Calibration, Validation, and Image Data Quality Control for KOMPSAT

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Korea Aerospace Research Institute (KARI)
Space Program in Korea

Korea Aerospace Research Institute (KARI)
Satellite data Calibration and Validation team (SCV)

CEOS WGCV-41 (2016)
Cal/Val team in KARI

- Calibration/Validation/Evaluation collaboration including information related to Image Data Processing and Quality

- National Satellite Operation and Application Center in KARI (NSOAC)
Cal/Val team in KARI

Cal/Val

- Characterization
- Calibration & Validation
- Image data Restoration

- KOMPSAT-2, 3, 3A, 5
- GK2, CAS, KOMPSAT-6, 7
- Cal/Val site: Develop/Monitoring
- Cal/Val S/W, Equip.: Develop
- Abs. Radio. Cal. (3,3A,7,CAS,GK2)
- SAR Processor & Product Processor: Develop

Image Quality Control

- Image data Quality Monitoring / Improvement
- IQ (Image data Quality)
- QR (Quality Report)
- Image data Quality Enhancement
- Meeting with Users Group
- CEOS WGCV IVOS/SAR

Korea Aerospace Research Institute (KARI)
Satellite data Calibration and Validation team (SCV)
Cal/Val Preparation for EO (KOMPSAT-3, 3A, 7, CAS)

< Cal/Val Preparation for SAR (KOMPSAT-6) >
Please see the next presentation at CEOS WGCV SAR Workshop.
“KOMPSAT-6 Mission and External Calibration System Design” by Dochul Yang
Cal/Val Work Flow in KARI

Pre-Launch

On-Ground Verification & Characterization

Initial values define

Post-Launch

LEOP

IAC (In-Orbit Activation & Check)

Characterization

Calibration / Validation

Restoration in IRPE

Performance Validation

Update values and parameters of Satellite, Camera and Image data Product Processor

Life-Time

Performance monitoring

Re-Characterization Re-Calibration

Performance validation
Cal/Val Flow after Launch (EO, IR)

Characterization
- Dynamic range, PAN selection
- Noise (Random, Periodic, Non-Linearity)
- MTF, SNR, GSD
- Geo-accuracy

Cal/Val
- Decide TDI Gain, Equalization (Vp, HF NUC)
- OD, POD, AOCS on-orbit Cal.+PAD
- PSF, MTF

Restoration
- Equalization (LF NUC, Butting zone, Uniformity)
- Reduce Noise, MTFC
- Registration, Planimetric accuracy
- Geo-accuracy with IRPE
- DN to Radiance

Enhancement
- Linear Stretch
- Fusion (PAN Sharpening)
- User’s Application
KOMPSAT-3 Cal/Val work Flow in LEOP Example

- **Think line box**: Checking K3 Spec. value
- **Blue painted box**: Final Cal/Val work
- **Gray painted box**: @ IAC & @ Normal
- **Black box**: Radiometric Cal/Val
- **Green box**: Spatial Cal/Val
- **Blue box**: Geometric Cal/Val
# KOMPSAT Cal/Val Target, Equipment

<table>
<thead>
<tr>
<th>Target</th>
<th>Cal/Val Parameter</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night Lamp</td>
<td>MTF, PSF</td>
<td>Portable</td>
</tr>
<tr>
<td>Star</td>
<td>MTF, PSF</td>
<td>Night</td>
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<tr>
<td>Tarp</td>
<td>Linearity, Radiometric</td>
<td>Portable</td>
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<tr>
<td>GCP DB</td>
<td>Pointing &amp; Location accuracy</td>
<td>Korea, Mongol</td>
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<tr>
<td></td>
<td>KPADS, AOCS, Registration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mapping quality</td>
<td></td>
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<tr>
<td>MAP data</td>
<td>Pointing &amp; Location accuracy</td>
<td>Korea, Mongol, Worldwide</td>
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<td></td>
<td>KPADS, AOCS, Registration</td>
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<tr>
<td>Radiometric equipment</td>
<td>Spectro-radiometer</td>
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<tr>
<td></td>
<td>Sun-photometer</td>
<td>Portable</td>
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<tr>
<td></td>
<td>Multi-Filter Rotating Shadow band Radiometer</td>
<td>Portable</td>
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<tr>
<td></td>
<td>Ultraviolet Multi-Filter Radiometer</td>
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<tr>
<td></td>
<td>Temperature measurement equipments</td>
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</tr>
<tr>
<td>Geometric equipment</td>
<td>GPS instrument</td>
<td>Portable</td>
</tr>
<tr>
<td></td>
<td>Total station</td>
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</table>

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<tr>
<th>Target</th>
<th>Cal/Val Parameter</th>
<th>Site</th>
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<tbody>
<tr>
<td></td>
<td>Imatest (MTF)</td>
<td>Commercial</td>
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<tr>
<td></td>
<td>ENVI, ERDAS (Remote Sensing S/W)</td>
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<tr>
<td></td>
<td>MODTRAN (Atmospheric simulation)</td>
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<td>STK (Imaging Planning)</td>
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<tr>
<td></td>
<td>Matlab, Visual Studio (Developing Tool)</td>
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<tr>
<td></td>
<td>Cal/Val SW</td>
<td>Develop</td>
</tr>
<tr>
<td></td>
<td>MTF Measurement SW</td>
<td>Develop</td>
</tr>
<tr>
<td>GRDB</td>
<td>Geometric Cal/Val site, Ortho image</td>
<td>Develop</td>
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<tr>
<td></td>
<td>MS SQL DBMS &amp; Server+RAID</td>
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<tr>
<td></td>
<td>Radiance Map in Worldwide</td>
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<tr>
<td></td>
<td>Radiance prediction S/W for ICPS</td>
<td>Develop</td>
</tr>
</tbody>
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CEOS WGCV-41 (2016)
Korea Aerospace Research Institute (KARI)
Satellite data Calibration and Validation team (SCV)
Cal/Val site for Geometric

Geometric Cal/Val Site

- Level 0 site
  - Geometric Calibration: Detector & Band distortion, Alignment, AOCS absolute calibration, Mapping accuracy
  - Accuracy < 3~10 cm, Mongolia, GoHeung, KimJe, SeoSan in Korea
- Level 1 site
  - Geometric validation: Location accuracy, Pointing accuracy
  - Accuracy < 5 m, Worldwide area: 50 sites
GRDB (Cal/Val Ground Reference DB)

- Geometric cal/val site
- Radiometric cal/val site
- Spatial cal/val site
KOMPSAT Cal/Val S/W

- Cal/Val S/W
  - Ground Reference DB
  - Cal/Val Image Plan
  - Data Processing Module
  - Characterization Module
  - Calibration Module
  - Validation Module
KOMPSAT Cal/Val S/W

Characterization Module
KOMPSAT Cal/Val S/W

Calibration/Validation Module

CEOS WGCV-41 (2016)
Korea Aerospace Research Institute (KARI)
Satellite data Calibration and Validation team (SCV)
Image Data Quality Control
### Product Quality Checking for Users during Normal period

**QR (Quality Report) for KOMPSAT-3 Image Data**

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
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<tbody>
<tr>
<td>QR No.</td>
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<td>Processed By</td>
<td>KARI, Gil-Dong Hong</td>
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<td>Anomalies Image</td>
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<tr>
<td>Dynamic range</td>
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<tr>
<td>Saturation</td>
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</tr>
<tr>
<td>Abnormal Pixel (except Blooming)</td>
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</tr>
<tr>
<td>Equalization: inter-Detector (NUC)</td>
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</tr>
<tr>
<td>Pattern noise</td>
<td></td>
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<tr>
<td>Compression noise</td>
<td></td>
</tr>
<tr>
<td>Registration (MS-MS)</td>
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</tr>
<tr>
<td>Registration (MS-PAN)</td>
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<tr>
<td>Location accuracy</td>
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<tr>
<td>Comments / Image chip</td>
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<tr>
<td>Review Date</td>
<td></td>
</tr>
<tr>
<td>Review Comments</td>
<td></td>
</tr>
</tbody>
</table>

- **Dynamic range**: Level 1: Accepted, Level 2: To be Proposed, Level 3: Rejected
- **Saturation**: Level 1: Accepted, Level 2: To be Proposed, Level 3: Rejected
- **Abnormal Pixel (except Blooming)**: Level 1: Accepted, Level 2: To be Proposed, Level 3: Rejected
- **Equalization: inter-Detector (NUC)**: Level 1: Accepted, Level 2: To be Proposed, Level 3: Rejected
- **Pattern noise**: Level 1: Accepted, Level 2: To be Proposed, Level 3: Rejected
- **Compression noise**: Level 1: Accepted, Level 2: To be Proposed, Level 3: Rejected
- **Registration (MS-MS)**: Level 1: Accepted, Level 2: To be Proposed, Level 3: Rejected
- **Registration (MS-PAN)**: Level 1: Accepted, Level 2: To be Proposed, Level 3: Rejected
- **Location accuracy**: Level 1: Accepted, Level 2: To be Proposed, Level 3: Rejected

**Comments / Image chip**

- Cloud, Water, Snow area: to be take off for constraints: saturation, compression, NUC and pattern noise

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*QR (Quality Report) is the Internal report in KARI to monitor the KOMPSAT-3 Product (Image data) Quality.*
• Reducing the Noise from Feb. 2015 after applying the additional Cal/Val
• But, Compression noise is still high.
  ✓ Because User(reseller) can choose the Compression ratio and still use ‘5.5’ for MS image data.
Enhancement: K3 Digital Zooming

KOMPSAT-3
(70cm)

KOMPSAT-3
(50cm)
KARI in CEOS WGCV

- CEOS WGCV IVOS #22, #23, QA4EO 2009
- CEOS WGCV IVOS #26, 2014.06.04~06, CalTech, Pasadena in California (4 presentations)
- CEOS WGCV #38, 2014.09.30~10.3, NOAA, College Park in Maryland (2 presentations)
- CEOS WGCV IVOS #27, 2015.11.18~20, ONERA, France (2 presentations)
- CEOS WGCV SAR Workshop 2015, 2015.10.27~29, Geneva, Swiss, (1 presentation)