Correction for the Meisei RS-06G Radiosonde data obtained at the Indonesia BMKG sites

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Introduction

During the extended observing period of the 2011-12 MJO field campaign, high-resolution (1 sec interval during the ascent) radiosonde sounding data were taken at the 13 stations of the Indonesian Meteorological, Climatological and Geophysical Agency (BMKG). In particular, 12 of their stations adopt Japanese Meisei RS-06G radiosonde system. Since it is essential to obtain high accurate data for analyses, quality control of those data has been carried out. For this purpose, we performed the correction to the following components; 1) time-lag error at lower temperatures, 2) dry bias due to solar-radiation during daytime sounding based on the simultaneous sounding comparison with cryogenic frost-point hygrometer, 3) discontinuity of relative humidity at 0 ˚C level due to insufficient correction scheme, 4) significantly heated/cooled values near the surface affected by surrounding obstacles, and 5) unrealistic noisy data and no-wind data caused by the wrong operation.

Table 1. Radiosonde observation summary.

	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
MEDAN	61	60	62	62	58	61	364
PADANG	60	59	124	62	57	59	421
PANGKAL PINANG	19	51	59	58	52	57	296
CENKARENG	56	57	62	61	58	62	356
RANAI	62	57	62	62	58	0	301
SURABAYA	62	60	62	61	58	62	365
MAKASSAR	60	55	61	55	52	53	336
PALU	62	60	62	62	58	62	366
KUPANG	60	59	56	59	56	59	349
MANADO	60	60	62	62	58	59	361
AMBON	59	60	62	62	58	62	363
BIAK	57	59	56	58	57	60	347
MERAUKE	61	60	62	61	58	62	364
	739	757	852	785	738	718	4589

lat	lon	Stn. No.	Code	Type	
3.56N	98.67E	96035	WIMM	Meisei	RS-06G
0.88S	100.35E	96163	WIMG	Meisei	RS-06G
2.16S	106.14E	96237	WIKK	Meisei	RS-06G
6.12S	106.68E	96749	WII	Meisei	RS-06G
3.91N	108.39E	96147	WION	Modern	M2K2DC
7.37S	112.78E	96935	WRSJ	Meisei	RS-06G
5.06S	119.53E	97180	WAAA	Meisei	RS-06G
0.92S	119.91E	97072	WAML	Meisei	RS-06G
10.18S	123.67E	97372	WRKK	Meisei	RS-06G
1.54N	124.92E	97014	WAMM	Meisei	RS-06G
3.71S	128.10E	97724	WAPP	Meisei	RS-06G
1.19S	136.10E	97560	WABB	Meisei	RS-06G
8.52S	140.41E	97980	WAKK	Meisei	RS-06G

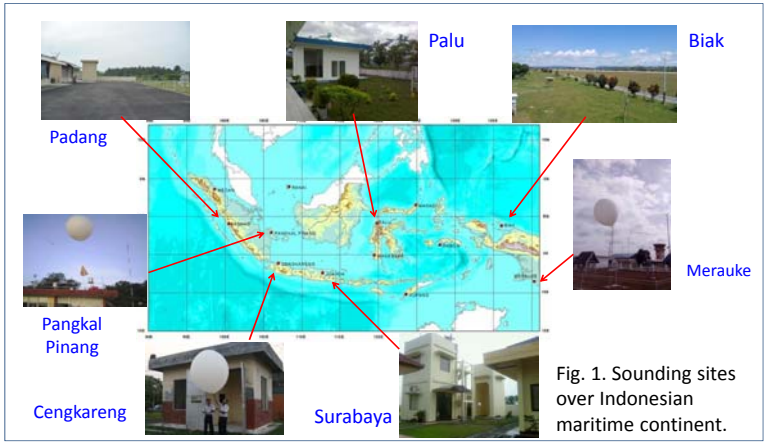


Fig. 1. Sounding sites over Indonesian maritime continent.

Operation

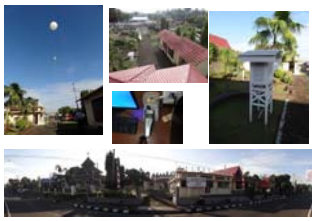


Fig. 2. Manado site.

Sounding operation is well organized.
However, a few problems have been noticed.

1) Sensor was exposed to the sunshine for a while prior to launch. It may cause sensor-arm heating.
2) Calibration sensors for ground check were broken at some sites. (Thus, no adjustment was performed. Actually, WMO recommends not to perform ground check, if instruments/technical supports are insufficient.)
3) While SYNOP data are used for PTU as surface values, wind data manually measured are used. Some operators seem to enter "zero", when wind is weak regardless of actual speed/direction.

Time-lag correction

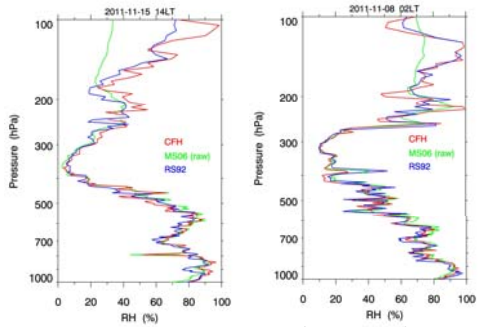


Fig. 3. Intercomparison among CFH, Vaisala RS92, and Meisei RS-06G. Observations were carried out onboard the R/V Mirai. At this moment, 13 CFH data are available for comparison (11 in daytime/ 2 in nighttime).

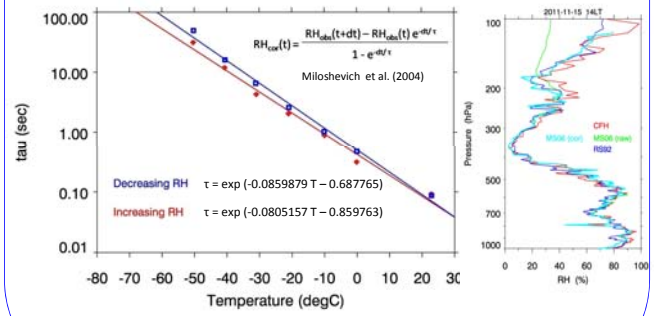


Fig. 4. Time-constant for Meisei RS-06G. Data were provided by Meisei. Right panel shows the results of time-lag correction (light blue).

Noisy Sounding

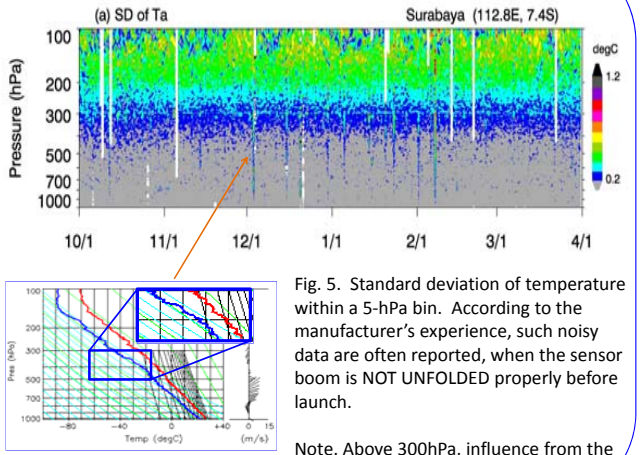
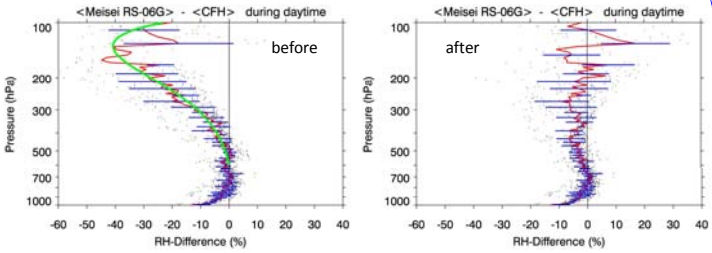


Fig. 5. Standard deviation of temperature within a 5-hPa bin. According to the manufacturer's experience, such noisy data are often reported, when the sensor boom is NOT UNFOLDED properly before launch.

Note. Above 300hPa, influence from the sensor package is removed by software.

Solar radiation-induced error



$$\Delta RH = -18 (\ln P)^5 + 541 (\ln P)^4 - 6417 (\ln P)^3 + 37926 (\ln P)^2 - 111683 (\ln P) + 130960$$

Fig. 6. Comparison between the RH profiles of CFH and Meisei sonde. Correction profile is obtained by applying a polynomial fitting to the mean profile.

Discontinuity of RH at 0 ºC level

$$RH_{cor} = RH_{obs} - (2.86 - 0.168 \times T - 0.00202 \times T^2)$$

where T in temperature (ºC), RH_{obs} is observed value, and RH_{cor} is corrected one.

To reduce the error related to temperature dependence of the RH sensor, above correction is applied ONLY to the range of "- 40 ºC ≤ T ≤ 0 ºC ". Thus, current Meisei sonde data always contain a gap at 0 ºC. Recently, Sugidachi & Fujiwara (2013, JMSJ) noticed this fact, and proposed to expand the range from 0 ºC to 14.5 ºC, where ΔRH=0, based on the chamber experiment.

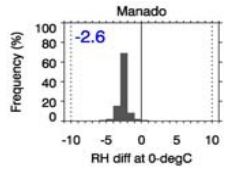


Fig. 7. Frequency of RH difference at 0 ºC level with 1 ºC bin.

Influence from surrounding conditions

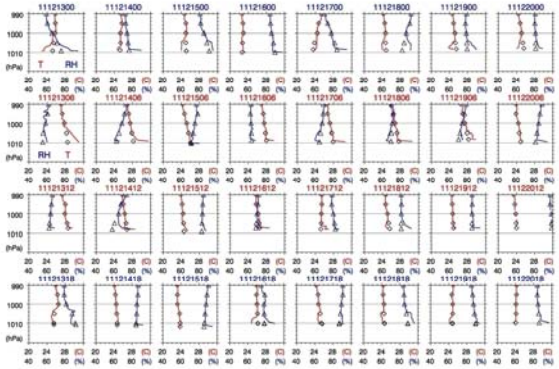


Fig. 8. Examples of near surface profiles of temperature (red) and relative humidity (blue) obtained at Padang. Marks with diamond/triangle indicate corrected values by extrapolating above layer. Heating/dry and cooling/wet conditions can be found during daytime and nighttime.