DCC analysis for MTSAT-1R/2 to Himawari-8

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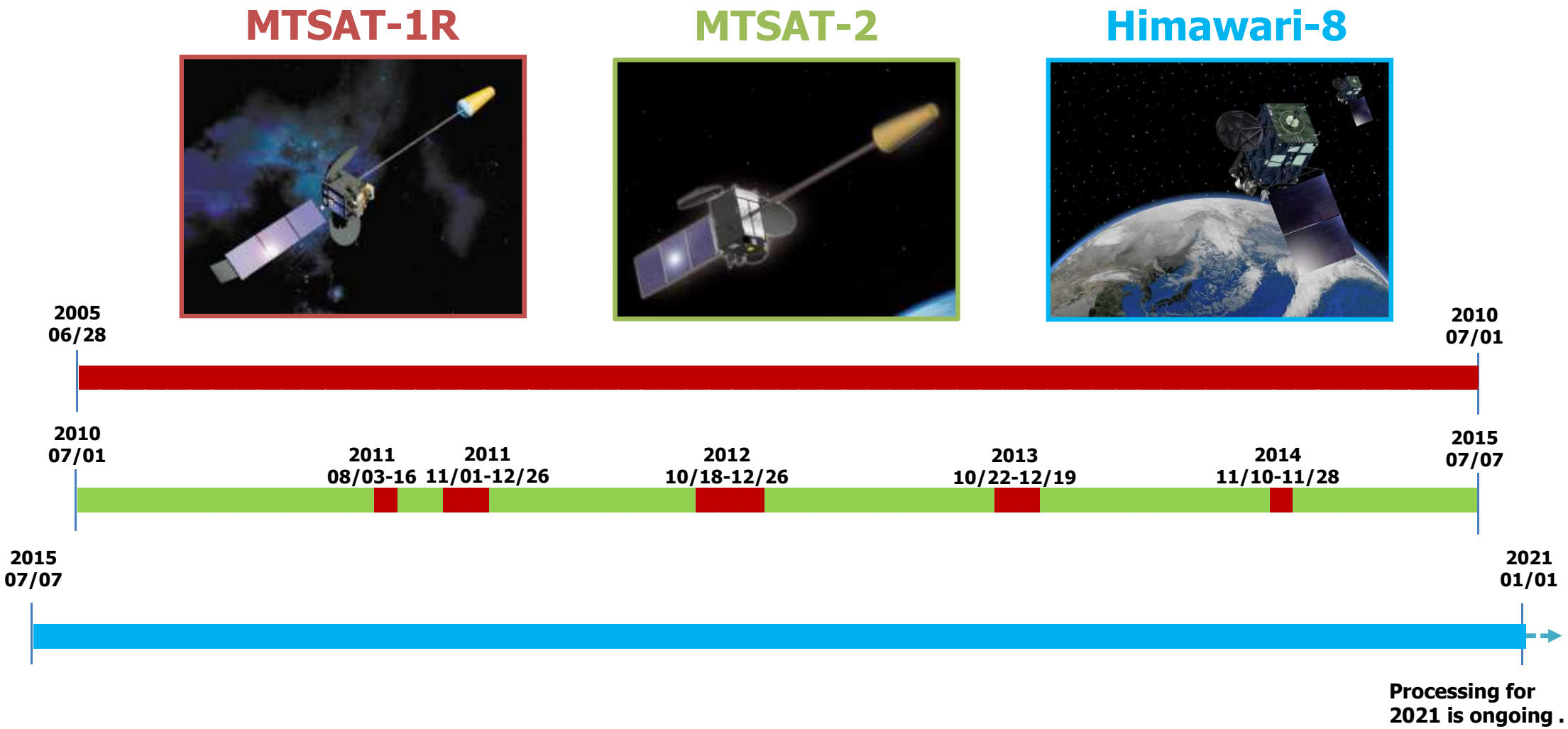
- DCC results for our satellite
- Conclusion and future plan

The period of applying DCC method

- DCC method was applied to three JMA's satellites (Jun.2005 to Dec.2020)



DCC conditions

In following page, DCC results are done under these conditions

MTSAT-1R/-2 DCC method

- **GEO**
  - **Original resolution of MTSAT data**
- **LEO**
  - **Aqua/MODIS C6.1 data (MYD02SSH) downloaded from NASA EARTH DATA web site.**

***The point spread correction function for MTSAT-1R data (Doelling, 2014) is Not applied.**

Himawari-8 DCC method

- **GEO**
  - **2km sub-sampled Himawari-8 data**
- **LEO**
  - **Aqua/MODIS C6 data (MYD02SSH) downloaded from NASA EARTH DATA web site.**

Conditions		GEO	LEO
Latitude boundary		±20° at SSP	
Longitude boundary		±20° at SSP	
GMT time rage (03:00LT)	MTSAT-1R/2	±1hrs	No restriction
	Himawari-8	±1.5hrs	
SZA,VZA range		< 40°	
VIS and IR sigma		3%,1K	No restriction
PDF statistic		Mode	
Applying ADM		Hu model	
BT threshold		205K	
SBAF		NASA web Tool (Scarino,2016)	

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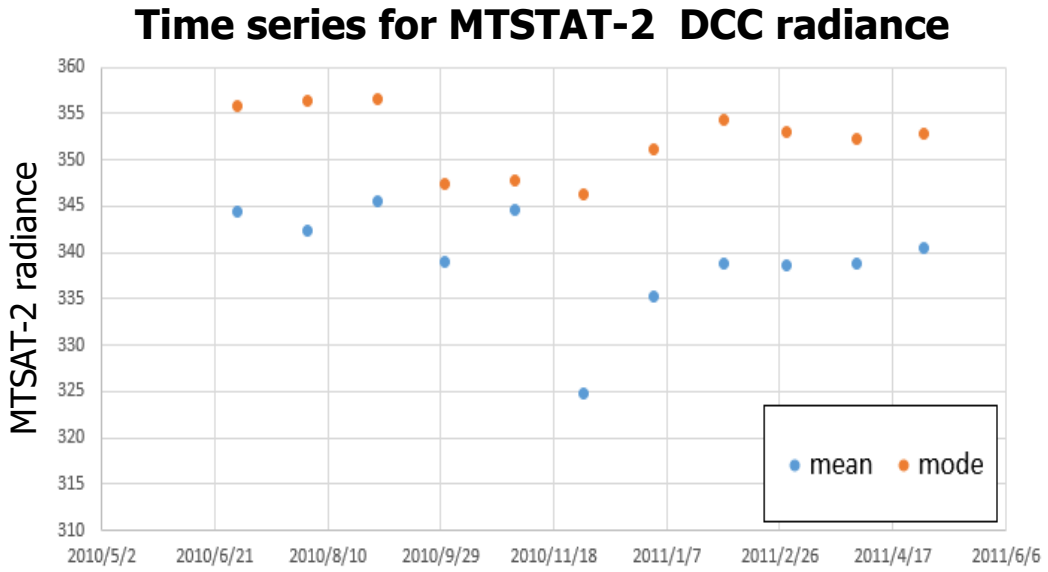
Mode or Mean ?

Robustness for time

- When checking MTSAT-2 the time-series, mode statistic is more stable than mean statistic.

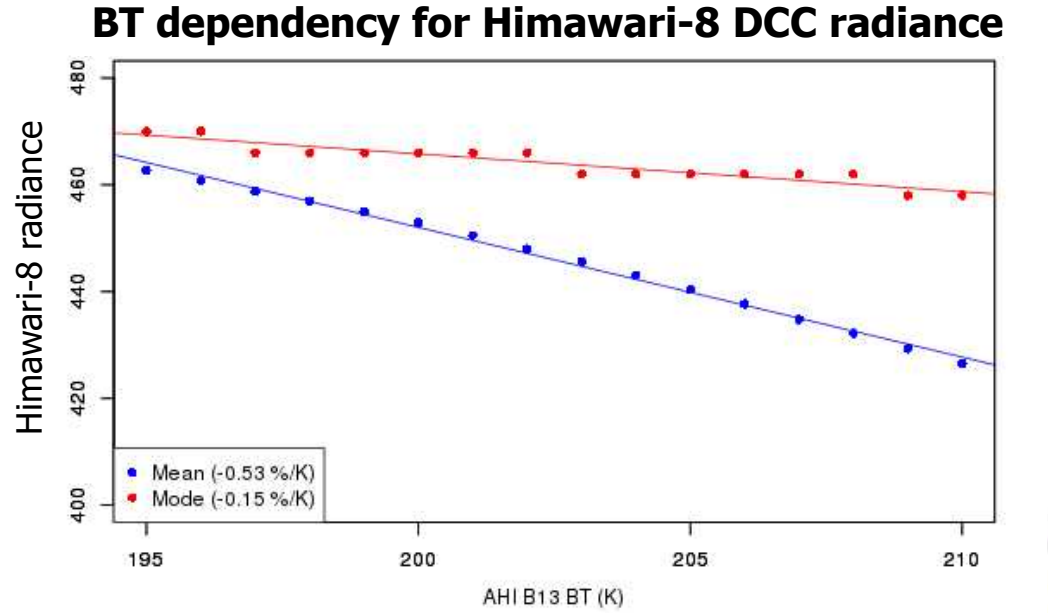
Mode statistic is better than Mean statistic



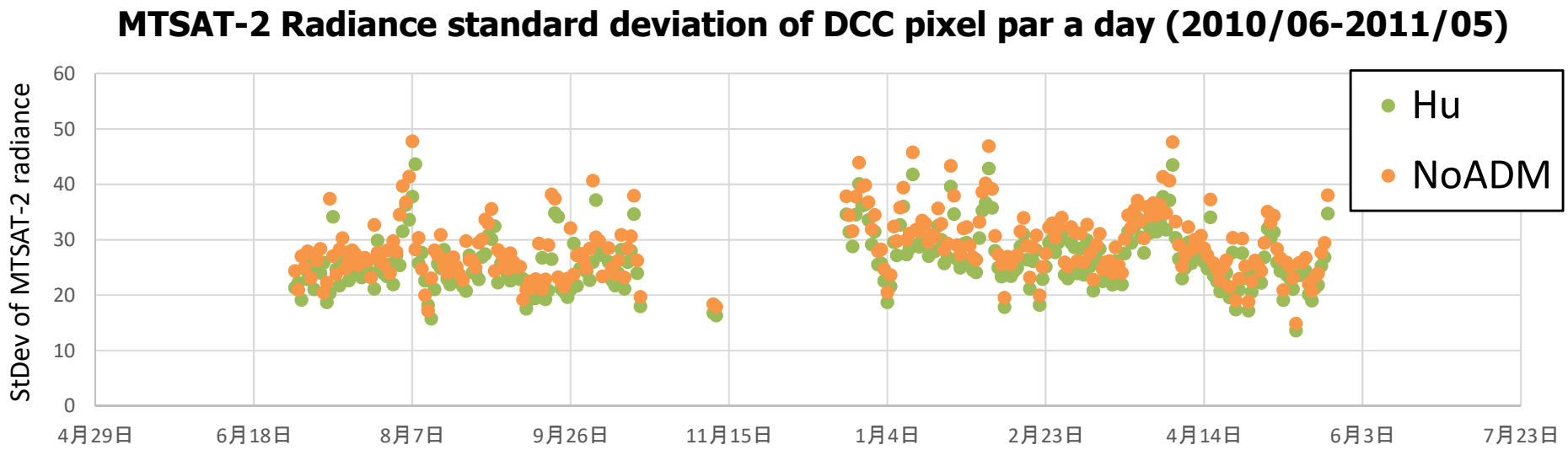
Robustness for BT threshold

- In Himawari8 Mode statistic is less dependent on the BT threshold than the mean statistic

Mode statistic is better than Mean statistic



Hu model or No ADM ?



- The graph shows applying Hu model is less variation than no applying case.

Applying Hu model is good in order to be small variation

Robustness of GEO PDF depending on BT thresholds

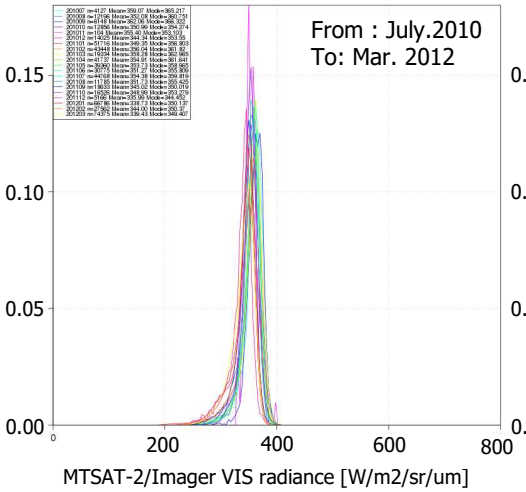
MTSAT-2

- MTSAT-2 PDF shapes at 195K look slightly rougher than ≧200 K

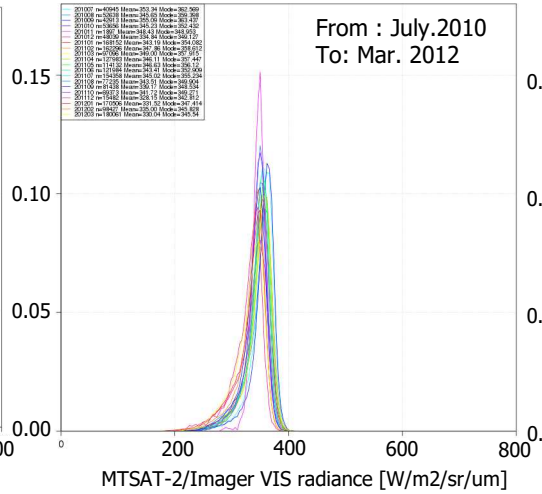
- For example, 195 K PDF shape on Nov.2011 is rougher than 200K and 205K PDF shapes.

MTSAR-2 BT threshold ≧200K is better

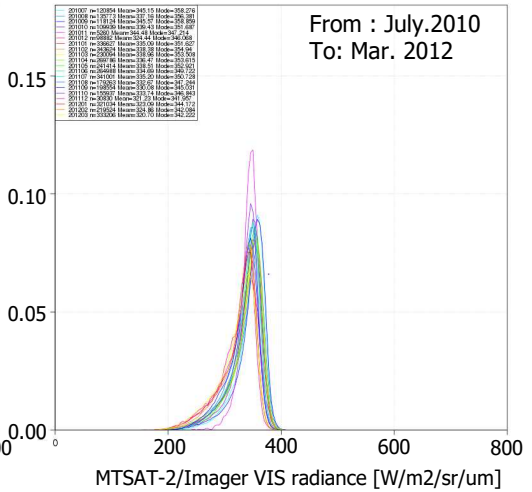
Case1 : 195K

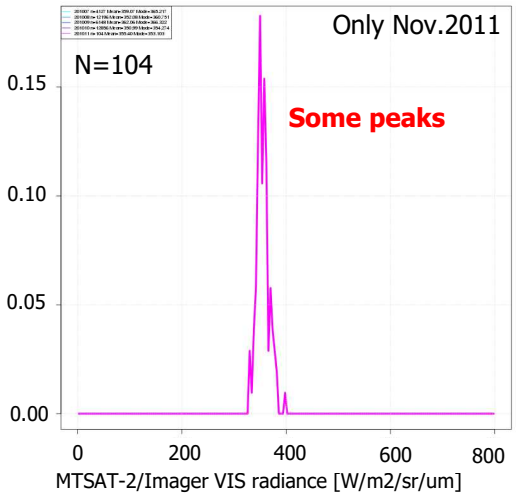


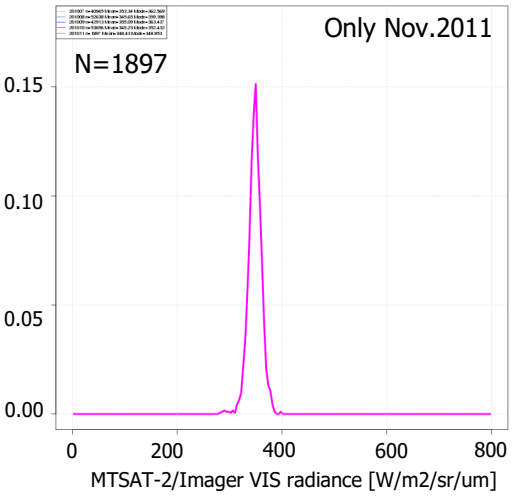
Case2 : 200K

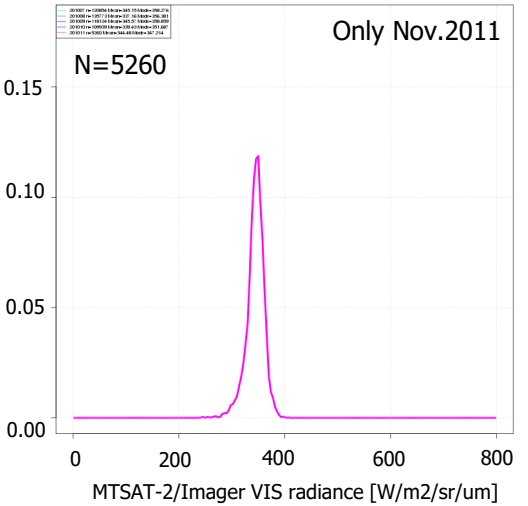


Case3 : 205K









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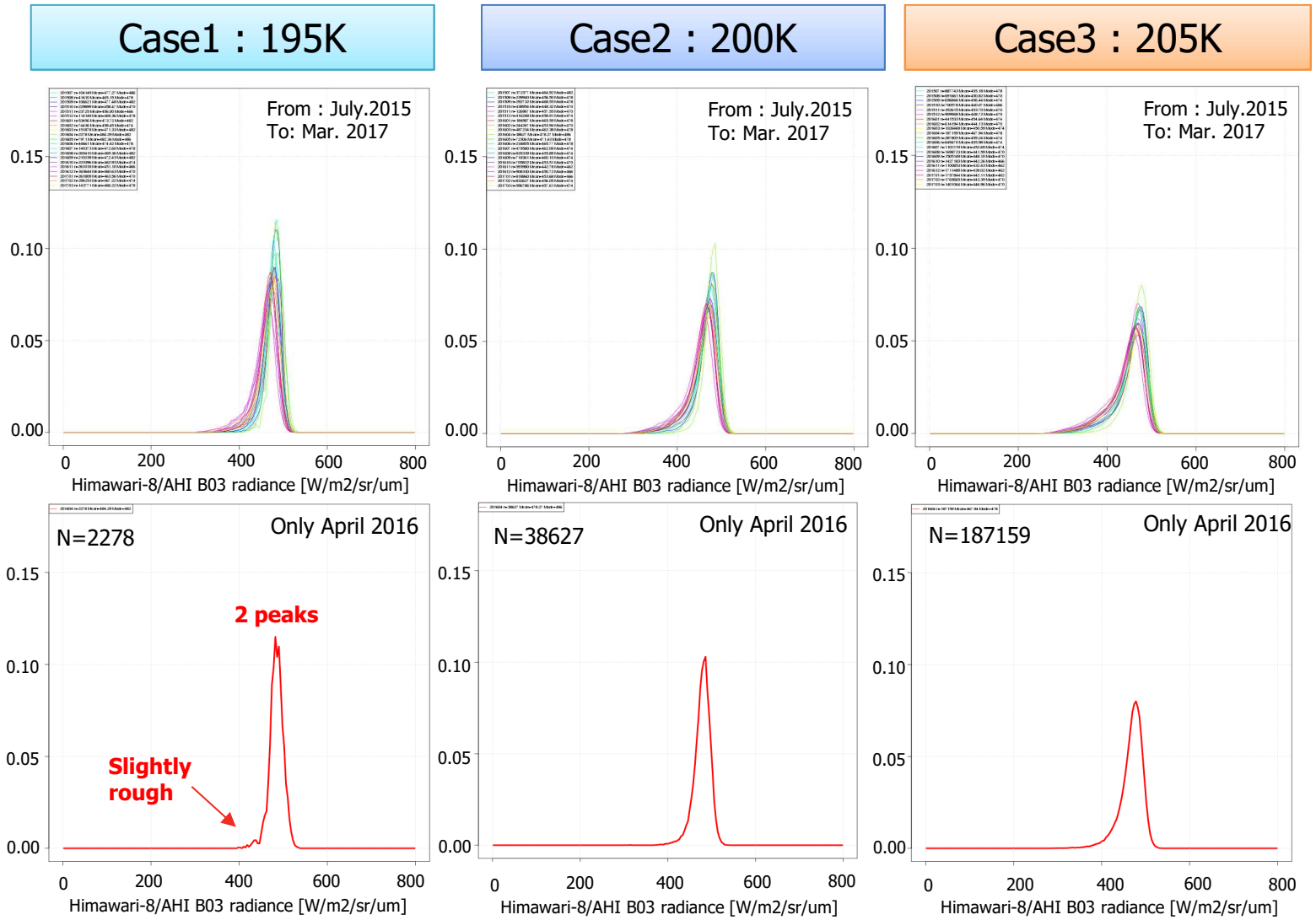
Robustness of GEO PDF depending on BT thresholds

Himawari-8

- Himawari-8 PDF shapes at 195K also look slightly rougher than ≧200 K

- For example, 195 K PDF shape on April 2016 is rougher than 200K and 205K PDF shapes.

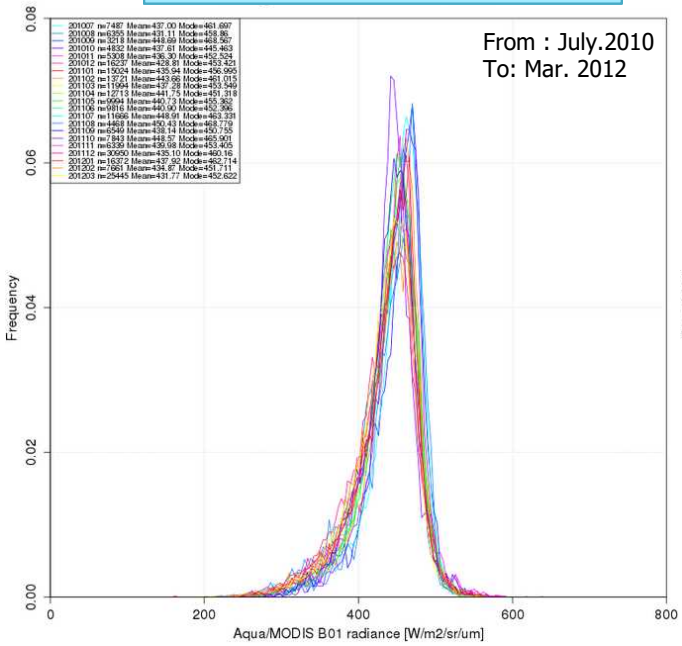
Himawari-8 BT threshold ≧200K is better



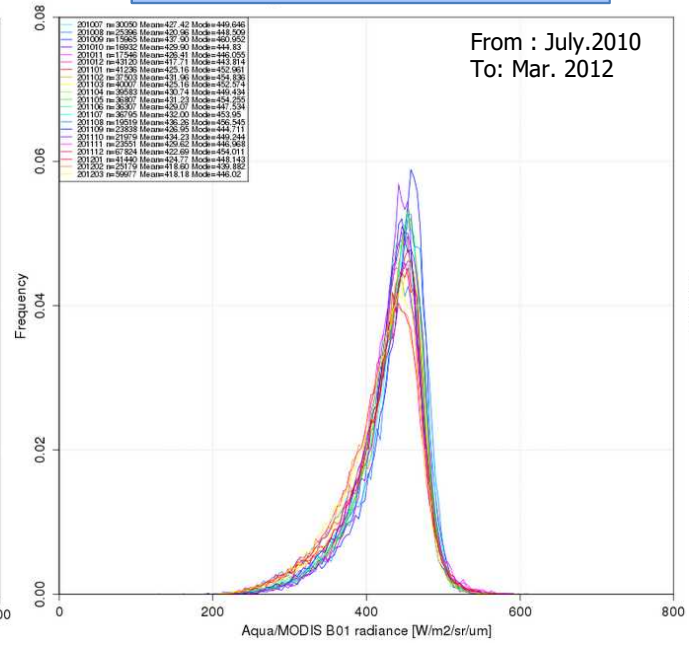
Robustness of LEO PDF depending on BT thresholds

Aqua/MODIS (MYD02SSH)

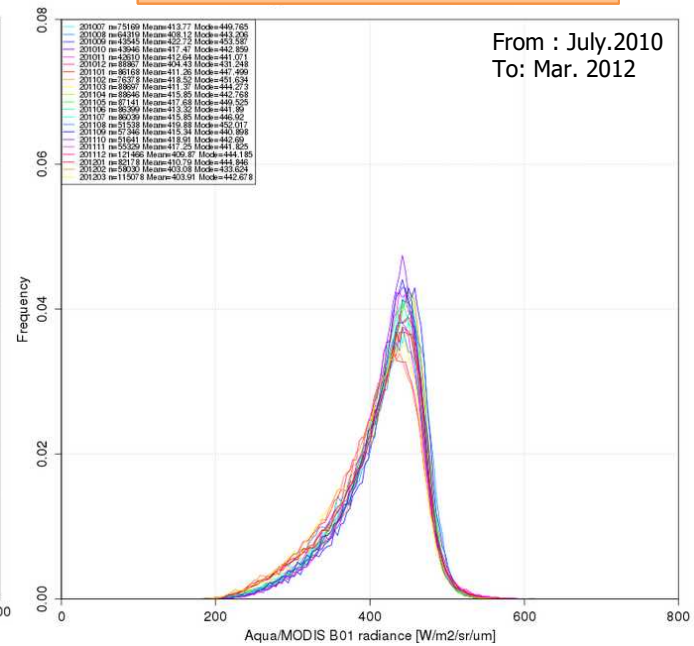
Case1 : 195K



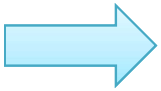
Case2 : 200K



Case3 : 205K



- MODIS PDF shapes at 195K and 200K look slightly rougher than at 205K, although PDFs at 205K are not perfectly smooth like Himawri-8.
  - ➢ Due to getting low number of DCC pixels by using MYD02SSH (5 km by 5 km subsampling MODIS data)?
  - ➢ Maybe, full resolution data is needed for more smooth PDFs

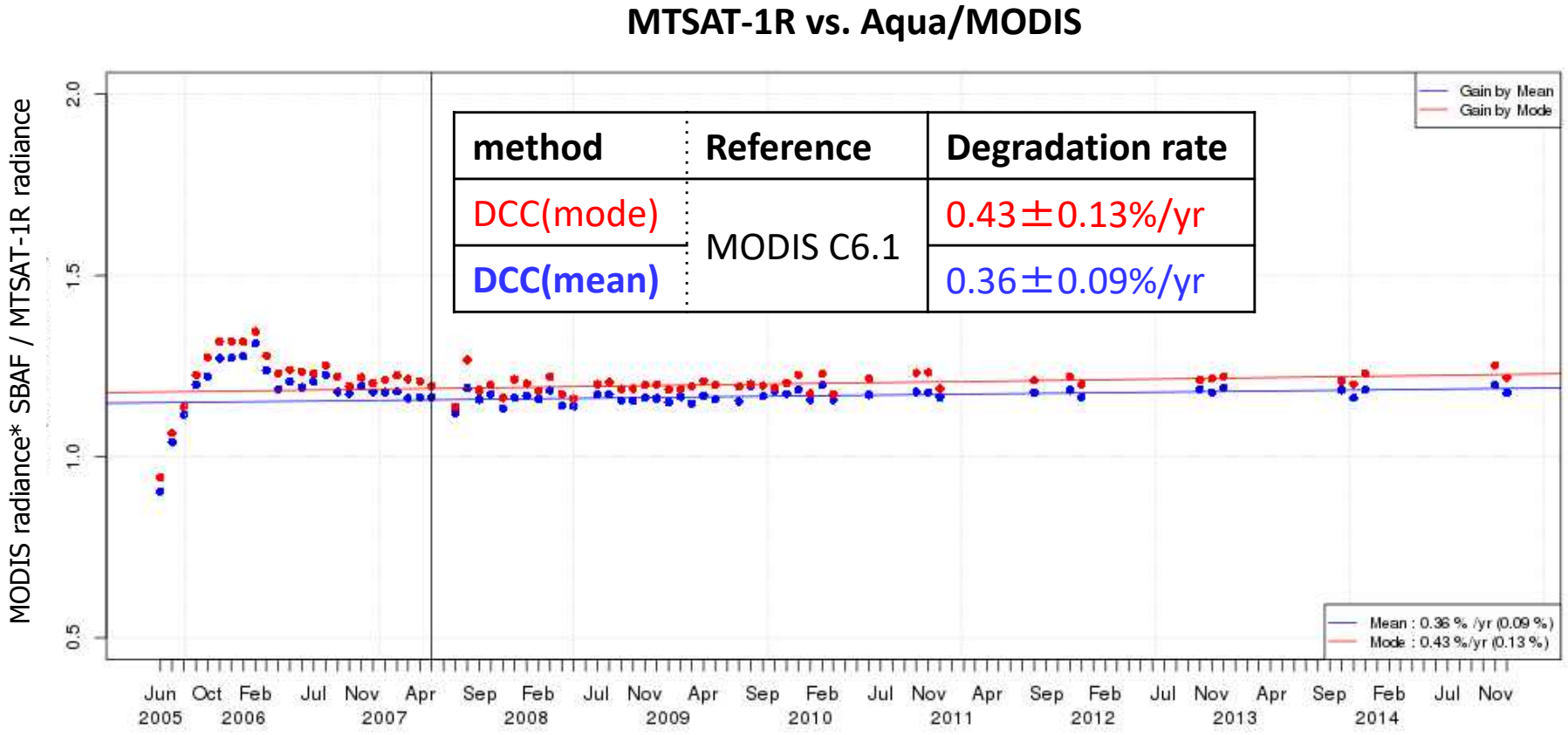


At 205K is better in case of using MYD02SSH

Investigation results of condition options

1. Mode or Mean
   - ➢ Mode statistic looks better
2. Hu model vs. no ADM
   - ➢ Applying Hu model is better
3. BT@10.3um
   - ➢ GEO(Himawari satellites) : ≧ 200K is better
   - ➢ LEO (Aqua/MODIS) : 205K is better
     - → 205K is selected

MTSAT-1R vs. Aqua/MODIS time series



method	Reference	Degradation rate
DCC(mode)	MODIS C6.1	0.43±0.13%/yr
DCC(mean)		0.36±0.09%/yr

- There is rapid degradation in early period. After that, the gain(= $\frac{\text{MODIS rad.}}{\text{MTSAT-1R rad.}}$ *SBAF) shows decrease and increase as pointed in Dave's paper (Doelling, 2014)
- The trend, (0.43 +/- 0.13%), is calculated for the period after May 2007.

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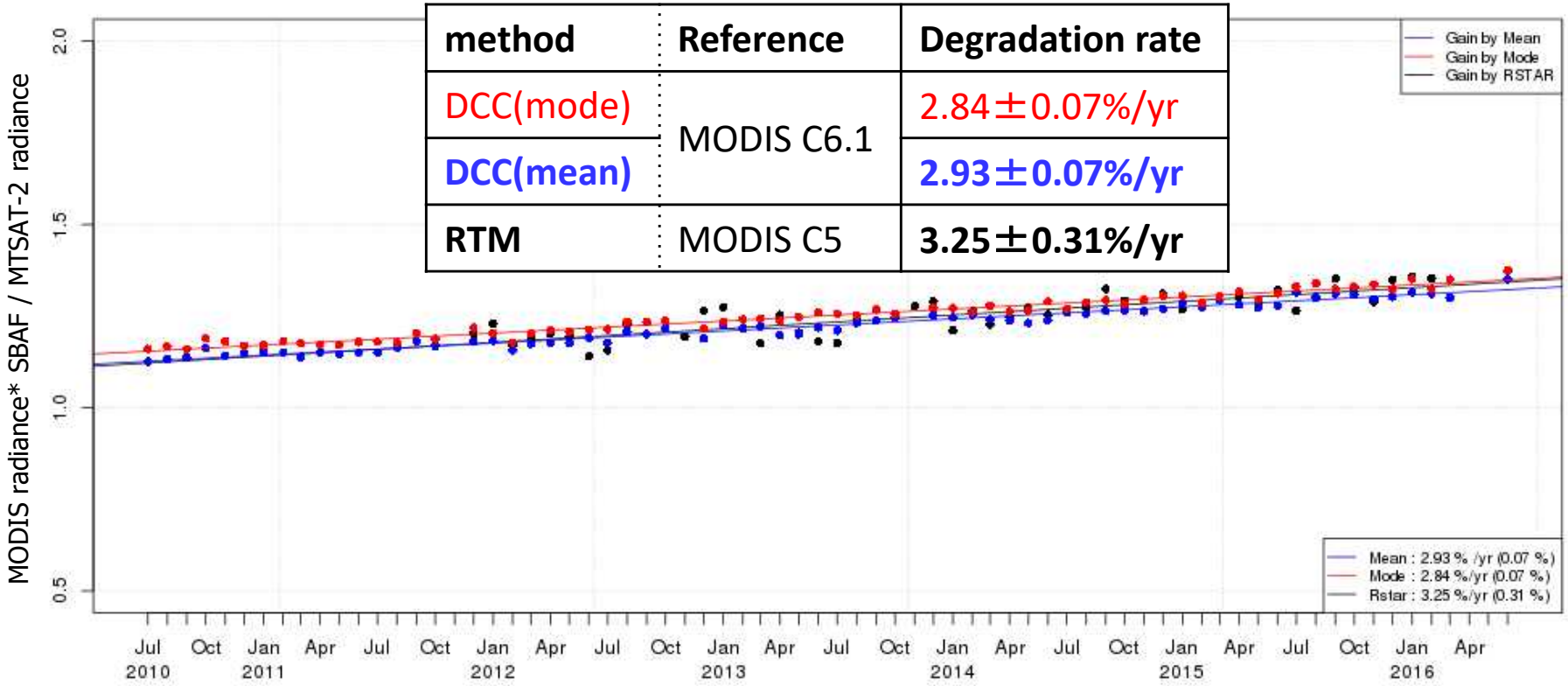
MTSAT-2 vs. Aqua/MODIS time series

MTSAT-2 vs. Aqua/MODIS

method	Reference	Degradation rate
DCC(mode)	MODIS C6.1	2.84±0.07%/yr
DCC(mean)		**2.93±0.07%/yr**
RTM	MODIS C5	**3.25±0.31%/yr**



- The degradation of MTSAT-2/Imager is 2.84±0.07%/yr.
- This result is generally consistent with the result validated by using RSTAR radiative transfer model.
  *In this case, we use MODIS C5 for RTM.

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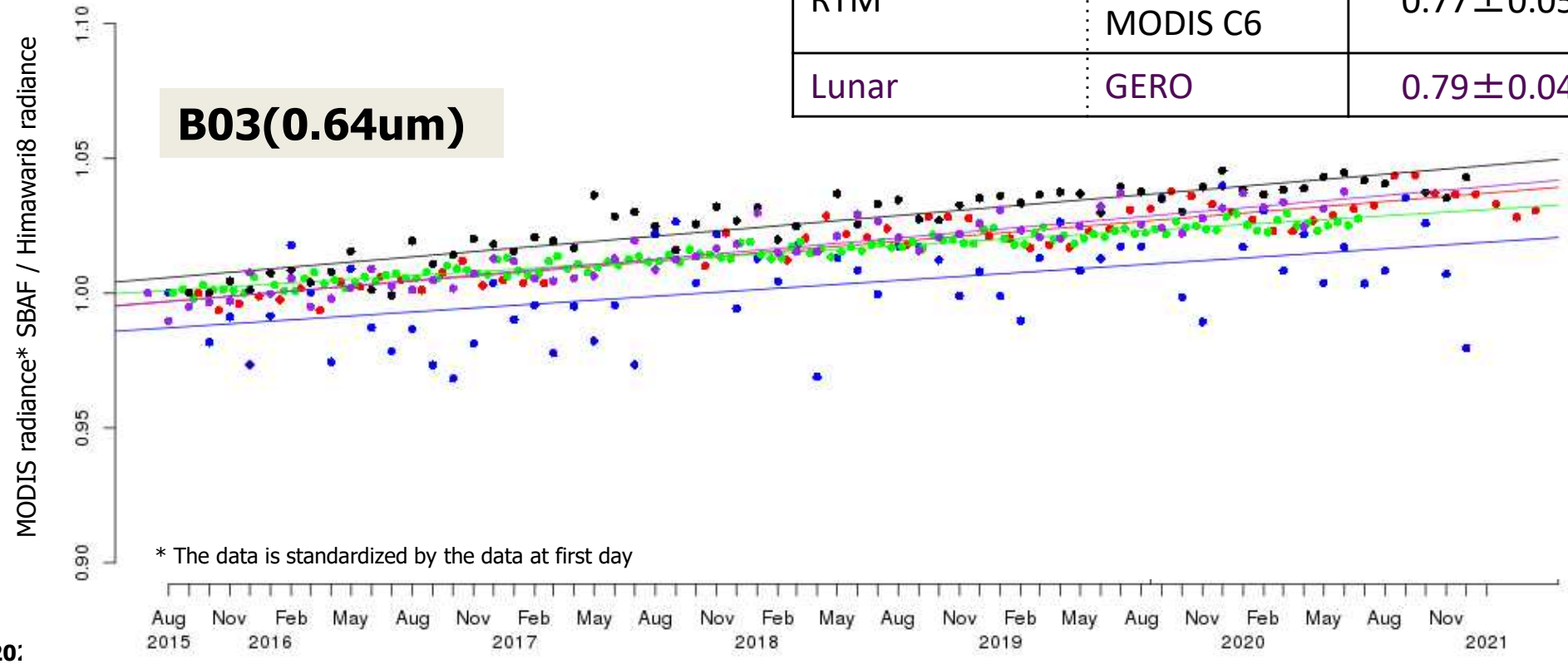
Himawari-8 vs. Aqua/MODIS time series

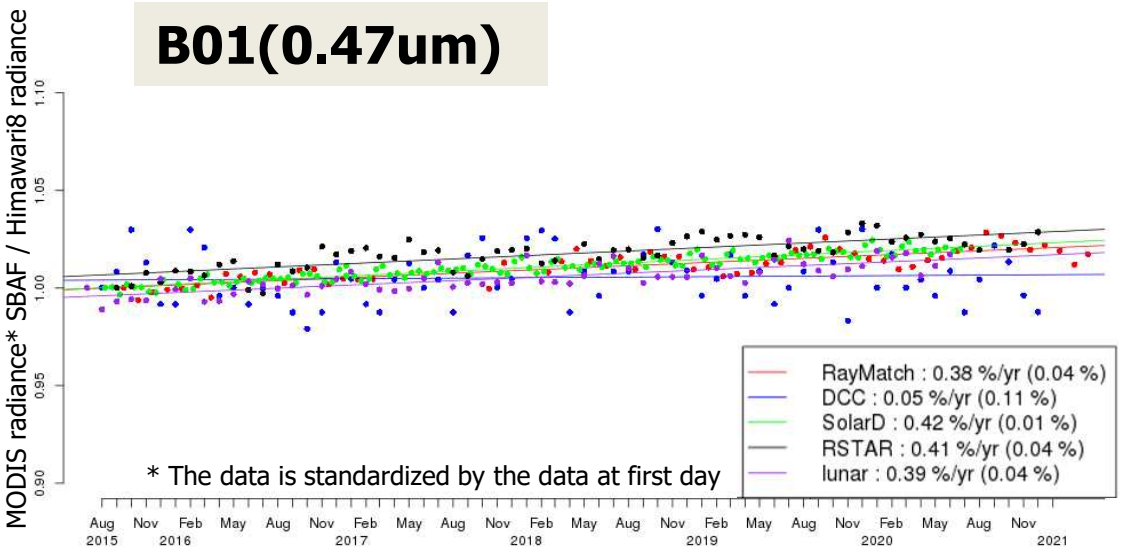
- The time-series trend of DCC method is good agreement with that of solar diffuser.
- But SE of DCC trend has larger than other methods.
  - ➢ Due to using sub-sampled MODIS data (MYD02SSH)?

Method	Reference	Degradation rate
Ray-match	SNPP/VIIRS	0.74±0.04%/yr
DCC(mode)	MODIS C6	0.59±0.12%/yr
Solar Diffuser		0.55 ±0.01%/yr
RTM	RTM with MODIS C6	0.77±0.05%/yr
Lunar	GERO	0.79±0.04%/yr



Applying for Himawari-8 other VNIR bands

B01(0.47um)



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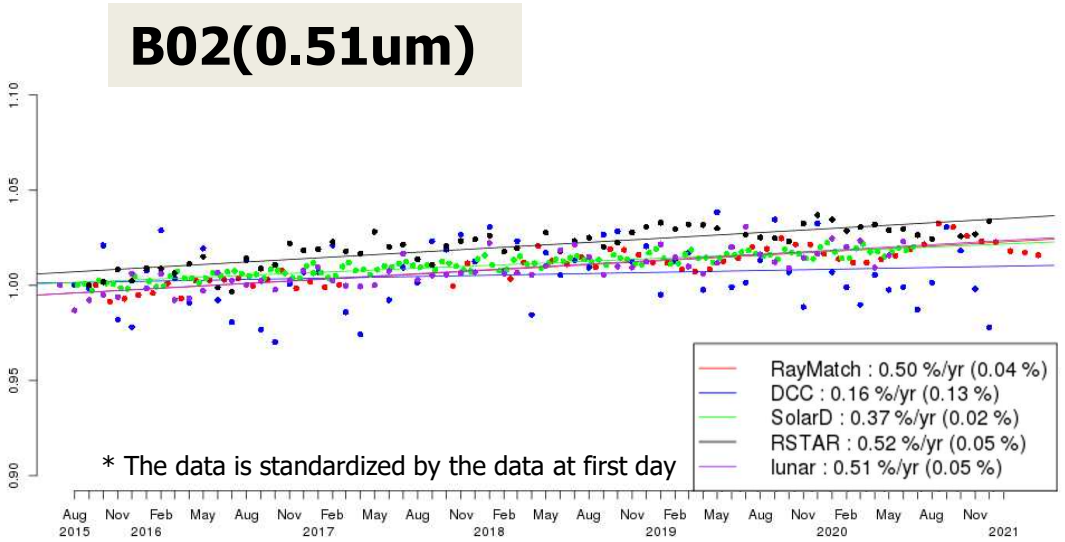
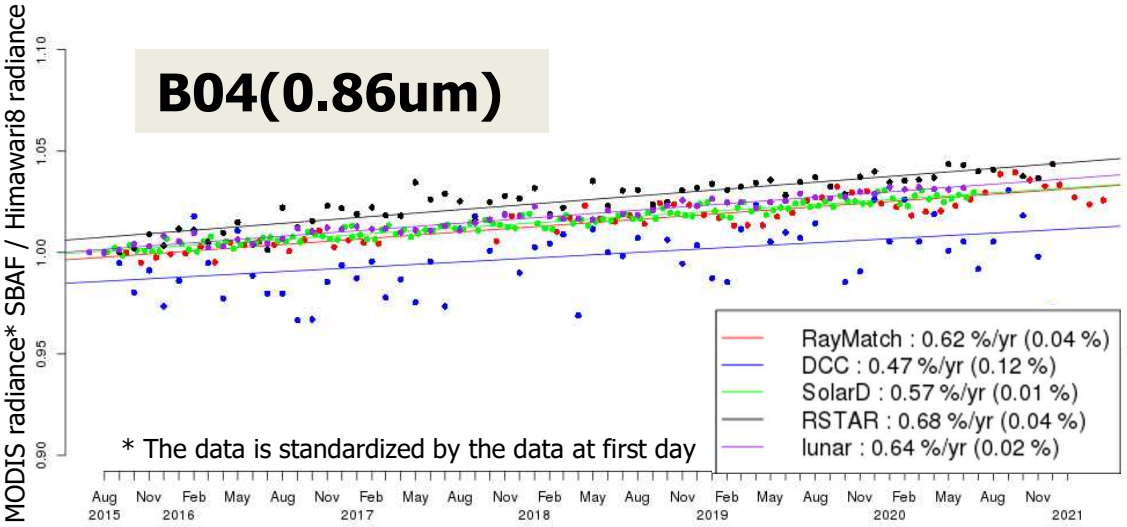
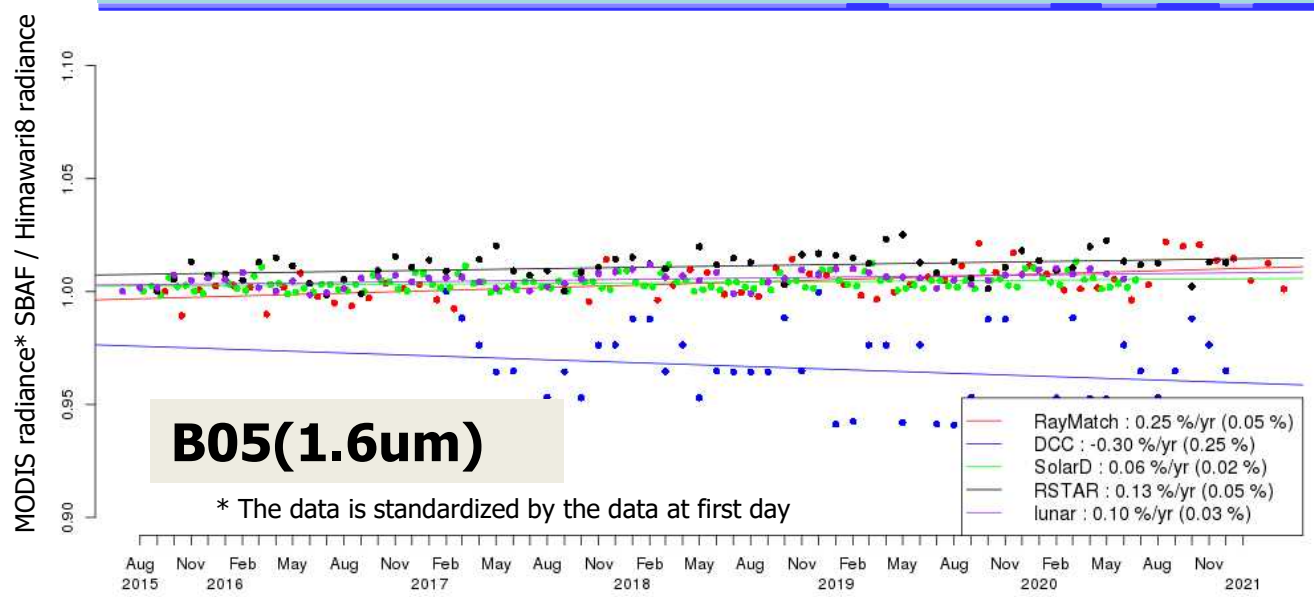


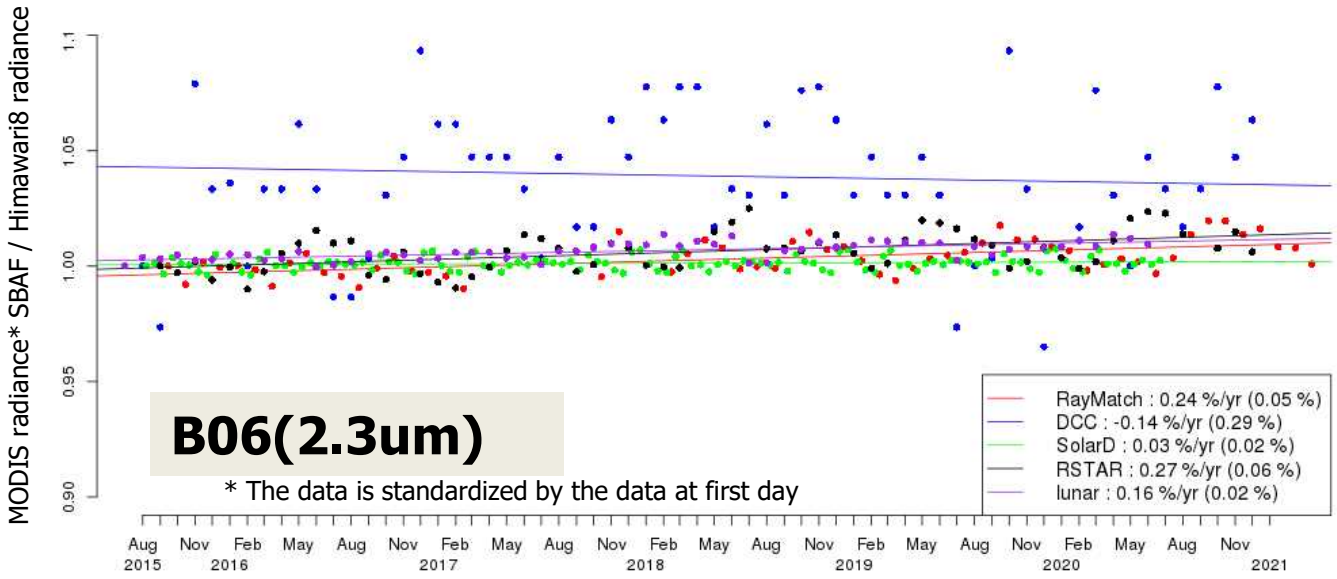
B04(0.86um)



- DCC method have larger variations than other methods in our implementation. (similar to B03 result)
- Degradation rate validated by DCC is slightly smaller than other methods.
  - ➢ Need more research

Applying for Himawari-8 NIR bands





In NIR bands,

- Large variation
- Not consistent with other methods

➢ Further improvement will be necessary.

Summary

- We have investigated the DCC conditions for our satellites.
  1. Mode statistic is good.
  2. applying Hu model is good due to be smaller variation.
  3. 205K BT threshold is better in case of using MYD02SSH.
     ≧ 200K BT thresholds are good for our satellite.

     } 205K is selected
- We applied DCC method to MTSAT-1R to Himwari-8 data (June.2005 to Dec.2020)

MTSAT-1R: Good agreement with Dave's paper (Doelling, 2014)

MTSAT-2: Good agreement with validation by using RTM

Himawari-8: Good agreement with the solar diffuser results but SE of DCC trend has larger than other methods.

Where do this large SE come from?

- We use sub-sampled MODIS data (MYD02SSH).
  - Should we use full resolution MODIS Data?
- Some parameters are not optimized yet?
- Other consideration is need ?

Further plan

- We consider…
  - DCC threshold optimization
  - Preparing the DCC method with VIIRS as reference
  - Investigation to apply DCC method for other bands
  - Application to Himawari-9 (operation in 2022)

END

- Thank you