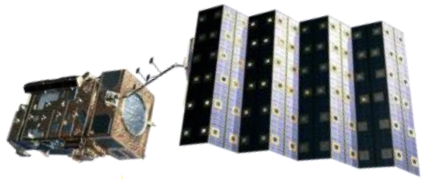
August 28, 2012
CALCON Technical Conference



KMA

Inter-calibration of COMS Infrared and Visible Channels

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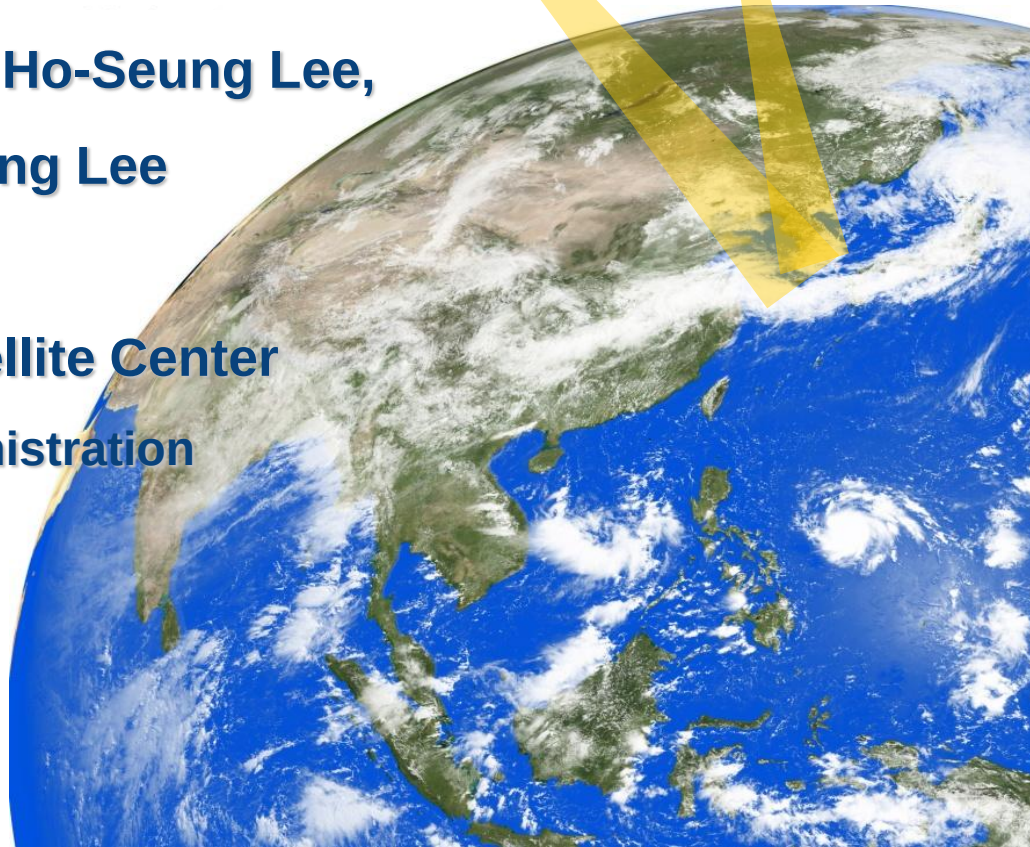
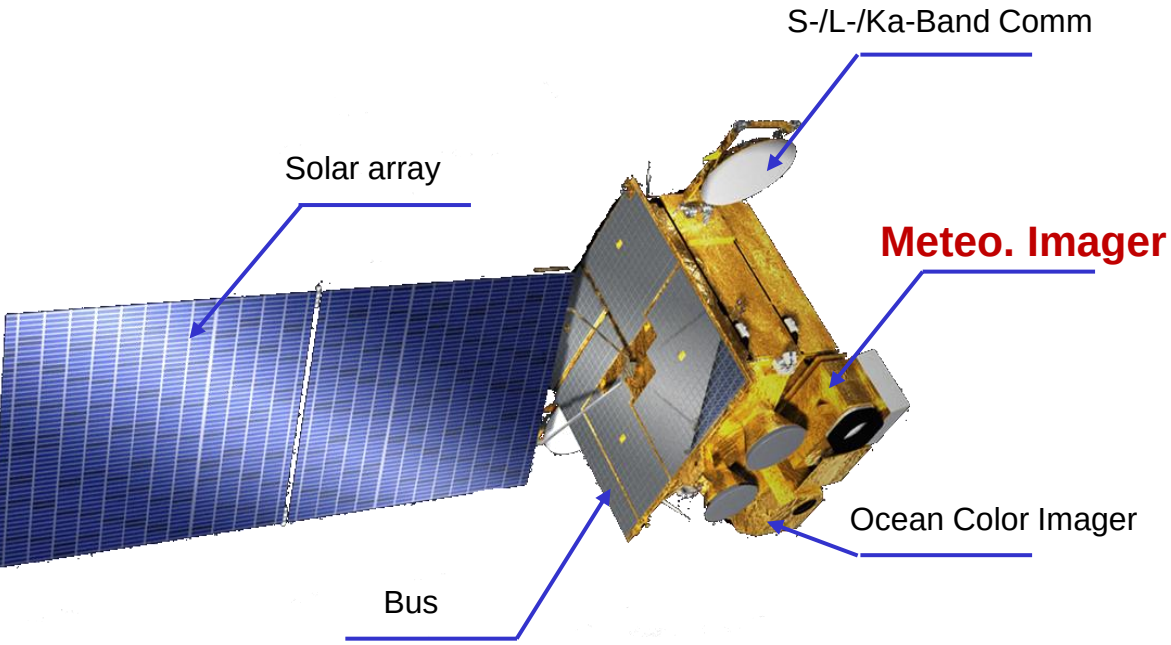


- ***Introduction of COMS***
- ***Inter-calibration of infrared channel***
- ***Moon calibration of visible channel***

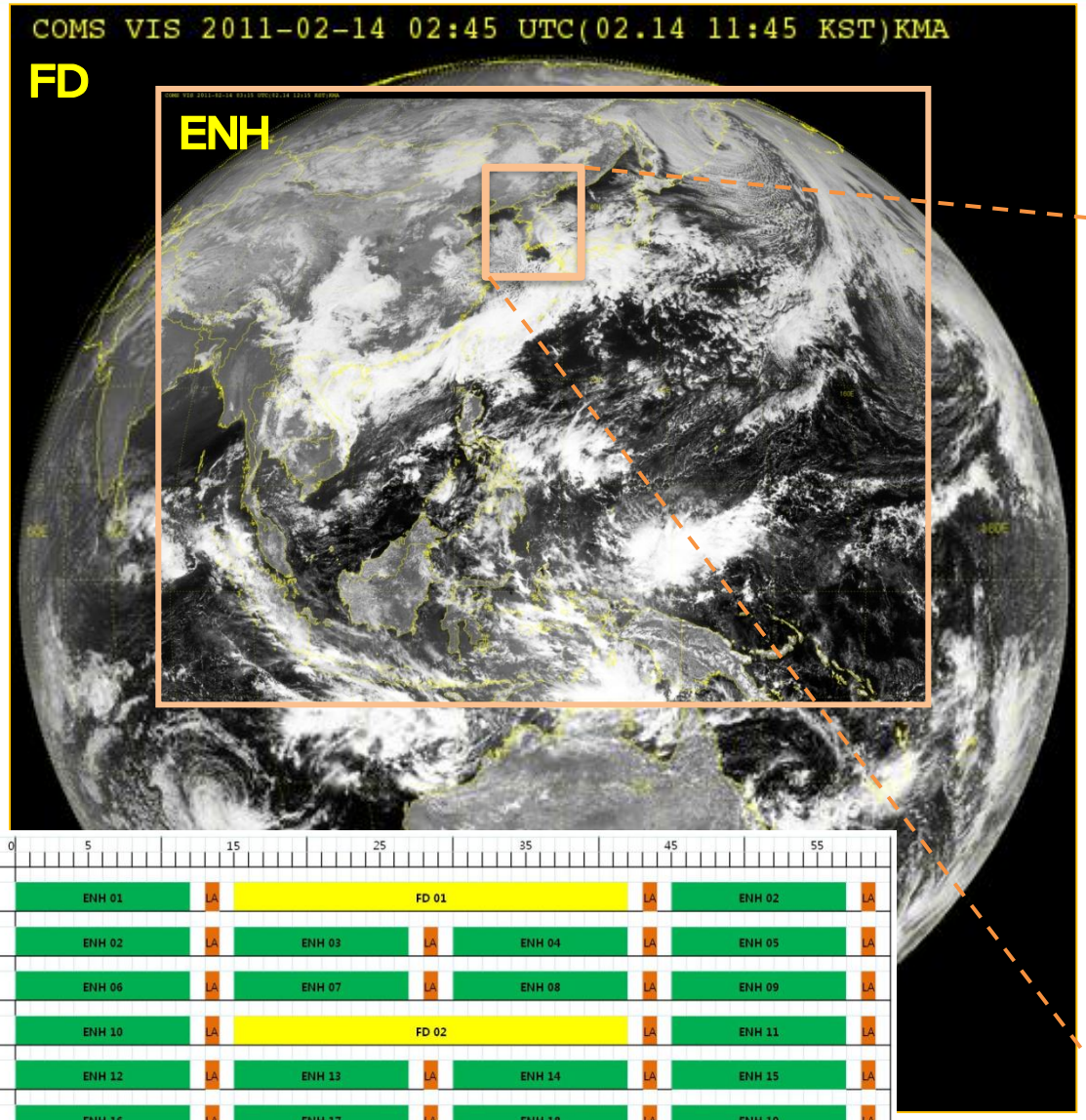
Introduction of COMS

- **Communication, Ocean, and Meteorological Satellite(COMS)**
- **Location : 128.2E**
- **Launch date : June 27, 2010 (Kourou in French Guiana)**
- **Design life time : 7 years(~2017)**

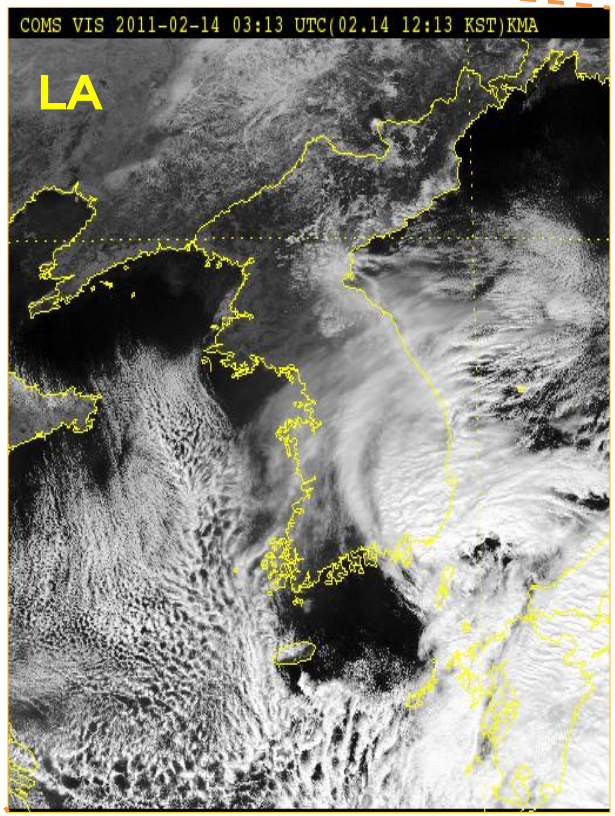


Channel	Center wavelength(㎛)	Spatial Resolution(km)
Visible	0.67	1
Shortwave IR (IR4)	3.7	4
Water Vapor (IR3)	6.7	4
IR1	10.8	4
IR2	12.0	4

COMS MI Observation Area

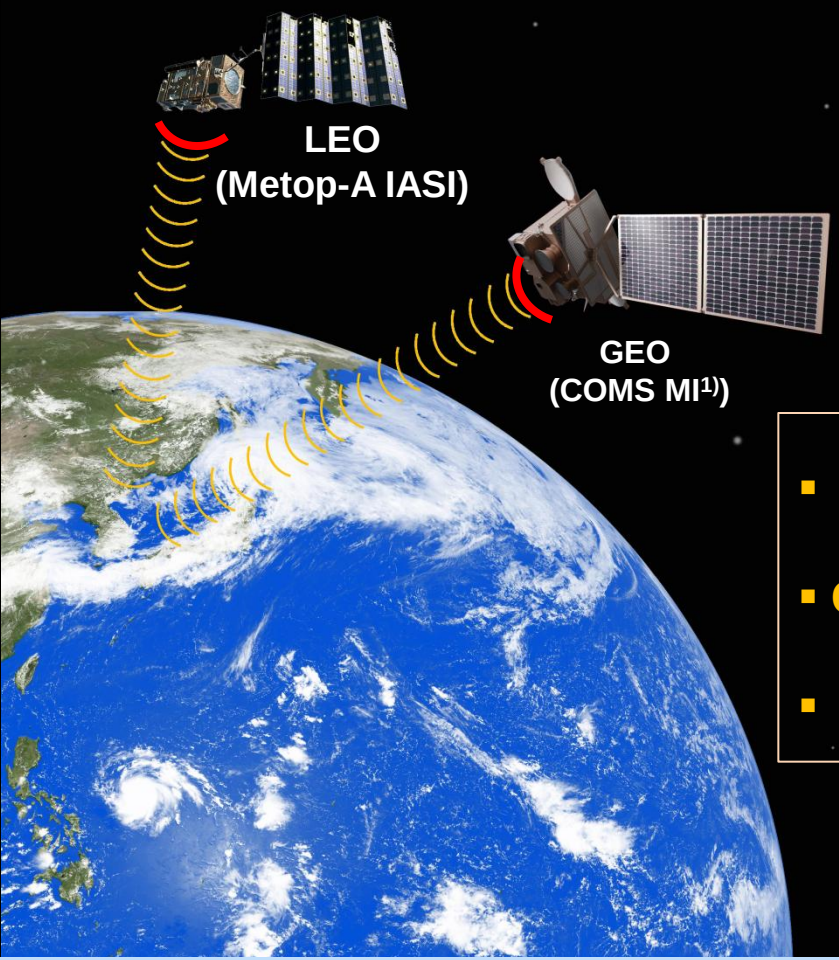


- FD : Full Disk
- ENH : Extended Northern Hemisphere
- LA : Local Area(Korean peninsula)



Inter-calibration of infrared channel

GSICS(Global Space-based Inter-Calibration System)



- COMS launch date : June 27, 2010
- In-orbit test : July 2010 ~ January 2011
- Official service : April 2011 ~
- quality check for first one year

- **Inter-calibration period : April 2011 ~ March 2012**
- **COMS MI data : level1B**
- **Reference data : Metop-A IASI level1C**

1) MI : Meteorological Imager

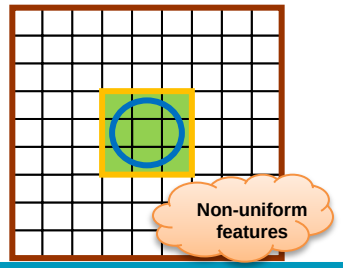
Inter-calibration methodology(1/2)
Collocation

TIME

$$|T_{LEO} - T_{GEO}| < 300s$$

SZA

$$\left| \frac{COS(\theta_{IASI})}{COS(\theta_{coms})} - 1 \right| < \varepsilon 1$$



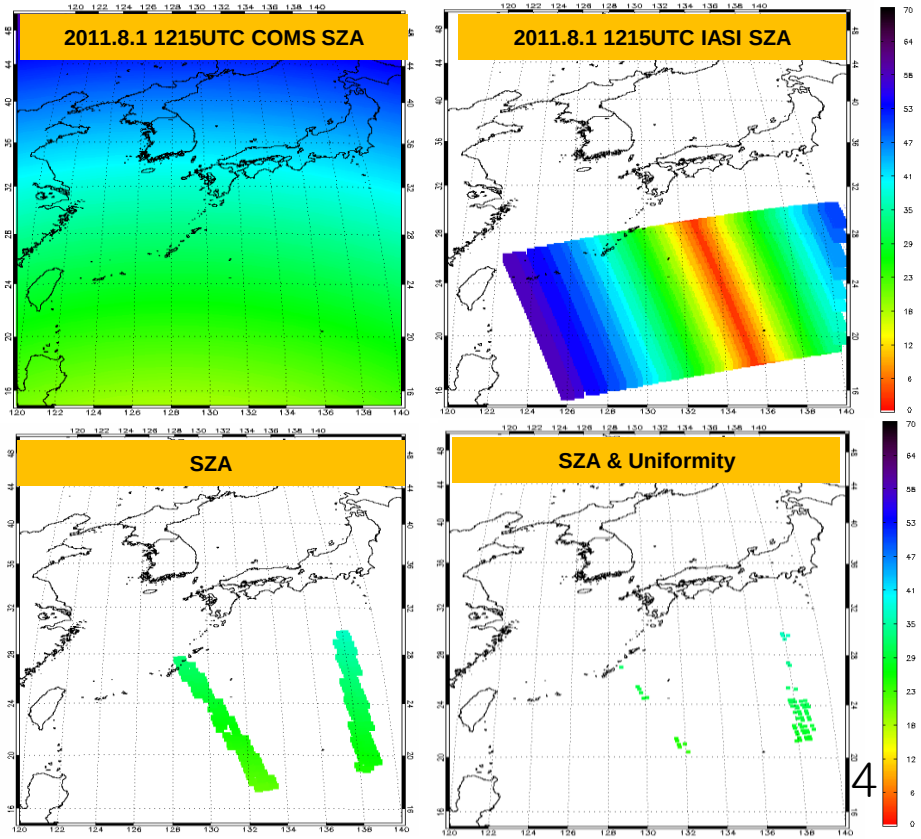
Uniformity

$$STDV(L_E) < \varepsilon 2$$

$$\frac{|MEAN(F)-MEAN(E)| \times 9}{STDV(E)} < Gaussian$$

F : FOV_BOX (COMS 3 X 3 pixels)
E : ENV_BOX (COMS 9 X 9 pixels)
L_E : COMS radiance in ENV_BOX

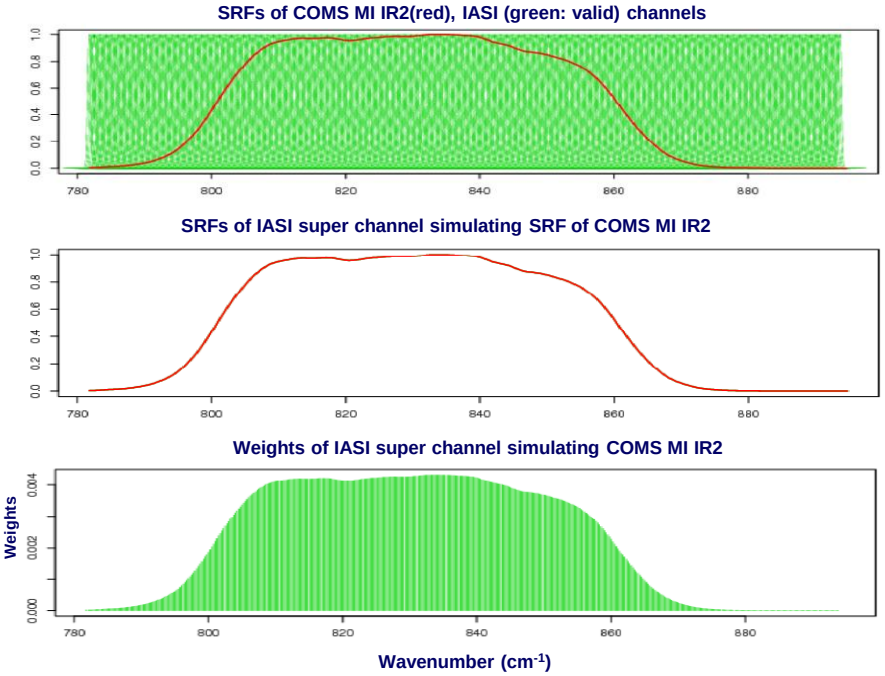
COMS channel	Weather Condition	Dt_{max} (minutes)	ε1	ε2	Gaussian
IR1 (10.8 μm)	Clear	5	0.01	1.65	2
	Cloudy	5	0.03	3.31	2
IR2 (12.0 μm)	Clear	5	0.01	1.82	2
	Cloudy	5	0.03	3.64	2
WV (6.8 μm)	All	5	0.01	0.311	1
SWIR (3.8 μm)	Clear	5	0.01	0.0151	2
	Cloudy	5	0.03	0.0302	2

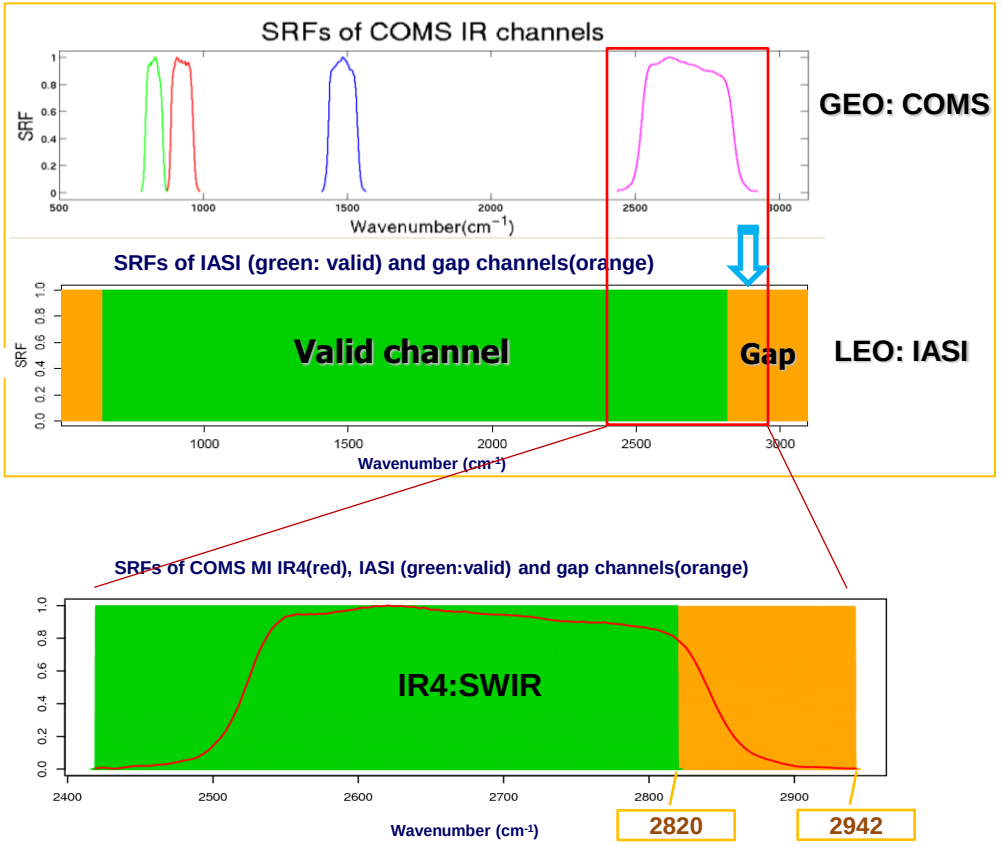


Inter-calibration methodology(2/2)
Simulated COMS MI radiance from IASI observations

- **Constraint method**

Generate a super channel consisting of combination of the hyper channel to imitate a broadband channel.
Proposed by Tahara (JMA)

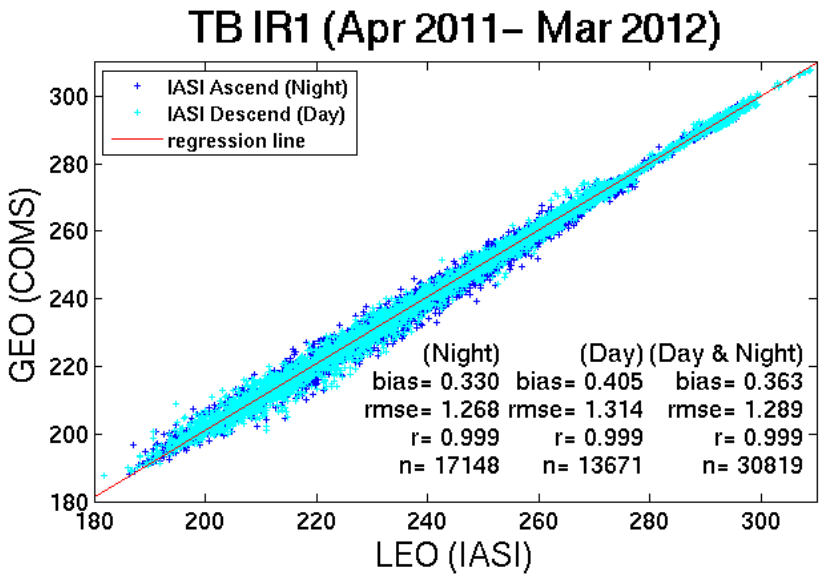


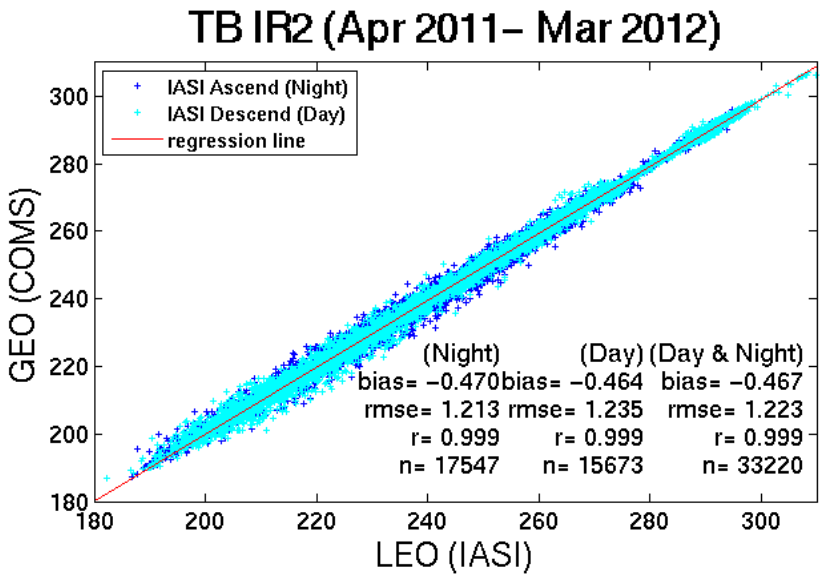


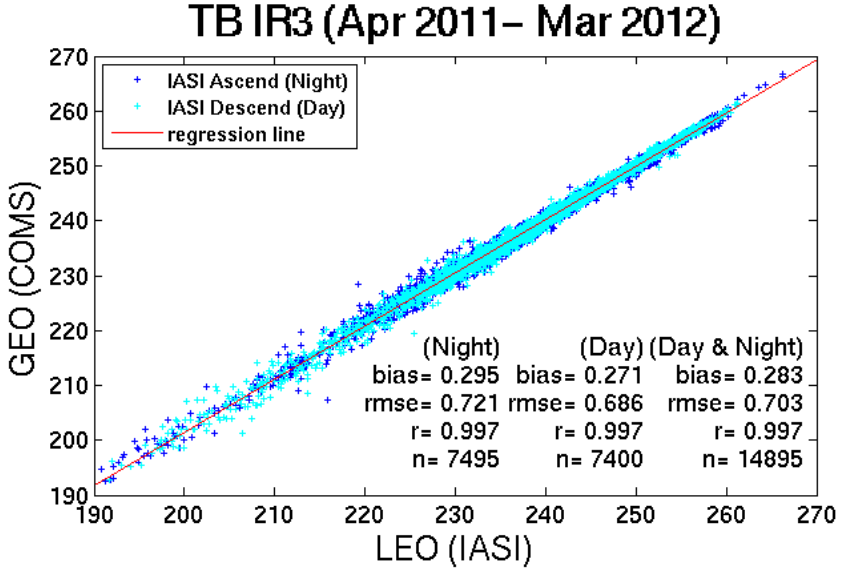
$$I_v = \frac{\sum_i w_i I_i}{\sum_i w_i}$$

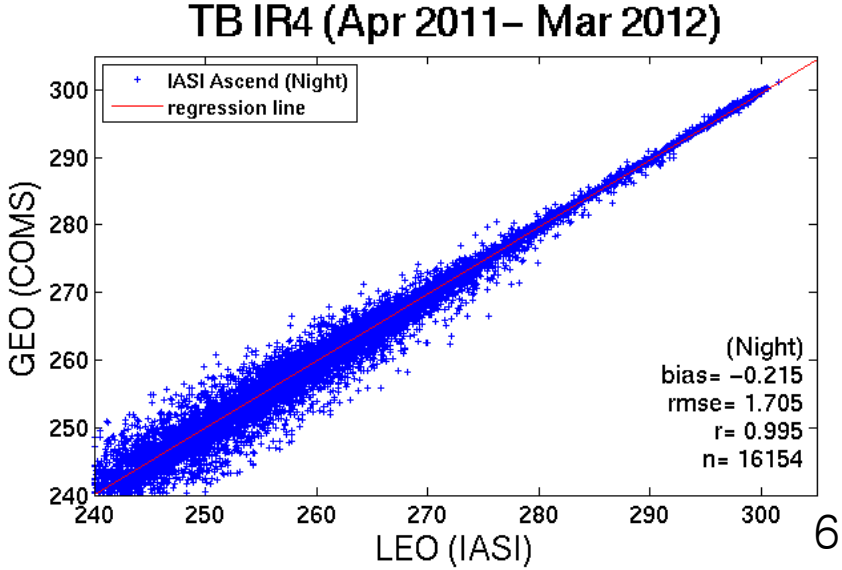
I_i : Radiances of IASI
w_i : Weights for IASI
I_v : Radiance of the super channel
i : Channel index numbers of IASI

COMS MI TB vs. Metop-A IASI TB

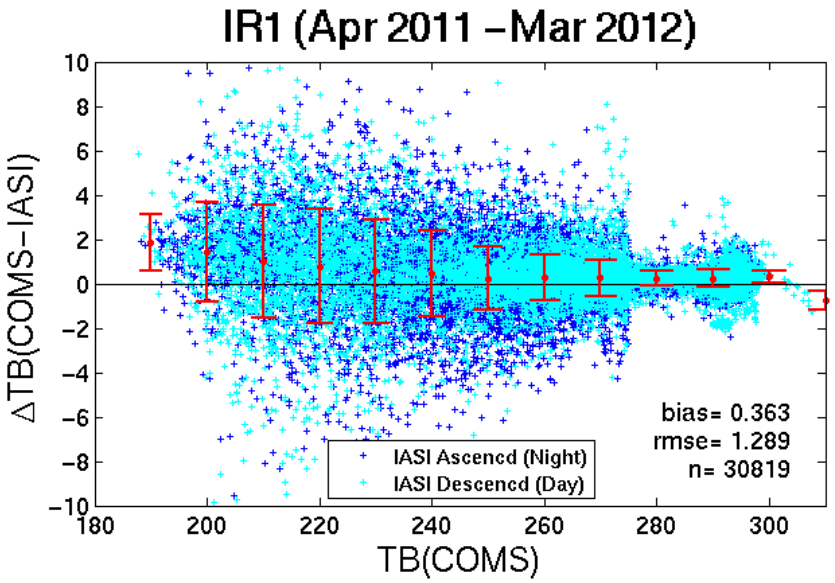


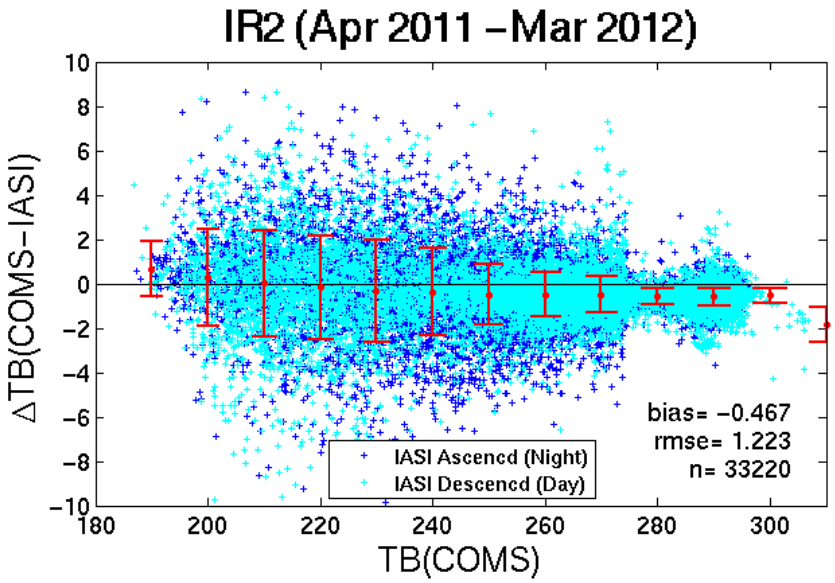


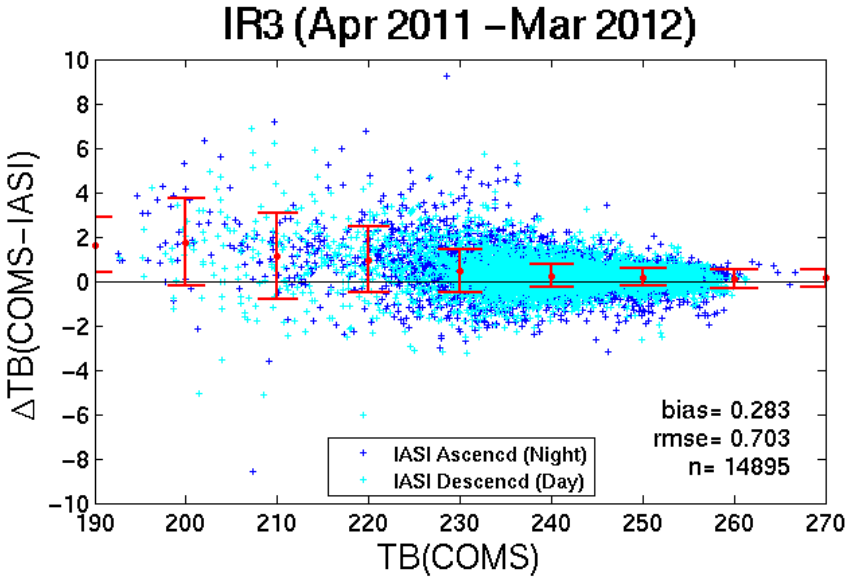


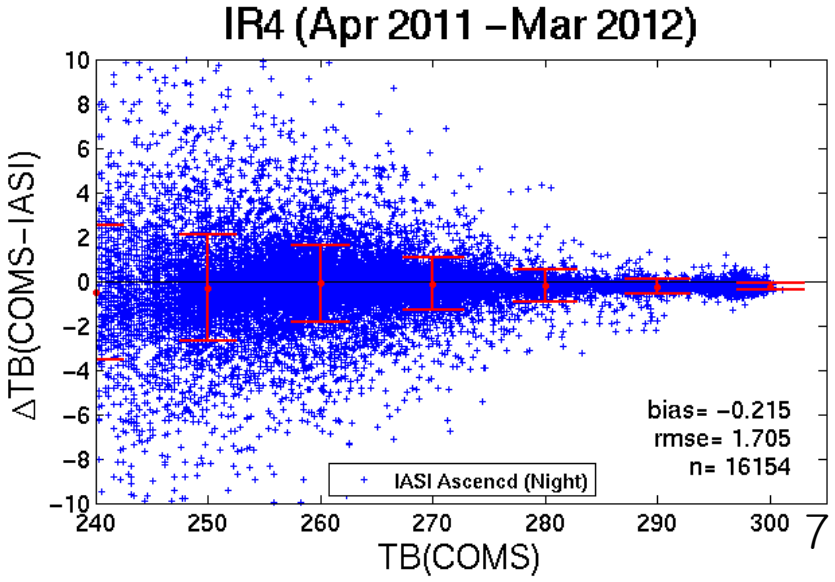


ΔTB(COMS MI - Metop-A IASI)

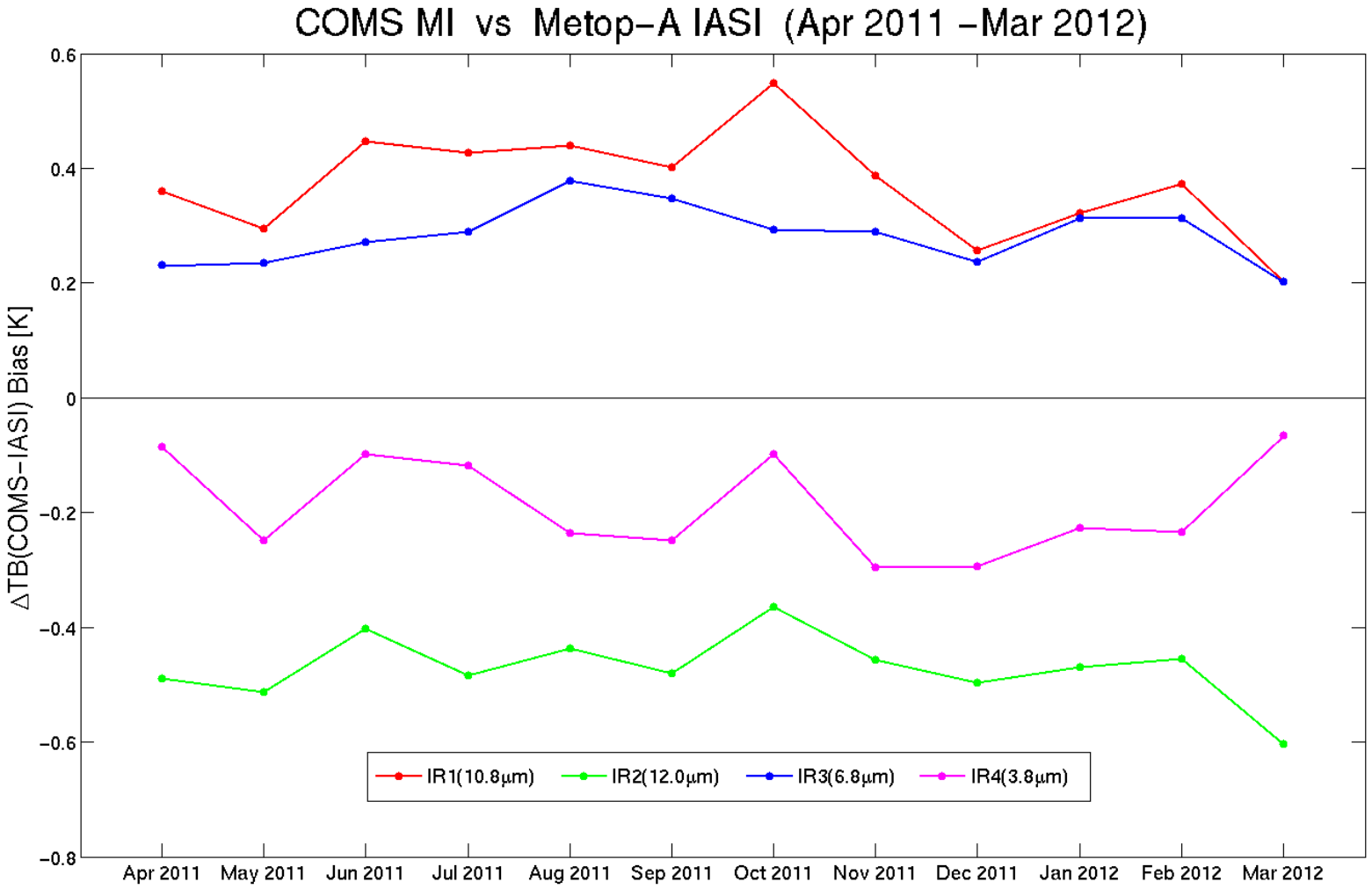






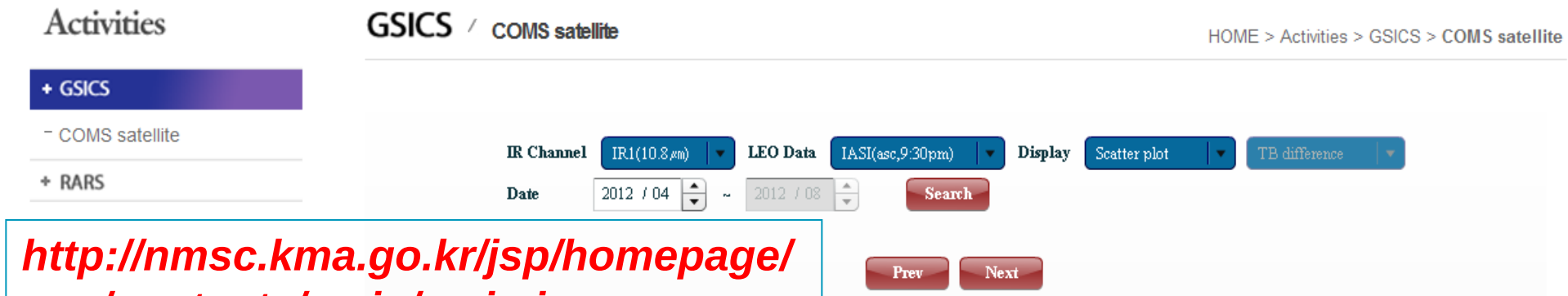


ΔTB(COMS MI - Metop-A IASI) Time Series



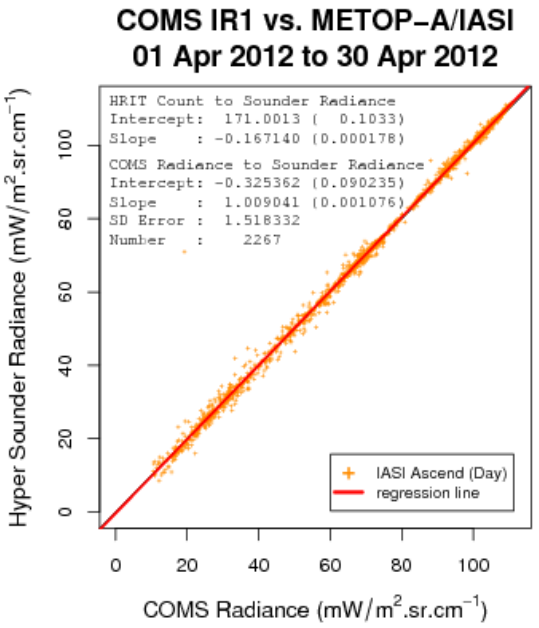
- **Positive bias : IR1, IR3**
- **Negative bias : IR2, IR4**
- **Small, stable biases < 0.5K**
- **Slope of monthly variation < 0.01**

KMA/NMSC web



http://nmsc.kma.go.kr/jsp/homepage/eng/contents/main/main.jsp

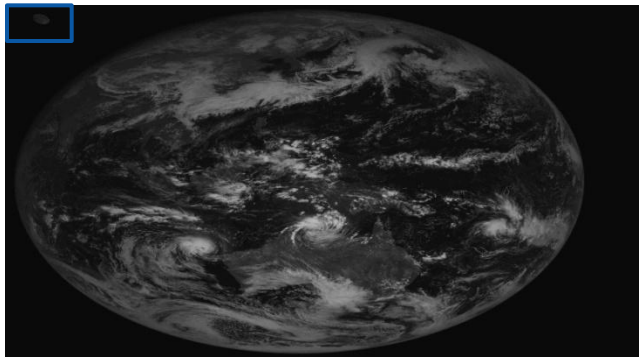
- ***Time sequence (TB difference)***
- ***Regression coefficients between COMS radiance and IASI radiance***
- ***Scatter plot (COMS rad. vs. IASI rad. and IASI TB – COMS TB)***



Moon Calibration of COMS visible (1/3)

- COMS has observed moon monthly for visible channel monitoring moon calibration since Feb. 2011.

- For observing moon, KMA choose two kind of moon observation method by using Local Area observation mode for moon(direct) and Full disk observation with moon(indirect).



- To process these observed data, KMA has used its own Moon Processing system in Image Processing Subsystem(IMPS) for Moon Calibration.

Moon Calibration of COMS visible (2/3)

- To measure the total degradation of the instrument visible channel
- Comparison between the Moon signal and ROLO model(moon irradiance computation model) of USGS
  - as a Function of Phase angle(Sun-Moon-Earth)
- Imager Response

$$P = \frac{I_{instrument}}{I_{ref}}$$

Where

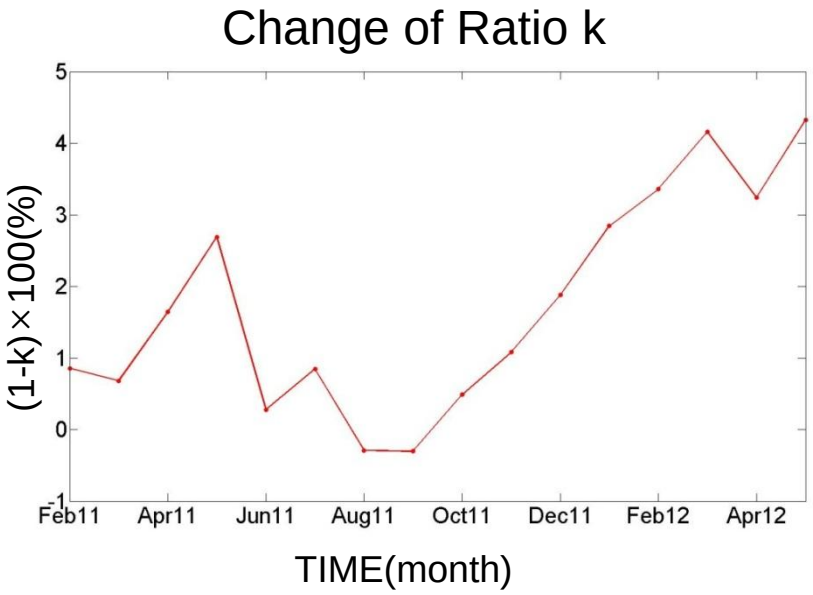
$I_{instrument}$ is the Moon irradiance as measured by the Imager

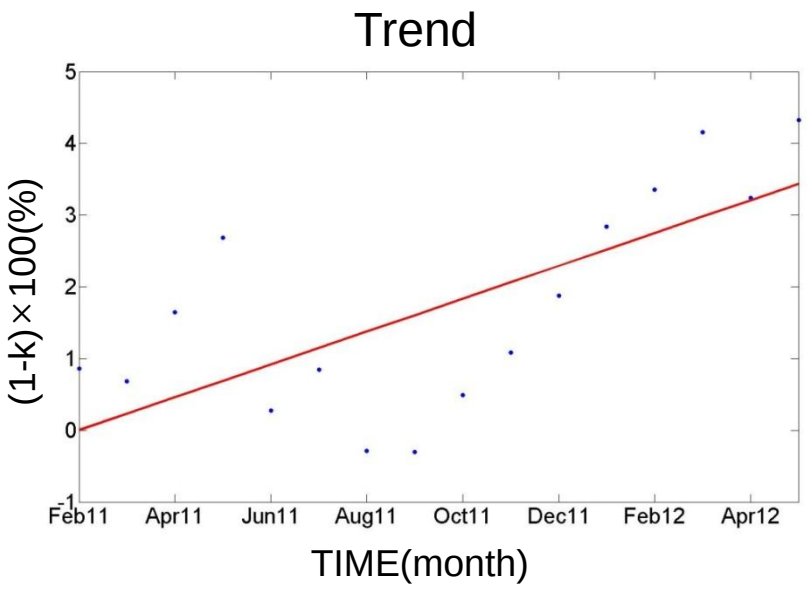
I_{ref} is the Moon irradiance computed from the ROLO model, under the same conditions(phase angle, positions of sun, moon, satellite, etc.)

- All Imager responses are linearly trended over the various Moon images with the ratio $k = \frac{P(t)}{P(t_0)}$ expressed in percentage.

Moon Calibration of COMS visible (3/3)

- Trend shows that there is about 3.4% COMS visible channel degradation from Feb 2011 to May 2012.





- **For obtaining more precise result, We need more data through the long term observation.**

Summary

- **Infrared channel**

- COMS MI IR channels have low-bias within 0.5K accuracy

- IR1, IR3 of difference between COMS TB and IASI TB showed positive bias while IR2, IR4 showed negative bias.

- Although there is a slight bias, infrared channels are stable and working well.

- **Visible channel**

- There is about 3.4% visible channel degradation from Feb 2011 to May 2012

Thank You !