Verification of AMVs in the T-PARC Period

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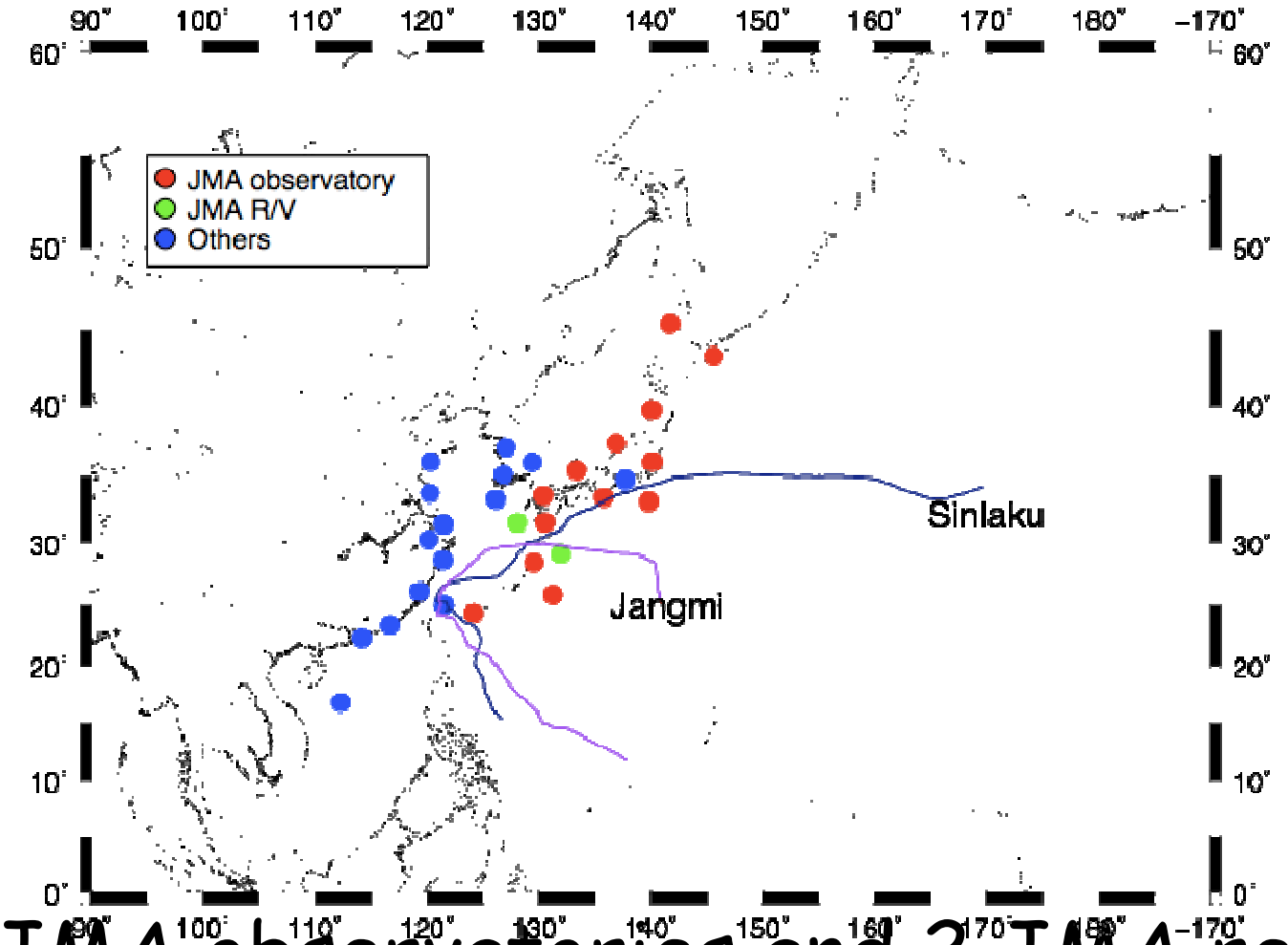
Methodology

- The AMVs using MTSAT2 rapid scan images (15 min. and 4 or 7 min. interval) are validated with the sonde data of JMA observatories, JMA research vessels and the other observatories in the eastern Asia regions. The non-JMA data are obtained from Wyoming university web site.
- The AMVs from IR1 channel (the middle and the upper levels) and WV channel (only cloudy area) are validated (only for QI > 0 cases).
- For the calculation, the two algorithms are used: the operational MSC (in 2008) algorithm, and the upgraded algorithm implementing new targeting algorithm by Shimoji (2010) (hereafter, we call 'MSC' and 'S10' respectively).

Introduction

- In the T-PARC 2008 period, the rapid scan observations with MTSAT2 are operated for Typhoon Sinlaku (Sep. 10th 13Z to 13th 05Z and 17th 13Z to 18th 11Z) and Typhoon Jangmi (Sep. 27th 13Z to 28th 11Z). And the atmospheric wind vectors are calculated using these rapid scan images with 15 min. and 4 or 7 min. interval.
- In this study, we aimed to validate the quality of these AMVs using rapid scan data.

Upper Air Observation Map



- 13 JMA observatories and 2 JMA research vessels
- 16 other observation sites (data from Wyoming University)

Parameters

- Validation of Wind Speed

$$(BIAS) = \frac{1}{N}\sum(SPD_i - SPD_r)$$

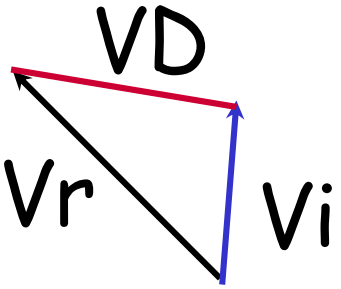
- Validation of Vector Difference

$$(VD) = \sqrt{(U_i - U_r)^2 + (V_i - V_r)^2}$$

$$(MVD) = \frac{1}{N}\sum(VD)_i$$

$$(SD) = \sqrt{\frac{1}{N}((VD)_i - (MVD))^2}$$

$$(RMSVD) = \sqrt{(MVD)^2 + (SD)^2}$$



AMV Calculation Settings

	Operational	This Study		
Template size (pixels)	32	32	16	8
Search Area size (pixels)	64	64	32	16
Grid (degrees)	0.5	0.5	0.25	
Cb Area	Not targeted	Targeted		
Image interval (minutes)	15	15 / 4 or 7		
Algorithm	MSC	MSC or S10		

Hereafter, the calculation settings are presented as T[template size]S[search area size]Deg[grid degrees] - like 'T16S32Deg050'.

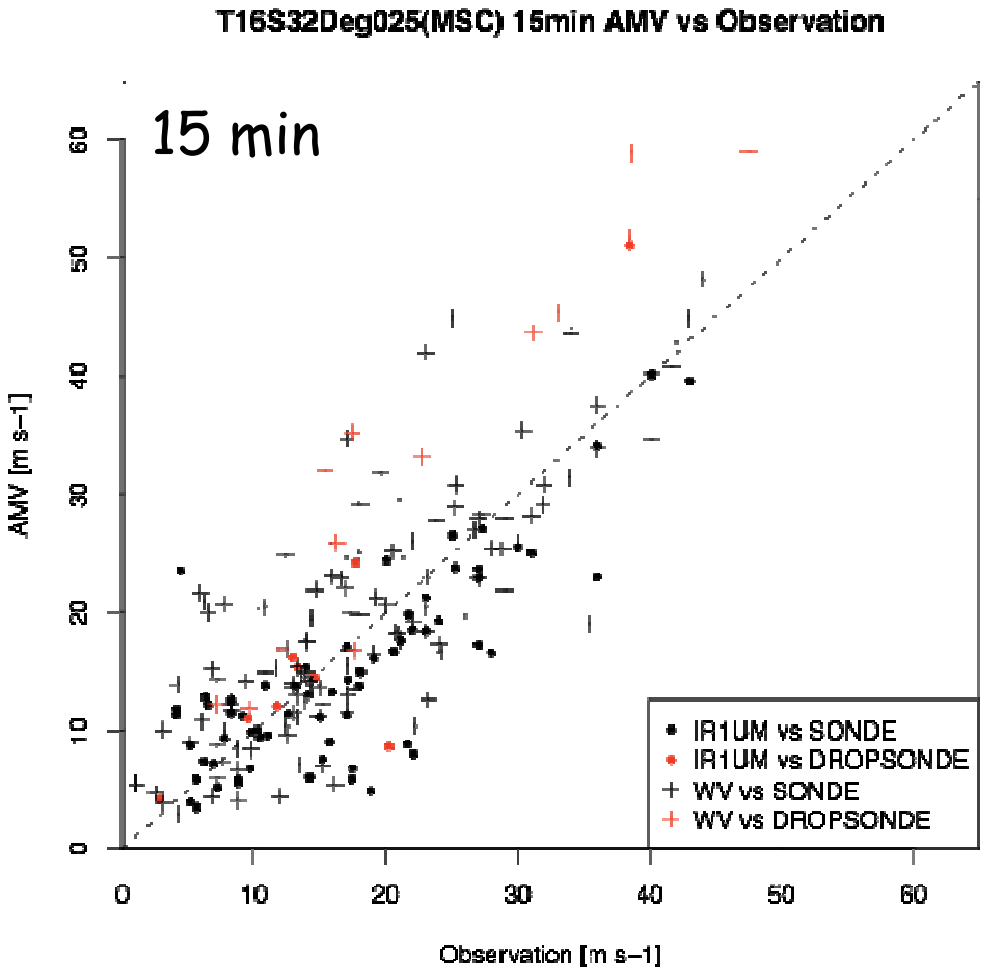
Match-up Limitations

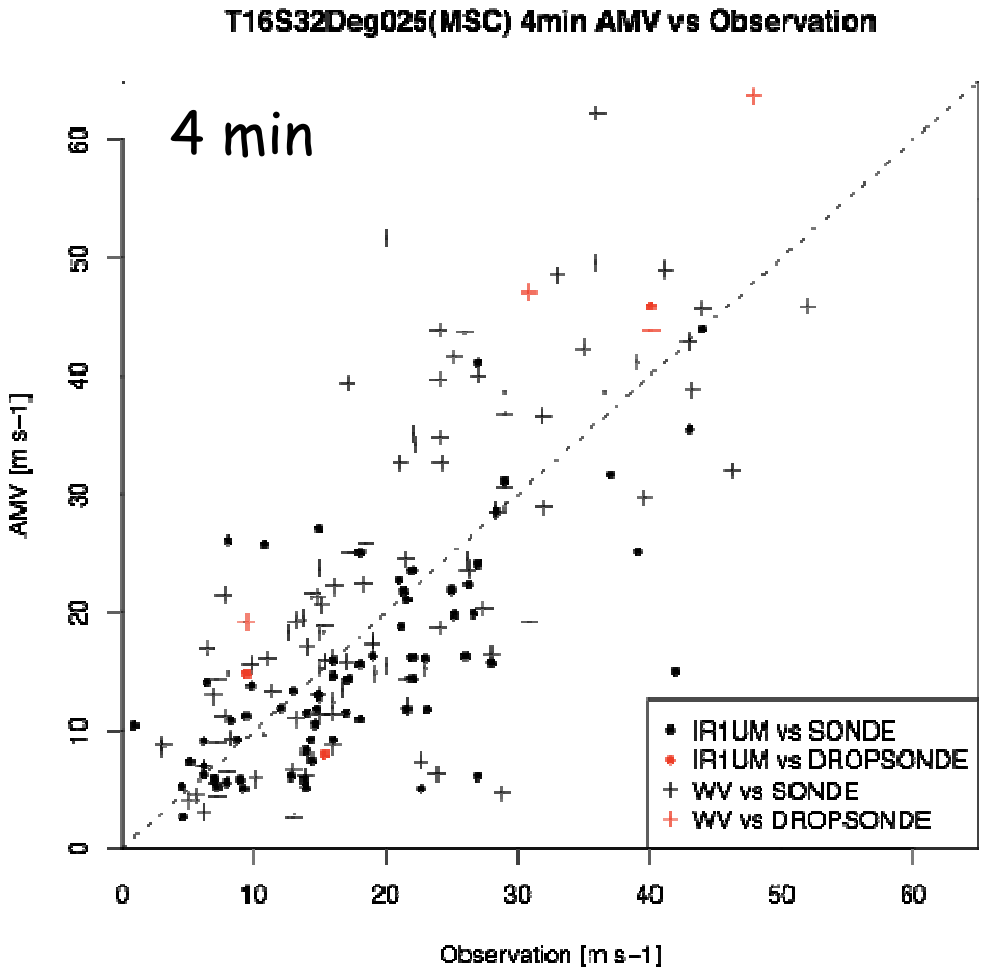
	Collocations
Distance from Observatory	0.3 deg lat (for Deg025) 0.5 deg lat (for Deg050)
Height	30 hPa (above 700Pa) 50 hPa (below 700 hPa)
Time	0 hr (for 15min) 1 hr (for 4/7 min)

Imagery interval:

- 01,04,07,10,13,16,19,22Z : 15 and 4 min.
- 02,05,08,11,14,17,20,23Z : 15 and 7 min.
- 00,03,06,09,12,15,18,21Z : 15 min. only

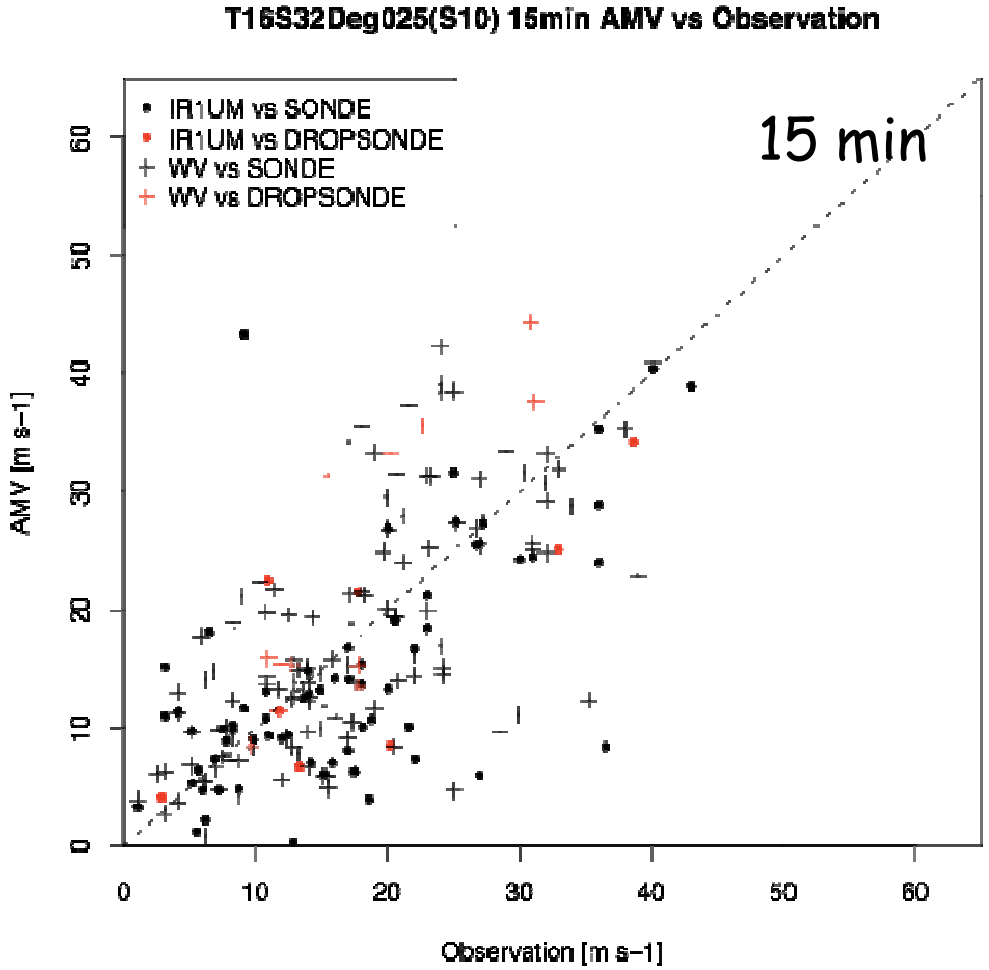
Validation of Wind Speed

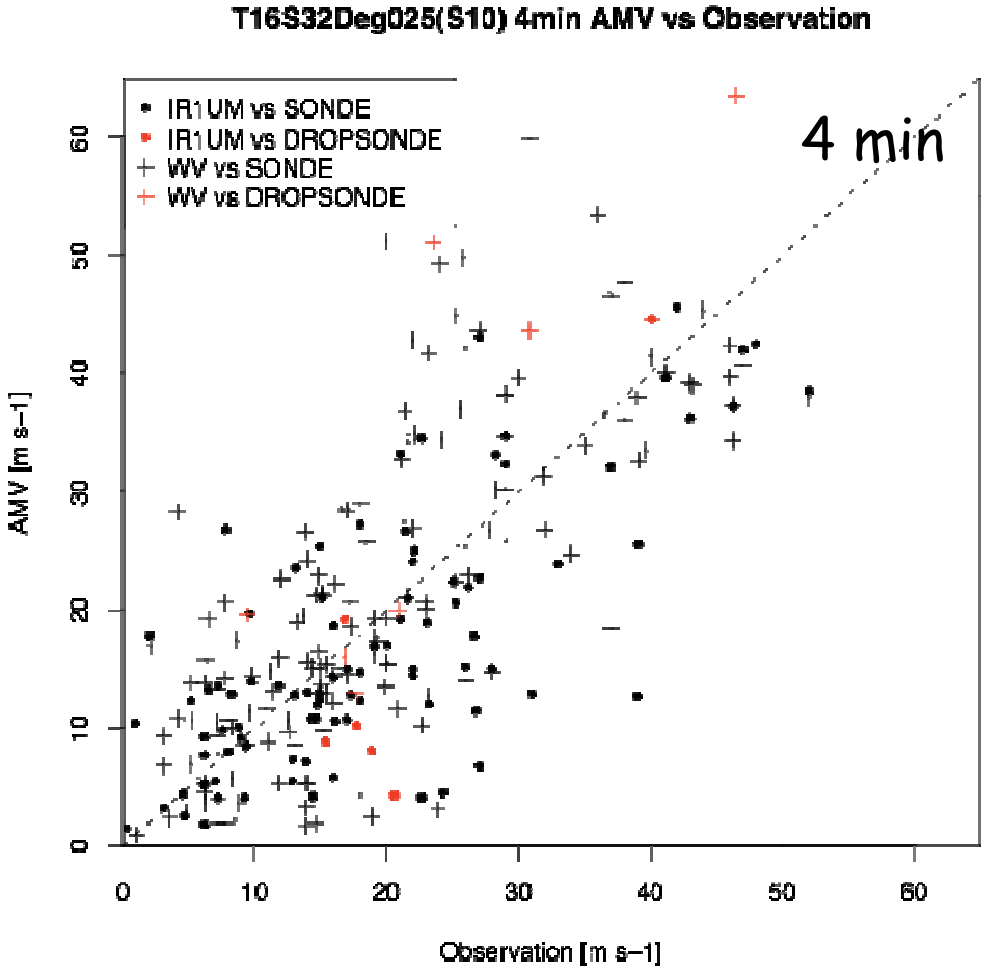




SPD_RMSE	15min	4min	7min
IR1 vs SONDE	5.96	7.70	7.16
WV vs SONDE	6.39	9.23	6.87

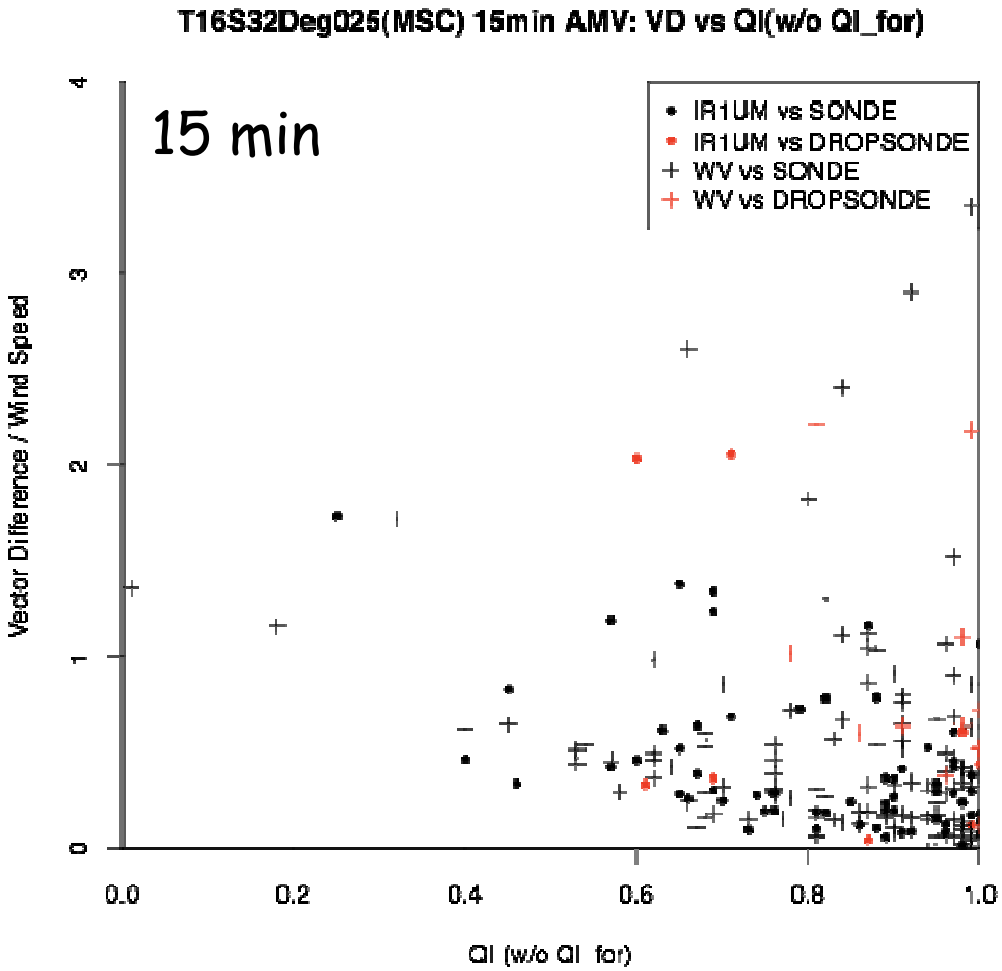
Validation of Wind Speed

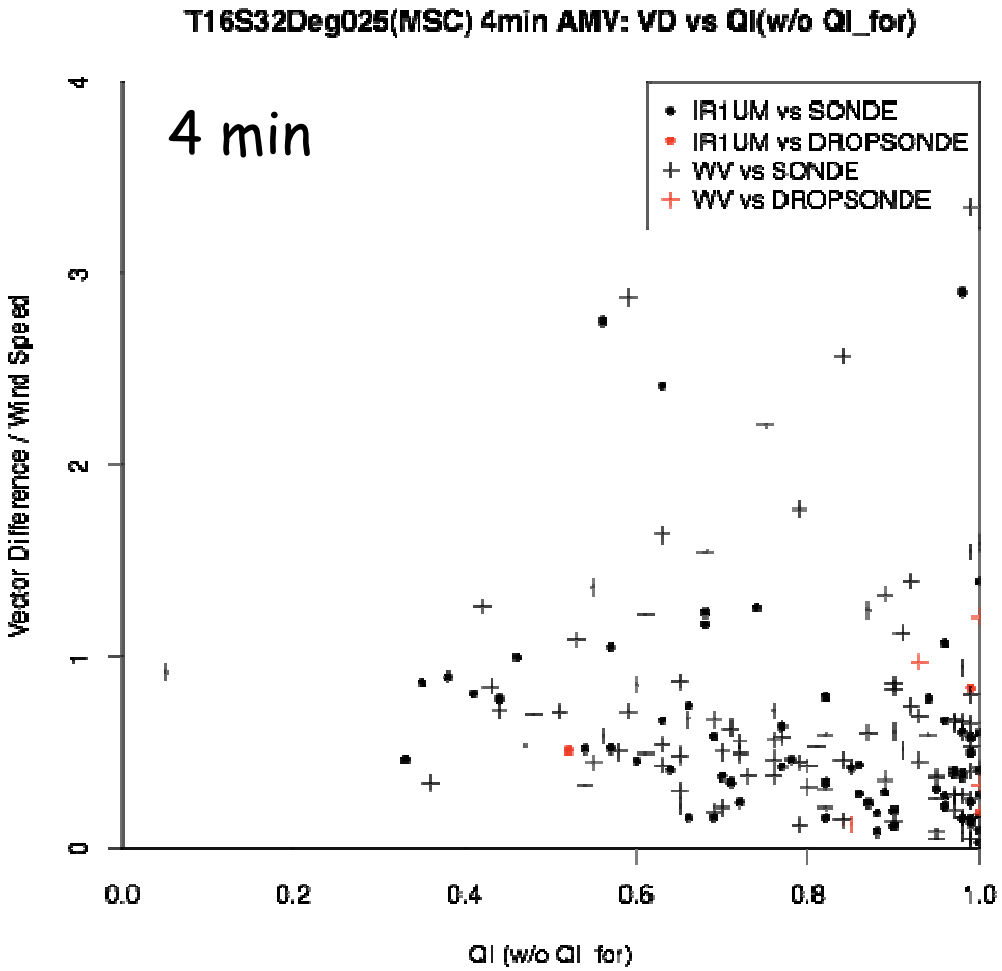




SPD_RMSE	15min	4min	7min
IR1 vs SONDE	8.40	8.40	9.40
WV vs SONDE	7.66	10.27	15.53

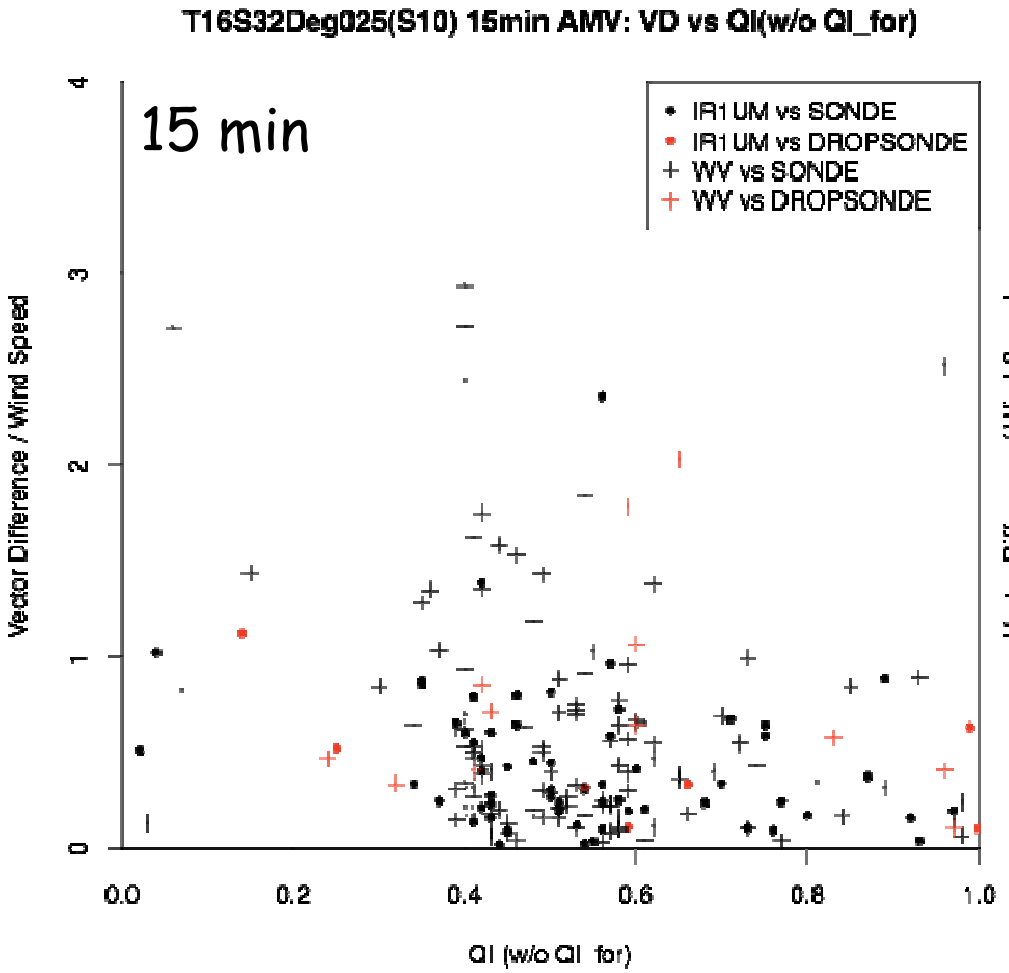
Vector Differences

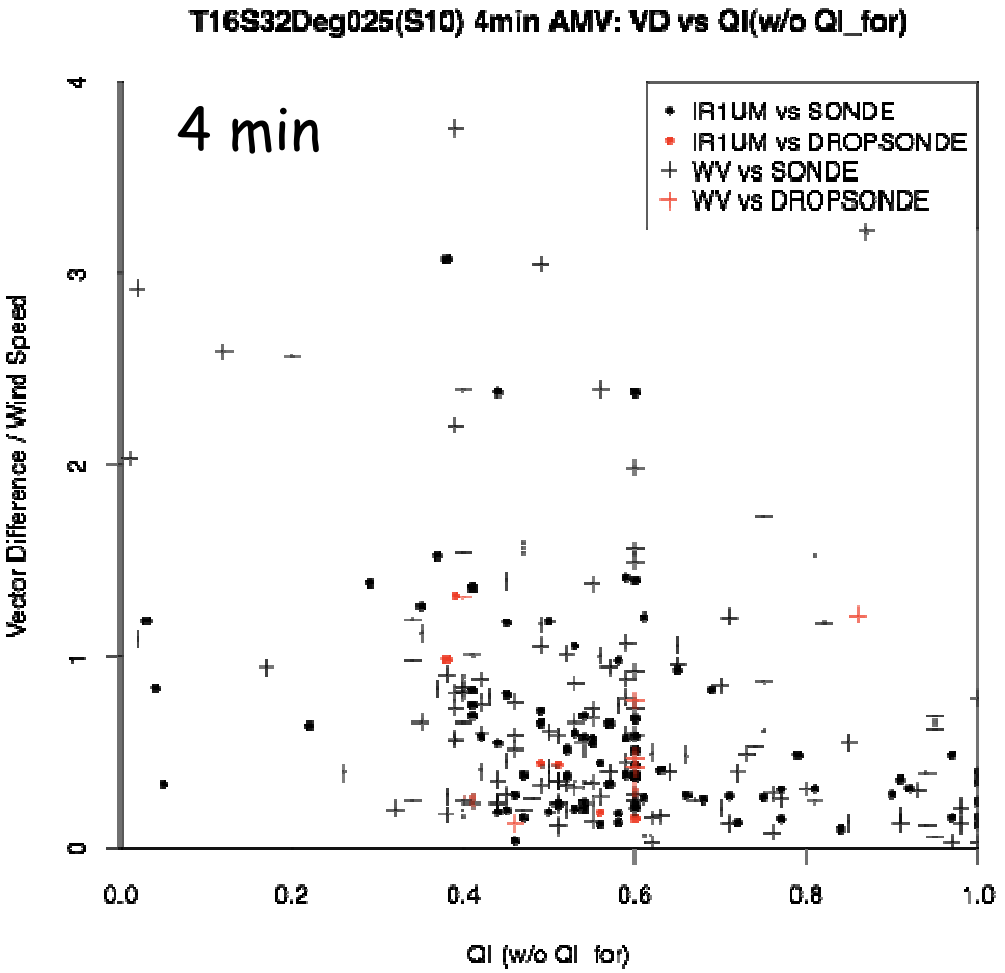




RMSVD	15min	4min	7min
IR1 vs SONDE	7.28	10.24	9.09
WV vs SONDE	9.21	12.90	10.16

Vector Differences





RMSVD	15min	4min	7min
IR1 vs SONDE	9.90	11.63	12.48
WV vs SONDE	14.58	15.23	19.33

Results of Validations (IR1)

		Int.	N	BIAS	RMSE	RMSVD
T08S16 Deg025	MSC	15	29	-1.14	4.73	6.73
		4	45	-1.88	7.48	9.97
		7	32	-0.91	9.09	11.44
	S10	15	35	-2.60	9.34	10.44
		4	59	-1.42	8.59	10.53
		7	53	-3.18	10.06	13.11
T16S32 Deg025	MSC	15	66	-2.15	5.96	7.28
		4	70	-2.51	7.70	10.24
		7	58	-3.43	7.16	9.09
	S10	15	67	-2.30	8.40	9.90
		4	90	-1.94	8.40	11.63
		7	88	-2.13	9.40	12.48

Results of Validations (WV)

		Int.	N	BIAS	RMSE	RMSVD
T08S16 Deg025	MSC	15	83	1.59	5.82	8.77
		4	65	2.32	9.78	12.51
		7	57	1.00	6.72	9.62
	S10	15	88	-0.40	7.56	13.23
		4	101	2.19	13.09	16.51
		7	96	1.83	8.52	12.98
T16S32 Deg025	MSC	15	119	1.39	6.39	9.21
		4	101	2.13	9.23	12.90
		7	112	1.46	6.87	10.16
	S10	15	121	0.38	7.66	14.58
		4	151	2.12	10.27	15.23
		7	149	3.29	15.53	19.33

Summary of Validation Results

- For the wind speed, the biases are about -3 to 3 m/s and the RMSEs are about 5 - 10 m/s for each configurations and algorithms.
- For the vector differences, RMSVDs are about 10 - 20 m/s.
- For IR AMVs, the differences of the algorithms or the target size selections seems not so significant.
- For WV AMVs, S10 algorithm seems to make the error larger.
- QI and VD error do not have so good correlation. Some of high QI data have large VD error.

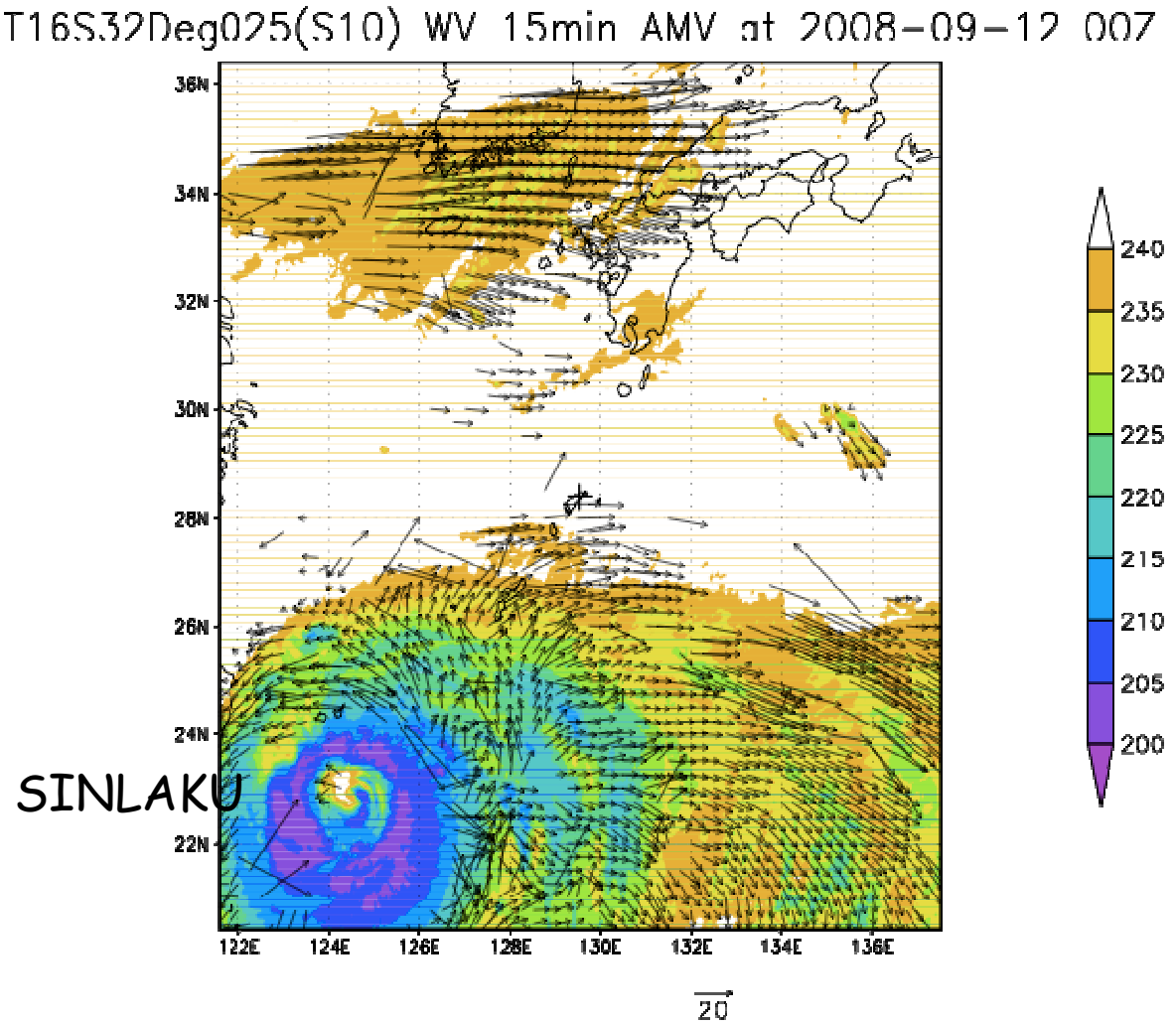
Large Error Cases (WV AMVs)

		15min	4min	7min
T08S16 Deg025	MSC	2 (83)	2 (65)	3 (57)
	S10	2 (88)	4 (101)	5 (96)
T16S32 Deg025	MSC	4 (119)	4 (101)	4 (112)
	S10	4 (121)	10 (151)	7 (149)

The numbers of the cases with the large VD error (VD / SPD_{SONDE} > 2 and SPD_{SONDE} > 5 m/s). The parenthetic numbers show the total number of match-up data.

WHERE these large error comes from ?

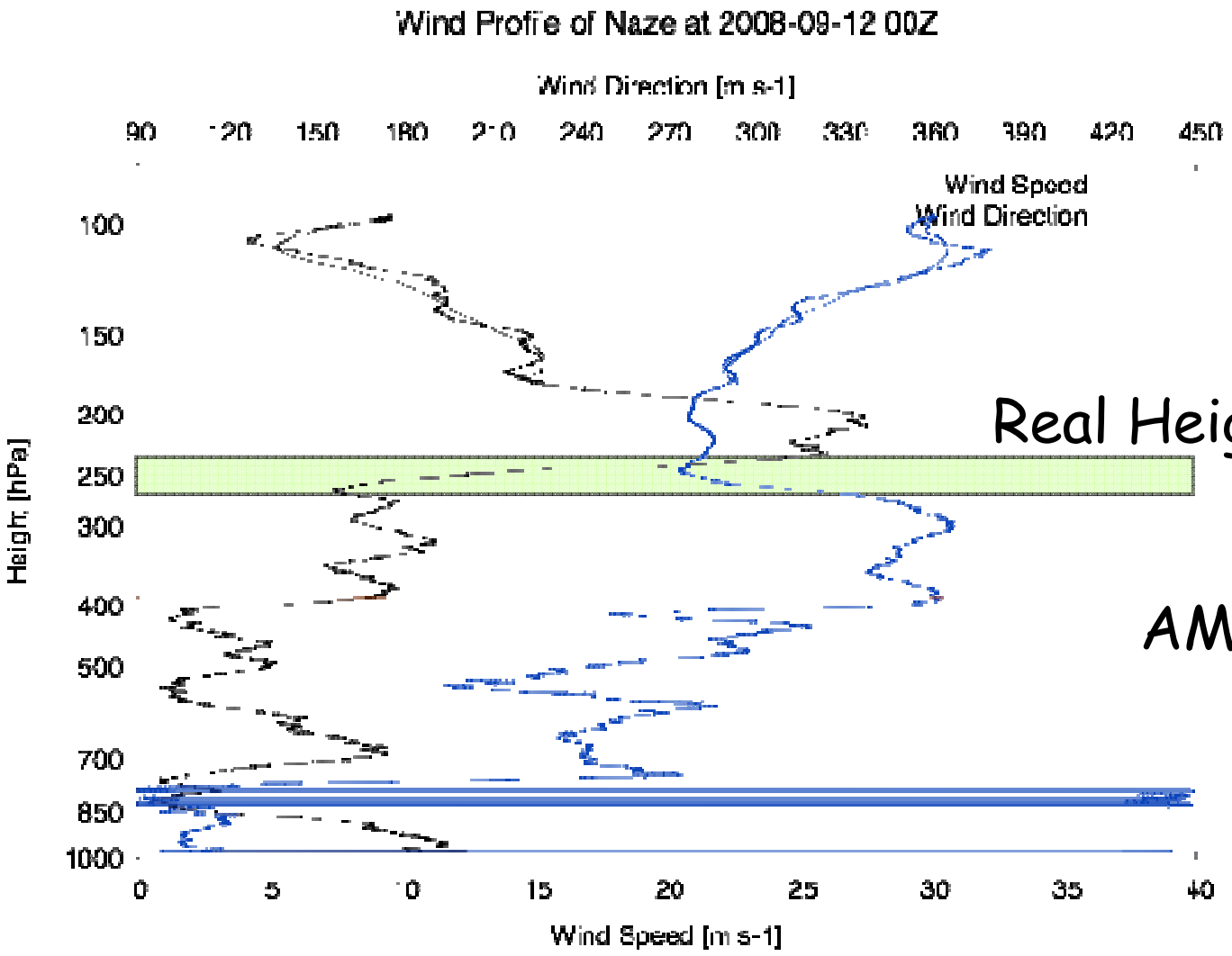
Example of large error case



SINLAKU

Sonde at Naze: 8.29 m/s, 3.46 deg
T16S32Deg025(S10) WV 15min AMV Wind :18.9 m/s, 271.8 deg
But in this figure, AMV seems consistent with neighbor AMVs and QI=0.80 (0.96 without QI_for!).

Height Assignment Problem

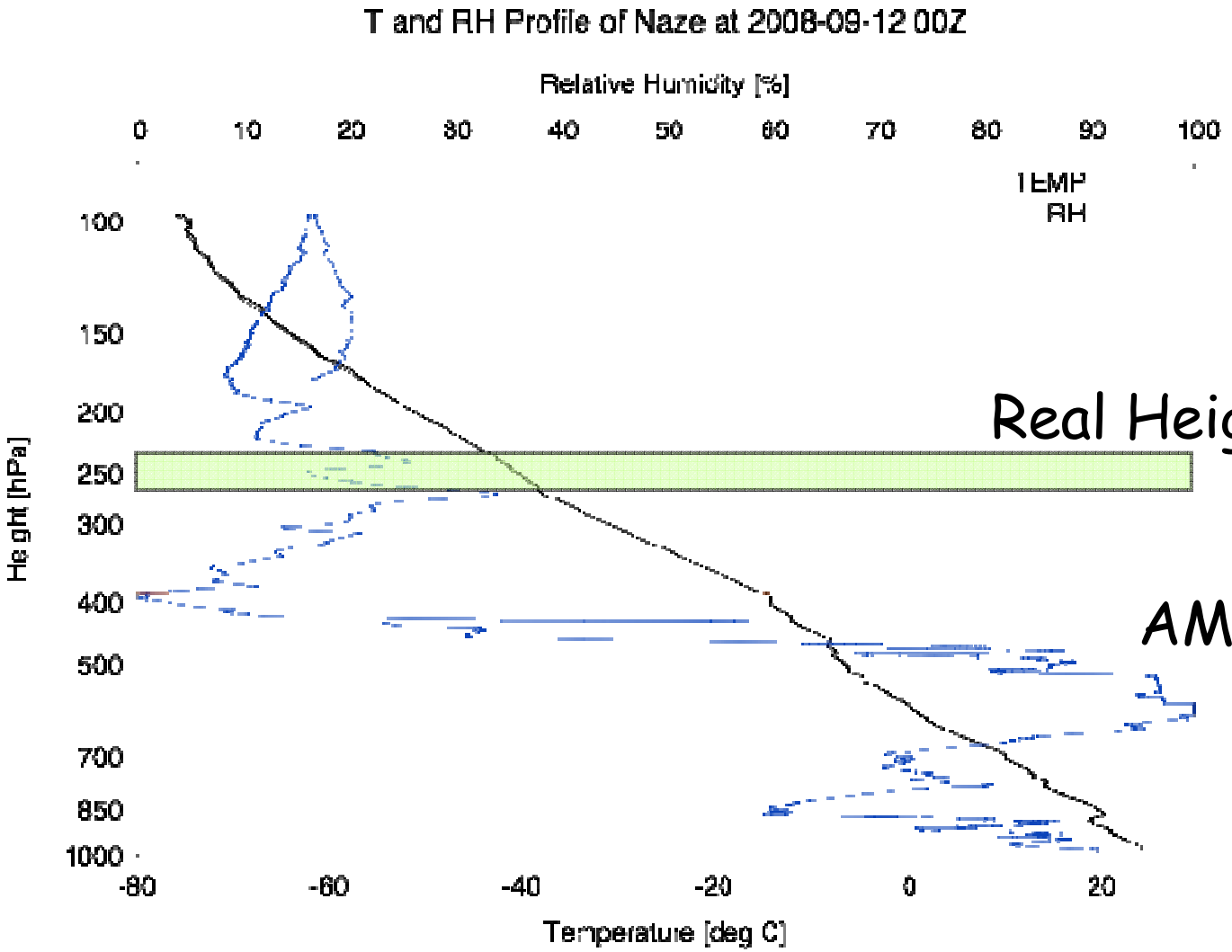


Real Height ?

AMV Height

T16S32Deg025(S10) WV 15min AMV Wind (18.9 m/s, 271.8 deg) are more consistent with near 250 hPa wind than AMV height (386.5 hPa) wind.

Height Assignment Problem



Real Height ?

AMV Height

The 'multi-layer' situation makes the height assignment difficult.

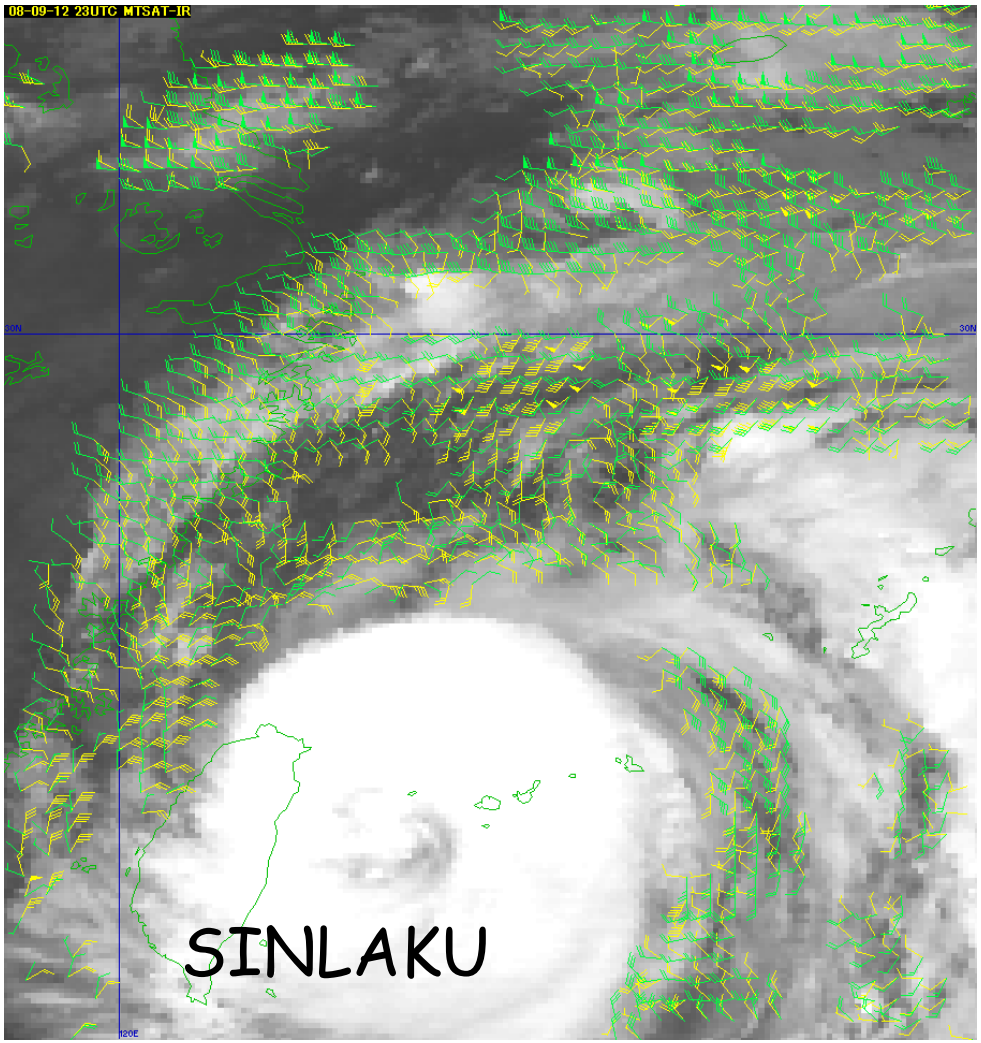
Height Assignment Problem

		15min	4min	7min
T08S16 Deg025	MSC	2 (2)	0 (2)	3 (3)
	S10	0 (2)	0 (4)	3 (5)
T16S32 Deg025	MSC	3 (4)	2 (4)	2 (4)
	S10	2 (4)	2 (10)	2 (7)

The numbers of the cases of possible miss-assignment of WV AMV height with the large VD error (VD / SPD_{SONDE} > 2 and SPD_{SONDE} > 5 m/s). The parenthetic numbers show the total number of the large error cases.

Almost case with possible height miss-assignment seems consistent with winds of 250 - 200 hPa layer.

Height Assignment Problem



Comparison of NWP and IR1 AMVs at 2008-09-12 00Z
GREEN: NWP, YELLOW: IR1 AMVs
Error become large in the thin cirrus region.

Summary

- The AMVs using MTSAT2 in the T-PARC 2008 period are validated with the sonde data of the JMA observatories, JMA research vessels and other observatories in the eastern Asia and the dropsonde data launched from Falcon.
- The two algorithms are used - the operational MSC and Shimoji (2010).
- For the wind speed, the biases are about -3 to 3 m/s and the RMSEs are about 5 - 10 m/s for each configurations and algorithms.
- For the vector differences, RMSVDs are about 10 - 15 m/s.

Future Issues

- For the height assignment problem, we don't have the way to know the quality of height assignment and to adjust to more reliable assignment. These problems are needed to be solved.
- The height assignment problem is one aspect of errors, so the reasons of the large error cases are not fully explained. We have to know the other reasons. (For 4 / 7 min AMVs, the time lag is the one of the possible reason of error.)

Thank you for your attention!