Study of using multi-Geo-satellites : PART III

Dohyeong Kim

2018.10.11.
NMSC/KMA
dolong@korea.kr

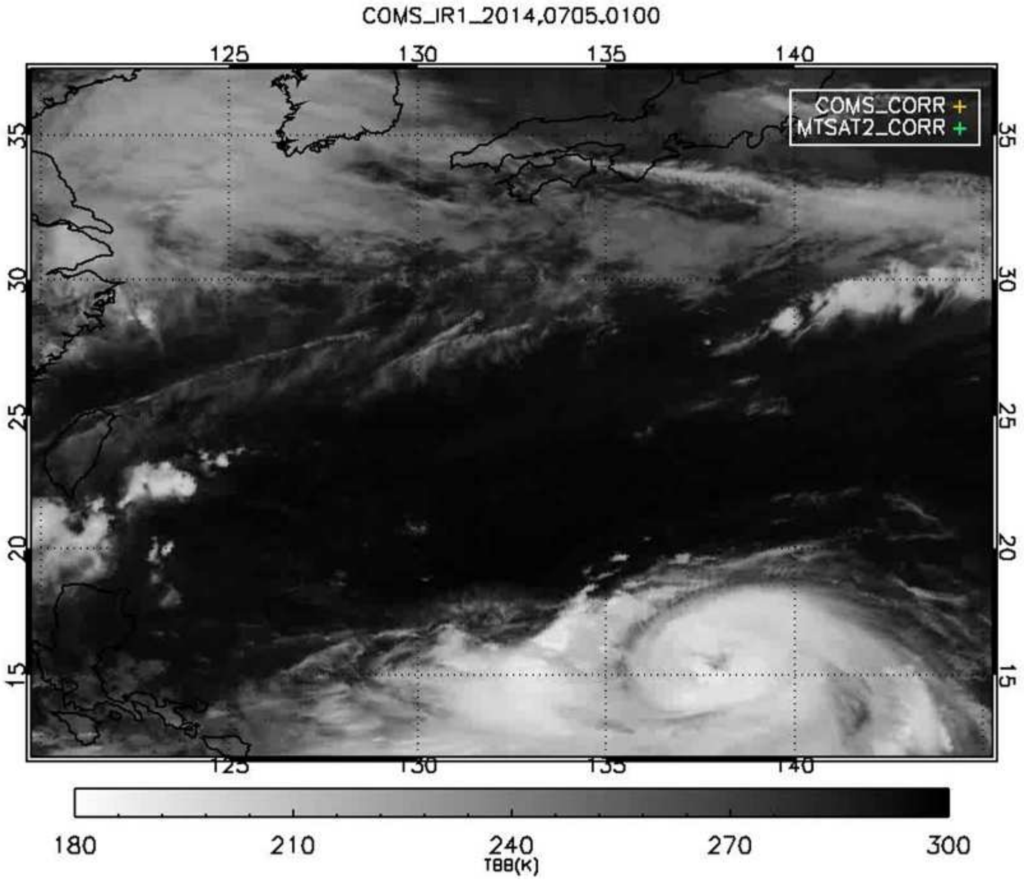
NMSC

Summary of previous reports

Advantage of using GEO-GEO

Image Composition

- Example: Typhoon NEOGURI

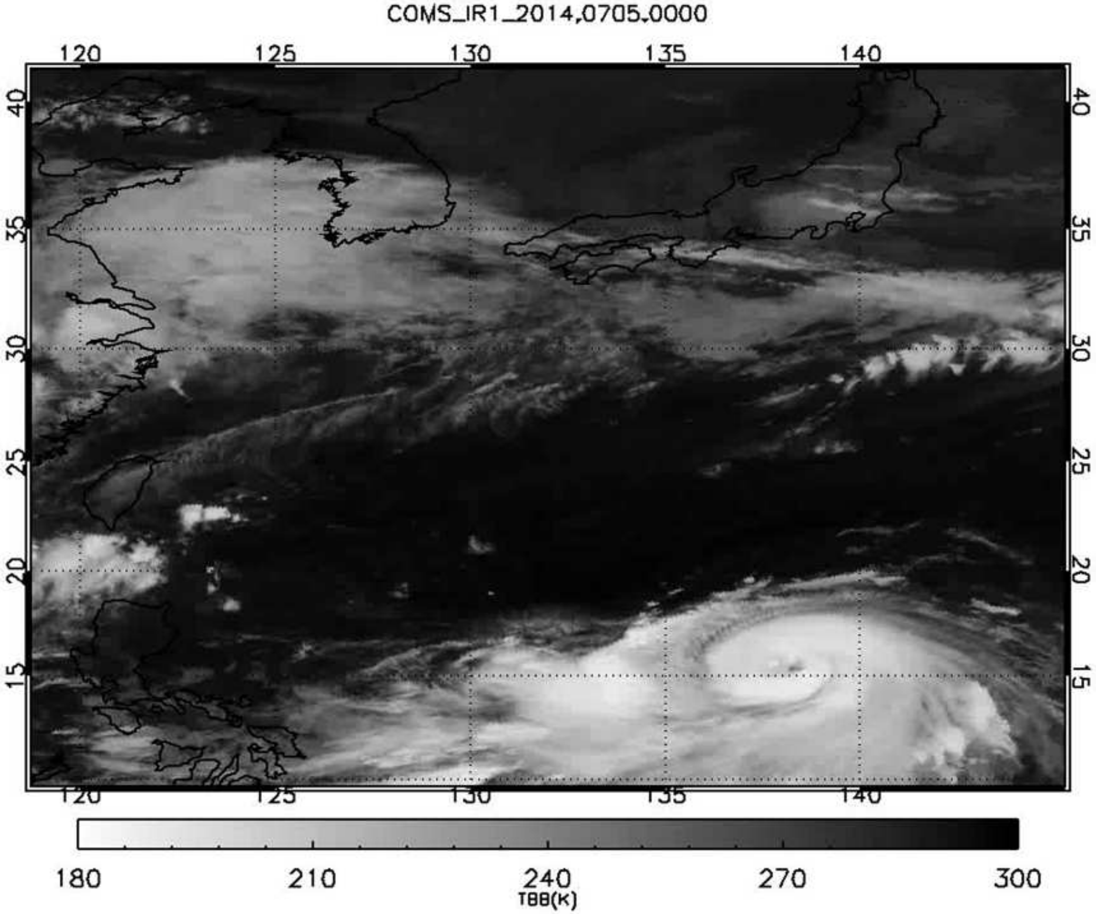


- COMS/MI vs. Himawari-8/Image
- Date : 2014.07. 05~08UTC
- COMS Image : Every 15, 30, 45 Min
- MTSAT-2 Image : Every Hour
- **Rapid scan satellite images** needed for utilization of rapidly developing thunderstorm, and typhoon analysis
- Different cloud position due to different satellite nadir position and parallax need to be corrected

Advantage of using GEO-GEO

Image Composition

- can be used together crossing

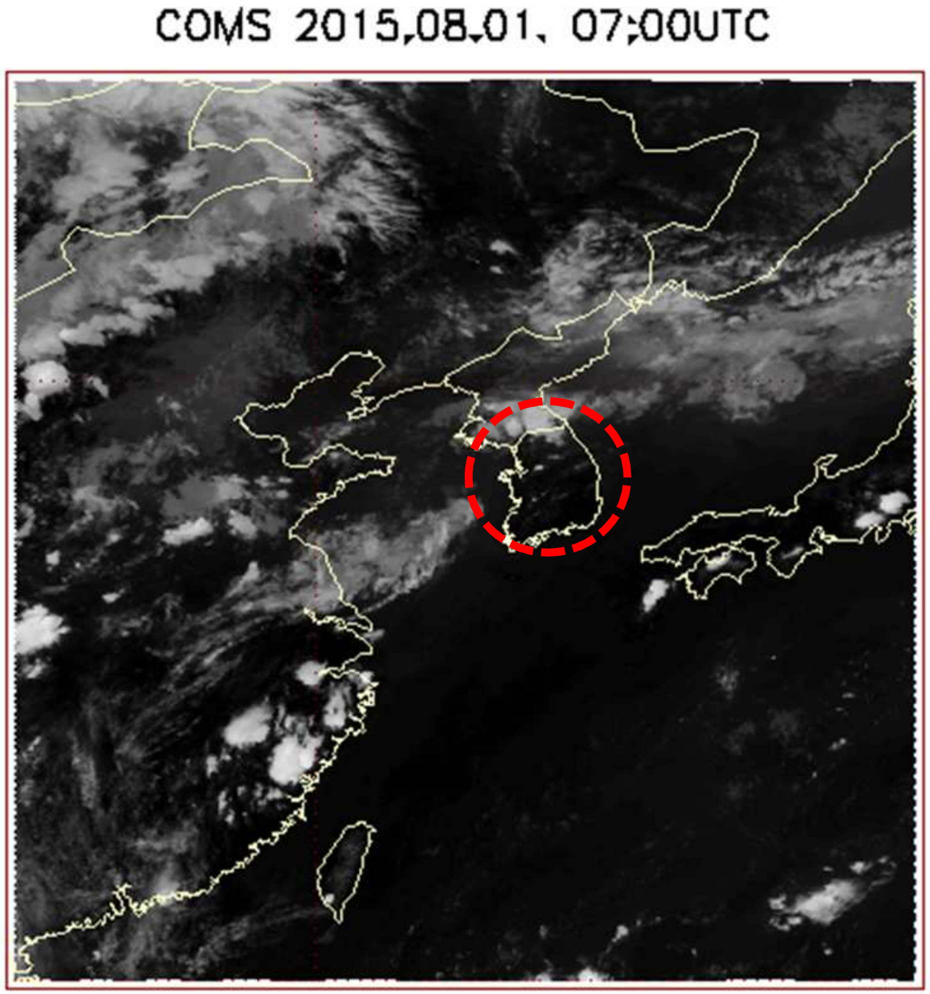


- Example: Typhoon NEOGURI
- COMS/MI vs. Himawari-8/Image
- Date : 2014.7.5.~8.
- COMS Image : Every 15, 30, 45 Min
- MTSAT-2 Image : Every Hour

Advantage of using GEO-GEO

Image Composition

- can be used together crossing



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

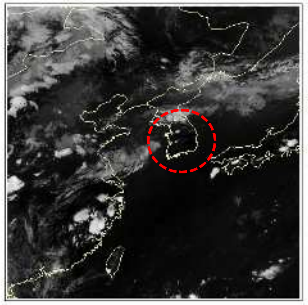
Advantage of using GEO-GEO

Image Composition

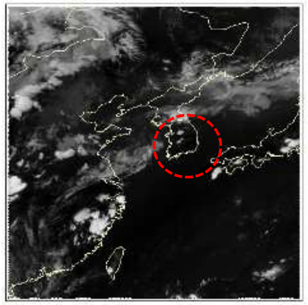
- Example: Rapidly developing thunderstorms
- COMS/MI vs. Himawari-8/AHI
- Case: 1 August 2015 07~08UTC


COMS 2015.08.01. 07:15UTC


COMS 2015.08.01. 07:30UTC


H8 2015.08.01. 07:20UTC


H8 2015.08.01. 07:40UTC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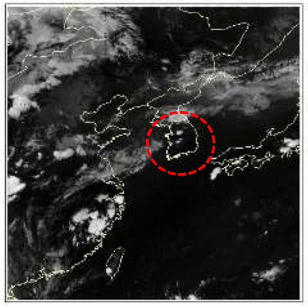
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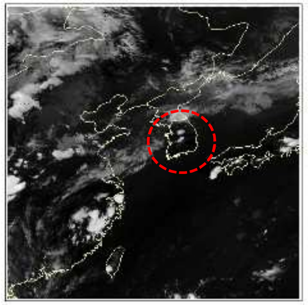
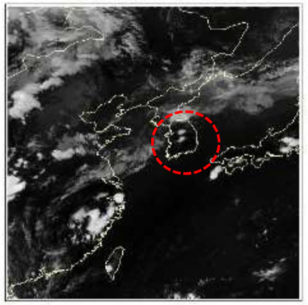
COMS 2015.08.01. 08:00UTC


H8 2015.08.01. 08:10UTC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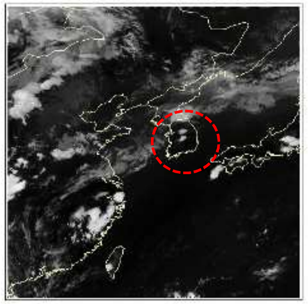
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3 **KMA Progress on GEO-GEO inter-calibration**

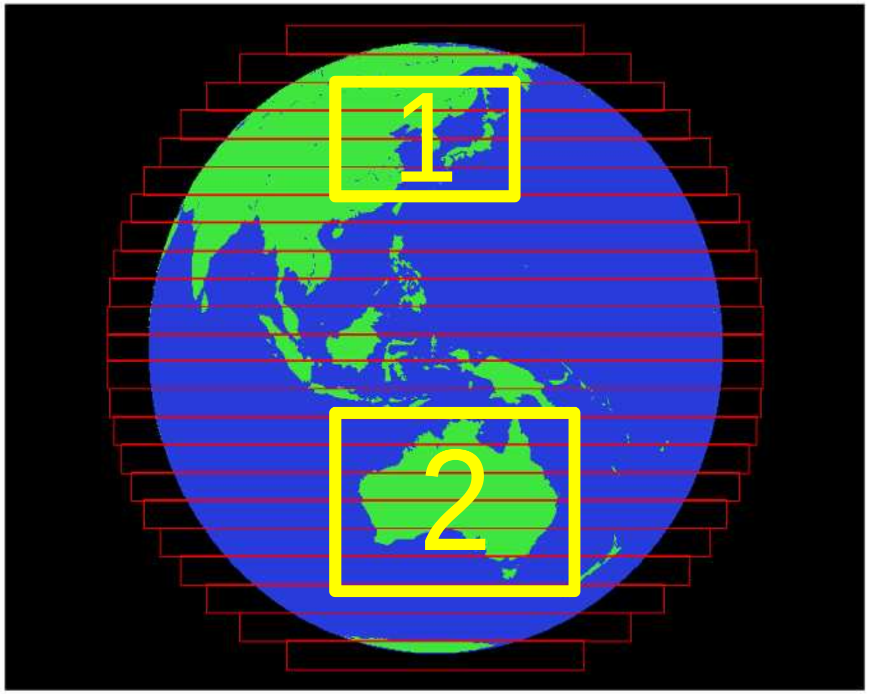
4 **Issues**

5 **Application**

Himawari-8,
FY-4A,
GK-2A

Himawari-8 and GK-2A

Observation Area and Time

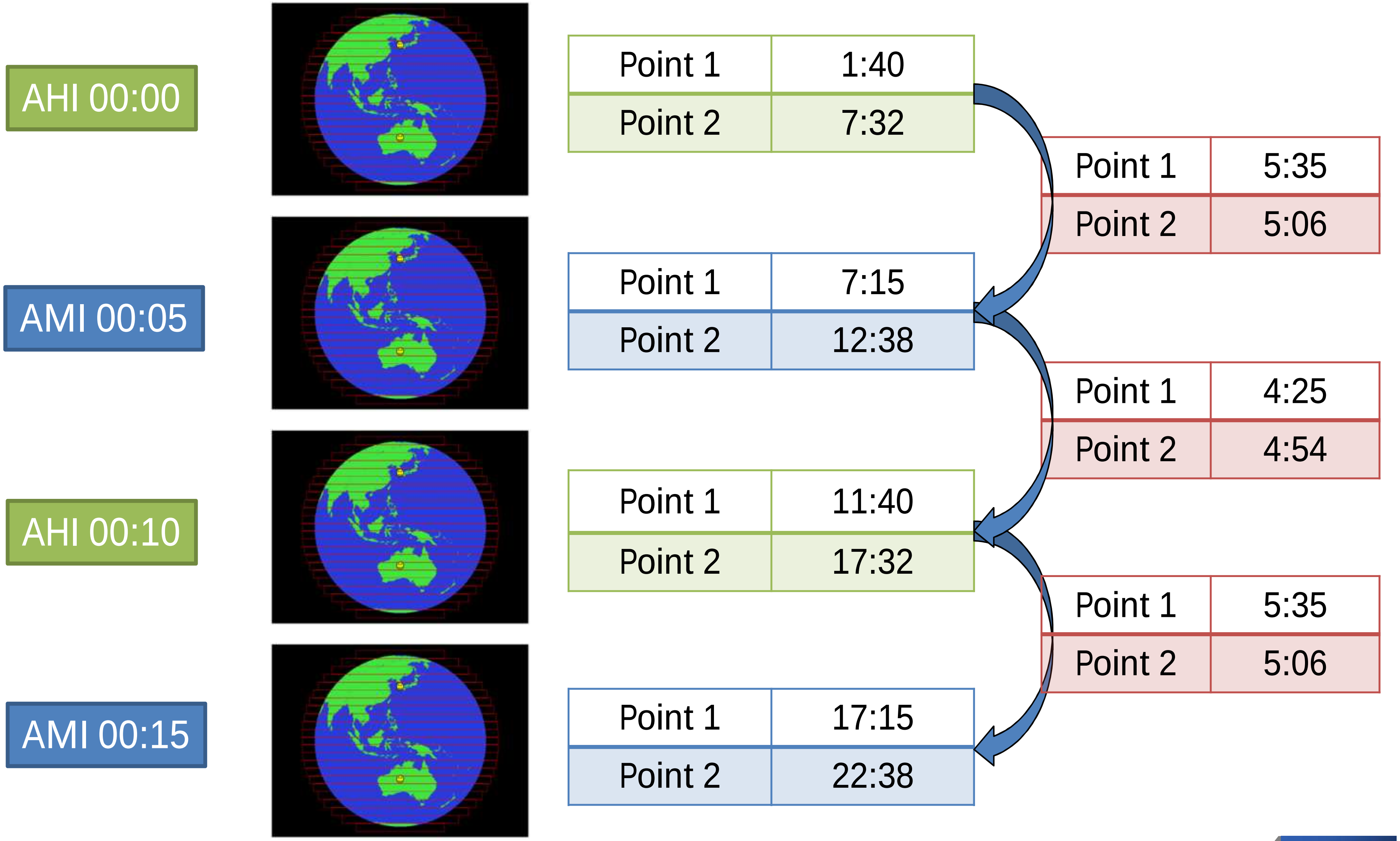


Area	Scan line No.	Observation time	
		AMI	AHI
Area 1 (Ease-Asia)	3 ~ 6 (5)	77~162 s	48~134 s
Area 2 (Australia)	15 ~ 20(17)	381~512 s	384~538 s

Swath No.	Time of Line center	
	AMI	AHI
5	135	100
17	458	452

Himawari-8 and GK-2A

Start observation alternately every 5 minutes



AHI 00:00

Point 1	1:40
Point 2	7:32

Point 1	5:35
Point 2	5:06

AMI 00:05

Point 1	7:15
Point 2	12:38

Point 1	4:25
Point 2	4:54

AHI 00:10

Point 1	11:40
Point 2	17:32

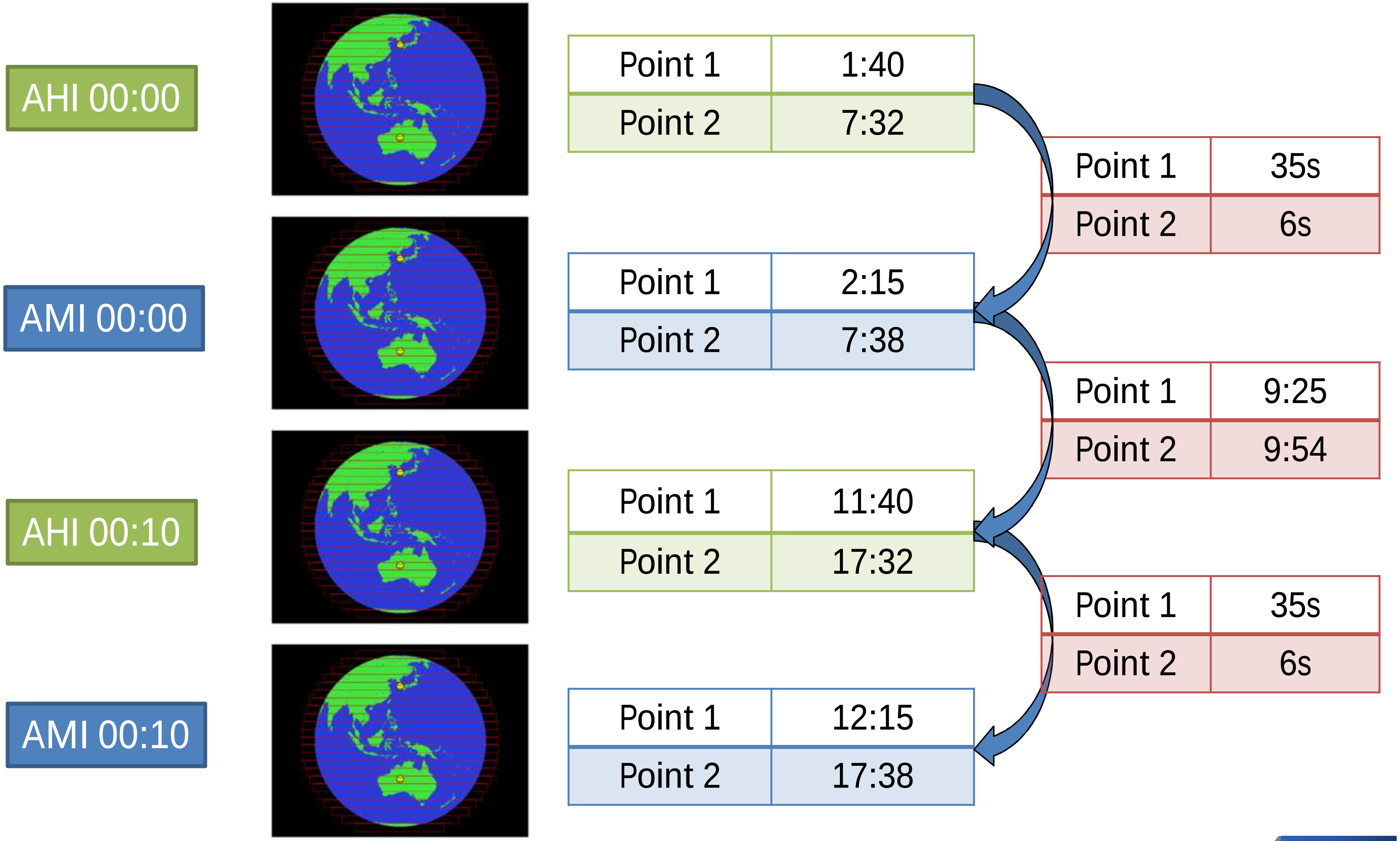
Point 1	5:35
Point 2	5:06

AMI 00:15

Point 1	17:15
Point 2	22:38

Himawari-8 and GK-2A

Start observation at the same time



AHI 00:00

Point 1	1:40
Point 2	7:32

Point 1	35s
Point 2	6s

AMI 00:00

Point 1	2:15
Point 2	7:38

Point 1	9:25
Point 2	9:54

AHI 00:10

Point 1	11:40
Point 2	17:32

Point 1	35s
Point 2	6s

AMI 00:10

Point 1	12:15
Point 2	17:38

Himawari-8, FY-4A, and GK2A

FY-4A/AGRI

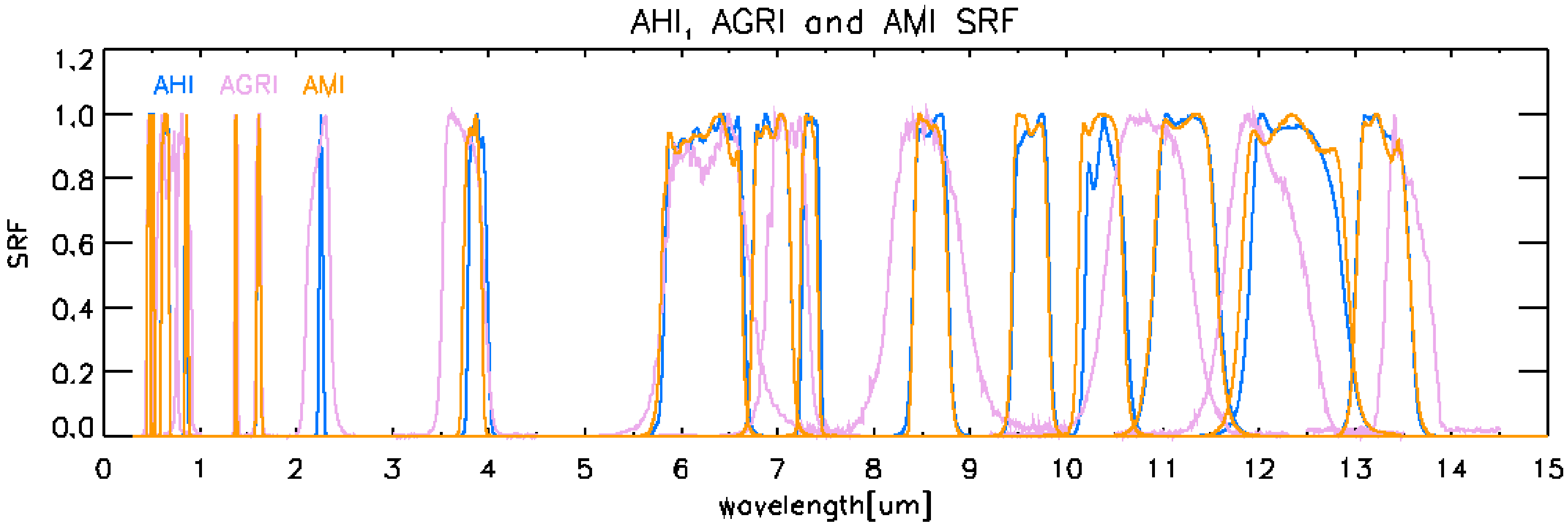
- launch: Dec. 2016
- Orbit: 105ºE
- 14 channels
- Providing Agency: CMA

GK2A/AMI

- launch: Dec. 2018
- Orbit: 128.2ºE
- 16 channels
- Providing Agency: KMA

Himawari-8/AHI

- launch: Oct. 2014
- Orbit: 140.7ºE
- 16 channels
- Providing Agency: JMA



Advantage of using GEO-GEO (by JMA)

Validation of GEO-LEO inter-calibration products

- can be implemented by **double-differencing**

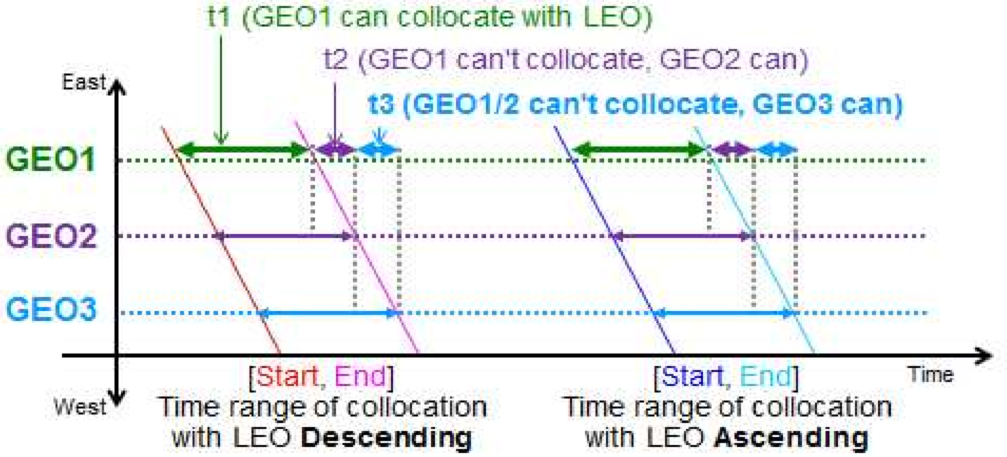
  ex) (GEO2-LEO1)-(GEO1-LEO1)=(GEO2-GEO1)

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)^{t2} – (GEO2 – GEO1)^{t2} – SBAF(GEO2/GEO1) = (GEO1 – LEO)^{t2}
  - t3: (GEO3 – LEO)^{t3} – (GEO3 – GEO2)^{t3} – SBAF(GEO3/GEO2) = (GEO2 – LEO)^{t3}

    (GEO2 – LEO)^{t3} – (GEO2 – GEO1)^{t3} – SBAF(GEO2/GEO1) = (GEO1 – LEO)^{t3}



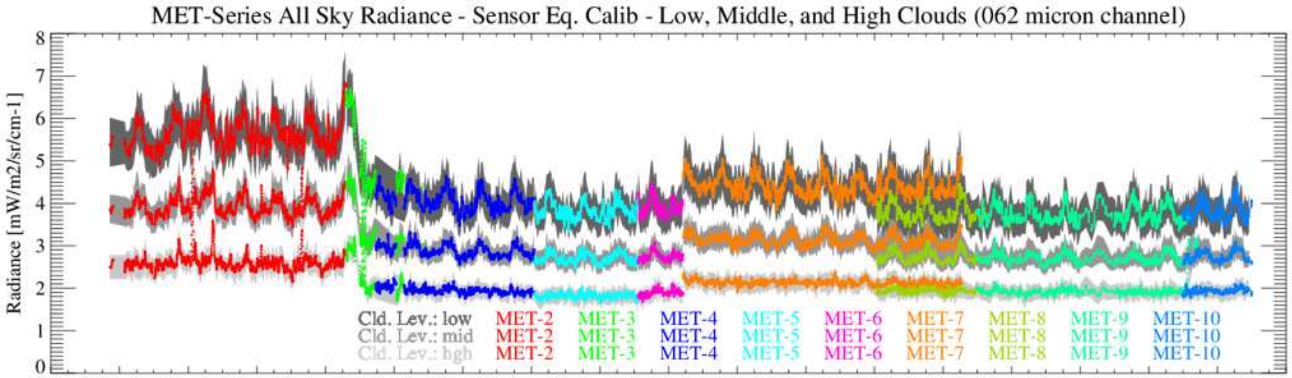
Advantage of using GEO-GEO

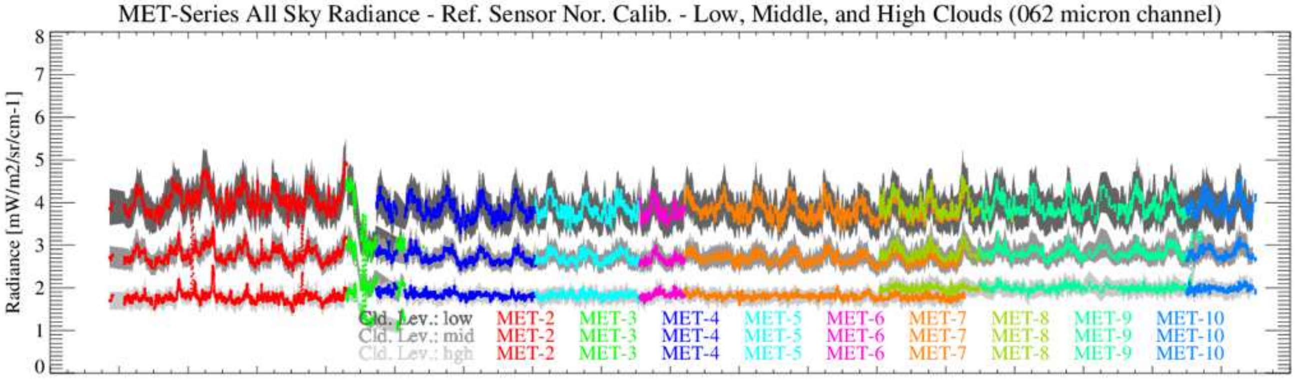
Hyperspectral-Multispectral comparisons

- SRF validation/retrieval

Generation Global climate data (GSICS and IOGEO)

- can be basis for FCDR


MET-Series All Sky Radiance - Sensor Eq. Calib - Low, Middle, and High Clouds (062 micron channel)

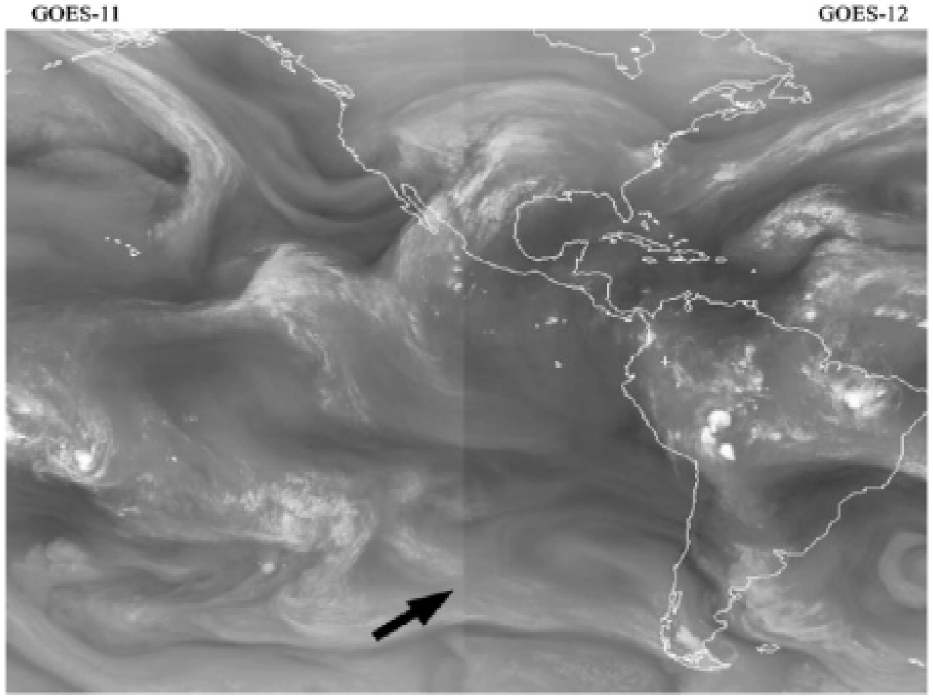

MET-Series All Sky Radiance - Ref. Sensor Nor. Calib. - Low, Middle, and High Clouds (062 micron channel)

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

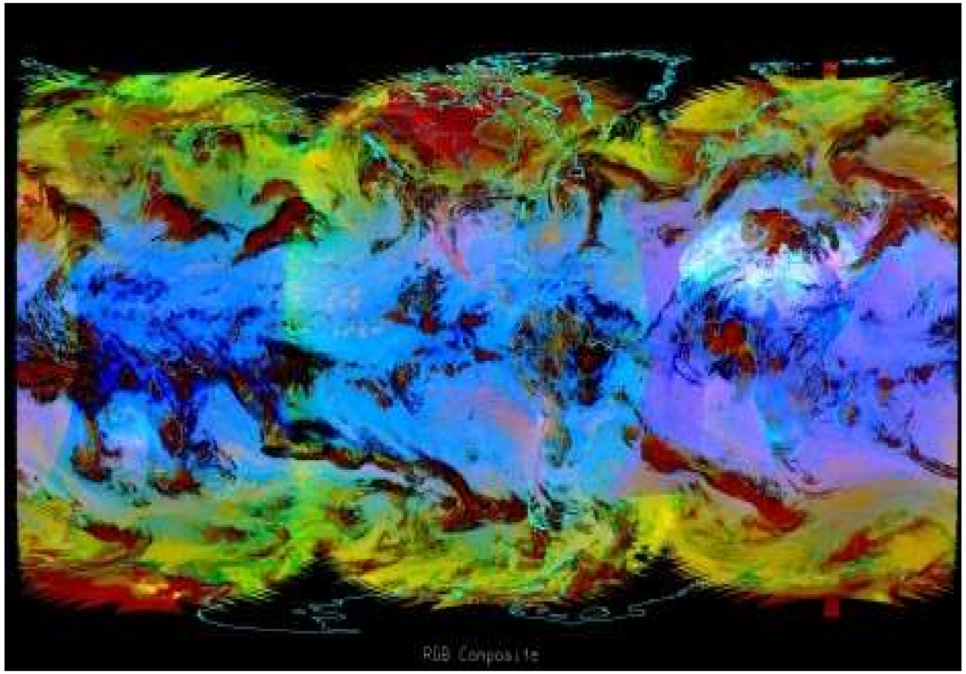
Advantage of using GEO-GEO

Image Composition

- can be used to **Composite Multi GEO Image**



- can be used to **Composite RGB image** (Airmass, Dust, etc.)



[Reference]

- Tim and Masaya, 2018, GEO-ring applications: Benefits of GEO-GEO Comparisons & RGB Composites, 2018 GSICS Annual meeting.
- 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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KMA Progress on GEO-GEO inter-calibration

- Diurnal Variation

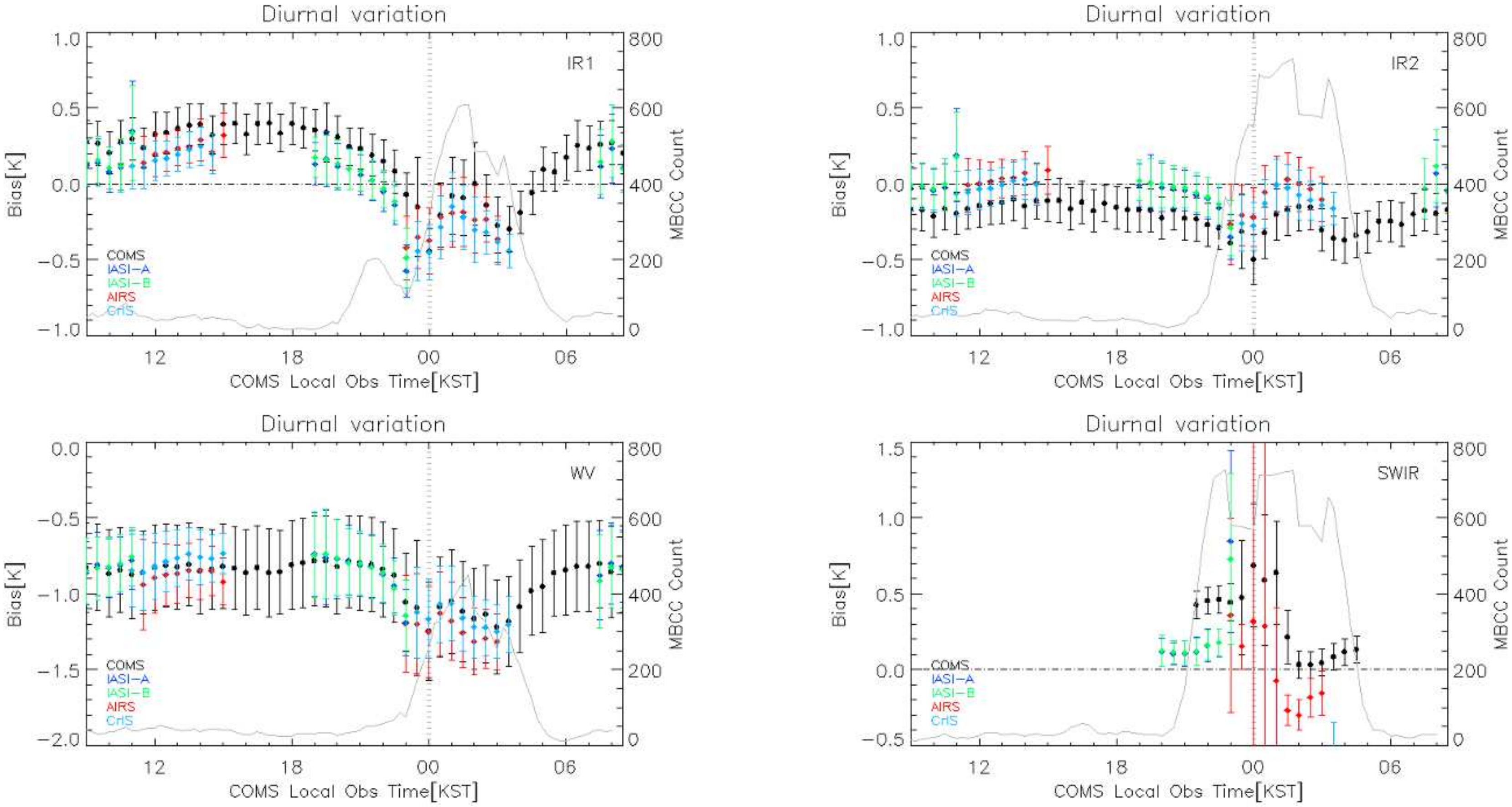
Tb Diurnal Variation

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

- Period: 2016~2017

Compatible channel information

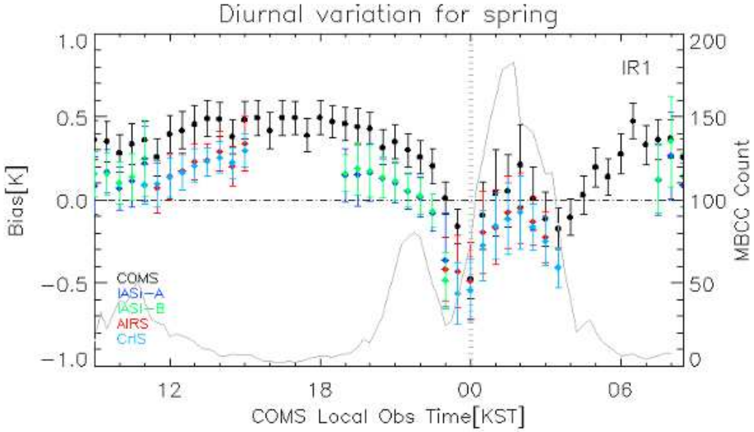
MI	VIS(0.67㎛)	IR1(10.79㎛)	IR2(12.06㎛)	WV(6.74㎛)	SWIR(3.75㎛)
AHI	VIS(0.64㎛)	b13(10.41㎛)	b15(12.38㎛)	b08(6.24㎛)	b07(3.89㎛)

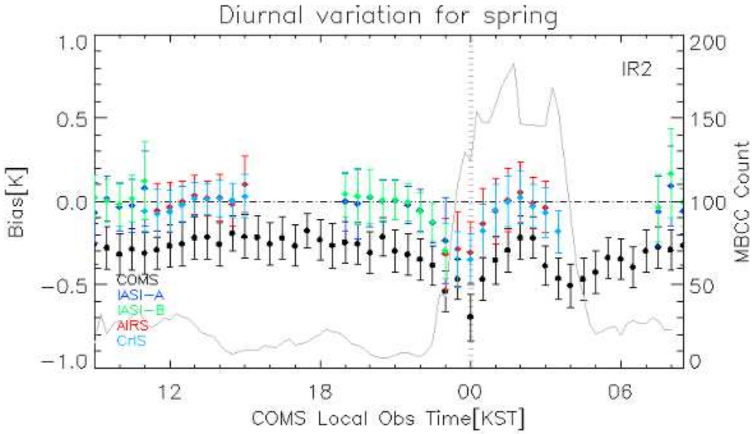


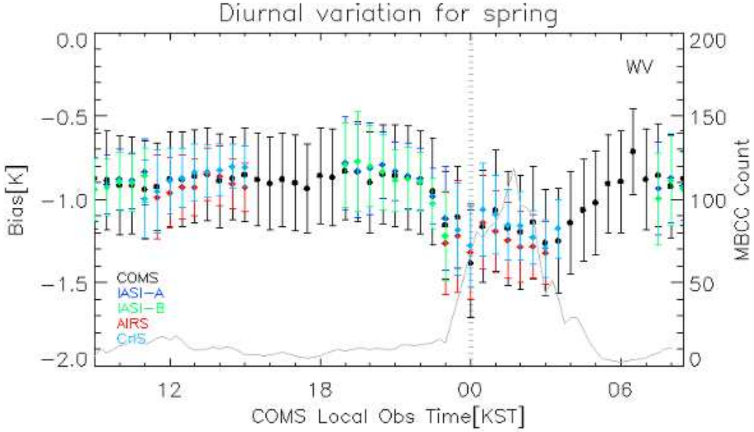
Tb Diurnal Variation

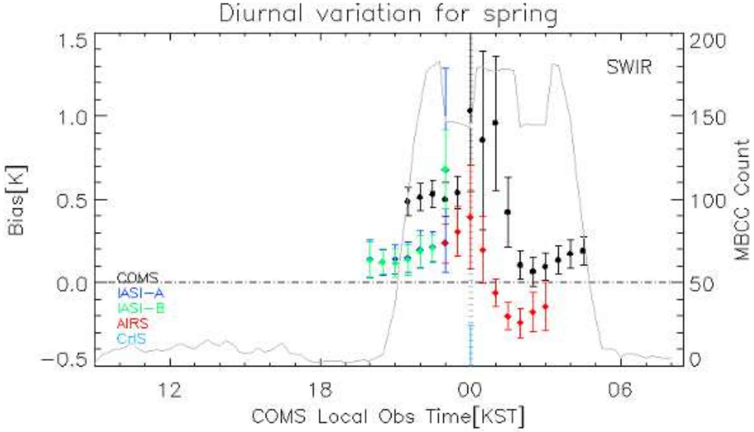
MI vs. AHI, MI vs. LEO (Seasonal)

- Spring (March, April, May)





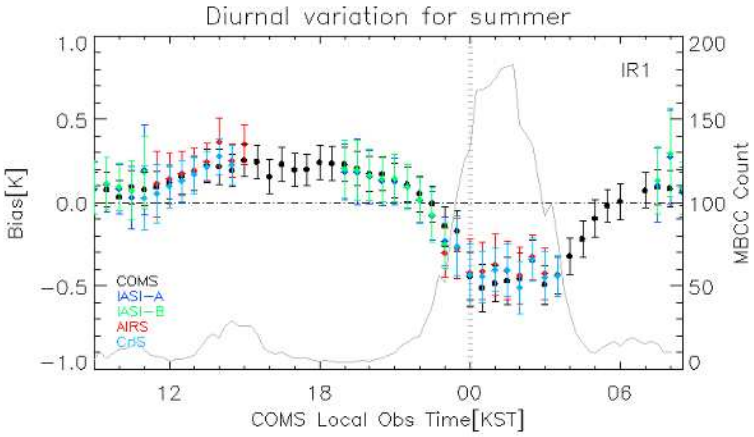


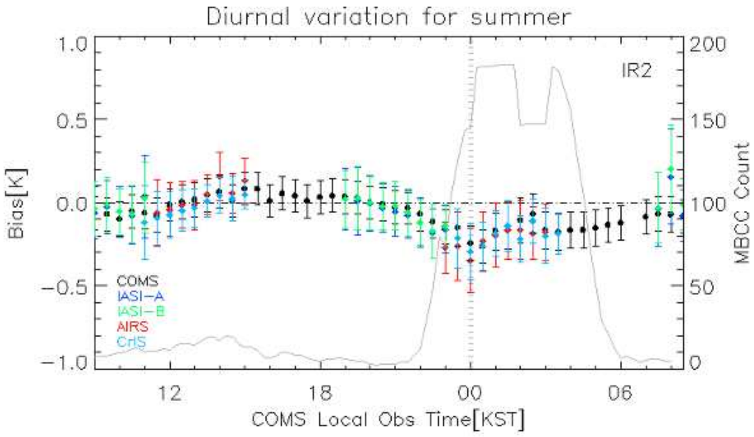


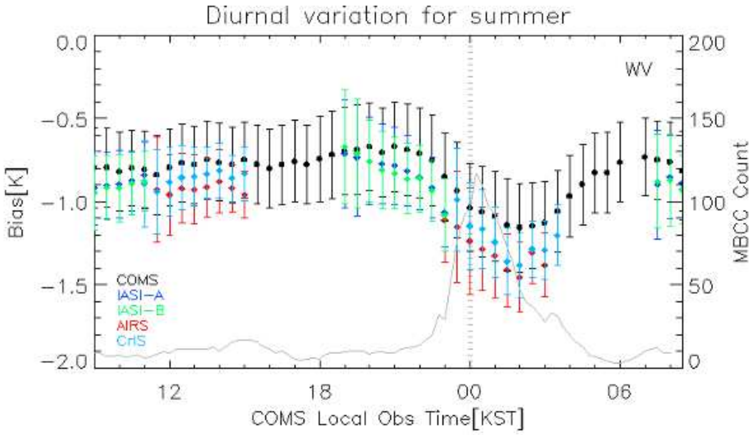
Tb Diurnal Variation

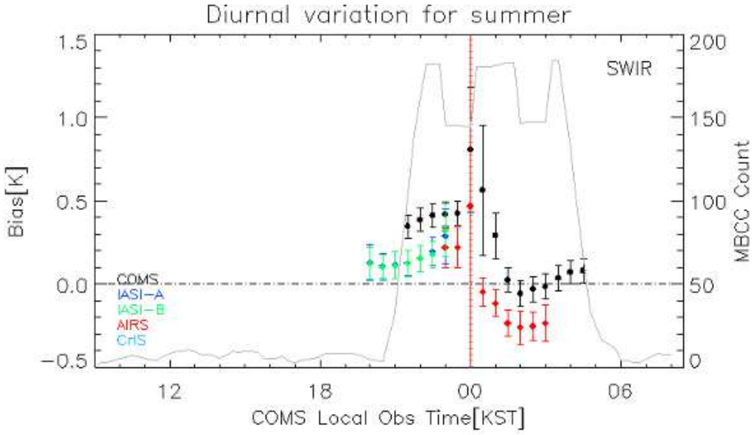
MI vs. AHI, MI vs. LEO (Seasonal)

- Summer (June, July, August)





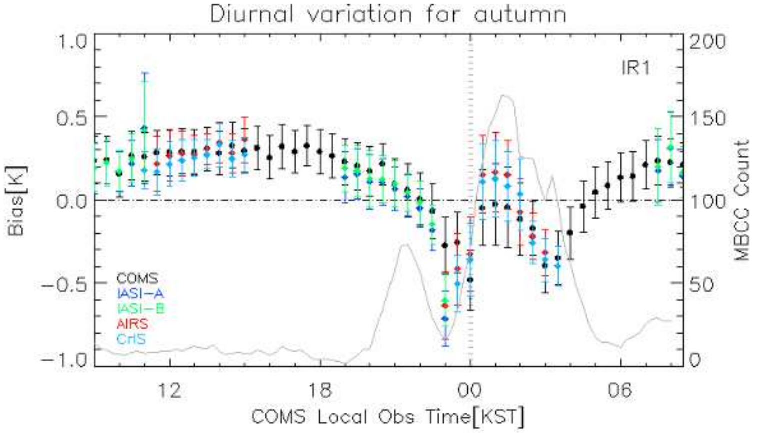


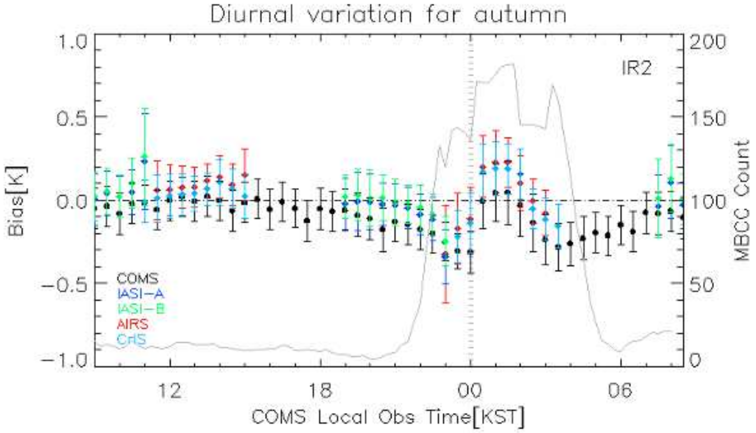


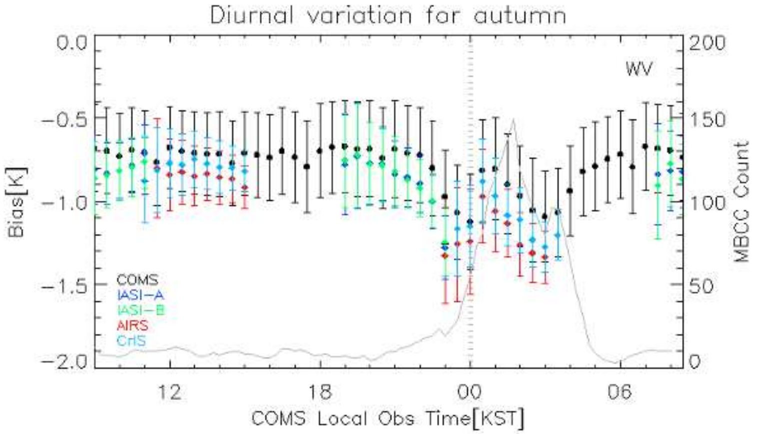
Tb Diurnal Variation

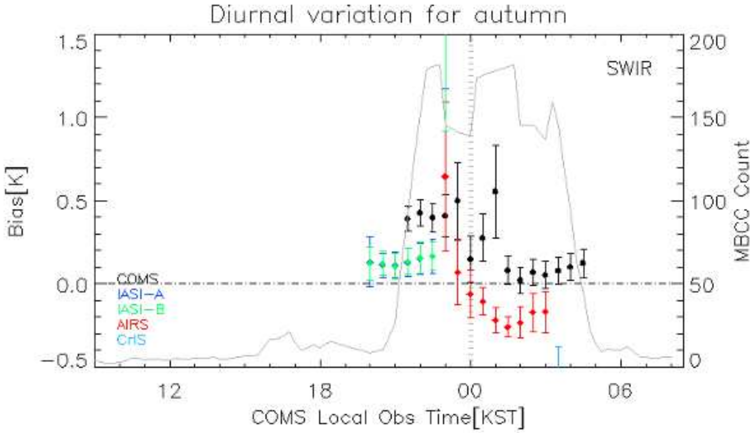
MI vs. AHI, MI vs. LEO (Seasonal)

- Autumn (September, October, November)





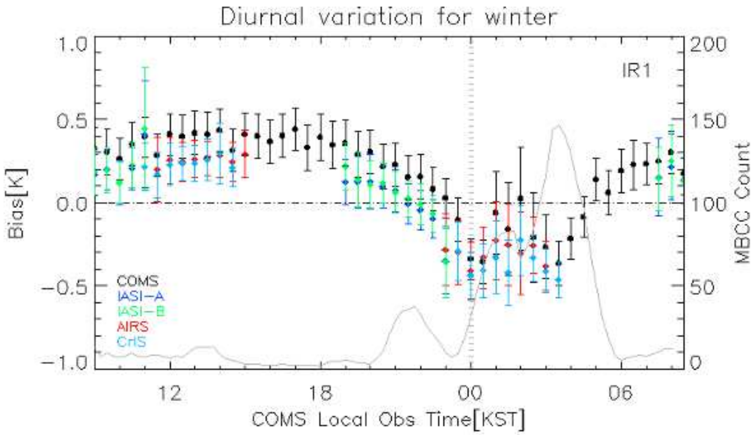


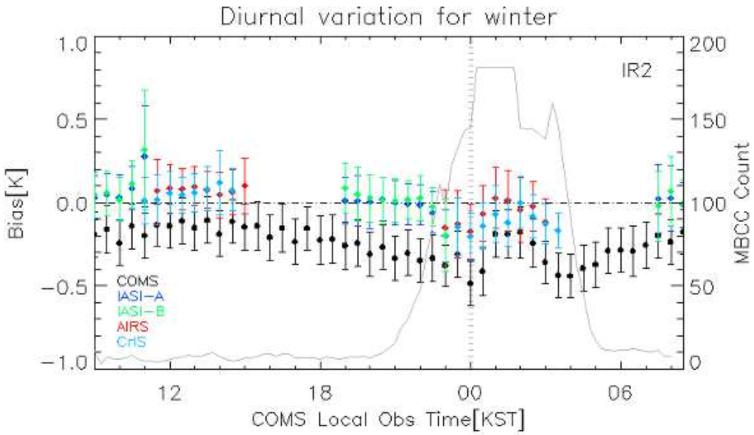


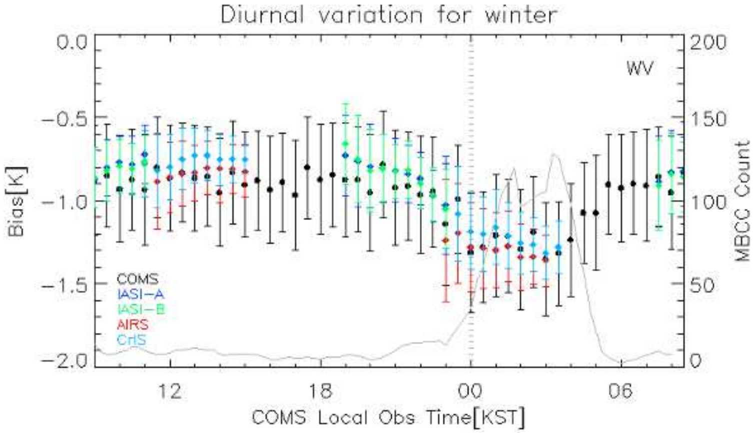
Tb Diurnal Variation

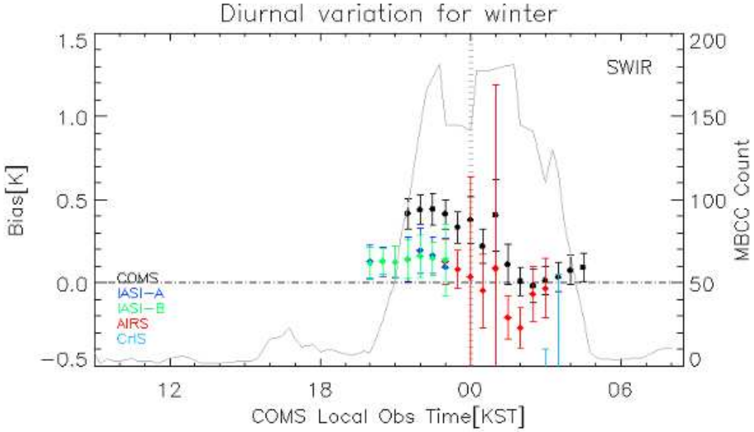
MI vs. AHI, MI vs. LEO (Seasonal)

- Winter (December, January, February)





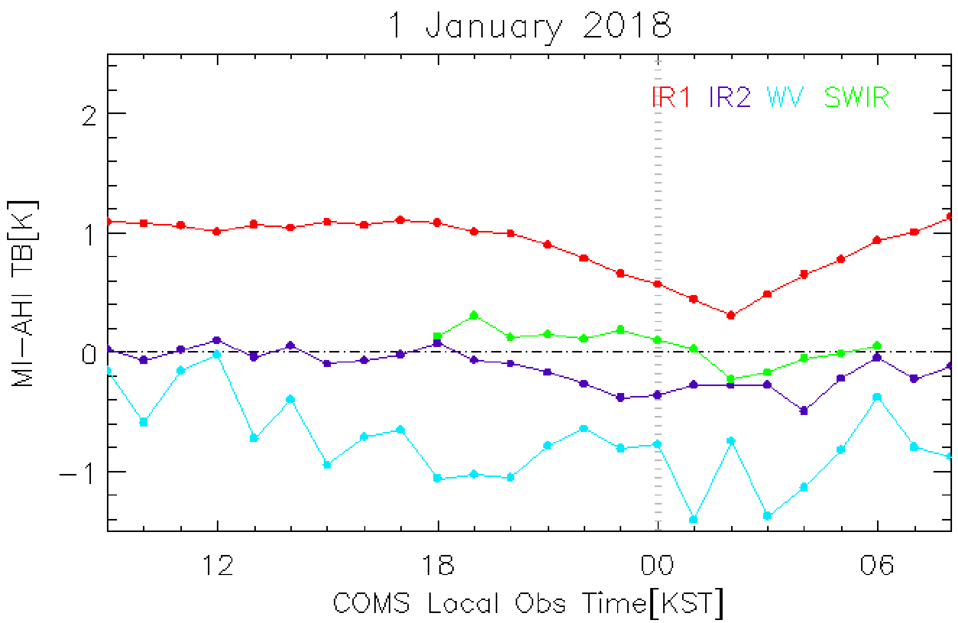


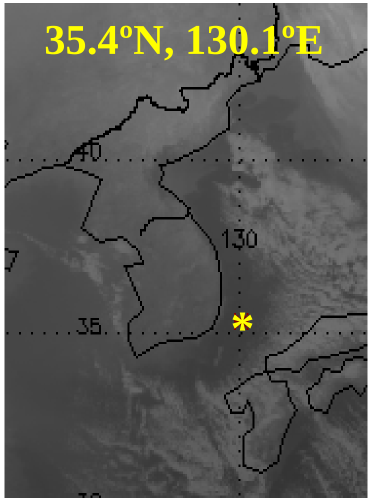


Tb Diurnal Variation

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, 35.4ºN, 130.1ºE
- 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]

- Tim and Masaya, 2018, GEO-ring applications: Benefits of GEO-GEO Comparisons & RGB Composites, 2018 GSICS Annual meeting.
- Wang et al., 2009, Intercalibration of GOES-11 and GOES-12 Water Vapor Channels with MetOp IASI Hyperspectral Measurements, AMS.
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