Korea Meteorological Administration

Australian Government
Bureau of Meteorology

Introducing KMA's modified Dust RGB composite for improved detection of weak dust events

30 April 2019

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National Meteorological Satellite Center (NMSC)
Korea Meteorological Administration (KMA)

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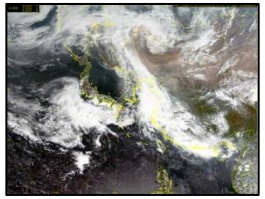
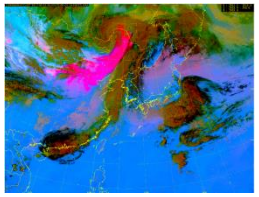
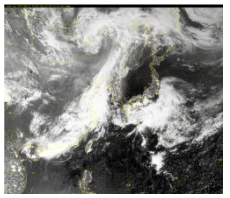
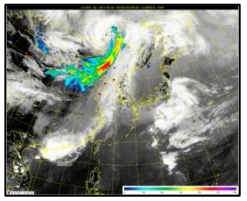
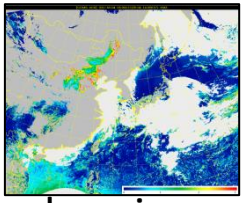
Socrative question 1: If you have to observe a dust episode, what product do you prefer for monitoring dusts? (Choose the best 3 products)

A. True Colour RGB 

B. The Dust RGB 

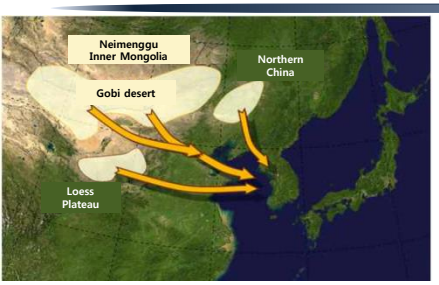
C. The single channel (Grayscale) visible imagery 

D. Dust detection products using the difference between IR1(10.4) and IR2(12.3) 

E. Aerosol optical depth(AOD) 

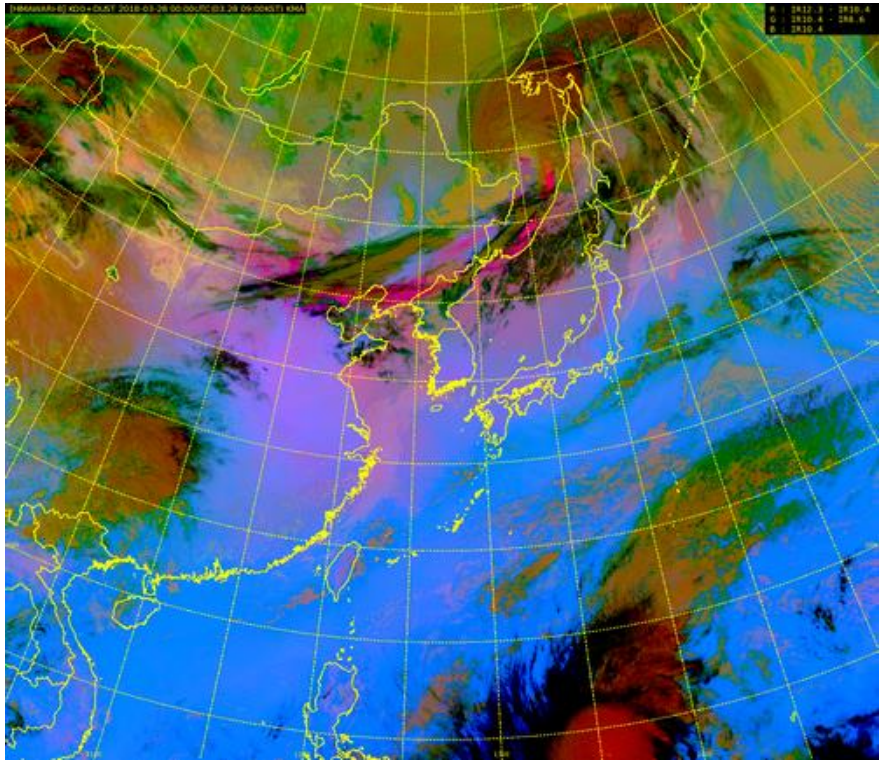
F. I have not looked at a dust episode using satellite data

Satellite products for dust detection in KMA

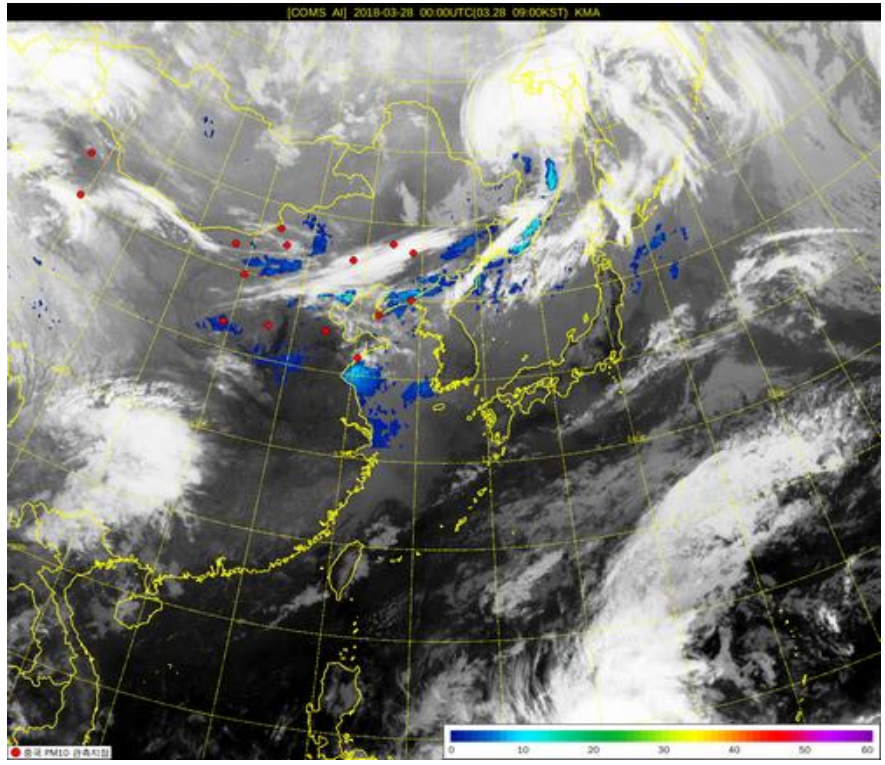


Loop1-2 (Dust events from 28th to 31st on March , 2018)

Himawari-8/ Dust RGB



COMS/Aerosol Index



Please start the PowerPoint Slide Show to activate the animation

1st improvement of Dust RGB in KMA(2018)

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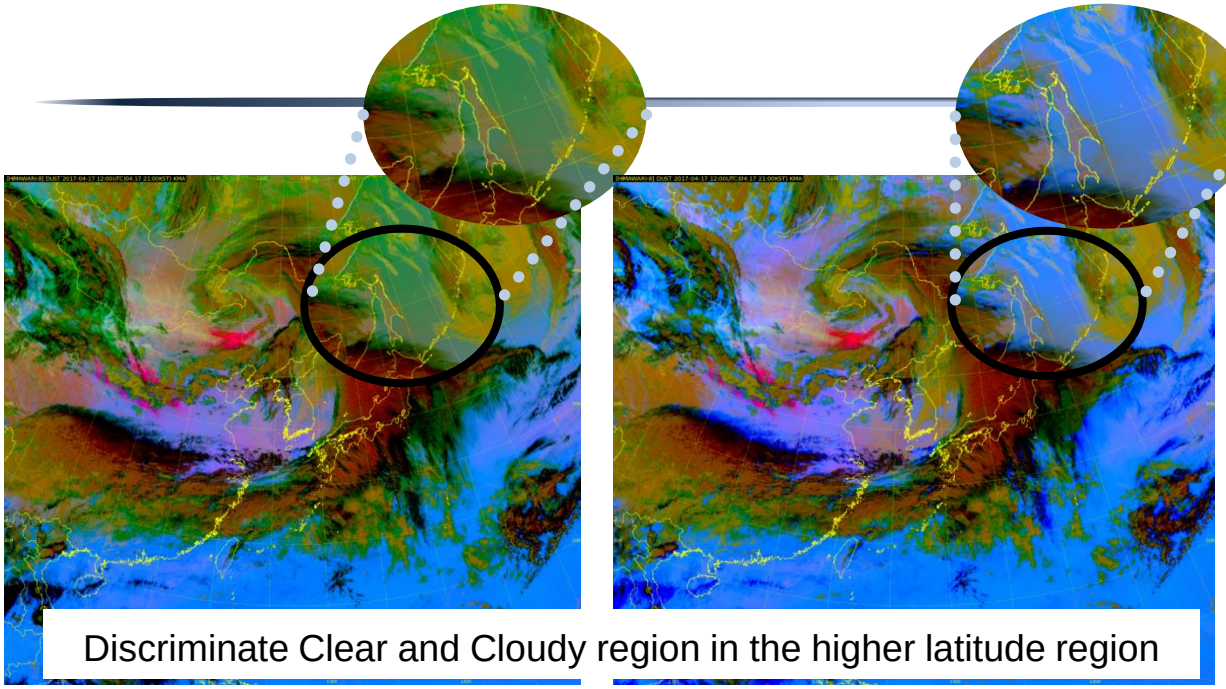
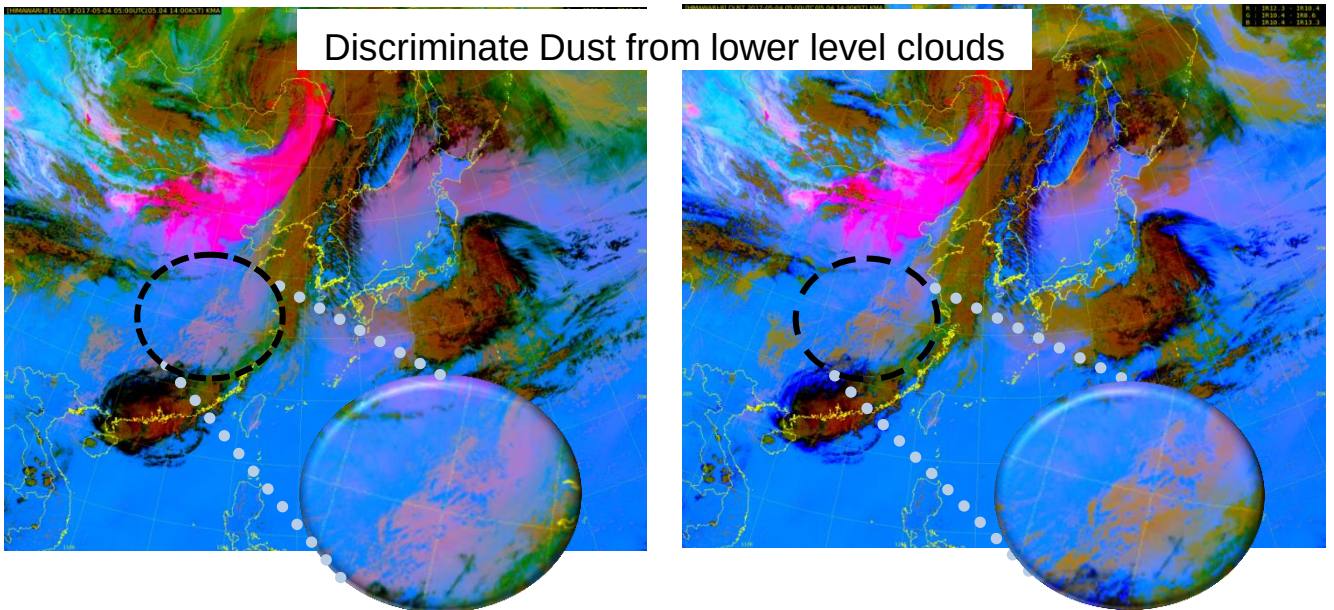


Discriminate Clear and Cloudy region in the higher latitude region

	EUMETSAT	**KMA(2018)**
Red	IR12.3 – IR10.4	IR12.3 – IR10.4
Green	IR10.4 – IR8.6	IR10.4 – IR8.6
Blue	IR10.4	**IR10.4 – IR13.3**

Range: 10~16K
Gamma: 1.0

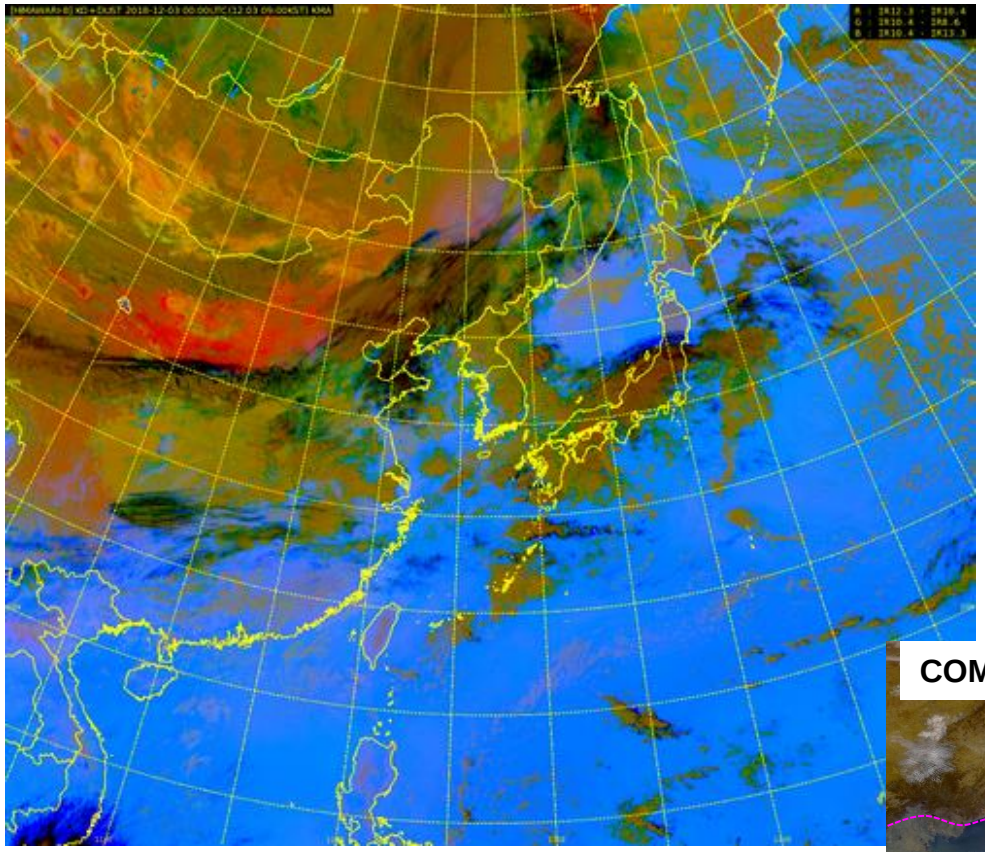
Improve ambiguous colors shown on the original dust RGB Provided by EUMETSAT recipe



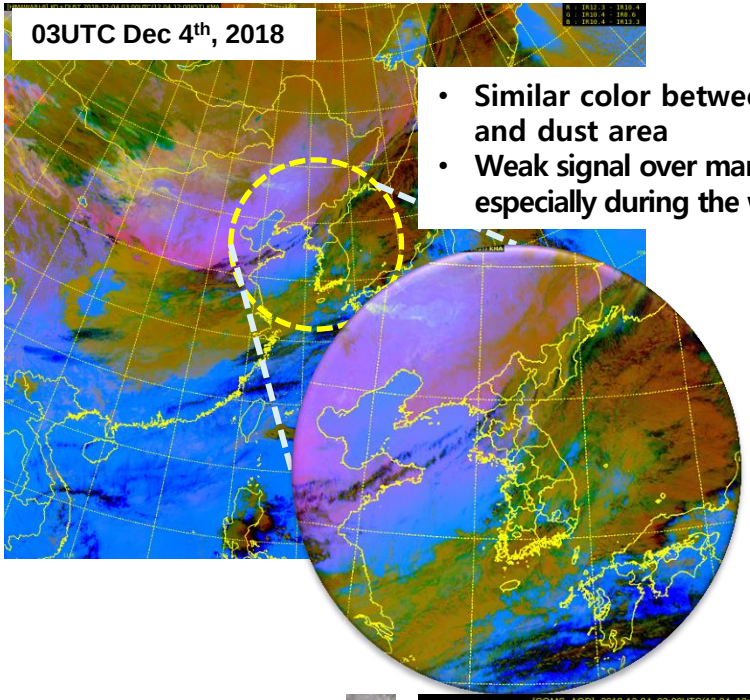
Discriminate Dust from lower level clouds

Motivation) Variations in Dust RGB – diurnal cycle, height and thickness

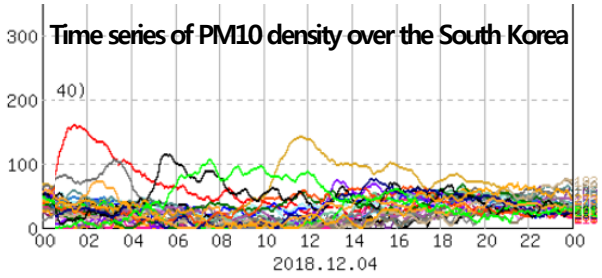
Loop3 (00UTC Dec. 03rd - 23UTC Dec. 4th, 2018)



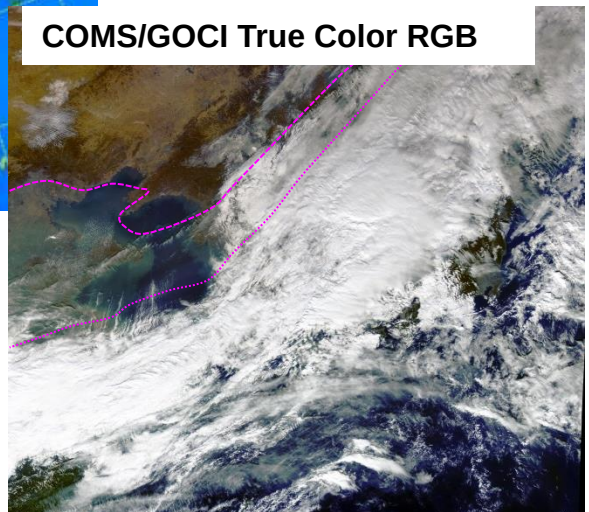
Dust RGB(ver.2018)

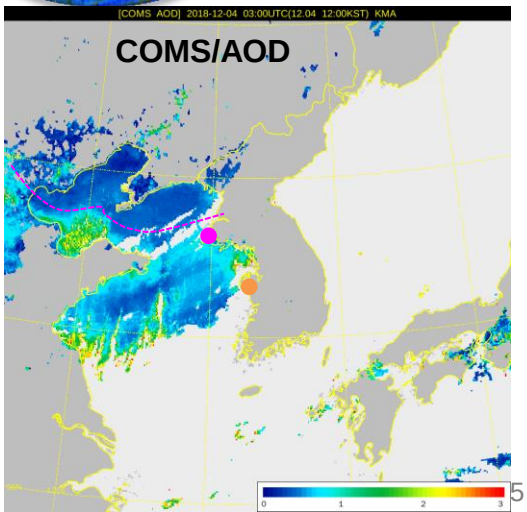


- Similar color between surface and dust area
- Weak signal over marine areas, especially during the winter season



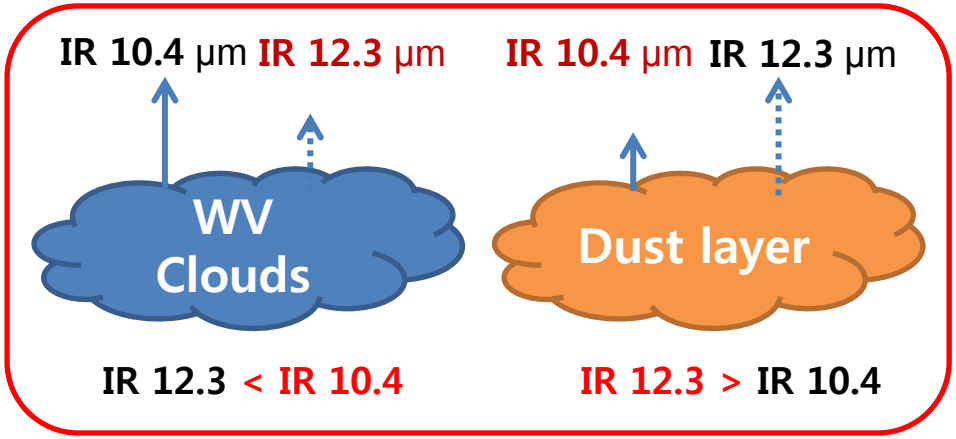
COMS/GOCI True Color RGB



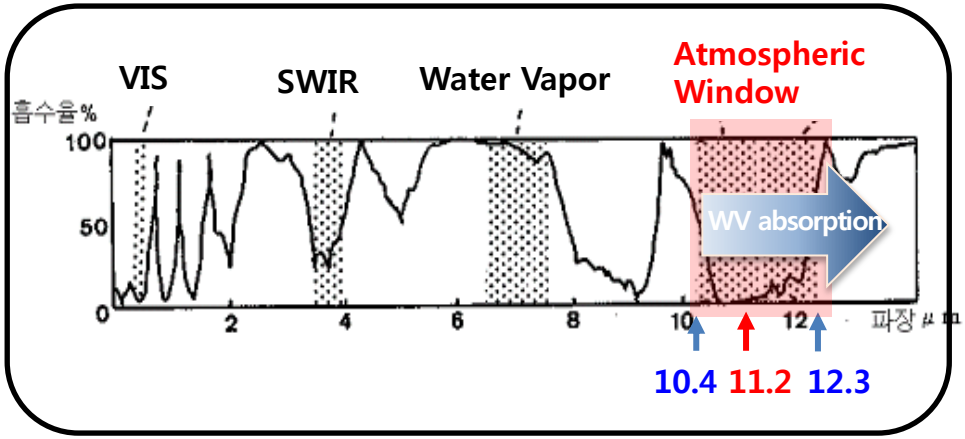


Cause Analysis) Properties in the Red Channel

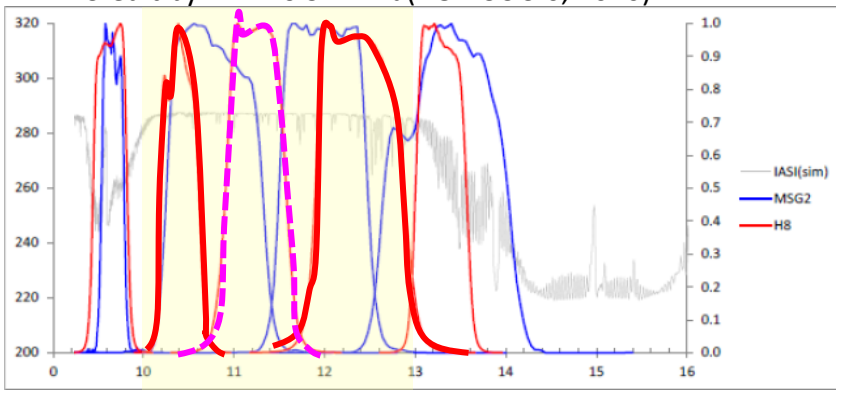
Transmitted radiation



WV absorption at the Window bands



Credit by Akihiro Shimizu(AOMSUC-6, 2016)



10.4
Clean window

12.3
dirty window

	EUMETSAT	KMA(2018)
Red	IR12.3 – IR10.4	IR12.3 – IR10.4
Green	IR10.4 – IR8.6	IR10.4 – IR8.6
Blue	IR10.4	IR10.4 – IR13.3

Is it possible to use the 11.2 μm band instead of 12.3 μm ?
to reduce the impact of WV absorption

Test 1) Changing the input beam of Red channel

(Using difference between 11.2 μm and 10.4 μm bands)

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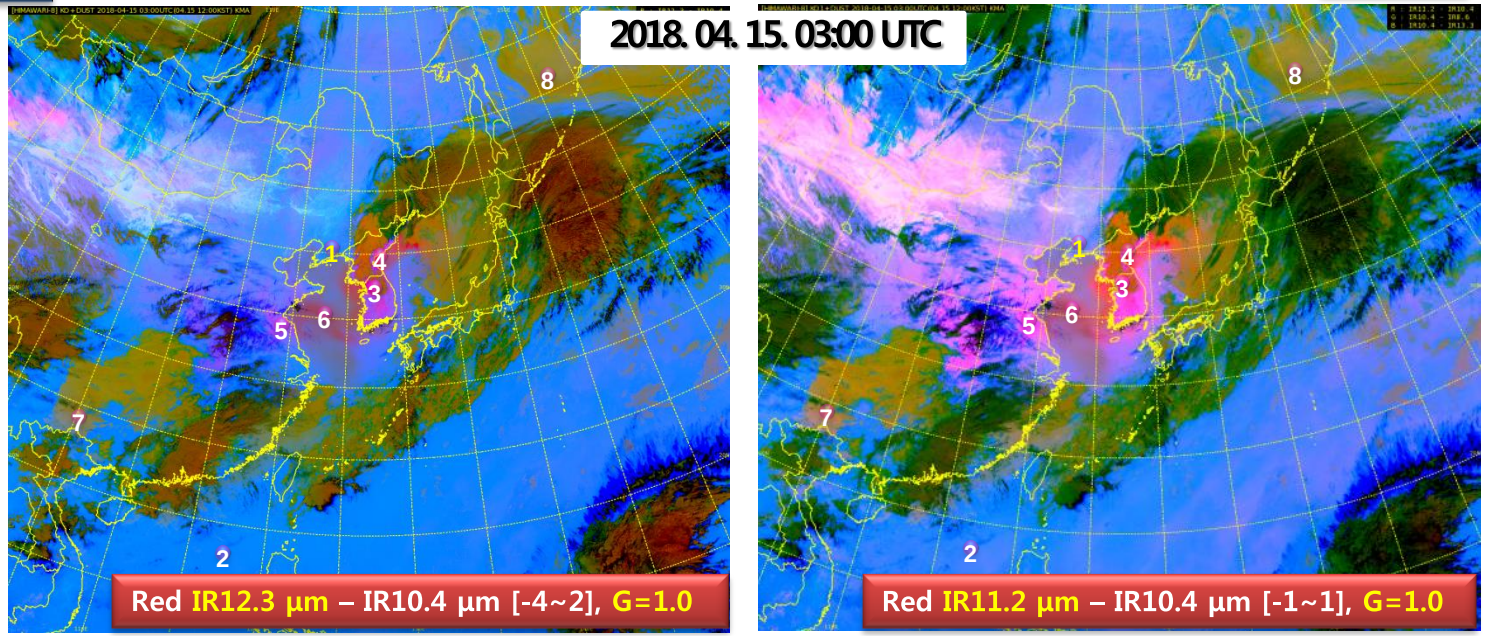
Now

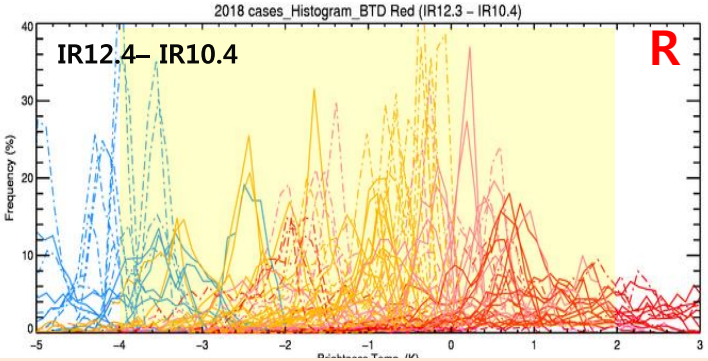
Dust events : 17 dust epsiodes for Spring & winter in 2018

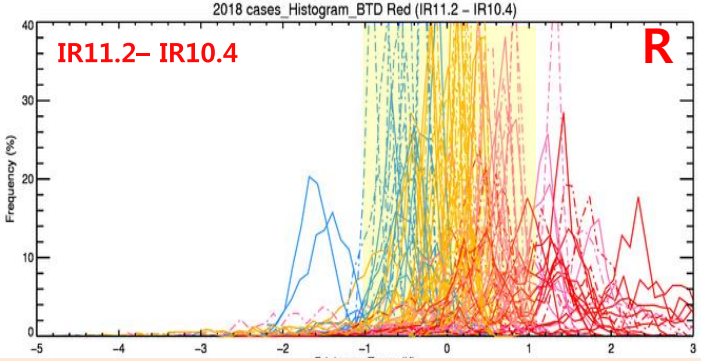
New



1 : clear(land)
2 : clear(marine)
3 : strong dusts(land)
4 : strong dusts(marine)
5 : weak dusts(land)
6 : weak dusts(marine)
7 : low level clouds(land)
8 : low level clouds(ocean)

area1
area2
area3
area4
area5
area6
area7
area8





The difference between 11.2 - 10.4 μm also can differentiate the dust signals from other phenomena!!
However pinkish colors are displayed excessively ➔ It's hard to distinguish dust signals

Test 2) Optimize the red signals using gamma correction

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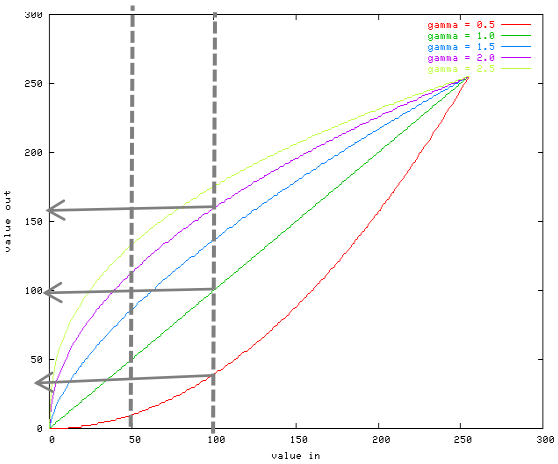
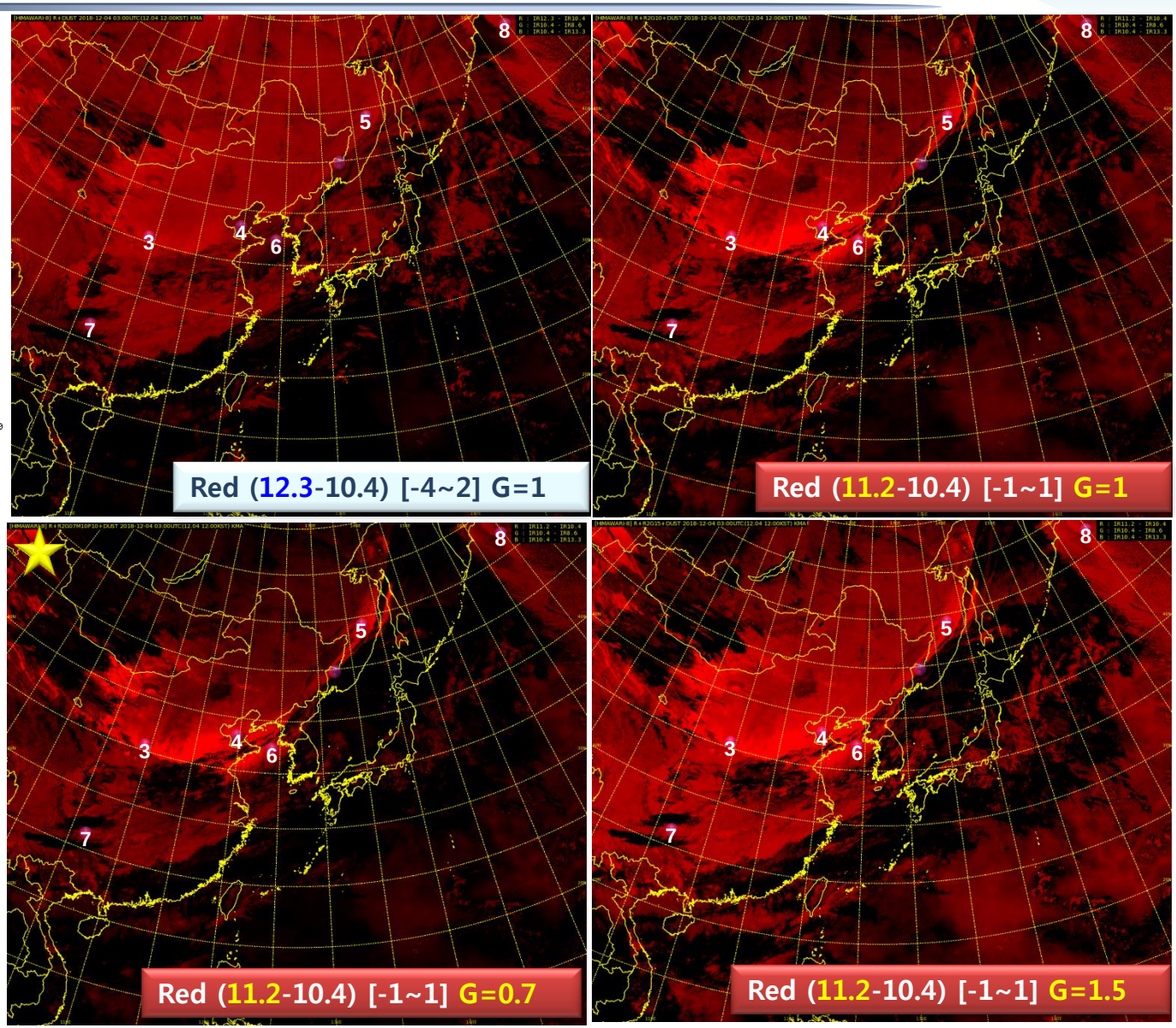
Gamma correction



- Gamma correction enhances the contrast of the higher or lower parts of the pixel values in an image

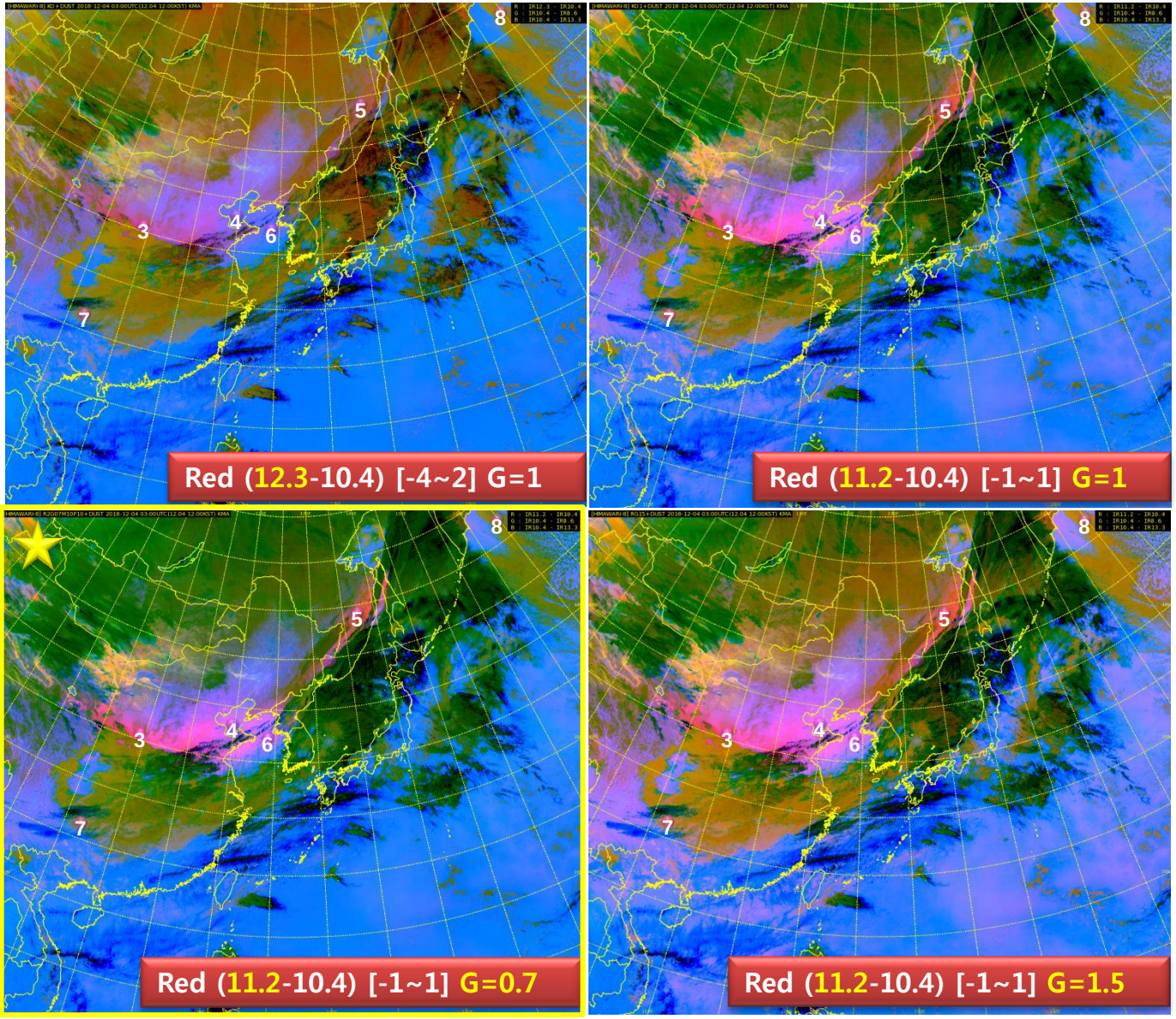
- Gamma ≥ 1 → contrast gets increased in the darker image parts
  ➔ image will be brighter
- Gamma < 1→ contrast gets increased in the brighter image parts
  ➔ Image will be darker

1 : clear(land)
2 : clear(marine)
3 : strong dusts(land)
4 : strong dusts(marine)
5 : weak dusts(land)
6 : weak dusts(marine)
7 : low level clouds(land)
8 : low level clouds(ocean)



Test 2) Optimize the red signals using gamma correction

- As Gamma < 1 pinkish areas became narrow as the contrast of red signals became clear due to gamma correction
- Moreover, the pinkish colors of dust areas became distinct from surrounding greenish areas
- However, dust areas seems to be displayed excessively



1 : clear(land)
2 : clear(marine)
3 : strong dusts(land)
4 : strong dusts(marine)
5 : weak dusts(land)
6 : weak dusts(marine)
7 : low level clouds(land)
8 : low level clouds(ocean)

Test 3) Optimize threshold values for red channel

by making the maximum value higher

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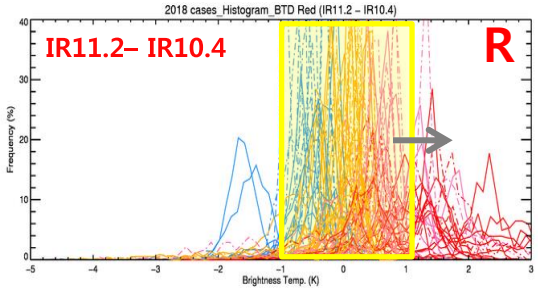
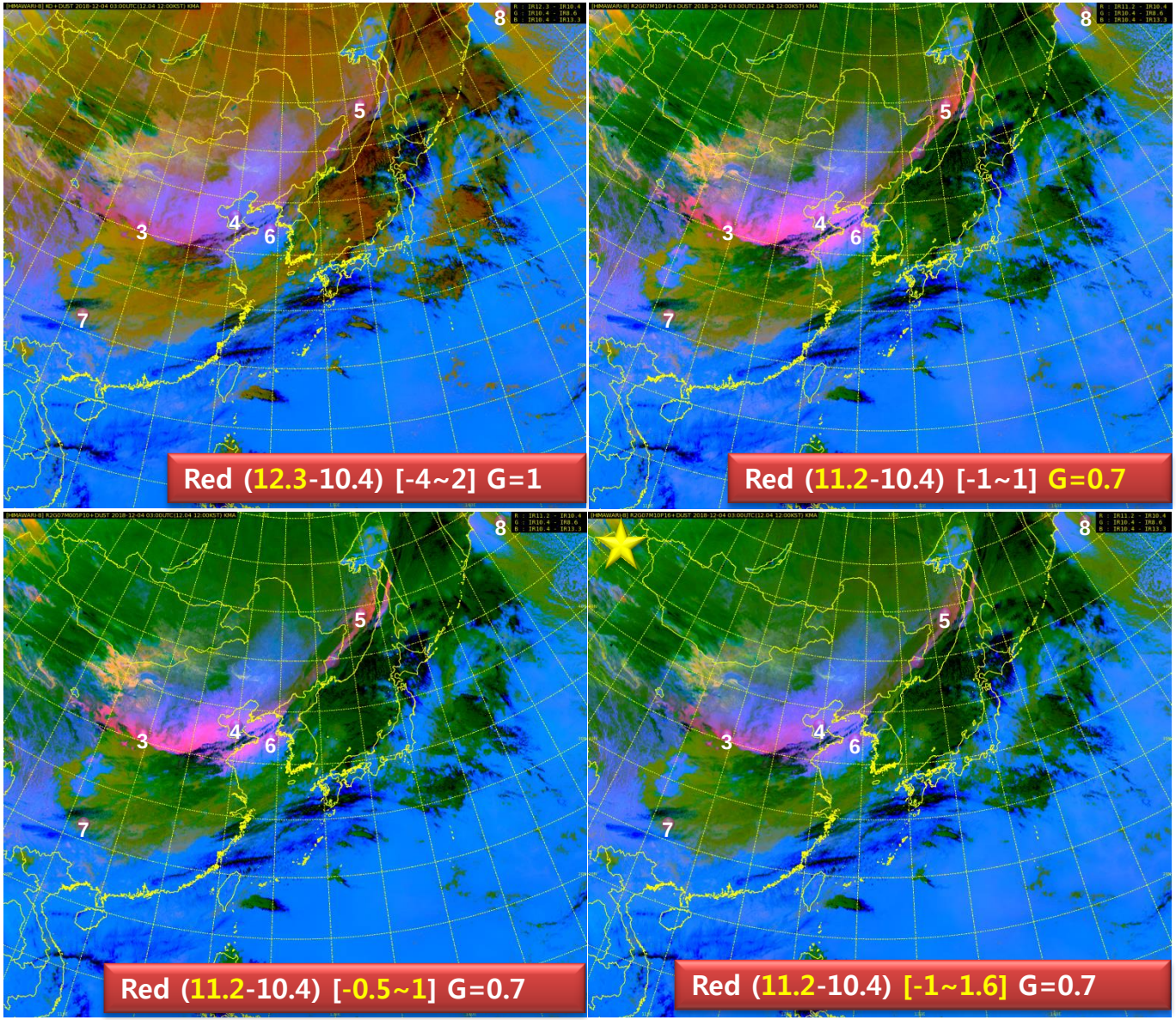


- As the maximum threshold value goes up, exaggerated pinkish color areas over the land, get reduced (especially over the Northeast China)



Test 3) Optimize threshold values for red channel

by making the maximum value higher

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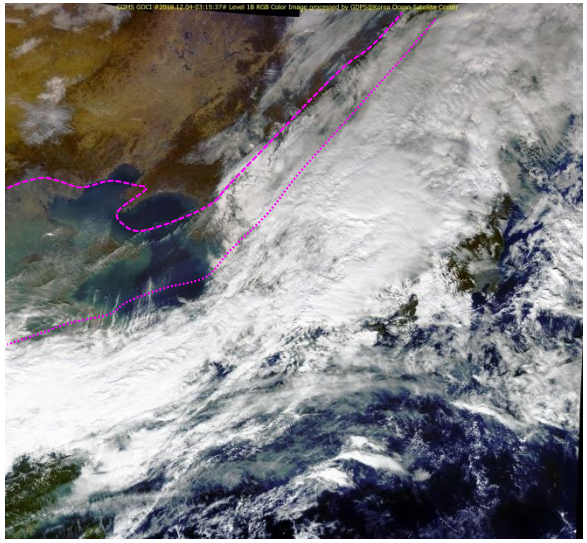
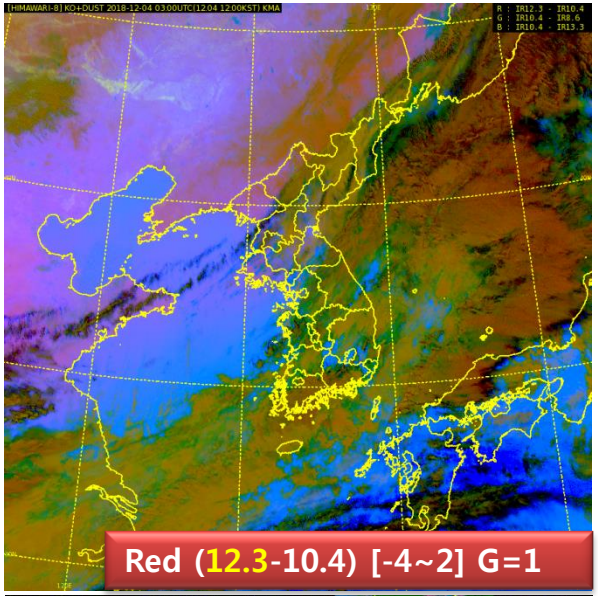
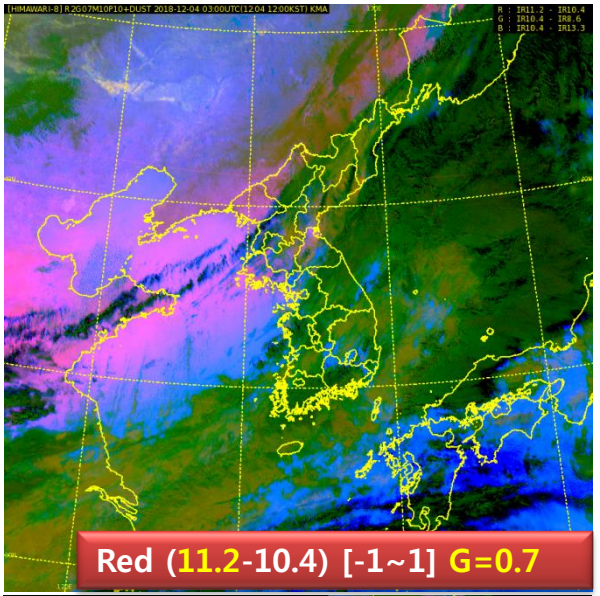
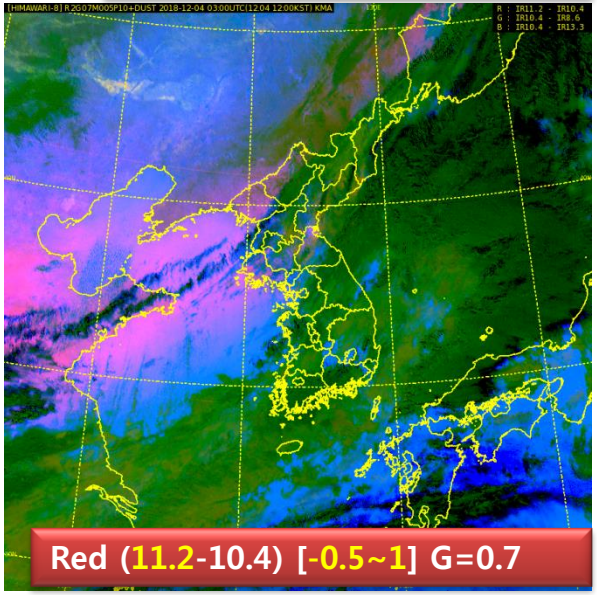
- As the maximum threshold value goes up, exaggerated pinkish colors over marine areas also displayed reasonable compared to other dust products

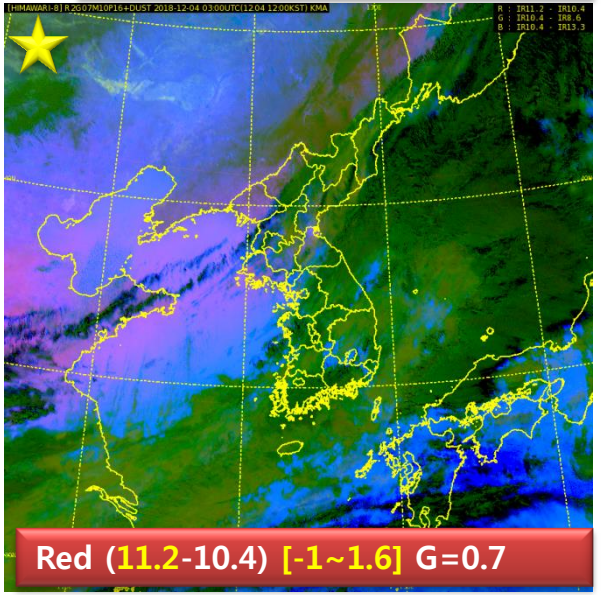
COMS/GOCI True Color RGB











Test 4) Fine tuning of threshold values for B and G channels

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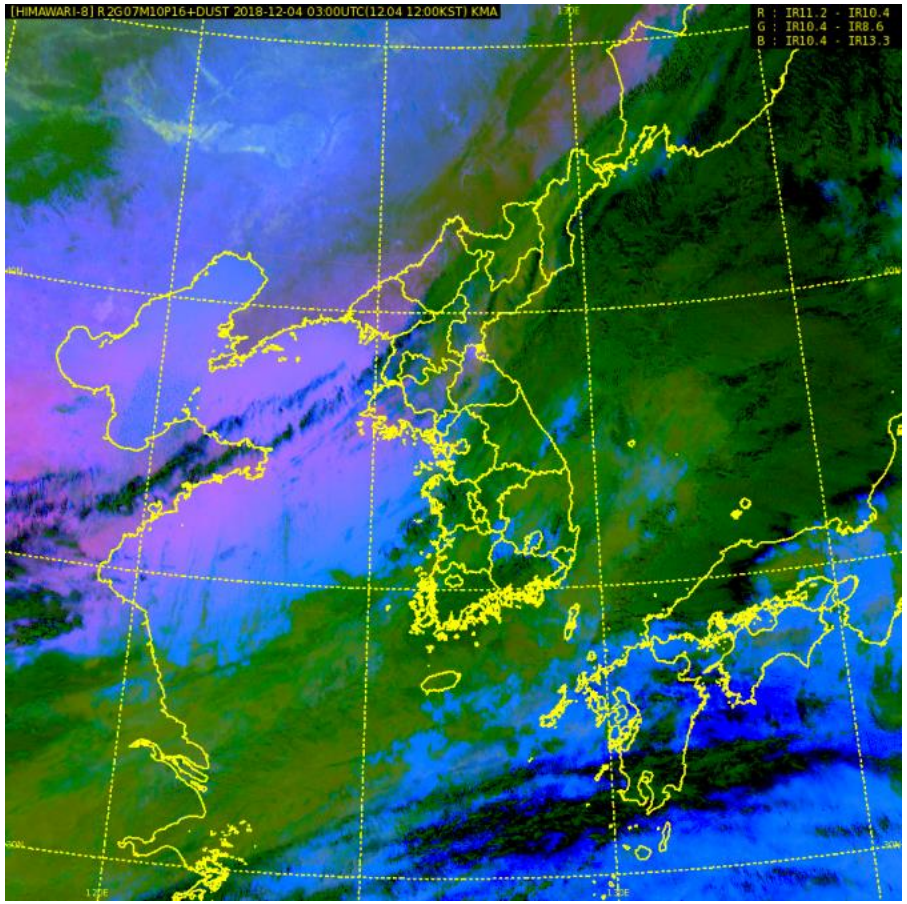
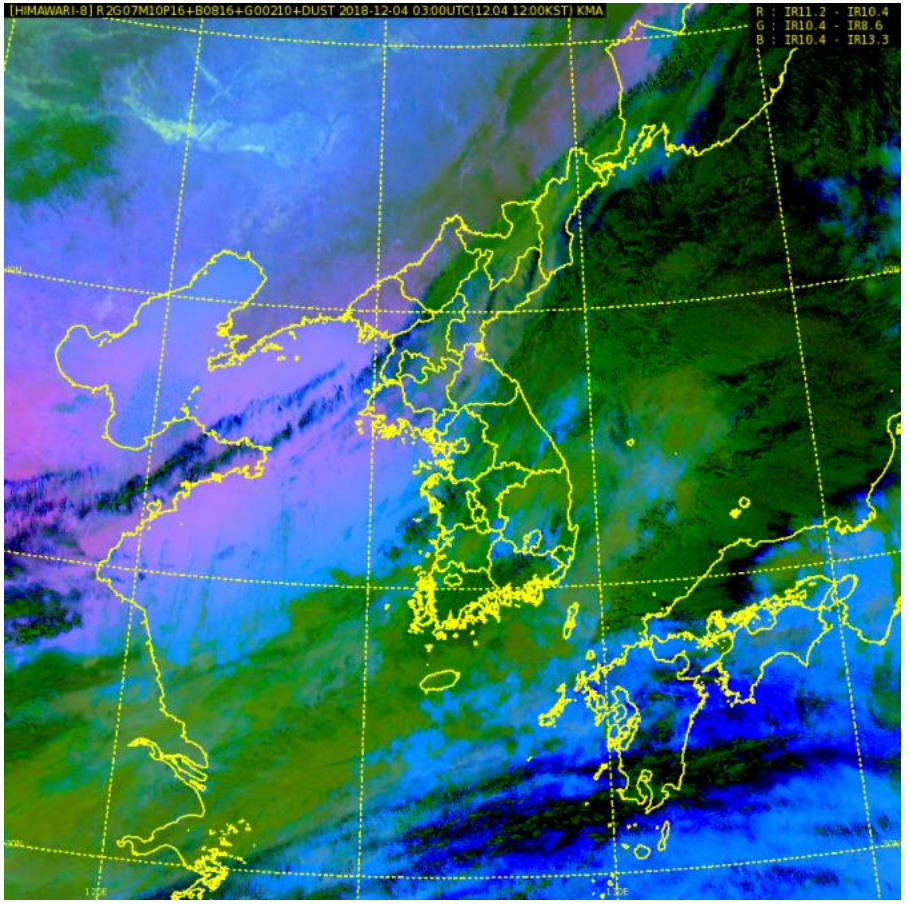


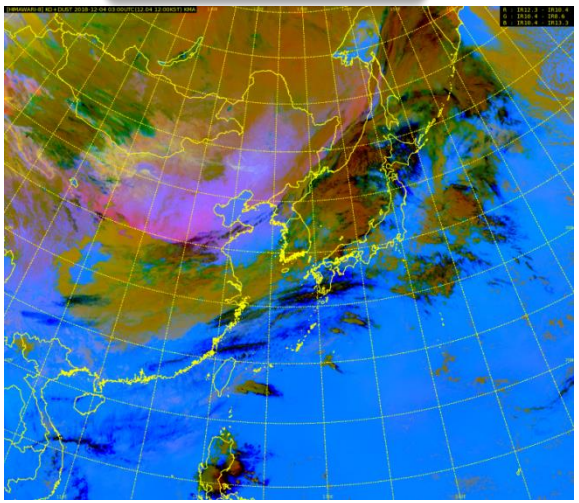


	KMA(2018)	value	gamma
R	**IR12.3** – IR10.4	-4~2	1
G	IR10.4 – IR8.6	0~15	2.5
B	IR10.4 – IR13.3	10~16	1

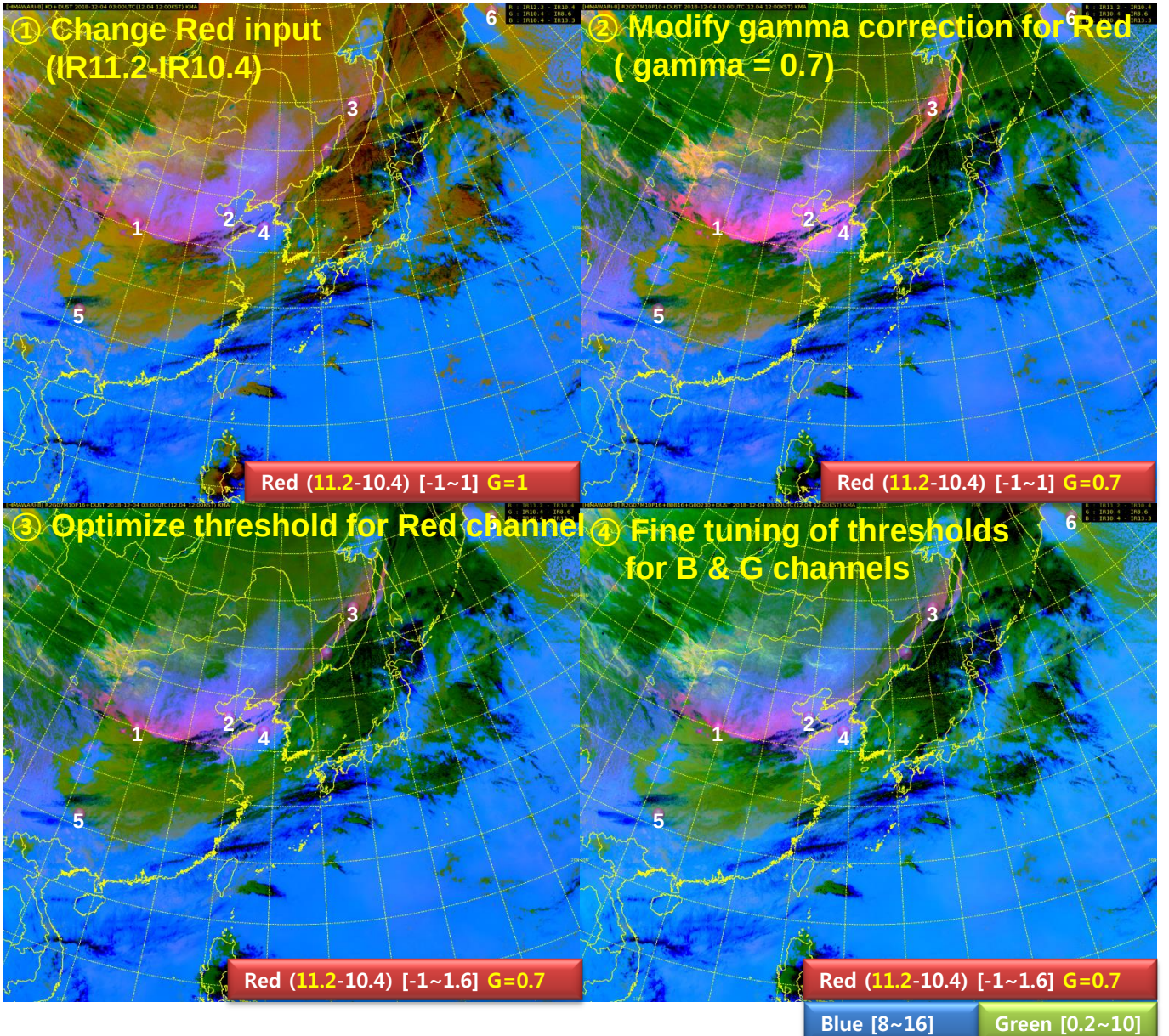
	KMA(2019)	value	gamma
R	**IR11.2** – IR10.4	**-1~1.6**	**0.7**
G	IR10.4 – IR8.6	0.2-10	2.5
B	IR10.4 – IR13.3	8-16	1

Process) Modification process of Dust RGB composite

Ver. 2018



	KMA(2018)	value	gamma
R	**IR12.3** – IR10.4	-4 ~ 2	1
G	IR10.4 – IR8.6	0~15	2.5
B	IR10.4 – IR13.3	10~16	1

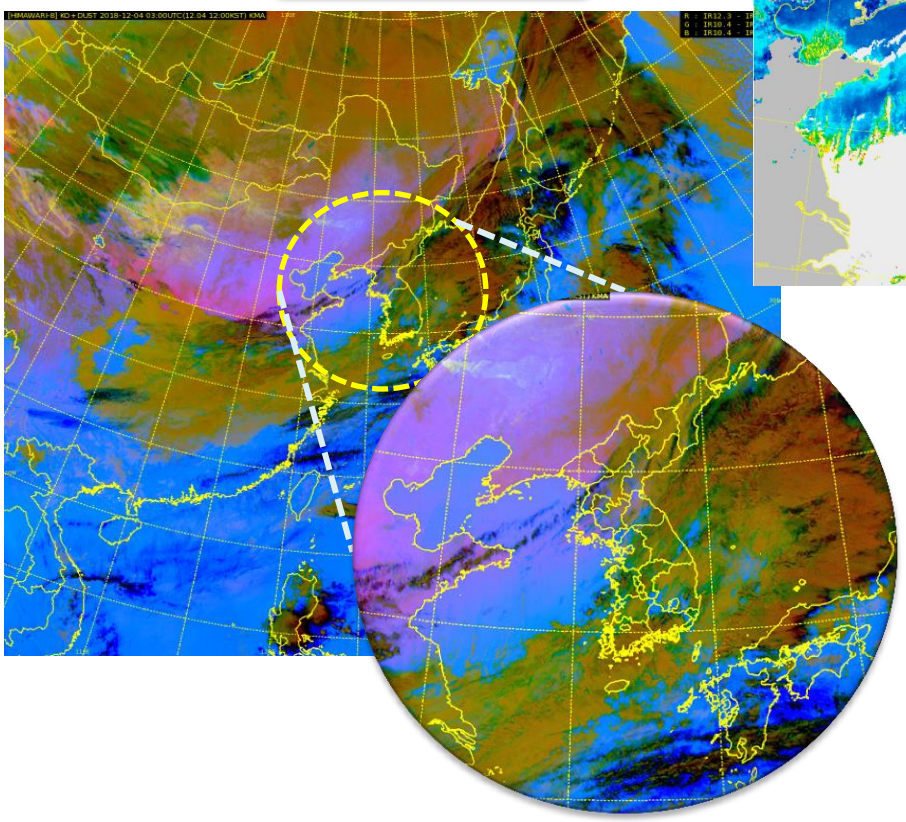


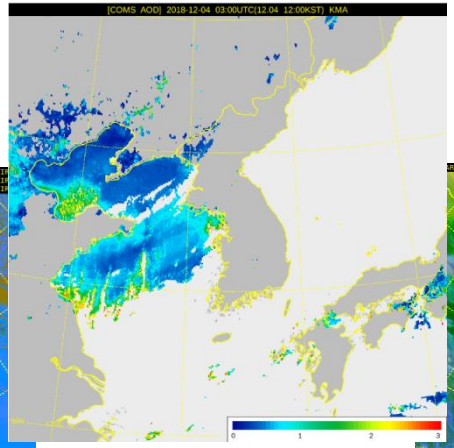
Result 1) Improvement of Dust RGB composite

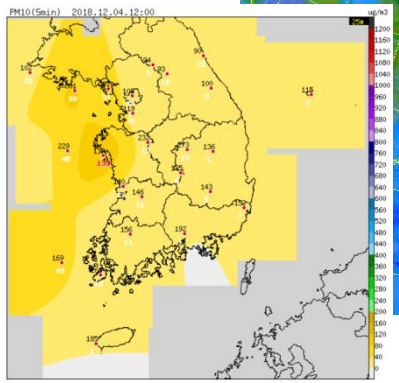
by modify threshold value and gamma correction for red channel

National Meteorological Satellite Center

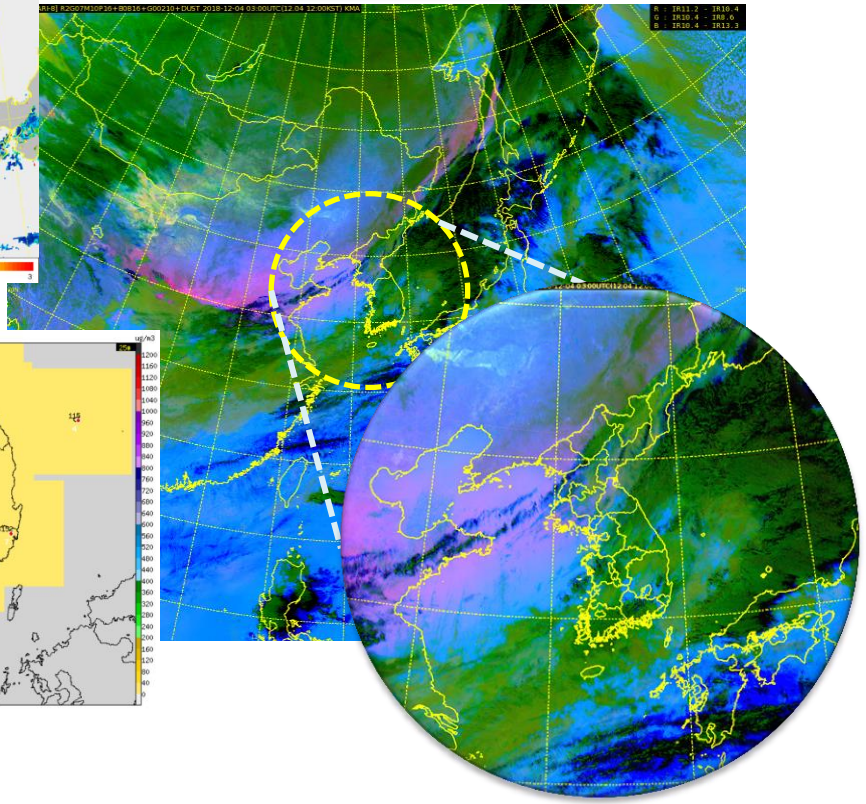
Ver. 2018







Ver. 2019



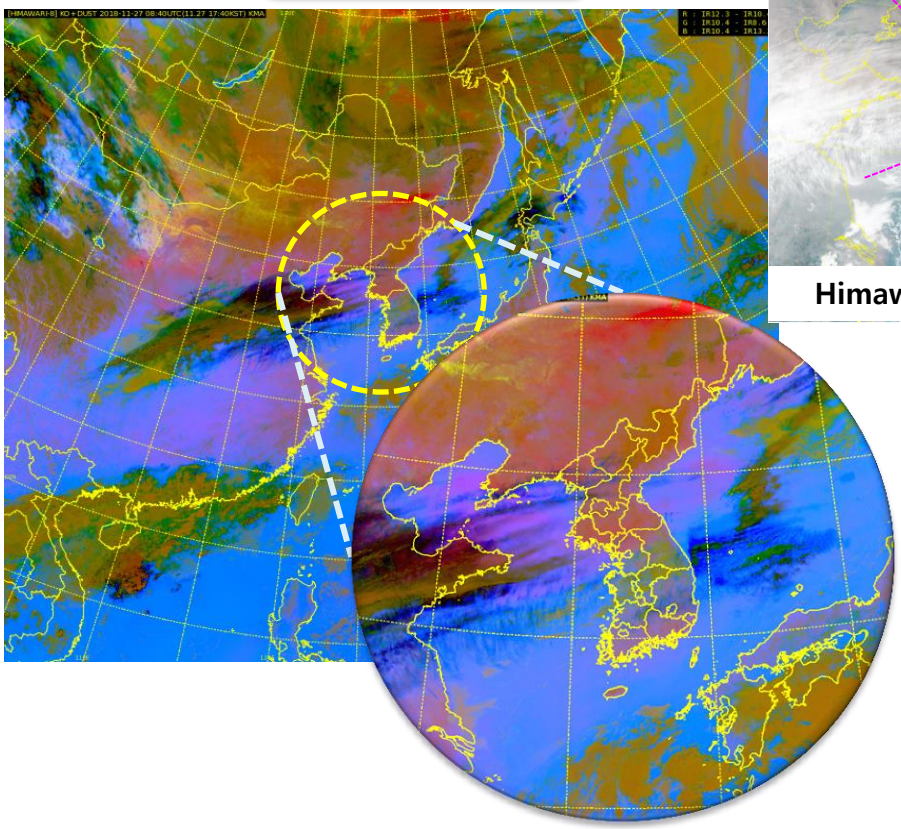
Winter/Daytime
03:00 UTC Dec. 4th 2018

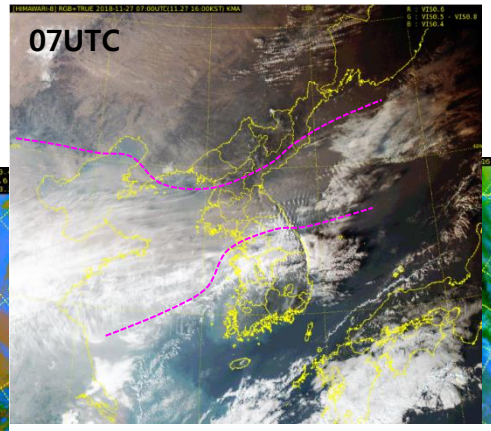
Result 2) Improvement of Dust RGB composite

by modify the threshold value and gamma correction for red channel

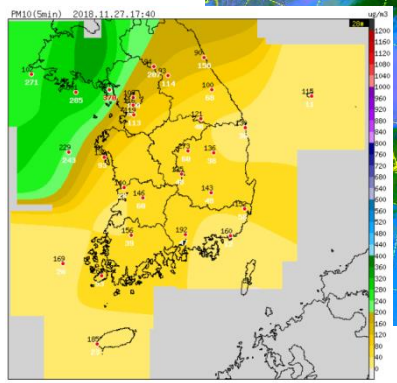
National Meteorological Satellite Center

Ver. 2018

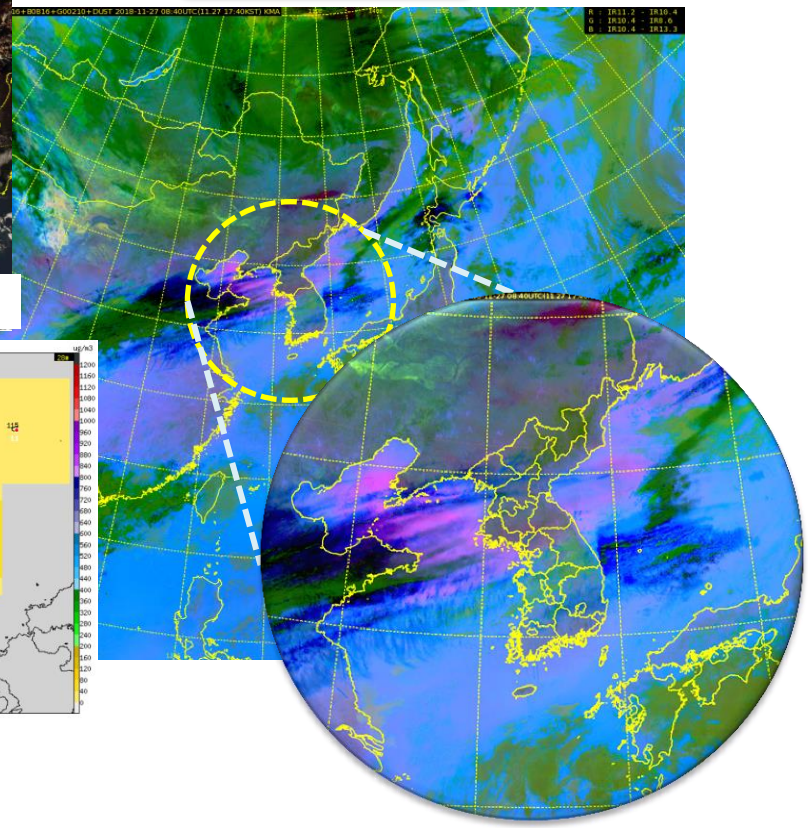




Himawari-8 True Color RGB



Ver. 2019



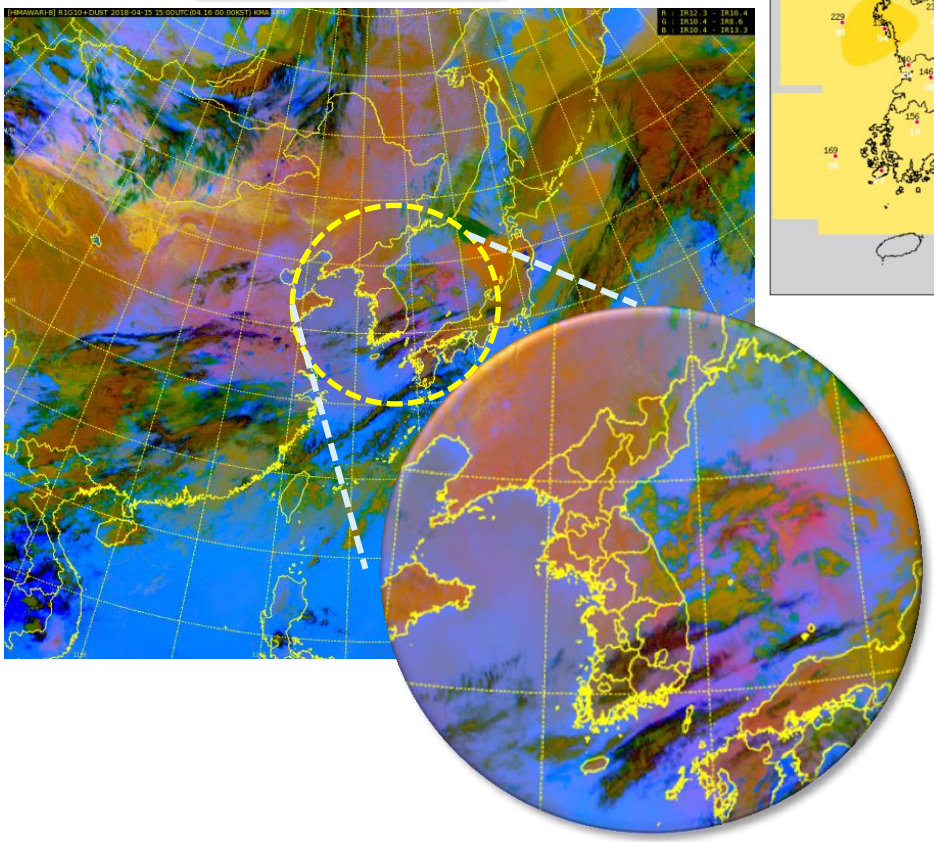
Winter/Nighttime
08:40 UTC Nov. 27th, 2018

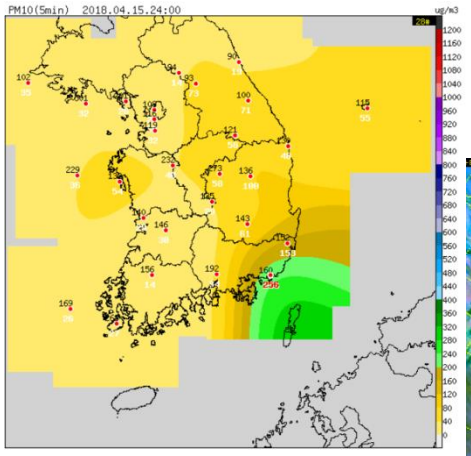
Result 3) Improvement of Dust RGB composite

by modify threshold value and gamma correction for red channel

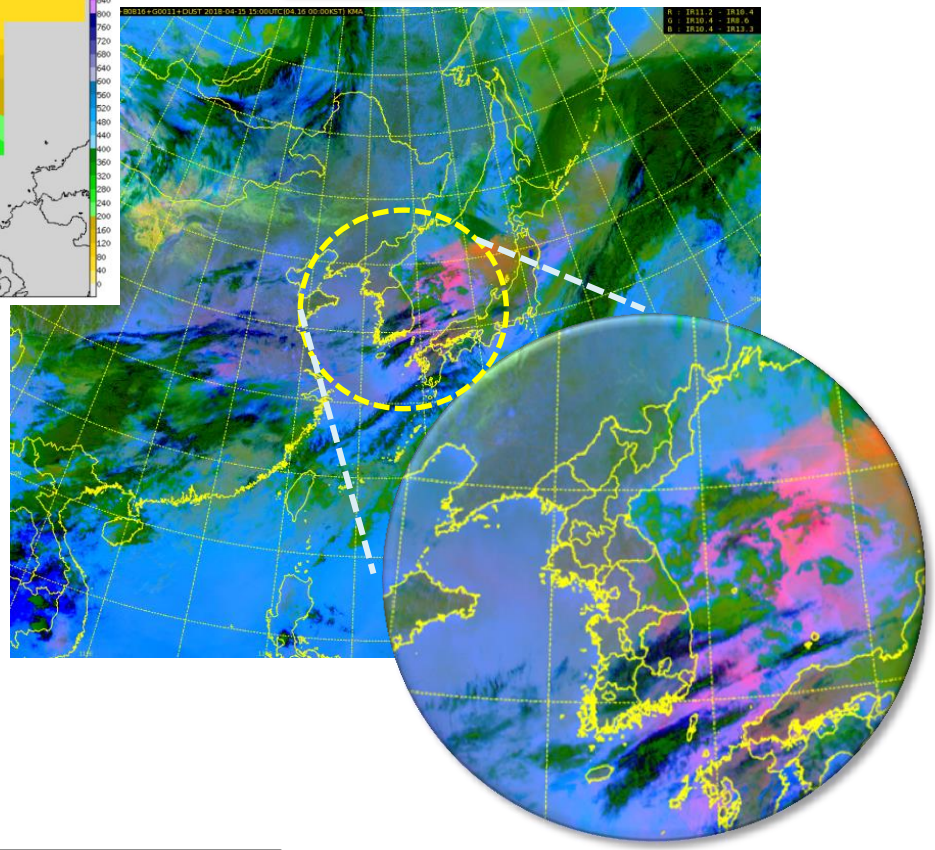
National Meteorological Satellite Center

Ver. 2018





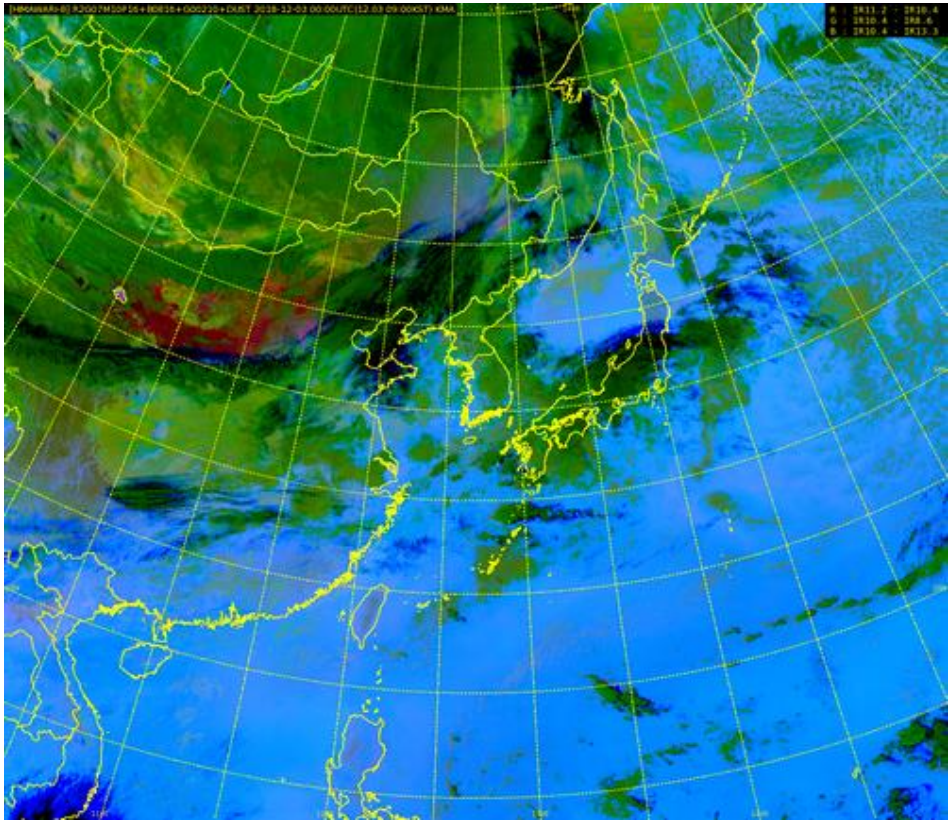
Ver. 2019



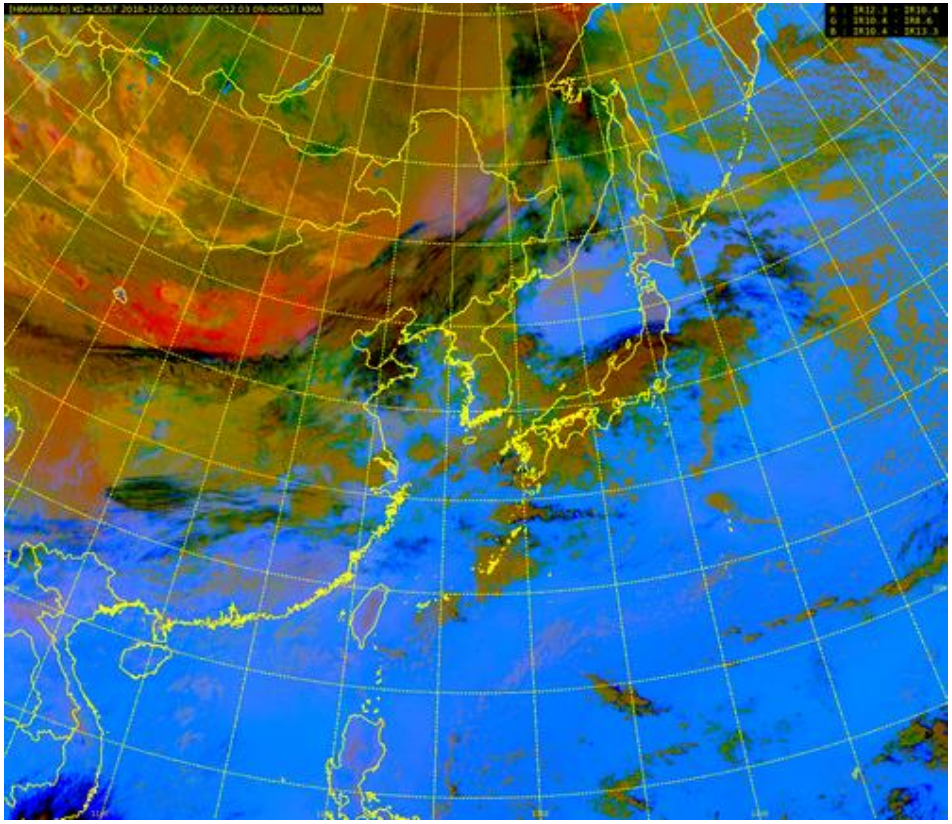
Spring/Nighttime
15:00 UTC April 15th, 2018

Socrative question 2: Which dust RGB image do you prefer for monitoring dusts?

A. Ver. 2019



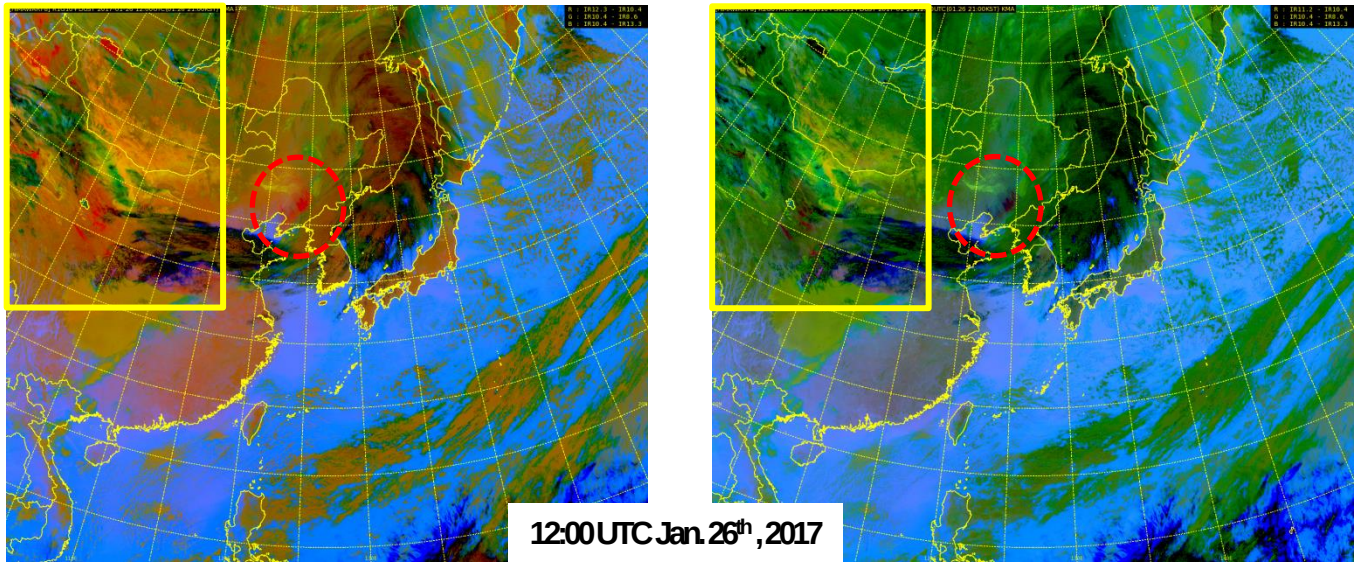
B. Ver. 2018



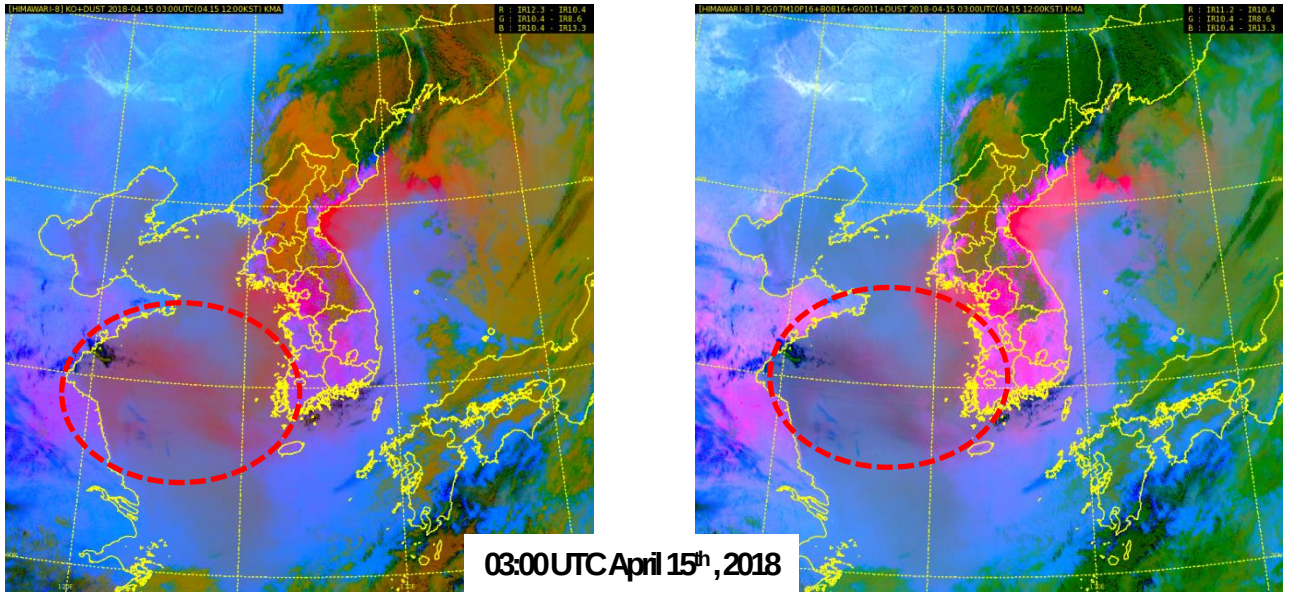
Loop (00UTC Dec. 3rd ~00UTC Dec. 5th , 2018)

Please start the PowerPoint Slide Show to activate the animation

Limitations) Variations in dust signals



12:00 UTC Jan. 26th, 2017



03:00 UTC April 15th, 2018

- Underestimate of dust signals underneath the clouds
- Sometimes, dust signals are displayed as dark-red from redish especially nighttime in winter season
- Sometimes, the colors of dust signals are displayed as pink-violet-dark violet especially over the marine

Summary

◆ **The KMA modified Dust RGB composite to improve detection of weak Asian Dusts especially nighttime in winter season**

➔ Change the Red beam input from IR(12.3-10.4) to IR (11.2-10.4)

➔ modify the gamma correction from 1 to 0.7

➔ Optimize threshold values (-1~1.6) for Red channel

◆ **The modified Dust RGB shows several improvements**

➔ Reduce the diurnal variation in Colors

➔ Distinguish dust signals distinctly from surrounding phenomena by displaying complementary colors (Dusts : pinkish, clouds: greenish, land/ocean : bluish colors)

➔ Weak dust signals over marine are also well detected compared to previous Dust image

◆ **However, Dust RGB composite still has several limitations**

➔ Underestimate of dust signals underneath the higher level clouds

➔ Sometimes dust signals are displayed as pinkish, violet, dark pinkish because redish signals are reduced by using the 11.2 instead of 12.3

Thank you very much for your attention!