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# Web-based near real-time SST quality monitor (SQUAM) for NESDIS AVHRR SST products

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## 1. Introduction

- Sea Surface Temperature (SST) Quality Monitor (**SQUAM**) is a web-based near real-time (NRT) tool used for continuous monitoring of NESDIS satellite SST products.
- Currently, SQUAM monitors SSTs from NOAA-16, -17, -18 and MetOp-A for stability and cross-platform consistency, using several global analysis SST fields as a reference.
- SQUAM is fully functional with two NESDIS SST products, produced by the heritage Main Unit Task (***MUT***) and by the new Advanced Clear-Sky Processor for Oceans (***ACSPO***).

## 2. The SQUAM Concept

The SQUAM concept draws from prior case studies (Ignatov *et al.*, 2004; Dash *et al.*, 2007).

- Customarily, satellite SSTs are validated against *in situ* SSTs, monthly. However, *in situ* data are sparse, geographically biased, of non-uniform quality, and not available in NRT.
- SQUAM employs global analyses or climatological SST fields as a reference. These fields cover full retrieval domain with a more uniform quality, and are available in NRT.
- Monitoring of SST is done in "anomaly space". Global ***SST anomaly***, $\Delta T_S = T_S - T_R$, is defined as the difference between satellite SST ($T_S$) and a global reference SST ($T_R$).
- Probability density functions of $\Delta T_S$ are near-Gaussian, even though $T_S$ and $T_R$ are highly skewed. **Figure 1** shows example $\Delta T_S$ maps for MetOp-A MUT SST minus OSTIA SST.

Outliers are present in $\Delta T_S$ data and greatly affect the statistical analyses

- Outliers in SQUAM are handled using robust statistics (Dash *et al.*, 2009).
- Example $\Delta T_S$ histograms before and after removing outliers are shown in **Figure 2**.

## 3. Input Data

- Satellite SSTs: NOAA-16, -17, -18, & MetOp-A AVHRR SSTs from
  - More than 4 years MUT SST (*e.g.*, Ignatov *et al.*, 2004) analyzed from 2004 to present
  - Some 3 months of ACSPO SST (*e.g.*, Liang *et al.*, 2009) preliminarily tested.
- Reference SSTs: These include:
  - weekly and two daily Reynolds OI SSTs (Reynolds *et al.*, 2002, 2007)
  - RTG low and high resolution (Thiébaux *et al.*, 2003; Gemmill *et al.*, 2007)
  - OSTIA (Stark *et al.*, 2007)
  - ODYSSEA (Autret & Piollé, 2007)
  - NCEP GFS SST
  - Bauer-Robinson climatology (Bauer & Robinson, 1985)
  - Pathfinder SST Climatology (Kilpatrick *et al.*, 2001).

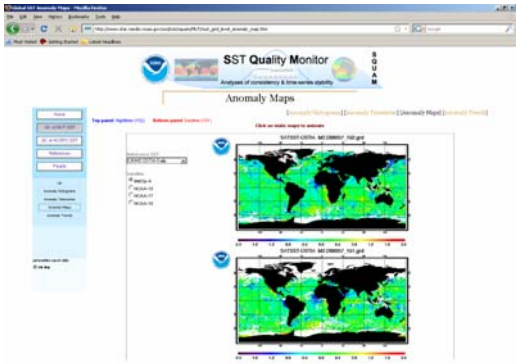


**Fig. 1. SQUAM webpage: http://www.star.nesdis.noaa.gov/sod/sst/squam/**

## 4. Effect of outliers

- **Global distribution of SST anomalies is near-Gaussian. First 4 moments (Mean, Standard deviation, Skewness, Kurtosis) are used for SST monitoring (*cf.*, Fig. 3).**
- **The outliers are removed based on "Median ± 4×RSD" criterion (Dash *et al.*, 2009).**

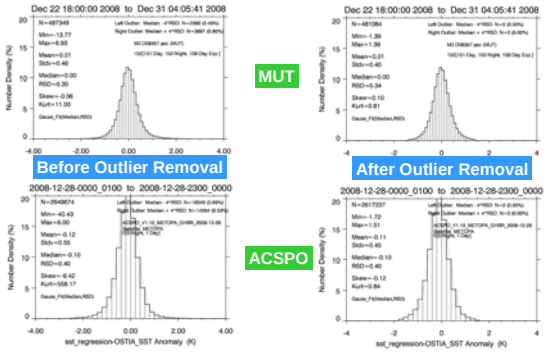


**Fig. 2. Density distribution of MetOp-A night SST anomaly *wrt.* OSTIA. [Top: MUT; Bottom: ACSPO; Left: Before; Right: After outliers' removal].**

## 5. Global Diagnostics

**(1): Trend statistical parameters as a function of time (check SST products for stability and cross-platform consistency)**

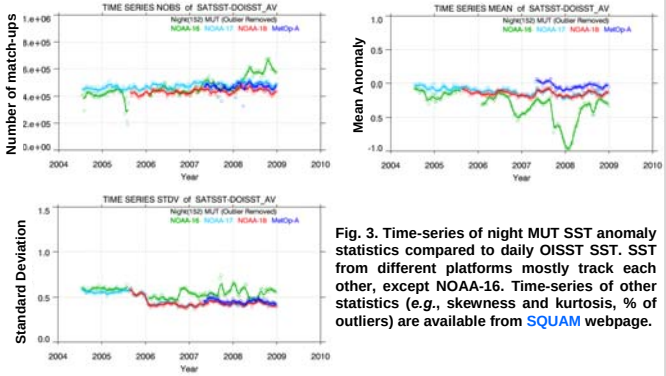


**Fig. 3. Time-series of night MUT SST anomaly statistics compared to daily OISST SST. SST from different platforms mostly track each other, except NOAA-16. Time-series of other statistics (*e.g.*, skewness and kurtosis, % of outliers) are available from SQUAM webpage.**

**(2): Plot mean anomaly *vs.* observational parameters (check SST product for self-consistency)**

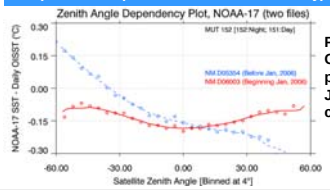


**Fig. 4. NOAA-17 MUT night SST anomaly (*wrt.* OISST) *vs.* view zenith angle (VZA), for two periods. The misallocation in VZA before January 2006 was detected (blue curve) and corrected (red curve).**

## 6. Summary and Future Work

- SQUAM monitors AVHRR SSTs for stability and cross-platform consistency.
- It processes NOAA-16, -17, -18, & MetOp-A SSTs from MUT & ACSPO, in NRT.
- Currently being tested for MSG SEVIRI (Shabanov *et al.*, 2009).
- Will be used for NOAA-N'/AVHRR, NPOESS/VIIRS, & GOES-R/ABI.

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