Current Status of COMS AMV in NMSC/KMA♪

NMSC/KMA

Eunha Sohn

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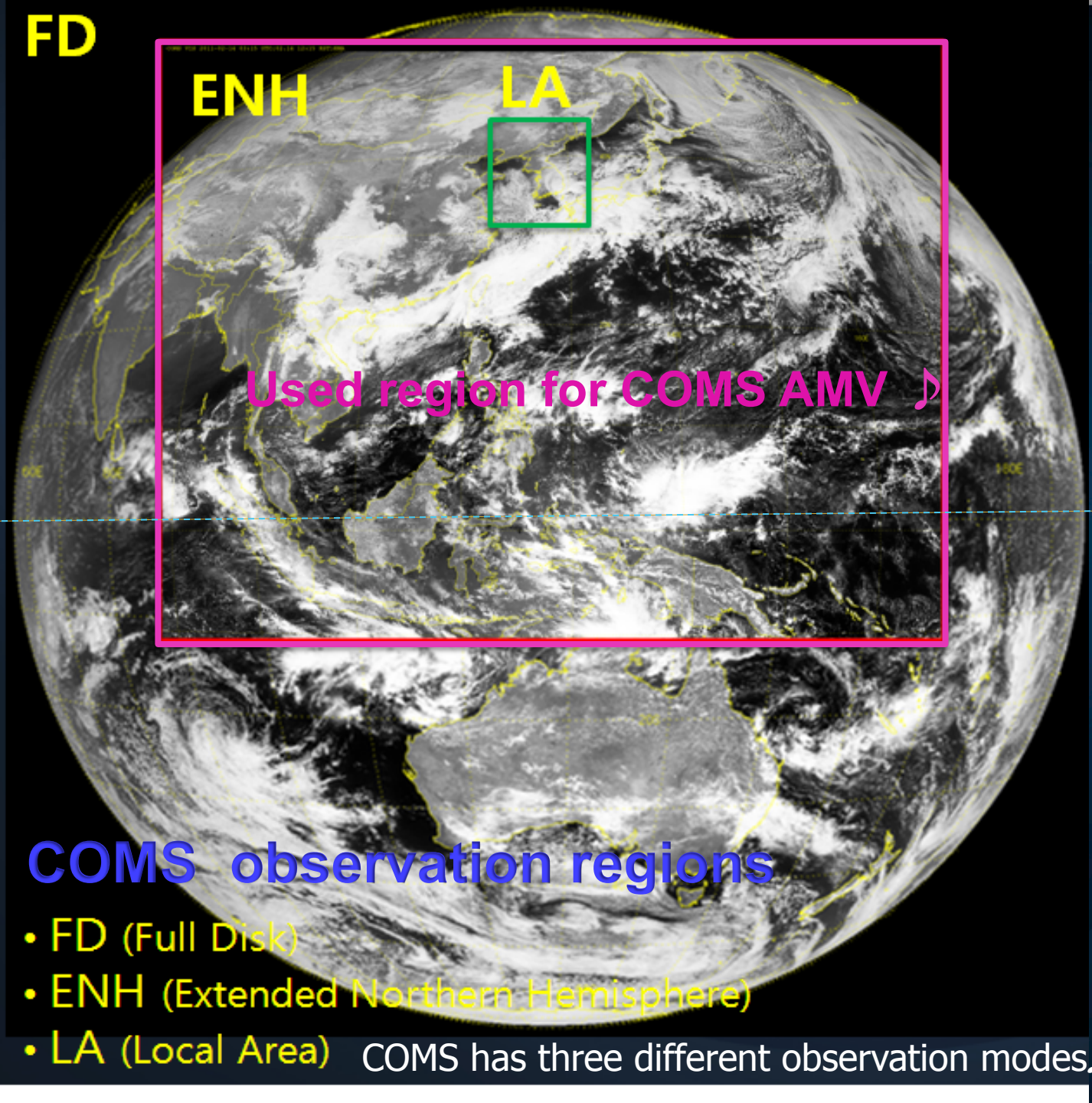
AMV Estimation in NMSC/KMA

- NMSC has produced in operation hourly COMS AMV with images of in terval time of 15 minutes since April 1, 2011. and made periodically monthly report including AMV accuracy and error statistics.

- NMSC changed several components for COMS AMV estimation.
  - Target size was replaced 32x32 pixel with 24x24pixel
  - Hourly NWP forecast data was used for hourly COMS AMV estim ation in stead of 6 hourly forecast NWP data used by temporal int erpolation before.
  - Higher horizontal resolution of UM N512L70 25km was used than GDAPS horizontal resolution of 100km

- NMSC completed COMS AMV BUFR format for dissemination via GTS



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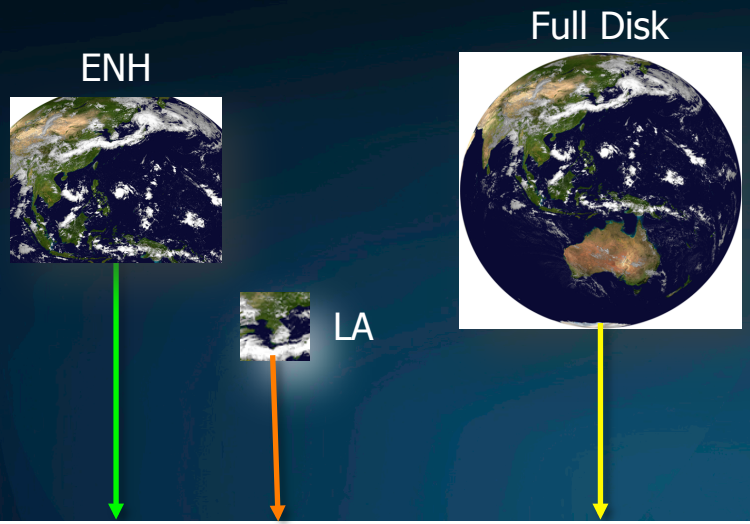
National Meteorological Satellite Center

COMS observation regions

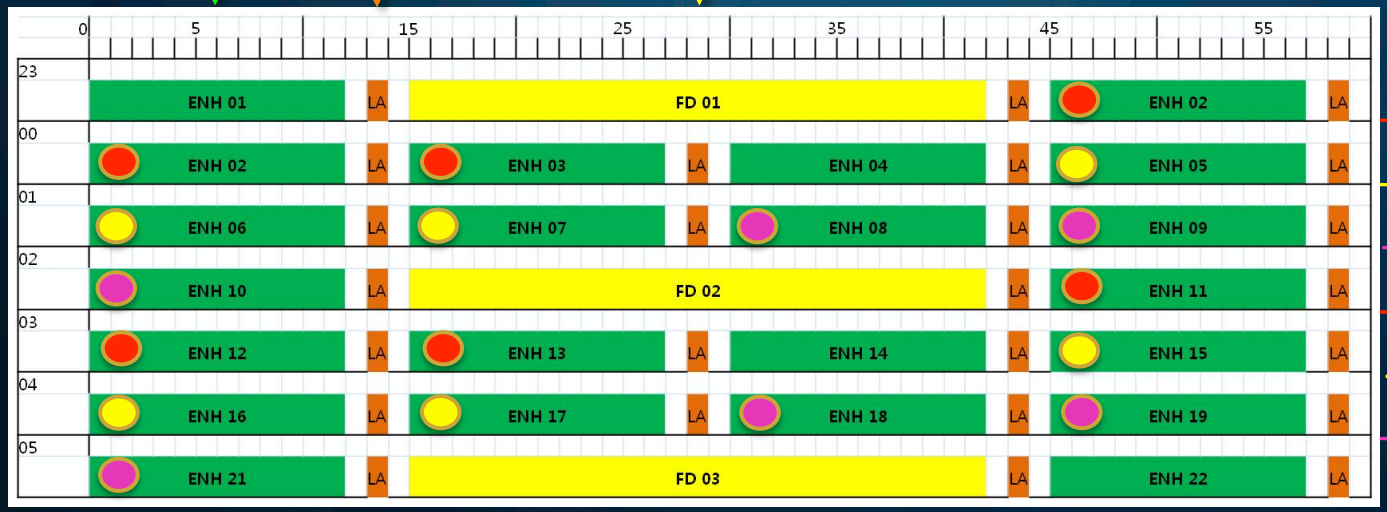
- FD (Full Disk)
- ENH (Extended Northern Hemisphere)
- LA (Local Area)

COMS has three different observation modes♪

COMS AMV Estimation Schedule

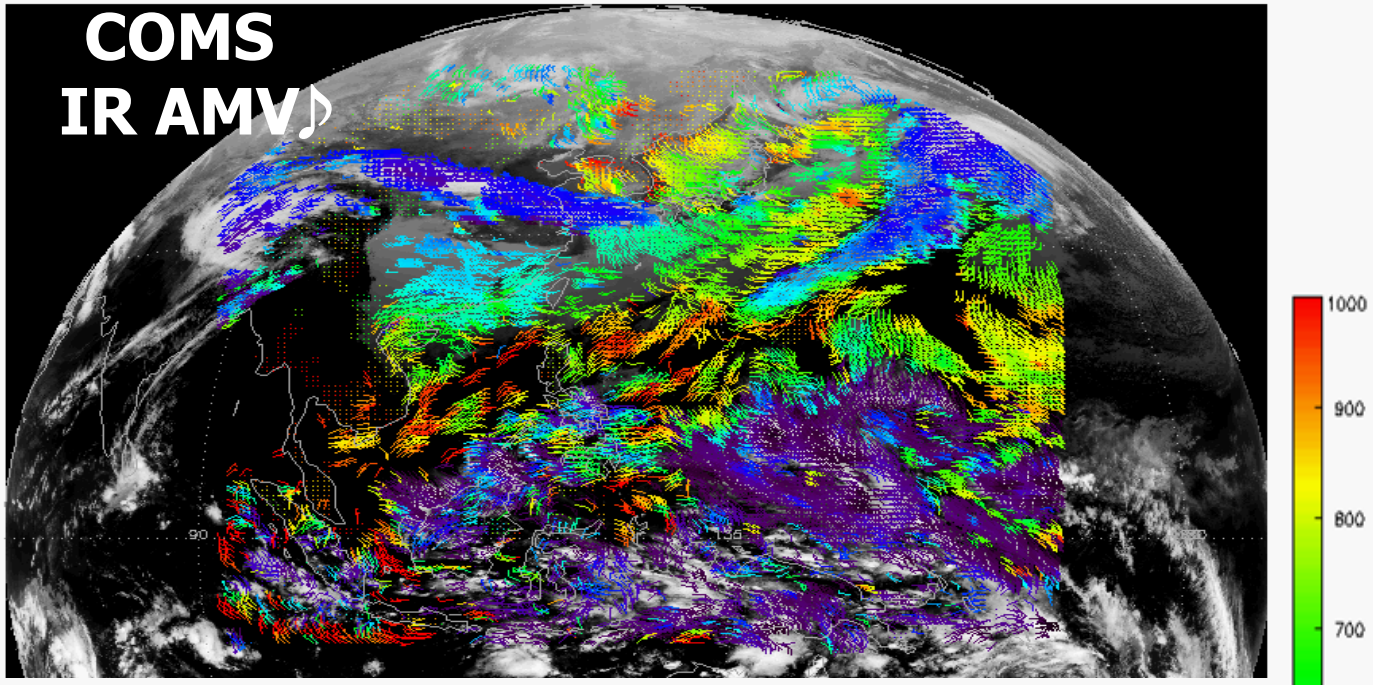


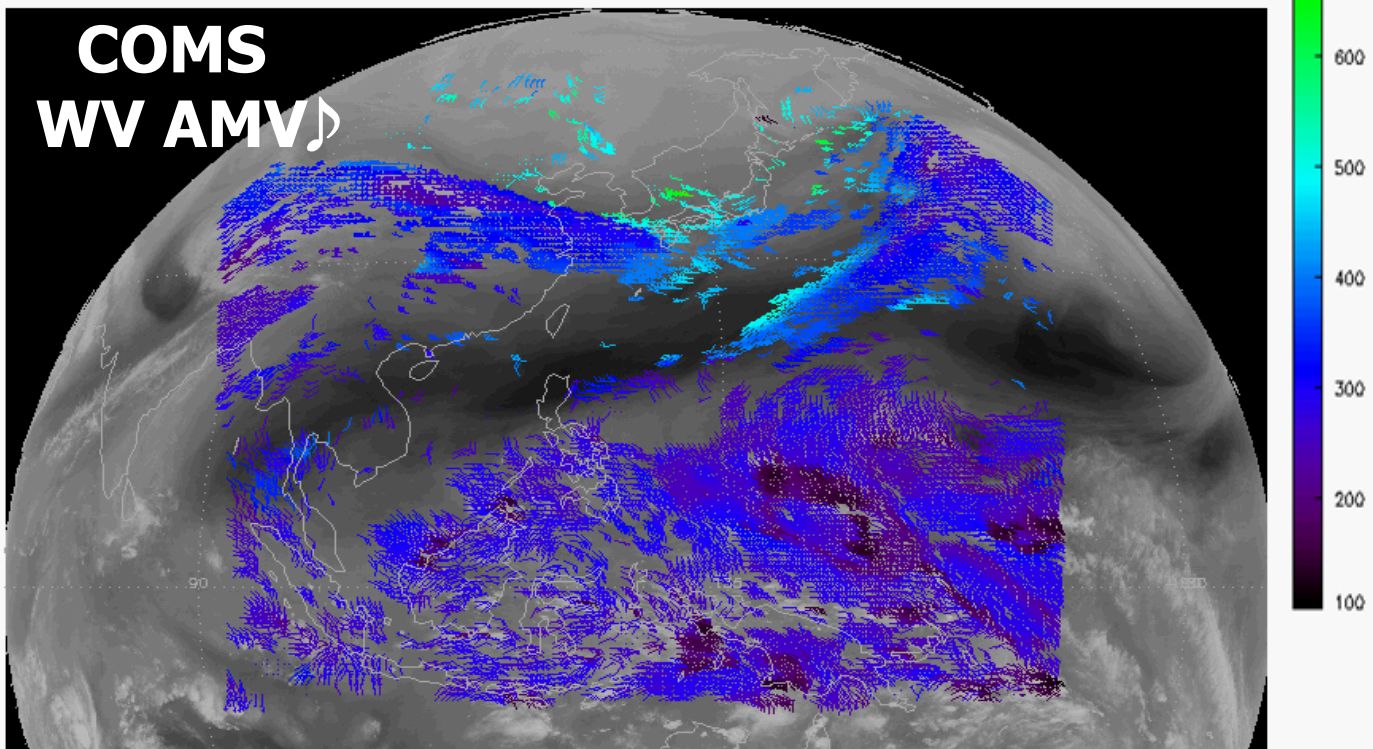
- Full disk : 1 / 3 hours
- ENH : 4 / 1hour
- LA : 4 / 1hour



- COMS observes ENH region 4 times an hour except for time band of FD observation.
- COMS AMV uses three consecutive data at 4500, 0000 and 1500 UTC .
- In time band of FD observation, COMS AMV is estimated by 3000, 4500 and 0000 UTC.

Specifications for COMS AMV Estimation		Operational products
Interval time	15 minutes	Hourly IR AMV (low, middle, high-level)
Target Size	24X24 pixel(96 km x 96 km)	
Search Size	64x64 pixel, Moving Search Area	
Height assign ment	EBBT, STC, IR/WV for IR and VIS AMV EBBT, NTC, NTCC for WV AMV • EBBT (10% coldest pixels within Target area) • The inversion-level correction and cloud-base correction are employed in low-level	Hourly High-level WV AMV
Tracking Met hod	Cross Correlation	Hourly low-level VIS AMV -Using visible data with spatial resolution of 4k m
Quality Indica tor	EUMETSAT QI	
Generation Coverage	Satellite Zenith Angle < 60^{o}	
Regular Grid	12X12 pixel(48 km x 48km)	
NWP	UM N512L70 (25km)	

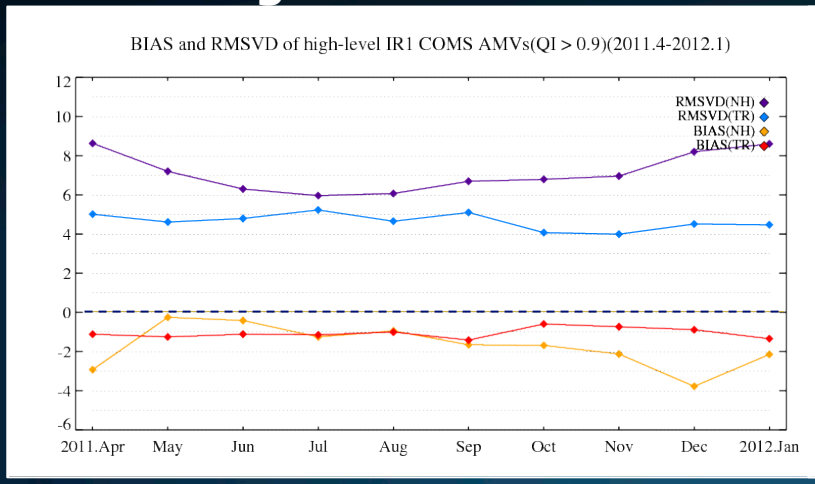

COMS
IR AMV♪


COMS
WV AMV♪

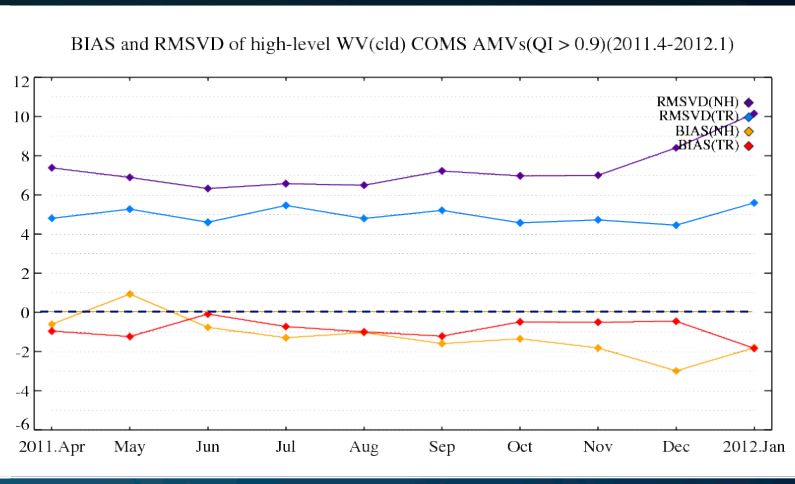
1000
900
800
700
600
500
400
300
200
100

Temporal variations of COMS AMV accuracy

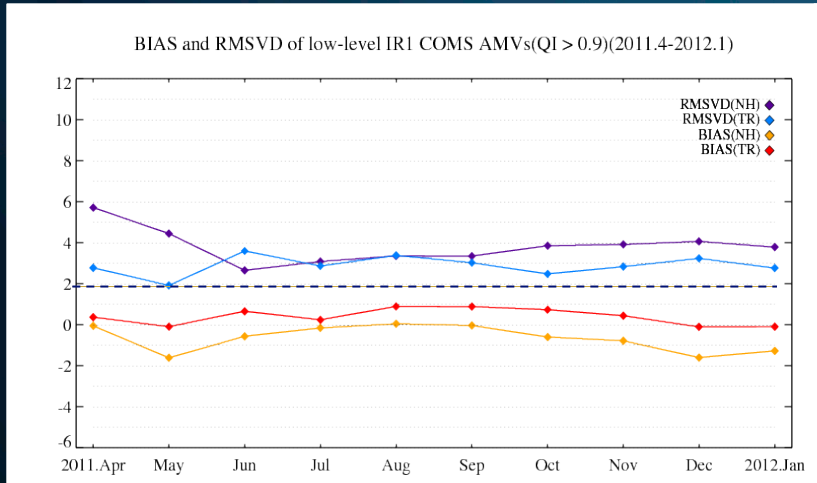
<High-level IR AMV>♪



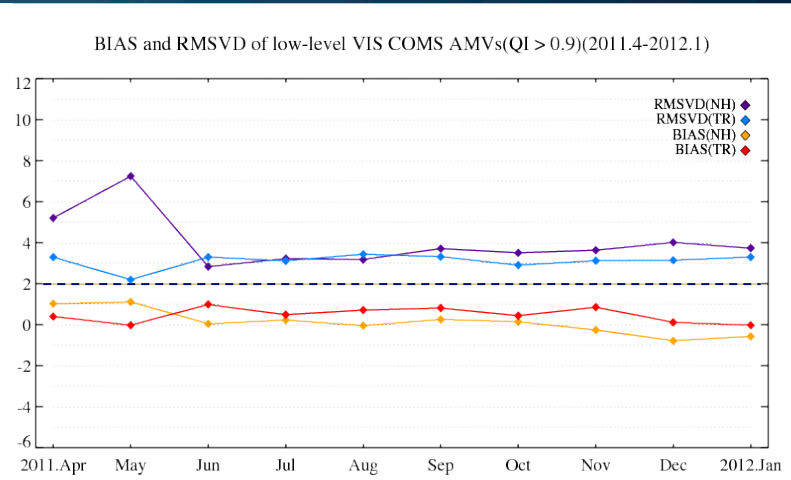
<High-level WV AMV>♪



<Low-level IR AMV>♪



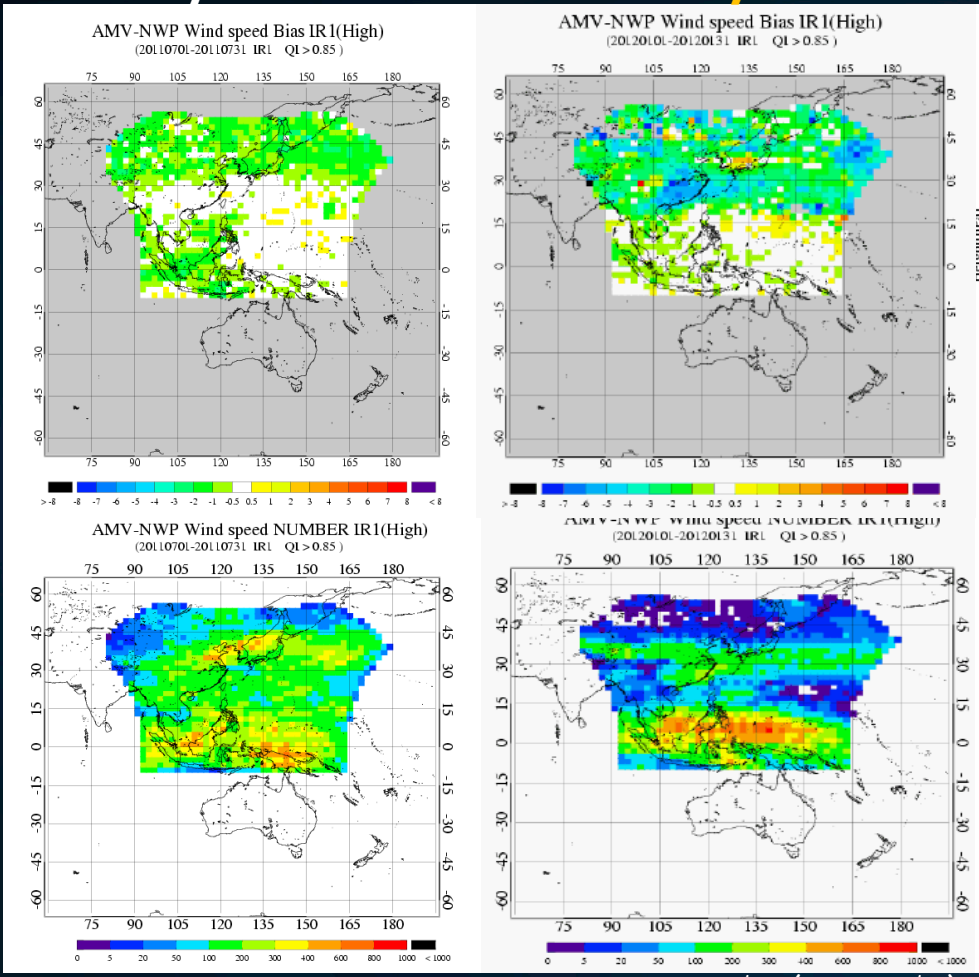
<Low-level VIS AMV>♪

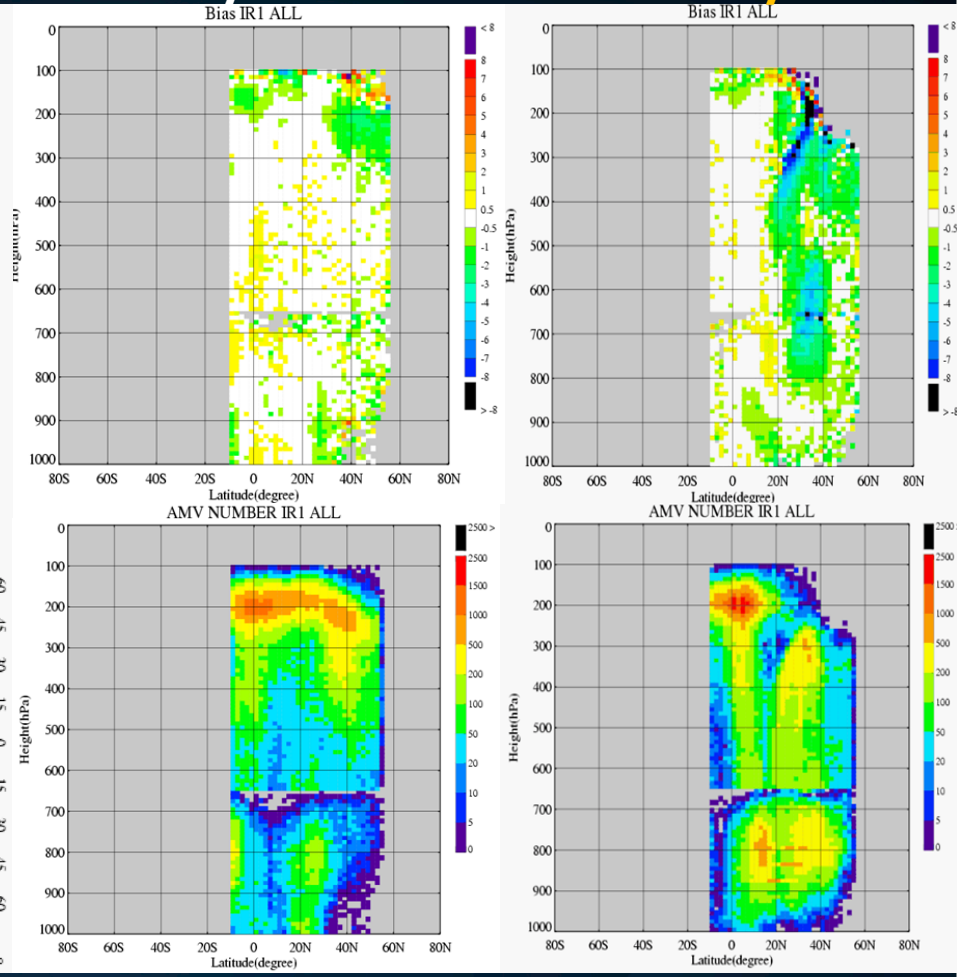


- Overall, COMS AMV has slow bias, especially in winter of NH, the AMV has slower bias (about -4 m/s in December) than any other seasons due to strong jet stream in high level.
- Low-level AMV shows relatively smaller slow bias than high level AMV.♪

Error characteristics of COMS IR AMV

<July 2011>♪ <January 2012>♪ <July 2011>♪ <January 2012>♪

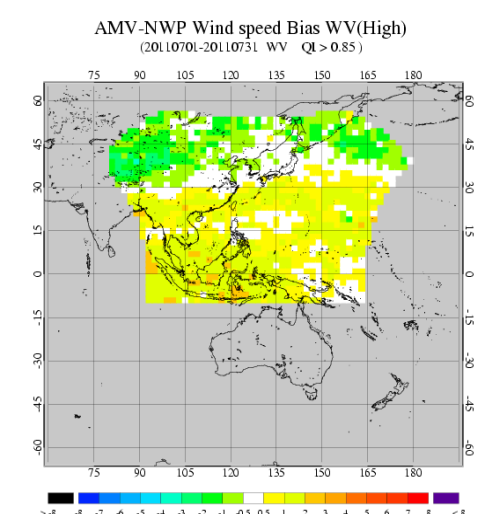


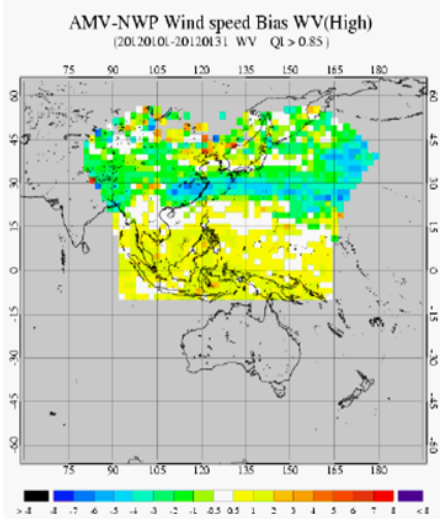


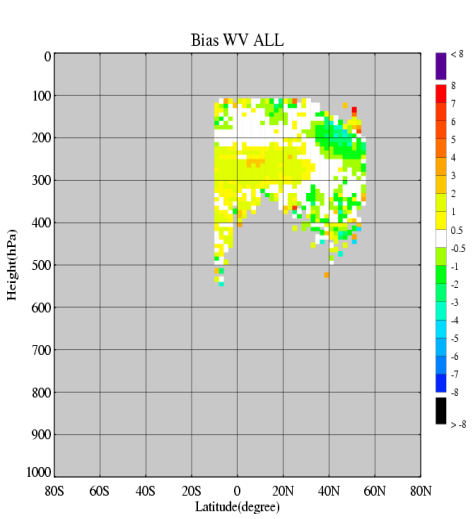
- The slow bias of larger than 5 m/s (−5 m/s) can be shown in the latitudinal band of 20 ~ 30 degree in both winter Hemispheres, while almost zero bias in tropical area with lower w ind speed. The height of maximum of AMV bias varies according to the latitude and seaso n. There is a discontinuity in tropopause level and also slower bias at around 250 hPa an d 650 hPa in winter time. ♪
- The accuracy of COMS AMV tends to contain statistically distinct seasonal variation.♪

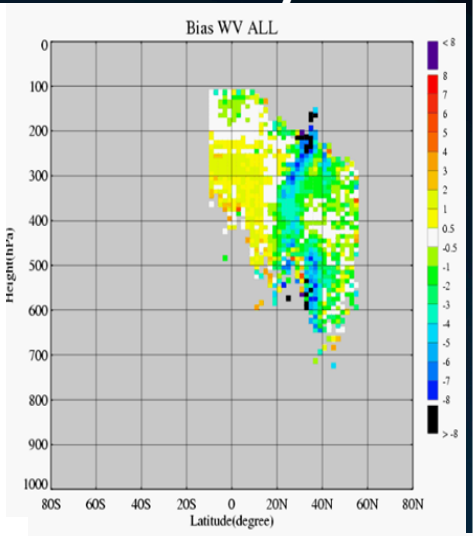
Error characteristics of COMS WV AMV

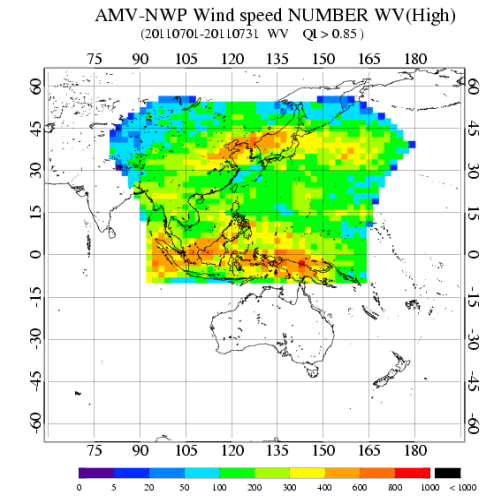
<July 2011>♪ <January 2012>♪ <July 2011>♪ <January 2012>♪

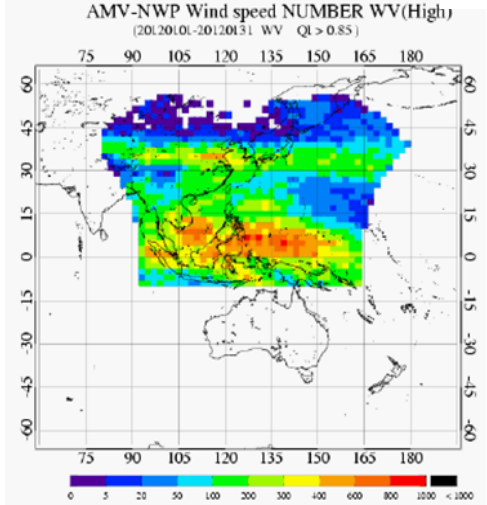


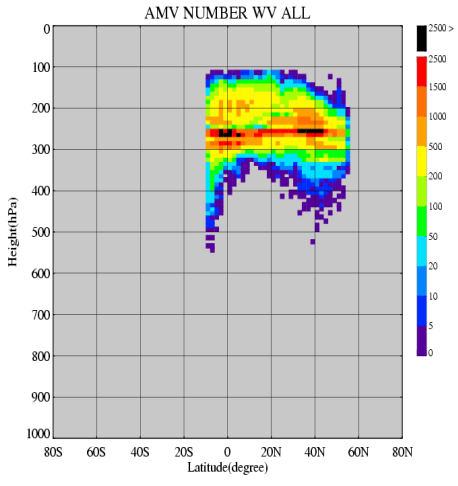


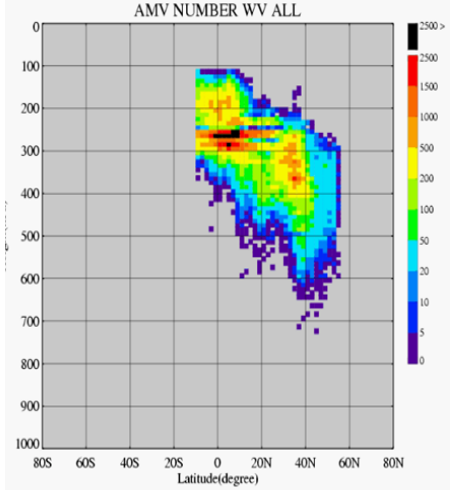












- High-level WV AMV is more distinctive slow bias pattern in mid-latitude than IR AMV. ♪
- High-level WV AMV has fast bias in tropical while high level IR AMV has zero bias .♪

KMA SATELLITE WINDS : CGMS - Report
(NWP comparison statistics)
Method : AMV _ NWP, AMV _ SONDE, NWP _ SONDE
Reporting Period : 2012010100 - 2012013123
Filtesrs : QUALITY >= 0.85
HEIGHT BOUNDARY : 0 - 1000 (hPa)
LATITUDE BOUNDARY : -50 - 50

Monthly Report♪

ir1

	ALL REGION			NH EX_TROP			TROP		
	AMV_NWP	AMV_SONDE	NWP_SONDE	AMV_NWP	AMV_SONDE	NWP_SONDE	AMV_NWP	AMV_SONDE	NWP_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
MIDLE 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

	A	B	C	D	E	F
1	No	F	X	Y	Element Name	Unit
2						
3	1	0	1	7	SATELLITE IDENTIFIER	CODE TABLE 1007
4	2	0	1	31	IDENTIFICATION OF ORIGINATING/GENERATING CENTRE (SEE NOTE 10)	CODE TABLE 1031
5	3	0	2	20	SATELLITE CLASSIFICATION	CODE TABLE 2020
6	4	0	2	28	SEGMENT SIZE AT NADIR IN X DIRECTION	M
7	5	0	2	29	SEGMENT SIZE AT NADIR IN Y DIRECTION	M
8	6	0	4	1	YEAR	YEAR
9	7	0	4	2	MONTH	MONTH
10	8	0	4	3	DAY	DAY
11	9	0	4	4	HOUR	HOUR
12	10	0	4	5	MINUTE	MINUTE
13	11	0	4	6	SECOND	SECOND
14	12	0	5	1	LATITUDE (HIGH ACCURACY)	DEGREE
15	13	0	6	1	LONGITUDE (HIGH ACCURACY)	DEGREE
16	14	0	2	152	SATELLITE INSTRUMENT USED IN DATA PROCESSING(6)	FLAG TABLE 2152
17	15	0	2	23	SATELLITE DERIVED WIND COMPUTATION METHOD	CODE TABLE 2023
18	16	0	7	4	PRESSURE	PA
19	17	0	11	1	WIND DIRECTION	DEGREE TRUE
20	18	0	11	2	WIND SPEED	M/S
	19	0	2	152	SATELLITE CHANNEL CENTRE FREQUENCY	Hz

	Byte	Filename
COMS IR AMV	157,398	coms_mi_le2_amv_ir1_201202130500.bufr
COMS WV AMV	189,166	coms_mi_le2_amv_wv_201202130445.buf
COMS VIS AMV	90,980	coms_mi_le2_amv_vis_201202130445.bufr

- NMSC/KMA has been producing Monthly Report for accuracy of COMS AMV.
- NMSC/KMA completed COMS AMV BUFR for IR AMV, WV AMV and VIS AMV.
- Time of dissemination of COMS AMV to other user centers is not exactly decided yet and under internal processing for GTS dissemination. ♪

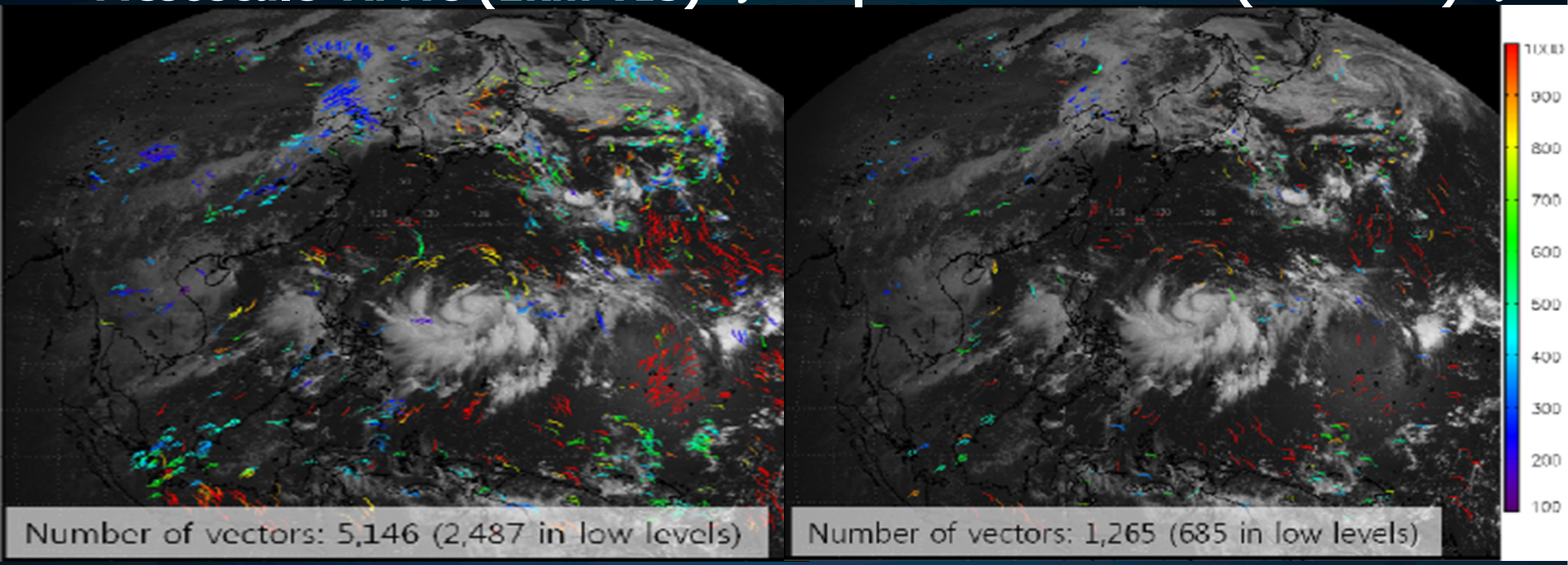
Recent works for COMS AMV

- NIMR/KMA derived COMS VIS AMVs with 1km Visible data (mesoscale AMV)
  - Target box is 24kmX24km, generation grid is 24km
  - Other conditions are similar to operational algorithm
  - Mesoscale AMVs are estimated for all levels with EBBT method.

  ✓ To compare validation results between mesoscale and operational AMV
  ✓ To find optimal QI method for mesoscale AMV
  ✓ To Validate mesoscale AMV with CALIOP cloud mask

- NWP center/KMA has applied COMS AMV for operational NWP data assimilation from Dec. 2011. ♪

<Mesoscale AMVs (1km VIS)>♪ <Operational AMVs (4km VIS)>♪



<Comparison of visible channel (a) mesoscale AMVs and (b) operational AMVs for 0000UTC on July 30, 2011 (QI>0.85) The color of AMVs indicates the vector's height and only 25% of all vectors are displayed> ♪

- Compared with the operational AMVs using visible channel images with 4km resolution, the number of vectors increases by about three times in mesoscale AMVs.

- In low levels, the number of mesocale AMVs is about 2.5 times as many as the operational AMVs and the mesoscale AMVs depict comparatively well cyclonic flows. ♪

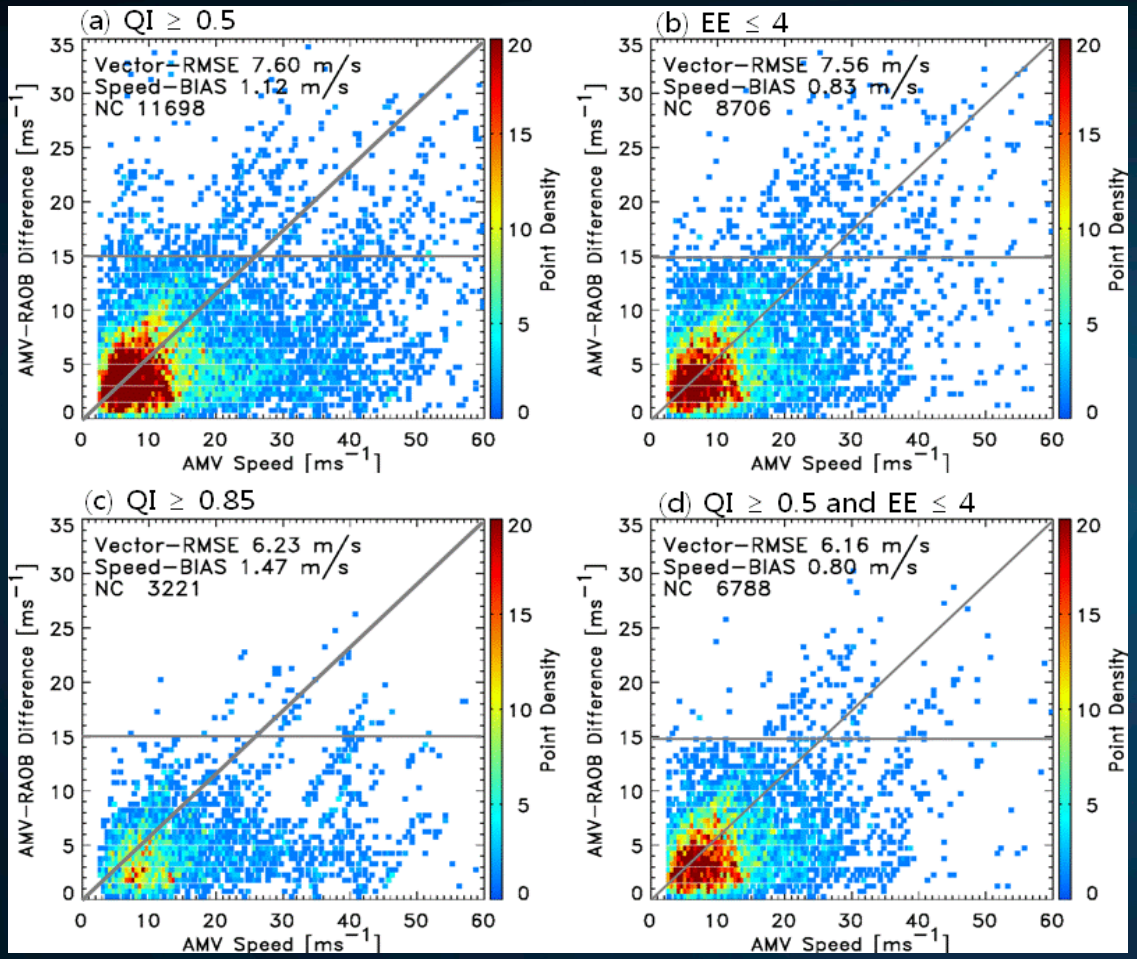
Comparison of validation results between mesoscale AMV and operational AMV (0000UTC, July 30. 2011)

QI ≥ 0.85	Mesoscale VIS AMV-NWP				Mesoscale VIS AMV-Sonde			
	Number of Collocated Vectors	Speed-BIAS	Vector-RMSE	Vector-NRMSE	Number of Collocated Vectors	Speed-BIAS	Vector-RMSE	Vector-NRMSE
All level	9865	0.54	5.05	0.53	85	2.26	7.54	0.77
High level	2580	1.21	5.97	0.38	52	1.54	7.09	0.61
Middle level	2679	1.50	6.29	0.65	13	5.30	11.38	1.13
Low level	4506	-0.40	3.40	0.56	20	2.17	5.17	1.16

QI ≥ 0.85	Operational VIS AMV-NWP				Operational VIS AMV-Sonde			
	Number of Collocated Vectors	Speed-BIAS	Vector-RMSE	Vector-NRMSE	Number of Collocated Vectors	Speed-BIAS	Vector-RMSE	Vector-NRMSE
All level	1294	-0.26	5.29	0.69	12	4.88	9.13	1.17
High level	220	0.87	5.30	0.40	8	5.76	10.09	1.24
Middle level	413	0.95	6.86	0.88	2	9.01	9.01	1.25
Low level	661	-1.39	4.00	0.72	2	0.62	3.44	0.49

- Most of vectors are derived in oceans, where available radiosonde data are sparse. when NWP winds are utilized for validation, mesoscale AMV can extract more vectors with high accuracy than operational AMV.
- In low levels, the speed-BIAS and vector-RMSE of mesoscale AMVs decrease by 71% and 15%,

Optimization of QC method for COMS AMV

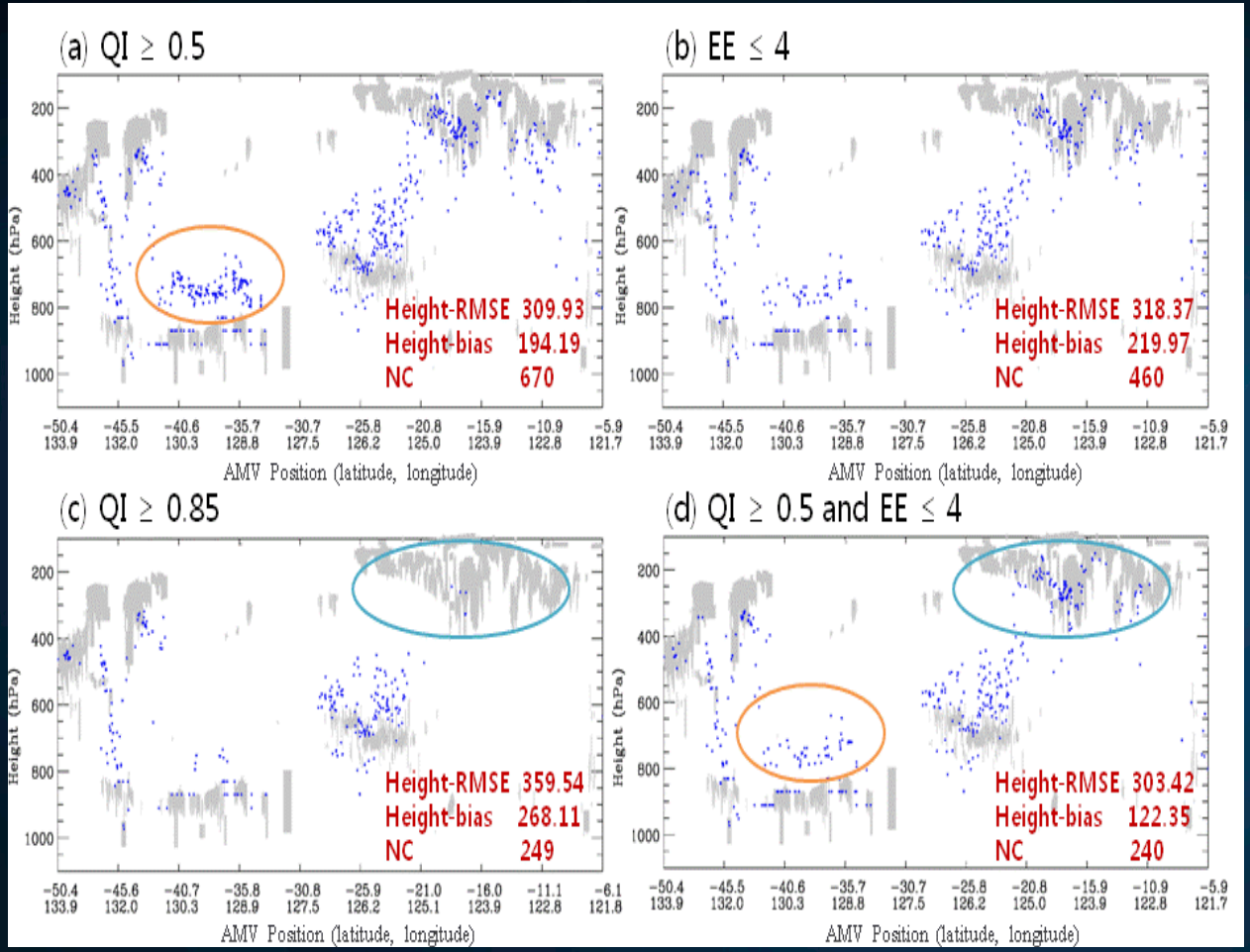


< Comparisons of quality control (QC) methods for mesoscale AMVs for February 2010. AMVs are extracted to satisfy individual QC condition: (a) QI ≥ 0.5 (left), (b) EE ≤ 4, (c) QI ≥ 0.85, and (d) QI ≥ 0.5 and EE ≤ 4 >

To improve QC method for mesoscale AMVs, sensitivity for QI threshold values and a new methodology is investigated.♪

- As a QI threshold gets higher from 0.5 to 0.85, Vector-RMSE decreases but Speed-BIAS increases. In addition, relatively low speed AMVs with high accuracy are removed out with use of a higher QI threshold.
- When the expected error (EE) is applied with a minimum QI value of 0.5, Vector-RMSE and Speed-BIAS decrease and more low speed AMVs with high accuracy remain. Therefore, QI (≥0.5) and EE (≤4) could be utilized together to reduce errors of mesoscale winds.♪

Validation of AMV height



< Validation of height assignment accuracy for mesoscale AMVs using CALIPSO cloud mask (0600 UTC 27 February, 2010). AMVs are extracted to satisfy individual QC condition: (a) QI ≥ 0.5 (left), (b) EE ≤ 4, (c) QI ≥ 0.85, and (d) QI ≥ 0.5 and EE ≤ 4 >

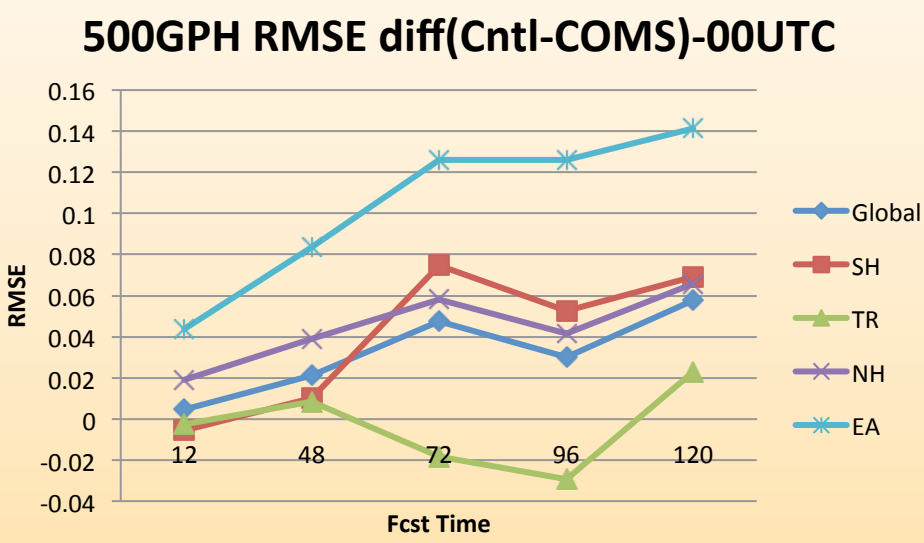
- In order to re-evaluate HA approaches of mesoscale AMVs, CALIPSO and CloudSAT satellites could be utilized and the cloud-top and cloud-base heights from those satellites are compared with AMV heights. ♪
- When a minimum QI value of 0.5 and a maximum EE value of 4 are applied, the bias and RMSE for height assignment (HA) are reduced and more vectors with high accuracy are derived in upper-level. These QC conditions tend to filter AMVs with poorly assigned heights and improve the accuracy of mesoscale AMVs.

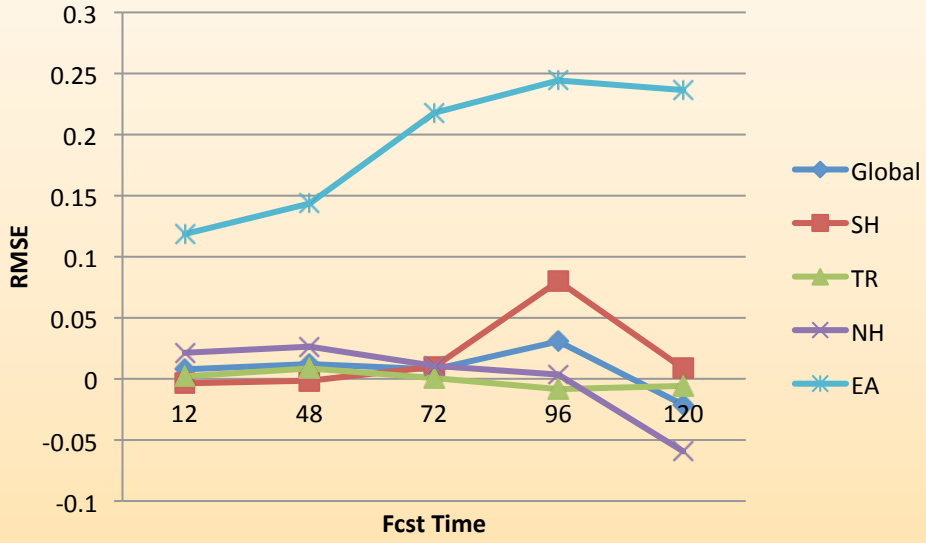
NWP Data Assimilation with COMS AMV in NWP center/KMA

기 상 청
국가기상위성센터
National Meteorological Satellite Center

- NWP center/KMA made experiment to apply hourly COMS AMV to NWP data a similation in operation and carried out positive effect in NWP performance, es ecially over East Asia region.
  - Period : 2011.9.1.~2011.10.30 / 4DVAR inner loop : N144L70
  - Time window : 2 hour (5 hourly COMS AMVs can be used)
  - OP : every 6 hours MTSAT AMV / EXP : hourly COMS AMV + every 6 hours MTSAT AMV

➔ 500 GPH RMSE of EXP was more improved by about 1% over East Asia region than that of OP.





NWPcenter /KMA♪

Conclusions

- NMSC/KMA has been producing and monitoring operationally COMS AMV since April 1, 2011. NWP center/KMA started using COMS AMV for operational UM NWP model running in the end of Dec. 2011.
- COMS AMV still needs to increase accuracy and vector number by improving height assignment and QI method etc.
- Mesoscale AMV showed better features in terms of accuracy and vector number than operational AMV (Preliminary results).
- NMSC/KMA have prepared to disseminate COMS AMV via GTS to other centers. But exact time is not determined and currently under internal processing.

Thank you