

Cirrus cloud observed from Himawar-8

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**Cirrus cloud and BTD (Brightness Temperature Difference) of
AHI (Advanced Himawari Imager)**

Evolution of deep convection and BTD

**Cirrus cloud optical parameters derived from
OCA (Optimal Cloud Analysis)**

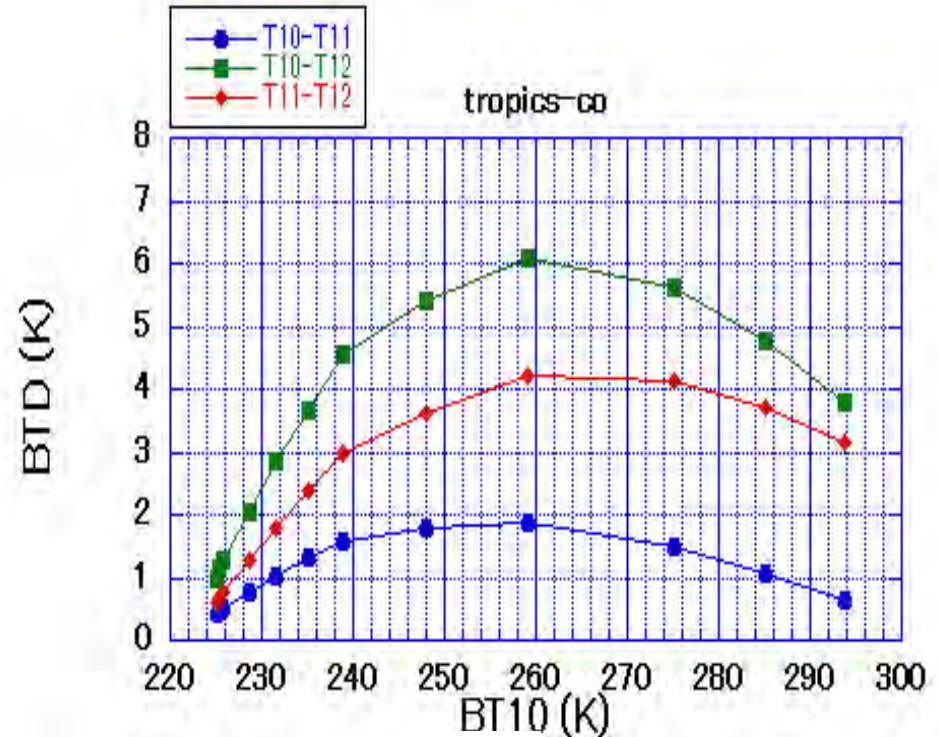
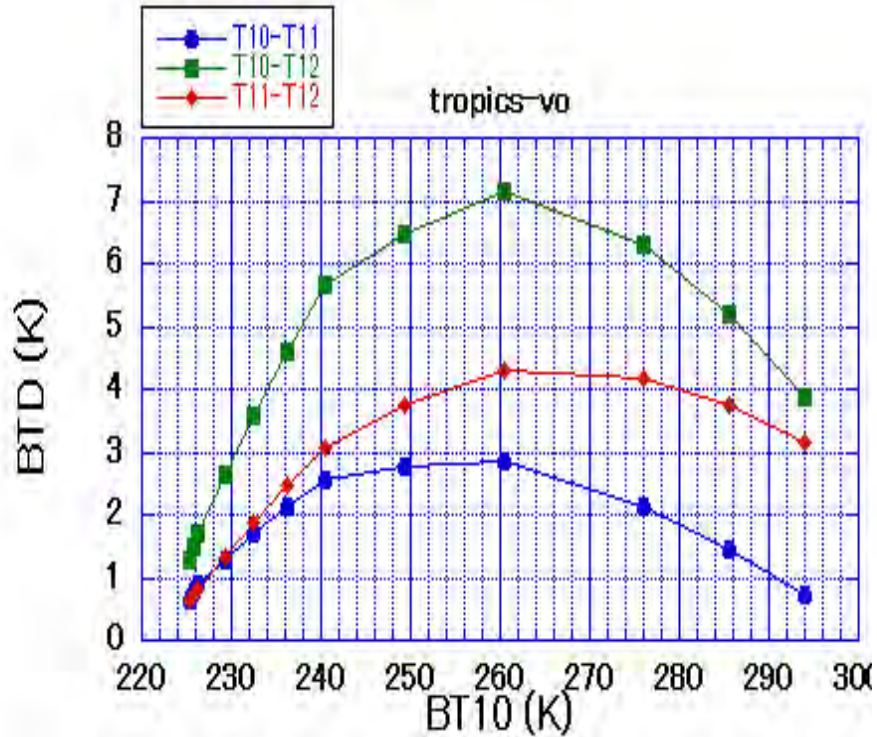
Diurnal variation of cirrus cloud in OCA

Thin and high cloud represented by NICAM and OCA

Simulated BTD for AHI

T10-T12 indicates larger BTD

Cirrus at 12km height
Standard Atmosphere
Tropics
EFR 30 μ m
TAU 0.1-10



Voronoi Aggregate

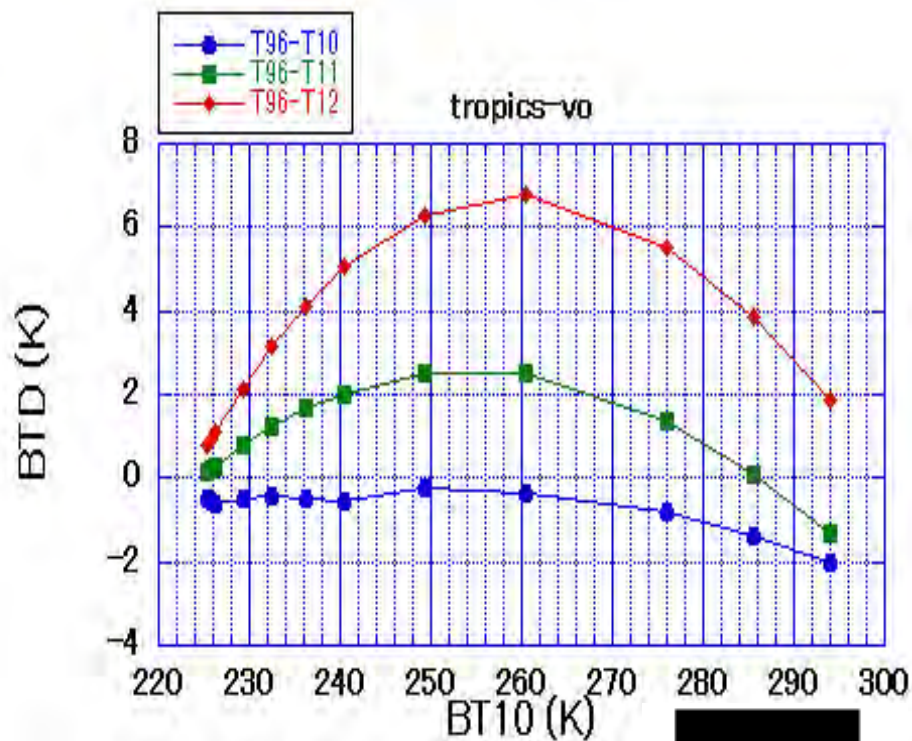
Ishimoto (2012)



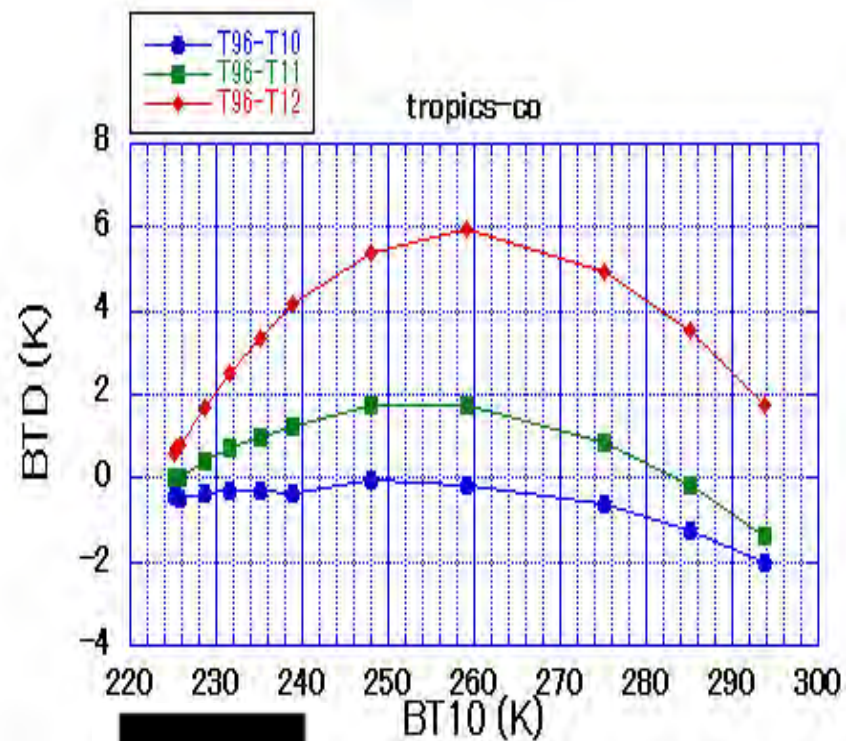
Solid column

Simulated BTD for AHI

T86-T12 indicates larger BTD as well



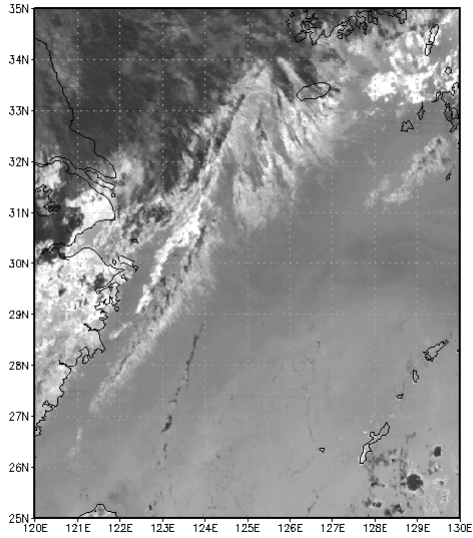
Voronoi Aggregate



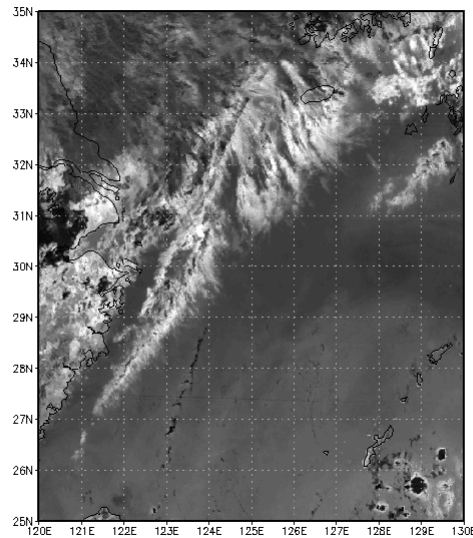
Solid column

BTD and VIS,IR Images

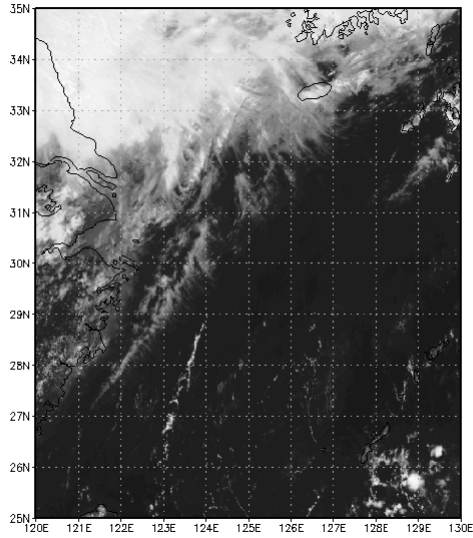
T10-T12



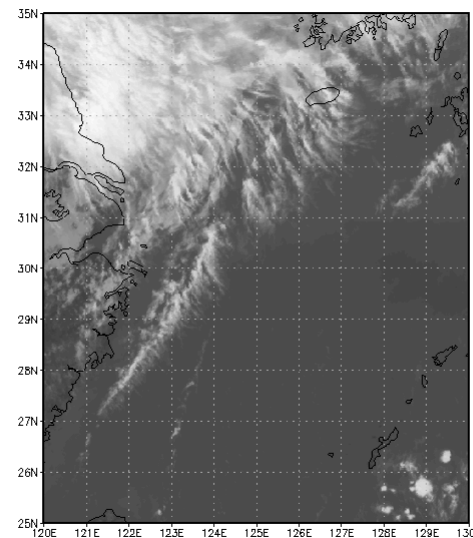
T10-T11



VIS

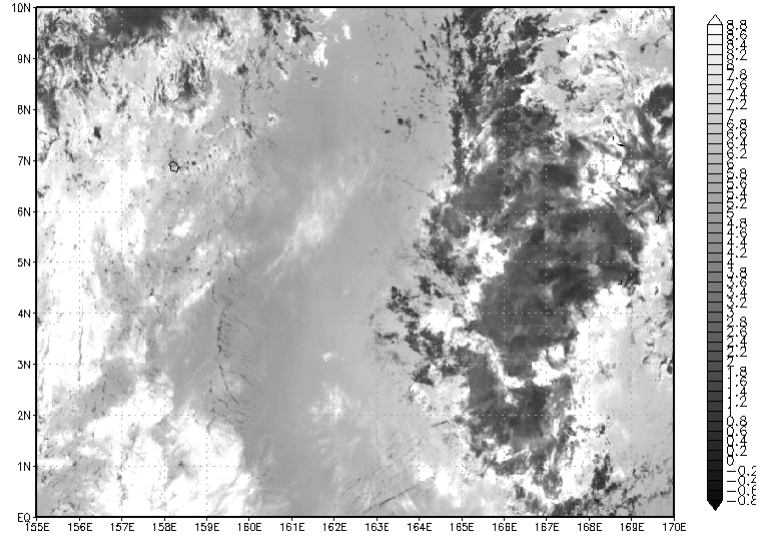


IR

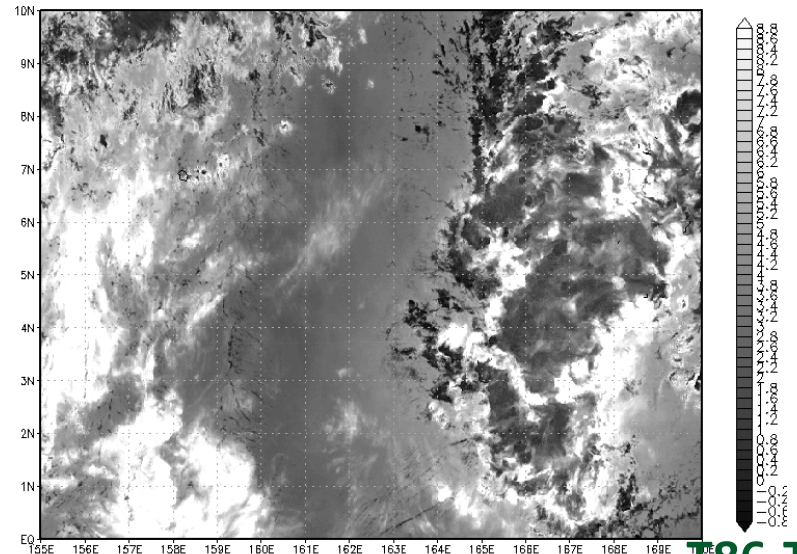
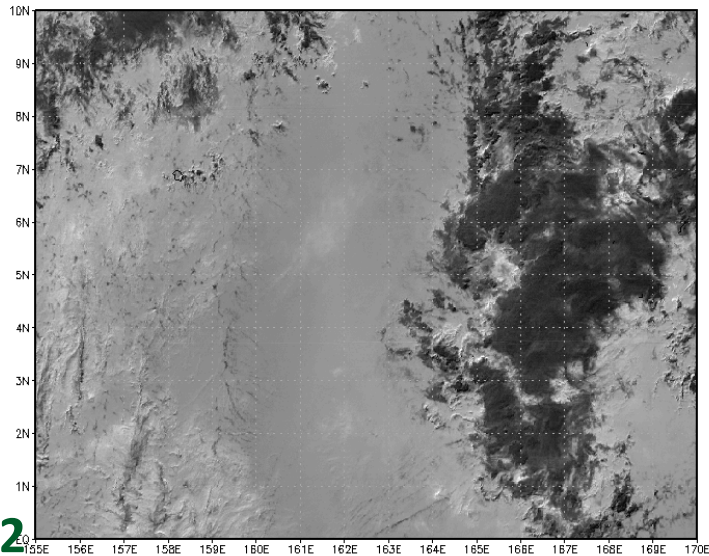
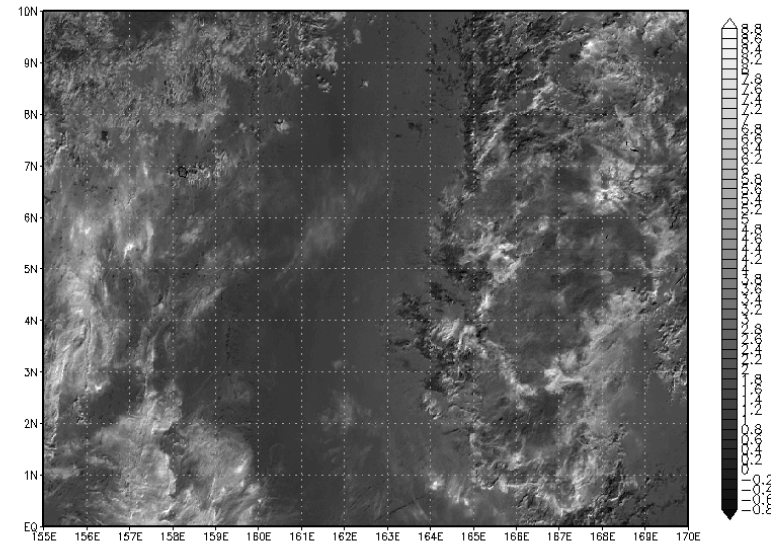


BTD Images

T10-T12



T10-T11

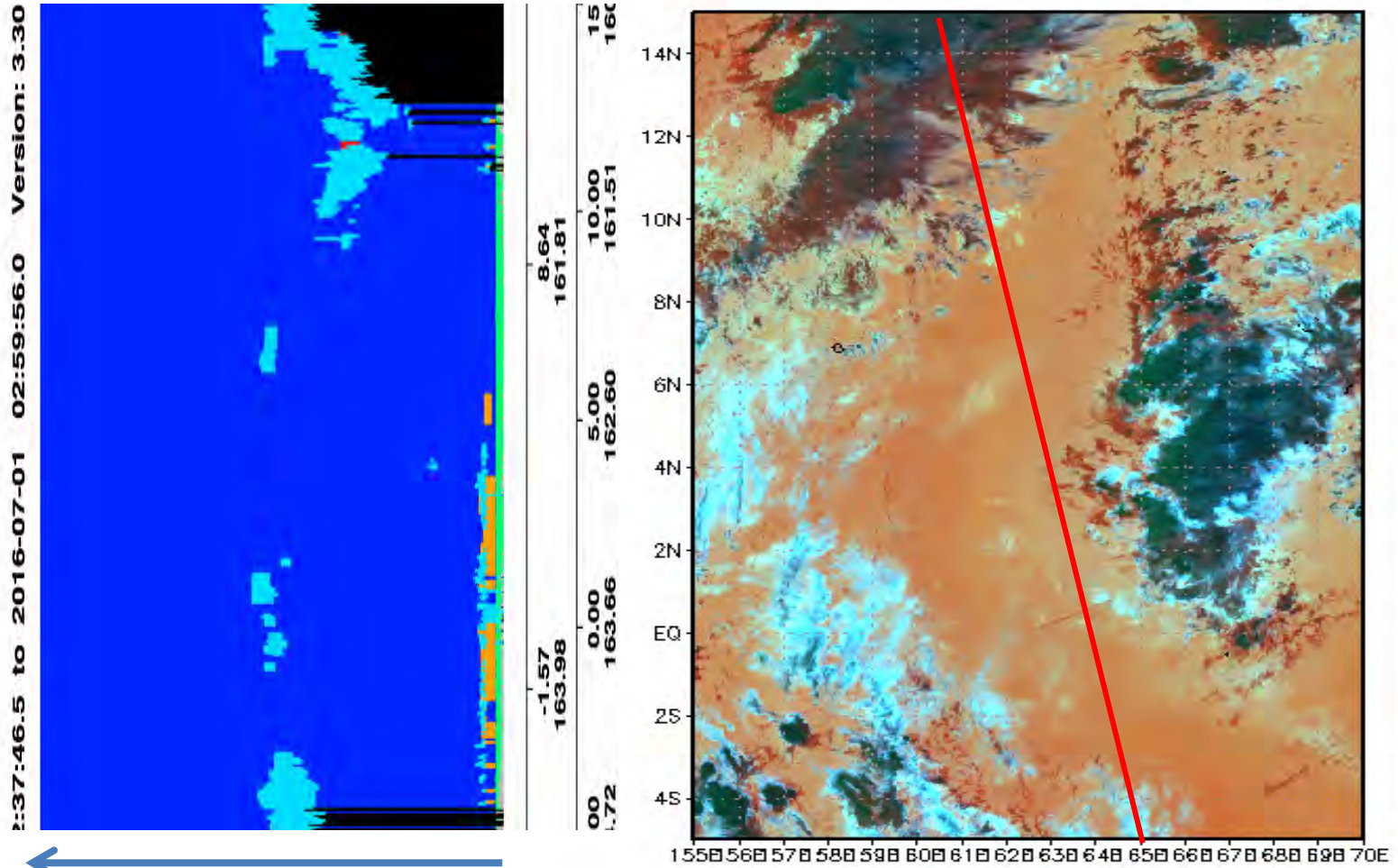


T11-T12

T86-T12

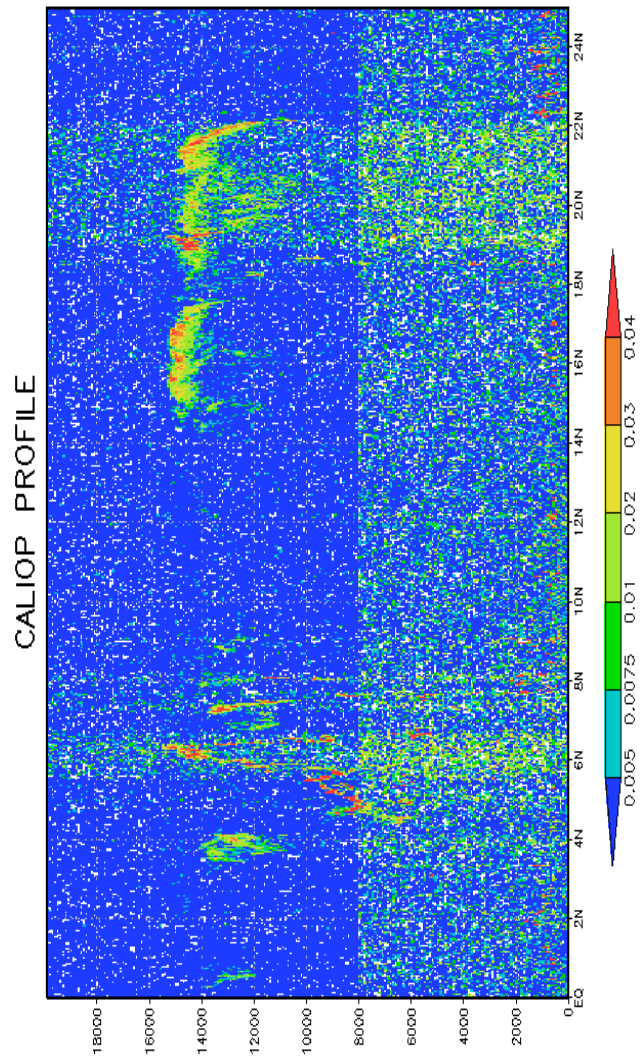
RGB Composite and CALIOP

R:IR G:T10-T12 B:T86-T12

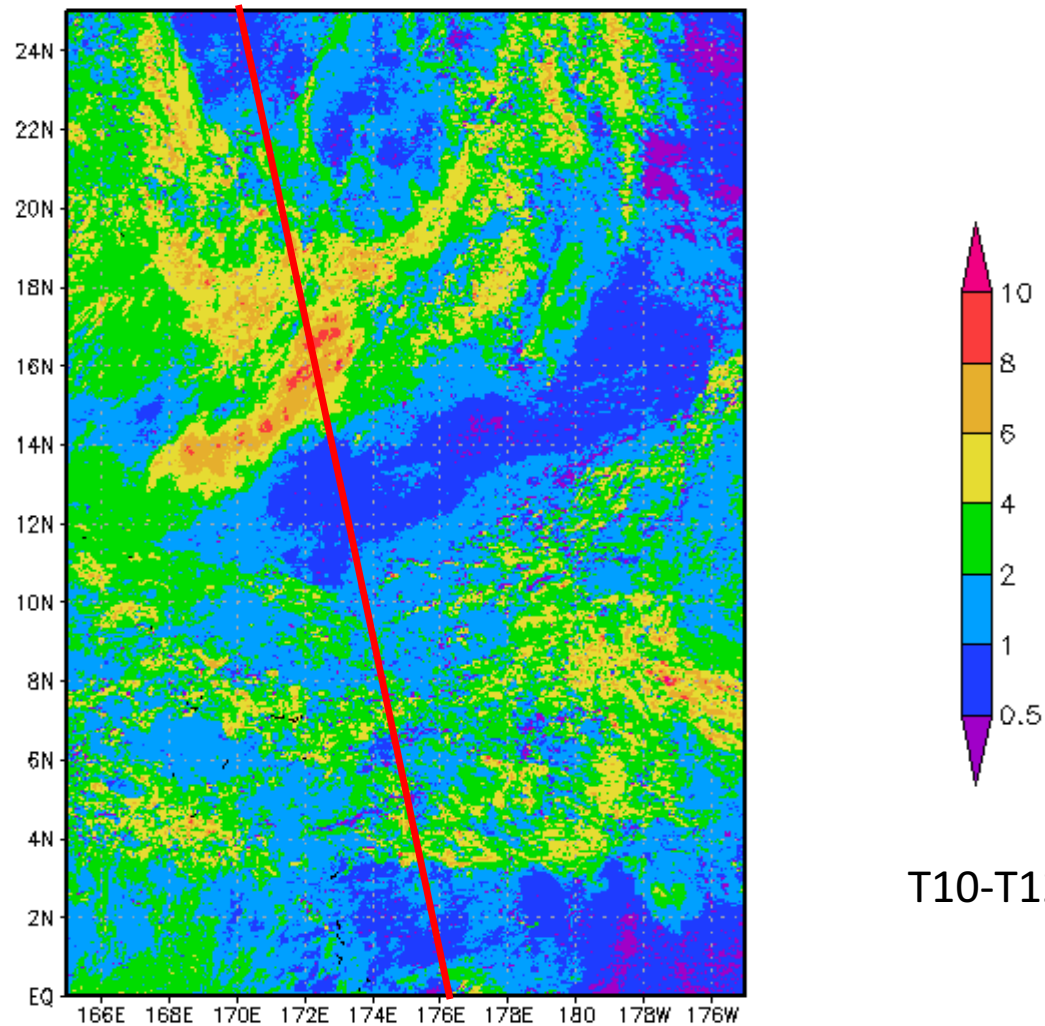


(After CALIPSO WEB SITE)

BTD and CALIOP

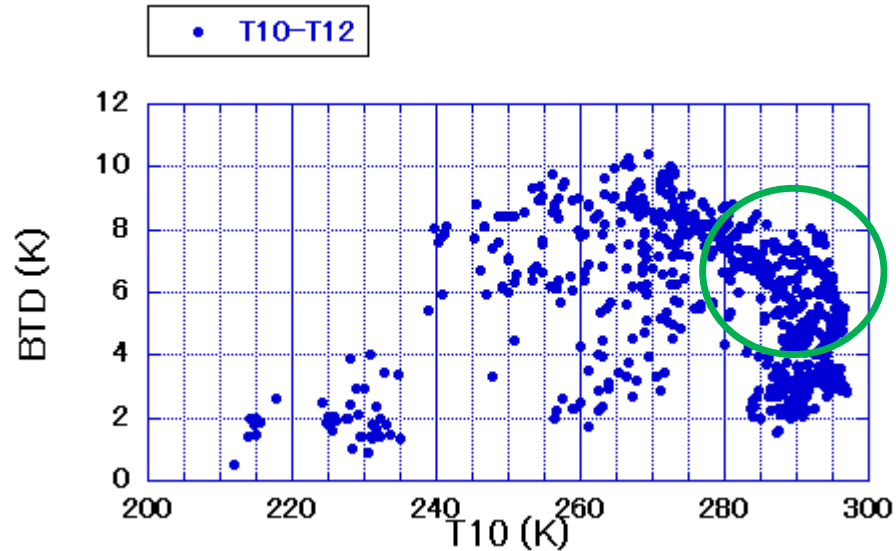


HIMAWARI-8

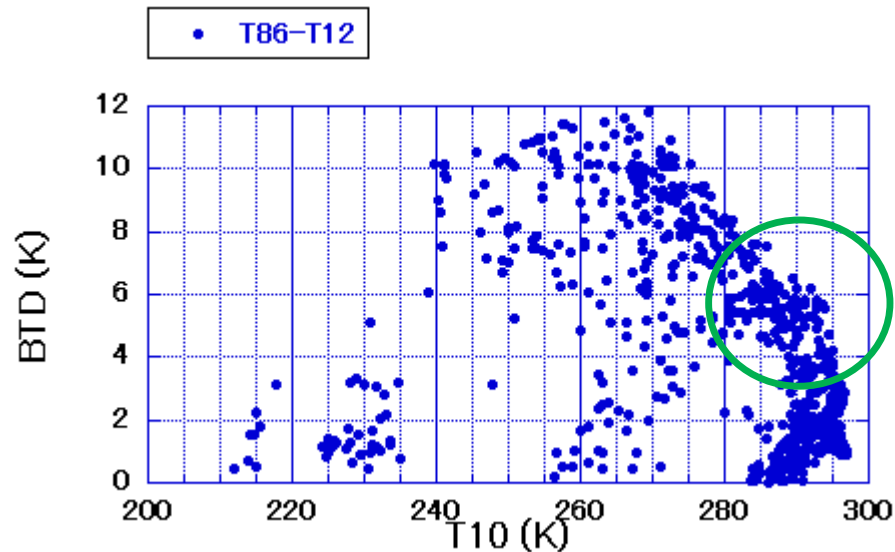


T10-T12

BTD for CALIOP signal seen at higher than 8km

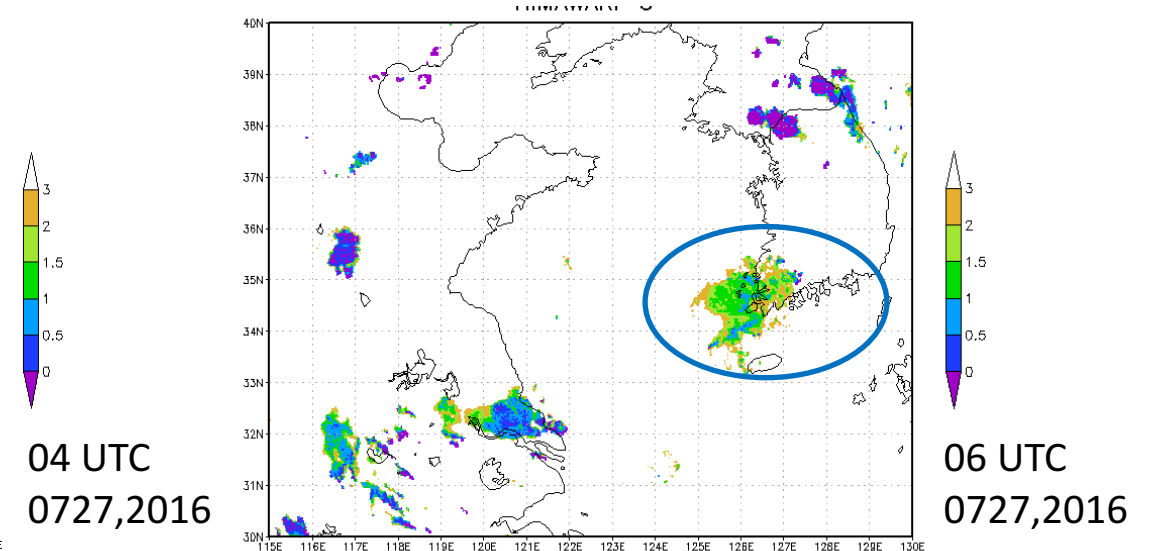
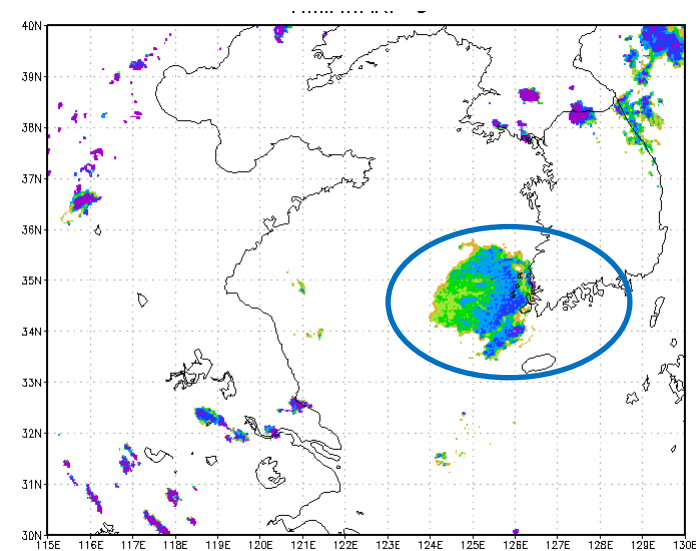
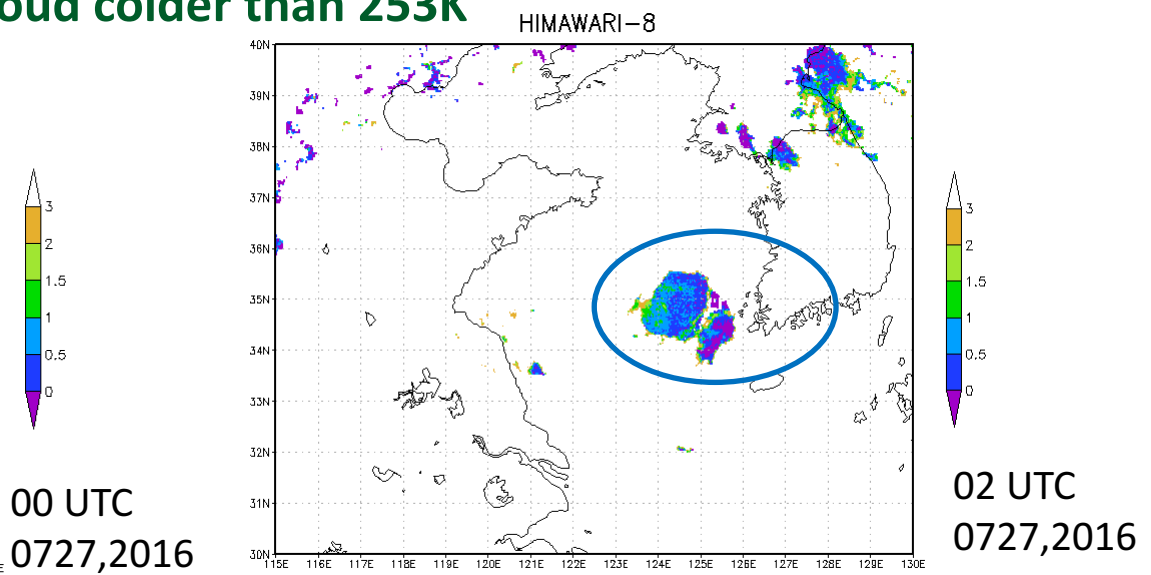
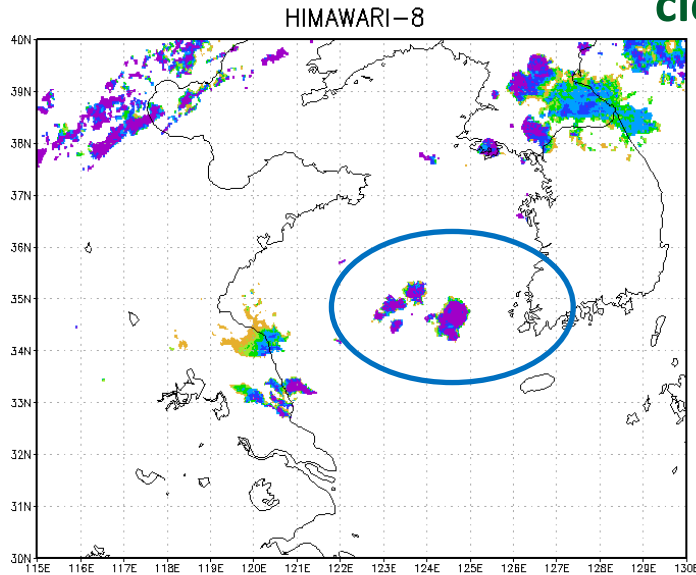


T10-T12 indicates larger BTD even for 280K<



Evolution of Deep Convection and BTD

Developing stage : T86-T12 is small. Decaying stage : T86-T12 becomes larger for cloud colder than 253K



Himawari-8 Optimal Cloud Analysis (OCA)

Inputs of OCA

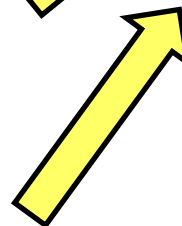
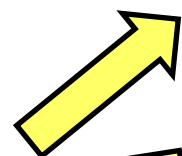
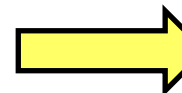
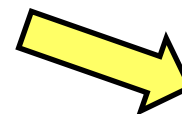
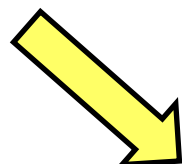
Himawari-8
Satellite Imageries
for all bands

JMA Cloud Mask
product
for Himawari-8

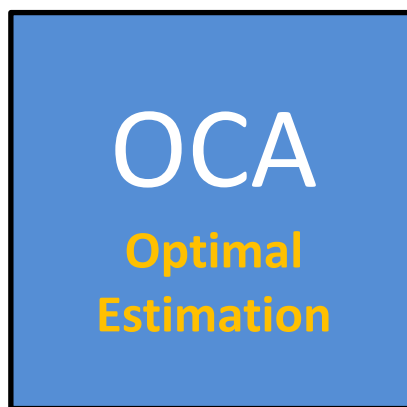
Surface radiative
properties from
MODIS products
- **Surface Reflectivity**
- **Surface Emissivity**

JMA Operational
NWP model data

Cloud Radiative
properties LUTs
computed by DISORT
- **Water Cloud**
- **Ice Cloud**

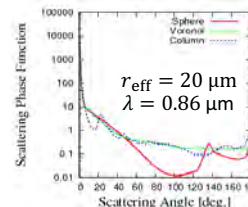
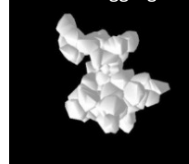


Hayashi is developing the OCA
Collaborating with EUMETSAT



Based on Watts et al. (1998),
EUMETSAT (2011)

Voronoi aggregate



Ice crystal shape is assumed as Voronoi aggregate.
Its single scattering properties are computed at
MRI/JMA (Ishimoto et al. 2012, *JQSRT*, 113)

Outputs of OCA

Cloud Optical
Thickness

Cloud Effective
Radius

Cloud Phase

Cloud Top
Pressure

Surface
Temperature

Bands of AHI

Himawari-8/-9 Imager bands (AHI)

OCA
VIS+IR

Wavelength (μm)	Himawari-8/9		MTSAT-1R/2		GOES-R		MSG	MTG
0.46	●	1			●	1		●
0.51	●	1						●
0.64	●	0.5	●	1	●	0.5	●	●
0.86	●	1			●	1	●	●
0.96								●
1.3					●	2		●
1.6	●				●	1	●	●
2.3	●				●			●
X 3.9	●		●		●		●	●
6.2	●		●		●		●	●
7	●			4	●			
7.3	●	2			●		●	●
8.6	●				●	2	●	●
X 9.6	●				●		●	●
10.4	●		●		●		●	●
11.2	●				●			
12.3	●		●		●		●	●
13.3	●	km		km	●	km	●	●

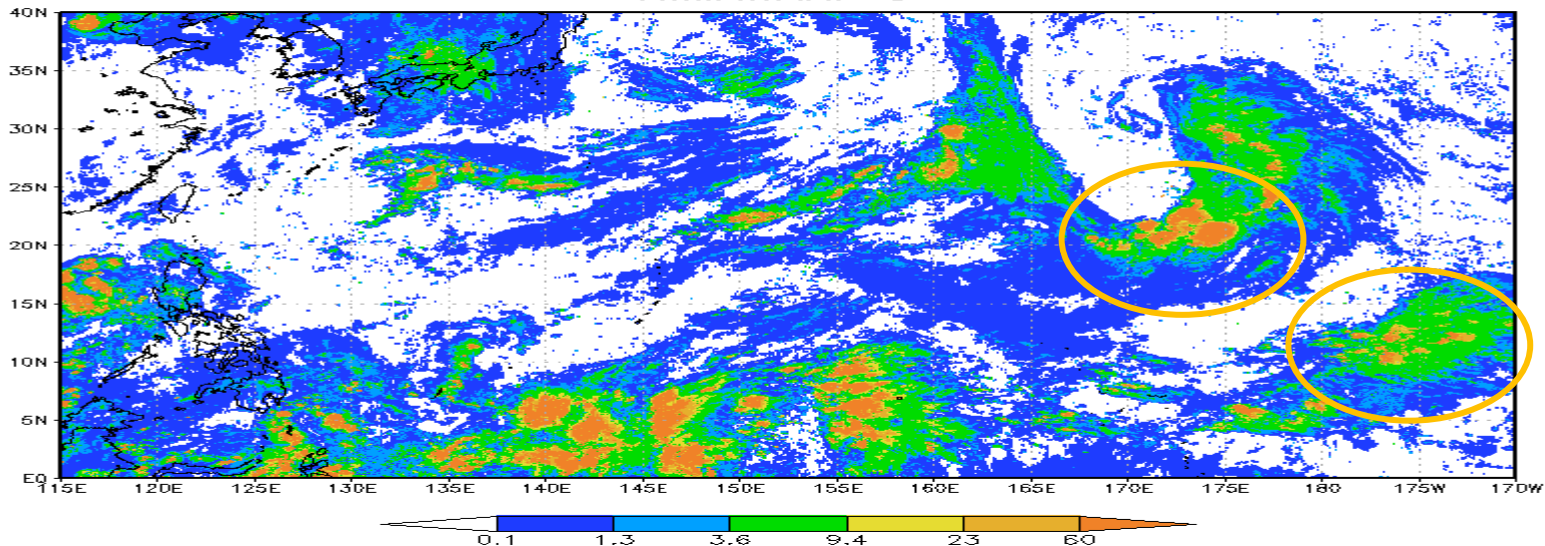
OCA
IR

OCA (COD)

Analysis Area: 20S-40N: 115E-170W Period : July 2016, hourly

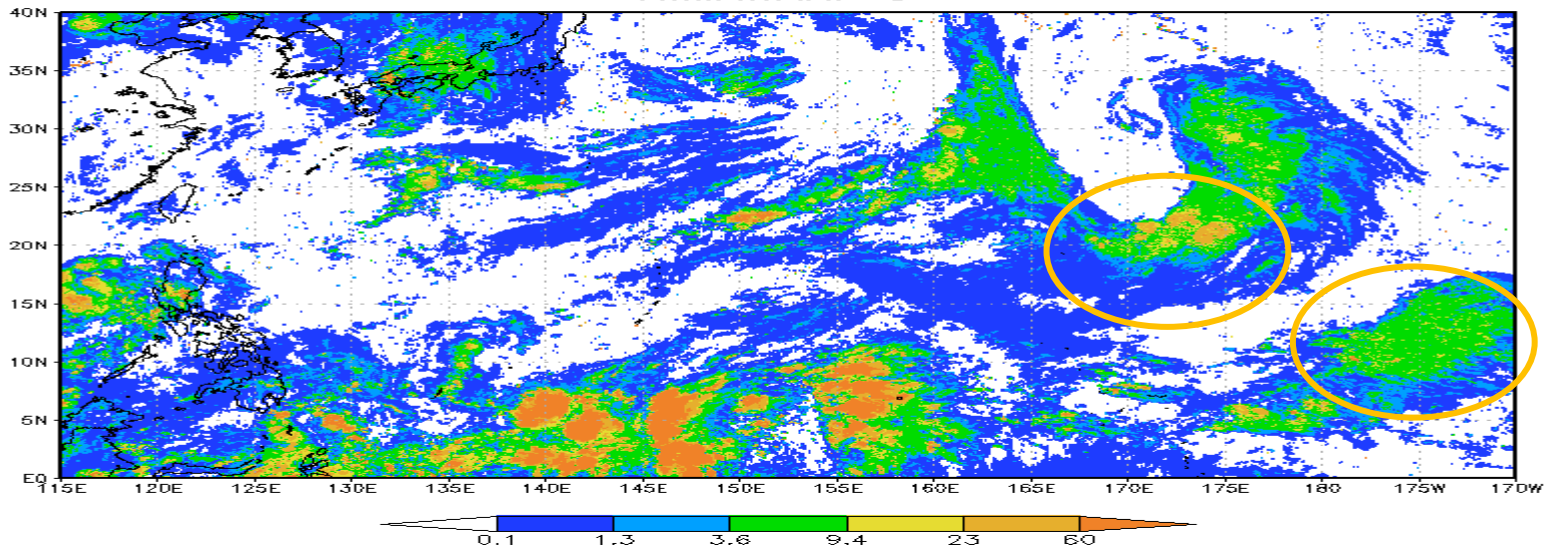
HIMAWARI-8

VIS+IR



HIMAWARI-8

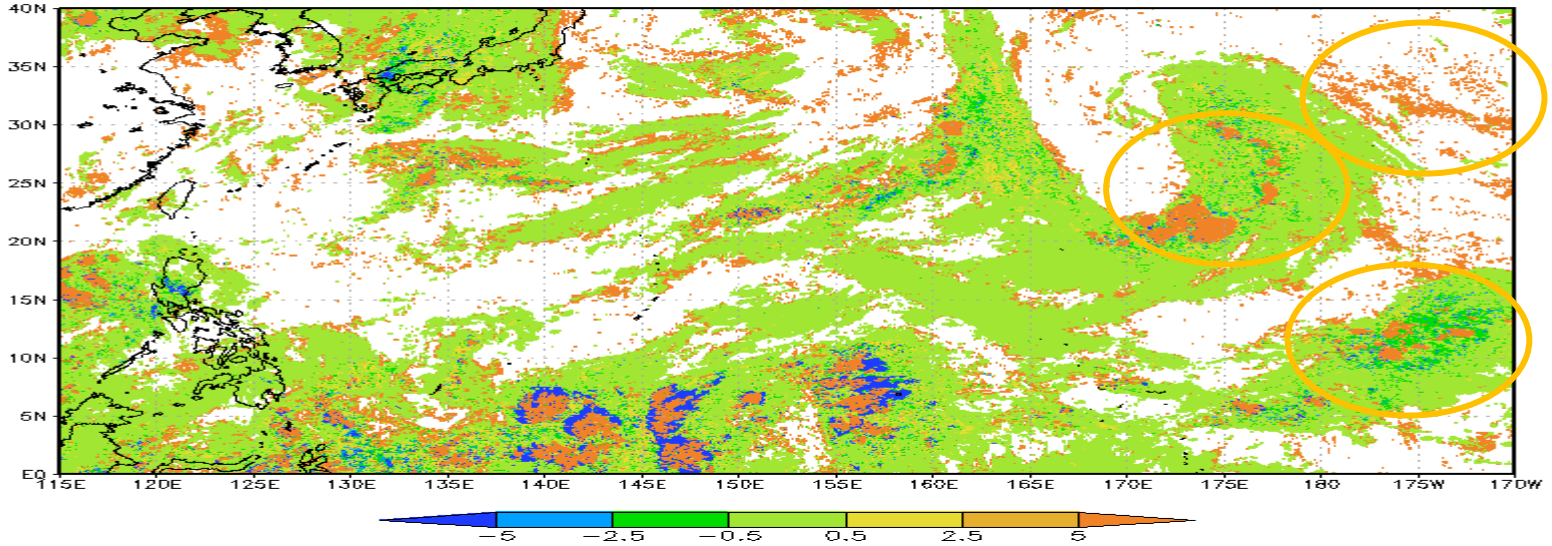
IR



Difference between VIS+IR and IR (COD)

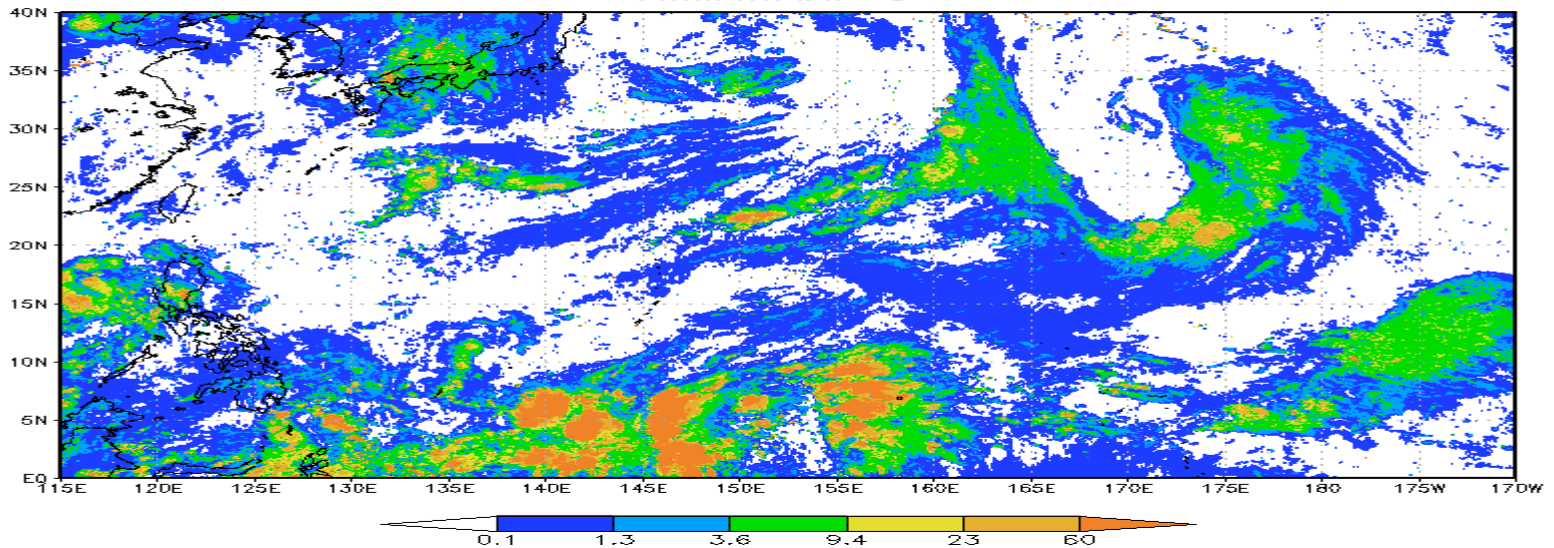
Difference is larger for thicker cloud

HIMAWARI-8



HIMAWARI-8

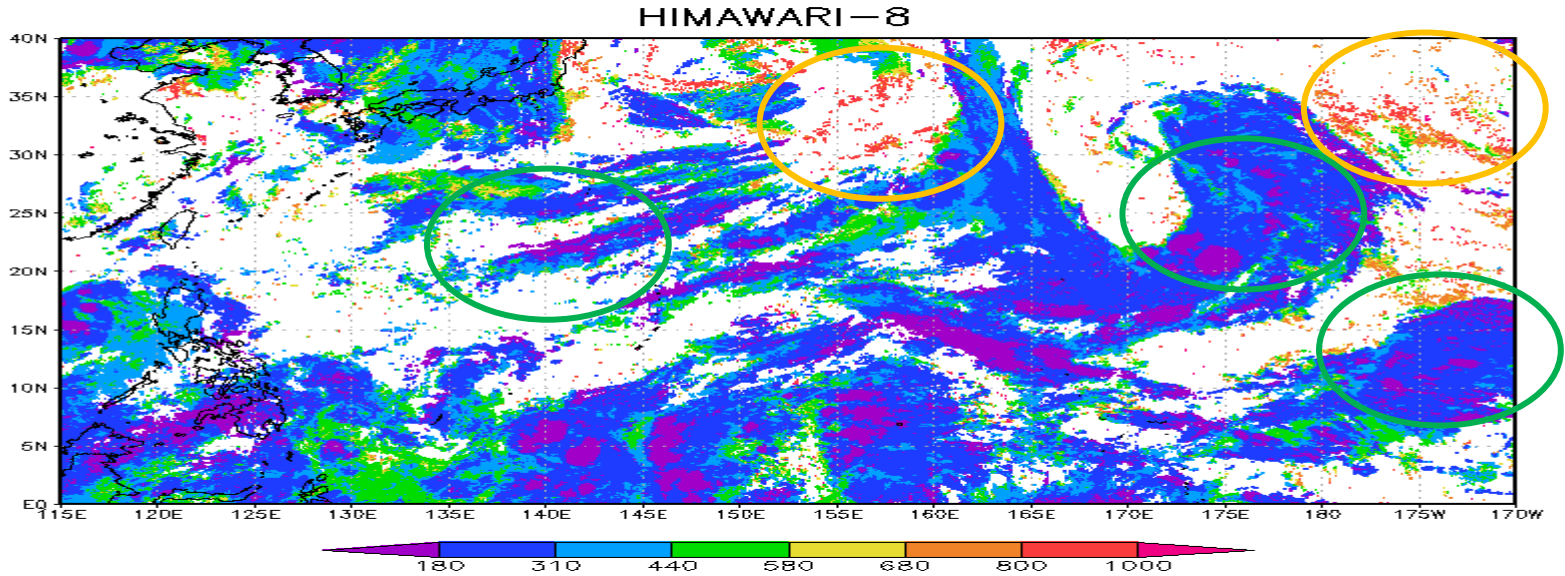
IR



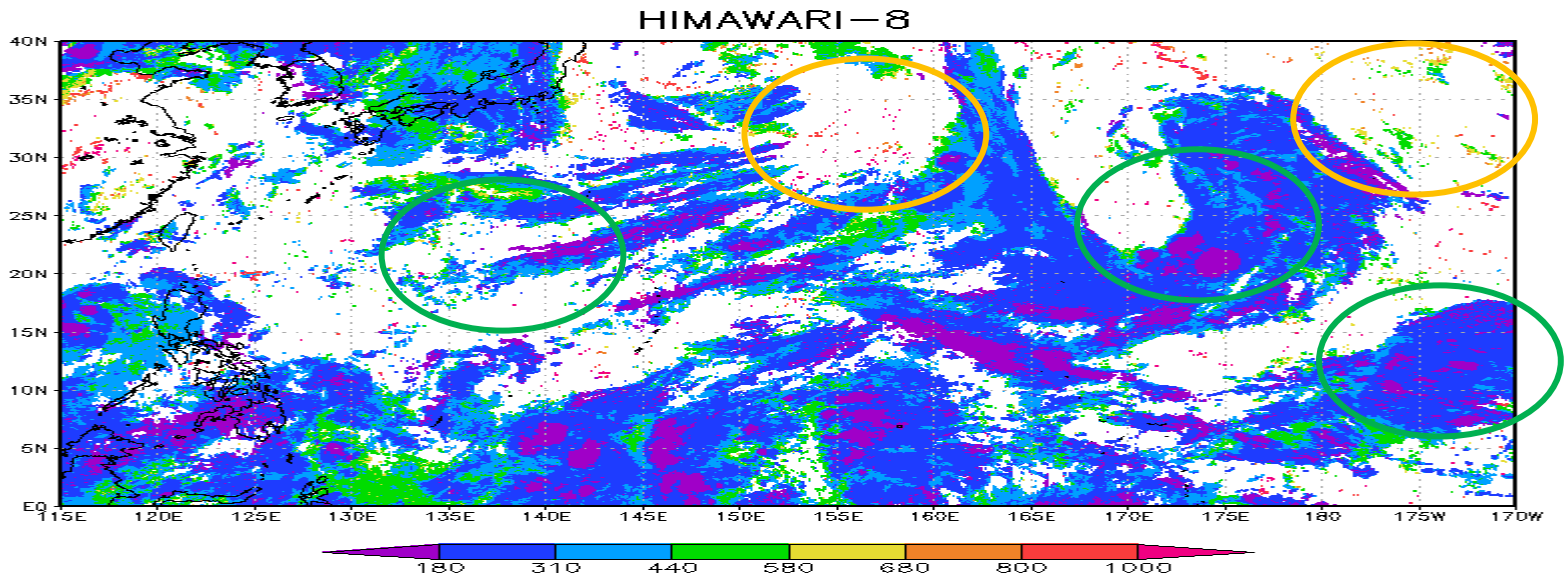
OCA (CTP)

Shallow cloud is not good in IR version

VIS+IR

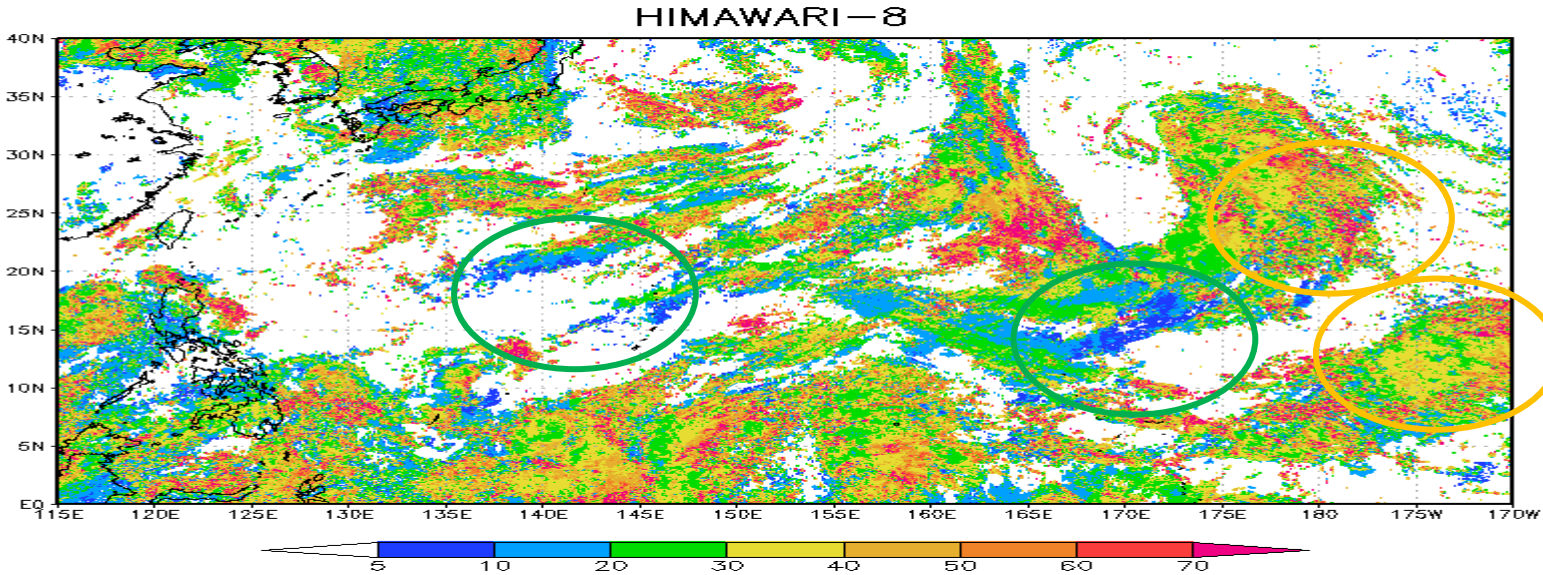


IR

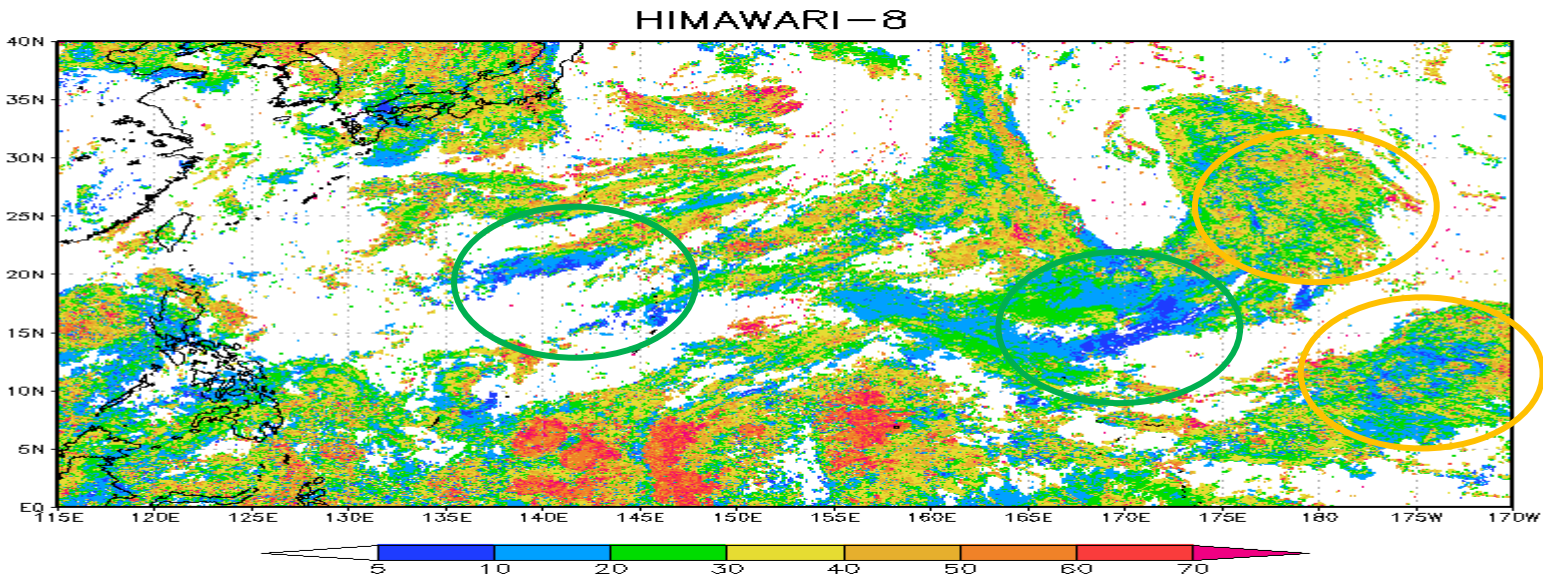


OCA (REF)

VIS+IR



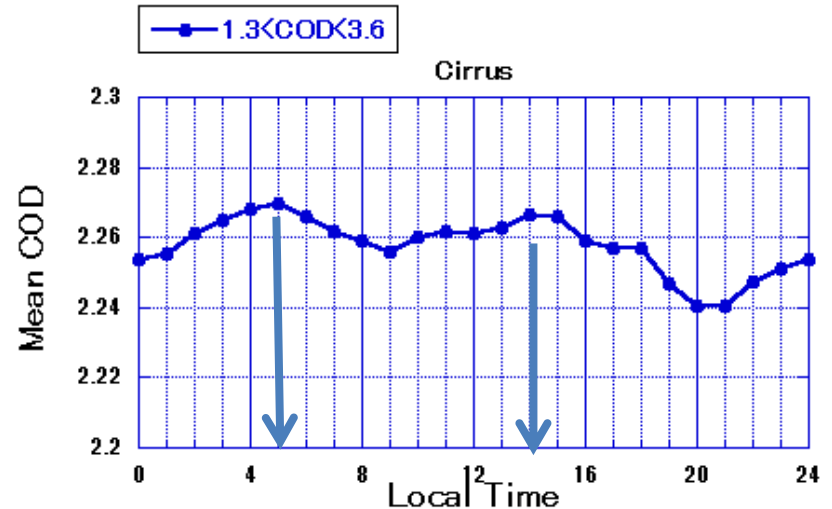
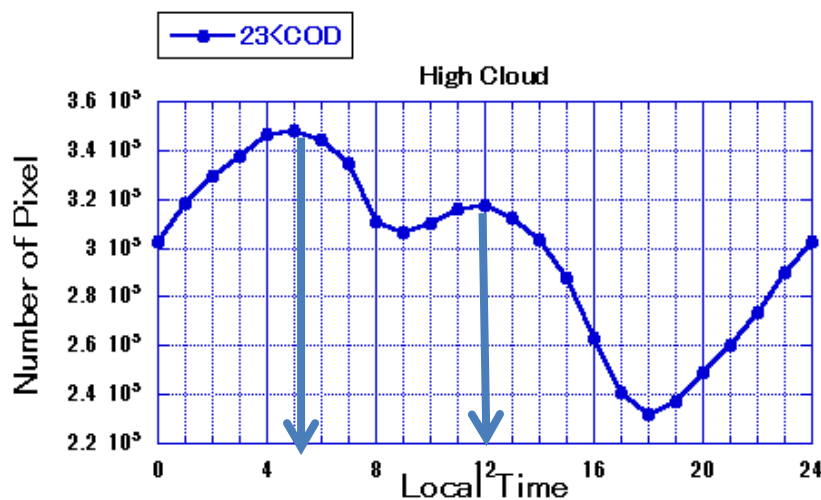
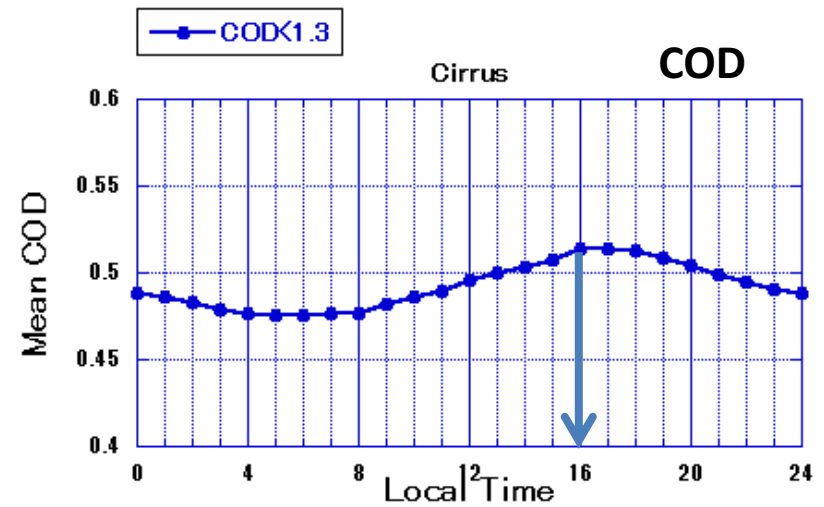
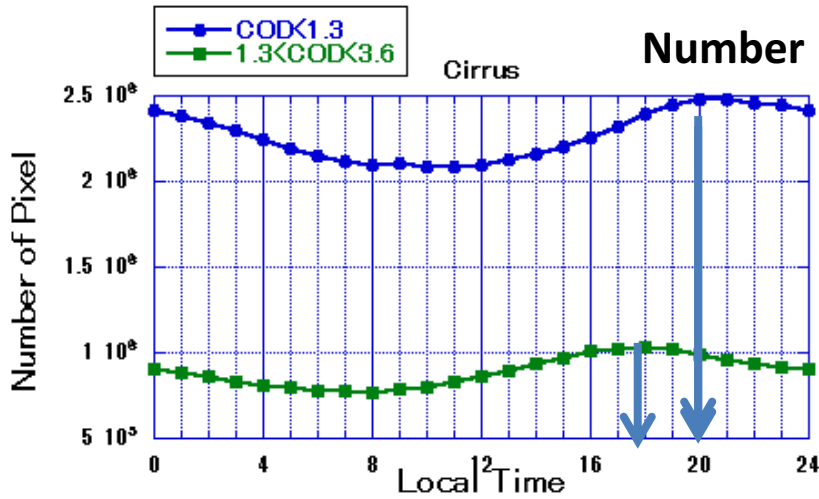
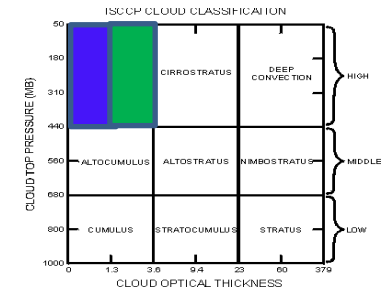
IR



Diurnal Variation of High Cloud

Afternoon Peak for cirrus

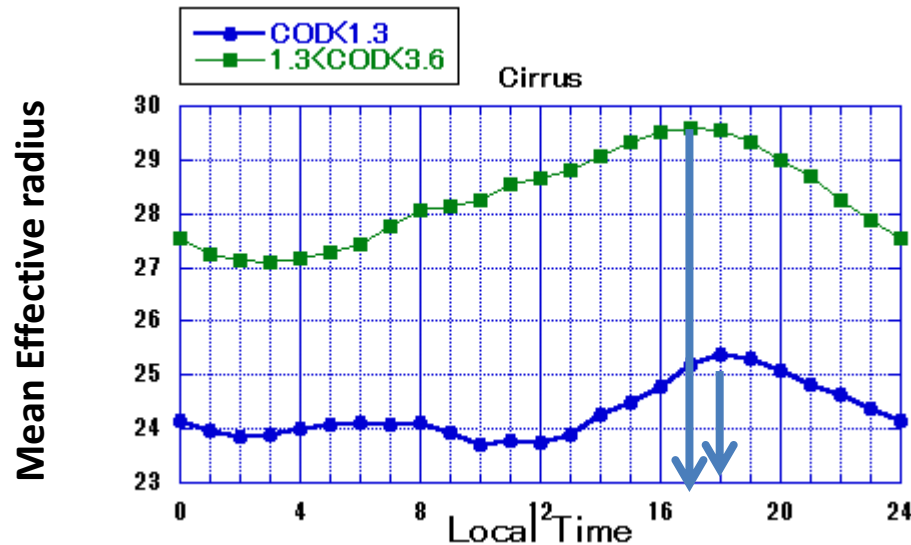
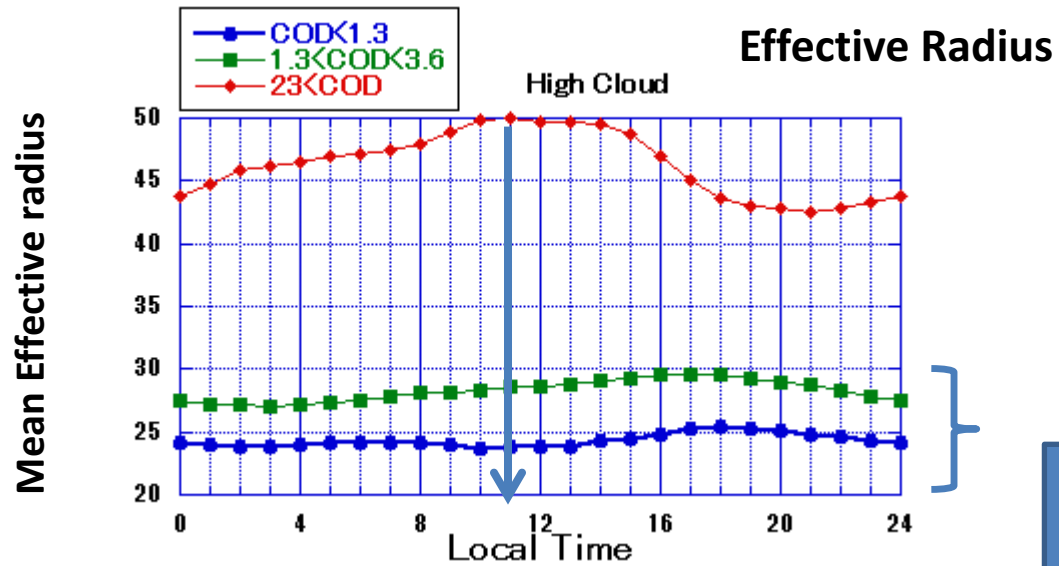
Early morning peak for DC



Diurnal Variation of High Cloud

Effective Radius Peak of Cirrus is afternoon

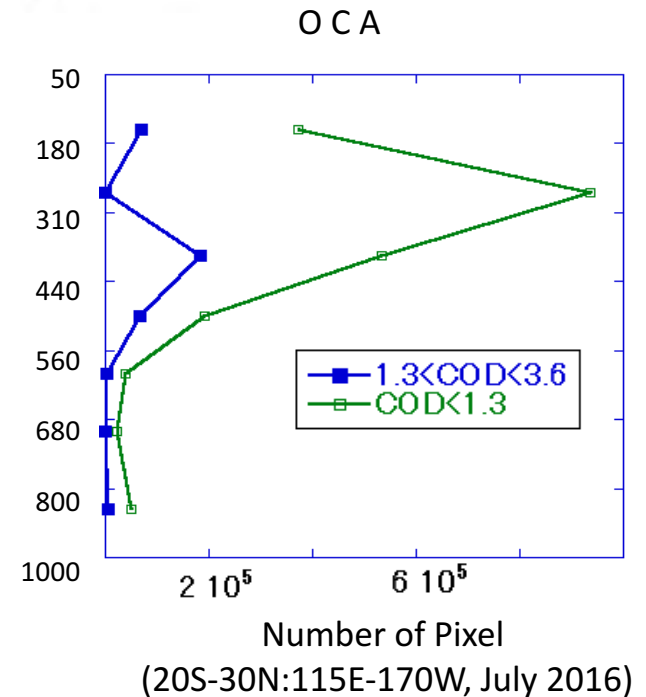
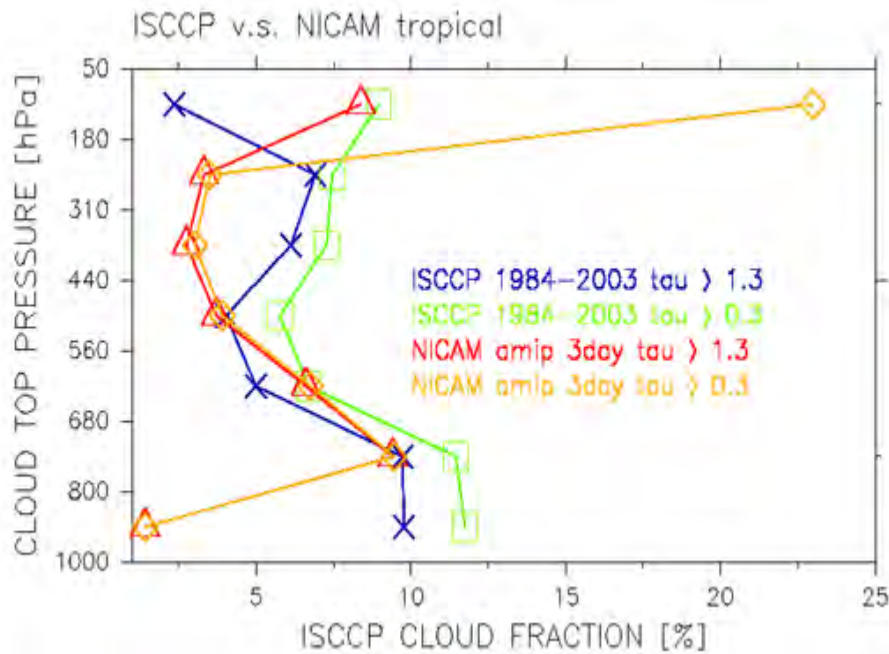
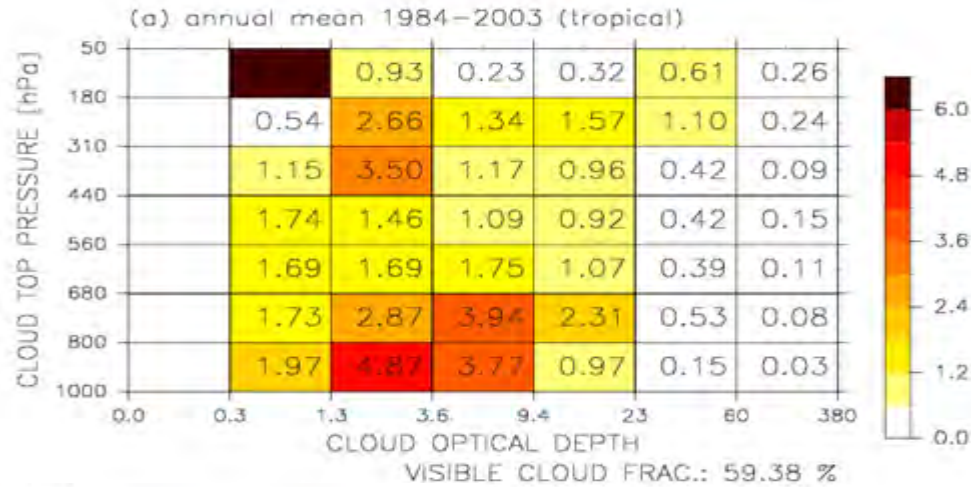
Edeective radius Peak of DC is noon



COD-REF-Number

Vertical Profile of Thin Cloud

NICAM Cloud
on ISCCP diagram



Summary

Both T10-T12 and T86-T12 are good indicators for detecting cirrus clouds

Life stage of deep convection can be identified by T86-T12

Diurnal variation of cirrus clouds is shown in OCA

Diurnal variation of COD and REF of cirrus is shown in OCA

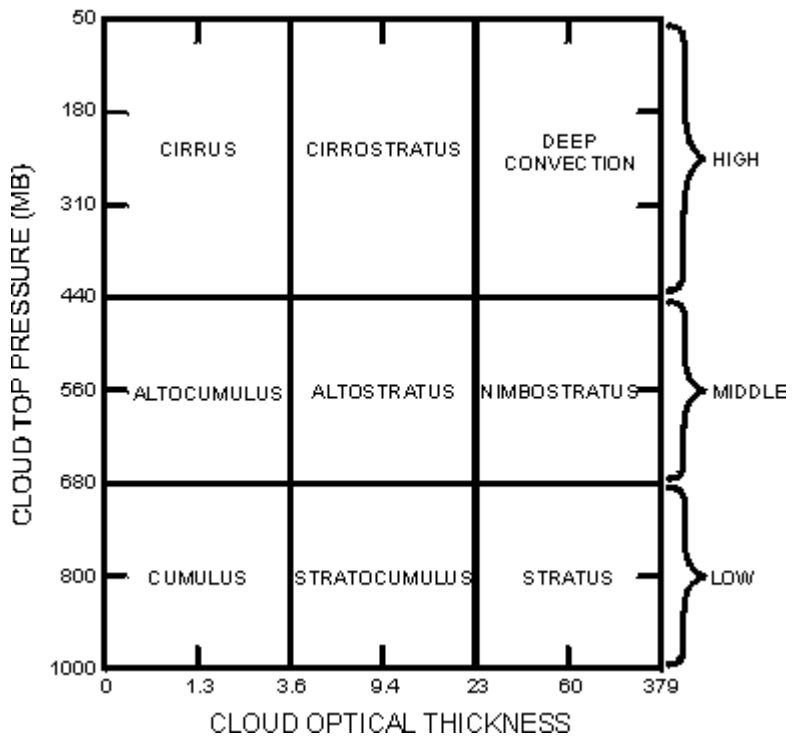
Optically thin high clouds are less in OCA than in NICAM simulation

Thank you for your patience.

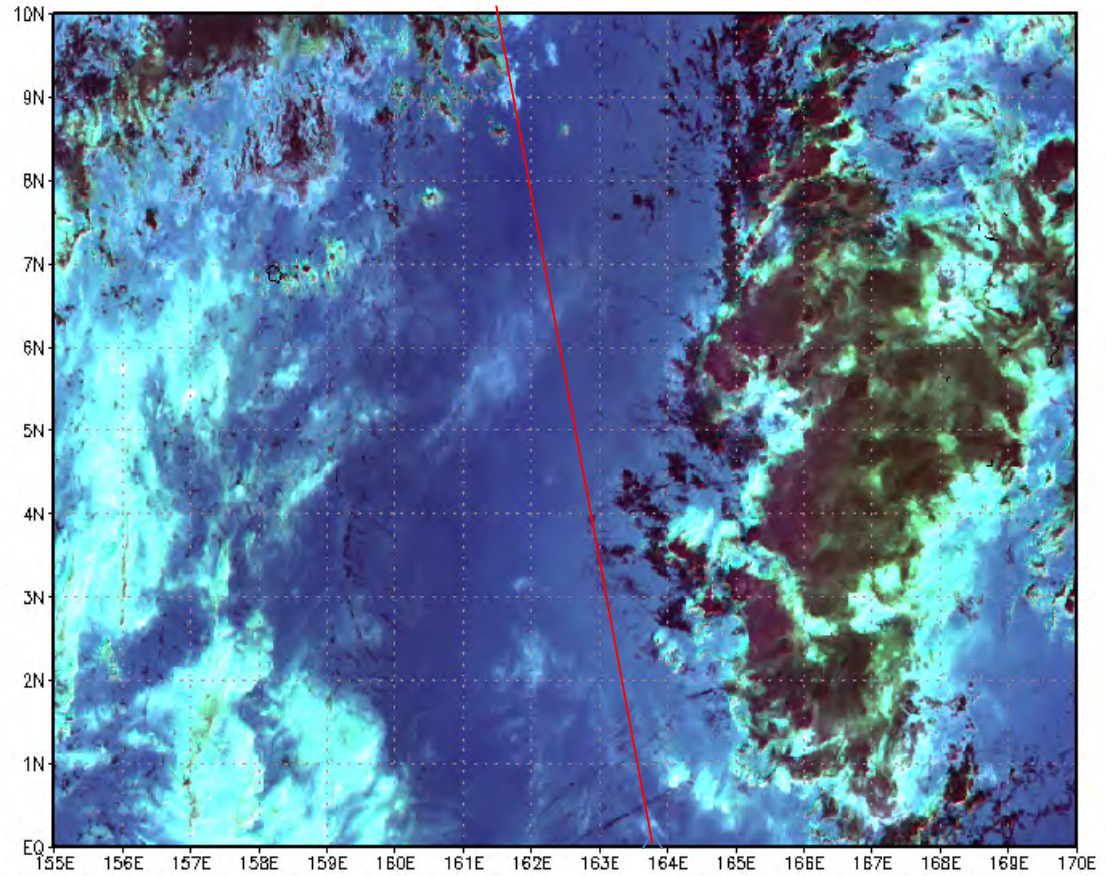
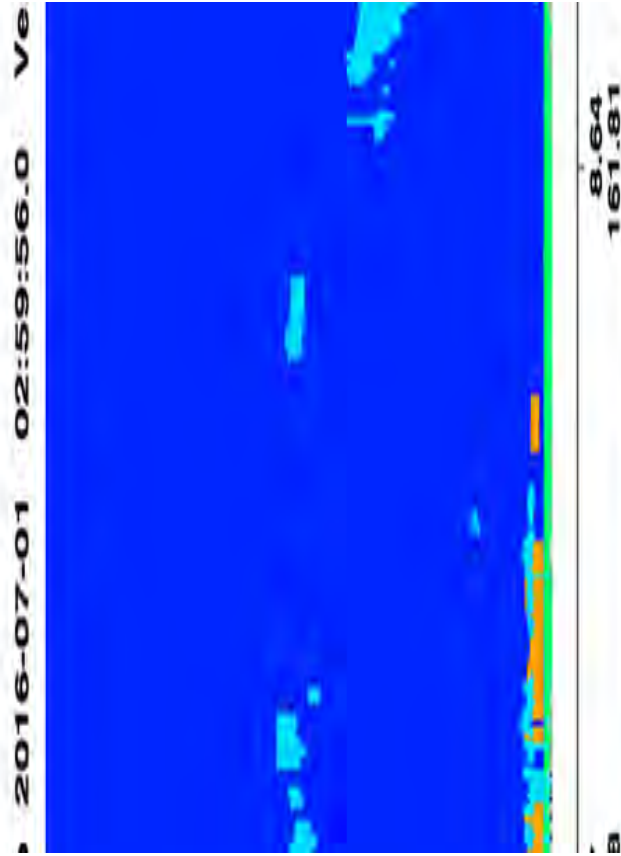


Goal is a long way to go.

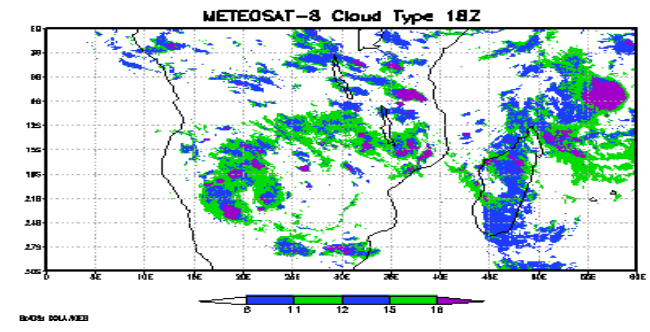
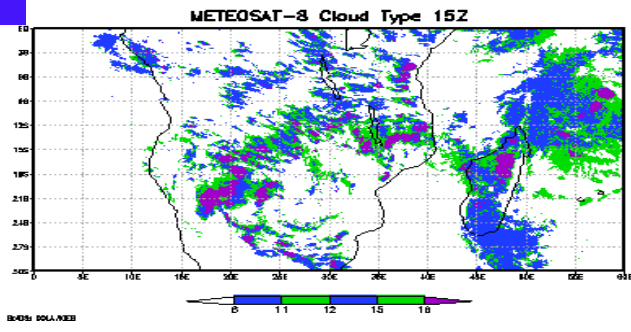
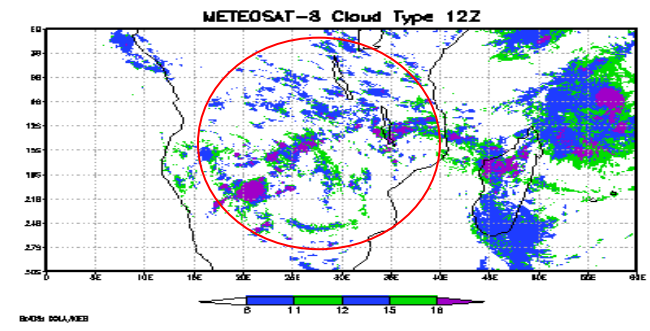
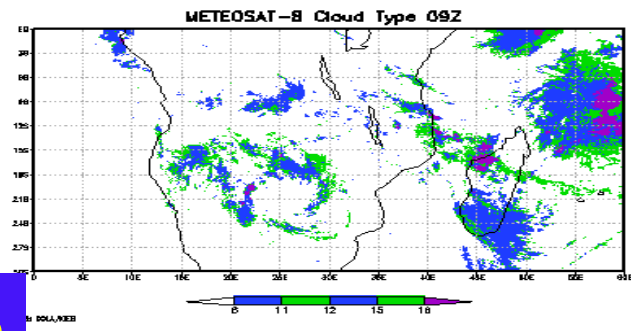
ISCCP CLOUD CLASSIFICATION



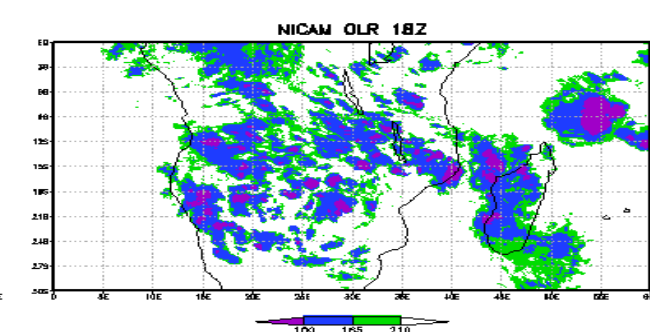
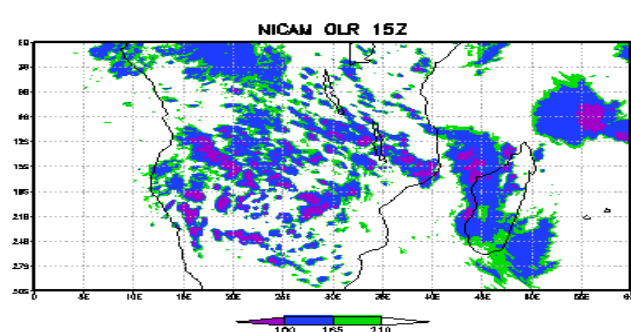
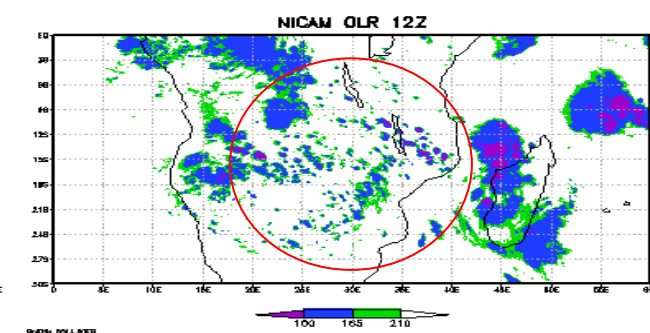
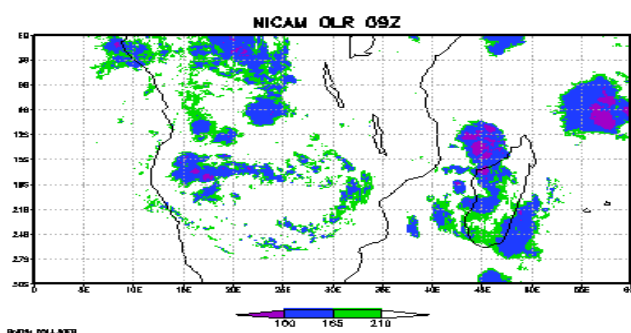
RGB Composite and CALIOP



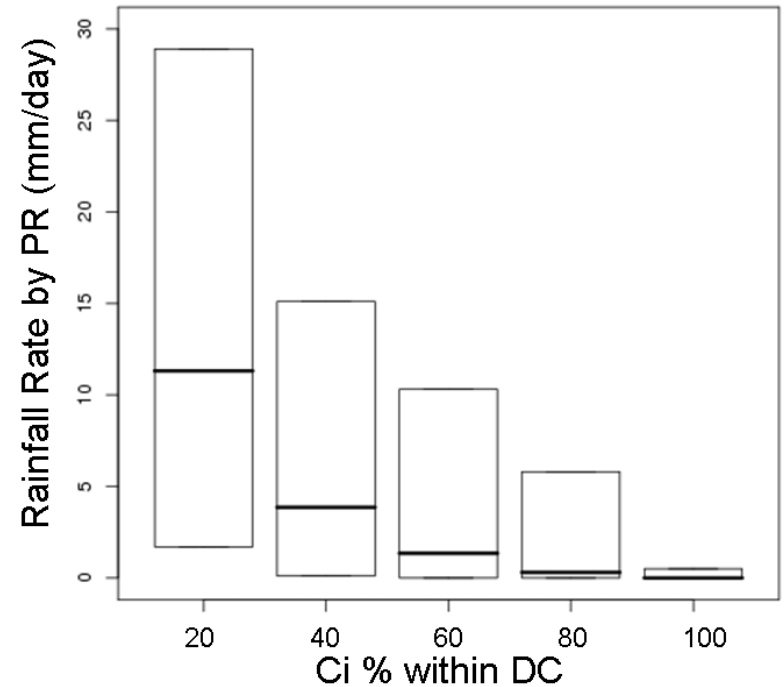
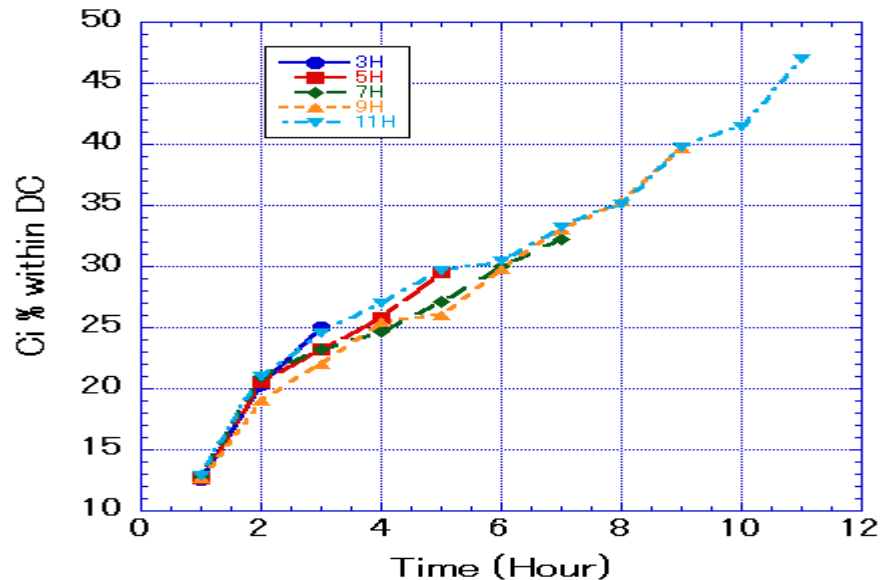
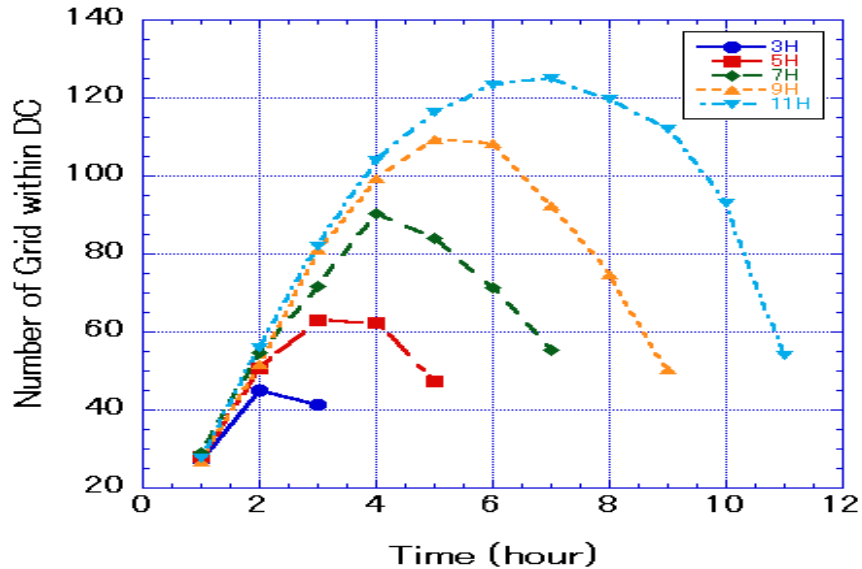
Cloud by Satellite



OLR by NICAM



Characteristics of Deep Convection in terms of Lifecycle



Rainfall rate is higher at developing stage.

