P9.19

Recent improvements to the NESDIS SST Quality Monitor (SQUAM)

Prasanjit Dash[1,2], Alexander Ignatov[1], Yury Kihai[1,3], and John Sapper[4]

[1]NOAA/NESDIS/STAR; [2]Colorado State University-CIRA; [3]Dell Perot Systems; [4]NOAA/NESDIS/OSDPD

Abstract

- The **SQUAM** is a web-based near real-time (NRT) tool to monitor level-2 (L2) satellite and level-4 (L4) analysis SST products for stability and cross consistency.
- Initially, SQUAM was employed only on two NESDIS AVHRR L2 products: the heritage Main Unit Task (*MUT*) and the new Advanced Clear-Sky Processor for Oceans (*ACSPO*), from five platforms: *NOAA 16-19* & *MetOp-A*.
- Subsequently, it was also expanded for L4 products. Newer products were (and are being) included in "L2-SQUAM" and "L4-SQUAM" (listed below).
- L4-SQUAM statistically inter-compares the various L4 (analysis) products whereas L2-SQUAM analyzes statistics of deviations in satellite SST (T_S) L2 products relative to several selected L4 SST "reference" fields (T_R) (currently, Reynolds SST, RTG, and OSTIA).

L2-SQUAM: (L2 – L4)

FRAC (Full Resolution Area Coverage)
- **NESDIS** ACSPO
- **EUMETSAT** O&SI SAF

GAC (Global Area Coverage)
- **NESDIS** PathFinder (NODC+U.Miami) Heritage MUT Newer ACSPO
- **NAVO** SEATEMP

L4-SQUAM: (L4 – L4)

(9 daily products compared) [1,4,7,8,9]

- Reynolds (AVHRR)
- Reynolds (AVHRR+AMSR-E)
- RTG high resolution
- RTG low res
- UKMO OSTIA
- ODYSSEA
- GMPE
- NAVO K10
- POES GOES Blended

*pending inclusion of JPL G1SST and CMC

1. Concept

L2-SQUAM

- Customarily, L2 SSTs are validated against *in situ* SSTs, which have known issues [10]. Complementarily, L2-SQUAM employs several L4 fields as reference [2,3,5]. These fields cover global domain with a more uniform quality than *in situ* SST, and are available in NRT.
- SST monitoring is done in difference space: $\Delta T_S = L2 - L4$.
- The assumption is: PDFs of ΔT_S are near-Gaussian (although T_S and T_R are skewed). Diagnostics are produced using ΔT_S maps, histograms, time series of statistical parameters, dependencies, & Hovmöller plots.
- Fig. 1 shows example diagnostics of *MetOp-A FRAC* and Fig.2 shows example for Pathfinder v5.0 GAC.

L4-SQUAM

- Similar to L2-SQUAM, monitoring is done in difference space: $\Delta T_S = L4 - L4$. Diagnostics are based on ΔT_S maps, histograms, time series of statistical parameters, and Hovmöller diagrams.
- Fig. 3 shows example Hovmöller plot (Reynolds – RTG).

NRT at: ***http://www.star.nesdis.noaa.gov/sod/sst/squam/***

2. AVHRR FRAC analyses

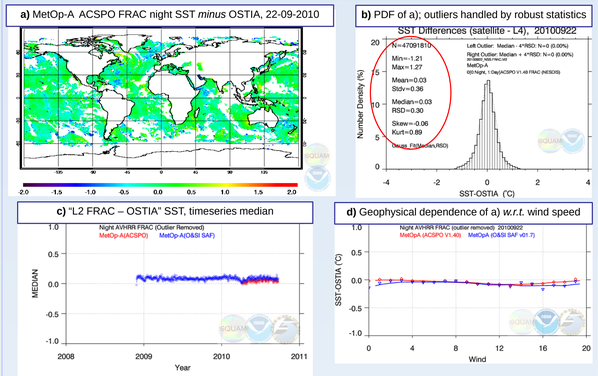


Fig. 1: L2-SQUAM diagnostics for MetOp-A FRAC SST *w.r.t.* OSTIA.
(more analyses at: ***http://www.star.nesdis.noaa.gov/sod/sst/squam/FRAC***)

3. Pathfinder: ~25 yr AVHRR

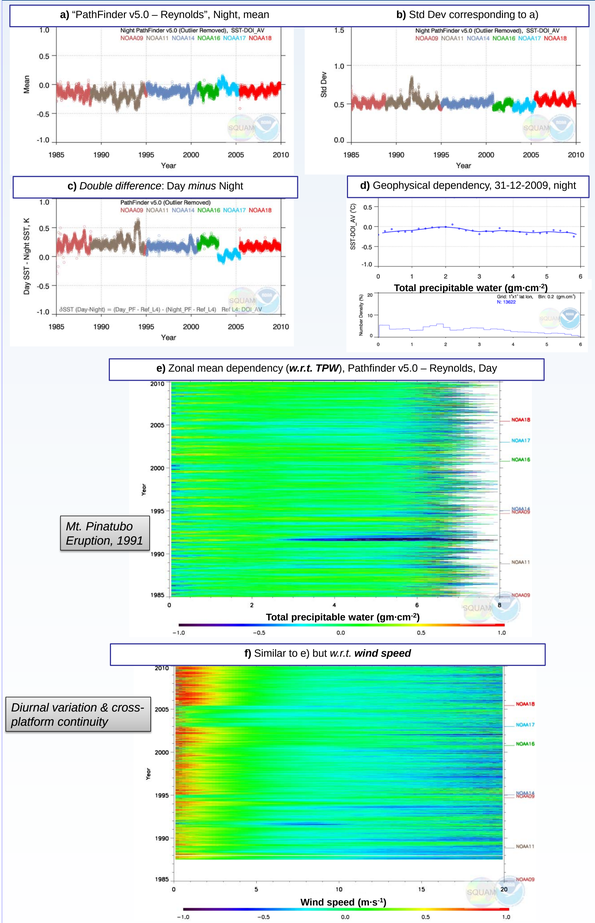
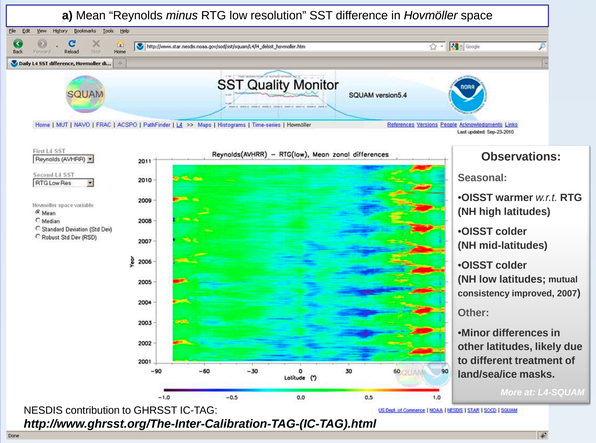


Fig. 2: PathFinder v5.0 SQUAM diagnostics
(more at: ***http://www.star.nesdis.noaa.gov/sod/sst/squam/PF***)

4. L4 intercomparison



NESDIS contribution to GHRSST IC-TAG:
http://www.ghrsst.org/The-Inter-Calibration-TAG-(IC-TAG).html

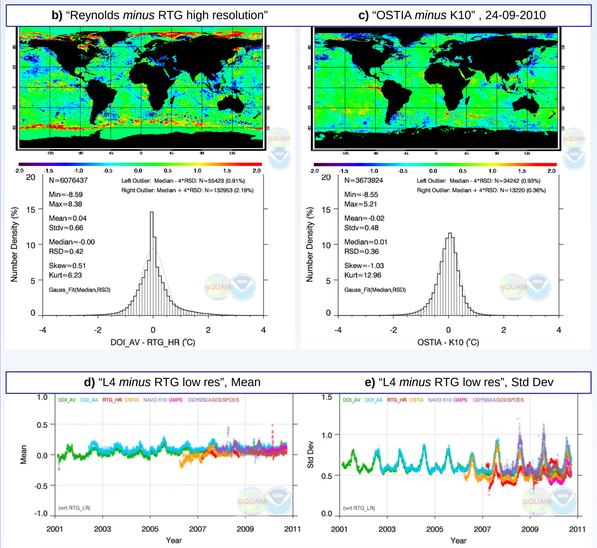
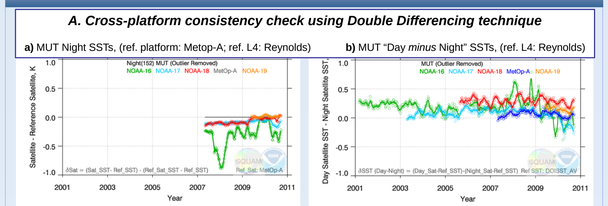


Fig. 3: L4-SQUAM: L4 intercomparison and analyses
(more at: ***http://www.star.nesdis.noaa.gov/sod/sst/squam/L4***)

L4-SQUAM Summary

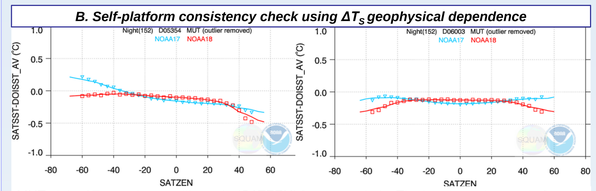
- **L4-SQUAM currently monitors nine daily L4 SSTs:**
  - **Two daily 0.25° (spatial grid) OISST (Reynolds) products**
  - **Two daily RTG products (0.5° low resolution and 1/12° high resolution)**
  - **UKMO 0.05° OSTIA, IFREMER 0.1° ODYSSEA, and GHRSST MPE 0.25° SSTs**
  - **NAVO K10 and NESDIS POES-GOES blended 0.1° SSTs**
- **Two daily L4 SSTs are pending inclusion in near future:**
  - **JPL/NASA 0.01° G1SST and CMC 0.2° SSTs**
- **In general, OISSTs are mutually consistent**
- **RTG products are less consistent with other L4s, and require further reconciliation. (Note that, RTG low resolution analysis uses NAVO regression SST whereas RTG high resolution uses newer NCEP physical SST as input.)**
- **OSTIA & ODYSSEA SSTs show mutual consistency (but ODYSSEA production temporarily halted)**
- **Largest differences between various L4 products are observed in high latitudes. These are likely due to different treatment of land /sea/ice mask and need to be reconciled.**

5. Examples of L2 analyses



Cross platform differences are due to: diurnal variability (DV) not accounted for in L4 SSTs, sensor calibration issues, and SST algorithms

"Day - *Night*" differences are larger for PM than for AM platforms. If DV is accounted for, curves are expected to converge at zero



MUT night ΔT_S *vs.* view zenith angle (SATZEN) for two periods. The bug in assignment of SATZEN to SST retrievals before January 2006 was detected (left) and corrected (right).

Fig. 4: L2 MUT GAC checks: **A.)** cross-consistency **B.)** self-consistency
(more at: ***http://www.star.nesdis.noaa.gov/sod/sst/squam/MUT***)

Summary

- L2-SQUAM performs statistical analyses on differences between satellite SST (T_S) and several global reference SST fields (T_R), such as, Reynolds, RTG, OSTIA and ODYSSEA SSTs.
- L2-SQUAM is fully functional with two AVHRR FRAC SST products (NESDIS ACSPO and EUMETSAT O&SI SAF) and four GAC products (NESDIS MUT and ACSPO, NAVO SEATEMP, and Pathfinder v5.0), for all available platforms.
- L4-SQUAM is fully functional for 9 daily L4 products. Inclusion of other L4 products is underway. L4-SQUAM may provide a community tool for L4-intercomparison .

Future work

- Reconcile: diurnal models; Improve SST Alg/Sensor Cal
- Add other L4 (G1SST, CMC) & L2 (MODIS,VIIRS)
- Add Val against *in situ* SST

References

[1] Autret, Piollé, 2007; ODYSSEA Manual, CERSAT – IFREMER
[2] Dash *et al.*, 2010, *JTech*, (doi: 10.1175/2010JTECHO756.1)
[3] Dash *et al.*, 2009; AMS, *ams.confex.com/ams/pdfpapers/144238.pdf*
[4] Gemmill *et al.*, 2007: RTG-HR. NOAA/NWS/NCEP #260, 39pp
[5] Ignatov *et al.*, 2004; *13th AMS Conf.*, Norfolk, VA, Sep., 2004
[6] Kilpatrick *et al.*, 2001; *JGR*, **106**, 9179-9198
[7] Reynolds *et al.*, 2007; *JClim*, **20**, 5473-5496
[8] Stark *et al.*, 2007; OSTIA. *Oceans 07, IEEE*, June 2007, Scotland
[9] Thiébaux *et al.*, 2003; RTG-R. *BAMS*, 84, 645-656
[10] Xu & Ignatov, 2010; JGR, 115, doi:10.1029/2010JC0061

Acknowledgements & disclaimer

This work was supported by NESDIS (PSDI, NDE, ORS), NPOESS Cal/Val, and JSDI. We thank SST colleagues at NCEP (Bob Grumbine), O&SI SAF (P. LeBorgne), UK Met Office (Matt Martin), NAVOCEANO (Doug May, Bruce McKenzie), NODC (Ken Casey, Tess Brandon), U. Miami (Bob Evans, Peter Minnett), and NESDIS STAR & OSDPD (XM. Liang, F. Xu, B. Petrenko, J. Stroup, N. Shabanov, D. Frey, E. Maturi, A. Harris, J. Mittaz, W. Meng) for support and collaboration. The views and findings are those of the authors and should not be construed as an official NOAA or US Government position, policy, or decision.

AMS 17th Conf. on Satellite Meteorology & Oceanography, 27 Sep – 1 Oct, 2010 Annapolis MD. prasanjit.dash@noaa.gov; prasanjit.dash@colostate.edu, tel.: +1-301-763-8053 x 168, fax: 301-763-8572