AVHRR GAC SST Reanalysis version 1 (RAN1)

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Motivation, Objective, Data

- ***ACSPO – Advanced Clear-Sky Processor for Ocean***
  - NOAA enterprise SST retrieval system
  - Fast CRTM is used to simulate TOA BTs
- ***Why ACSPO AVHRR Reanalysis?***
  - NOAA Coral Reef Watch (CRW) and Geo-Polar Blended (GPB) Teams are ACSPO SST users
  - Long-term ACSPO AVHRR SSTs were requested by the CRW and GPB, to generate an "L4 GPB climatology" for CRW anomaly analyses
- ***Current Status***
  - Data of NOAA-15, -16, -17, -18, -19, Metop-A , -B from 2002 – 2015 processed w/ACSPO v2.40, analyzed in the NOAA SQUAM and MICROS
  - Analyses summarized in (Ignatov et al, 2016)
  - Archival with NOA CW and NCEI underway

ACSPO Algorithms

MCSST (Night; Solar Zenith Angle, SZA > 90°)

$$T_S = a_o + a_1 T_{3.7} + a_2 T_{3.7} S + a_3 (T_{11} - T_{12}) + a_4 (T_{11} - T_{12}) S + a_5 S \quad (1)$$

NLSST (Day; SZA ≤ 90°)

$$T_S = b_o + b_1 T_{11} + b_2 T_{11} S + b_3 (T_{11} - T_{12}) + b_4 (T_{11} - T_{12})(T_o - 273.15) + b_5 (T_{11} - T_{12}) S + b_6 S \quad (2)$$

Here, $T_{3.7}$, T_{11} and T_{12} are brightness temperatures (BTs) in AVHRR bands centered at 3.7, 11 and 12 µm, respectively; $S = sec(VZA) - 1$; VZA is the view zenith angle; and T_o is the first guess (CMC 0.2) SST interpolated in space to the retrieval pixel. For details of regression algorithms, see (Petrenko et al., 2014).

ACSPO Clear-Sky Mask is used (Petrenko et al, 2010).

New ACSPO Single-Scanner Error Statistics are used (Petrenko et al, 2016). Correcting the regression SSTs for SSES bias effectively results in "bulk" SSWT which is closer to buoy SST.

Nighttime SSTs Using Static Coefficients

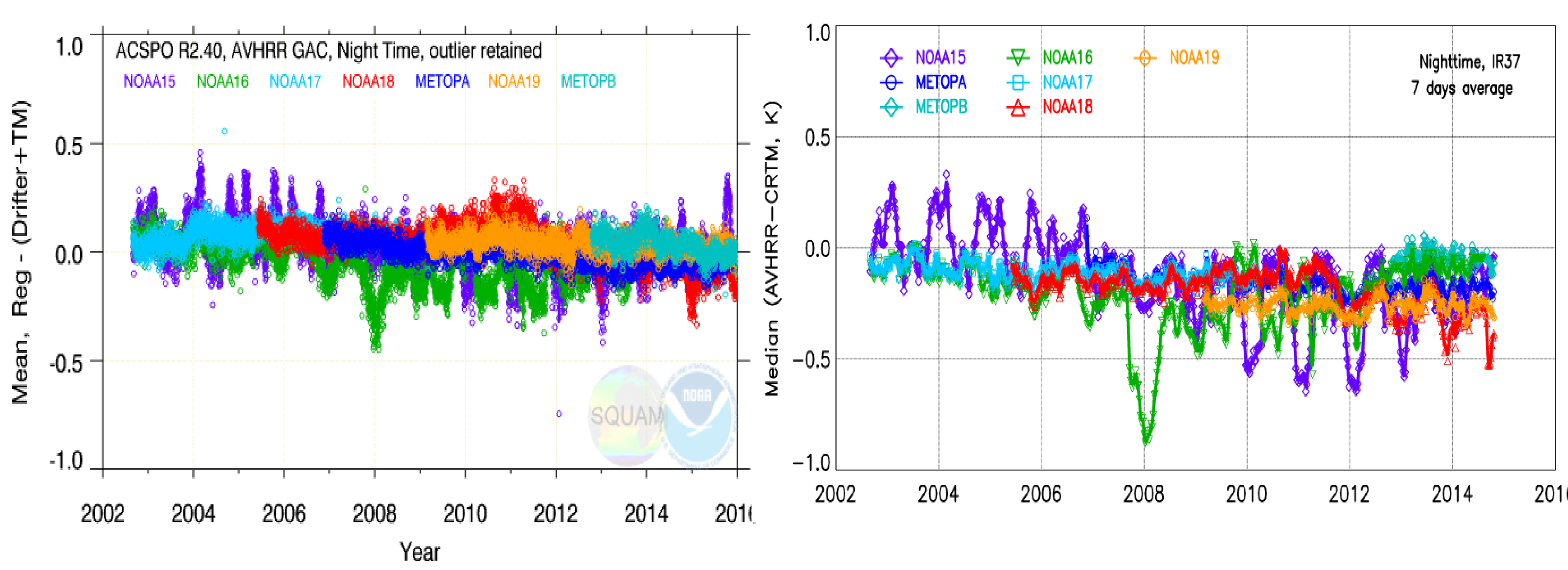

Fig. 1: (Left) Mean $\Delta T_S = T_S - T_{in\ situ}$ (T_S derived using static coefficients) and (right) $\Delta T_B = T_O - T_M$ (in band 3b)

ACSPO BTs have been matched up with quality controlled *in situ* SSTs from *i*Quam2 within (10km, 2hr), and initial static SST regression coefficients calculated using one full year of matchups. Derived SSTs are stable for some satellites and very unstable for the others.

The major reason for the SST artifacts are the unstable BTs, which in turn are due to the suboptimal AVHRR calibration (He et al., 2016). Work is underway to generate an improved AVHRR L1b dataset, and use it in the future ACSPO RANs.

In the meantime, the main focus of RAN1 was on using the most stable sensors and periods of their operation, and improving the stability of the corresponding SST time series using variable SST regression coefficients.

Al, the newly derived Single Sensor Error Statistics (SSES; Petrenko et al., 2016) was implemented in ACSPO RAN1. All results below show this SSES-corrected regression SST.

Nighttime SSTs Using Variable Coefficients

Two most stable satellites are used in RAN1 at any time, one mid-morning and one afternoon. The selected satellites and periods are listed in Table.

NOAA-16	Afternoon/PM	30 August 2002–6 June 2005
NOAA-18	Afternoon/PM	7 June 2005–21 February 2009
NOAA-19	Afternoon/PM	22 February 2009–present
NOAA-17	Midmorning/AM	30 August 2002–14 December 2006
Metop-A	Midmorning/AM	15 December 2006–present

Variable daily regression coefficients have been calculated with respect to drifters and tropical moorings, using a moving window centered at the day ±45days.

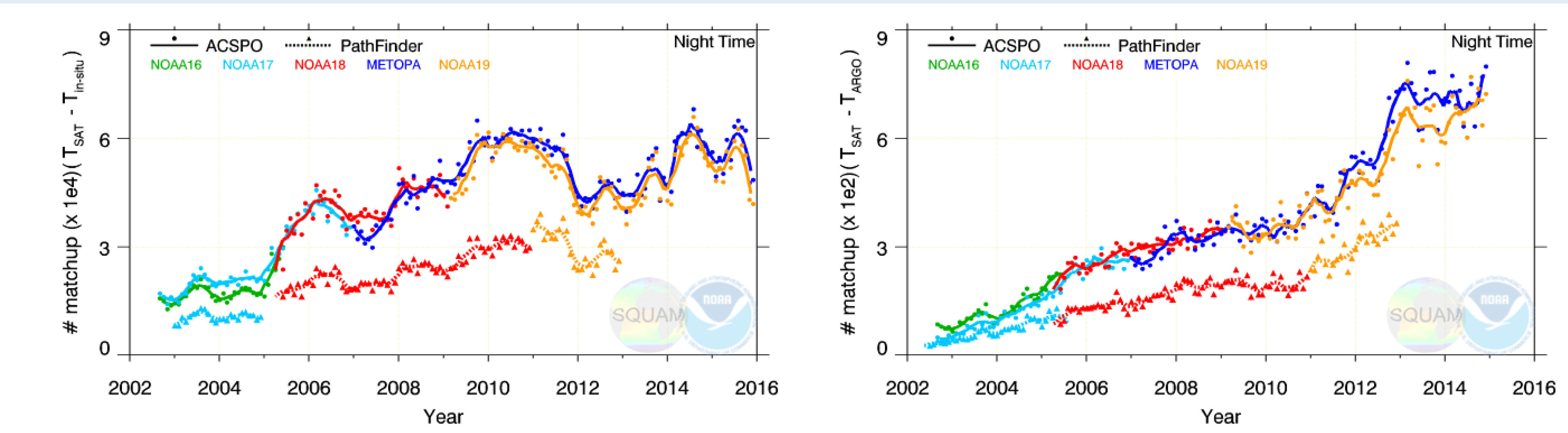

Fig. 2: Monthly number of matchups with: (**left**) drifters/tropical moorings; (**right**) ARGO floats.

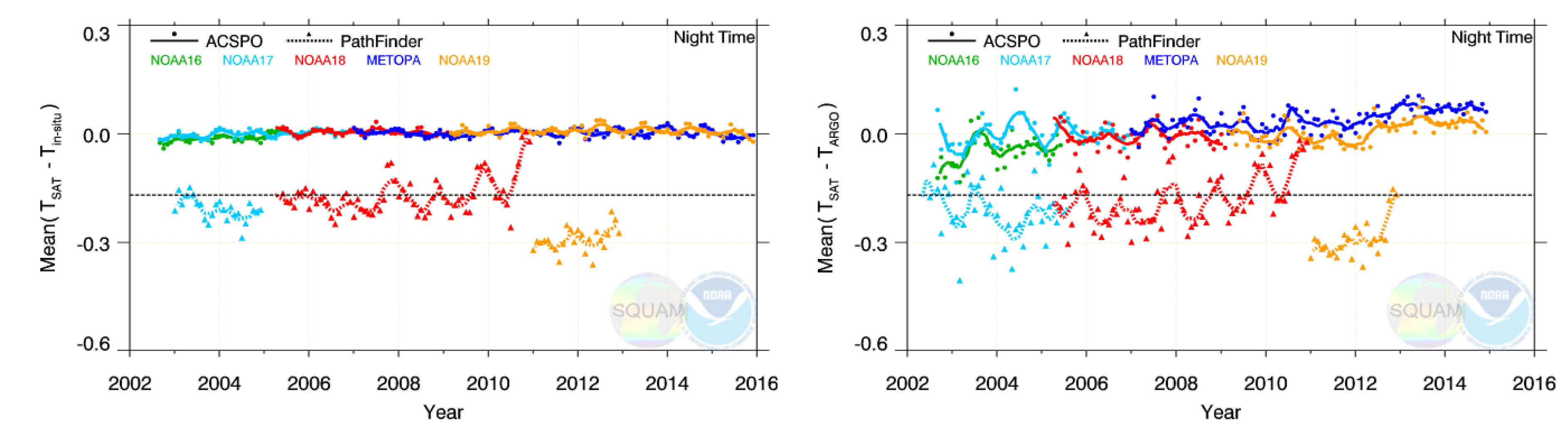

Fig. 3: Monthly mean biases of $\Delta T_S = T_S - T_{in\ situ}$ against: (**left**) drifters/tropical moorings; (**right**) ARGO floats.

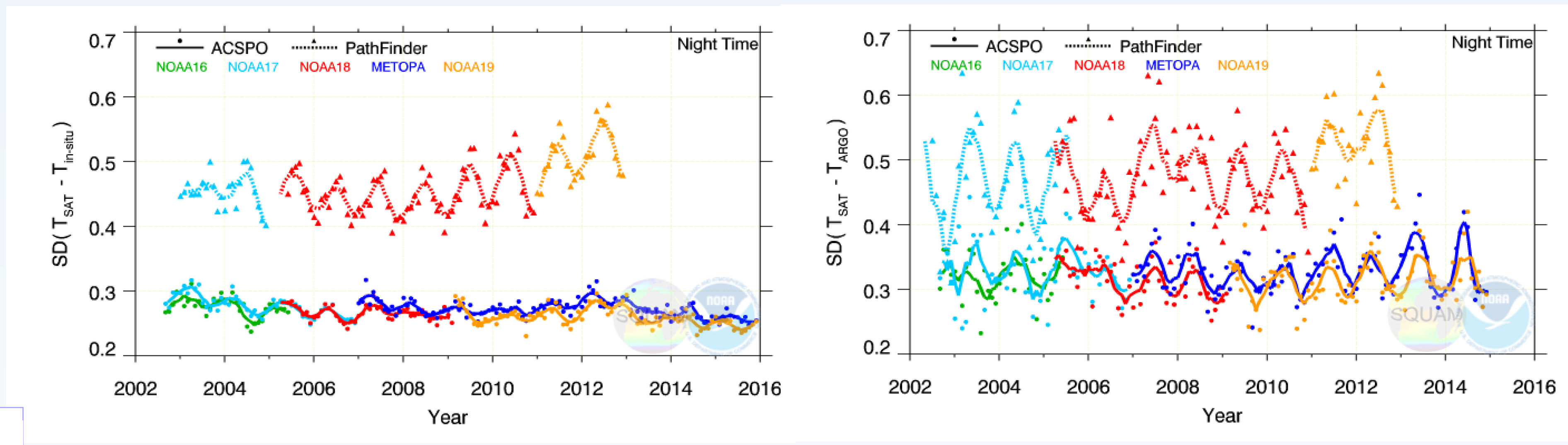

Fig. 4: Monthly mean SDs of $\Delta T_S = T_S - T_{in\ situ}$ against: (**left**) drifters/tropical moorings; (**right**) ARGO floats.

The RAN1 SST is in good agreement with drifters/tropical moorings as expected. There is also a good agreement with Argo floats, although the corresponding statistics are more noisy (note two orders of magnitude smaller Argo match-up datasets, compared with drifters and tropical moorings).

Comparison with PFV5.2 suggests that the RAN1 SSTs are more stable and cross-platform consistent, and generally better agree with *in situ* data.

Work is underway to archive the RAN1 data set with NCEI.

Future Work

- Recalibrate AVHRR/3, create new improved L1b, and reprocess SST
- Extend time series initially back to 1994, and later to 1981
- Work with NOAA CoastWatch and NCEI to archive
- Work with users to evaluate RAN1 in L4 analyses
- Work to produce various flavors of RAN L3 (L3U, L3C, L3S)

References

Petrenko et al., ACSPO Clear-Sky Mask, *JTECH* 2010,

Petrenko et al., JPSS SST Algorithms, *JGR* 2014.

Petrenko et al, ACSPO SSES, *JTECH* 2016.

Ignatov et al, ACSPO AVHR GAC RAN1, *Remote Sens.* 2016

He et al., Toward improved AVHRR L1b: NOAA 3S system, *Remote Sens.* 2016

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