

Cross-calibration for satellite SST

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Introduction

We developed a new cross-calibration method which aims improvements in consistency in SSTs retrieved from satellite data. The method is based on an SST algorithm^[1] which we developed for Himawari-8 SSTs, and expected to improve consistency in JAXA's L2 SST products generated by using satellite IR data including Himawari-8, MODIS, and GCOM-C SGLI. For an experiment, we used it and corrected Himawari-8 data by using Terra/MODIS data as a reference standard. As shown in this poster, the preliminary result shows a good capability of the method. Extension to the MW SSTs, such as GCOM-W/AMSR2 and WindSat, is an issue with the method in future.

Data

We used Himawari-8 data and the Terra/MODIS L1 product correction 6. We also used buoy data to screen out the data which are likely contaminated by clouds.

Cross-calibration

To calibrate Himawari-8 data, we used a formula:

$$corI_{\lambda} = a_{\lambda}I_{\lambda} + b_{\lambda} \quad (1)$$

Here, λ is the wave length and a_{λ} and b_{λ} are the calibration coefficients. Calibration coefficients were calculated by following the steps below. Terra/MODIS data for April 2016 were used as a reference standard.

- 1) generate a match-up data set of Himawari-8, Terra/MODIS, and buoy data,
- 2) screen out cloudy data by checking the difference between buoy and satellite SSTs,
- 3) simulate Himawari-8 data by using the SST and transmittance data retrieved from Terra/MODIS, and
- 4) calculate the calibration coefficients by the comparison between the original and estimated Himawari-8 data.

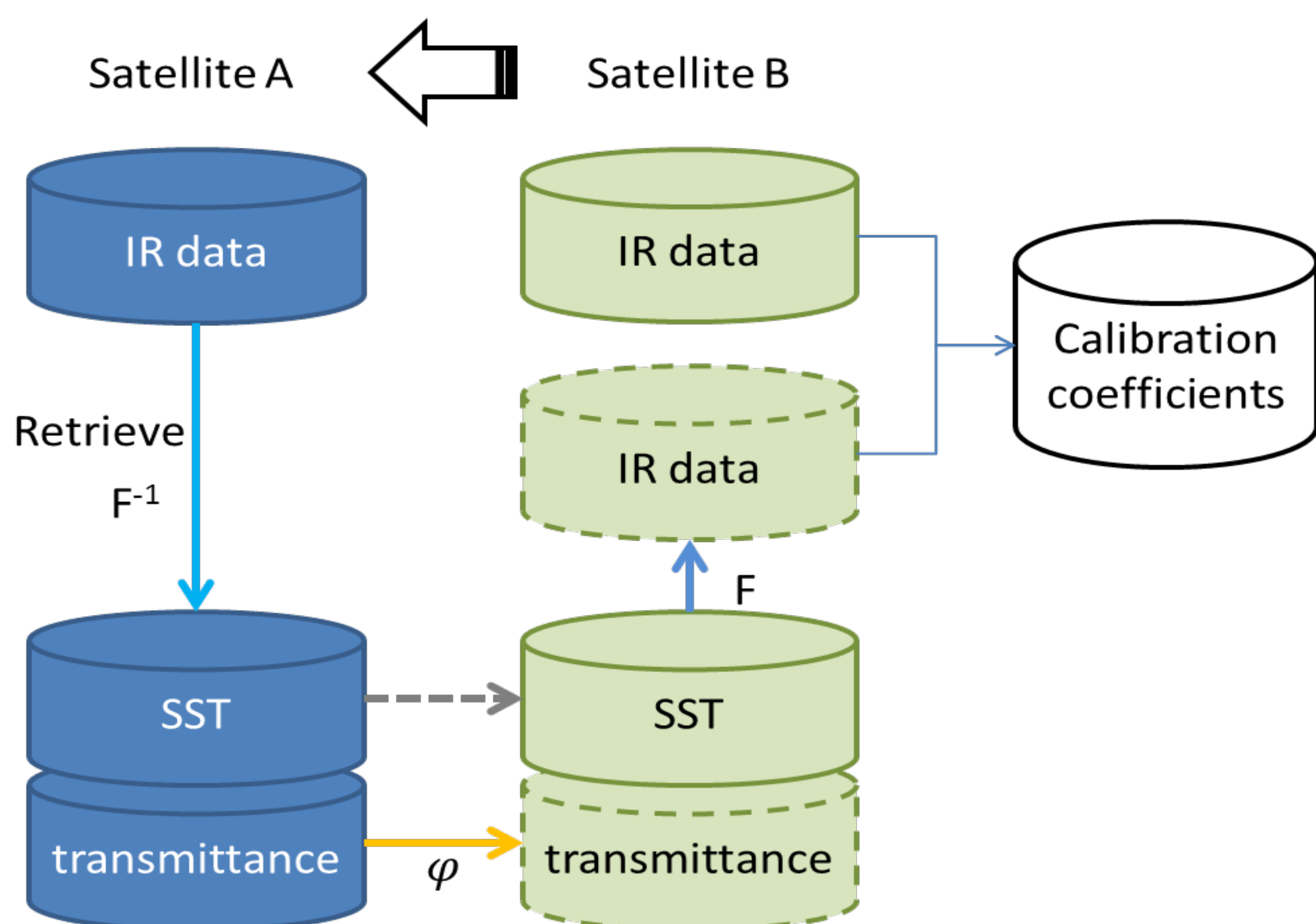


Fig. 1 Cross-calibration

F denotes a parameterized radiative transfer equation which was derived by simplifying the IR radiative transfer equation:

$$\begin{aligned} \bar{I}_{\lambda} + \Delta I_{\lambda} &= \varepsilon_{\lambda}(\bar{I}_{\lambda}^s + \Delta I_{\lambda}^s)(\bar{\tau}_{\lambda} + \Delta \tau_{\lambda}) + \\ &(1 - \varepsilon_{\lambda})(\bar{I}_{\lambda}^{\downarrow} + \Delta I_{\lambda}^{\downarrow})(\bar{\tau}_{\lambda} + \Delta \tau_{\lambda}) + \\ &(\bar{I}_{\lambda}^{\uparrow} + \Delta I_{\lambda}^{\uparrow}). \end{aligned} \quad (2)$$

References

[1] Kurihara, Y., Murakami, H., and Kachi, M. (2016). Sea surface temperature from the new Japanese geostationary meteorological Himawari-8 satellite. Geophys. Res. Letters, DOI: 10.1002/2015GL067159.

[2] Xu, F. and Ignatov, A. (2014). In situ sst quality monitor (iQuam). J. Atmos. Oceanic Technol., 31(1): 126-141, <https://www.star.nesdis.noaa.gov/sod/sst/iQuam/v2/about.html>

Table 1 Coefficients calculated by using match-ups for April 2016

WL (λ)	a	b	RS	N
10.4	1.0022	0.00754	0.048	23520
11.2	1.0048	-0.0185	0.049	23520
12.4	1.0051	-0.0567	0.073	23520
8.6	0.9755	0.24347	0.080	23520
3.9	0.9933	0.00890	0.0086	23469

WL: wave length (μm), a, b: coefficients, RS: fitting residual (W), N: total number of data

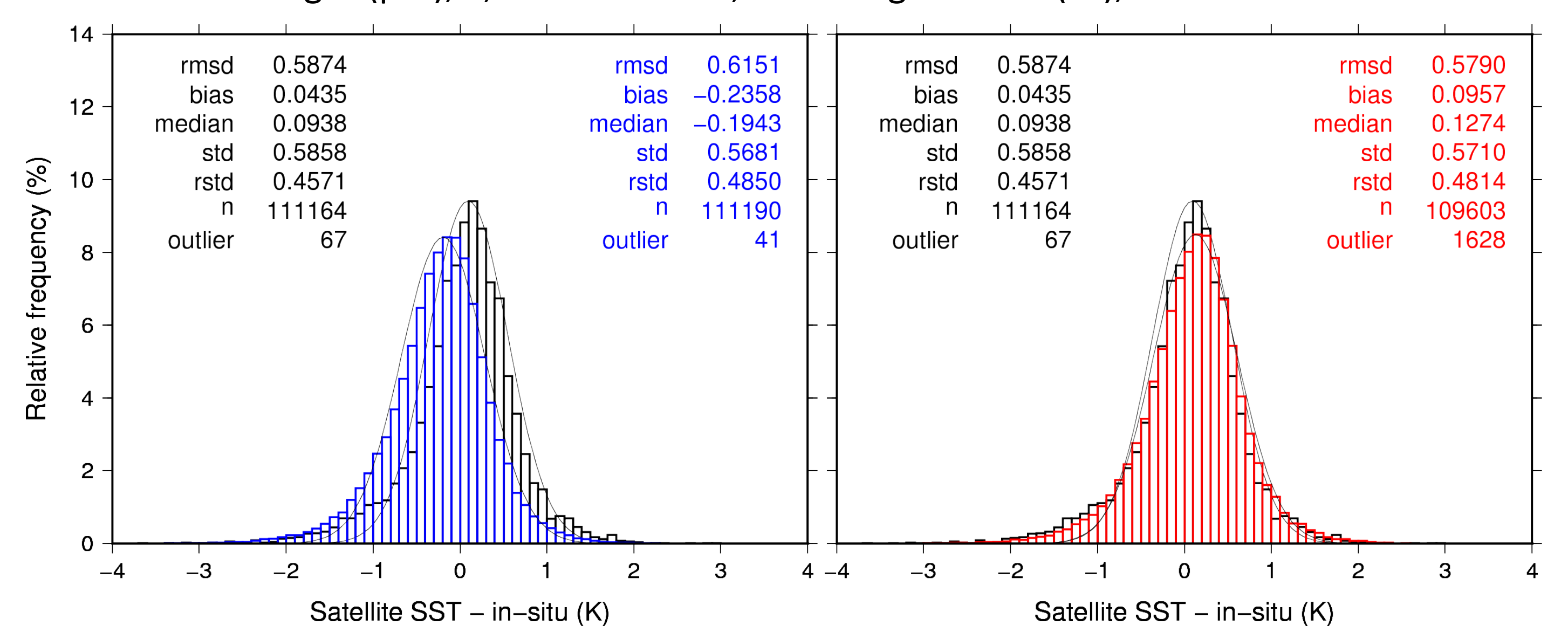


Fig. 2 Histogram of the differences between buoy data and satellite SSTs

Blue shows the histogram for Himawari-8 SST, red shows the Himawari-8 SST corrected by using the coefficients shown in the table 1, and black shows the Terra/MODIS SST.

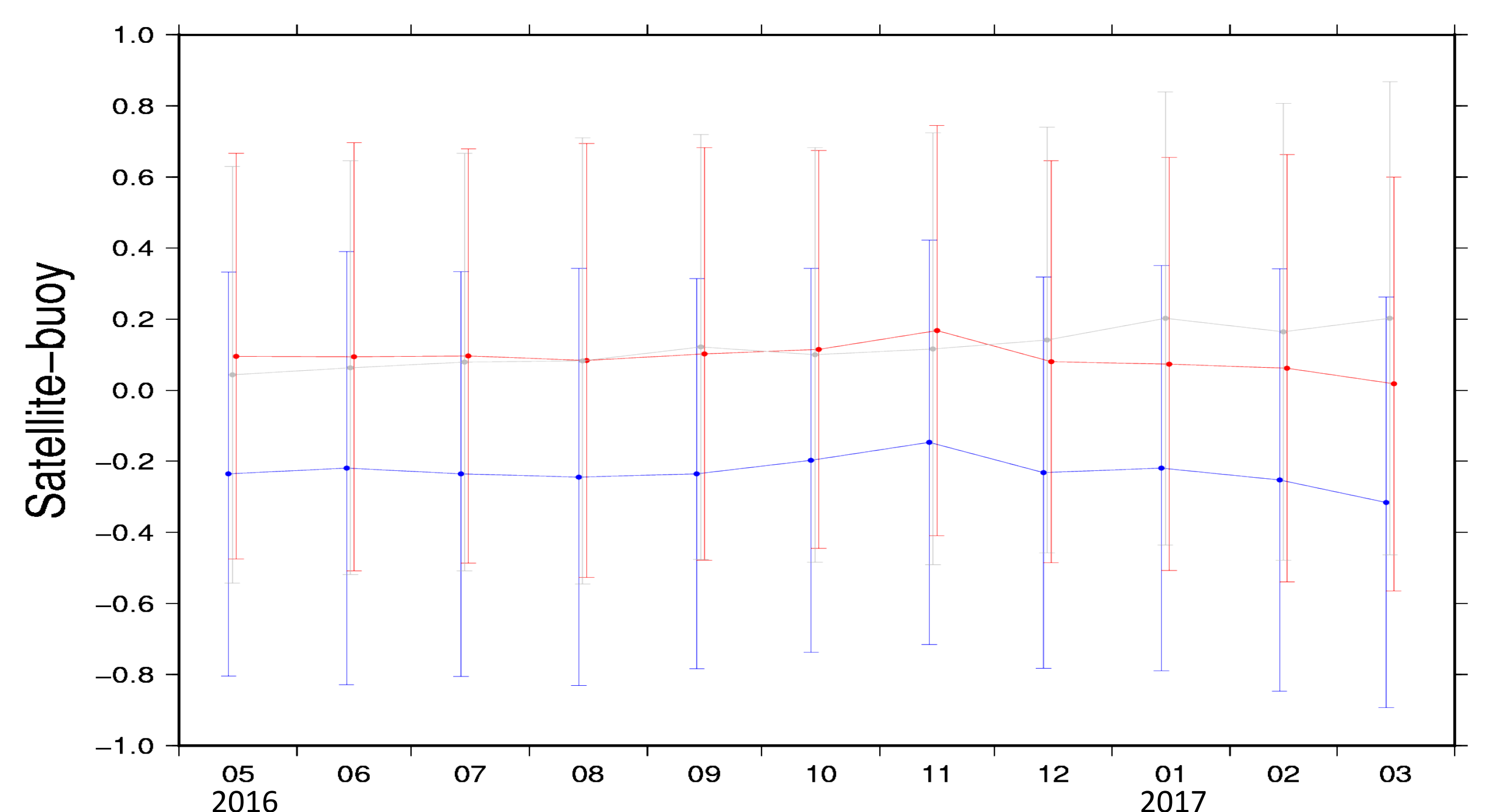


Fig. 3 Monthly bias and STDs of the Himawari-8 SSTs (blue), the corrected Himawari-8 SSTs (red) and the Terra/MODIS SSTs

Relative differences between MODIS and Himawari-8 SSTs are improved from 0.26~0.52 to 0.0013~0.19 K.

Summary

We developed a new cross-calibration method. A preliminary result shows a good capability of the method. The method is expected to improve consistency in JAXA's L2 SST products.

Acknowledgements

Terra/MODIS L1 correction 6 products were downloaded from the LAADS DAAC of NASA. Himawari-8 data and NWP data were provided by JMA. Buoy data were downloaded from iQuam^[2] of NOAA. RTTOV was developed by the NWP SAF of EUMETSAT.