Examining the status of COMS IR channel calibration

Bo-Ra Kim, B. J. Sohn, and J. C. Yang

School of Earth and Environmental Sciences,

Seoul National University, Seoul, 151–747, Korea

1. Introduction

On 27 June 2010, the first Korean geostationary satellite Communication, Ocean, Meteorological Satellite (COMS) was launched and is now located on 128.2°E. The main concern to use the measured data is the calibration accuracy of the onboard meteorological sensor (MI; Meteorological Imager) measuring IR brightness temperatures. The MI was designed to have the error range within 1 K (Jin and Seo, 2011) in the pre-launch calibration systems. However, the sensor accuracy could be changed during launching, so the assessing interest is the calibration accuracy of the four IR channels, centered at 3.7 μm, 6.7 μm, 10 μm, and 12 μm.

In this study, we try to examine the status of COMS IR channel calibration by intercomparing against MODIS measurements at similar bands, Ch. 20, 27, 31, and 32 for MODIS/Terra. However, since MODIS water vapor (WV) channel has 2-3 K cold bias compared to the hyperspectral measurements (Sohn et al., 2010; Tobin et al., 2006), the bias of the MODIS WV measurements had been adjusted to the hyperspectral measurements before used as reference. Under the assumption that the WV channel bias is dependent on the amount of the water vapor, the MODIS WV channel bias correction was performed on the monthly basis. Then, the observations of the corrected MODIS WV channel and measured other three IR channels are used as references to examine the COMS IR channel performances. Details are described in the next sections.

2. Data and Methodology

1) Data

Used COMS data were obtained from NMSC/KMA and MODIS data were from via MODIS webpage. And IASI measurements were downloaded from CLASS/NOAA. These covered the four months in 2011, from January to April. The COMS data, digital counts, were converted to the TBs using look-up table. The MODIS data were MOD02 (radiance measurements), MOD03 (geolocation data), and MOD35 (level 2 cloud mask). The measured IASI hyperspectral radiances were converted to the equivalent broad-band radiances and brightness temperatures using the equation (1) and Planck function to derive the theoretical relationship between COMS and MODIS.

$$L_v = \frac{\int_{v1}^{v2} I_v SRF_v dv}{\int_{v1}^{v2} SRF_v dv} \qquad (1)$$

where, SRF is the spectral response function and Fv is the radiance at each wavenumber.

2) MODIS WV channel calibration

MODIS/Terra is used as a reference sensor to calibrate COMS IR channels, but the WV measurements should be corrected before used. In this study, the three-way calibration method is used to calibrate the MODIS WV channel measurements (Figure 1). In this algorithm, the MTSAT-1R is used as a surrogate because the path-time difference of Terra and MetOp is greater than 90 minutes over the Tropics. And the MTSAT-1R was reported that the mean bias of WV channel is about 0.2 K compared to the IASI measurements which has been robust at reference temperature since the calibration accuracy was reported. Using this algorithm, the MODIS calibration coefficients were estimated on the monthly basis. The derived coefficients are shown in Table 1.

3) Selecting matchup data

The COMS IR channel calibration was performed using the collocated data sets of COMS and MODIS. As shown in Tobin et al. (2006), MODIS/Aqua IR channels but for WV channel are accurate compared to the hyperspectral measurements of which errors are less than 1 K. It is also same to the MODIS/Terra according to Sohn et al. (2008). The COMS and MODIS data were collected over a tropical region

(30°N~10°S, 100°E ~180°E) in which satellite viewing angle (SVA) is smaller than 35°. Matched data were selected if the time difference between COMS and MODIS are less than 5 minutes and absolute value of their SVA difference is within 5 degree. The clear scenes were classified by using MODIS cloud mask results.

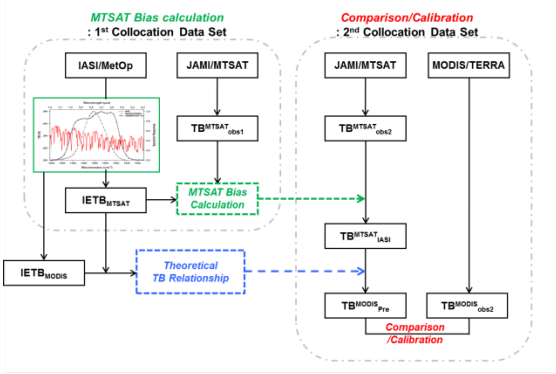

Figure 1. The schematic diagram of the three-way calibration method.

Table 1. Estimated MODIS/Terra WV channel calibration coefficients

	offset	slope		offset	slope
Jan	15.185	0.945	Jul	20.234	0.924
Feb	18.231	0.933	Aug	18.090	0.934
Mar	14.304	0.948	Sep	18.887	0.929
Apr	16.867	0.937	Oct	16.878	0.938
May	13.790	0.949	Nov	28.989	0.893
Jun	19.864	0.925	Dec	18.472	0.934

3. Results

The COMS IR channel status is shown in Figure 2. The SWIR channel comparison was performed using the nighttime measurements. As the results say, the four IR channels of MI/COMS show the accurate performance compared to the MODIS measurements and satisfy the calibration accuracies intended at the design phase. And the results are consistent with the GSICS comparison results provided from the NMSC/KMA (not shown here).

4. Acknowledgement

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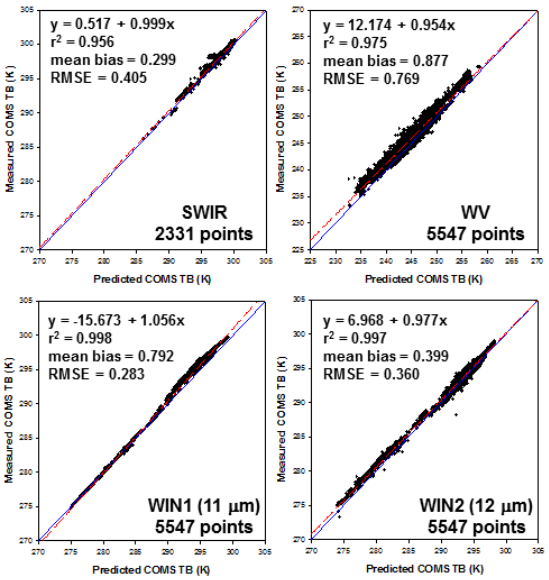

Figure 2. The scatter plots to show COMS IR channel status. MODIS

5. References

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