Application of Airmass RGB imagery

Joint Australia Korea VLab Centres of Excellence
Regional Focus Group meeting

2018. 10. 30.(Tue.)

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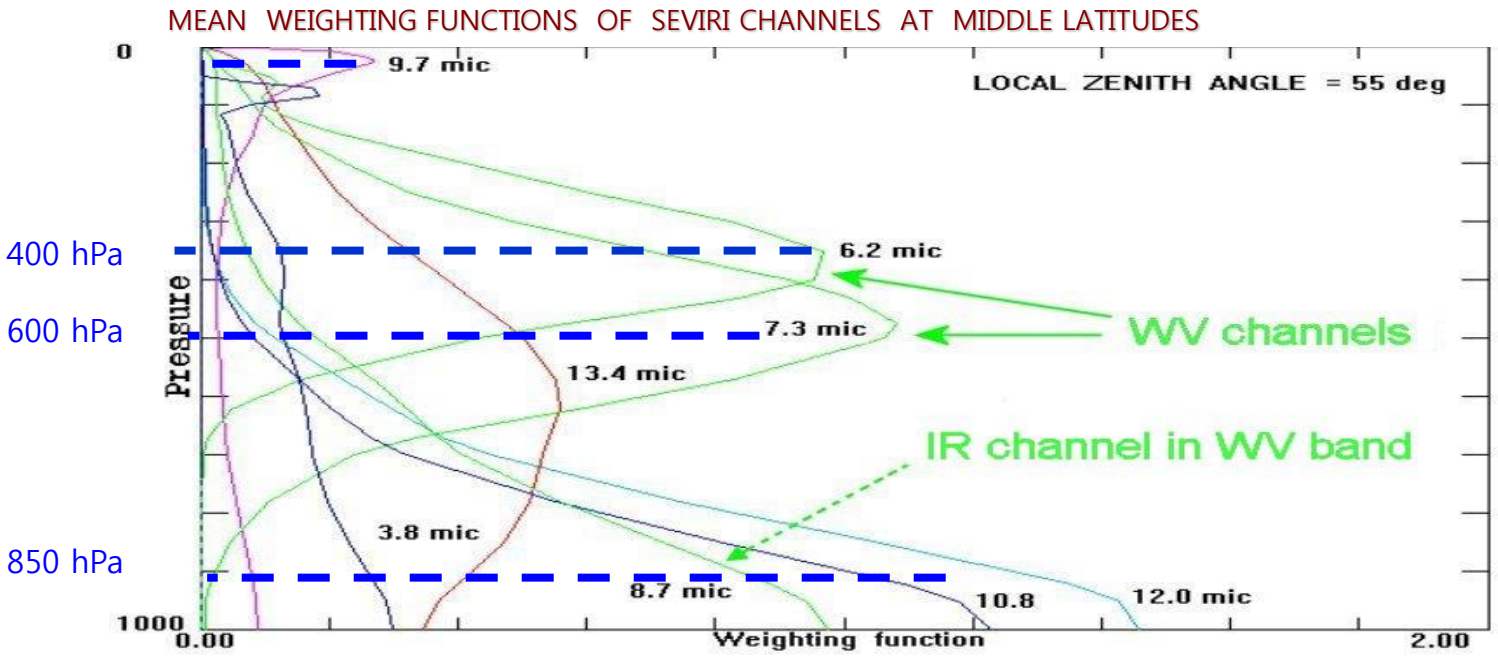
Color Interpretation of Airmass RGB

Comparison of channels of GEO. satellite

채널	중심 파장(㎛)					
	AMI (COMS-2A)	ABI (GOES-R)	AHI (Himawari)	MI (COMS)	SEVIRI (MSG)	MODIS
1(VIS) blue	0.470	0.470	0.46			0.466 (B03)
2(VIS) green	0.511		0.51			0.554 (B04)
3(VIS) red	0.640	0.640	0.64	0.675	0.6	0.647 (B01)
4(VIS)	0.856	0.865	0.86		0.8	0.857 (B02)
5(NIR)	1.380	1.378				1.382 (B26)
6(NIR)	1.610	1.610	1.6		1.6	1.629 (B06)
NIR		2.250	2.3			2.114 (B07)
7(IR)	3.830	3.90	3.9	3.75	3.9	3.788 (B20)
8(WV)	6.241	6.185	6.2		6.2	6.765 (B27)
9(WV)	6.952	6.95	7.0	6.75		6.765 (B27)
10(WV)	7.344	7.34	7.3		7.3	7.337 (B28)
11(IR)	8.592	8.50	8.6		8.7	8.529 (B29)
12(IR)	9.625	9.61	9.6		9.7	9.734 (B30)
13(IR)	10.403	10.35	10.4	10.8	10.8	B30+B31
14(IR)	11.212	11.20	11.2			11.019 (B31)
15(IR)	12.364	12.30	12.3	12.0	12.0	12.032 (B32)
16(IR)	13.31	13.30	13.3		13.4	13.365 (B33)

Weighting Functions(WF) of Channels



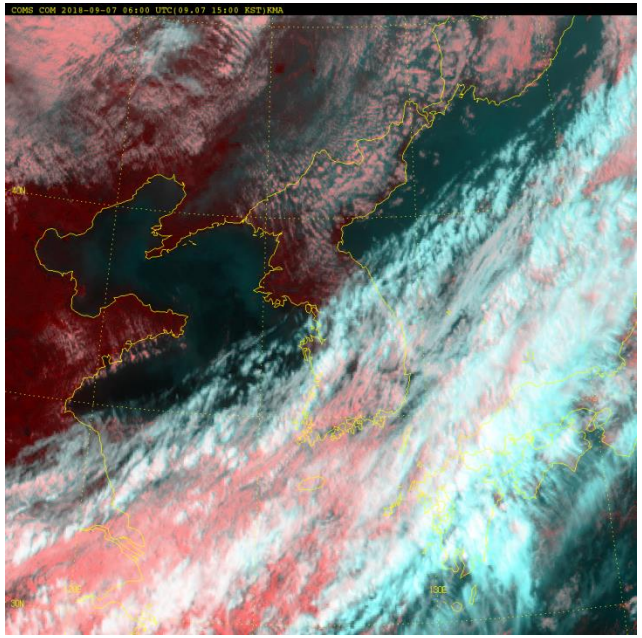
- The WV channel weighting functions are peaking at different altitudes and the levels of maximum contribution to the total radiation emitted by moisture are different for the two channels.
- The WV channels of MSG may serve as tools for observing moisture regime in different layers of the troposphere.

from EUMETRAIN

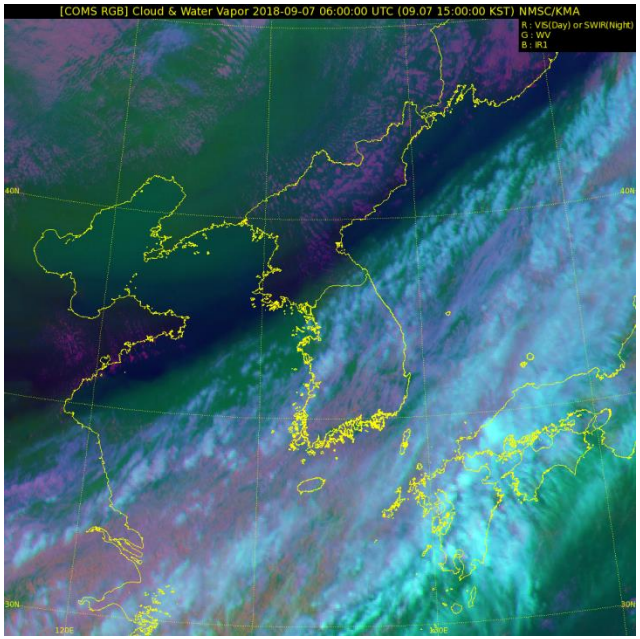
COMS RGB images

◆ COMS RGB images from 5 channels

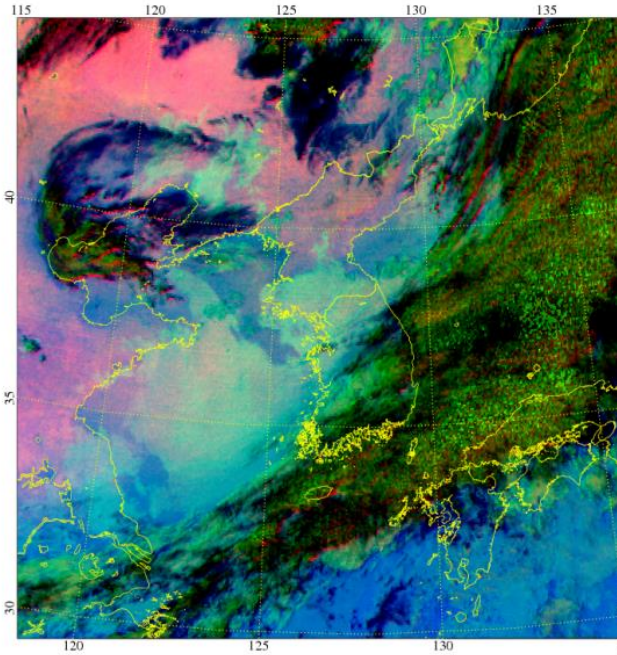
VIS+IR RGB



VIS+WV RGB



FOG RGB

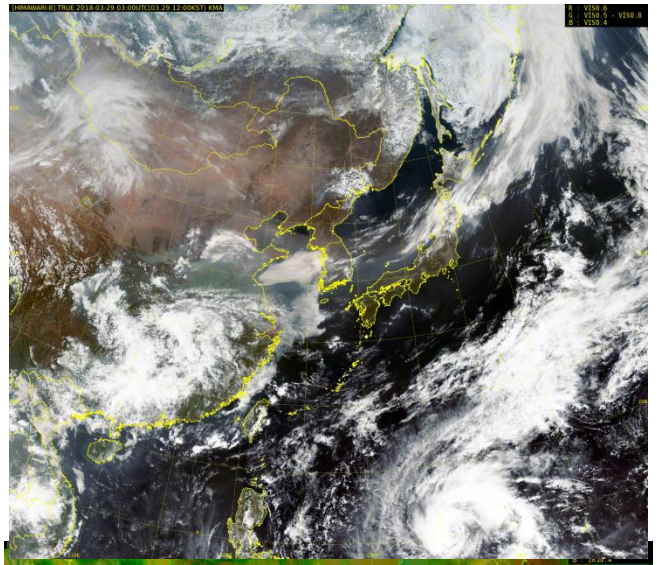


- VIS+IR RGB : three-dimensional analysis of low, middle and high cloud
- WV RGB : low level cloud with WV
- FOG RGB: FOG analysis at day and night

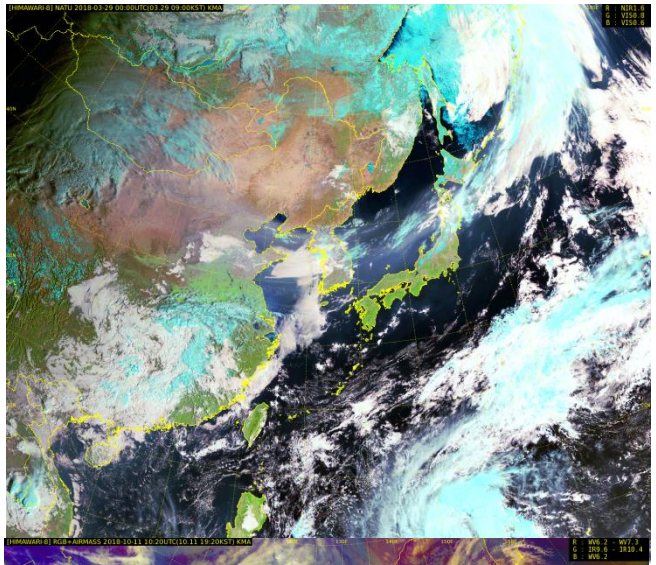
Himawari 8 RGB images

- HW8 RGB images from 16 channels
- More RGB images are available

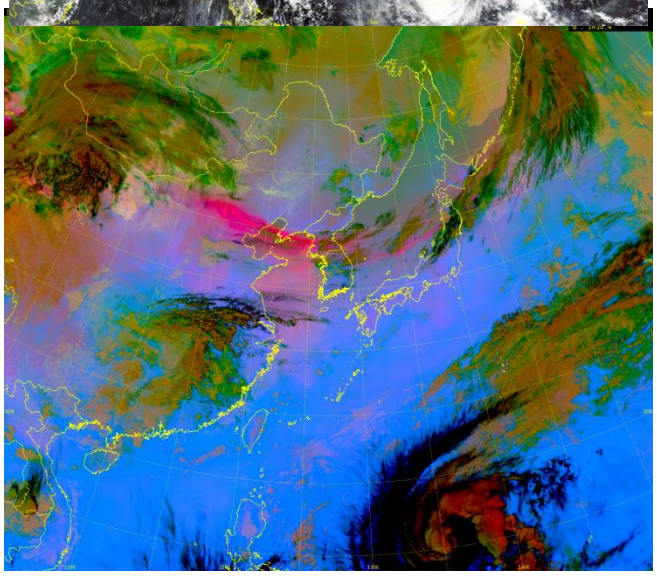
True color



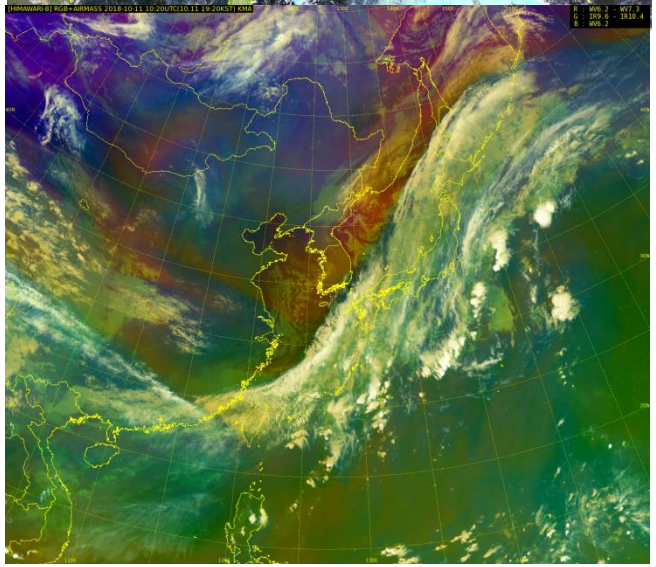
Natural Color



Dust

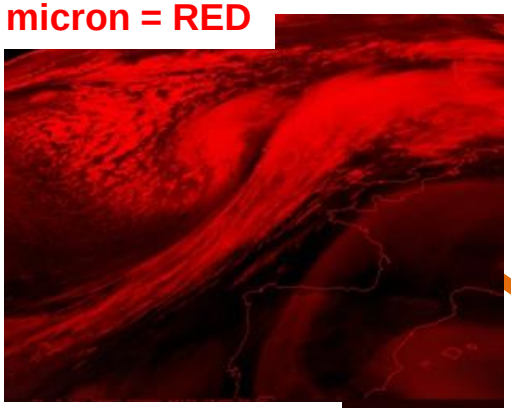


Airmass RGB

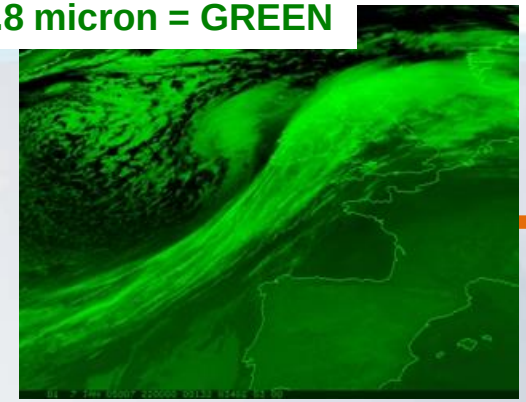


Air Mass RGB

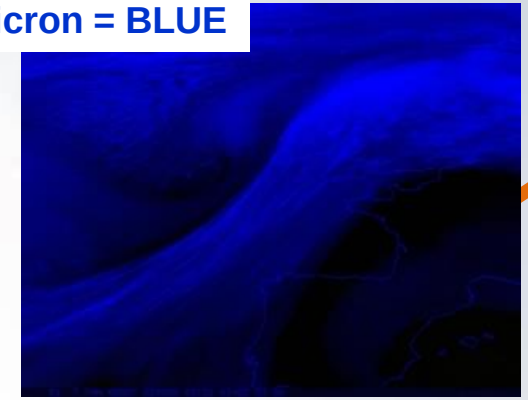
6.2-7.3 micron = RED



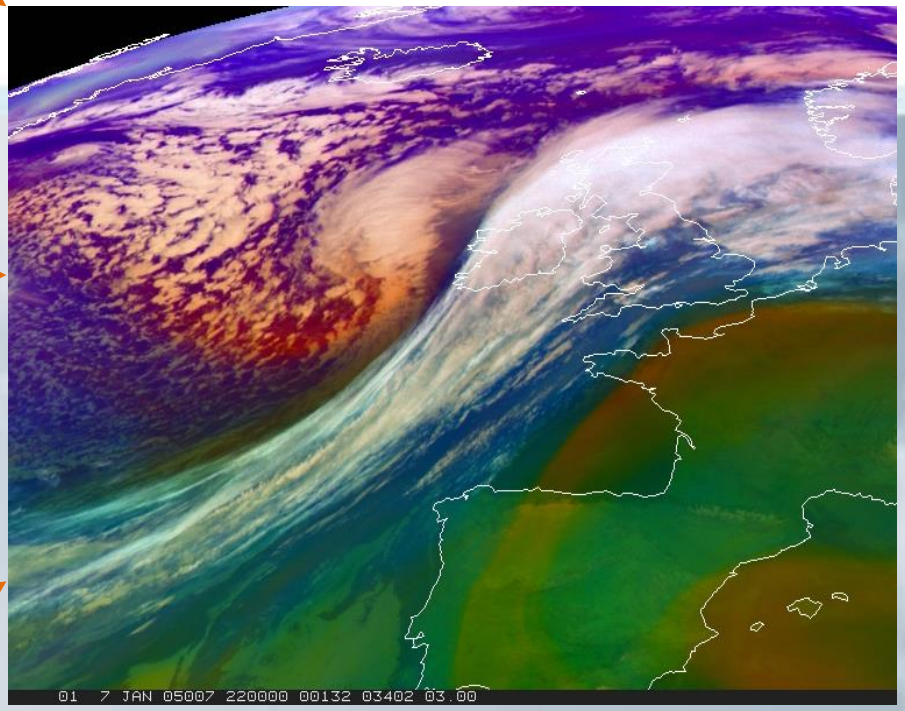
9.7-10.8 micron = GREEN



6.2 micron = BLUE



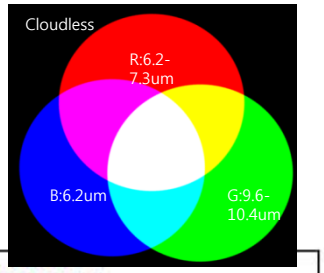
- **Application: Cold air, Warm air, dry air, sinking and etc.**



North Atlantic Ocean and Northwest Europe
7 January 2005

images from EUMETSAT and BoM Bodo

Interpretation of Air Mass RGB image



Air Mass RGB : R:6.2-7.3um, G:9.6-10.4um, B:6.2um

Colour Interpretation

Air masses:

1 Cold, ozone rich polar air mass

2 Warm, ozone poor tropical air masses (high upper tropospheric humidity)

3 Warm air masses with low upper tropospheric humidity

4 Dry air masses (indicating e.g. subsiding air, PV anomalies and the position of jet streams)

Clouds:

5 High-level thick clouds

6 Mid-level ice and water clouds

7 Low-level clouds: no specific colour, just the structure is visible, appears bluish in polar and greenish in tropical air masses.

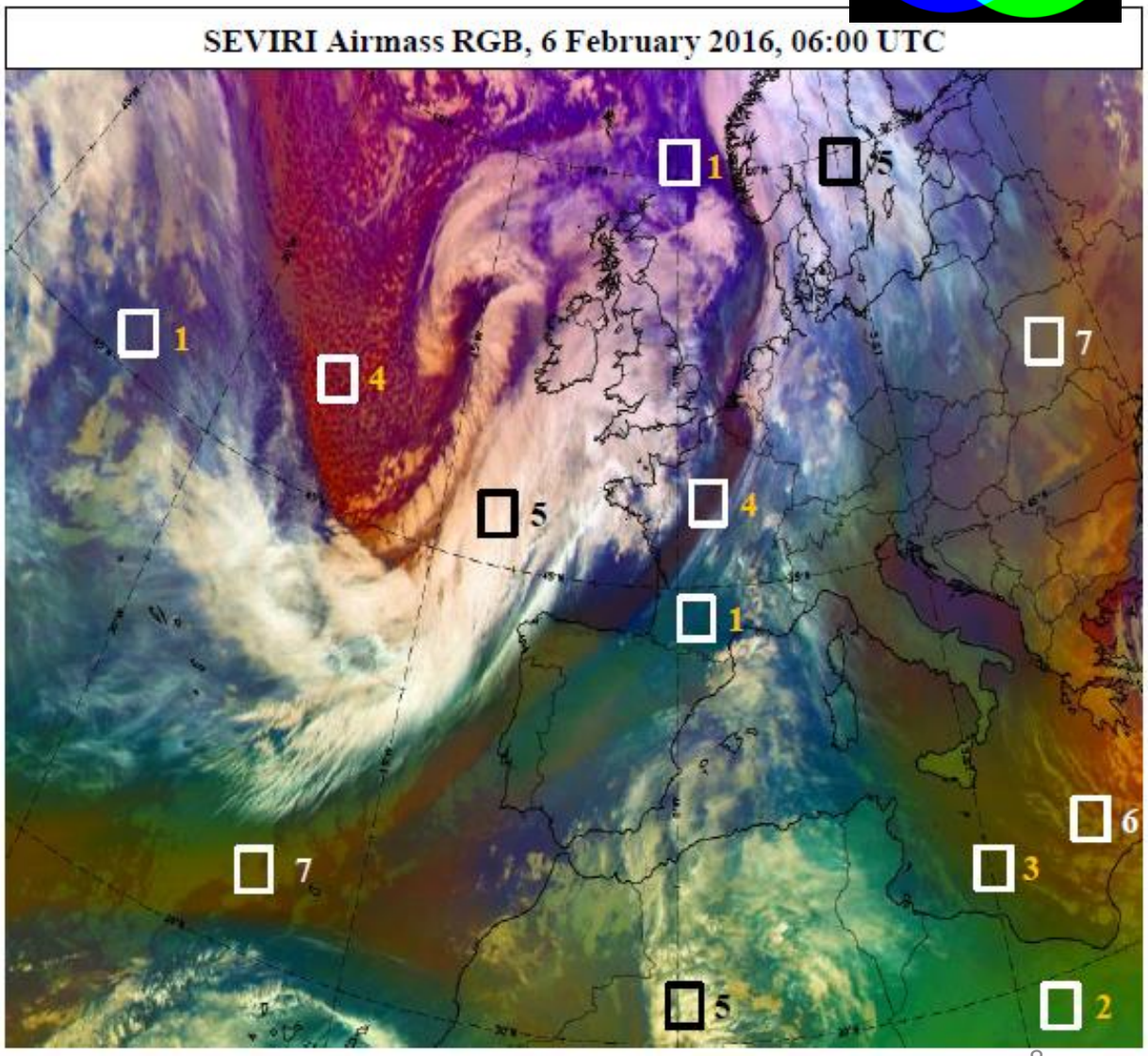
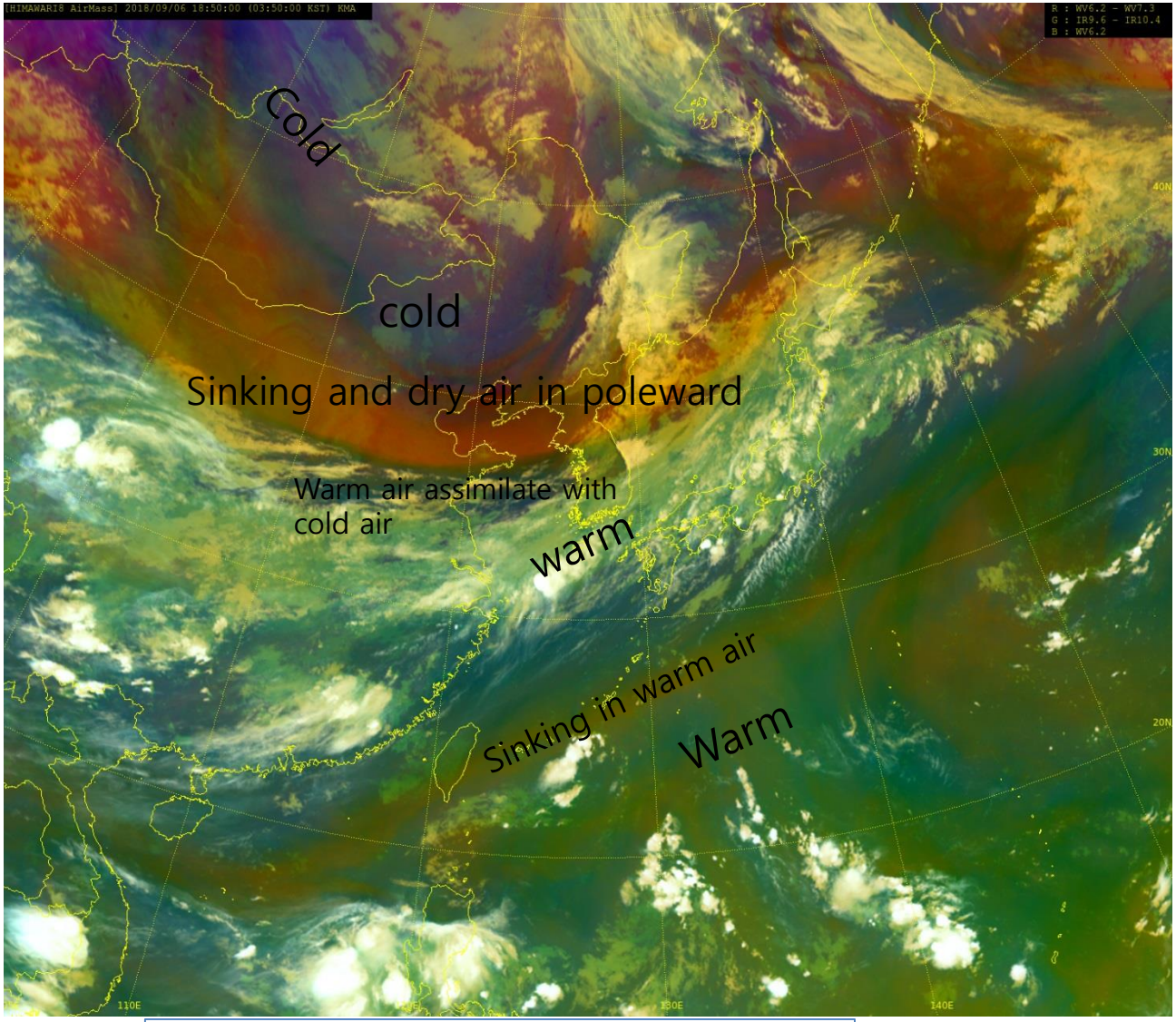


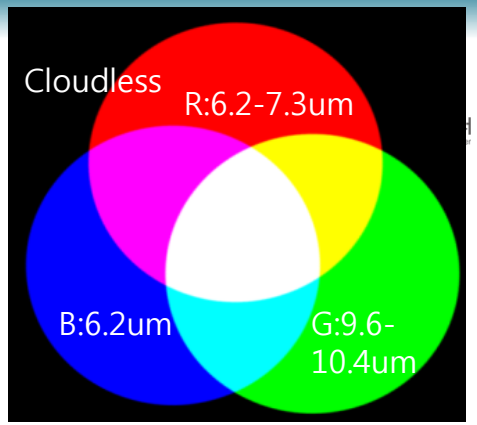
Image from EUMETSAT

from EUMETRAIN

Interpretation of Airmass in East Asia



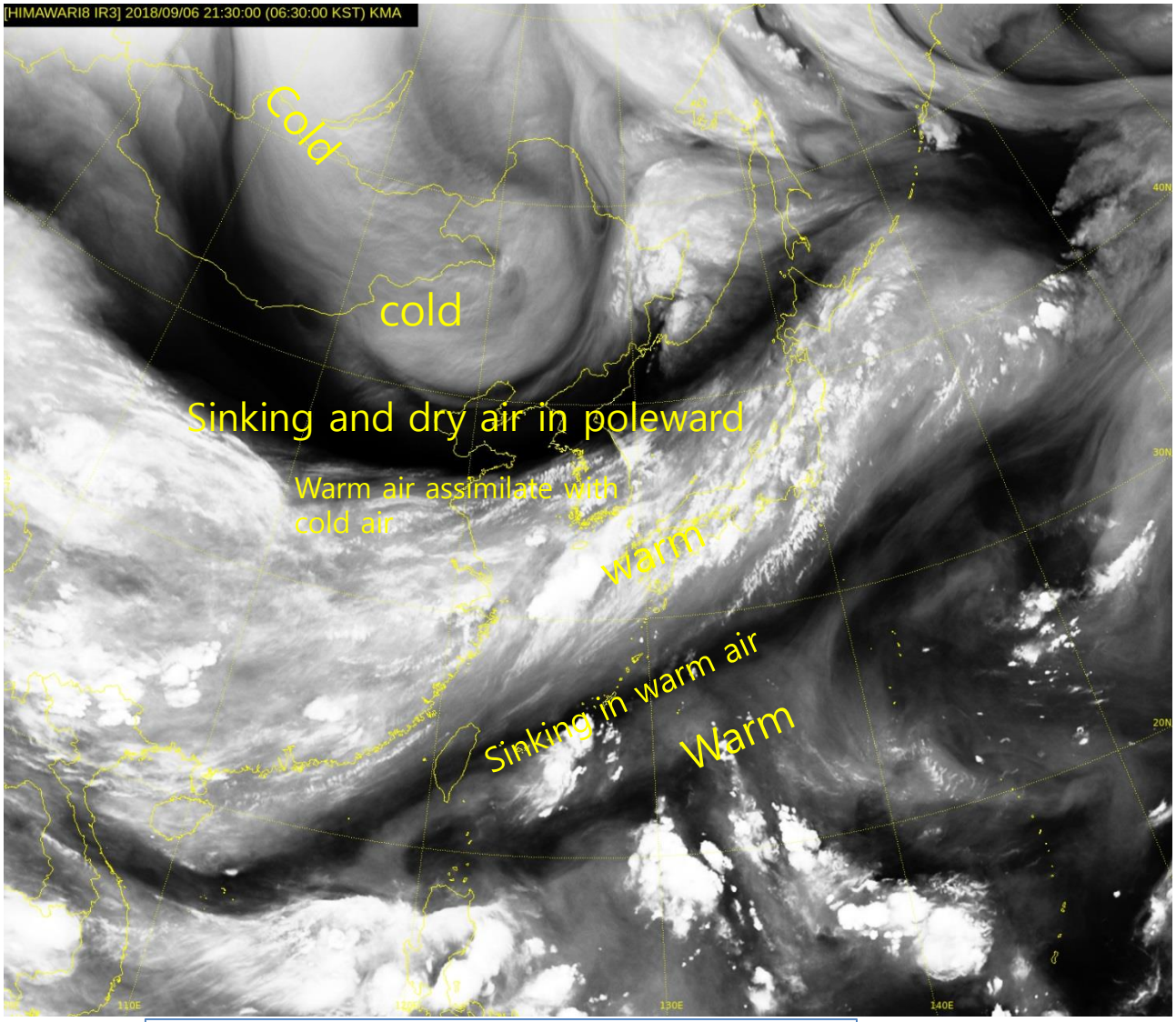
2018. 9. 7. 03:50KST HW8 Airmass RGB



Color interpretation

- Cold of polar air mass
- Warm of tropical air mass
- Warm air masses with low upper tropospheric humidity
- Dry air masses (indicating e.g. subsiding air,PV anomalies and the position of jet streams)

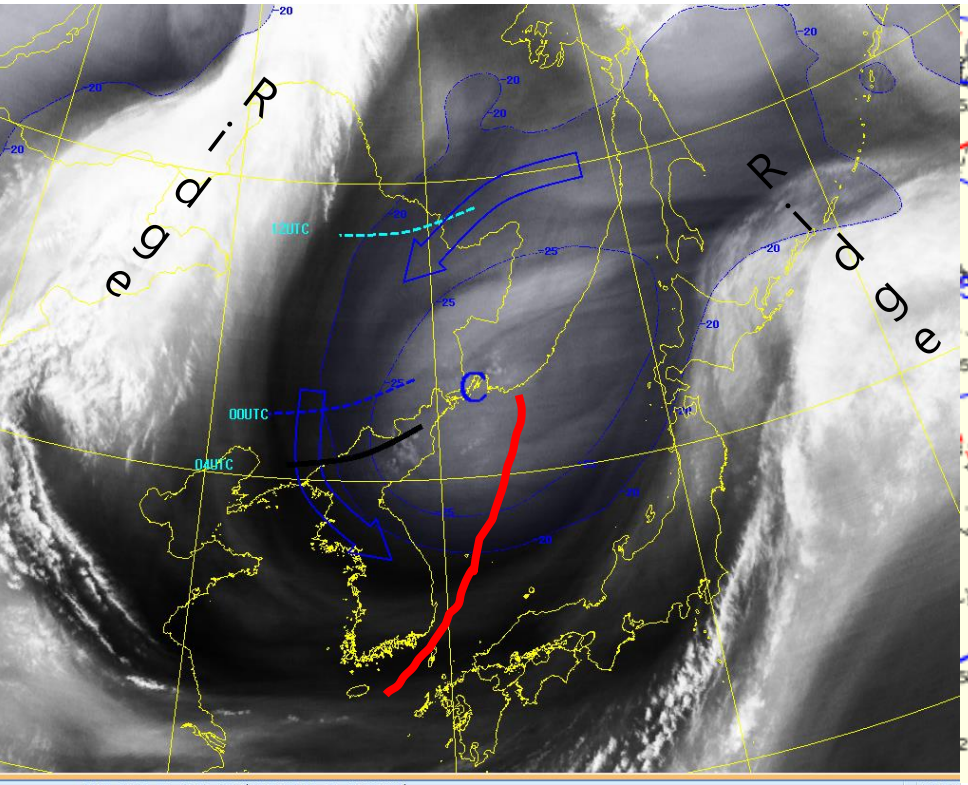
Interpretation of WV in East Asia



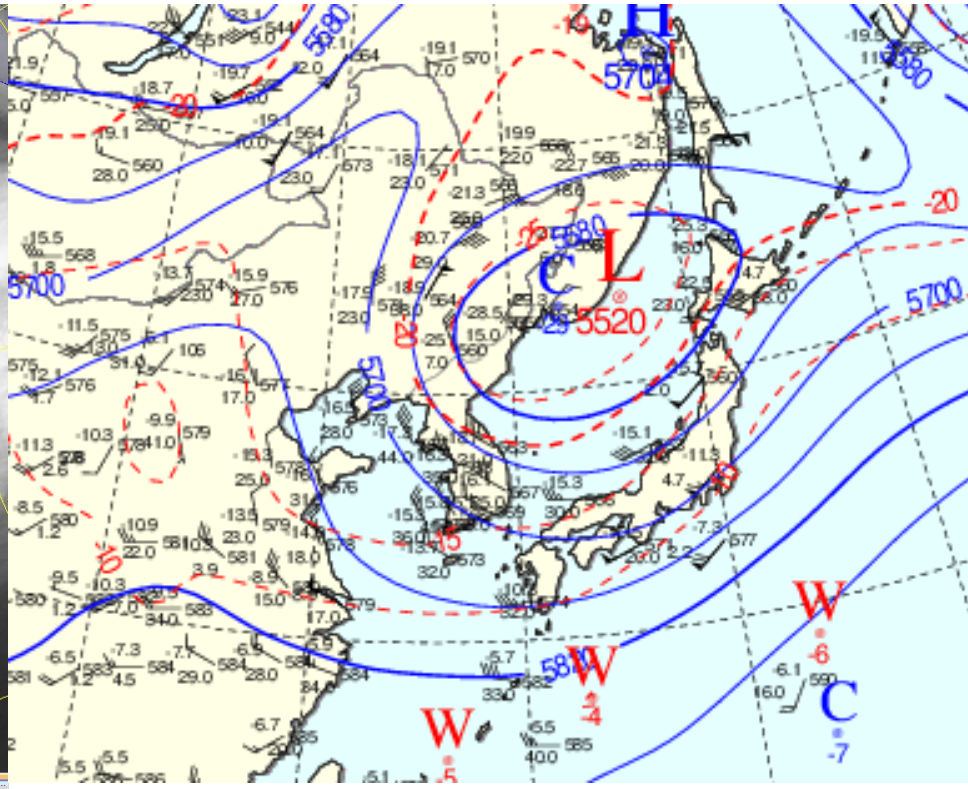
2018. 9. 7. 03:50KST HW8 WV 6.2um

Synoptic and Mesoscale Analysis
Case study

Cold core of Upper level, low cumulus cloud



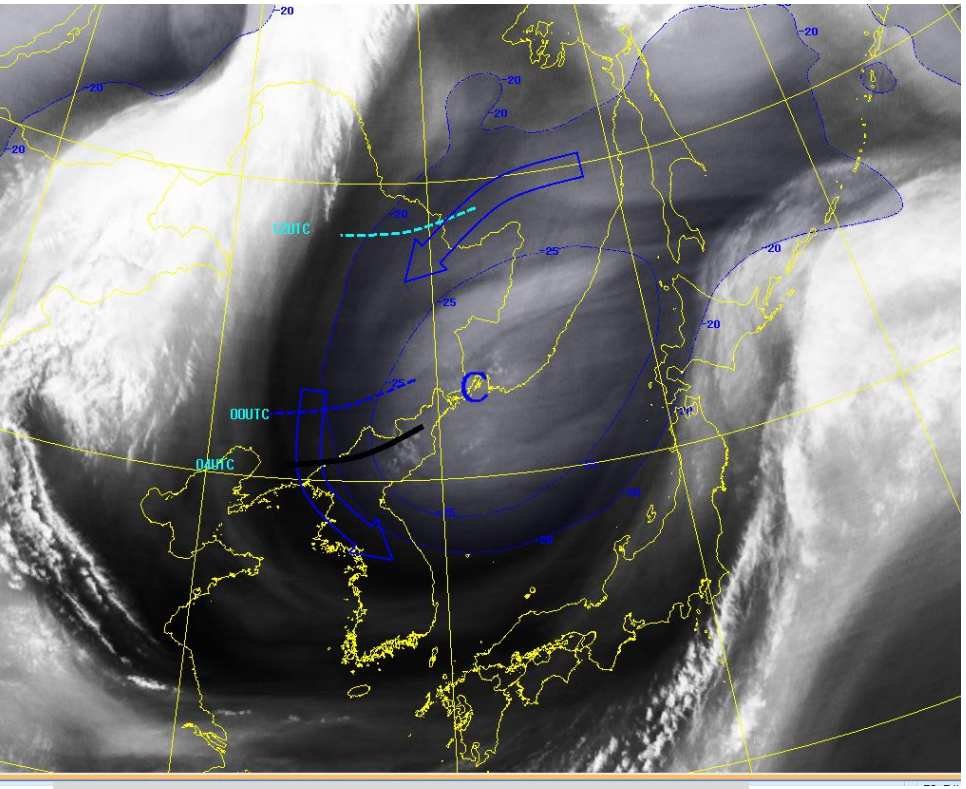
2018. 5.9. 13:00KST COMS WV
+ 500hPa Temp.(Cold core: under -20 ℃, blue solid line)



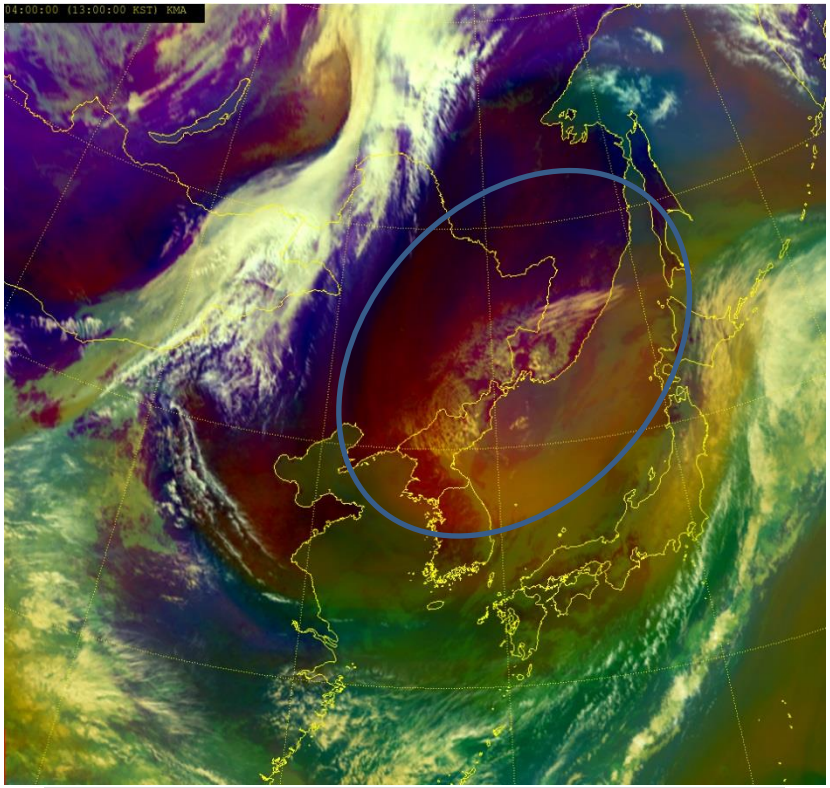
2018. 5.9. 09:00KST 500hPa surface chart

- A trough with Cold core is moving from north to south over the Korean Peninsula.
- A cyclonic system is going southward with cold air.

Cold core of Upper level, low cumulus cloud



2018. 5.9. 13:00KST COMS WV + 500hPa Temp. (cold core: under -20℃, Blue solid line)

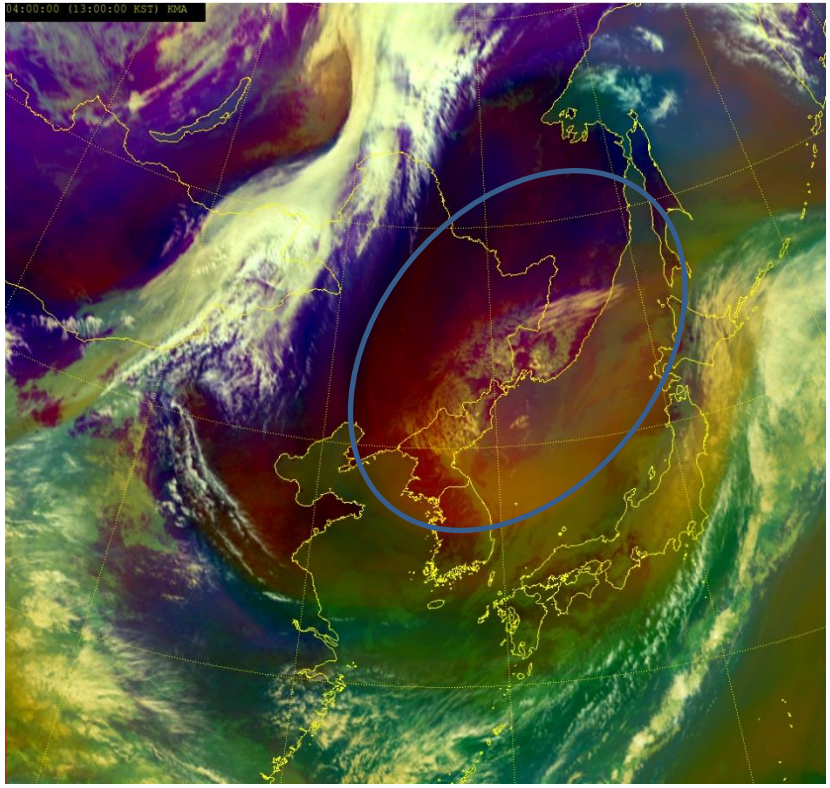


2018. 5.9. 13:00KST HW8 airmass

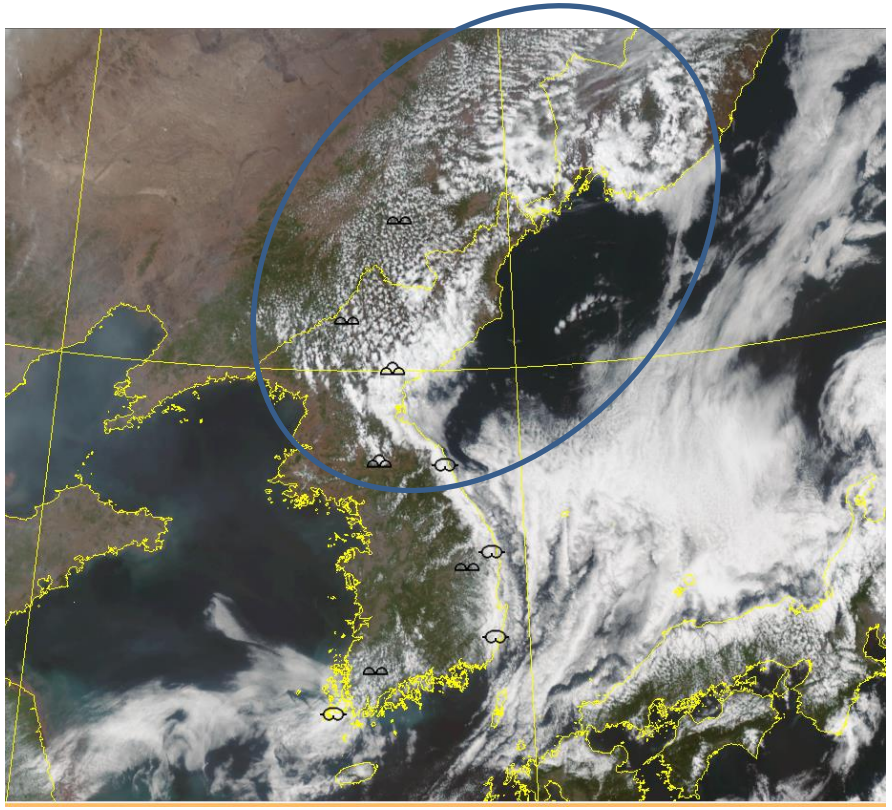
- Cold core over the North Korea is moving to the southward in WV.
- In airmass RGB image, the cold core with reddish color is located at the same area of WV.

Cold core of Upper level, low cumulus cloud

국가기상위성센터
National Meteorological Satellite Center



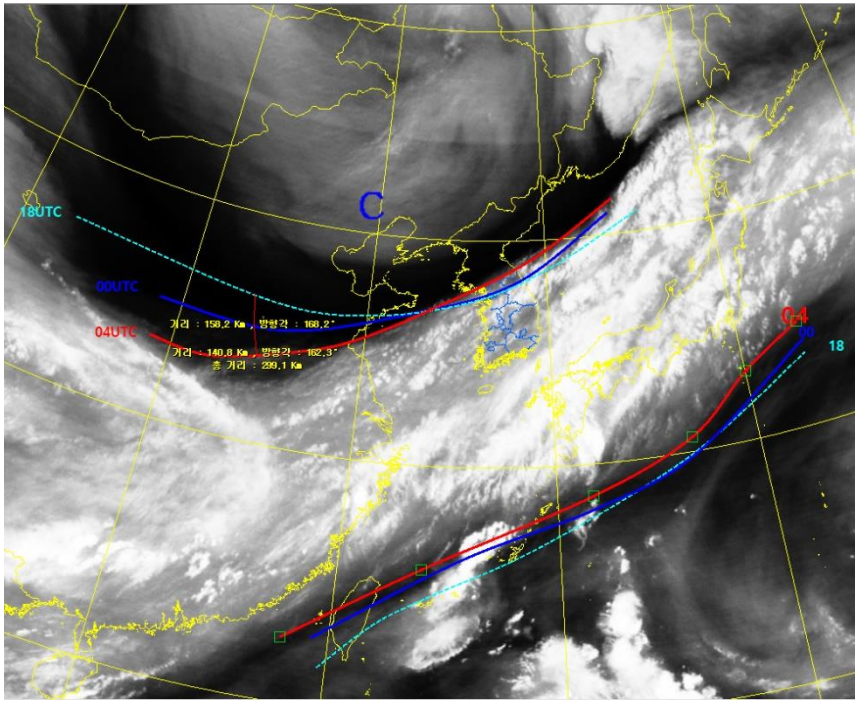
2018. 5.9. 13:00KST HW8 airmass



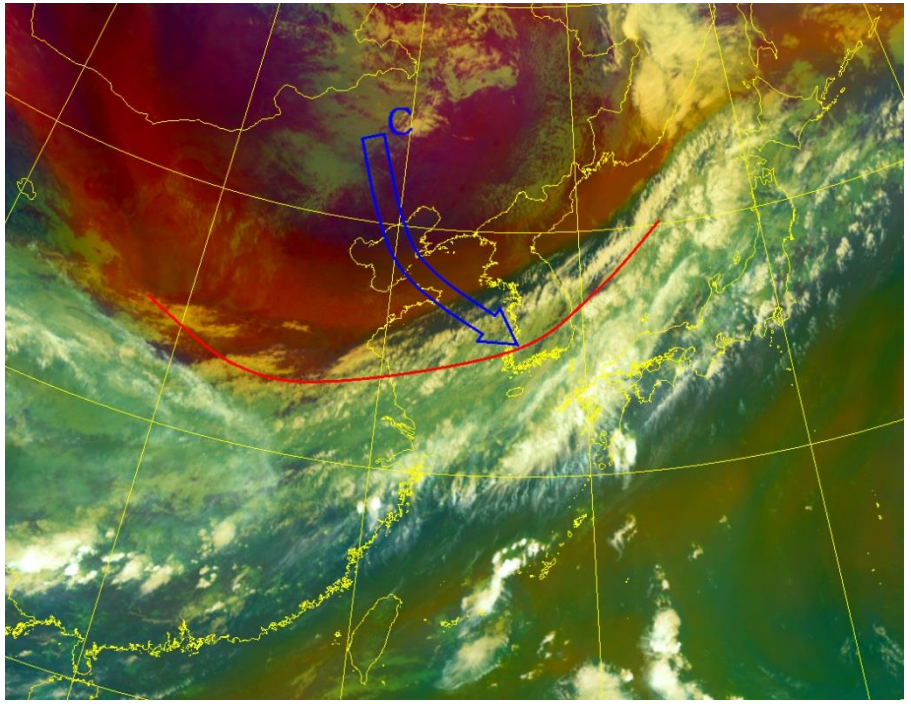
2018. 5.9. 14:00KST HW8 true color

- Under the cold area, low cumulus cloud are generated and cumulus cloud area is moving to South Korea

Cloud band between Cold and Warm air



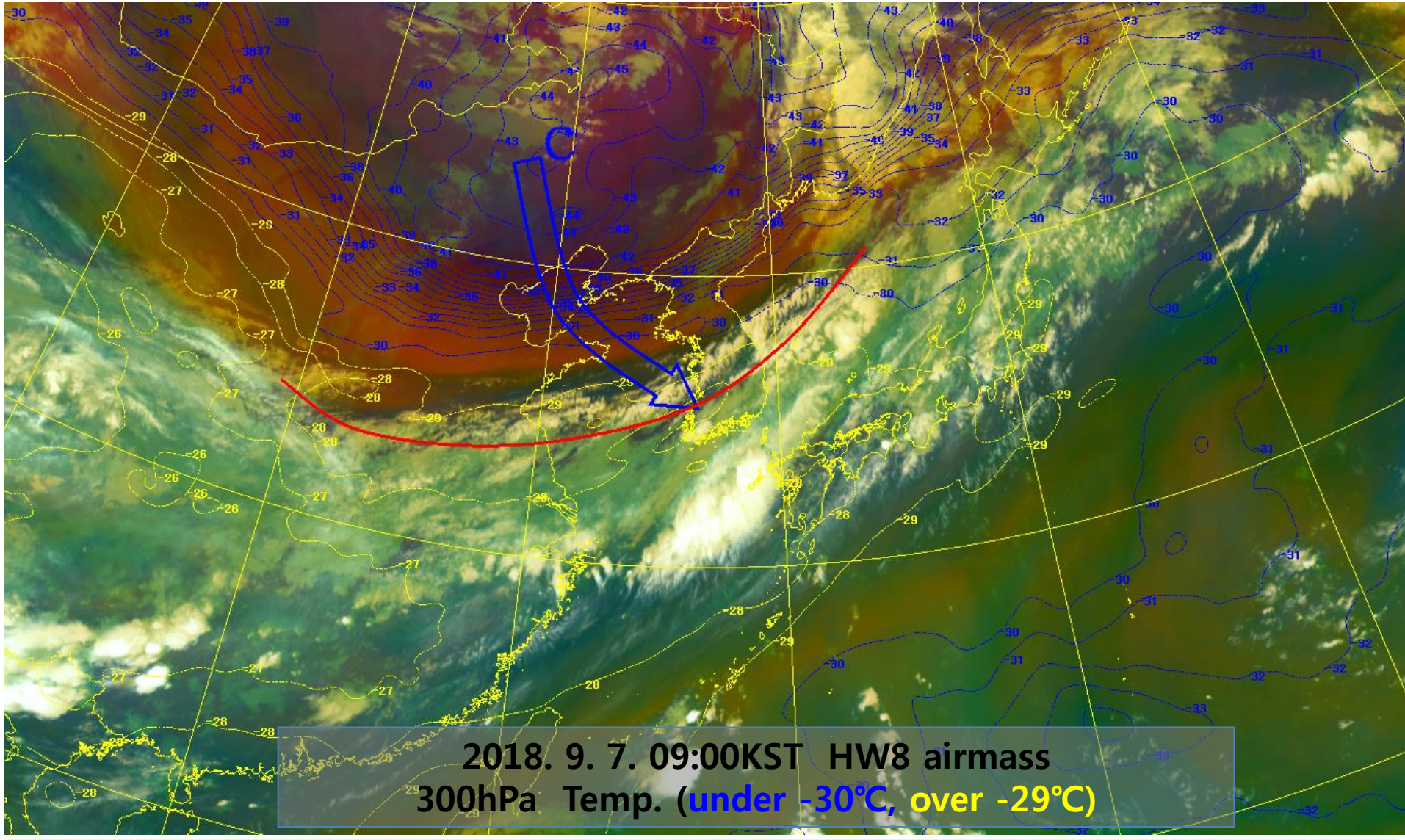
2018. 9. 7. 13:00KST COMS WV



2018. 9. 7. 13:00KST HW8 airmass

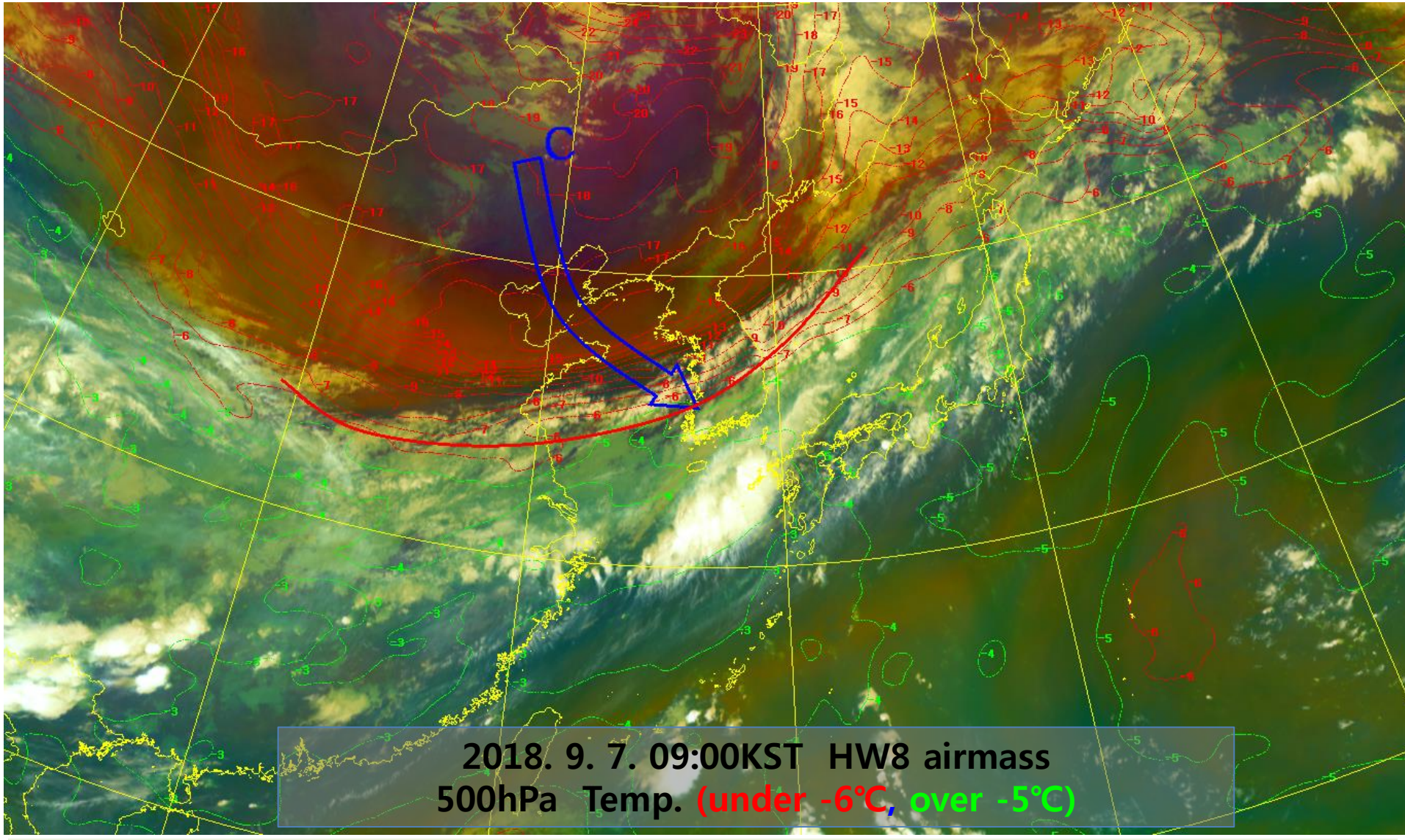
- **WV:** cloud band between cold air and warm air is almost stationary around South Korea
- **Airmass**: North area of the cloud band is cold air with reddish color and south area is warm air with greenish color
- Cold air from upper level to lower level is expanded to red line, southern

Cold air southward, sinking to the lower level(300hPa T)



- 300hPa Temp. : cold air(dry) under -30℃ located in reddish area, Temp. gradient is dense.

Cold air moving southward, sinking to the low level(500hPa)



- 500hPa Temp. : cold air(dry) under -6℃ located in reddish area, dense area of temp. gradient is southward to middle S.K.

Cold air moving southward, sinking to the low level(850, 925hPa)

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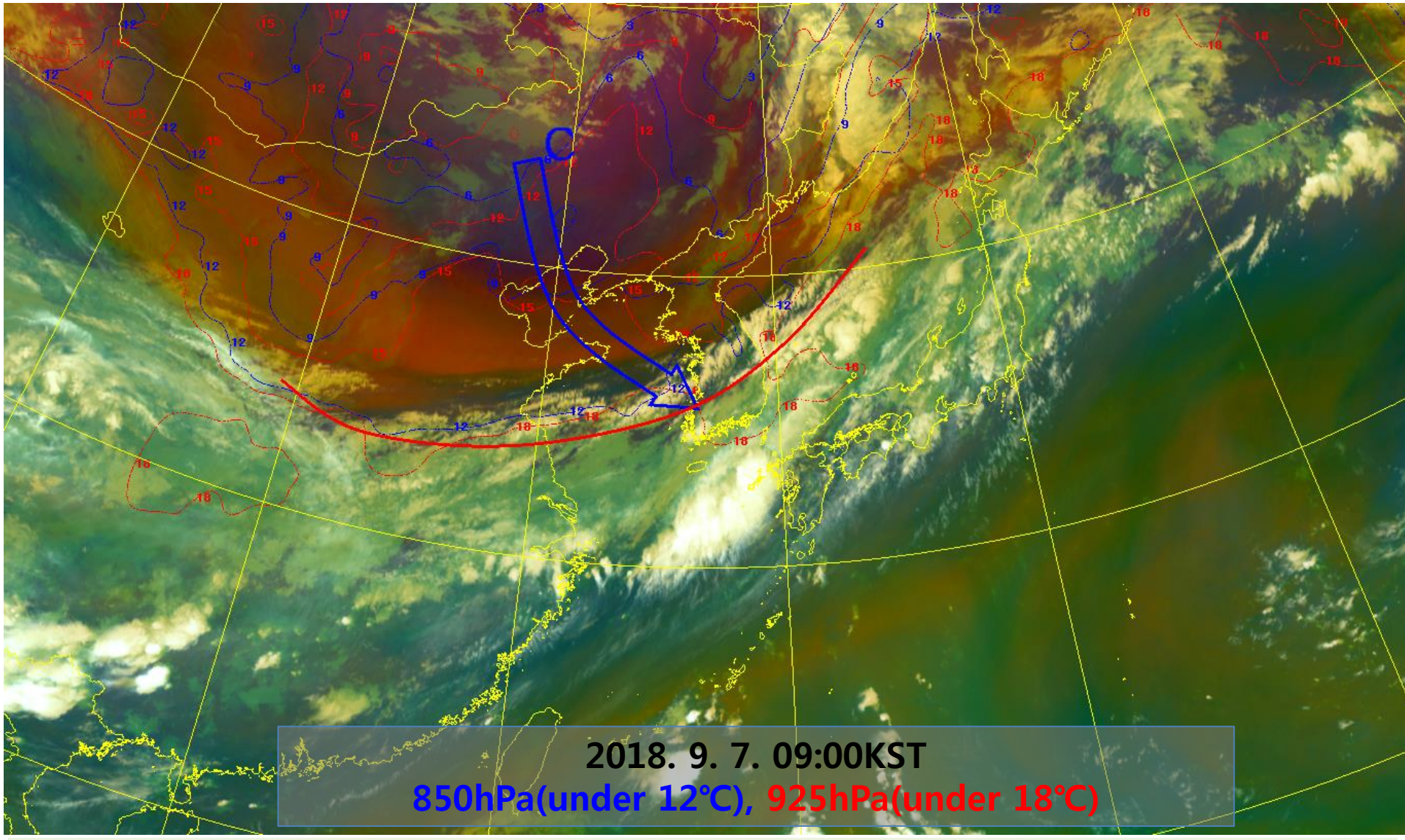
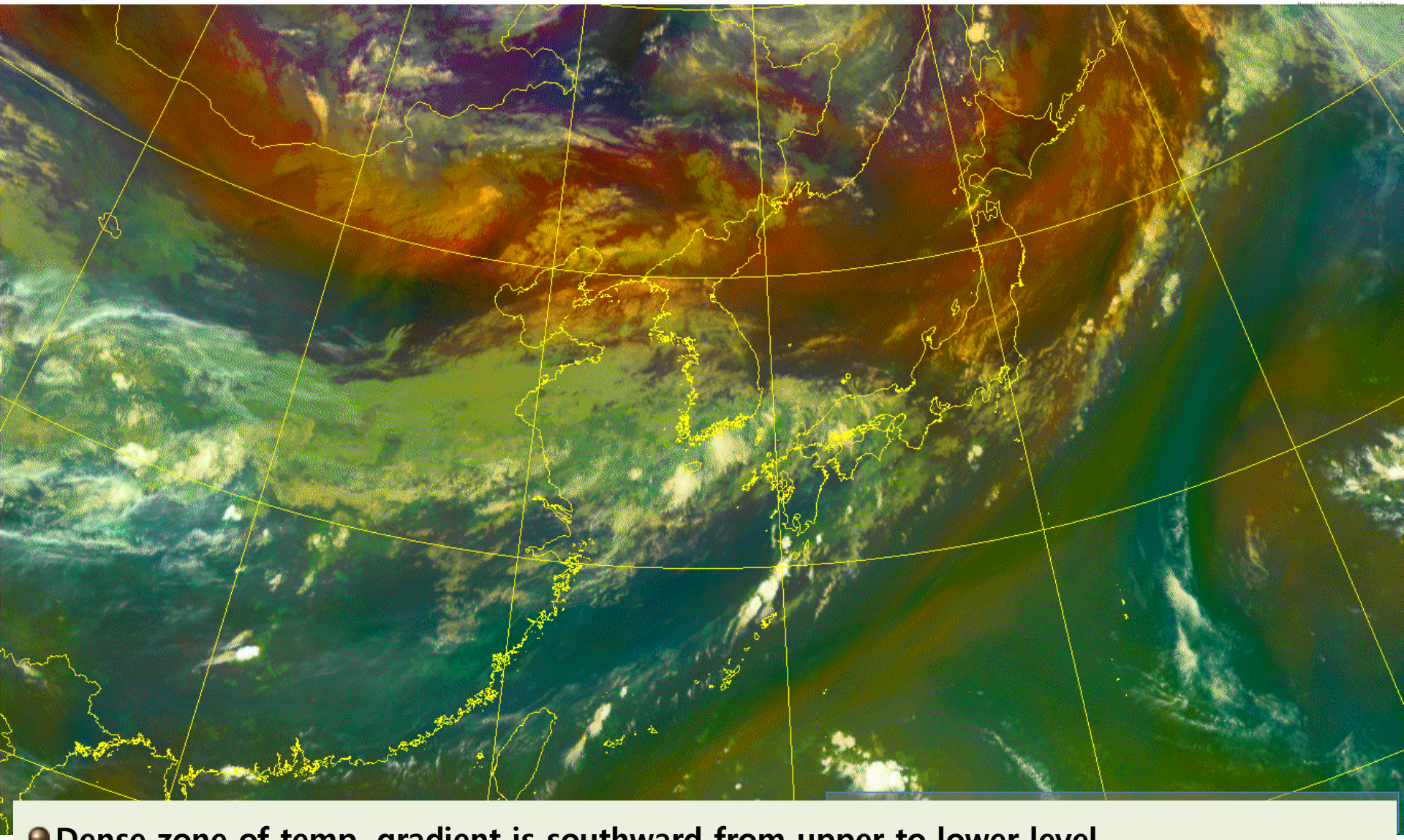
National Meteorological Satellite Center



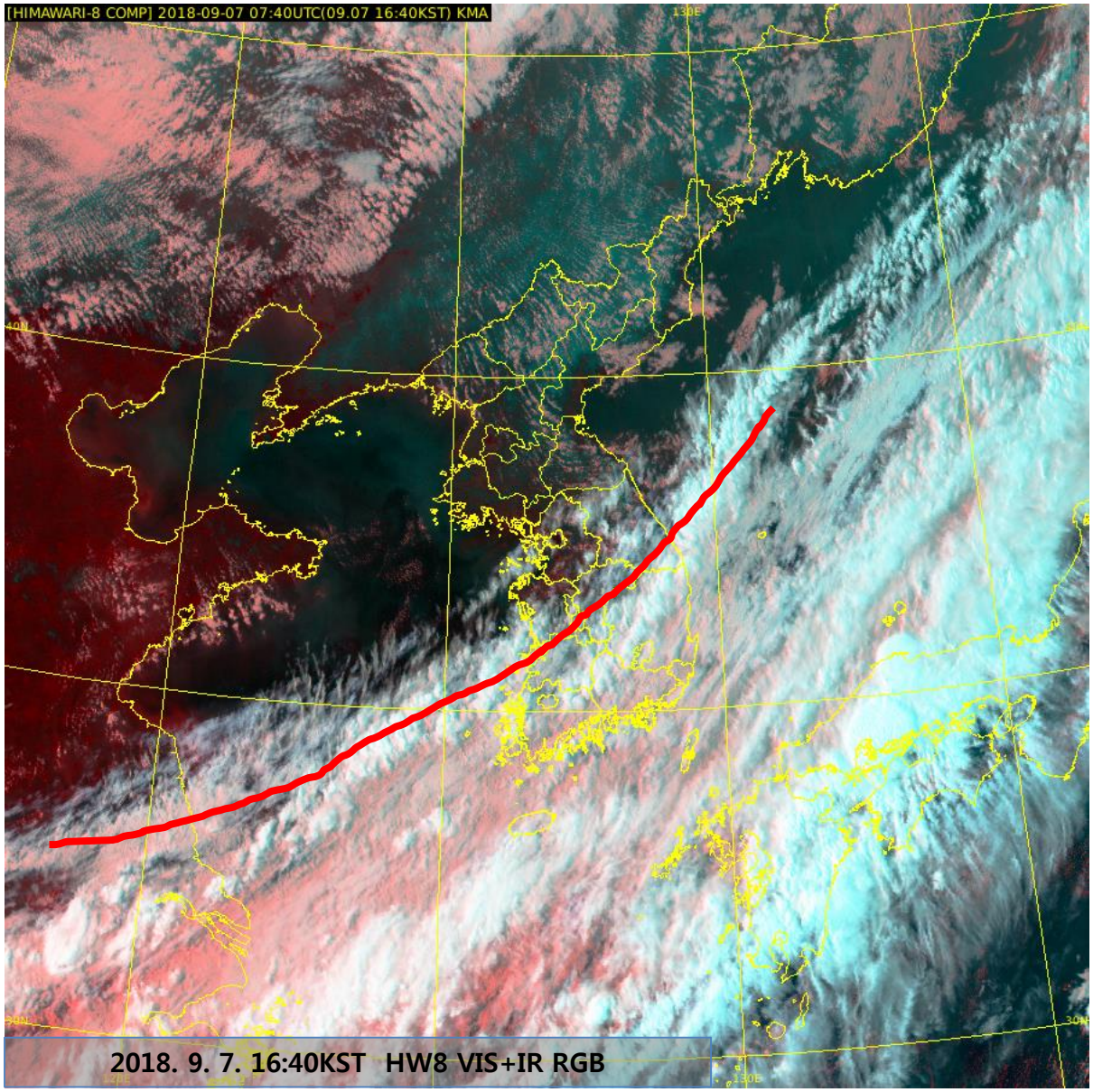
- 850hPa under 12℃ and, 925hPa under 18℃ T line located with cold air

Cold air moving southward, sinking to the low level



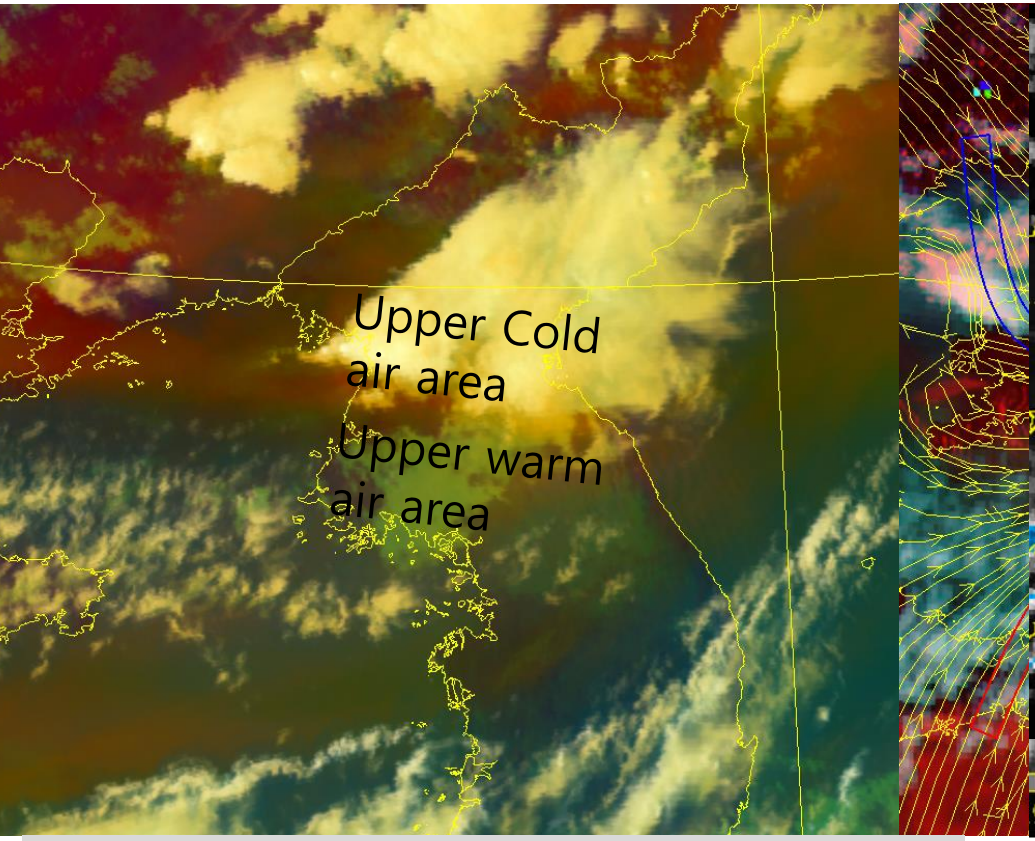
- Dense zone of temp. gradient is southward from upper to lower level.
- => The cold air has descended to the southward

Cumulus cloud in lower level with upper cold core

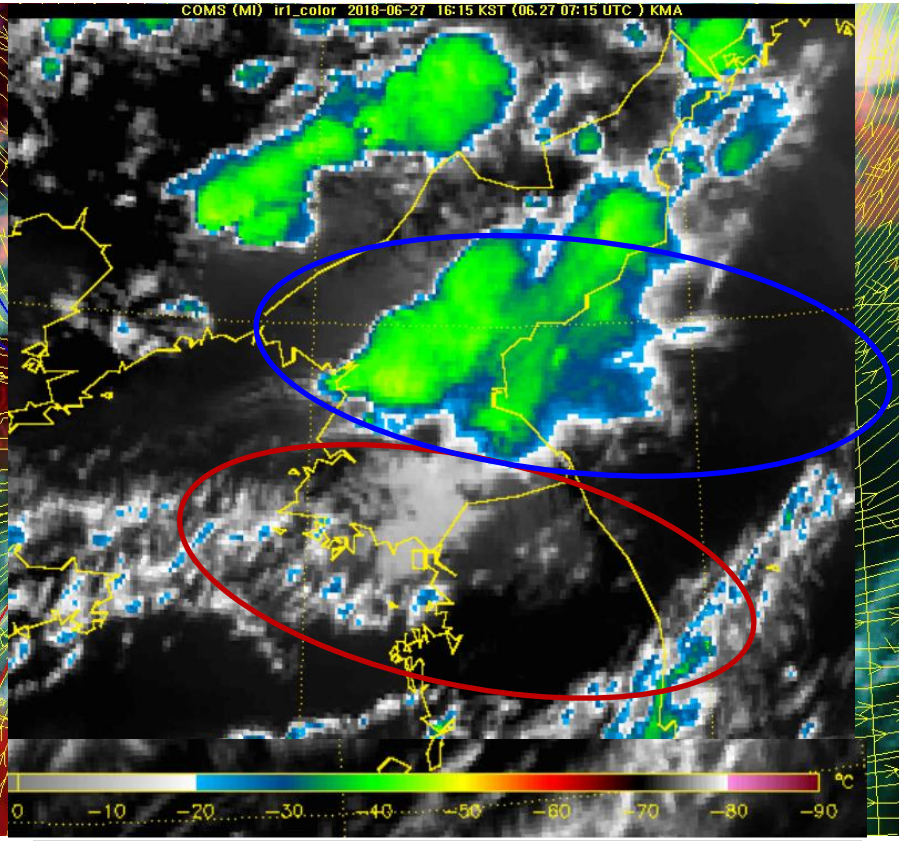


- S.K. is cloudy with cumulus low and multi level cloud
- Generated Cumulus cloud in lower level with sinking upper cold air

Suppression of convective development in upper warm area



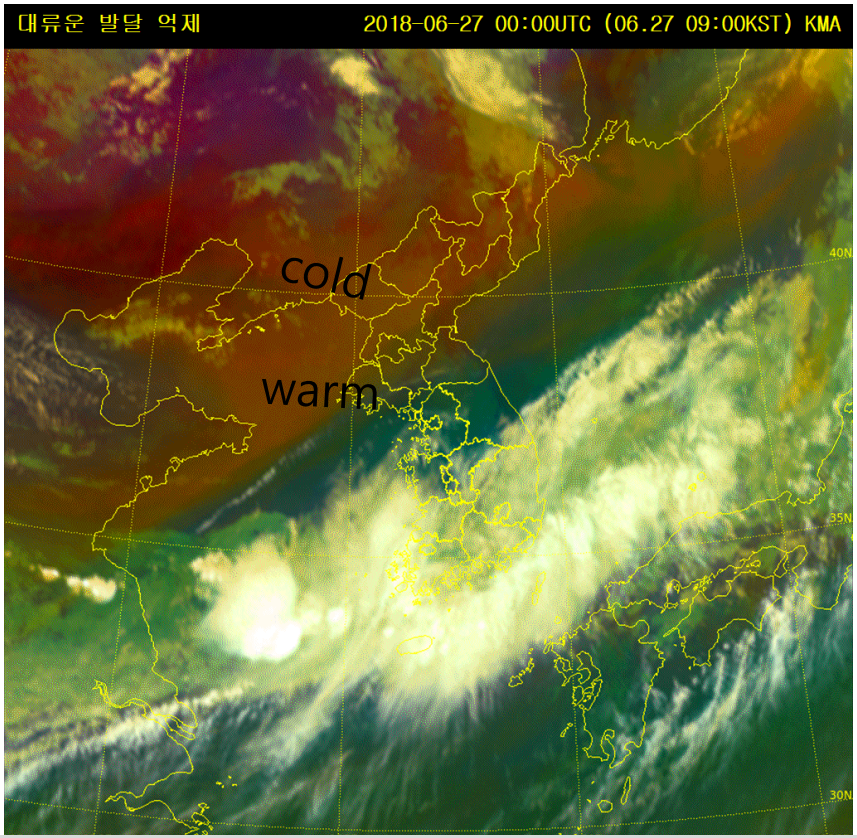
2018. 6.27. 15:50KST HW8 airmass
+ upper cold(under -10℃) and upper warm



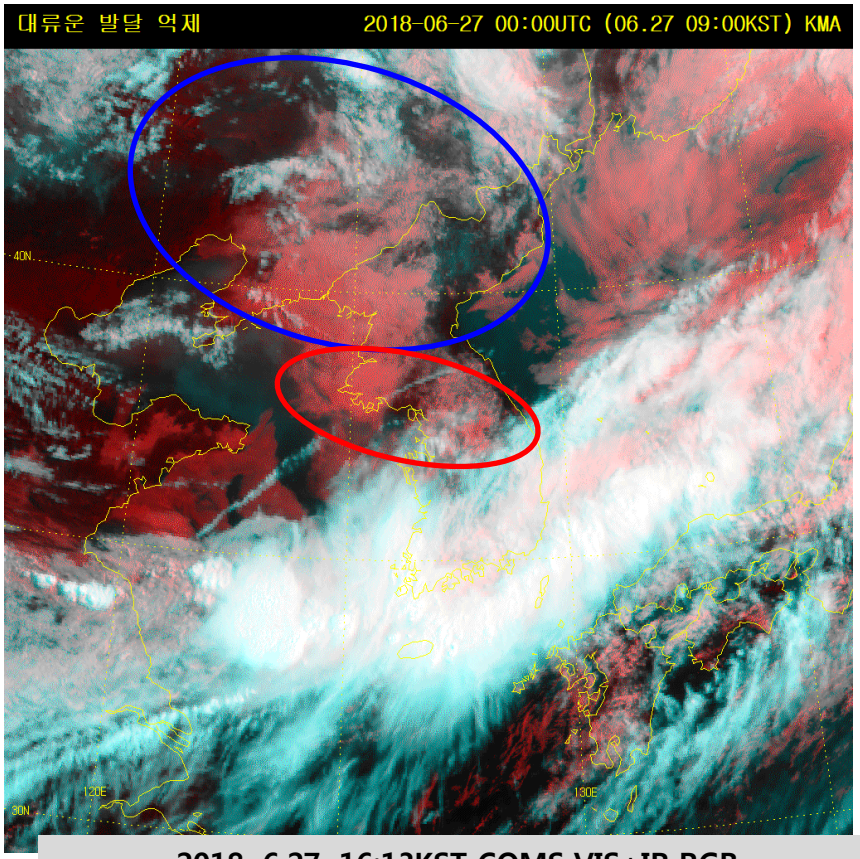
2018. 6.27. 16:13KST COMS 합성영상+enhanced IR
Top temp. -45℃

- In the lower layer, there is the ground heating, and in the situation where the convergence between southwesterly and the northwesterly, thermal unstabilities are strengthening in cold air area of the upper part.
- The cumulonimbus are generating and moving to eastward from generated place.
- The border of cold air(blue) and warm air(red) of upper level: cumulonimbus growth over the northern North Korea in upper cold air area and suppression of Cumulonimbus development over the southern North Korea in upper warm air

Suppression of convective development in upper warm area



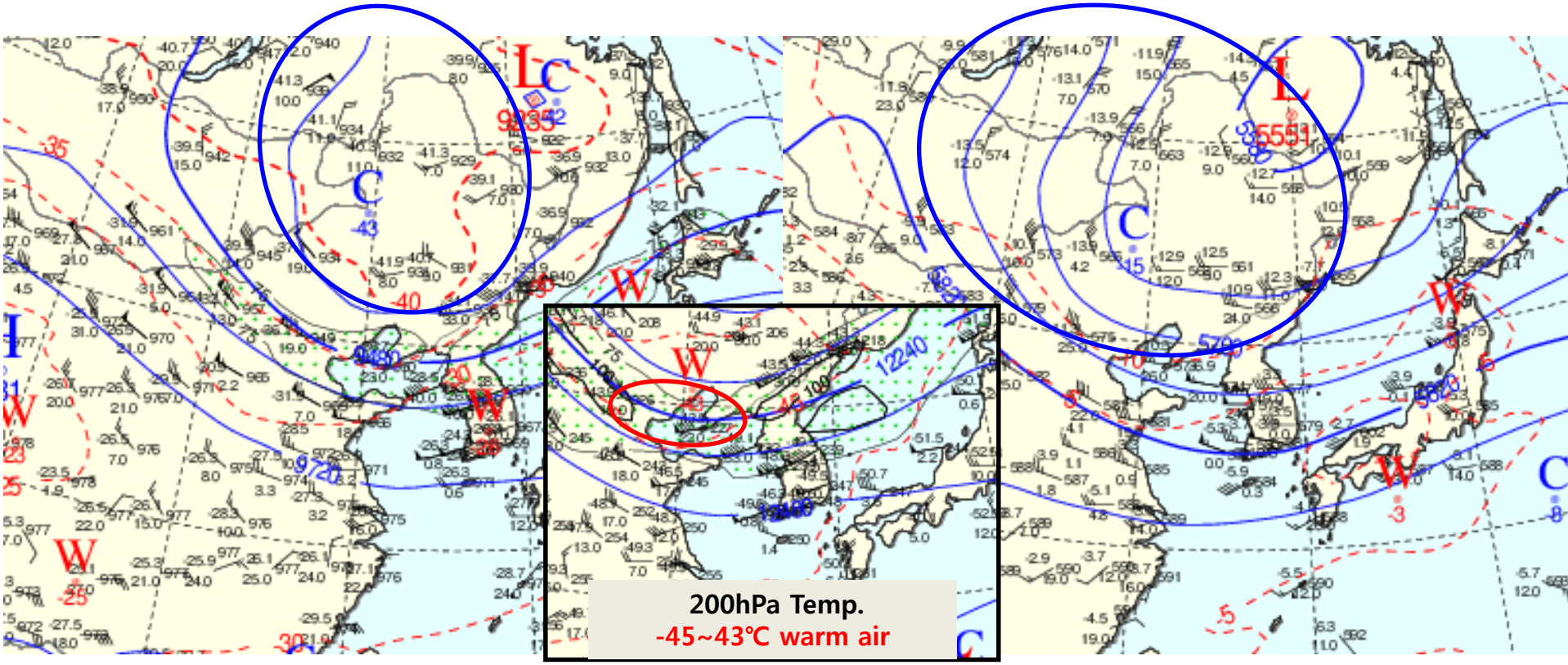
2018. 6.27. 15:50KST HW8 airmass



2018. 6.27. 16:13KST COMS VIS+IR RGB

- The border of cold air(blue) and warm air(red) of upper level:
- Cumulonimbus growth over the northern North Korea in upper cold air area and suppression of Cumulonimbus development over the southern North Korea in upper warm air

Weather chart: upper level temperature



2018. 6.27. 09:00KST 300hPa
Under -40℃ cold

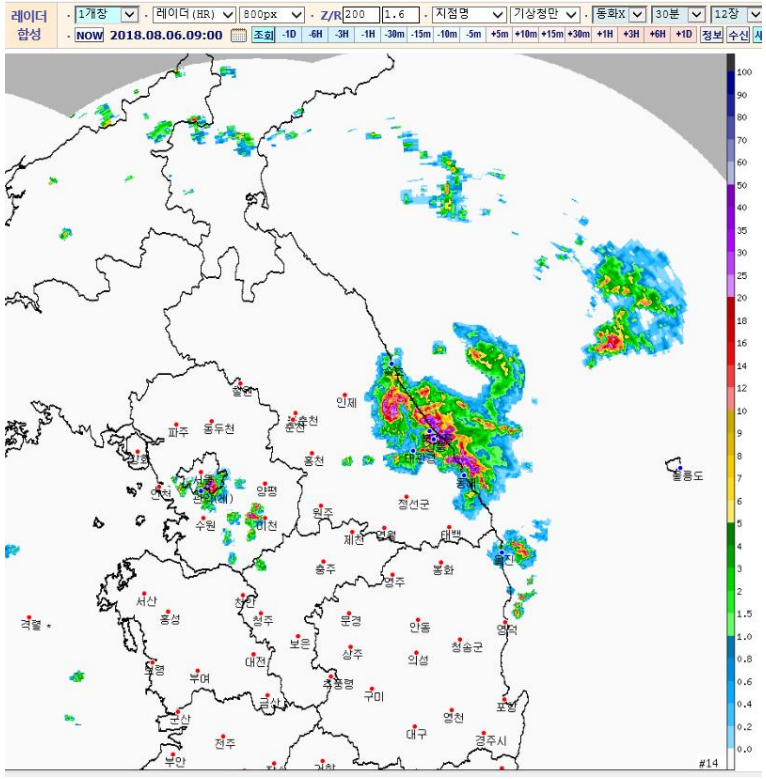
2018. 6.27. 09:00KST 500hPa
Under -10℃ cold

- Cumulonimbus growth area is upper warm air(over -45) in 200hPa
- Suppression area of Cumulonimbus development is upper cold air(under -40) in 300hPa

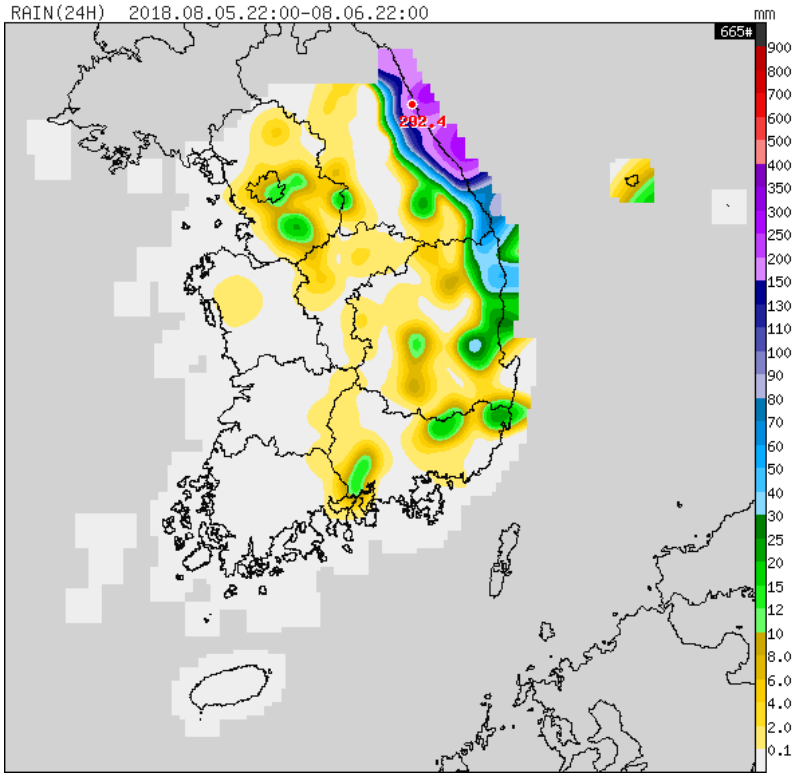
Cold air Inflow of upper layer and convection development

Case : 2018. 8. 5.~6.
Heavy rains

Weather



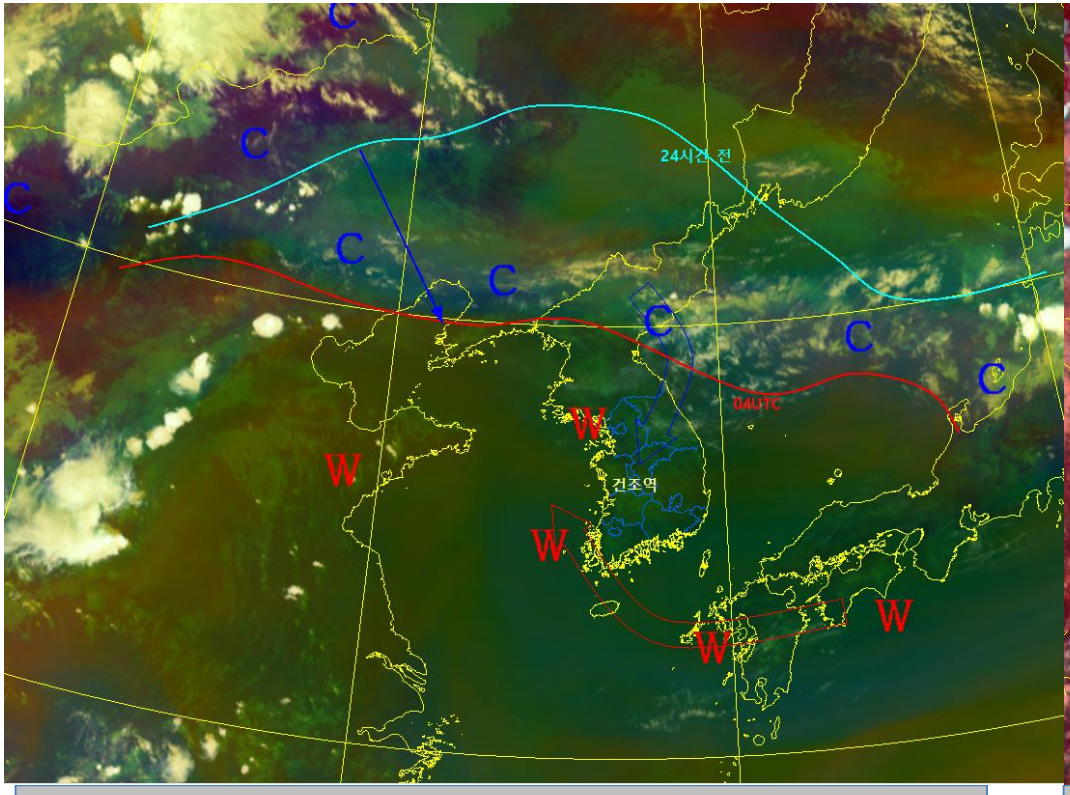
2018. 8. 6. 09:00KST radar echo



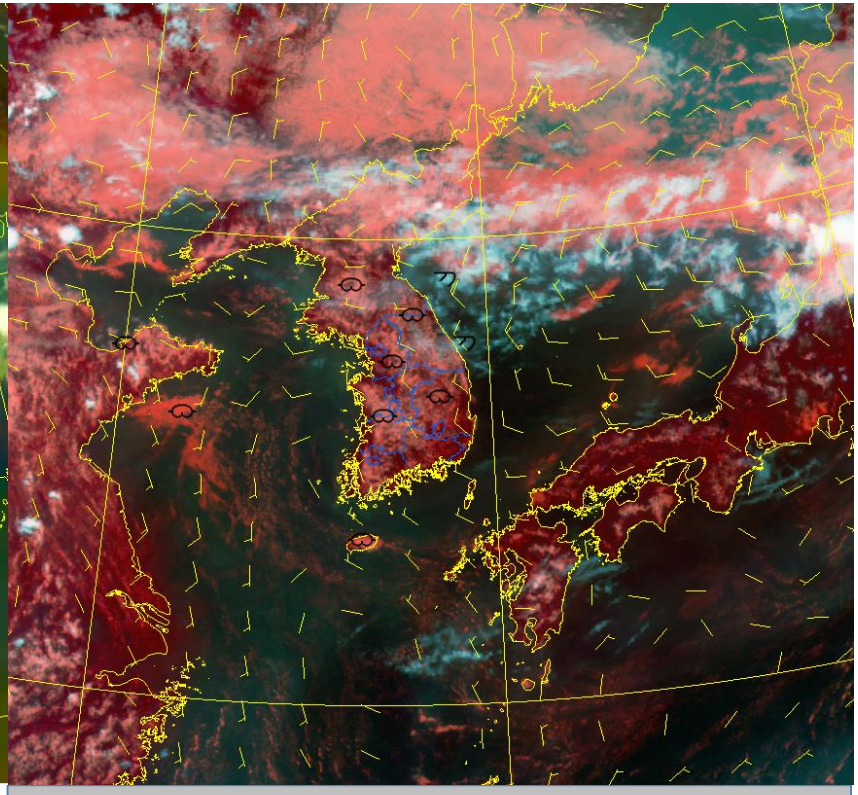
2018. 8. 6. 22:00KST precipitation

- **Radar : 50mm/hr radar echo**
- **AWS precipitation: 292mm/24hr in Shokcho, East costal area**

Cold air Inflow of upper layer



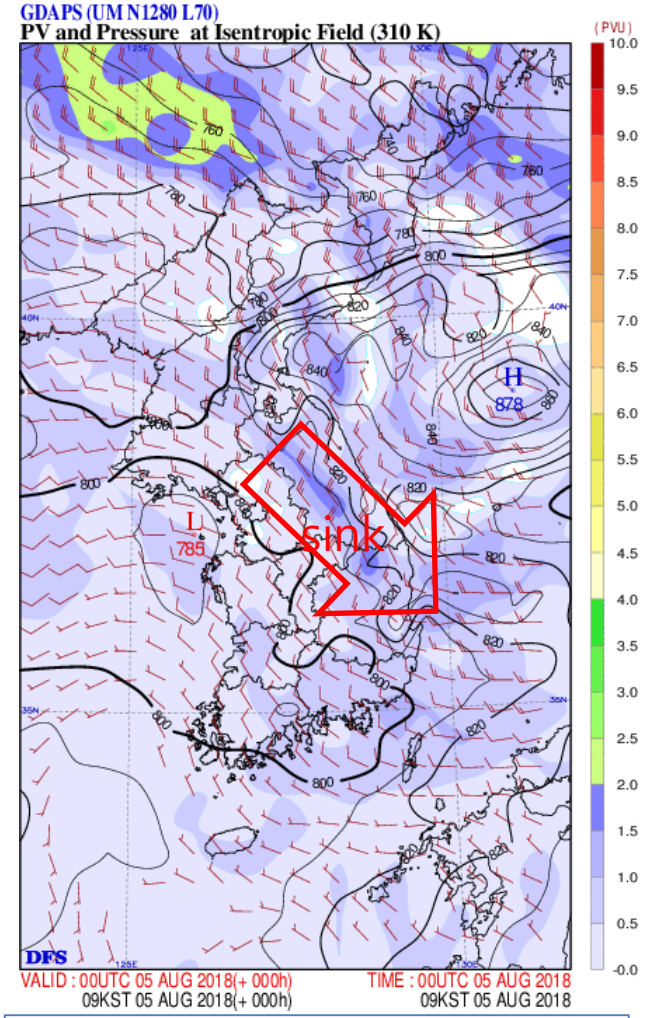
2018. 8. 5. 14:00KST HW8 airmass
+ cold air line(from cyan to red/24hr)



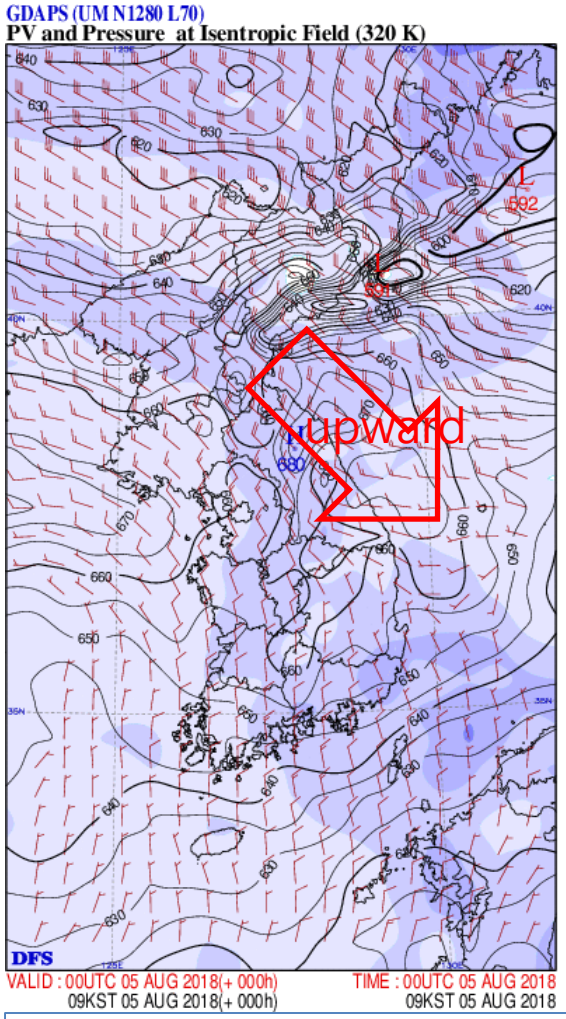
2018. 8. 5. 14:00KST COMS VIS+IR RGB
+ 925hPa wind vector

- Cold air is moving to southward from the N.K. and Warm air is dominant over the S.K. in airmass.
- In the lower level, warm and humid air are inflow from sea to inland of the S.K.
- Cumulus is generating on the S.K. with ground heating

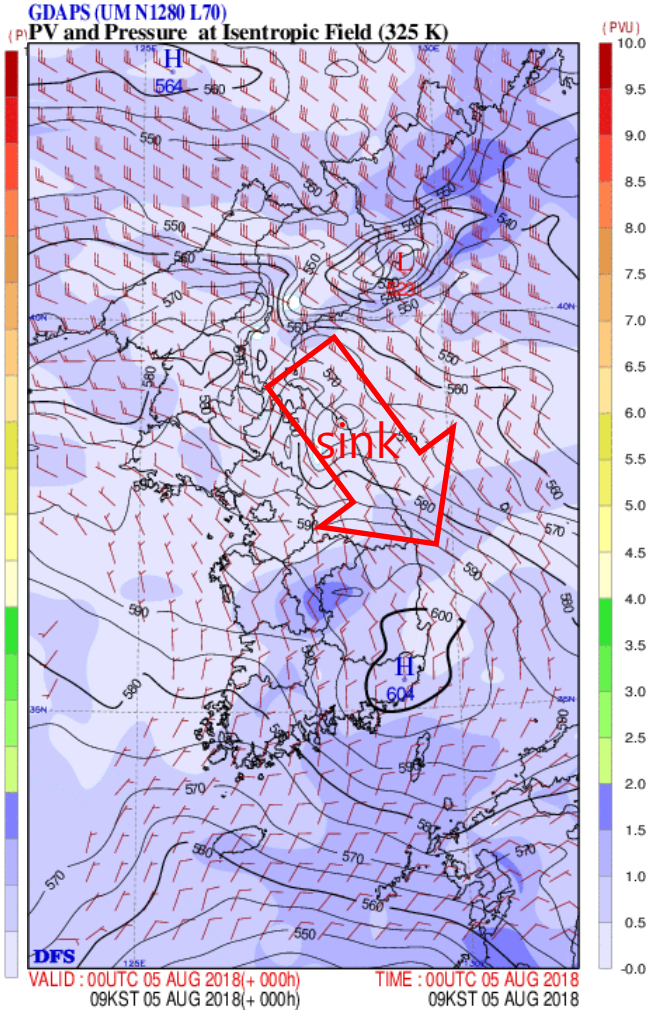
Isentropic surface (2018.8.5. 00UTC)



2018. 8. 5. 09:00KST 310K(Low level)



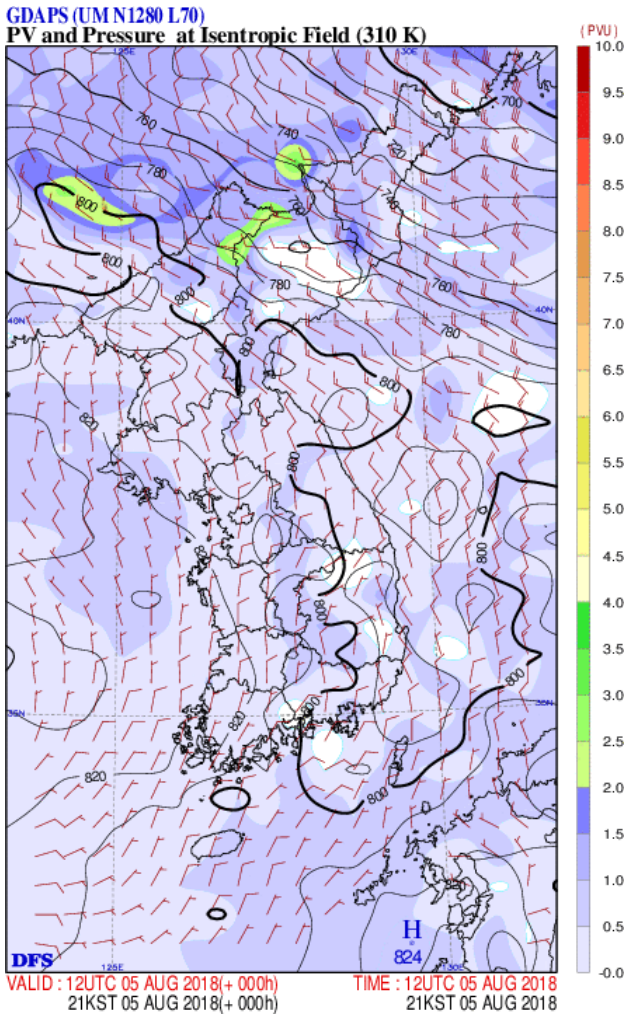
2018. 8. 5. 09:00KST 320K(middle)

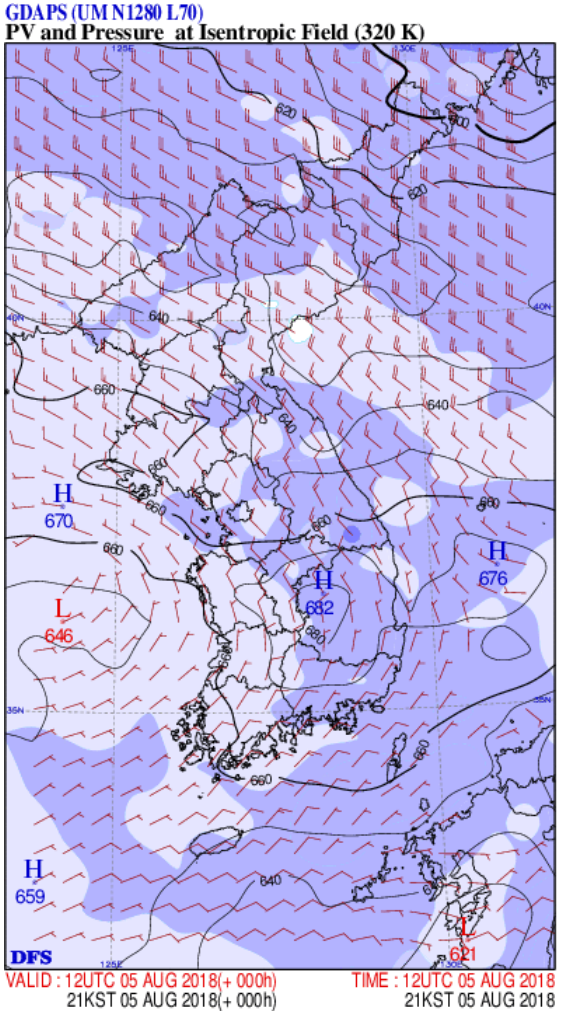


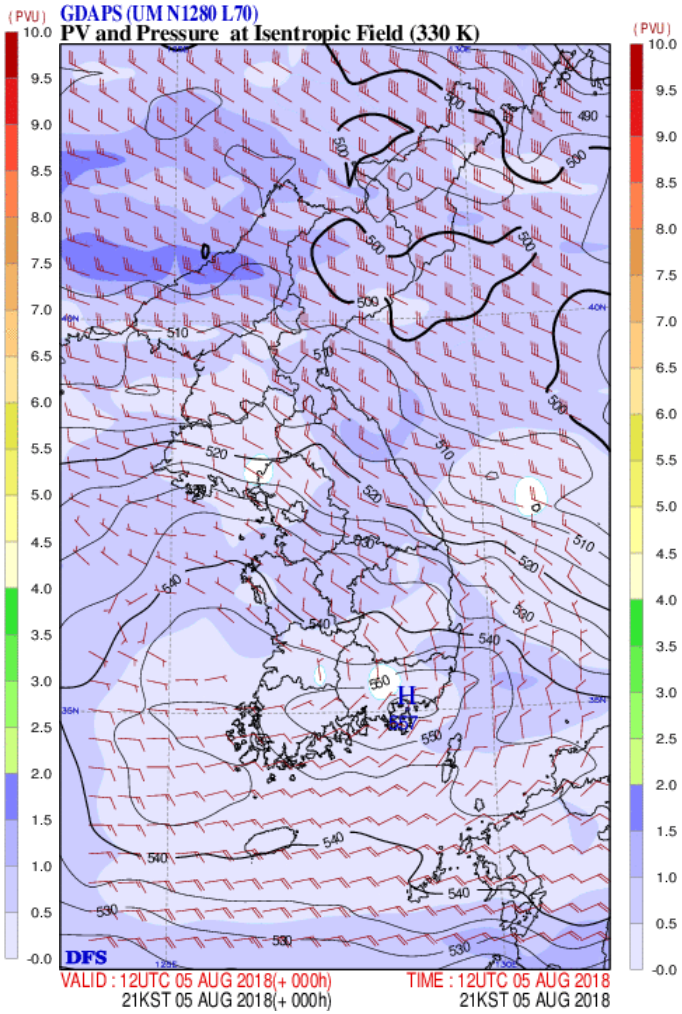
2018. 8. 5. 09:00KST 325K(upper)

- East costal area of S.K. in the lower level: 800->820 sinking motion
- In the middle level: 670->660hPa rising motion
- In the upper level : 560->590hPa sinking motion
- => rising motion around 600hPa, sinking motion over 600hpa , under 2PVU

Isentropic surface(2018.8.5. 12UTC)







2018. 8. 5. 21:00KST 310K(low level)

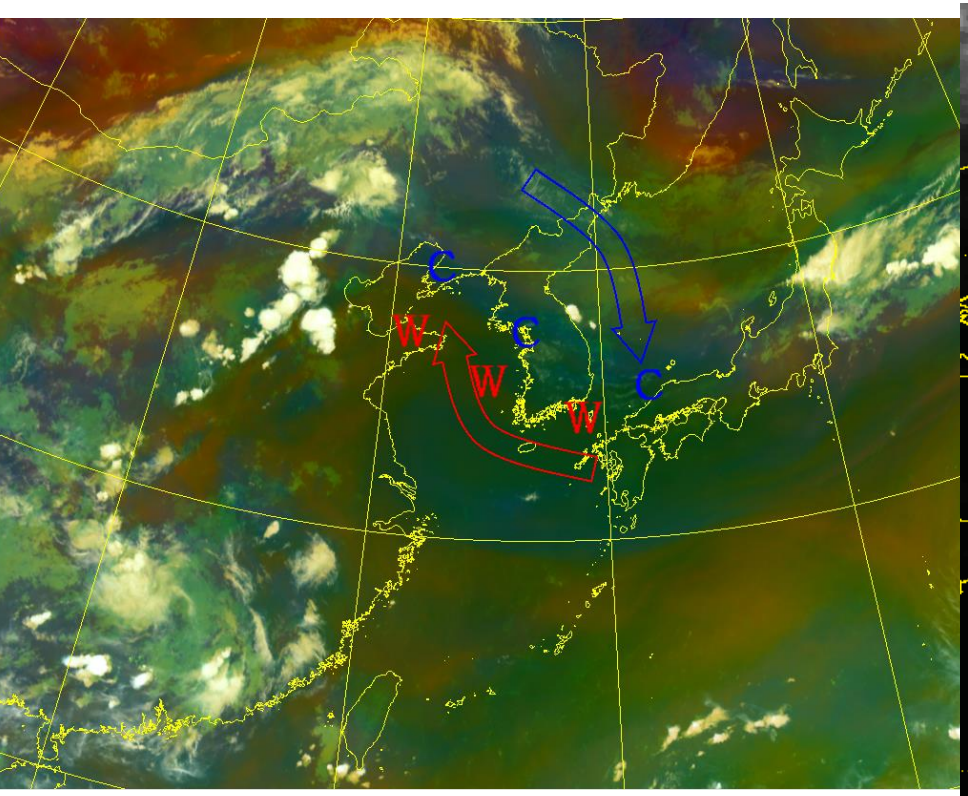
2018. 8. 5. 21:00KST 320K(middle)

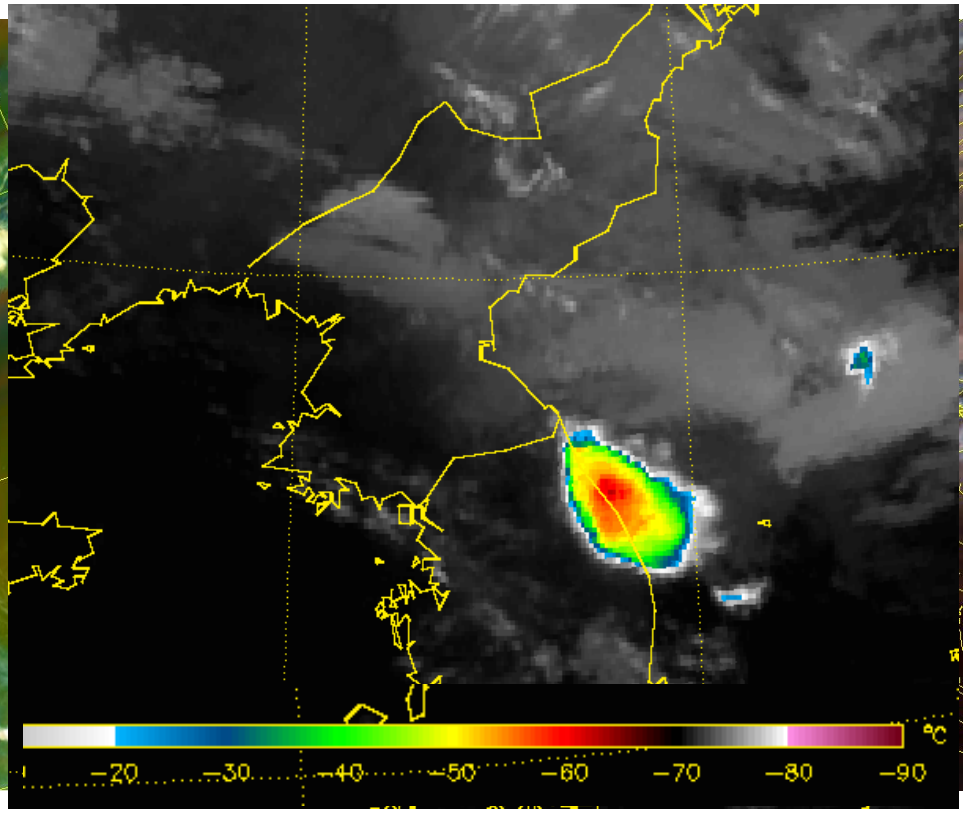
2018. 8. 5. 21:00KST 330K(upper)

- Lower level: 800->820hPa sinking motion
- Middle : 640->660hPa sinking motion
- Upper : 510->540hPa sinking motion
- => sinking motion in all layer of East coastal area of S.K., under 2 PVU

Cold air Inflow of upper layer

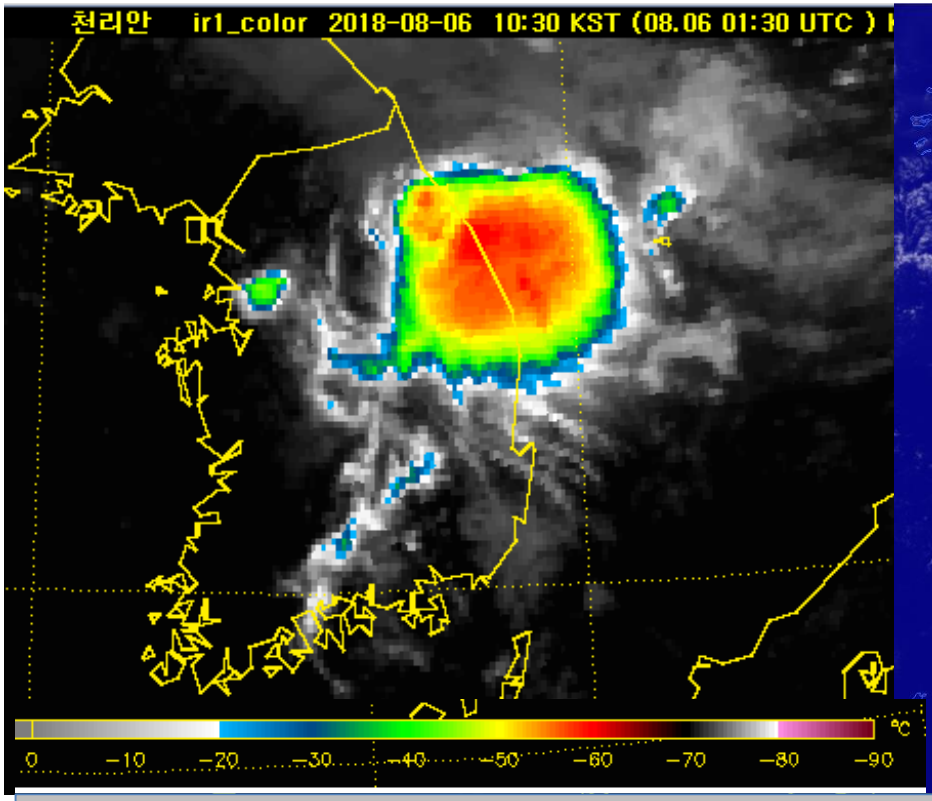
2018. 8. 6. 03KST convective cloud



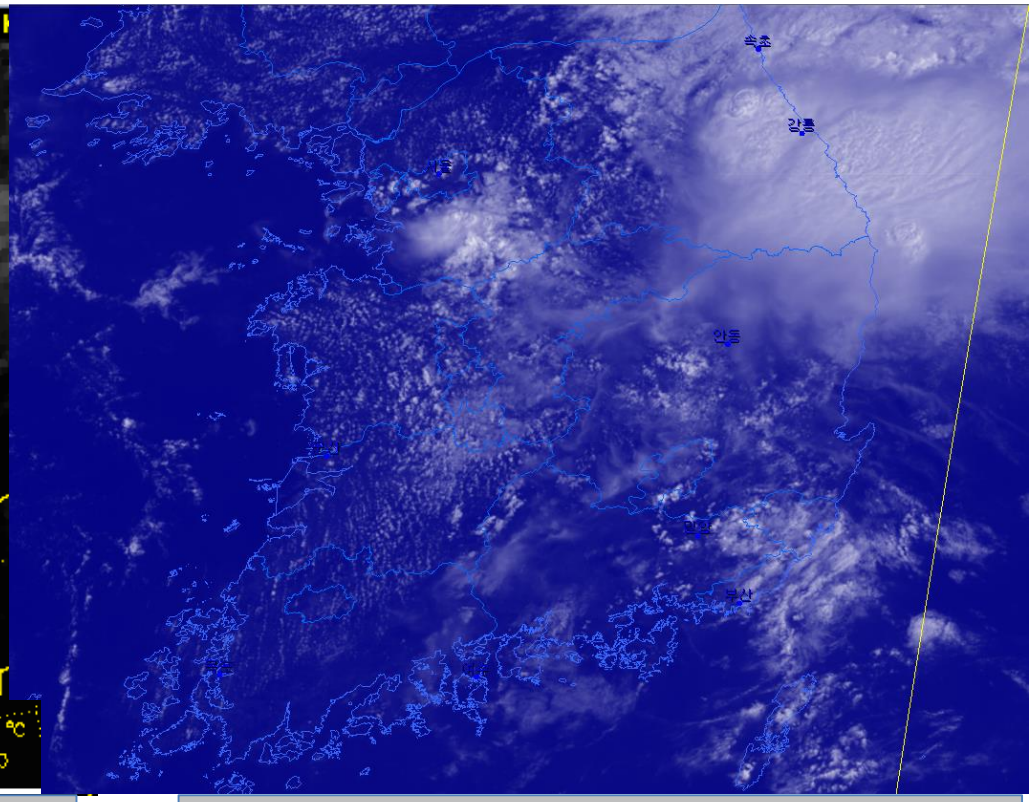


- **Because of cold air inflow, increse of convection, and convective cloud are developed and exploded by dry air pressing behind cold air**
- **Cloud top temperature of cumulonimbus : -55~60℃**

Cumulonimbus



2018. 8. 6. 10:30KST COMS enhanced IR image

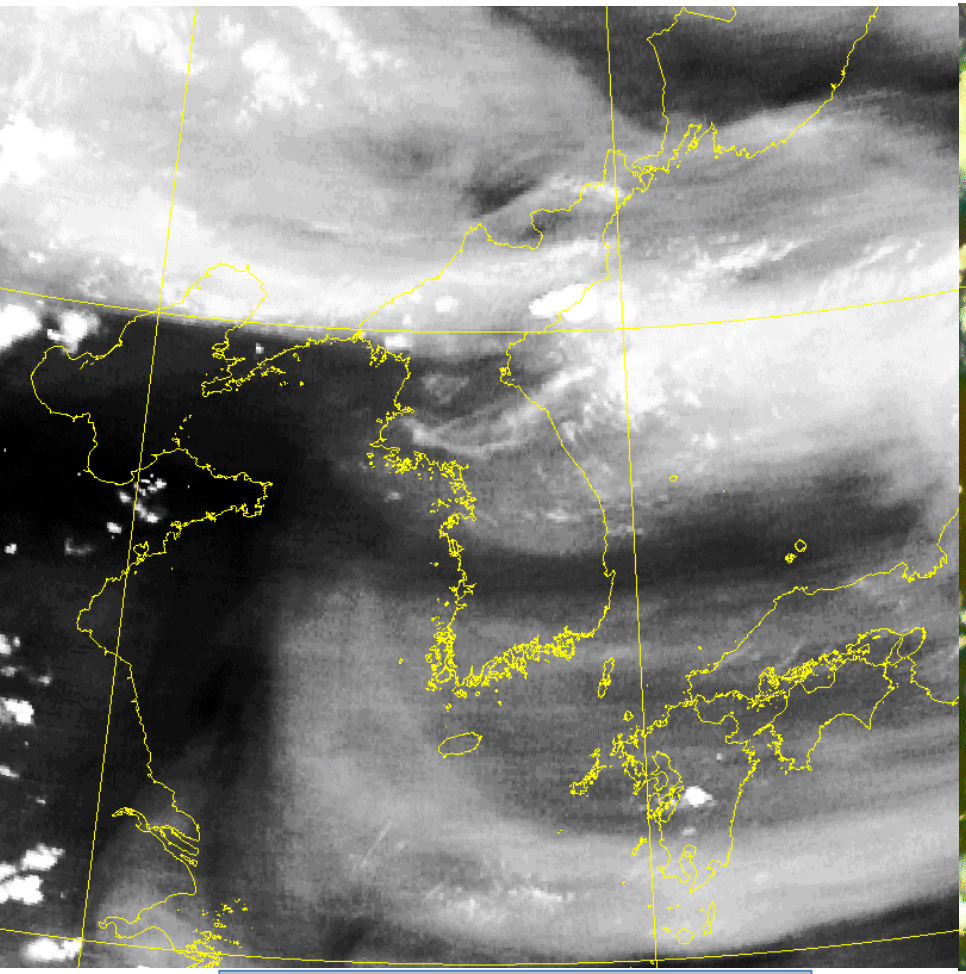


2018. 8. 6. 10:28KST HW8 VIS

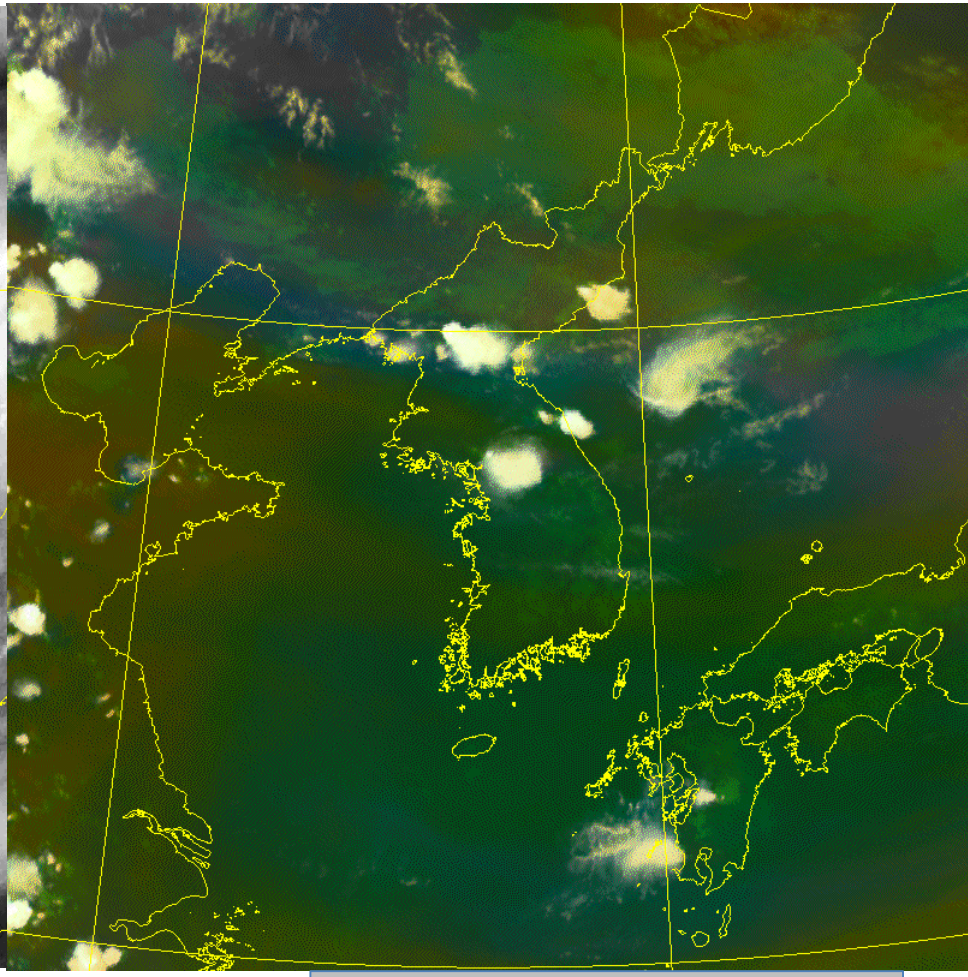
- Cloud top temperature of cumulonimbus : -55~60℃
- Cloud are wider and bigger

Dry air southeastward and upper cold air Southwestward

국가기상위성센터
National Meteorological Satellite Center



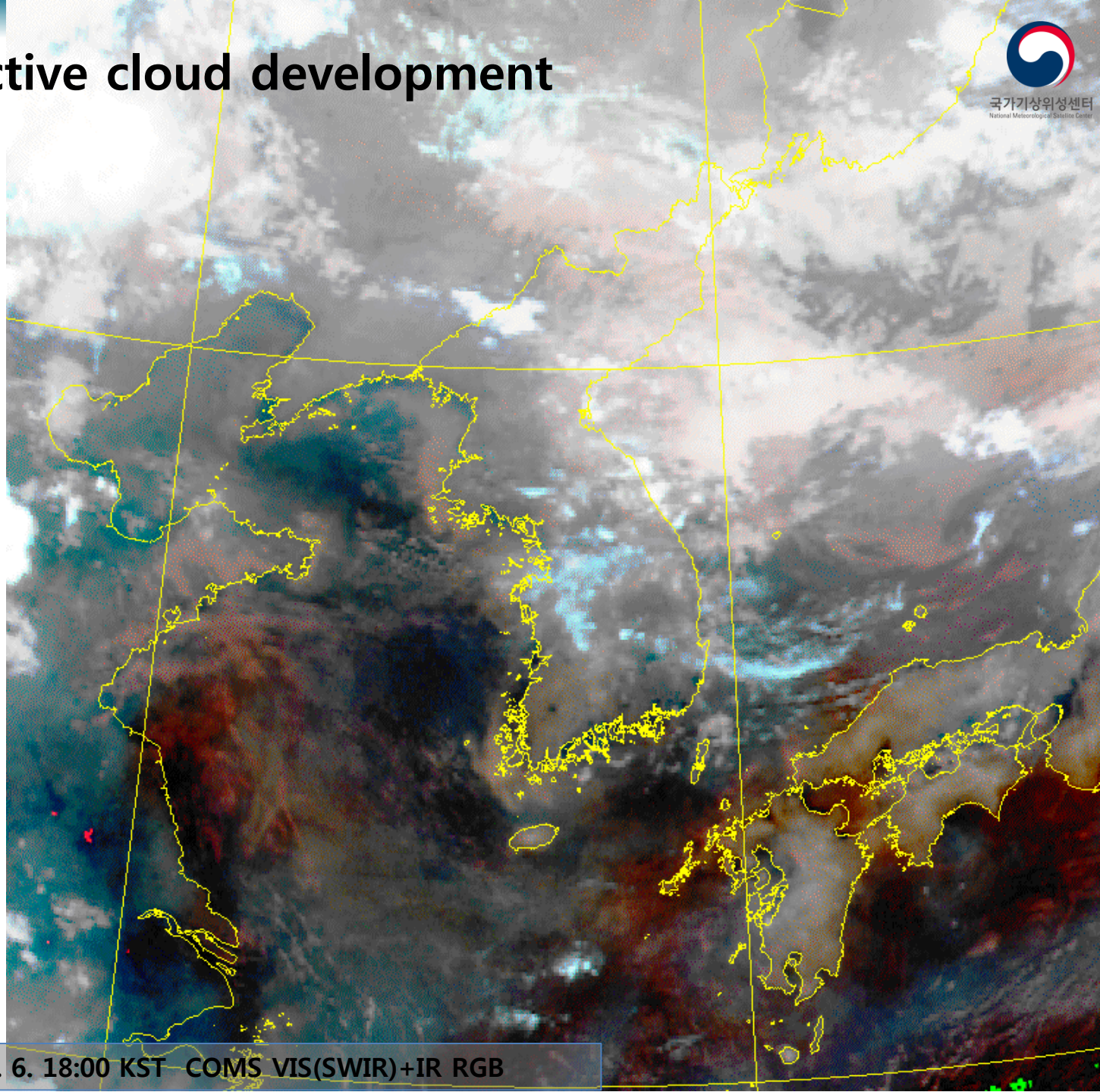
COMS WV



HW8 airmass

2018. 8. 5. 15:00~8. 6. 18:00KST

Convective cloud development



2018. 8. 5. 15:00~8. 6. 18:00 KST COMS VIS(SWIR)+IR RGB

Summary

- Analysis of **cold air inflow, warm air flow, intrusion of dry air, and sinking motion** using color of airmass imagery
- Analysis of **trough, ridge, jet stream, deformation zone, and etc.** using color of airmass imagery
- Airmass RGB imagery is effective in **detecting PV anomalies associated with the generation of cyclone**
- Possible to trace the cause of cloud generating as following the upper cold air
- Analysis of the cause of convective development by watching the boundaries between cold air and dry air

Thank you

National Meteorological Satellite Center/ KMA