국가기상위성센터
National Meteorological Satellite Center

Discrimination of Convective Clouds using Himawari-8 Data with Logistic Regression over Korea

Ki-Hong PARK

National Meteorological Satellite Center (NMSC),

Korea Meteorological Administration (KMA)

parkkihong@korea.kr

2018 CWG Workshop

Ljubljana, Slovenia

19 April 2018

KMA's RDT in 2017

국가기상위성센터
National Meteorological Satellite Center

- The NMSC/KMA has introduced **"Convective cloud detection and tracking" algorithm (RDT)** developed by NWCSAF/EUMETSAT (PGE11 v2013).
  - ➔ *focused on monitoring of convective cloud system*

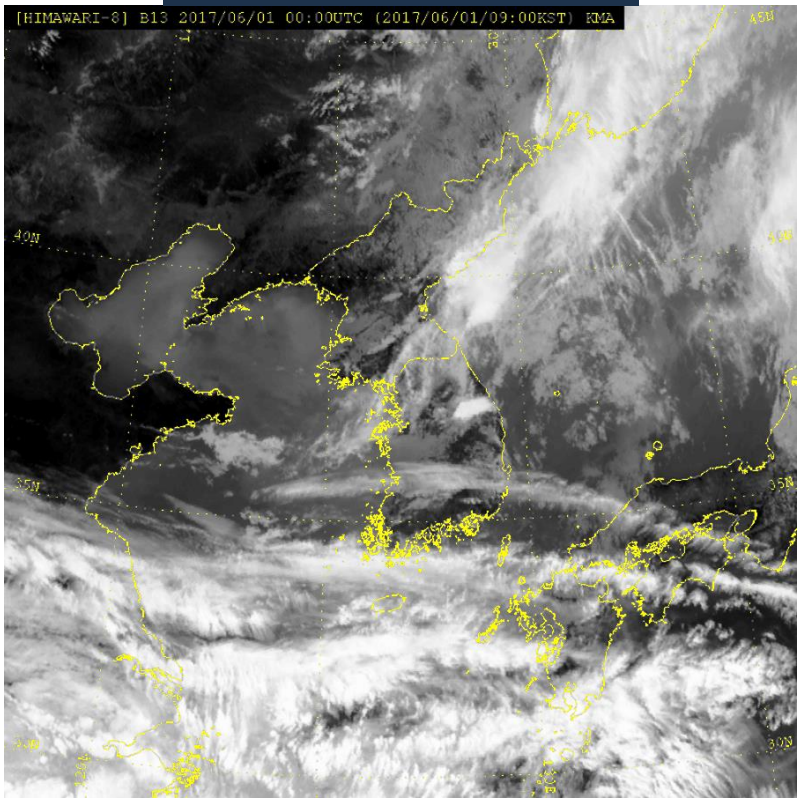
- We adapted **Himawari-8 data** to PGE11 module.
  - ➔ *Himawari-8 is similar to **GeoKompsat-2A(GK-2A)/AMI**, which will be launched in November 2018*

- Also, We first performed the tuning of discrimination model by an ensemble of **logistic regression** (using R software).
  - ➔ *following the discrimination process of Météo-France*
  - ➔ *suitable for the Korean Peninsula and its surrounding region*
  - ➔ *resolution : 4(3)km → **2km**, 15min. → **10min.***

Target Area

- The **Korean Peninsula** has been influenced by heavy rain of rapidly developing convective cells in summer season.
- Generally convective cloud system in this area **flows into inland from the coast** of the Yellow Sea.
- Also, **locally developed** convective cell often occurs over the Korean Peninsula due to instable atmosphere.

Himawari-8/AHI IR10.4㎛
2017. 6. 1. 00:00~14:50UTC



Using PGE11 module (v2013)

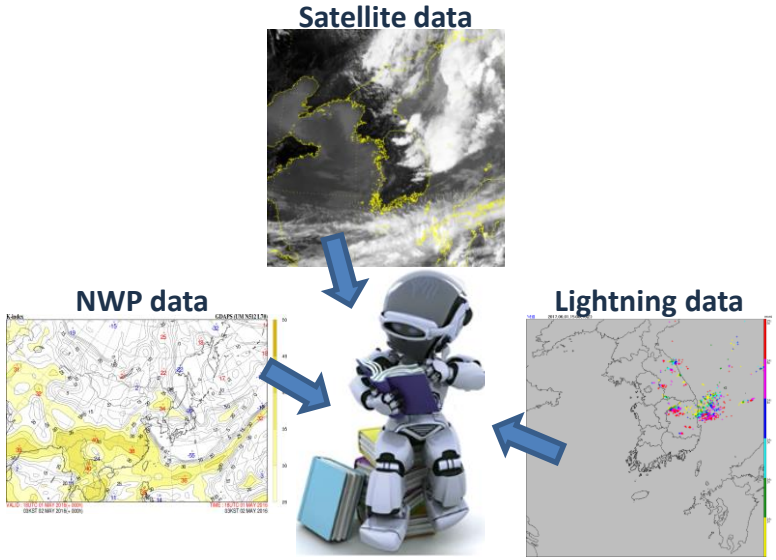
- The main changes implemented in 2017 concern:

  - *Input data: Himawari-8/AHI (2 km, every 10 min.), Unified Model (KMA oper.)*

  ➔ *IR10.4μm, IR12.3μm, IR3.9μm, WV6.2μm, WV7.3μm, IR8.6μm + NWP data*

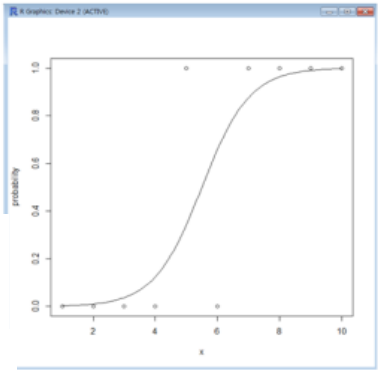
  - *6 Category(same as PGE11), 6 Depth, 1 Mode (full configuration)*

  - *111 Discriminating parameters (because of time depths and additional channel)*



Logistic Regression in R

```
> y = c(0,0,0,0,1,0,1,1,1,1)
>
> x = c(1,2,3,4,5,6,7,8,9,10)
>
> d = as.data.frame(cbind(y,x))
>
> res = glm(y~x,family=binomial,d)
>
> plot(x,y,xlab="x",ylab="probability",type="n")
>
> curve(predict(res,data.frame(x=x),type="resp"),add=TRUE)
```



$$\mathbb{P}(Y=1|x) = \frac{\exp(\beta_0+\beta_1 x)}{1+\exp(\beta_0+\beta_1 x)}$$

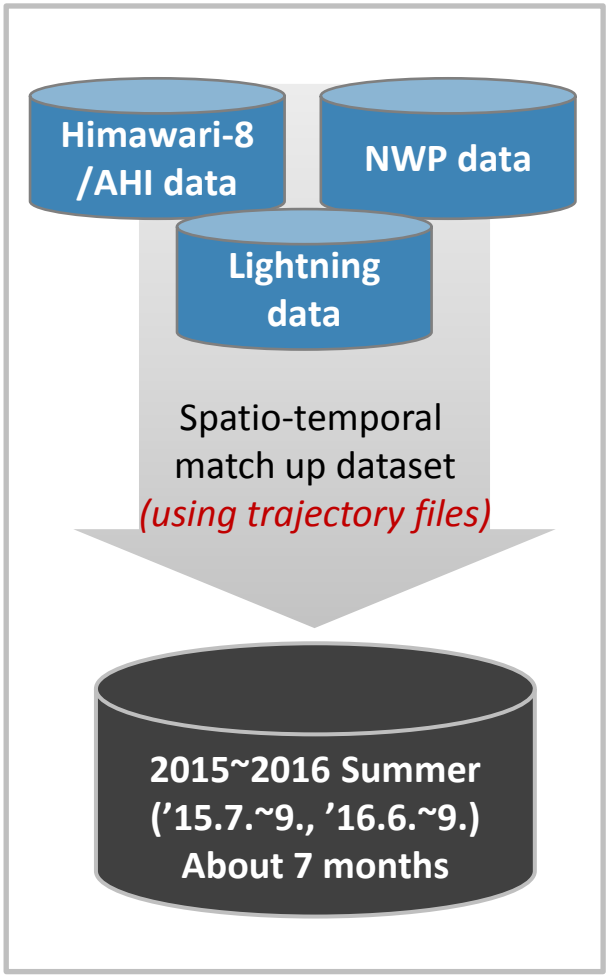
$$\log\left(\frac{\mathbb{P}(Y=1|x)}{1-\mathbb{P}(Y=1|x)}\right) = \beta_0+\beta_1 x$$

Comparison of spectral bands

국가기상위성센터
National Meteorological Satellite Center

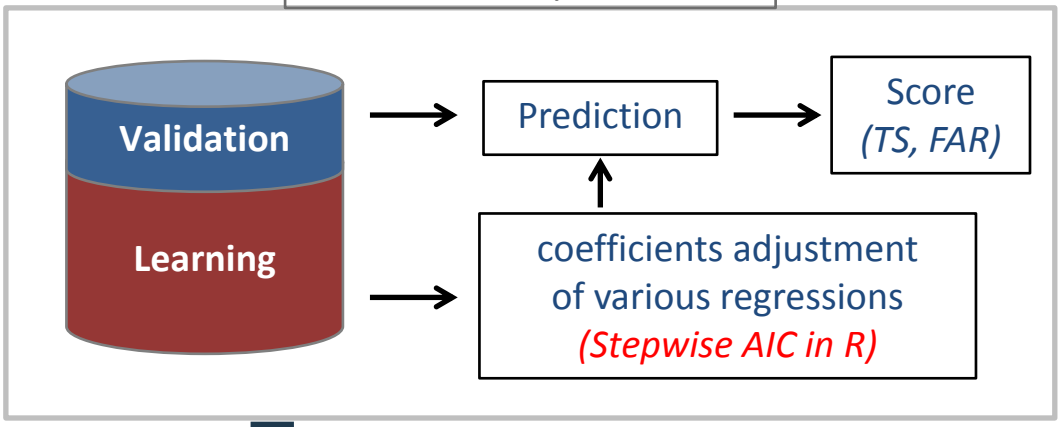
Channel	Central Wavelength(㎛)					
	AMI (GK-2A)	ABI (GOES-R)	AHI (Himawari-8)	MI (COMS)	SEVIRI (MSG)	MODIS (Aqua,Terra)
1(VIS) Blue	0.470	0.470	0.46			0.466 (B03)
2(VIS) Green	0.511		0.51			0.554 (B04)
3(VIS) Red	0.640	0.640	0.64	0.675	0.6	0.647 (B01)
4(NIR)	0.856	0.865	0.86		0.8	0.857 (B02)
5(NIR)	1.380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

Discrimination tuning methodology



- handling missing values and outliers
- sampling of training datasets using lightning information *(dependent variable)*

50 randomly dataset



Identification best model
(parameters and coefficients)

Discrimination

Discriminating parameters

국가기상위성센터
National Meteorological Satellite Center

N°	Parameter	Meaning
1	**Min_Tmin**	minimum of top temperature
2	**Max_TxTmin**	Maximum of top temperature rate processed on two following images
3	**Min_TxTmin**	minimum of top temperature rate processed on two following images
4	**Max_TxTmin2**	Secondary maximum of top temperature rate processed on two following images
5	**Max_TxTmin10**	Maximum of top temperature rate processed on 10 minutes
6	**Max_TxTmin20**	Maximum of top temperature rate processed on 20 minutes
7	**Max_TxTmin30**	maximum of top temperature rate processed on 30 minutes
8	**Max_TxTmin40**	maximum of top temperature rate processed on 40 minutes
9	**Max_TxTmin50**	maximum of top temperature rate processed on 50 minutes
10	**Max_TxTmin60**	maximum of top temperature rate processed on 60 minutes
11	**MinMaxPos**	continuous cooling Boolean Min_TxTmin >0. && Max_TxTmin1 >0.
12	**MinMaxNeg**	Min_TxTmin <0. && Max_TxTmin1 <0.
13	**MinNegMaxPos**	Min_TxTmin <=0. && Max_TxTmin1 >0. && ecart_age_Min_TxTmin > ecart_age_Max_TxTmin1
14	**Max_TauxTmoy**	Maximum of mean temperature
15	**Max_TxTmoyST**	Maximum of mean temperature, defined on ST, processed on two consecutives images. ST is a cell defined at a DTtower (6°C) warmer than top temperature
16	**sqrt(Max_DTmoyTmin)**	sqrt(maximum mean temperature – top temperature)
17	**Max_DTmoyTmin**	maximum mean temperature – top temperature
18	**sqrt(Max_DTmoyTminST)**	sqrt(maximum mean temperature – top temperature defined on ST)
19	**Max_DTseuilTmoy**	Maximum temperature of base – mean temperature
20	**Max_DTseuilTmoyST**	Maximum temperature of base – mean temperature defined on ST
21	**Max_Gpm**	Maximum of the mean peripheral gradient processed on IR10.4
22	**Max_Qgp95**	Maximum of quantile 95% of peripheral gradient
23	**Max_Volume**	Maximum of system volume. The volume is calculated on IR10.4 data. The base of volume is –25°C for mature object and +5°C for transition object
24	**Max_RapportAspect**	Maximum of long axe / small axe of ellipse enclosing
25	**Max_SurfaceST**	Maximum of the ST surface
26	**Max_DSurfaceBTST**	Maximum of cell surface – ST surface
27	**Min_WV**	Mini of WV6.2
28	**Min_WV2**	Mini of WV7.3
29	**Min_IR39**	Mini of IR3.9
30	**Min_IR86**	Mini of IR8.6
31	**Min_IR123**	Mini of IR12.3
32	**Max_TxWV**	Maximum WV6.2 rate processed on two following images
33	**Max_TxWV10**	Maximum WV6.2 rate processed on 10 minutes
34	**Max_TxWV20**	Maximum WV6.2 rate processed on 20 minutes
35	**Max_TxWV30**	Maximum WV6.2 rate processed on 30 minutes
36	**Max_TxWV40**	Maximum WV6.2 rate processed on 40 minutes
37	**Max_TxWV50**	Maximum WV6.2 rate processed on 50 minutes
38	**Max_TxWV60**	Maximum WV6.2 rate processed on 60 minutes
39	**Max_TxWV2**	Maximum WV7.3 rate processed on two following images
40	**Max_TxWV210**	Maximum WV7.3 rate processed on 10 minutes
41	**Max_TxWV220**	Maximum WV7.3 rate processed on 20 minutes
42	**Max_TxWV230**	Maximum WV7.3 rate processed on 30 minutes
43	**Max_TxWV240**	Maximum WV7.3 rate processed on 40 minutes
44	**Max_TxWV250**	Maximum WV7.3 rate processed on 50 minutes
45	**Max_TxWV260**	Maximum WV7.3 rate processed on 60 minutes
46	**Max_TxIR86**	Maximum IR8.6 rate processed on two following images
47	**Max_Tx IR8610**	Maximum IR8.6 rate processed on 10 minutes
48	**Max_Tx IR8620**	Maximum IR8.6 rate processed on 20 minutes
49	**Max_Tx IR8630**	Maximum IR8.6 rate processed on 30 minutes
50	**Max_Tx IR8640**	Maximum IR8.6 rate processed on 40 minutes
51	**Max_Tx IR8650**	Maximum IR8.6 rate processed on 50 minutes
52	**Max_Tx IR8660**	Maximum IR8.6 rate processed on 60 minutes
53	**Max_TxIR123**	Maximum IR12.3 rate processed on two following images
54	**Max_Tx IR12310**	Maximum IR12.3 rate processed on 10 minutes
55	**Max_Tx IR12320**	Maximum IR12.3 rate processed on 20 minutes
56	**Max_Tx IR12330**	Maximum IR12.3 rate processed on 30 minutes
57	**Max_Tx IR12340**	Maximum IR12.3 rate processed on 40 minutes
58	**Max_Tx IR12350**	Maximum IR12.3 rate processed on 50 minutes
59	**Max_Tx IR12360**	Maximum IR12.3 rate processed on 60 minutes

N°	Parameter	Meaning
60	**Max_BTDmax**	Maximum of WV6.2-IR10.4
61	**Max_BTD**	maximum of quantile 75% of WV6.2-IR10.4
62	**Max_BTD90**	maximum of quantile 90% of WV6.2- IR10.4
63	**Max_BTDRatio**	maximum of BTD structure BTD=WV6.2 – IR10.4 structure is the ratio between contiguous BTD pixel >-2 and BTD pixel > -2
64	**Max_WBTDmax**	maximum of WV6.2- WV7.3
65	**Max_WBTD**	maximum of quantile 75% of WV6.2- WV7.3
66	**Max_WBTD90**	maximum of quantile 90% of WV6.2- WV7.3
67	**Max_WBTDRatio**	Maximum of WBTD structure WBTD= WV6.2- WV7.3 structure is the ratio between contiguous WBTD pixel > -1 and WBTD pixel > -1
68	**Max_BTD3max**	Maximum of IR3.9-IR10.4
69	**Max_BTD3Q1**	maximum of quantile 75% of IR3.9-IR10.4
70	**Max_BTD3Q2**	maximum of quantile 90% of IR3.9-IR10.4
71	**Max_BTD3Ratio**	maximum of BTD structure BTD= IR3.9-IR10.4 structure is the ratio between contiguous BTD pixel >0 and BTD pixel > 0
72	**Max_BTD4max**	Maximum of IR8.6-IR10.4
73	**Max_BTD4Q1**	maximum of quantile 75% of IR8.6-IR10.4
74	**Max_BTD4Q2**	maximum of quantile 90% of IR8.6-IR10.4
75	**Max_BTD4Ratio**	maximum of BTD structure BTD= IR8.6-IR10.4 structure is the ratio between contiguous BTD pixel >-2 and BTD pixel > -2
76	**Max_BTD5max**	maximum of IR12.3-IR10.4
77	**Max_BTD5Q1**	maximum of quantile 75% IR12.3-IR10.4
78	**Max_BTD5Q2**	maximum of quantile 90% IR12.3-IR10.4
79	**Max_BTD5Ratio**	maximum of BTD structure BTD= IR12.3-IR10.4 structure is the ratio between contiguous BTD pixel >0 and BTD pixel > 0
80	**Max_TxBTD**	maximum of WV6.2-IR10.4 rate processed on two following images
81	**Max_TxBTD10**	maximum of WV6.2-IR10.4 rate processed on 10 minutes
82	**Max_TxBTD20**	maximum of WV6.2-IR10.4 rate processed on 20 minutes
83	**Max_TxBTD30**	maximum of WV6.2-IR10.4 rate processed on 30 minutes
84	**Max_TxBTD40**	maximum of WV6.2-IR10.4 rate processed on 40 minutes
85	**Max_TxBTD50**	maximum of WV6.2-IR10.4 rate processed on 50 minutes
86	**Max_TxBTD60**	maximum of WV6.2-IR10.4 rate processed on 60 minutes
87	**Max_TxWBTD**	maximum of WV6.2- WV7.3 rate processed on two following images
88	**Max_TxWBTD10**	maximum of WV6.2- WV7.3 rate processed on 10 minutes
89	**Max_TxWBTD20**	maximum of WV6.2- WV7.3 rate processed on 20 minutes
90	**Max_TxWBTD30**	maximum of WV6.2- WV7.3 rate processed on 30 minutes
91	**Max_TxWBTD40**	maximum of WV6.2- WV7.3 rate processed on 40 minutes
92	**Max_TxWBTD50**	maximum of WV6.2- WV7.3 rate processed on 50 minutes
93	**Max_TxWBTD60**	maximum of WV6.2- WV7.3 rate processed on 60 minutes
94	**Max_TxBTD4**	maximum of IR8.6-IR10.4 rate processed on two following images
95	**Max_TxBTD410**	maximum of IR8.6-IR10.4 rate processed on 10 minutes
96	**Max_TxBTD420**	maximum of IR8.6-IR10.4 rate processed on 20 minutes
97	**Max_TxBTD430**	maximum of IR8.6-IR10.4 rate processed on 30 minutes
98	**Max_TxBTD440**	maximum of IR8.6-IR10.4 rate processed on 40 minutes
99	**Max_TxBTD450**	maximum of IR8.6-IR10.4 rate processed on 50 minutes
100	**Max_TxBTD460**	maximum of IR8.6-IR10.4 rate processed on 60 minutes
101	**Max_TxBTD5**	maximum of IR12.3-IR10.4 rate processed on two following images
102	**Max_TxBTD510**	maximum of IR12.3-IR10.4 rate processed on 10 minutes
103	**Max_TxBTD520**	maximum of IR12.3-IR10.4 rate processed on 20 minutes
104	**Max_TxBTD530**	maximum of IR12.3-IR10.4 rate processed on 30 minutes
105	**Max_TxBTD540**	maximum of IR12.3-IR10.4 rate processed on 40 minutes
106	**Max_TxBTD550**	maximum of IR12.3-IR10.4 rate processed on 50 minutes
107	**Max_TxBTD560**	maximum of IR12.3-IR10.4 rate processed on 60 minutes
108	**Max_NWPMaskConv**	Convective mask from NWP indexes : 0=non conv, 1=neutral, 2=convective*/
109	**Max_NWPIndexConv**	Maximum of Lifted index
110	**Max_NWPTtropo**	Distance (°C) to tropopause
111	**Max_NWPPtropo**	Value of of Tropopause pressure over cell

Predictors for each model

국가기상위성센터
National Meteorological Satellite Center

		0. Mature						1. Mature transition						2. Cold transition						3. Warm2 transition						4. Warm1 transition						5. Warm							>= 10
	The number of predictios→	21	24	34	32	40	42	25	23	33	22	27	0	18	18	27	16	28	37	22	20	23	24	27	37	17	27	25	29	21	41	19	21	27	0	0	0		
	Detph	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5		
1	Min_Tmin	O		O			O	O	O	O				O		O	O		O	O	O	O	O		O	O	O			O	O	O						20	*
2	Max_TxTmin																																					0	
3	Min_TxTmin	O		O	O	O	O	O	O	O				O	O	O	O	O	O	O					O							O	O	O				19	*
4	Max_TxTmin2			O			O				O	O				O			O			O	O	O					O		O							11	*
5	Max_TxTmin10																																					0	
6	Max_TxTmin20			O						O							O	O	O			O	O	O			O	O			O			O				12	
7	Max_TxTmin30									O	O					O		O																				4	
8	Max_TxTmin40				O	O					O	O						O							O						O							7	
9	Max_TxTmin50					O						O						O												O	O							5	
10	Max_TxTmin60																														O							1	
11	MinMaxPos	O		O	O			O		O				O	O				O	O					O	O		O						O				13	
12	MinMaxNeg																																					0	
13	MinNegMaxPos																																					0	
14	Max_TauxTmoy																																					0	
15	Max_TxTmoyST			O			O					O		O					O	O											O			O				8	
16	sqrt(Max_DTmoyTmin)	O	O	O	O	O	O	O	O	O					O				O	O		O	O			O	O	O		O	O							19	
17	Max_DTmoyTmin																																					0	
18	sqrt(Max_DTmoyTminST)																																					0	
19	Max_DTseuilTmoy		O			O		O		O	O				O	O	O	O		O	O		O	O	O	O			O	O	O	O	O					19	*
20	Max_DTseuilTmoyST	O			O				O			O		O					O	O		O					O											9	*
21	Max_Gpm		O		O	O		O	O	O		O						O		O	O		O	O	O	O	O		O			O		O				18	*
22	Max_Qgp95		O	O	O	O		O				O			O	O			O						O	O	O		O			O						10	*
23	Max_Volume		O	O												O		O						O	O	O	O	O			O							10	
24	Max_RapportAspect																																					0	
25	Max_SurfaceST	O	O	O	O	O	O	O	O	O	O					O			O								O				O	O		O				16	*
26	Max_DSurfaceBTST		O																												O	O						3	*
27	Min_WV							O	O									O		O	O	O	O								O	O						9	*
28	Min_WV2				O	O	O				O				O	O			O								O				O	O						10	*
29	Min_IR39			O	O	O	O										O			O		O		O		O	O	O	O	O	O	O	O					17	
30	Min_IR86	O	O			O	O	O	O	O								O				O			O		O							O				12	*
31	Min_IR123	O		O			O	O		O				O	O		O			O				O	O			O	O			O	O						15	*
32	Max_TxWV	O		O	O		O	O	O	O					O	O	O		O		O		O		O								O	O				16	*
33	Max_TxWV10																																					0	
34	Max_TxWV20		O			O									O						O		O		O						O		O					9	*
35	Max_TxWV30				O	O						O						O				O	O				O				O			O				8	*
36	Max_TxWV40						O					O																										2	
37	Max_TxWV50					O												O							O													3	
38	Max_TxWV60																		O						O						O							3	
39	Max_TxWV2			O		O									O					O				O		O	O	O	O	O	O		O					13	*
40	Max_TxWV210																																					0	
41	Max_TxWV220						O			O														O						O			O					5	
42	Max_TxWV230				O					O									O									O						O				5	
43	Max_TxWV240						O												O									O	O									4	
44	Max_TxWV250					O	O																															2	
45	Max_TxWV260						O																								O							2	
46	Max_TxIR86	O	O			O	O		O		O	O				O	O				O	O		O	O			O	O					O				16	*
47	Max_Tx IR8610																																					0	
48	Max_Tx IR8620		O		O		O											O			O				O			O					O					9	
49	Max_Tx IR8630			O						O						O						O						O			O							6	
50	Max_Tx IR8640																								O													1	
51	Max_Tx IR8650																		O					O	O													3	
52	Max_Tx IR8660																		O																			1	
53	Max_TxIR123			O								O													O		O		O				O					6	*
54	Max_Tx IR12310																																					0	
55	Max_Tx IR12320											O						O							O		O	O			O			O				7	
56	Max_Tx IR12330					O				O						O			O			O							O					O				7	
57	Max_Tx IR12340				O	O												O																				3	
58	Max_Tx IR12350																														O	O						2	
59	Max_Tx IR12360						O																		O													2	

Predictors for each model (cont.)

국가기상위성센터
National Meteorological Satellite Center

		0. Mature						1. Mature transition						2. Cold transition						3. Warm2 transition						4. Warm1 transition						5. Warm							
	The number of predictios→	21	24	34	32	40	42	25	23	33	22	27	0	18	18	27	16	28	37	22	20	23	24	27	37	17	27	25	29	21	41	19	21	27	0	0	0		>= 10
	Detph	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5	0	1	2	3	4	5		
60	Max_BTDmax				O	O	O					O		O		O		O	O								O	O										10	*
61	Max_BTD							O	O	O				O		O	O			O	O	O	O				O	O					O					13	*
62	Max_BTD90					O				O		O		O																	O		O					6	*
63	Max_BTDRatio	O			O	O	O																															4	
64	Max_WBTDmax	O					O			O	O								O	O	O				O	O					O	O						11	*
65	Max_WBTD	O						O	O	O						O	O	O		O	O					O	O		O	O			O					14	
66	Max_WBTD90						O												O										O	O		O	O					6	
67	Max_WBTDRatio	O	O	O	O	O	O	O		O				O					O		O																	10	
68	Max_BTD3max	O	O	O	O	O	O	O	O	O	O			O	O	O		O	O	O	O	O	O	O	O	O	O	O	O	O	O	O						28	
69	Max_BTD3Q1			O	O	O			O	O		O		O	O	O					O							O		O	O		O	O				15	
70	Max_BTD3Q2	O	O	O			O	O			O			O				O	O	O		O	O	O					O				O	O				16	
71	Max_BTD3Ratio			O		O	O	O	O	O		O		O	O	O			O		O	O	O	O	O	O	O		O		O			O				21	
72	Max_BTD4max		O	O	O	O	O	O	O	O	O			O						O	O	O	O	O	O	O	O	O	O	O	O	O	O	O				25	*
73	Max_BTD4Q1		O	O	O		O	O	O		O					O			O		O											O						11	
74	Max_BTD4Q2		O			O	O										O	O	O						O								O	O				9	
75	Max_BTD4Ratio		O	O	O	O	O	O	O	O	O			O			O			O	O	O		O	O		O	O			O		O					20	*
76	Max_BTD5max	O													O										O							O						5	*
77	Max_BTD5Q1	O		O	O			O						O			O	O		O			O	O	O	O	O	O	O	O	O	O						18	*
78	Max_BTD5Q2		O	O	O		O			O	O				O						O	O											O					10	*
79	Max_BTD5Ratio	O			O	O	O								O			O	O			O		O	O				O	O								12	*
80	Max_TxBTD		O					O	O	O							O			O			O			O			O									9	*
81	Max_TxBTD10			O						O													O					O	O									5	
82	Max_TxBTD20		O	O	O				O			O			O	O					O	O					O							O				11	
83	Max_TxBTD30															O			O			O							O					O				5	
84	Max_TxBTD40				O	O											O	O					O															5	
85	Max_TxBTD50																							O	O														2	
86	Max_TxBTD60						O												O												O							3	
87	Max_TxWBTD			O			O		O							O								O				O	O		O			O				9	*
88	Max_TxWBTD10			O			O												O					O				O		O								6	*
89	Max_TxWBTD20					O				O		O													O		O		O		O			O				8	*
90	Max_TxWBTD30				O	O				O	O	O											O							O								7	
91	Max_TxWBTD40				O	O	O				O												O							O	O							7	
92	Max_TxWBTD50					O	O											O						O	O													5	
93	Max_TxWBTD60																		O																			1	
94	Max_TxBTD4	O														O		O						O			O				O							6	
95	Max_TxBTD410															O		O					O	O														5	
96	Max_TxBTD420		O						O			O							O					O	O														6	
97	Max_TxBTD430			O		O					O	O							O					O				O			O							8	
98	Max_TxBTD440					O					O							O	O																				4	
99	Max_TxBTD450											O																		O									2	
100	Max_TxBTD460						O																		O						O								3	
101	Max_TxBTD5			O		O					O	O																	O		O							6	
102	Max_TxBTD510			O							O	O																	O									4	
103	Max_TxBTD520														O	O			O															O				4	
104	Max_TxBTD530					O				O						O																						3	
105	Max_TxBTD540				O						O	O													O					O									5	
106	Max_TxBTD550						O												O																				2	
107	Max_TxBTD560						O																								O								2	
108	Max_NWPMaskConv																																						0	
109	Max_NWPIndexConv	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O				32	*
110	Max_NWPTtropo		O					O																O		O					O		O					6	
111	Max_NWPPtropo																																						0	

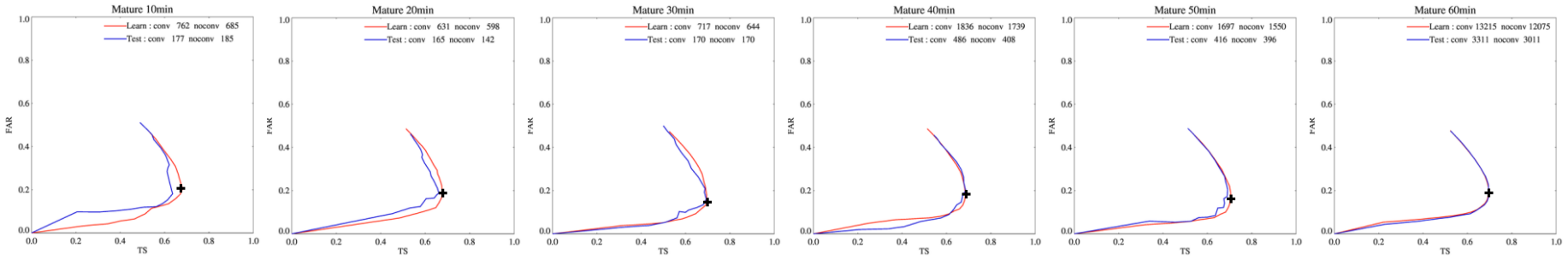
Cross validation

국가기상위성센터
National Meteorological Satellite Center

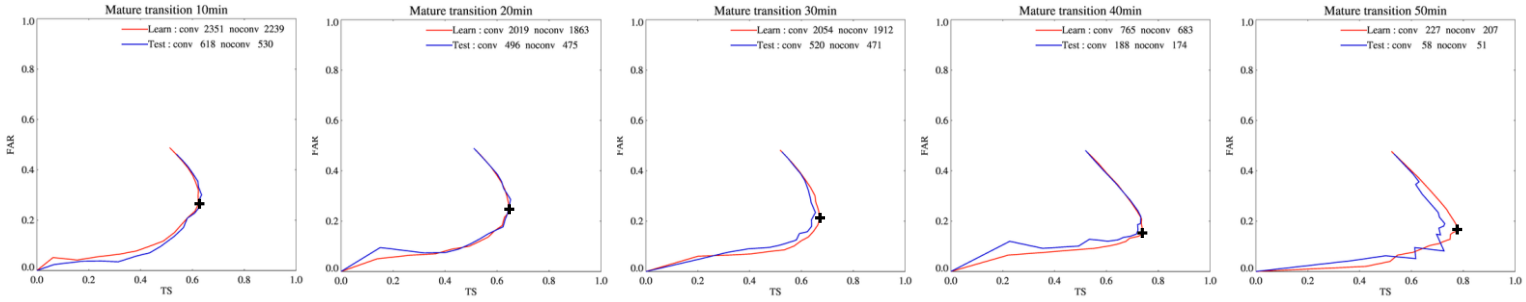
➢ TS/FAR curves for each category/depth (Mature ~ Cold transition)

Depth

0. Mature

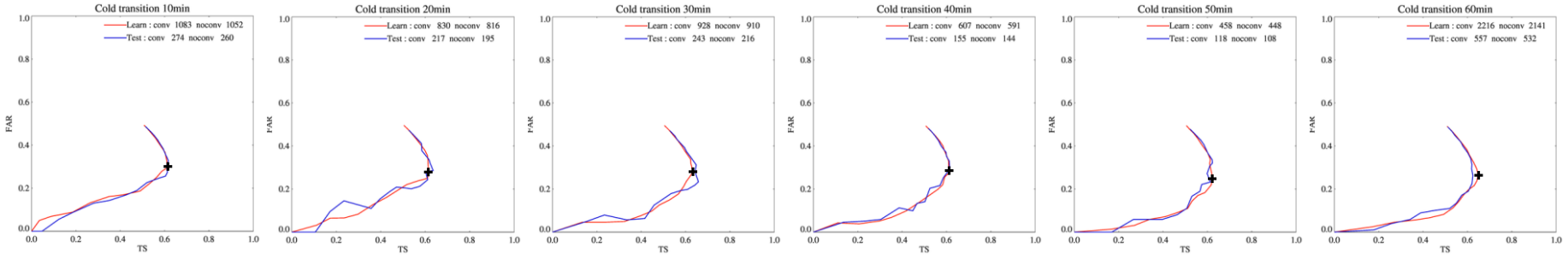


1. Mature transition



Not created for lack of data

2. Cold transition



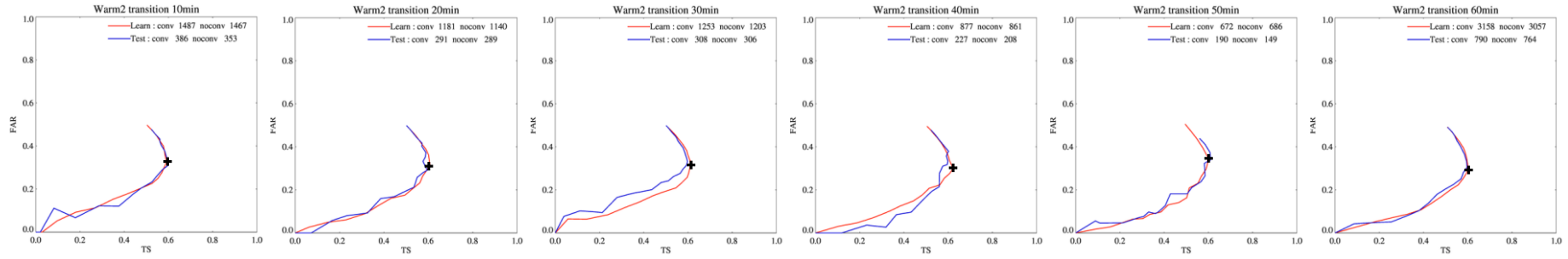
Cross validation (cont.)

국가기상위성센터
National Meteorological Satellite Center

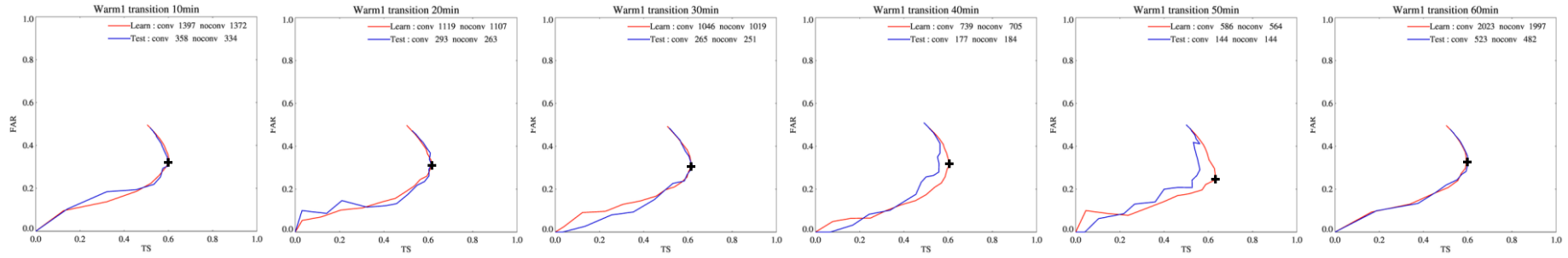
➢ TS/FAR curves for each category/depth (Warm2 transition ~ Warm)

Depth

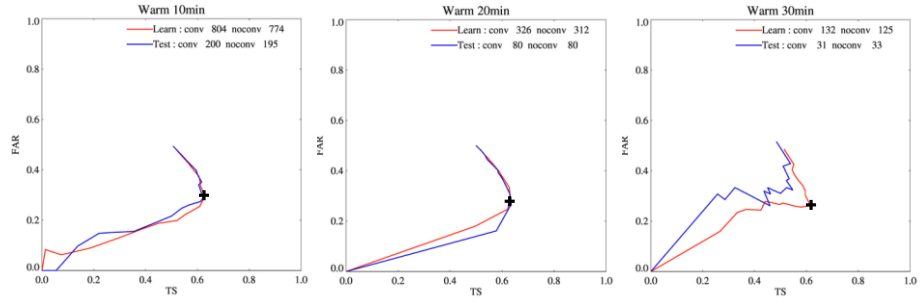
3. Warm2 transition



4. Warm1 transition

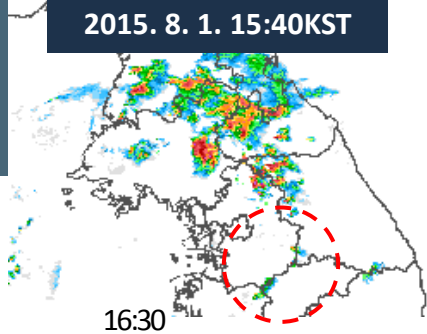


5. Warm



Not created for lack of data

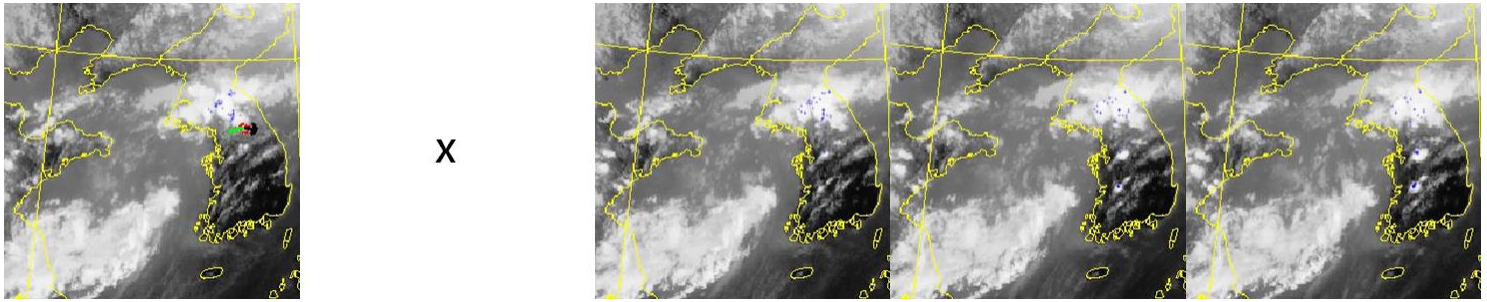
Case 1



- 2015. 8. 1. 15:30 ~ 16:30 KST

COMS RDT (v2009)

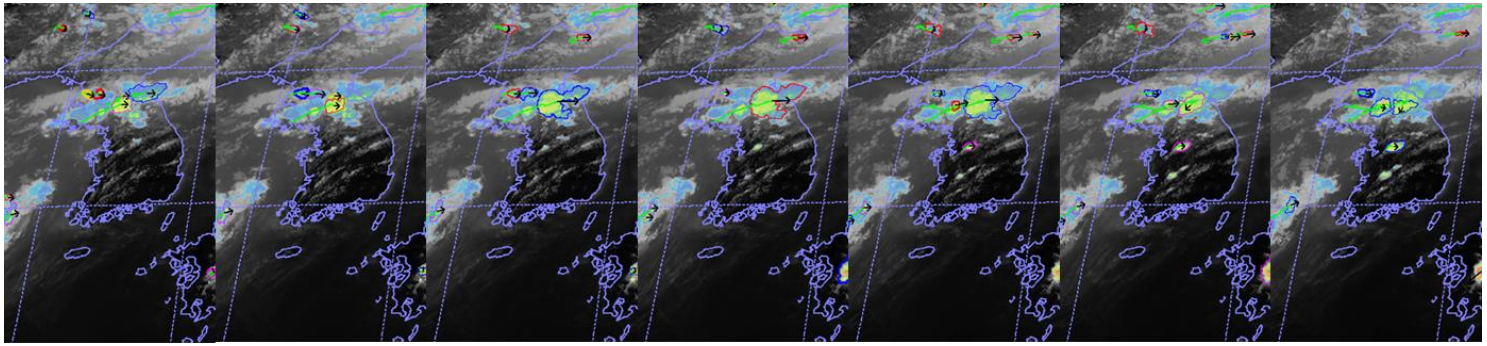
15:30 KST | 15:45 | 16:00 | 16:15 | 16:30



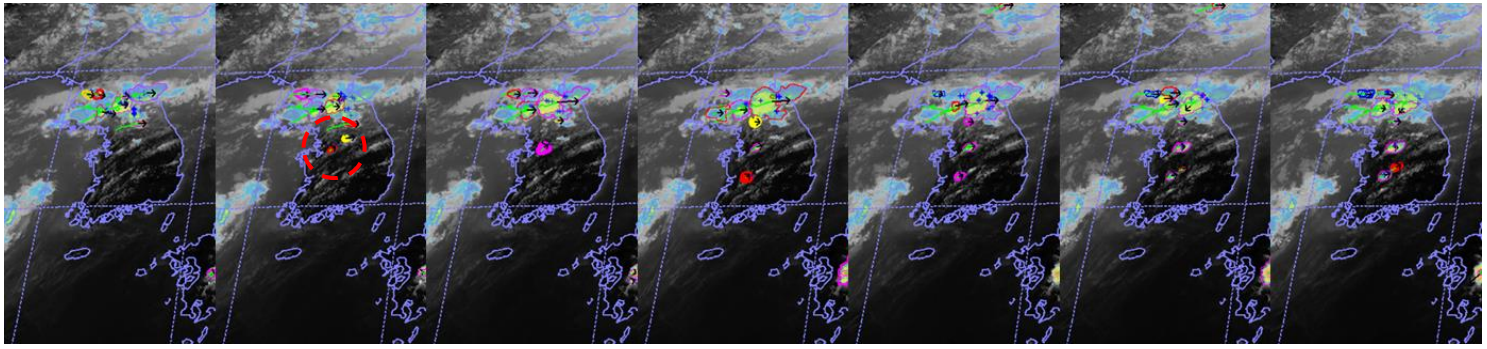
X

Himawari RDT (v2013)

15:30 KST | 15:40 | 15:50 | 16:00 | 16:10 | 16:20 | 16:30



★ **Himawari RDT (NEW)**



Case 2

국가기상위성센터
National Meteorological Satellite Center

- 2017. 5. 11. 03:30 ~ 06:20 KST
  - ➔ *Crop damage from untimely hail event in May*

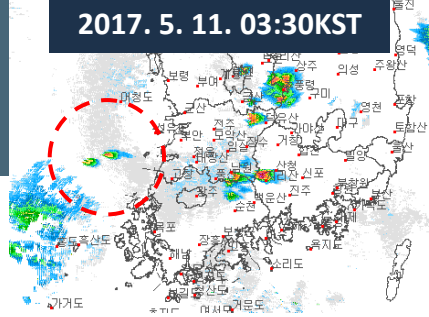
'때 아닌 5월 우박' 전북 남부지역 일부 농작물 피해

2017-05-11 16:16 전북CBS 임상훈 기자✉

댓글(0) 페이스북 4

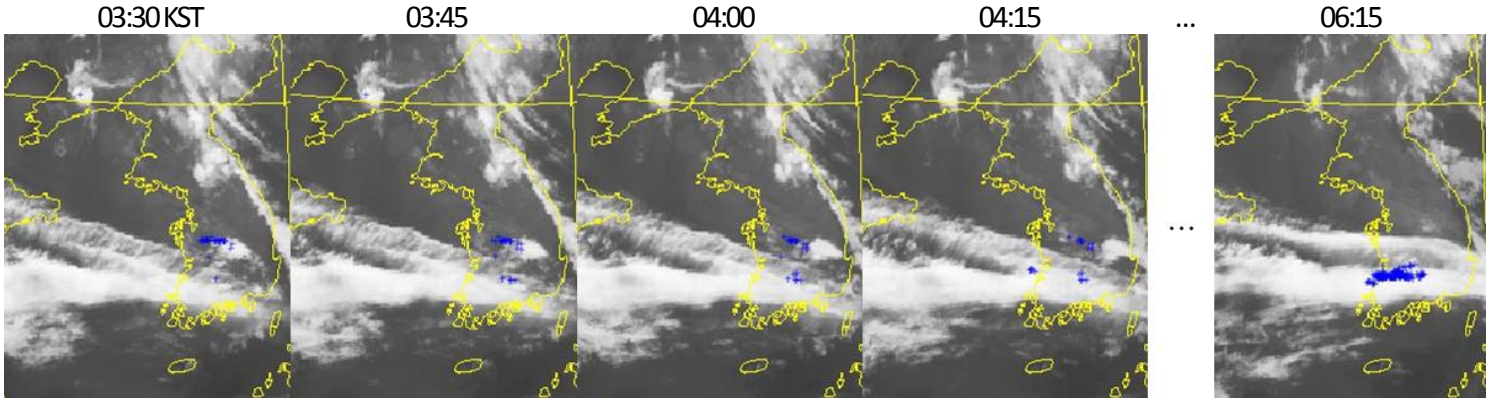
▲ 11일 전북 순창군 등 남부지역에 1~2cm 크기의 우박이 떨어져 일부 농작물 피해가 발생했다. (사진=순창군청 제공)

Case 2 (cont.)

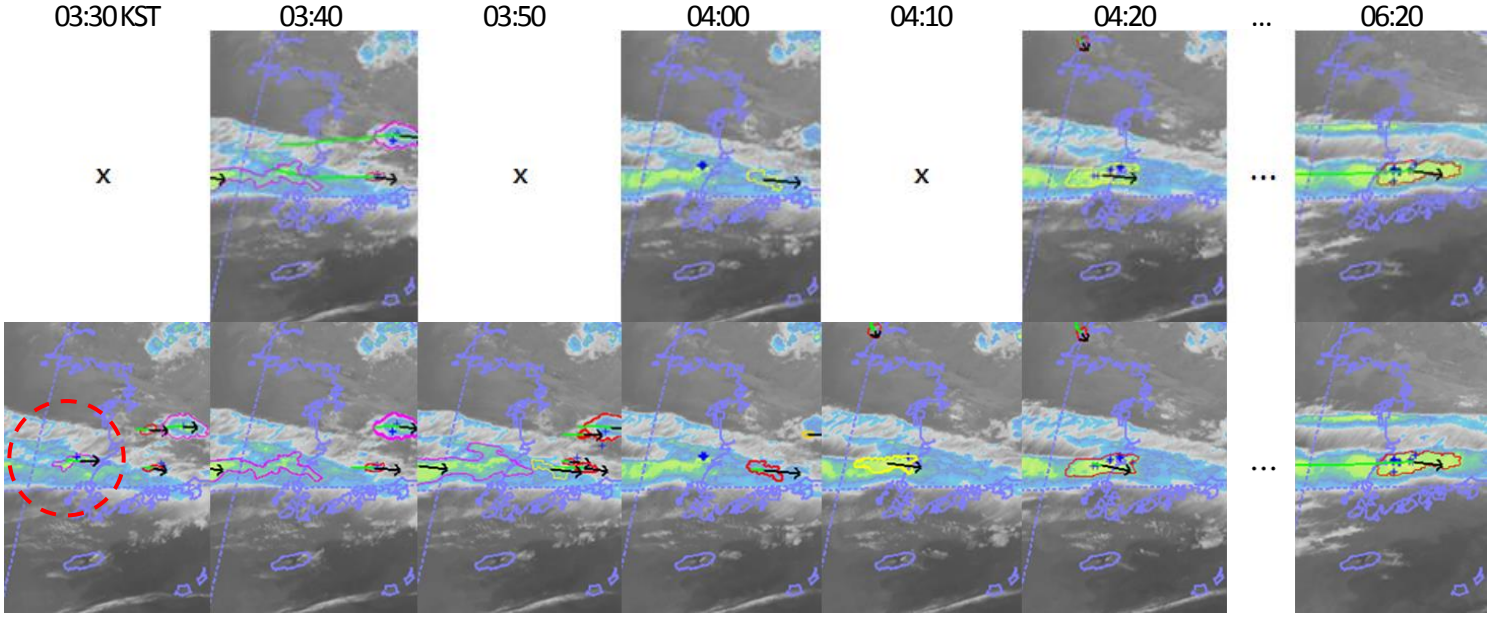


- 2017. 5. 11. 03:30 ~ 06:20 KST

COMS RDT (v2009)



Himawari RDT (v2013)



★ **Himawari RDT (NEW)**

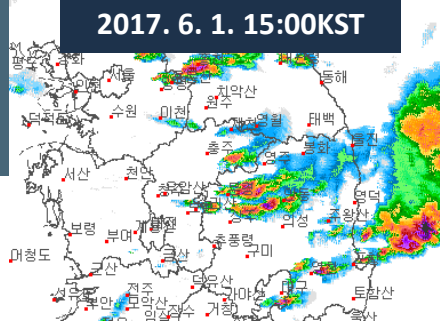
Case 3

국가기상위성센터
National Meteorological Satellite Center

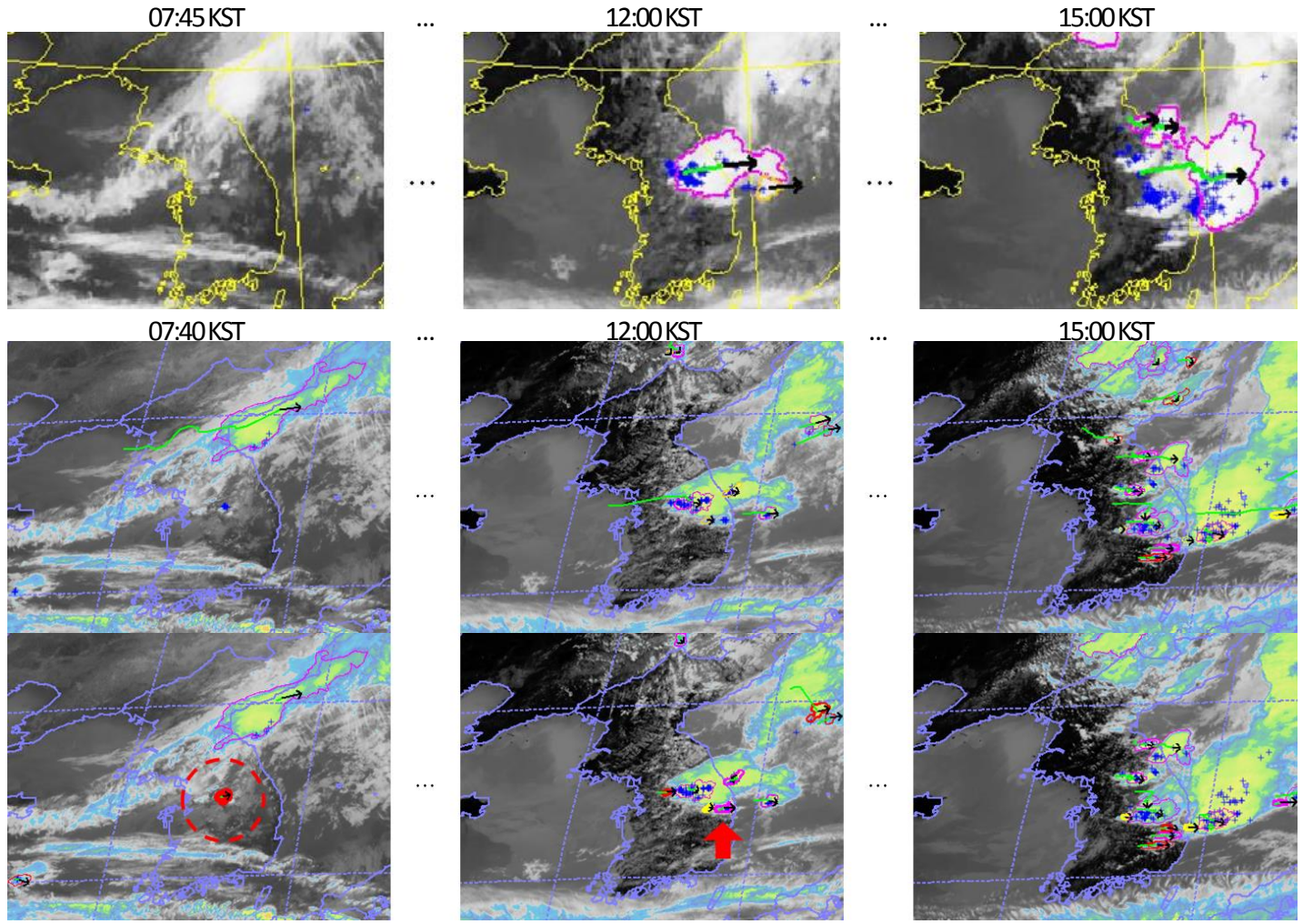
- 2017. 6. 1. 07:40 ~ 15:00 KST

  ➔ *A strong storm dropped a golf ball sized hail.*

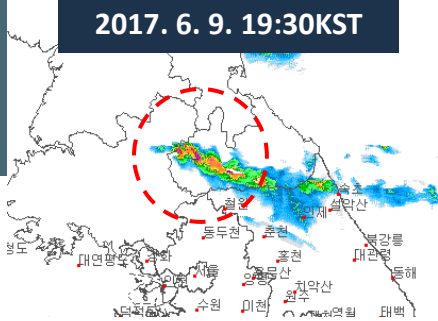
Case 3



➢ 2017. 6. 1. 07:40 ~ 15:00 KST



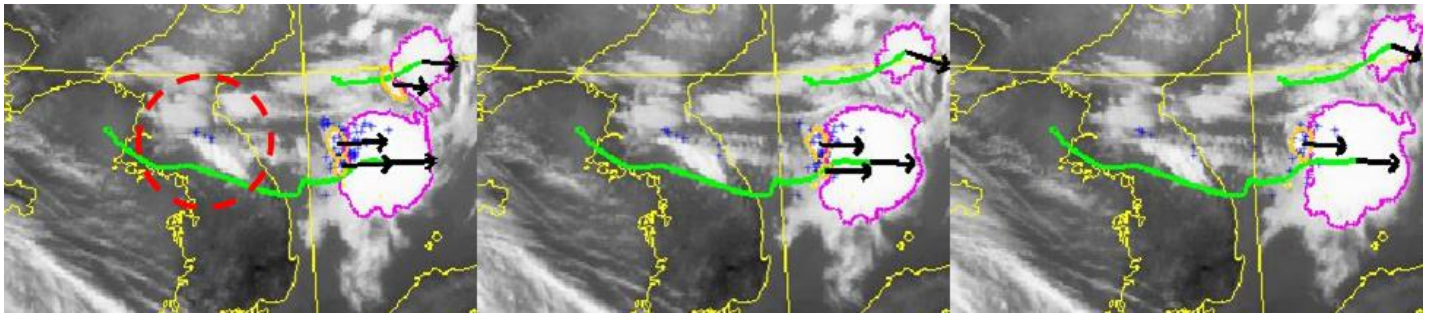
Case 4



➢ 2017. 6. 9. 19:30 ~ 20:00 KST

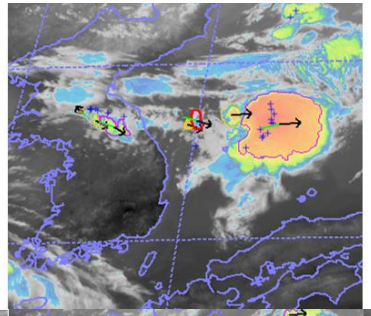
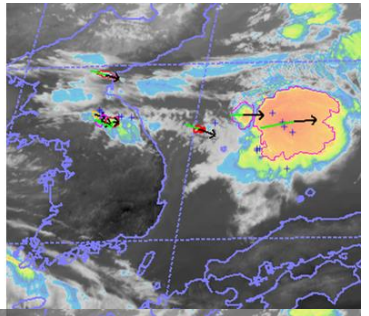
COMS RDT (v2009)

19:30 KST | 19:45 | 20:00

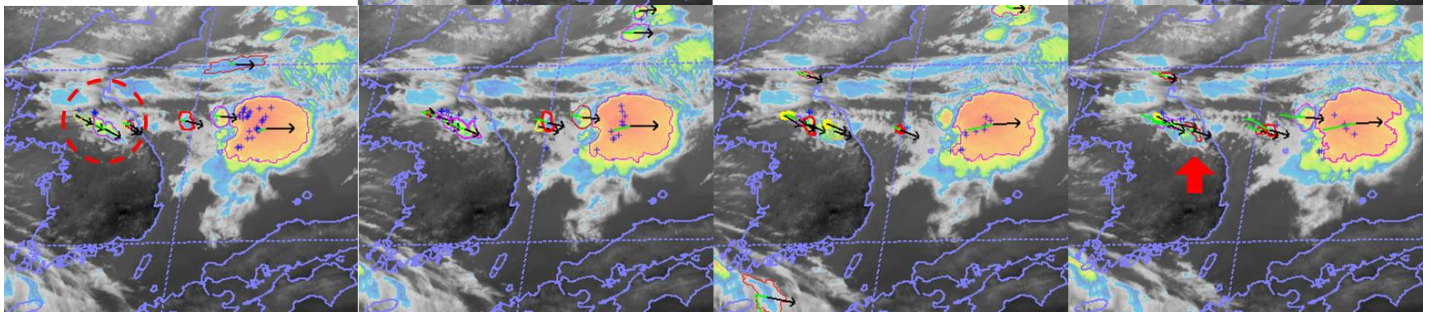


Himawari RDT (v2013)

19:30 KST | 19:40 | 19:50 | 20:00

X |  | X | 

★ Himawari RDT (NEW)



Validation results

국가기상위성센터
National Meteorological Satellite Center

- The discrimination skills are based on lightning occurrences.
  - *Period: 1 ~ 15 August 2015*
  - *distance from lightning : Up to 35 km*

		Observed		POD=a/(a+c) POFD=b/(b+d) FAR=b/(a+b) TS=a/(a+b+c)
		Yes	No	
Forecast	Yes	a (GD)	b (FA)	a+b
	No	c (MI)	d (CR)	c+d
		a+c	b+d	n=a+b+c+d

〈 Himawari RDT (v2013) 〉

Low Lightning activity
--- Trajectory ---
convective = 2858
non convective = 53339
GD = 320, MI = 504, FA = 2538, CR = 52835
POD = 38.83, POFD = 4.58, FAR = 88.80, TS = 9.52

Moderate Lightning activity
--- Trajectory ---
convective = 309
non convective = 226
GD = 305, MI = 224, FA = 4, CR = 2
POD = 57.66, POFD = 66.67, FAR = 1.29, TS = 57.22

Severe Lightning activity
--- Trajectory ---
convective = 557
non convective = 140
GD = 557, MI = 138, FA = 0, CR = 2
POD = 80.14, POFD = 0.00, FAR = 0.00, TS = 80.14

〈 Himawari RDT (NEW) 〉

Low Lightning activity
--- Trajectory ---
convective = 1346
non convective = 52866
GD = 257, MI = 559, FA = 1089, CR = 52307
POD = 31.50, POFD = 2.04, FAR = 80.91, TS = 13.49

Moderate Lightning activity
--- Trajectory ---
convective = 276
non convective = 256
GD = 275, MI = 251, FA = 1, CR = 5
POD = 52.28, POFD = 16.67, FAR = 0.36, TS = 52.18

Severe Lightning activity
--- Trajectory ---
convective = 538
non convective = 135
GD = 538, MI = 134, FA = 0, CR = 1
POD = 80.06, POFD = 0.00, FAR = 0.00, TS = 80.06

KMA's RDT in 2018

- The KMA plans to combine the RDT and CI algorithms.

  ➔ *This algorithm will be applied to the GK-2A/AMI data.*

- We want to apply various machine learning methods such as random forest in order to improve the discrimination skills of the convective cloud.

- Also, We intend to use the ground radar reflectivity and visible channel data

  ➔ *To improve the discrimination of small sized cells in the daytime*

Thank you for your attention!