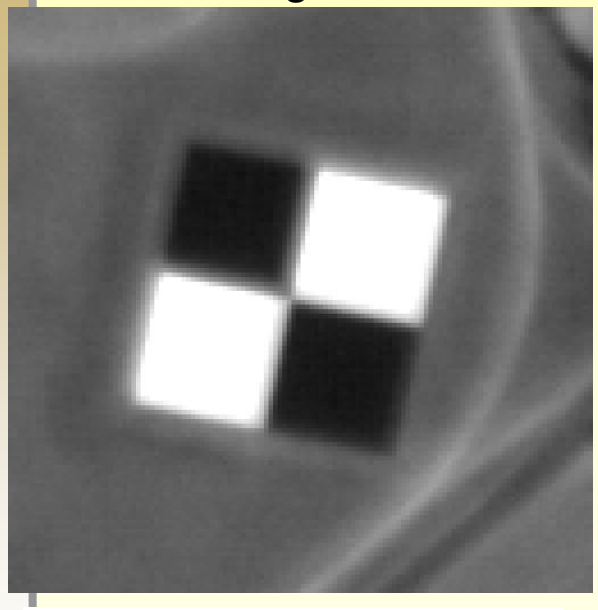


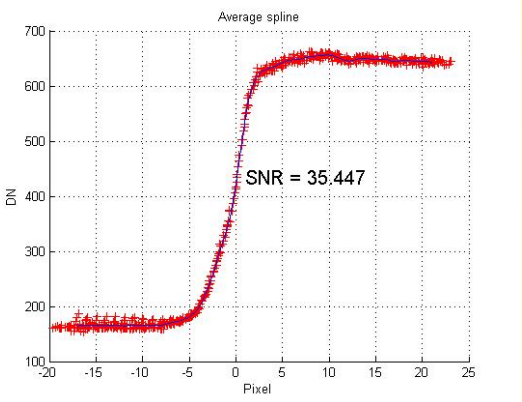
1. Magnification difference between CCD1 and CCD2
2. Move CCD2 to Right and Up



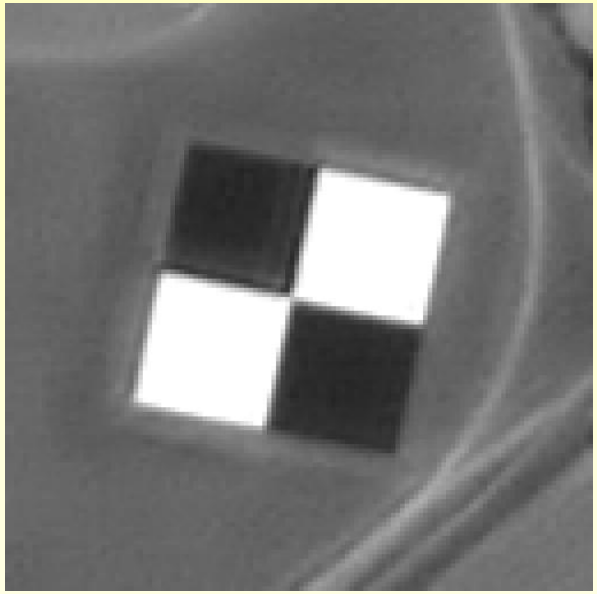
MTF Compensation in KOMPSAT-2

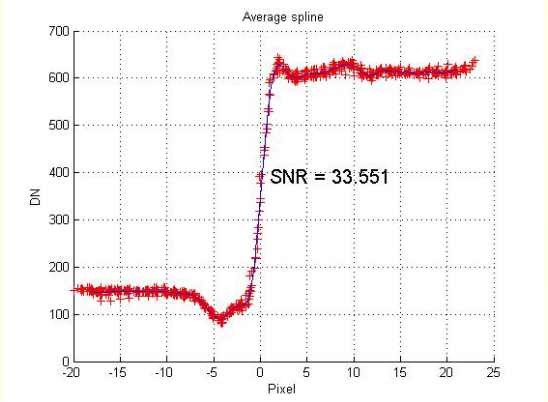
Origin



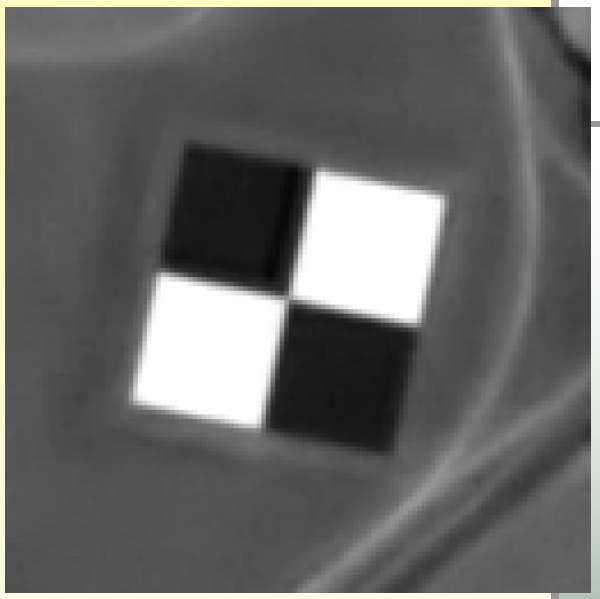


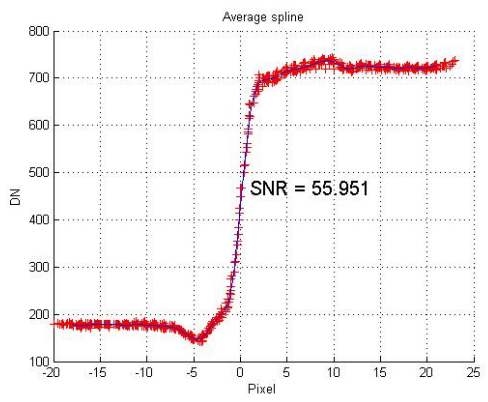
MTF C. With 13





MTF C. With 7

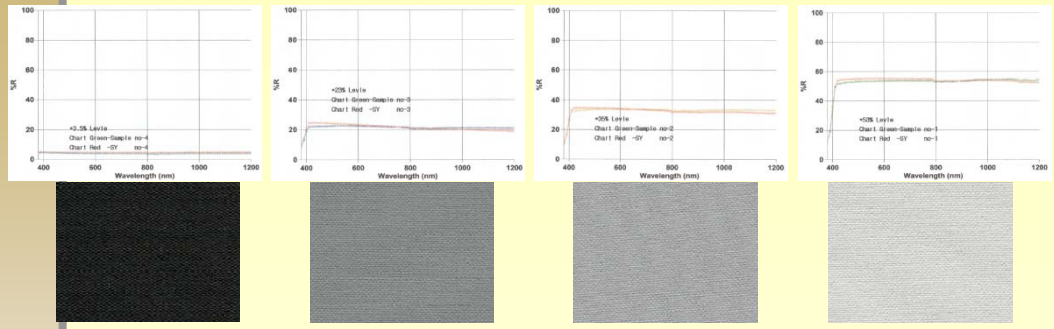




Cal/Val Targets and Equipments

Target	Cal/Val Parameter	Site	Schedule
Siemens (TBD)	MTF	Korea	Ready
Edge	MTF, PSF, Absolute radiometric Cal.	Mongol	2010
Simul target	MTF, PSF, GCP, GSD	Portable	Ready
Night Lamp	MTF, PSF	Portable	Ready
Tarp	MTF, PSF, Radiometric	Portable	Ready
GCP DB, MAP data	Interior Orientation, Geo-accuracy, KPADS, AOCS, Planimetric, Registration	Korea, Mongol, Worldwide	2005 ~ 2010
DSM	Planimetric, Registration	Korea	2009 ~ 2010
Radiometric equipments	Spectrometer, Sky-radiometer, etc.		Ready
Geometric equipments	Total station, DGPS Receiver		Ready
S/W	Imatest, ENVI, ERDAS, Matlab, Modtran, Visual studio, Algorithm, etc.		Ready, 2009 ~ 2010

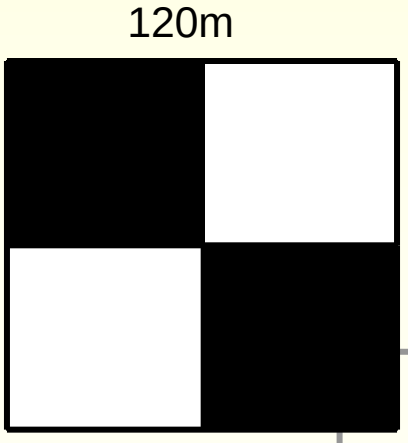
Cal/Val Targets and Equipments

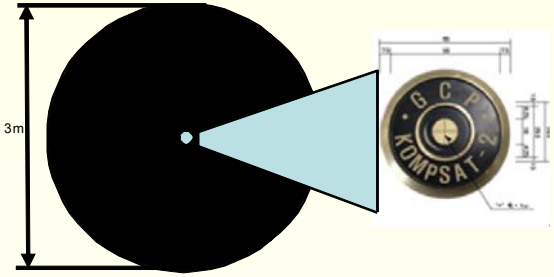


3.5% 23% 35% 53%

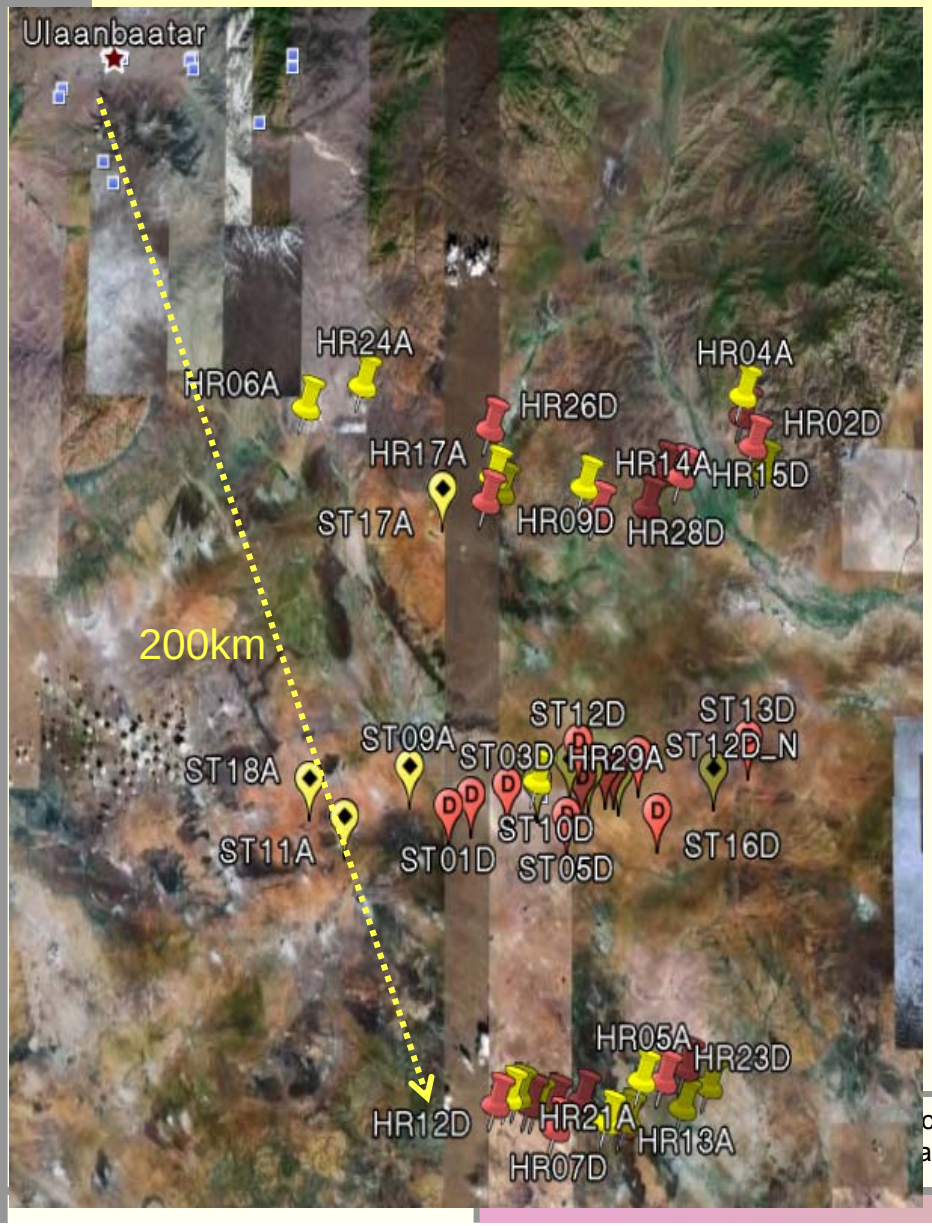
KOMPSAT Cal. site in Mongolia

Items	Target Type	Requirement	
		Specification	Characteristic
Spatial	Concrete square	120m x 120m	Concrete basis and Painting on Black part
	Night lamp	1kw (6~9EA)	On ground
Radiometric	Tarp	20m x 20m per each gray level	4 gray level with fixed reflectance
	Grass field	40m x 40m	Spectroradiometer
	Desert	40m x 40m	Spectroradiometer
	bare land (soil)	40m x 40m	Spectroradiometer
Geometric	Digital Map	Map coverage: 20km x 20km	Map scale: 1/5000 ~ 1/10000 Accuracy<5m
	Ortho image	Coverage: 20km x 20km	Accuracy<5m, GSD=1m
	GCP Target	Diameter=3m Coverage: 16km x 16km	White or Black painting
KOMPSAT-5 Corner Reflector	Install	Around 52 CRs	Install with Concrete basis





KOMPSAT-5 Corner Reflector in Mongol



Mongolia~!

KARI's Future works

- **Standardization of KOMPSAT image data**
  - **Image data Quality**
  - **Image data Storage format**
  - **Communication with Users**
  - **CEOS WGCV & QA4EO**
- **Calibration & Validation**
  - **Share the Cal/Val site, target & activity**
    - **Mongolian Cal/Val site & targets**
    - **Korean Cal/Val site & targets**
    - **Cal/Val activities**