Study of using multi-Geo-satellites : PART III

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NMSC
Summary of previous reports
Advantage of using GEO-GEO

Image Composition

Example: Typhoon NEOGURI

- COMS/MI vs. Himawari-8/IMAGE
- Date: 2014.07.05~08UTC
- COMS Image: Every 15, 30, 45 Min
- MTSAT-2 Image: Every Hour
- Rapid scan satellite images needed for utilization of rapidly developing thunderstorm, and typhoon analysis
- Different cloud position due to different satellite nadir position and parallax need to be corrected
Advantage of using GEO-GEO

Image Composition

- can be used together crossing

Example: Typhoon NEOGURI
- COMS/MI vs. Himawari-8/Image
- Date: 2014.7.5.~8.
- COMS Image: Every 15, 30, 45 Min
- MTSAT-2 Image: Every Hour
Advantage of using GEO-GEO

Image Composition

- can be used together crossing

**COMS 2015.08.01, 07:00UTC**

- Example: Rapidly developing thunderstorms
- COMS/MI vs. Himawari-8/AHI
- Case: 2015.8.1. 07~08UTC
Advantage of using GEO-GEO

Image Composition

- Example: Rapidly developing thunderstorms
- COMS/MI vs. Himawari-8/AHI
- Case: 1 August 2015 07~08UTC
Contents

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2 Advantage of using GEO-GEO
3 KMA Progress on GEO-GEO inter-calibration
4 Issues
5 Application
Himawari-8,
FY-4A,
GK-2A
Observation Area and Time

<table>
<thead>
<tr>
<th>Area</th>
<th>Scan line No.</th>
<th>Observation time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area 1 (Ease-Asia)</td>
<td>3 ~ 6 (5)</td>
<td>77~162 s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48~134 s</td>
</tr>
<tr>
<td>Area 2 (Australia)</td>
<td>15 ~ 20(17)</td>
<td>381~512 s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>384~538 s</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Swath No.</th>
<th>Time of Line center</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>AMI: 135, AHI: 100</td>
</tr>
<tr>
<td>17</td>
<td>AMI: 458, AHI: 452</td>
</tr>
</tbody>
</table>
Start observation alternately every 5 minutes

AHI 00:00

Point 1 1:40
Point 2 7:32

AMI 00:05

Point 1 7:15
Point 2 12:38

AHI 00:10

Point 1 11:40
Point 2 17:32

AMI 00:15

Point 1 17:15
Point 2 22:38

Point 1 5:35
Point 2 5:06

Point 1 4:25
Point 2 4:54

Point 1 5:35
Point 2 5:06

National Meteorological Satellite Center
Himawari-8 and GK-2A

Start observation at the same time

<table>
<thead>
<tr>
<th></th>
<th>AHI 00:00</th>
<th></th>
<th>AMI 00:00</th>
<th></th>
<th>AHI 00:10</th>
<th></th>
<th>AMI 00:10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point 1</td>
<td>1:40</td>
<td>Point 1</td>
<td>2:15</td>
<td>Point 1</td>
<td>11:40</td>
<td>Point 1</td>
<td>12:15</td>
</tr>
<tr>
<td>Point 2</td>
<td>7:32</td>
<td>Point 2</td>
<td>7:38</td>
<td>Point 2</td>
<td>17:32</td>
<td>Point 2</td>
<td>17:38</td>
</tr>
<tr>
<td>Point 1</td>
<td>35s</td>
<td>Point 1</td>
<td>9:25</td>
<td>Point 1</td>
<td>35s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point 2</td>
<td>6s</td>
<td>Point 2</td>
<td>9:54</td>
<td>Point 2</td>
<td>6s</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Himawari-8, FY-4A, and GK2A

**FY-4A/AGRI**
- Orbit: 105°E
- 14 channels
- Providing Agency: CMA

**GK2A/AMI**
- Launch: Dec. 2018
- Orbit: 128.2°E
- 16 channels
- Providing Agency: KMA

**Himawari-8/AHI**
- Orbit: 140.7°E
- 16 channels
- Providing Agency: JMA

![](image.png)
Advantage of using GEO-GEO (by JMA)

Validation of GEO-LEO inter-calibration products
- can be implemented by double-differencing
  - ex) (GEO2-LEO1)-(GEO1-LEO1)=(GEO2-GEO1)

Check the calibration performance
- can be used to Quantifying diurnal variation of radiance
- have higher temporal, spatial resolution than result of GEO-LEO inter-calibration
- can be used for Calibration transfer when GEO is not collocated with LEO
  - t1: GEO1 – LEO
  - t2: (GEO2 – LEO)² – (GEO2 – GEO1)² – SBAF(GEO2/GEO1) = (GEO1 – LEO)²
  - t3: (GEO3 – LEO)² – (GEO3 – GEO2)² – SBAF(GEO3/GEO2) = (GEO2 – LEO)²
  - (GEO2 – LEO)² – (GEO2 – GEO1)² – SBAF(GEO2/GEO1) = (GEO1 – LEO)²
Advantage of using GEO-GEO

Hyperspectral-Multispectral comparisons

- SRF validation/retrieval

Generation Global climate data (GSICS and IOGEO)

- can be basis for FCDR

Ref: Rob et al, 2018, Planning comparison study SCM IOGEO and GSICS, 2018 GSICS Web meeting on GEO-GEO Inter-calibration
Advantage of using GEO-GEO

Image Composition

- can be used to Composite Multi GEO Image
- can be used to Composite RGB image (Airmass, Dust, etc.)

[Reference]
- Wang et al., 2009, Intercalibration of GOES-11 and GOES-12 Water Vapor Channels with MetOp IASI Hyperspectral Measurements, AMS.
- Hidehiko et al., 2018, Himawari-8/9 AHI GEO-GEO Comparisons, 2018 GSICS Annual meeting.
- Tabata, 2018, Re-calibration of IR and WV channel onboard historical JMA’s GEO satellites (collaboration with EUMETSAT), 2018 GSICS Web meeting on GEO-GEO Inter-calibration.
- Rob et al, 2018, Planning comparison study SCM IOGEO and GSICS, 2018 GSICS Web meeting on GEO-GEO Inter-calibration.
KMA Progress on GEO-GEO inter-calibration
- Diurnal Variation
Tb Diurnal Variation

MI vs. AHI, MI vs. LEO (Annual)

- Period: 2016~2017

<table>
<thead>
<tr>
<th>Compatible channel information</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI</td>
</tr>
<tr>
<td>AHI</td>
</tr>
</tbody>
</table>
Tb Diurnal Variation

MI vs. AHI, MI vs. LEO (Seasonal)
- Spring (March, April, May)
Tb Diurnal Variation

MI vs. AHI, MI vs. LEO (Seasonal)

- Summer (June, July, August)
**Tb Diurnal Variation**

**MI vs. AHI, MI vs. LEO (Seasonal)**

- Autumn (September, October, November)
**Tb Diurnal Variation**

**MI vs. AHI, MI vs. LEO (Seasonal)**

- Winter (December, January, February)
**Tb Diurnal Variation**

**MI vs. AHI (All day clear condition)**
- MI and AHI Tb diurnal variation is analyzed in clear pixels without cloud effect all day
- Case: Jan. 1 2018, 35.4°N, 130.1°E
- Standard temperature: 285.985K(SWIR), 237.568K(WV), 286.262K(IR1), 285.069K(IR2)
Issues
Issues

Usage of multi GEO satellites data is affected by

- **Level1b data quality by sensor, radiance**
  - ✓ In case of RGB composition, color can be differ and Tb diurnal variations have scene dependence
- **SRF difference**
  - ✓ Uncertainty from SRF difference. SBAF or common channel is needed
- **Viewing angle difference**
  - ✓ For Image composition, Calibration diff. < SRF diff. < Limb diff.
- **Water Vapor**
  - ✓ In RGB composition, all IR channels to be used, the amount of WV in the atmosphere should be considered.
- **GSICS Inter-calibration uncertainty**
Thank you!

[Reference]
- Wang et al., 2009, Intercalibration of GOES-11 and GOES-12 Water Vapor Channels with MetOp IASI Hyperspectral Measurements, AMS.
- Hidehiko et al., 2018, Himawari-8/9 AHI GEO-GEO Comparisons, 2018 GSICS Annual meeting.
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