JPSS SST STAR Progress Report

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Summary

1. **ACSPO S-NPP VIIRS users (PM Session today)**
   - Canadian Met Centre (CMC) and Geo-Polar Blended (NOAA) L4s continue assimilating L2P SST
   - Met Office, NOAA CRW started using L3U SST
   - ABOM, JMA, JPL, and NOAA (WCOFS, NCEI, NCEP) explore L2P/L3U SSTs

2. **ACSPO L2P/L3U SSTs fully archived in PO.DAAC/NCEI (S. Baker-Yeboah/V. Lance)**
   - Data are fully searchable/accessible at podaac.jpl.nasa.gov and www.nodc.noaa.gov

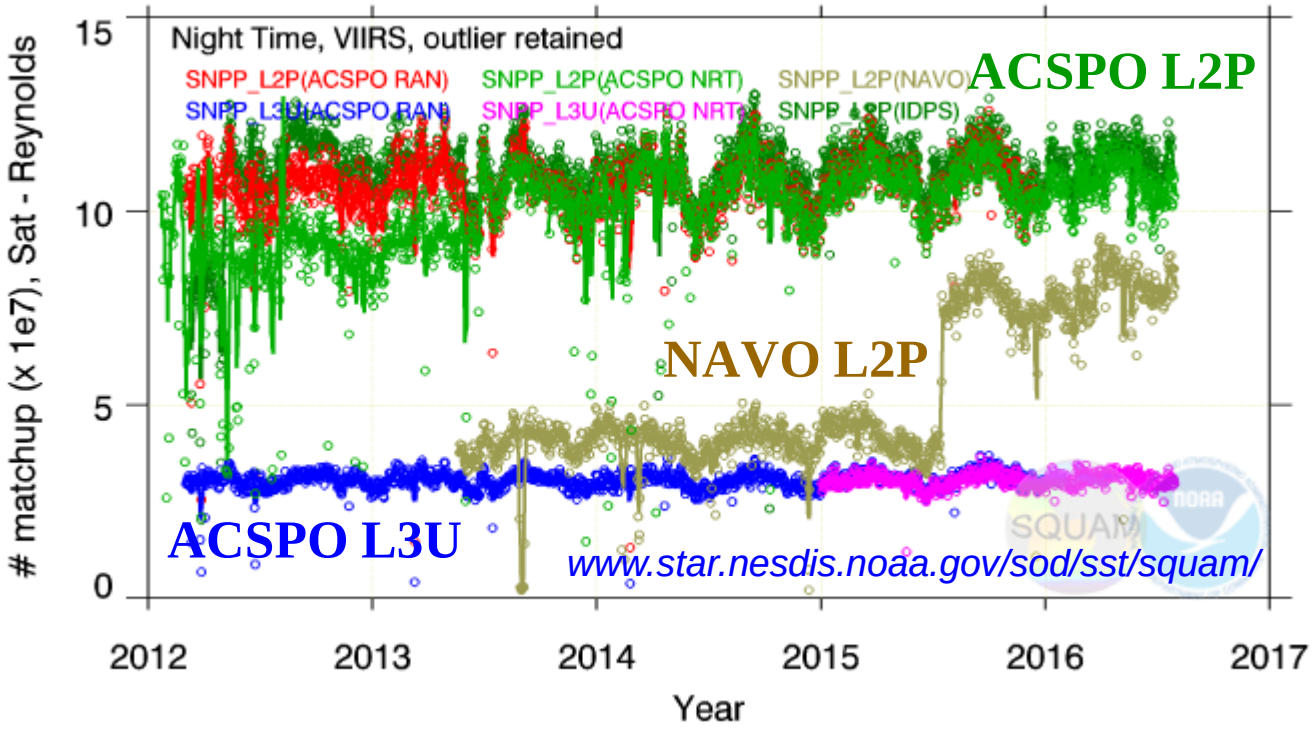
3. **ACSPO v2.41 in testing; 2.50/2.60 in development (I. Gladkova/Y. Ding/B. Petrenko)**
   - Capable of processing S-NPP/JPSS and Himawari-8/GOES-R SST; Improved L2P and L3U processing
   - Underway: ACSPO v2.50 (improved SST imagery & algorithms) & v2.60 (use for pattern recognition)

4. **Validation of VIIRS SSTs (ACSPO/IDPS/NAVO) (A. Ignatov)**
   - ACSPO Regional Monitor for SST (ARMS; www.star.nesdis.noaa.gov/sod/sst/arms/) (**Y. Ding/I. Gladkova**)
   - ACSPO SST consistently meets/exceeds JPSS specs, in the full retrieval domain
   - Quantified Effect of new ACSPO Error Characterization (Single-Scanner Error Statistics, SSES)
   - SST Team provides critical feedback to SDR Team on VIIRS performance (WUCD)

5. **ACSPO S-NPP RAN1 w/U. Wisconsin (A. Ignatov)**
   - Data from 1 Mar 2012 – 31 Dec 2015 reprocessed (but part are lost)
   - Several days are missing/suboptimal quality – working to fix before archival with PO.DAAC/NCEI

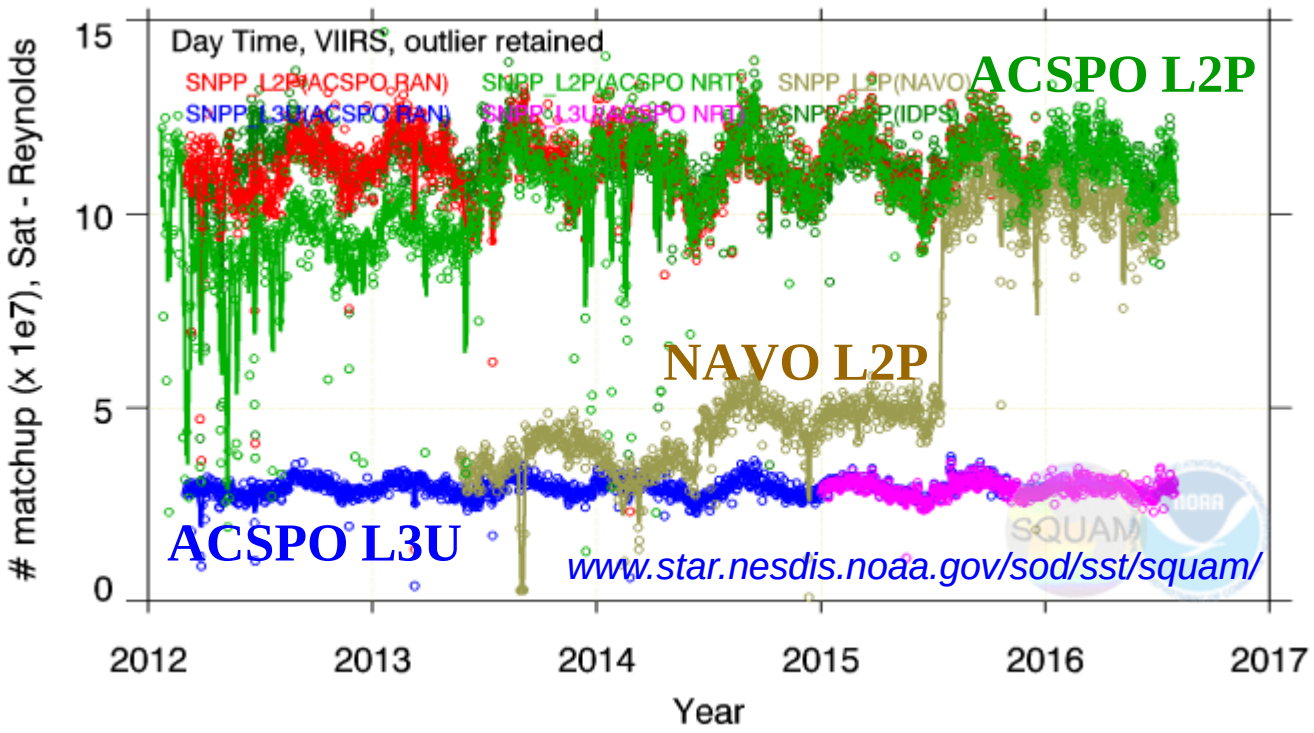
Number of VIIRS SST Pixels

Number of VIIRS SST pixels at Night



- ACSPO 0.02º L3U: ~30M (M=Million)
- ACSPO L2P: ~110M
- NAVO L2P: was ~40M; after Jul 2015 ~80M (~70% ACSPO)

Number of VIIRS SST pixels during Day



- ACSPO 0.02º L3U: ~30M
- ACSPO L2P: ~110M
- NAVO L2P: was ~40M; after Jul 2015 ~100M (~90% ACSPO)

JPSS Requirements

JPSS SST Requirements

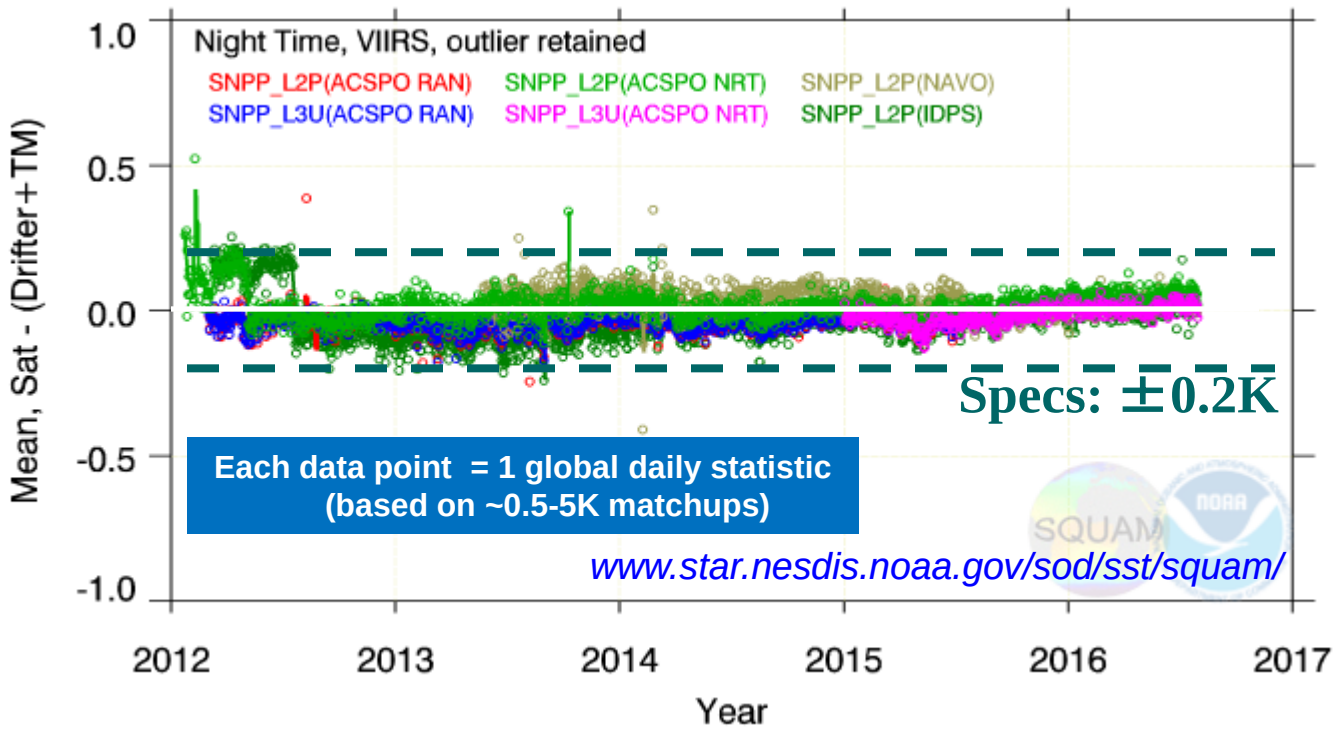
EDR Attribute	Threshold	Objective
a. Horizontal Cell Size (Res)	1.6km[1]	0.25km
b. Mapping Uncertainty, 3σ	2km[1]	0.1km
c. Measurement Range	271 K to 313 K	271 K to 318 K
d. Measurement Accuracy[2]	0.2K	0.05K
e. Measurement Precision[2]	0.6K	0.2K (<55° VZA)
f. Refresh Rate	12 hrs	3 hrs
g. Latency	90 min	15 min
h. Geographic coverage	Global cloud and ice-free ocean; excluding lakes and rivers	Global cloud and ice-free ocean, plus large lakes and wide rivers

[1]Worst case scenario (corresponding to swath edge); both numbers are ~1km at nadir

[2]Represent global mean bias and standard deviation validation statistics against quality-controlled drifting buoys (for day and night, in full VIIRS swath, in full range of atmospheric conditions). Uncertainty is defined as square root of accuracy squared plus precision squared. Better performance is expected against ship radiometers.

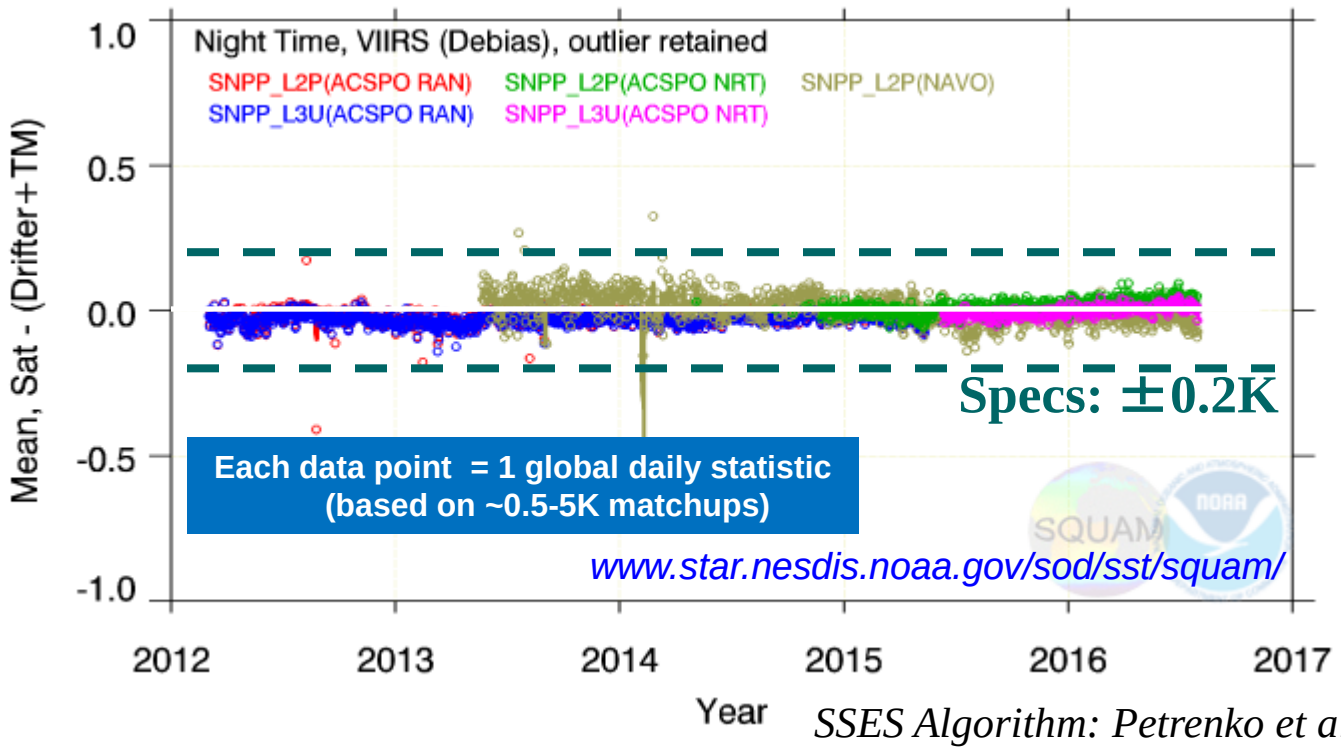
VIIRS – *in situ* Biases
Night

Global "VIIRS – *in situ*" SST Biases at Night
Baseline Regression SSTs



- Products broadly consistent, more so in recent years
- All products meet specs, marginal in the first 1-2 months in RT products
- Reprocessing improves stability of ACSPO SSTs in time

Global "VIIRS – *in situ*" SST Biases at Night
After SSES bias correction



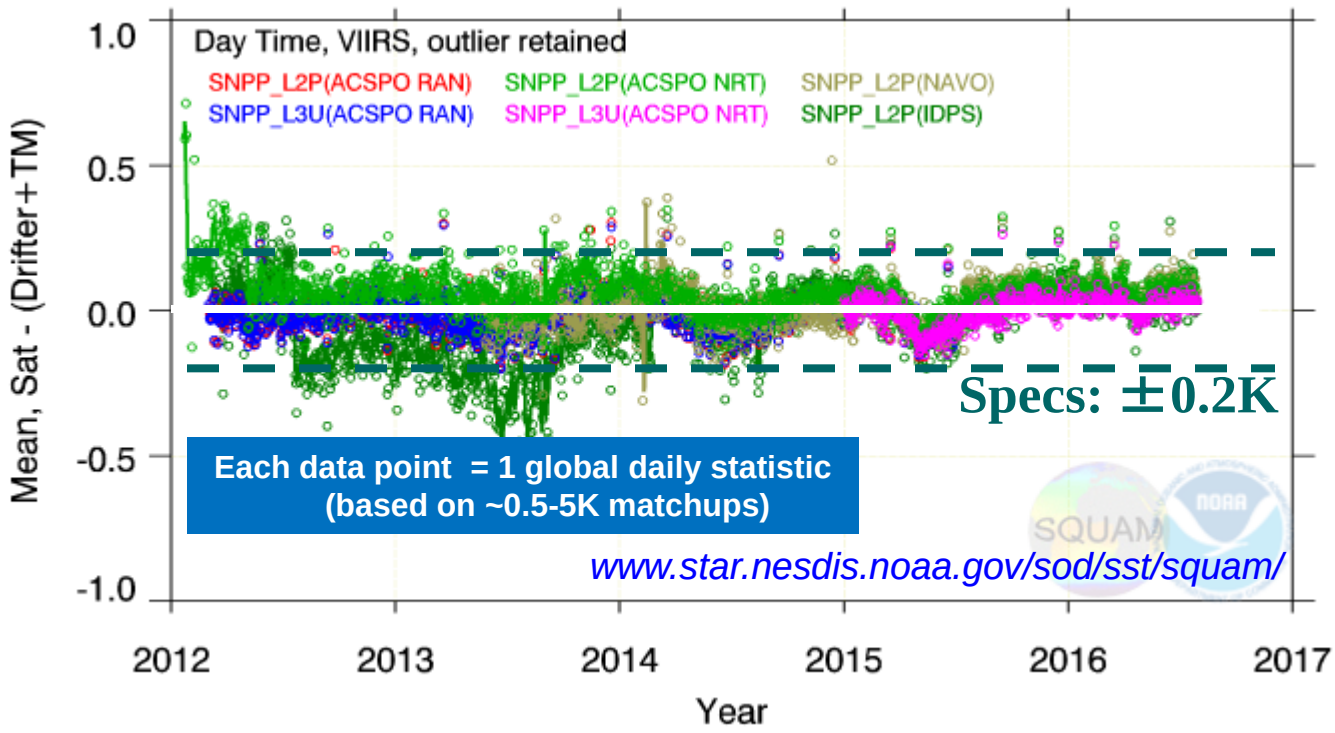
SSES Algorithm: Petrenko et al., JTECH 2016

- VIIRS RAN employs fixed coefficients
- Applying SSES bias correction makes ACSPO biases smaller & time series tighter
- NAVO SST and clear-sky mask algorithms have changed – time series less stable

VIIRS – *in situ* Biases

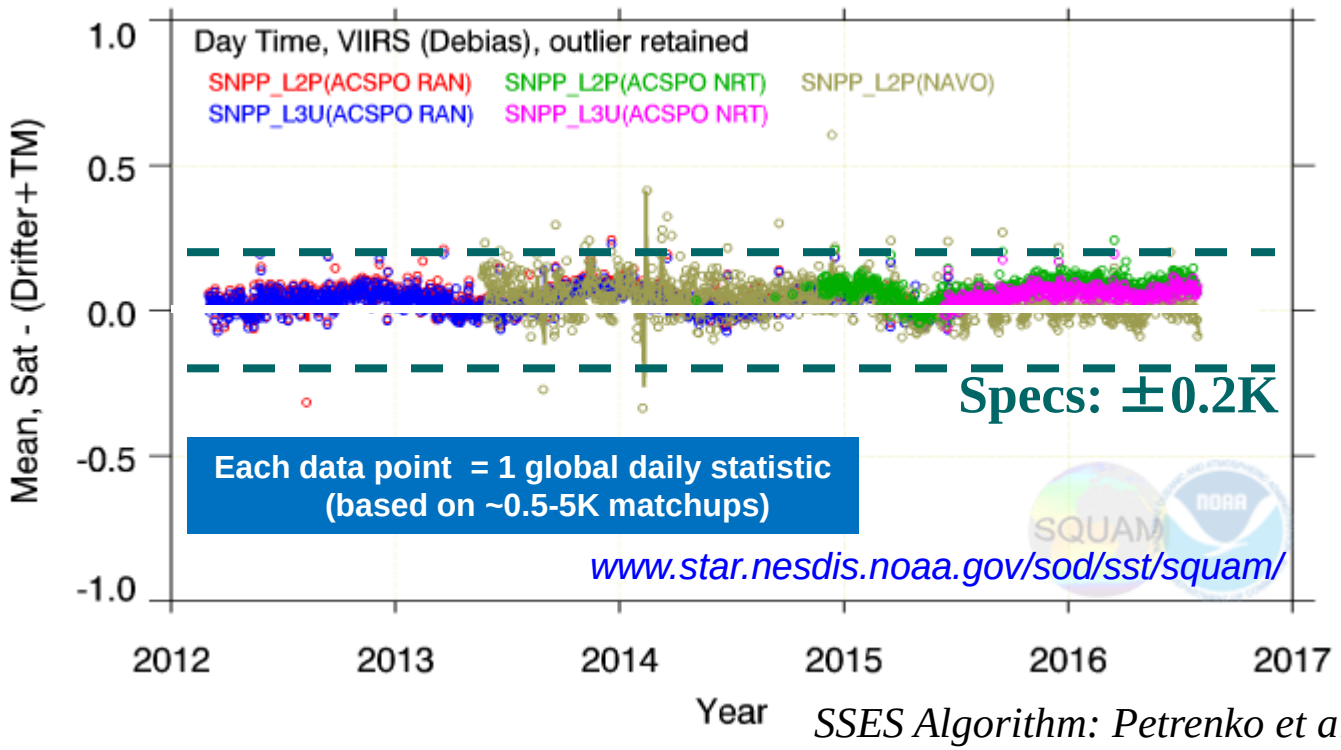
Day

Global "VIIRS – *in situ*" SST Bias during Day Baseline Regression SSTs



- Typically, products meet specs (except IDPS, first months in RT, and WUCD days)
- Warm-Up Cool-Down pop-ups occur every quarter – SDR team working to resolve
- Clear seasonal cycle suggests periodicity of diurnal warming signal
- Reprocessing improves stability of ACSPO SSTs in time

Global "VIIRS – *in situ*" SST Bias during Day
After SSES bias correction



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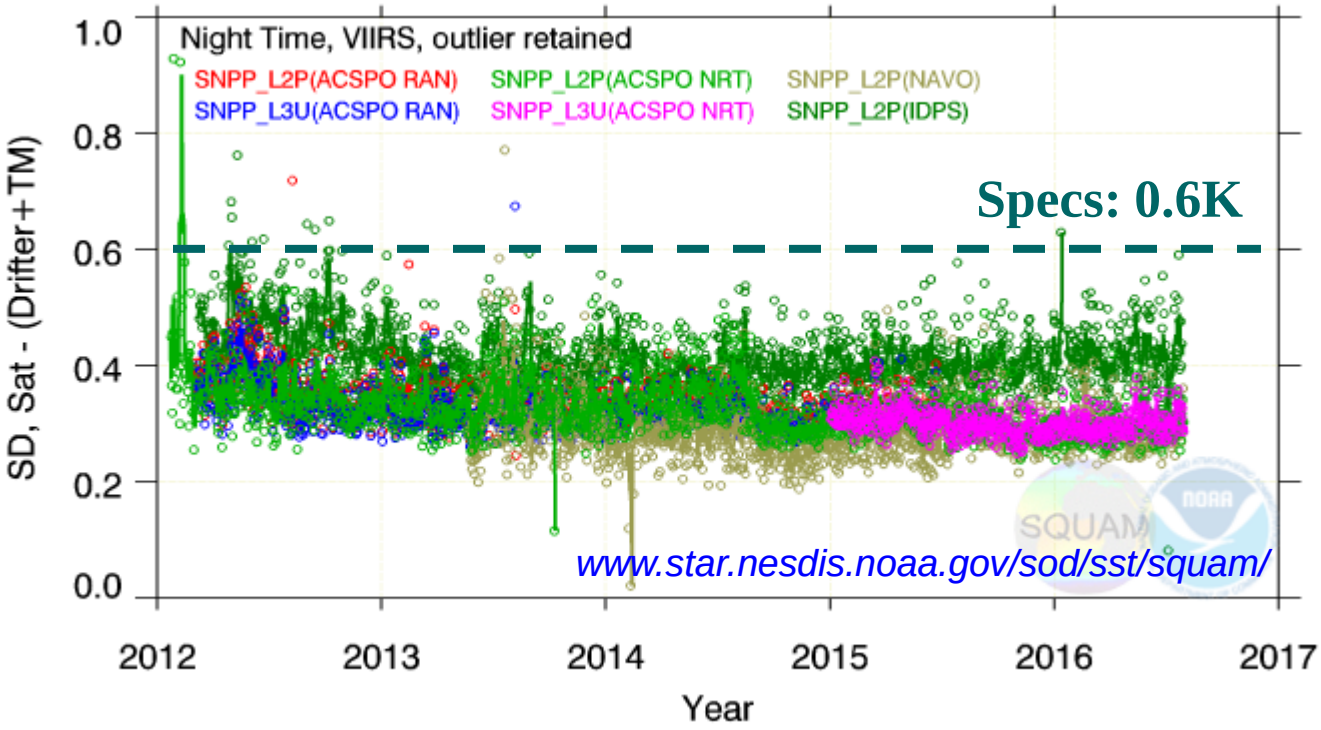
- VIIRS RAN employs fixed coefficients
- Applying SSES bias correction makes ACSPO biases smaller & time series tighter
- NAVO SST and clear-sky mask algorithms have changed – time series less stable
- Seasonal signal is still there although reduced in magnitude

VIIRS – *in situ* Standard Deviations
Night

Global "VIIRS – *in situ*" SST Biases at Night
Baseline Regression SSTs



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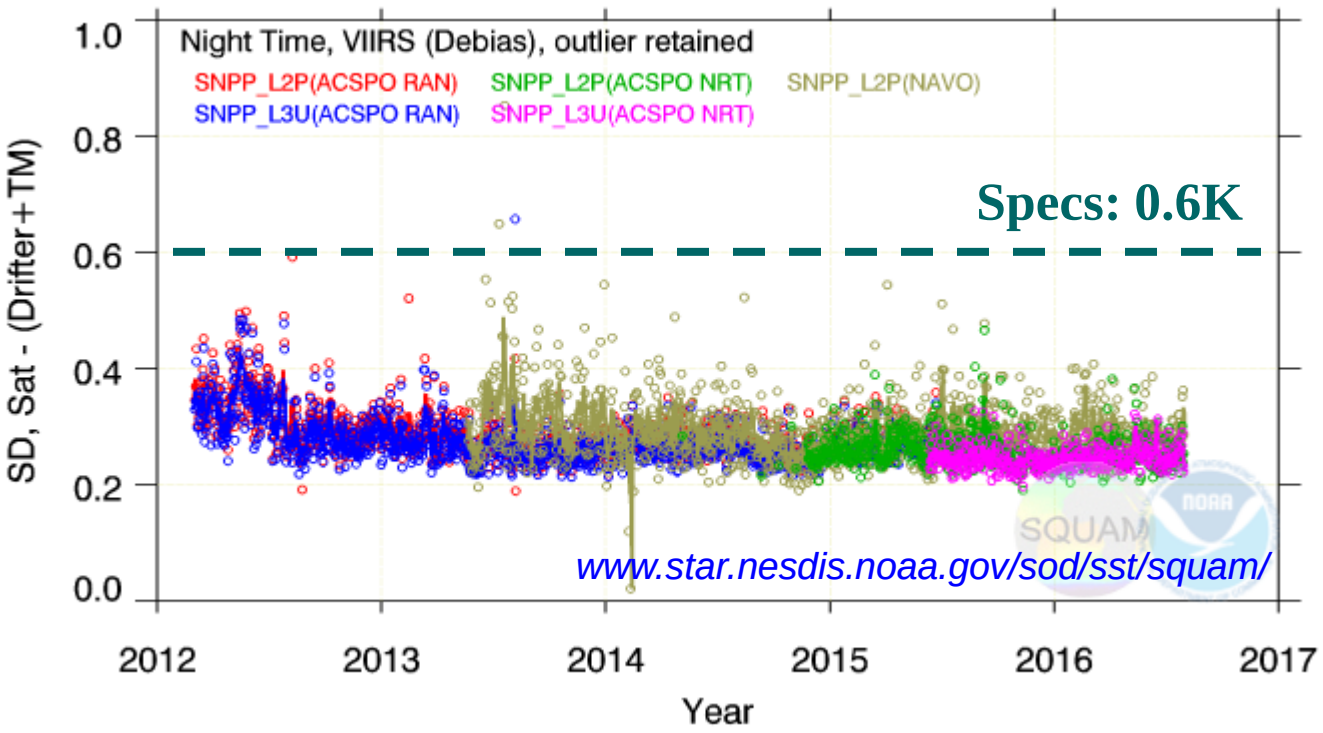

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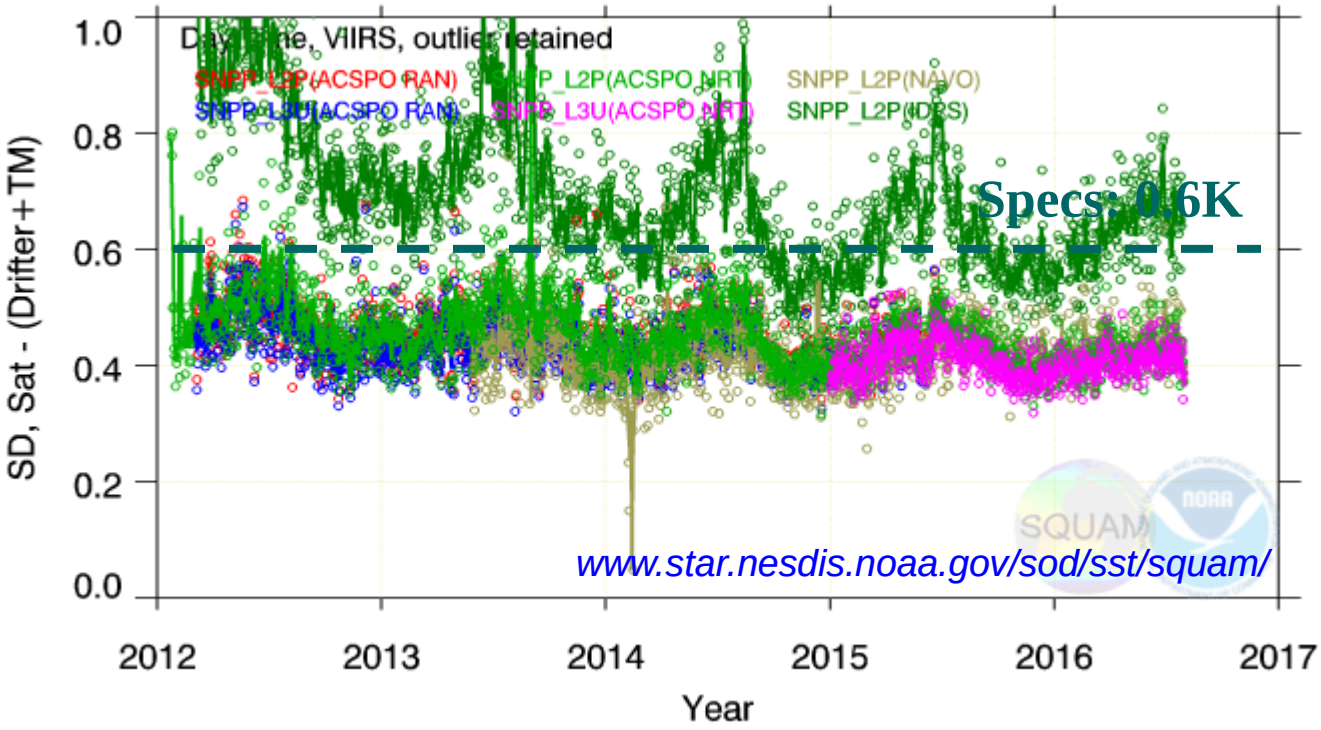
Baseline Regression SSTs



- Products broadly consistent (more so in recent years)
- Products meet specs, except IDPS and first months in RT
- Clear seasonal cycle suggests periodicity of diurnal warming signal
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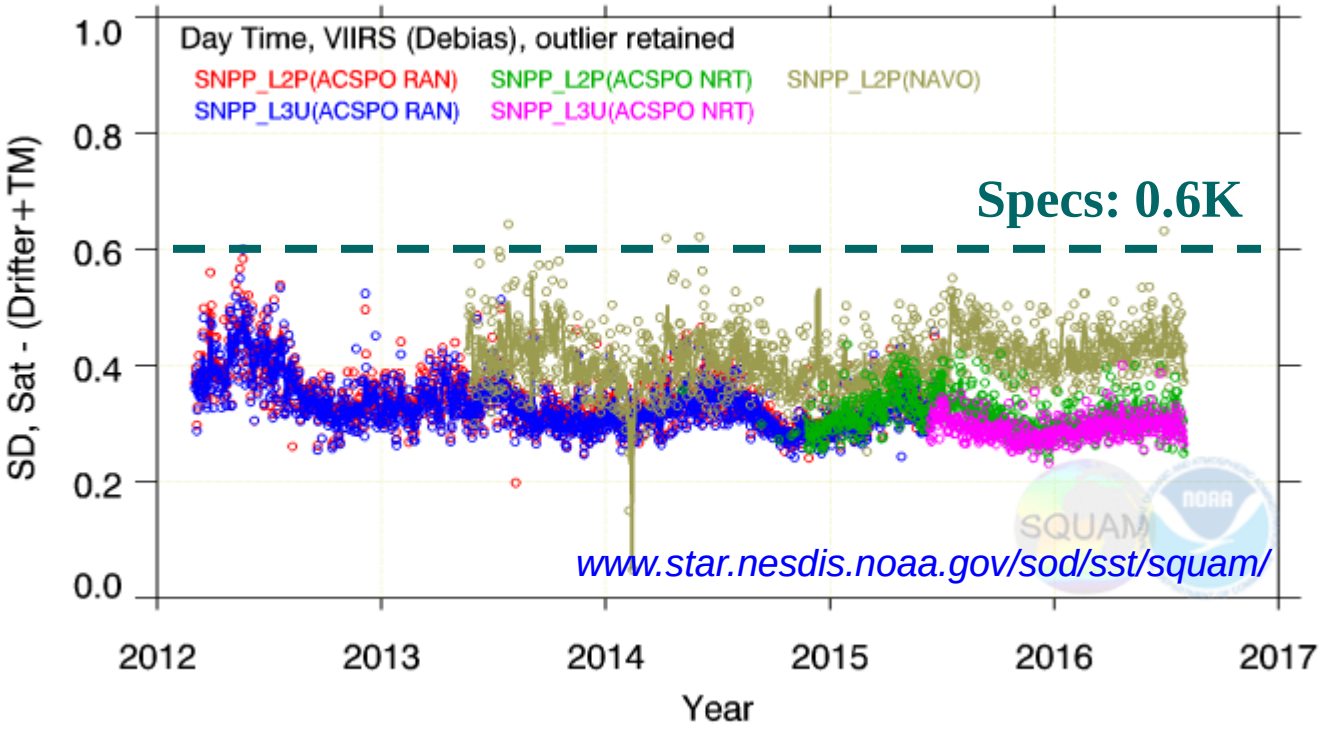
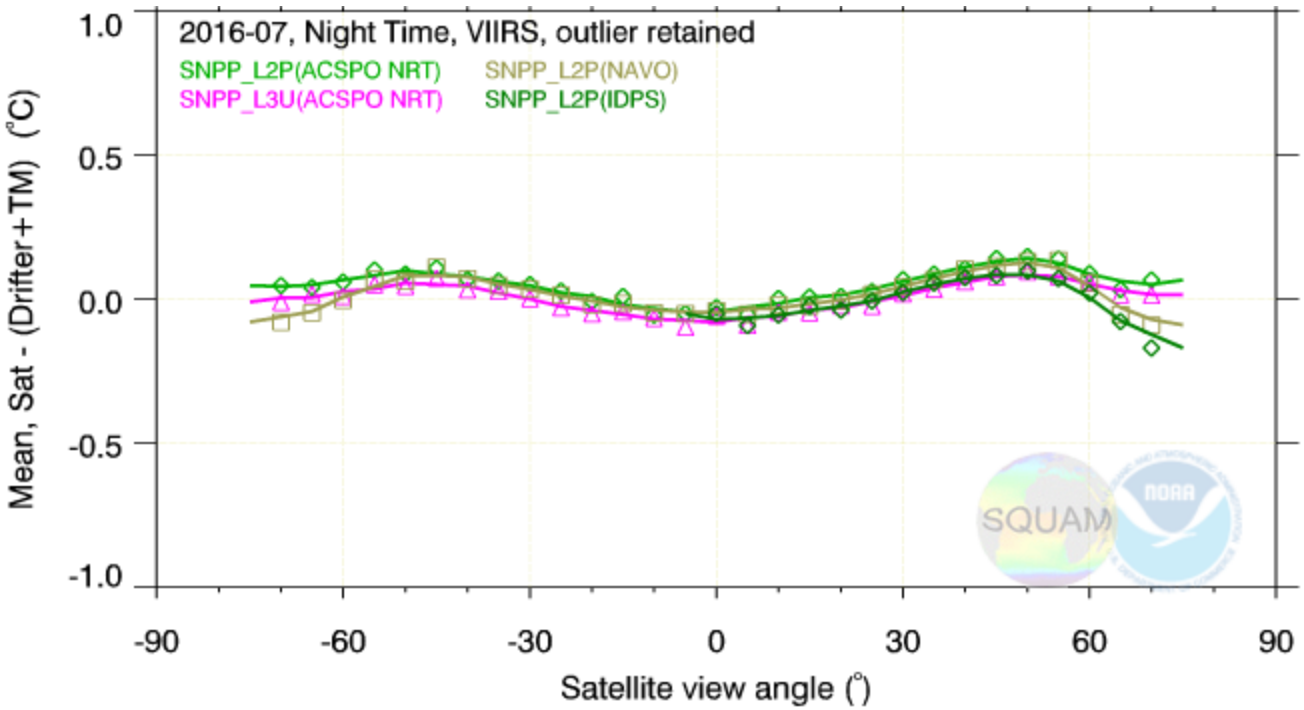
After SSES bias correction



- Products broadly consistent (more so in recent years)
- All products meet specs, except for the first months in RT
- Seasonal cycle in ACSPO SST reduced (SSES corrected for part of it)
- Reprocessing improves stability of ACSPO SSTs in time

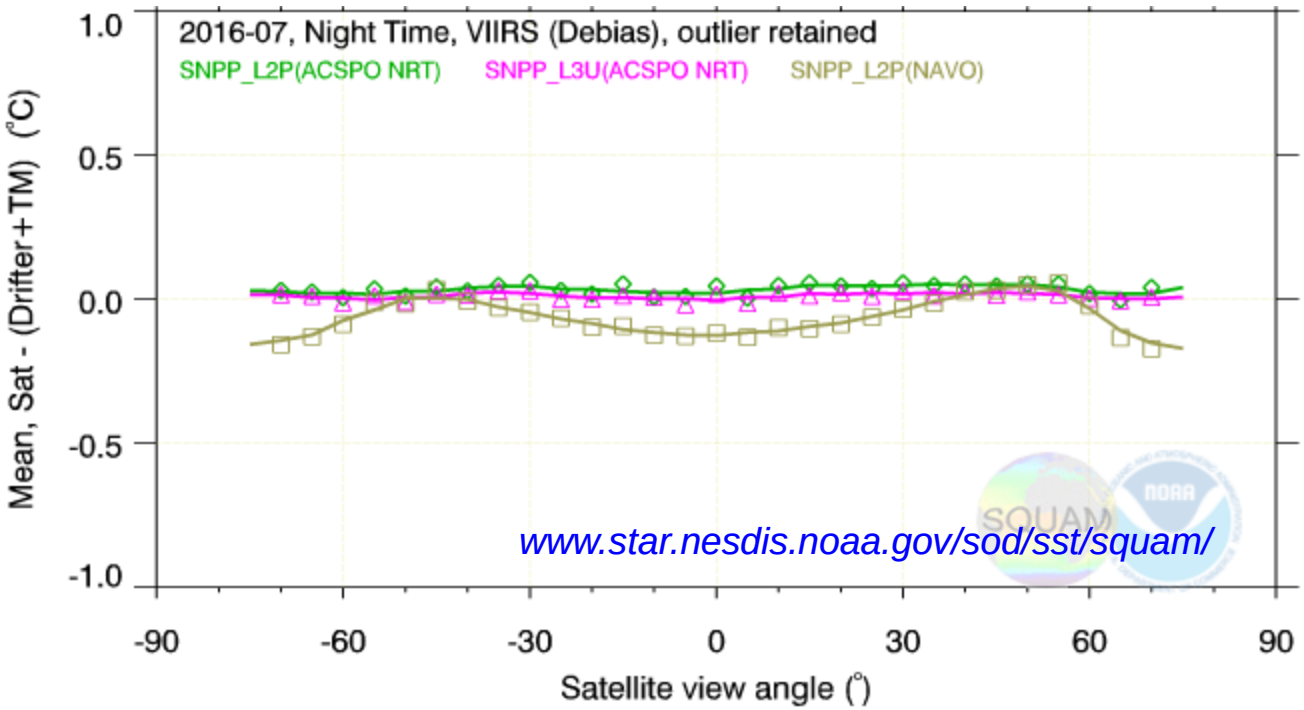
View Zenith Angle Biases
Night

Global "VIIRS – *in situ*" SST Bias during Night
Baseline Regression SST (July 2016)



- All products show a wave-shaped bias dependence (several hundredths of a deg K)

Global "VIIRS – *in situ*" SST Bias during Night
After SSES bias correction (July 2016)

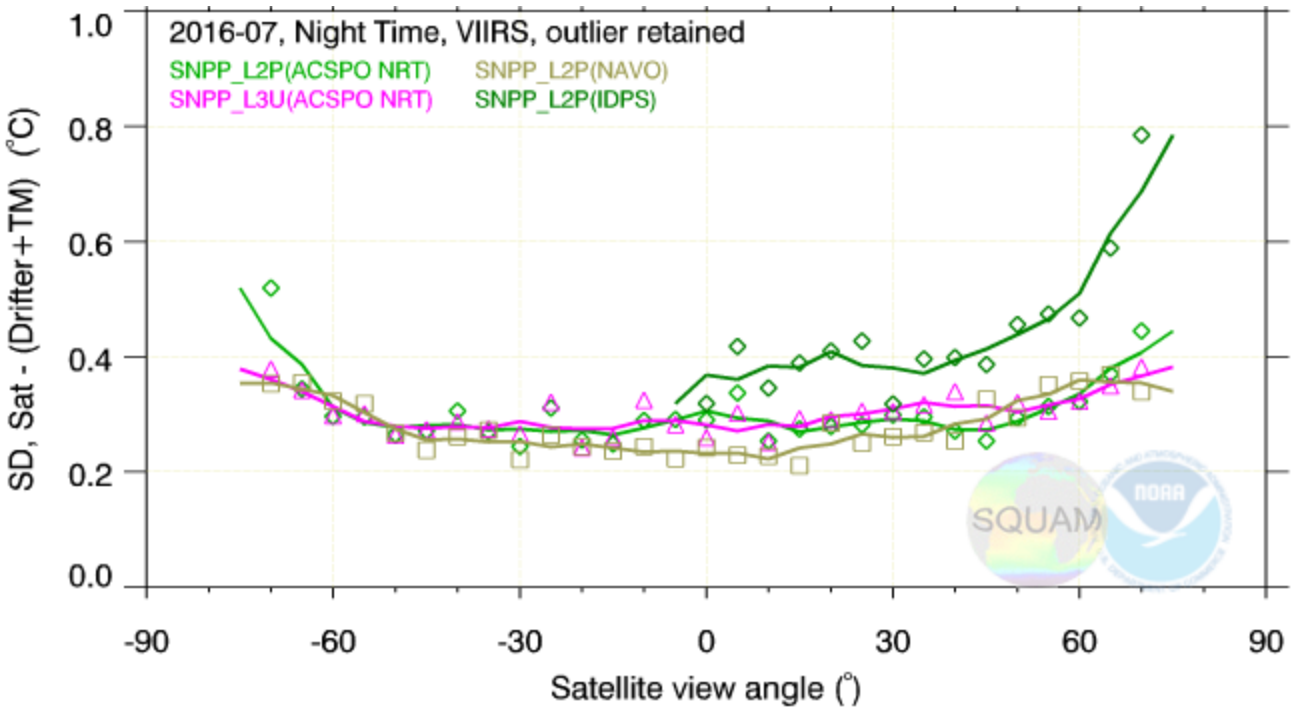


- Applying SSES bias correction flattens out ACSPO VZA dependencies

View Zenith Angle Standard Deviations

Night

Global "VIIRS – *in situ*" SST SD during Night
Baseline Regression SST – July 2016



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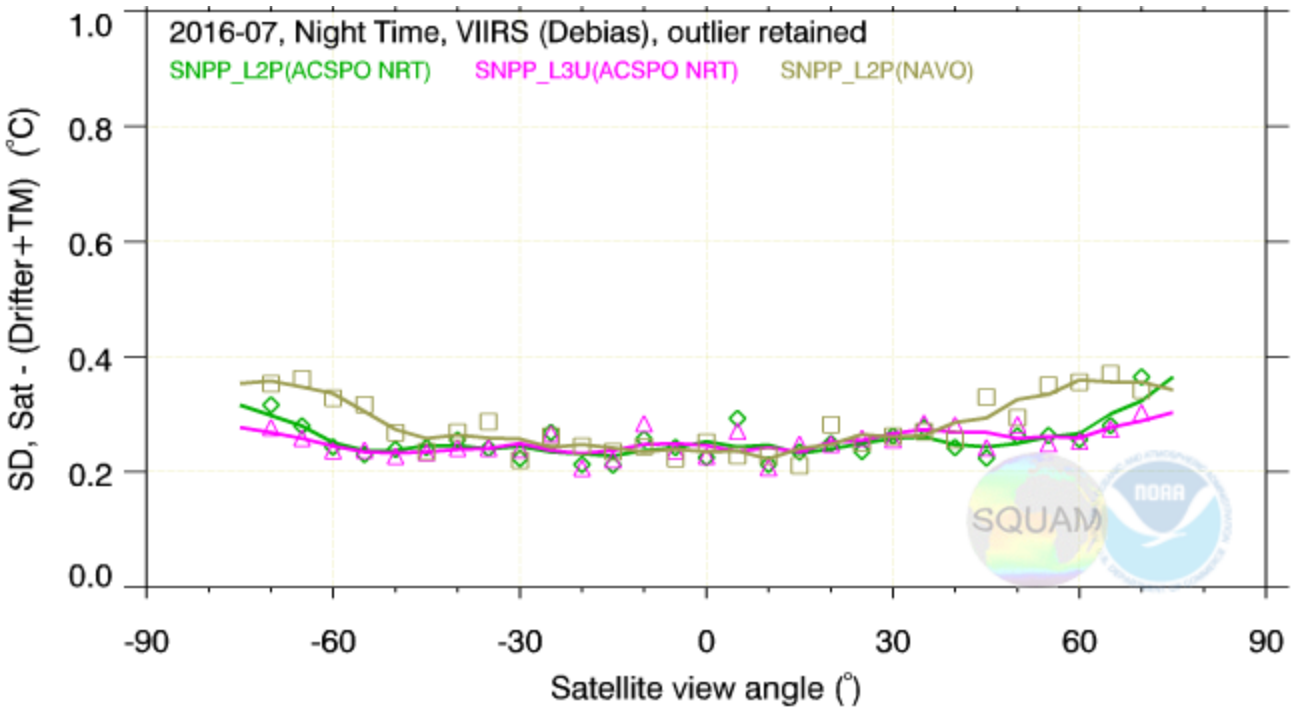
Global "VIIRS – *in situ*" SST SD during Night After SSES bias correction

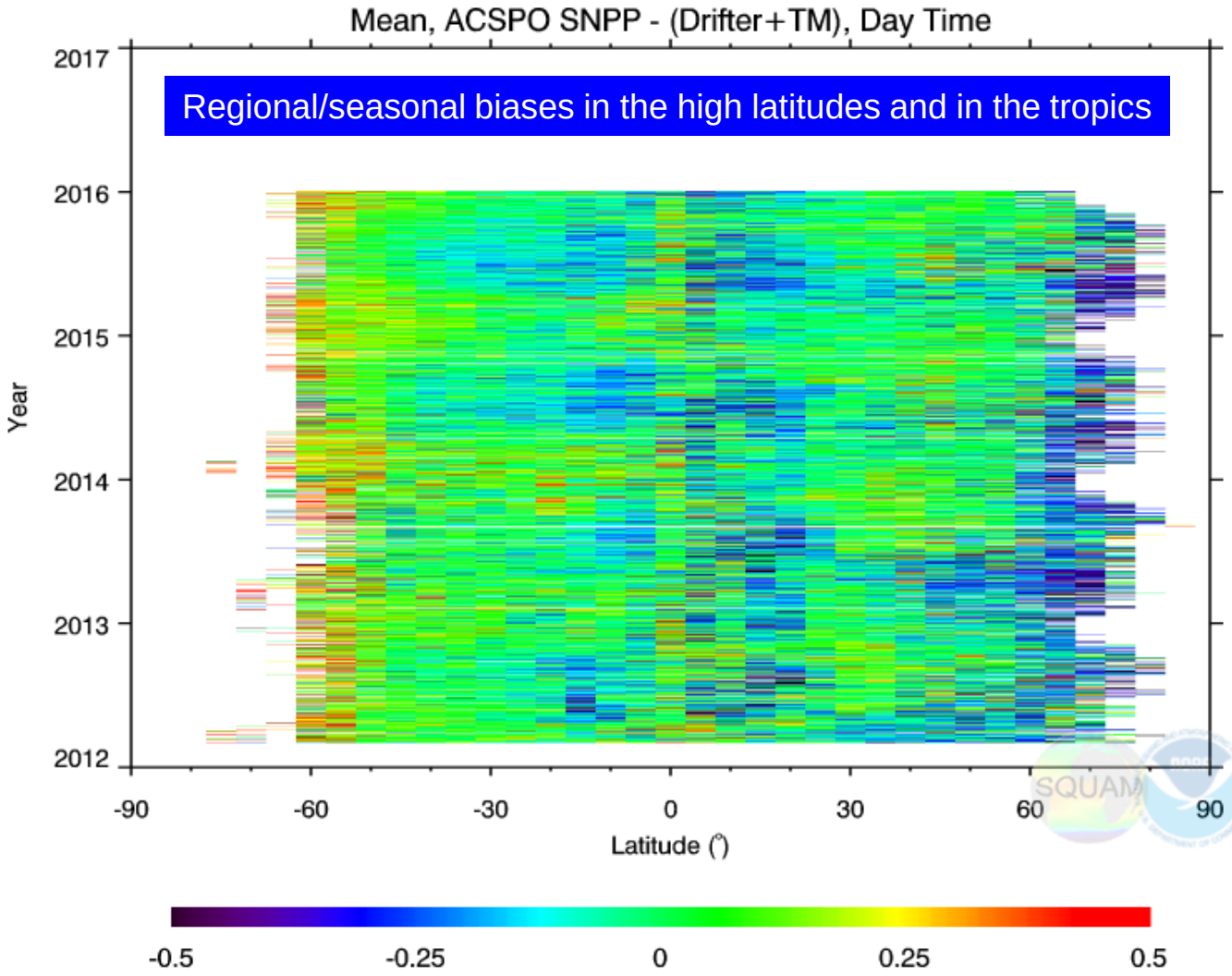


- Applying SSES bias correction flattens out ACSPO VZA dependencies

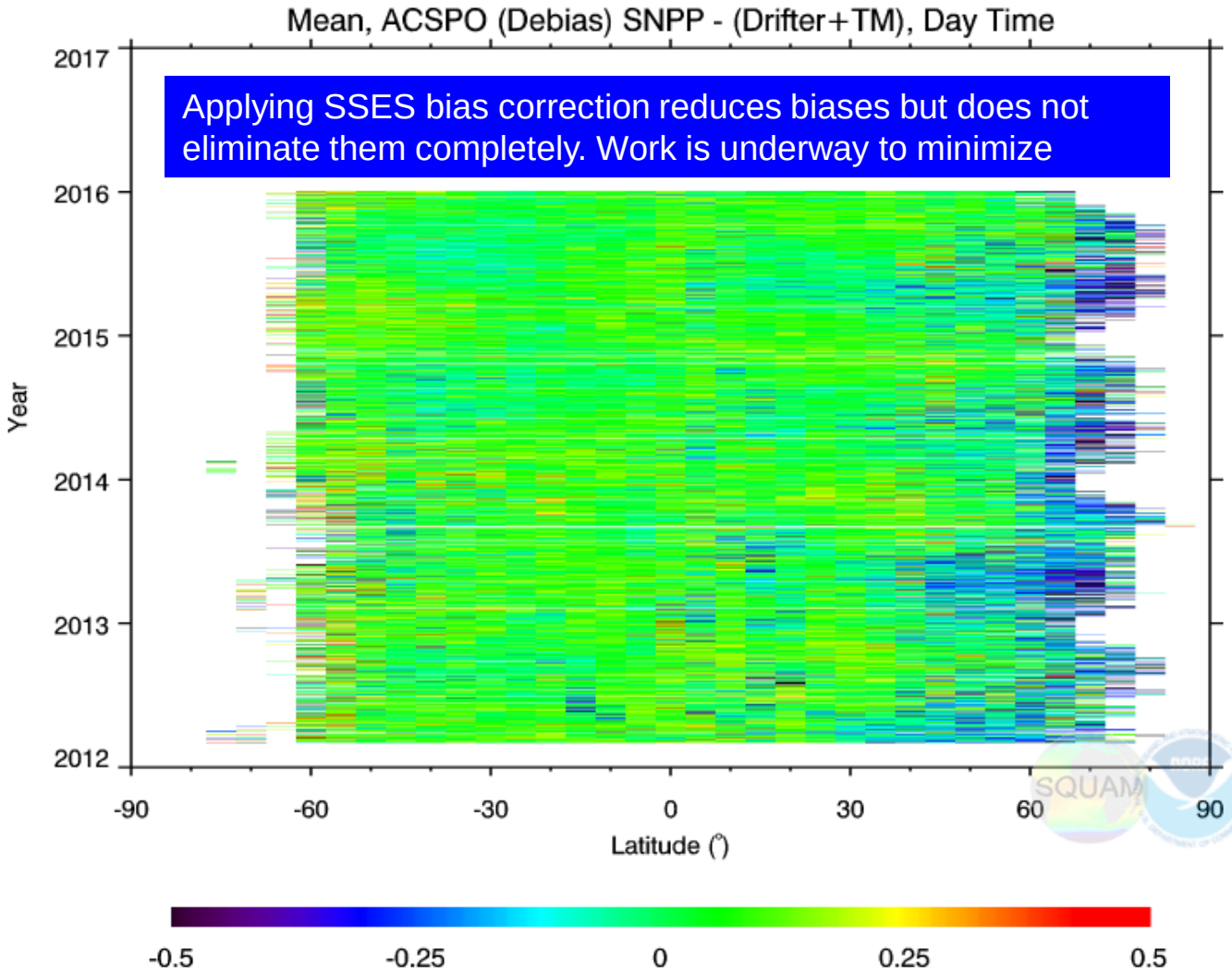
Zonal Hovmoller Diagrams of Bias

Day

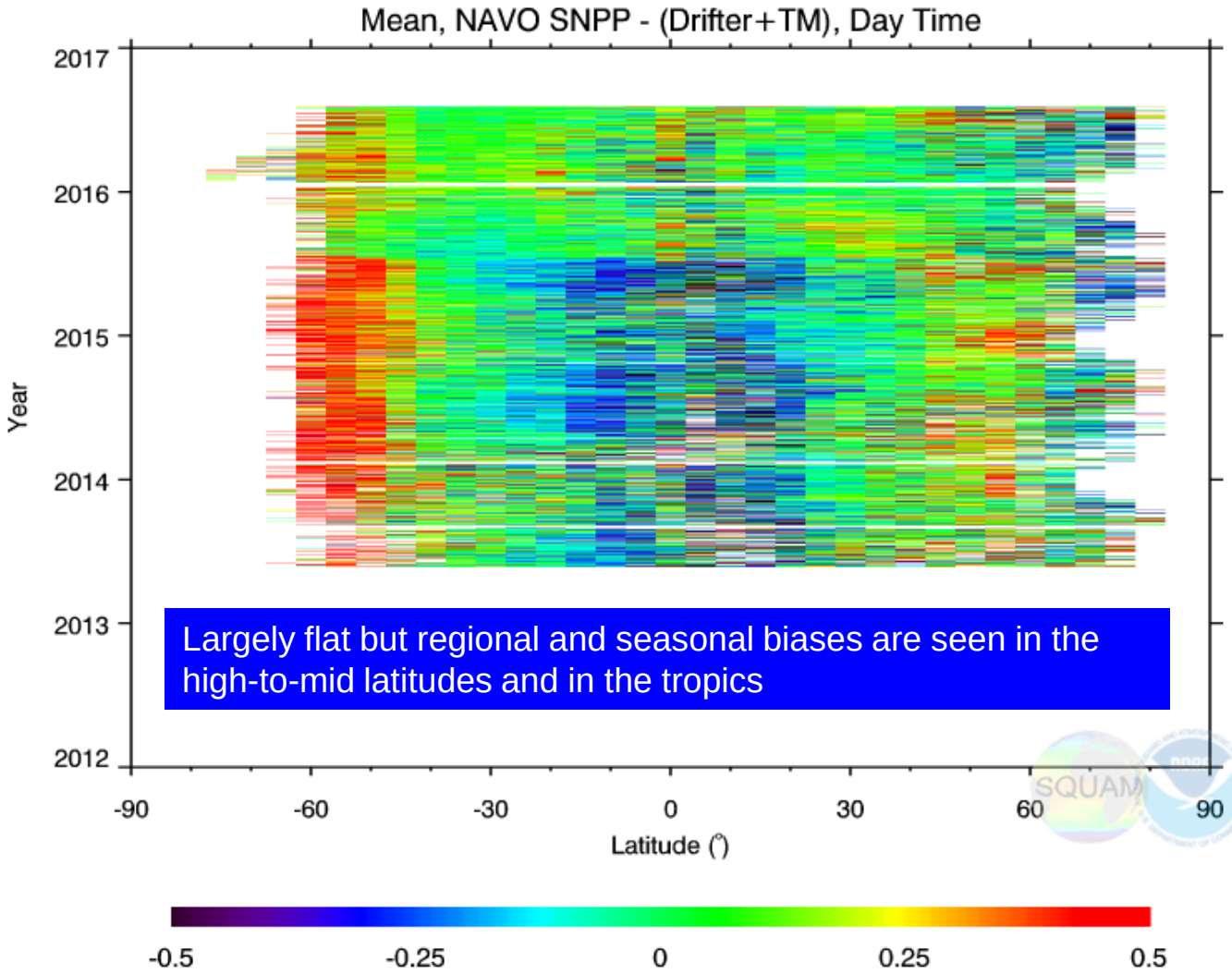
Global "VIIRS – *in situ*" SST Biases Daytime Baseline Regression SST – ACSPO SNPP RAN1



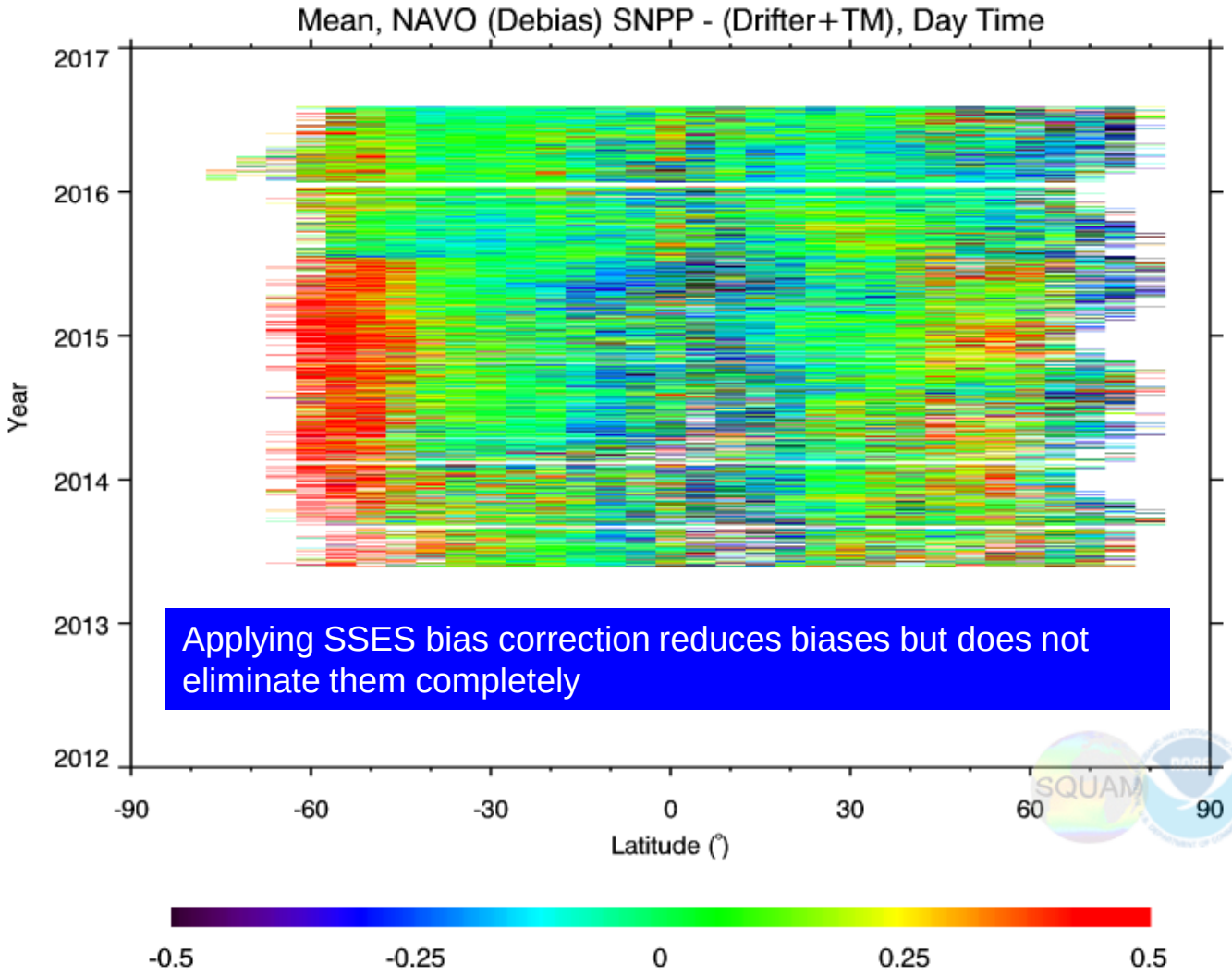
Global "VIIRS – *in situ*" SST Biases Daytime
After SSES bias correction – ACSPO SNPP RAN1



Global "VIIRS – *in situ*" SST Biases Daytime
Baseline Regression SST – NAVO



Global "VIIRS – *in situ*" SST Biases Daytime
After SSES bias correction – NAVO



Key Points

- RAN1 extends ACSPO VIIRS data back in time and improves SST stability, accuracy and precision
- Note that part of the RAN1 data appear lost on Wisconsin computers, before download to STAR was complete
- Correcting for SSES bias improves comparison with *in situ* data (specifically, minimizes regional biases). It is recommended to improve data assimilation (especially for those products blending ACSPO data with *in situ* SSTs)
- Overall ACSPO VIIRS product compares favorably to other products (IDPS, NAVO). It is mature and ready for the use in various applications including assimilation in L4 analyses

Future Work

- Support J1 launch
- Complete S-NPP RAN1 and archive with PO.DAAC, NCEI, CW
- Two coming ACSPO releases (I. Gladkova / B. Petrenko)
  - V2.50: Improved SST imagery (v2.50); Improved SST algorithms
  - V2.60: Improved cloud mask; Ocean fronts output as an extra layer
- Reduce regional/seasonal biases, improve spatial/temporal contrasts
  - Cold biases in the Tropics: Aerosol contamination?
  - Biases in the high-to-mid latitudes: SST/SSES algorithms limitations?
  - Ensure sensitivity to true SST ~1 (B. Petrenko)
- Document ACSPO VIIRS Product
  - Peer-reviewed pub
  - ATBD


Thank You!