NOAA ACSPO SST and Clear-Sky mask algorithms for Himawari-8 AHI and GOES-R ABI

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NOAA ACSPO SST and Clear-Sky Mask Algorithms for Himawari-8 AHI and GOES-R ABI

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1. INTRODUCTION

Sea surface temperature (SST) is a key product derived from the Advanced Baseline Imager (ABI) scheduled for launch onboard the new generation US GOES-R satellite in November 2016. To prepare for the GOES-R ABI, and to continue the MTSAT2 line of SST product, NOAA is processing the Advanced Himawari Imager (AHI) flown onboard the Japanese Himawari-8 (H8) satellite launched in October 2014. The Advanced Clear-Sky Processor for Oceans (ACSPO), initially developed to process data of polar-orbiting sensors, was adapted for geostationary AHI and ABI. Here, the performance of the ACSPO SST and Cloud Mask algorithms for AHI is described.

2. CLEAR-SKY MASK

The ACSPO Clear-Sky Mask (ACSM) [1] provides efficient quality control and cloud screening as well as seamless transition between the night (when only IR bands are available) and the day (when solar reflectance bands 3 (0.64 µm) and 4 (0.86 µm) are also used for better cloud detection). Typically, the ACSM produces 18-25% clear-sky pixels, out of all ocean pixels within the AHI SST domain.

3. BASELINE SST

The ACSPO Baseline SST (BSST) is retrieved from four AHI bands 11 (8.6), 13 (10.4), 14 (11.2) and 15 (12.35 µm) using a single regression equation for day and night. The equation was designed to provide a tradeoff between precision of fitting *in situ* SST and sensitivity to "skin" SST [2]. The BSST fits *in situ* SST with SD~0.4-0.5 K and with average sensitivity to "skin" SST of ~0.95 [3] and efficiently reproduces the diurnal warming cycle.

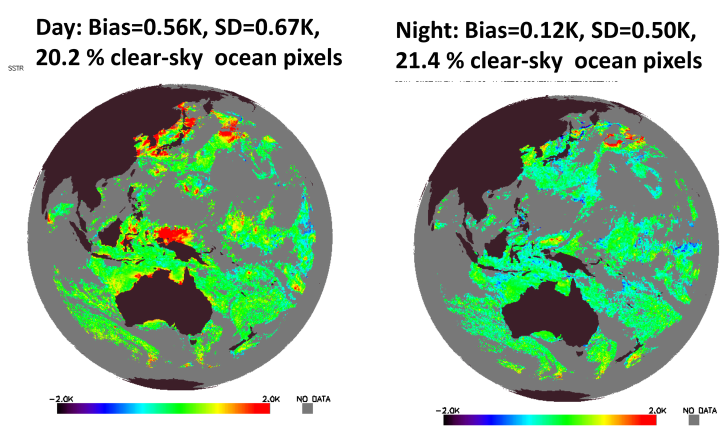

Fig.1. 11 August 2016: (Left) daytime (0530 UTC) and (right) nighttime (1730 UTC) deviations of BSST from the L4 SST by Canadian Meteorological Center (CMC).

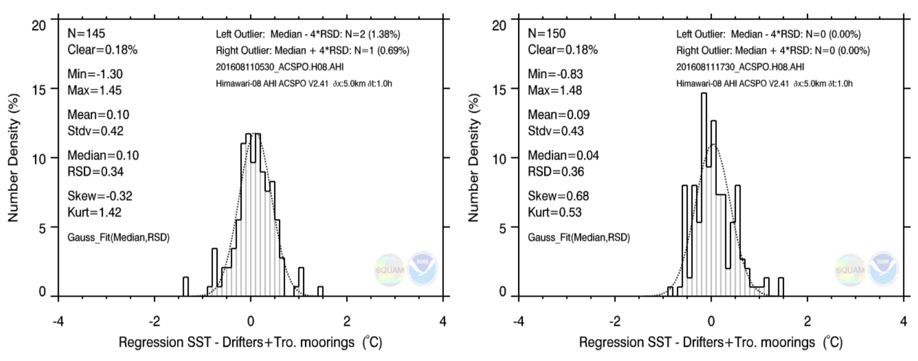

Fig.2. (Left) daytime and (right) nighttime histograms of BSST-in situ SST corresponding to the images shown in Fig. 1.

4. DE-BIASED SST

SSES bias and standard deviation are estimated in ACSPO separately for different segments of the SST domain, defined in the space of regressors [4]. The SSES algorithm for AHI uses the same four bands employed for BSST retrievals. Correction of AHI BSST for SSES biases reduces the effects of cloud leakages, angular dependencies and (during the daytime) the effect of diurnal warming. As a result, the de-biased SST fits *in situ* SST more precisely compared to the BSST.

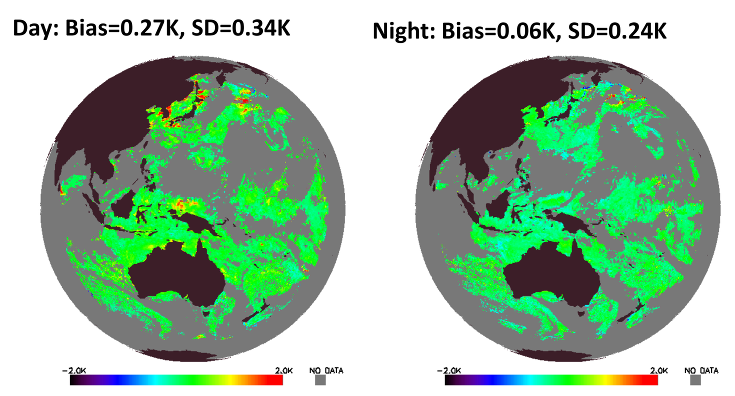

Fig.3. 11 August 2016: (Left) Daytime (0530 UTC) and (right) nighttime (1730 UTC) deviations of De-biased SST from CMC.

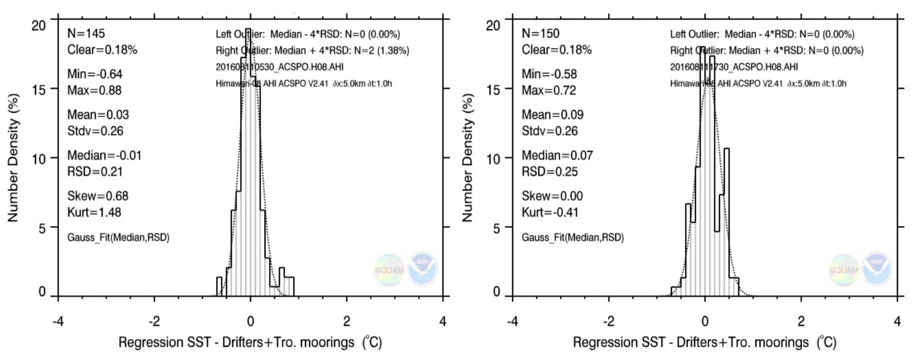

Fig.4. (Left) daytime and (right) nighttime histograms of De-biased SST- in situ CMC for the images shown in Fig. 3.

5. REPRODUCING DIURNAL WARMING CYCLE AND FITTING MATCHUPS

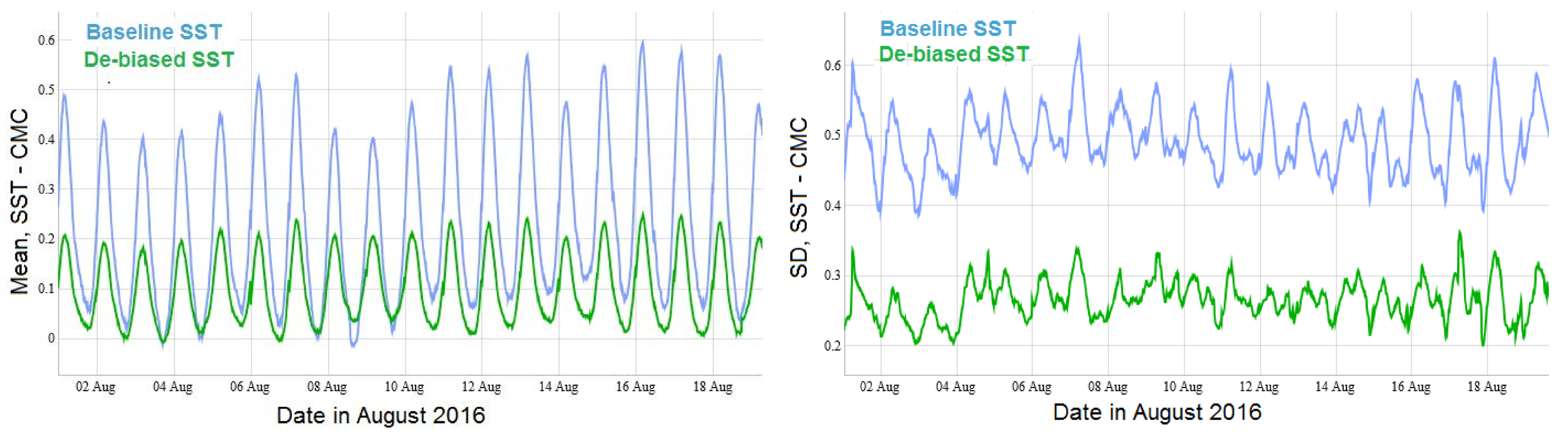

Fig.5. Time series of (left) bias and (right) SD of AHI SST – CMC. Baseline SST reproduces the diurnal cycle with the amplitude of ~0.4–0.5 K. The magnitude of diurnal cycle in de-biased SST is 0.15-0.20 K. De-biased SST improves precision wrt CMC from 0.4K-0.6 K to 0.2-0.35 K.

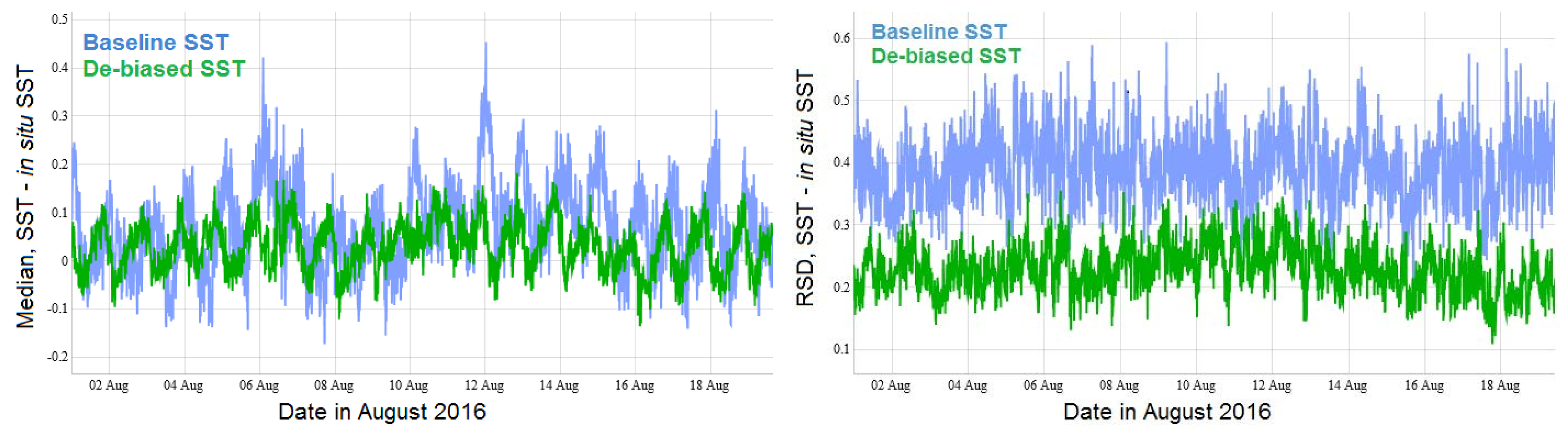

Fig.6. Time series of (left) median and (right) robust SD of AHI – in situ SST. The median varies within -0.1 – +0.3 K for Baseline SST and ±0.1 K for De-biased SST. De-biased SST improves the precision wrt matchups from ~0.4 K to ~0.25 K.

5. SUMMARY

- The ACSPO, initially designed for SST retrieval from polar-orbiting sensors (NOAA AVHRR GAC, Metop AVHRR FRAC, JPSS VIIRS, Terra and Aqua MODIS), is now used for geostationary Himawari-8 AHI and will be used for GOES-R ABI.
- The Baseline ACSPO SST provides mean sensitivity of ≈0.95, shows biases against drifters within -0.1 to +0.3 K, SD within 0.4-0.5 K and reproduces a clear and smooth diurnal cycle with the magnitude of 0.4-0.5 K.
- The biases and SD in De-Biased ACSPO SST wrt drifters are within ±0.1 K and 0.2-0.3 K respectively, and the magnitudes of the diurnal cycle are within 0.15 – 0.20 K.
- The features and performance of the ACSPO BSST and De-Biased SST suggests considering those as estimates of "skin" and "depth" SST.
- The current work on ACSPO SST algorithms is aimed at bringing the BSST closer to "skin" SST.

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