Application to typhoon, severe weather detection and data services of GK2A

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The 12th Asia/Oceania Meteorological Satellite User's Conference
Training event

Satellite-based Typhoon Analysis with GK2A

November 11, 2022
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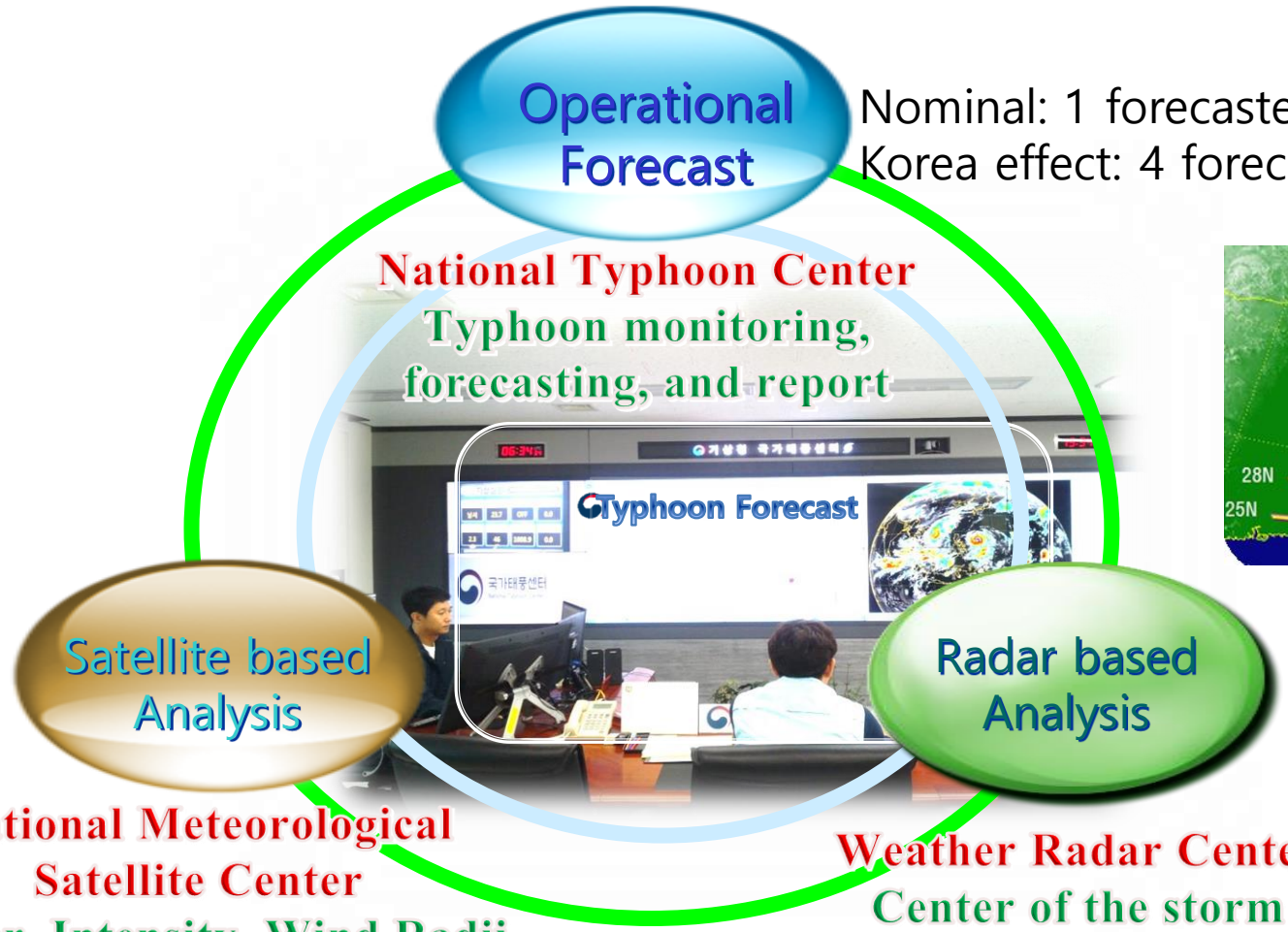
Korea Meteorological Administration

국가기상위성센터
National Meteorological Satellite Center

Operational Structure



Nominal: 1 forecaster 12-hr shift
Korea effect: 4 forecasters 24-hr shift

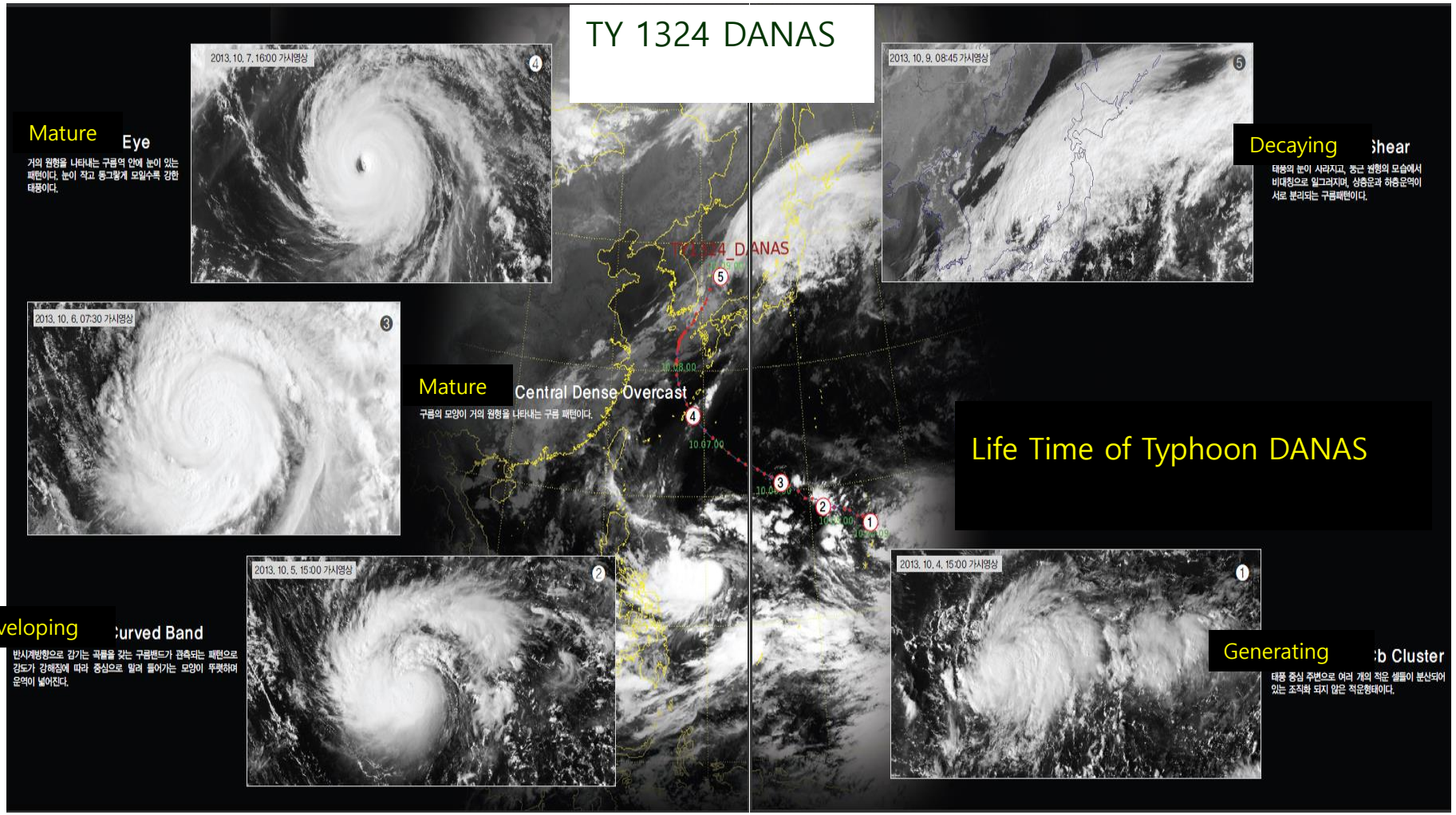
Nominal: 1 operator 12-hr shift
Korea effect: 2 operators 24-hr shift

Nominal: 1 operator 12-hr shift
Korea effect: 2 operators 24-hr shift

Web-based Satellite imagery Analysis System

- New user friendly web-based system for GK2A
- Using Dvorak Technique from SSEC/CIMSS
- Create own UI, DB, and intensity algorithm for ADT/SDT
- Including all available observation data
- Automated tools including finding center position, intensity, wind radii beside subjected analysis by human
- Comparisons with other agencies report and best track

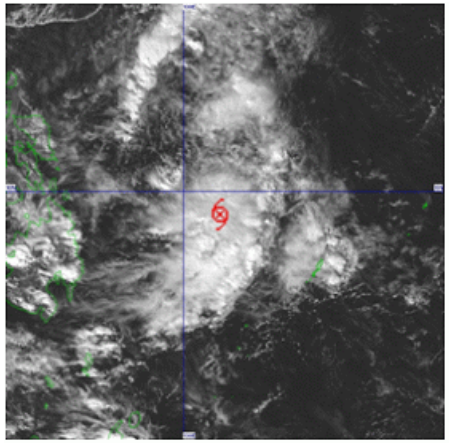
Typical pattern of Typhoon near Korea



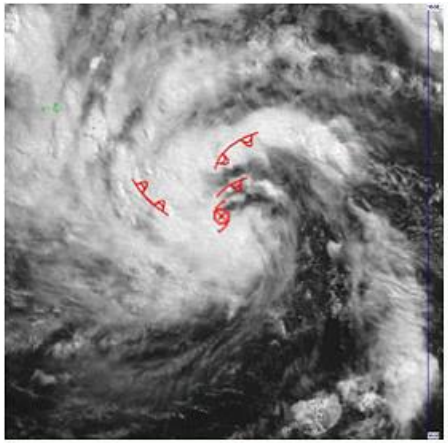
Generating -> Developing -> Mature -> Weaking

①Cb Cluster -> ②Curved Band -> ③CDO -> ④EYE -> ⑤SHEAR

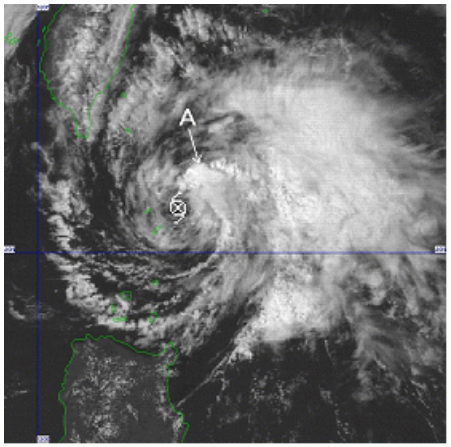
Cloud Patterns



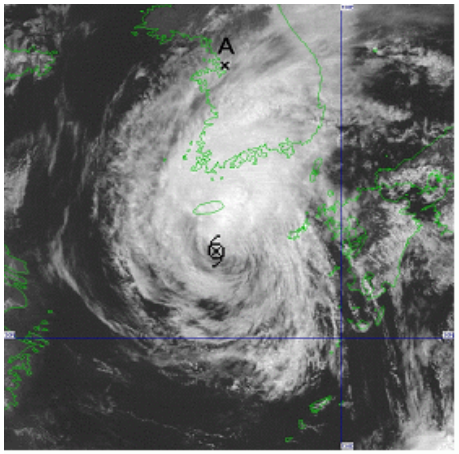
Unorganized
Cb-cluster Pattern



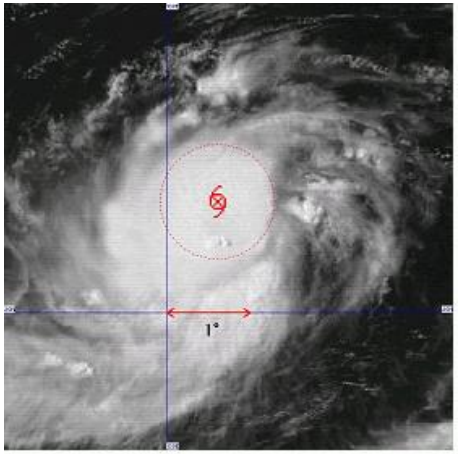
Organized
Cb-cluster Pattern



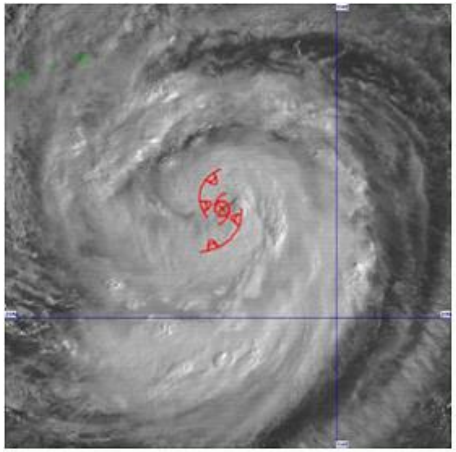
Low Level Cloud
Vortex Pattern



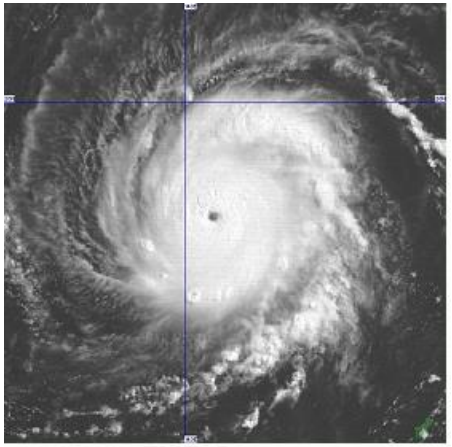
SHEAR Pattern



CDO Pattern



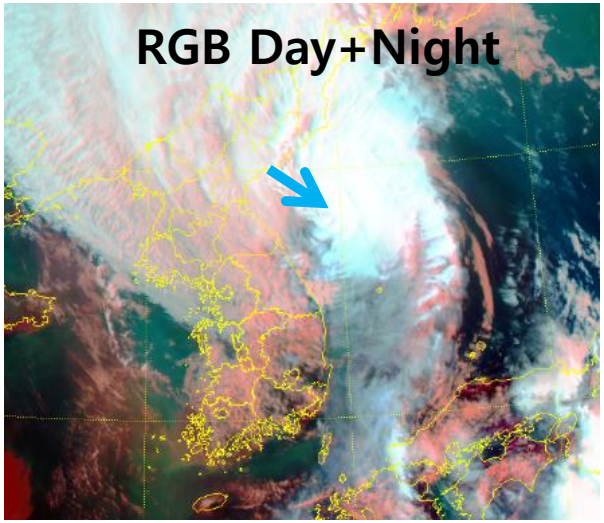
BAND Pattern

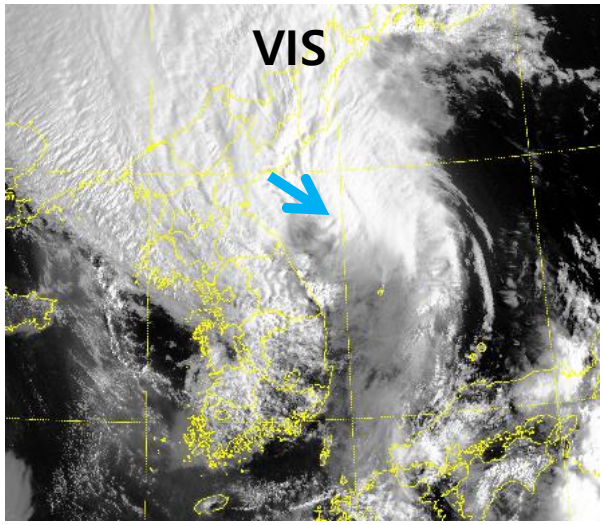


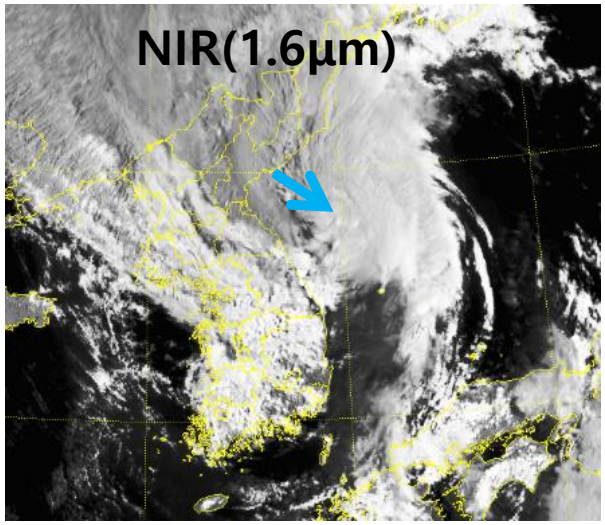
EYE Pattern

Which imagery we can use?

DAY

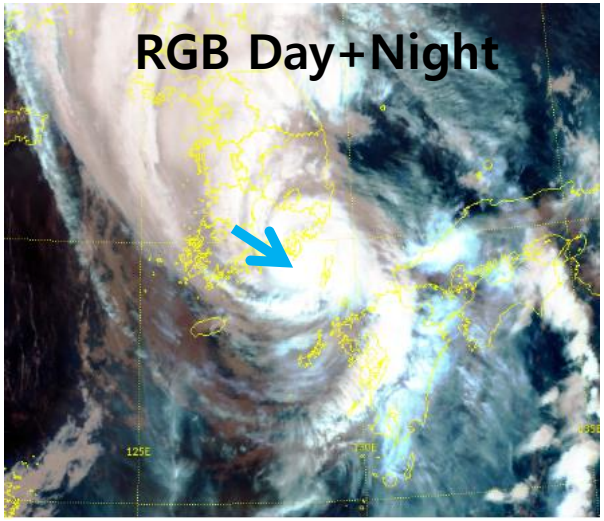


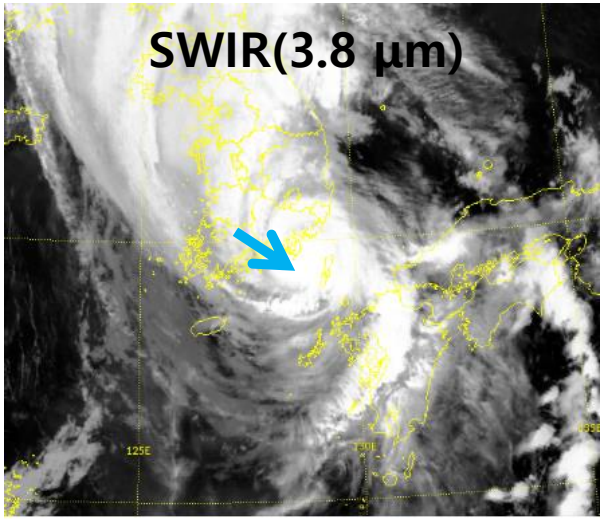


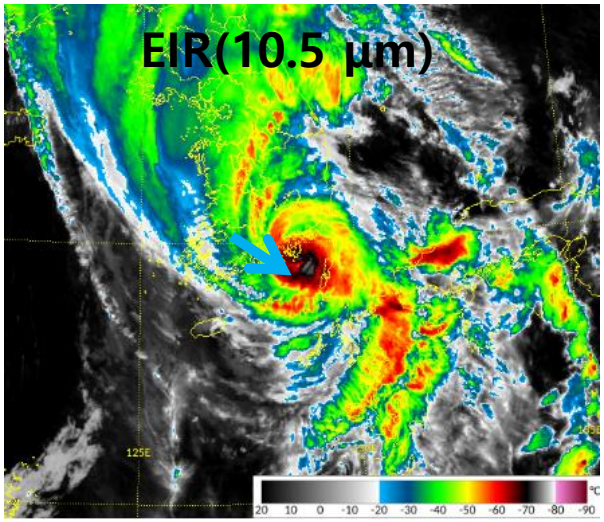


2009 Typhoon MAYSAK, 2020. 09. 03. 09KST

NIGHT

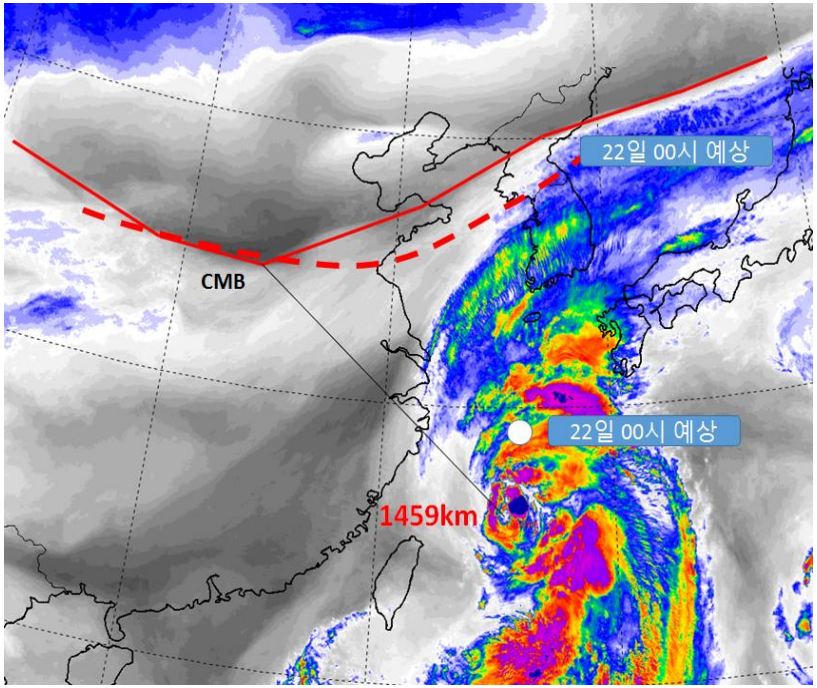


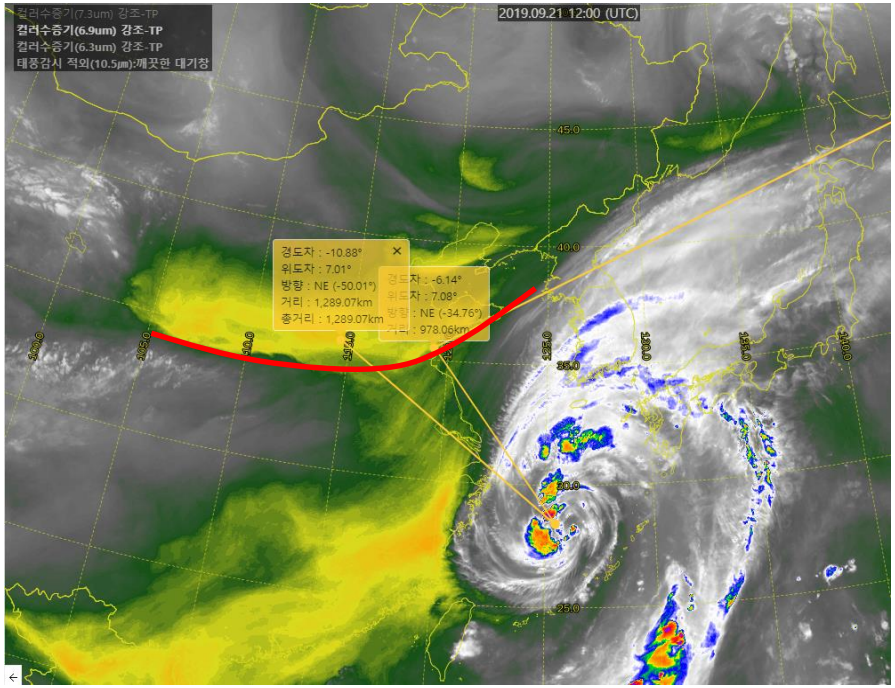




2009 Typhoon MAYSAK, 2020. 09. 03. 01KST

Find recurving point using Water Vapor imagery



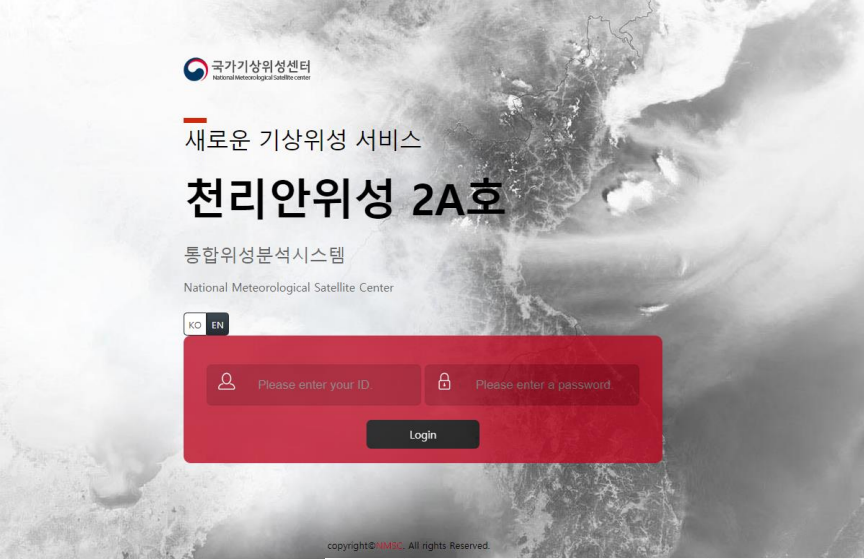


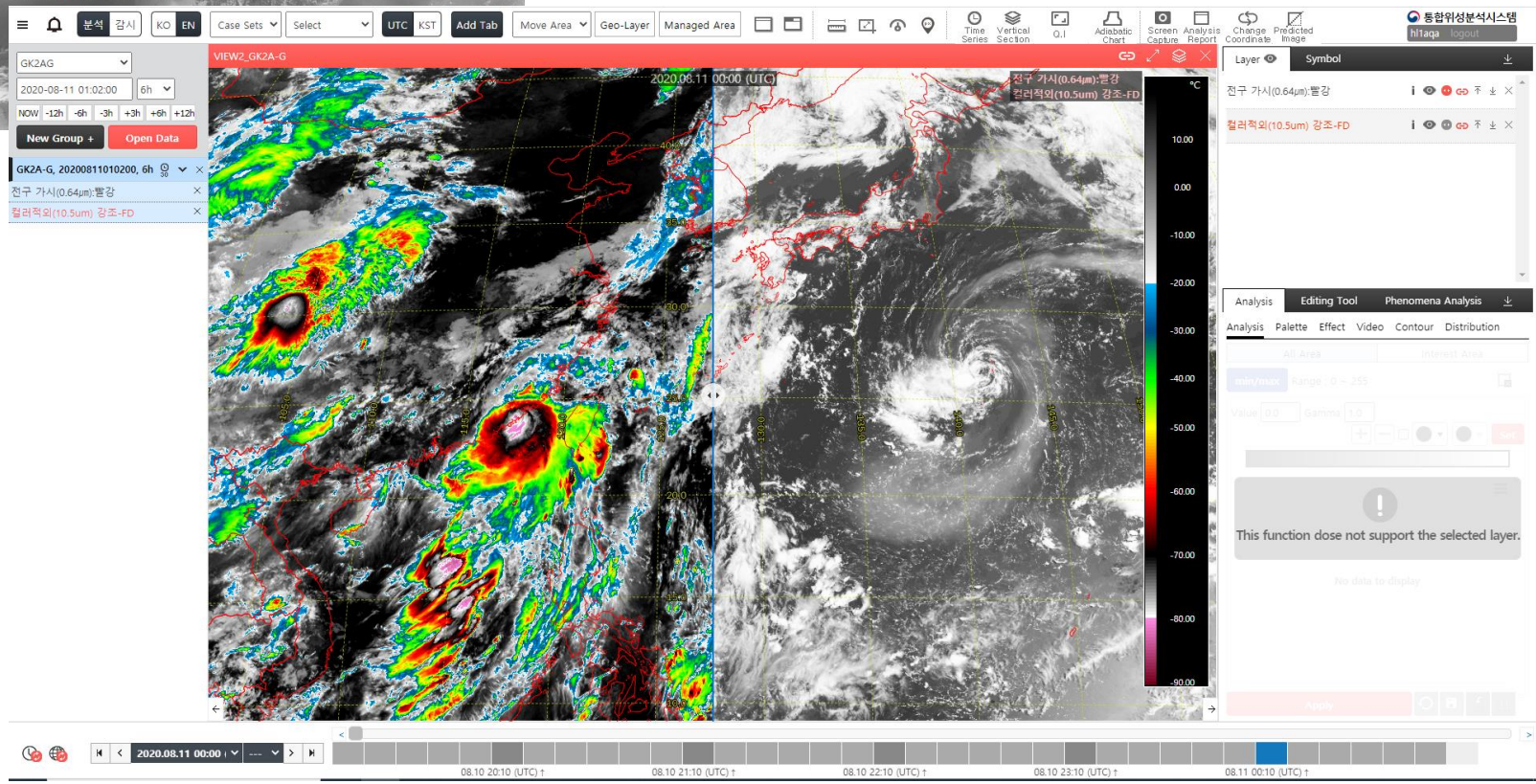
2019. 9. 21. 09KST Water Vapor Enhanced imagery

- Expect the recurving point using the distance between center of the storm and curved moisture band, CMB over GK2A Water Vapor imagery
- Normally recurving starts the distance less than 1,000km

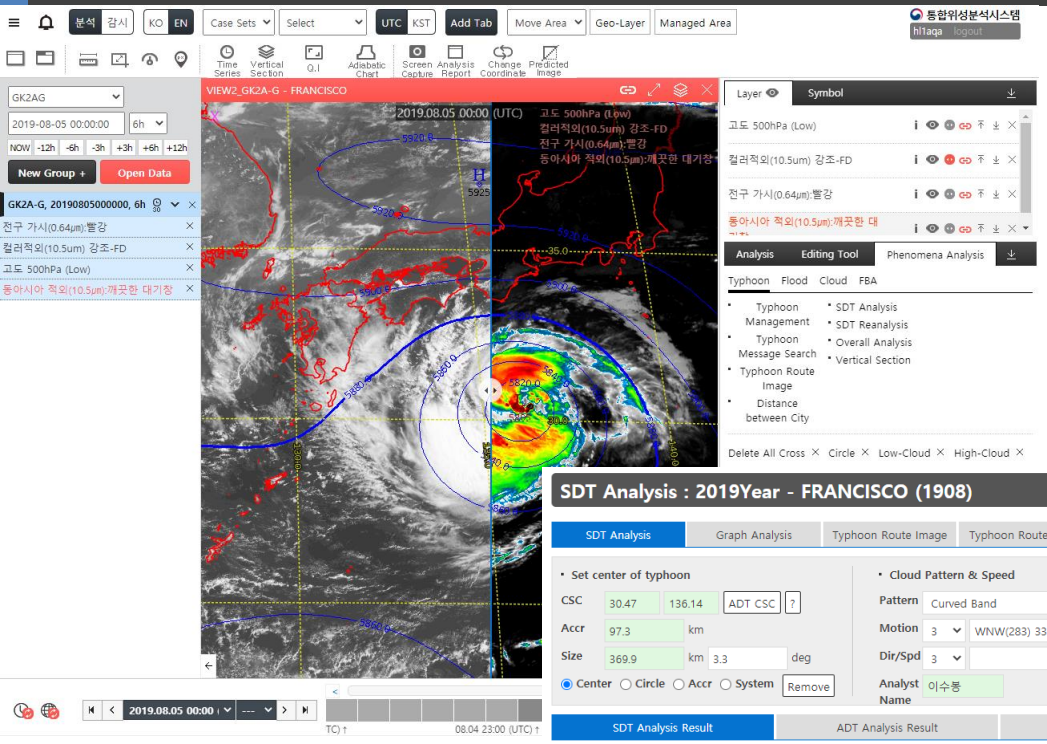
New GK2A web-based analysis system

Web based Satellite imagery Analysis System



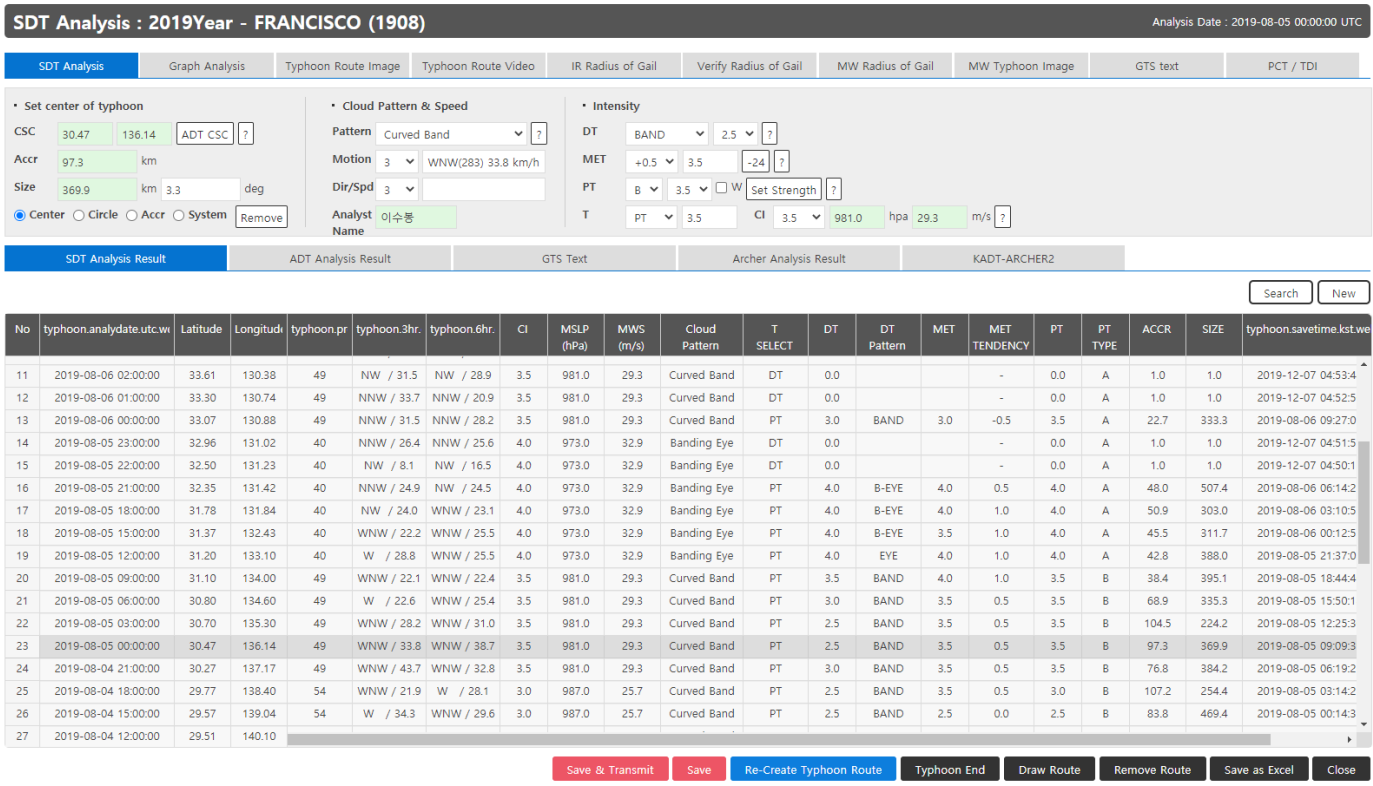


Tropical Cyclone Analysis



Main Window

- Data selection(time, area, type, etc)
- Layer display
- Analysis tools(palette, effect, video, contour, distribution, editing, etc)
- Phenomena(Typhoon, Flood, Cloud, Fire/Volcanic ash/Fog etc)



No	typhoon.analydate.utc.w	Latitude	Longitud	typhoon.pr	typhoon.3hr.	typhoon.6hr.	CI	MSLP (hPa)	MWS (m/s)	Cloud Pattern	T SELECT	DT	DT Pattern	MET	MET TENDENCY	PT	PT TYPE	ACCR	SIZE	typhoon.savetime.kst.we
11	2019-08-06 02:00:00	33.61	130.38	49	NW / 31.5	NW / 28.9	3.5	981.0	29.3	Curved Band	DT	0.0			-	0.0	A	1.0	1.0	2019-12-07 04:53:4
12	2019-08-06 01:00:00	33.30	130.74	49	NNW / 33.7	NNW / 20.9	3.5	981.0	29.3	Curved Band	DT	0.0			-	0.0	A	1.0	1.0	2019-12-07 04:52:5
13	2019-08-06 00:00:00	33.07	130.88	49	NNW / 31.5	NNW / 28.2	3.5	981.0	29.3	Curved Band	PT	3.0	BAND	3.0	-0.5	3.5	A	22.7	333.3	2019-08-06 09:27:0
14	2019-08-05 23:00:00	32.96	131.02	40	NNW / 26.4	NNW / 25.6	4.0	973.0	32.9	Banding Eye	DT	0.0			-	0.0	A	1.0	1.0	2019-12-07 04:51:5
15	2019-08-05 22:00:00	32.50	131.23	40	NW / 8.1	NW / 16.5	4.0	973.0	32.9	Banding Eye	DT	0.0			-	0.0	A	1.0	1.0	2019-12-07 04:50:1
16	2019-08-05 21:00:00	32.35	131.42	40	NNW / 24.9	NW / 24.5	4.0	973.0	32.9	Banding Eye	PT	4.0	B-EYE	4.0	0.5	4.0	A	48.0	507.4	2019-08-06 06:14:2
17	2019-08-05 18:00:00	31.78	131.84	40	NW / 24.0	WNW / 23.1	4.0	973.0	32.9	Banding Eye	PT	4.0	B-EYE	4.0	1.0	4.0	A	50.9	303.0	2019-08-06 03:10:5
18	2019-08-05 15:00:00	31.37	132.43	40	WNW / 22.2	WNW / 25.5	4.0	973.0	32.9	Banding Eye	PT	4.0	B-EYE	3.5	1.0	4.0	A	45.5	311.7	2019-08-06 00:12:5
19	2019-08-05 12:00:00	31.20	133.10	40	W / 28.8	WNW / 25.5	4.0	973.0	32.9	Banding Eye	PT	4.0	EYE	4.0	1.0	4.0	A	42.8	388.0	2019-08-05 21:37:0
20	2019-08-05 09:00:00	31.10	134.00	49	WNW / 22.1	WNW / 22.4	3.5	981.0	29.3	Curved Band	PT	3.5	BAND	4.0	1.0	3.5	B	38.4	395.1	2019-08-05 18:44:4
21	2019-08-05 06:00:00	30.80	134.60	49	W / 22.6	WNW / 25.4	3.5	981.0	29.3	Curved Band	PT	3.0	BAND	3.5	0.5	3.5	B	68.9	335.3	2019-08-05 15:50:1
22	2019-08-05 03:00:00	30.70	135.30	49	WNW / 28.2	WNW / 31.0	3.5	981.0	29.3	Curved Band	PT	2.5	BAND	3.5	0.5	3.5	B	104.5	224.2	2019-08-05 12:25:3
23	2019-08-05 00:00:00	30.47	136.14	49	WNW / 33.8	WNW / 38.7	3.5	981.0	29.3	Curved Band	PT	2.5	BAND	3.5	0.5	3.5	B	97.3	369.9	2019-08-05 09:09:3
24	2019-08-04 21:00:00	30.27	137.17	49	WNW / 43.7	WNW / 32.8	3.5	981.0	29.3	Curved Band	PT	3.0	BAND	3.5	0.5	3.5	B	76.8	384.2	2019-08-05 06:19:2
25	2019-08-04 18:00:00	29.77	138.40	54	WNW / 21.9	W / 28.1	3.0	987.0	25.7	Curved Band	PT	2.5	BAND	3.5	0.5	3.0	B	107.2	254.4	2019-08-05 03:14:2
26	2019-08-04 15:00:00	29.57	139.04	54	W / 34.3	WNW / 29.6	3.0	987.0	25.7	Curved Band	PT	2.5	BAND	2.5	0.0	2.5	B	83.8	469.4	2019-08-05 00:14:3
27	2019-08-04 12:00:00	29.51	140.10																	

Save & Transmit | Save | Re-Create Typhoon Route | Typhoon End | Draw Route | Remove Route | Save as Excel | Close

Secondary Window

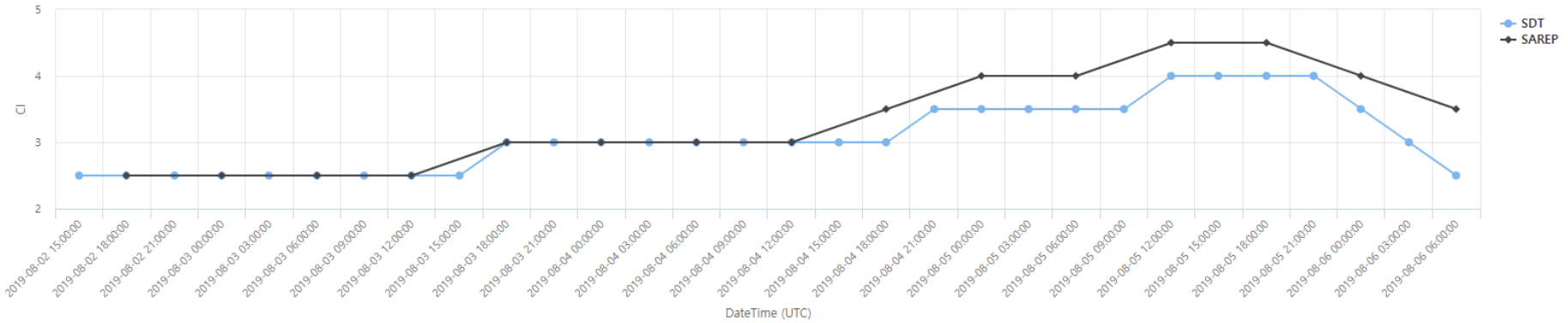
- SDT Analysis (intensity, center position, etc)
- Automated analysis (ADT, KADT, GTS, Archer, etc)

Comparisons

SDT Analysis : 2019Year - FRANCISCO (1908) Analysis Date : 2019-08-05 00:00:00 UTC

SDT Analysis | Graph Analysis | Typhoon Route Image | Typhoon Route Video | IR Radius of Gail | Verify Radius of Gail | MW Radius of Gail | MW Typhoon Image | GTS text | PCT / TDI

- Start Year: 2019
- Typhoon: FRANCISCO (1908)
- Classification: CI
- Interval: 3hour
- Period: 2019-08-02 00:00 ~ 2019-08-06 12:00
- Typhoon Analysis Result : [x] SDT [ ] Automatic ADT 8.2.1 [ ] KADT-IR [ ] KADT-NRT [x] SAREP [ ] KMA [ ] JMA [ ] JTWC [ ] CMA

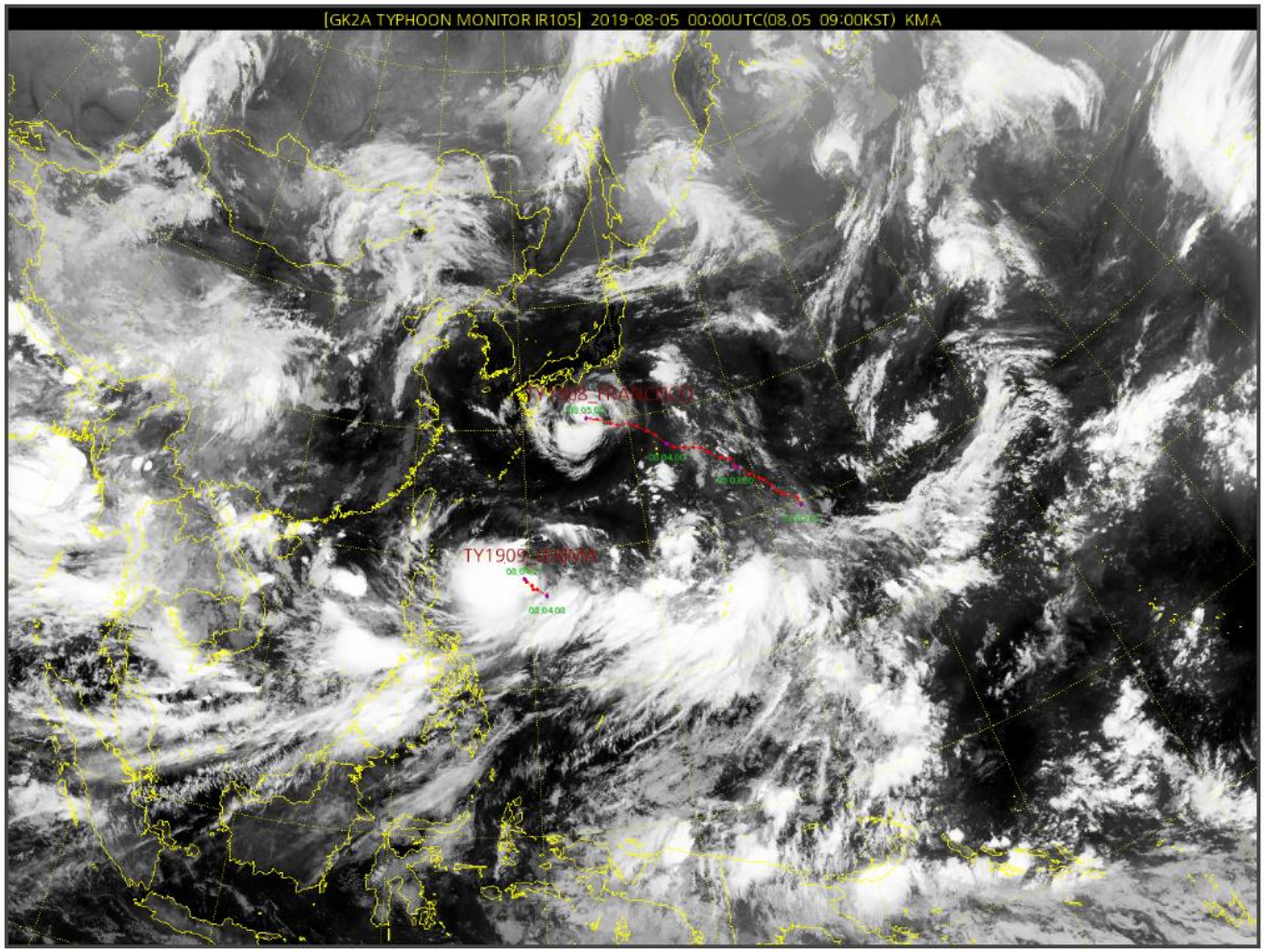


Route image

SDT Analysis : 2019Year - FRANCISCO (1908)

SDT Analysis | Graph Analysis | Typhoon Route Image | Typhoon Route Video | IR Radius of Gail | Verify Radius of Gail | MW Radius of Ga

2019-08-05 00:00:00 UTC

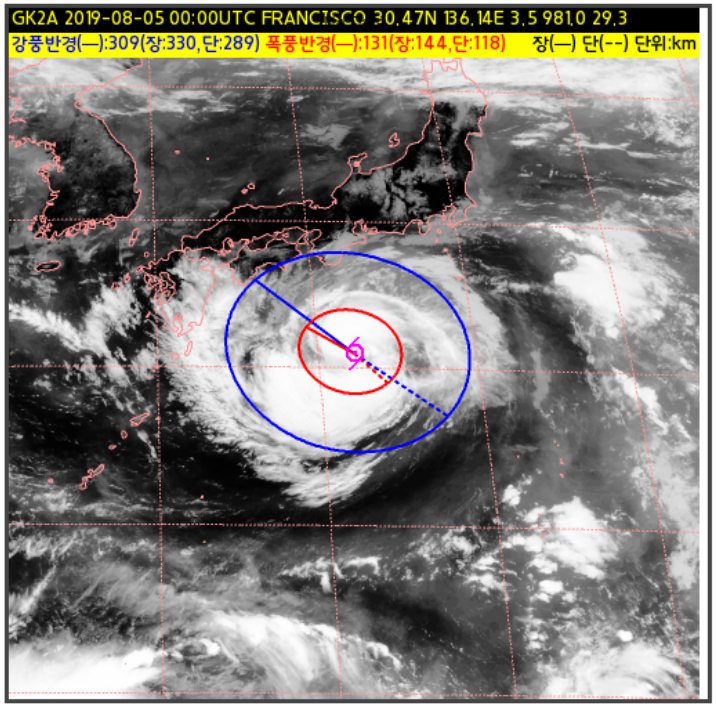


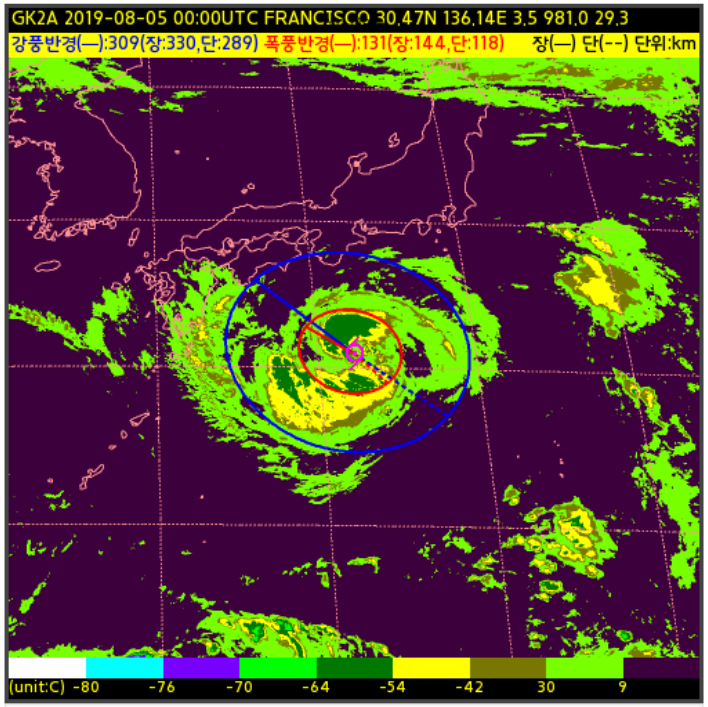
IR based Wind Radii (15 and 25 m/s)

SDT Analysis : 2019Year - FRANCISCO (1908)

SDT Analysis | Graph Analysis | Typhoon Route Image | Typhoon Route Video | IR Radius of Gail | Verify Radius of Gail | MW Radius of G

2019-08-05 00:00:00 UTC





강풍반경 장반경: 329.71km
강풍반경 단반경: 288.65km
강풍반경 평균반경: 309.06km
폭풍반경 장반경: 144.03km
폭풍반경 단반경: 118.36km
폭풍반경 평균반경: 131.23km

Coefficient of Gail Radius: 15
Coefficient of Storm Radius: 25
Minimum Limit Dist of Center: 48

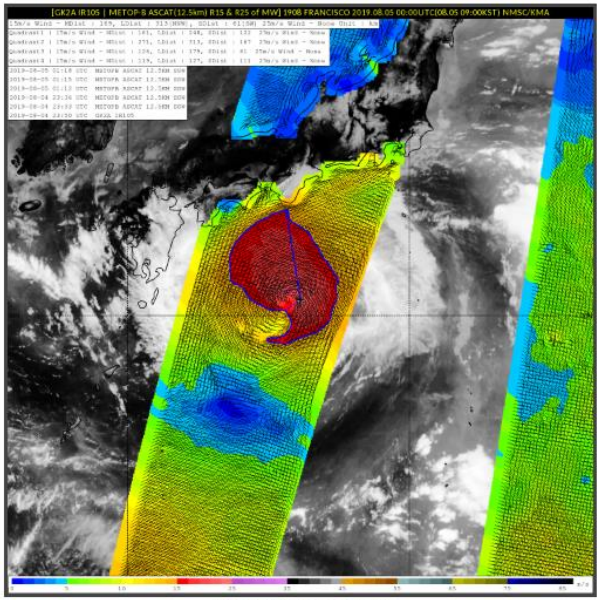
Drawing users:
Automatic / Manual
Radius of Gail / Radius of Storm
Long radius Direction: Deg
Long radius length: km
Short radius length: km
Drawing | Apply

Additional Wind Radii

SDT Analysis : 2019Year - FRANCISCO (1908) Analysis Date : 2019-08-05 00:00:00 UTC

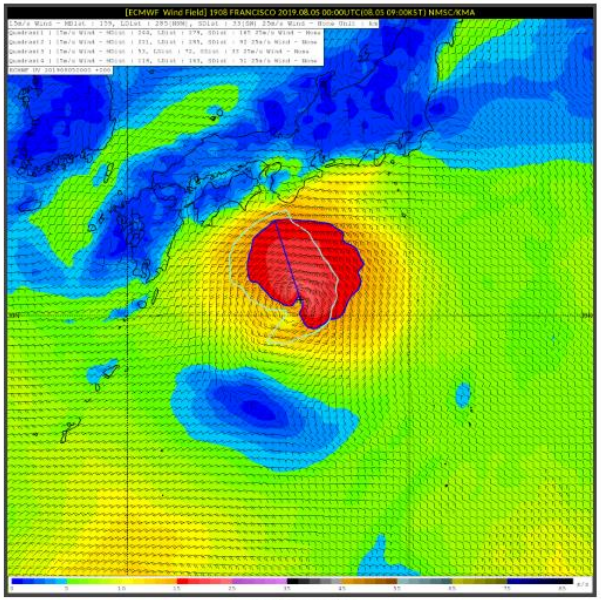
SDT Analysis | Graph Analysis | Typhoon Route Image | Typhoon Route Video | IR Radius of Gail | Verify Radius of Gail | **MW Radius of Gail** | MW Typhoon Image | GTS text | PCT / TDI

2019-08-05 | 00:00 utc METOPB ASCAT



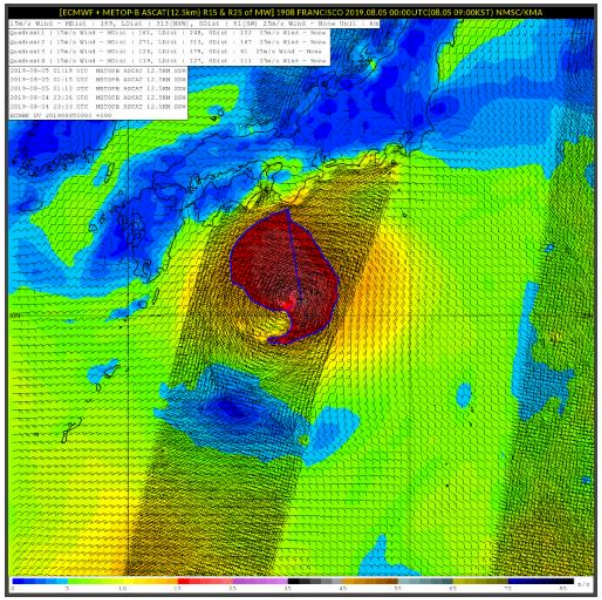
<< 강풍반경 METOPB ASCAT >>

Microwave



<< 수치모델 바람장 >>

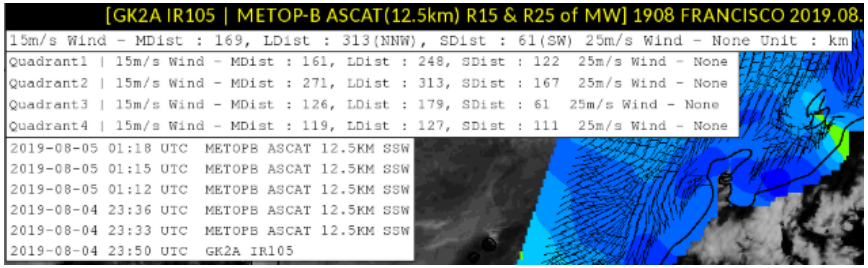
Numerical Model



<< 강풍반경/수치모델 합성 >>

MW + Model

Search | Close

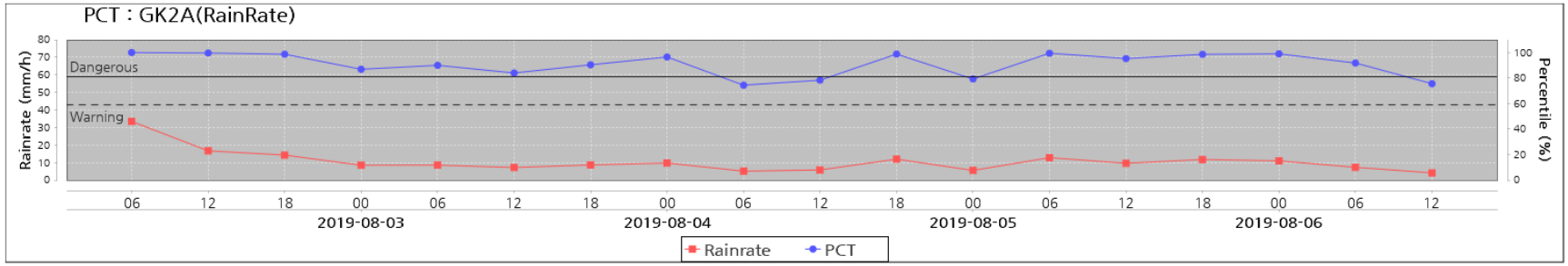


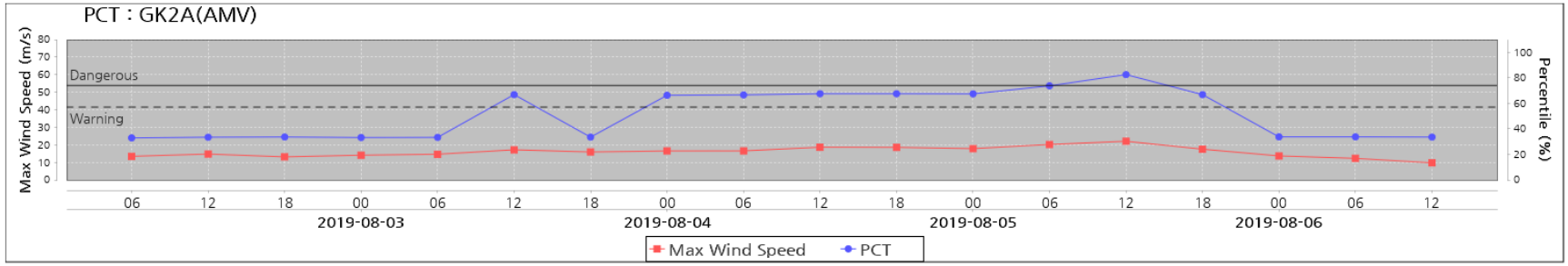
Graph Analysis

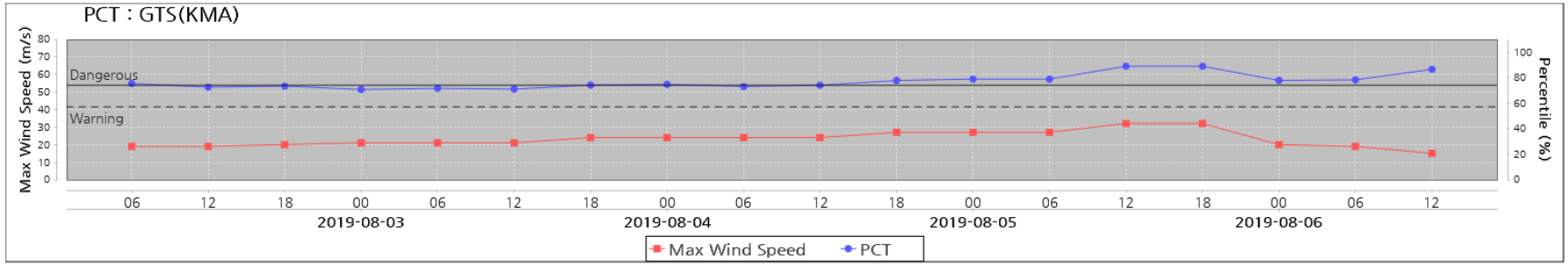
SDT Analysis : 2019Year - FRANCISCO (1908) Analysis Date : 2019-08-05 00:00:00 UTC

SDT Analysis | Graph Analysis | Typhoon Route Image | Typhoon Route Video | IR Radius of Gail | Verify Radius of Gail | MW Radius of Gail | MW Typhoon Image | GTS text | PCT / TDI

PCT | TDI



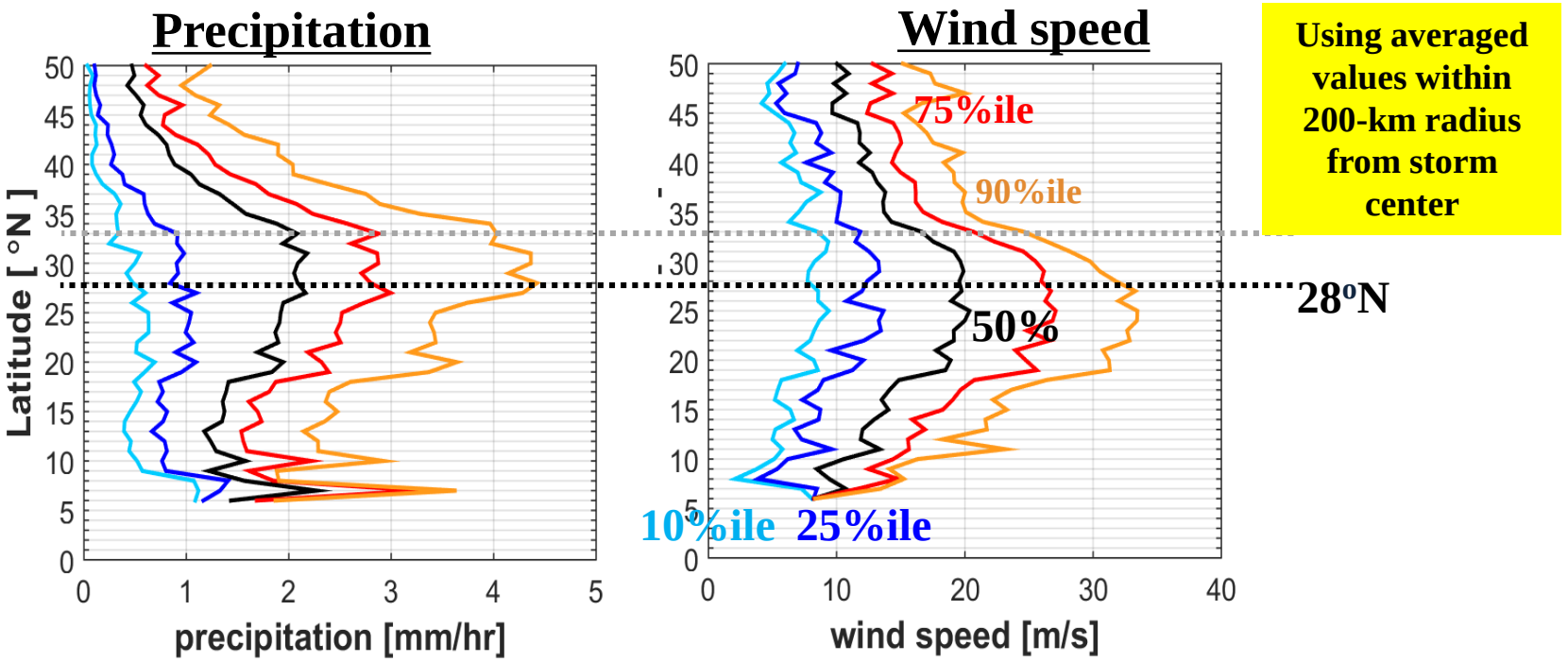




Search Close

Percentile analysis on Rain & Wind

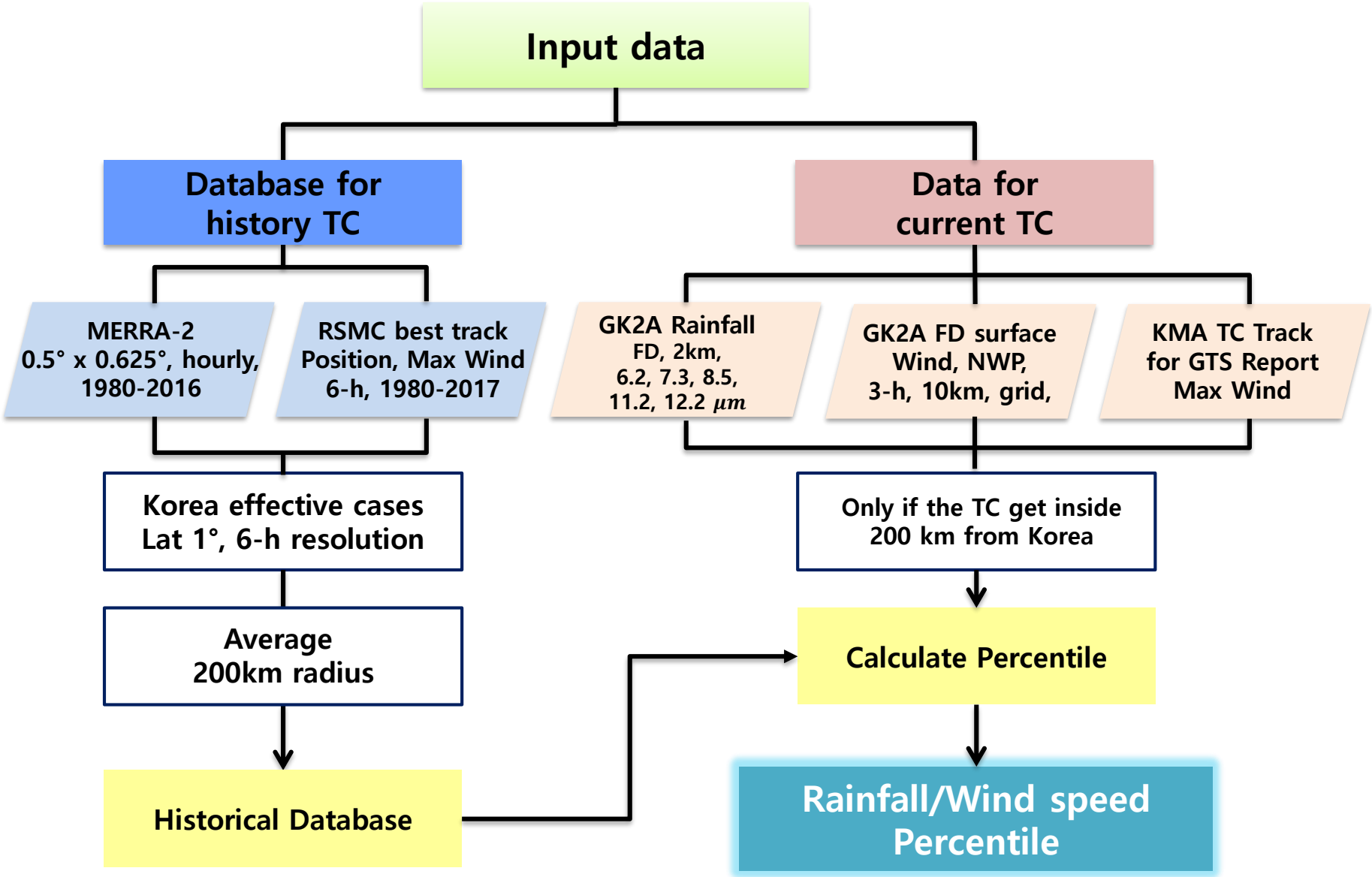
Percentile analysis for Historical Typhoons



[Example] The calculated 10%, 25%, 50%, 75%, 90% tile of precipitation and wind speed along every 1° latitude, which are estimated using MERRA-2 data for 113 historical typhoons

- Around 28°N latitude, 90%tile is about 4.3 mm/hour for precipitation and 33 m/s for wind speed. Here the values are averaged within 200-km radius from a storm center
- The latitude with peak value for rainfall data is **2-3°** higher than wind speed.

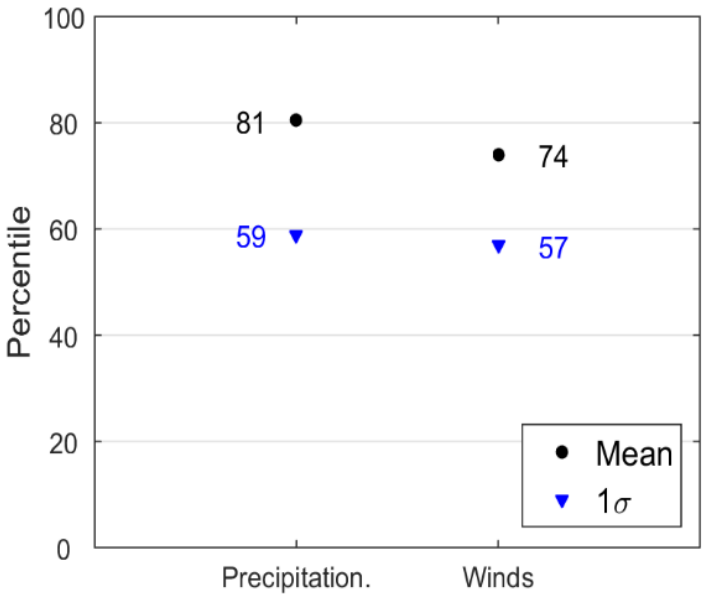
Algorithm


Input data
Database for history TC
Data for current TC
MERRA-2
0.5° x 0.625°, hourly,
1980-2016
RSMC best track
Position, Max Wind
6-h, 1980-2017
GK2A Rainfall
FD, 2km,
6.2, 7.3, 8.5,
11.2, 12.2 μm
GK2A FD surface
Wind, NWP,
3-h, 10km, grid,
KMA TC Track
for GTS Report
Max Wind
Korea effective cases
Lat 1°, 6-h resolution
Only if the TC get inside
200 km from Korea
Average
200km radius
Calculate Percentile
Historical Database
Rainfall/Wind speed
Percentile

Rain/wind warning threshold

Warning Thresholds

Warning Thresholds (Possibility)	Types According to Percentiles		
	Rain-Dominant	Wind-Dominant	Rain-Wind-Dominant
Warning (Medium)	59th–81st Percentile	57th–73rd Percentile	Both Satisfied
Severe Warning (High)	Above 82nd Percentile	Above 74th Percentile	Both Satisfied

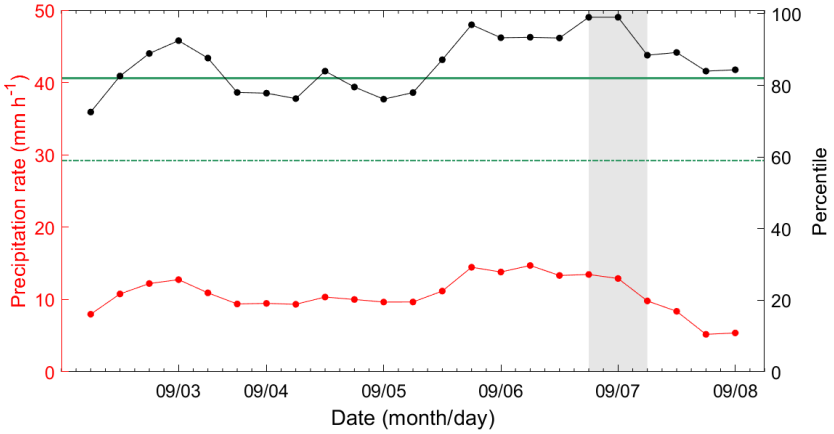


Mean and std of average top cases percentile near 32N during 1980 ~ 2017

Test Case (1913 LINGLING)

00:00 UTC Sep. 2 ~ 00:00 UTC Sep 8, 2019

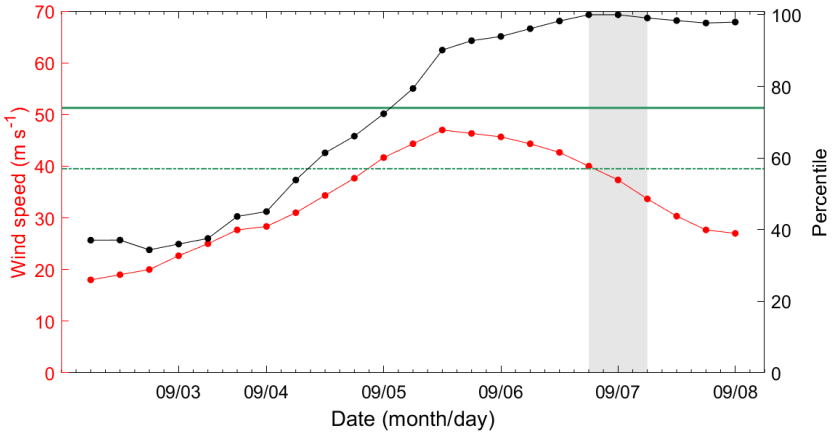
GK2A Rain



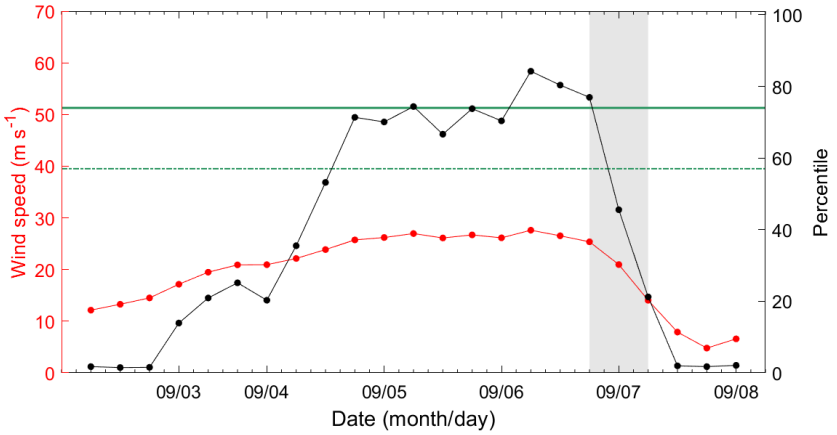
GK2A PREC : Severe
GK2A WIND : Severe
GTS WIND : Severe
to warning

Rainfall and Wind effect

GK2A Wind



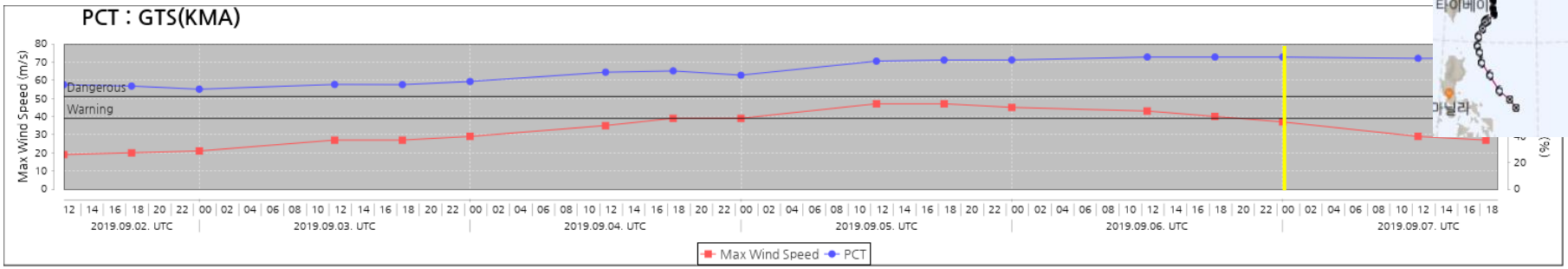
GTS Wind (WTKO20 RKSL)



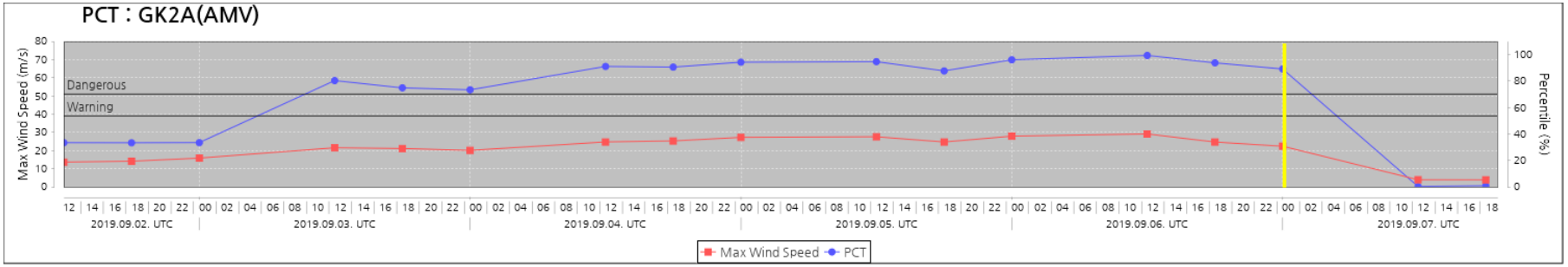
Case study – cont.

00:00 UTC Sep. 2 ~ 00:00 UTC Sep 8, 2019 for 13th typhoon Lingling

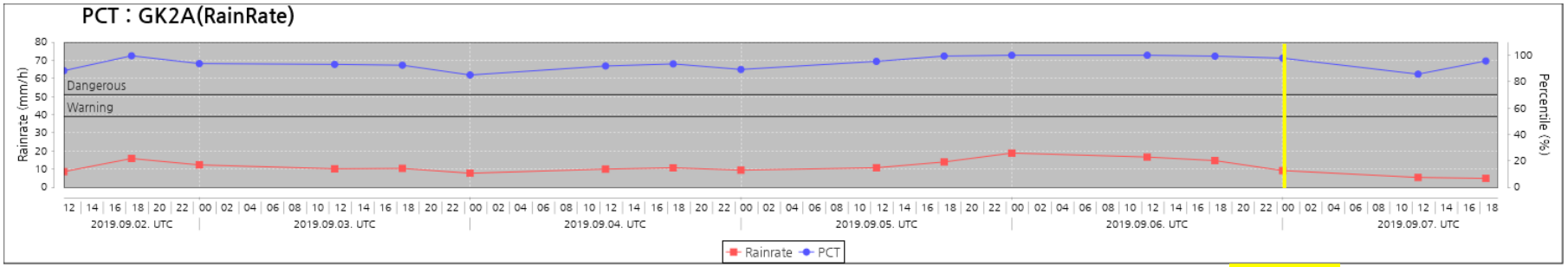
GTS Wind → Severe



GK2A Wind → Severe



GK2A Rain → Severe



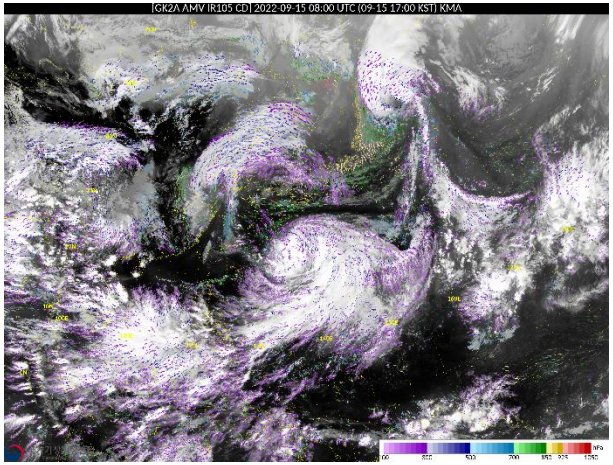
32°N

Application of Lower level Winds

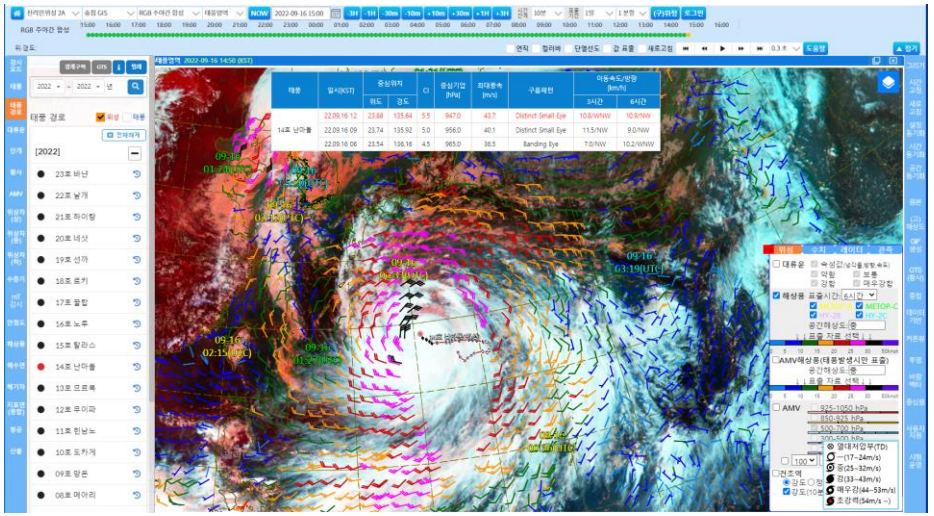
Background

❖ GEO wind field

- GK2A AMV (5 layers)
  - · 925-1050hPa, 850-925hPa
  - · 500-700hPa, 300-500hPa
  - · 100-300hPa
- ocean surface wind
- scatterometer payloaded LEO satellite
  - · METOP-B, C
  - · **HY-2B, 2C (from 2022)**
  - · 2 times per day



GK2A AMV
For typhoon
Namadol at 08:00
UTC Sep. 15, 2022

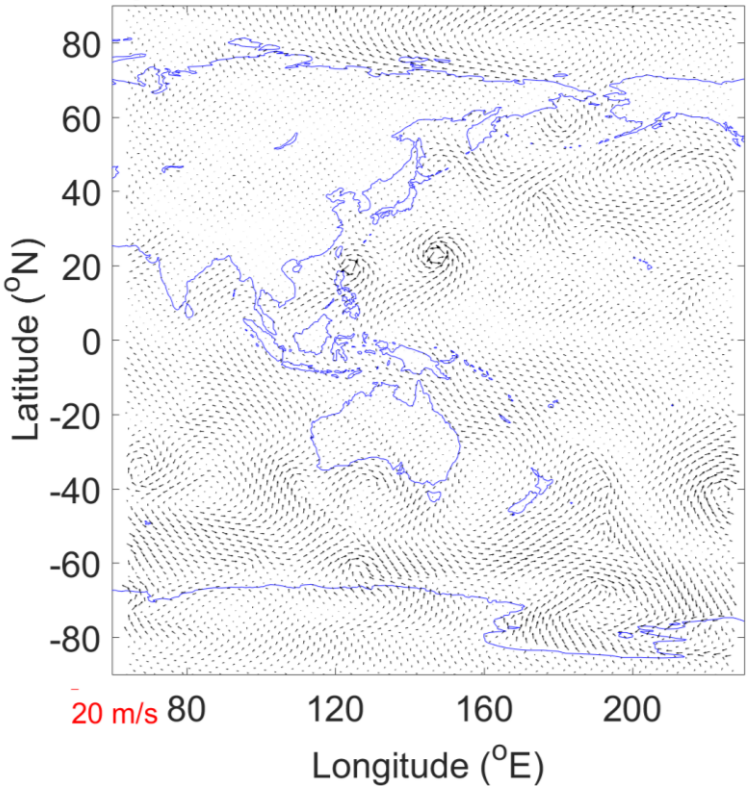


METOP-B,C HY-2B, 2C composite wind in
6 hours time window on Sep. 15, 2022

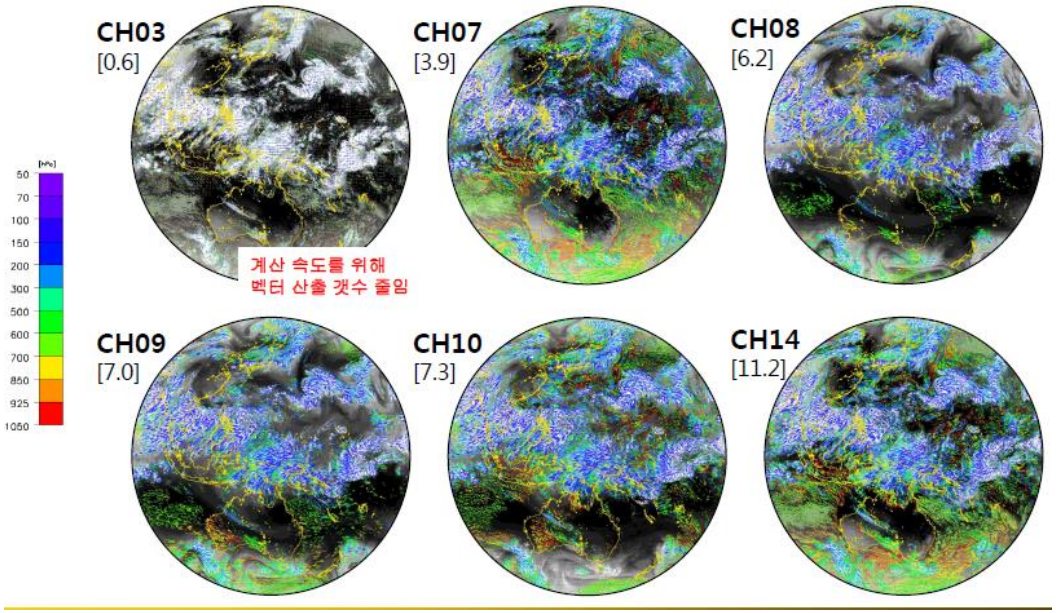
Full Disk Wind

❖ FD wind data

➢ UM model data

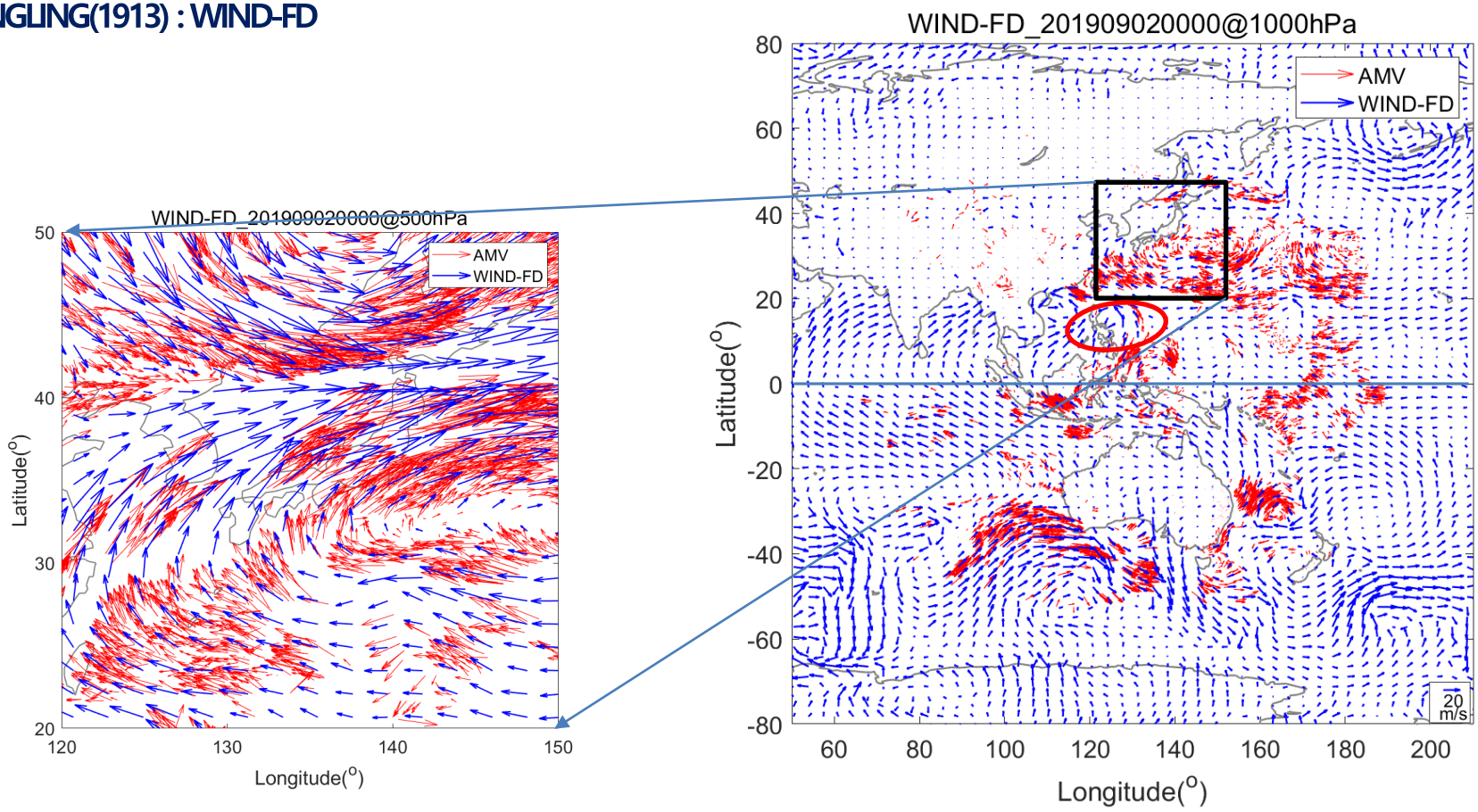


➢ AMV



Validation

TC LINGLING(1913) : WIND-FD



Thank you for attention!

Next subject of severe weather detection will be continued
by Senior researcher, Ok Hee Kim

국가기상위성센터
National Meteorological Satellite Center

The 12th Asia/Oceania Meteorological Satellite User's Conference
Training event

Application of GK2A data for severe weather detection

2022. 11. 11.

Ok Hee KIM

KMA

국가기상위성센터
National Meteorological Satellite Center

Contents

1. Key points of pre-detecting signals of developing cloud

15 Key points of pre-detecting signals of developing cloud

1. Updraft area in front of the boundary of the upper dry area of mT(marine Tropical)
2. Updraft area in front of the dry area due to the trough
3. Compressed wet zone between the southern and northern dry zones
4. Warm advection with warm conveyor belt (WCB) (warm advection accompanied by low pressure)
5. Lower cumulus clouds along strong southwesterly air stream (lower jets)
6. Ci cloud as divergent in the upper strong wind zone - (in the case of lower-level convergence): upper-level divergence
7. Upper level cold core (localized heavy rain due to instability between upper and lower layers)
8. Meso-scale cyclonic clouds of upper, middle, and low level on the stationary front
9. Periodic upper-level wave inflow on the stationary front
10. The cooling rate of the developing convective cloud lasts less than -3 ℃ / 10 minutes
11. Clouds thickness of 10 km or more (from the lower layer to the upper layer)
12. Heavy rainfall critical index of 30 or higher (heavy rain advisory level or higher)
13. TPW(total precipitation water) of 60mm/h or higher area
14. High instability area
15. Others: Forced rising motion due to topographic factors, duration of heavy rain clouds (moving speed less than 15 km/h), etc.

In heavy rain case, satellite analysis key point 1

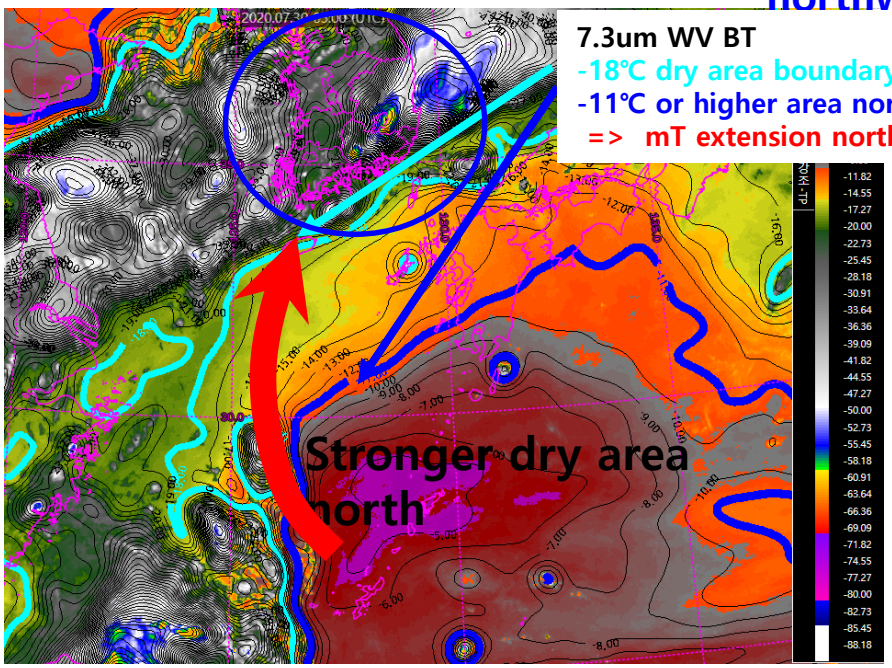
1. Extension of mT upper dry area boundary and stronger dry area behind it

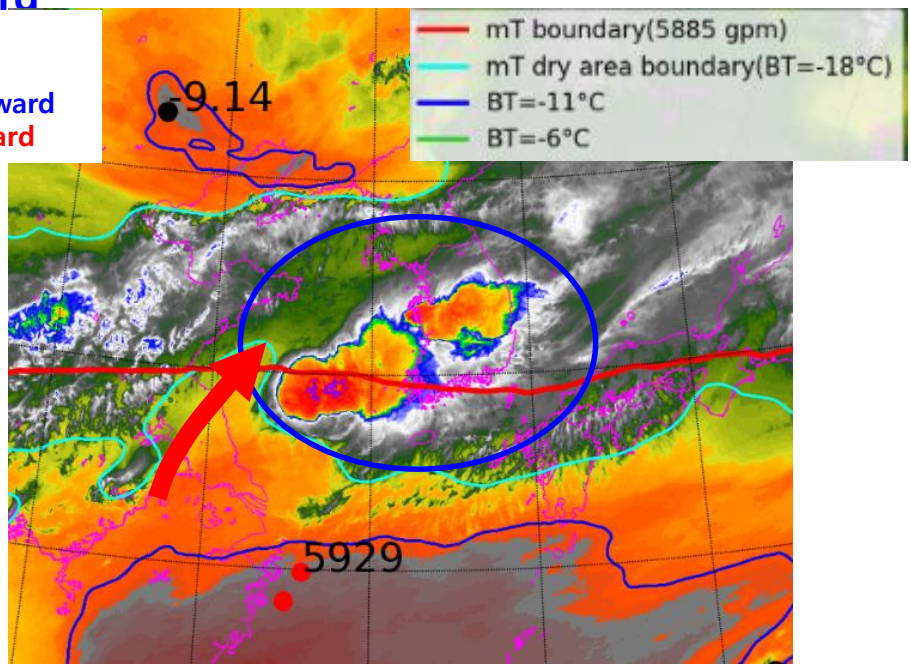
- Analysis of the updraft area in front of the mT upper dry area boundary (BT -18℃) in the 7.3 WV

- Inflow of stronger dry area (BT -11 ℃ or higher) behind the boundary of the mT upper dry area

* As the boundary of the upper dry area above -18℃ moves northward, the closer the distance to the convective cloud, the stronger the convective cloud develops.

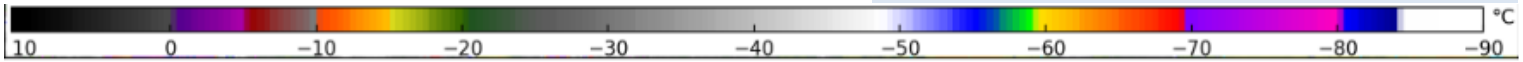
Boundary of the upper dry area northward





2020. 07. 30. 14:00 KST 7.3 μm WV

2021. 09. 01. 03:00 KST 7.3 μm WV

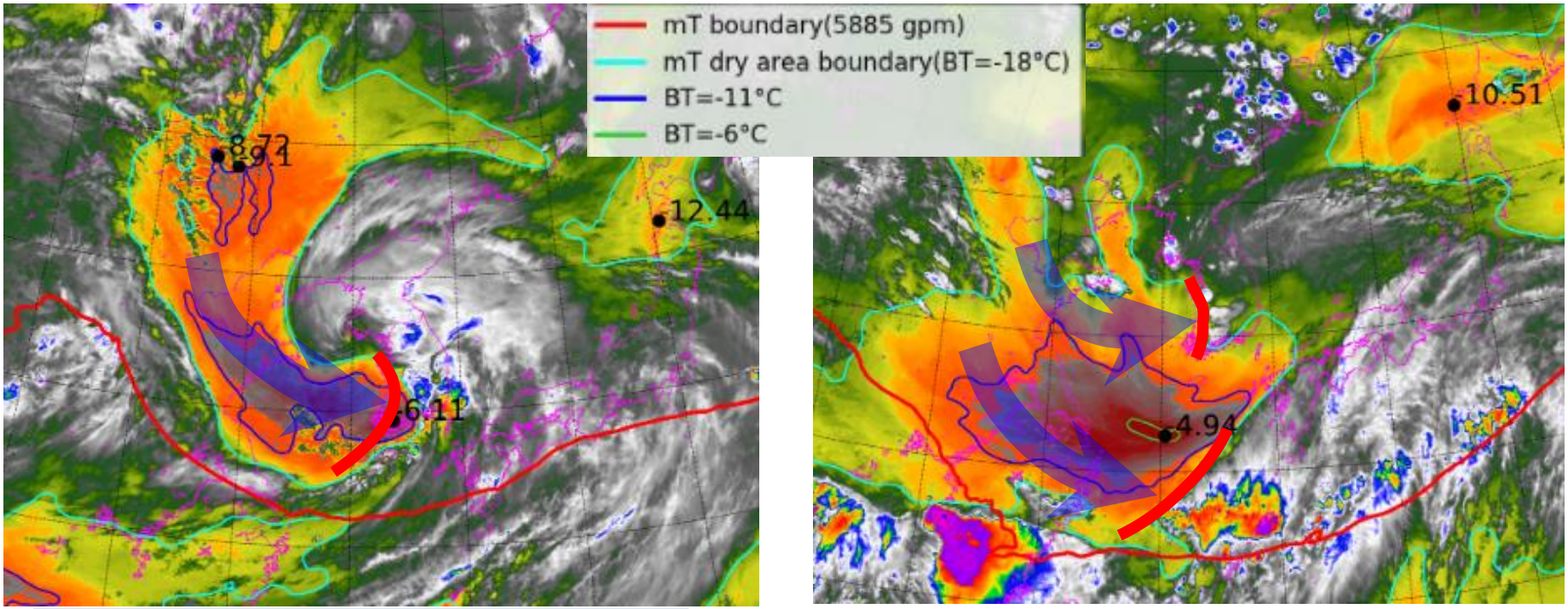


In heavy rain case, satellite analysis key point 2

2. Updraft area in front of the dry intrusion due to the trough

- As the dry area accompanying the trough is strengthened, strong convective clouds are developed and strengthened in the forward direction of the dry area.

dry intrusion accompanying trough



2020. 07. 23. 21:00 KST 7.3 μm WV

2021. 06. 28. 15:00 KST 7.3 μm WV

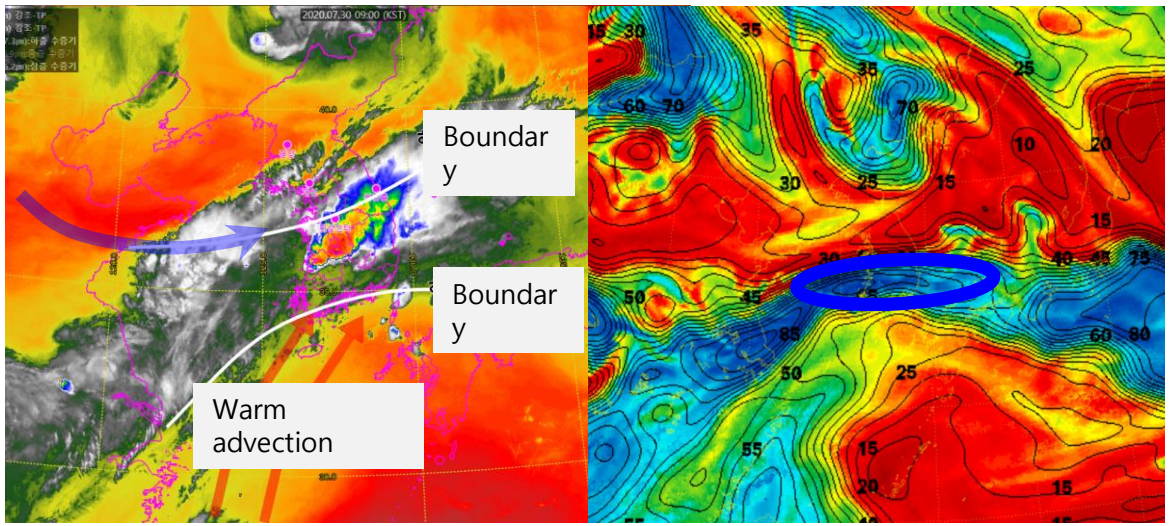
In heavy rain case, satellite analysis key point 3

3. Compressed wet zone between the southern and northern dry zones

- The northern dry area southward, and the dry area at mT boundary northward

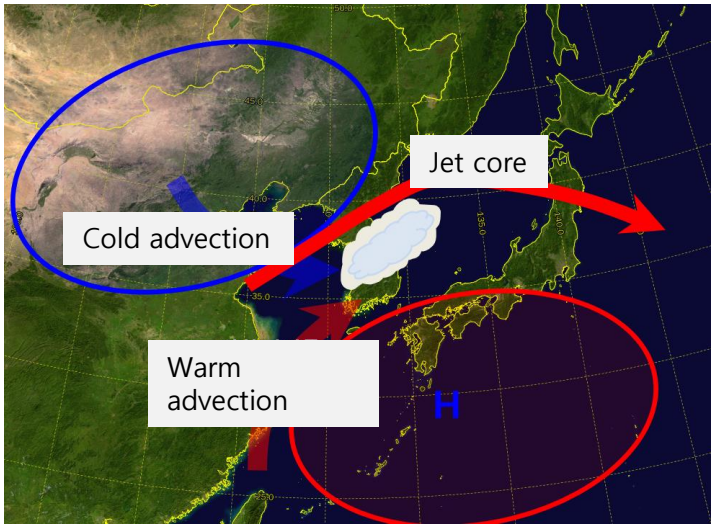
- Convective clouds develop in the compressed water vapor river between the southern and northern dry regions.

compressed moisture path between the southern and northern dry area



2020. 07. 30 09:00 KST 7.3 μm WV, 500hPa RH(NWP+Sat.)

Convective clouds develop in the compressed moisture path



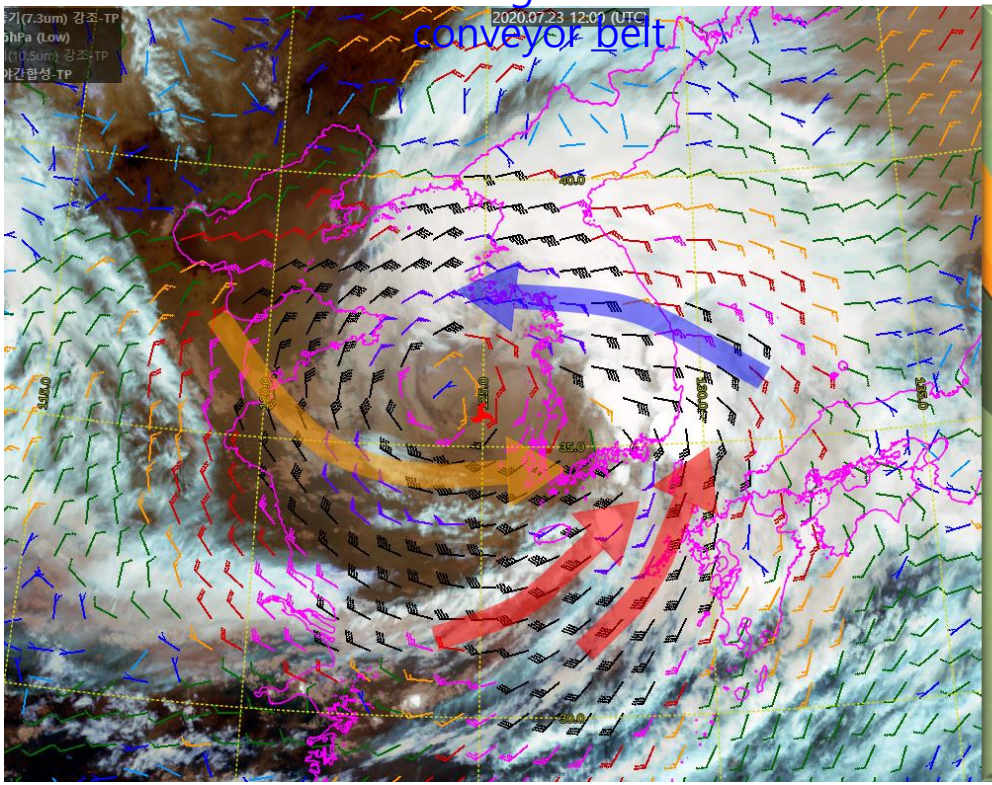
moisture path schematic diagram

In heavy rain case, satellite analysis key point 4

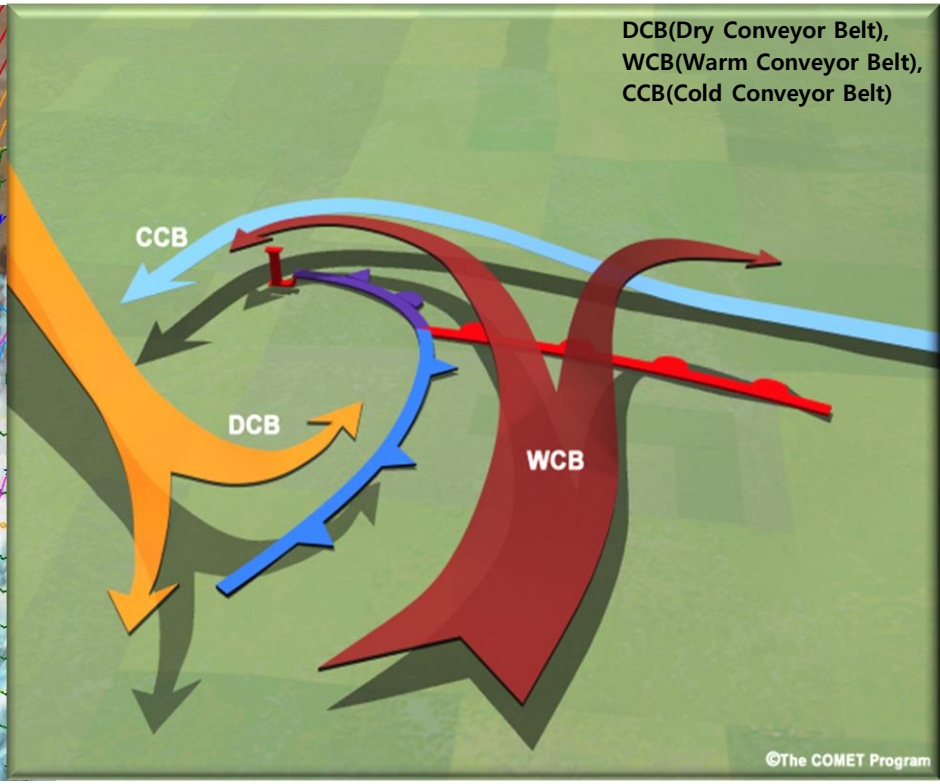
4. Convective cloud development by warm advection in warm conveyor belt (WCB)

- DCB is formed in the southwest of the low pressure center, WCB is formed in the southeast, and CCB is formed in the northeast
- Continuous warm advection and humid air to Korea along with WCB from the south triggers the development of convective clouds

Strong Warm advection with warm conveyor belt



2020. 07. 23. 21:00 KST RGB composite +925hPa wind

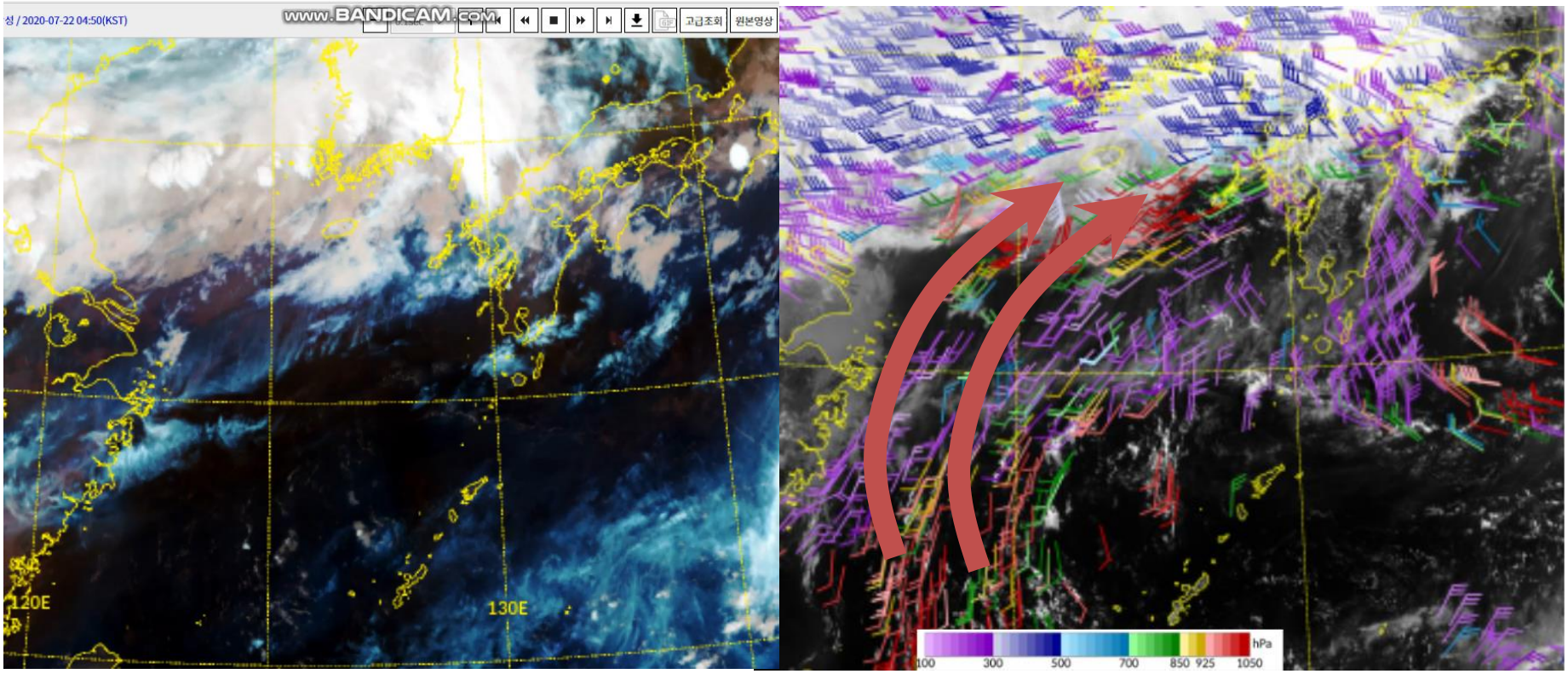


Conveyer Belt Model

In heavy rain case, satellite analysis key point 5

5. Lower cumulus clouds along strong southwesterly air stream (lower jets) with mT extension

- In the RGB day/night composite image, northward of the texture shape along with the southwest wind
- In the AMV, the lower cloud (red series) moves north along with the southwest air stream

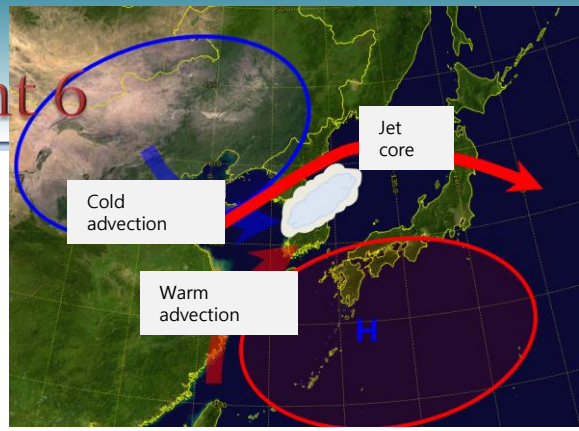


2020. 07. 22. 09:00 KST RGB day/night composite image, AMV(Visible)

In heavy rain case, satellite analysis key point 6

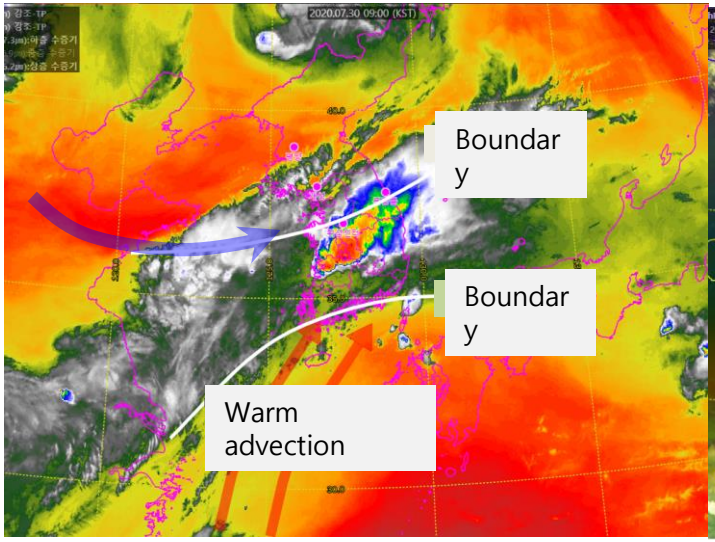
6. Ci cloud as divergent in the upper strong wind : upper-level divergence

- Convergence of the lower layers in the compressed water vapor passage between the north-south dry zone
- Convective clouds develop due to upper layers divergence as strong winds with the upper layers
- Confirmation of strong winds in the area of convective cloud development in the upper atmospheric motion vector

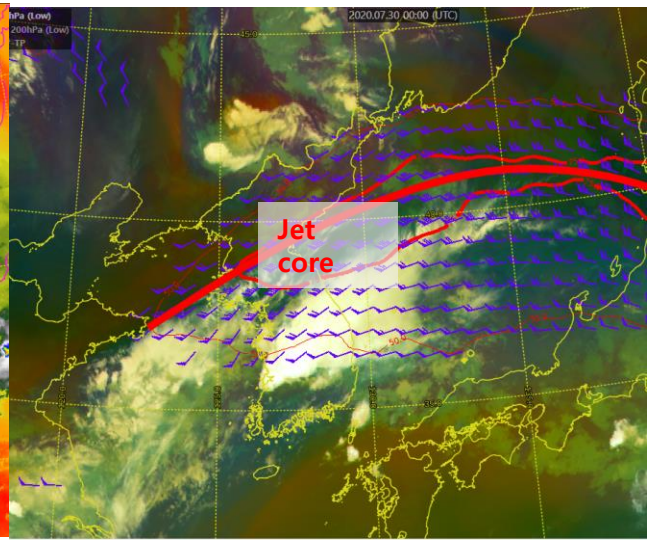


Schematic diagram of lower-level convergence and upper-level divergence

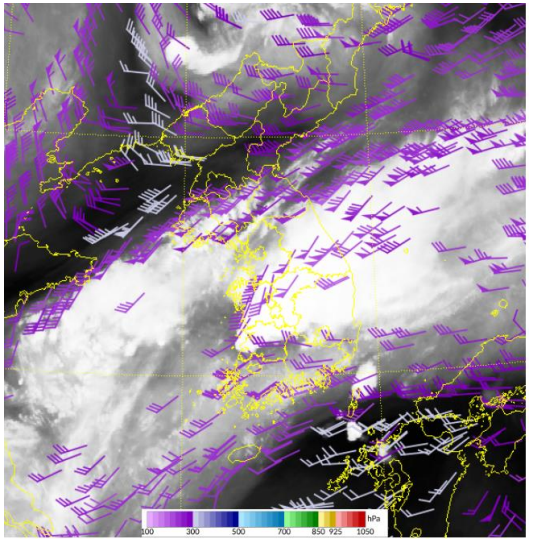
Compression of the north-south dry zone, convergence of the lower layers of the southwest and northwest



Upper level strong wind area: upper level divergence



Upper level strong winds: convective cloud development

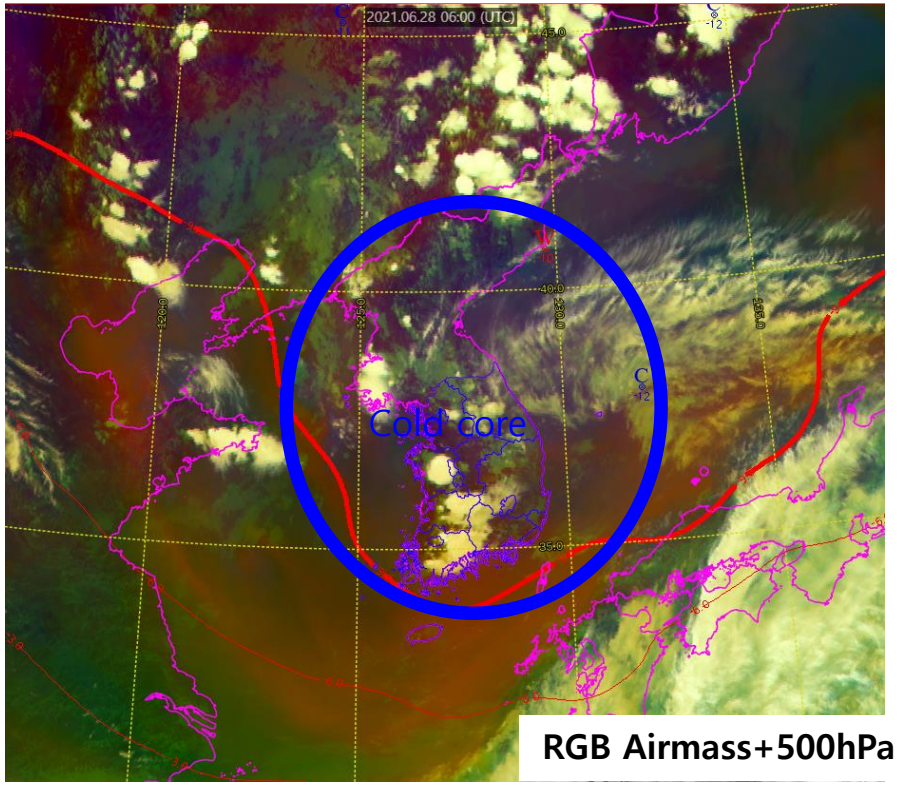


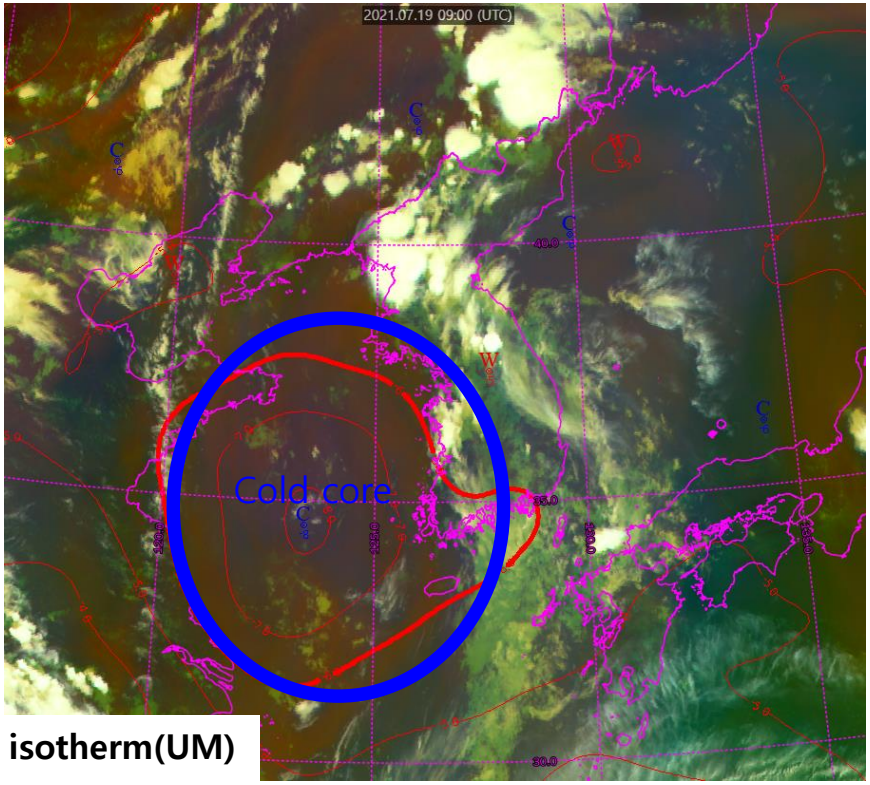
2020. 07. 30 09:00 KST 7.3μm WV, RGB Airmass(UM 200hPa isotach), 6.3μm WV AMV

In heavy rain case, satellite analysis key point 7

7. Upper level cold core (localized heavy rain due to instability between upper and lower layers)

- Upper level cold core over the Korea: Atmospheric instability caused by the temperature difference between the upper and lower atmospheres -> Localized heavy rainfall
- Upper cold core: Red-purple area near the center of the low-pressure in the RGB airmass image
- Convective cloud development around mountainous areas due to forced rising motion by topography and updraft area in front of dry boundary





RGB Airmass+500hPa isotherm(UM)

2021.06.28. 15:00KST
Heavy rain case in Jeolla, Chungnam

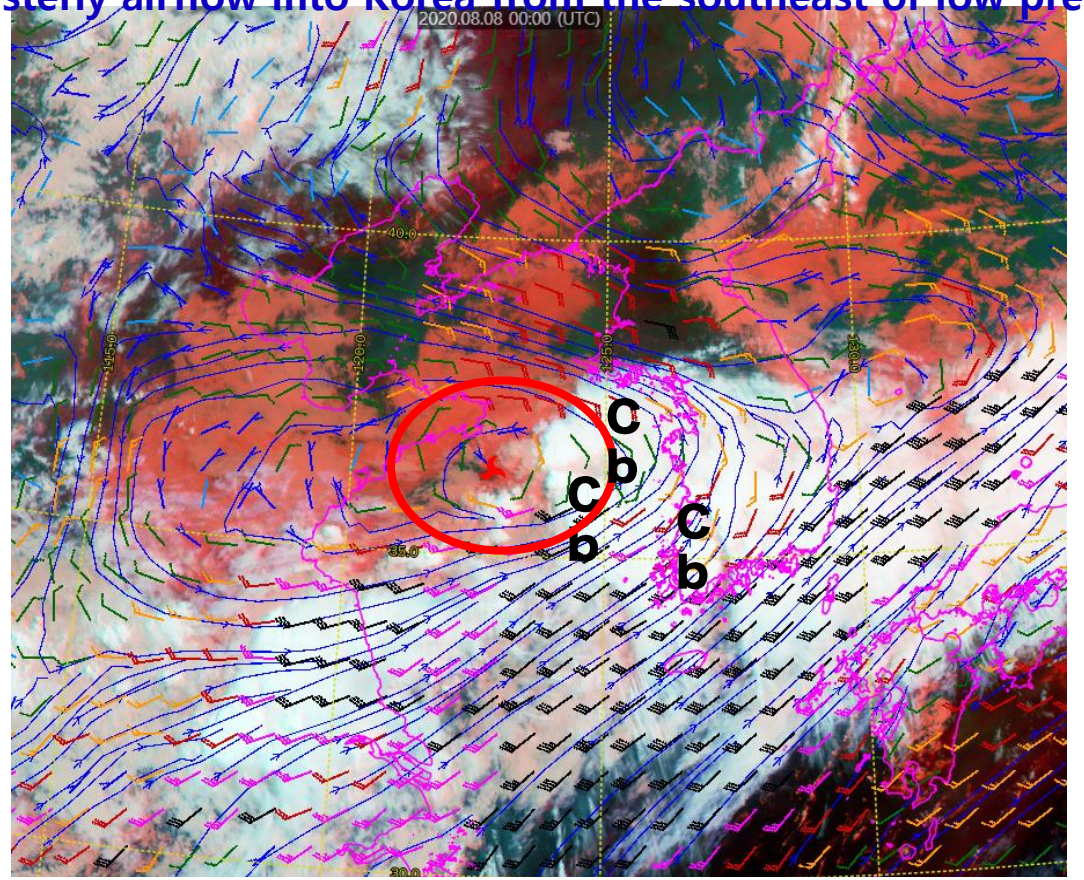
2021.07.19. 18:00KST
Heavy rain case in the central region

In heavy rain case, satellite analysis key point 8

8. Mesoscale cyclonic clouds in the middle and low level on the stationary front

- Mesoscale cyclone on the stationary front cloud band in the middle and low level, airflow converges

- Strong southwesterly airflow into Korea from the southeast of low pressure (strong low level jet stream)

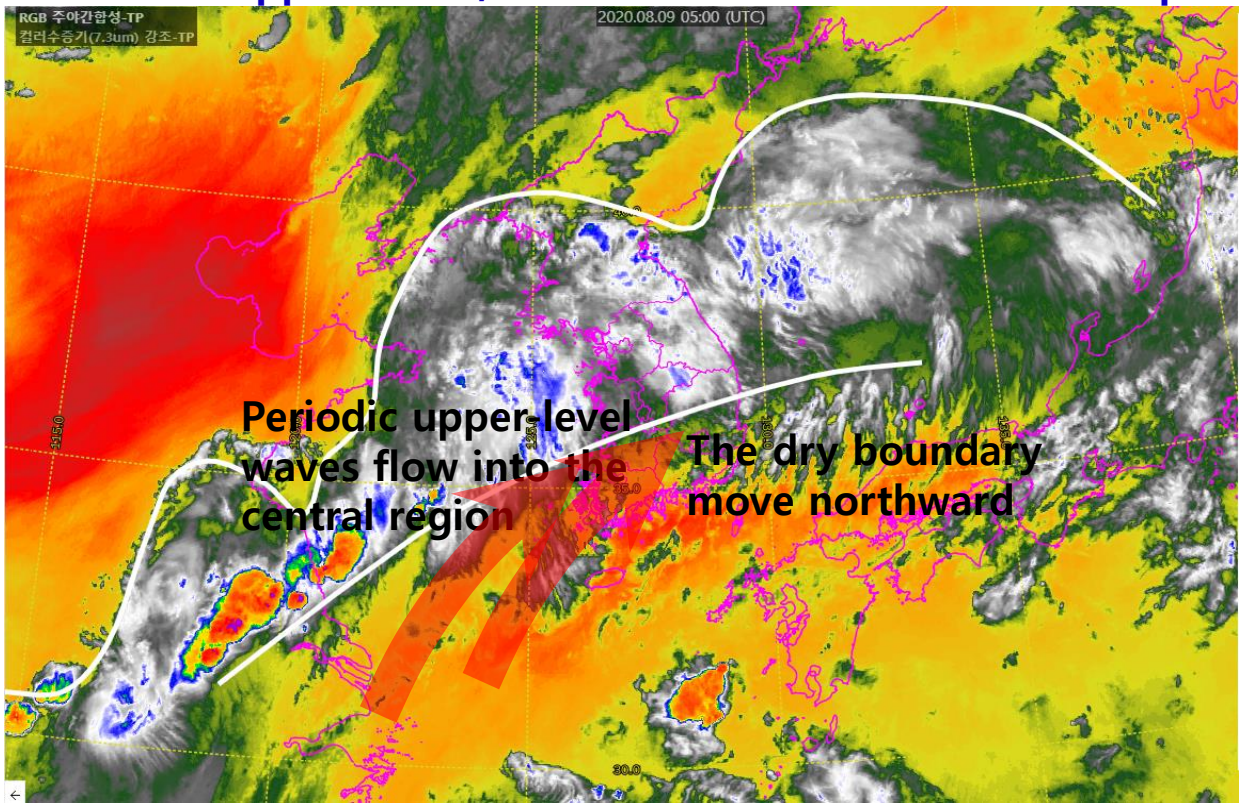


2020. 08. 08. 09:00KST RGB composite + 925hPa wind, streamline

In heavy rain case, satellite analysis key point 9

9. Periodic upper-level wave inflow on the stationary front

- As the boundary of the upper dry area of mT moves north, strong warm air with high temperature and humidity flows into Korea.
- On the stationary front in Korea, the upper wave periodically passes, and the dry air penetrate between the upper waves, and the convective clouds develop

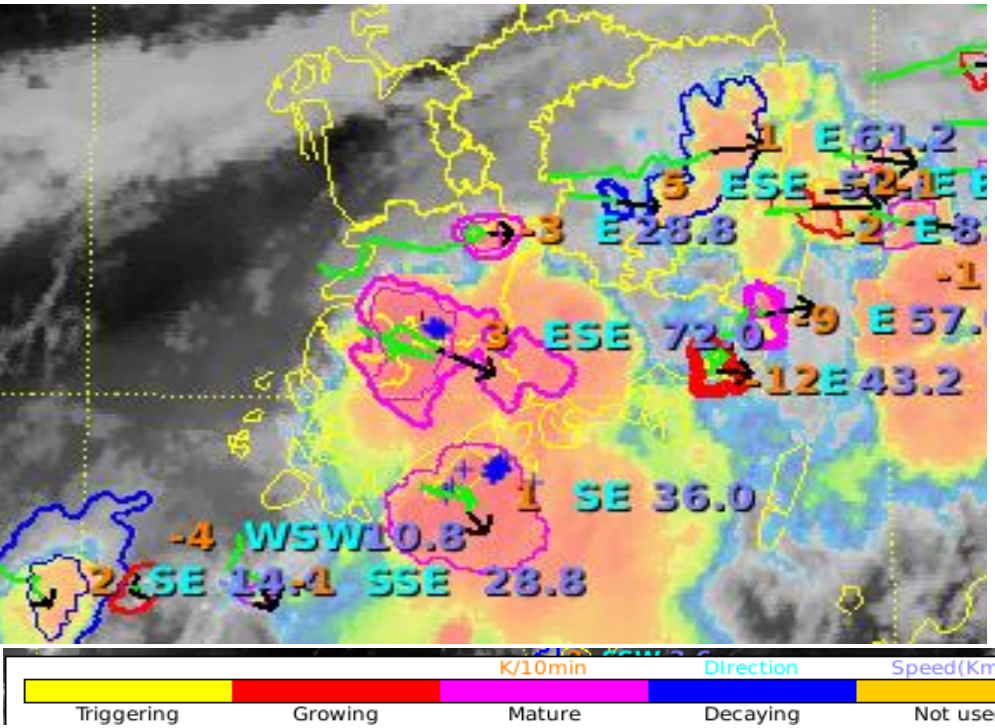


2020.08.09. 14:00KST 7.3 μm WV

In heavy rain case, satellite analysis key point 10

10. Cooling rate is greater than -3 ℃ / 10 minutes on the developing convective cloud

- Cooling rate is greater than -3 degrees/10 minutes
- -3~-10 ℃ /10 min: strong convective cloud development
- -10~-20 ℃ or more/10 min: explosively strong convective cloud development



Cooling rate (℃/10min)	Stage of development	State
0 ~ -3	weak	continuously developing
-3 ~ -6	moderate	strongly developing
-6 ~ -10	strong	
-10 ~ -20	very strong	rapid development in a short time
-20 ~ more	explosively strong	

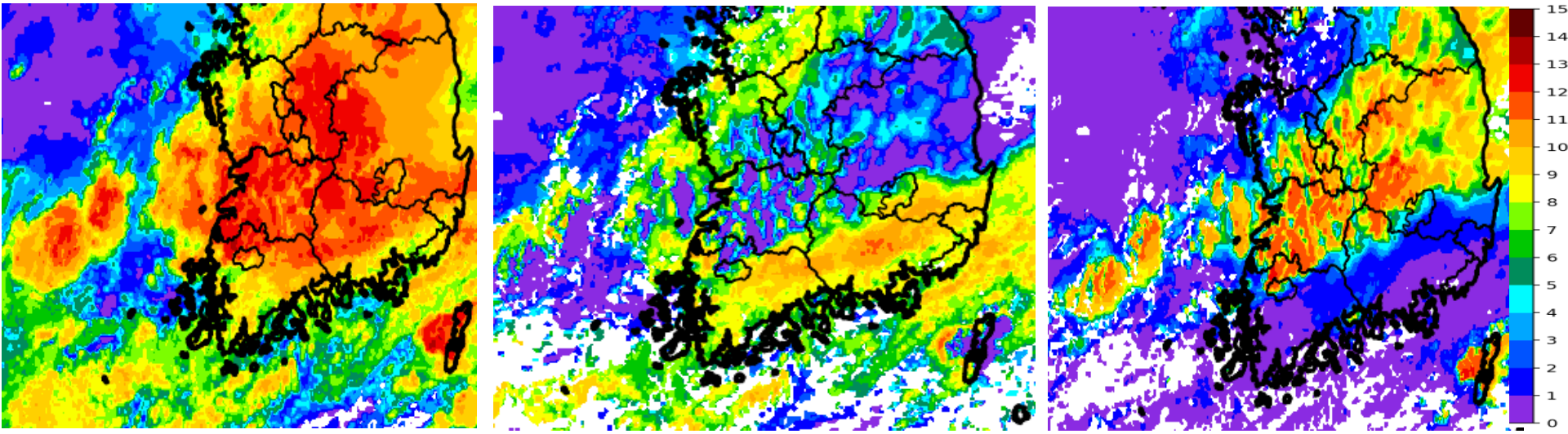
Source: Heavy Rain Guidance Technical Note(2020)

In heavy rain case, satellite analysis key point 11

11. Heavy rainfall with Clouds thickness of 10 km or more (developed cloud from the lower layer to the upper layer)

- **Strong precipitation in the densely developed cloud from the lower layer to the upper layer with a thickness of about 10 km considering the CTH and CBH**

CTH **CBH** **Cloud thickness**

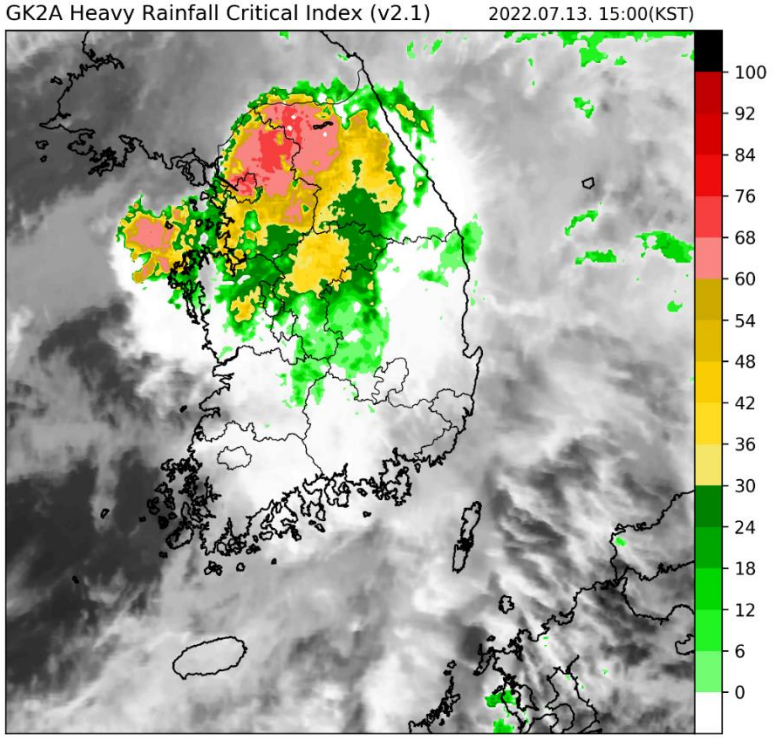


2020.7.30. 12:00 KST heavy rainfall clouds in central region of korea

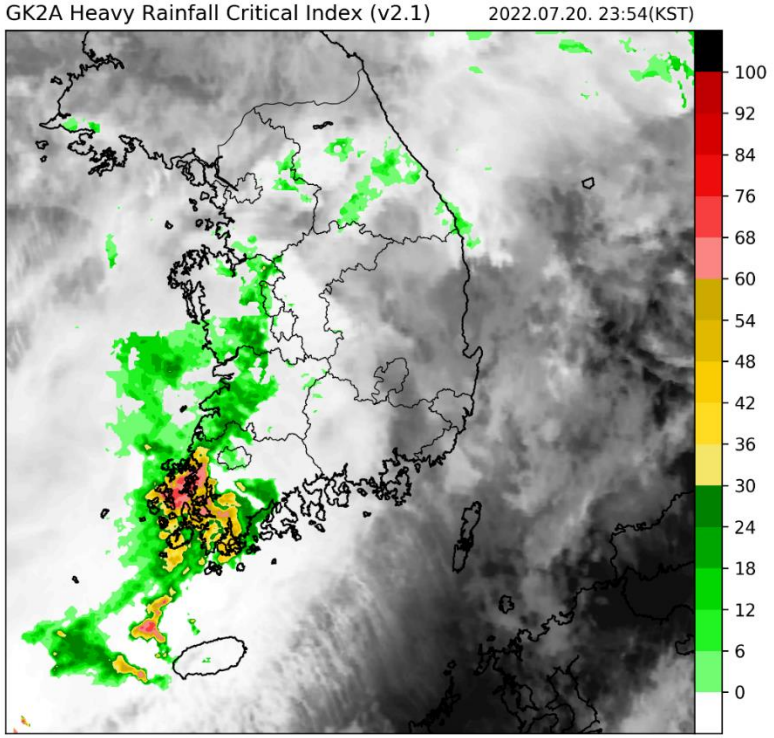
In heavy rain case, satellite analysis key point 12

12. Heavy rainfall critical index: heavy rain advisory level or higher

- Heavy rainfall critical index of 30 (heavy rain advisory level) or higher



2022.7.13. 15:00KST



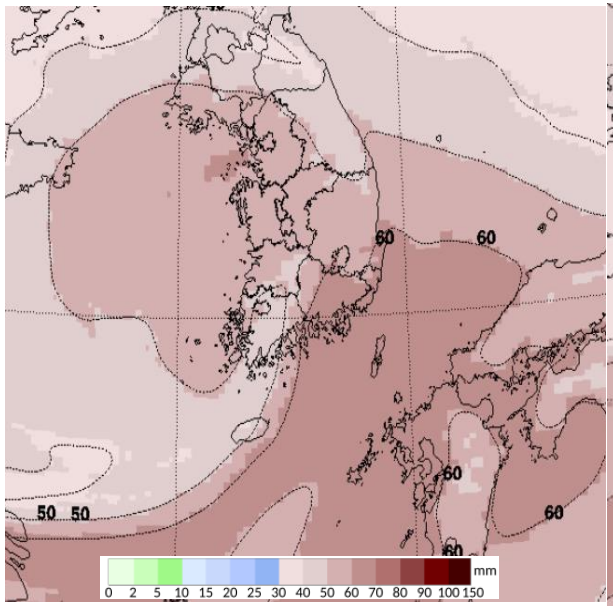
2022.7.21. 00:00KST

In heavy rain case, satellite analysis key point 13

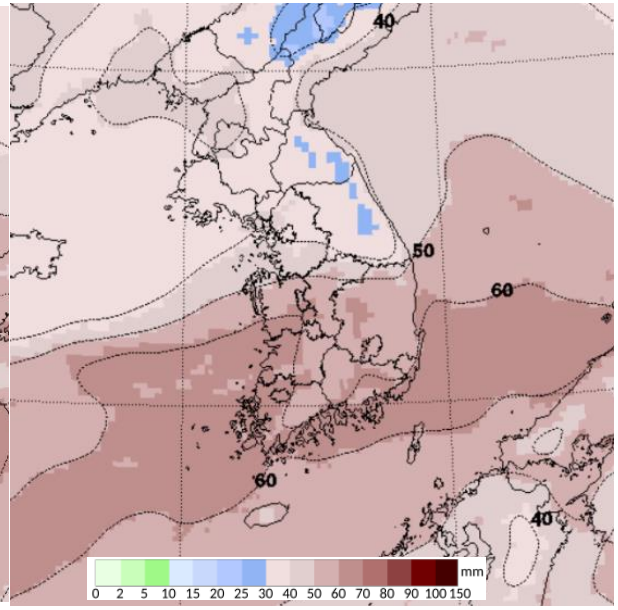
13. TPW(total precipitation water) of 60mm/h or higher area

- **Possibility of heavy rain is very high in areas with TPW 60mm/h or more**

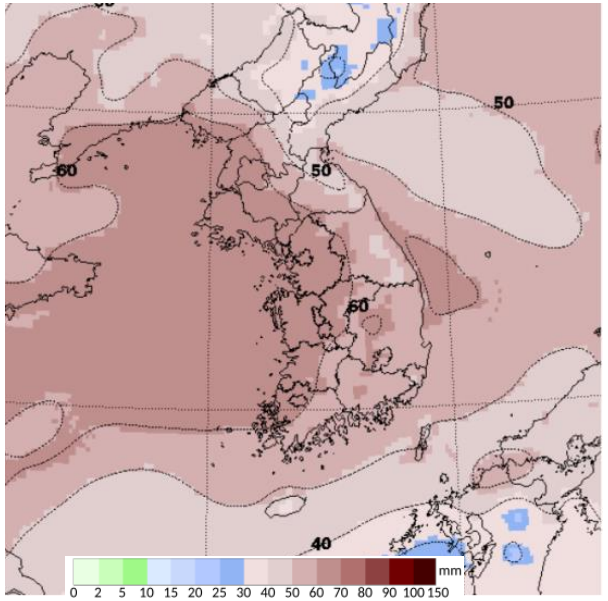
TPW(NWP +Sat.)



2020.7.23. 09:00KST



2020.7.30 09:00KST



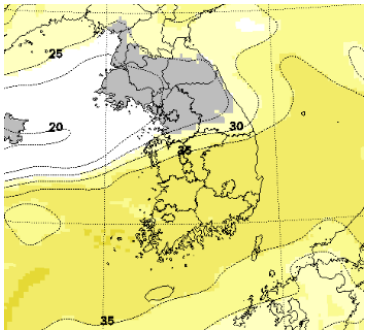
2020.8.2. 15:30KST

In heavy rain case, satellite analysis key point 14

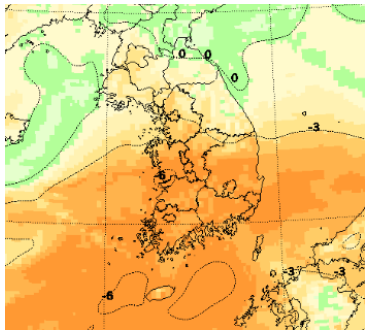
14. Instability index: High instability area

- High probability of heavy rain cloud formation in areas with high instability

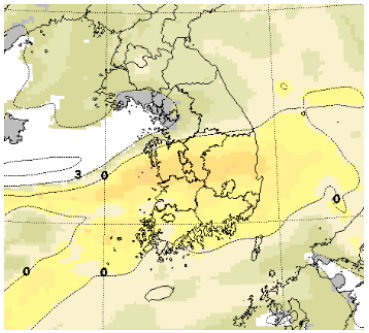
Index	Applying time	Thunderstorm intensity			
		weak	moderate	strong	severe
KI	Summer	25 ~ 30	30 ~ 40	≥ 40	
SSI	All year round	6 ~ 3	3 ~ −3	−3 ~ −6	−6
LI	All year round	0 ~ −2	−3 ~ −5	< −5	<−6
TTI	October to May	42 ~ 48	48 ~ 54	54 ~ 60	≥ 60
CAPE	April to November	300 ~ 500	500 ~ 900	900 ~ 1800	≥ 1800



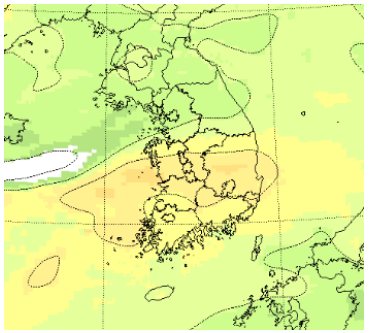
KI(NWP+Sat.)



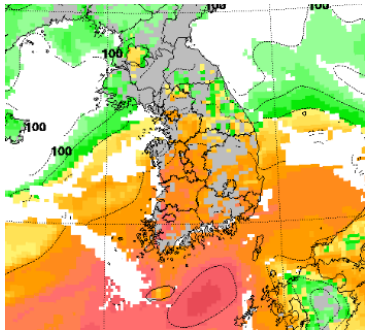
LI(NWP+Sat.)



SSI(NWP+Sat.)



TTI(NWP+Sat.)

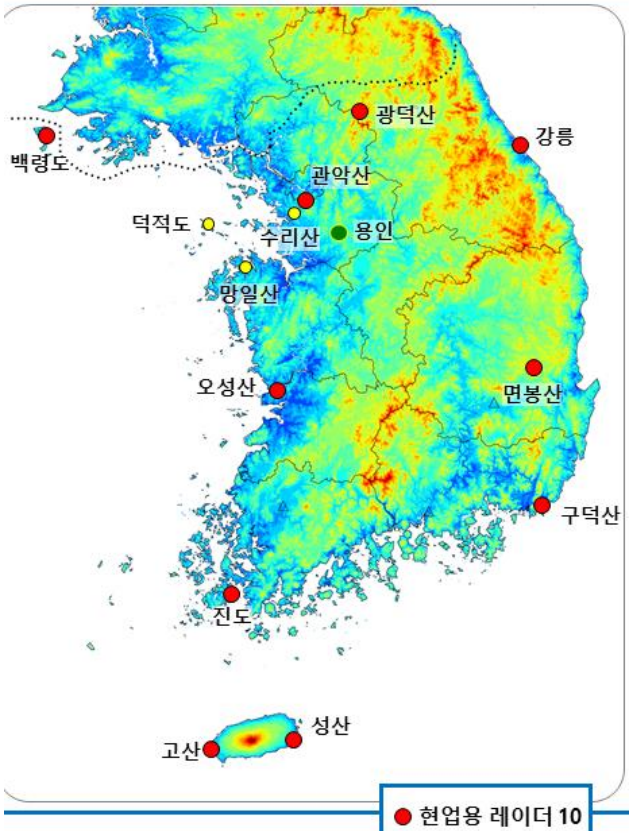


CAPE(NWP+Sat.)

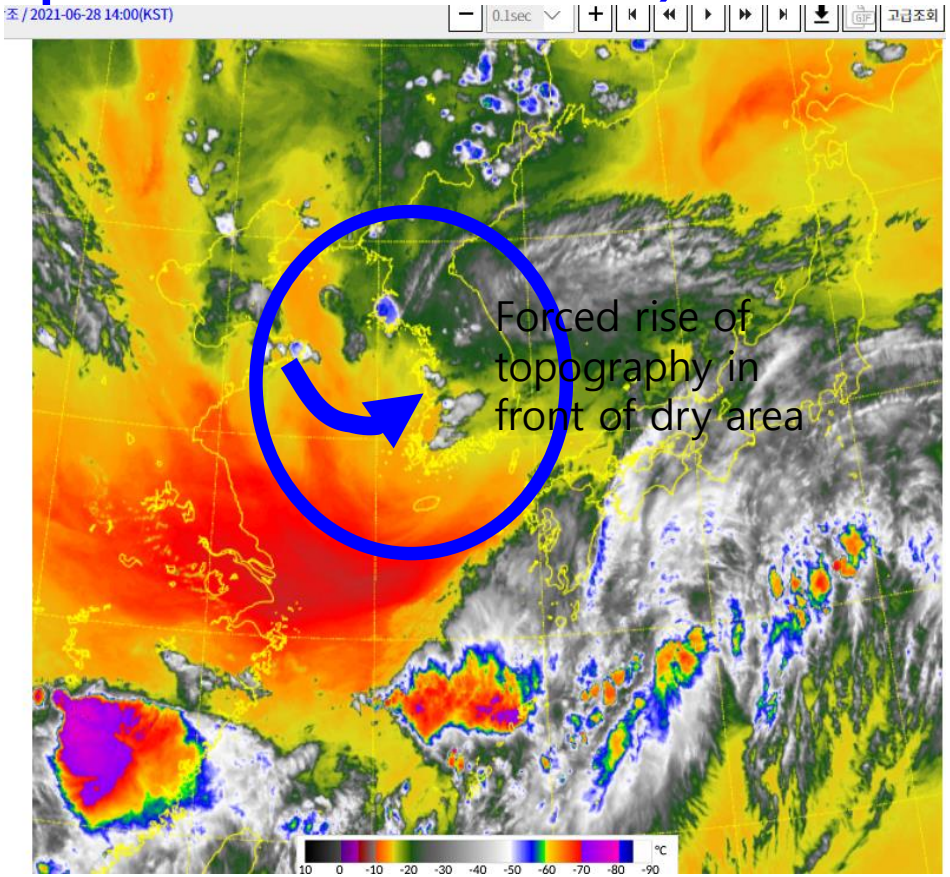
2020.7.30. 09:00KST

In heavy rain case, satellite analysis key point 15

15. Others: Forced rising motion due to topographic factors, duration of heavy rain clouds (moving speed less than 15 km/h), etc.



Topography of South Korea



2022.7.21. 00:00KST

Key points of pre-detecting signals before developing cloud

1. Updraft area in front of the boundary of the upper dry area of mT(marine Tropical)
2. Updraft area in front of the dry area due to the trough
3. Compressed wet zone between the southern and northern dry zones
4. Warm advection with warm conveyor belt (WCB) (warm advection accompanied by low pressure)
5. Lower cumulus clouds along strong southwesterly air stream (lower jets)
6. Ci cloud (jet stream) as divergent in the upper strong wind zone - (in the case of lower-level convergence): upper-level divergence
7. Upper layer cold core (localized heavy rain due to instability between upper and lower layers)
8. Medium and small-scale low-pressure rotating clouds of upper, middle, and lower layers on the stationary front
9. Periodic upper-level wave inflow on the stationary front
10. The cooling rate of the developing convective cloud lasts less than -3 ℃ / 10 minutes
11. Clouds thickness of 10 km or more (from the lower layer to the upper layer)
12. Heavy rainfall critical index of 30 or higher (heavy rain advisory level or higher)
13. TPW(total precipitation water) of 60mm/h or higher area
14. High instability area
15. Others: Forced rising motion due to topographic factors, duration of heavy rain clouds (moving speed less than 15 km/h), etc.

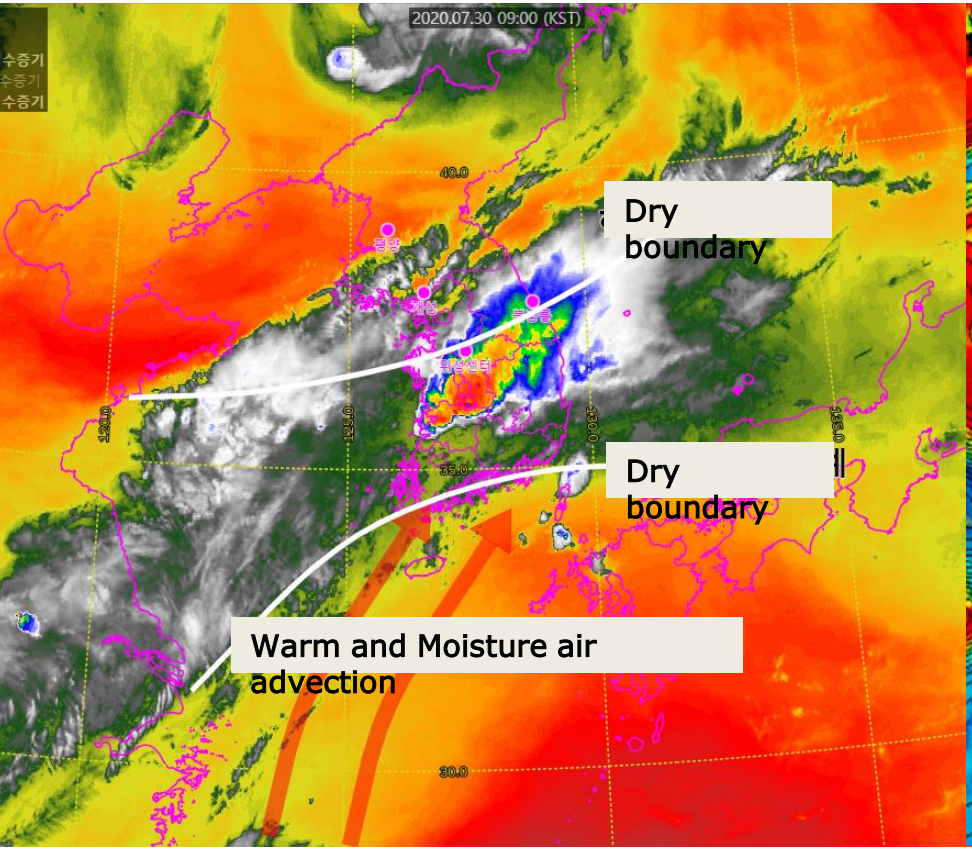
Among the features from 1 to 13

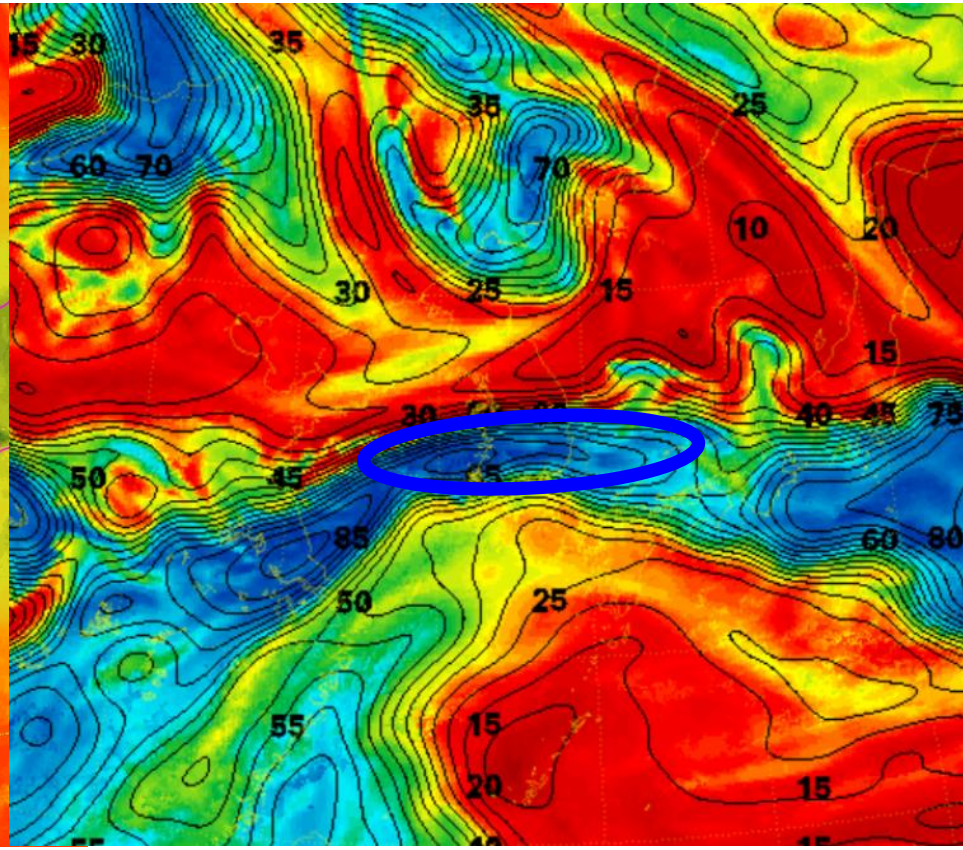
- ❖ **Heavy rain occurs when 6 or more features appear**
- ❖ **High probability of heavy rain when 4 or more appear**

2. Case Analysis

Heavy rain case on July 30, 2020

Compressed wet zone between the southern and northern dry area



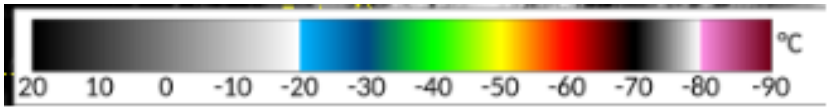


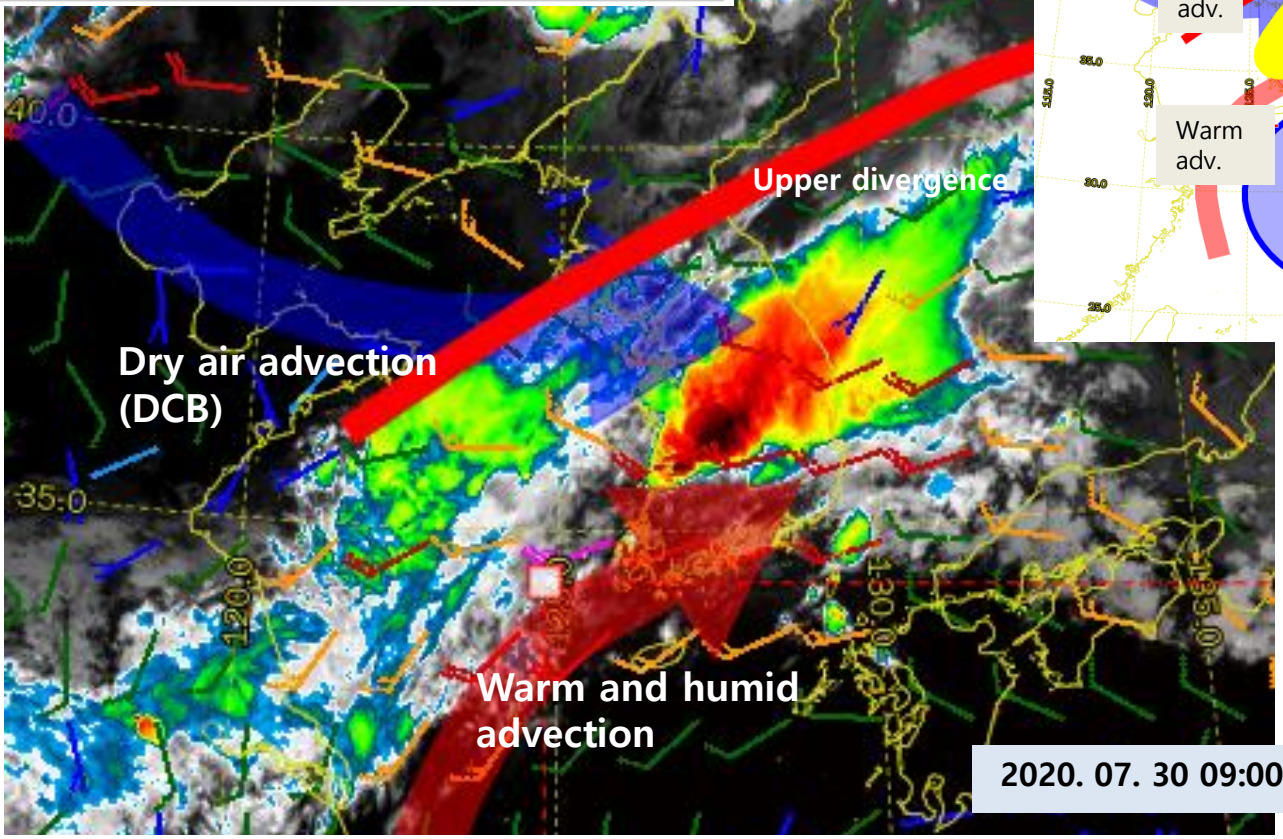
2020. 07. 30 09:00 KST 7.3μm WV, 500hPa RH(UM)

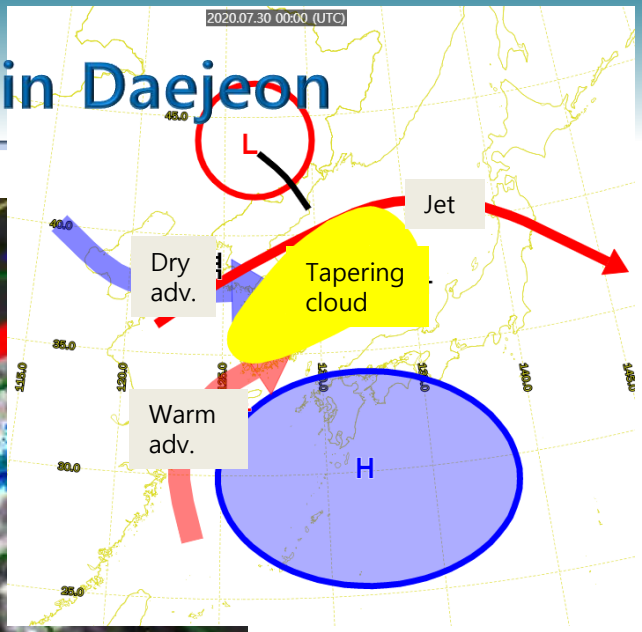
Compressed wet zone between the southern and northern dry zones around

- The northern dry area southward, and the dry area at mT boundary northward
- Convective clouds develop in the compressed water vapor river between the southern and northern dry regions.

Deep convective cloud development in Daejeon





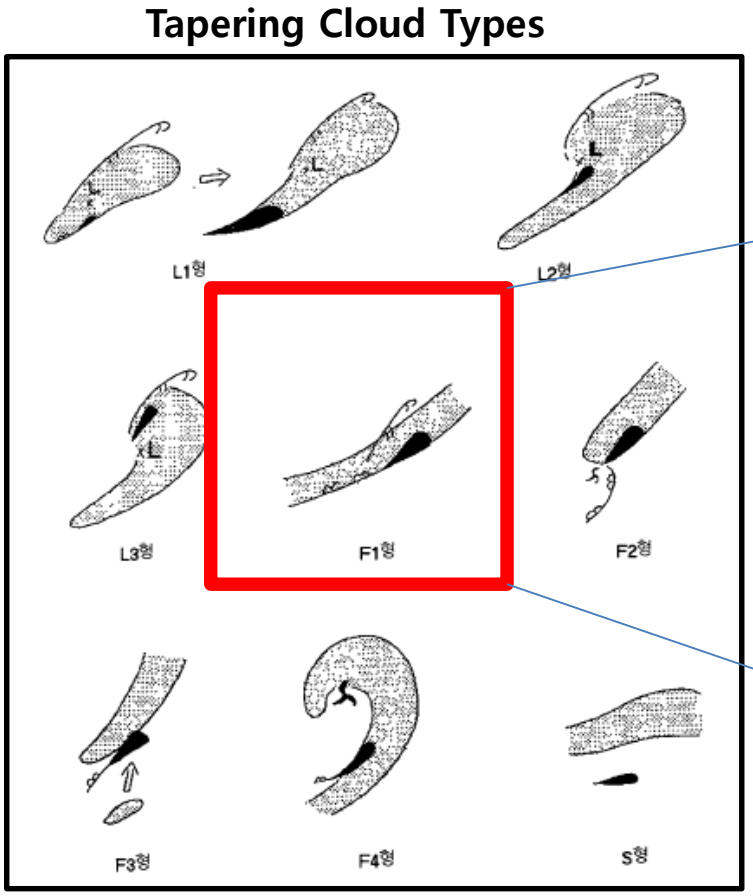


Lower jet type

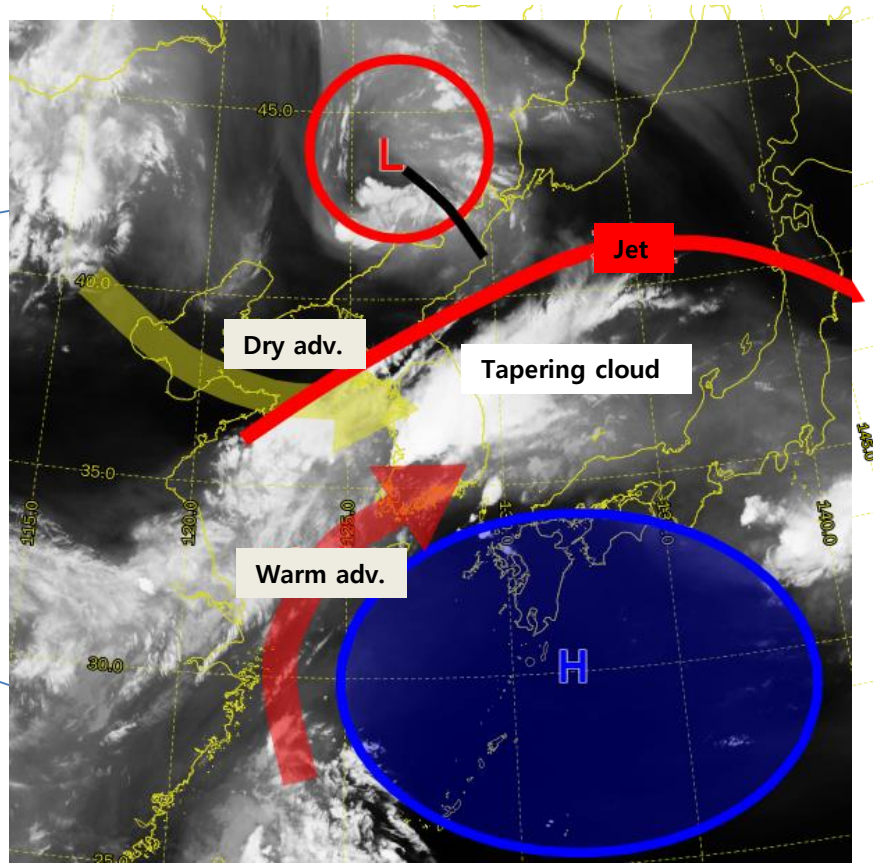
2020. 07. 30 09:00 KST EIR+850hPa wind

- In the lower atmosphere (850 hPa) a strong warm advection from the southwest of mT boundary into the West Sea of Korea.
- Atmospheric trough is located in the West Sea
- Due to the convergence between the southwest and northwest airstream, strong cumulonimbus clouds are developing(CTT -70 ℃ or less, CTH of 15 km) in Daejeon area

Tapering Cloud types



(Source: from JMA)

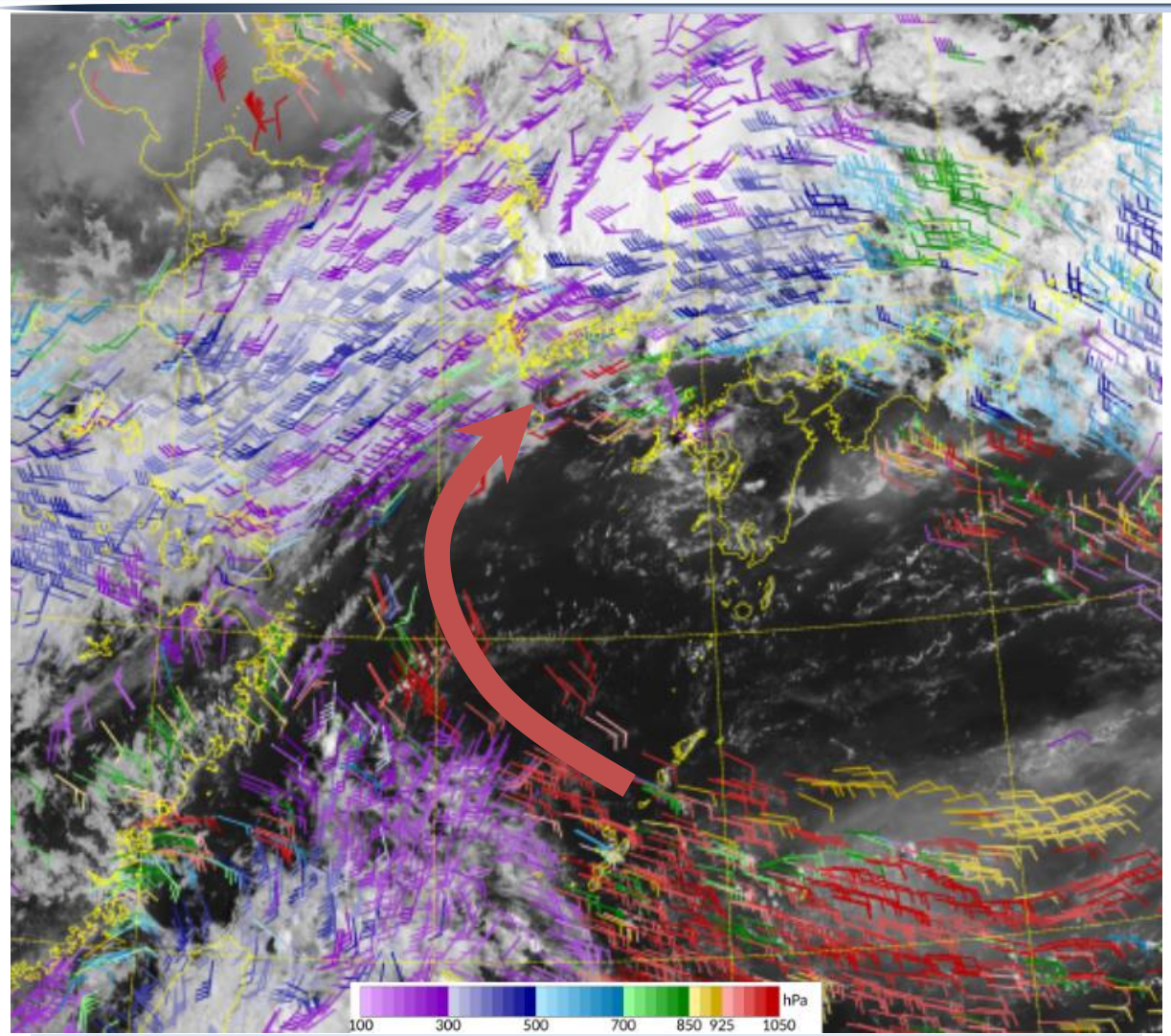


F1 type: Occurs at the southern edge or center of the cloud band

Tapering Cloud developing conditions

- Around the cyclonic center and near warm area of the stationary front
- In case of significant inflow of dry air over the warm and humid air mass in the lower layer
- In case of strong wind zone in the upper layer, strong vertical shear and upper layer divergence

Compressed Water vapor path between north and south dry air



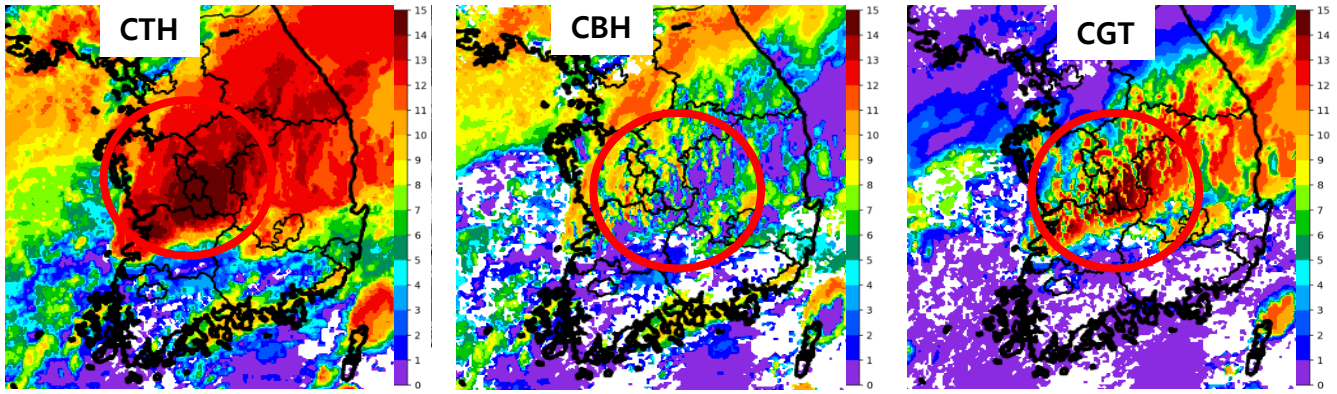
2020. 07. 30 09:00 KST AMV(Visible)

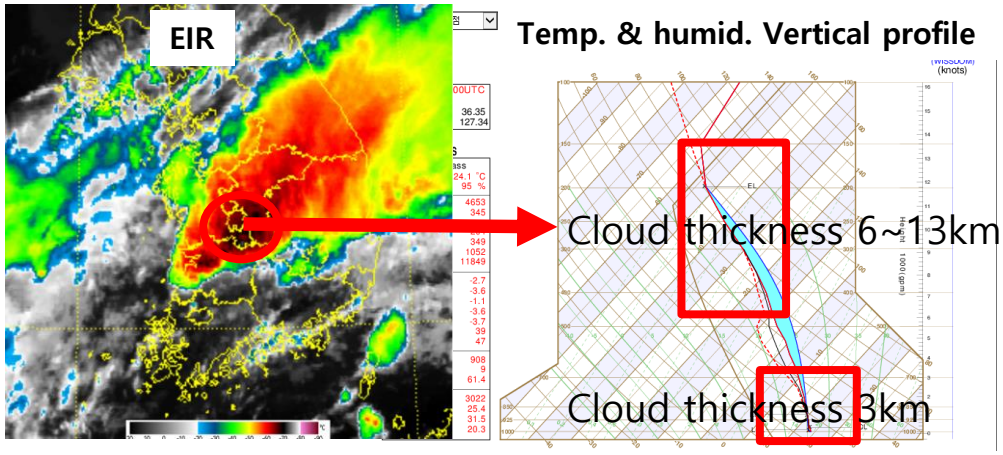
- The lower winds from the southern seas flow into the the West Sea and flow into the inland of Jeolla-do of southern part of South Korea
- Convection clouds develop into inland as the warm and humid air from the southwest flow strongly into Korea.

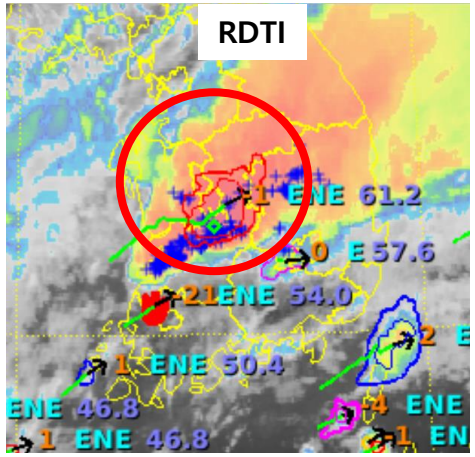
Application products on July 30, 2020 (Daejeon) case

❖ **Convection clouds develop strongly due to lower convergence and upper divergence**

- Thick clouds are distributed from CBH 6km to CTH 15km of the developed clouds in Daejeon (similar to the model)
- With cooling rate of -1°C/10 minutes, clouds may gradually weaken after mature







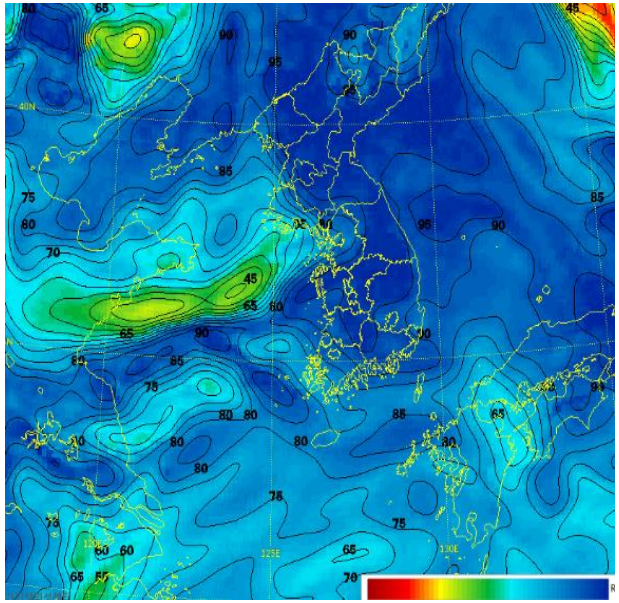
2020. 07. 30. 09:00KST

Application products on July 30, 2020 (Daejeon) case

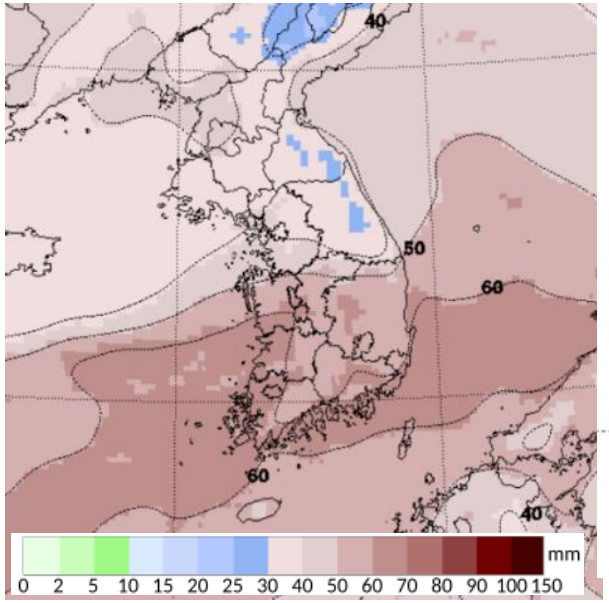
❖ **Convection clouds develop strongly due to lower convergence and upper divergence**

- RH 90% of the lower atmosphere
- Total Precipitable Water 60mm/h or more in southern Chungcheong
- Critical Index of Heavy Rainfall is Warning and Alert level in the southern part of Chungcheong Province

RH(850hPa UM+Sat.)



TPW(UM+Sat.)



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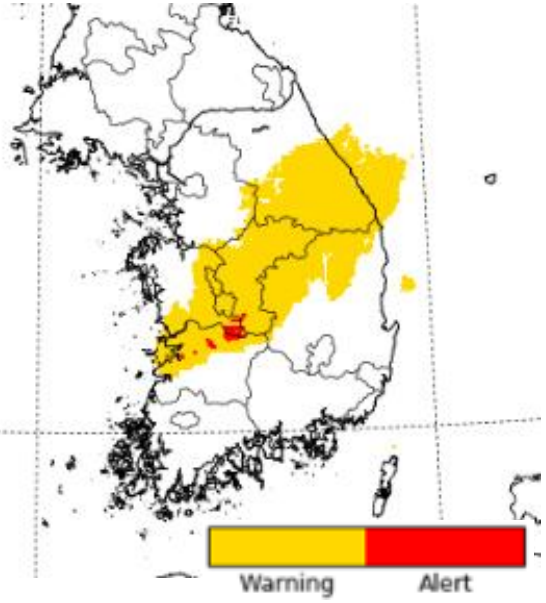

2020. 07. 30. 09:00KST

Thank you

The 12th Asia/Oceania Meteorological Satellite User's Conference
Training event

Introduction to KMA's Satellite Data Service

NMSC / KMA

Taekyu Jang

국가기상위성센터
National Meteorological Satellite Center

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국가기상위성센터
National Meteorological Satellite Center

Overview

01 • Overview of KMA's Satellite Data Service

Internet service

- Internet service of satellite meteorological data

Weather broadcasting Service

- Large-scale broadcast receiver (LDUS)
- Medium-scale broadcasting receiver (MDUS)
- Small-scale broadcasting receiver (SDUS)

Rapid Scan Service

- Over the Asian Pacific region (RA II and RA V)
- Every 2 minute observation with two kind of mode (fixed or tracking)

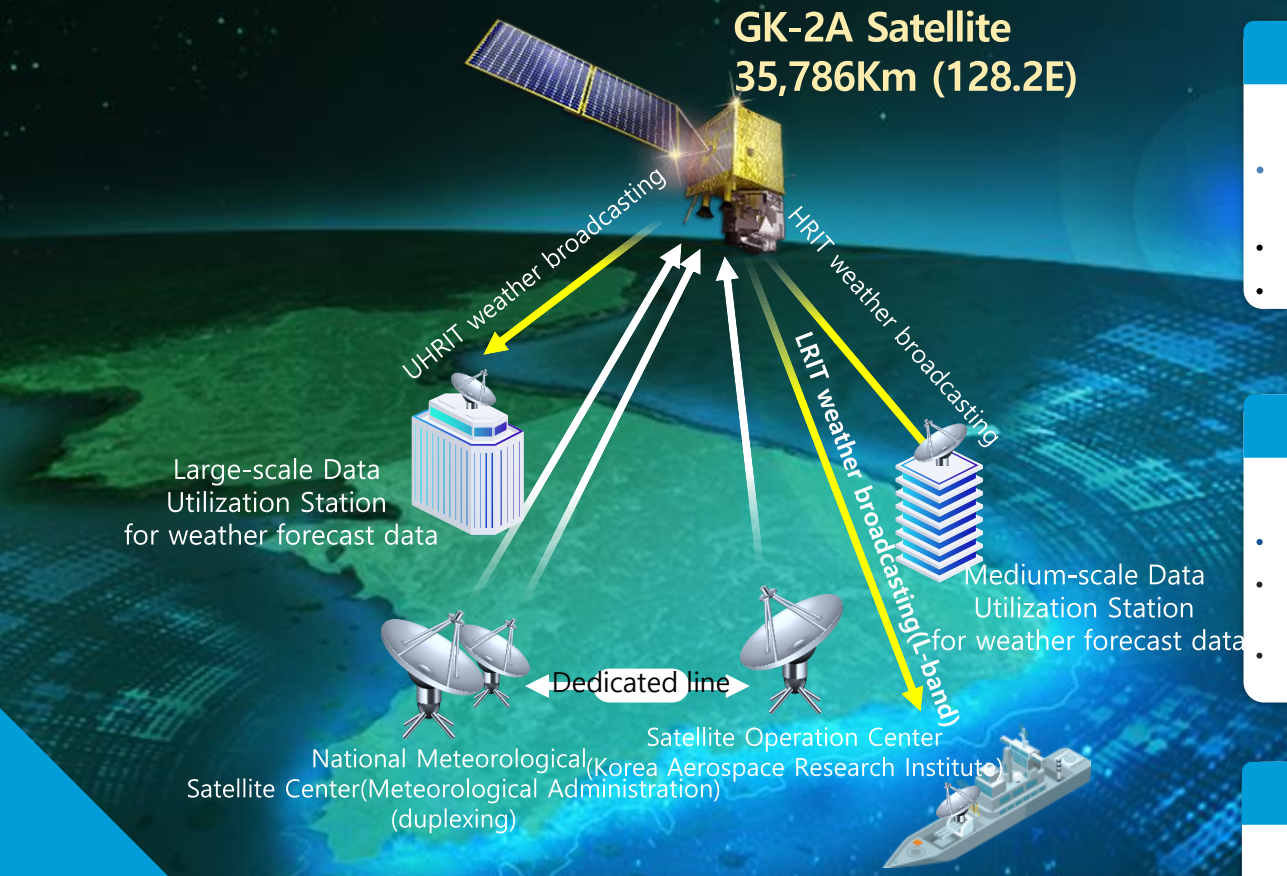
DCPC service

- Core component service of WMO WIS

Weather Broadcasting Service

01 • Weather Broadcasting Service

국가기상위성센터
National Meteorological Satellite Center



Non-stop **weather broadcasting service**

- LRIT(Low Rate Information Transmission)
- HRIT(High Rate Information Transmission)
- UHRIT(Ultra High Rate Information Transmission)

Large-scale Data Utilization Station(LDUS)

Large-Scale Data Utilization Station

- **UHRIT broadcasting**(high resolution Level 1B) **reception**
- Utilization of commercial DVB-S2 receiver
- Weighted/synthetic image display

Medium-scale Data Utilization Station(MDUS)

Medium-Scale Data Utilization Station

- **HRIT broadcasting reception**
- Application of SDR (SW demodulation/ decoding) technology
- Backward compatibility with COMS broadcasting receivers

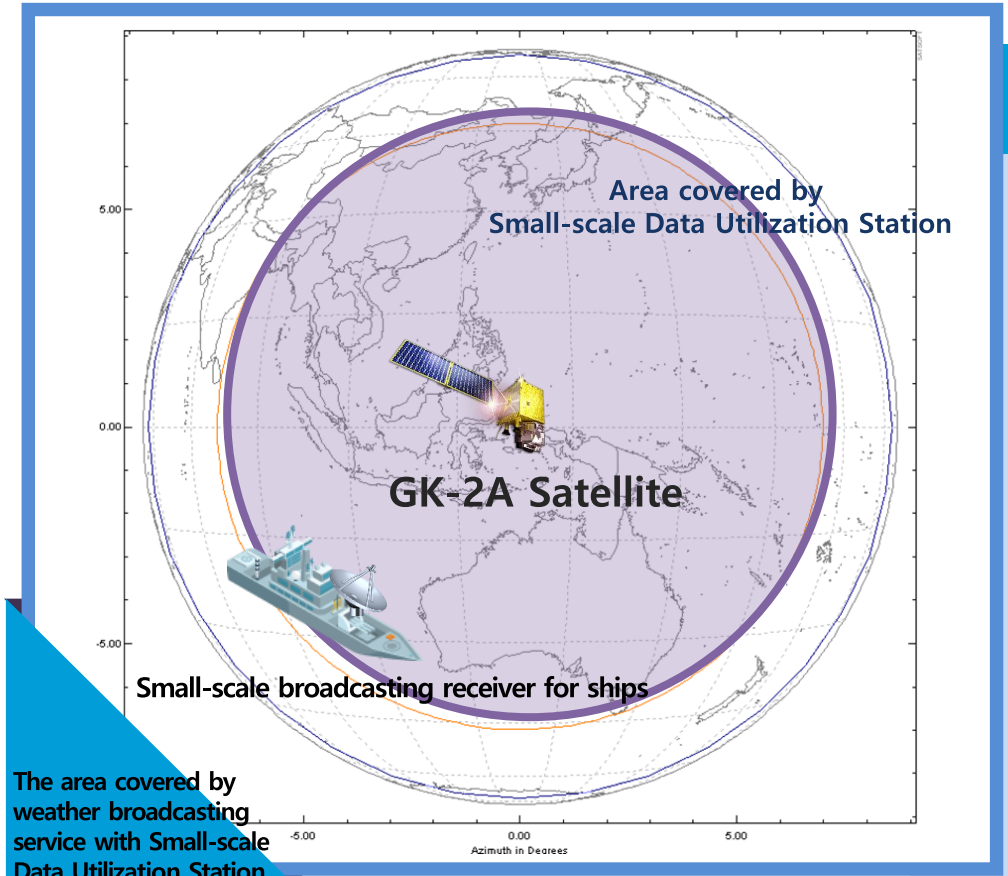
Small-scale Data Utilization Station(SDUS)

Small-Scale Data Utilization Station

- **LRIT broadcasting reception**
- Application of SDR (SW demodulation/ decoding) technology
- Building the low-cost system (application of omni-directional antenna)

02 • Weather Broadcasting Service

Small-sized broadcasting receiver is a low-priced terminal which can be easily installed on a ship, and provides service for a extensive area.



The area covered by weather broadcasting service with Small-scale Data Utilization Station

LRIT Service

- Frequency Band: L-band
- Transmission Rate: ≥ 8kbps
- Broadcasting Information: Weather FAX replaceable Image and Text(Satellite Image, Weather Information, and Daily Climate Map, etc.)

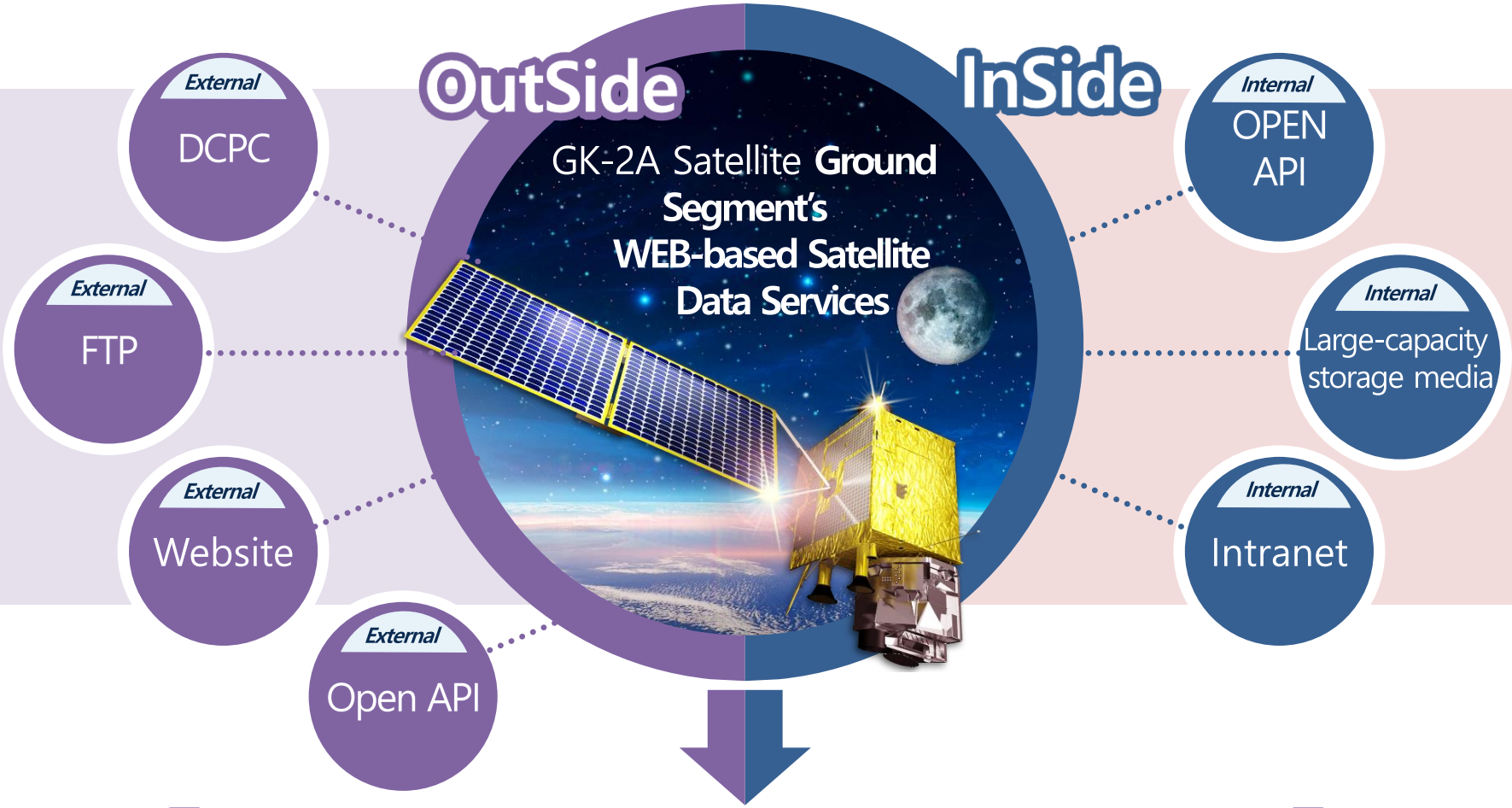
※ Providing service with the same specification as COMS Satellite LRIT service(frequency, Information transfer rate, and transmission specification, etc.) (Difference at Transmission Rate)

Small-scale Data Utilization Station(SDUS)

- Main Function: Reception of LRIT Broadcasting, Displaying and Management of Received Data
- Configuration: Small Antenna/LNB, A/D Converter, and Mini-PC
- Implementing demodulator/decoder with S/W (adopting SDR concept)
- Providing Service through Personal Smartphone

Internet Service

01 • Internet Service



[Various types of satellite meteorological datasets is shared]

02 • Internet Service

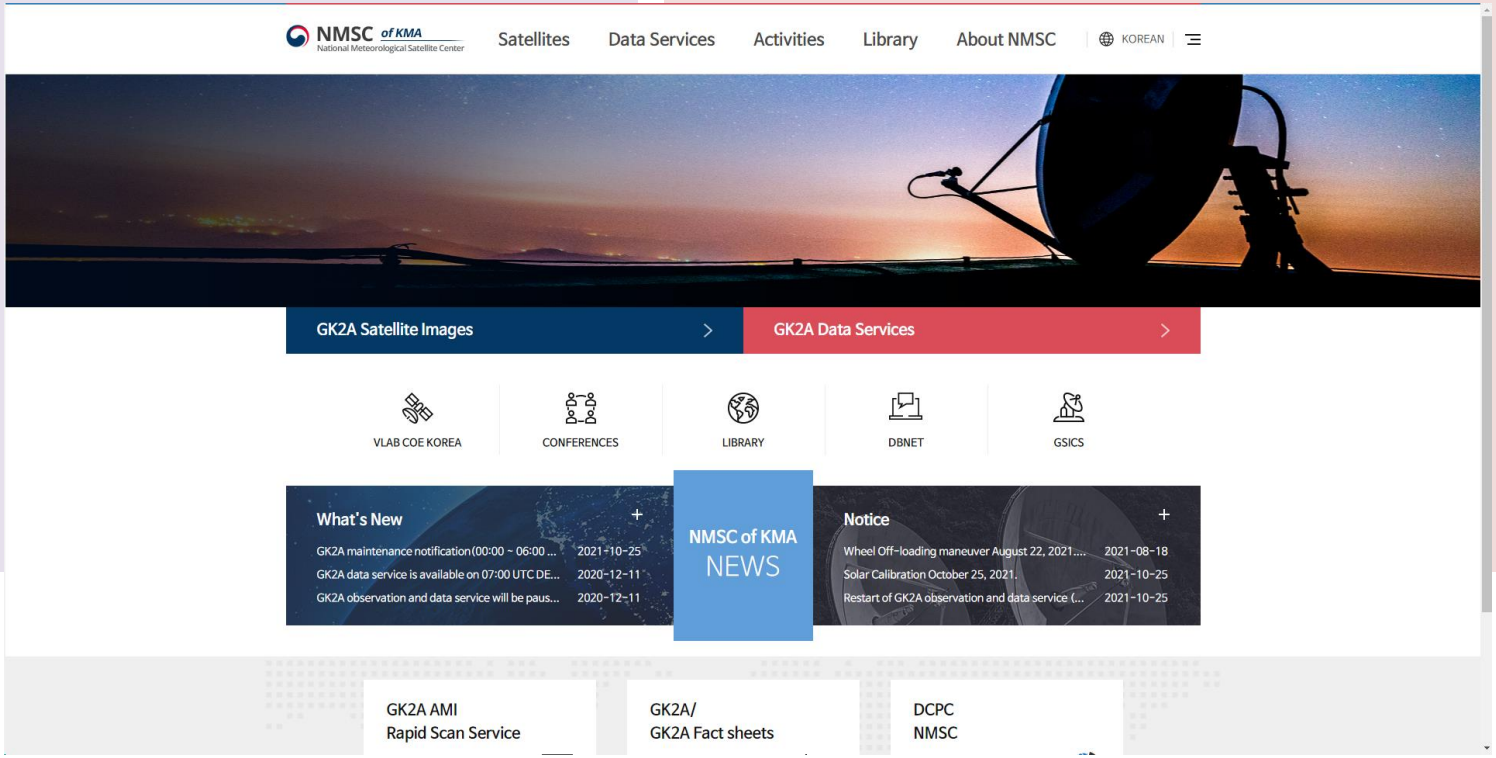
FTP

Currently, 16 countries are using the real time ftp service.

04 • Internet Service

Website

The website of the National Meteorological Satellite Center
http://nmsc.kma.go.kr/enhome/html/main/main.do



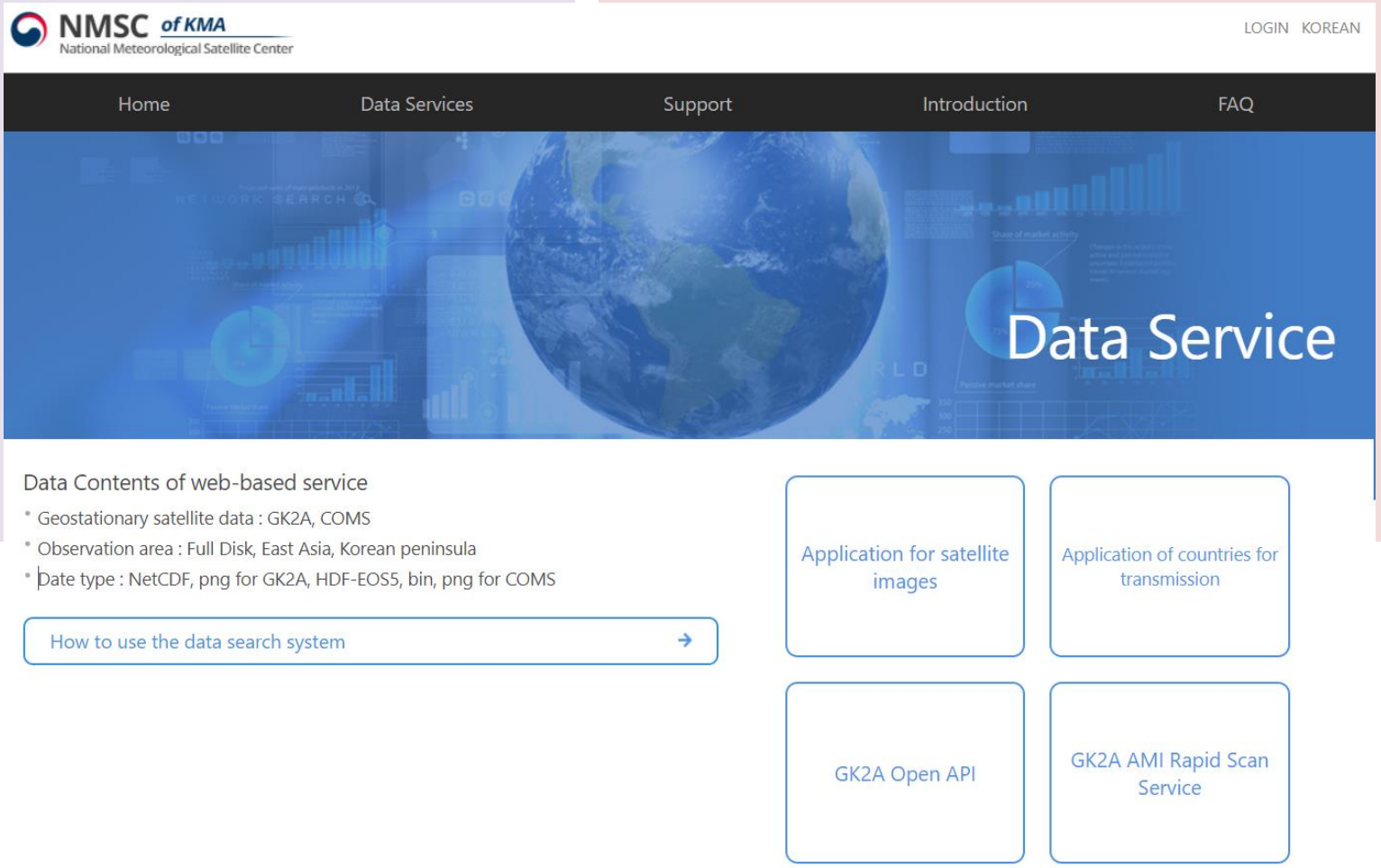
GK2A Satellite Images – shows the various satellite images and informations for the GK2A
GK2A Data Services – data download, service request(open api, rapid scan)

06 • Internet Service

Website

The website of the National Meteorological Satellite Center

http://nmsc.kma.go.kr/enhome/html/main/main.do -> data services

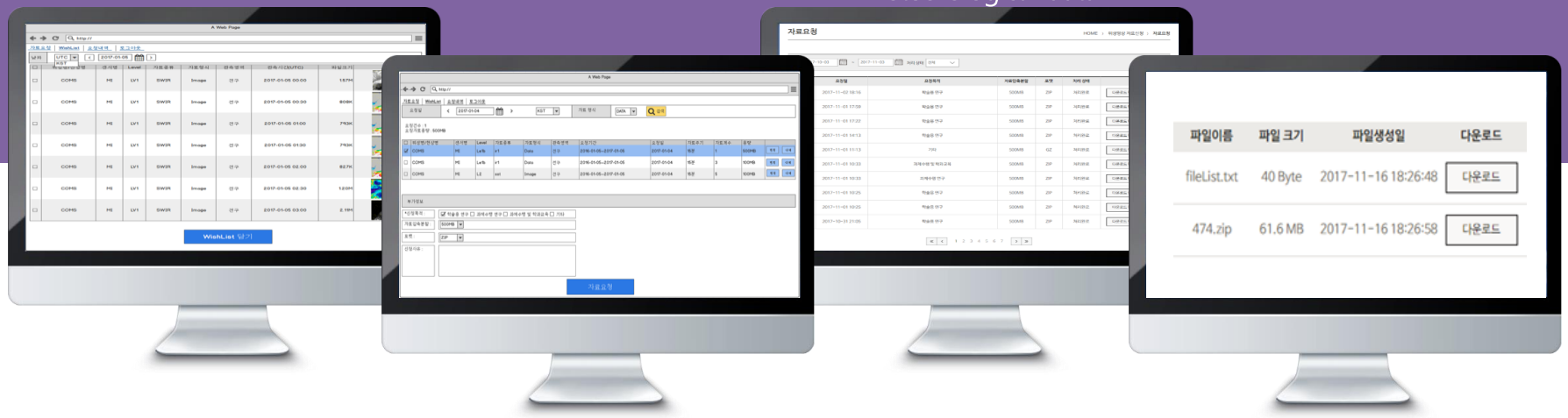


• Internet Service

Download

Various satellite meteorological data services(such as searching, displaying, or downloading) can be provided on the data website of the National Meteorological Satellite Center.

1	2	3	4
Display of the search list of satellite meteorological data	Request	Status is displayed, such as "Being Prepared" or "Download Possible"	HTTP download service is provided
Satellite, area, data type, and period selected by user	Select data list, format, and request final order	Preparation status to be able to download satellite meteorological data	Download of Satellite meteorological data

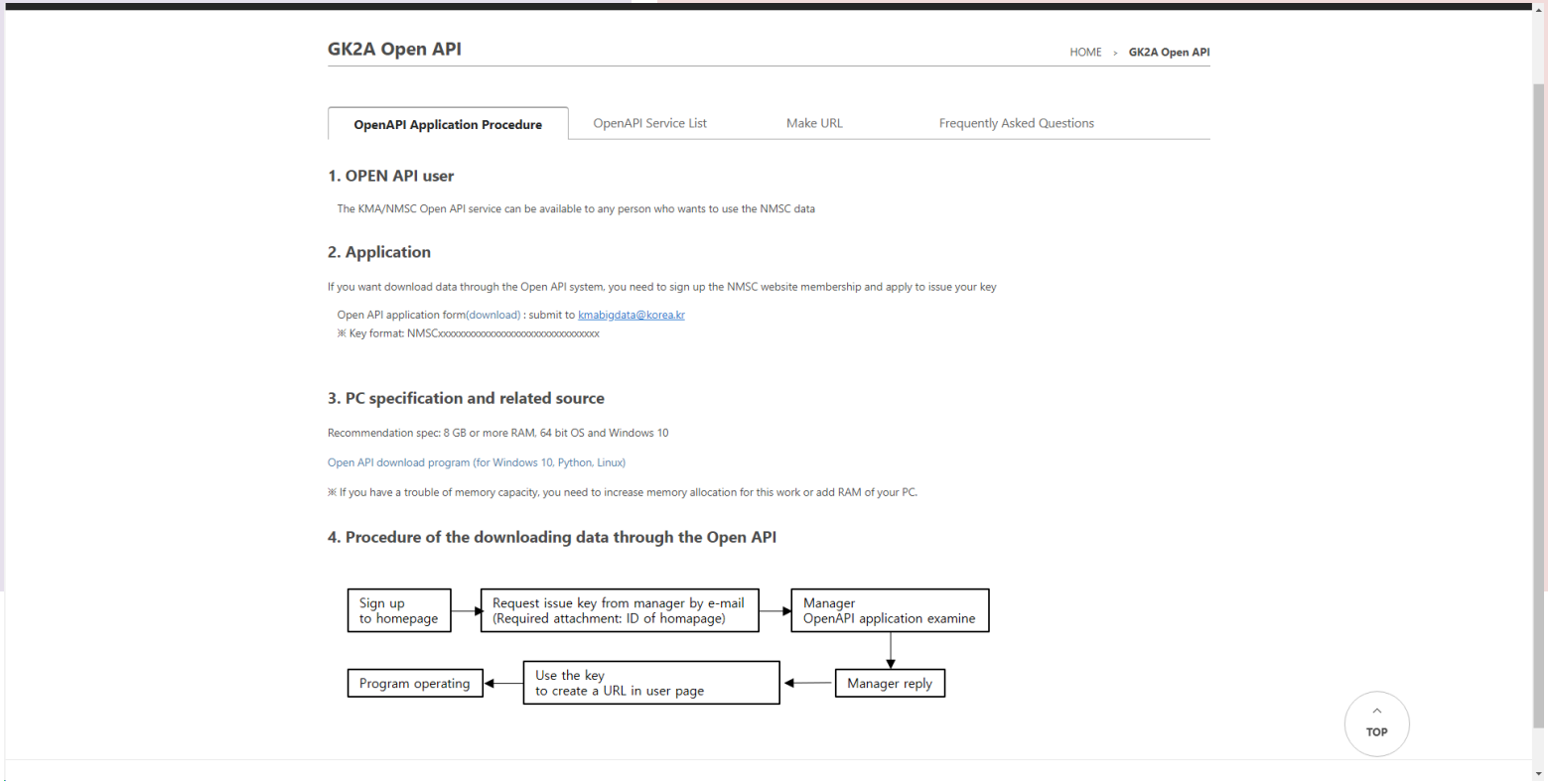


Customized satellite data service allowing the users to select a kind of satellite, area, data type, period, and data format

07 • Internet Service

Open API

The website of the National Meteorological Satellite Center
http://nmsc.kma.go.kr/enhome/html/main/main.do



GK2A Open API

HOME › GK2A Open API

OpenAPI Application Procedure | OpenAPI Service List | Make URL | Frequently Asked Questions

1. OPEN API user

The KMA/NMSC Open API service can be available to any person who wants to use the NMSC data

2. Application

If you want download data through the Open API system, you need to sign up the NMSC website membership and apply to issue your key

Open API application form(download) : submit to kmabigdata@korea.kr
※ Key format: NMSCxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

3. PC specification and related source

Recommendation spec: 8 GB or more RAM, 64 bit OS and Windows 10

Open API download program (for Windows 10, Python, Linux)

※ If you have a trouble of memory capacity, you need to increase memory allocation for this work or add RAM of your PC.

4. Procedure of the downloading data through the Open API

Sign up to homepage → Request issue key from manager by e-mail (Required attachment: ID of homapage) → Manager OpenAPI application examine → Manager reply → Use the key to create a URL in user page → Program operating

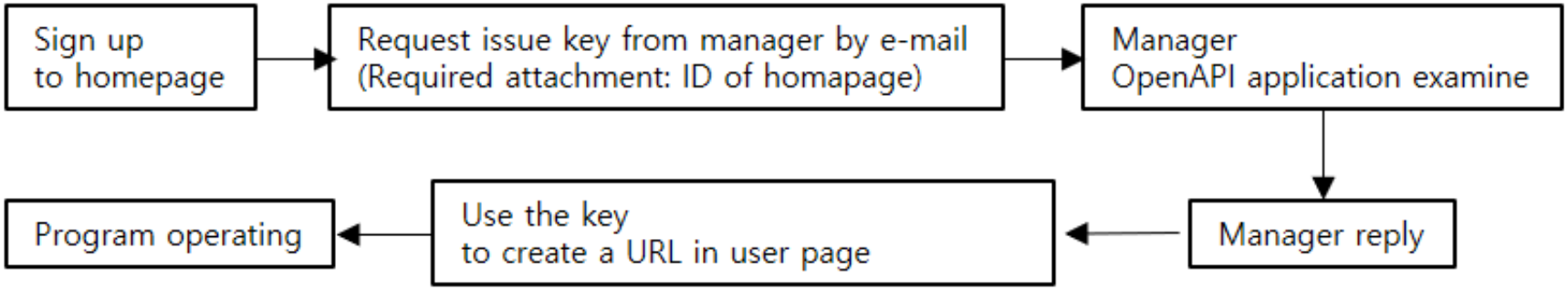
TOP

Open API – Open Application Programming Interface
– API Key-based System(need registration)

08 • Internet Service

Open API

Procedure of Open API Service

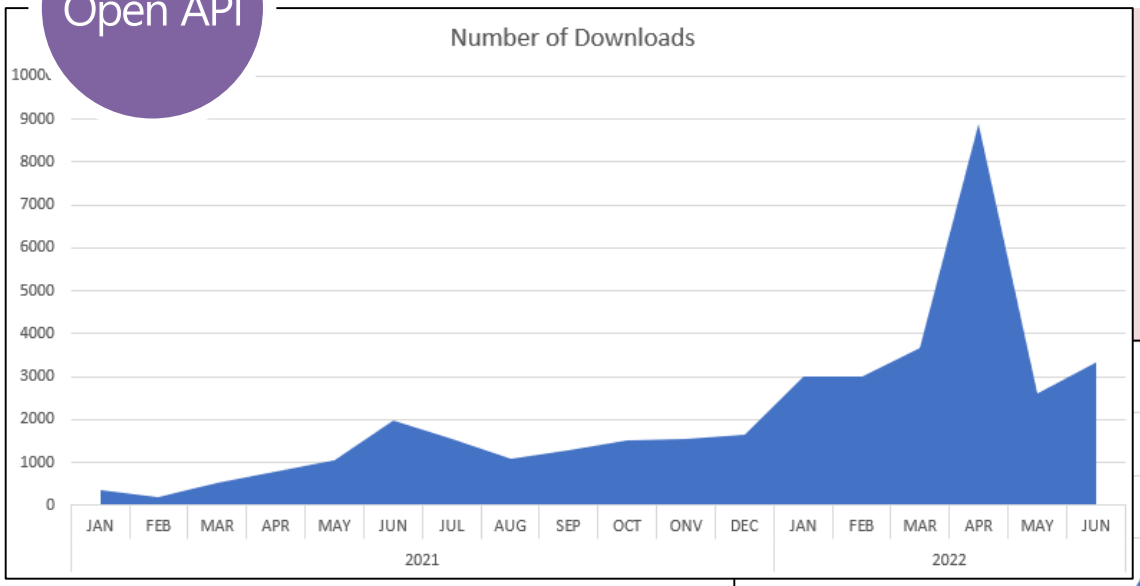


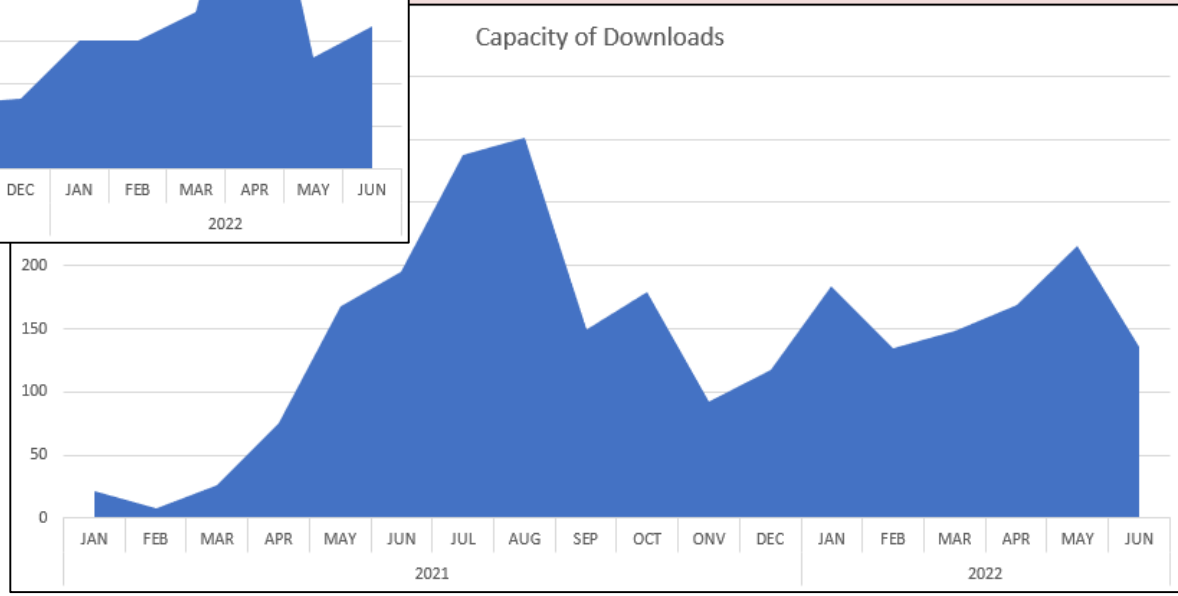
Open API – Open Application Programming Interface
– API Key-based System(need registration)

09 • Internet Service

Open API

Open API Service Usage



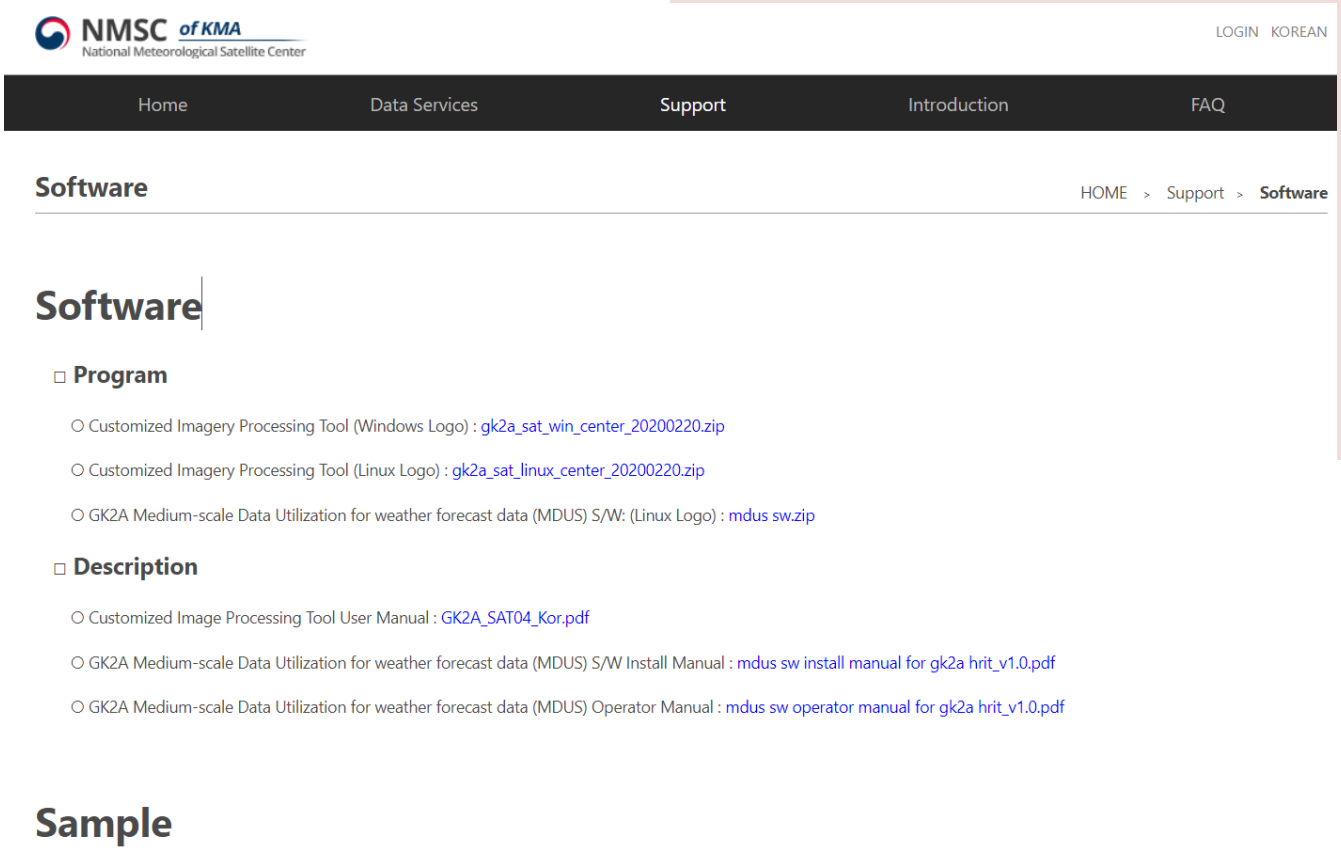


The usage of Open API service is continuously increasing.

09 • Internet Service

Software

Software support page
- Data Processing Tool, Manual, Sample code/data
- SRF(Spectral Response Function)
- lat/lon coordinate data(GEOS, LCC)/(NetCDF, Ascii, Bin)



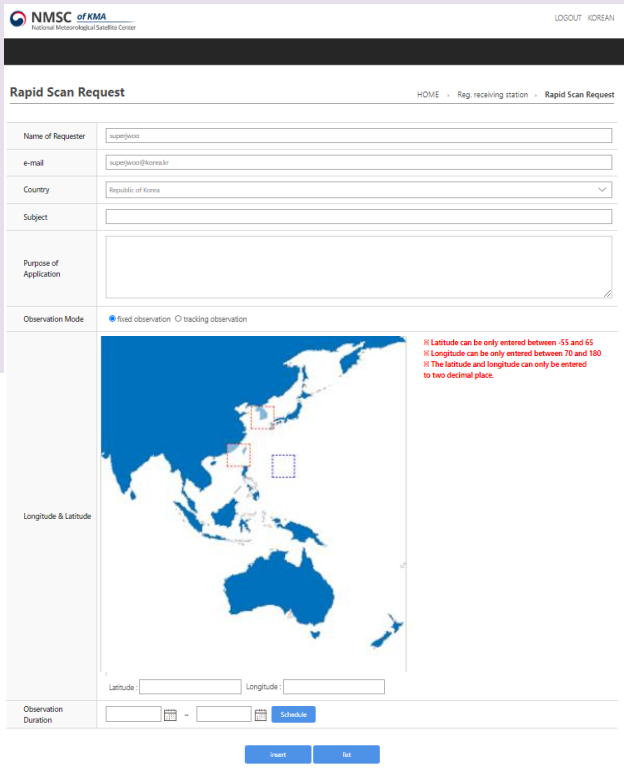
Rapid Scan Service

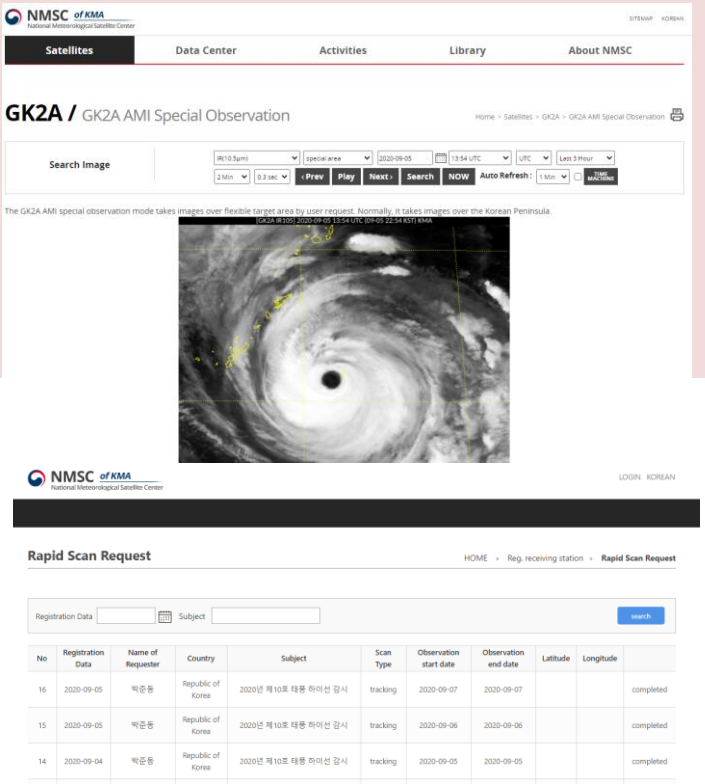
01 • Rapid Scan Service

Rapid Scan

Over the Asian Pacific region (RA II and RA V)

- Provide significant improvements in the real-time monitoring of hazardous weather such as Typhoon, thunderstorm and dust events
- Users can submit official request form defining specific measurement area via rapid scan request webpage(http://datasvc.nmsc.kma.go.kr/datasvc/html/special/specialReqMain.do)
- The number of joined countries is 7.



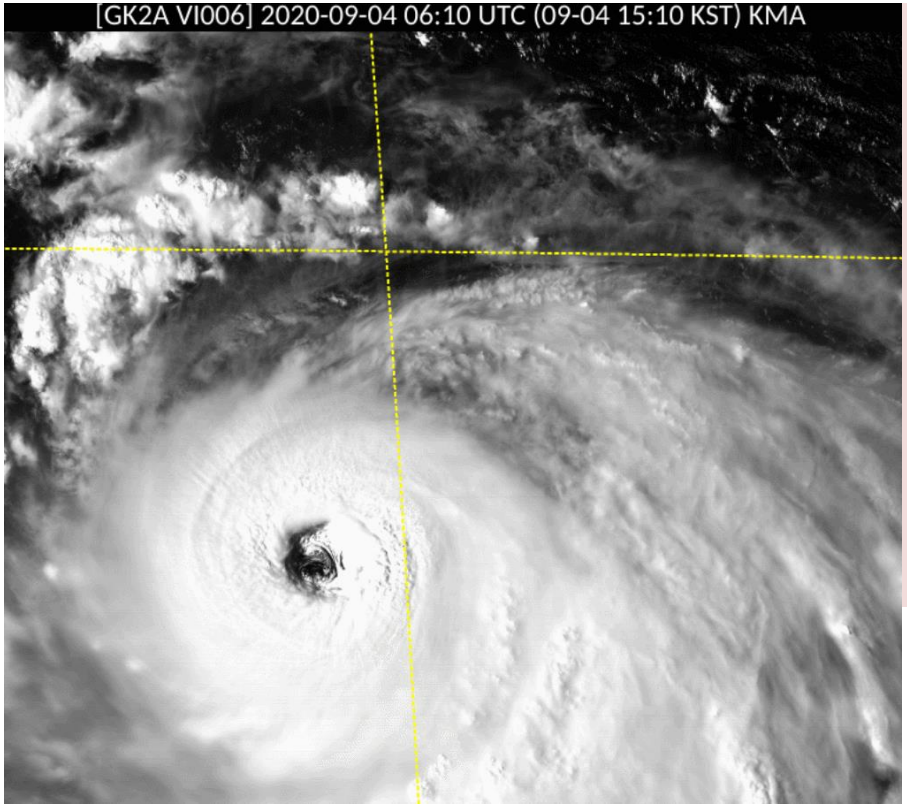


02 • Rapid Scan Service

Rapid Scan

Rapid Scan
Target Observation

Typhoon HAISHEN
2020. 9. 4. 06 ~ 09 UTC
(VI006, every 2 min., 0.5km)



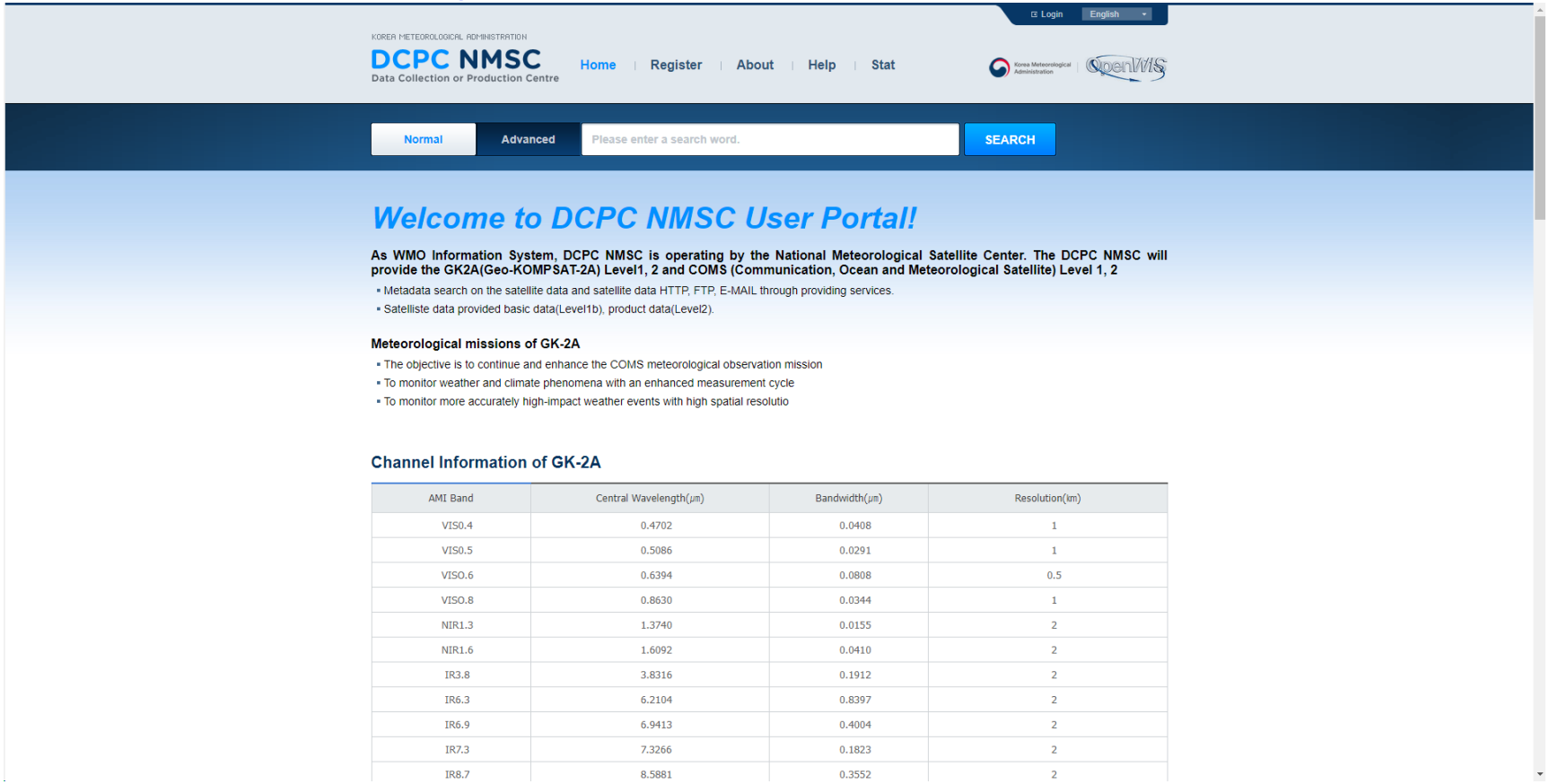
DCPC Service

05

• DCPC NMSC

Data Collection or Production Center(WIS Core Components)

- Metadata search
- Basic data(Level1b), product data(Level2)
- http://dcpc.nmsc.kma.go.kr/openwis-user-portal/srv/en/main.home



Login English

KOREA METEOROLOGICAL ADMINISTRATION

DCPC NMSC
Data Collection or Production Centre

Home | Register | About | Help | Stat

Normal | Advanced | Please enter a search word. | SEARCH

Welcome to DCPC NMSC User Portal!

As WMO Information System, DCPC NMSC is operating by the National Meteorological Satellite Center. The DCPC NMSC will provide the GK2A(Geo-KOMPSAT-2A) Level1, 2 and COMS (Communication, Ocean and Meteorological Satellite) Level 1, 2

- Metadata search on the satellite data and satellite data HTTP, FTP, E-MAIL through providing services.
- Satelliste data provided basic data(Level1b), product data(Level2).

Meteorological missions of GK-2A

- The objective is to continue and enhance the COMS meteorological observation mission
- To monitor weather and climate phenomena with an enhanced measurement cycle
- To monitor more accurately high-impact weather events with high spatial resolutio

Channel Information of GK-2A

AMI Band	Central Wavelength(㎛)	Bandwidth(㎛)	Resolution(㎞)
VIS0.4	0.4702	0.0408	1
VIS0.5	0.5086	0.0291	1
VISO.6	0.6394	0.0808	0.5
VISO.8	0.8630	0.0344	1
NIR1.3	1.3740	0.0155	2
NIR1.6	1.6092	0.0410	2
IR3.8	3.8316	0.1912	2
IR6.3	6.2104	0.8397	2
IR6.9	6.9413	0.4004	2
IR7.3	7.3266	0.1823	2
IR8.7	8.5881	0.3552	2

Thank you

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National Meteorological Satellite Center