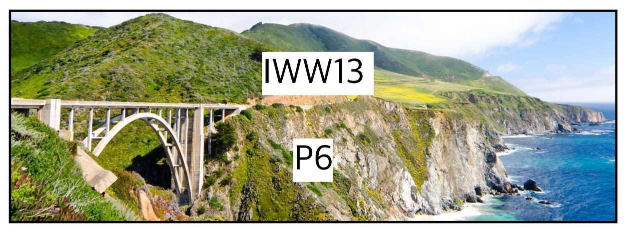


AMV Quality Control Method for the Next Generation Geostationary Satellite of Korea

Jae Hwan Kim*, Hyungmin Park
Department of Atmospheric Science, Pusan National University, Rep. of Korea
jaekim@pusan.ac.kr

Introduction

Atmospheric Motion Vector (AMV) is very important data for numerical weather prediction (NWP) models as it provides valuable wind information, especially where no ground measurement exist. To obtain qualitative information from each AMV product, Quality Control (QC) is required to verify the quality of the product. Two popular QC schemes that are used are Quality Indicator (QI) (Holmlund, 1998) and Expected Error (EE) scheme (Le Marshall et al., 2004; Berger et al., 2008). The QI is a simple scheme which consists of five vector consistency tests, which are emphasized on spatial and temporal consistency. The EE is essentially an extension of the QI, but it is based on regression between the difference of AMV and rawinsonde wind with respect to the five QI tests results and AMV's speed, pressure, NWP model vertical temperature gradient, and wind shear. We have performed two QC methods on the AMV derived from Current Korean geostationary satellite (COMS).

In this study, we present AMV QC (QI and EE) characteristics of Current Korean geostationary satellite (COMS) for the next Korean geostationary satellite Geo-Kompsat-2A (GK-2A) AMV quality control.

COMS and GK-2A Specification

For Further Information of the GK2A AMV Status Poster #2

Sensor

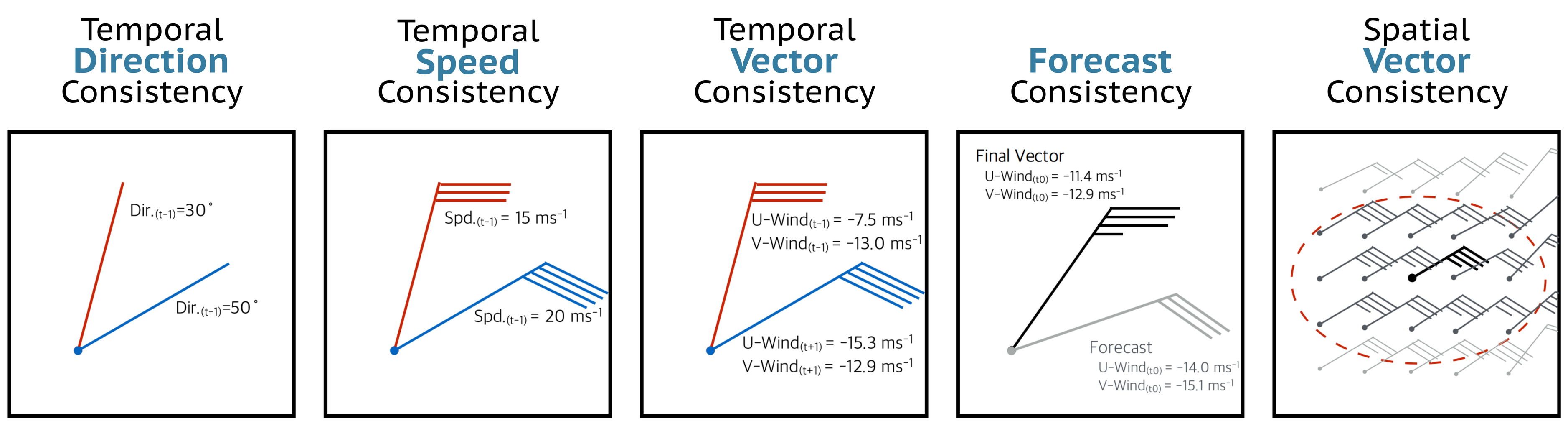
	COMS MI	GK-2A AMI
Spectral Coverage	5 bands	16 bands
Spatial Resolution		
0.6 ㎛	1.0 km	0.5 km
Visible	-	1.0 km
Infrared	4.0 km	2.0 km
Temporal Resolution		
Full Disk	3 hours	10 mins
ENH	15 min	5 mins
LA	7 mins	2 mins

Operational AMV info. and plan

	COMS MI	GK-2A AMI
Target Selection	Regular	Optimal
Target Size	24x24 (96x96 km^2)	24x24 (TBD) (48x48 km^2)
Tracking Method	Cross Correlation	Cross Correlation
Height Assignment		
Clear Target	NTC, NTCC	NTC, NTCC
Cloud Target	STC, EBBT IR/WV intercepts	GK2A-AMI CTH
Height Pixel Selection	Coldest 15%	CCC
Quality Control	QI	QI, EE

Quality Indicator (QI)

The Quality Indicator is an index which computed by weighted averaged 5 contingency tests, temporal direction consistency, temporal speed consistency, temporal vector consistency, spatial vector consistency, and consistency with the forecasted wind (Holmlund, 1998). Current COMS AMV has been used only QI as their Quality Control (QC).



$$\mathrm{QI} = \sum_{i=1}^{5} W_i \Phi_i$$

❖ Direction Test

$$\Phi_{dir.} = 1 - \left[\tanh\left\{\frac{Diff.(Dir.)}{coeff.A \cdot \exp\left(\frac{-Spd._{avg}}{coeff.B}\right) + coeff.C \cdot Spd._{avg} + coeff.D}\right\}\right]^{coeff.E}$$

❖ Others

$$\Phi_{other} = 1 - \left[\tanh\left\{\frac{Diff.}{MAX(coeff.A \cdot Spd._{avg},\ coeff.B) + coeff.C}\right\}\right]^{coeff.D}$$

Expected Error (EE)

The Expected Error (EE) is calculated from the 9 components which are the wind speed, the wind speed and temperature shear, the pressure level and the five QI values. The vertical wind and temperature shear are clearly related to AMV error, determining how heigh assignment errors influence AMV quality. Least square regression is used to compute the root mean square error from the EE components. The EE will be used Geo-Kompsat 2A AMV quality control algorithms with QI.

Step 1. Collect past collocated data between AMV and rawinsonde observation

Step 2. Obtain linear regression coefficients (= EE coefficients) against the wind vector difference

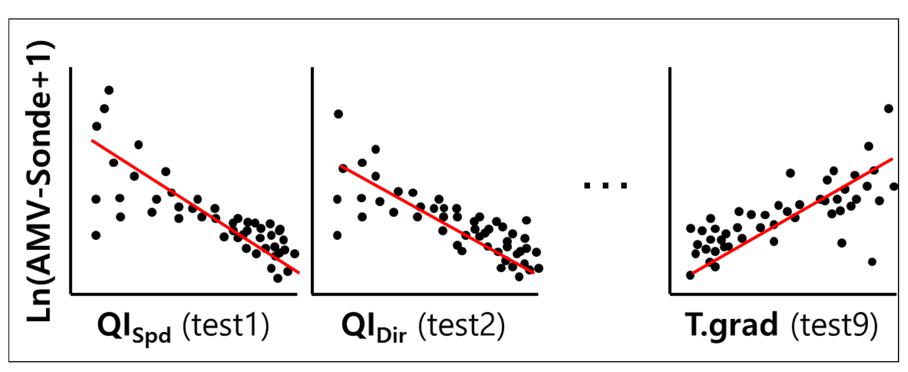
$$\ln(DIFF(AMV, RAOB) + 1) = Const. + \boldsymbol{a_1}x_1 + \boldsymbol{a_2}x_2 + \cdots + \boldsymbol{a_9}x_9$$

<Components>

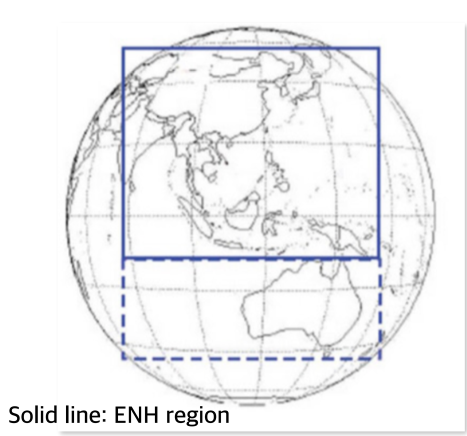
1. QI_{speed}
2. $QI_{direction}$
3. $QI_{vector\ diff.}$
4. $QI_{local\ vector}$
5. $QI_{forecast}$
6. Wind Speed
7. Pressure Level
8. Wind Shear (at 200 hPa)
9. Temp. Gradient (at 200 hPa)

Step 3. Compute EE at every AMVs using EE coefficients

$$\mathrm{EE} = \exp(Const. + a_1x_1 + \cdots + a_9x_9) - 1 \approx DIFF(AMV, RAOB)$$



Test Dataset



Solid line: ENH region

Satellite & Sensor	COMS MI
Region	COMS ENH Region
Channel	IR 1 (10.8 ㎛)
Period	2014. Jan. ~ Feb. (2 month), every 6 hours 2014. Jun. ~ Jul. (2 month), every 6 hours
Target Size	24x24 pixel^2 (96x96 km^2)
Target Selection	Regular
Quality Control	QI, EE

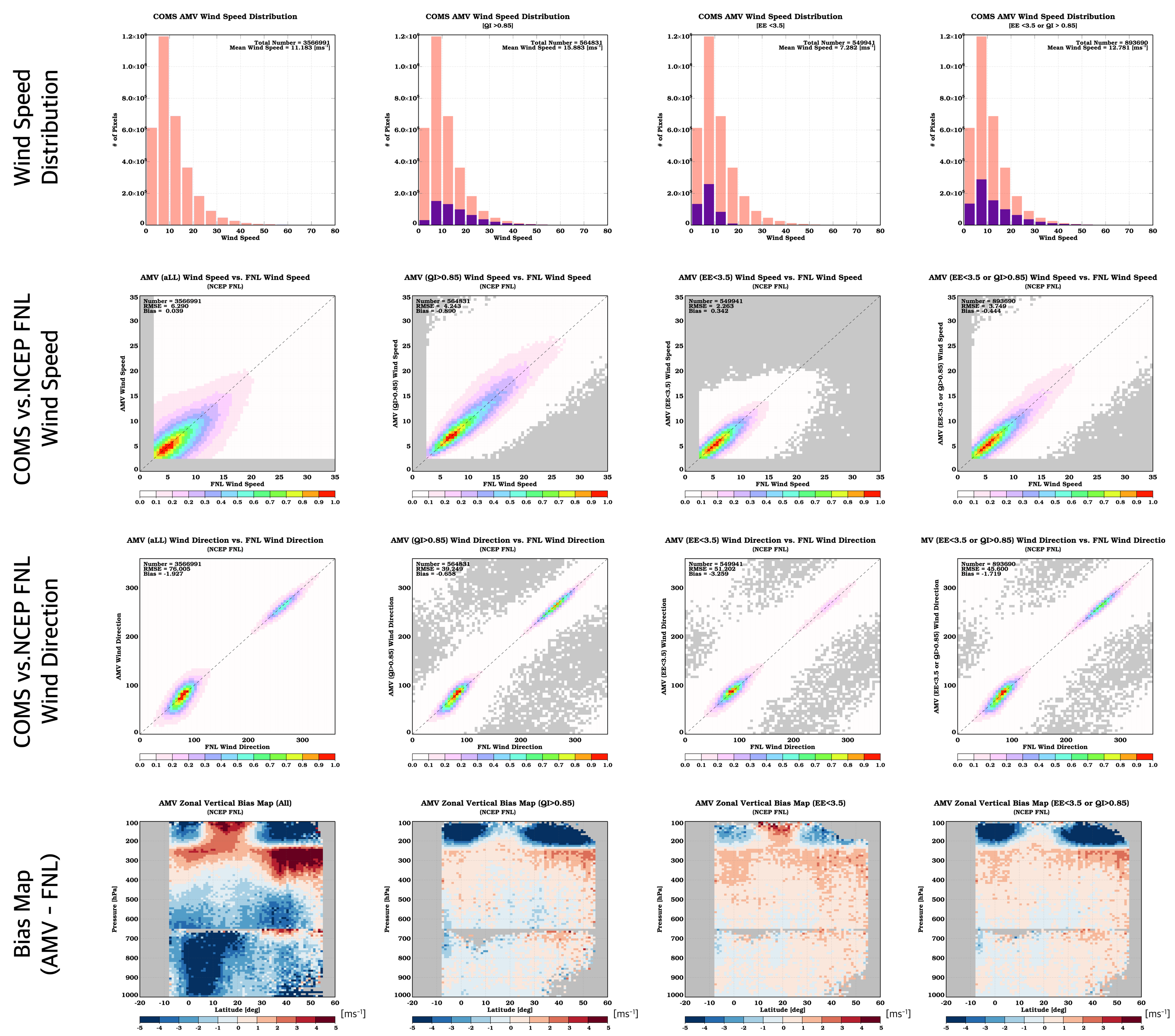
Validation Dataset

Data	NCEP Reanalysis FNL
Period	2014. Jan. ~ Feb. (2 month), every 6 hours 2014. Jun. ~ Jul. (2 month), every 6 hours

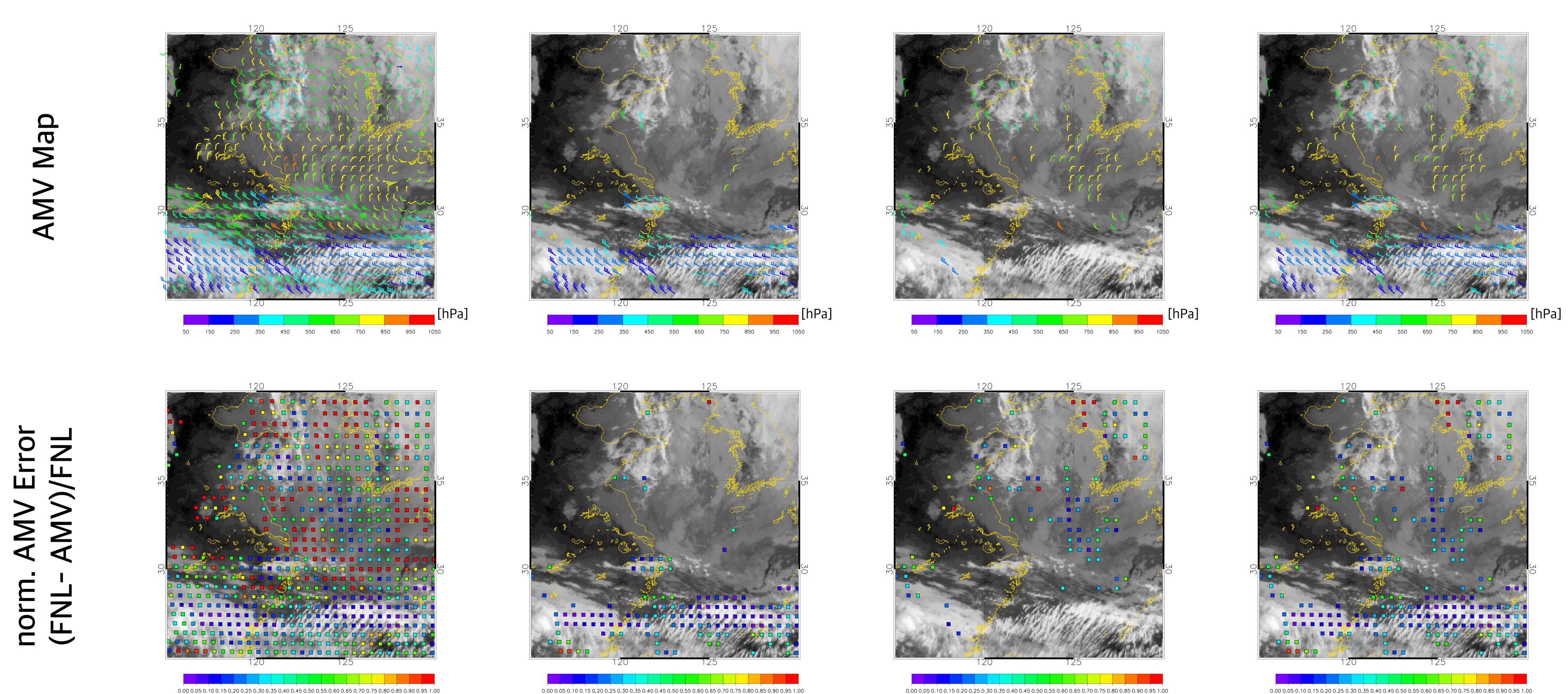
Results of Quality Control

We have performed two QC methods (QI, EE) on the AMVs derived from current Korean geostationary satellite (COMS-MI). The Analysis shows when QI is applied, a significant portions of slow wind vectors where are located in low altitude are eliminated [Column 2]. On the contrary, when EE is applied , relatively strong wind in high altitude is eliminated whereas slow wind in low altitude is selected [Column 3]. The combined QI and EE has provided improved AMV performance in selecting qualitative wind vectors both in low and high altitudes [Column 4].

<June ~ July 2014>



<June 5th 00UTC 2014>



<Stats>

	January ~ February 2014				July ~ August 2014			
	ALL	QI	EE	QI+EE	ALL	QI	EE	QI+EE
# of AMVs	2,562,503	508,775	339,007	**650,278**	3,039,345	558,762	462,559	**805,295**
Mean Vector Difference	7.934	4.177	2.639	**3.869**	6.475	4.104	2.579	**3.653**
Bias (Wind Speed)	-2.418	-0.502	-0.356	**-0.523**	-0.039	0.890	-0.342	**0.444**
RMSE (Wind Speed)	8.397	3.969	2.304	**3.679**	6.290	4.243	2.263	**3.749**
RMS Vector Difference	10.588	5.249	3.261	**4.901**	8.584	5.346	3.183	**4.799**
Normalized BIAS	-0.159	-0.027	-0.041	**-0.032**	-0.003	0.059	-0.044	**0.035**
Normalized RMSE	0.552	0.211	0.266	**0.226**	0.550	0.281	0.291	**0.298**
Normalized RMSVD	0.696	0.279	0.379	**0.301**	0.751	0.354	0.409	**0.381**

Plan

- Optimizing QI and EE coefficients for Himawari8 AHI (for simulation) and GK-2A AMI sensor
- Improving QI to evaluate every vector quality (highly curving or linear wind)
- Developing automatic EE coefficient extracting program

References

- Holmlund, K., 1998: The utilization of statistical properties of satellite-derived atmospheric motion vectors to derive quality indicators, Weather and Forecasting, 13, 1093-1104.
- Le Marshall, J., L. Leslie, R. Seecamp, and M. Dunn, 2004: Error Characterisation of Atmospheric Motion Vectors. Aust. Met. Mag. 53, 123-131.
- Berger, H., C. Velden, S. Wanzong, and J. Daniels, 2008: Assessing the 'Expected Error' as a Potential New Quality Indicator for Atmospheric Motion Vectors. Proc. 9th Int. Winds Workshop, Annapolis, Maryland, USA.