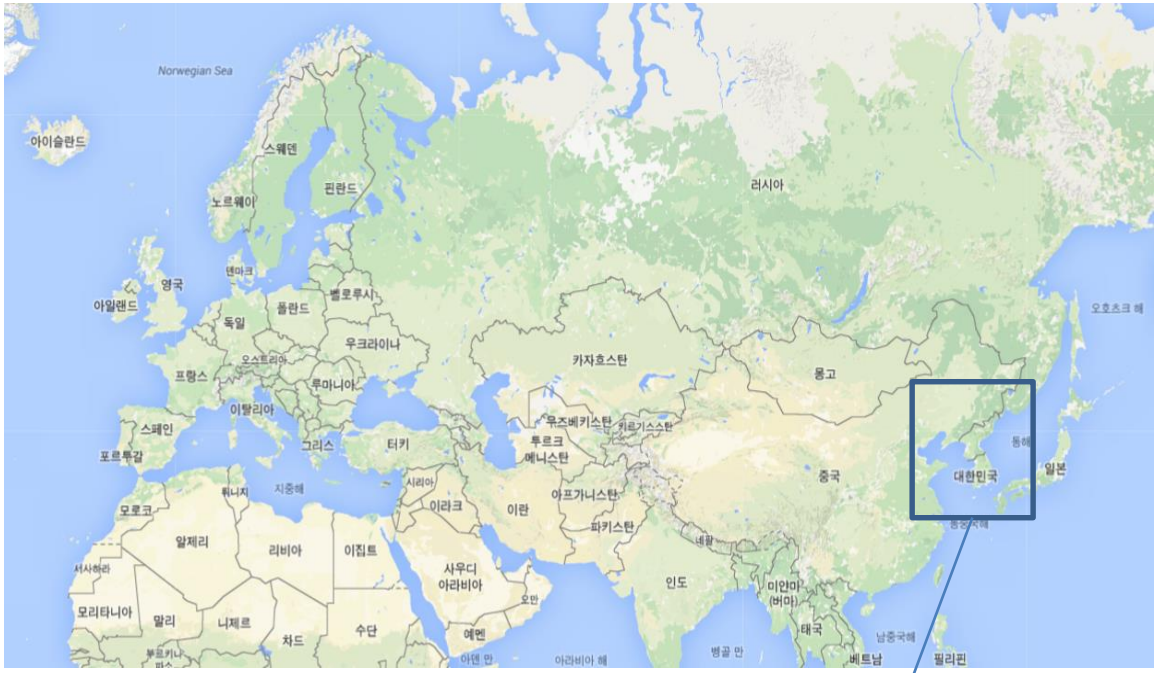
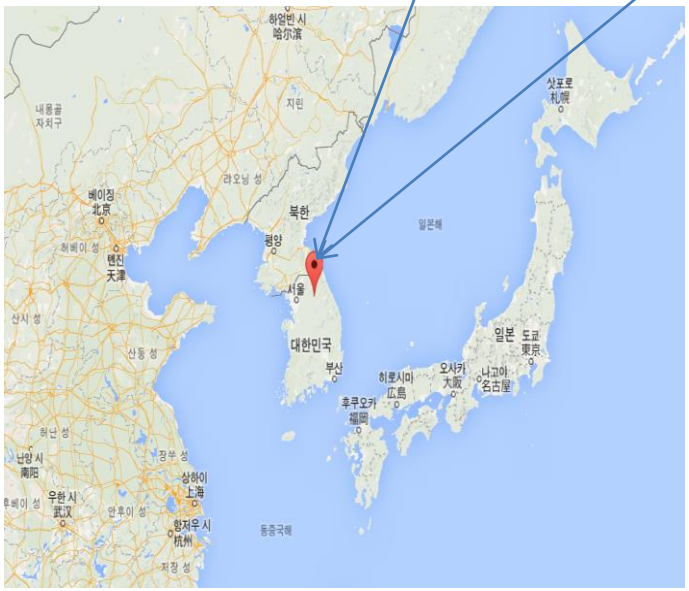
Monitoring Convective cloud with COMS at KMA

National Meteorological Satellite Center/KMA
Eunha Sohn





I am Eunha Sohn at NMSC/KMA

National Meteorological Satellite Center

국가기상위성센터
National Meteorological Satellite Center

KMA/NMSC

1. Organization & Personnel

- New organization (since April 30, 2009)
- 3 divisions and 43 employees

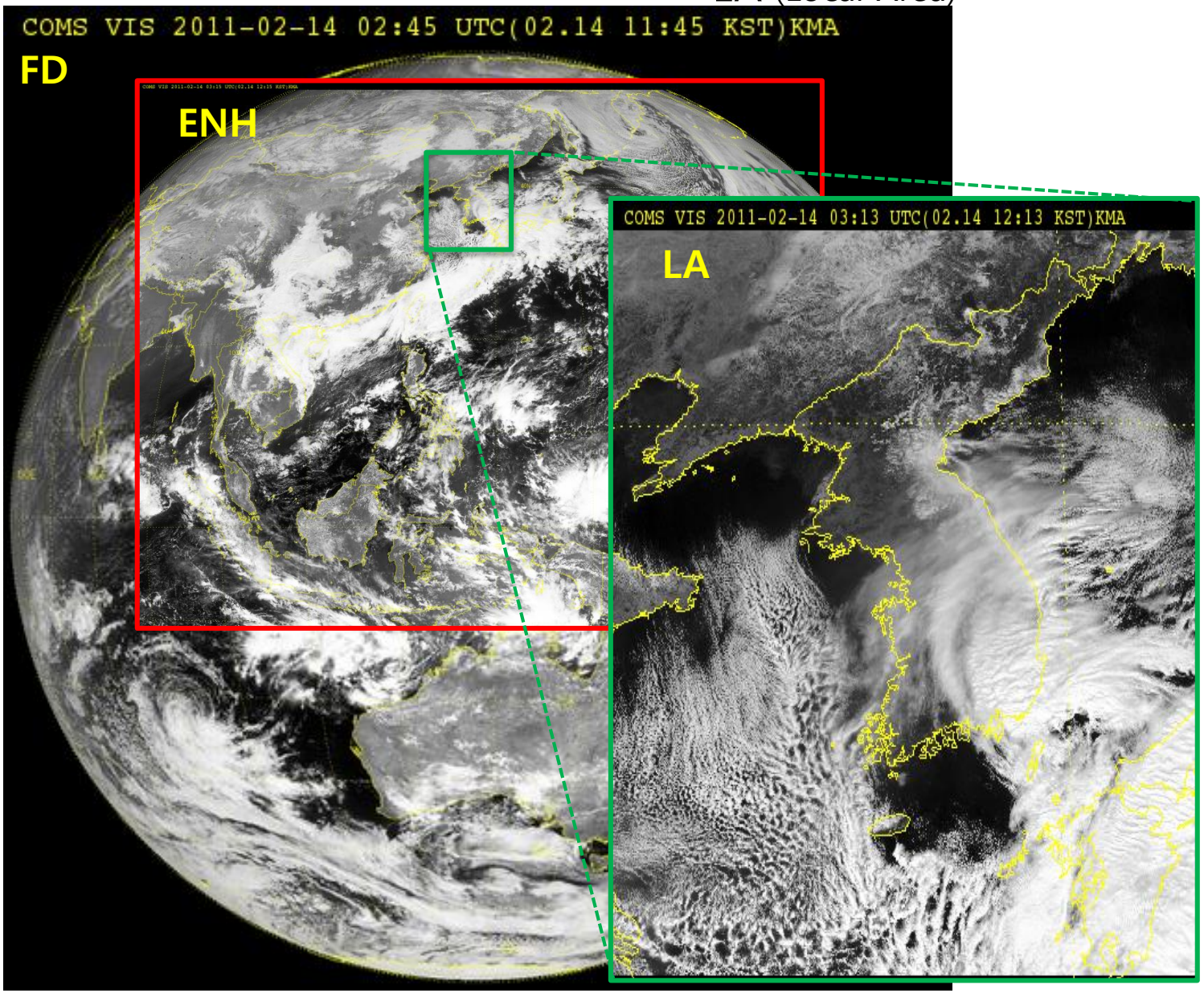
	Satellite planning division	Satellite operation division	Satellite analysis division
Current(43)	16	15	12

2. Missions

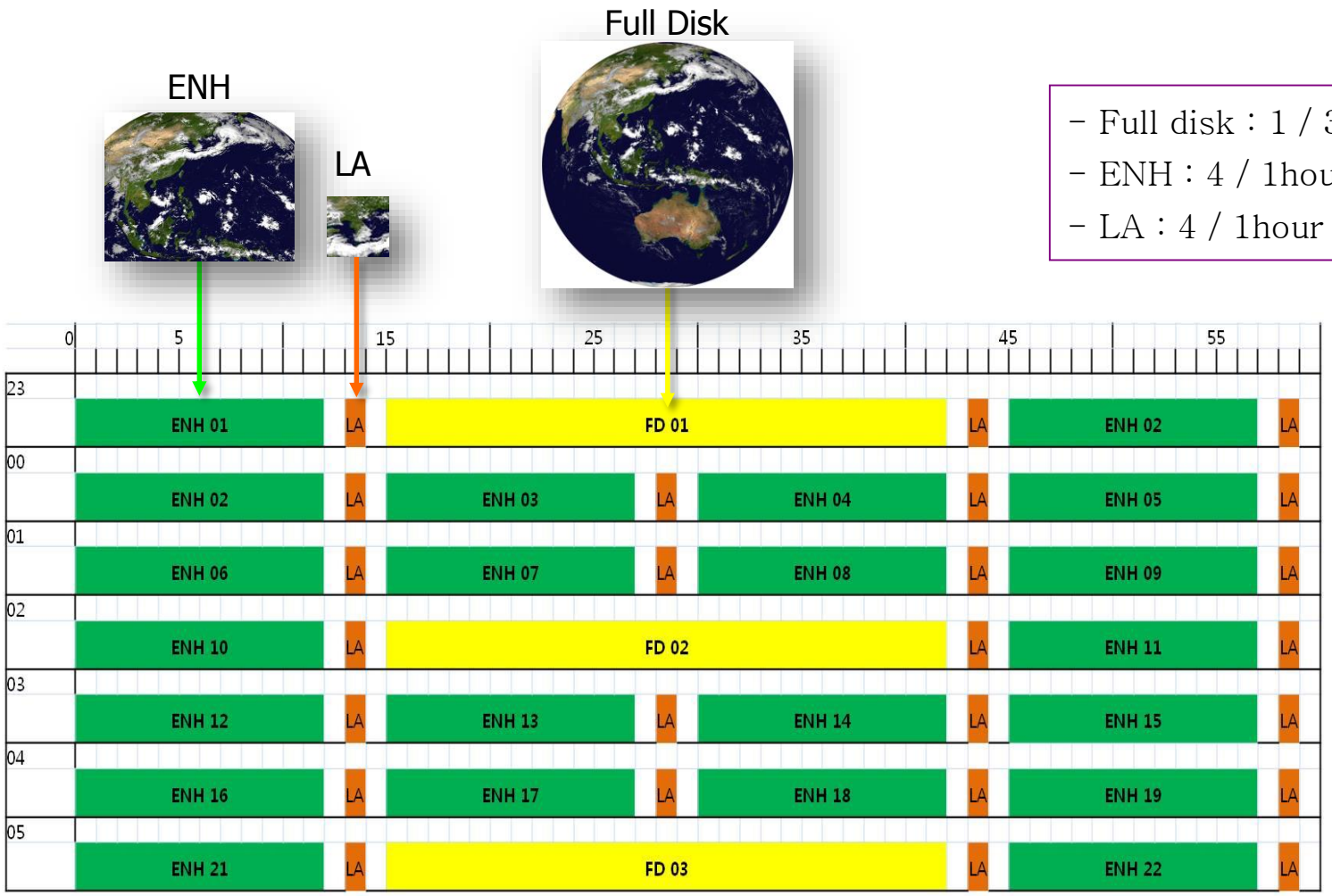
- Meteorological Satellite Development & Operation
- Foreign Satellite Data Reception/ Process/Analysis/Distribution
- Real-time Analysis and Service of Meteorological Satellite Data
- International and Nationwide Cooperation in Meteorological Satellite

COMS OBS. Modes

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



COMS Obs. schedule



- Full disk : 1 / 3 hours
- ENH : 4 / 1hour
- LA : 4 / 1hour

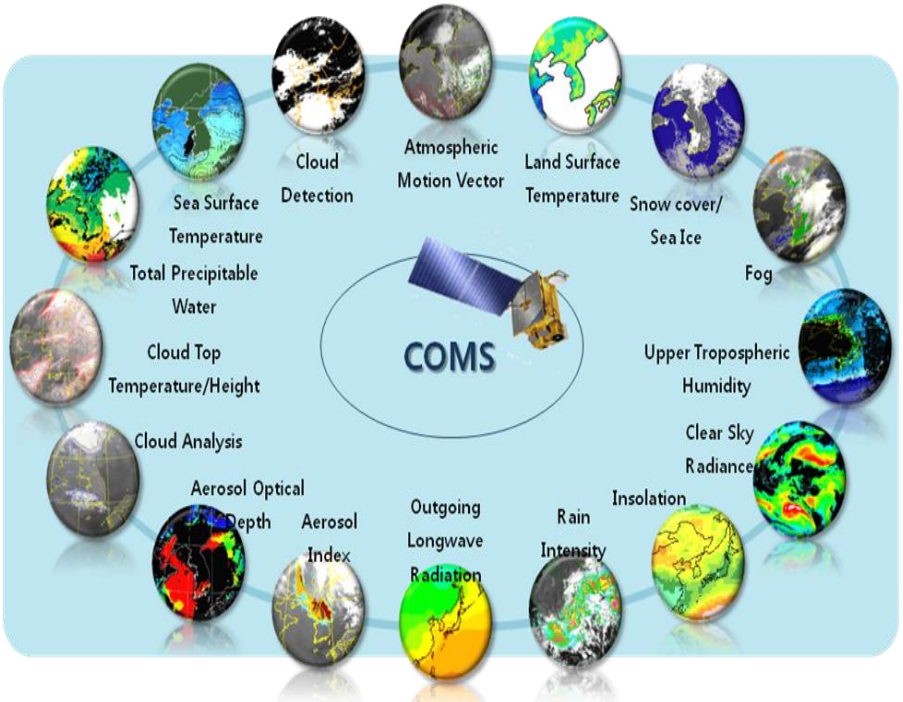
- COMS MI produces FD image every 3 hours and ENH image every 15 minutes
- LA image can be obtained between ENH and FD

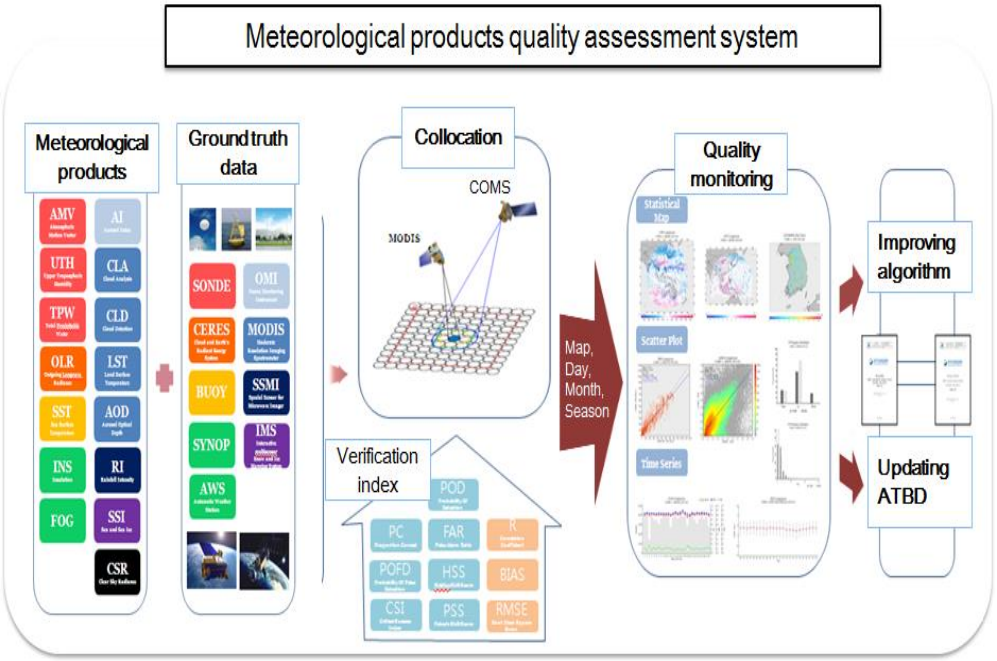
Characteristics of COMS observation

- COMS observation schedule focus on supporting now-casting weather service.
  - ✓ It was designed for frequent observation, 4 times (00, 15, 30, 45min.) an hour over ENH region.
- Especially, NMSC/KMA can obtain 8 times an hour satellite data over Korea Peninsular (KP).
  - ✓ It is significantly effective to monitor heavy rain producing convective cloud which develops locally or is coming from west sea of KP during summertime.
- We can get more distinctive satellite images over KP with COMS .
  - ✓ Since COMS is located at 128.2E, COMS image has smaller shadow area and lower SZA over KP for MTSAT image.

COMS 16 products

- COMS public service started officially on April 1, 2011.
- COMS 16 secondary products has been produced operationally by CMDPS(COMS Meteorological Data Processing System).
- All of COMS secondary products are validated with ground based observation data or polar orbit satellite derived products etc. and reported periodically.





COMS Products for monitoring convective cloud (1)

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National Meteorological Satellite Center

❖ COMS WV RGB images
- Every 15 mins over ENH region from COMS

❖ Monitoring WV AMV and NWP PV changes

❖ Monitoring NWP instability and TB of WV – IR

❖ RDT (Rapid Developing Thunderstorm) :
- Every 15 mins over ENH region from COMS
- Developed by EUMETSAT NWCSAF
- Provides the direction and velocity of movement of convective cell

❖ COMS Convective RGB images

❖ Cloud Type, Cloud Top Temperature/Pressure
- Every 15 mins over ENH region from COMS

COMS Products for monitoring convective cloud (2)

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National Meteorological Satellite Center

QPE from COMS

❖ COMS RI (Rainfall Intensity, mm/h) :

- Every 15 mins over ENH region
- PMM (Probability Matching Method(Atlas et al (1990) & Crosson et al (1996))
- SSMI/DMSP RR(Rainfall Rate, mm/h)

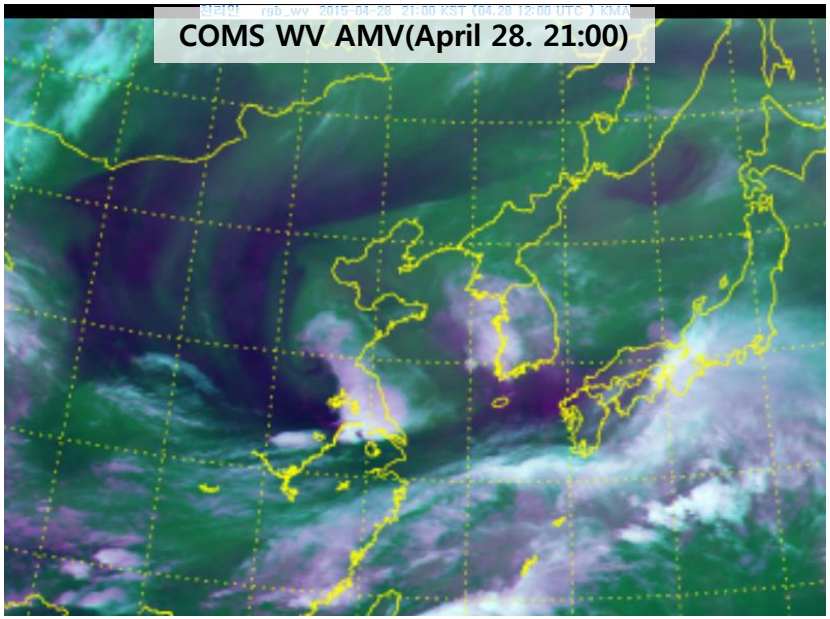
$$\int_{R_t}^{R_i} P(R)dR = \int_{BTT_t}^{BTT_i} P(BTT)dBTT$$

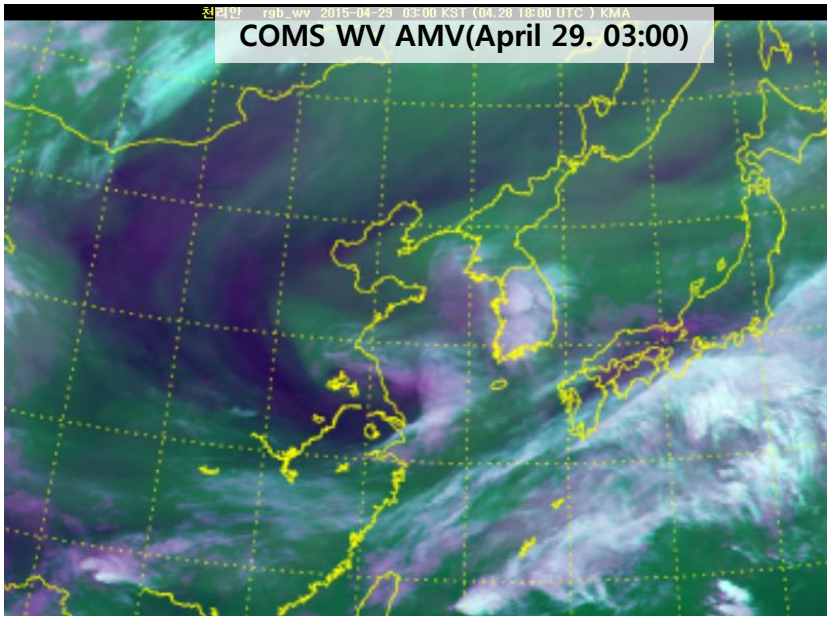
✓ R : SSMI RR, BTT : COMS IR brightness temperature
✓ SSMI RR /DMSP F13-F15(25km X 25 km) about 20 times a day observing over ENH region

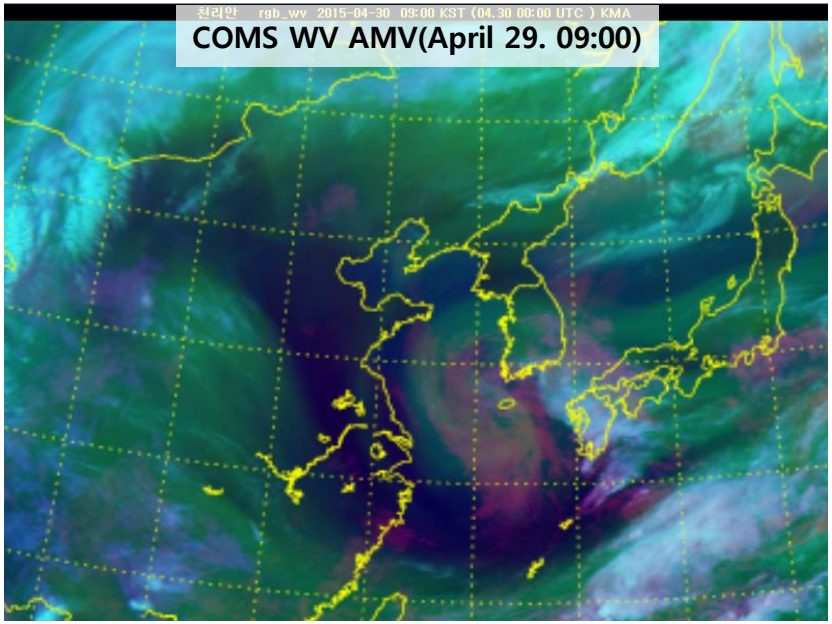
❖ COMS CRR (Convective Rainfall Rate, mm/h) :

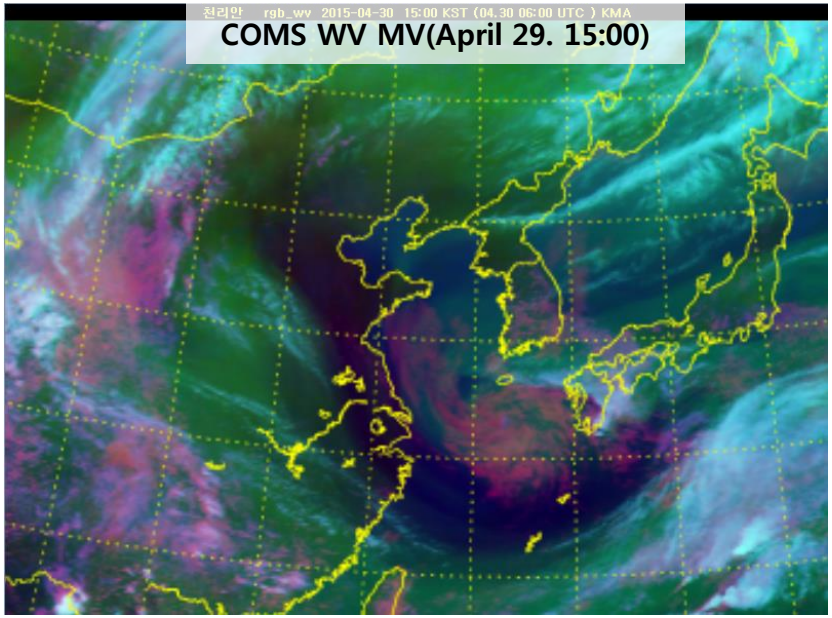
- Every 15 mins over ENH region
- Developed by EUMETSAT NWCSAF using LUT between IR Tb and radar rain rate
- Estimated for convective cloud with radar reflectivity of greater than 35 dBz
- Corrected for orographic effect, lightning, moisture, etc.

❖COMS WV RGB images



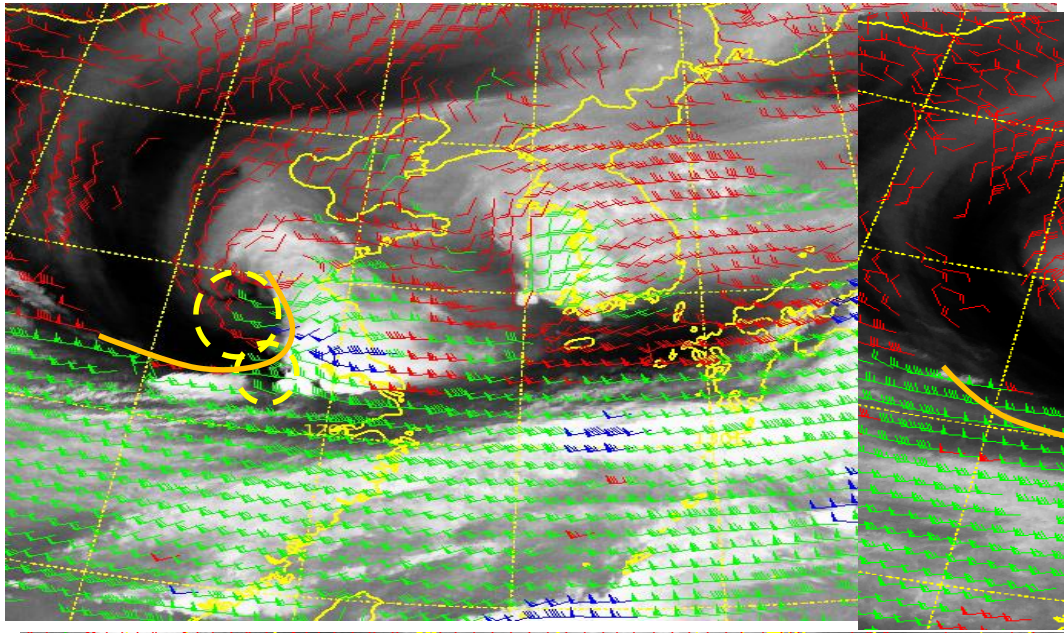




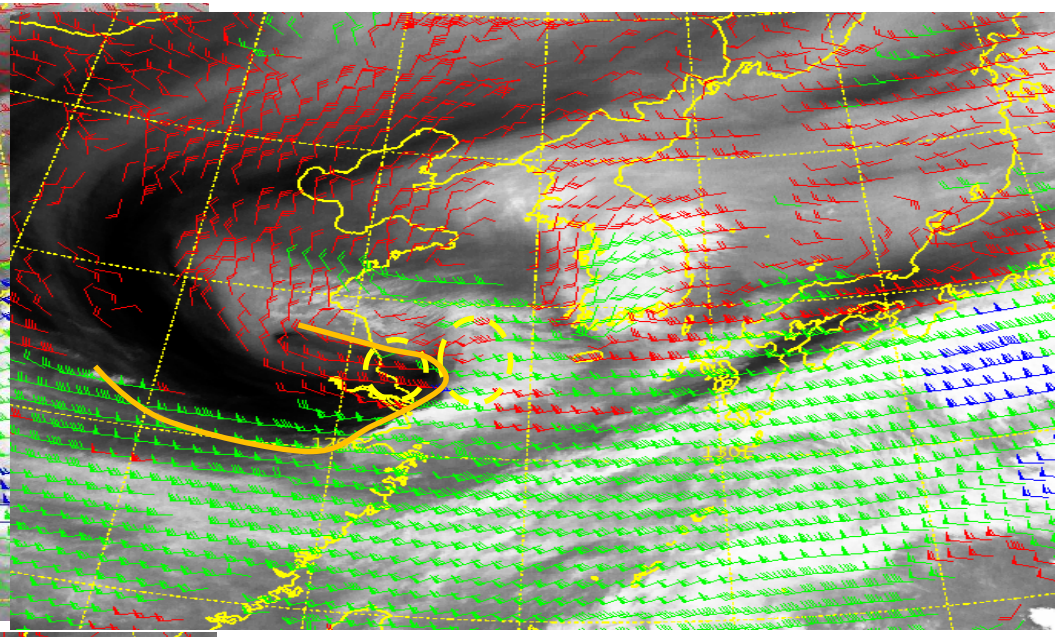


COMS WV AMV

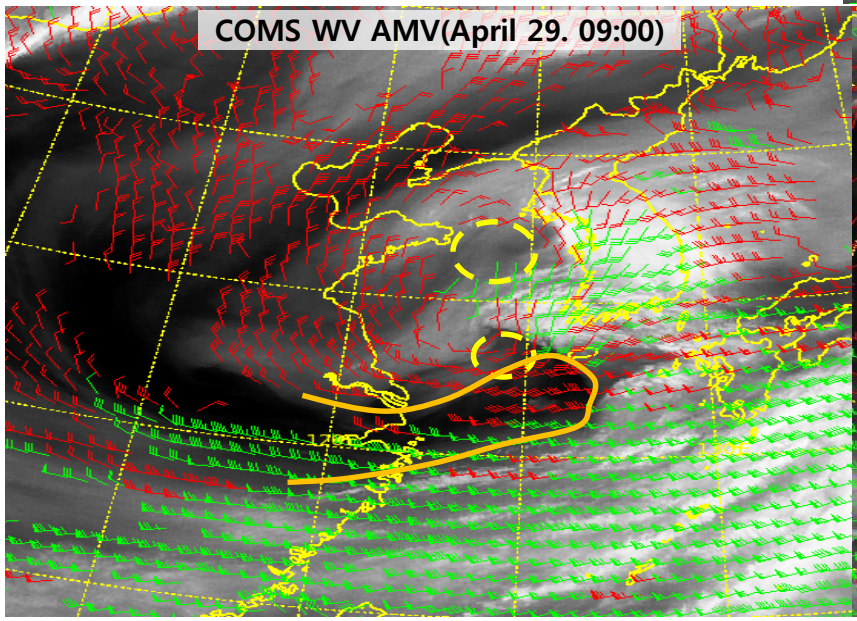
COMS WV AMV(April 28. 21:00)



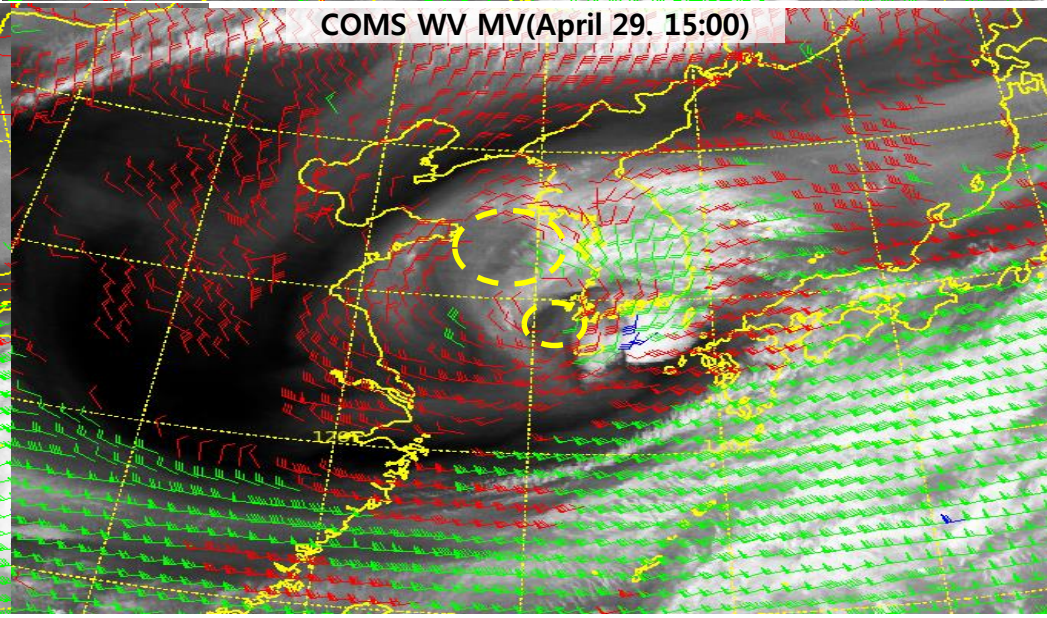
COMS WV AMV(April 29. 03:00)



COMS WV AMV(April 29. 09:00)



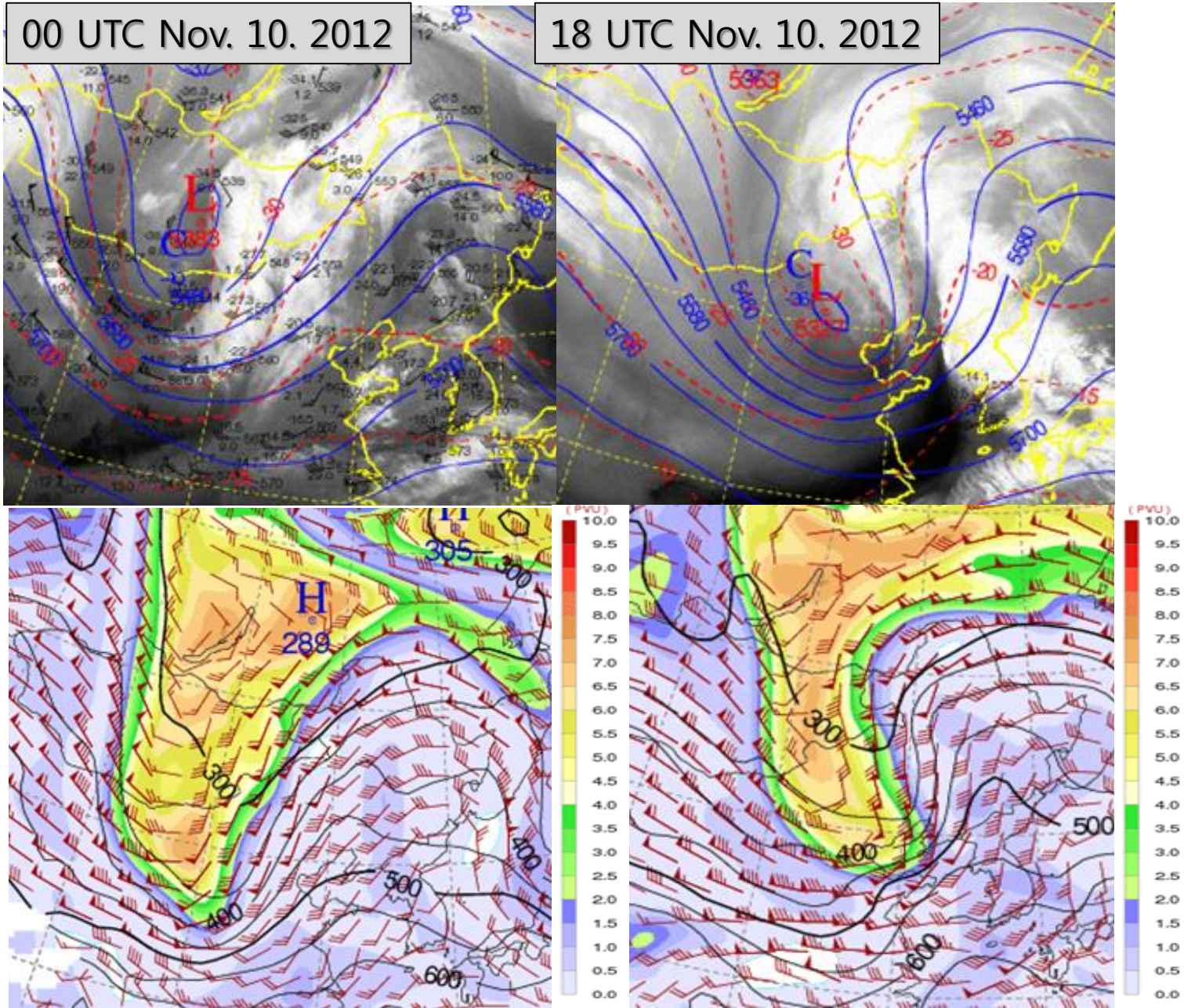
COMS WV MV(April 29. 15:00)



NWP PV changes

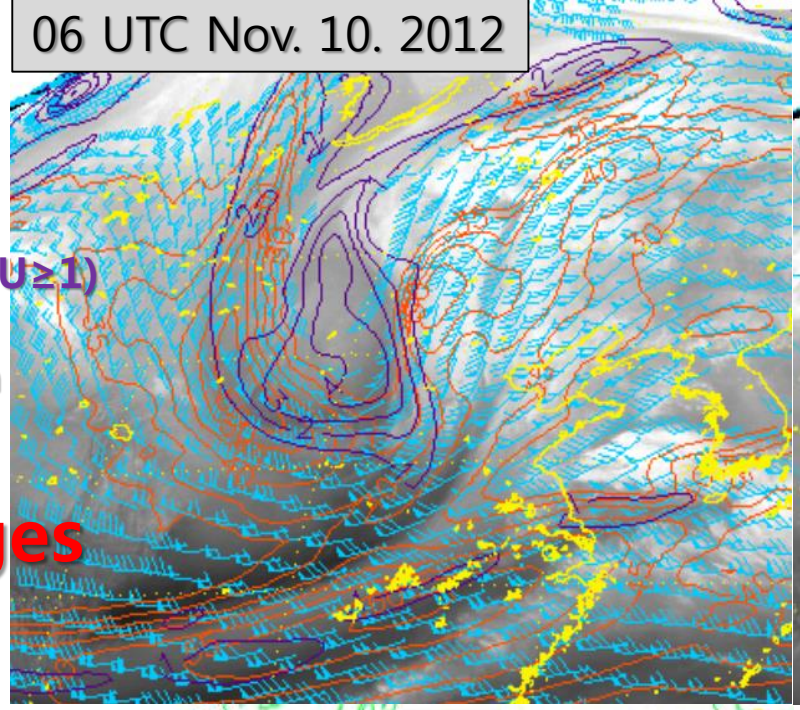
500 hPa

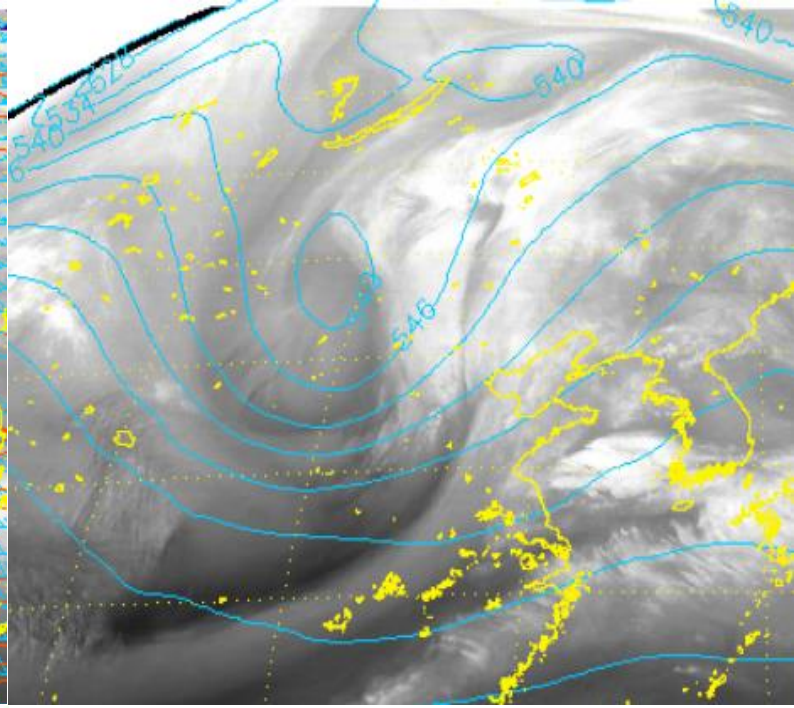
PV
At 310K
theta surface



06 UTC Nov. 10. 2012

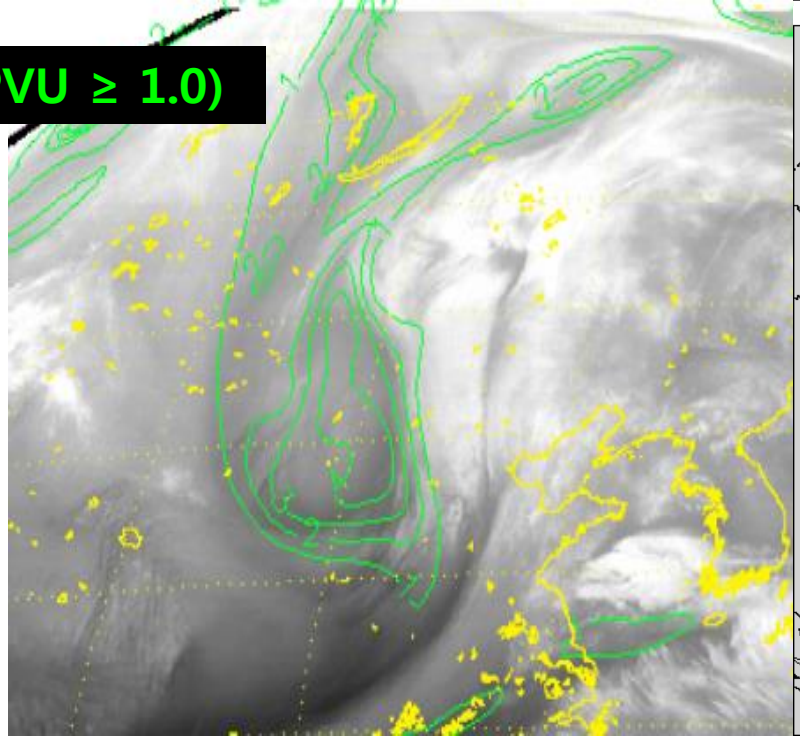
400 hPa PV (PVU≥1)
400 hPa Wind
400 hPa isotach

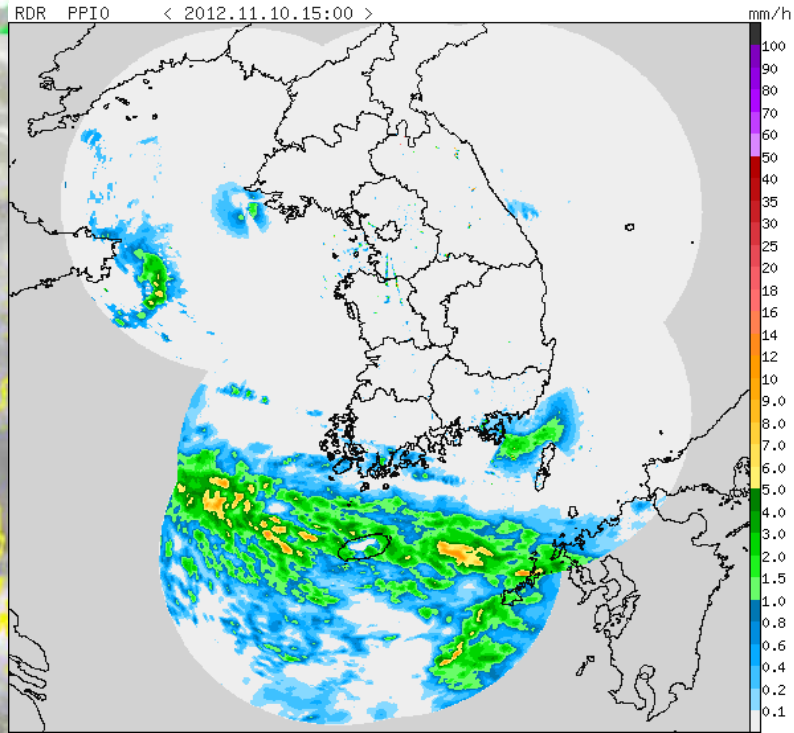




PV Changes

400 hPa PV (PVU ≥ 1.0)

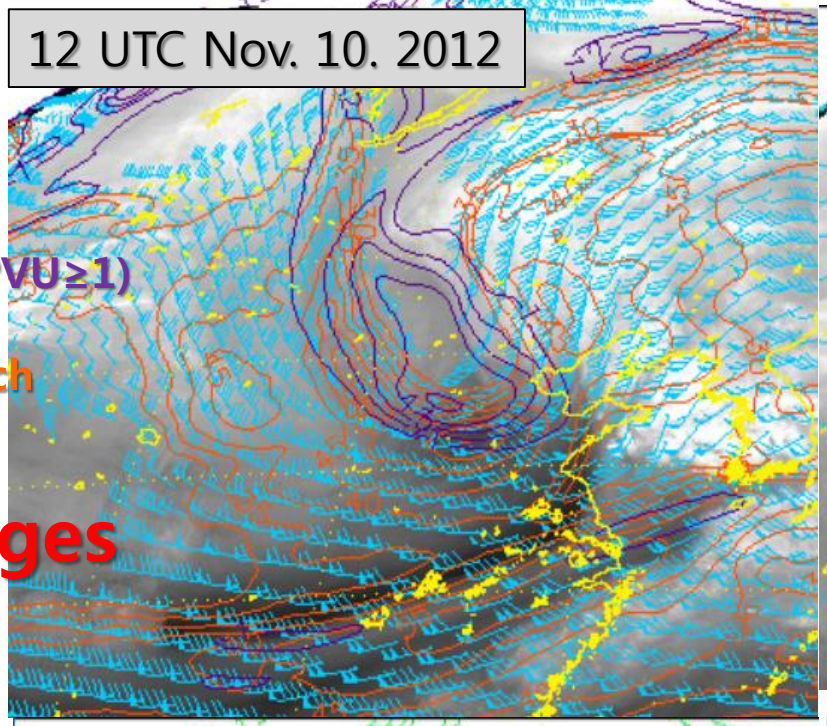


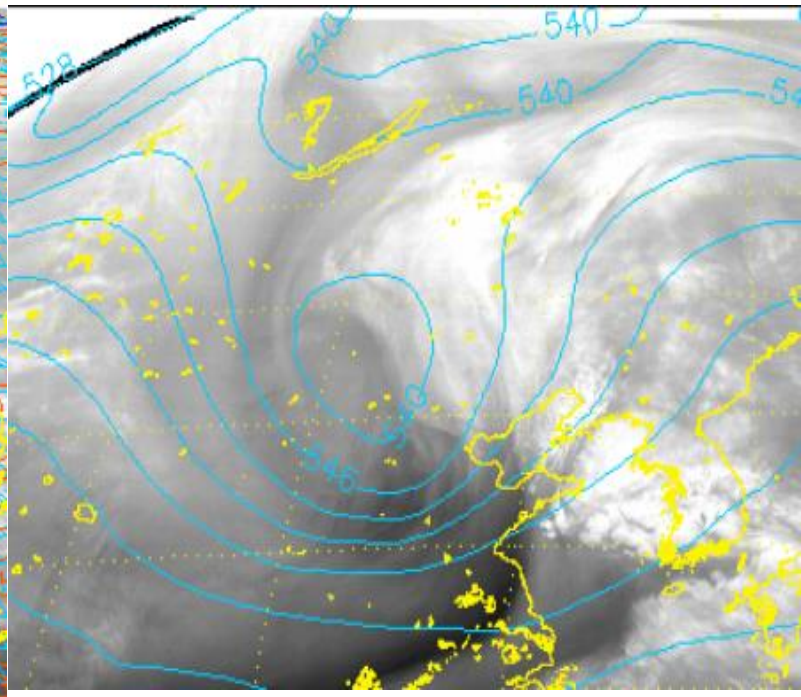


12 UTC Nov. 10. 2012

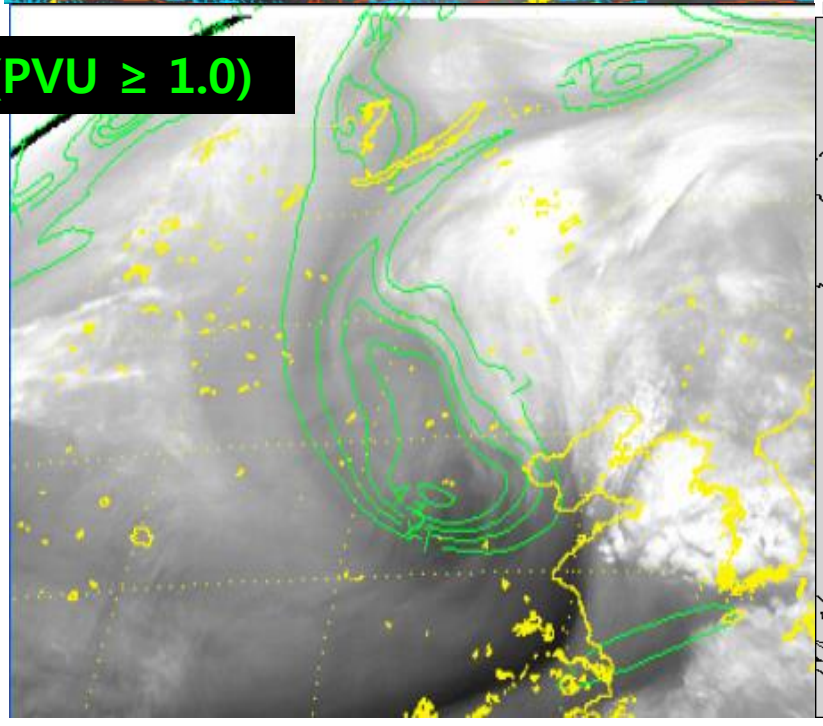
400 hPa PV (PVU≥1)
400 hPa Wind
400 hPa isotach

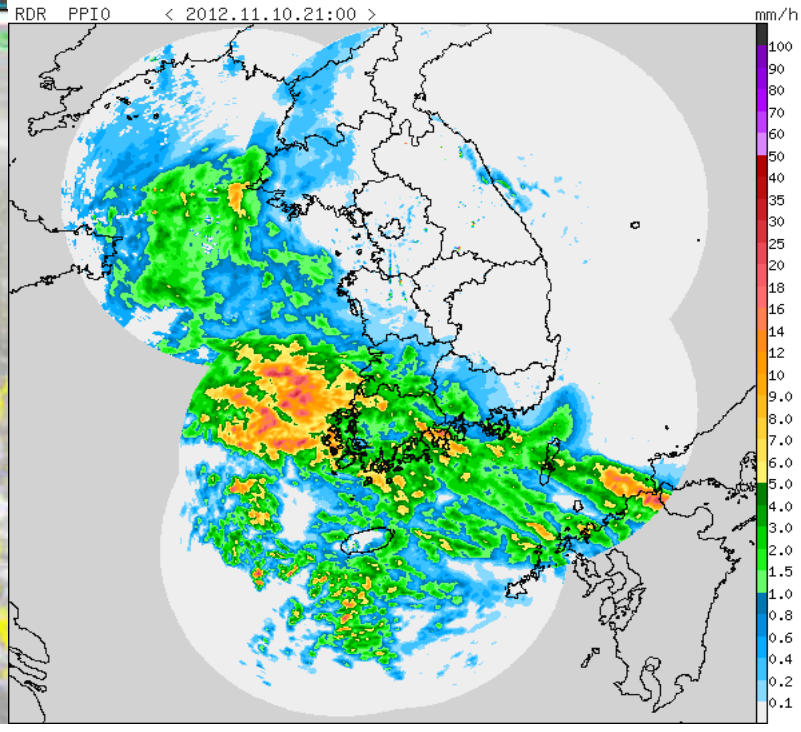
PV Changes





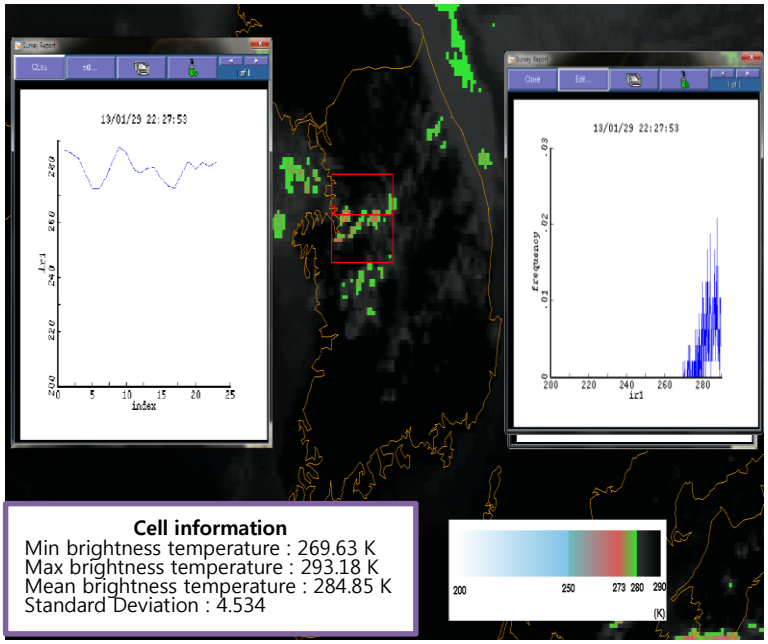
400 hPa PV (PVU ≥ 1.0)





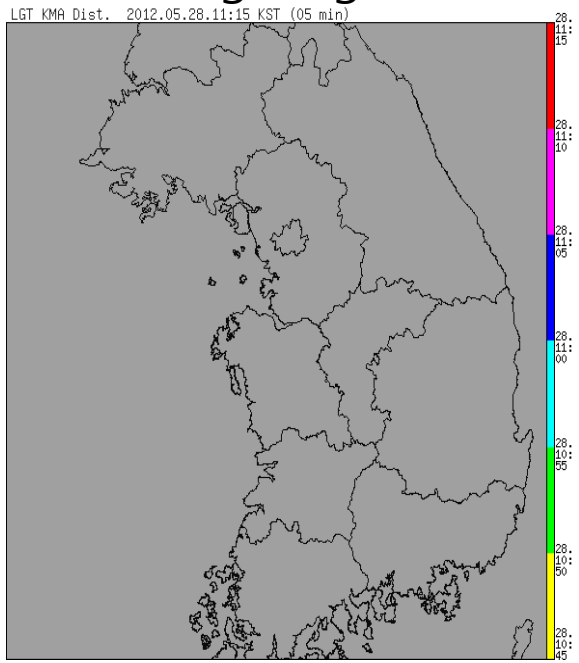
Monitoring WV - IR

0215UTC(t-60)

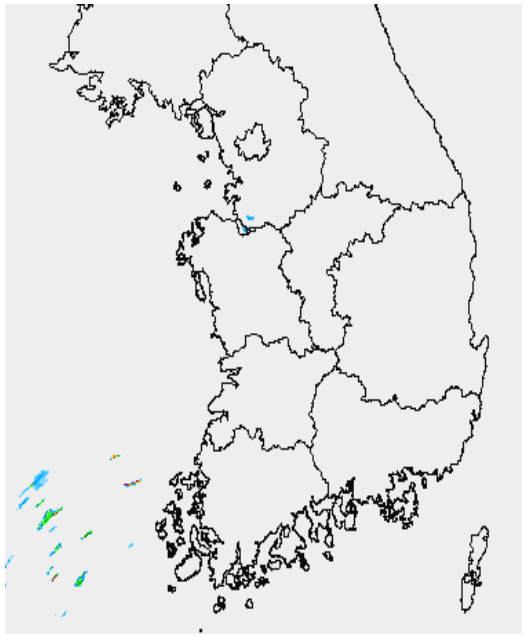


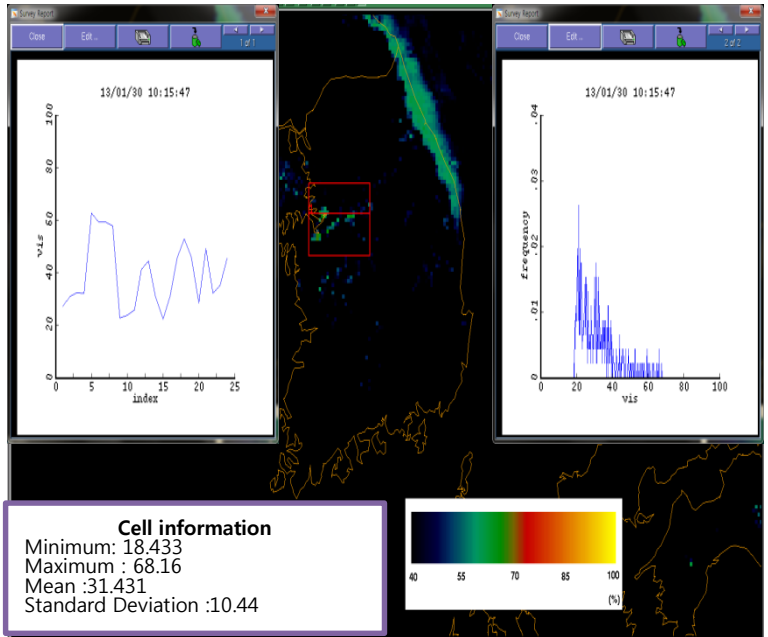
Cell information
Min brightness temperature : 269.63 K
Max brightness temperature : 293.18 K
Mean brightness temperature : 284.85 K
Standard Deviation : 4.534

Lighting



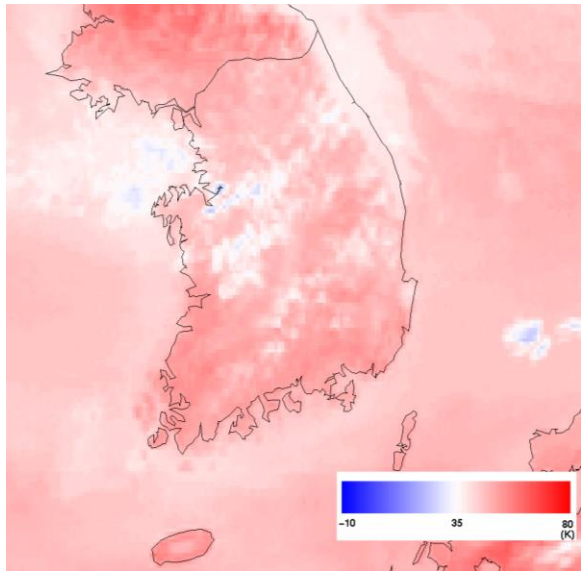
Radar Rain Rate





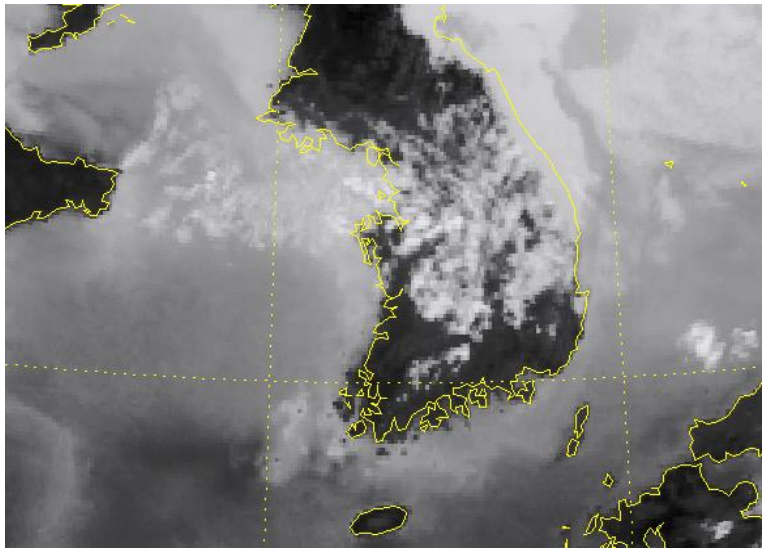
Cell information
Minimum: 18.433
Maximum : 68.16
Mean :31.431
Standard Deviation :10.44

WV - IR

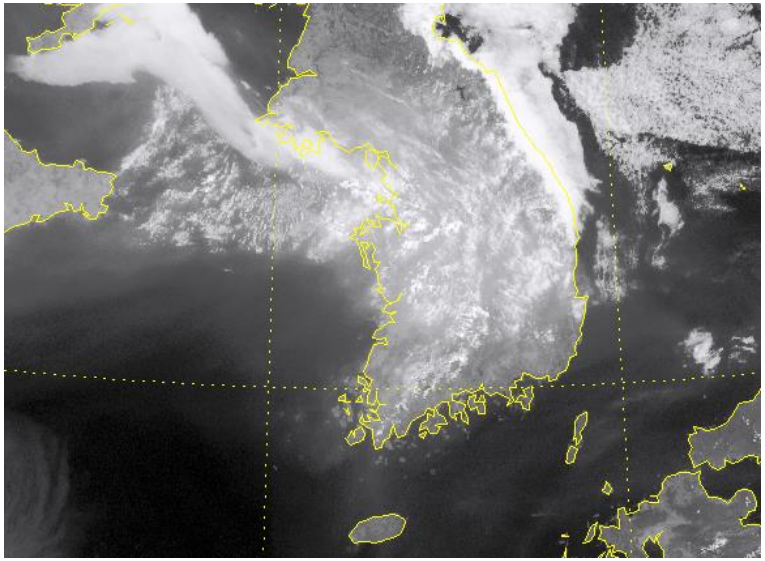


Monitoring NWP instability

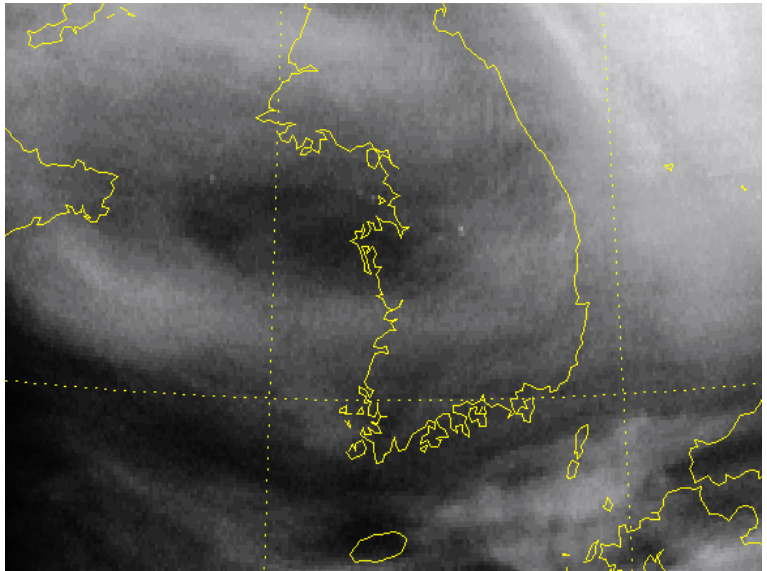
0243UTC(t-30) IR1

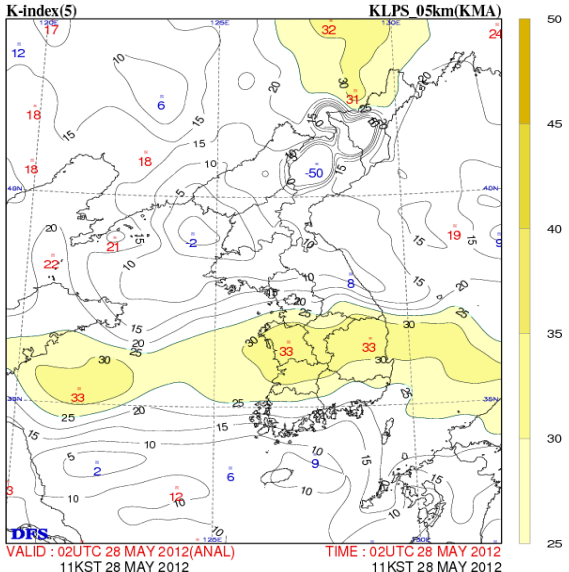


VIS



WV

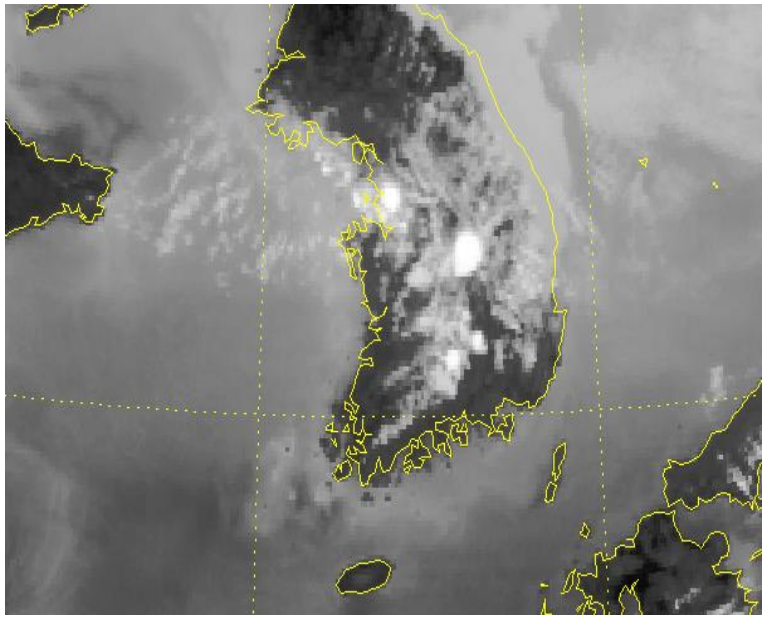




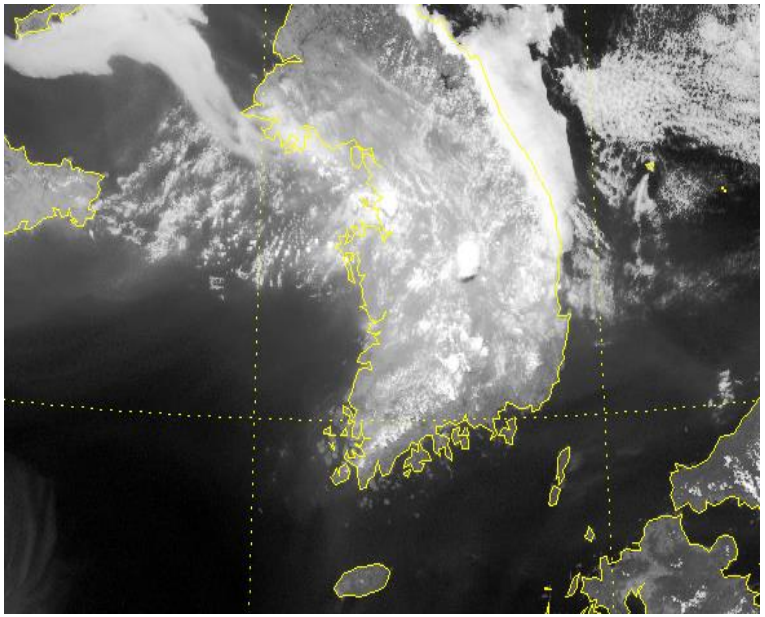
K-index	Probability for convective cloud with lightning
15 >	0%
15-20	20%
20-25	20-40%
25-30	40-60%
30-35	60-80%
35-40	80-90%
40-45	90% 이상

0345UTC(t+30)

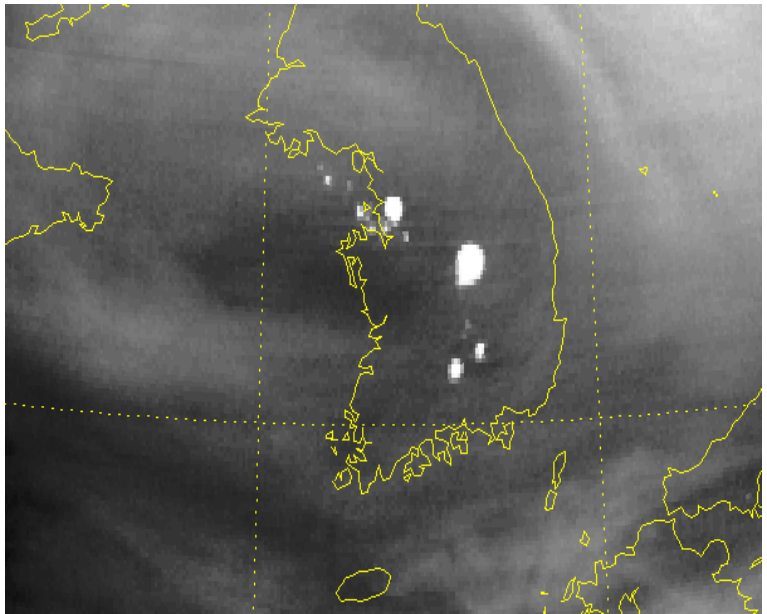
IR1



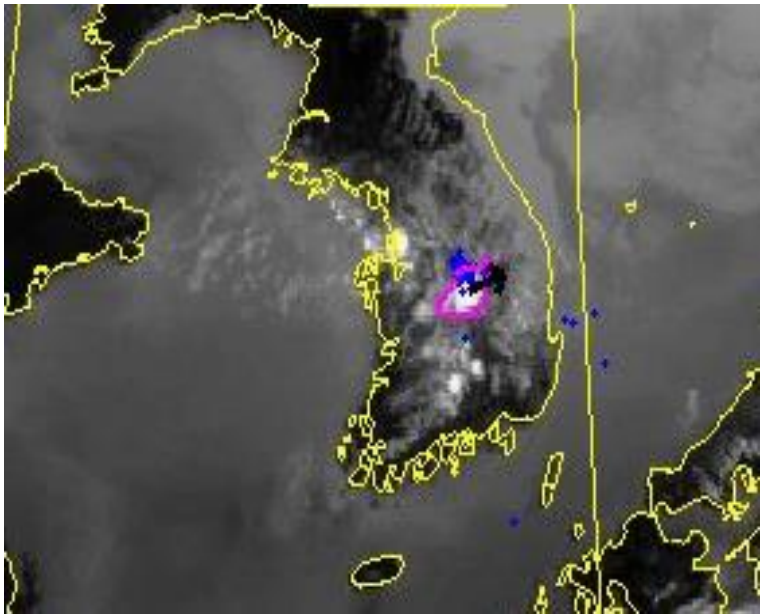
VIS



WV

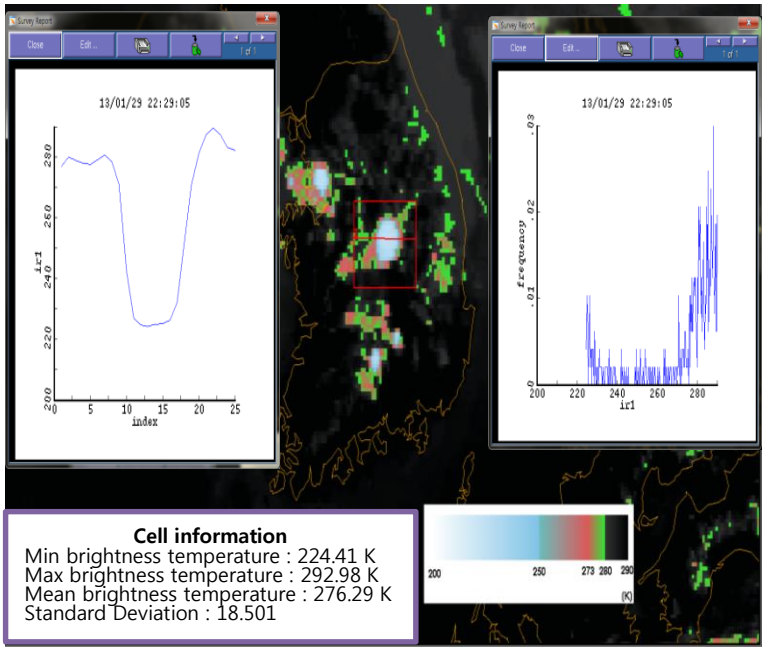


RDT



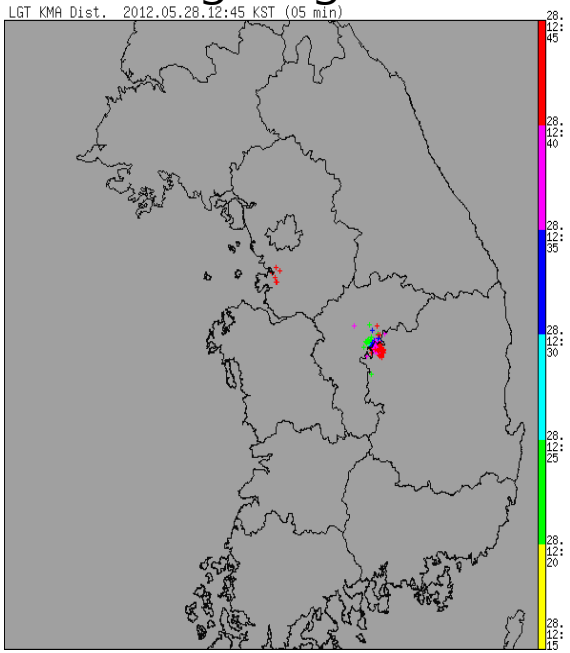
Monitoring WV - IR

0345UTC(t+30)

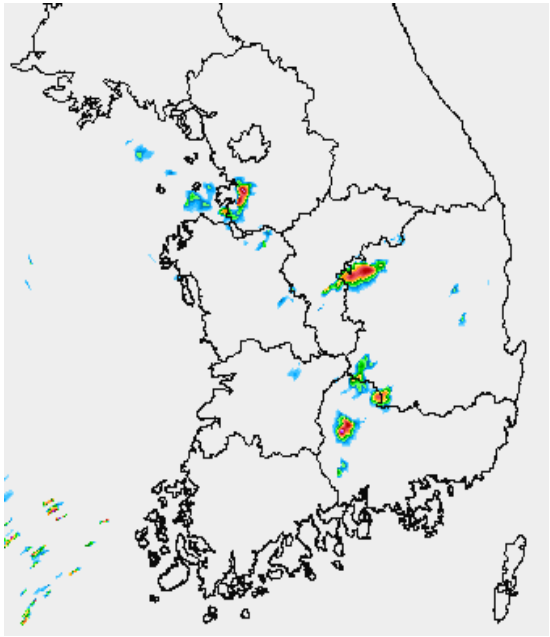


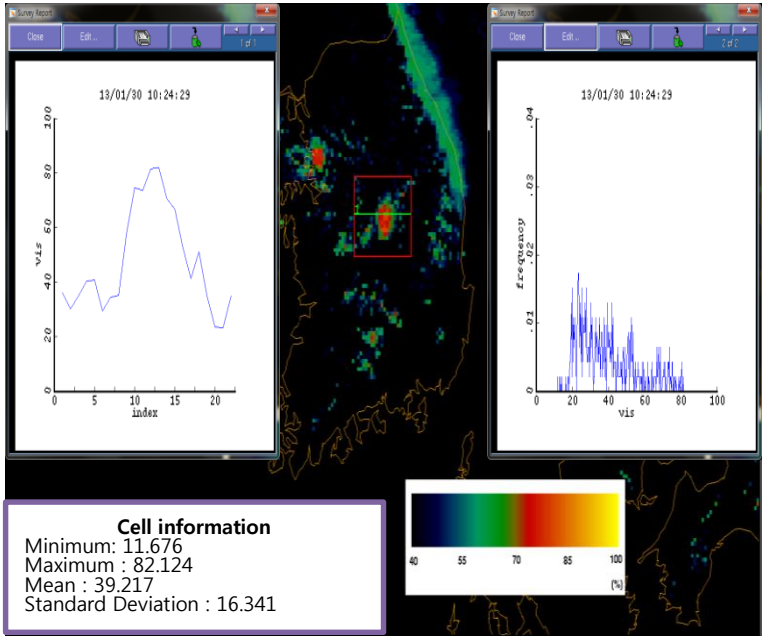
Cell information
Min brightness temperature : 224.41 K
Max brightness temperature : 292.98 K
Mean brightness temperature : 276.29 K
Standard Deviation : 18.501

Lighting



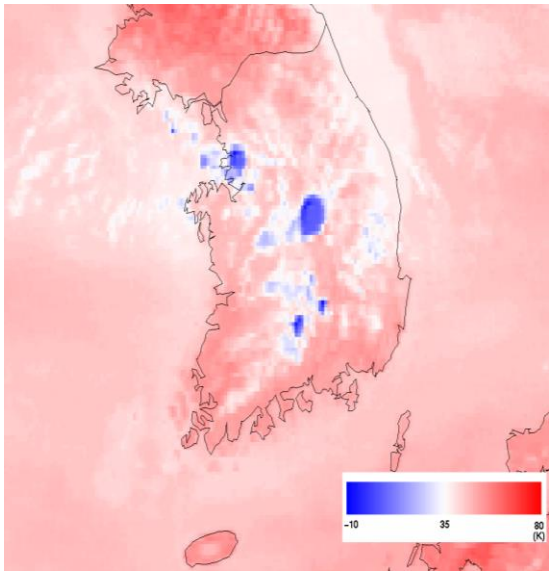
Radar Rain Rate





Cell information
Minimum: 11.676
Maximum : 82.124
Mean : 39.217
Standard Deviation : 16.341

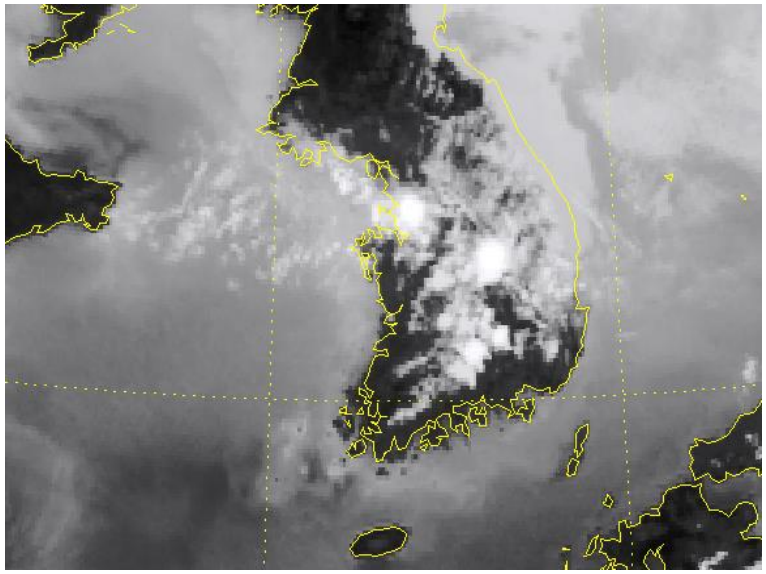
WV - IR



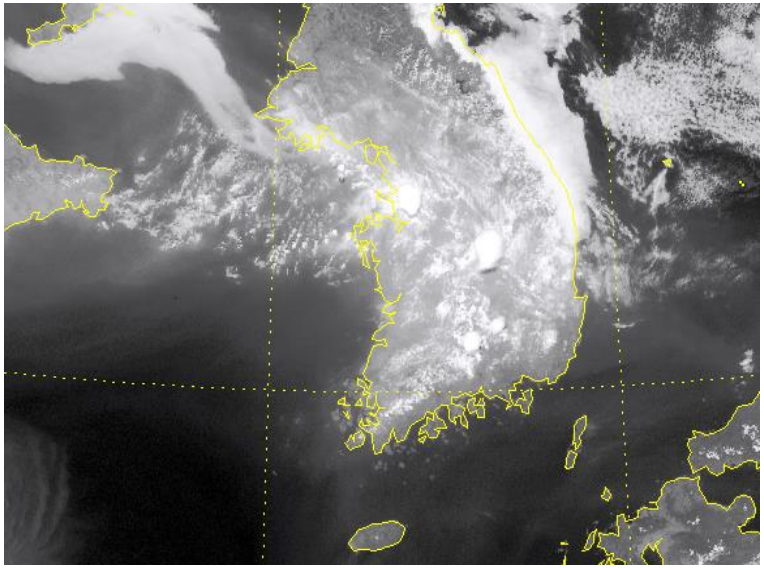
Monitoring NWP instability

0358UTC(t+45)

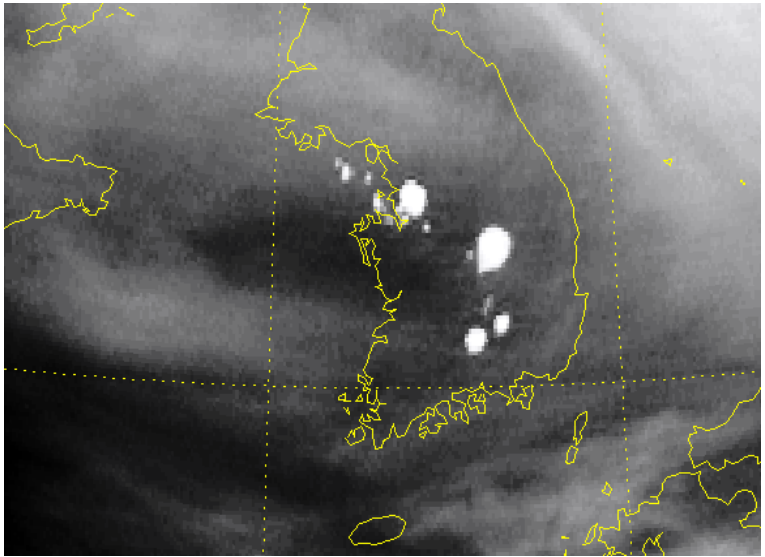
IR1

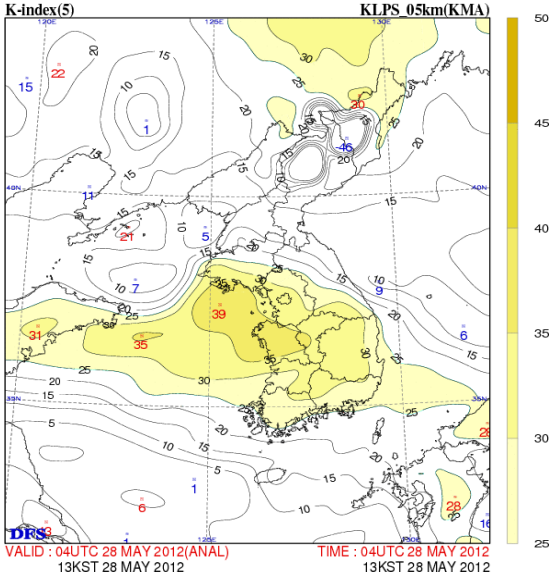


VIS



WV





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20-25	20-40%
25-30	40-60%
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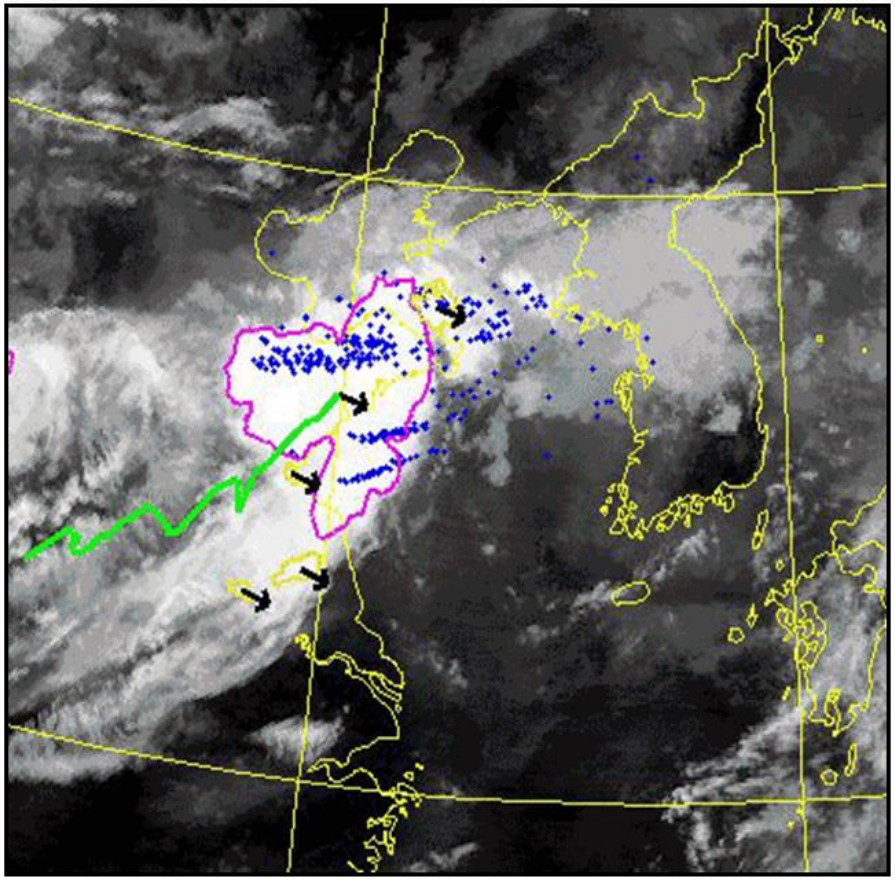
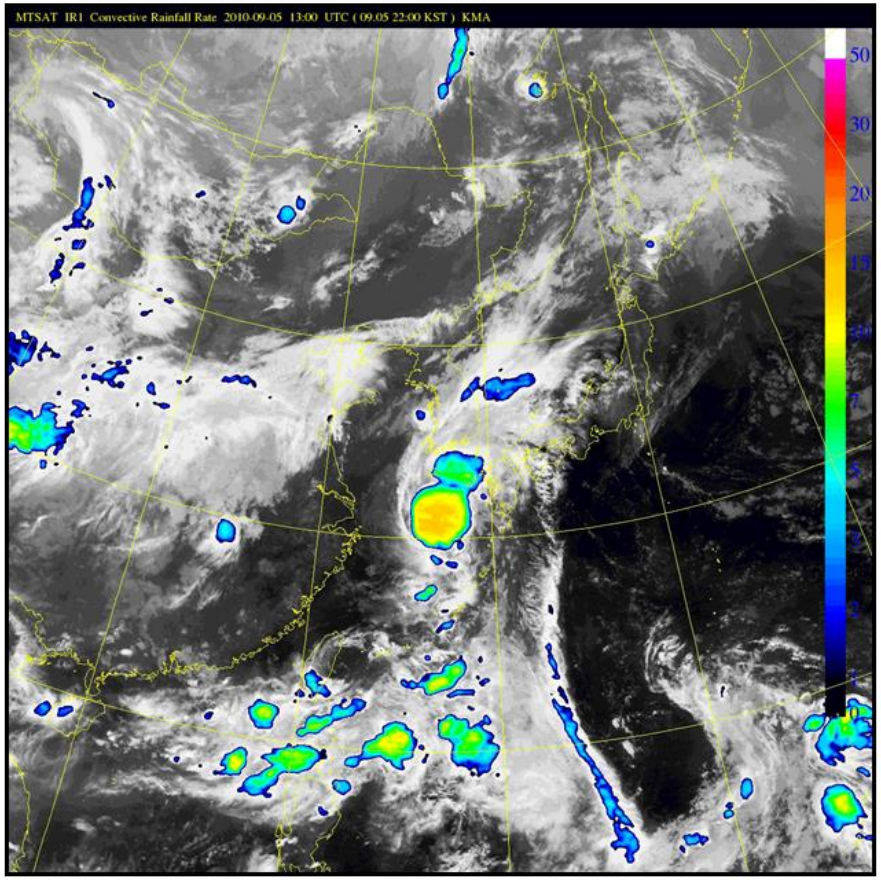
35-40	80-90%
40-45	90% 이상

Detection & tracking of convective cloud



Convective Rainfall Rate(mm/hr)



Developing cloud Decaying cloud → direction lightening Traveling route

- NMSC/KMA introduced S/W package from NWC SAF of EUMETSAT for detection & tracking of convective cloud and convective rainfall rate and has been producing them operationally with COMS data.
- In left side animation, pink colored line represents developing cloud meanwhile yellow colored line is for decaying cloud. Black arrow indicates where this cloud flows into in developing.
-Since normally, westerly cloud system with heavy rain influences on KP, it has been monitored with caution.

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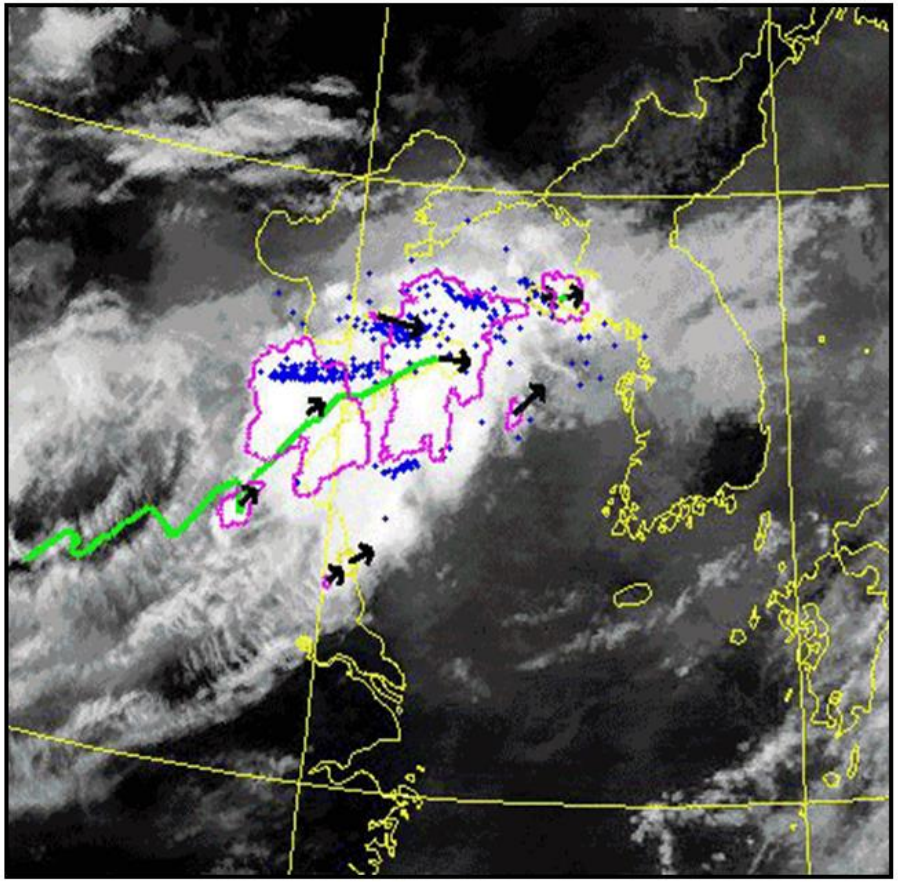
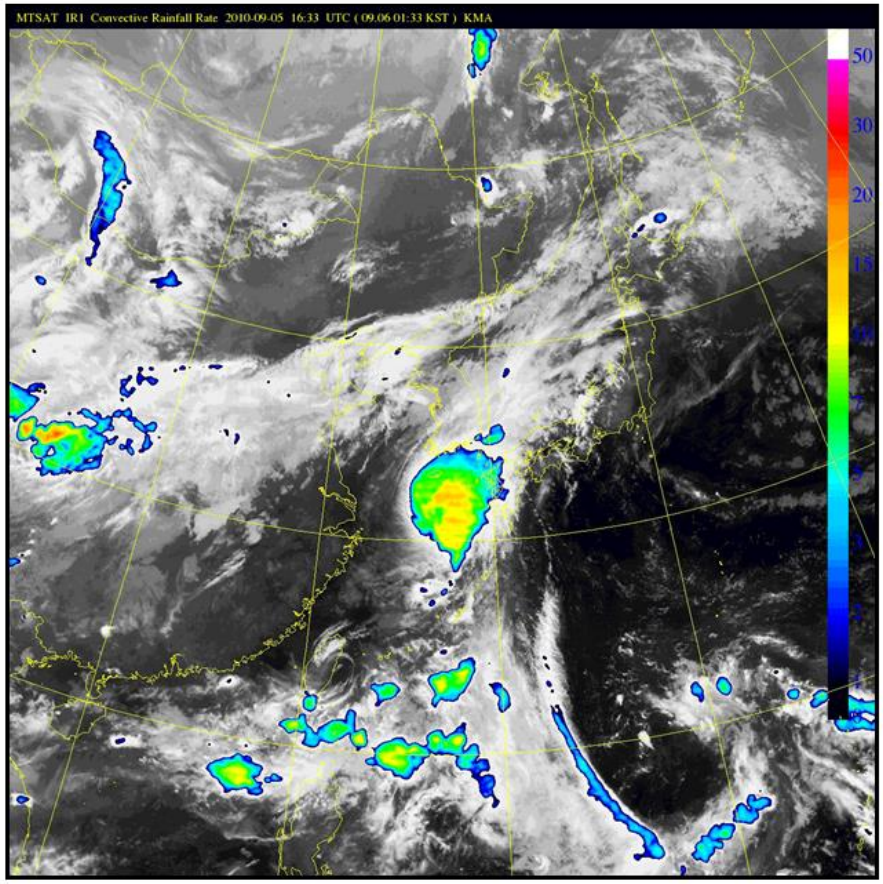
National Meteorological Satellite Center

Detection & tracking of convective cloud



Convective Rainfall Rate(mm/hr)



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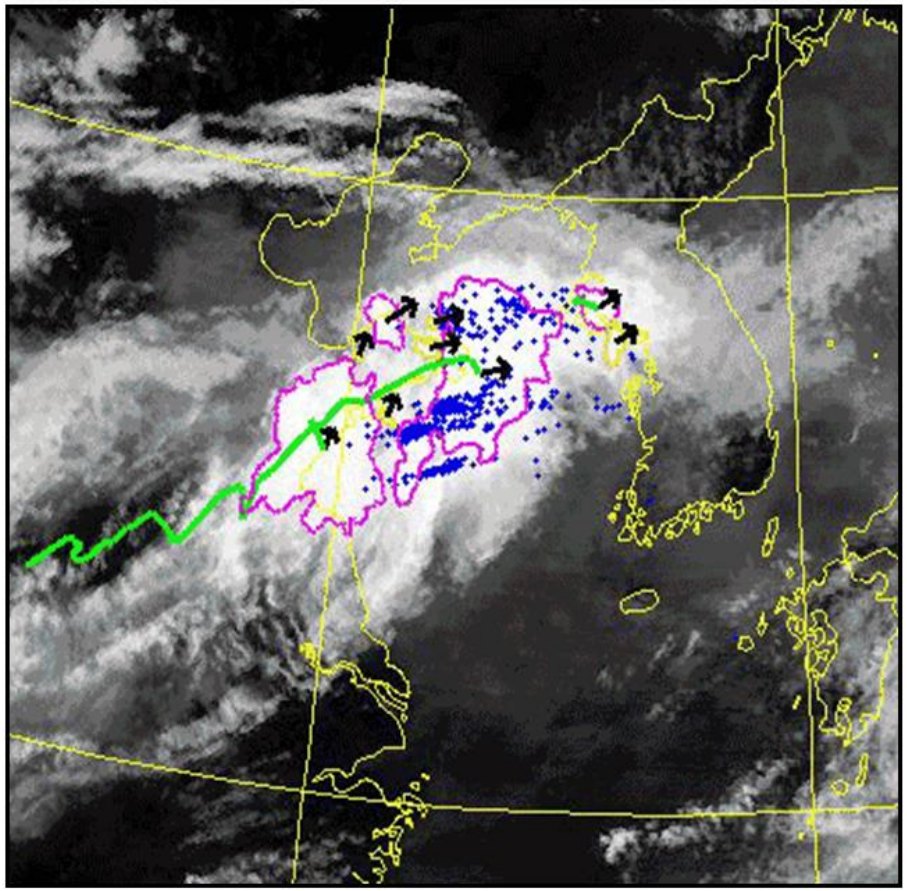
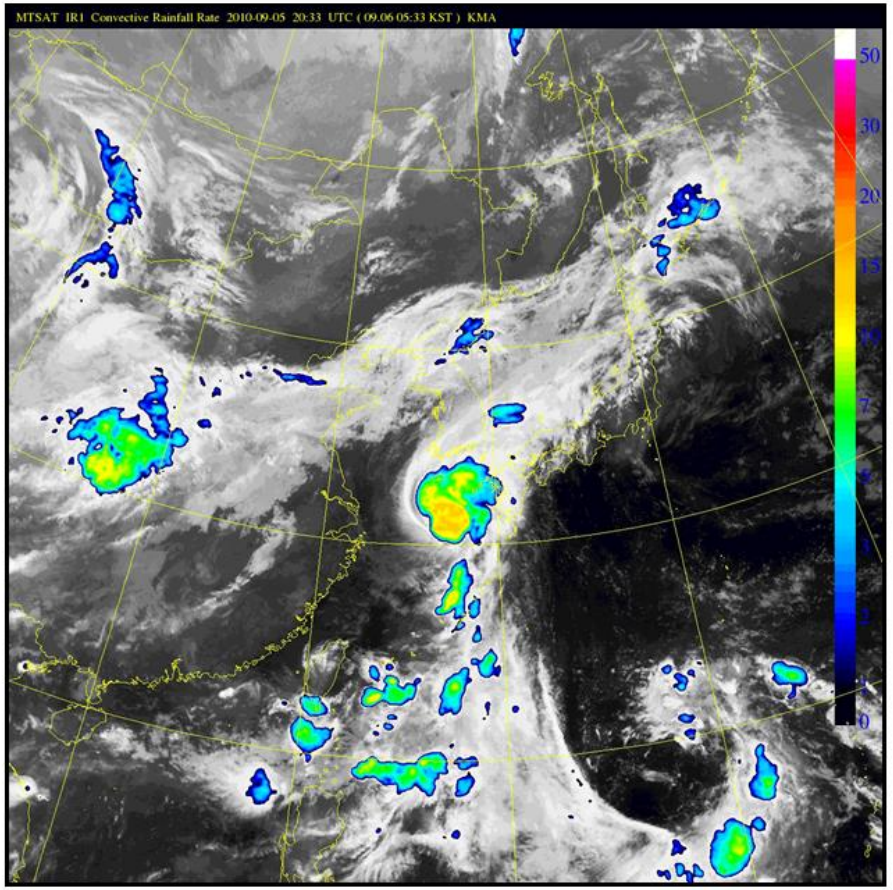
Detection & tracking of convective cloud

Convective Rainfall Rate(mm/hr)

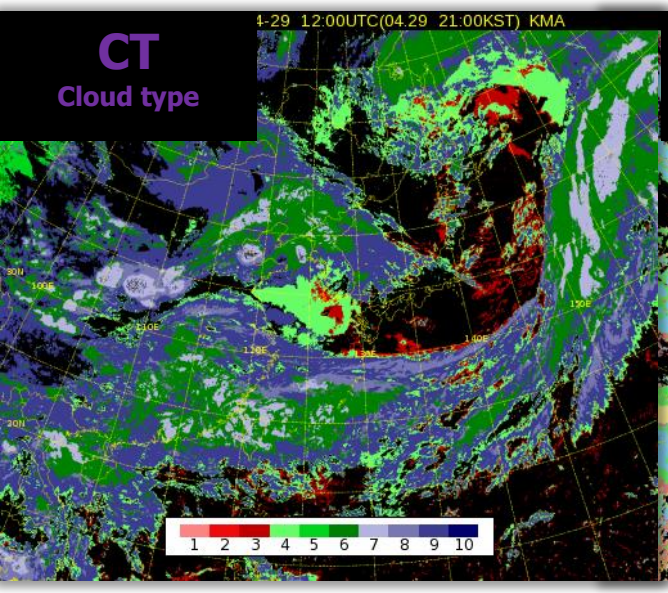


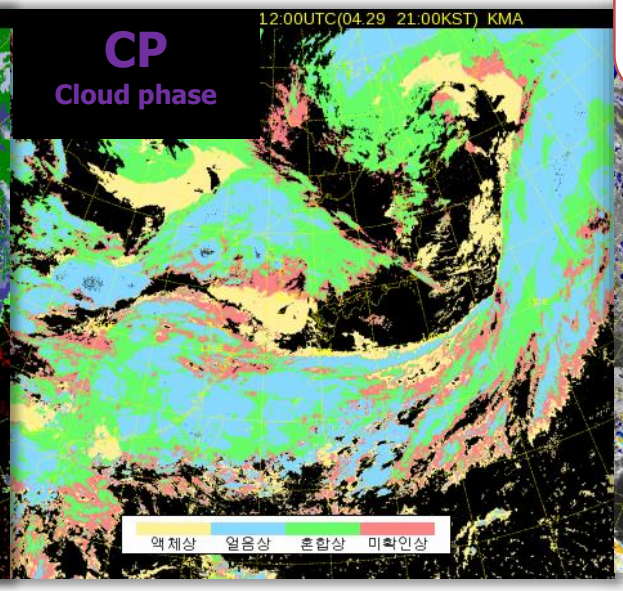


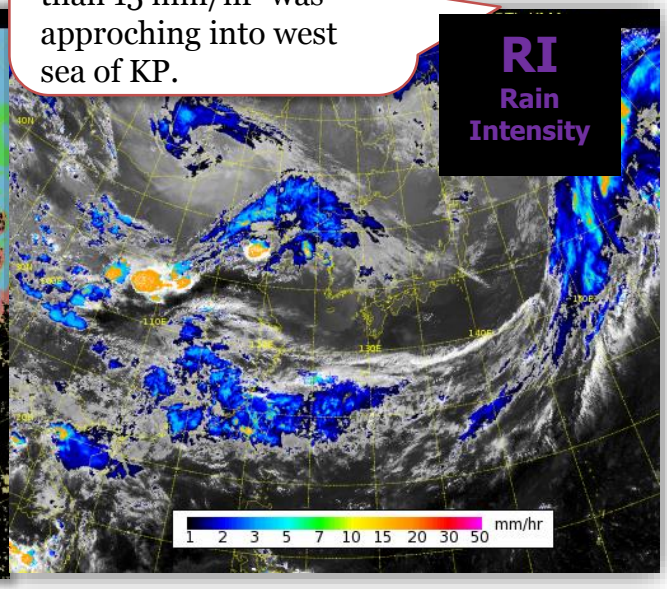
Developing cloud Decaying cloud direction lightening Traveling route

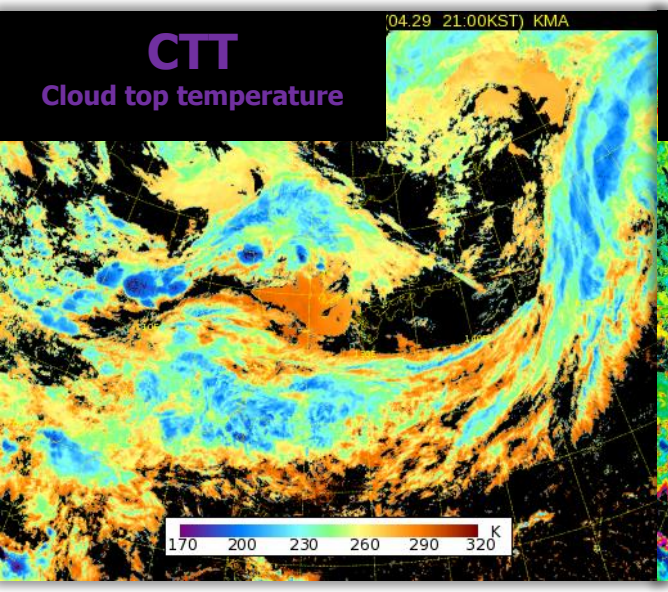
- NMSC/KMA introduced S/W package from NWC SAF of EUMETSAT for detection & tracking of convective cloud and convective rainfall rate and has been producing them operationally with COMS data.
- In left side animation, pink colored line represents developing cloud meanwhile yellow colored line is for decaying cloud. Black arrow indicates where this cloud flows into in developing.
-Since normally, westerly cloud system with heavy rain influences on KP, it has been monitored with caution.

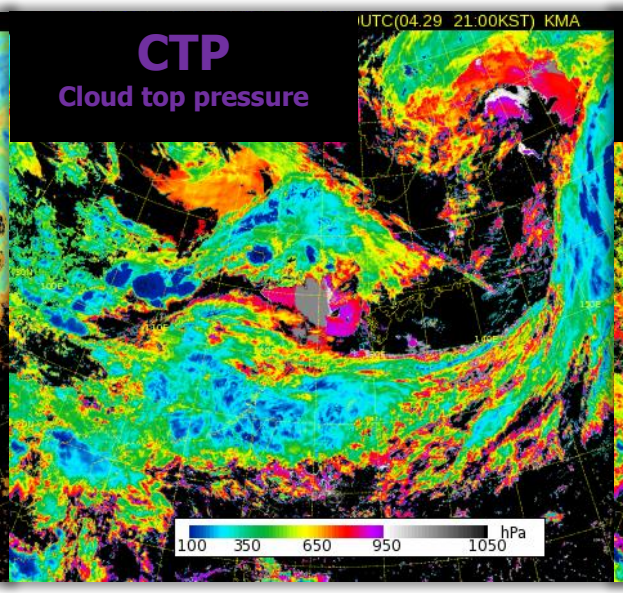
✓ **COMS RI** :
Convective cells with rainfall rate of greater than 15 mm/hr was approching into west sea of KP.

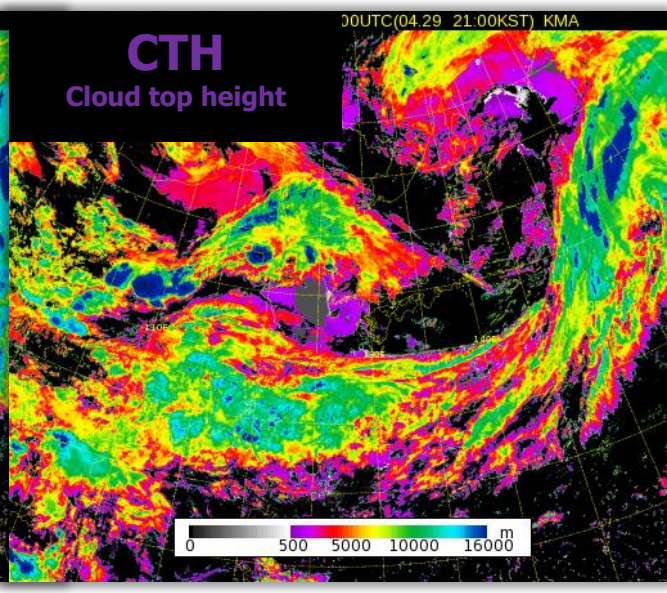








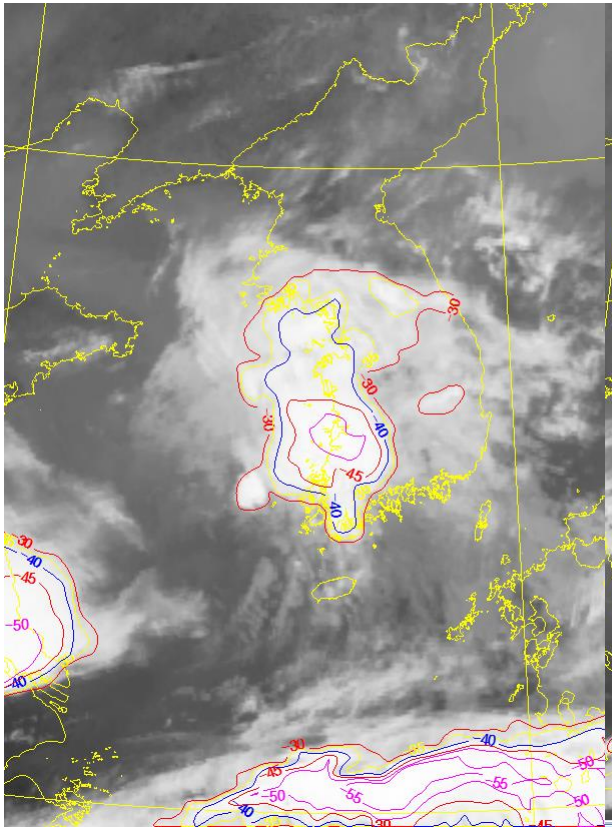




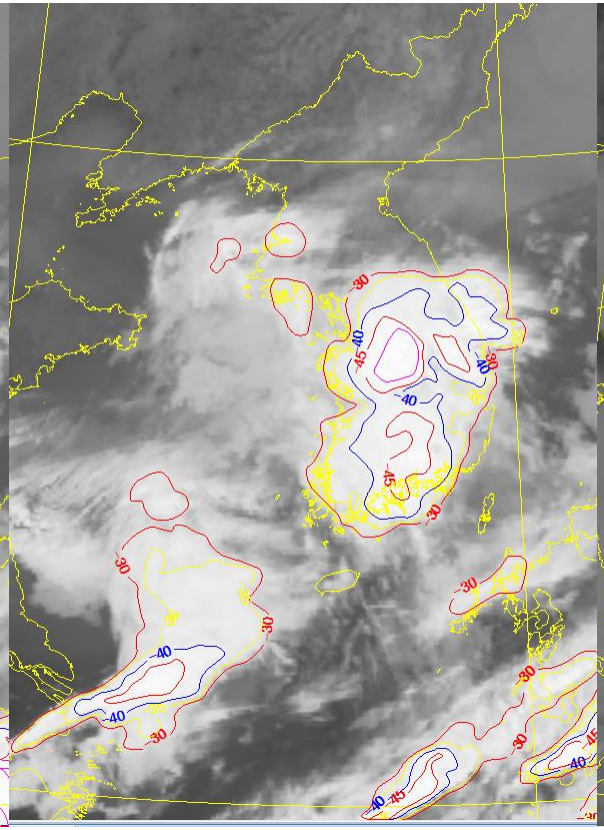
- Satellite analyst are providing cloud analysis report for weather forecasting with COMS products such as CT, CP, CTT and CTP.

COMS Cloud Top Temperature (CTT)

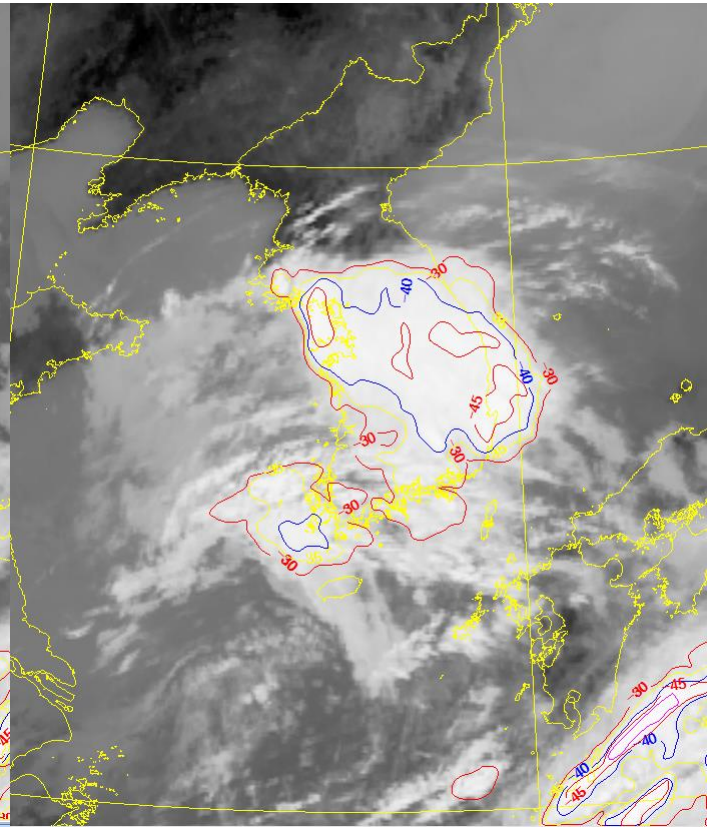
21:00 KST April 28.



03:00 KST April 29



09:00 KST April 29

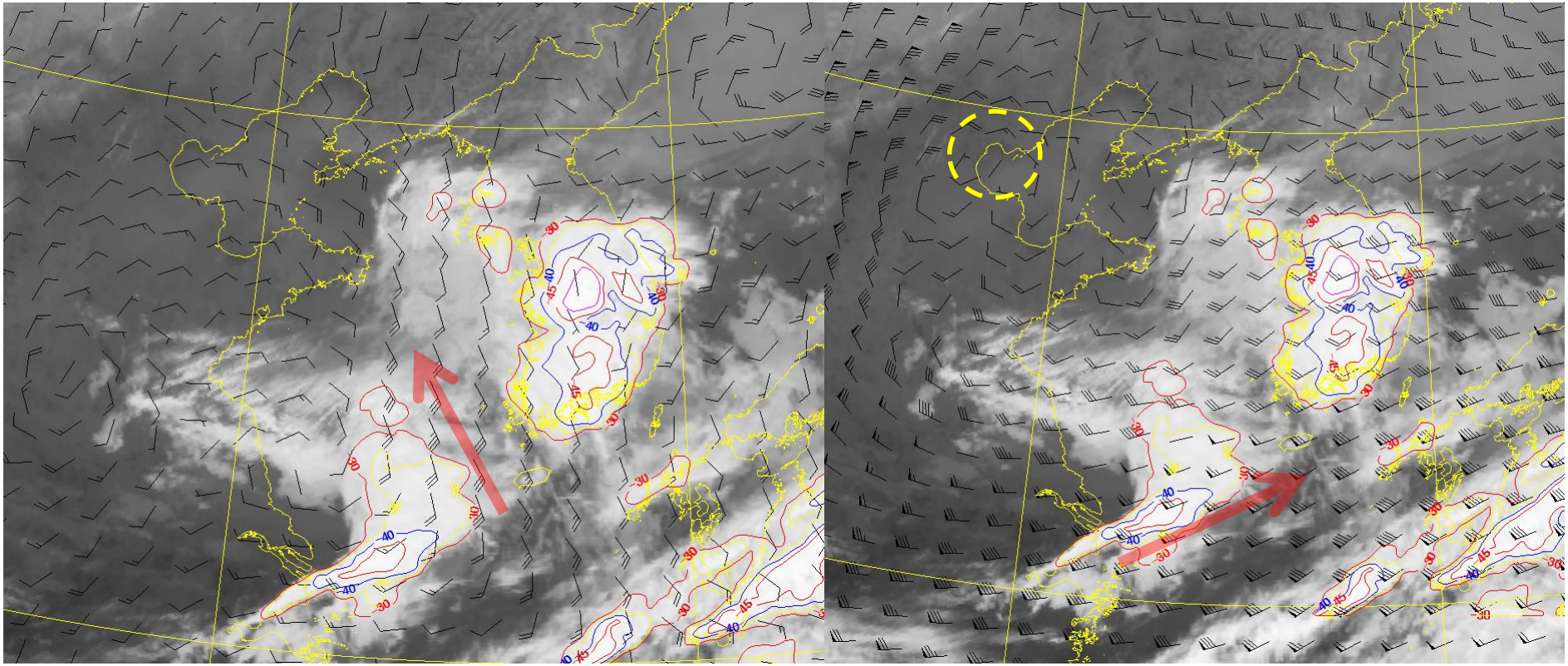


Vertical wind field when rain intensity peaks

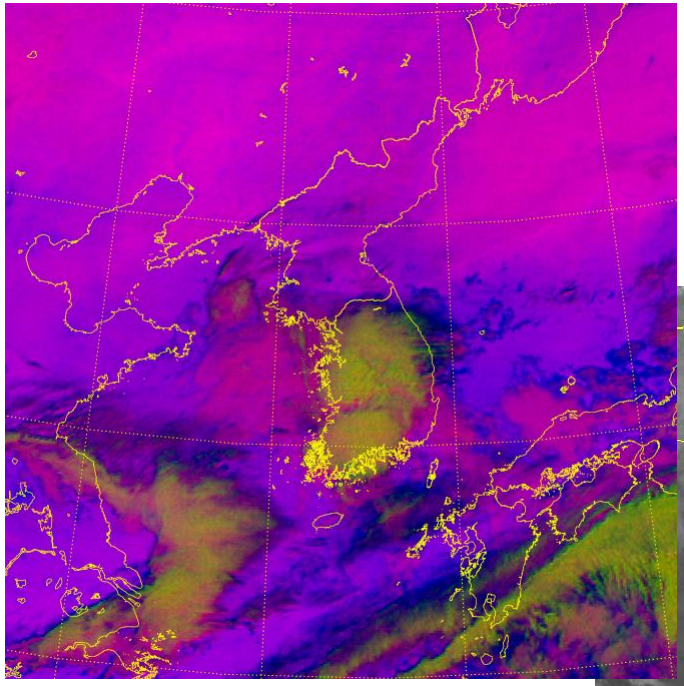
(03:00 KST April 29)

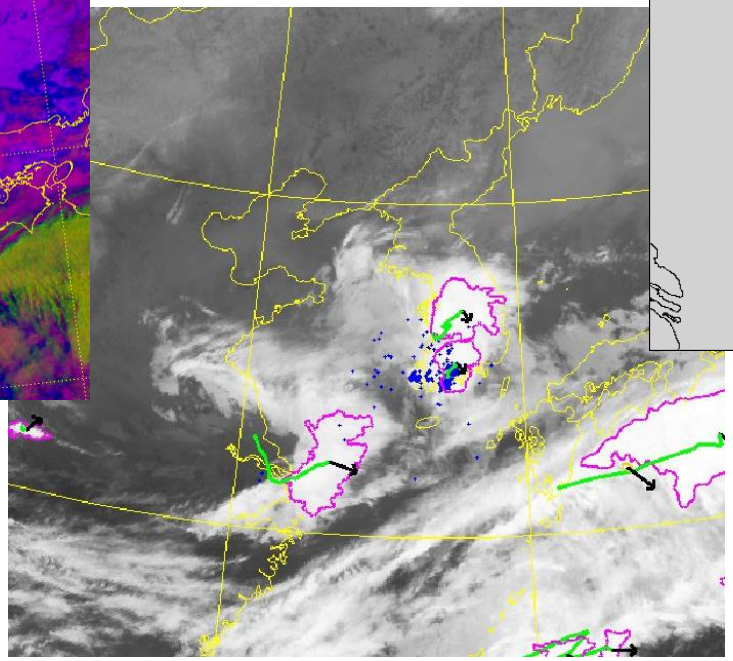
925 hPa Wind field

300hPa wind field

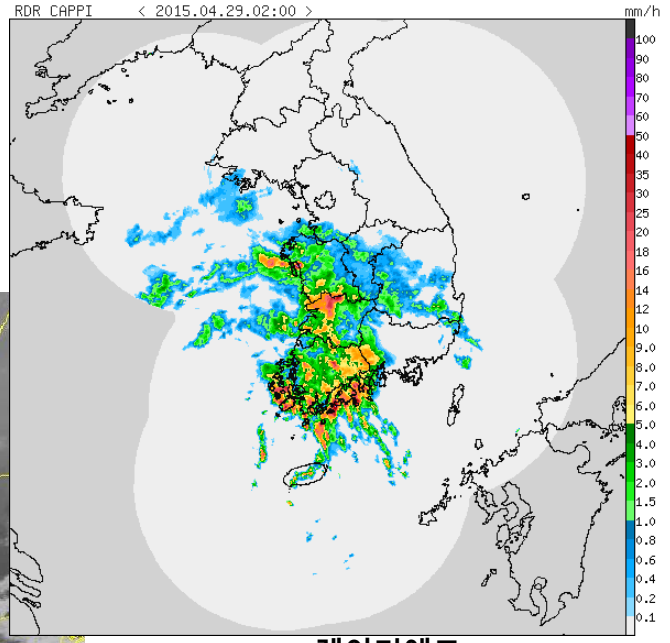


Convective RGB images





Radar rainfall rate

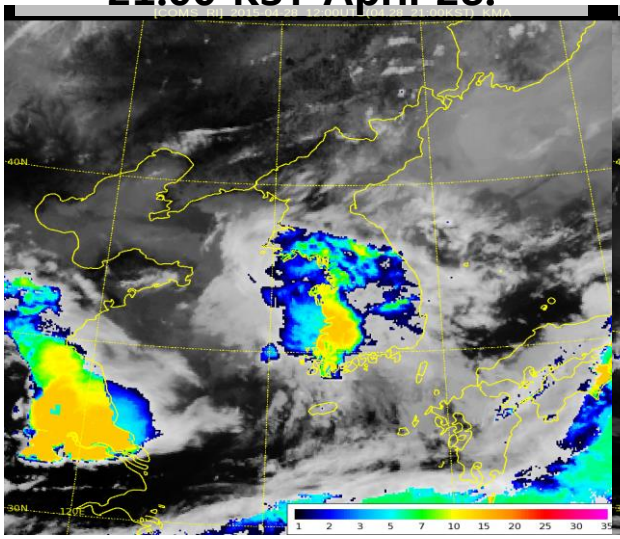


레이더에코

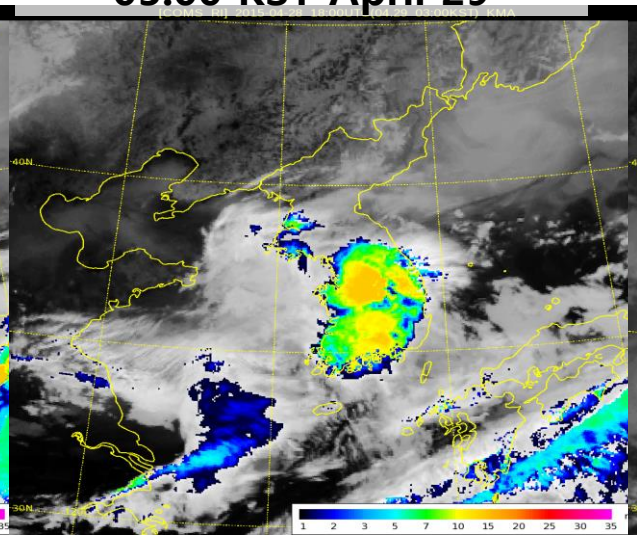
RDT
(Rapid Developing Thunderstorm)

COMS RI

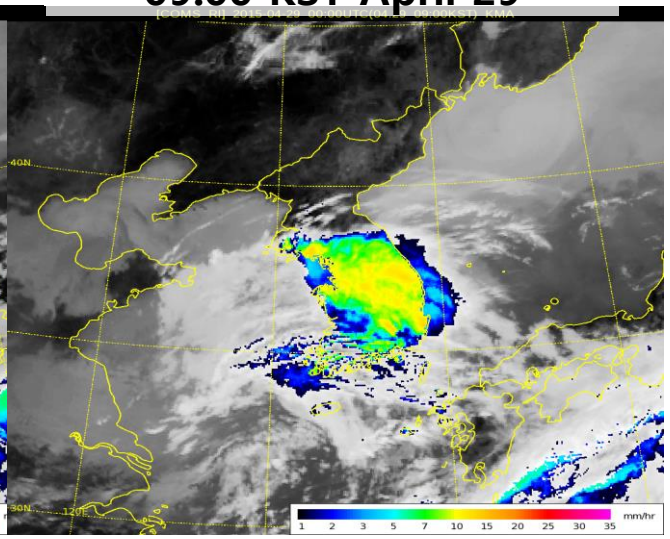
21:00 KST April 28.



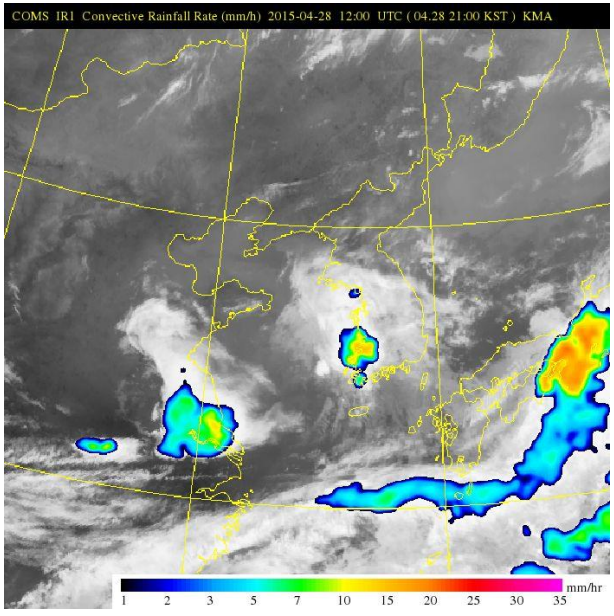
03:00 KST April 29

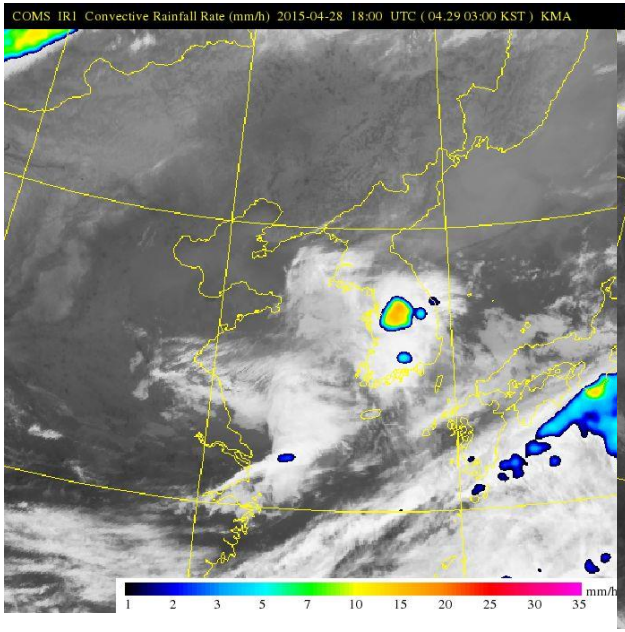


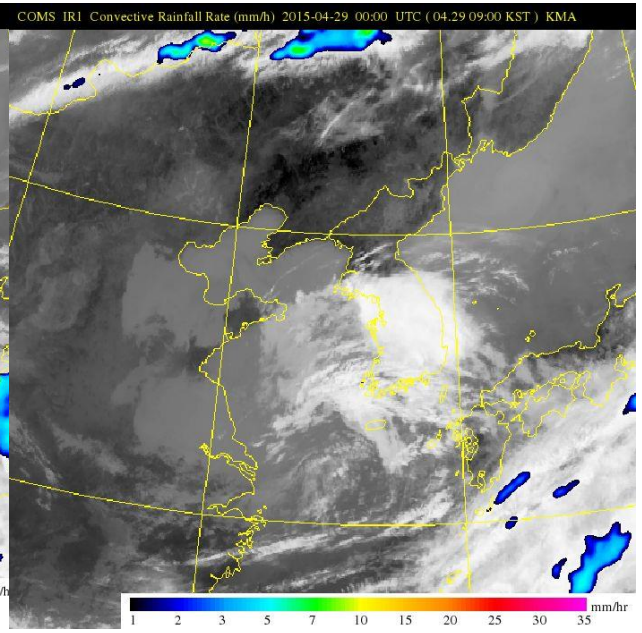
09:00 KST April 29



COMS CRR

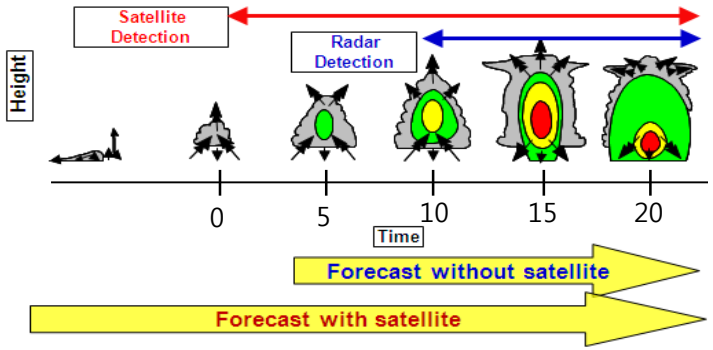




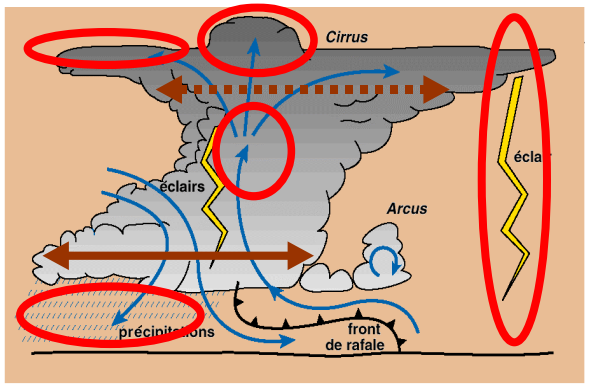


On going CI retrieval

✓ **Detection of convective cloud producing heavy rain is very important in supporting nowcasting and shortterm forecasting**



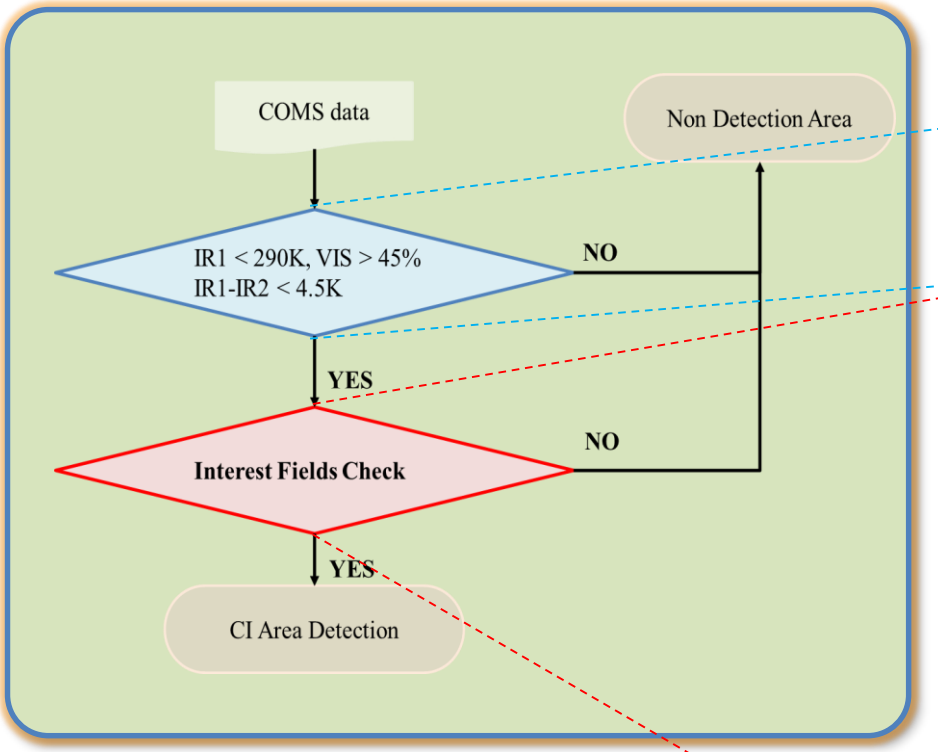
(2012, Mecikalski)

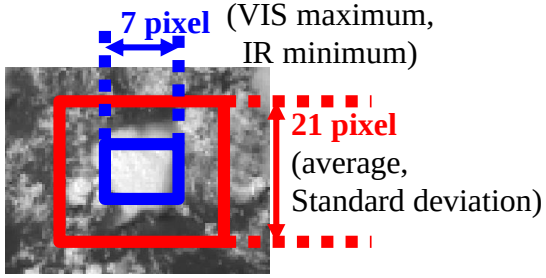


(2013, Moisselin)

✓ **Our goal is to detect cloud which has chance to develop into convective cloud with heavy rain within 1 hour**

Flow chart of CI

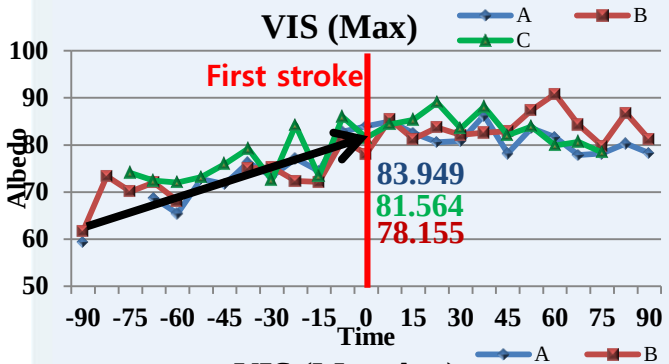


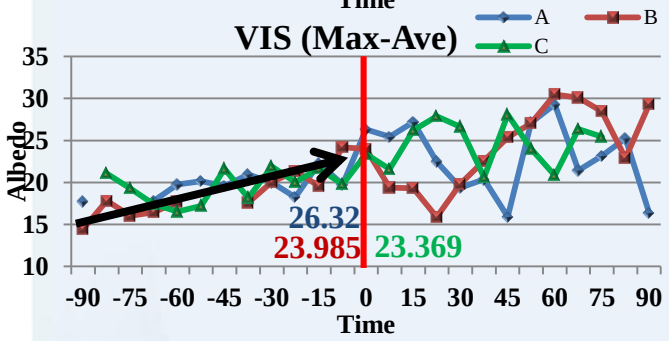


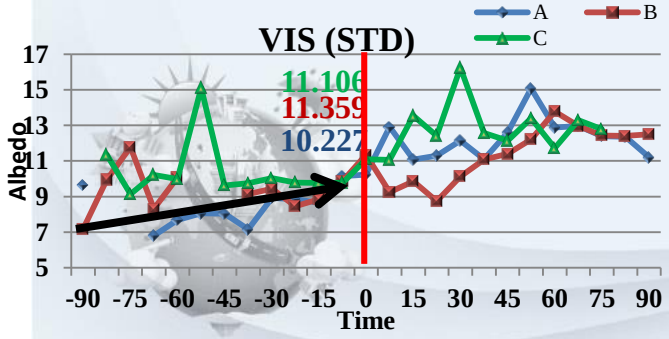
CI determinant parameters

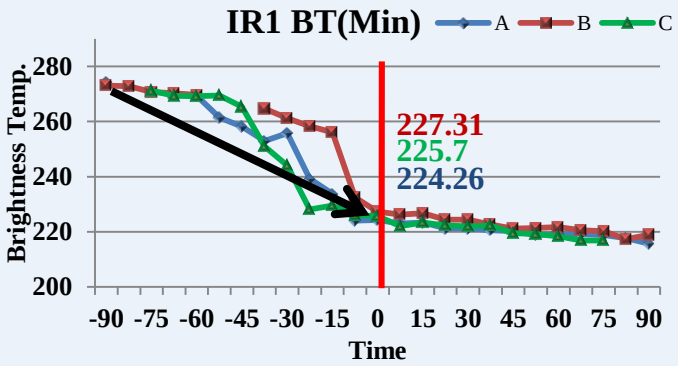
COMS Interest field		
VIS	Preprocess	Clear sky removal
IR		
IR1 – IR2		Cirrus removal
VIS Maximum – Average	Convective cloud estimation by cloud roughness	
VIS Standard Deviation		
IR1 Brightness Temperature Minimum – Average		
IR1 Brightness Temperature Standard Deviation		
IR3(WV) – IR1	Convective cloud estimation	
Time trend of VIS Maximum	Time trend of convective cloud (use of AMV)	
Time trend of VIS Average		
Time trend of IR1 Average		
Time trend of IR1 Minimum		

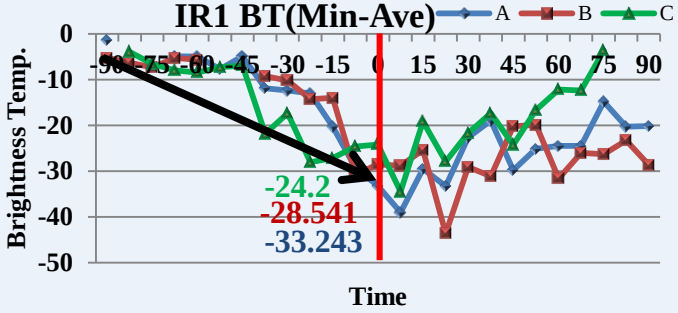
May 28. 2012 (Convection by instability)

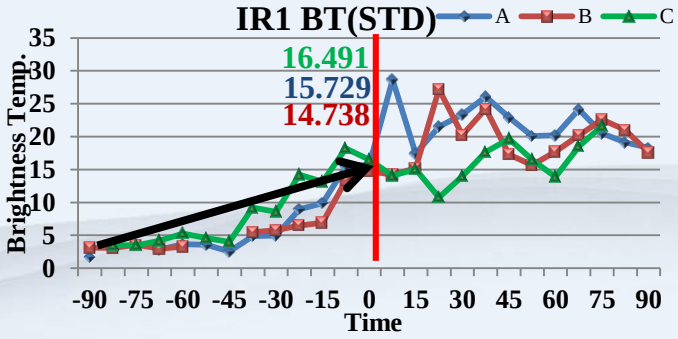




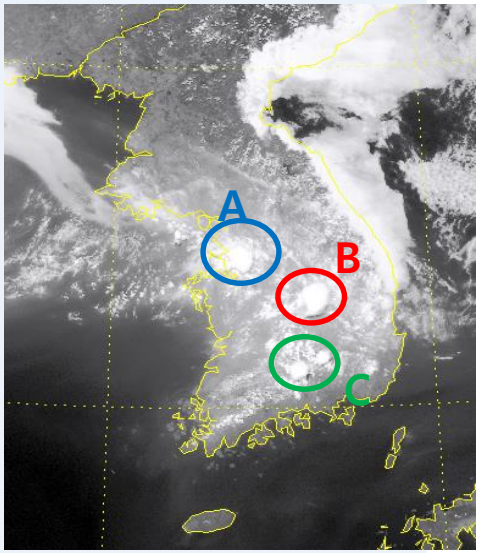






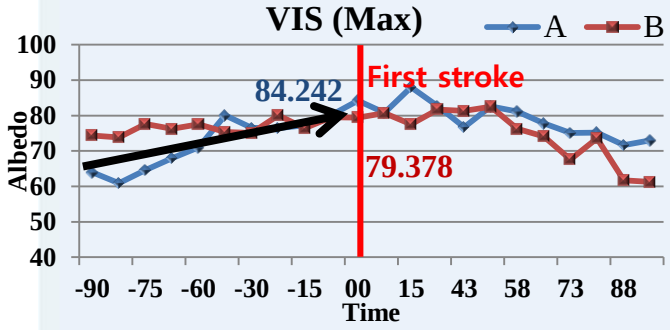


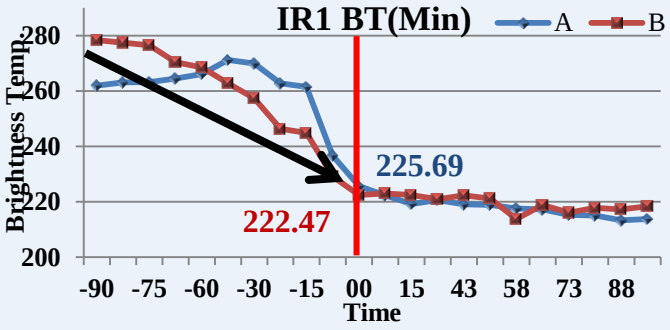
2012.05.28.0400UTC VIS영상

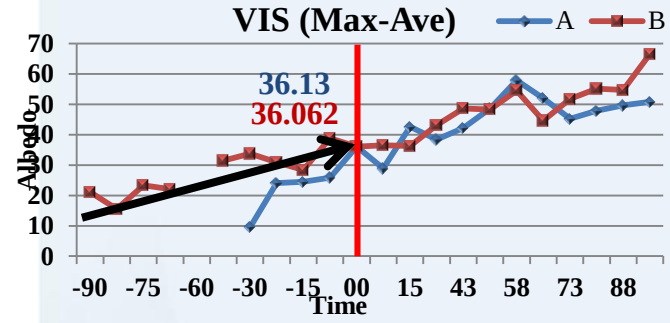


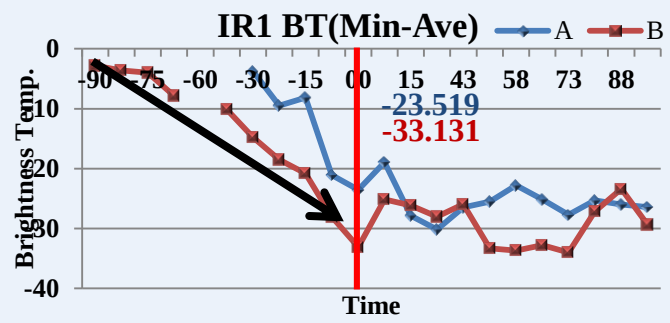
COMS Interest field	Critical value
VIS	40-75%
IR	230~290K
IR1 – IR2	X
VIS Max – Ave	10 ~ 25%
VIS STD	5.0 ~ 10.0
IR1 BT Min – Ave	-30 ~ 0K
IR1 BT STD	1.0 ~ 15.0
IR3(WV) – IR1	-40 ~ -10K

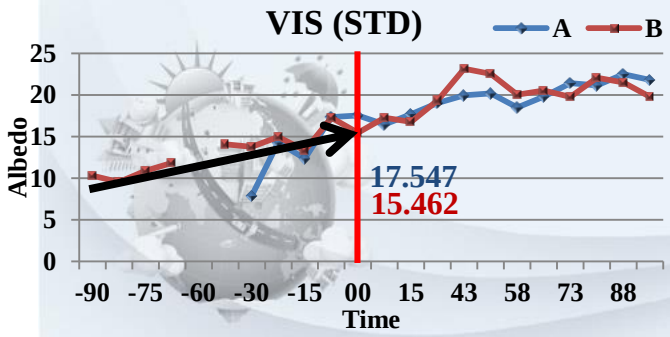
August 3 2011 (Convection accompanying with front and low system)

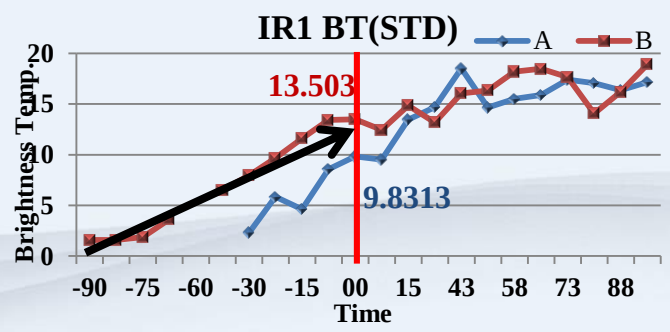




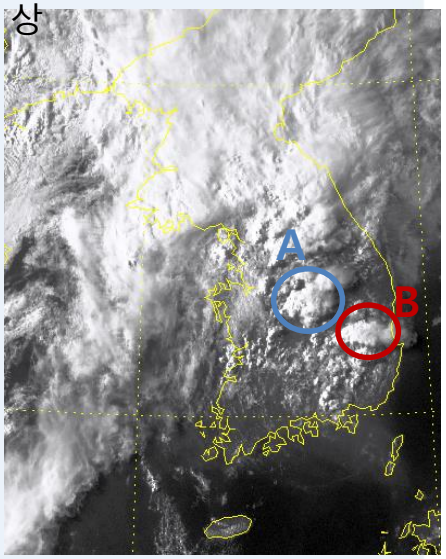








2011.08.03.0800UTC VIS영상



COMS Interest field	Critical value
VIS	X
IR	230 ~ 290K
IR1 – IR2	X
VIS Max – Ave	5 ~ 35%
VIS STD	5.0 ~ 15.0
IR1 BT Min – Ave	-25 ~ 0K
IR1 BT STD	1.0 ~ 12.0
IR3(WV) – IR1	-30 ~ 0K

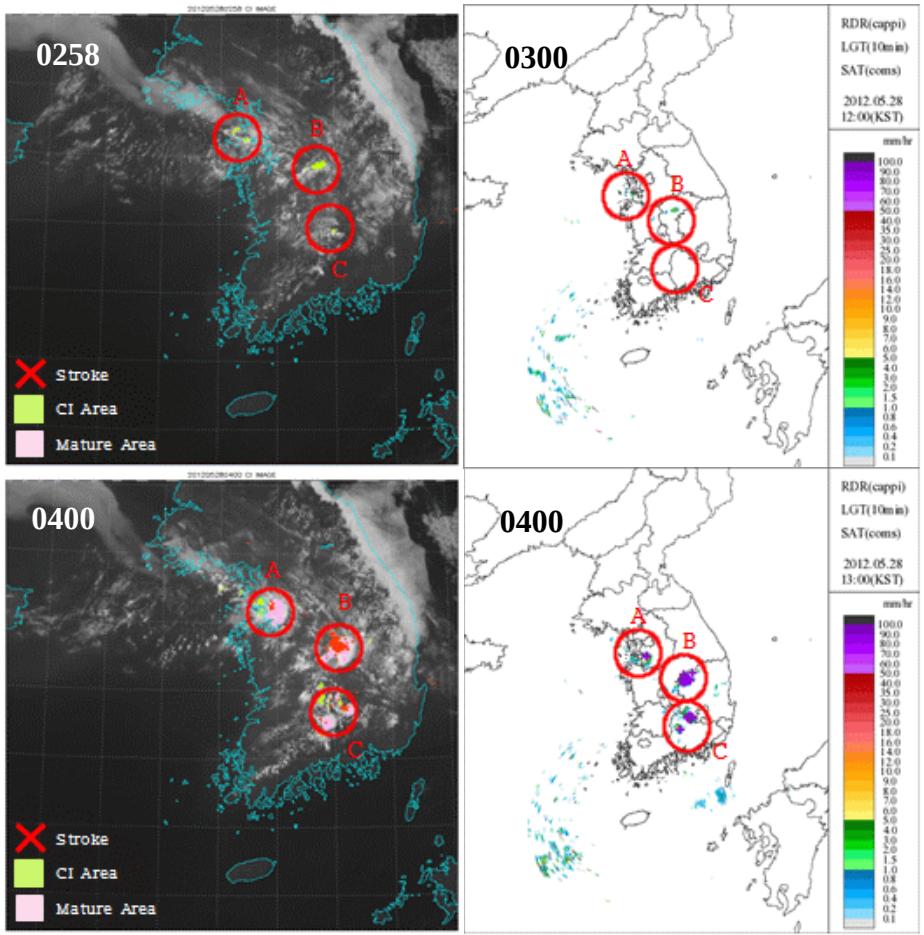
Convection by instability

- Lead time at A, B, C: 30-45 mins.
- CIs at A and C were detected earlier than Radar echo

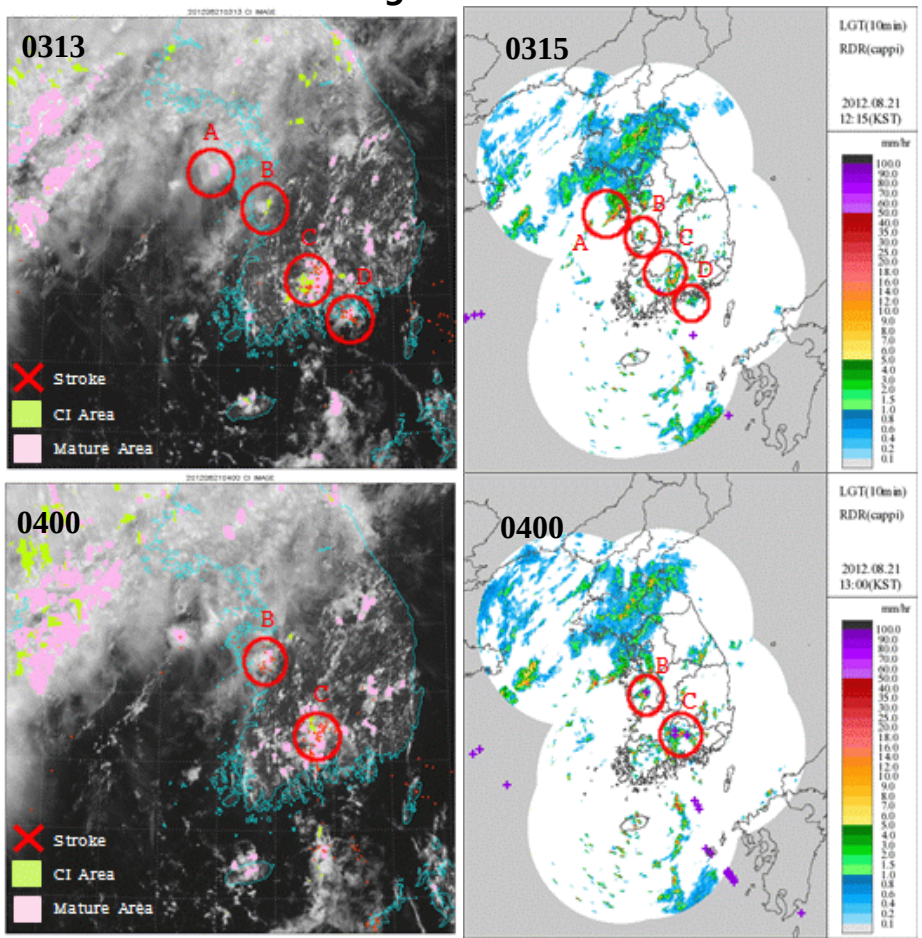
Convection accompanying with front and low system

- Lead time at A, B, C: 30-45 mins.
- CI at D was detected in 15 mins after first stroke occurs

May 28 2012

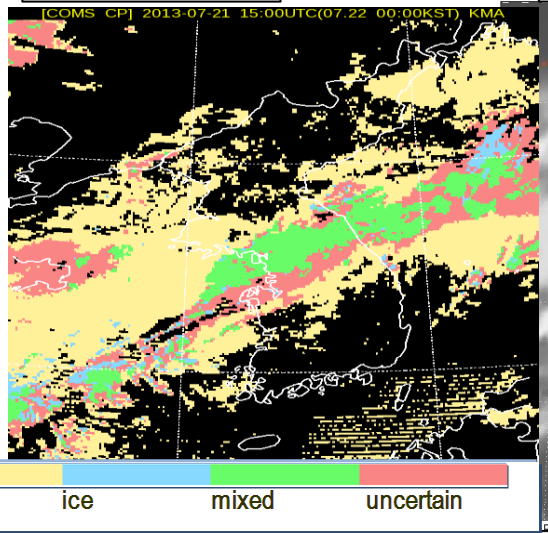


Aug. 21 2012

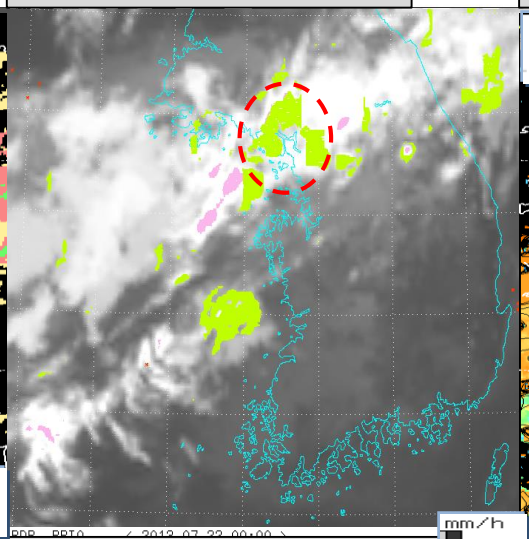


1500 UTC, July 21. 2013

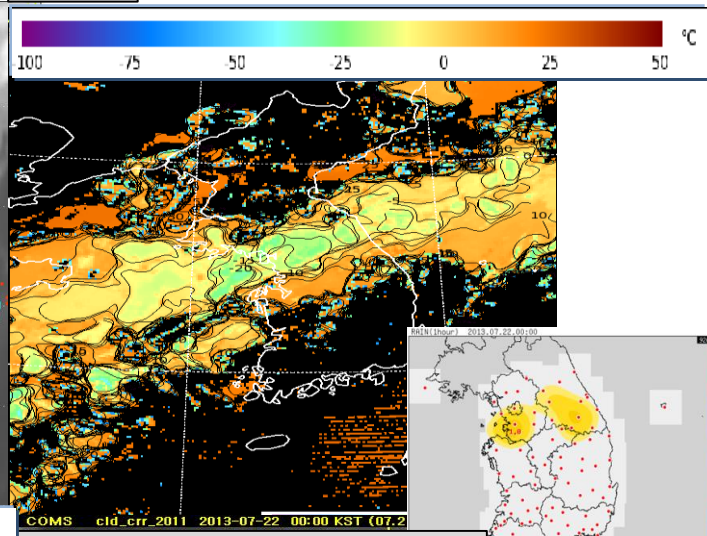
Cloud Phase



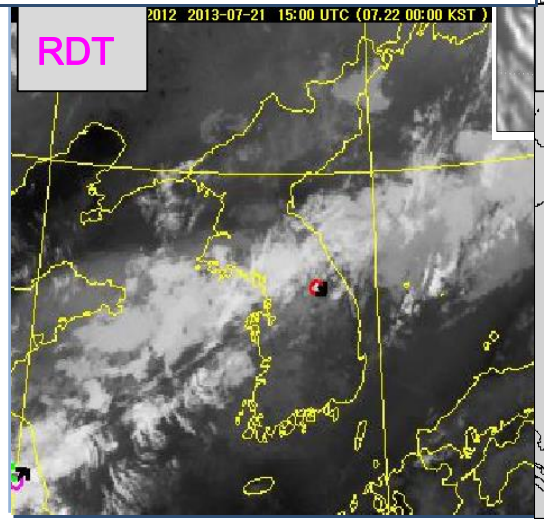
Convective Initiation



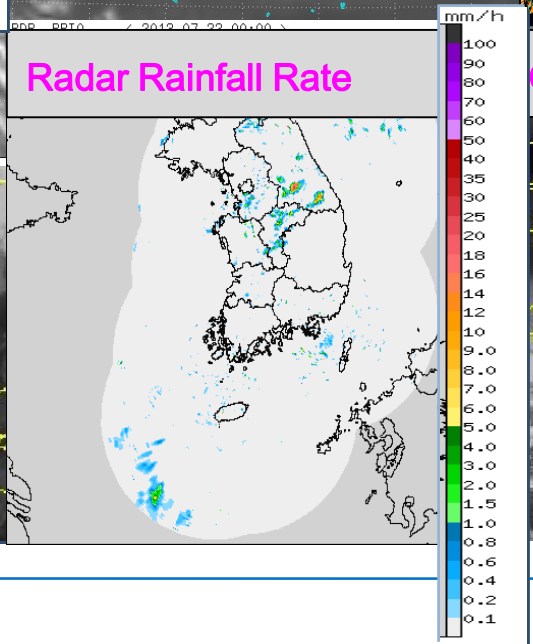
CTT



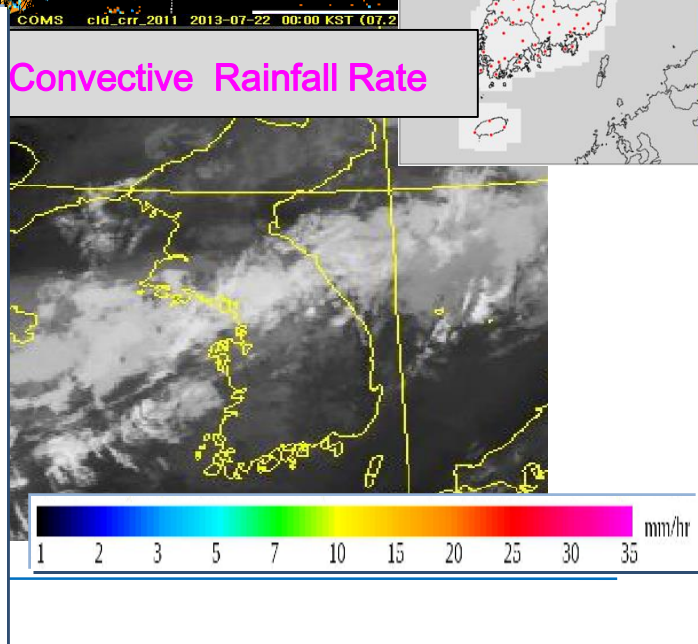
RDT



Radar Rainfall Rate

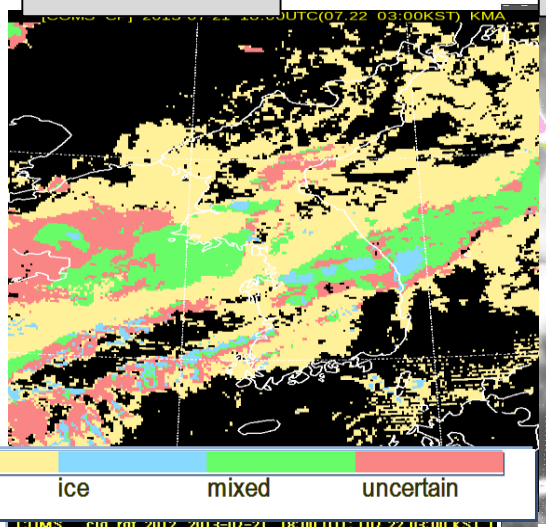


Convective Rainfall Rate

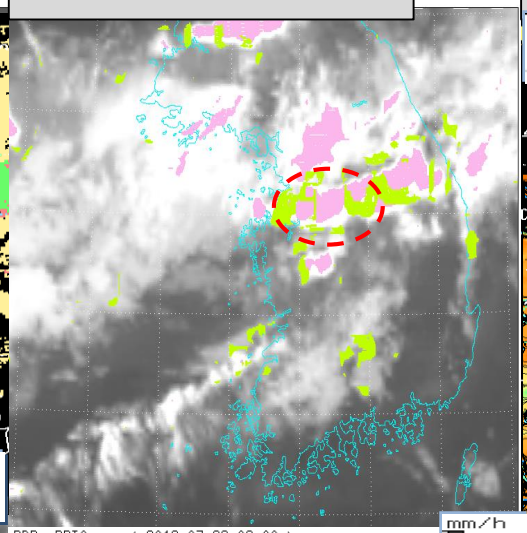


1830 UTC, July 21. 2013

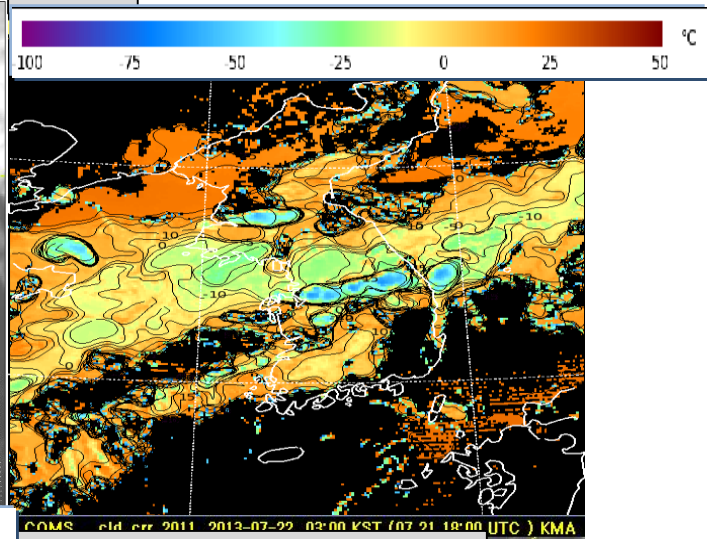
Cloud Phase



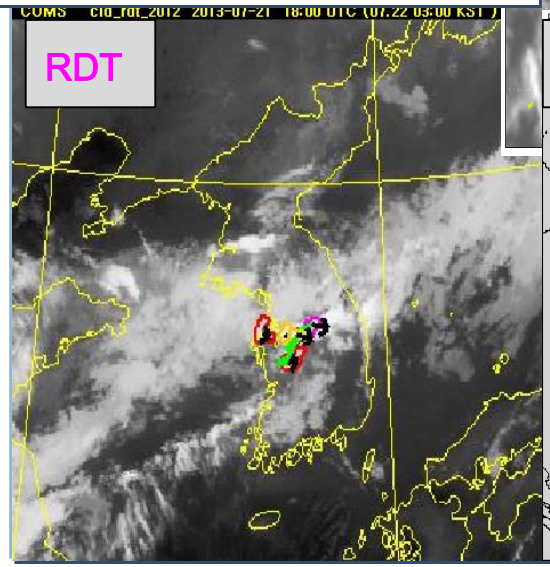
Convective Initiation



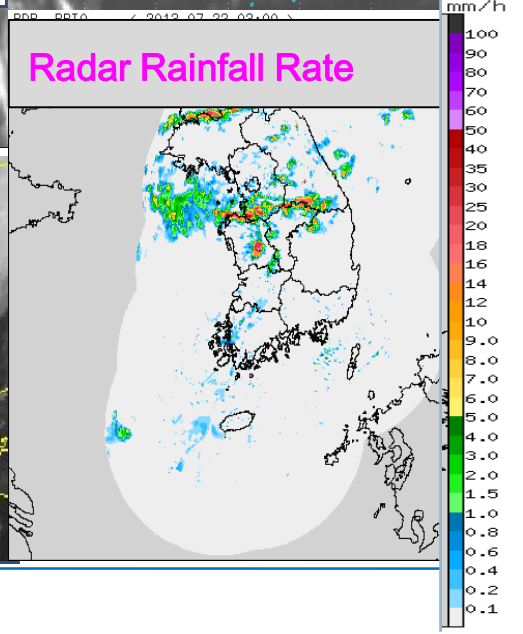
CTT



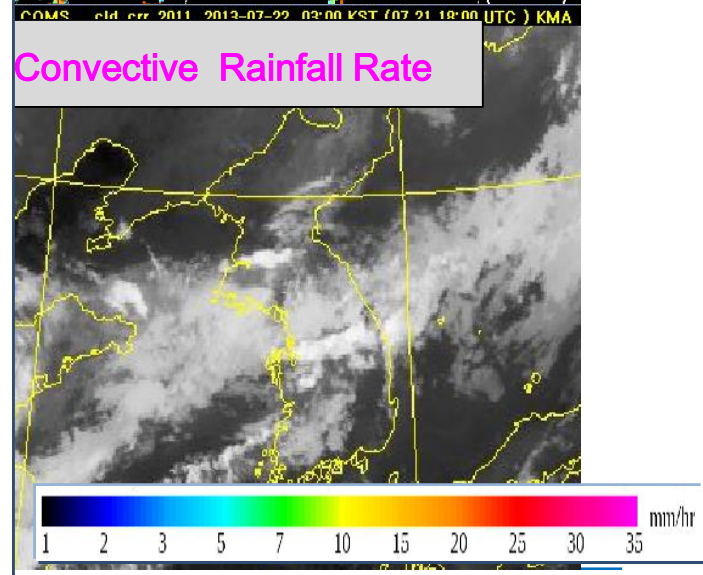
RDT



Radar Rainfall Rate

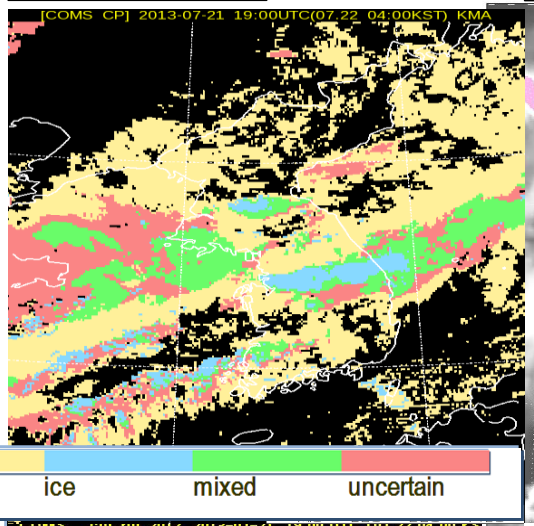


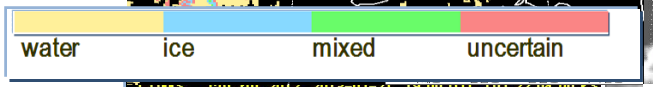
Convective Rainfall Rate



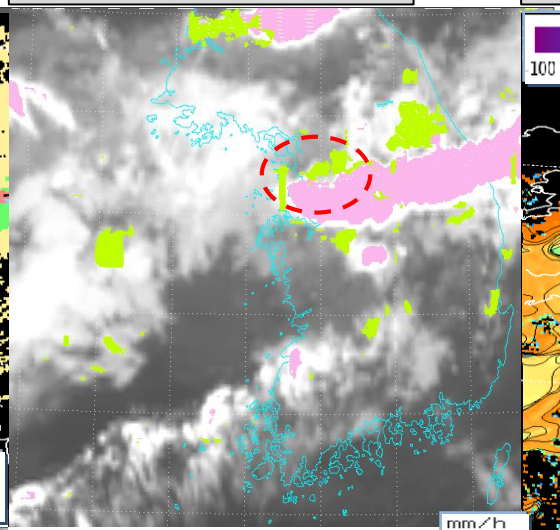
1900 UTC, July 21. 2013

Cloud Phase

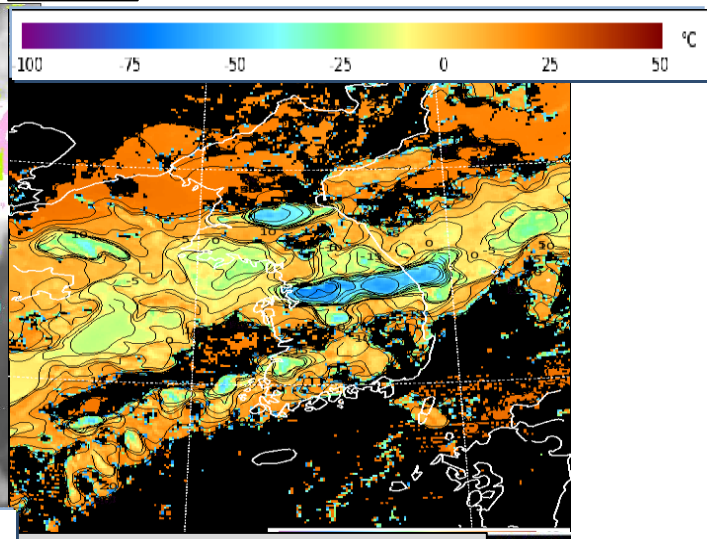




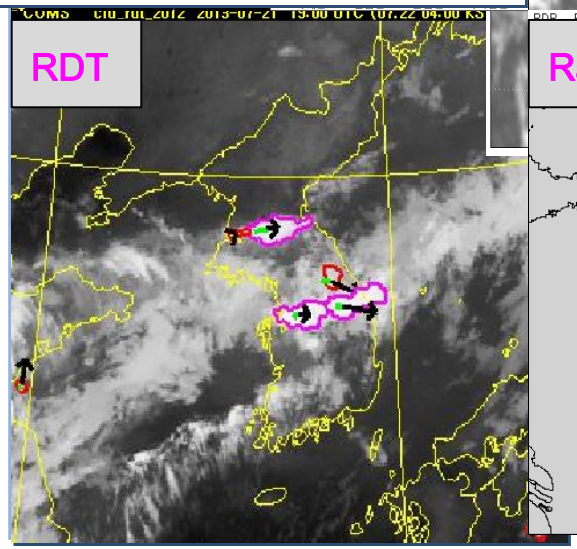
Convective Initiation



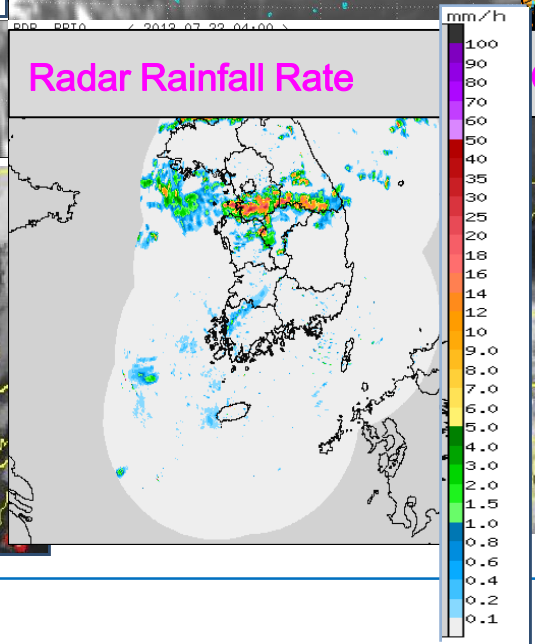
CTT



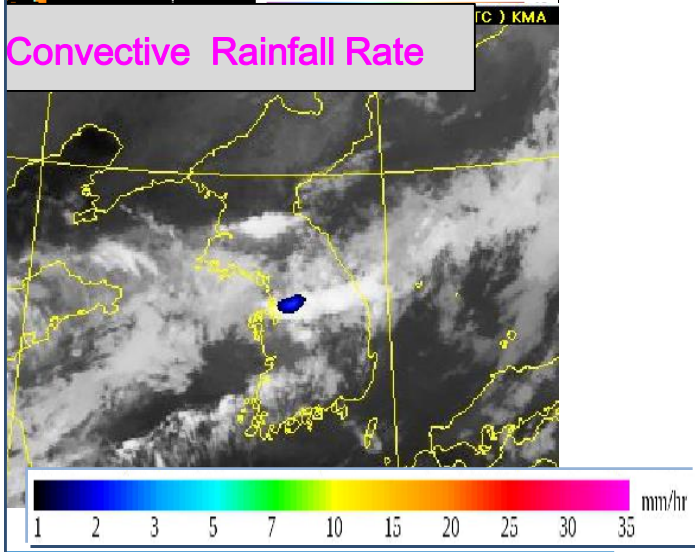
RDT



Radar Rainfall Rate

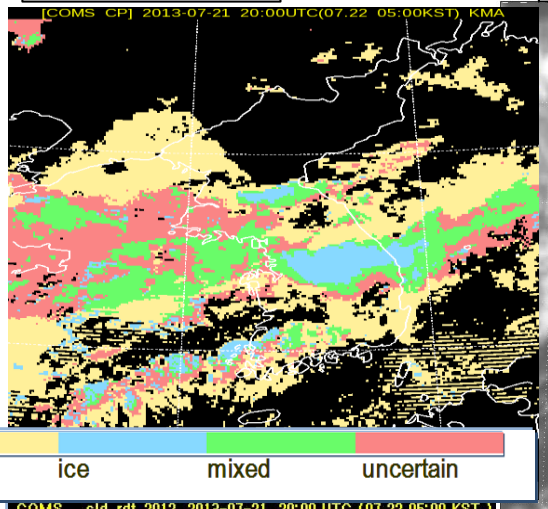


Convective Rainfall Rate

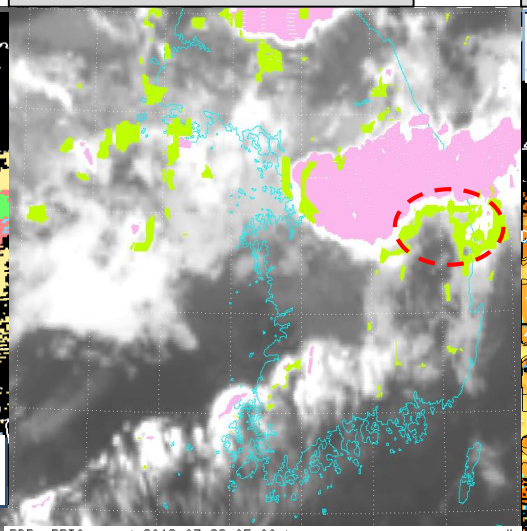


2000 UTC, July 21. 2013

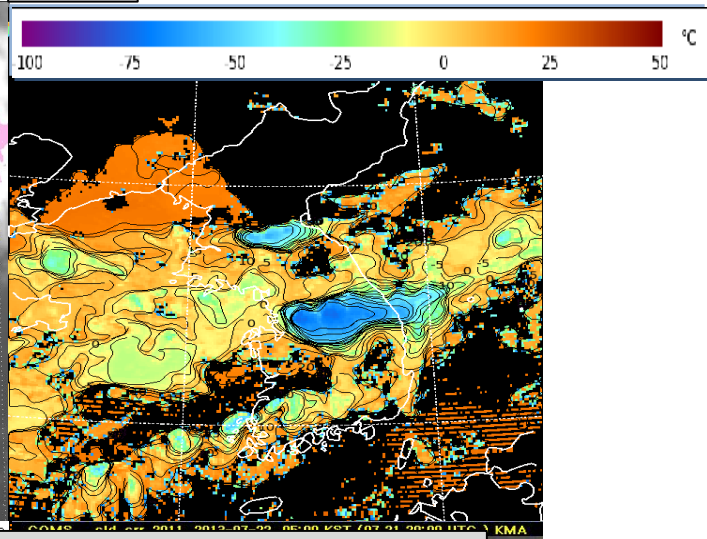
Cloud Phase



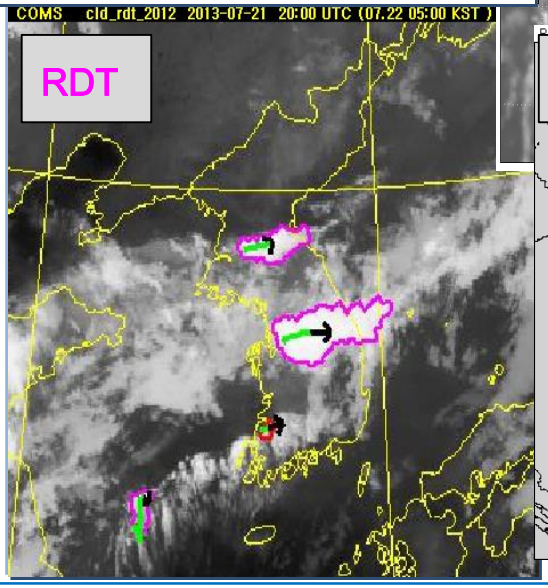
Convective Initiation



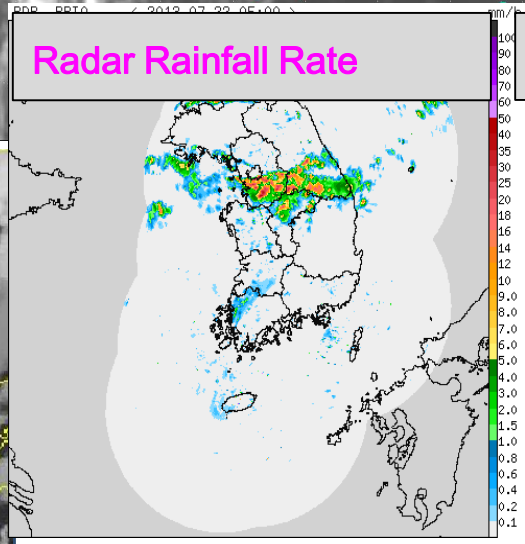
CTT



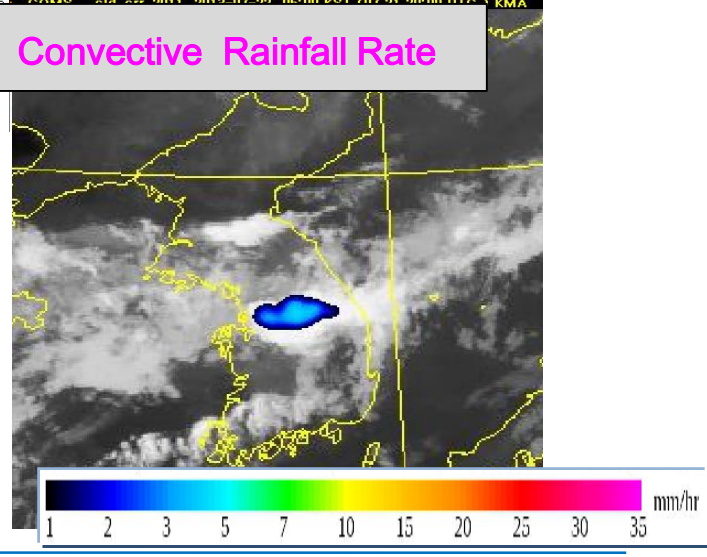
RDT



Radar Rainfall Rate

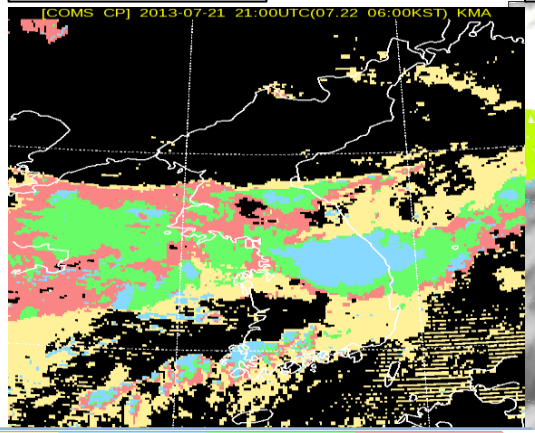


Convective Rainfall Rate

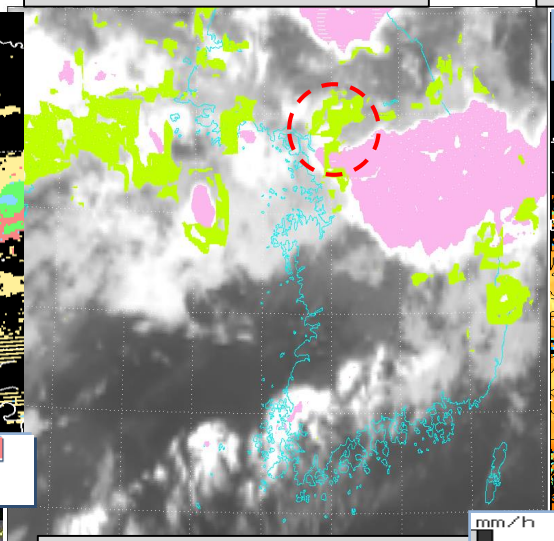


2100 UTC, July 21. 2013

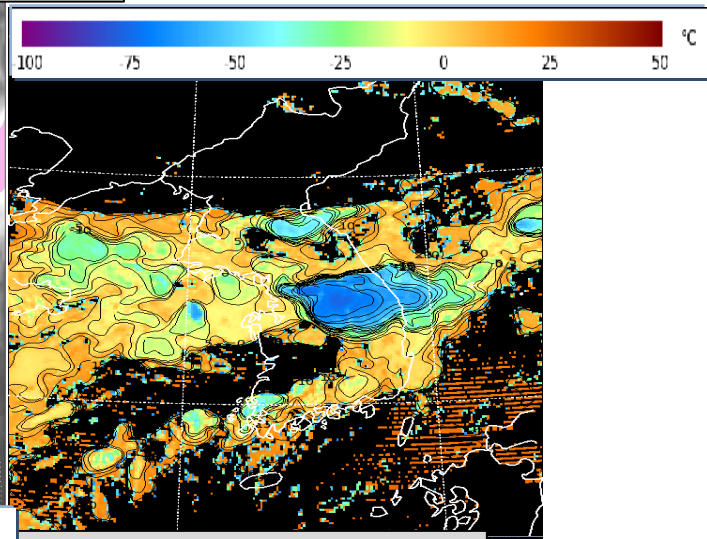
Cloud Phase



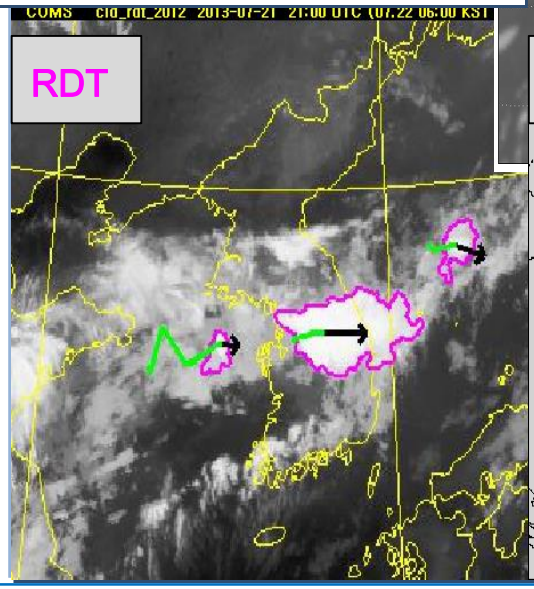
Convective Initiation



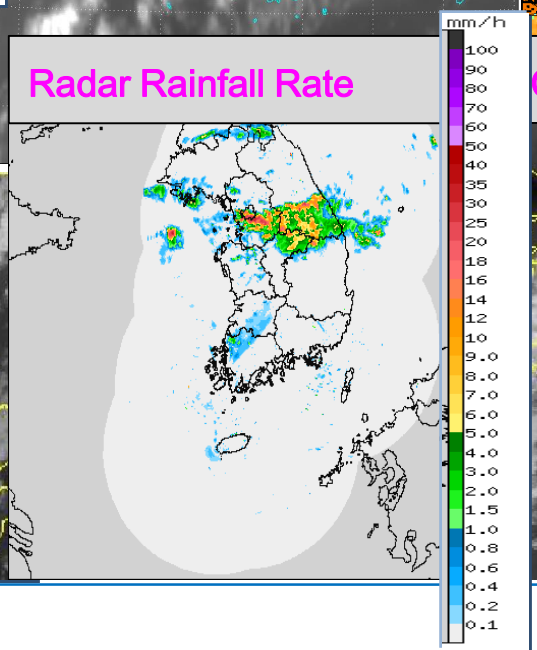
CTT



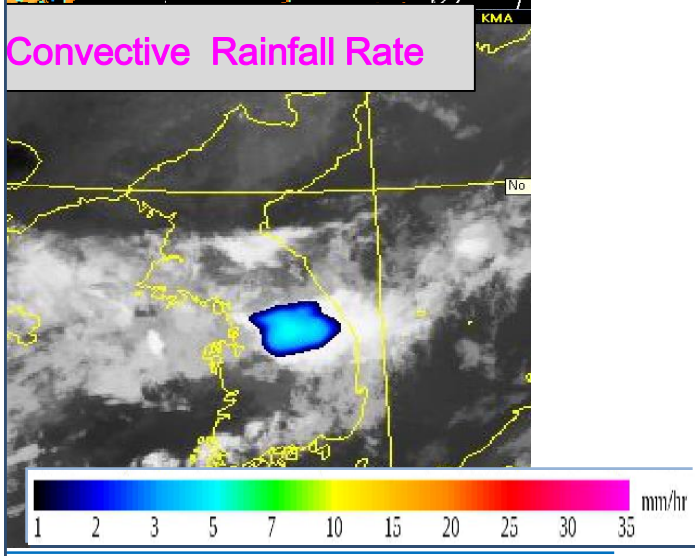
RDT



Radar Rainfall Rate

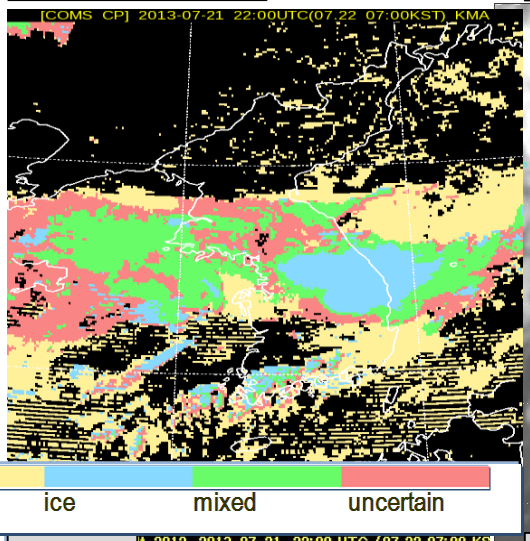


Convective Rainfall Rate

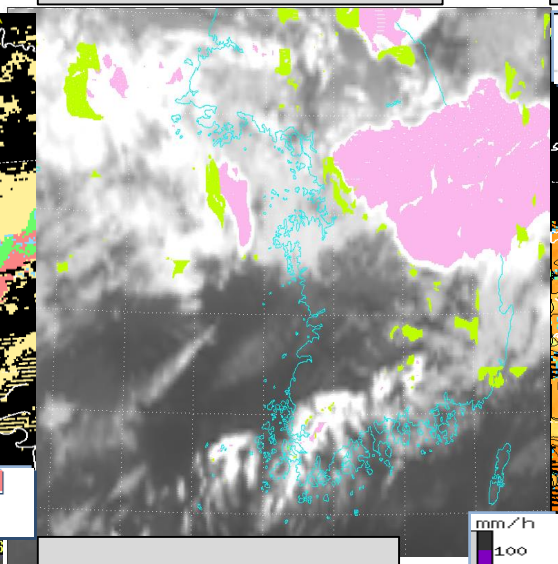


2200 UTC, July 21. 2013

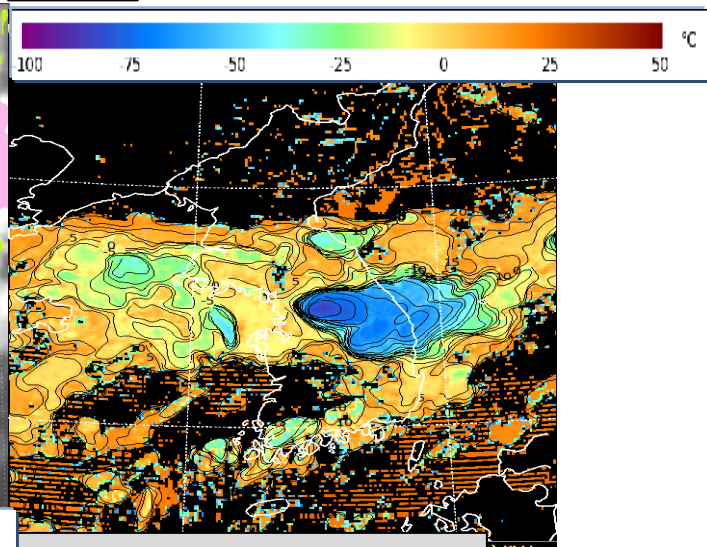
Cloud Phase



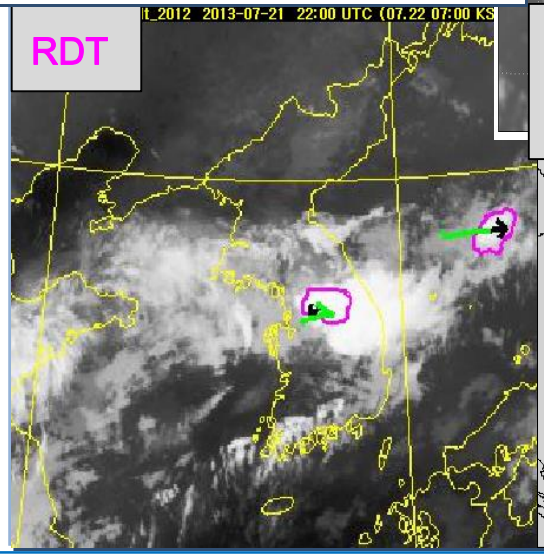
Convective Initiation



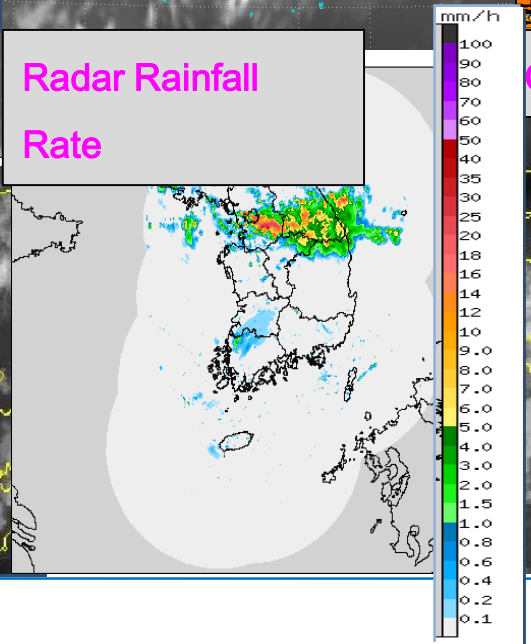
CTT



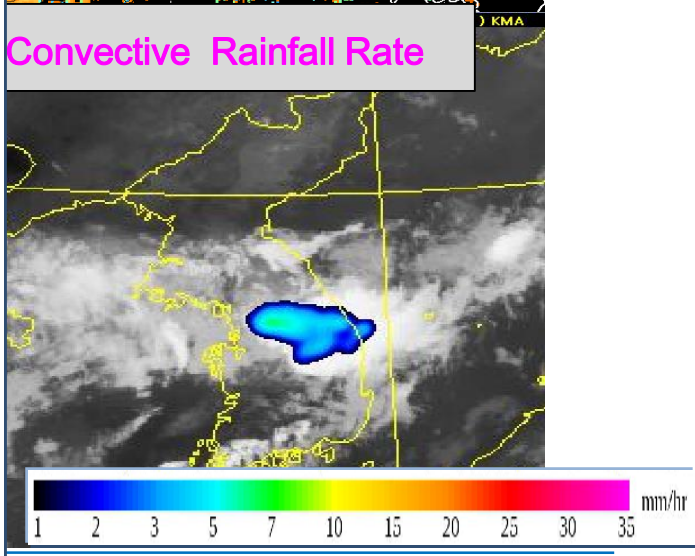
RDT



Radar Rainfall Rate

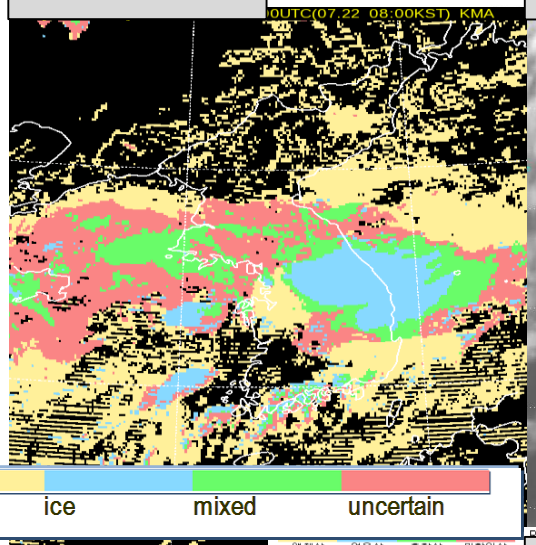


Convective Rainfall Rate



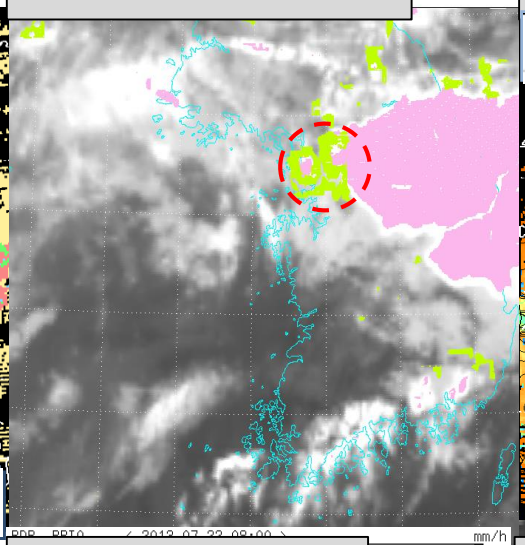
2300 UTC, July 21. 2013

Cloud Phase



water ice mixed uncertain

Convective Initiation



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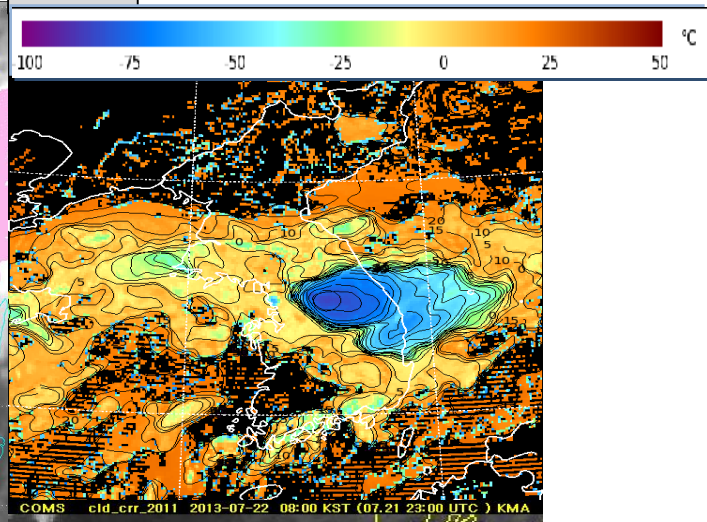

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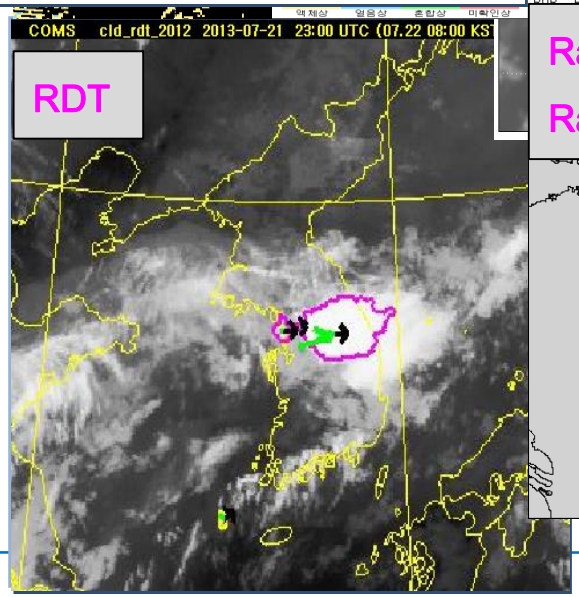
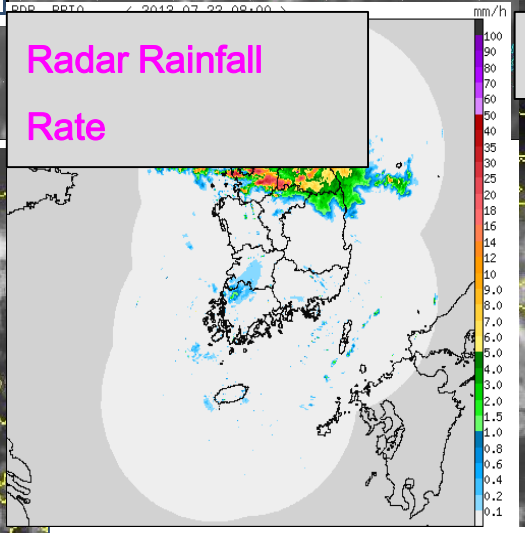
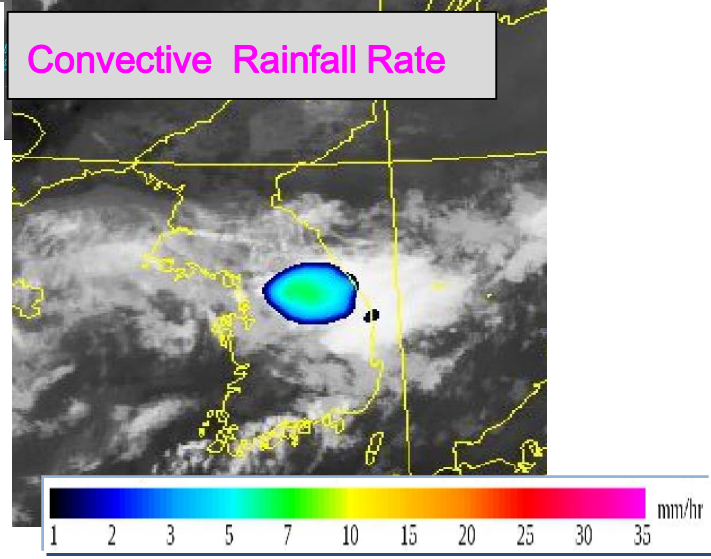


Radar Rainfall Rate

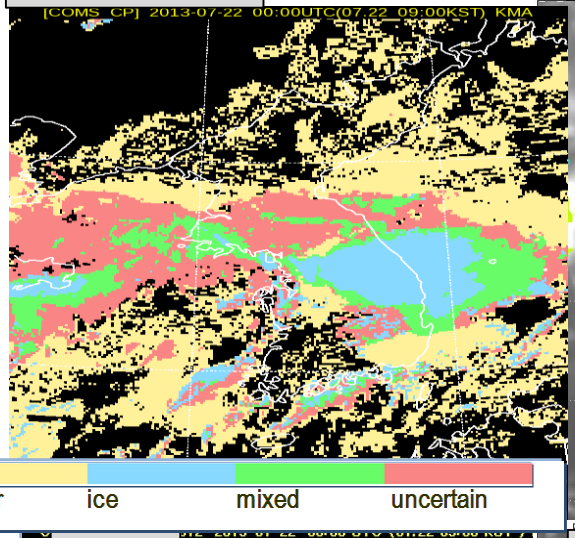


Convective Rainfall Rate

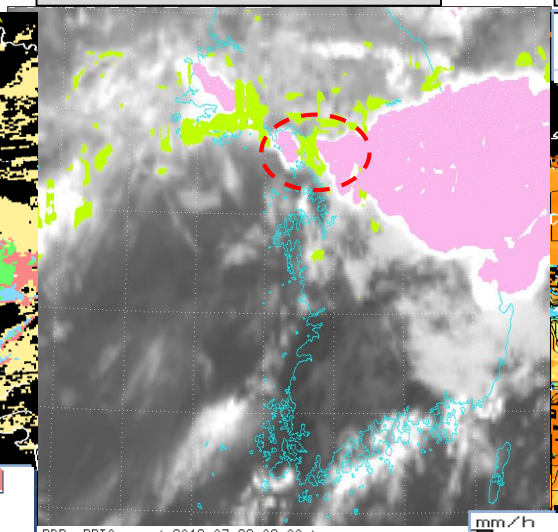


0000 UTC, July 22. 2013

Cloud Phase



Convective Initiation



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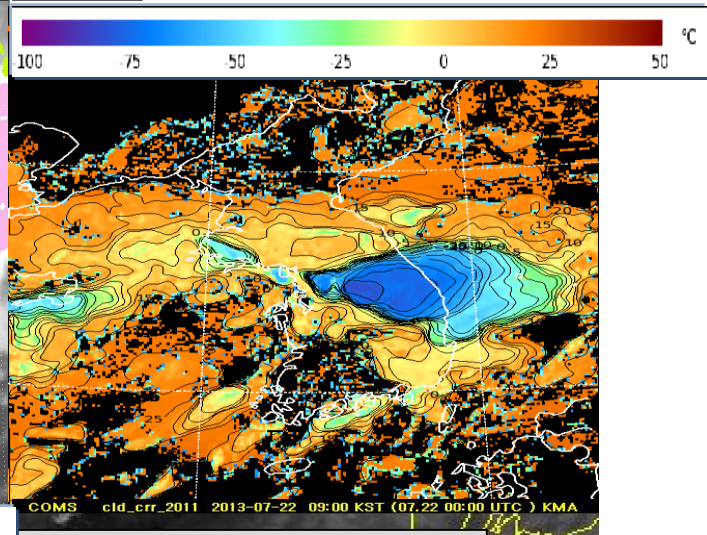

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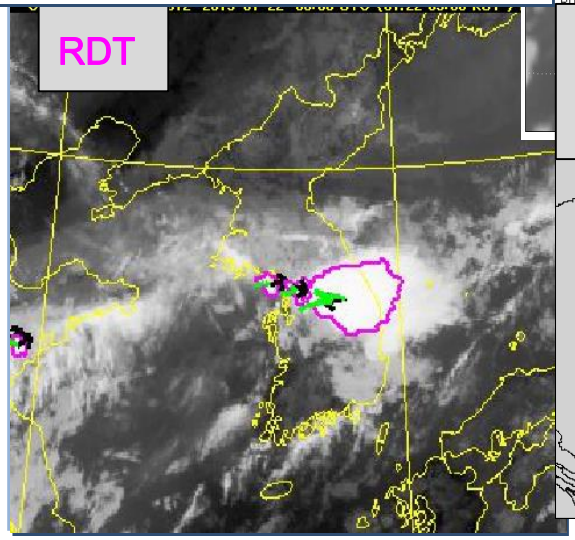
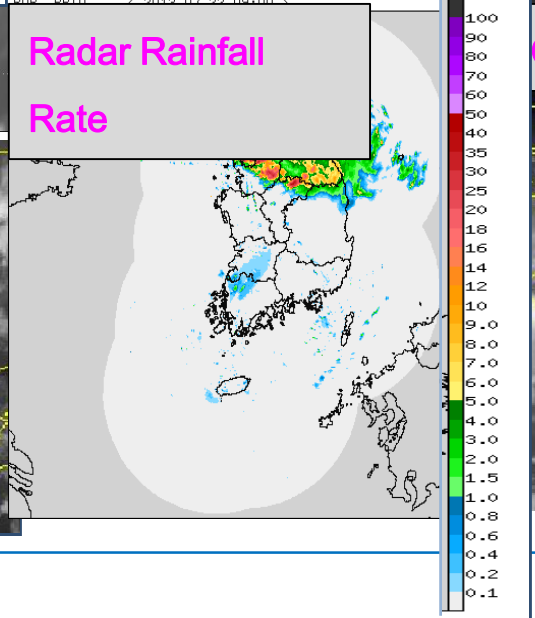
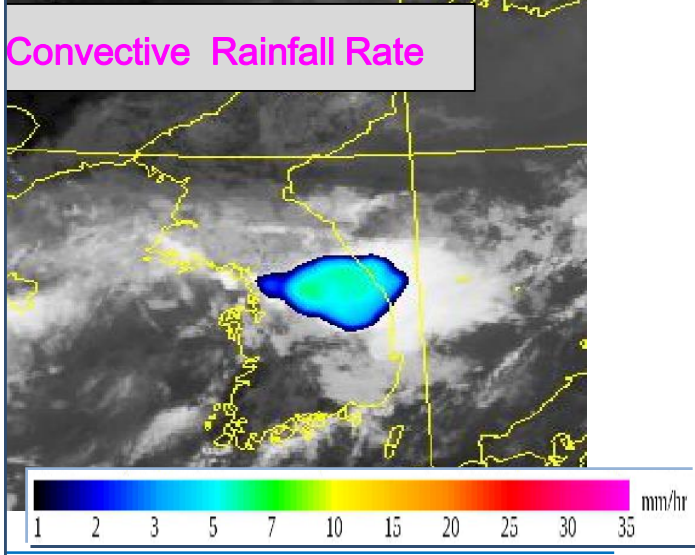


Radar Rainfall Rate

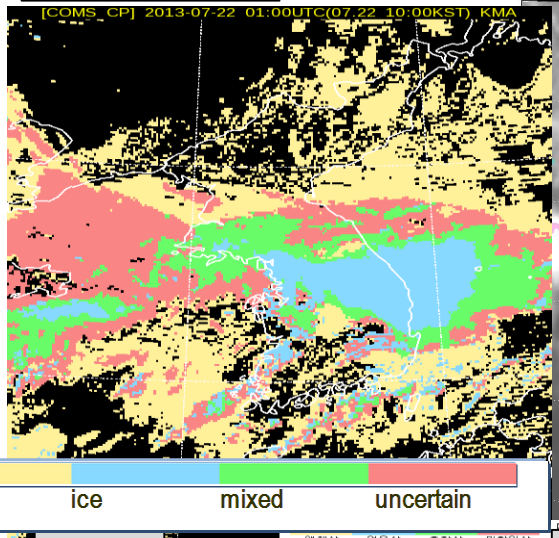


Convective Rainfall Rate

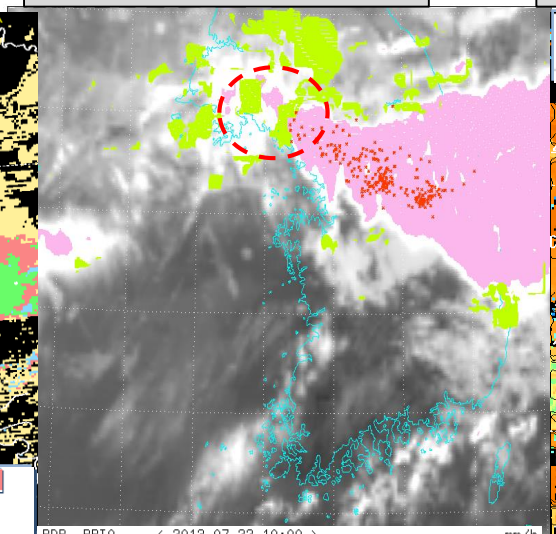


0100 UTC, July 22. 2013

Cloud Phase



Convective Initiation



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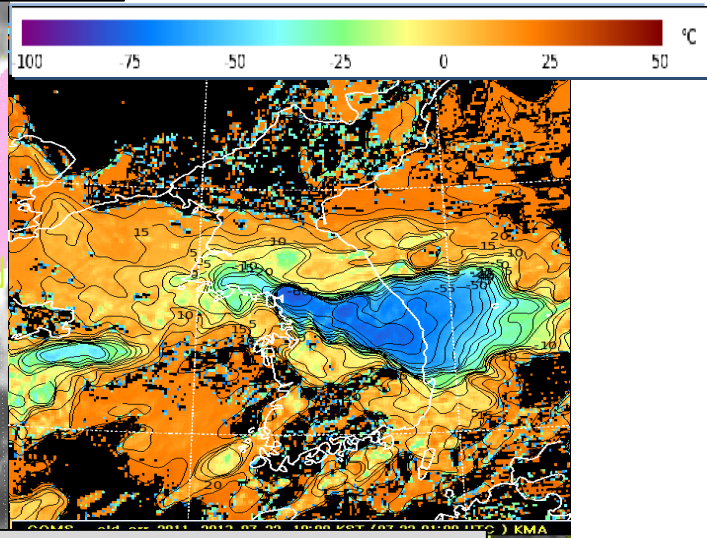
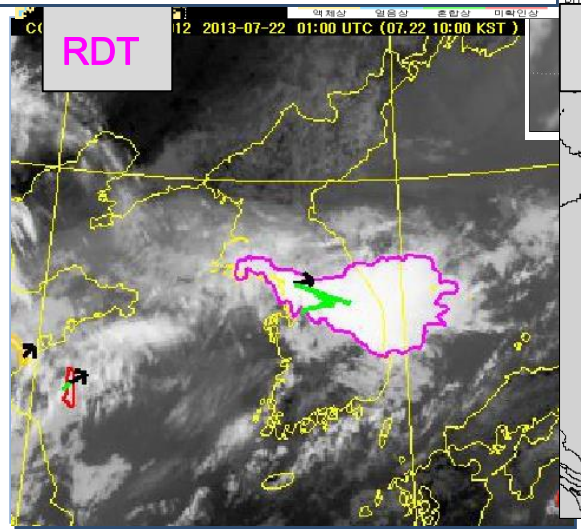
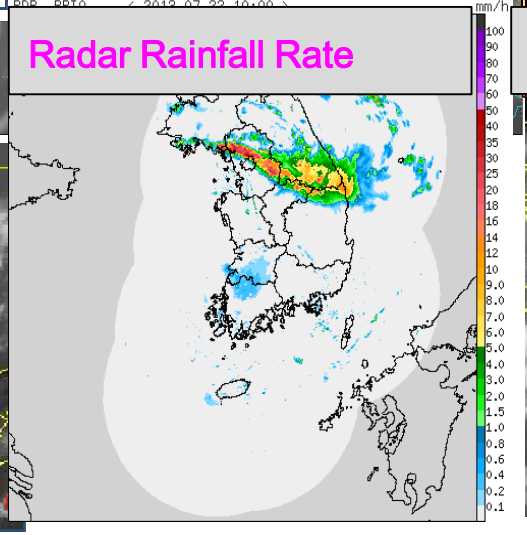


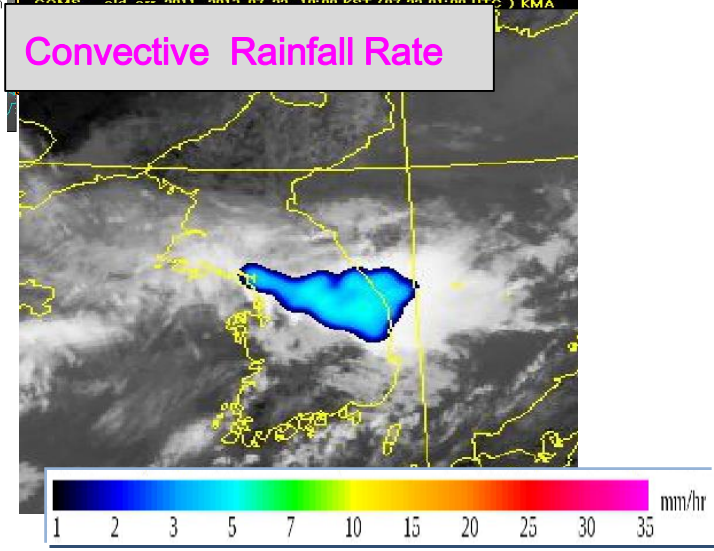
RDT



Radar Rainfall Rate

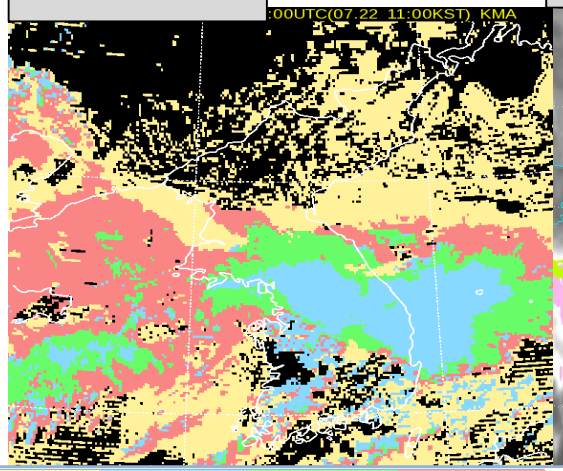


Convective Rainfall Rate



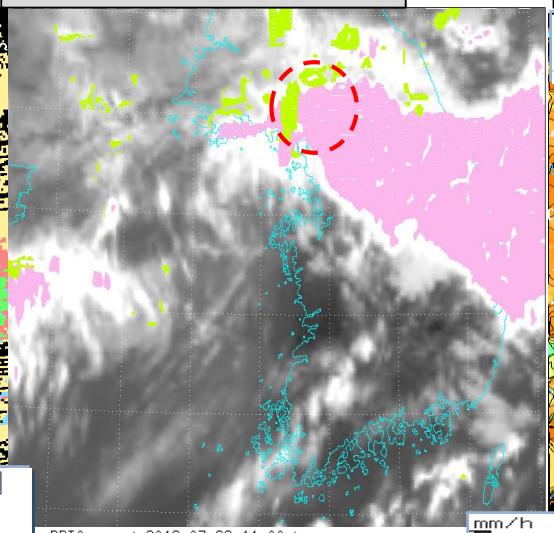
0200 UTC, July 22. 2013

Cloud Phase



water ice mixed uncertain

Convective Initiation



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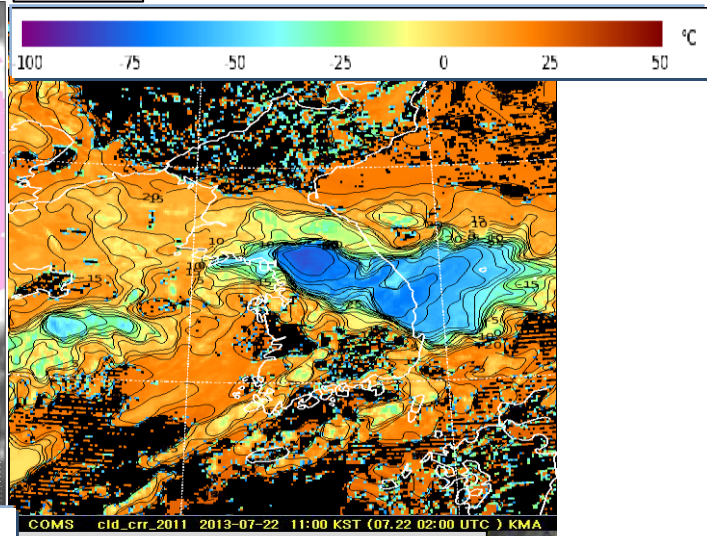
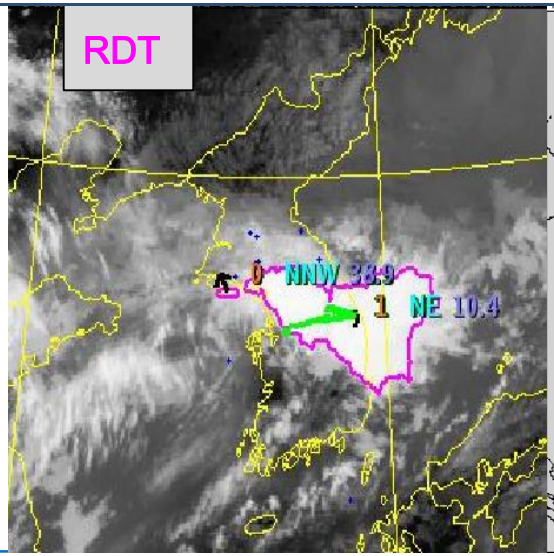
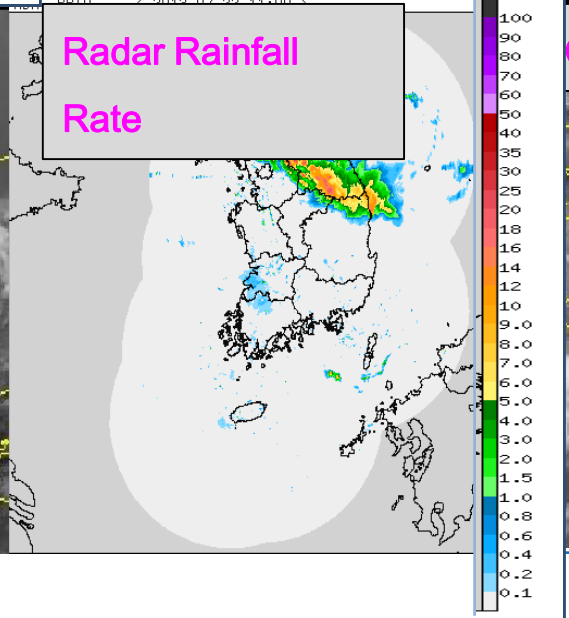


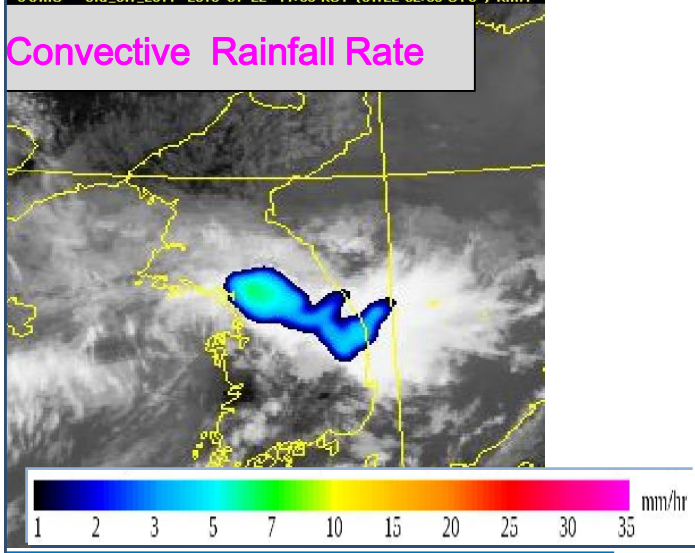
RDT



Radar Rainfall Rate

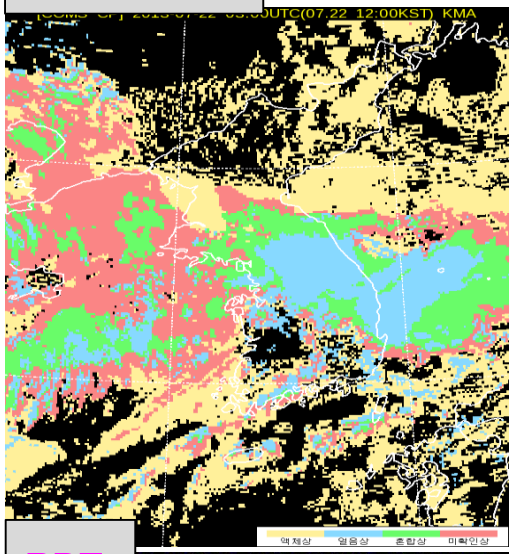


Convective Rainfall Rate

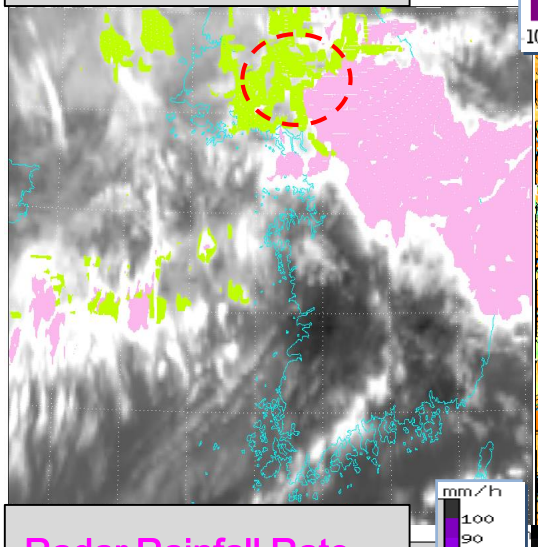


0300 UTC, July 22. 2013

Cloud Phase



Convective Initiation



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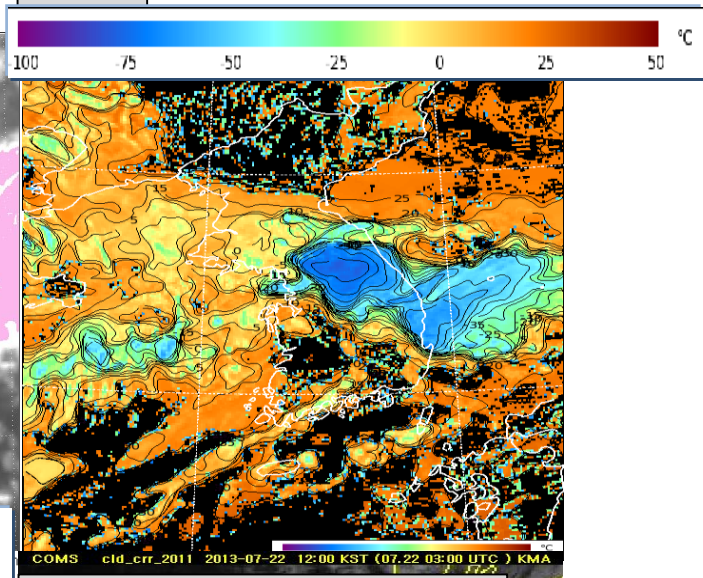
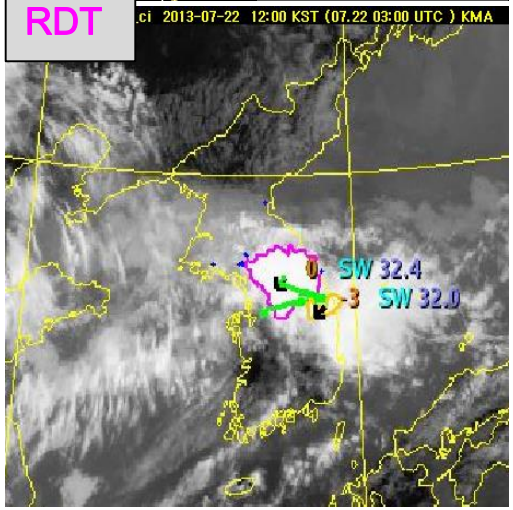
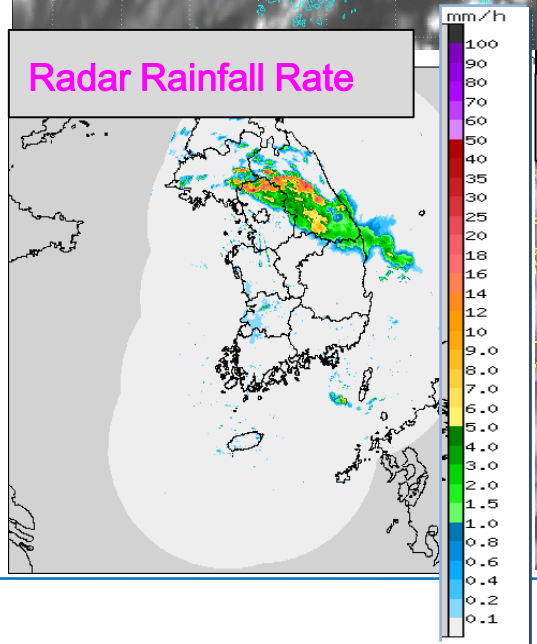


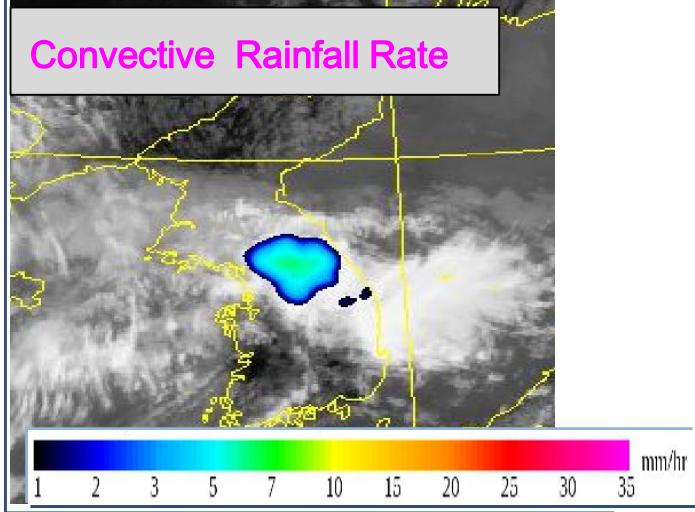
RDT



Radar Rainfall Rate



Convective Rainfall Rate




기상청
Korea Meteorological Administration
Thank you