



NOAA ACSPO* SST Products

***ACSPO = Advanced Clear-Sky Processor for Ocean, NOAA enterprise SST system**

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NOAA; GST Inc; CCNY

ACSPO supported by NOAA JPSS and GOES-R Programs

*ACSPO data are archived in PO.DAAC in close partnership with
Ed Armstrong, Wen-Hao Li, Tim McKinght*



New NOAA Polar and Geostationary Constellations: JPSS VIIRS and GOES-R ABI



JPSS VIIRS		GOES-R ABI (Himawari-8/9 AHI, GK2A AMI)	
Nadir: 0.74km Swath edge(67°) 1.5km		Nadir: 2km Swath edge(67°): 12km	
Global: Twice daily		FD: 10 min	
$\lambda, \mu m$	Spec NEDT, K @300K	$\lambda, \mu m$	Spec NEDT, K @300K
3.7	0.11	3.9	≤ 0.10
8.6	0.05	8.4	≤ 0.10
10.8	0.07	10.3	≤ 0.10
12.0	0.07	11.2	≤ 0.10
—	—	12.3	≤ 0.10



JPSS/GOES-R carry VIIRS/ABI sensors have superior spatial & temporal resolution, more & better positioned SST bands, improved radiometric performance



ACSPO Data Products & Volumes (GB/Sensor/Day)

- All ACSPO products are available in two flavors: L2P (swath) and L3 (0.02° gridded)
 - Polar L3U products: Uncollated in time
 - Geo L3C products: Collated in time (1-hr produced by collating 10-min data; collation algorithm presented at GHRSSST-XIX)
- L3 products are smaller & preferred by users
- Many US users requested a sensor-agnostic super-collated gridded product, L3S. Work is underway, Gladkova et al, Tue, 11:20am

Polar: 10-min granules; 144/day

Sensor	L2P	L3U (0.02°)
VIIRS*	26.0	0.5 (x58)
AVHRR FRAC*	8.0	0.5 (x16)
AVHRR GAC	0.7	0.5 (x1.5)
MODIS*	7.5	0.5 (x16)

Geo: 1-hr FD granules; 24/day

Sensor	L2P	L3C (0.02°)
G16/17 ABI**	1.0	0.6 (x1.6)
H08 AHI**	1.0	0.6 (x1.6)

* VIIRS/FRAC/MODIS L2Ps are heavy.. Should take a look?

** Geo L2Ps were ~6.5 Gb/day before lat/lons were removed

Major ACSPO Progress Since GHRSSST-XIX

NOAA is producing VIIRS RAN2 (NPP/N20) and ABI RAN1 (G16/G17) L2/L3 products, & working with PO.DAAC partners to archive

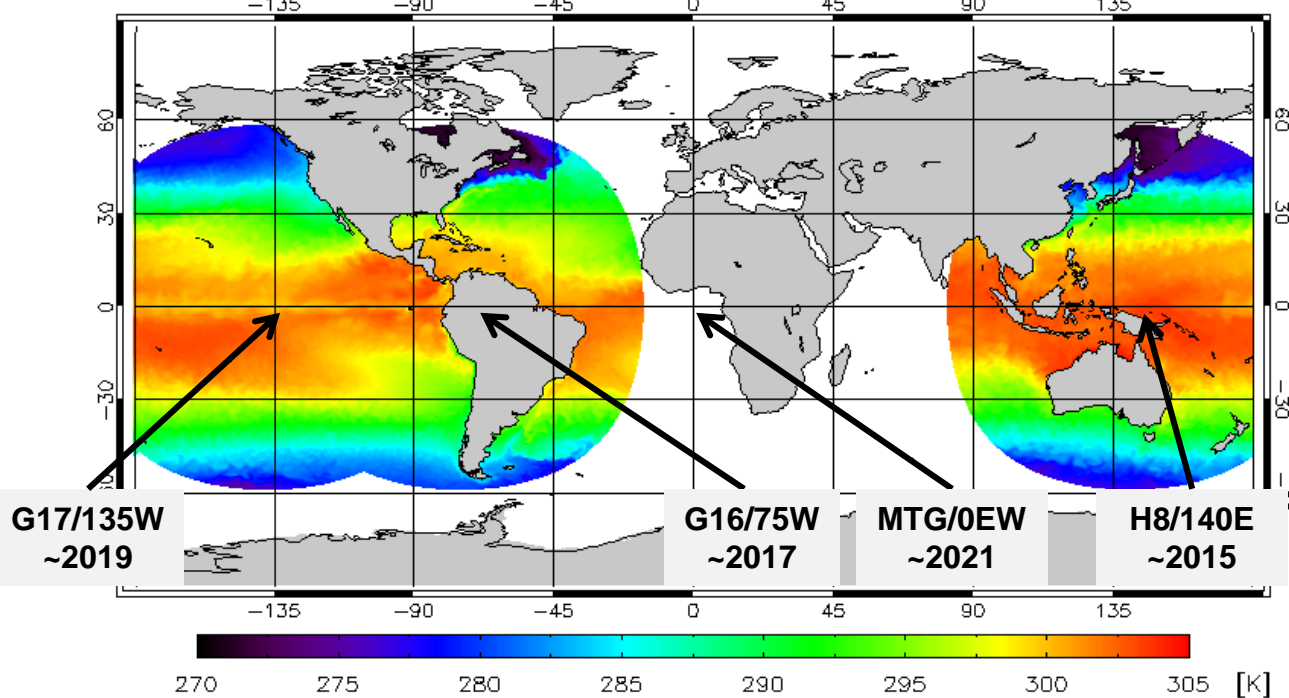
VIIRS Reanalysis-2 (“VIIRS RAN2”)

- Uniformly process w/ACSPO v2.61 two VIIRSs from NPP (Feb’2012 – pr) & N20 (Jan’2018 – pr)
- Correct known VIIRS L1b issues (quarterly NPP/N20 warm-up cool-downs & initial N20 IR anomalies)

ABI Reanalysis-1 (“ABI RAN1”)

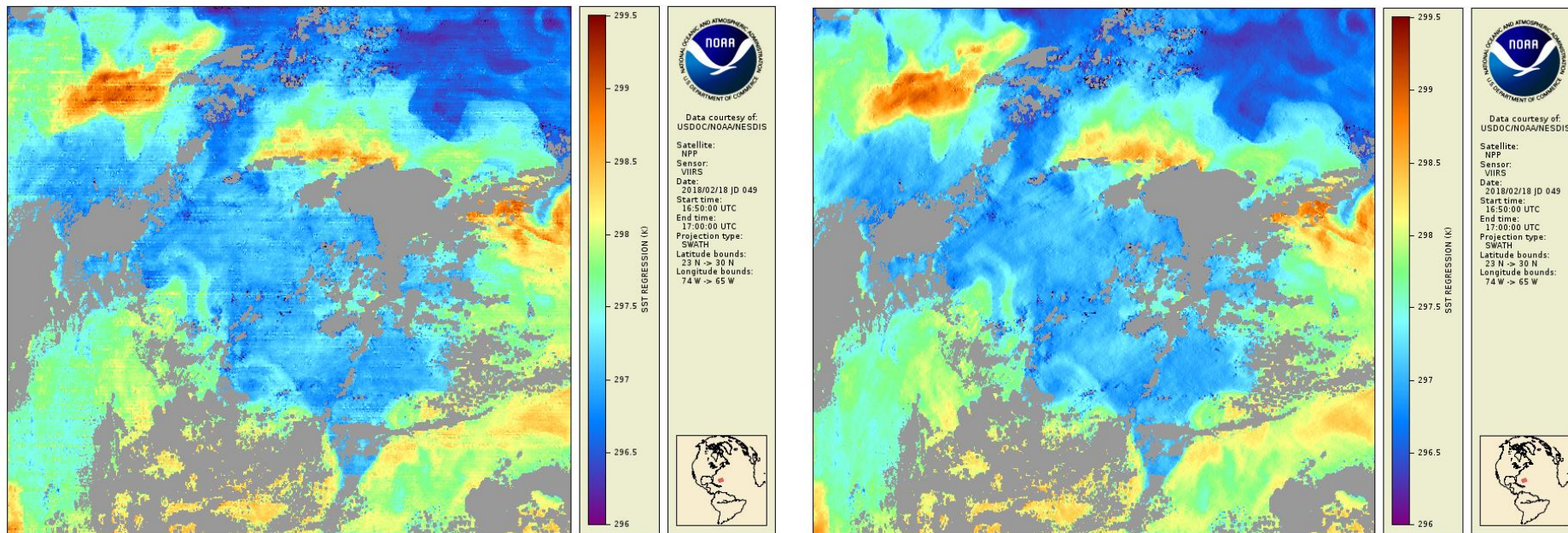
- Uniformly process full ABI record w/ACSPO v2.70 (for the first time, using collation-in-time)
- Current ABI RAN1 includes G16 (Dec’2017 – pr)
- G17 will be added, pending finalizing its algorithms
- Correct known CAL issue w/G16/ABI (Jun’2018), mitigate G17/ABI sensor anomalies

GEO New Generation Coverage (G16/G17/H8; Sat. Zenith Angle $\leq 65^\circ$)



In ACSPO 2.61, the BT & SST L2P imagery is destriped

- Any residual striping in BTs is amplified in SST
- In ACSPO 2.61, all channels used in SST retrievals are destriped
- Bouali and Ignatov (2014) algorithm is employed (with implementation described in Mikelsons et al., 2015)

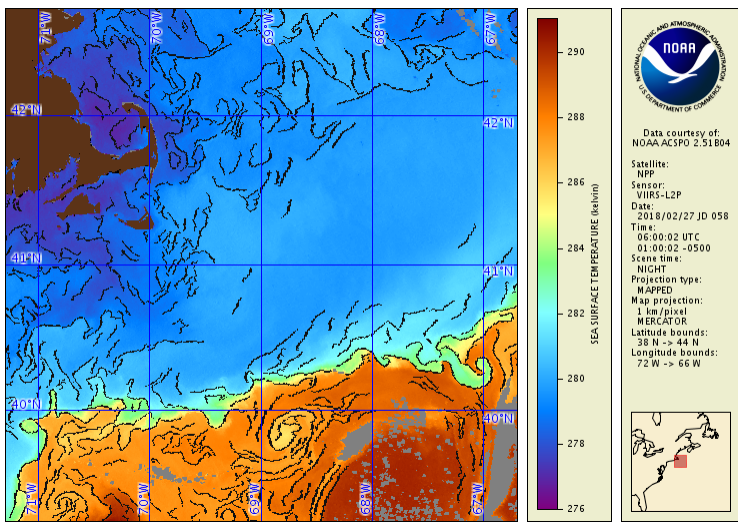
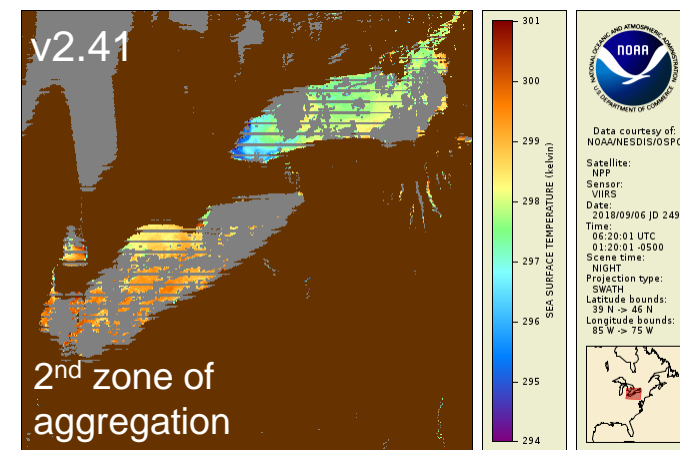
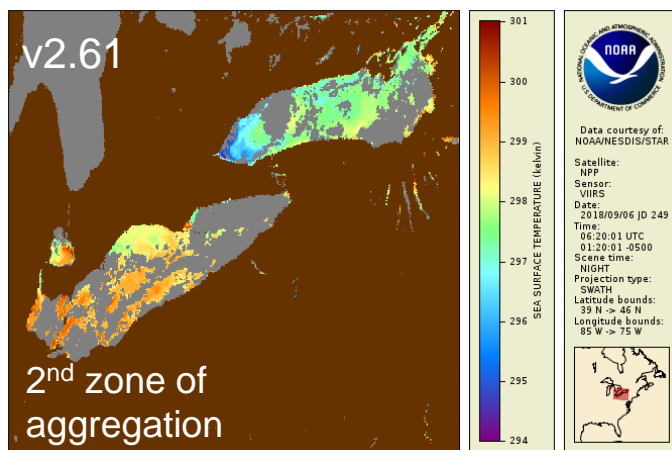
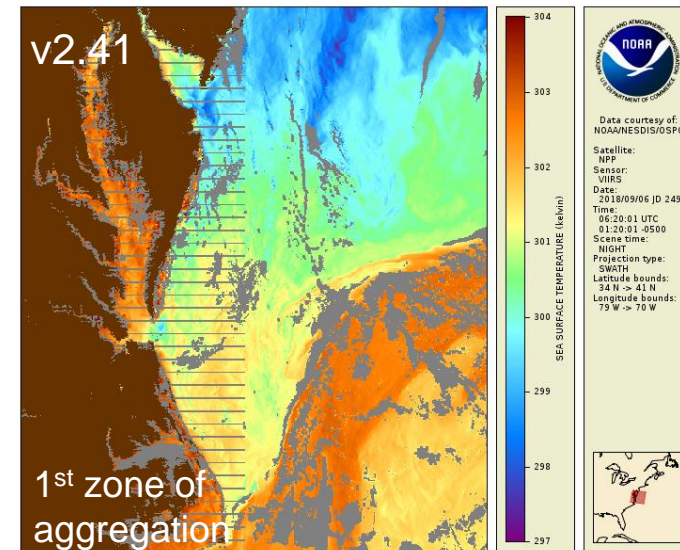
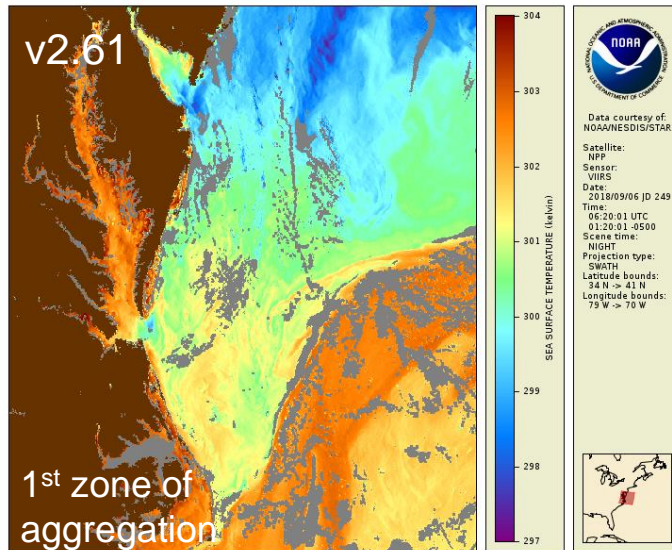


SST from original VIIRS BTs

SST from destriped VIIRS BTs

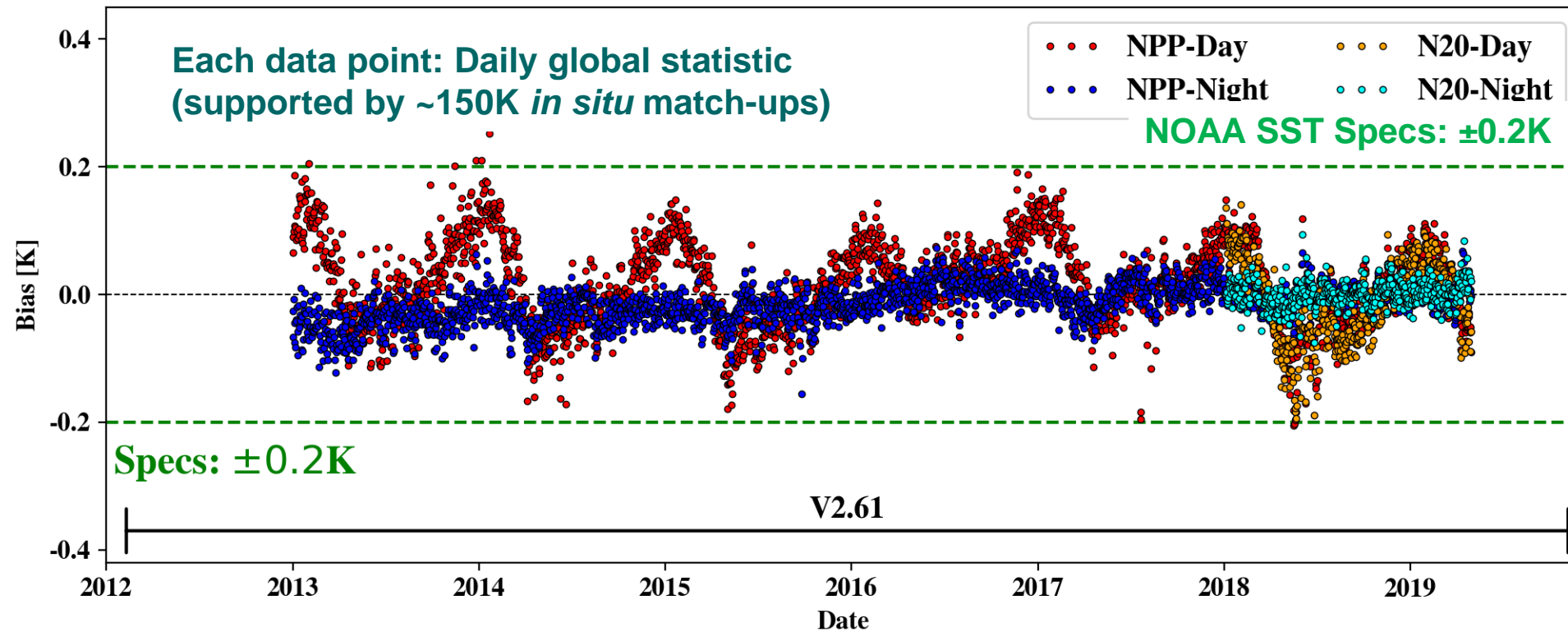
In ACSPO 2.61, the BT & SST L2P imagery is resampled

- VIIRS & MODIS are multi-detector sensors, affected by bow tie deletions and distortions
- In ACSPO 2.61, BTs employed in SST retrievals are resampled using Gladkova et al. (2016) algorithm
- ACSPO is now ready for pattern recognition & thermal fronts detection. Those are currently being explored.





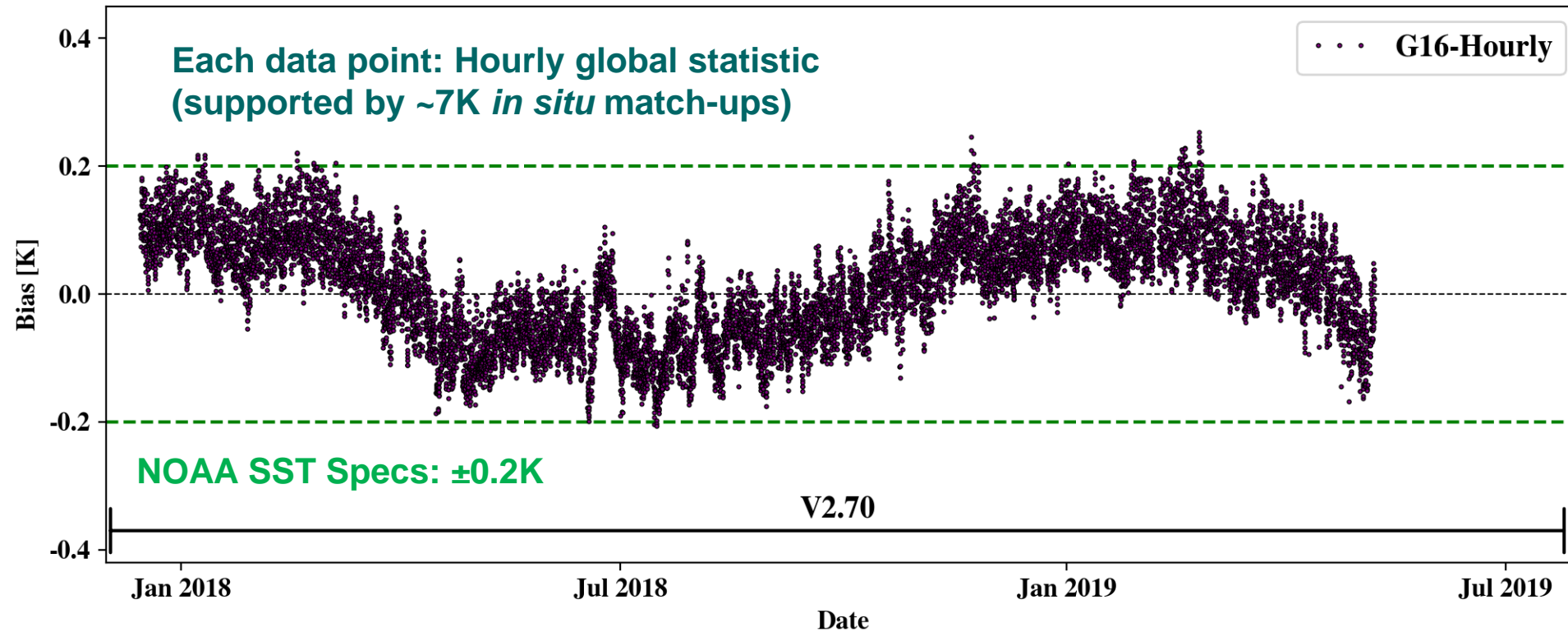
VIIRS RAN2 minus *i*Quam2 (Drifters + Trop. Moorings) SST



- NPP and N20 SSTs consistently reprocessed with ACSPO v2.61 constituting “VIIRS RAN2”
- Archival w/PO.DAAC underway (plan to complete in 2019)
- More details: Poster Jonasson et al. “ACSPO VIIRS SST Reanalysis 2 (RAN2)”



G16/ABI RAN1 minus *i*Quam2 (Drifters + Trop. Moorings) SST



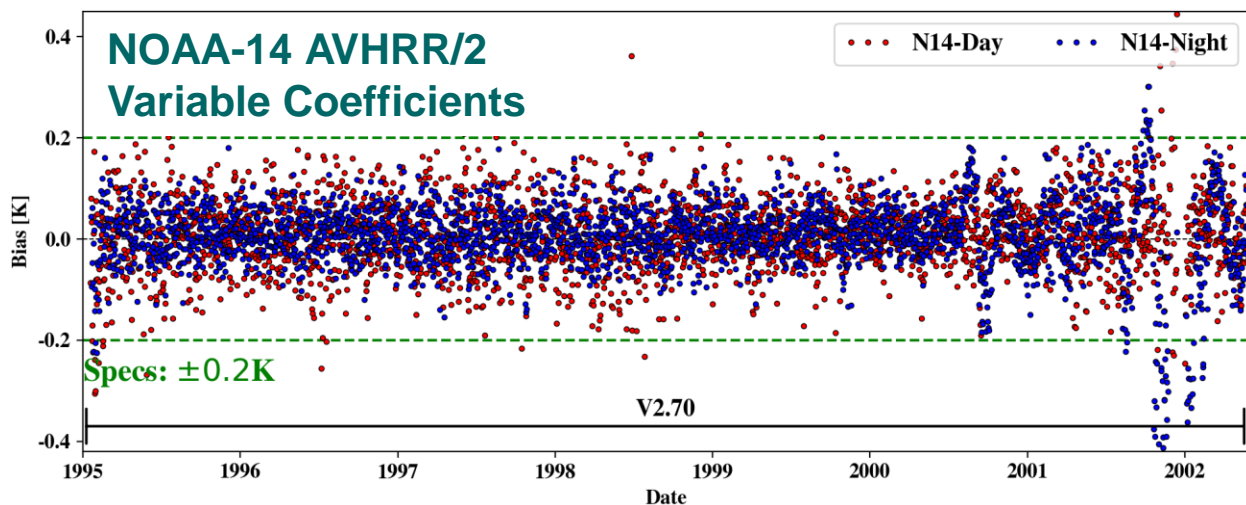
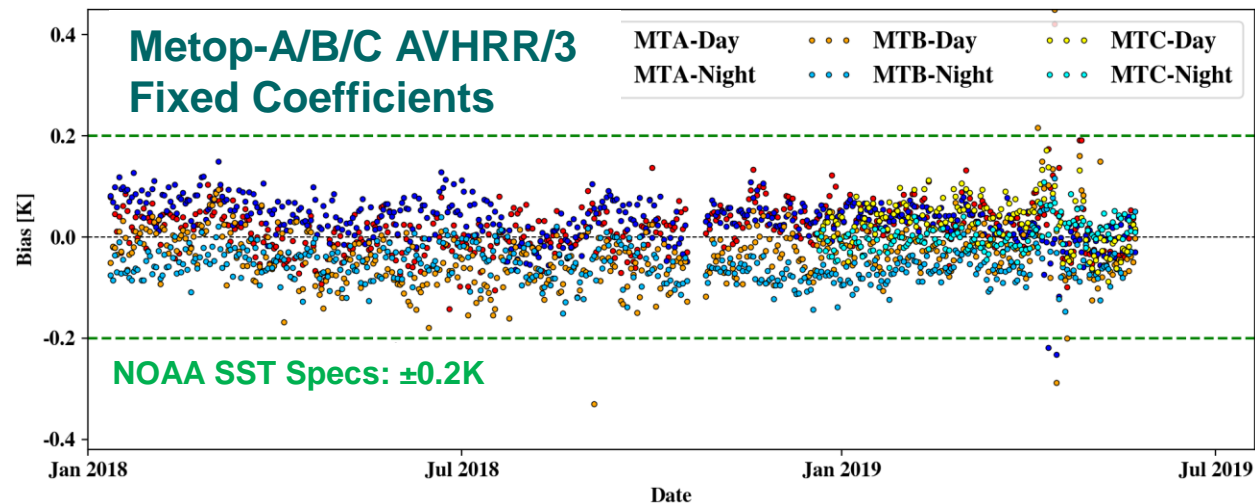
- G16 SSTs consistently reprocessed with ACSPO v2.70 constituting “ABI RAN1”
- G17 algorithms are currently being finalized and will be included in ABI RAN1
- G16 RAN1 archived w/PO.DAAC: L2P (doi:10.5067/GHG16-2PO27; 10.5067/GHG16-3UO27)
- More details: Poster Pennybacker et al “Geo Collation algorithm from G16/17 and H08”



Other ACSPO Developments Since GHRSSST-XIX

NOAA Operational AVHRR Processing

- Processing of GAC data discontinued (4 Jun 2019)
- Production of L2P/L3U from Metop-A/B FRAC commenced with ACSPO 2.70 (4 Jun 2019)
- Metop-C (launched Nov 2018 and experimentally processed since Dec 2018) is in family w/Metop-A/B
- NOAA is looking for best platform to run Metop-C. In interim, STAR runs “moderate assurance” processing



2nd AVHRR GAC Reanalysis (AVHRR GAC RAN2)

- AVHRR GAC RAN1 (released in 2015) covered period from 2002 – pr, AVHRR/3 only (Ignatov et al. 2016)
- Work is underway to add AVHRR/2 & release RAN2
- Shown are time series of NOAA-14, from 1995-2002 (processed with variable regression coefficients)
- Working to add other AVHRR/2s (NOAA-7/9/11) & release AVHRR GAC RAN2



ACSPO Data Access

- ✓ NOAA PDA (“Product Distribution & Access”; formerly “Data Distribution Server”) – Operational (NPP/N20 VIIRS L2P/L3U, G16/G17 ABI L2P/L3U, AVHRR GAC/Frac L2P/L3U; MODIS L2P/L3U)
- ✓ EUMETCast – Operational (NPP/N20 L3U)
- ✓ NOAA Coast Watch – Pre-Archive (all Sensors) (Also provides entry points to all NRT and RAN ACSPO products, e.g. PO.DAAC, NCEI)
- ✓ NASA PO.DAAC – Archive (NPP/N20 VIIRS L2P/L3U; G16/17 ABI L2P/L3C)
- ✓ NOAA NCEI – Archive (NPP/N20 VIIRS L2P/L3U; In the future G16/17 ABI L2P/L3C)

The screenshot shows a web browser window displaying the NOAA CoastWatch website. The page title is "Sea Surface Temperature (SST)". The content includes a search bar, navigation links, and a detailed description of satellite SST data. A list of data sources is provided, categorized into "NOAA ACSPO" and "NOAA Heritage". The URL <https://coastwatch.noaa.gov/cw/satellite-data-products/sea-surface-temperature.html> is highlighted in blue at the bottom of the page.

File Edit View History Bookmarks Tools Help
NOAA CoastWatch/OceanWat: X
https://coastwatch.noaa.gov/cw_html/sst.html
80%
Most Visited http://www.mozilla.or... ftp://ftp.star.nesdis.no... Monitoring of IR Clear... iQuam - in situ SST qu... ACSPO Regional Moni... Polar L2/L3 - SQUAM J...

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Sea Surface Temperature (SST)

Satellite SST is the longest and most mature application of ocean remote sensing. Passive observations are made with infrared (IR) sensors onboard multiple polar-orbiting and geostationary platforms, and microwave sensors onboard polar platforms. The IR sensors have higher spatial (1-4km) and temporal (10-15min, onboard geostationary satellites) resolution, and superior radiometric performance. However, IR sensors cannot “see through cloud”, thus typically limiting retrievals to ~20% of the global ocean, whereas microwave sensors may see through clouds (except heavily precipitating) and therefore have higher coverage, but have coarser spatial resolution (~20-50km) and radiometric performance, cannot be used in coastal and marginal ice zone areas, and may be subject to other errors (due to e.g. radio frequency interference, RFI)

NOAA produces several L2 (Level 2) (original swath), L3 (gridded), and L4 (gap-free analysis) SST products in international Group for High-Resolution SST (GHRSSST) Data Specifications version 2 (GDS2) and makes them available from NOAA CoastWatch:

NOAA ACSPO
VIIRS (S-NPP, JPSS)
AVHRR GAC (NOAA, MetOp)
AVHRR FRAC (MetOp)
MODIS (Terra, Aqua)
ABI (GOES-16 - on)
AHI (Himawari-8 - on)

NOAA Heritage
GOES Imager (GOES-15 and earlier) L3
SEVIRI (MSG) L3
Geo-Polar Blended L4
AVHRR (NOAA-18/19, MetOp-1/2) L3
VIIRS (S-NPP) L3

NOAA Satellites and Information
<https://coastwatch.noaa.gov/cw/satellite-data-products/sea-surface-temperature.html>
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National Oceanic and Atmospheric Administration
Center for Satellite Applications and Research
Satellite Oceanography & Climatology Division



Priorities for Coming Year

Focus on Reprocessing

- **(Advanced)** Complete NPP/N20 VIIRS RAN2 & archive w/PO.DAAC/NCEI
- **(Advanced)** Complete ABI RAN1 (add G17) & archive w/PO.DAAC/NCEI
- **(Test Runs)** Produce AHI RAN1, explore archival with PO.DAAC/NCEI
- **(Test Runs)** Continue working towards AVHRR GAC RAN2 (1981 – present)
- **(Hasn't started)** Reprocess full records of 3 AVHRR FRACs and 2 MODISs

New ACSPO Products in Pipeline (requested by users)

- Thermal fronts & Pattern recognition improvements (initially, VIIRS only)
- Polar Data Fusion / Super-Collated L3C/S



Suggested Topics to Discuss at GHRSSST-XIX

GDS2 and Polar L2P Data Size Discussion

- ✓ satellite_zenith_angle reported as 8bit (1deg quantization) rendering it useless for many applications (e.g., SST retrievals)
 - Suggest report as 16bit (0.01deg)
- ✓ The dt_analysis is also reported as 8bit (0.1K quantization), which is crude for any high-accuracy quantitative applications
 - Suggest report as 16bit (0.01K quantization)
- ✓ These changes are insignificant for file size (especially after compression)
- ✓ Reduce polar L2P size by half (VIIRS: 10TB/yr; MODIS/FAC: ~4Tb/yr)
 - Remove brightness temperatures? (not part of GDS2; we are not aware of users; can provide BTs offline, if needed)
 - Revisit reporting lat/lon for each pixel – e.g. similarly to EUMETSAT
https://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_VIIRS_SDR_PF_UG&RevisionSelectionMethod=LatestReleased&Recondition=Web



More ACSPO Resources at GHRSSST-XX

- Irina Gladkova (Oral): Towards Hi-Res Multi-Sensor gridded ACSPO SST Product, 4 Jun (Tue) @11:20AM
- Matt Pennybacker (Poster): ACSPO Collated SST Products from G16/17 and H08, 4 Jun (Tue), 17:00-18:00
- Olafur Jonasson (Poster; Presented by Sasha Ignatov): VIIRS SST Reanalysis 2 (“VIIRS RAN2”), 6 Jun (Thu), 16:00-17:00

Thank You!