Application of NWC SAF in NMSC/KMA

Eunha Sohn
Satellite Analysis Division
National Meteorological Satellite Center / KMA

EUMETrain NWC-SAF Event Week (21st November 2013, 09:00 UTC)

Who am I ?

Eunha Sohn

Satellite Analysis Division

National Meteorological Satellite Center / KMA

NMSC

National Meteorological Satellite Center

국가기상위성센터
National Meteorological Satellite Center

1. Location

- Jincheon (100km from SEOUL to the south)

2. Organization & Personnel

- Established in April 2009
- 3 divisions and 43 employees

	Satellite planning division	Satellite operation division	Satellite analysis division
Quota(43) Current(43)	16/16	14/14	13/13

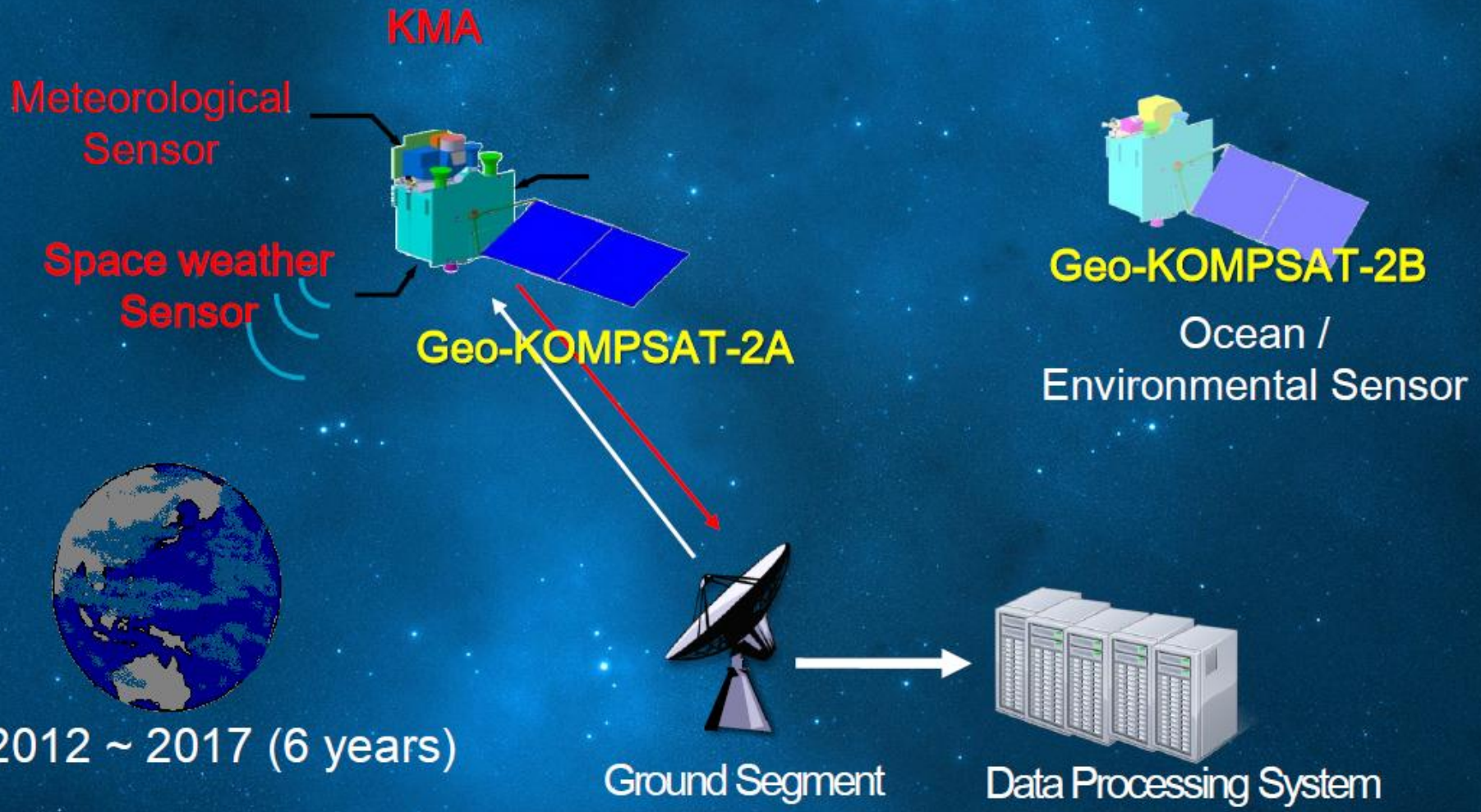
3. Major missions

- Meteorological Satellite Operation
- Satellite Data Reception / Processing / Analysis / Distribution to support forecasts
- Maintaining meteorological satellites
- International Cooperation
- User support activities

Geo-KOMPSAT-2 Program

국가기상위성센터
National Meteorological Satellite Center

→ GK-2A for the next generation Meteorological Imager
→ GK-2B for the Ocean and Atmospheric Trace Gas monitoring



GEO-KOMPSAT-2A payload

국가기상위성센터
National Meteorological Satellite Center

16 channels

FPM	Band name	AMI(Geo-KOMPSAT-2A)		ABI(GOES-R)		AHI(Himawari-8/9)		MI (COMS)	
		Center Wavelength (μm)	Resolution (km)	Center Wavelength (μm)	Resolution (km)	Center Wavelength (μm)	Resolution (km)	Center Wavelength (μm)	Resolution (km)
VNIR	VIS0.4	0.47	1	0.47	1	0.46	1		
	VIS0.5	0.51	1			0.51	1		
	VIS0.6	0.64	0.5	0.64	0.5	0.64	0.5	0.675	2
	VIS0.8	0.856	1	0.865	1	0.86	1		
	NIR1.3	1.378	2	1.378	2				
	NIR1.6	1.61	2	1.61	1	1.6	2		
	NIR2.2			2.25	2	2.3	2		
MWIR	IR3.8	3.9	2	3.9	2	3.9	2	3.75	4
	IR6.3	6.185	2	6.185	2	6.2	2		
	IR6.9	6.95	2	6.95	2	7.0	2	6.75	4
	IR7.3	7.34	2	7.34	2	7.3	2		
	IR8.7	8.5	2	8.5	2	8.6	2		
LWIR	IR9.6	9.61	2	9.61	2	9.6	2		
	IR10.5	10.35	2	10.35	2	10.4	2	10.8	4
	IR11.2	11.2	2	11.2	2	11.2	2		
	IR12.3	12.3	2	12.3	2	12.3	2	12.0	4
	IR13.3	13.3	2	13.3	2	13.3	2		

NWC SAF in NMSC/KMA

- **NWC SAF package was introduced in 2009.**
- **CRR, ASII and RDT (NWC SAF PGE modules) was tested using MTSAT data in 2010.**
- **NWC SAF products have been produced using COMS data since April 1st 2011.**

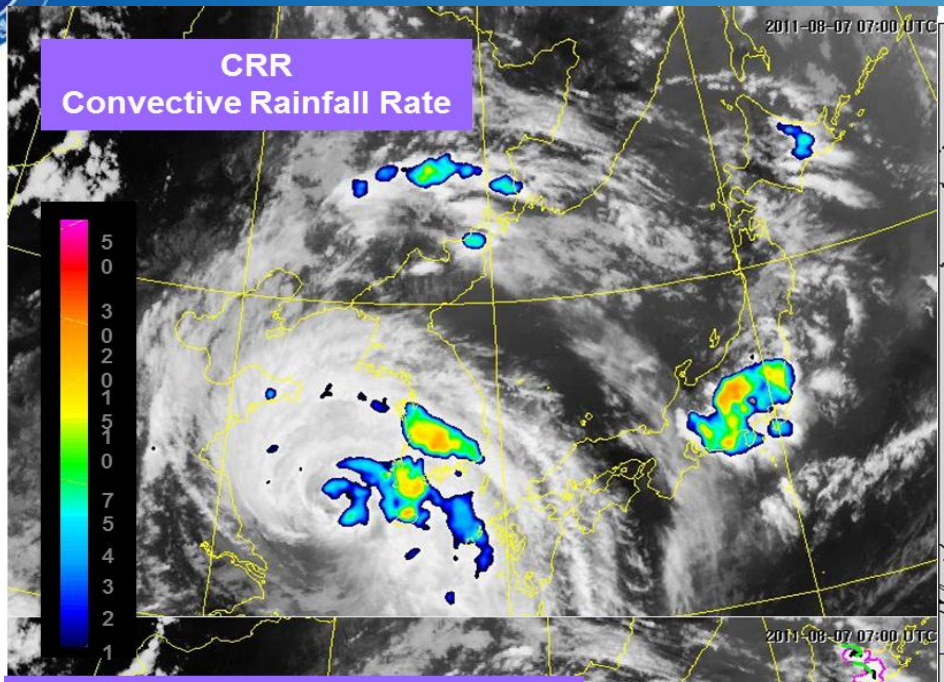
- **Visits to ZAMG (Austrian Meteorological Agency)**
  - Period : September 29, 2012 - October 21, 2012 (3 Weeks)
  - Visitors / Place : Ok-Hee Kim, Eunha Sohn / ZAMG (Vienna)
  - Discussion on the development status of ASII (PGE10) in ZAMG and operational application of manual SATREP in NMSC/KMA.
- 2013 World Wide Weather Briefing by EUMETrain
  - Period : May 20~24 2013
  - Participants : Ok-Hee Kim
  - Subjects : Satellite image-based Asian dust and Typhoon analysis in NMSC.

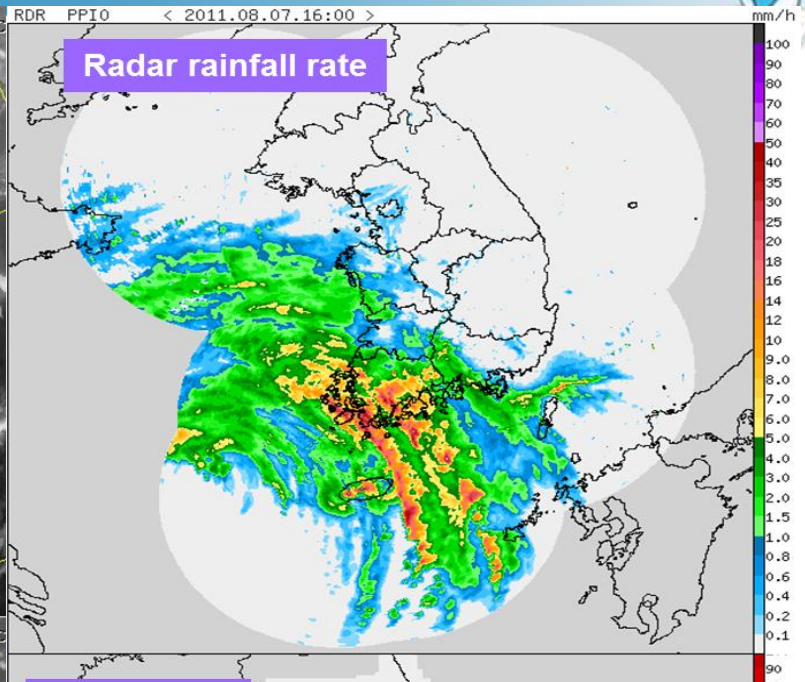
NWC SAF in NMSC/KMA

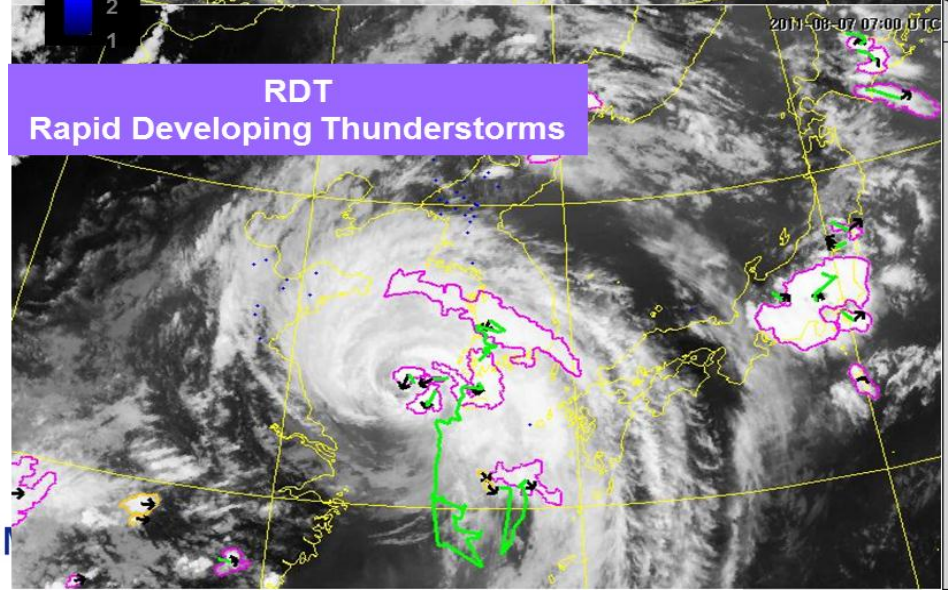
- **Adaption to COMS data and modification parts of PGE modules including:**
  - **PGE05(CRR) : Changes of CM (Calibrated Matrix) using radar data over Korea.**
    Validation with ground observation(AWS rain-rate)
  - **PGE10(ASII) : Adjustment of some thresholds in concept models of ASII.**
    Case study and validation using SATREP at NMSC.
  - **PGE11(RDT) : No changes in module but use of 3 COMS channels**
    MSG SEVIRI (WV6.2, WV7.3, IR12.0, IR8.7and IR10.8)
  - **PGE09(HRW) : Use of COMS cloud analysis data**
    Compare operational COMS wind with PGE09 HRW derived wind
- **NWC products with COMS data was upgraded to version 2012 in 2013.**
- **RDT, CRR, ASII has been producing every 15 min in NMSC.**

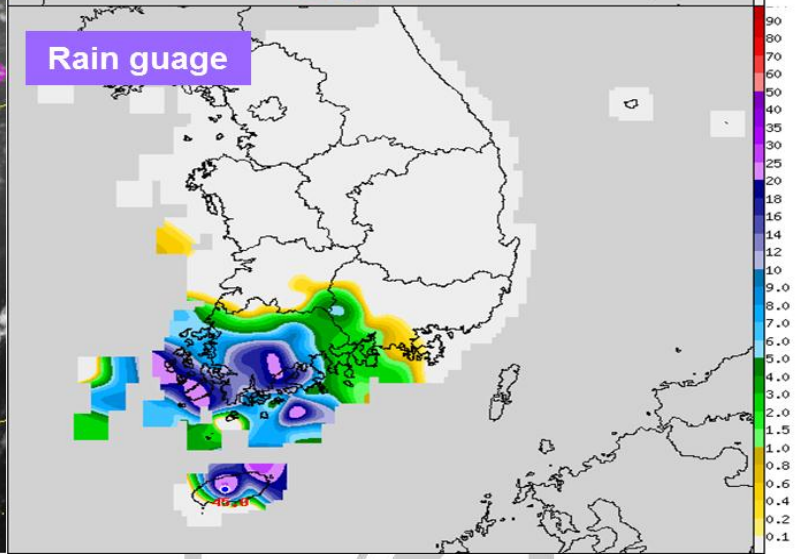
KMA Korea Meteorological Administration

PGE05 : CRR (Convective Rainfall Rate)



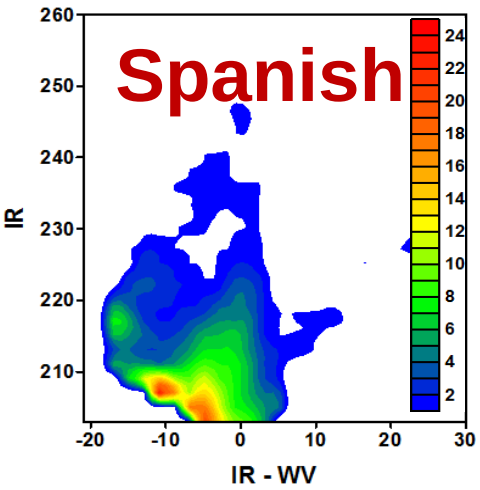


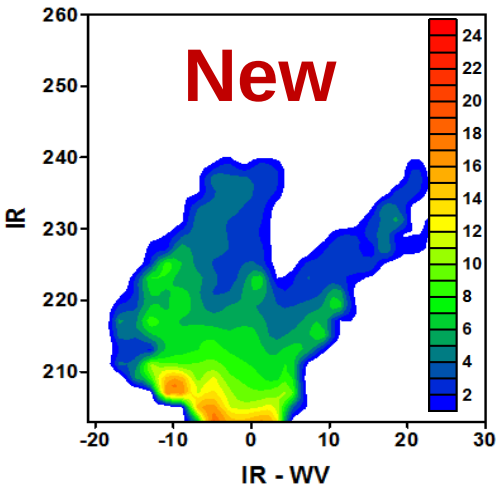




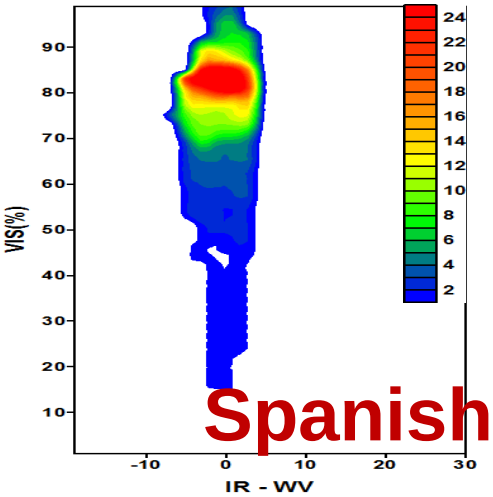
PGE05 : CRR (Convective Rainfall Rate)

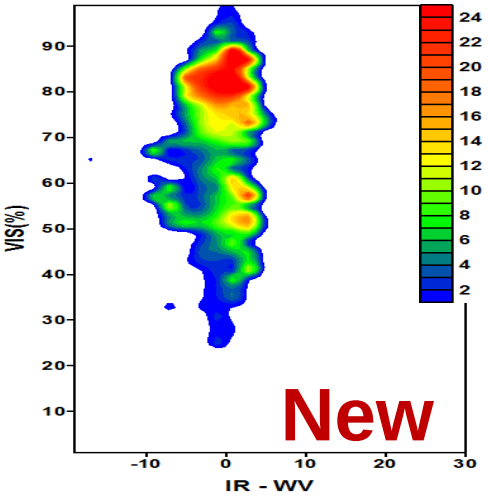
<2D CM>





<3D CM at 203K (IR TBB) >



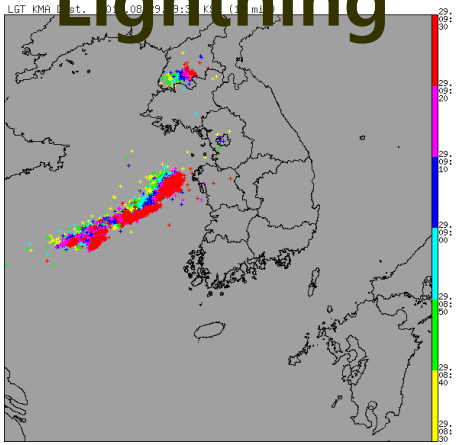


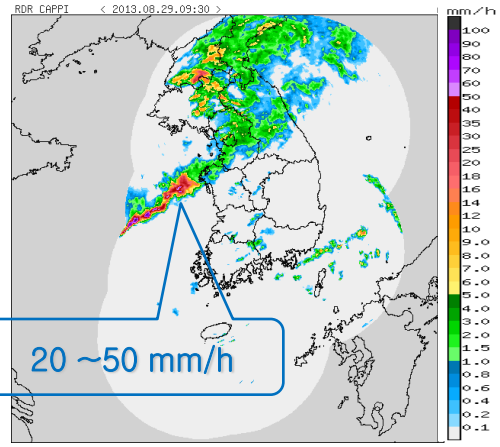
<Comparison of CRR accuracy for different CMs>

	POD(%)	FAR(%)	CSI(%)	ME	MAE	RMS
2D Spain	52.22	36.34	44.70	0.99	2.20	4.22
3D Spain	49.89	47.59	34.34	0.68	1.55	3.88
2D New	61.81	35.74	46.00	0.54	1.65	3.57
3D New	58.44	42.40	40.86	0.70	1.59	3.71

- NMSC/KMA with the new CM(Calibration Matrix) estimated Convective Rain rate using satellite data and Radar rainfall rate data.
- Consequently, the new CM exhibits the improved result

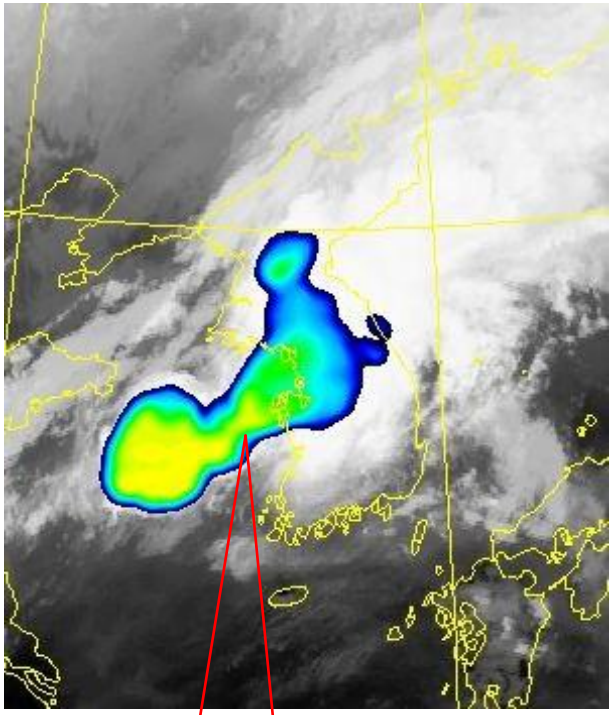
Lightning



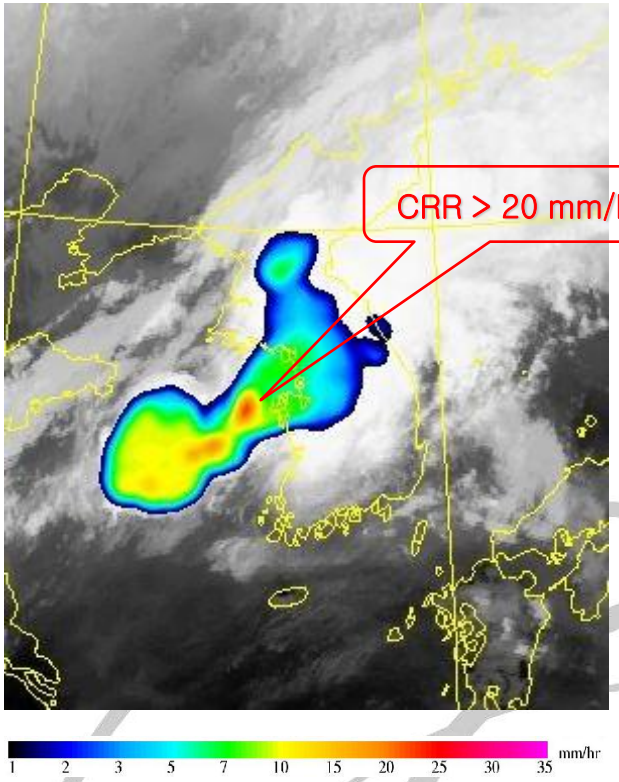


Radar

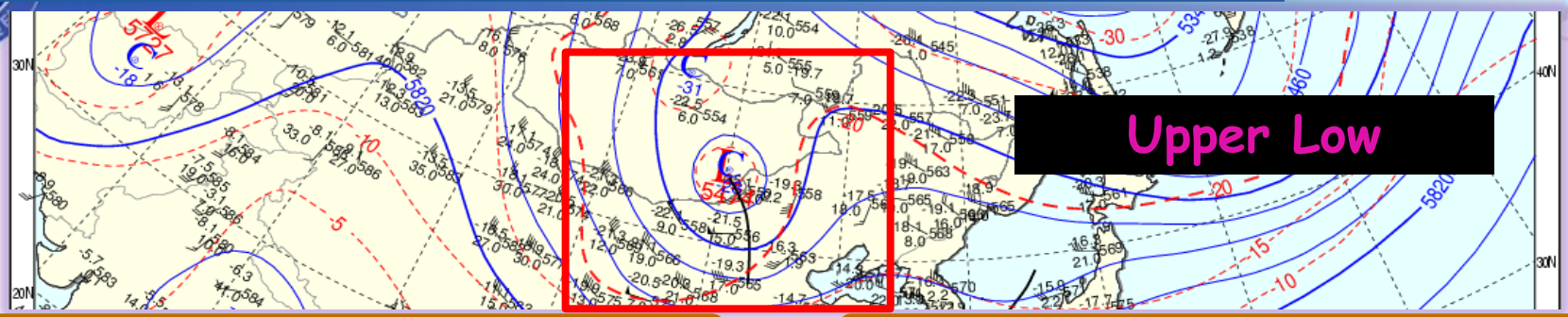
W/O lightning Correction



With lightning Correction

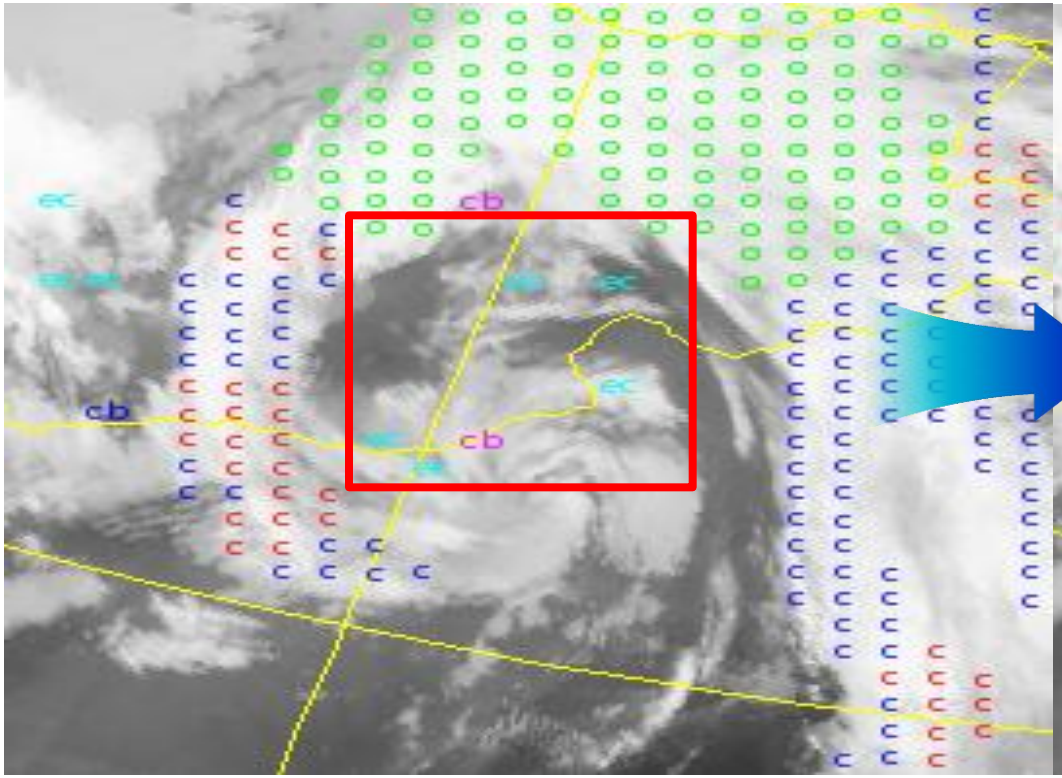


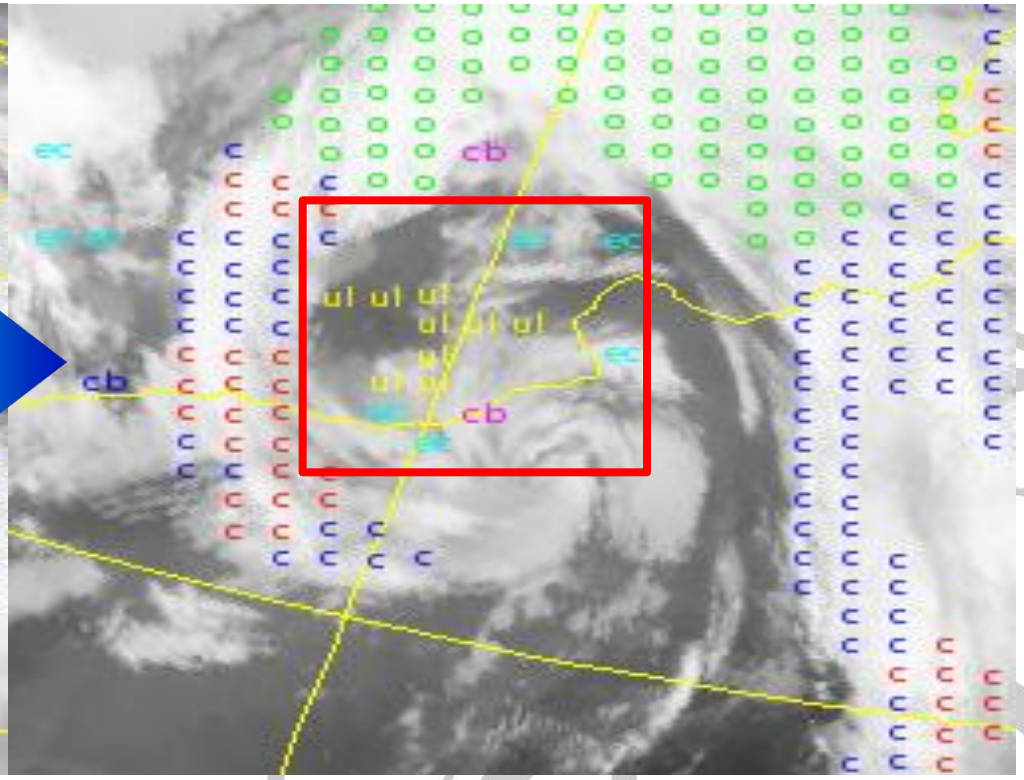
PGE10 : ASII (Automatic Satellite Image Interpretation)



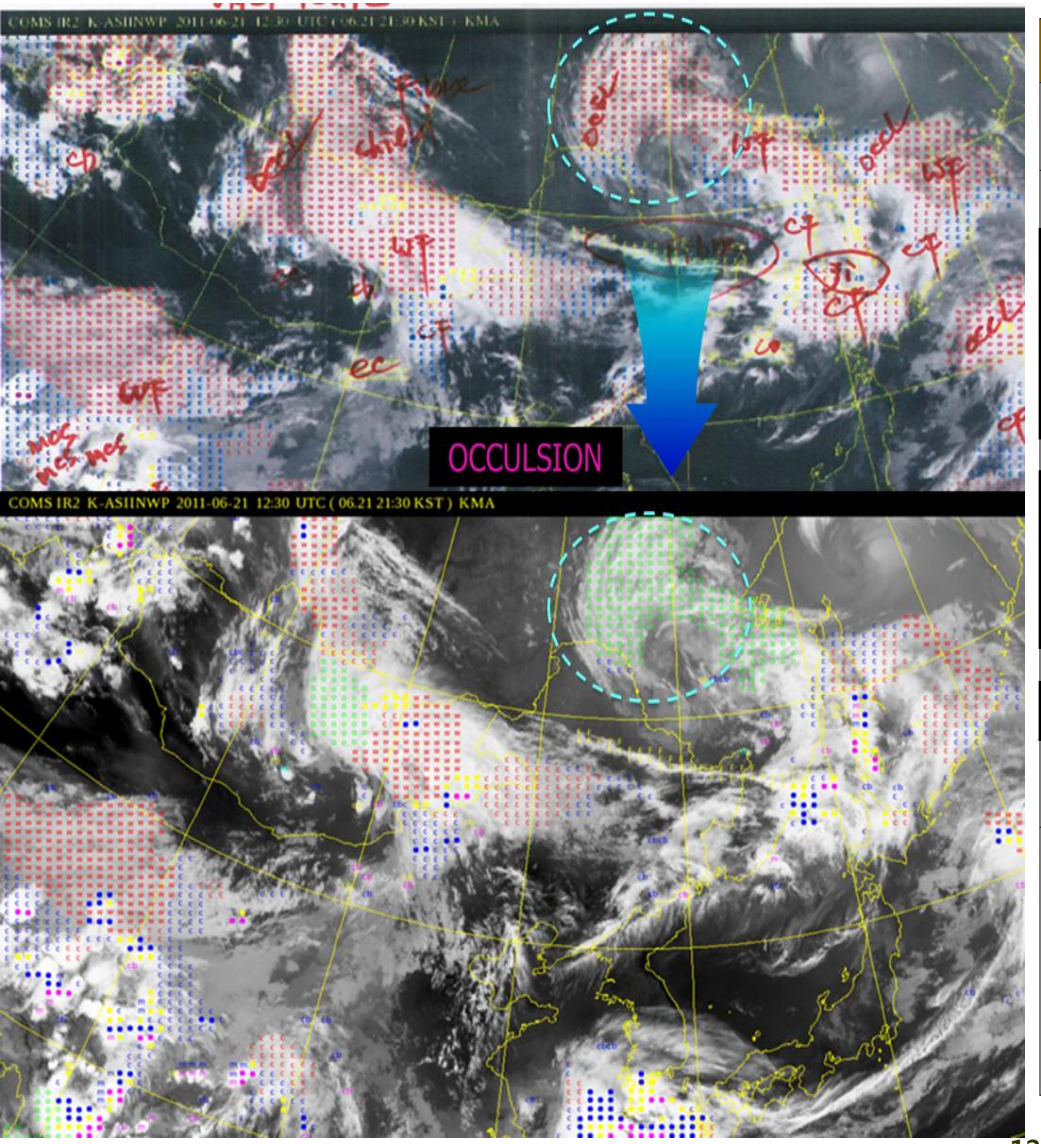
10. 13. 2011 0100UTC (old)

10. 13. 2011 0100UTC (New)





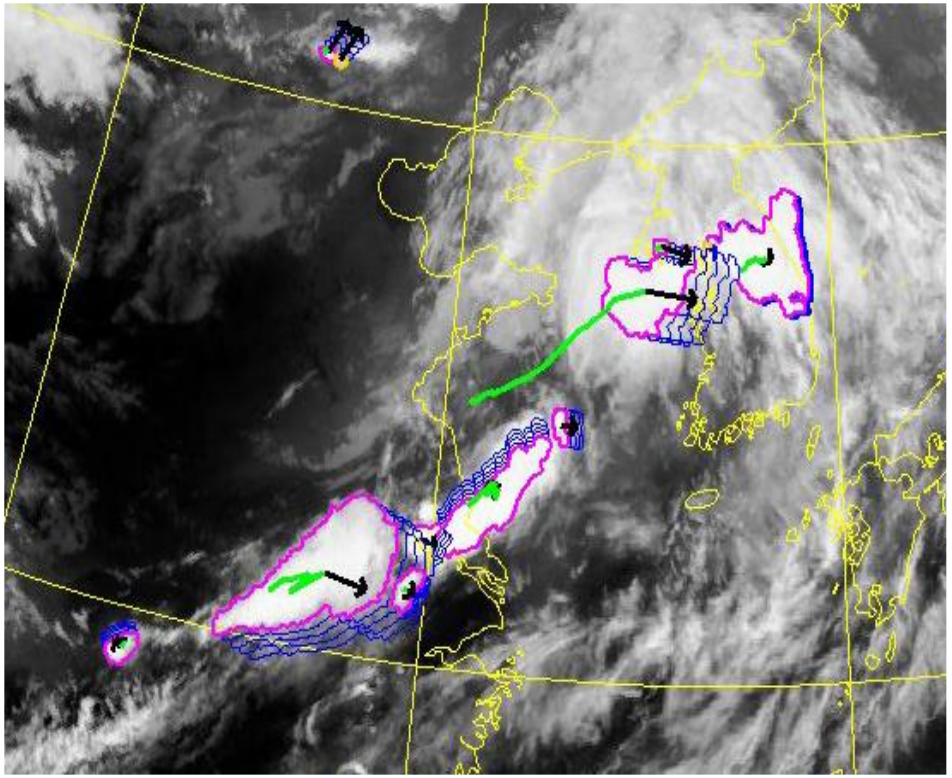
PGE10 : ASII (Automatic Satellite Image Interpretation)



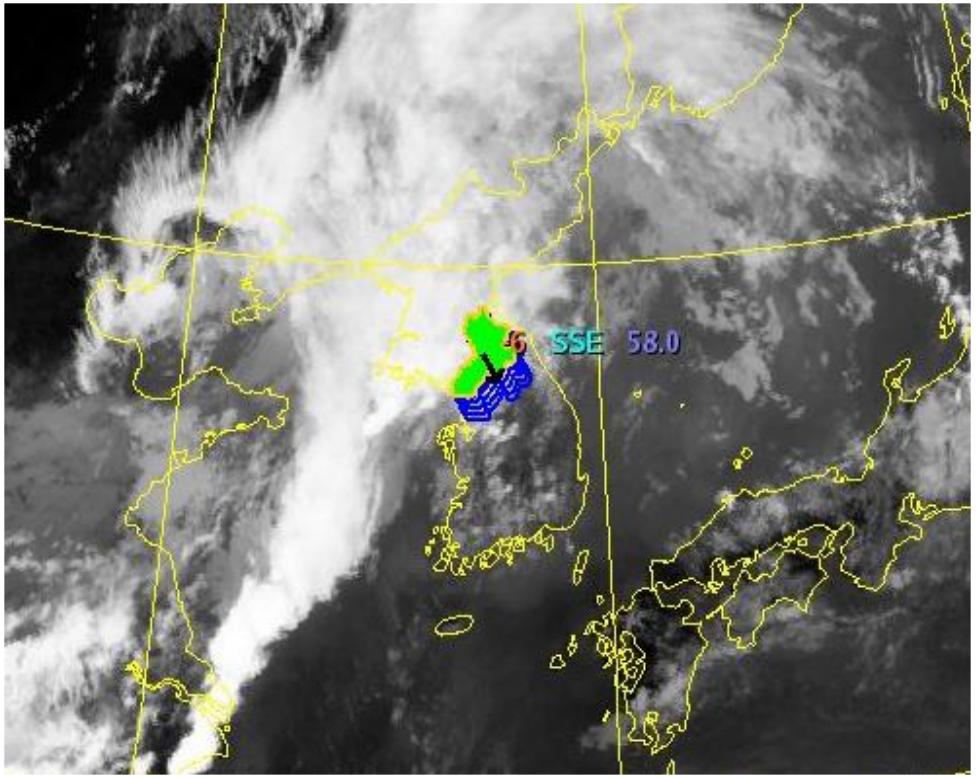
OLD		NEW	
4. OCCLUSION -- create attributes --			
let DIST(RV85)	= DISTMAX (RV850 4 0.06)	let DIST(RV85)	= DISTMAX (RV850 -6 0.06)
let DIST(RV500)	= DISTMAX (RV500 6 0.06)	let DIST(RV500)	= DISTMAX (RV500 -10 0.06)
		let DIST(PVA500)	= DISTMAX (PVA500 4 0.06)
let REG(RV85)	= BOOL_GT (DIST(RV85) 0.4)	let REG(RV85)	= BOOL_GT (DIST(RV85) 0.4)
let REG(RV500)	= BOOL_GT (DIST(RV500) 0.4)	let REG(RV500)	= BOOL_GT (DIST(RV500) 0.4)
		let REG(PVA500)	= BOOL_GT (PVA500 0.4)
		let REG(HH100)	= BOOL_LT (HH100 -3)
do	MULT (REG(RV85) REG(RV500))	do	MULT (REG(RV85) REG(RV500) REG(PVA500) REG(HH100))
let ZERO(RV500)	= BOOL_LT (ZER(RV500) 0.5)	let ZERO(RV500)	= BOOL_LT (ZER(RV500) 0.5)
let NEG(RV500)	= BOOL_GT (RV500 0)	let NEG(RV500)	= BOOL_GT (RV500 0)
do	MULT (NEG(RV500) ZERO(RV500))	do	MULT (NEG(RV500) ZERO(RV500))
4. OCCLUSION -- build probability --			
let P_NWP(OC)	= CREATE (11)	let P_NWP(OC)	= CREATE (11)
do	MULT (P_NWP(OC) REG(RV85))	do	MULT (P_NWP(OC) REG(RV85))
do	MULT (P_NWP(OC) NEG(RV500))	do	MULT (P_NWP(OC) NEG(RV500))
		do	MULT (P_NWP(OC) REG(PVA500))
		do	MULT (P_NWP(OC) REG(HH100))

PGE11 : RDT (Rapid Developing Thunderstorms)

Detection and Prediction of convective cloud



Cloud top cooling rate (ºC /hr)

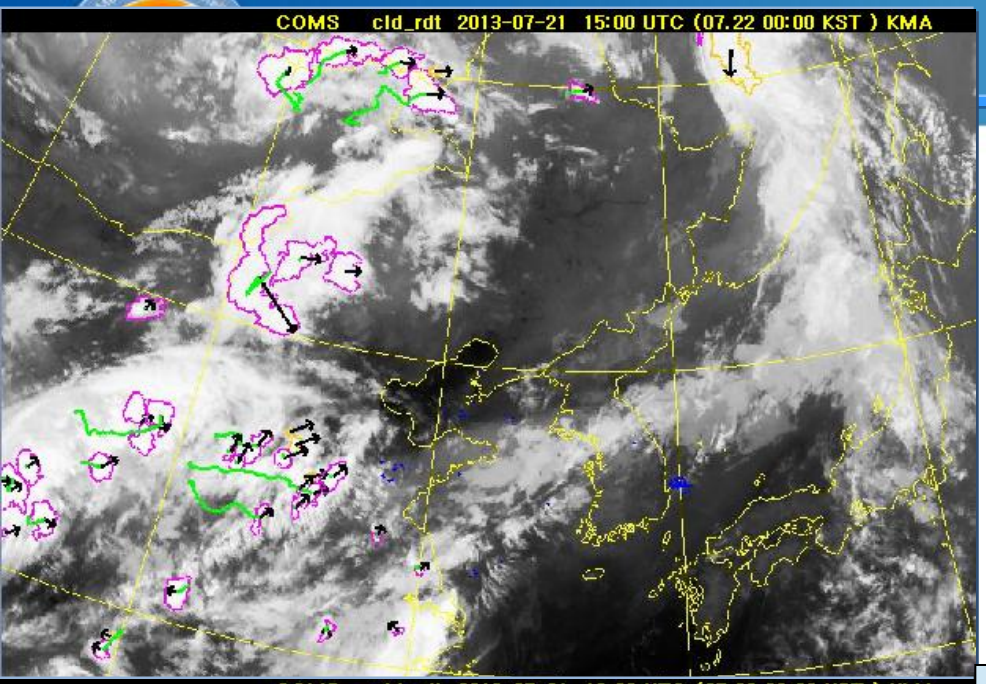


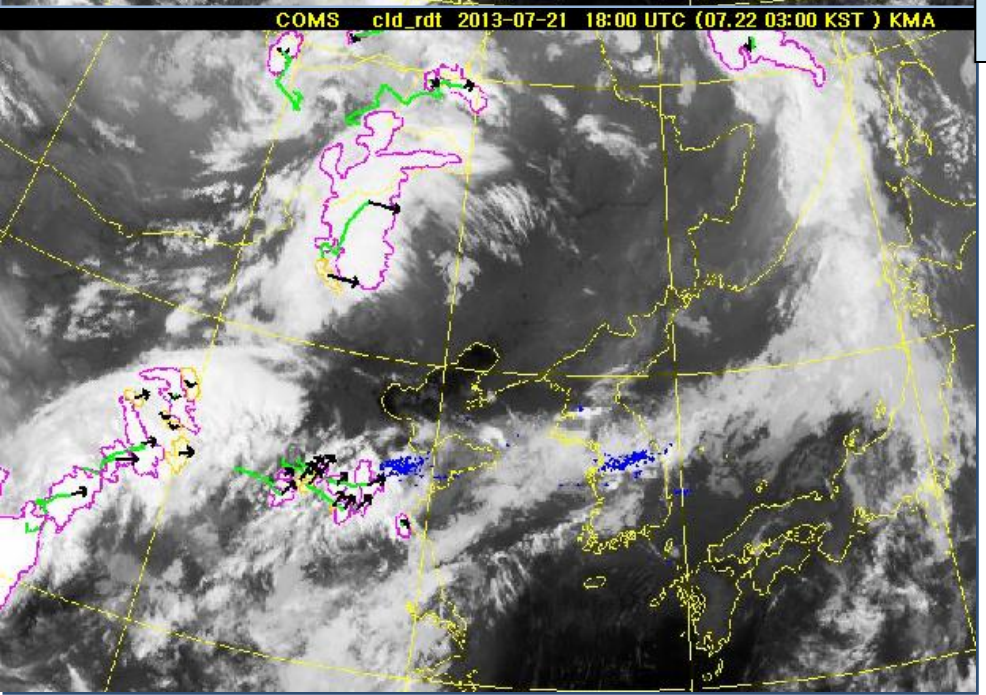
KP was affected because convective clouds system is moving westerly with heavy rainfall. Accordingly, it has been monitored with caution. Blue-colored boundary lines in the left-hand side figure represent the predicted location of convective clouds after 15, 30, 45 and 60 minutes. Otherwise, in the right-hand side figure, the numbers mean the cloud top cooling rate, direction, and velocity of convective clouds respectively.

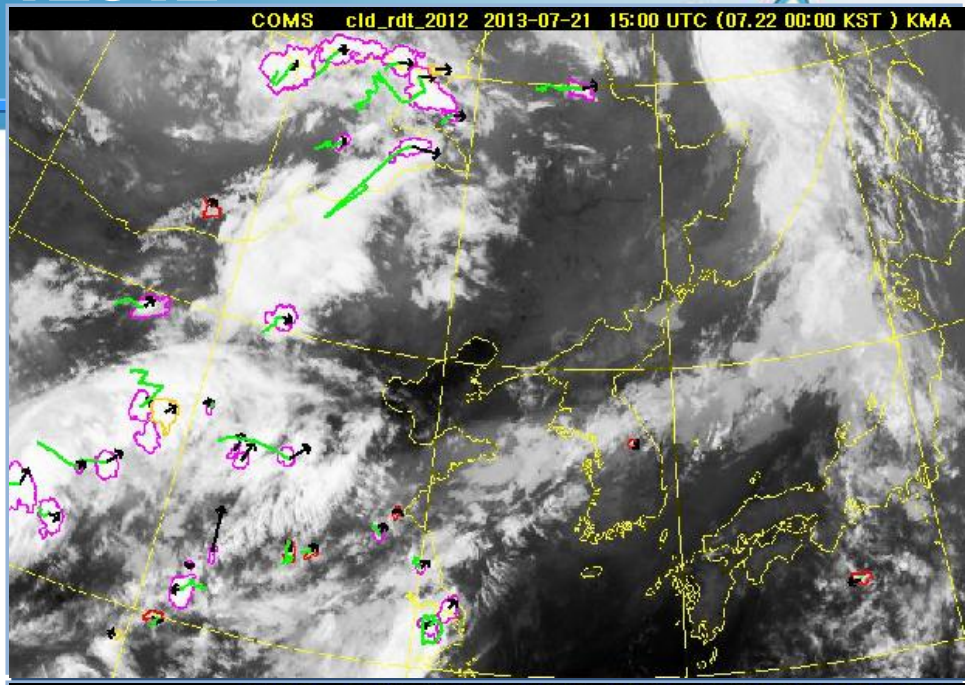
Developing cloud | Decaying cloud | direction | lightening | Traveling route

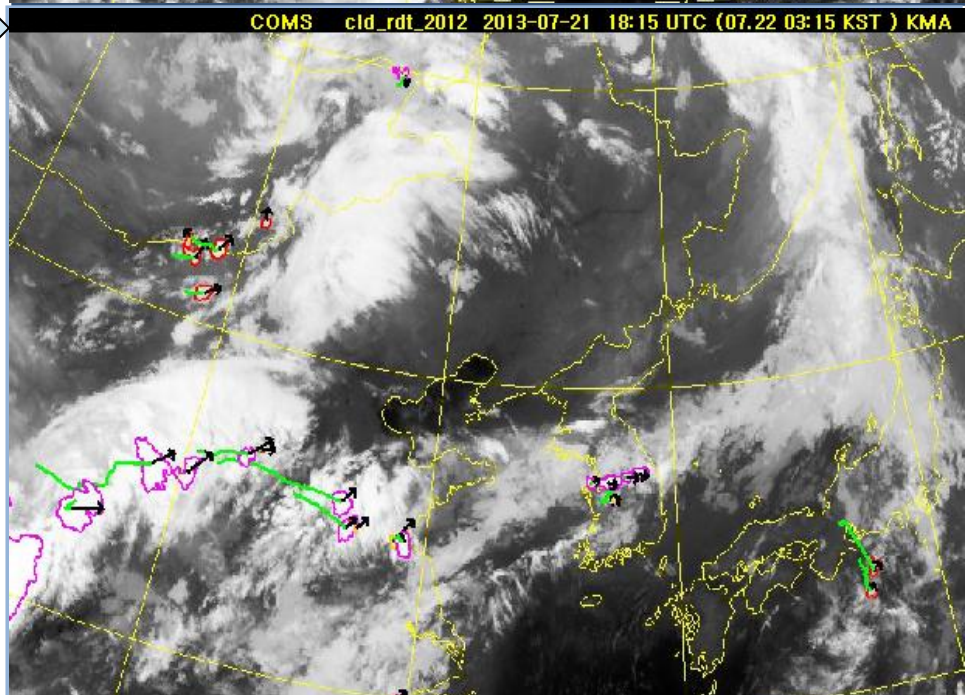
v2009

v2012


COMS cld_rdt 2013-07-21 15:00 UTC (07.22 00:00 KST) KMA

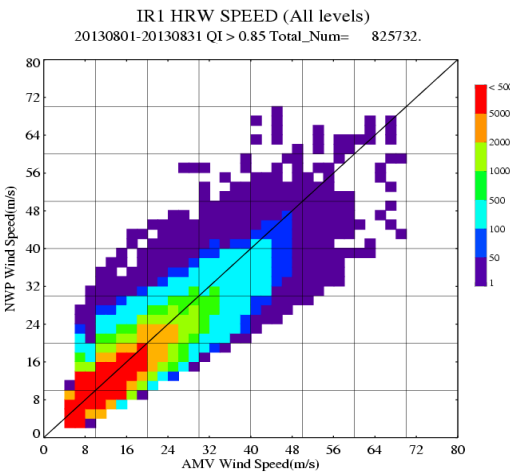

COMS cld_rdt 2013-07-21 18:00 UTC (07.22 03:00 KST) KMA

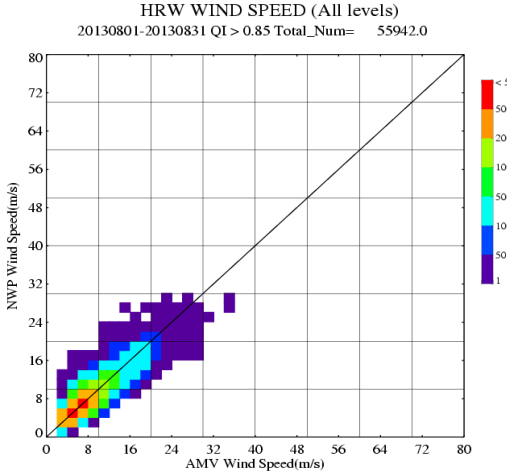

COMS cld_rdt_2012 2013-07-21 15:00 UTC (07.22 00:00 KST) KMA

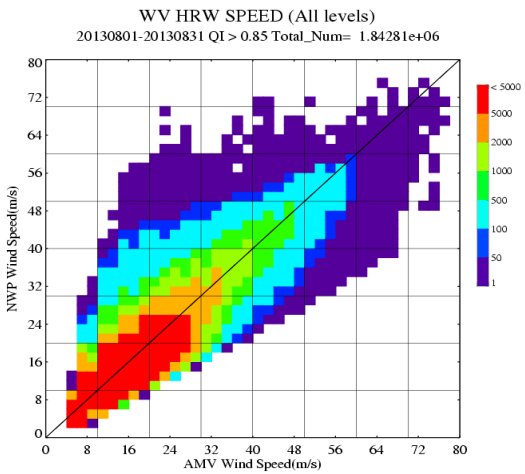

COMS cld_rdt_2012 2013-07-21 18:15 UTC (07.22 03:15 KST) KMA

PGE09 : HRW (High Resolution Wind)

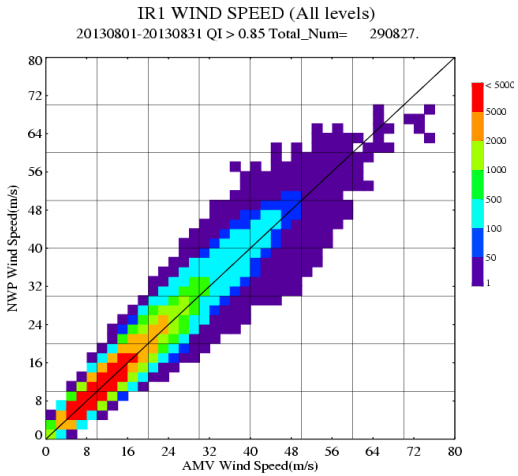
HRW (NWC/SAF)

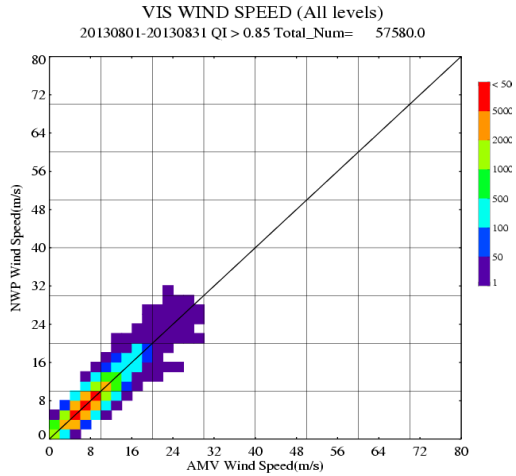


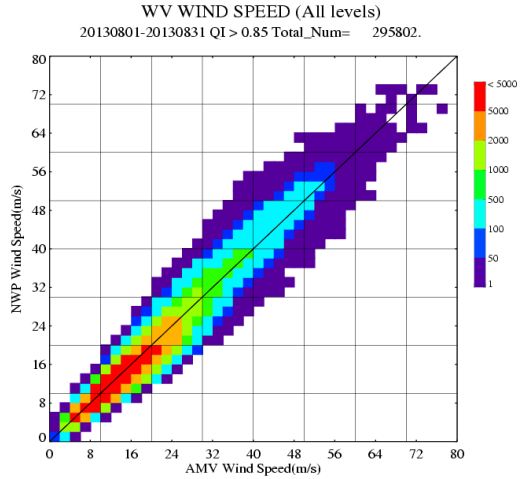




COMS AMV (NMSC)



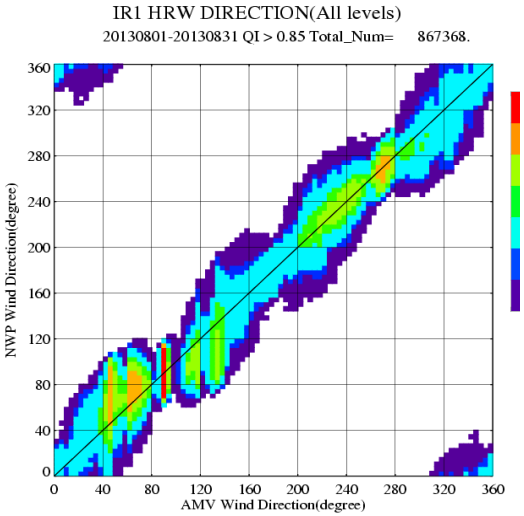


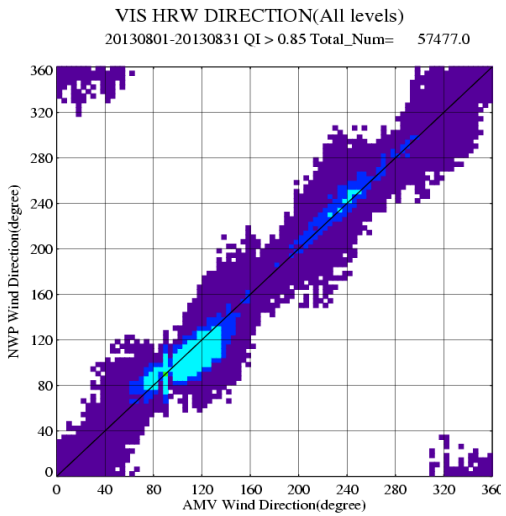


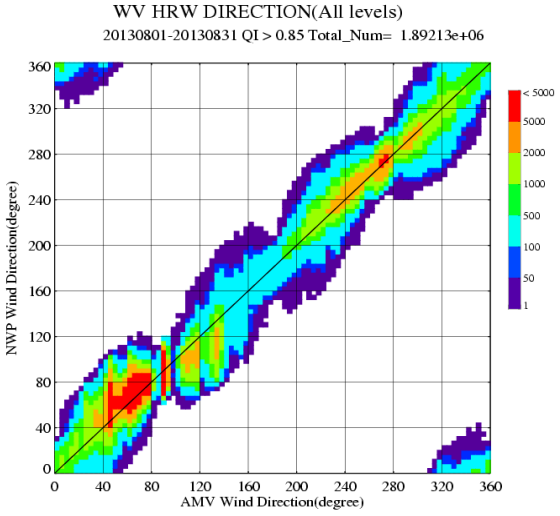
KMA Korea Meteorological Administration

PGE09 : HRW (High Resolution Wind)

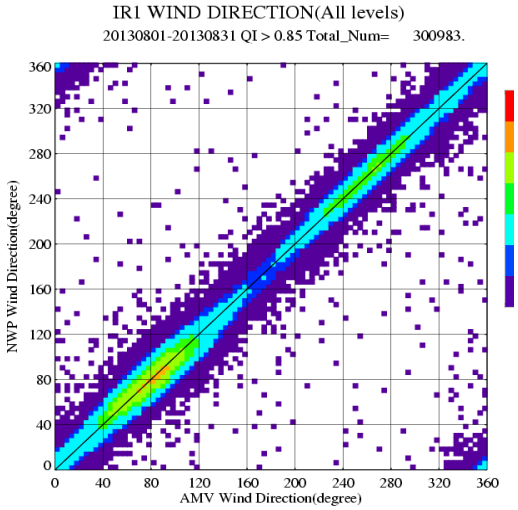
HRW (NWC/SAF)

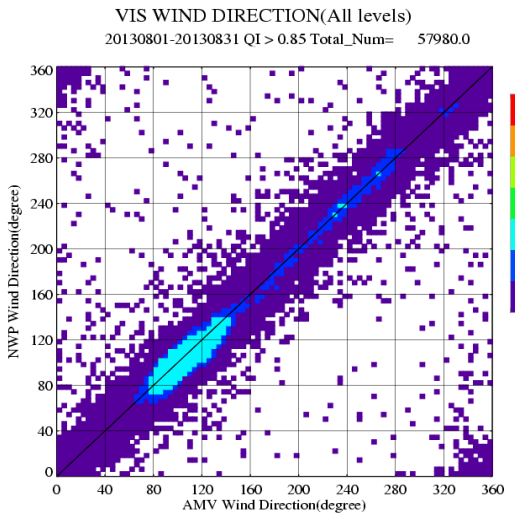


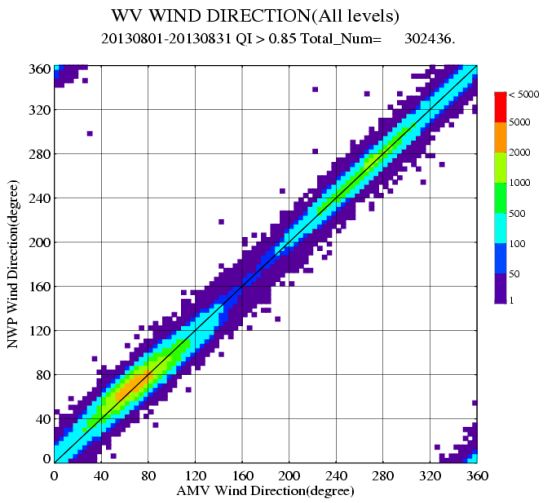




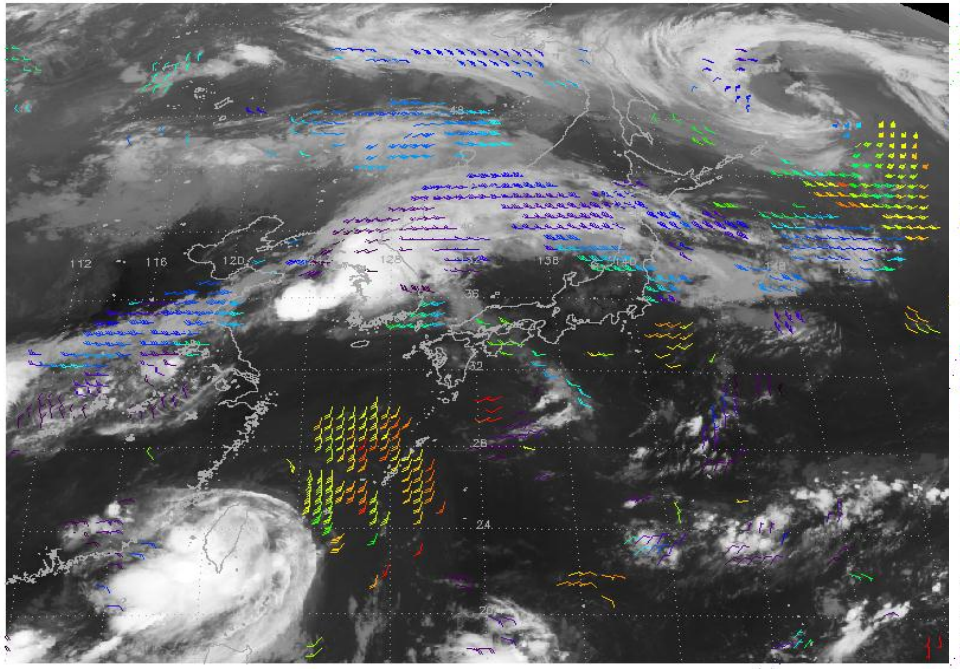
COMS AMV (NMSC)



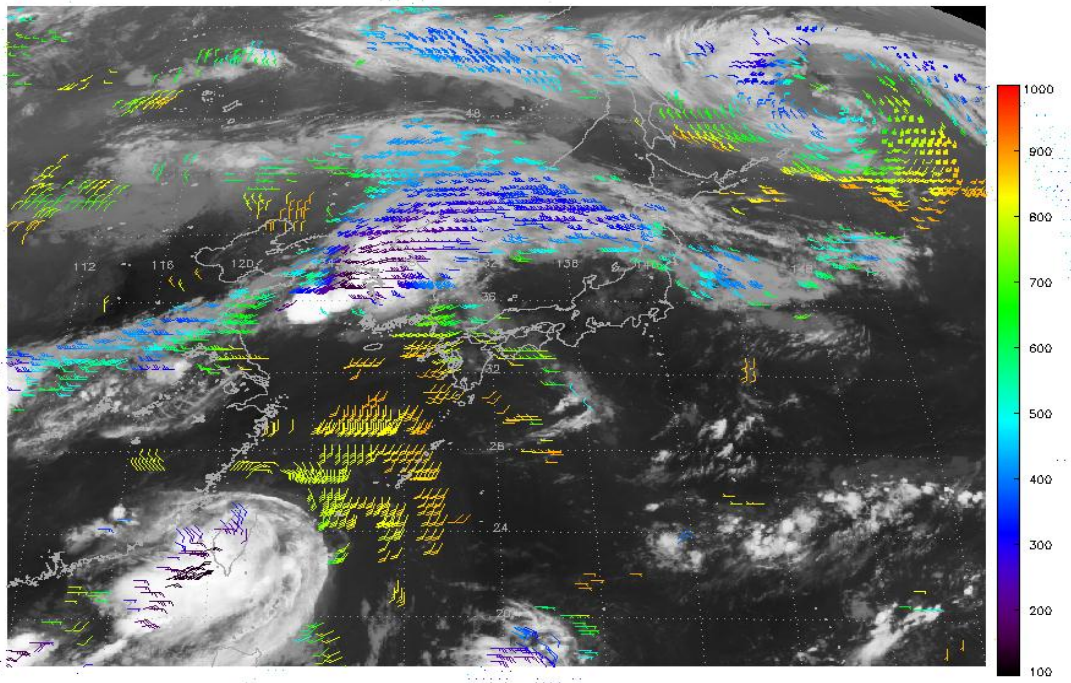




COMS AMV/NMSC



PGE09 HRW/NWC SAF

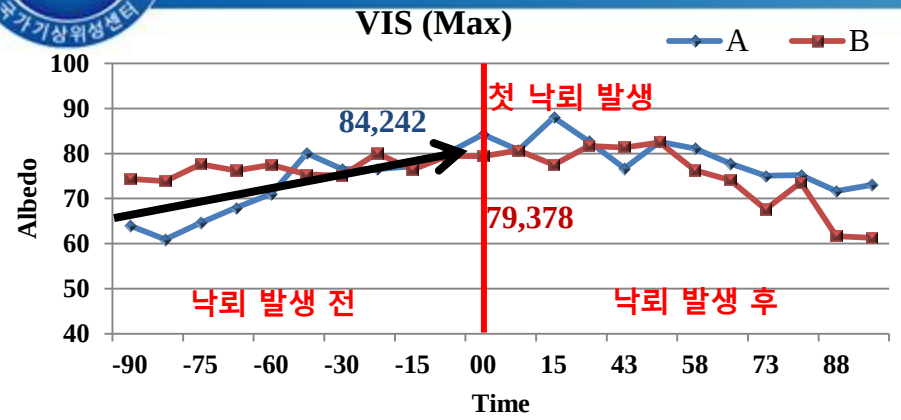


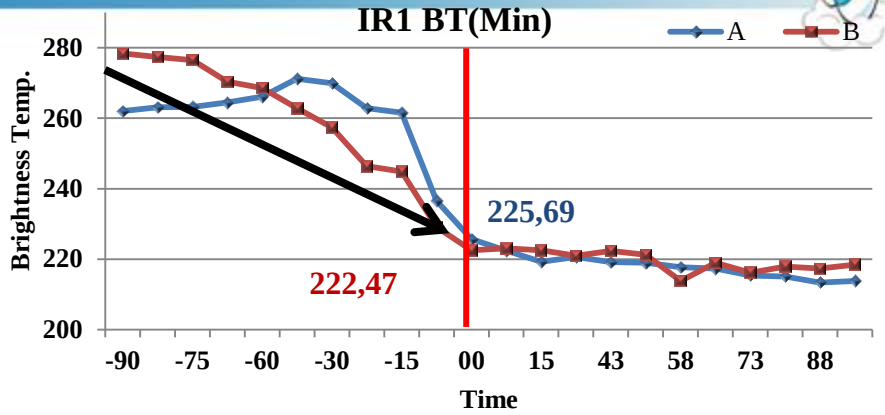
Accuracy : HRW_IR vs. COMS_IR

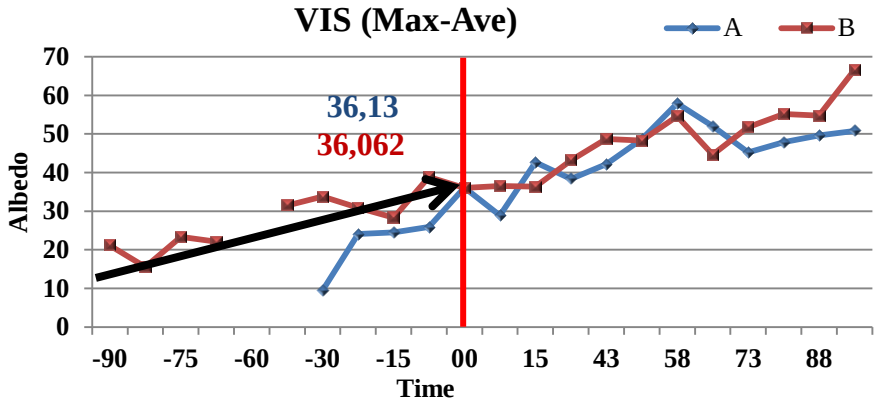
HRW_IR1	ALL REGION			NH EX_TROP			TROP		
ALL Level	AMV_NWP	AMV_SONDE	NWP_SONDE	AMV_NWP	AMV_SONDE	NWP_SONDE	AMV_NWP	AMV_SONDE	NWP_SONDE
Number	805932	13285	13285	338753	9775	9775	467179	3510	3510
SPD	11.01	18.86	18.86	13.07	19.94	19.94	9.52	15.83	15383
MVD	3.66	6.15	5.17	3.87	6.33	5.23	3.50	5.64	5.02
Bias	0.36	0.86	-0.19	0.56	0.71	-0.36	0.21	1.28	0.28
RMSVD	4.39	7.17	6.07	4.65	7.38	6.14	4.19	6.55	5.87
NRMSVD	0.40	0.38	0.32	0.36	0.37	0.31	0.44	0.41	0.37

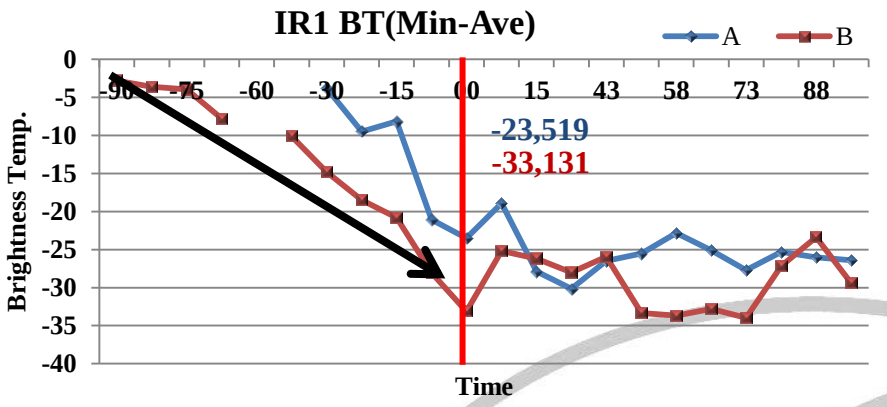
COMS_IR1	ALL REGION			NH EX_TROP			TROP		
ALL Level	AMV_NWP	AMV_SONDE	NWP_SONDE	AMV_NWP	AMV_SONDE	NWP_SONDE	AMV_NWP	AMV_SONDE	NWP_SONDE
Number	292765	14186	14186	116988	9500	9500	175777	4686	4686
SPD	14.03	17.67	17.67	16.79	18.75	18.75	12.19	15.47	15.47
MVD	2.41	4.50	4.27	2.67	4.81	4.48	2.24	3.89	3.84
Bias	-0.34	-1.31	-0.77	-0.47	-1.45	-0.81	-0.26	-1.03	-0.69
RMSVD	2.91	5.39	5.04	3.25	5.73	5.29	2.65	4.63	4.50
NRMSVD	0.21	0.31	0.29	0.19	0.31	0.28	0.22	0.30	0.29

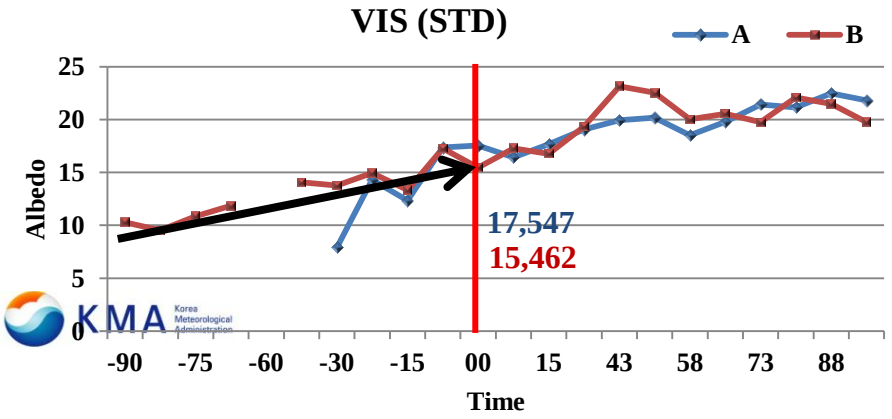
CI (Convective Initiation) in NMSC

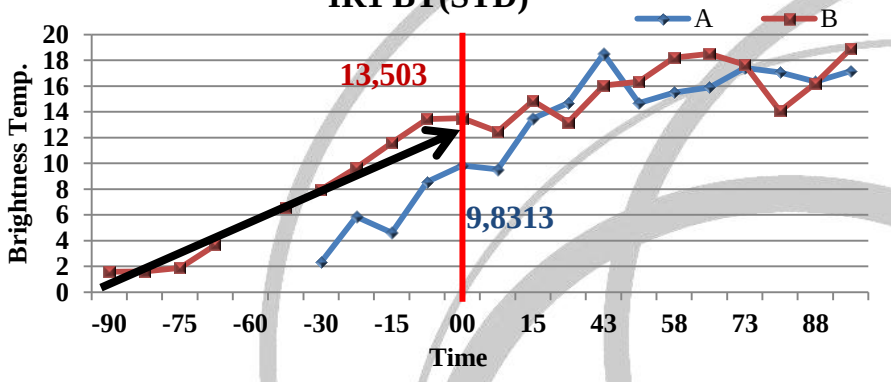






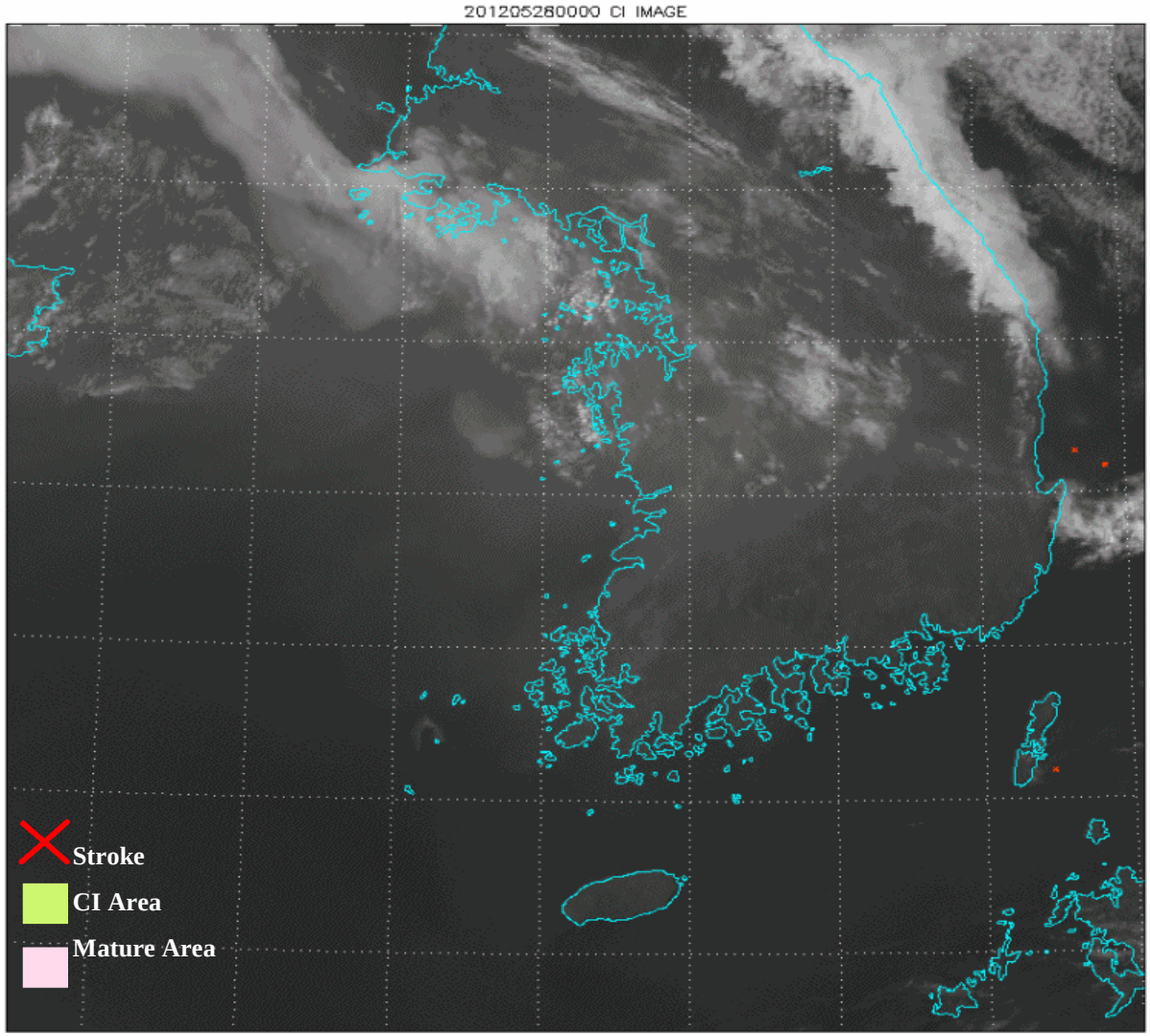






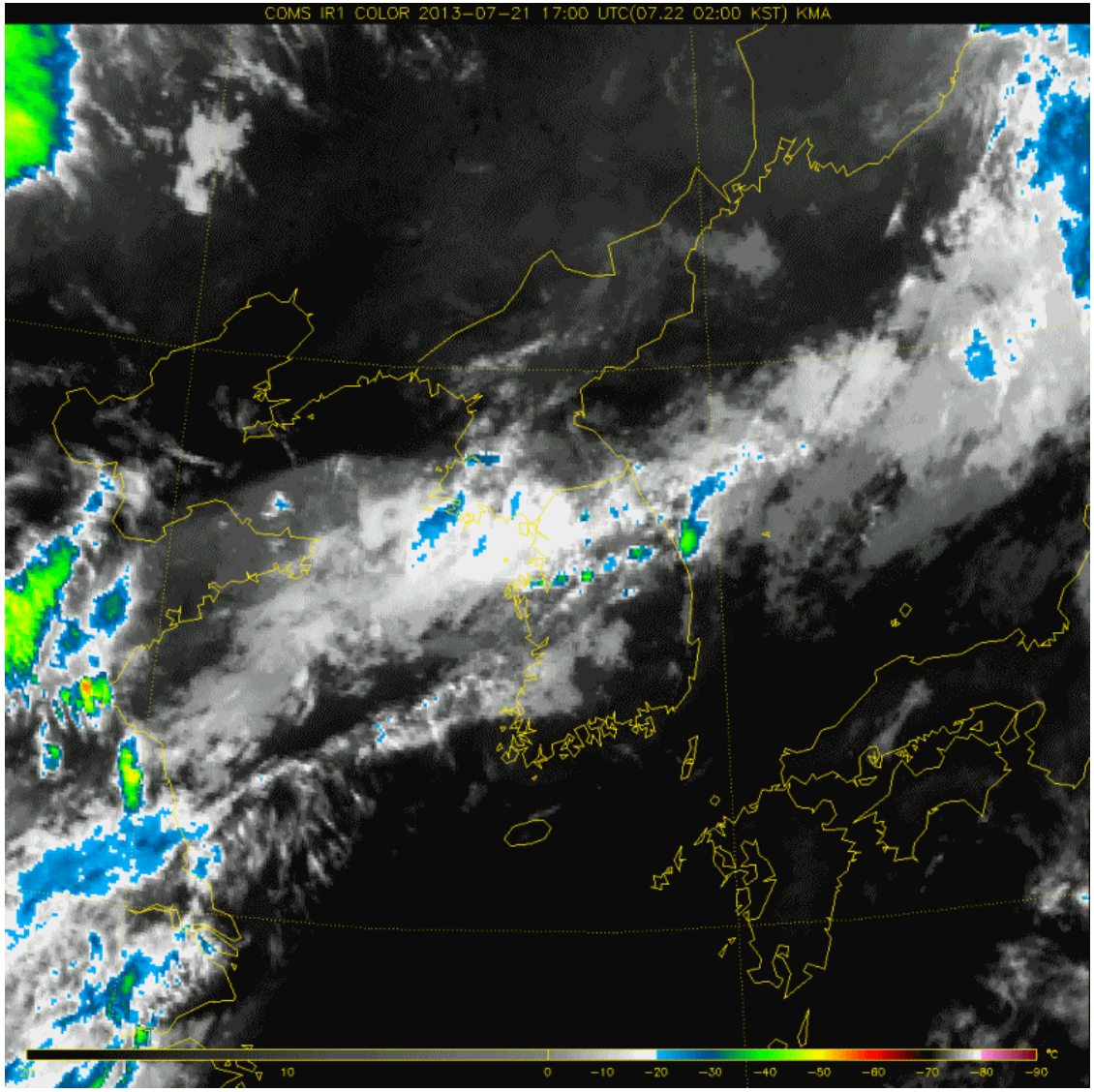
KMA Korea Meteorological Administration

CI (Convective Initiation) in NMSC



KMA Korea Meteorological Administration

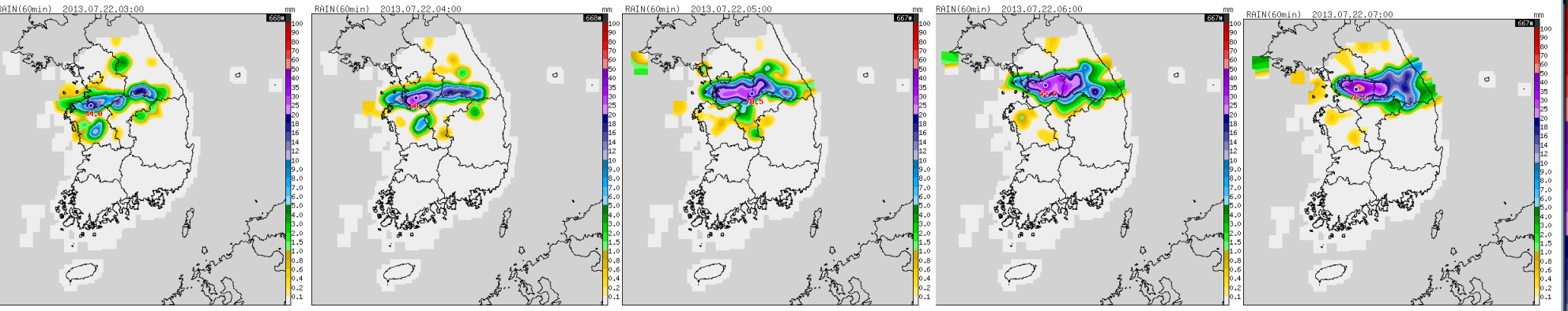
CASE (“Jang-Ma”)
(17:00 UTC July 21. – 04:00 UTC July 22. 2013.)



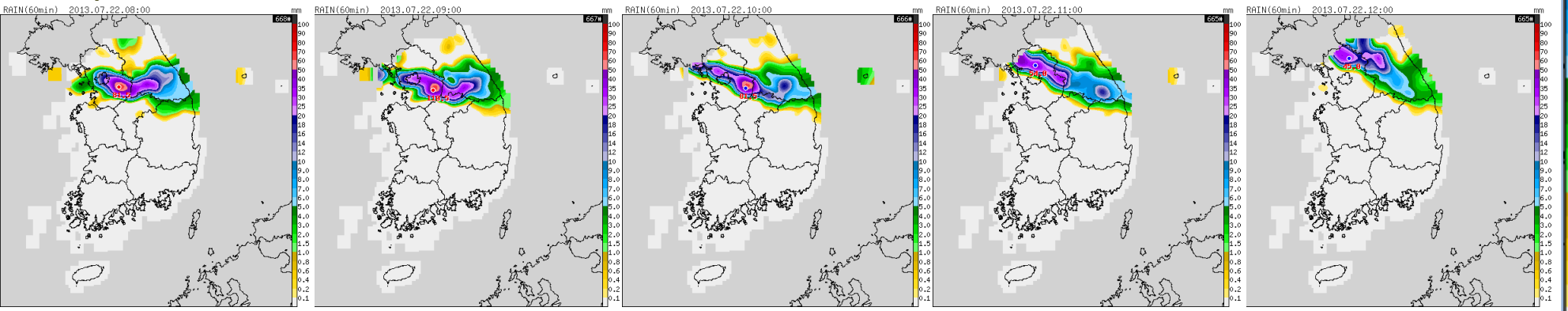
CASE (18:00 UTC July 21. – 04:00 UTC July 22. 2013)

Ground Rain guage (mm/hr)

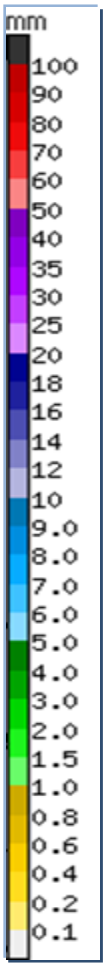
- Rainfall Rate had the duration time of over 10 hours.
- Maximum instantaneous rainfall rates(mm) ranged from 230 to 300.
- The distribution of rain had large discrepancy between northern area and southern area.



18 UTC July 21 2013 | 19 UTC | 20 UTC | 21 UTC | 22 UTC

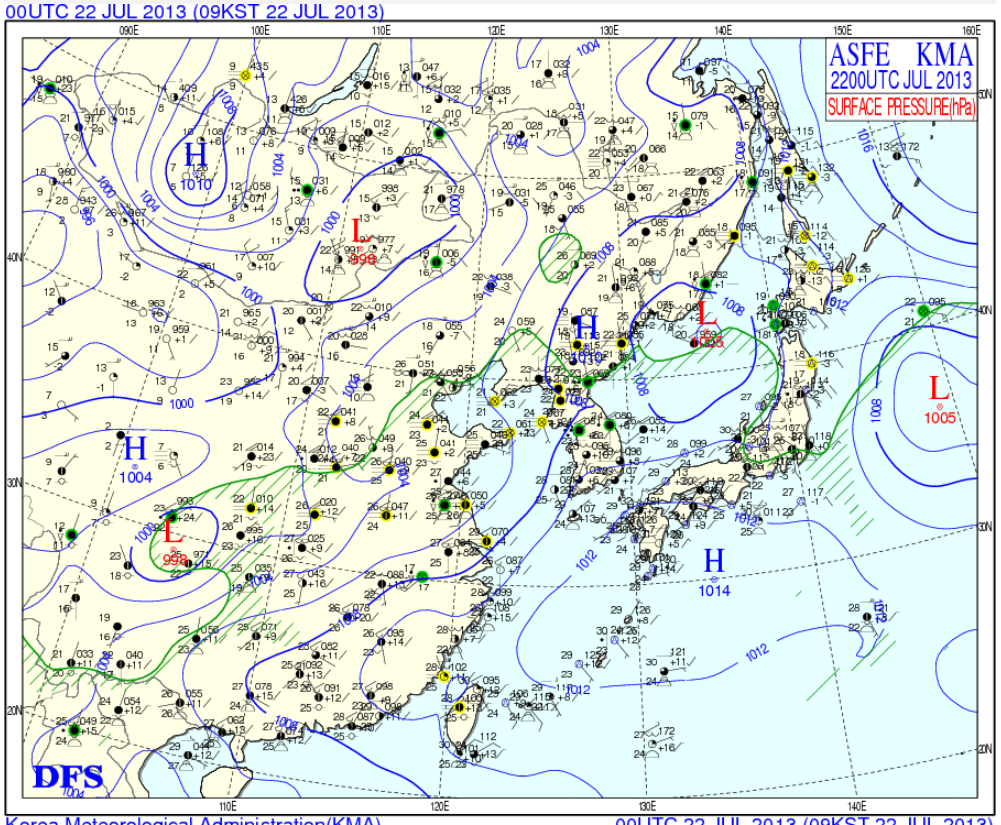


23 UTC | 00UTC July 22 2013 | 01 UTC | 02 UTC | 03 UTC

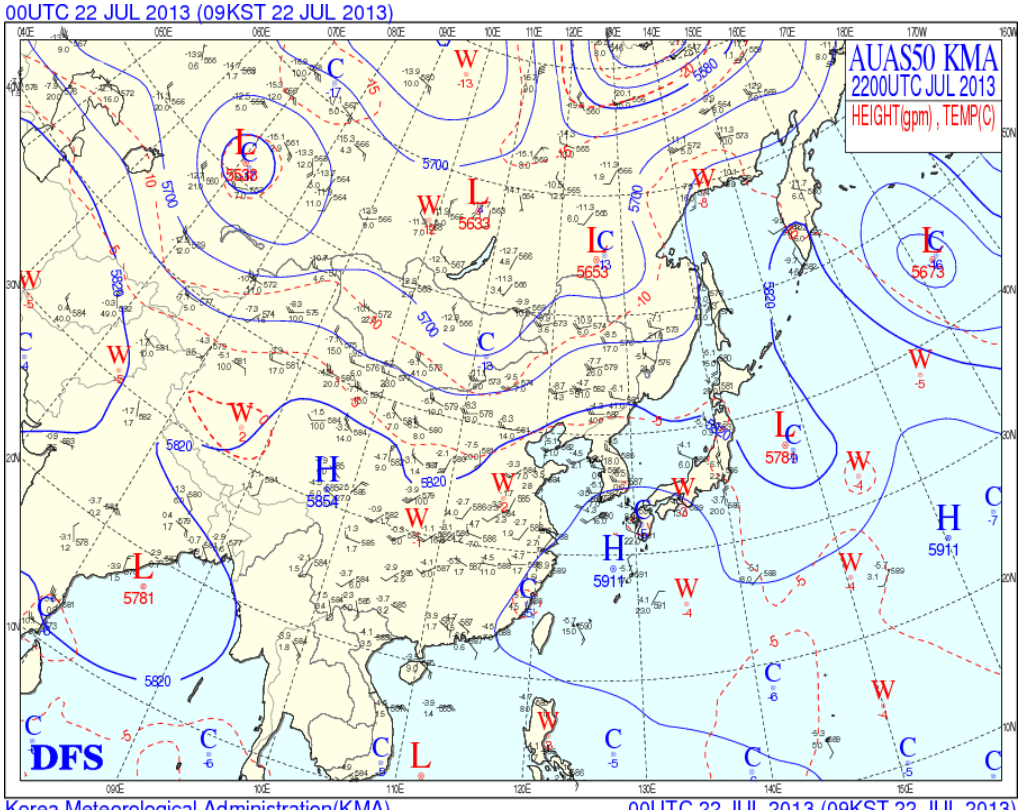


Weather Chart (Surface, 500hPa)

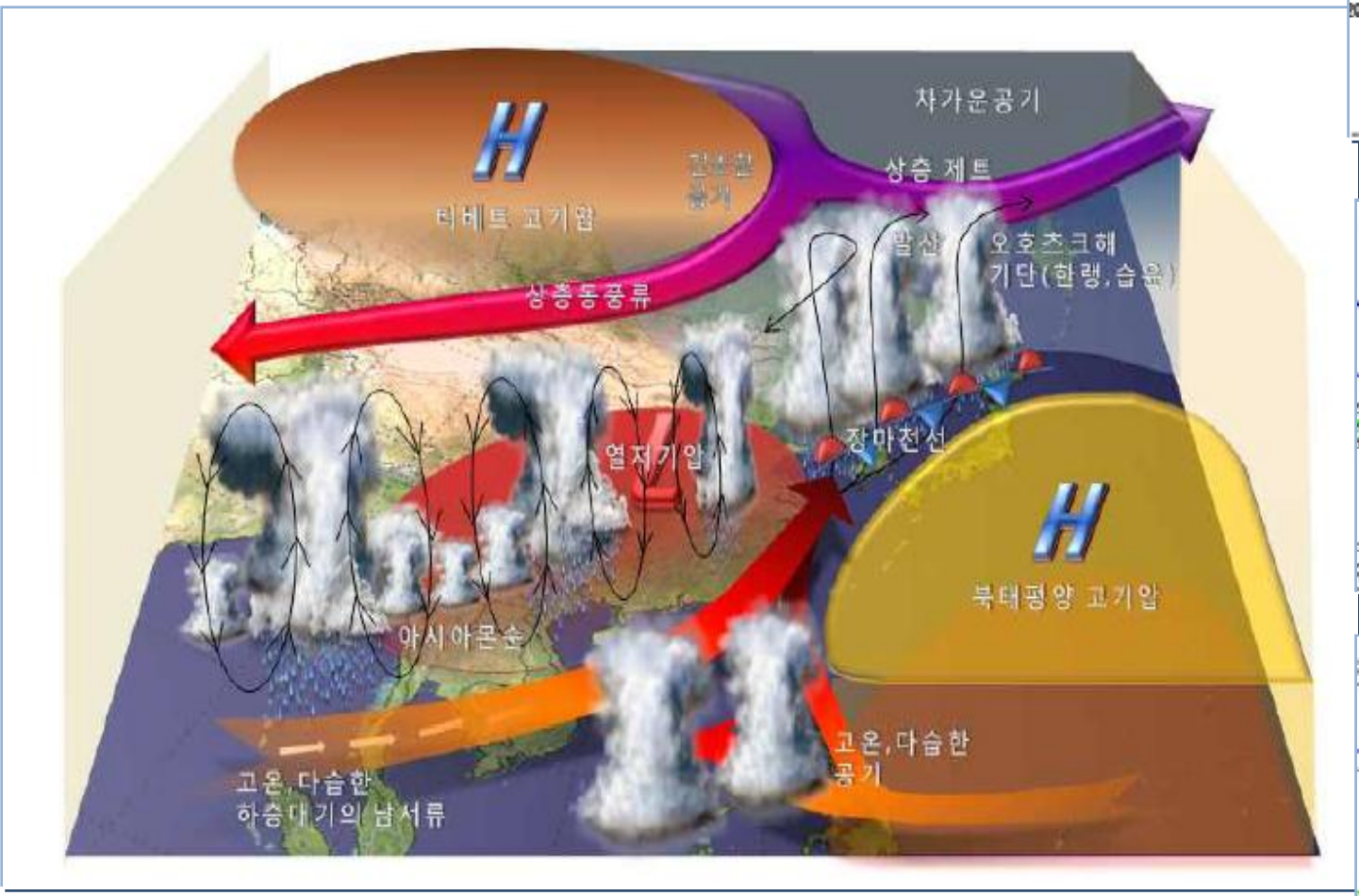
00 UTC, July 22. 2013 - Surface

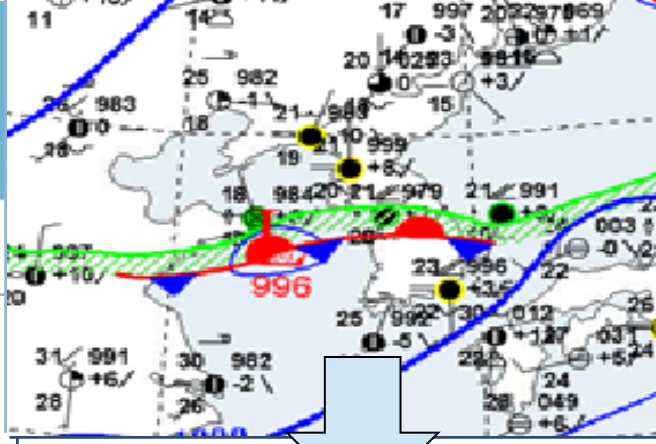


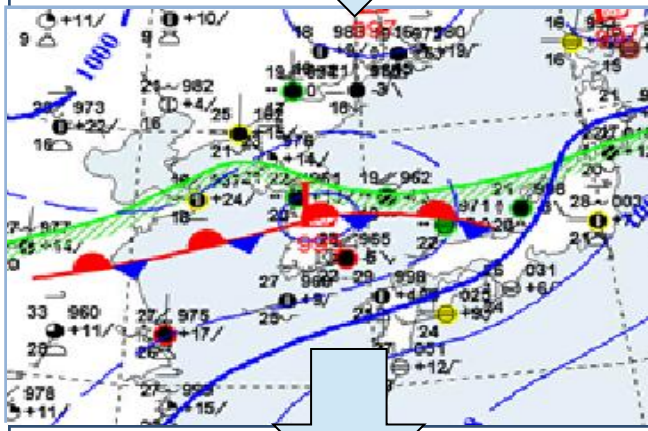
00 UTC, July 22. 2013 – 500hPa

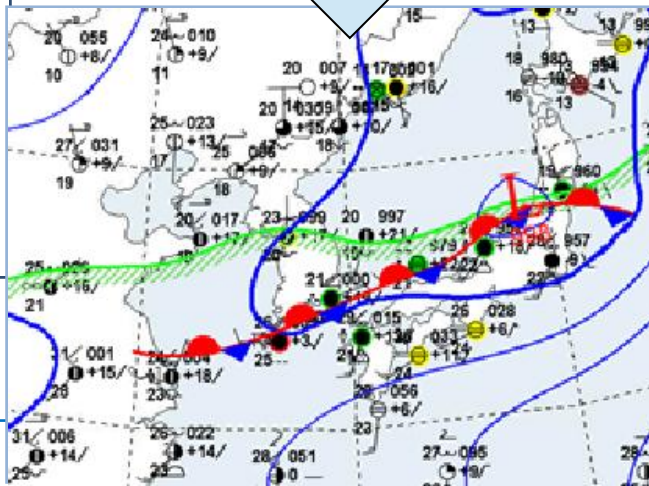


“Jang-Ma”

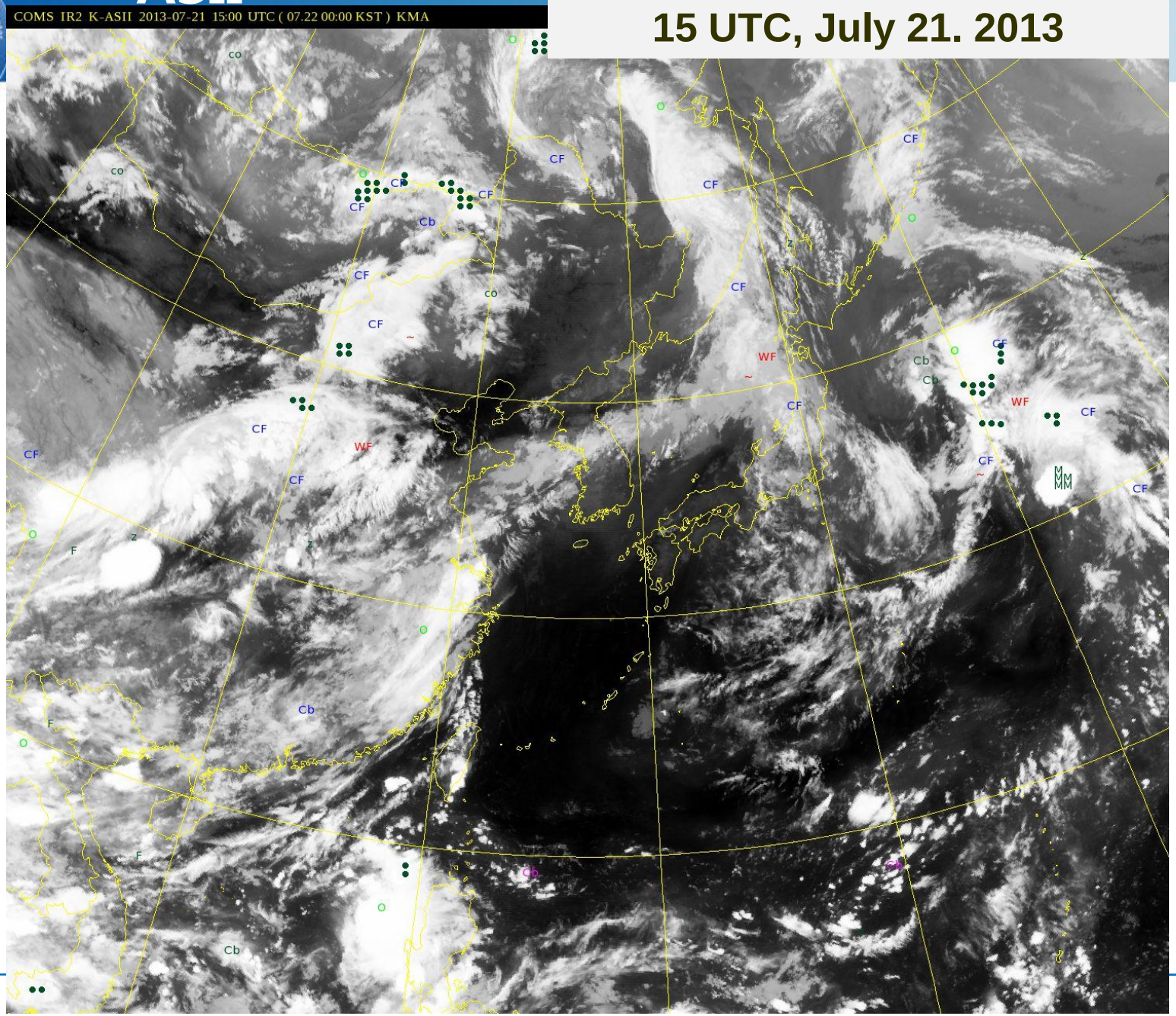

H
티베트 고기압
차가운공기
상층 제트
상층동풍류
열저기압
장마전선
오호츠크해
기단(한랭,습윤)
H
북태평양 고기압
아시아몬순
고온,다습한
공기
고온,다습한
하층대기의 남서류





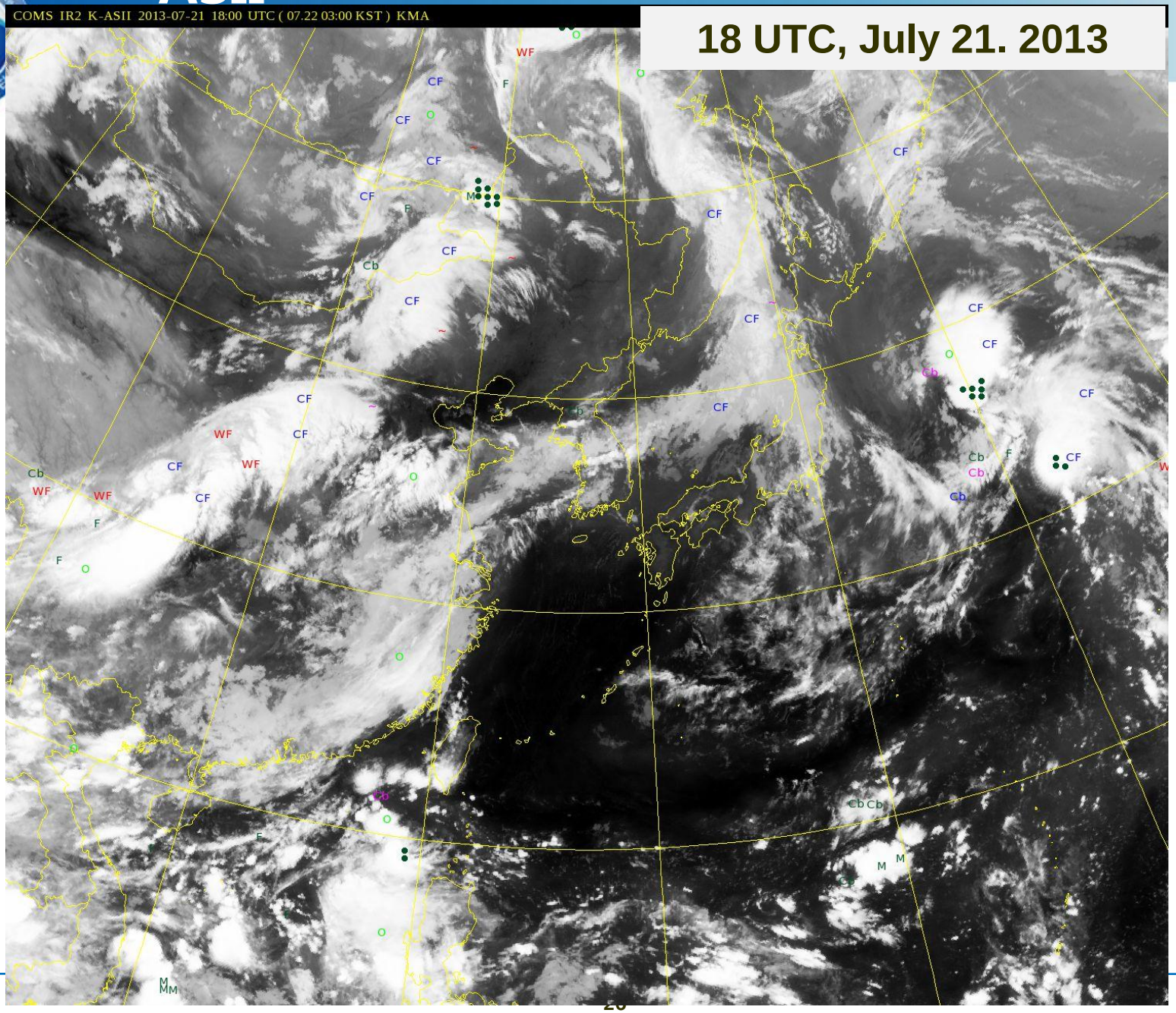


ASII

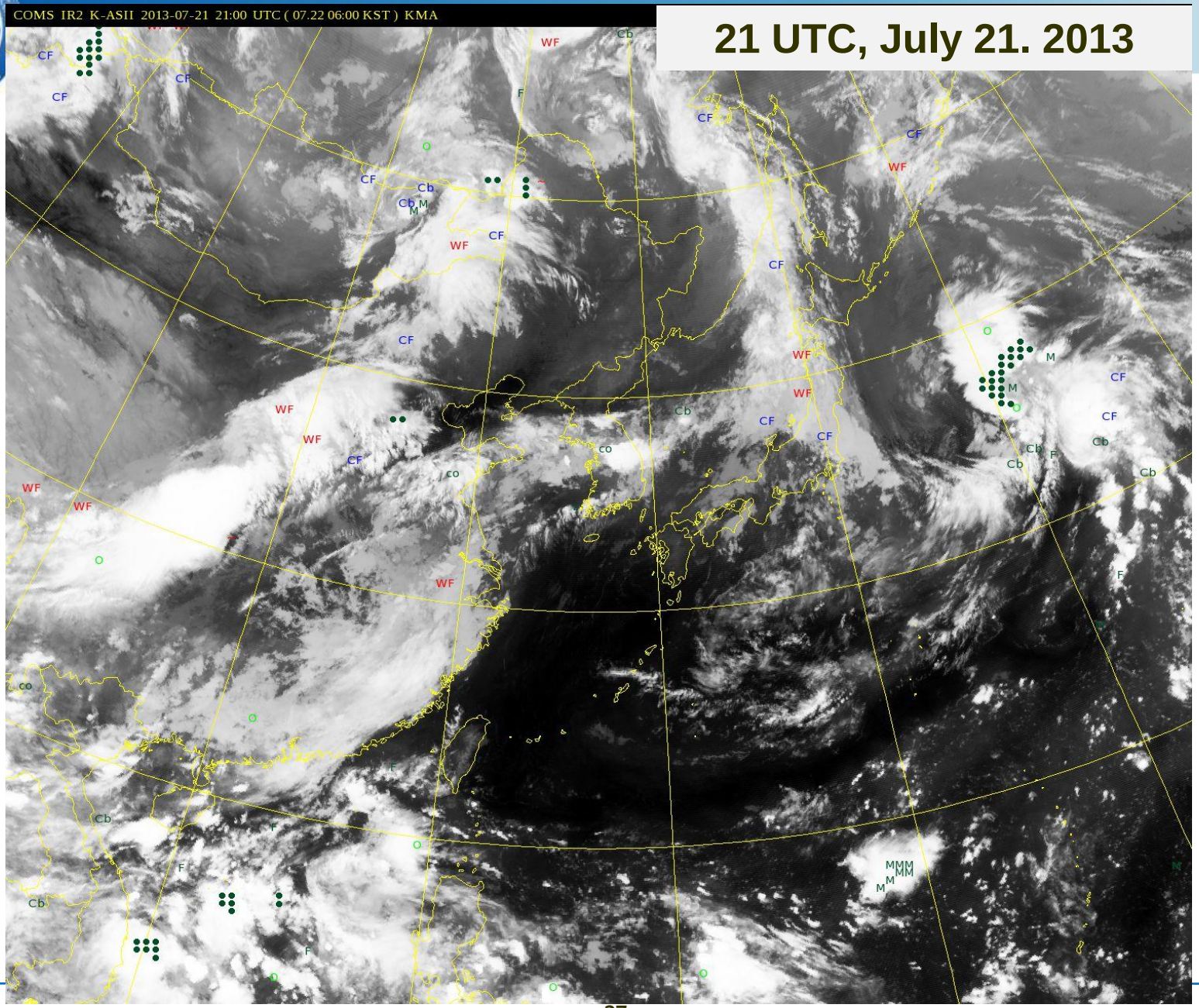


15 UTC, July 21. 2013

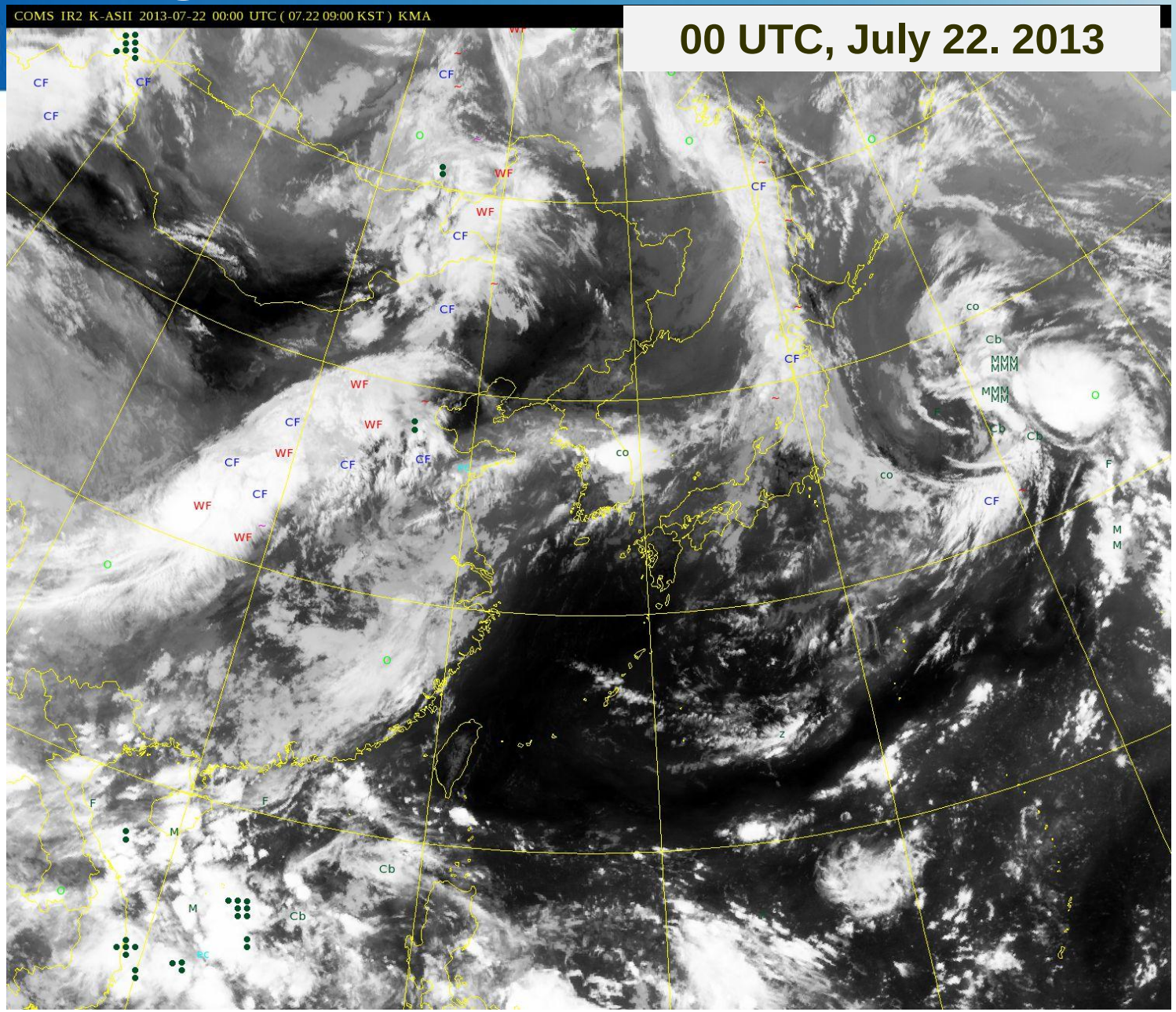
ASII


COMS IR2 K-ASII 2013-07-21 18:00 UTC (07.22 03:00 KST) KMA
18 UTC, July 21. 2013

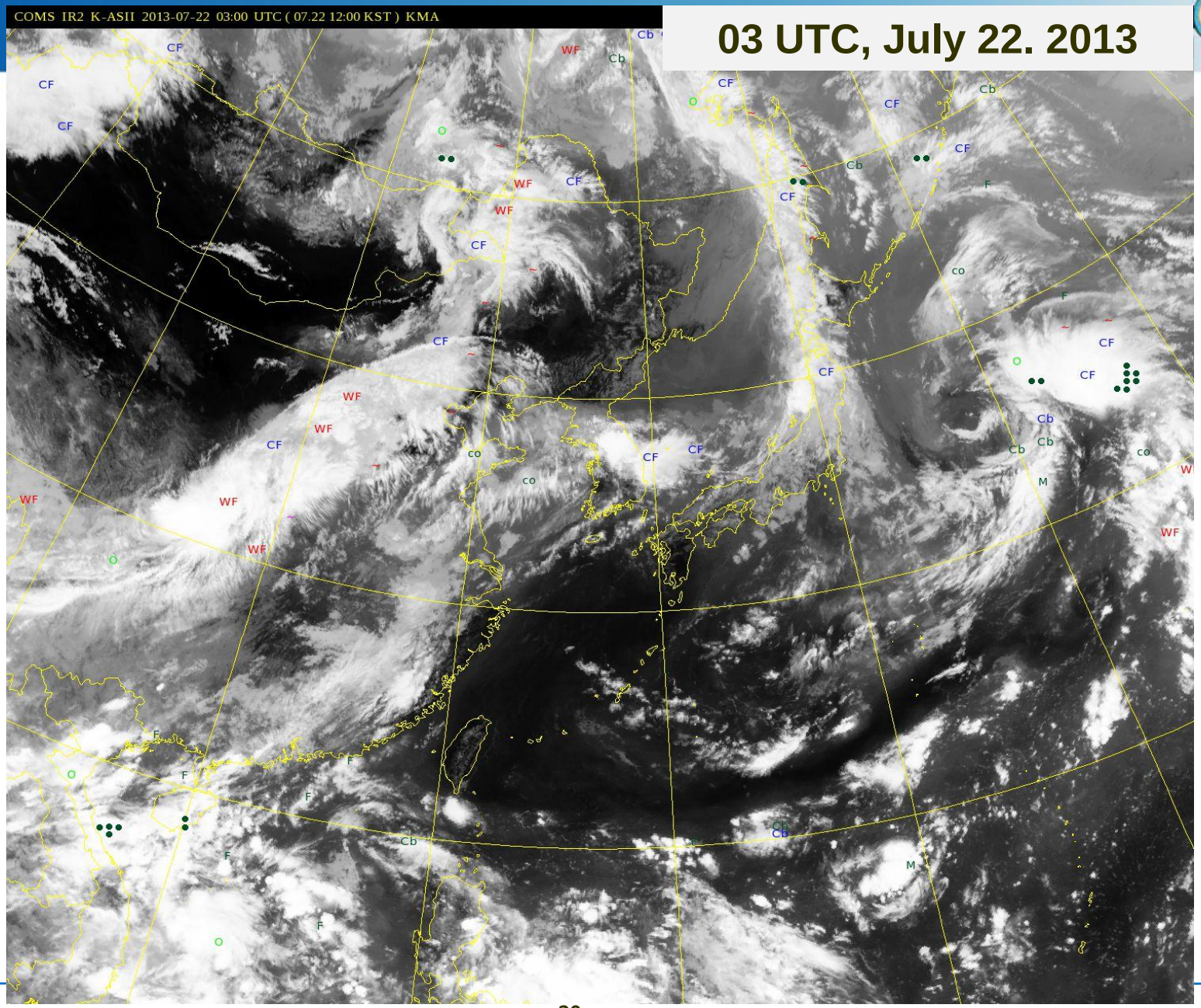
ASII


COMS IR2 K-ASII 2013-07-21 21:00 UTC (07.22 06:00 KST) KMA
21 UTC, July 21. 2013

ASII

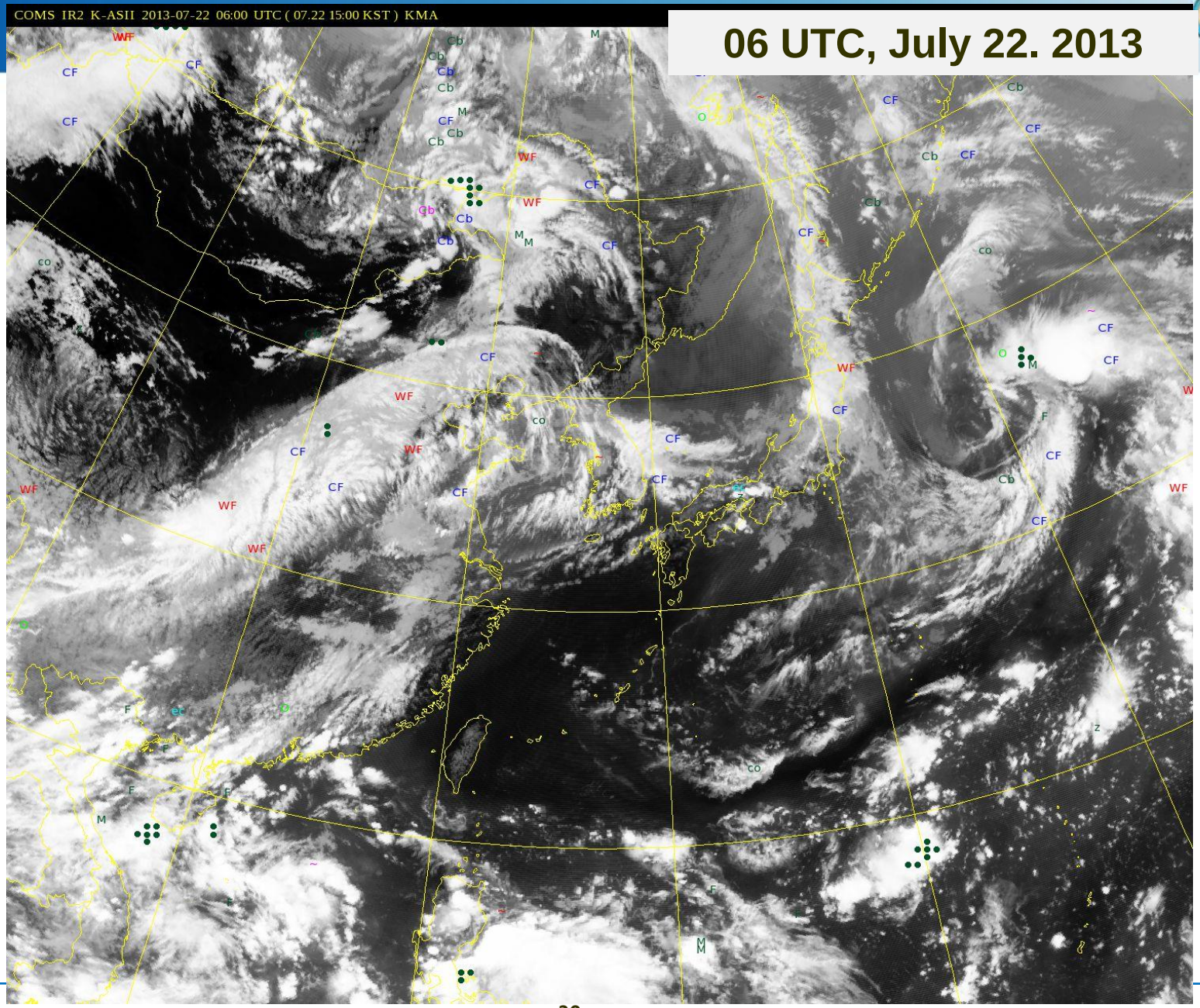

COMS IR2 K-ASII 2013-07-22 00:00 UTC (07.22 09:00 KST) KMA
00 UTC, July 22. 2013

ASII



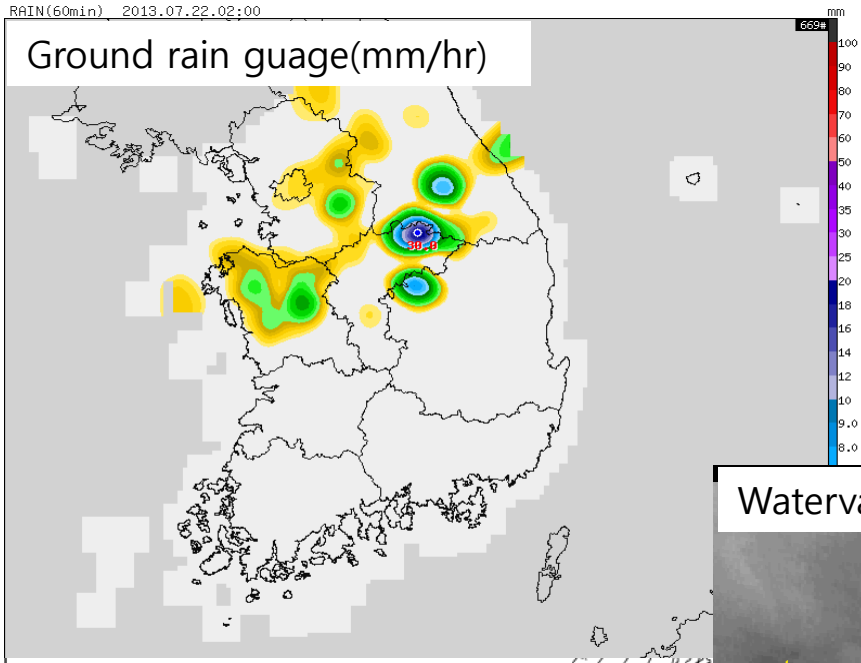
03 UTC, July 22. 2013

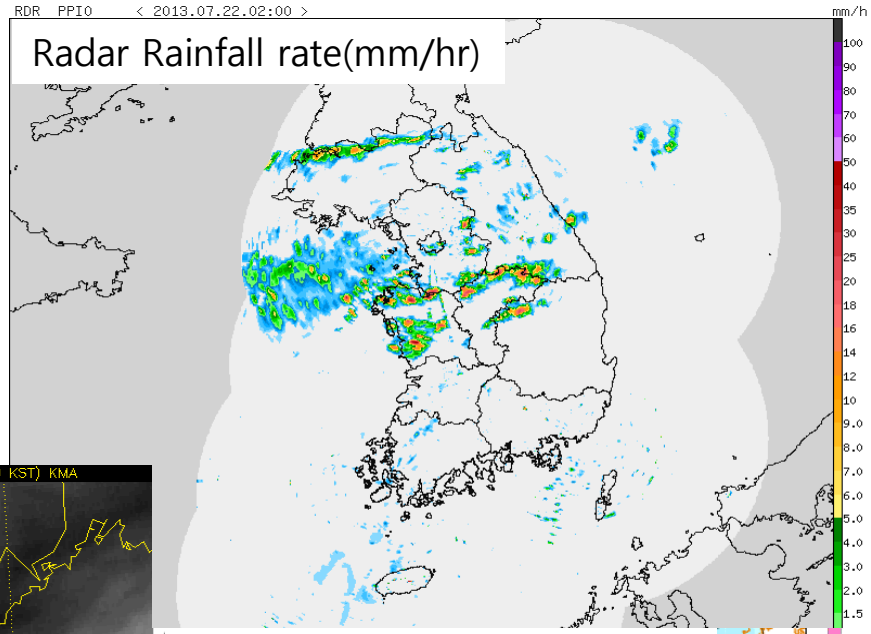
ASII

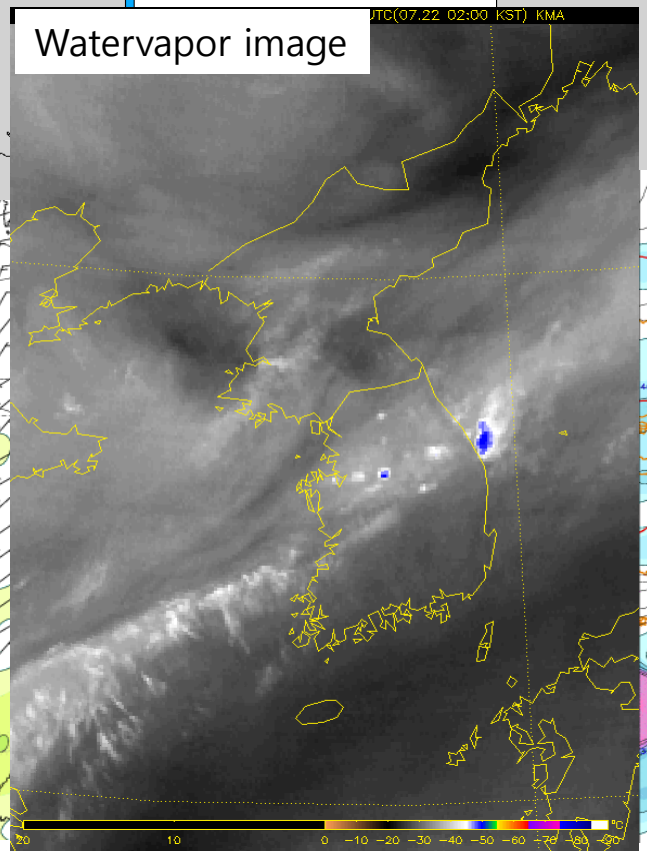


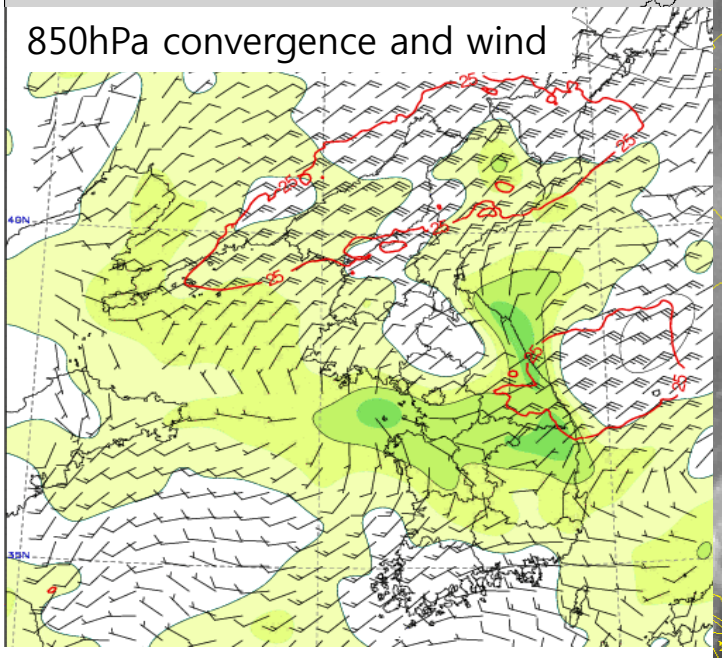
06 UTC, July 22. 2013

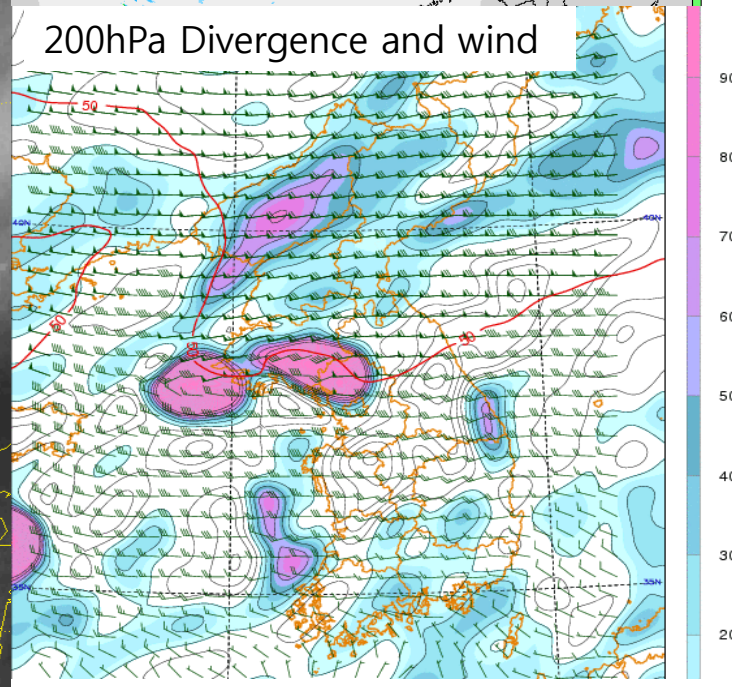
17:00 UTC 21 July 2013



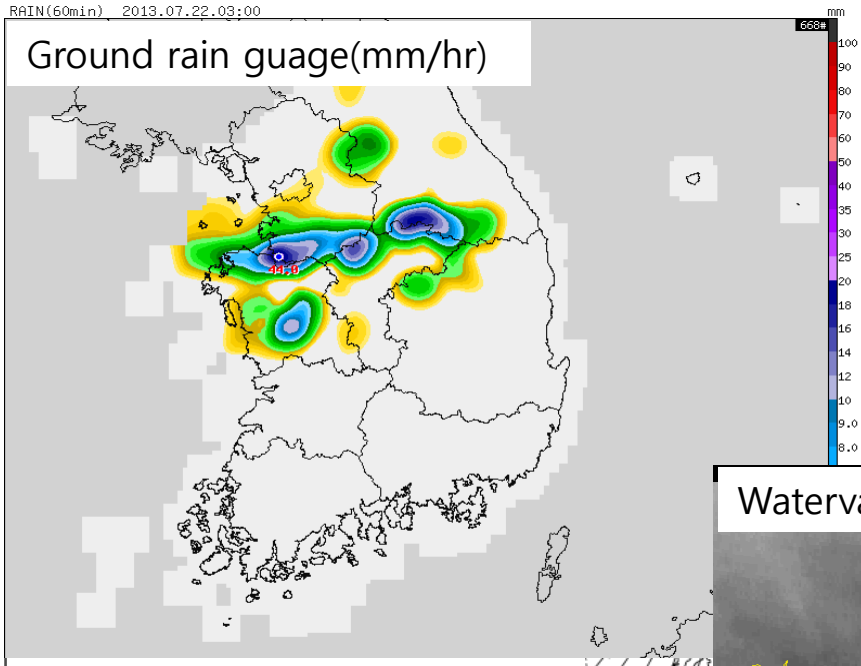


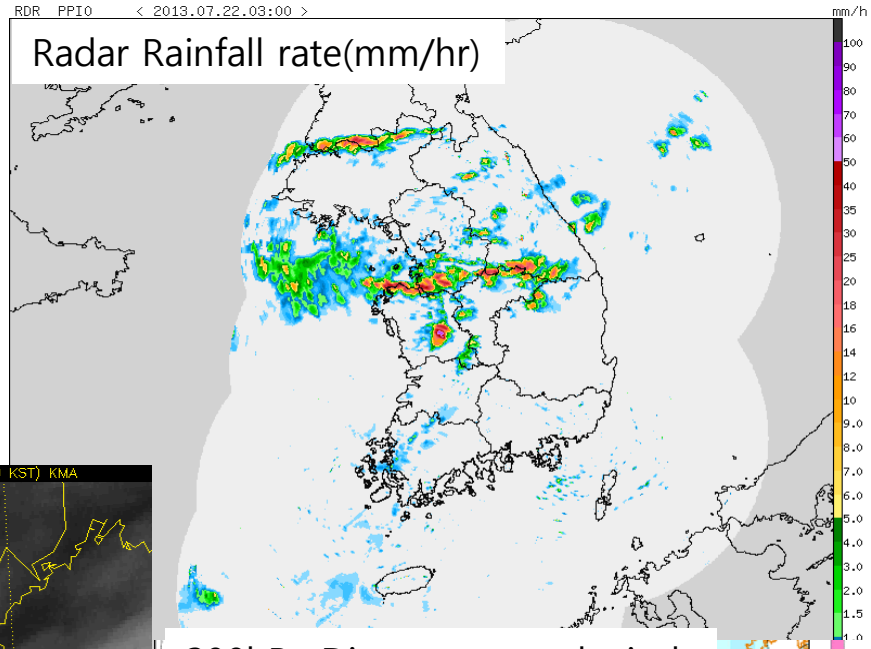


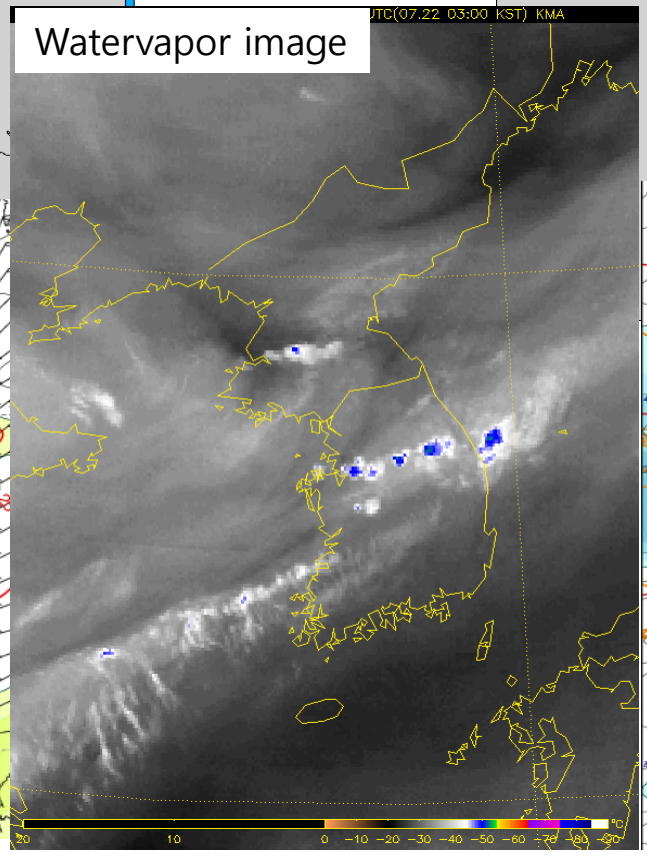


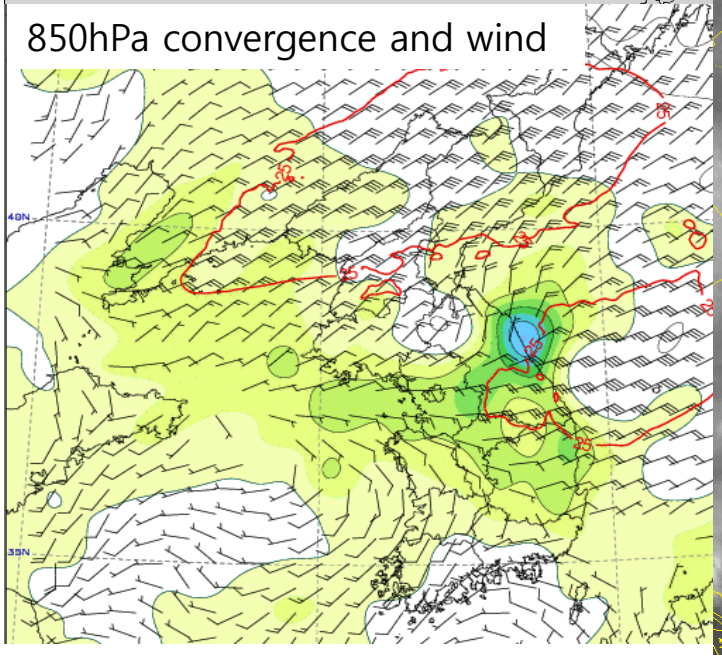


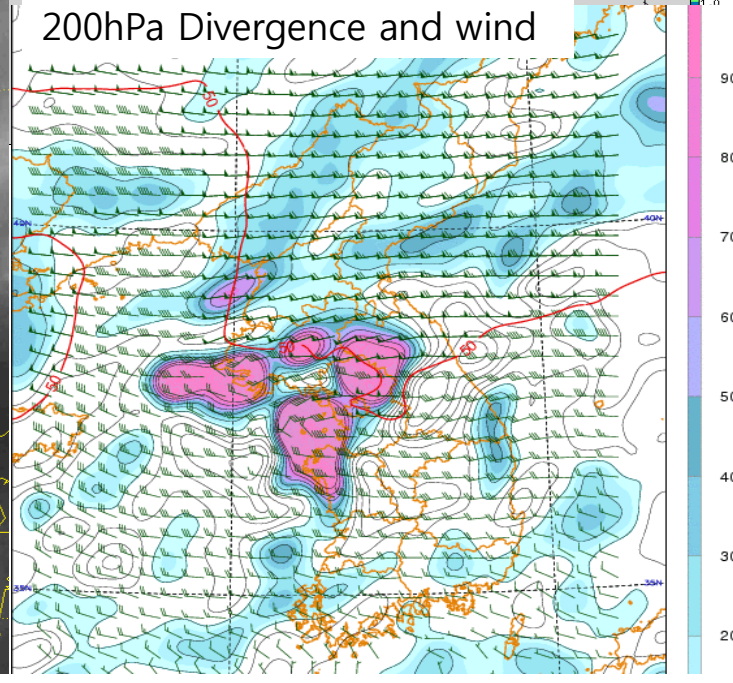
18 UTC, July 21. 2013



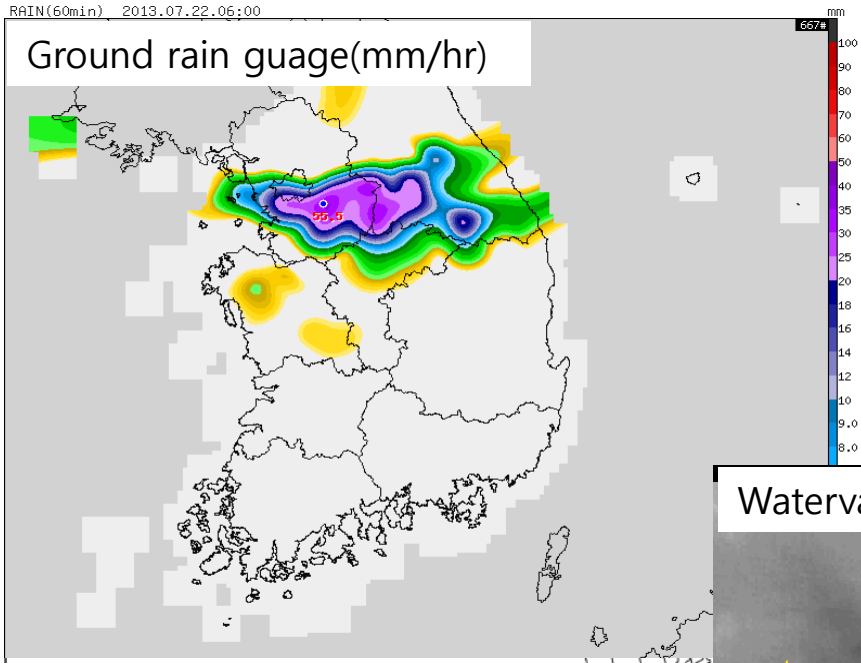


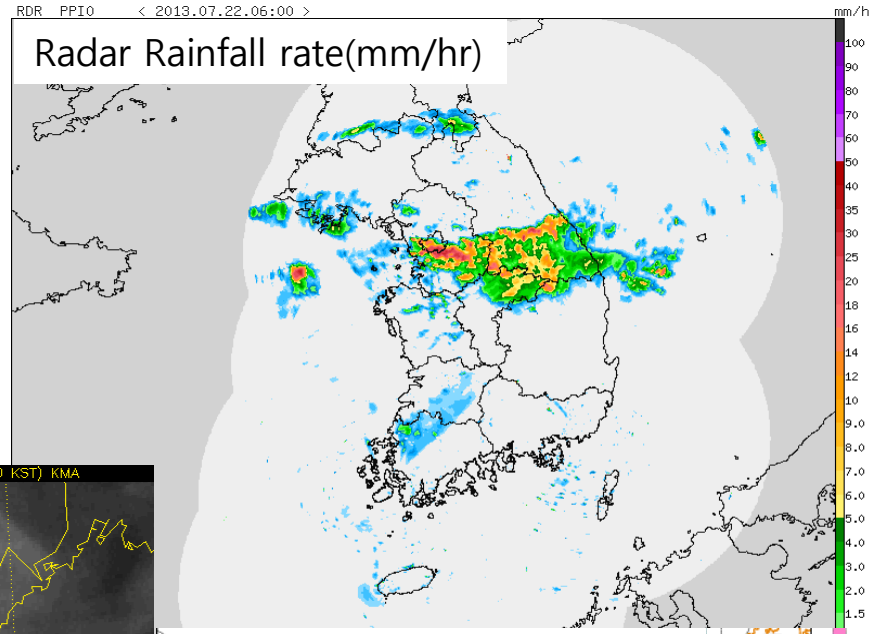


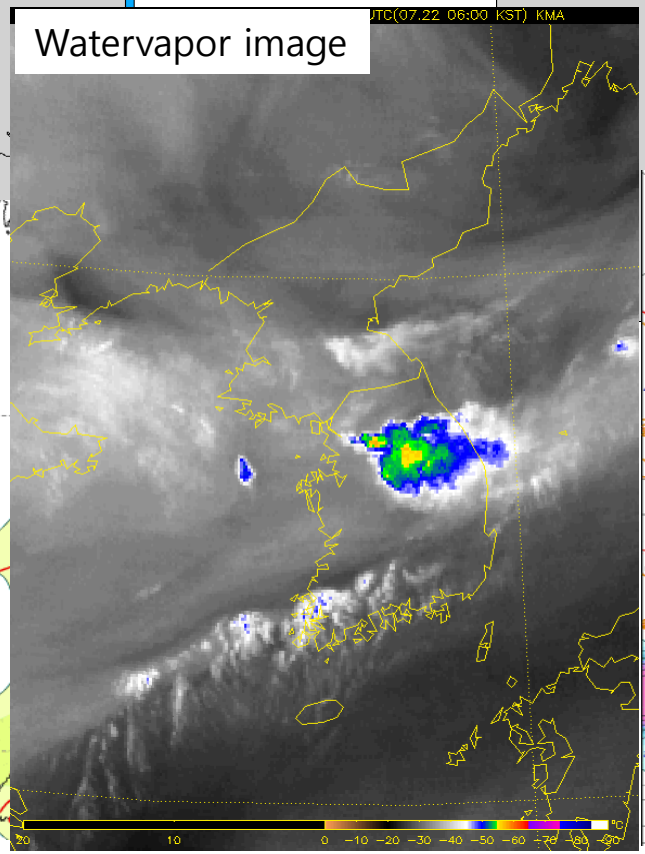


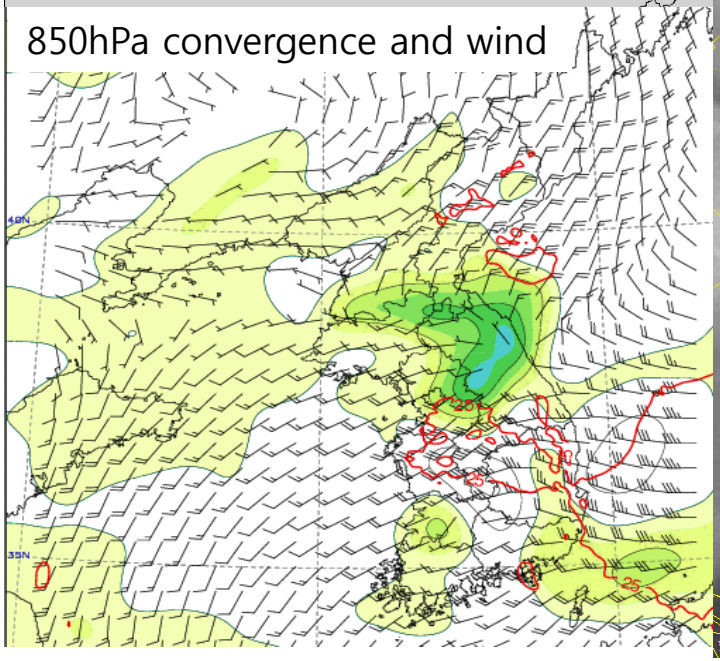


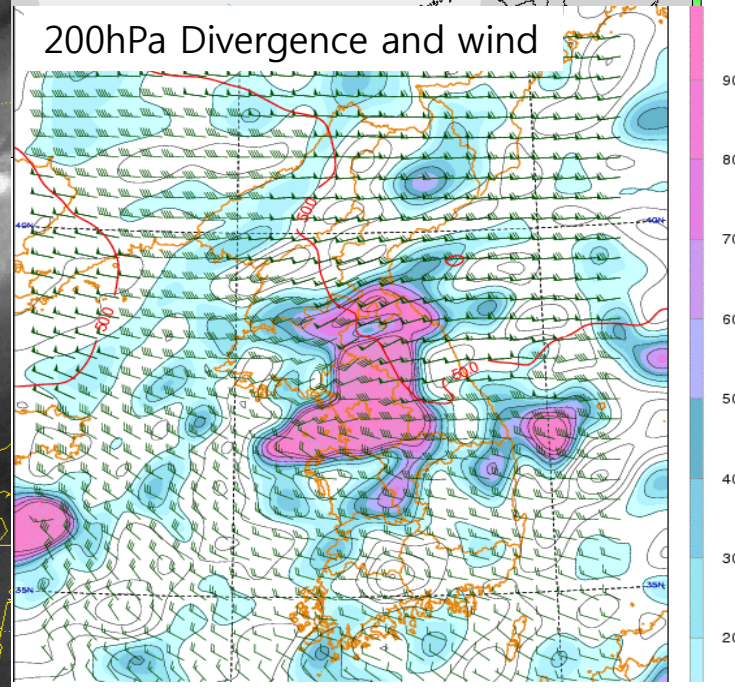
21 UTC, July 21. 2013



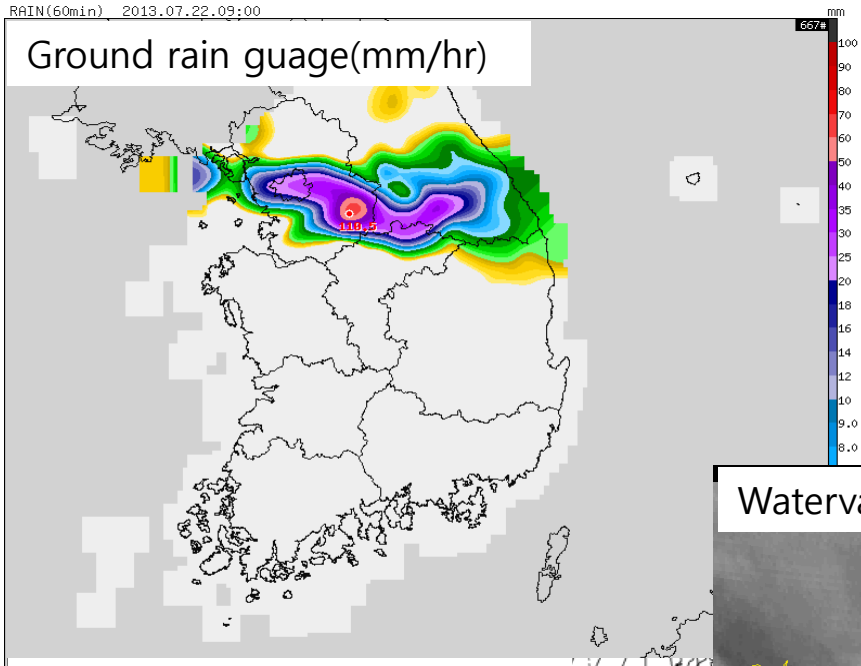


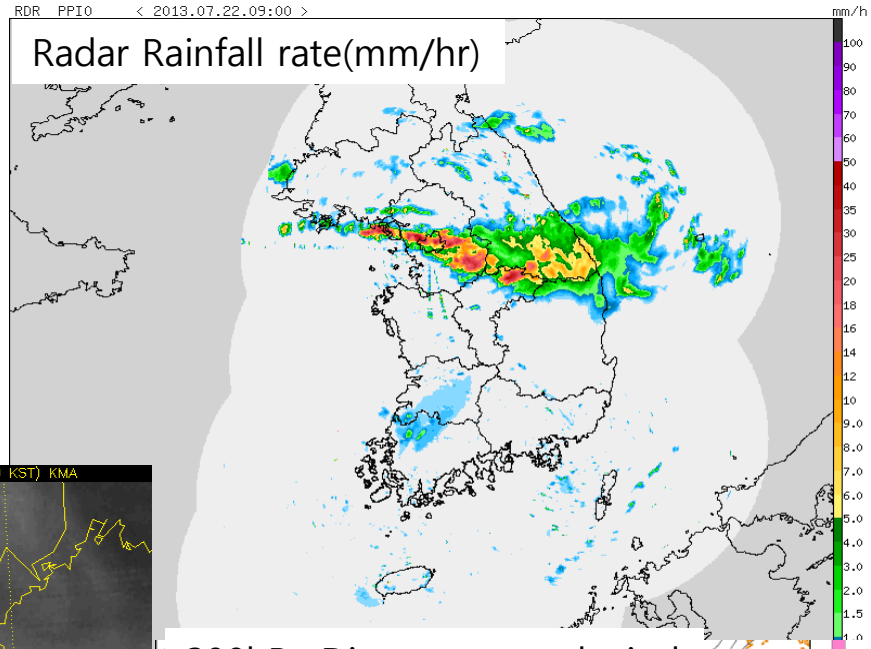


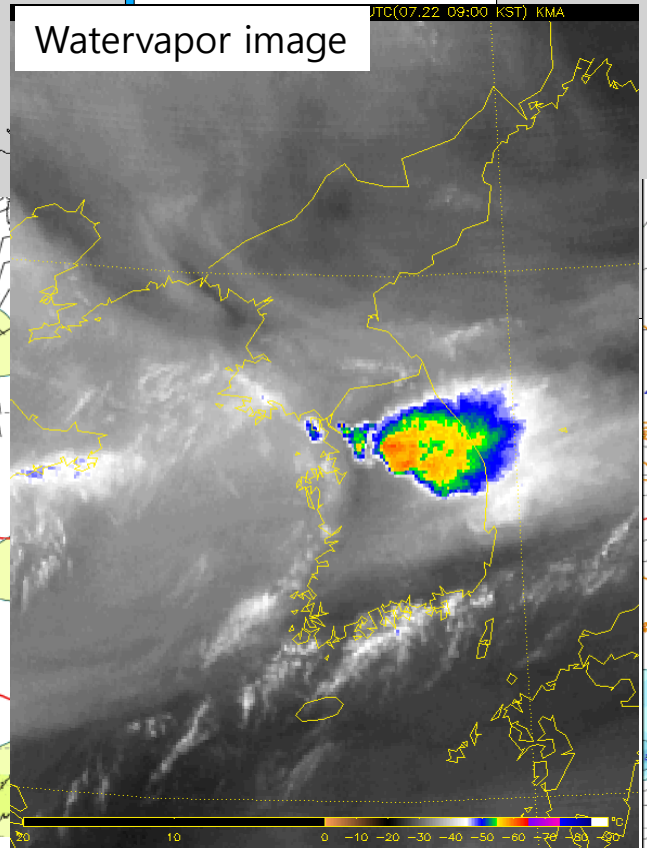


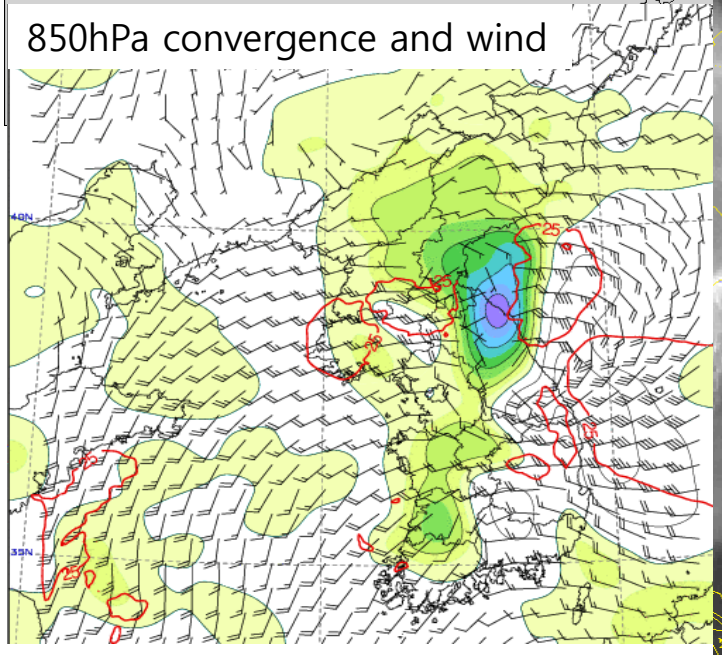


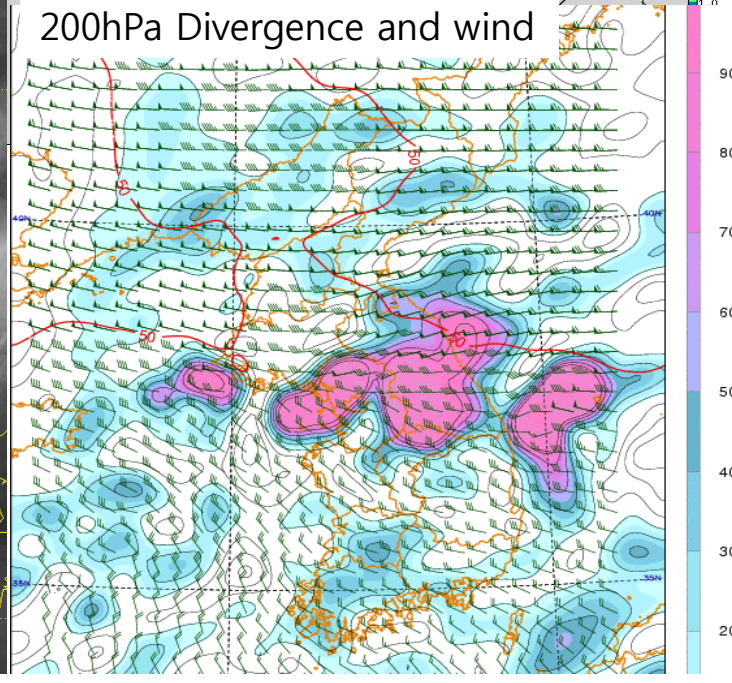
00 UTC, July 22. 2013



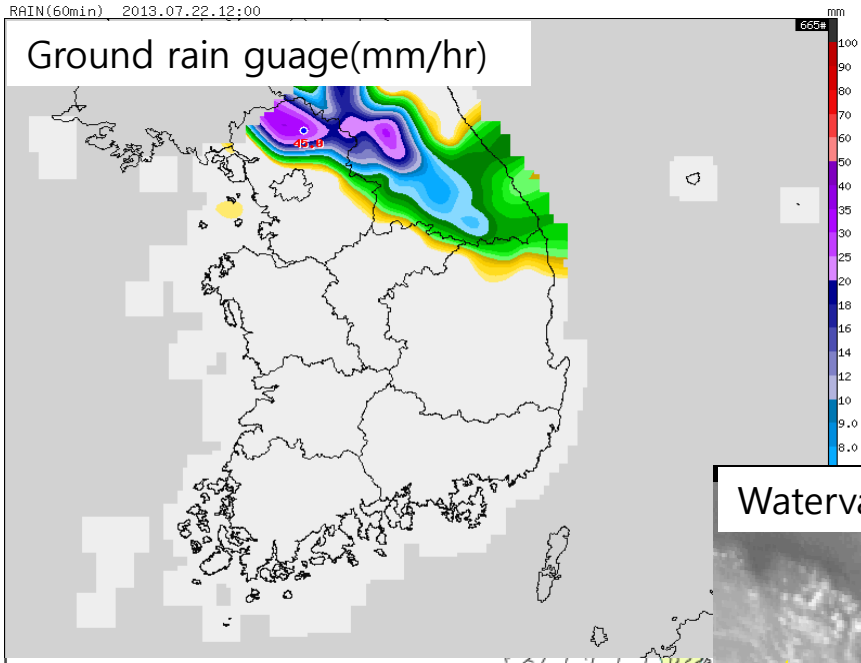


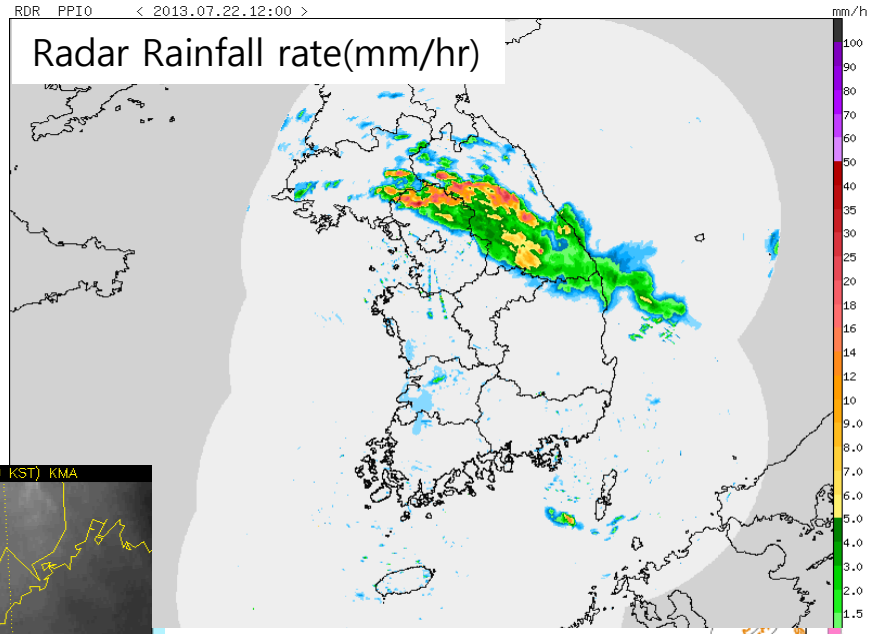


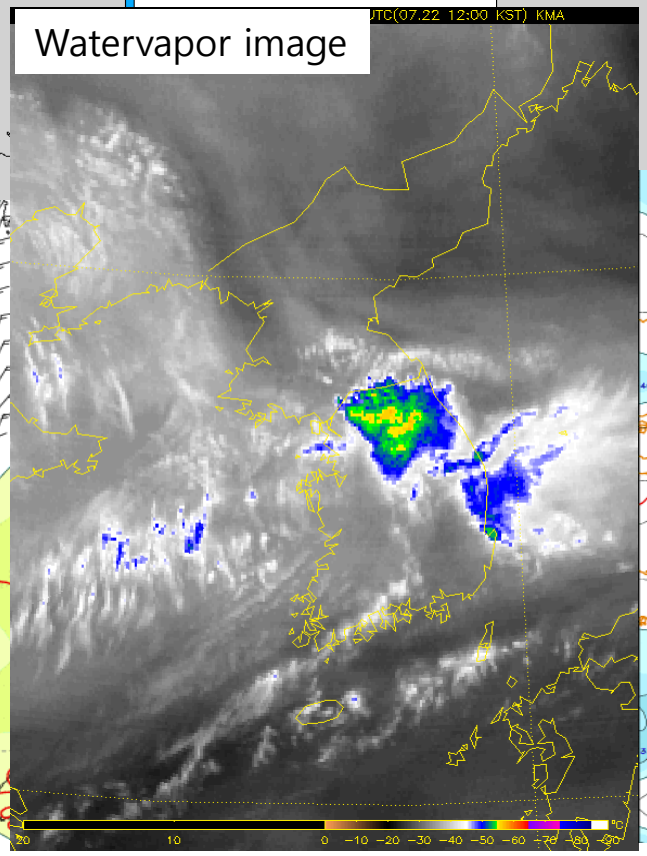


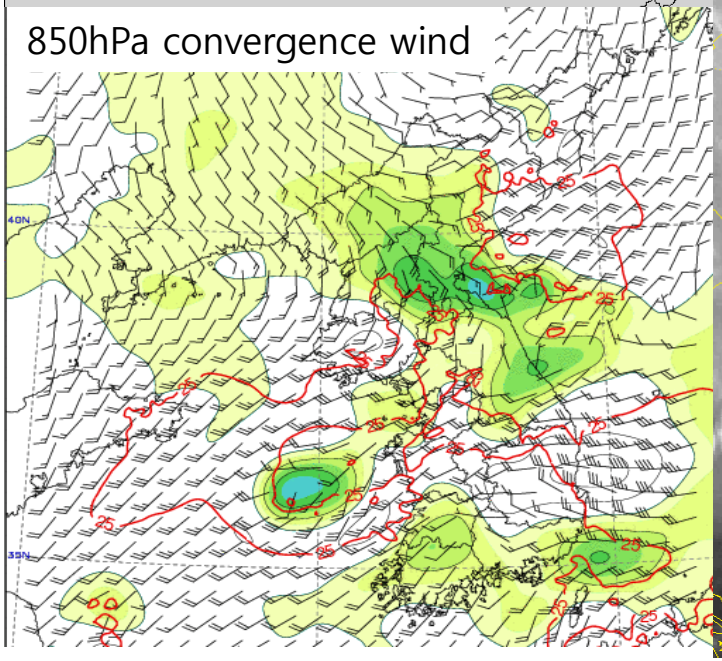


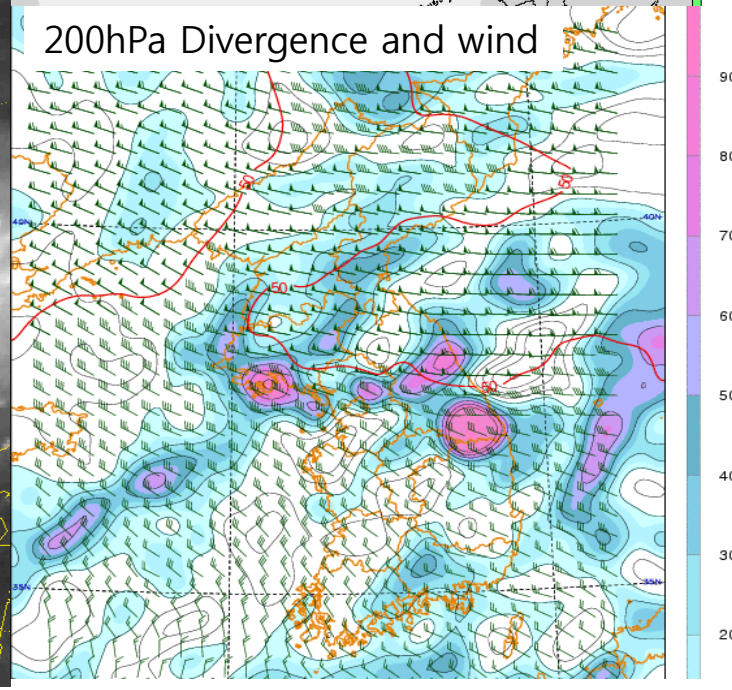
03 UTC, July 22. 2013



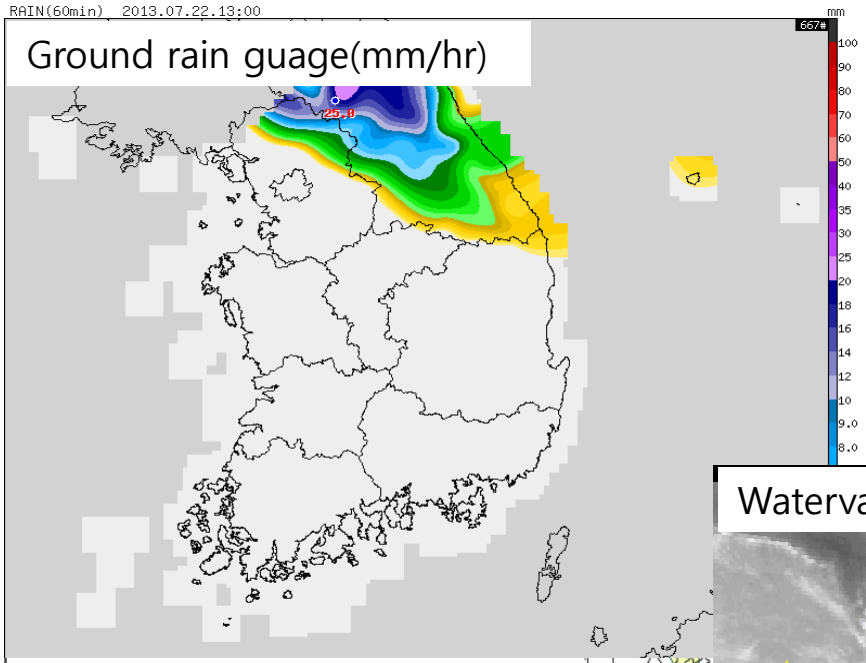


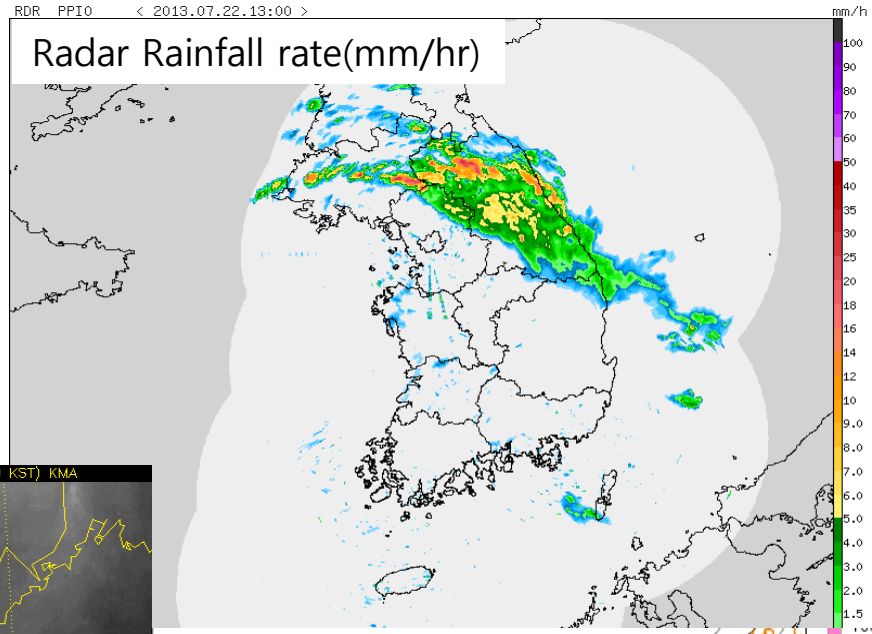


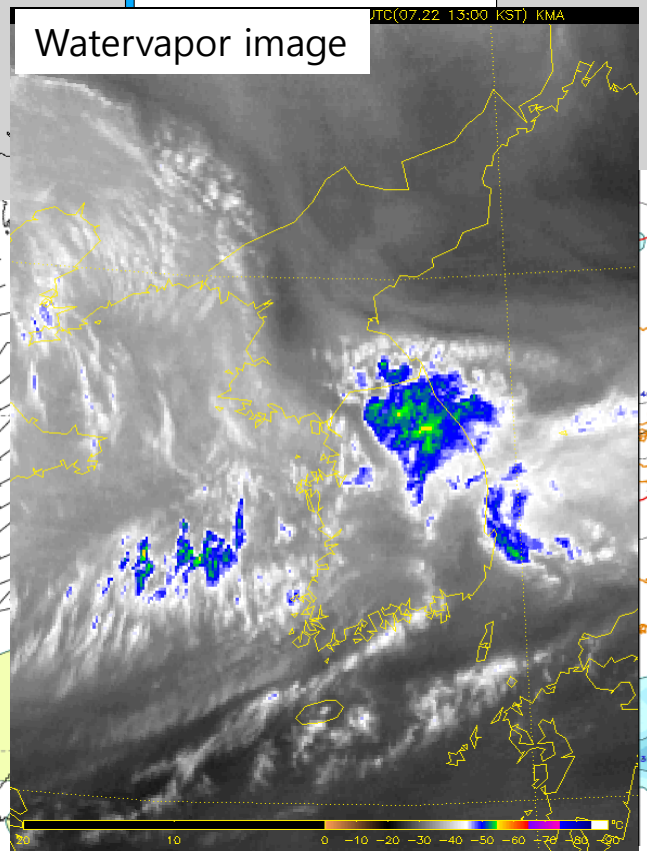


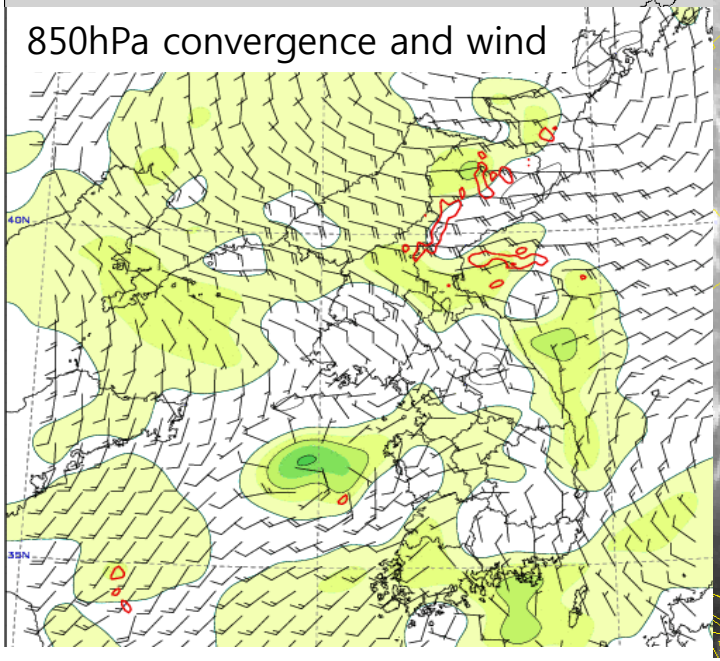


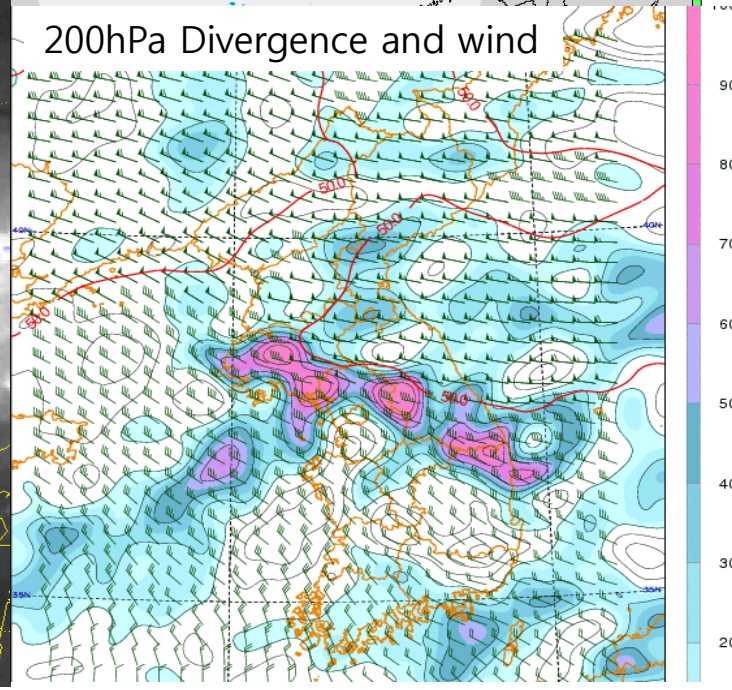
04 UTC, July 22. 2013





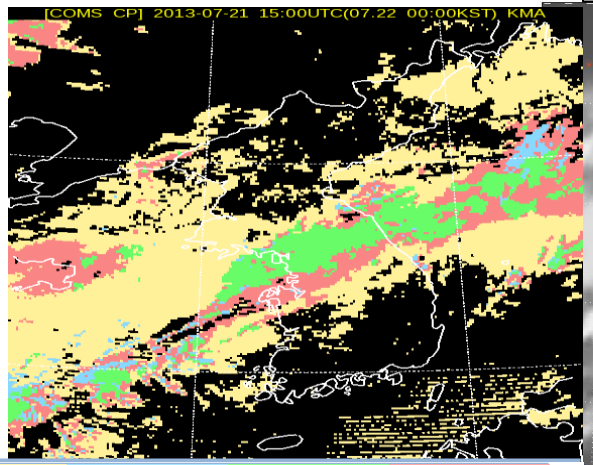




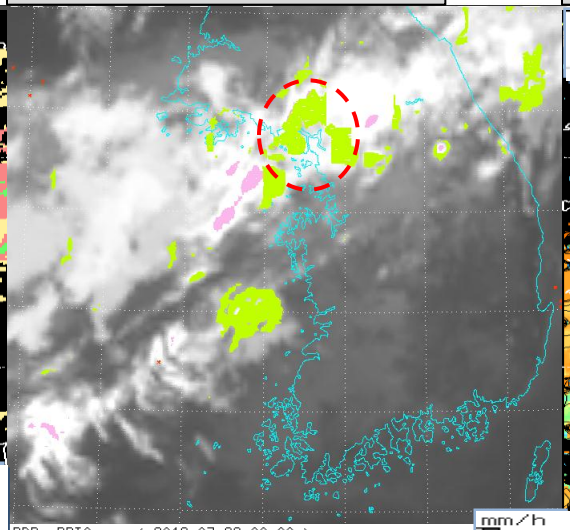


1500 UTC, July 21. 2013

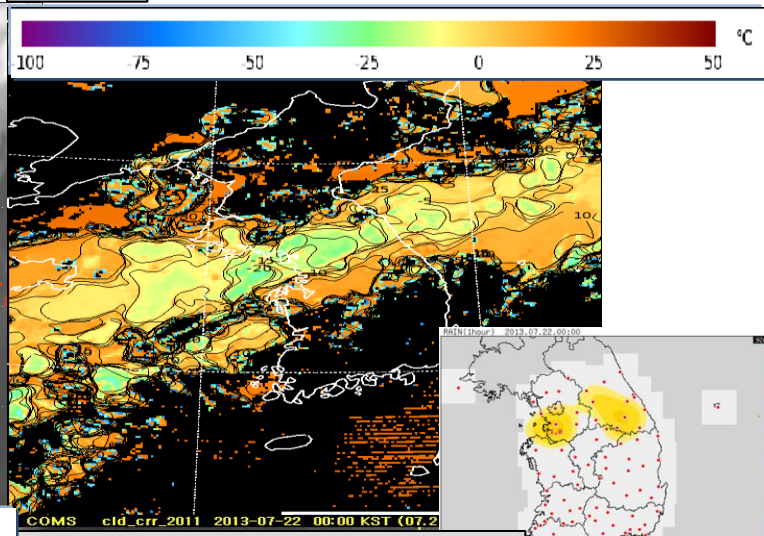
Cloud Phase



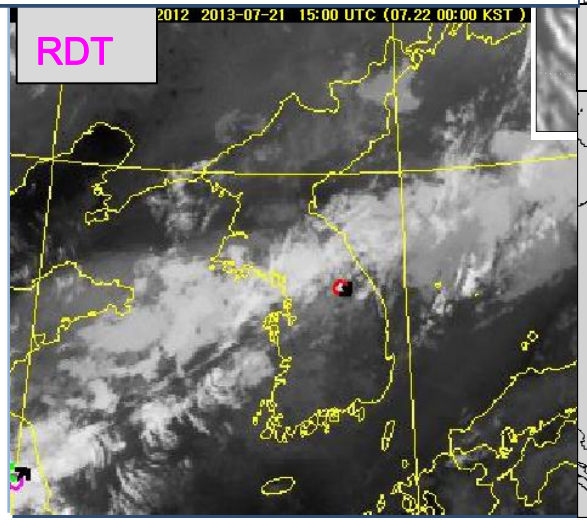
Convective Initiation



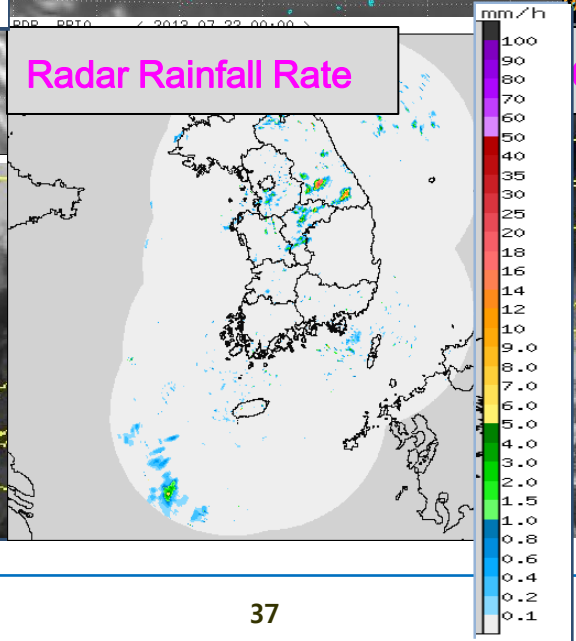
CTT



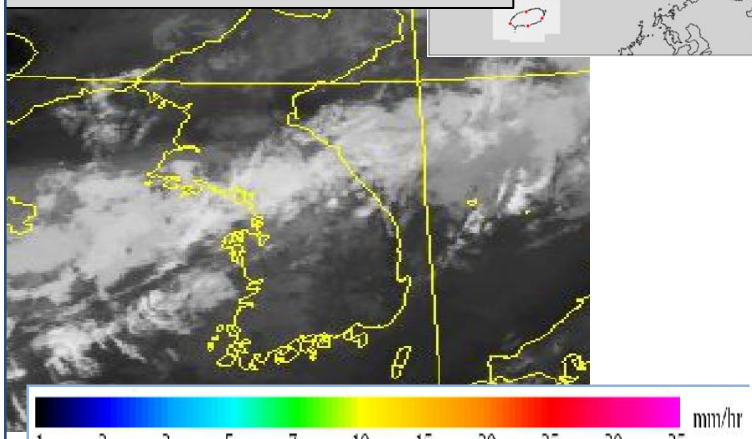
RDT



Radar Rainfall Rate

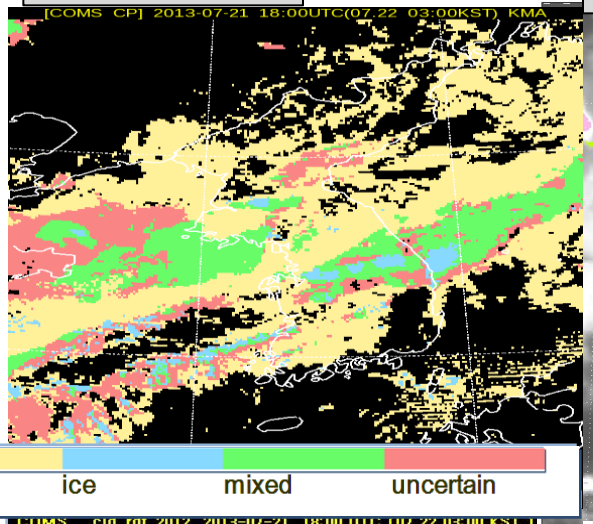


Convective Rainfall Rate

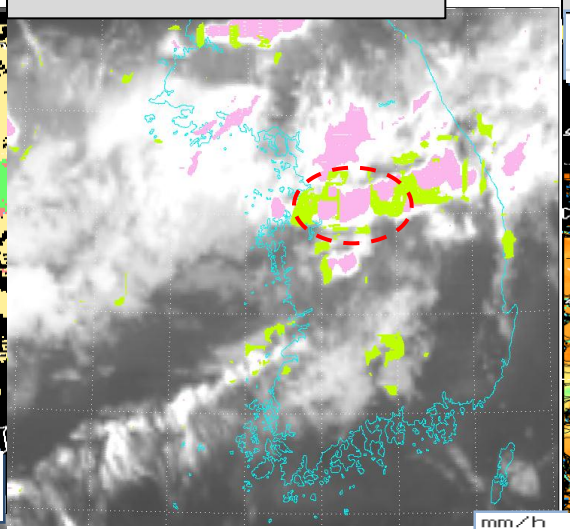


1830 UTC, July 21. 2013

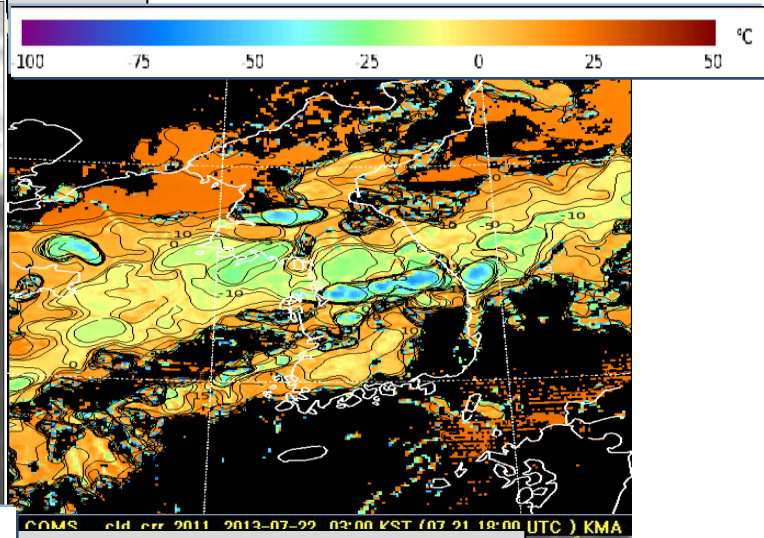
Cloud Phase



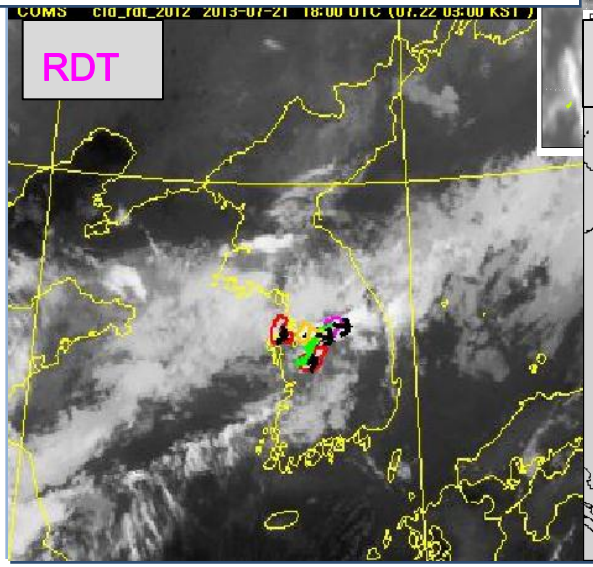
Convective Initiation



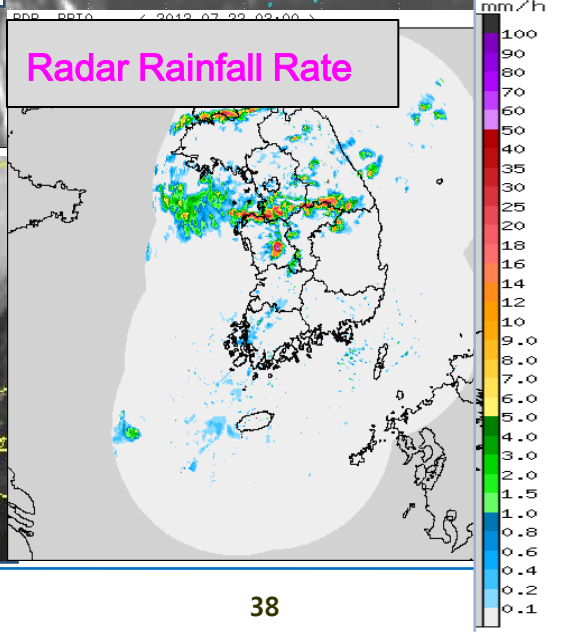
CTT



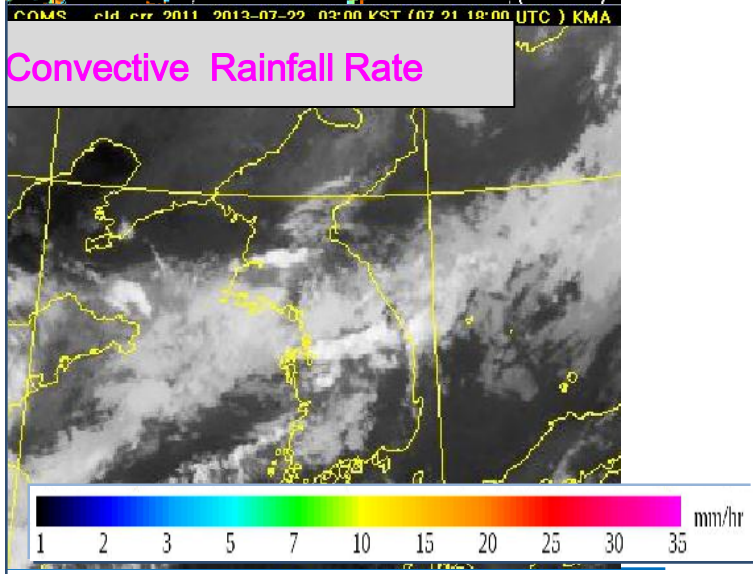
RDT



Radar Rainfall Rate

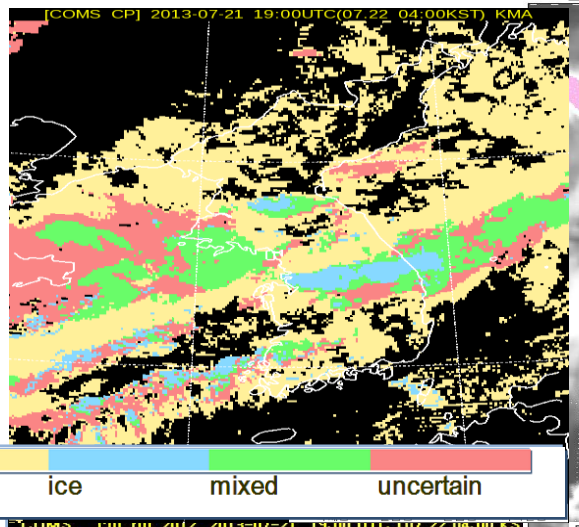


Convective Rainfall Rate

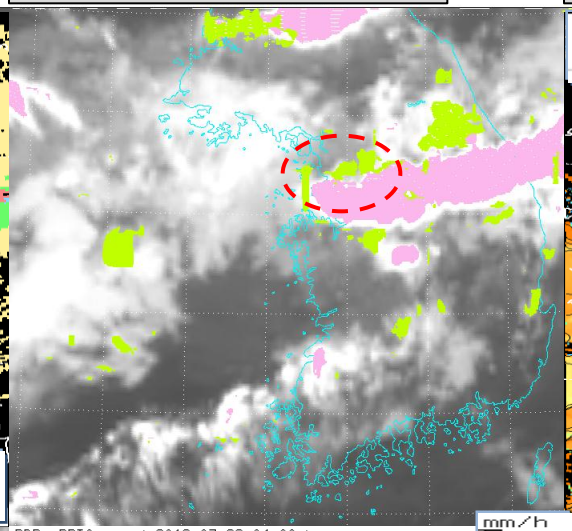


1900 UTC, July 21. 2013

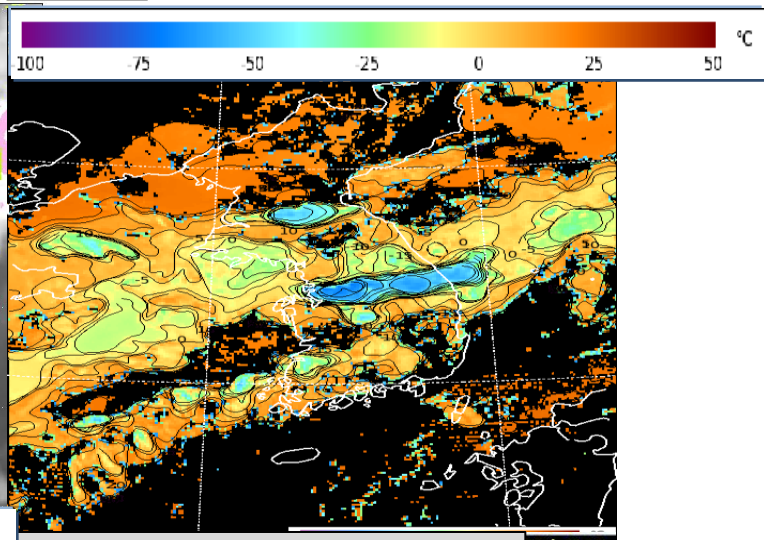
Cloud Phase



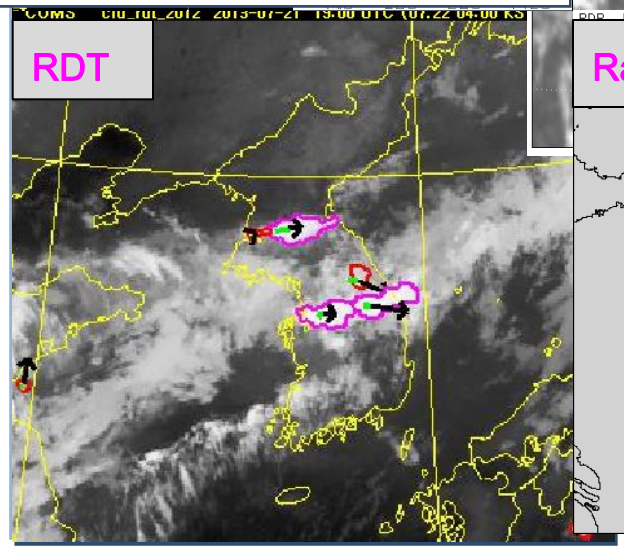
Convective Initiation



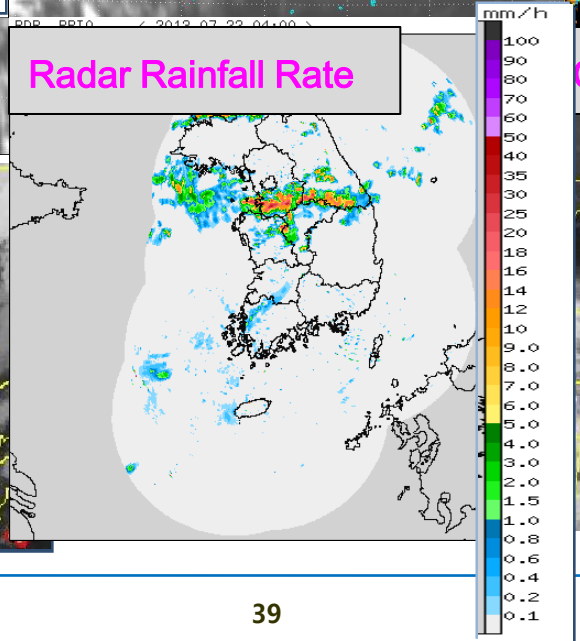
CTT



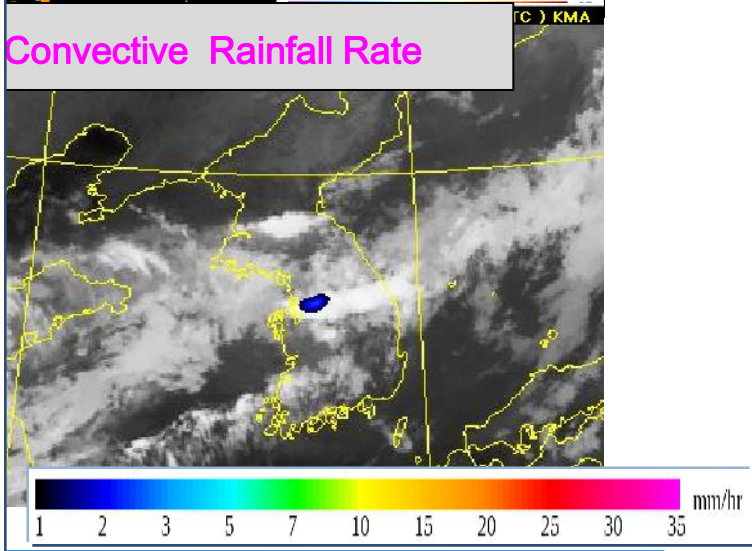
RDT



Radar Rainfall Rate

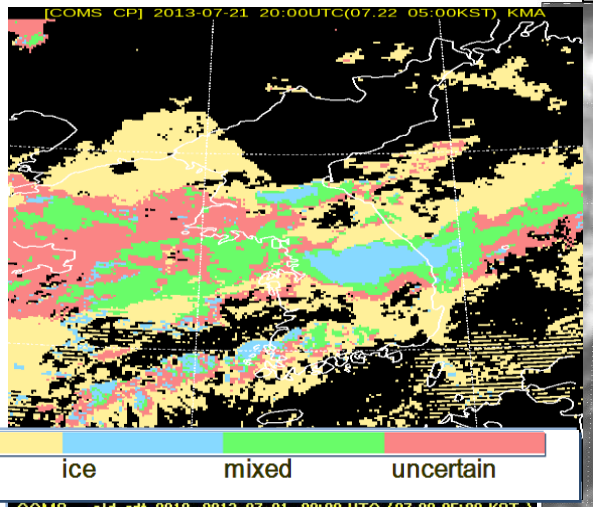


Convective Rainfall Rate

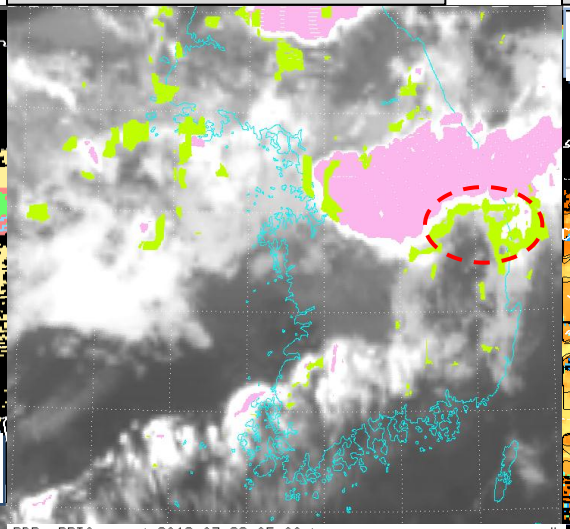


2000 UTC, July 21. 2013

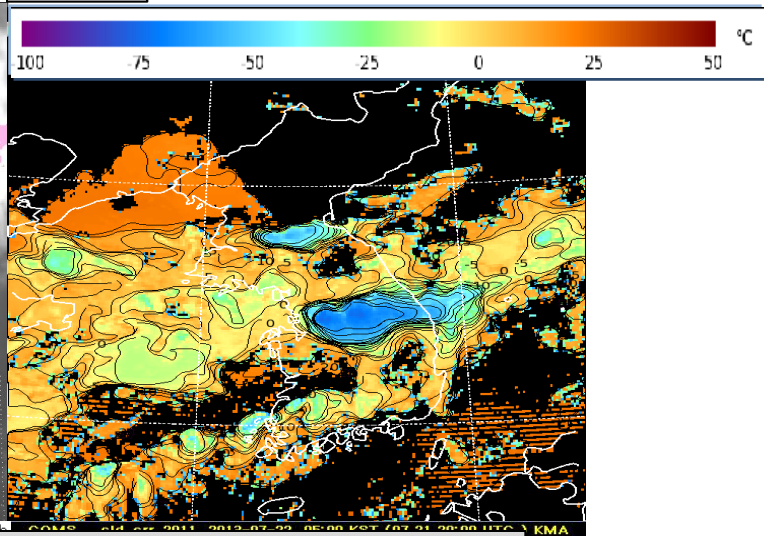
Cloud Phase



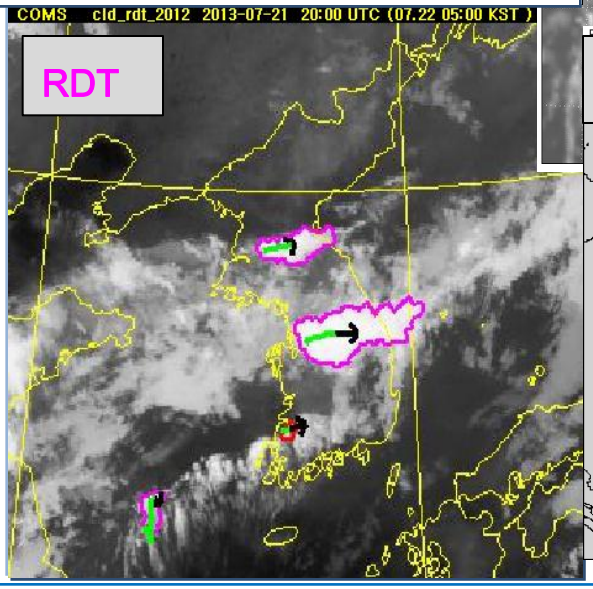
Convective Initiation



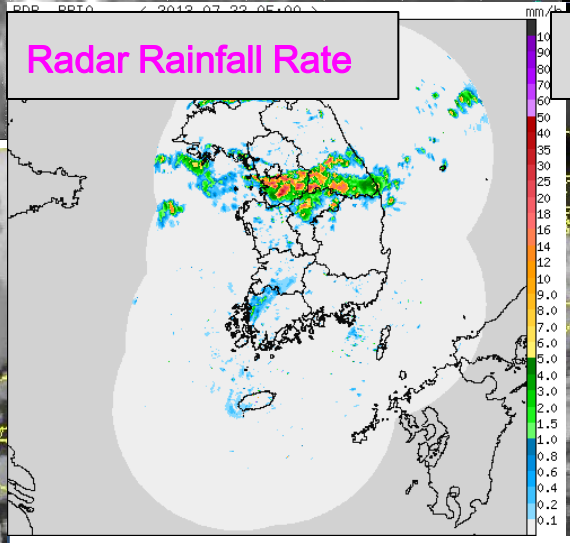
CTT



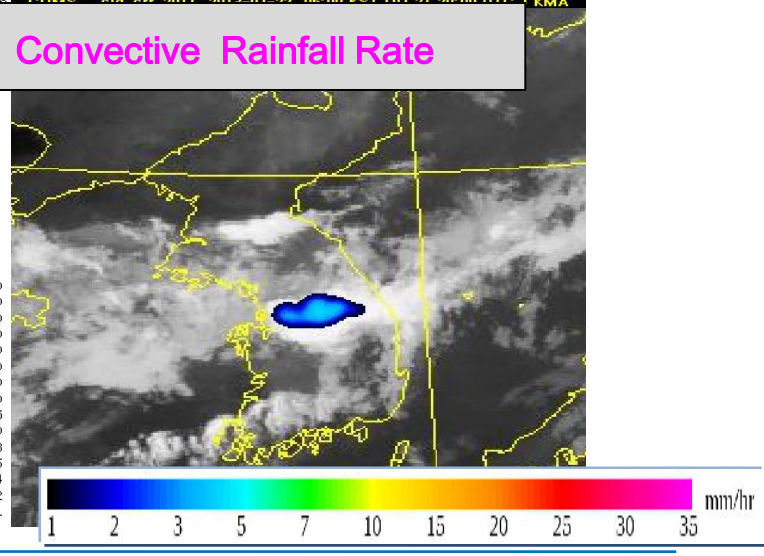
RDT



Radar Rainfall Rate

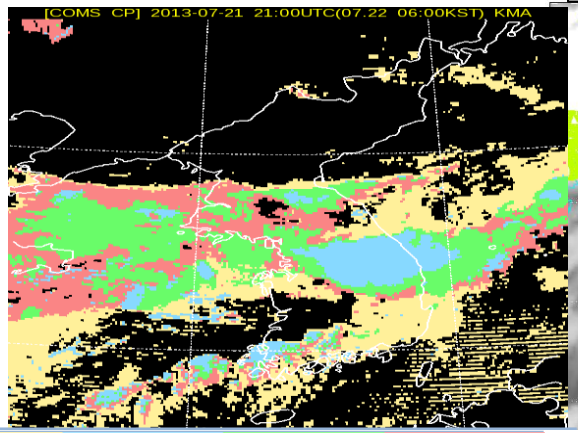


Convective Rainfall Rate



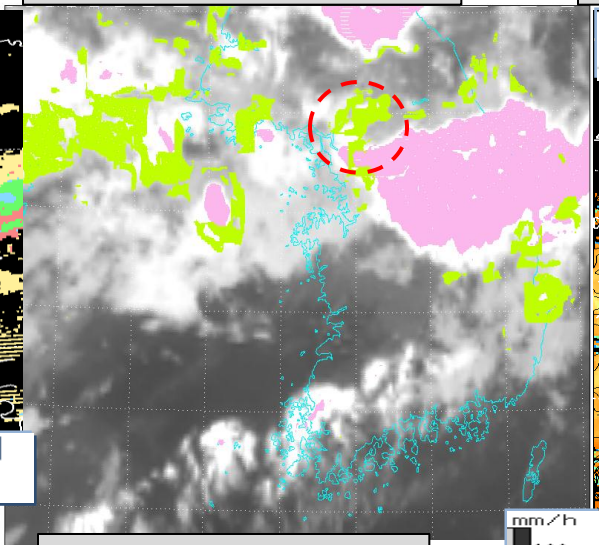
2100 UTC, July 21. 2013

Cloud Phase

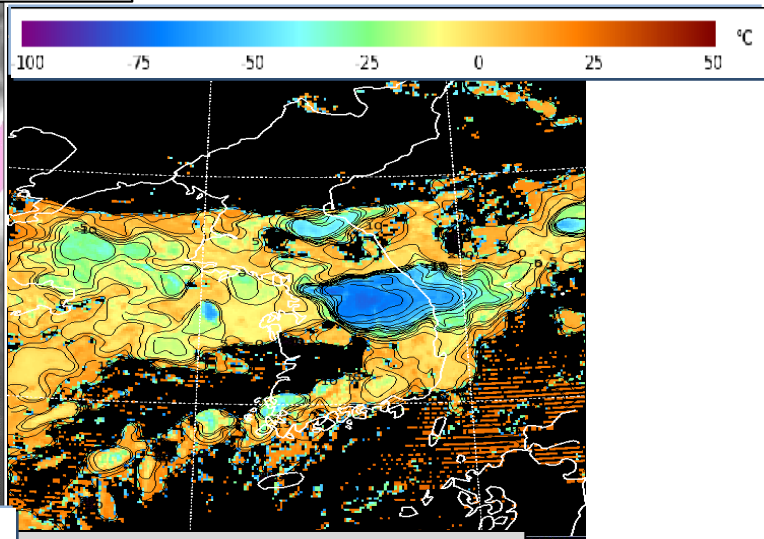


water ice mixed uncertain

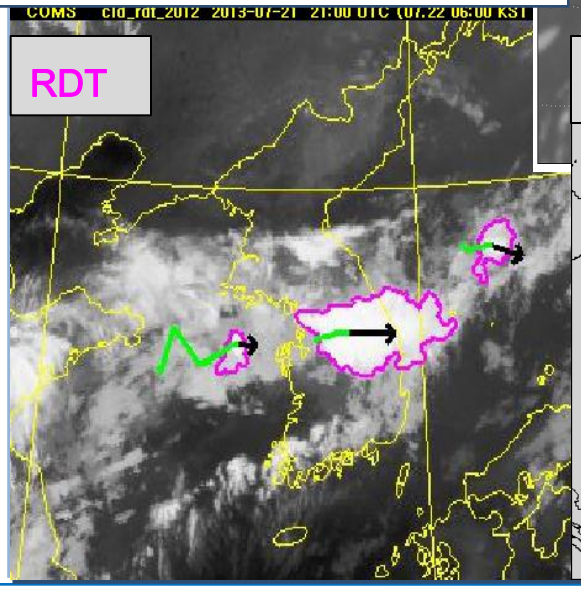
Convective Initiation



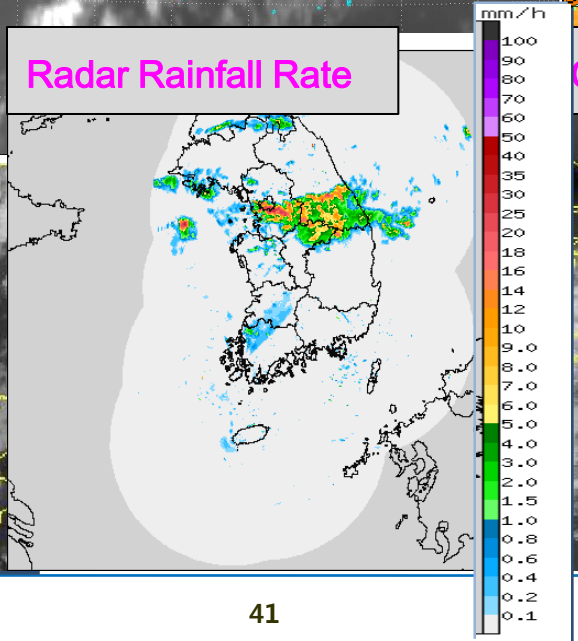
CTT



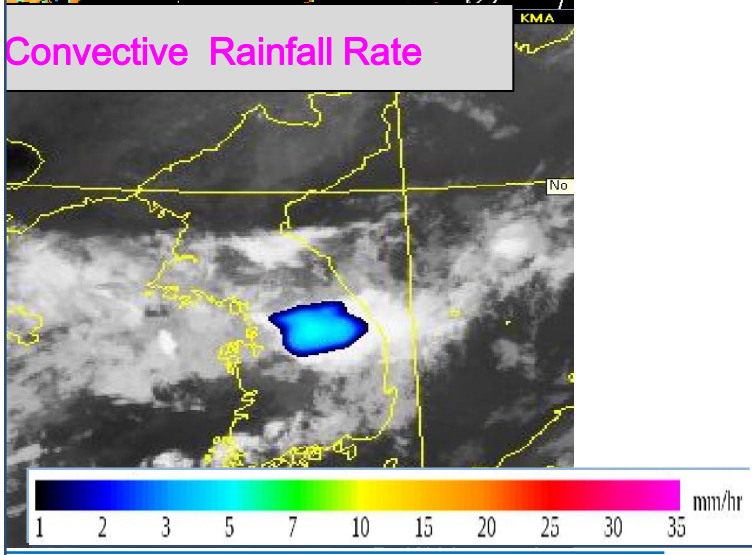
RDT



Radar Rainfall Rate

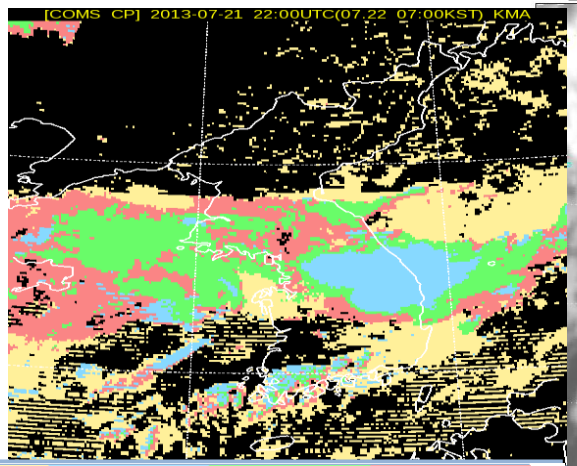


Convective Rainfall Rate

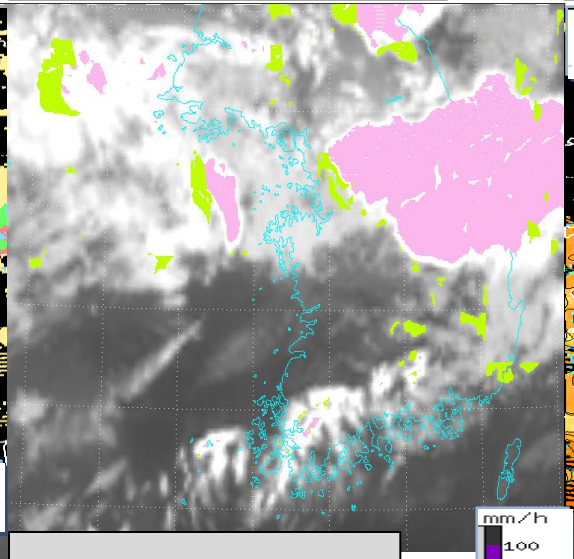


2200 UTC, July 21. 2013

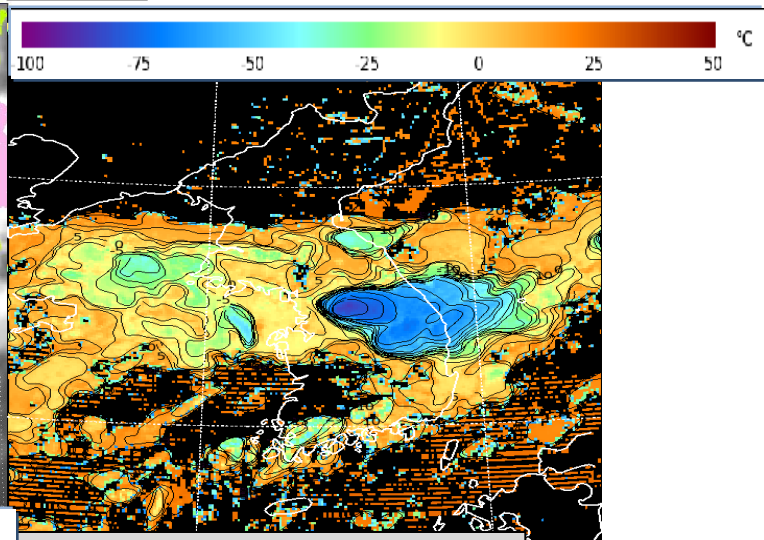
Cloud Phase



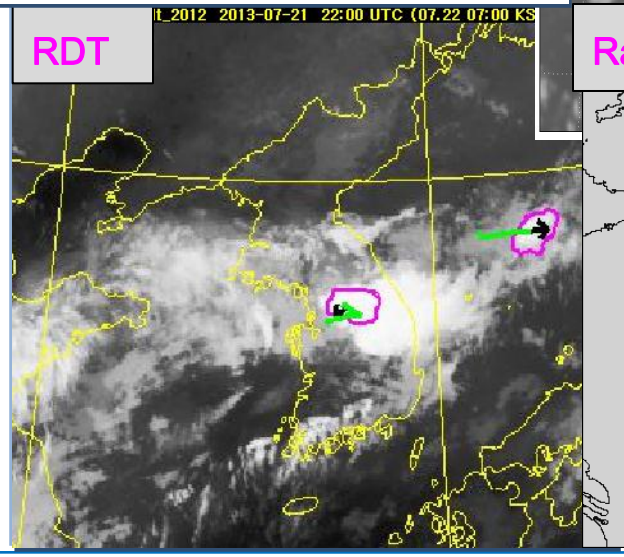
Convective Initiation



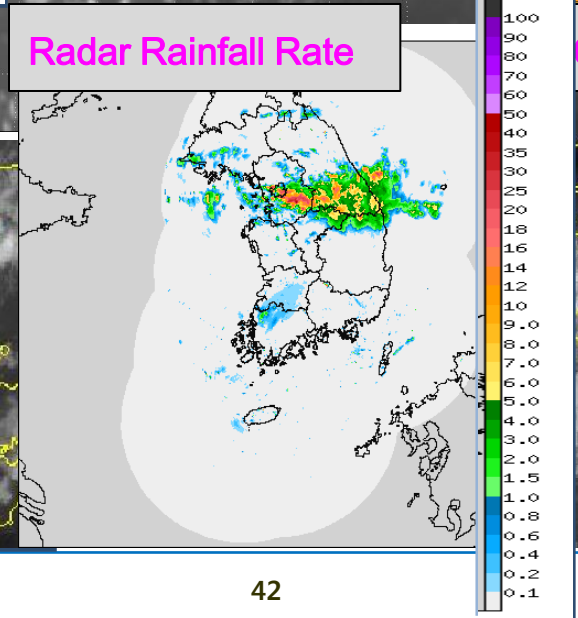
CTT



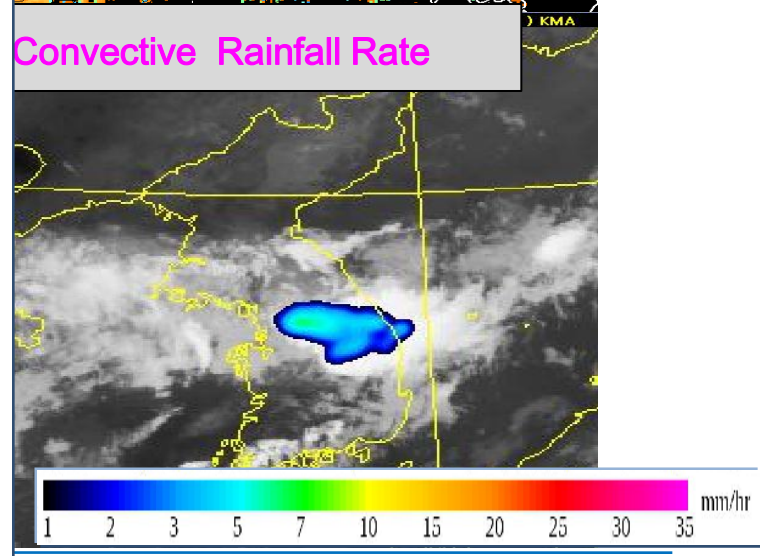
RDT



Radar Rainfall Rate

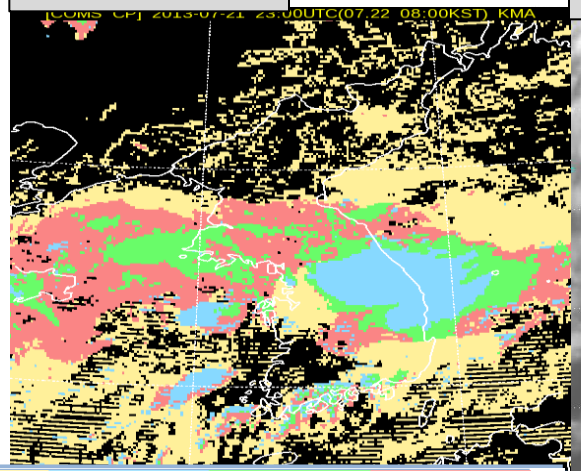


Convective Rainfall Rate



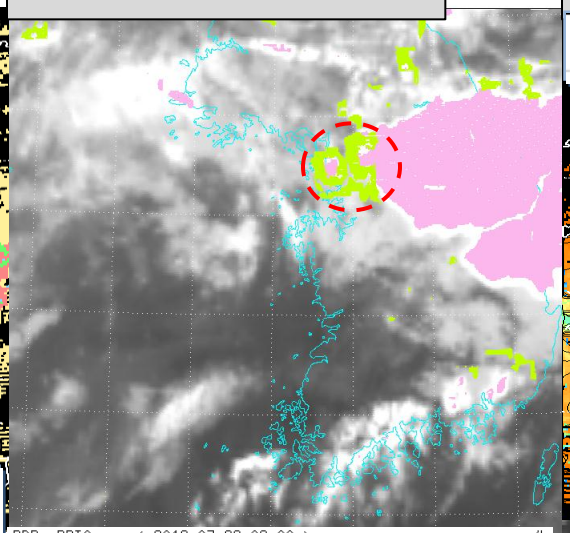
2300 UTC, July 21. 2013

Cloud Phase

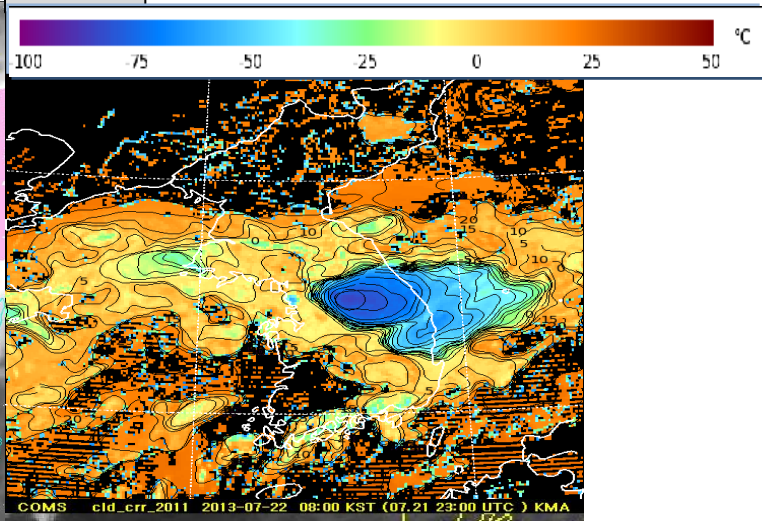


water ice mixed uncertain

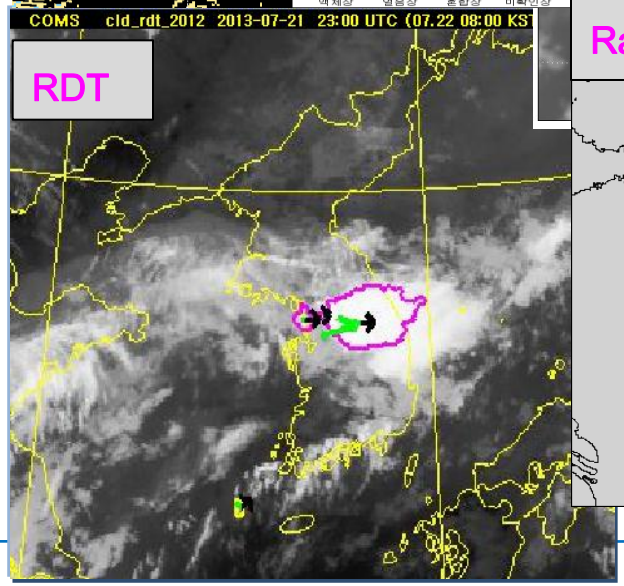
Convective Initiation



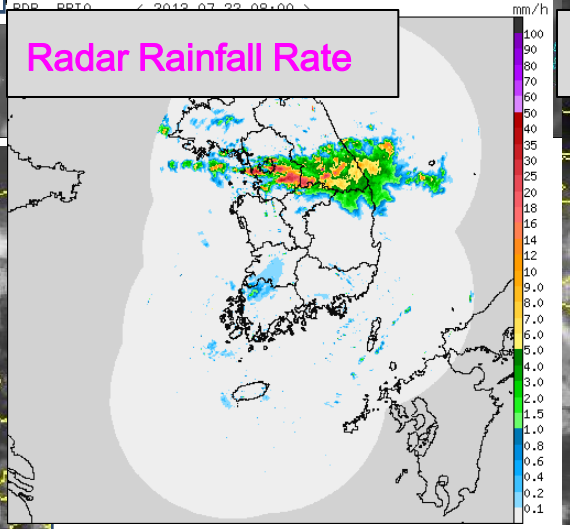
CTT



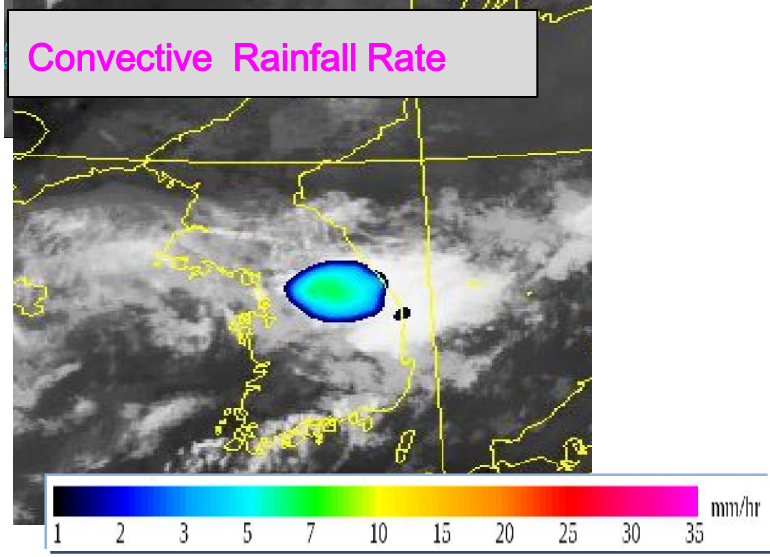
RDT



Radar Rainfall Rate

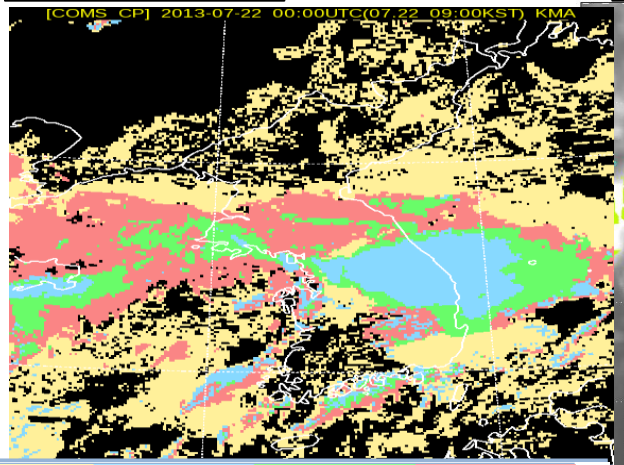


Convective Rainfall Rate



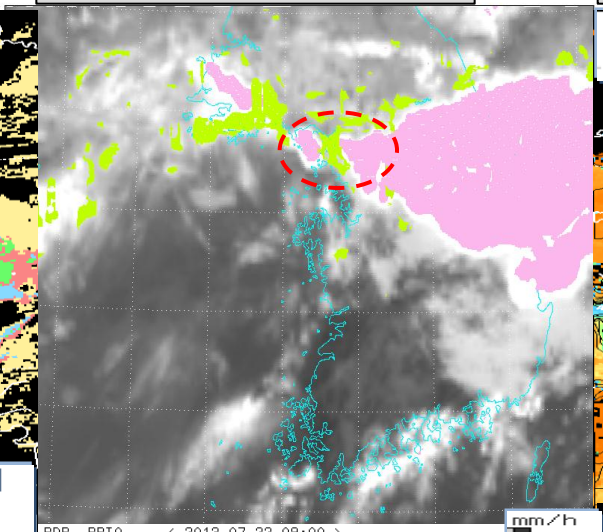
0000 UTC, July 22. 2013

Cloud Phase

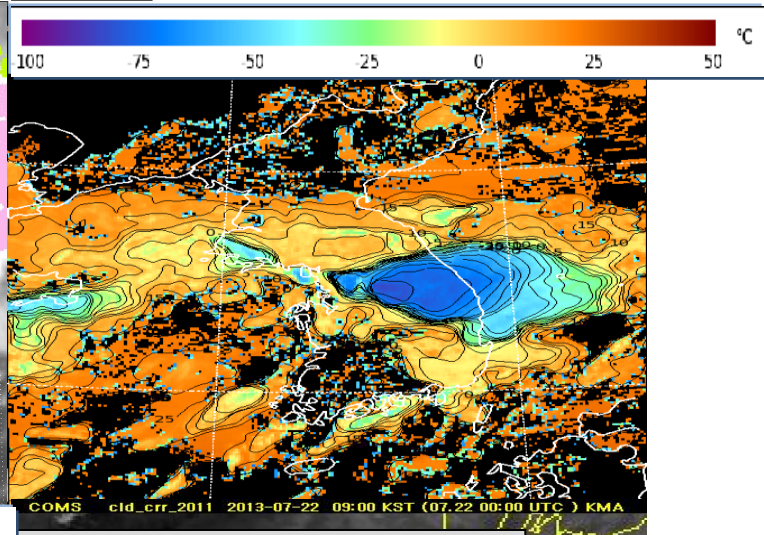


water ice mixed uncertain

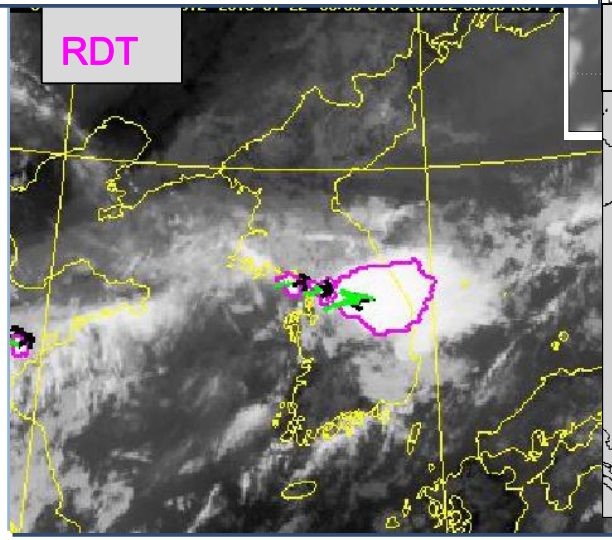
Convective Initiation



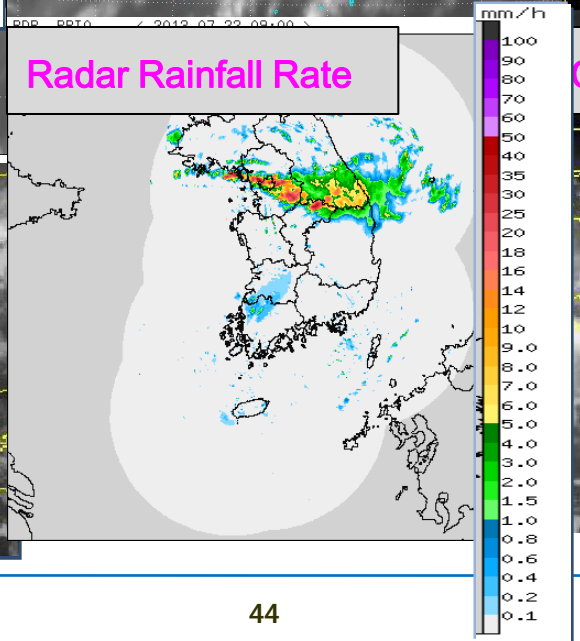
CTT



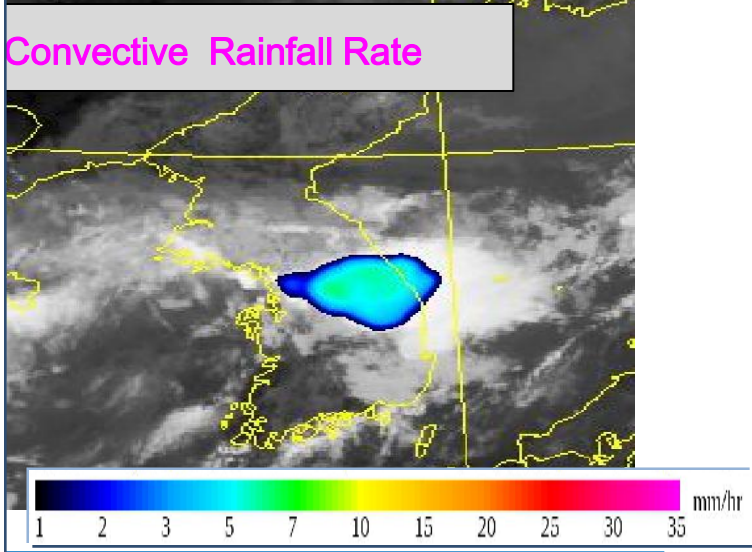
RDT



Radar Rainfall Rate

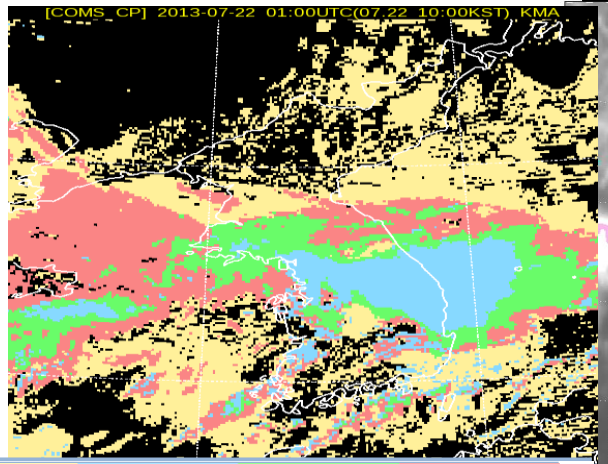


Convective Rainfall Rate



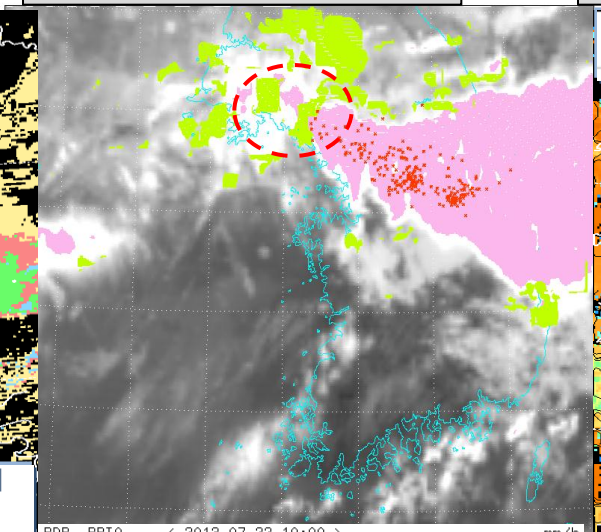
0100 UTC, July 22. 2013

Cloud Phase

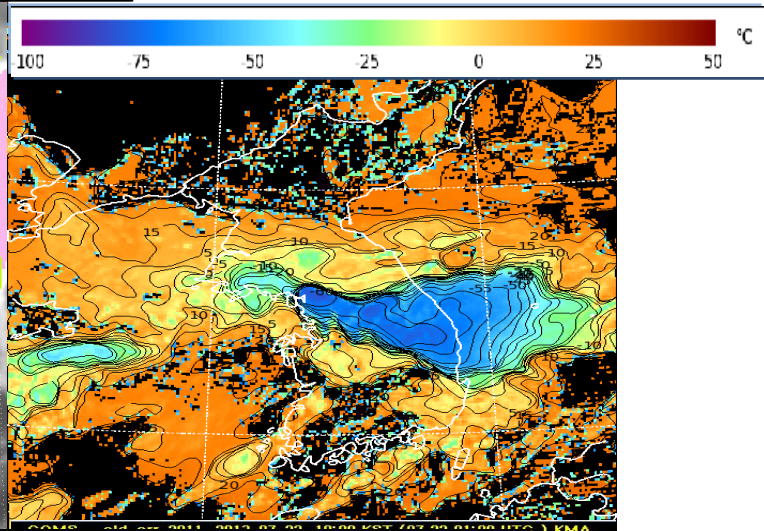


water ice mixed uncertain

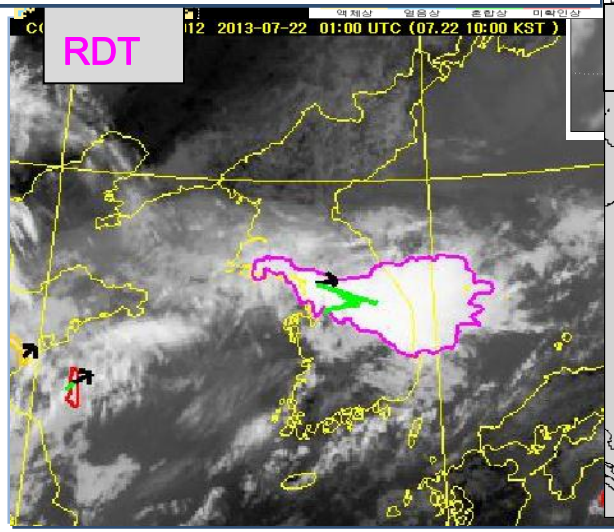
Convective Initiation



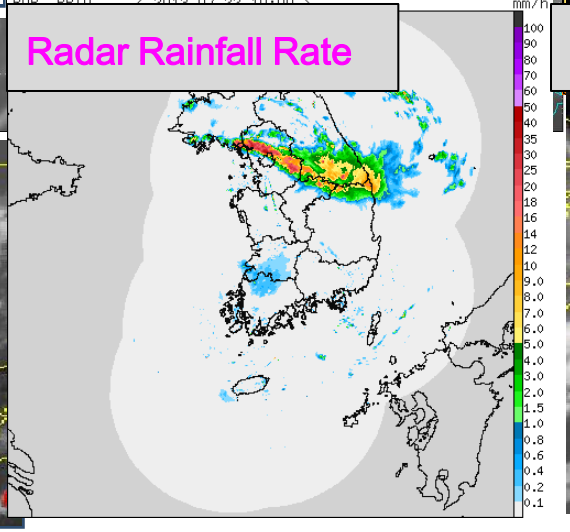
CTT



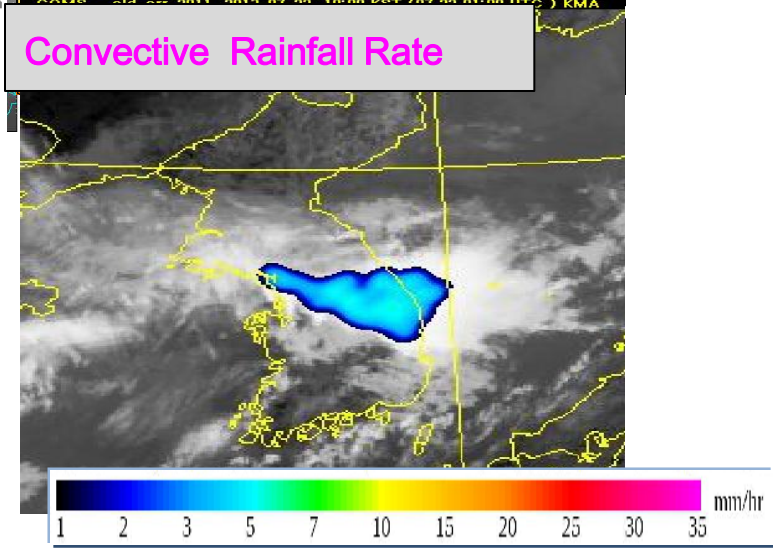
RDT



Radar Rainfall Rate

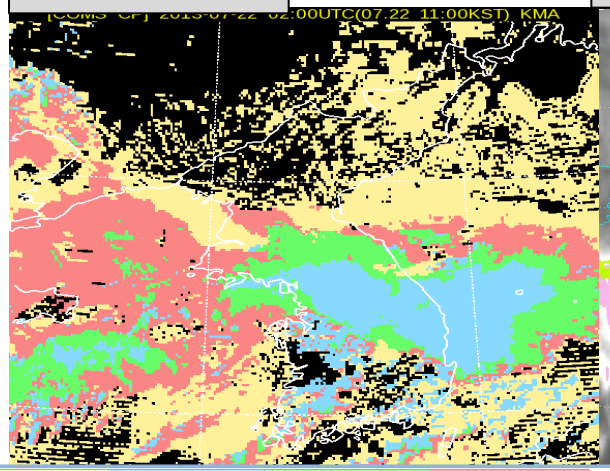


Convective Rainfall Rate

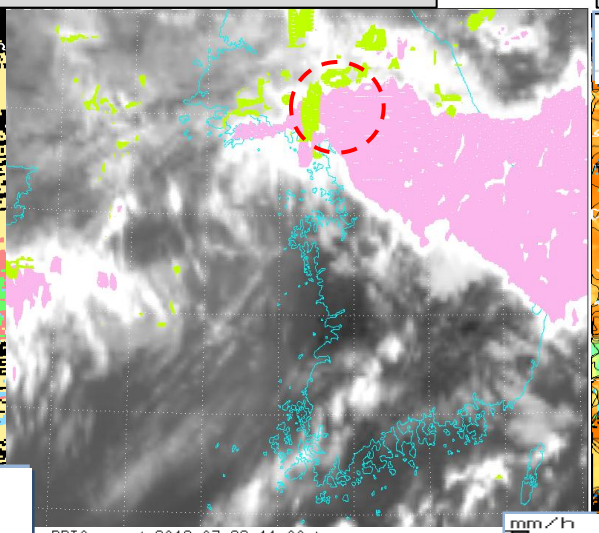


0200 UTC, July 22. 2013

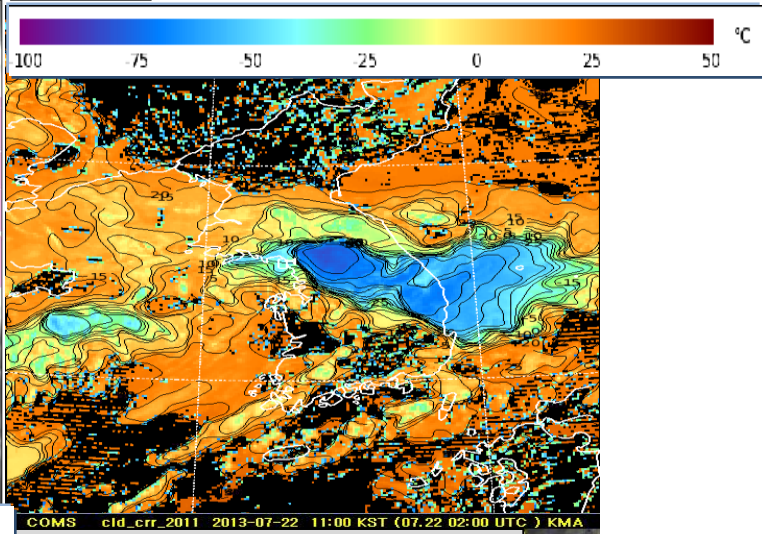
Cloud Phase



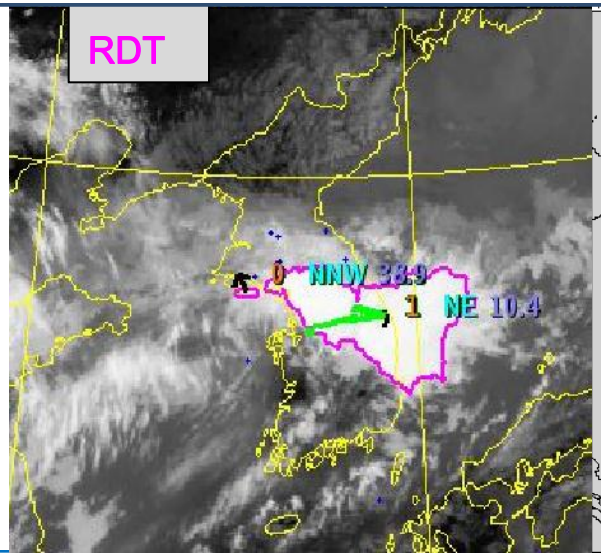
Convective Initiation



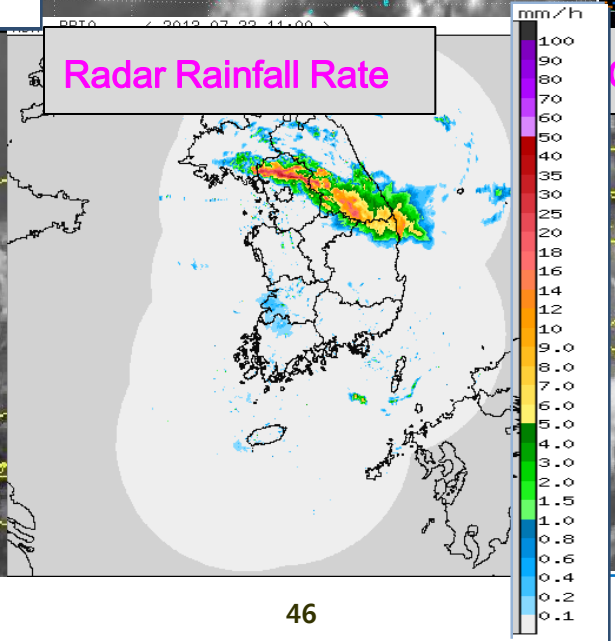
CTT



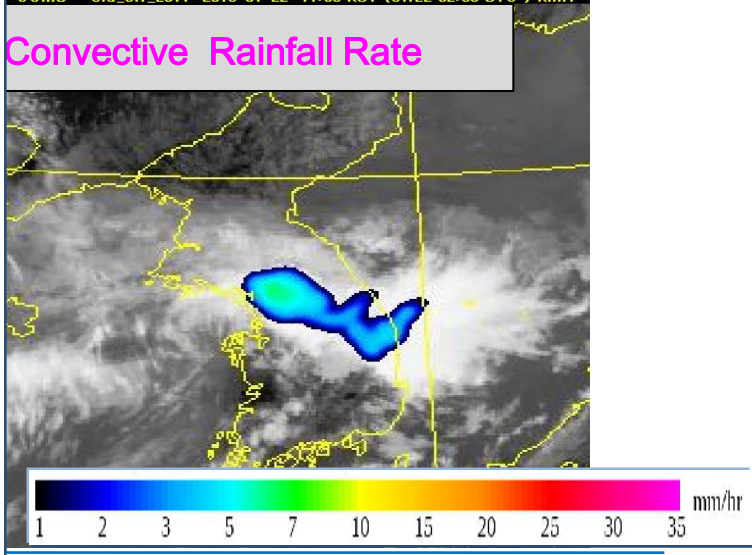
RDT



Radar Rainfall Rate

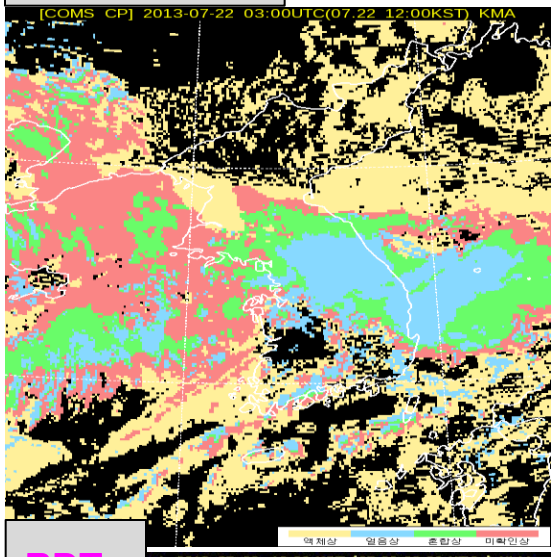


Convective Rainfall Rate

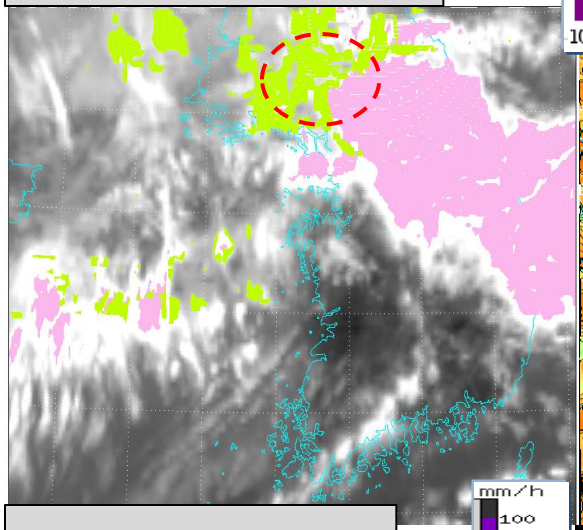


0300 UTC, July 22. 2013

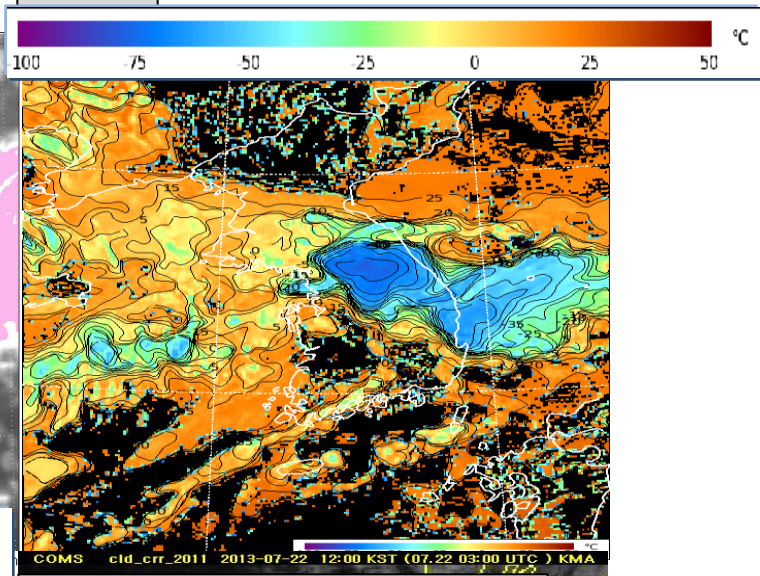
Cloud Phase



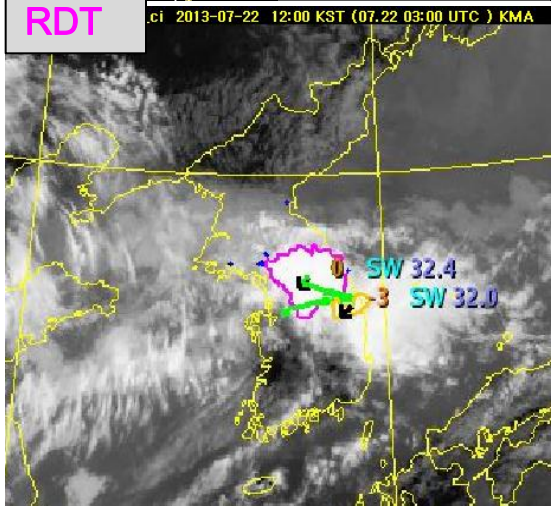
Convective Initiation



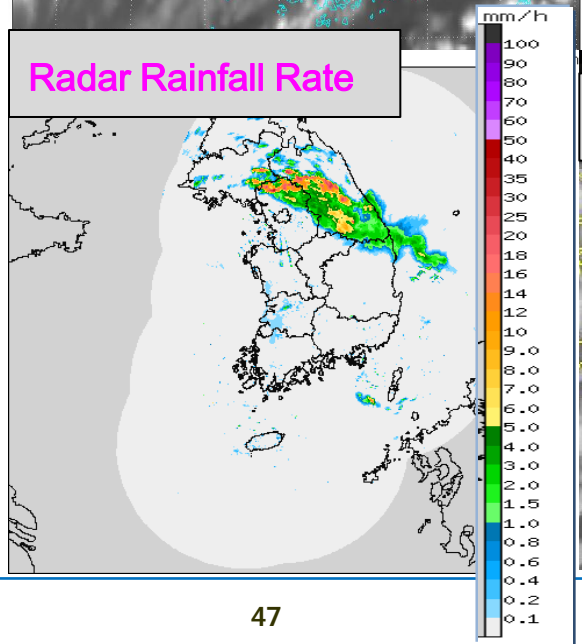
CTT



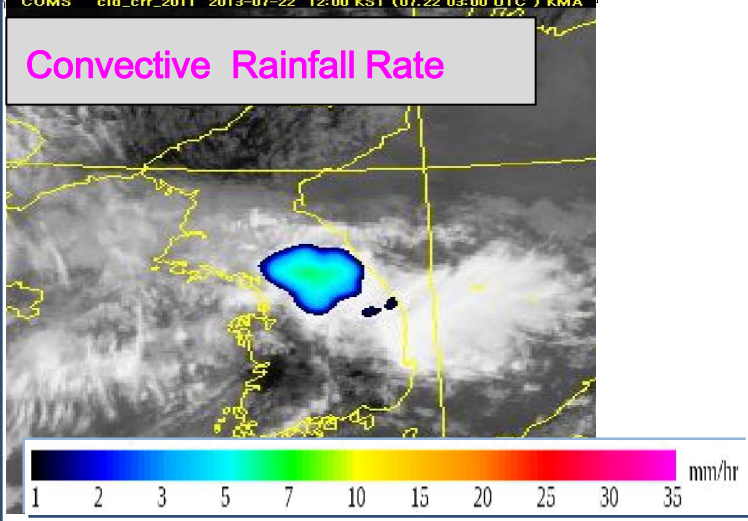
RDT



Radar Rainfall Rate



Convective Rainfall Rate



Results

- We inspected "Jang-ma front" over the middle of Korea peninsular in 2013, accompanying with heavy rain producing storm trains.
- Cloud top temperature (CTT) of developed storm reached to -70°C and kept CTT for 3 hours. When CI developed to mature convective cloud, Cloud phase changed from mixed to ice. Convective Initiation (CI) product in NMSC gave the early information for convection area which may occur in near future.
- ASII
  - New concept models such as stationary front should be made, which occurs in eastern Asia region.
- RDT
  - Convective cloud had no good agreement with radar echo in early step in terms of location.
- CRR
  - Even though new CM(Calibration Matrix) was applied, compared with radar rainfall rate, CRR has much less rainfall rate by above 10 mm/hr.

Thank you!