NOAA ACSPO SST Products

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NOAA; CIRA; GST Inc; CCNY

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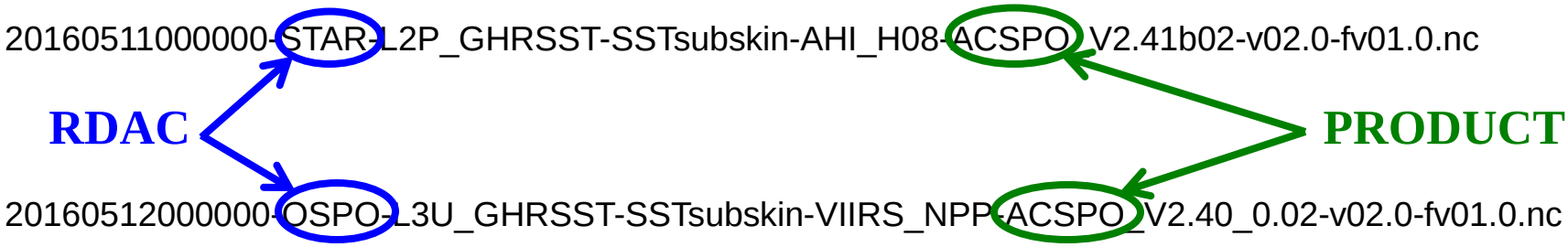
ACSPO Product and NOAA Regional Data Assembly Centers



- **ACSPO = Advanced Clear-Sky Processor for Ocean**
  - NOAA Enterprise SST Product from polar and geostationary platforms

- **STAR = NOAA Center for Satellite Applications and Research**
  - Research arm of NOAA satellites
  - Reprocessed **[RAN]** and Experimental **[EXP]** Products

- **OSPO = NOAA Office of Satellite and Product Operations**
  - Operational (24/7) arm of NOAA satellites
  - Operational Products **[OPS]**

NOAA Enterprise SST Product: ACSPO

Work is underway to consolidate NOAA algorithms into "enterprise".
NOAA enterprise SST: ACSPO (Advanced Clear-sky Processor for Ocean)

Polar Sensors / Platforms

1 – **VIIRS**: S-NPP (launch: Oct'2011) **[OPS] + [RAN1, Mar'2012-Dec'2015]**
(to be followed by J1 in ~Jan'2017 to J4 in ~2026)

3 – **AVHRR**: Various NOAA and Metop platforms **[RAN1, 2002-2015]**

Geostationary Platforms / Sensors

– **GOES-R**: Advanced Baseline Imager (ABI). Planned for launch in Oct'2016, and to be followed by GOES-S to -U

2 – **Himawari-8**: Advanced Himawari Imager (AHI) launched Oct'2014 – sister instrument to ABI **[EXP → OPS]**

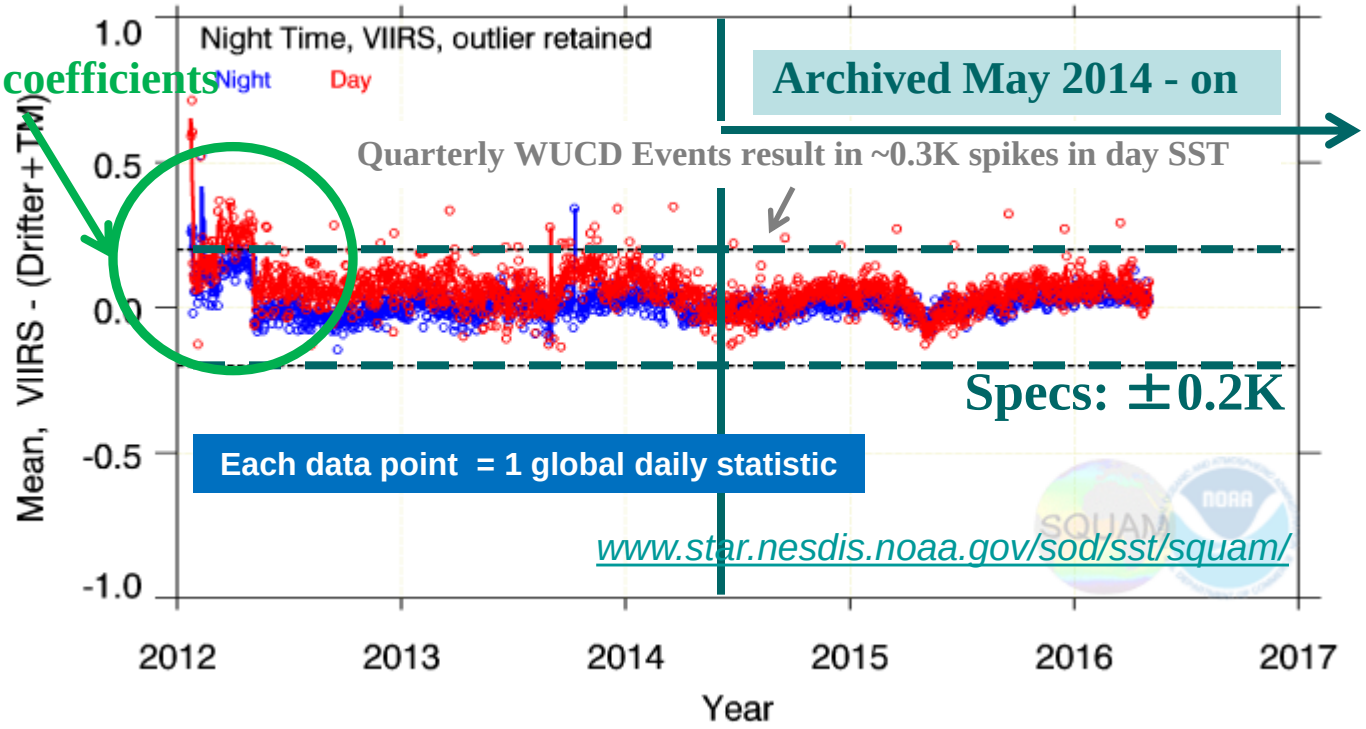
NB: Historical geo sensors (GOES Imager, MSG SEVIRI) will continue to be processed with the NOAA heritage geo SST system (Eileen Maturi's brief)

Visible Infrared Imager Radiometer Suite (VIIRS)

- S-NPP (Suomi National Polar-orbiting Partnership) satellite launched on 28 October 2011. Bridgehead to the Joint Polar Satellite System (JPSS) series.
- **J1 (NOAA-20) will be launched in Jan'2017.** Will be followed by J2 (2021) – J3 (2026) – J4 (2031)
- S-NPP/JPSS carry VIIRS which replaces AVHRR in the NOAA operations
- NOAA/EUMETSAT signed Joint Polar System agreement: S-NPP/JPSS covers 1:30am/pm orbit while Metop AVHRR covers 9:30am/pm orbit
- ACSPO **OPS** & **RAN1** *sub-skin* VIIRS SST Products
  - L2P (~27GB/day); 0.02º L3U (<1GB/day; ABoM)
- Major users of ACSPO VIIRS **OPS** L2P/L3U
  - NOAA geo-polar blended & CMC assimilate L2P
  - UKMO OSTIA and NOAA WCOFS (West-Coast Ocean Forecast System) started assimilating L3U

VIIRS L2P VAL BIAS vs *i*Quam Drifters + Trop. Moor. 1

Initial SST coefficients



Day

Night

- Product meets JPSS specs and users' expectations, during both day and night
- Biases gradually improve in time as ACSPO algorithms mature
- Reprocessing underway to produce uniform & complete time series
- Every 3 month, "global warming" of ~0.3K occurs in daytime SST, due to black body warm-up cool-down exercises performed by NASA. Work is underway to resolve

VIIRS L2P VAL SD vs *i*Quam Drifters + Trop. Moor.

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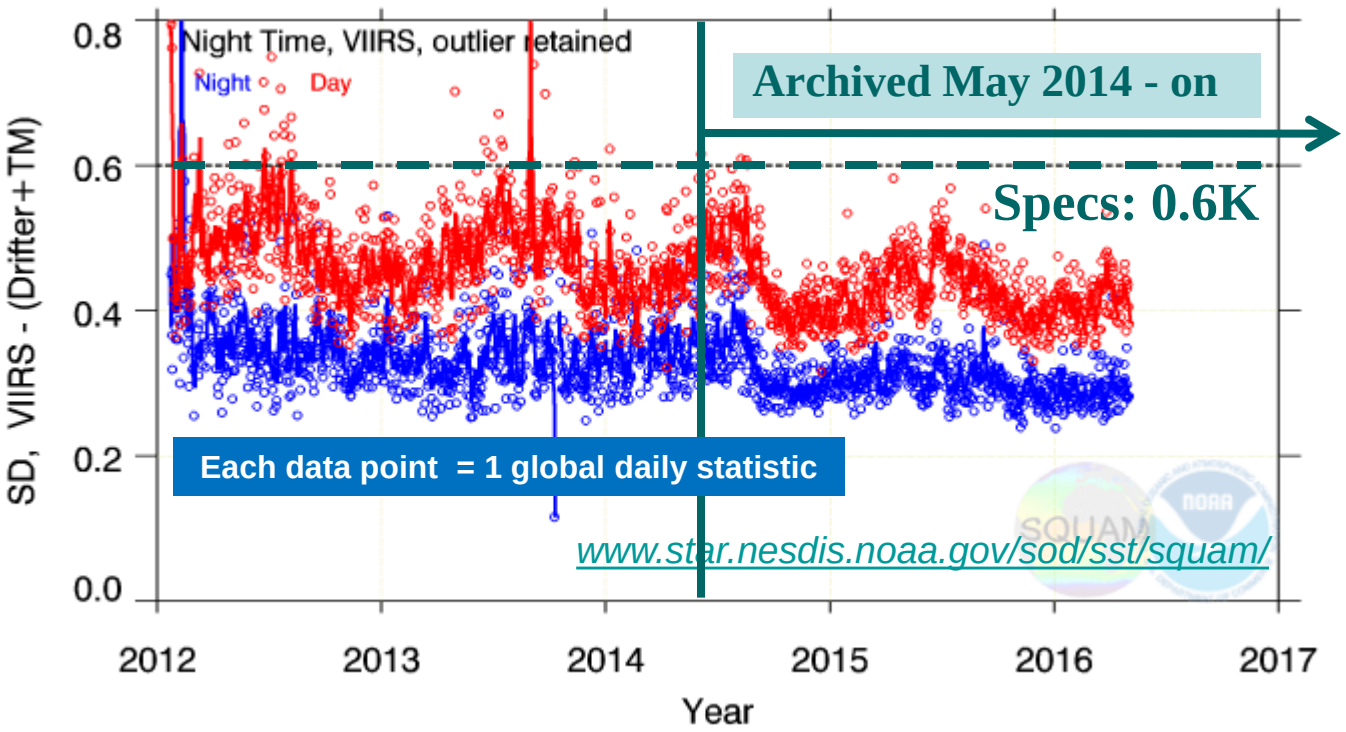


Day

Night

- STD smaller at night (sub-skin VIIRS SST is closer to buoy bulk SST)
- Global SDs improved with time as ACSPO SST algorithms matured
- Current SDs ~0.35K (Night) and ~0.45K (Day) are well within specs

S-NPP VIIRS progress since G16

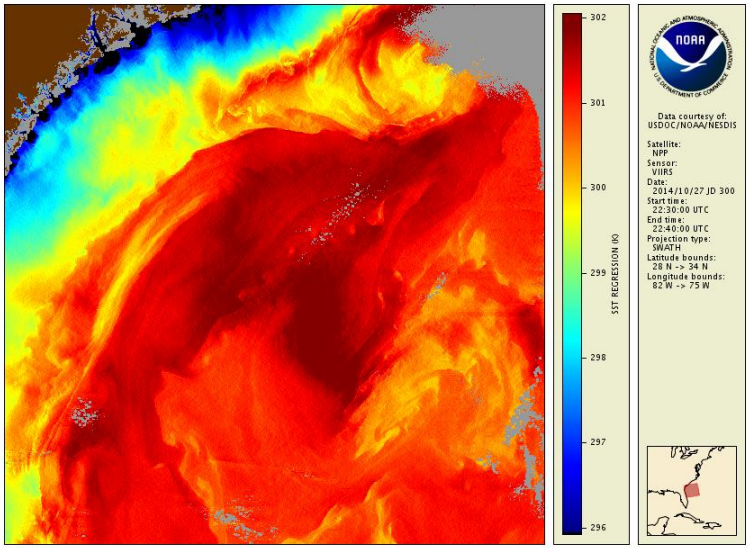
ACSPO VIIRS v2.40 L2P product (May'2014 – on)

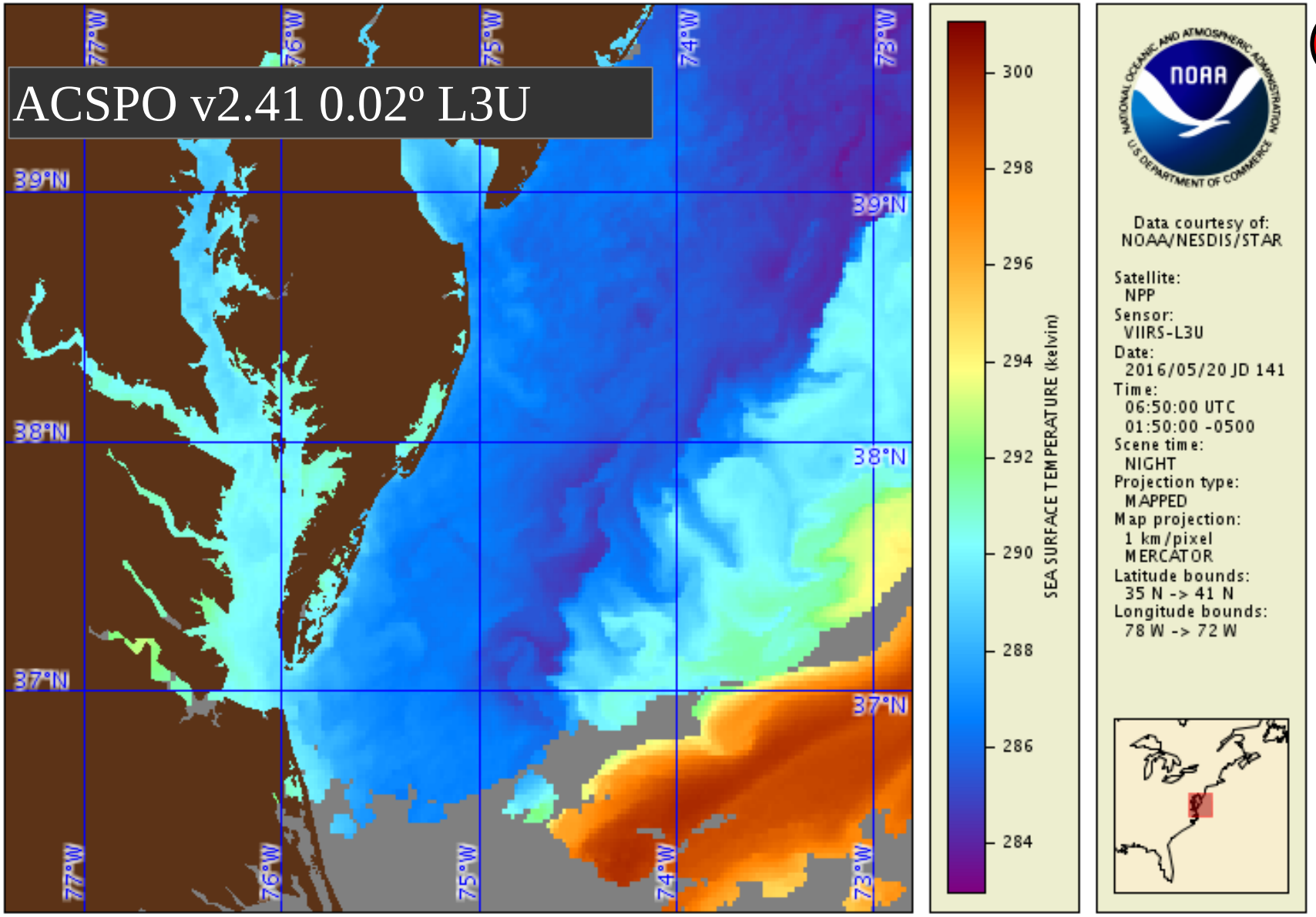
- http://podaac.jpl.nasa.gov/dataset/VIIRS_NPP-OSPO-L2P-v2.4
- http://data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:GHRSST-VIIRS_NPP-OSPO-L2P

ACSPO VIIRS v2.40 L3U product (May'2015 – on)

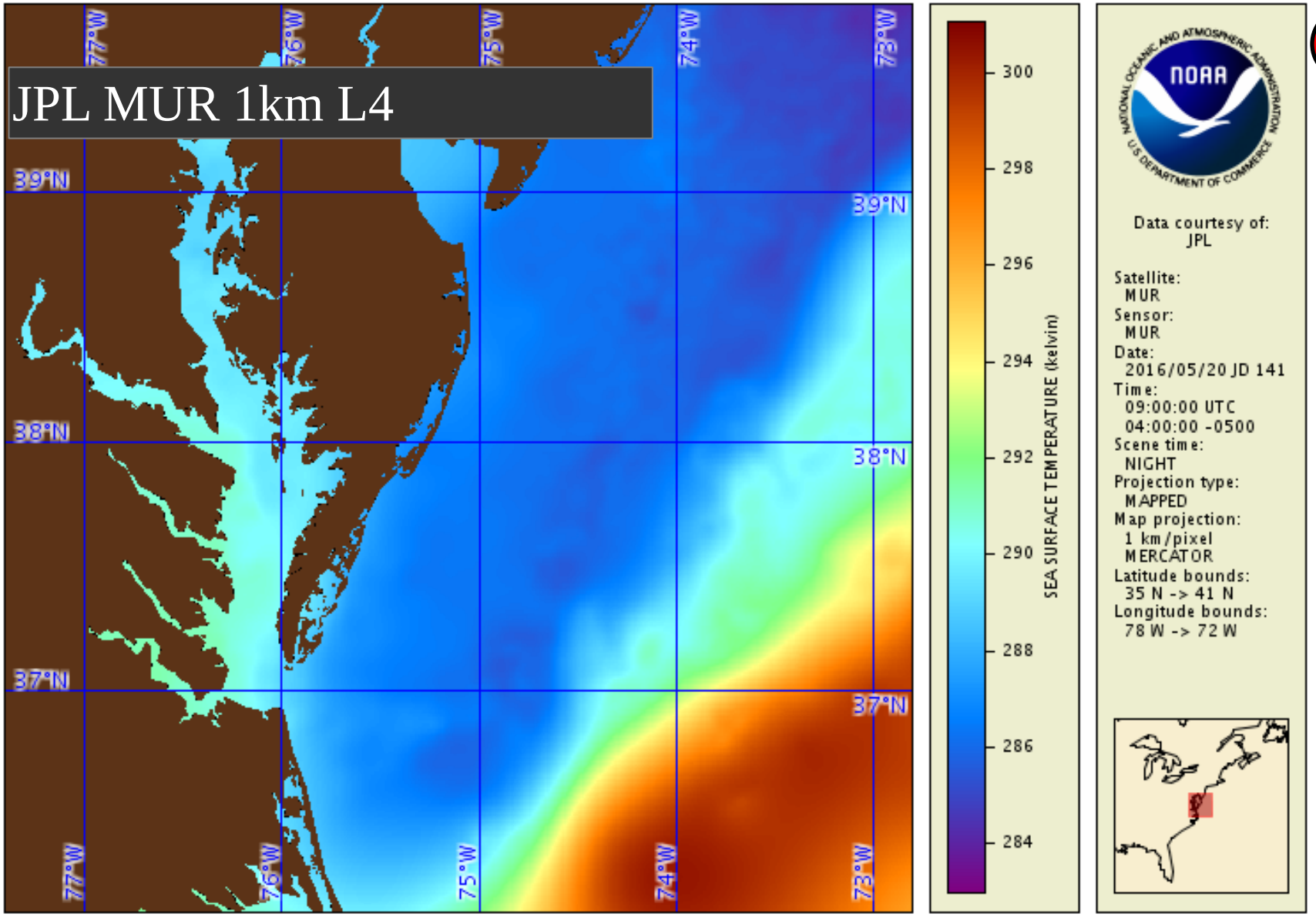
- http://podaac.jpl.nasa.gov/dataset/VIIRS_NPP-OSPO-L3U-v2.4
- http://data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:GHRSST-VIIRS_NPP-OSPO-L3U
- Distributed via EUMETCAST

- Initial Reanalysis-1 (RAN1) with ACSPO v2.40 performed from Mar 2012 – pr. Analyses and archival underway
- ACSPO v2.41 under testing
  - Consolidated geo-polar code
  - Improved Clear-Sky Mask, SST, SSES
  - Improved ACSPO L3U product





More info: Gladkova et al. (Wed @10:30am); Ding et al. (Poster #7)



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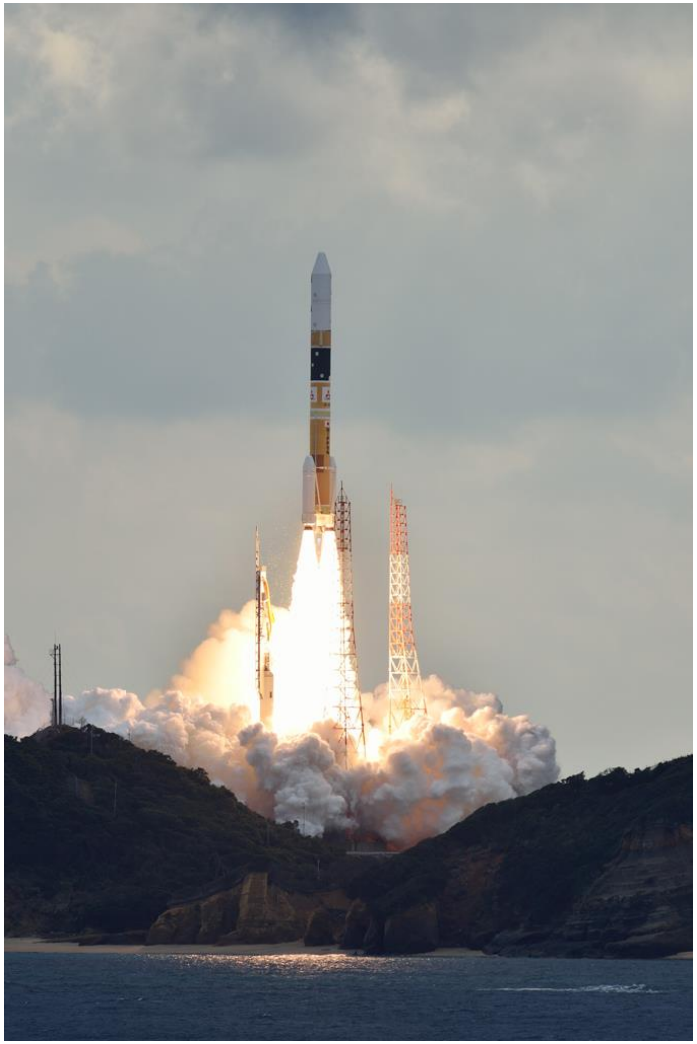
Himawari-8 (H8) AHI and GOES-R/ABI

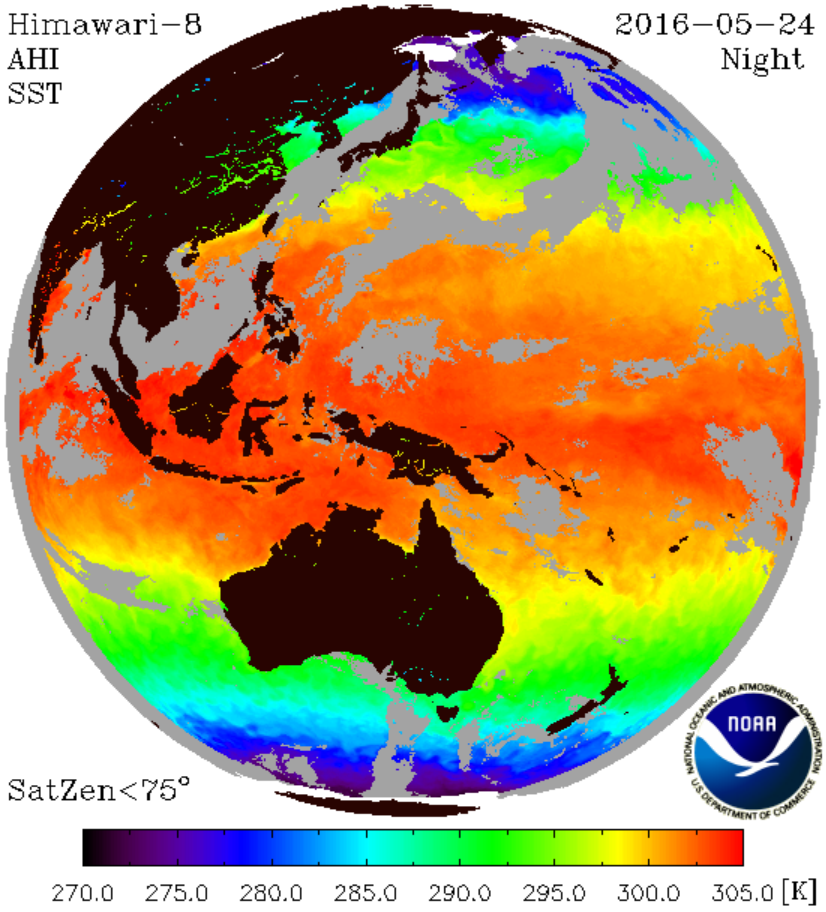


- H8 launched on 7 October 2014 by JAXA. H9 planned for launch in 2016 (?)
- The AHI (Advanced Himawari Imager) onboard H8 significantly improves upon H7 (MTSAT-2) imager
- AHI – sister instrument to ABI (Advanced Baseline Imager) onboard GOES-R. Planned GOES-R launch: Oct'2016, to be followed by GOES-S, -T and -U through 2036)
- NOAA produced **EXP** ACSPO H8 SST in Jul'2015
  - To replace NOAA H7 (MTSAT2) L2P SST in geo-polar blended L4 analysis
  - To establish end-to-end SST processing chain in preparation for GOES-R launch in Oct'2016
- NOAA will produce ACSPO GOES-R SST
  - Plan generate **EXP** ACSPO L2P/L2C product in 2017

Himawari-8 (H8) AHI and GOES-R/ABI

2

- **Progress since G16**
  - L2P H8 **EXP** ACSPO SST assimilated into NOAA geo-polar blended SST (4 Dec 2015)
  - Rotated buffer ftp://ftp.star.nesdis.noaa.gov/pub/sod/sst/acspo_data/l2/ahi/
  - Diagnostics in SQUAM (including monitoring of NOAA heritage H7 and JAXA H8 SSTs) www.star.nesdis.noaa.gov/sod/sst/squam/GEO/
  - More info: Come to H8 session today from 6-9pm
- **Coming year**
  - Support GOES-R Cal/Val (lunch in Oct'2016)
  - Generate 1hr **EXP** H8 L2C/L3C, with 4-6GB/day (the current L2P is ~45GB/day)
  - Iterate on clear-sky mask, SST SSES algorithms
  - Work to transition to **OPS** and archive



L2C ("Collated in Time") AHI SST Product: 1 hr

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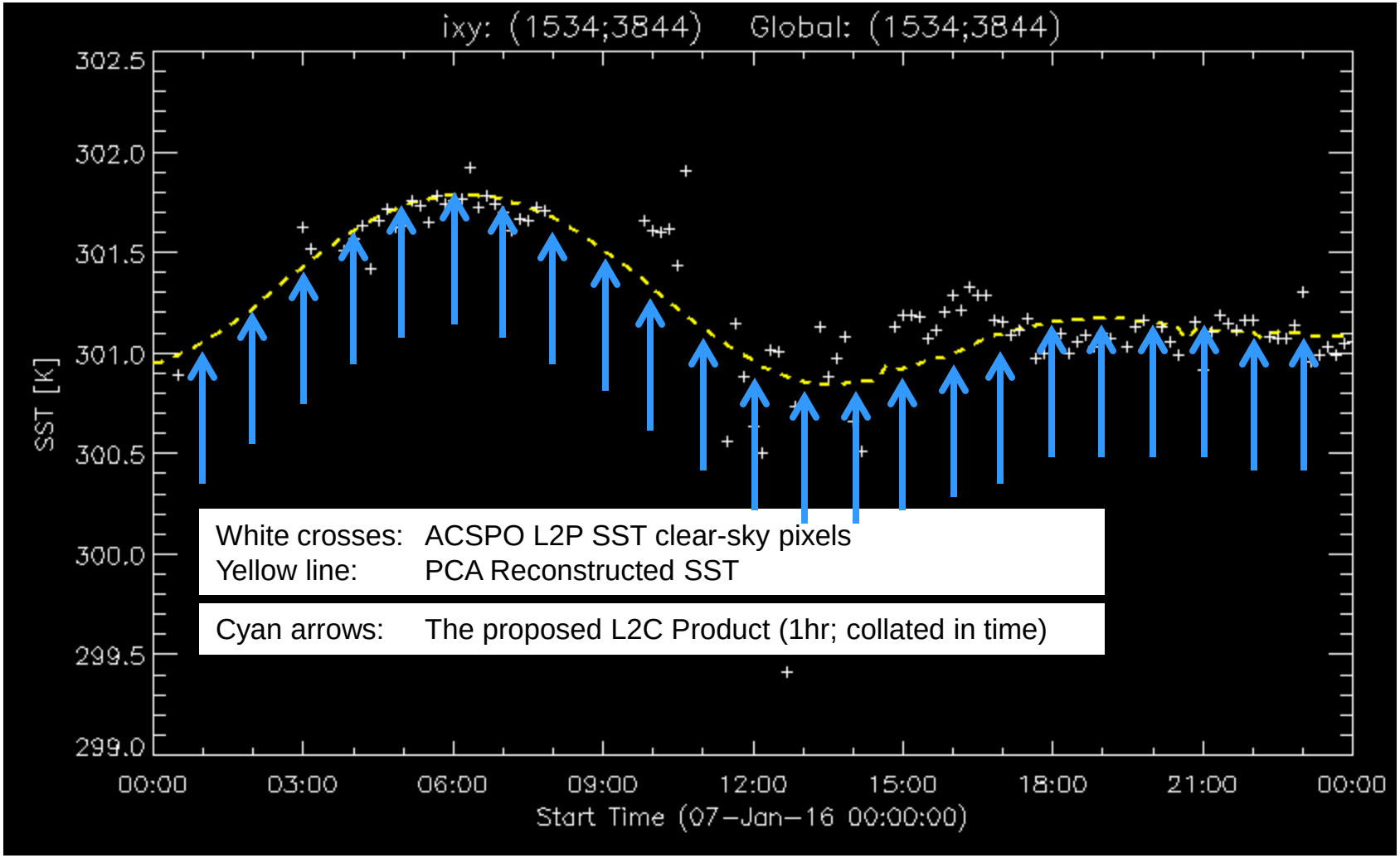
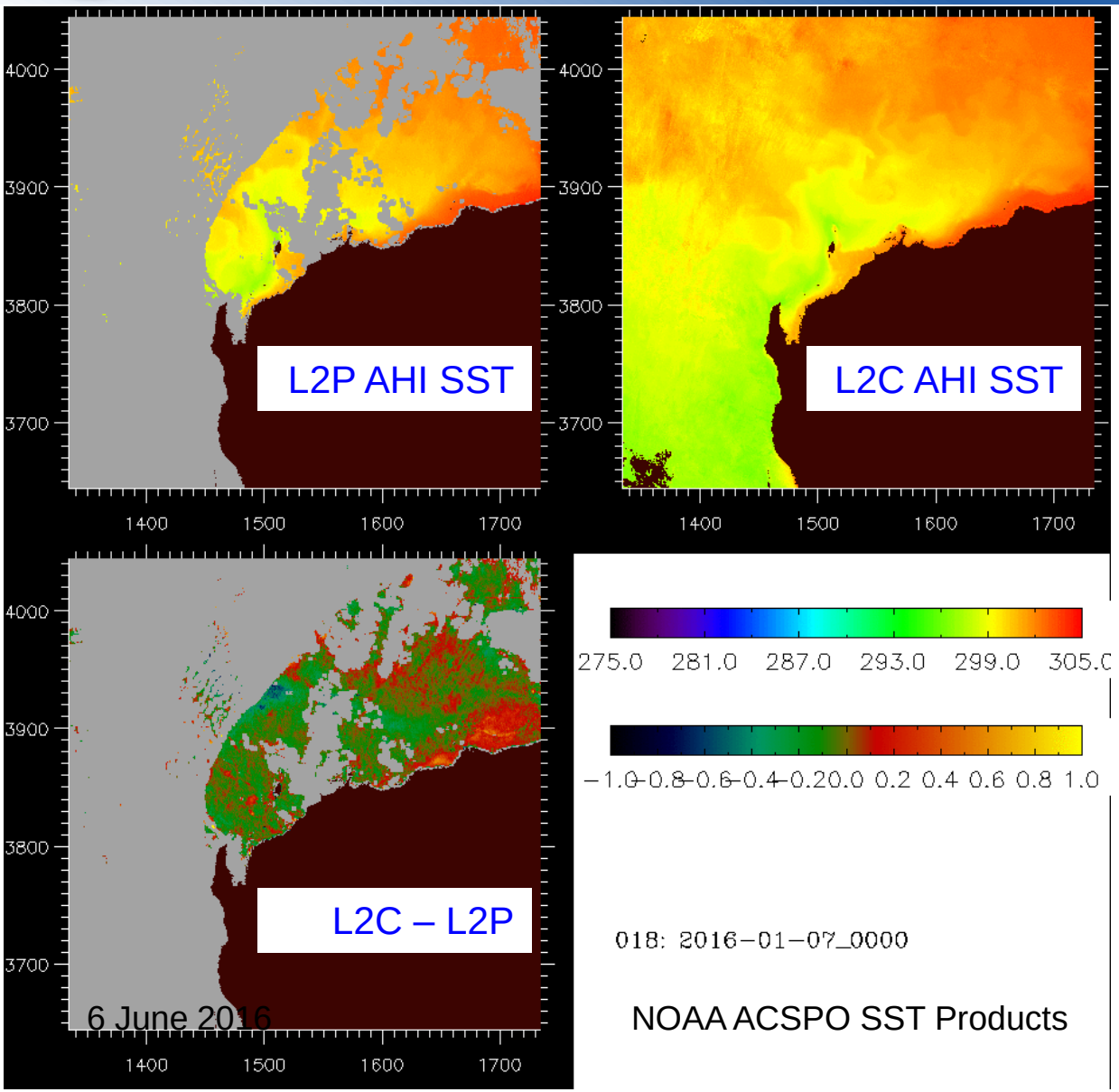


L2C "Collated" AHI SST Product



- The L2C product will be in original swath projection but "collated in time" (reported @1hr instead of 10min)
- This will reduce the data volume to ~8GB/day (from 45 GB/day in L2P)
- The "temporal noise" will be reduced by fitting a smooth curve through cloud free data
- Many cloud gaps will be filled "from temporal context" (but areas with persistent cloud will still remain data voids)

AVHRR GAC SST Reanalysis (RAN1) 2002 – 2015

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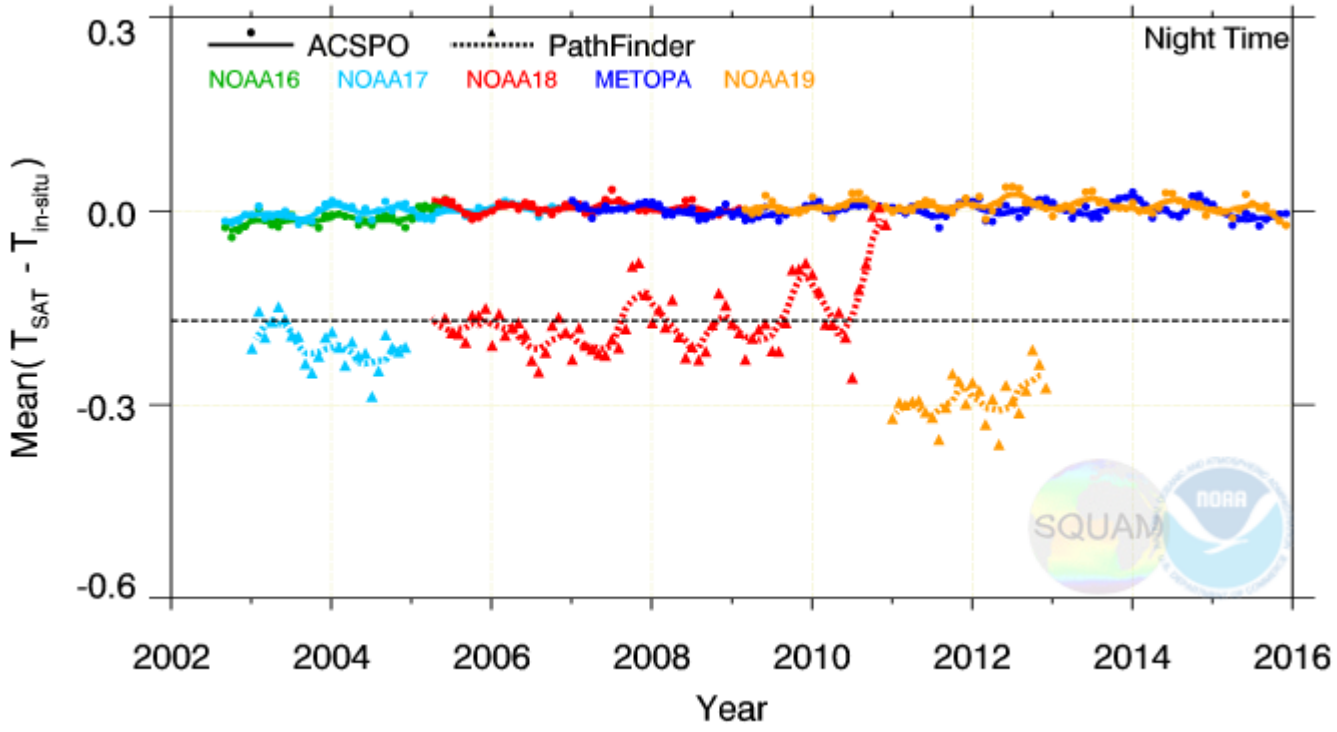
- AVHRRs with split-window bands have been flown onboard US NOAA satellites (since 1981) and EUMETSAT Metop satellites (since 2006)
- Coral Reef Watch and Geo-Polar Blended Teams requested a long-term consistent ACSPO SST record from AVHRR GAC
- **RAN1** product (Jul'2002 – Dec'2015) from 5 AVHRR/3s: 3 PM (N-16, -18, -19) and 2 mid-AM (N-17, Metop-A) (two platforms at a time)

- SST coefficients smoothed in time (similarly to PFV5.2)
- Newly developed ACSPO SSES (Petrenko et al., JTECH 2016) implemented in RAN1
- RAN1 documented (Ignatov et al., RS 2016)

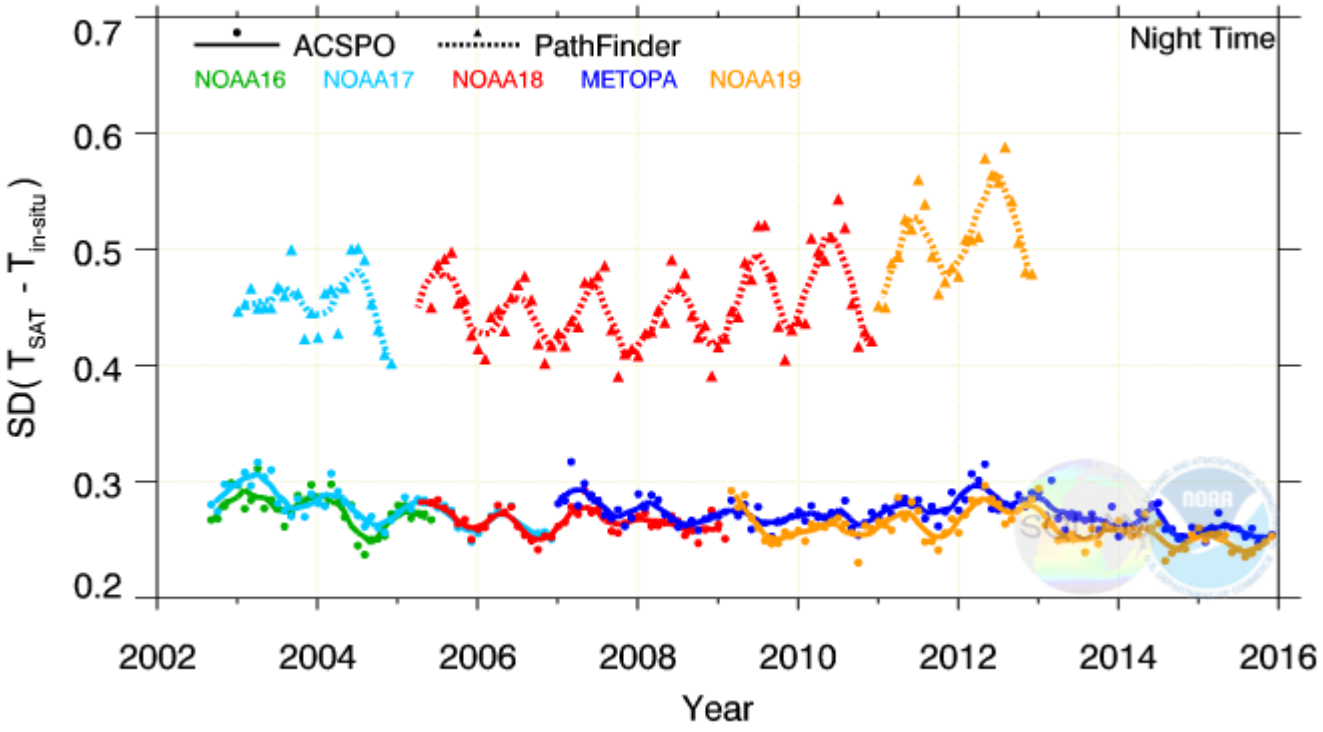
VAL vs. *i*Quam drifters + Tropical Moorings: MEAN



- Typical RAN1 bias vs. *in situ* drifters + TMs is within ±0.05K
- RAN1 SST are more stable & cross-platform consistent than PFV5.2 (Note that PFV5.2 is a "skin product" resulting in a -0.17K bias)

For more info, see Poster #54 Zhou et al, ACSPO AVHRR GAC RAN1

AVHRR RAN1 Validation: Standard Deviation against *i*Quam (Drifters + Tropical Moorings)



- Typically, RAN1 validates vs. (drifters + TM) to within SD~0.3K
- Compares favorably with PFV5.2 with SD~0.4-0.6K

For more info, see Poster #54 Zhou et al, ACSPO AVHRR GAC RAN1

ACSPO Summary

Main ACSPO Objective: Support Users

- ✓ L4 producers are currently our main users. We expect L4s to move to high space-time resolution, making use of high-quality VIIRS and AHI/ABI SSTs
- ✓ Users want long-term, high space-time resolution L3U/L3C/L3S products

Major ACSPO research focus

- ✓ Explore spatial information (polar/geo)
  - Improve clear-sky mask & SST coverage in dynamic/coastal/hi-lat areas
  - Derive new ocean fronts; high quality L3U/L3C/L3S products
- ✓ Explore temporal information (geo)
  - Derive L2C/L3C products to reduce data volume, while preserving diurnal cycle
- ✓ Revisit SST algorithms to ensure sensitivity to true SST = 1
  - Need accurately reproduce diurnal cycle and spatial variability
- ✓ Continue Reprocessing (Reanalysis; “RANs”) efforts
  - S-NPP VIIRS RAN1, AVHRR GAC RAN2, H8 RAN1

Exciting year is ahead of us

- ✓ Launch of GOES-R in Oct’2016 and J1 in Jan’2017

Topics to Discuss at G17

ACSPO archival (Currently working with Coast/Ocean Watch)

- ✓ S-NPP VIIRS RAN1 Jan 2012 – on
  - **L2P**: 10TB/yr; **L3U:** 0.5TB/yr
- ✓ N16/18/19 and N17/Metop-A AVHRR GAC Sep 2002 – on
  - **L2P:** 0.6TB/yr; **L3U:** 0.03TB/yr
- ✓ H8 (Mar 2015 – on) and GOES-R (TBD 2017 – on)
  - **L2C:** 2TB/yr

Users' feedback on ACSPO products appreciated

- ✓ VIIRS L3U; AVHRR L2P/L3U; H8 L2C; ACSPO SSES (Example: Brasnett and Surcel-Colan, JTECH, 2016)

Annual JPSS Meeting (US College Park, 8-12 August 2016)

- ✓ 2 breakouts: Product developers and users (~2hrs each)

More ACSPO Resources at G17

- Himawari-8 breakout, 6 Jun (Mon), 6-9pm
- Irina Gladkova – Improved SST imagery and pattern recognition analyses in ACSPO v2.50/2.60, 8 Jun (Wed) @10:30am
- Yanni Ding – ACSPO VIIRS L3U product, Poster #7
- Xinjia Zhou – ACSPO AVHRR GAC RAN1, Poster #57
- Boris Petrenko – Possible Definitions of SST Quality Levels in ACSPO, Poster #38
- Gang Liu – Coral Reef Watch, Poster #19

Thank You!