

Improved status of COMS meteorological Products



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Introduction : Current GEO Satellite(COMS)



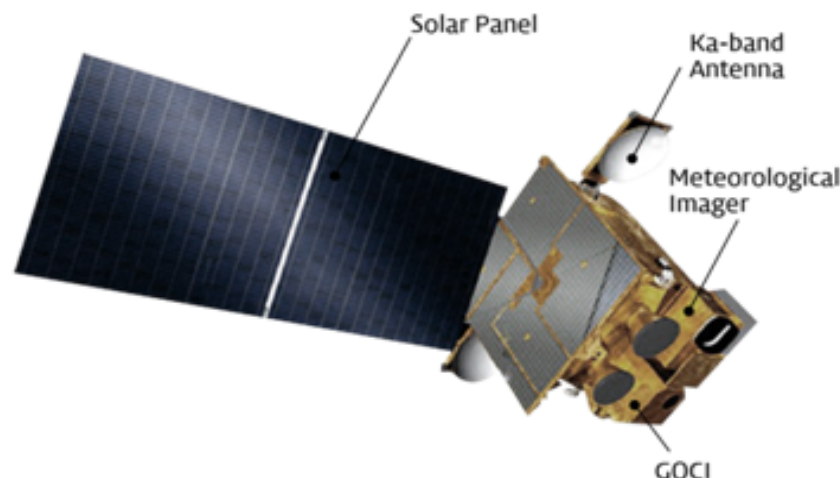
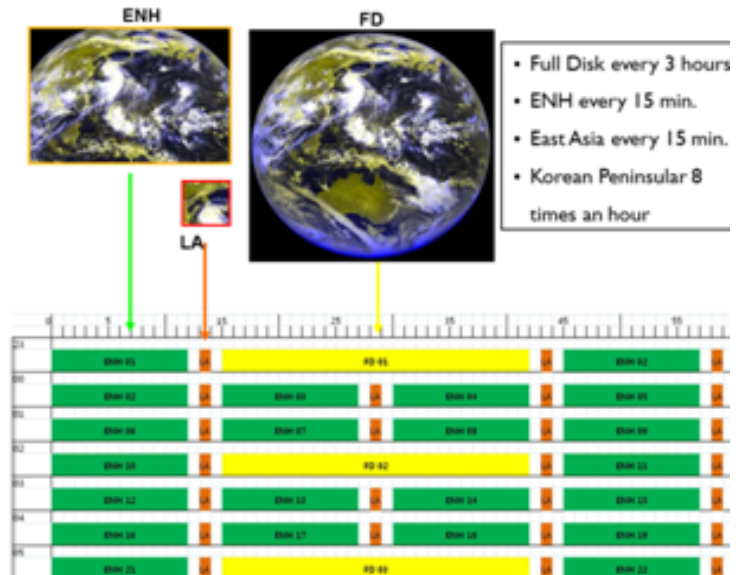
CURRENT GEO SATELLITES

- COMS (Communication, Ocean, and Meteorological Satellite)
 - Launch : 26/06/2010
 - Orbit : 128.2°E
 - Payloads :
 - MI(5-channel VIS/IR Meteorological Imager)
 - GOCI(Geostationary Ocean Color Imager)
 - Lifetime estimated : 2011 - 2018
 - Operator : KMA, KIOST

The channels of COMS/MI

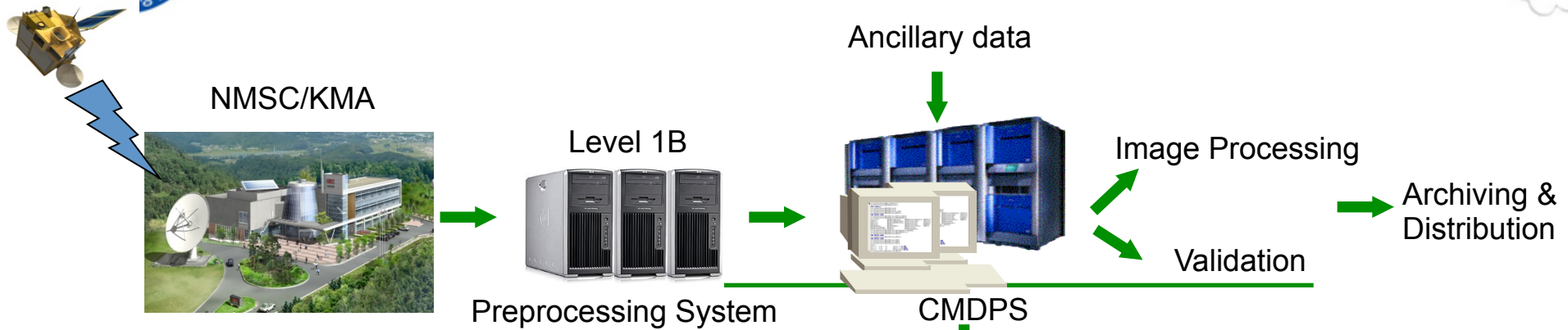
channel	Wave length(μm)
Visible	0.67
Shortwave IR(IR4)	3.7
Water Vapor(IR3)	6.7
IR1	10.8
IR2	12.0

COMS MI Observation Schedule

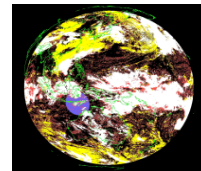




COMS Products

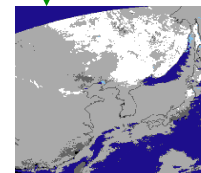


CMDPS

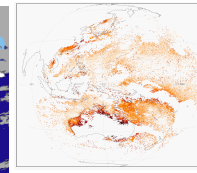


CLD

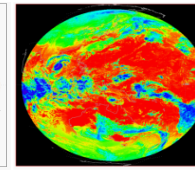
- ☐ confidently cloudy
- ☒ cloudy
- ☒ probably cloudy
- ☒ probably clear
- ☒ confident clear



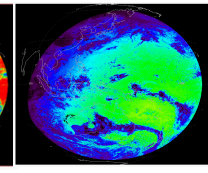
SSI



AI/AOD

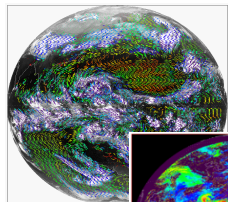


OLR

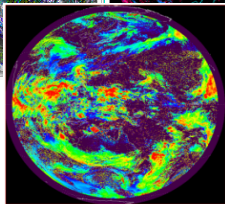


INS

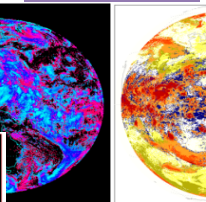
Cloud



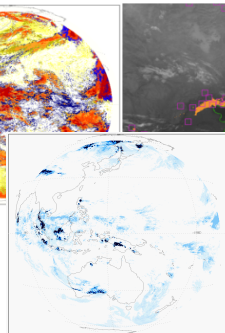
AMV



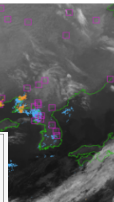
CTTP



CLA

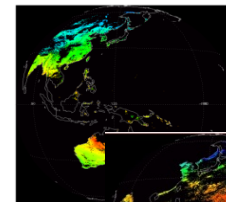


RI

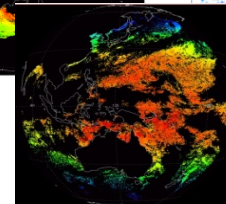


Fog

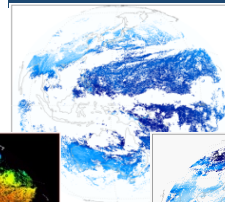
Clear sky



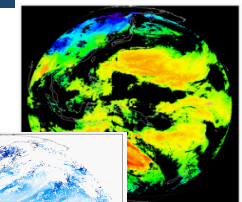
LST



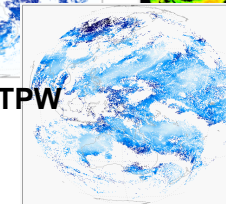
SST



TPW

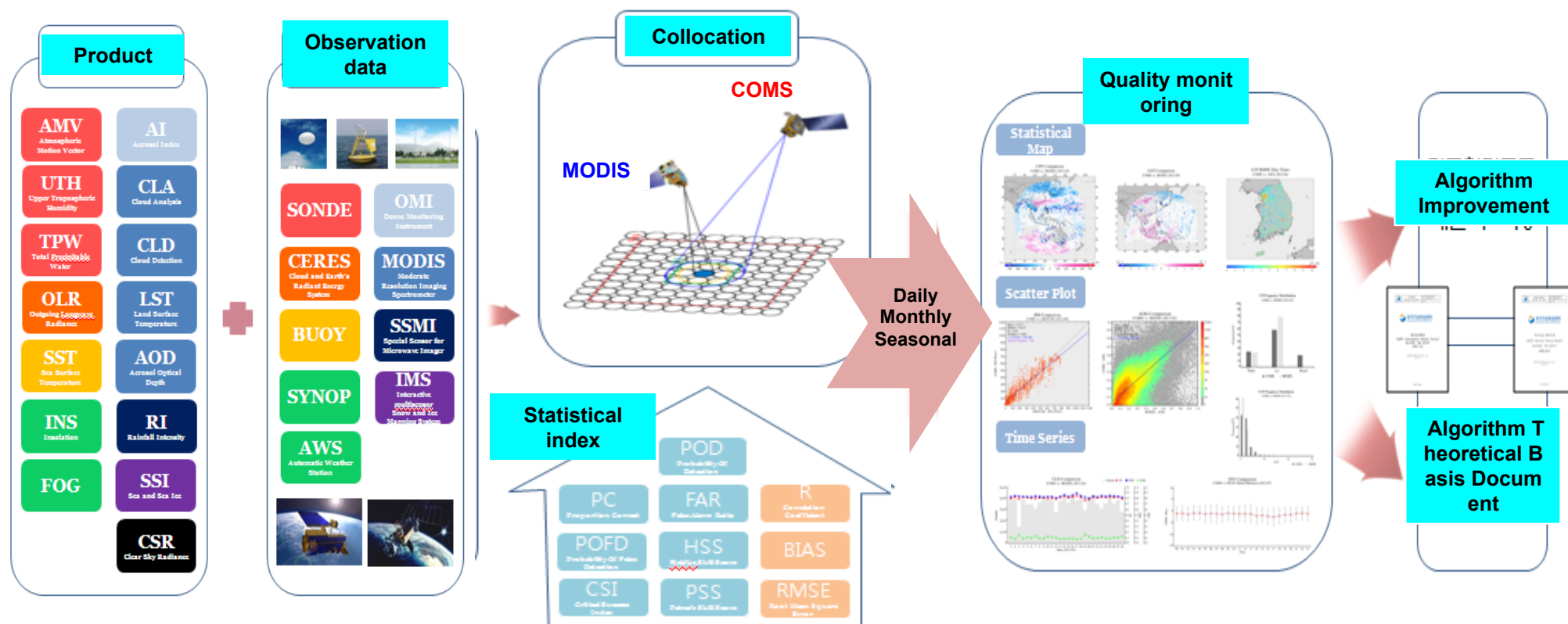


CSR



UTH

Product Validation & Quality Monitoring -





Product Validation & Quality Monitoring - Quantitative Analysis



❖ Comparison of Target accuracy & Current accuracy

Statistical index	Products
R, bias, RMSE	CTTP, CA, COT, AOD, TPW, UTH, LST, SST, INS, OLR, RI
RMSVD, MVD, bias	AMV
POD, FAR, PC	CLD, AI
POD, FAR, CSI	SSI, Fog
R, bias, RMSE, POD, PC, HSS	RI
PC, PSS, HSS	CP, CT

* PC : Proportion Correct

* FAR : False Alarm Ratio

* PSS : Peirce's Skill Score

* RMSVD : Root Mean Square Vector Difference

* RMSE : Root Mean Square Error

* POD : Probability of Detection

* CSI : Critical Success Index

* HSS : Heidke Skill Score

* R : Correlation

❖ Statistical Result

Satisfaction	Dissatisfaction	Others
AMV, CLD CP, CA CT, COT AOD, TPW LST, SSI	CTTP, CT Fog*, RI UTH, SST INS, OLR	AI*-

* : Qualitative product
- : lack of observational data for accuracy test

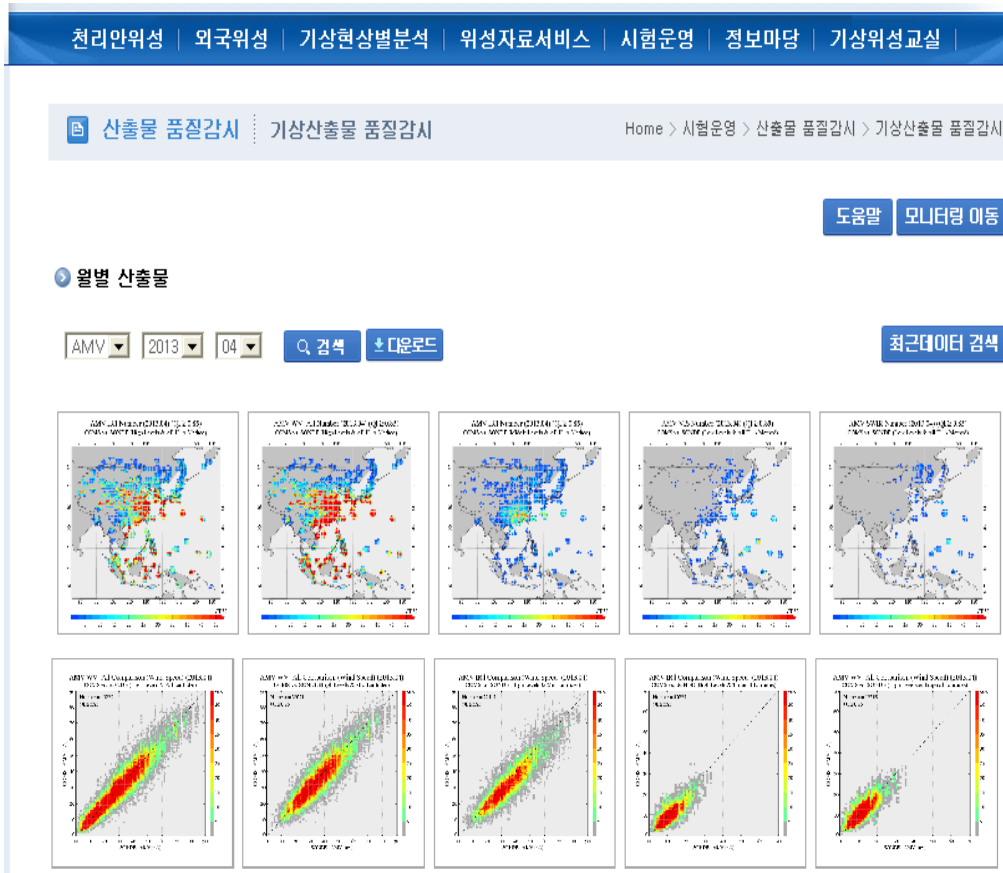


Product Validation & Quality Monitoring - web-based information system



* Monthly product

* Statistical Result



KMA SATELLITE WINDS : COMS - Report
(NMP comparison statistics)
Method : AMV_NMP, AMV_SONDE, NMP_SONDE
Reporting Period : 2012010100 - 2012013123
Filters : QUALITY >= 0.85
HEIGHT BOUNDARY : 0 - 1000 (hPa)
LATITUDE BOUNDARY : -50 - 50

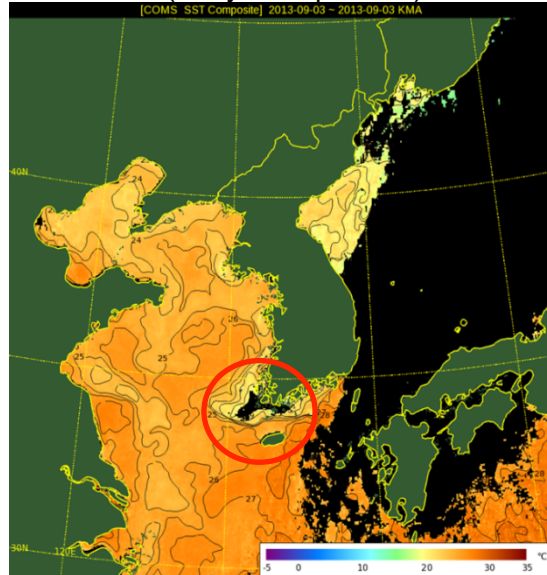
ir1	ALL REGION			NH EX_TROP			TROP		
	AMV_NMP	AMV_SONDE	NMP_SONDE	AMV_NMP	AMV_SONDE	NMP_SONDE	AMV_NMP	AMV_SONDE	NMP_SONDE
ALL Level									
Number	325829	11693	11693	144093	6567	6567	181736	5126	5126
SPD	17.83	28.42	28.42	26.27	39.59	39.59	11.14	14.11	14.11
MVD	2.93	5.54	4.81	3.93	6.84	5.55	2.15	3.88	3.86
Bias	-0.85	-2.02	-0.57	-1.77	-2.61	-0.29	-0.13	-1.27	-0.93
RMSVD	3.76	7.05	5.78	4.90	8.49	6.61	2.52	4.59	4.48
NRMSVD	0.21	0.25	0.20	0.19	0.21	0.17	0.23	0.33	0.32
HIGH Level									
Number	143314	8018	8018	37425	3649	3649	105889	4369	4369
SPD	21.60	31.34	31.34	46.11	51.10	51.10	12.95	14.84	14.84
MVD	3.29	5.91	5.13	5.67	8.19	6.47	2.44	4.00	4.01
Bias	-0.93	-2.30	-0.51	-2.82	-3.39	0.16	-0.26	-1.39	-1.06
RMSVD	4.21	7.54	6.15	6.72	9.91	7.57	2.83	4.72	4.64
NRMSVD	0.19	0.24	0.20	0.15	0.19	0.15	0.22	0.32	0.31
MIDDLE Level									
Number	70127	2562	2562	44170	2216	2216	25957	346	346
SPD	20.60	26.94	26.94	27.15	29.42	29.42	9.45	11.01	11.01
MVD	3.55	5.40	4.57	4.50	5.64	4.74	1.93	3.84	3.49
Bias	-1.09	-1.64	-0.90	-1.76	-1.68	-0.88	0.06	-1.38	-1.06
RMSVD	4.40	6.52	5.35	5.27	6.79	5.54	2.24	4.42	3.98
NRMSVD	0.21	0.24	0.20	0.19	0.23	0.19	0.24	0.40	0.36
LOW Level									
Number	112388	1113	1113	62498	702	702	49890	411	411
SPD	11.30	10.79	10.79	13.78	11.84	11.84	8.18	9.00	9.00
MVD	2.10	3.27	3.04	2.47	3.62	3.33	1.63	2.67	2.53
Bias	-0.61	-0.89	-0.30	-1.13	-1.47	-0.78	0.04	0.09	0.53
RMSVD	2.53	3.87	3.51	2.95	4.24	3.82	1.87	3.13	2.90
NRMSVD	0.22	0.36	0.33	0.21	0.36	0.32	0.23	0.35	0.32



Product Validation & Quality Monitoring - Qualitative Analysis(Sea surface temp.)

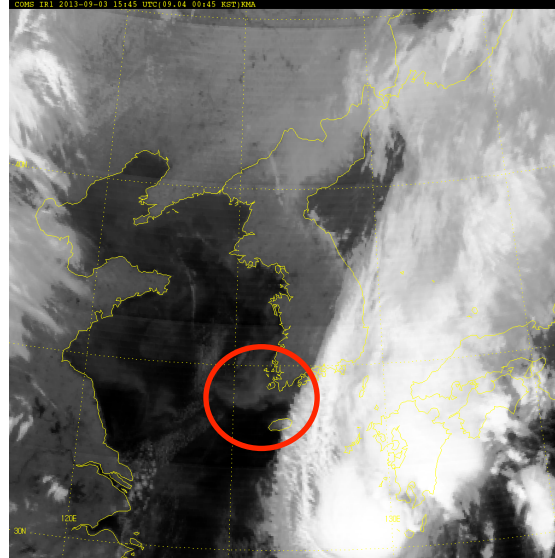


COMS SST(Daily, 4 Sep. 2013)



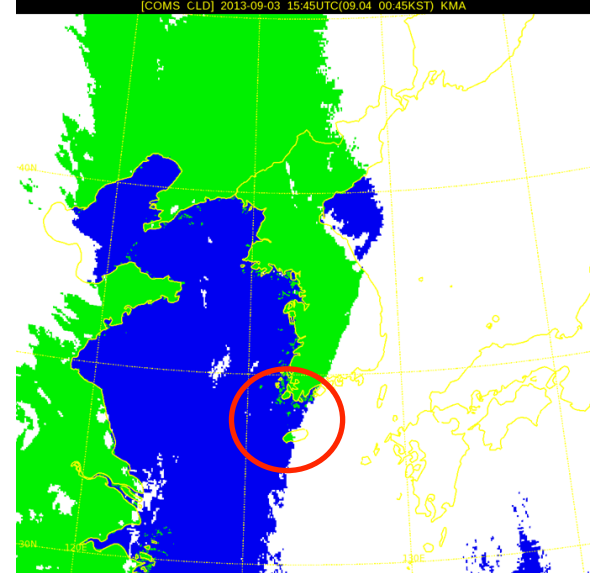
No SST product area

COMS IR(1545UTC 4 Sep. 2013)



low temperature area

COMS CLD(1545UTC 4 Sep. 2013)



Clear sky area

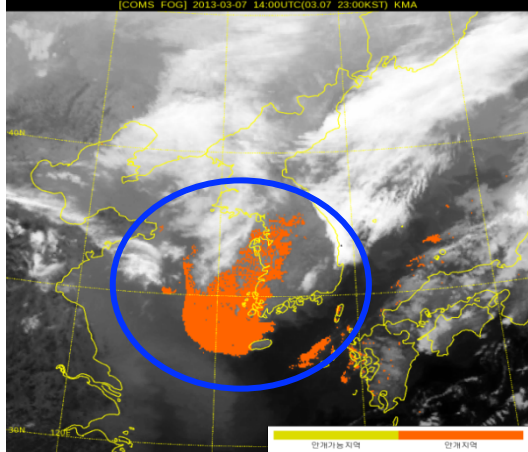
No SST product area over the southwestern coastal area(red ellipse)
→ regional effect : low SST region(climatology SST – SST < 5 °C)



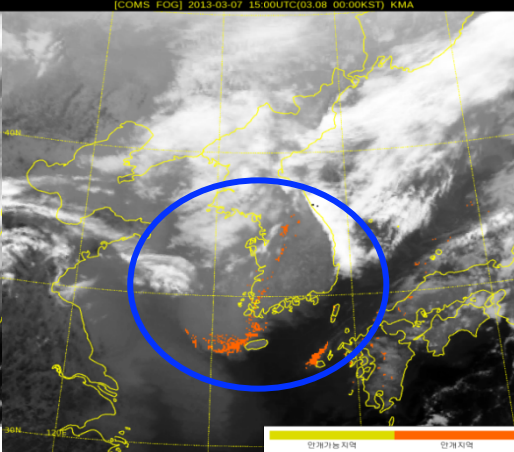
Product Validation & Quality Monitoring - Qualitative Analysis(Fog)



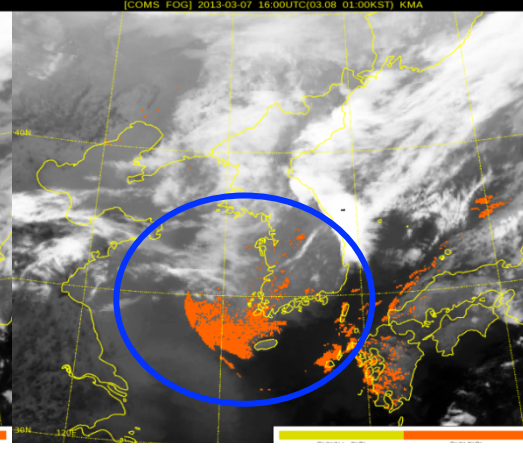
COMS Fog(14:00 UTC 7 Mar. 2013)



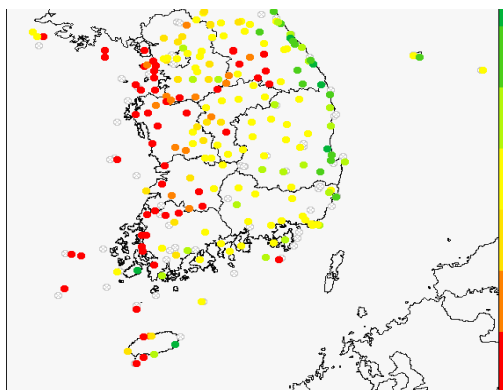
COMS Fog(15:00 UTC 7 Mar. 2013)



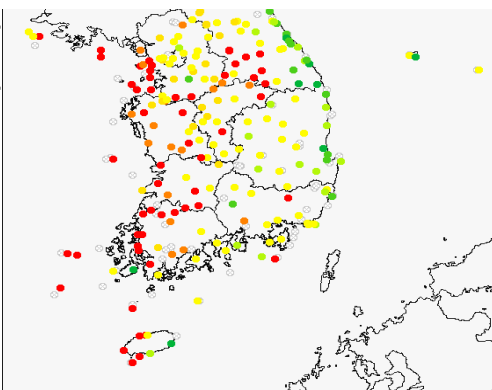
COMS Fog(16:00 UTC 7 Mar. 2013)



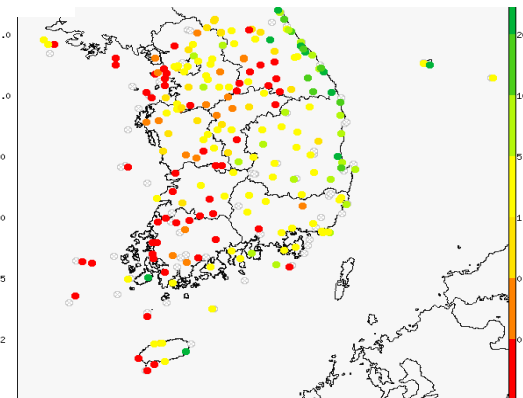
Ground Fog(14:00UTC 7 Mar. 2013)



Ground Fog(15:00UTC 7 Mar. 2013)



Ground Fog(16:00UTC 7 Mar. 2013)



fog area : red dot

Discontinuous observation in the middle of the night(blue ellipse)



Operational Applications



- ❖ Typhoon
- ❖ Nowcasting (NWC SAF)
- ❖ Asian dust
- ❖ Volcanic ash
- ❖ Fog & Smog
- ❖ Aviation products



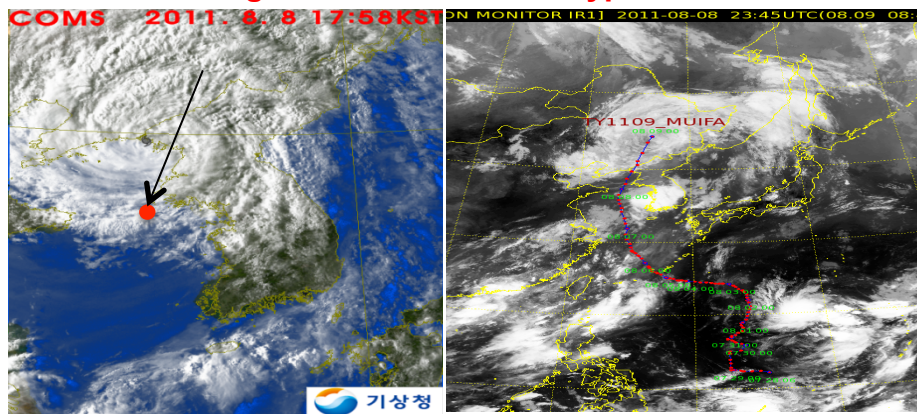
Operational Applications - Typhoon



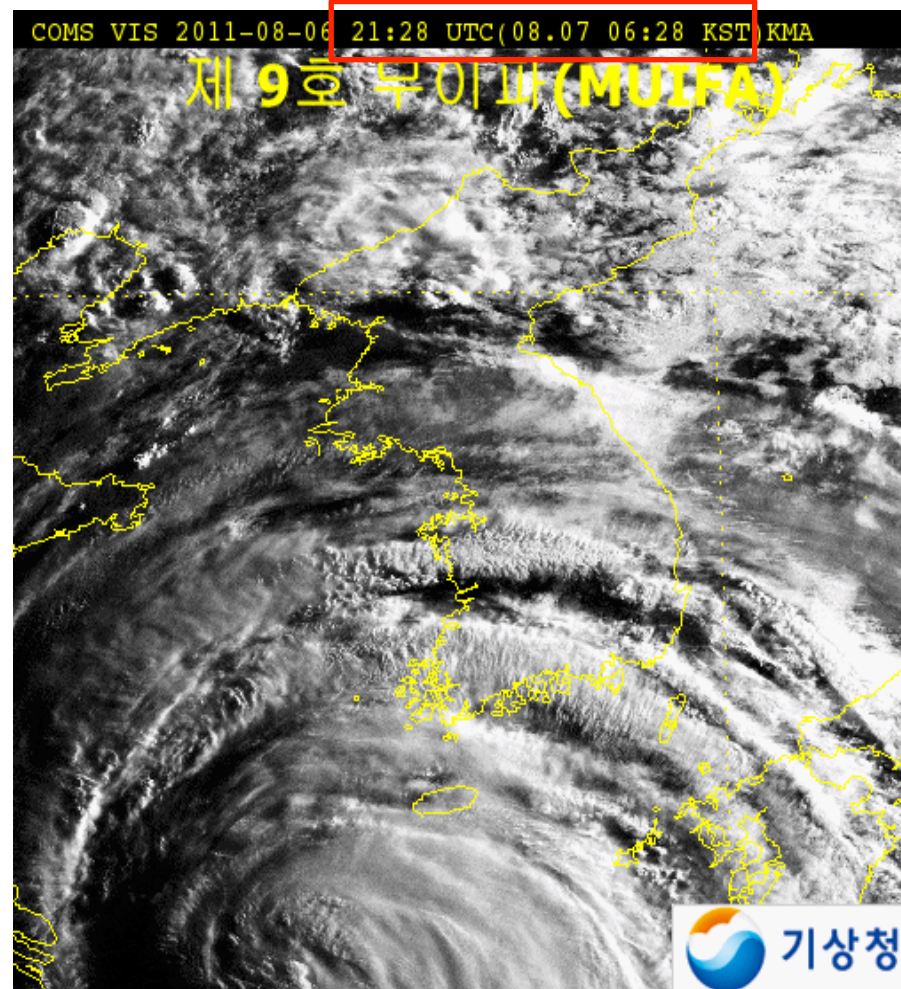
* NMSC/KMA Typhoon analysis : Advanced Dvorak Technique Subjective Dvorak Technique

- ❖ Typhoon analysis information
 - : Type of TC(eye, band, shear etc)
 - : TC center position, intensity
 - : Minimum center pressure
 - : Maximum sustained wind
 - : Radius of 15m/s wind

Landing location of 2011 9th Typhoon MUIFA



Case : 2011 9th Typhoon 'MUIFA'



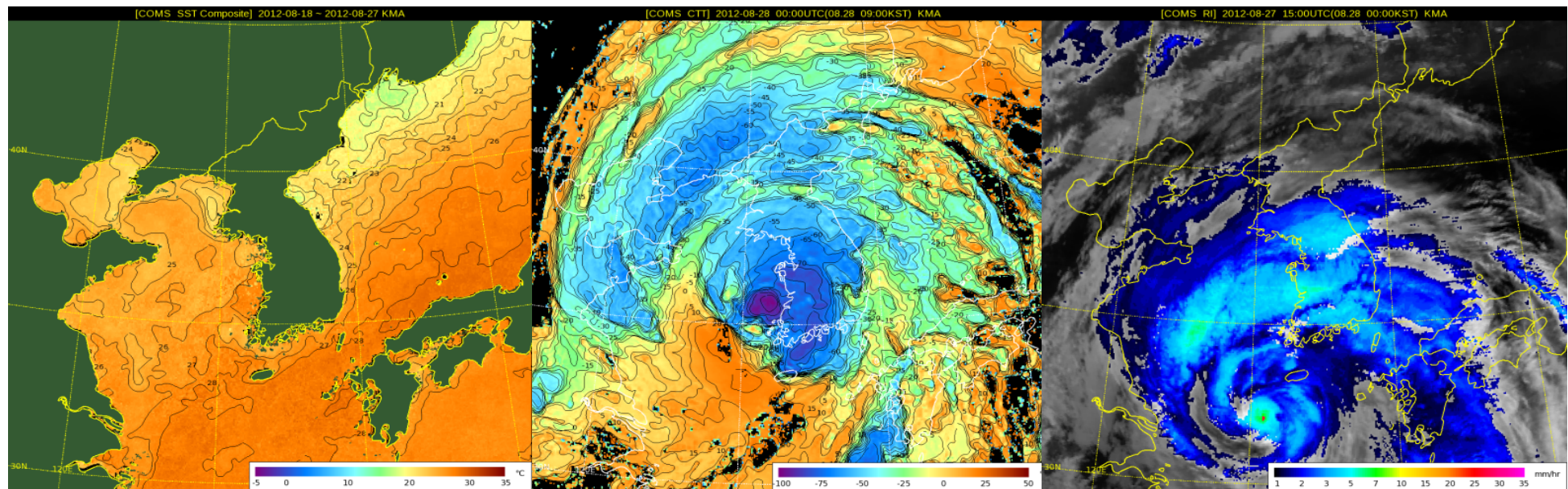
Observational frequency : every 8 min.



Operational Applications - Typhoon



- * Typhoon analysis using COMS Products :
 - Sea Surface Temperature, Cloud Top Temperature
 - Rainfall Intensity, Atmospheric Motion Vector





Operational Applications - Typhoon



* NMSC Typhoon analysis : Historical Perspective

1. SDT

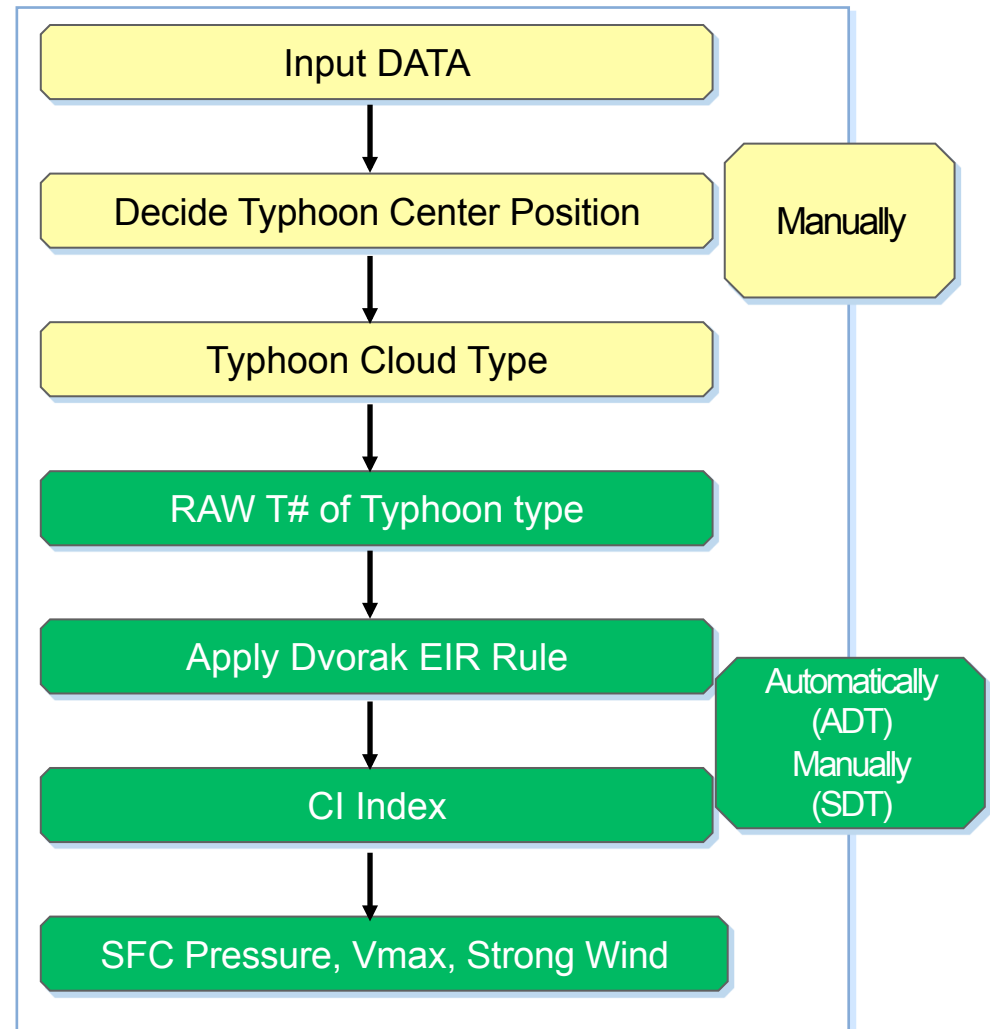
- 2001 : Introduction of SDT from JMA
- 2002 : Operate Typhoon intensity analysis

2. ADT

- 2005 : AODT algorithm(Wisconsin Univ.)
- 2007~2012 : Upgrade of AODT algorithm
- 2013 : Strong Wind Radius(15m/s) analysis (ADT & SDT)

* AODT : Advanced Objective Dvorak Technique

* ADT & SDT Analysis Process

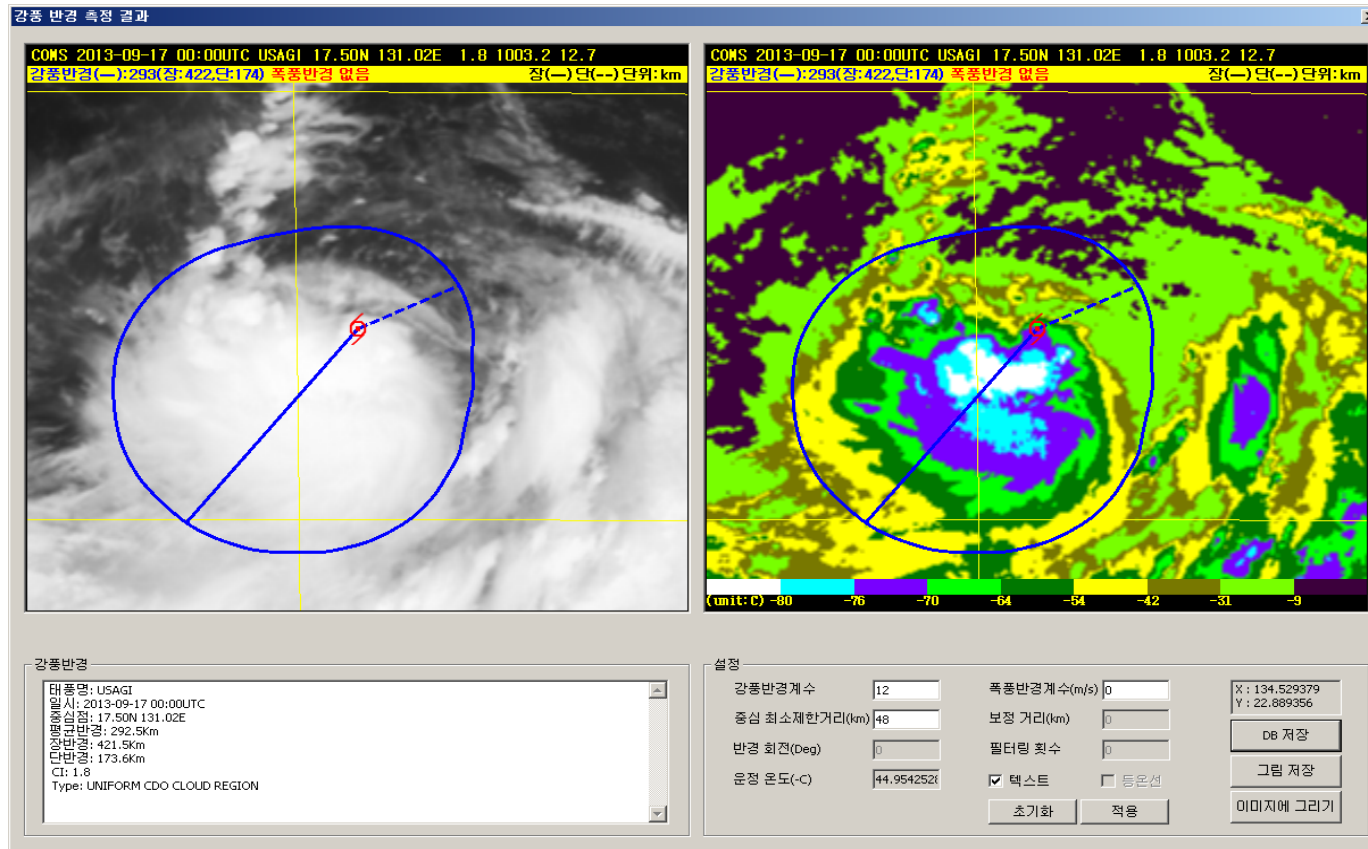




Operational Applications - Typhoon



* Decision process : Radius of 15m/s winds in web-based Typhoon Analysis System



- Basic algorithm :

Brightness Temperature → CI → Vmax → Rmax → Radius of wind speed with 15m/s

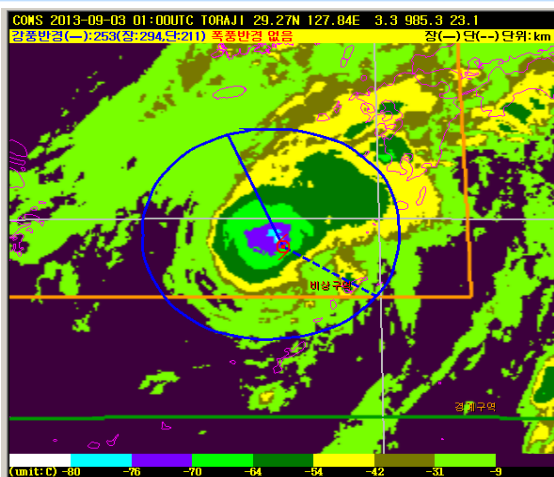


Operational Applications - Typhoon

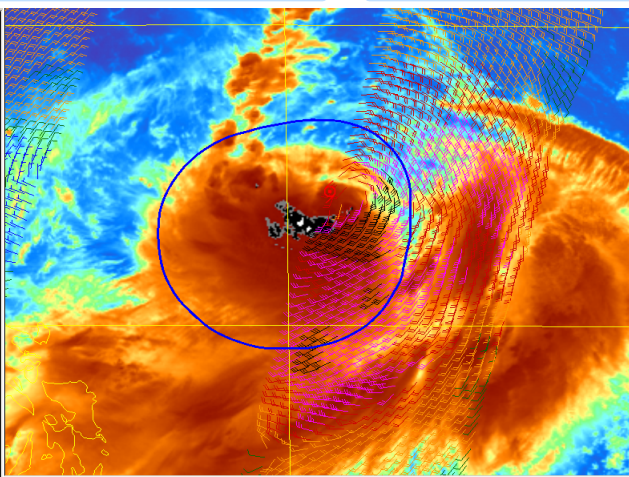


* Verification process : Radius of 15m/s winds and observational data

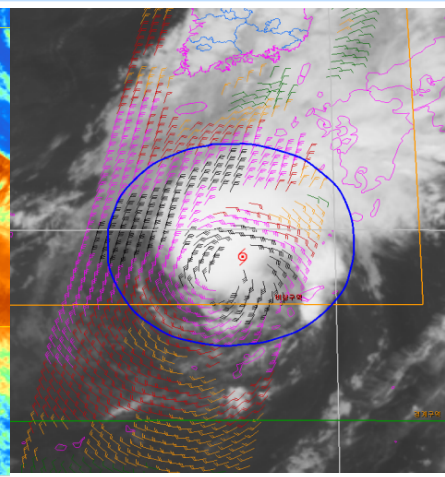
* Case study : 2013 17th Typhoon
'TORAJI'



Calculated Radius of 15m/s winds



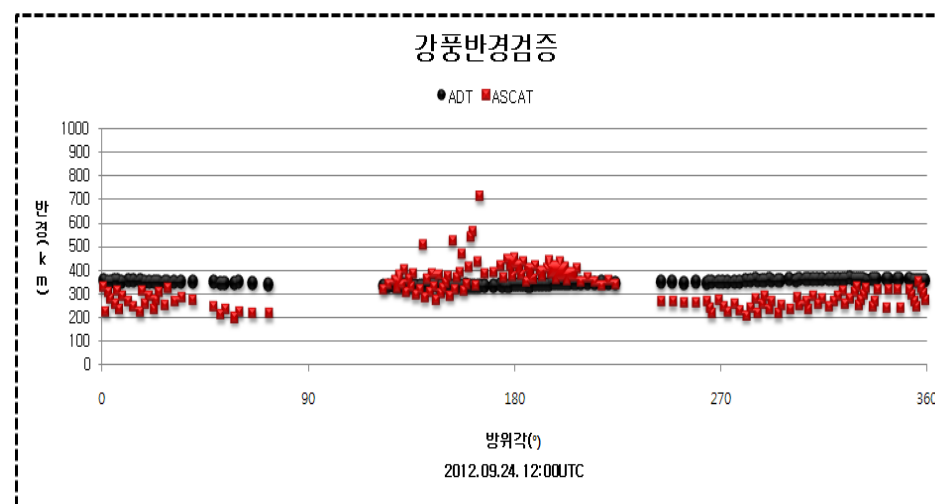
COMS enhanced + ASCAT wind



ASCAT wind

* Observational data set for Verification

- Microwave wind : ASCAT, Windsat, SSMIS, TMI (<http://www.nrlmry.navy.mil/TC.html>)
- Ground observational data
 - o KMA, JMA, CMA, CWB, PAGASA etc





Operational Applications - Nowcasting (NWC SAF)



* NWC SAF in NMSC/KMA (1)

- ❖ NWC SAF package was introduced in 2009
- ❖ NWC SAF / PGE modules were tested using MTSAT data in 2010
- ❖ Adapted COMS in 2011 using old version(2009, 2010 ver.)
- ❖ **Compare old and new(2012) version of NWC SAF in 2013**
 - Convective Rainfall Rate : CRR(PGE05)
 - High Resolution Winds : HRW(PGE09) * *newly introduced in 2013*
 - Automatic Satellite Image Interpretation : ASII(PGE10)
 - Rapid Development Thunderstorms : RDT(PGE11)
- ❖ Bilateral Cooperation with EUMETSAT
 - 1st(17-18 April 2012), 2nd(18 Sep.2013) NMSC-NWC SAF workshop
 - Discussion of “ NWC SAF products in NMSC/KMA”

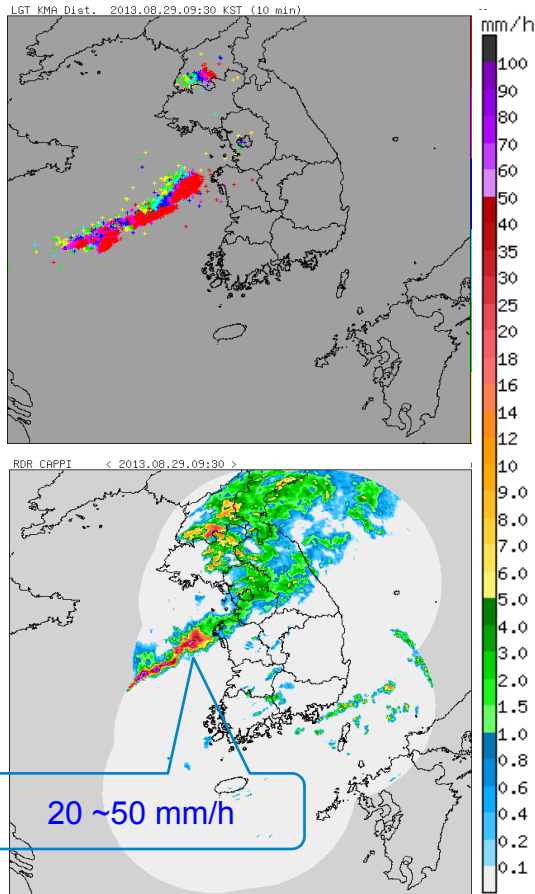


Operational Applications - NWC SAF(Convective Rain Rate)



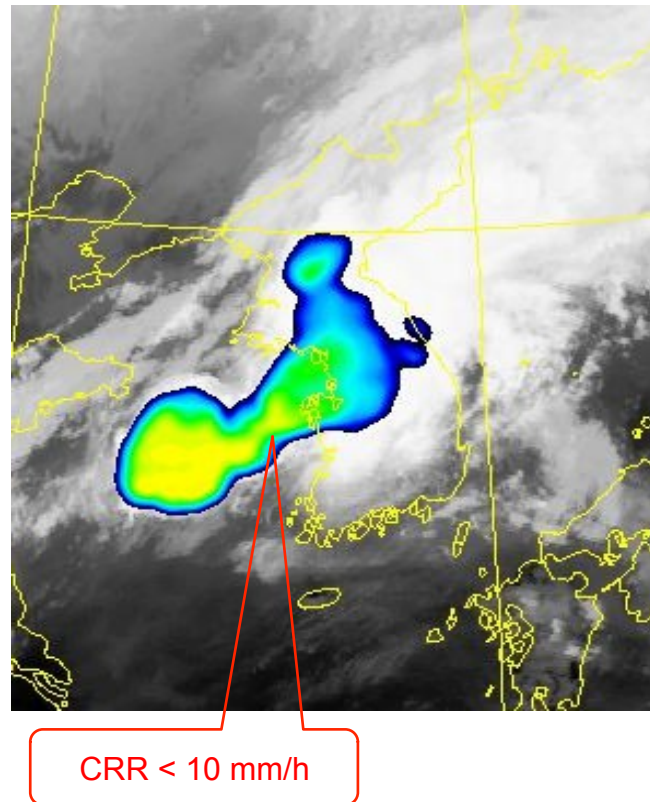
Case : 00:30 UTC 29 Aug. 2013

Lightning

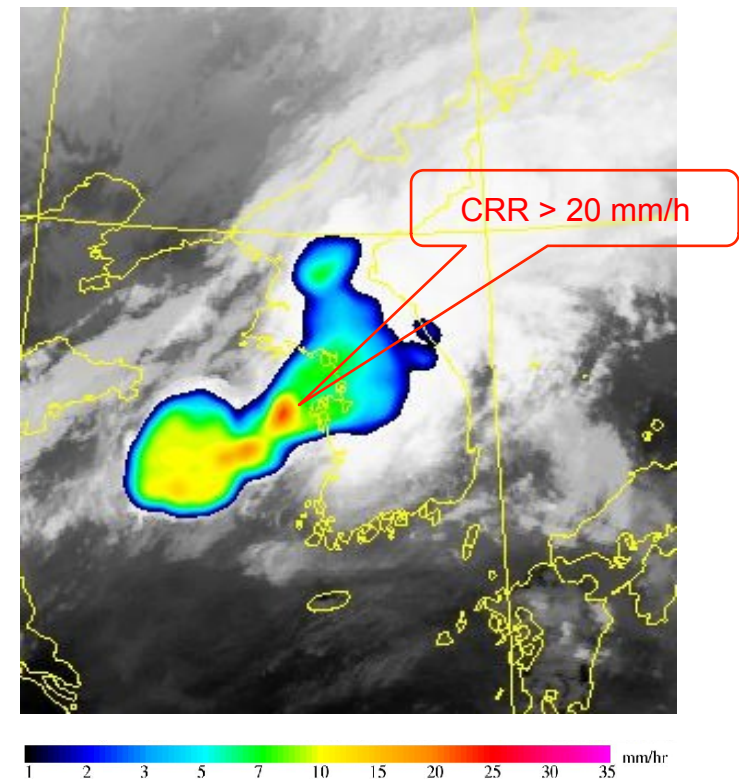


Radar

CRR (ver. 2010)

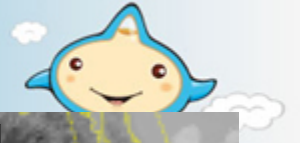


CRR (ver. 2012)

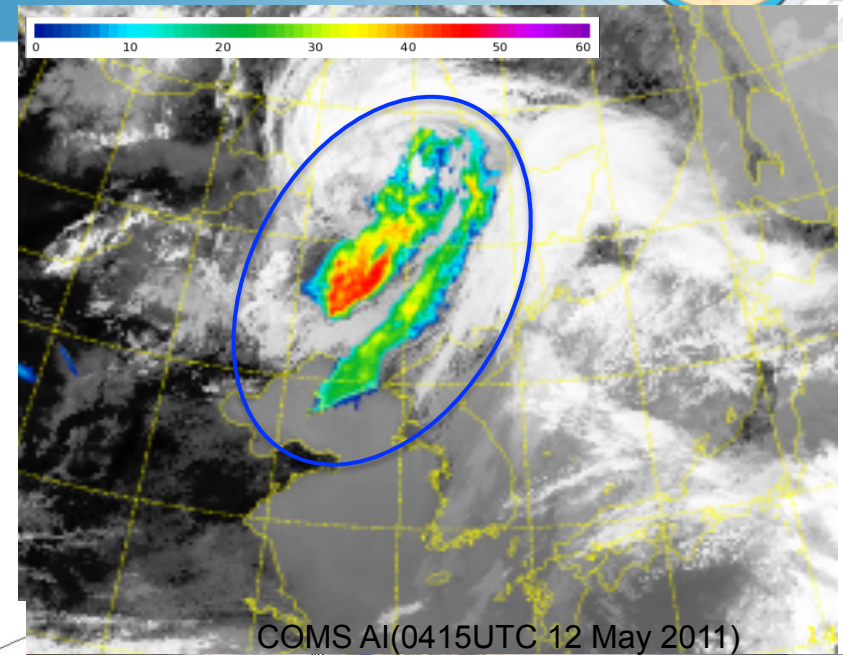
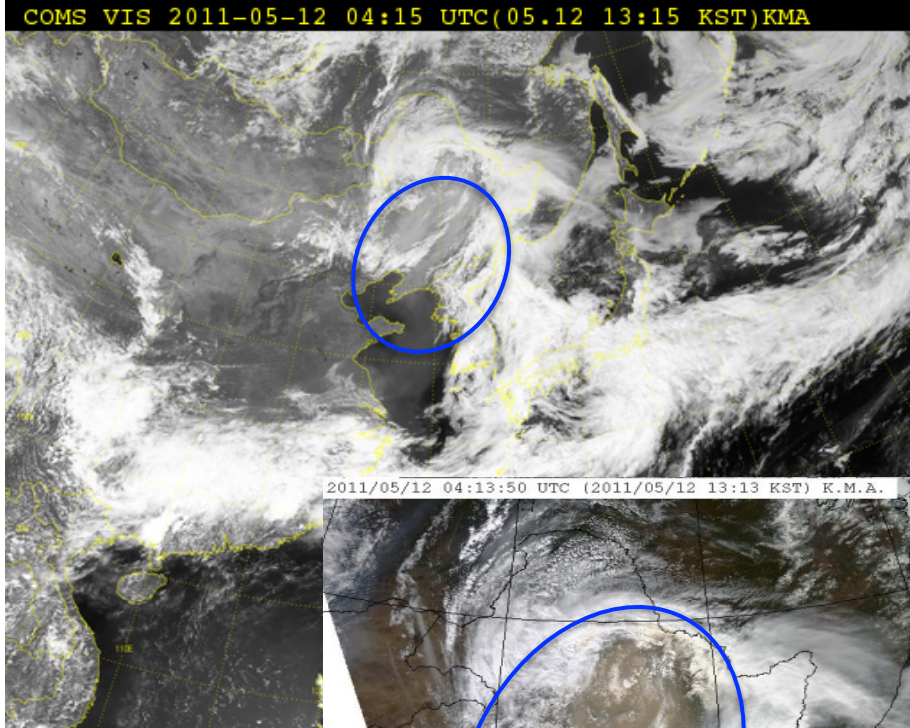




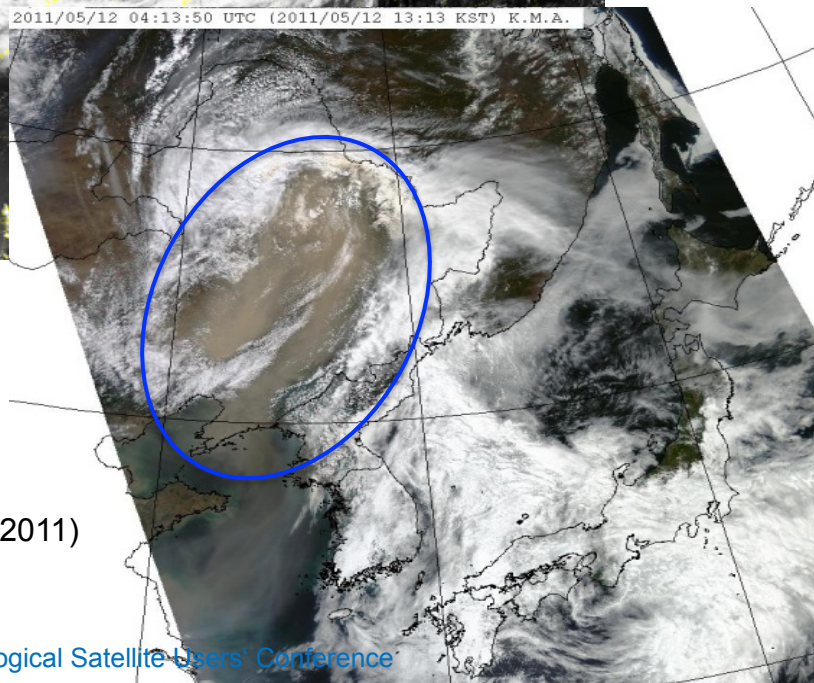
Operational Applications - Asian dust



COMS VIS(0415UTC 12 May 2011)



AQUA(0413UTC 12 May 2011)

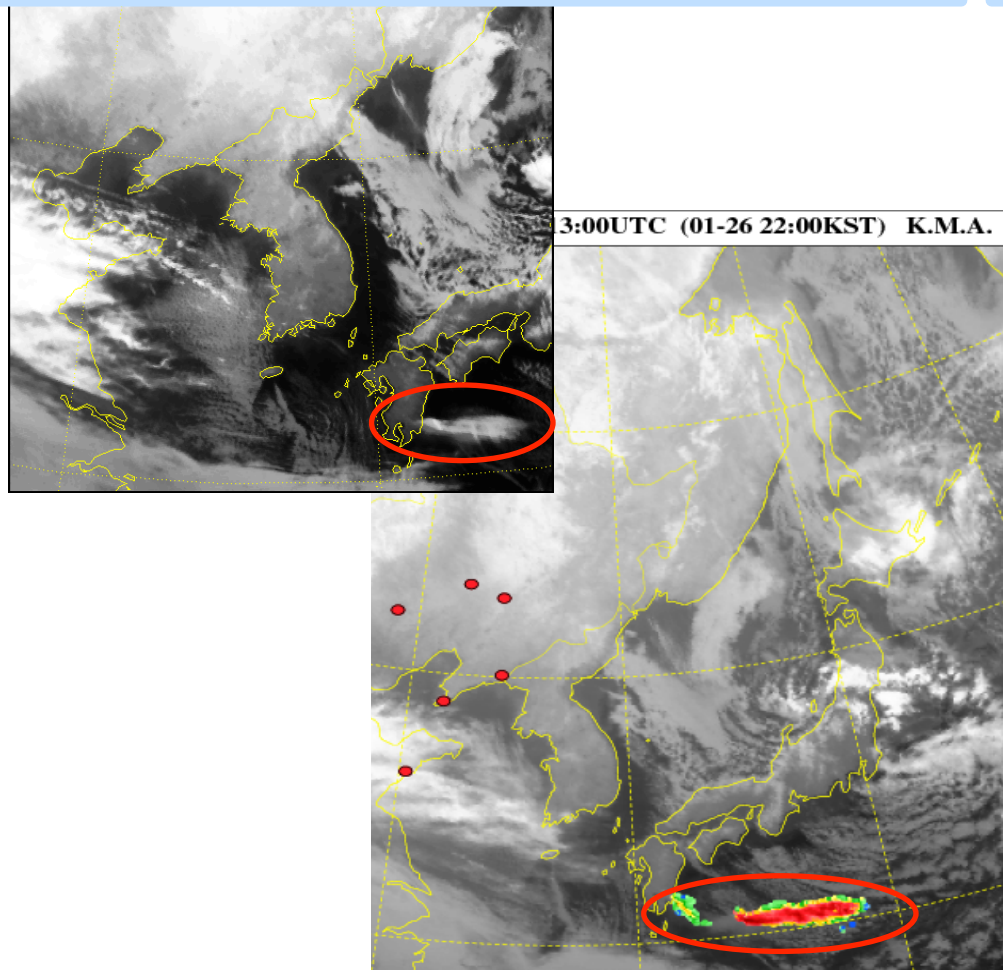




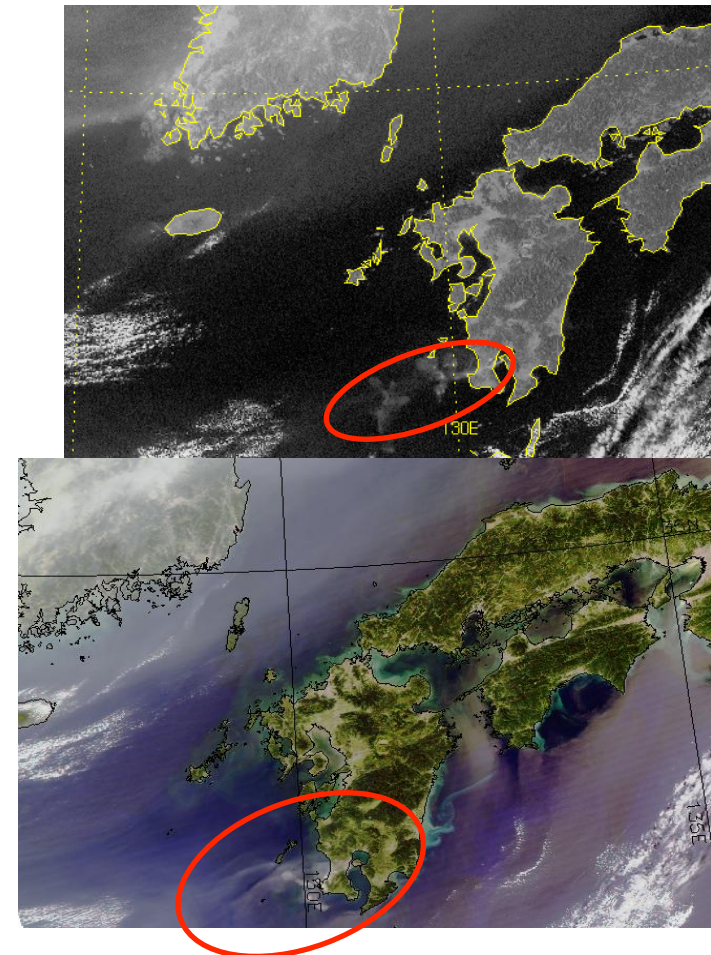
Operational Applications - Volcanic ash



* Shinmoedake, Japan :
MTSAT IR(upper) 10:00 UTC 26 Jan. 2011
IODI(lower) 13:00 UTC 26 Jan. 2011



* Sakurajima, Japan :
COMS VIS 06:16 UTC 17 Sep. 2013
AQUA : 03:56 UTC 17 Sep. 2013



* IODI : Infrared Optical Depth Index

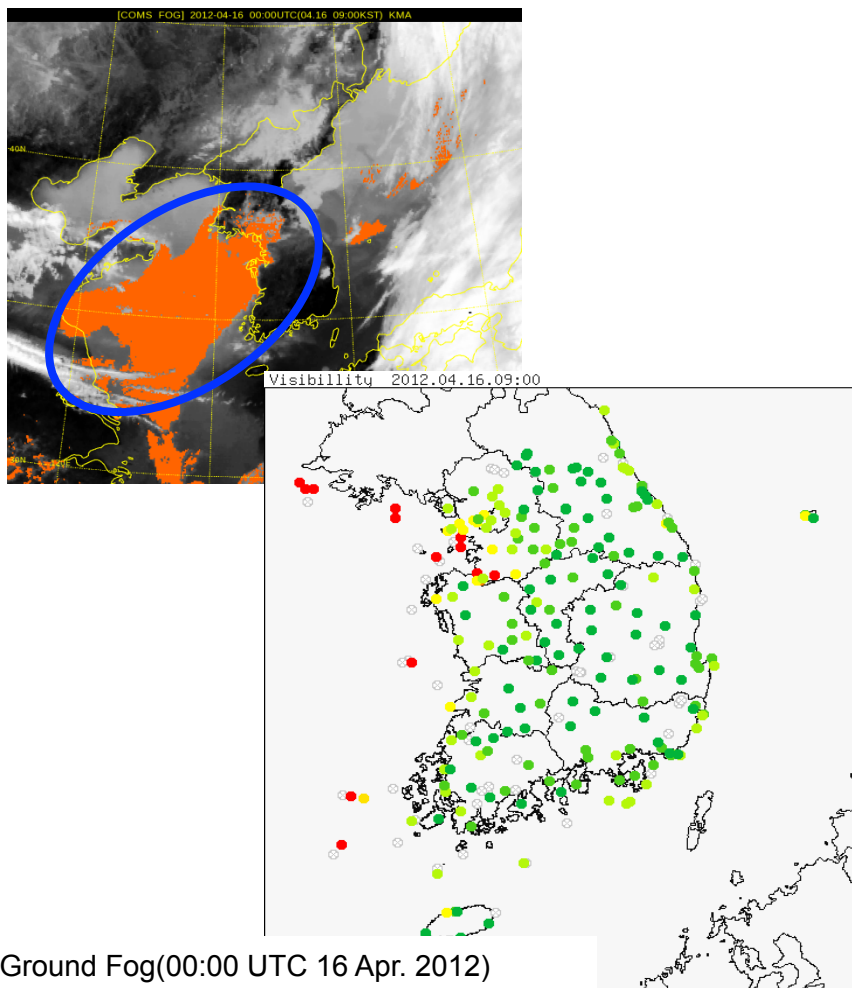


Operational Applications - Fog & Smog



* Case : Sea fog over the Yellow Sea

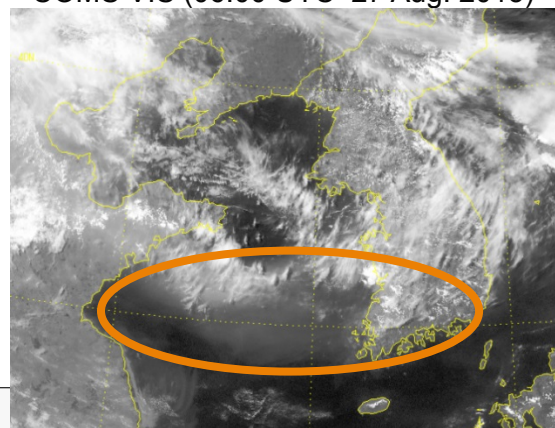
COMS Fog. (00:00 UTC 16 Apr. 2012)



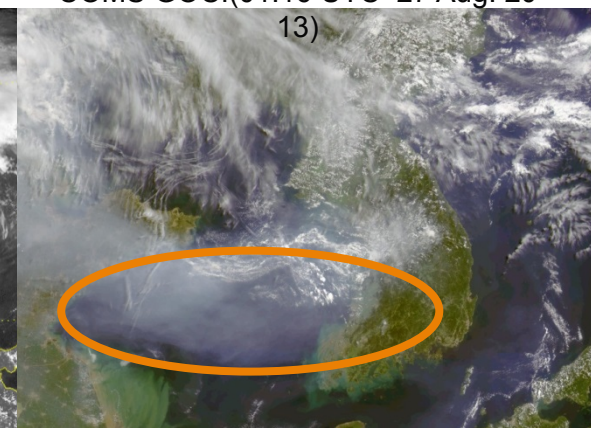
Ground Fog(00:00 UTC 16 Apr. 2012)
fog area : red dot

* Case : Smog over the Yellow Sea

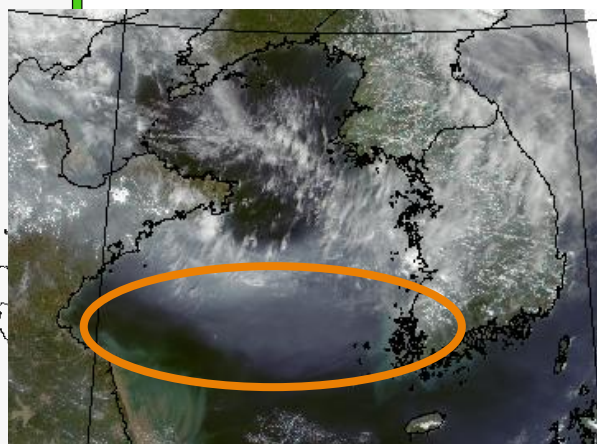
COMS VIS (06:00 UTC 27 Aug. 2013)



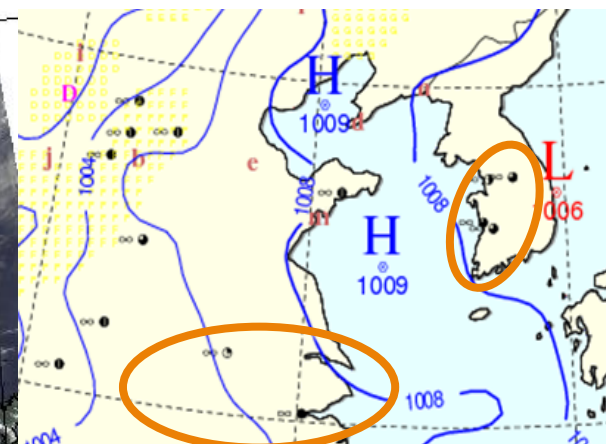
COMS GOCI(01:16 UTC 27 Aug. 2013)



AQUA(05:15 UTC 27 Aug. 2013)



Surface weather chart(06:00 UTC 27 Aug. 2013)

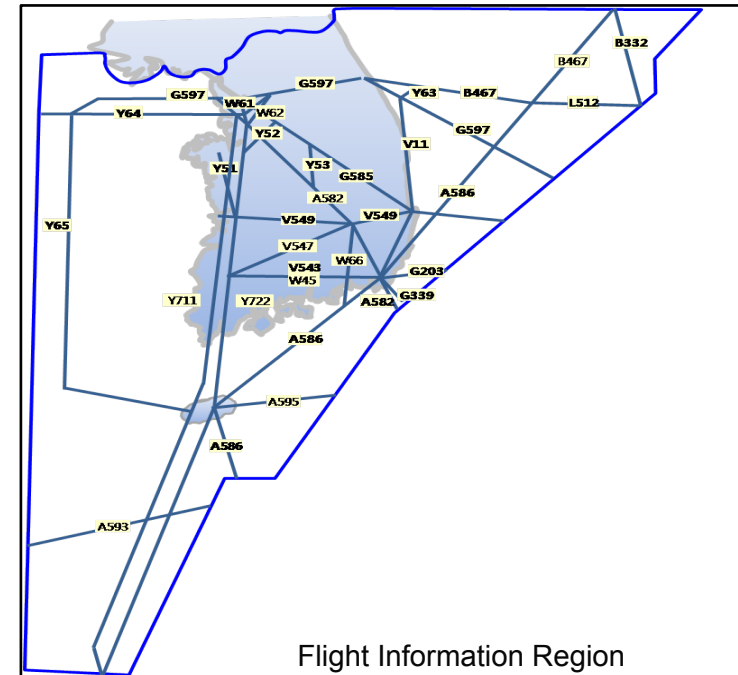
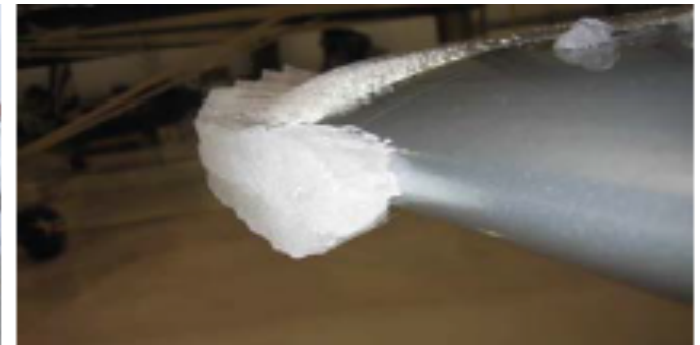


Operational Applications - Aviation Products



* COMS derived aviation products

- ❖ Turbulence
- ❖ Flight Icing
- ❖ Convective Initiation
- ❖ Tracking of convective cloud
- ❖ Asian dust storm
- ❖ Volcanic Ash



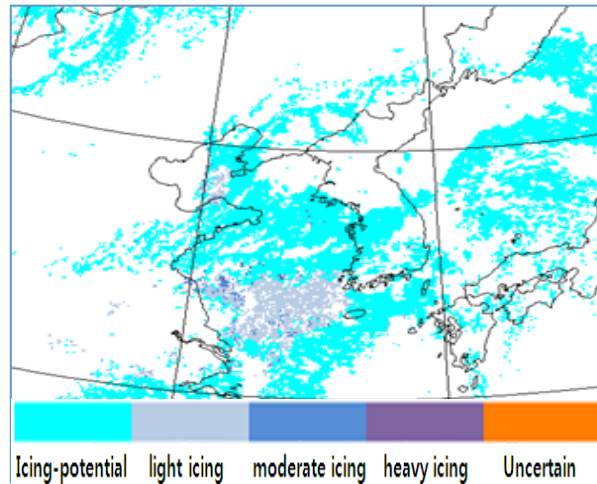


Operational Applications - Aviation Products

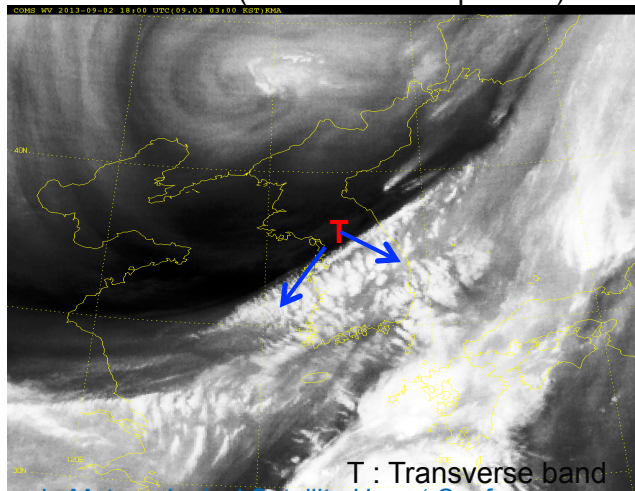


* Flight Icing

COMS Icing (19:45 UTC 2 Sep. 2013)

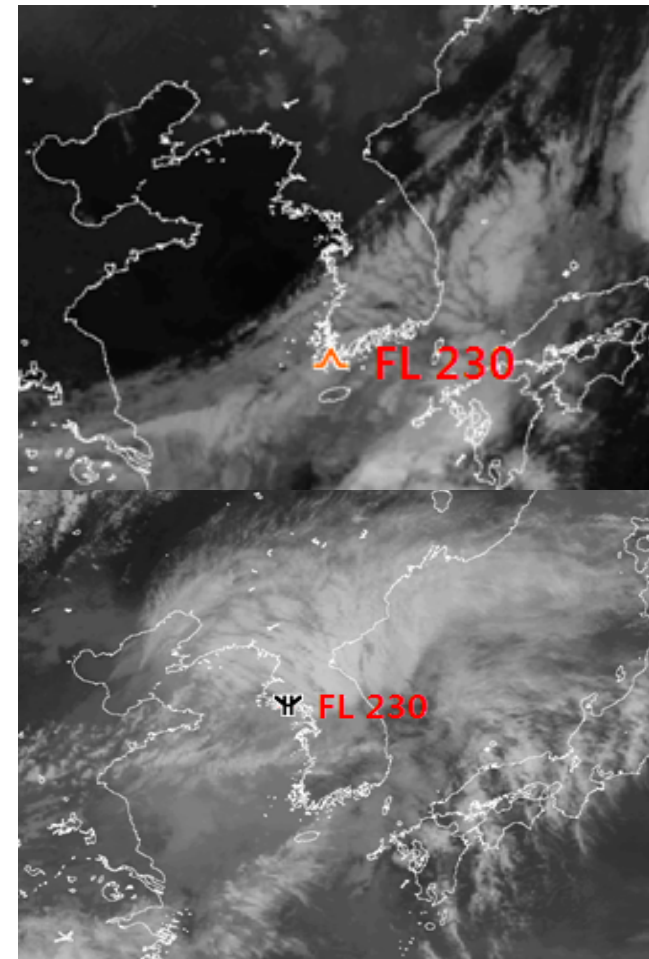


COMS WV (19:45 UTC 2 Sep. 2013)



* Turbulence

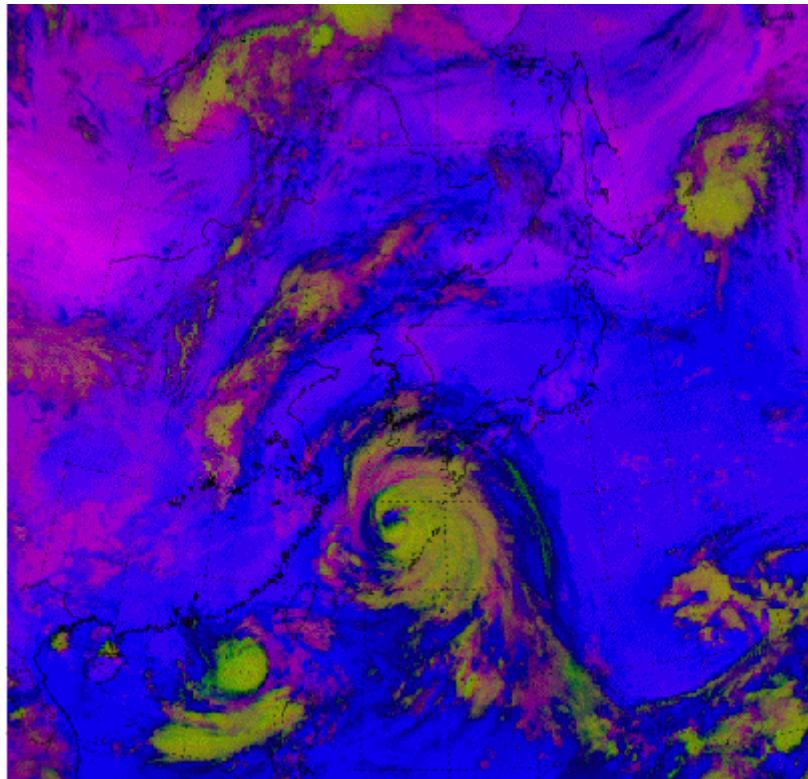
COMS IR(17:45 UTC 18 May 2013)



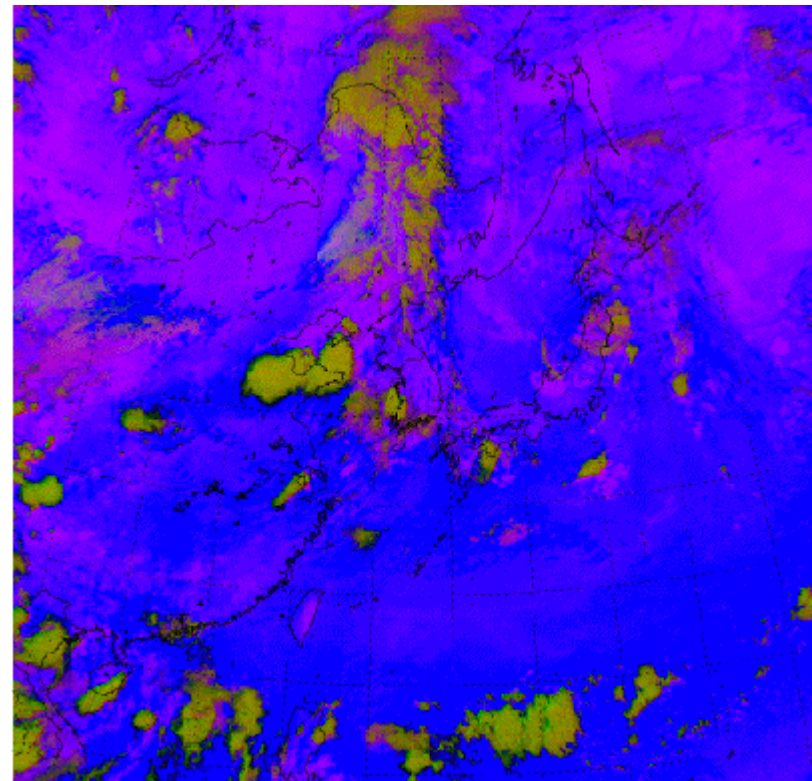


(1) Convective clouds detection ex) Typhoon, stationary rainy front

Color	Channel (μm)	Threshold (K)
Red	IR12.0 – IR10.8	-4 ~ 2
Green	IR10.8 – WV6.75	-15 ~ 20
Blue	IR10.8	210 ~ 300



2012 15th Typhoon 'VOLABEN'



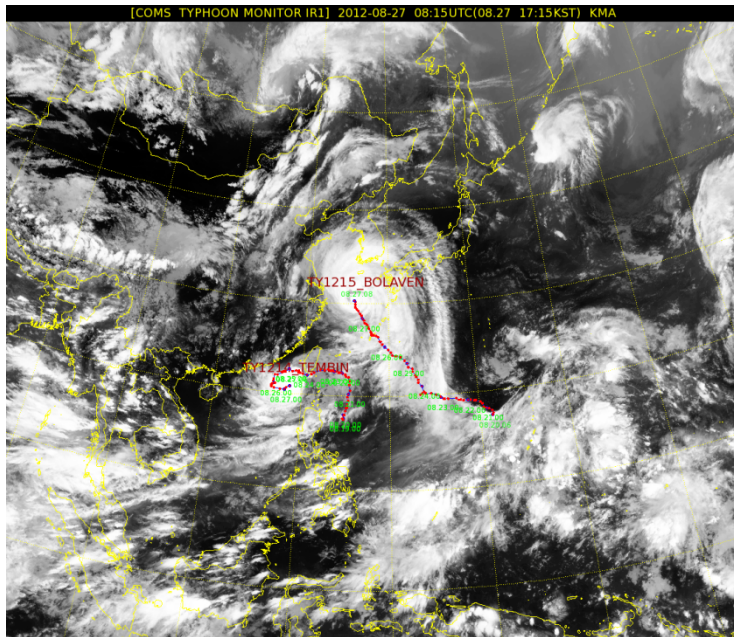
2013 Stationary rainy front
(‘Chang-Ma’ in Korean)



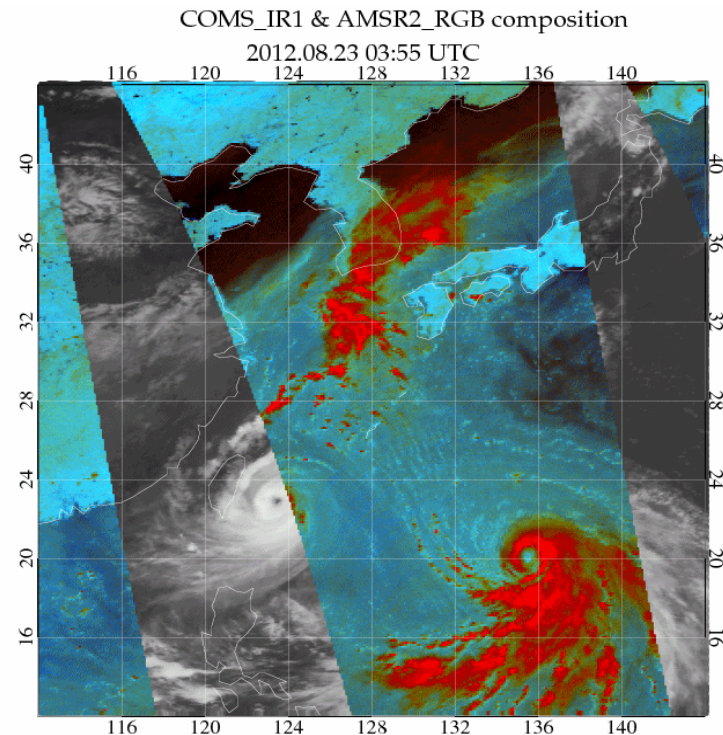
(2) Low-orbit satellite(Microwave sensors)

- GCOM-W/AMSR 2, TRMM/TMI
- Typhoon monitoring

Color	Channel (μm)	Threshold (K)
Red	89GHz PCT	260 ~ 280
Green	TB at 89V GHz	160 ~ 300
Blue	TB at 89H GHz	180 ~ 310



COMS IR (Aug. 27 2012 18UTC)



Superposition of multiple satellite images
(COMS/MI+GCOM-W/AMSR2, TRMM/TMI)

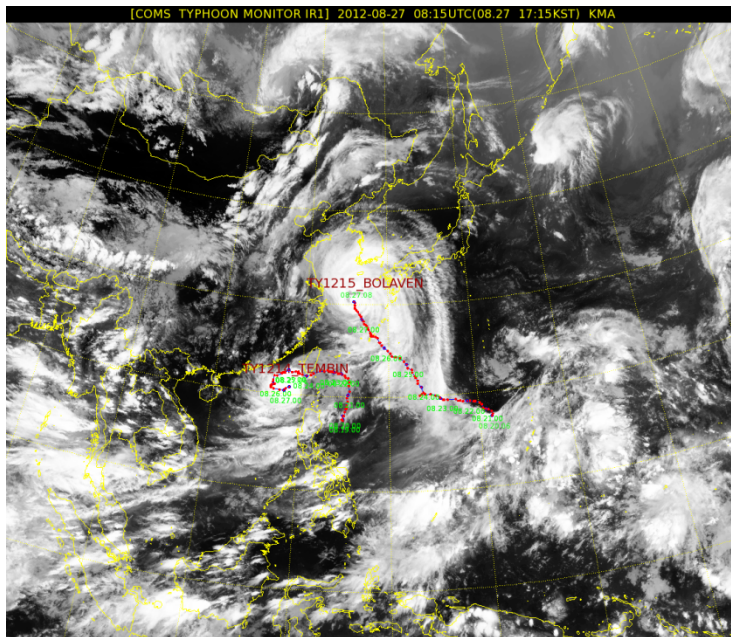
Case : 2012 15th Typhoon 'VOLABEN'

Research activity - Application of microwave observation

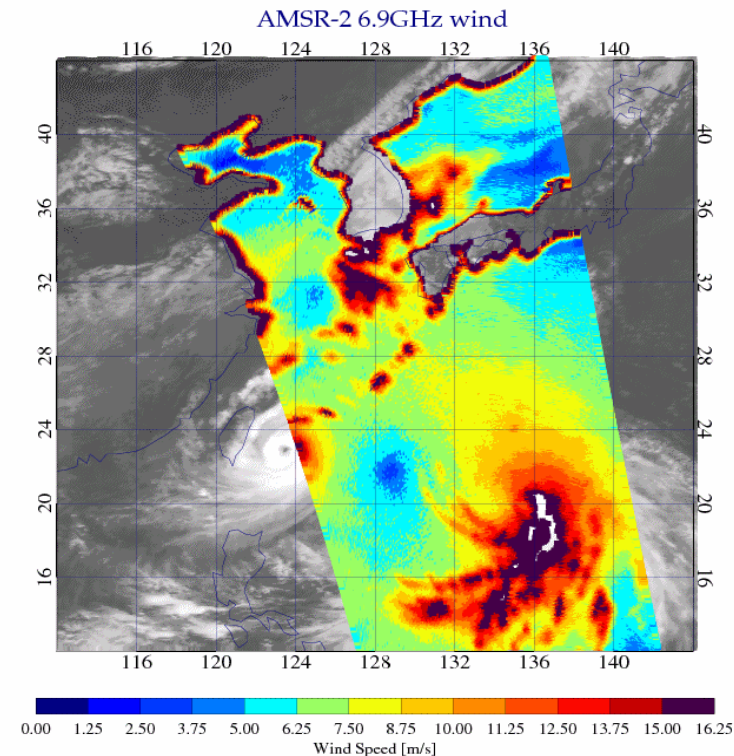


(1) Wind speed (m/s)

- GCOM-W/AMSR2 at 6.9 GHz channel
- Disaster monitoring



COMS IR (18UTC 27 Aug. 2012)



Estimation of the radius of maximum wind speed (m/s)

Case : 2012 15th Typhoon 'VOLABEN'

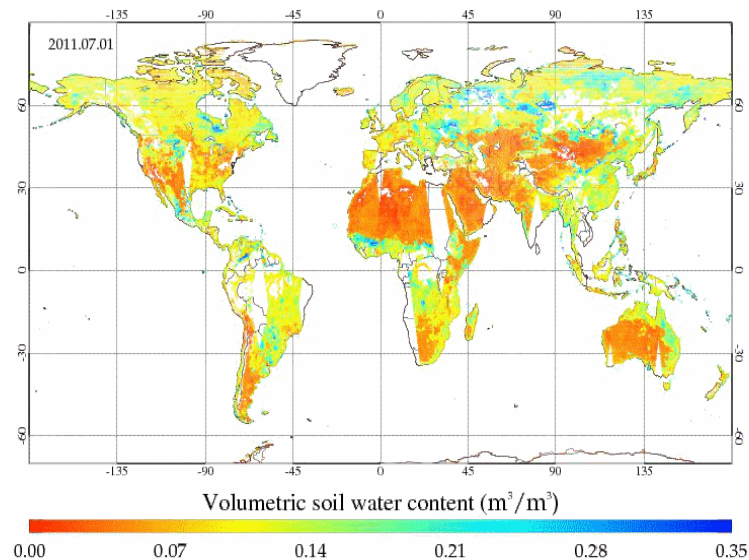


Research activity - Application of microwave observation

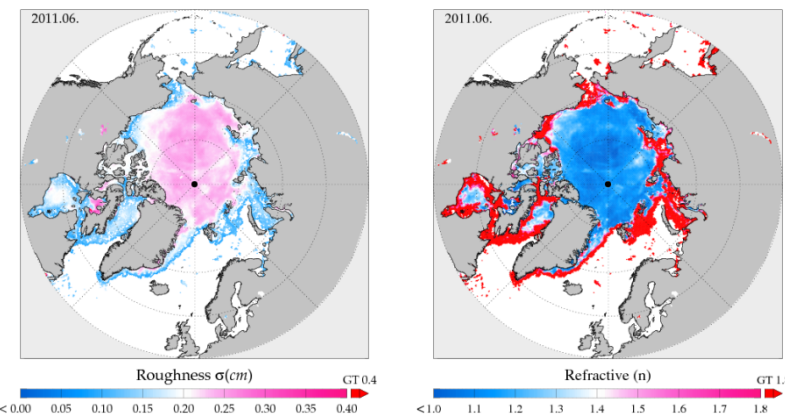
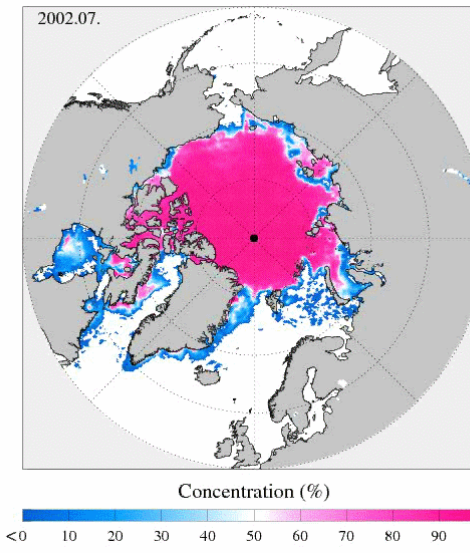


(2) Soil Moisture & Sea ice properties

- AQUA/AMSR-E, GCOM-W/AMSR2 observations
- Hydrological and Climatological monitoring



Soil moisture amount using AQUA/AMSR-E data
(Daily variation of Soil moisture during the Jul. of 2011)



Concentration, Small-scale roughness and refractive index of sea ice surfaces (Jun. 2011) using AQUA/AMSR-E data



4. Summary & Future plan



- ❖ COMS Products
 - Publish of Quality control report and operate of website
 - Develop of aviation meteorological information ♪
 - Develop of Korean conceptual model based for meso and synoptic scale
- ❖ Research Activity
 - Changeover from research to operational forecast system
 - Enlarge for climate, hydrology, ocean, environmental disaster prevention etc
- ❖ Development of GEO-KOMSAT02A
 - launch in 2017
 - 16 channels : 4 visible, 2 near-infrared and 10 infrared channels
 - 52 meteorological products : Cloud, Precipitation, AMV, Aerosol, Land surface



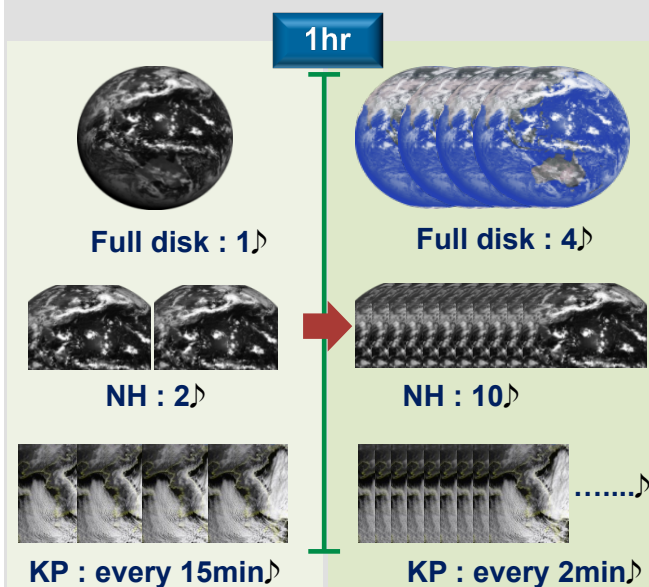
4. Summary & Future plan - COMS & GEO-KOMPSAT-2A



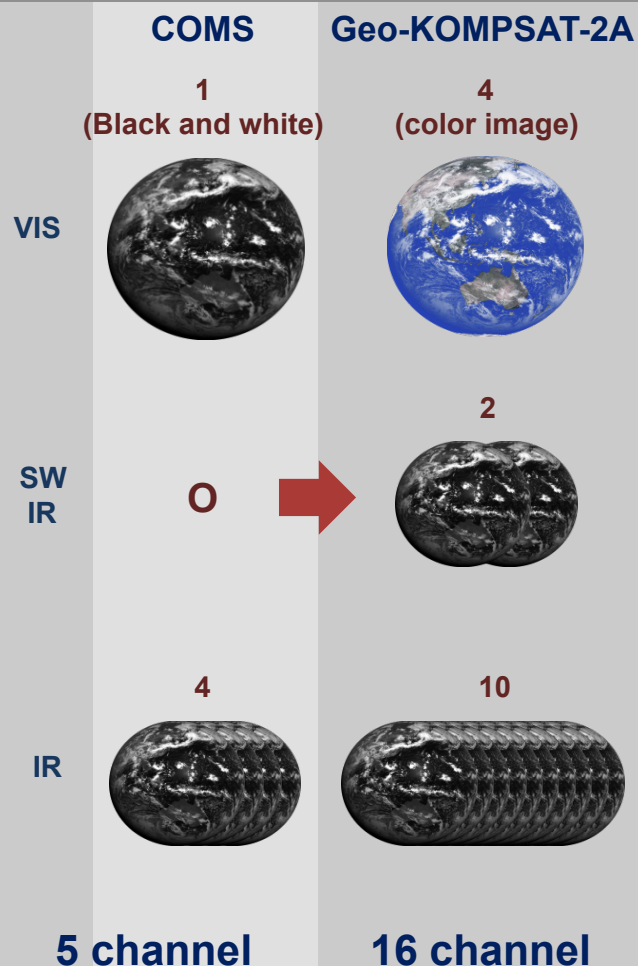
resolution **4times** upgrade



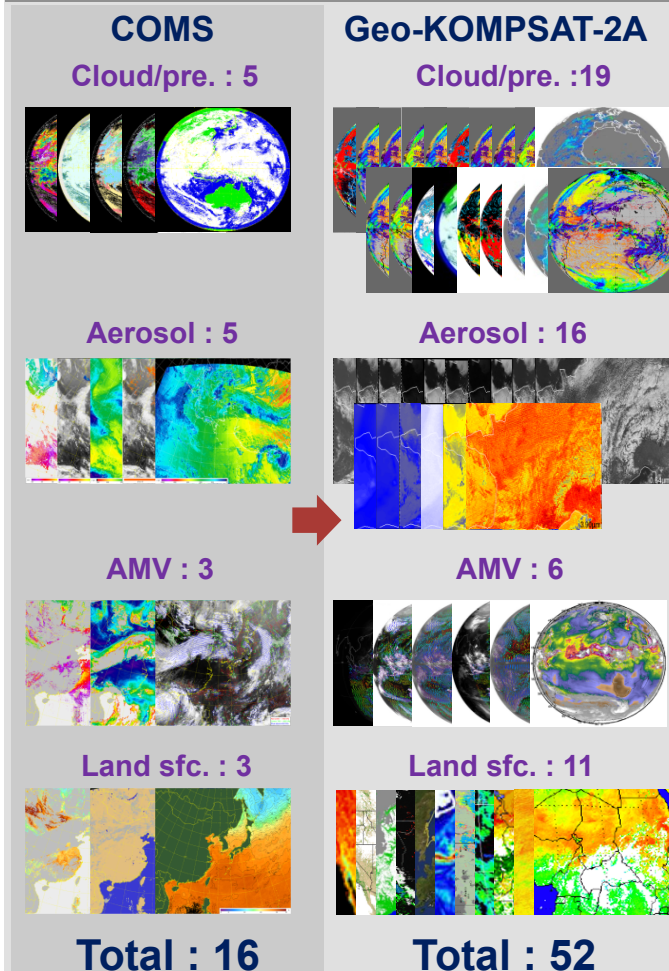
Observation frequency **4 times**



channel **3times** increase



products **3.5 times** increase





Thank you
<http://nmssc.kma.go.kr>