NOAA JPSS and Himawari-8 SST Products

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Content

- NOAA Enterprise SST System: ACSPO (Advanced Clear Sky Processor for Oceans)
- NOAA SST Monitoring System
- Focus of this report: Two ACSPO Products
  - **VIIRS: S-NPP (Oct 2011 – pr)** + JPSS 1-4 (2017-2026)
  - **AHI*: Himawari-8 (Oct 2014 – pr)** + Himawari-9 (2016?)
- Future work

*** ACSPO SST product will be also produced from ABI sensor which is very similar to AHI, and will be flown onboard GOES-R (Oct 2016)**

ACSPO: NOAA Enterprise SST System

- Historically, NOAA geo and polar, operational and reprocessing SST systems have diverged
- ACSPO is the NOAA enterprise system aimed at uniform SST processing across different platforms and sensors, in real time and retrospectively
- This presentations focuses on two new ACSPO products
  - **VIIRS (0.75 km) onboard S-NPP** (+ JPSS 1-4, from 2017-26)
  - **AHI (2km) onboard Himawari-8** (+ ABI onboard GOES-R/S/T/U)
- ACSPO Algorithms have been documented elsewhere and not discussed here
  - Clear-Sky Mask – Petrenko et al., JTECH, 2010
  - Regression SST algorithms – Petrenko et al, JGR, 2015
  - Destriping – Bouali and Ignatov, JTECH, 2014
  - Single Scanner Error Statistics (SSES) – Petrenko et al., JTECH, 2016 (in review)
  - Ongoing improvements – Gladkova et al, RSE, 2015; Gladkova et al., RS, 2016 (in review)

NOAA SST Monitoring: Key for product evaluation

SQUAM - SST Quality Monitor (see "SQUAM" presentation by P. Dash)
www.star.nesdis.noaa.gov/sod/sst/squam/

- ✓ Monitors SST Products (L2/3/4) for Self- and Cross-Consistency
- ✓ Validates against *in situ* SSTs (from *iQuam*)

iQuam - In situ Quality Monitor
www.star.nesdis.noaa.gov/sod/sst/iquam/

- ✓ QCs *in situ* SSTs; Monitors online; Distributes to users (including SQUAM)

MICROS - Monitoring IR Clear-sky Radiances over Oceans for SST
www.star.nesdis.noaa.gov/sod/sst/micros/

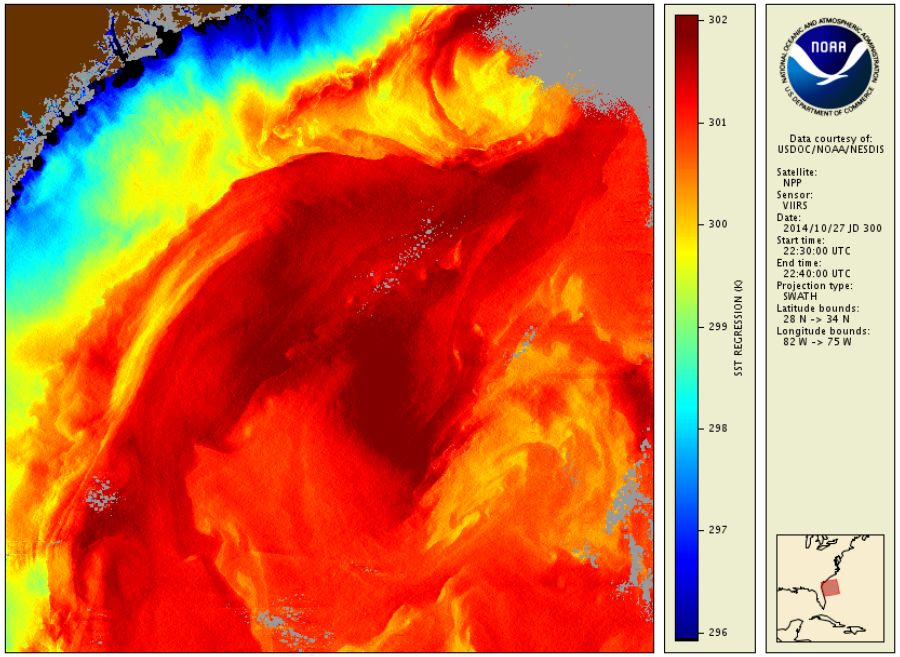
- ✓ Monitors Clear-sky ocean BTs for self-/cross-consistency
- ✓ Validates measured BTs against CRTM simulated

NOAA Transition from POES to JPSS via S-NPP

- S-NPP (the Suomi National Polar-orbiting Partnership) was launched on 28 October 2012
- Bridgehead from POES to JPSS (Joint Polar Satellite System) NOAA operational system
- NOAA plans to launch four JPSS satellites (JPSS1-4) from 2017-2026
- S-NPP/JPSS satellites carry VIIRS (Visible Infrared Imager Radiometer Suite) sensor. VIIRS replaces AVHRR in NOAA operations
- NOAA-EUMETSAT signed Joint Polar System (JPS) agreement: S-NPP/JPSS VIIRS covers afternoon orbit (1:30am/pm) while Metop AVHRR covers mid-morning orbit (9:30am/pm)

ACSPO VIIRS L2P and L3U SST Products

- Features of ACSPO VIIRS SST products
  - More complete global coverage (e.g., coastal areas, internal waters, high latitudes)
  - Improved Single Scanner Error Statistics (uncertainty estimates in each pixel)
  - SST is destriped (important for imagery and ocean dynamics analyses)
  - Future versions will improve SST imagery (fix bow tie distortions) and use it to enhance clear-sky mask and derive ocean fronts
- Reprocessing from Jan 2012 – pr underway



Access ACSPO VIIRS L2P product

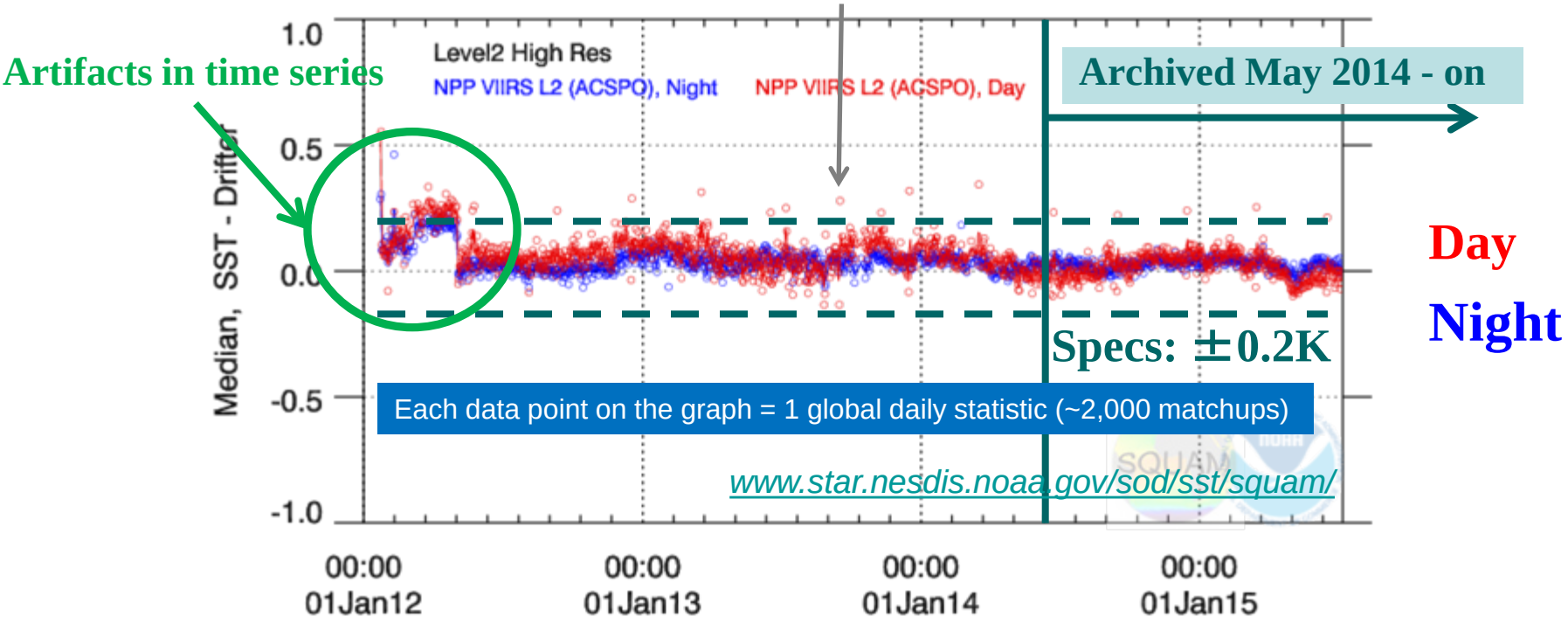
- http://podaac.jpl.nasa.gov/dataset/VIIRS_NPP-OSPO-L2P-v2.4
- http://data.nodc.noaa.gov/cgi-bin/iso?id=gov.noaa.nodc:GHRSST-VIIRS_NPP-OSPO-L2P

Access ACSPO VIIRS L3U product

- 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

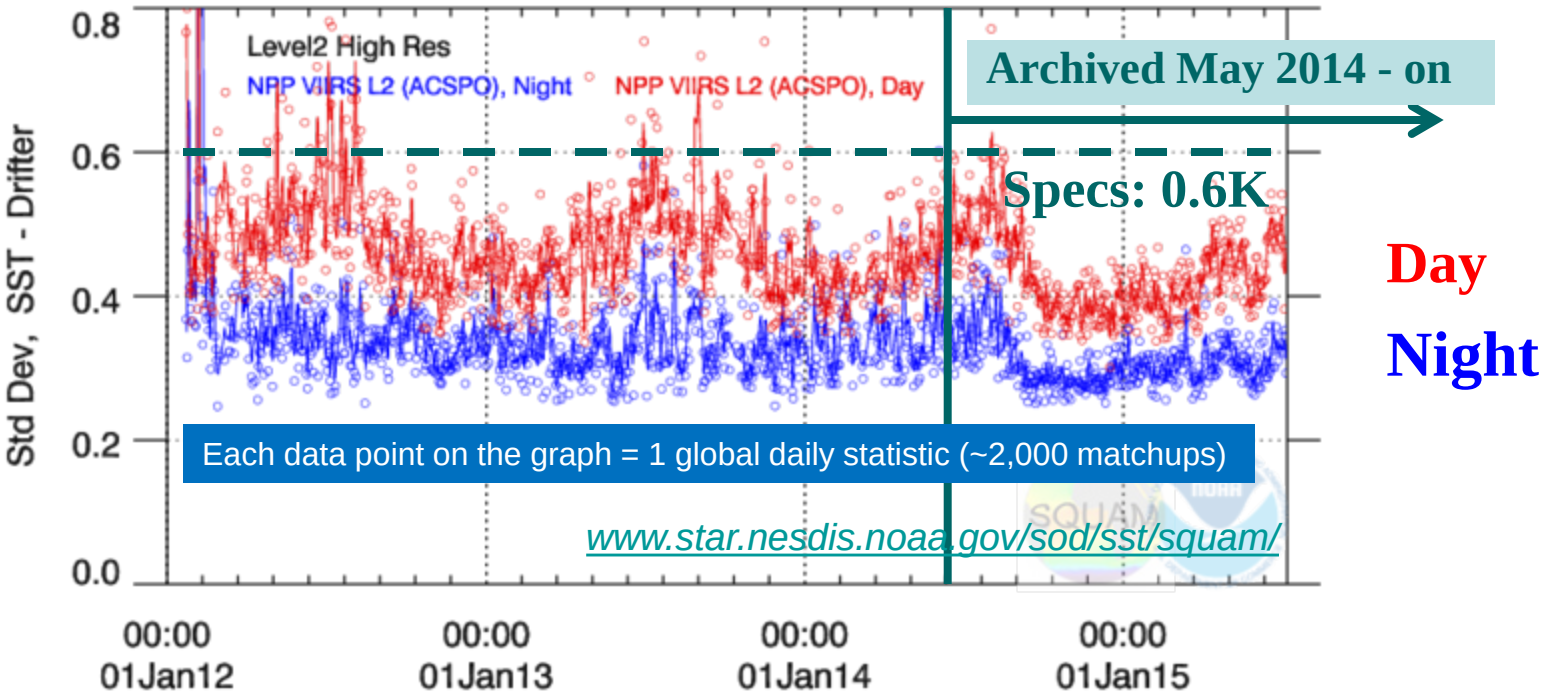
Global VAL BIAS wrt. *i*Quam *in situ* drifters

Quarterly Warm-Up / Cool-Down Events result in ~0.3K spikes in day SST



- Global Biases gradually improved as ACSPO algorithms matured. Currently, product meets JPSS specs and users' expectations
- 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
- Reprocessing will produce more uniform & complete time series from Jan 2012 – pr

Global VAL STD wrt. *i*Quam *in situ* drifters



- Global STDs gradually improved with time as ACSPO SST algorithms matured.
- Current ly, STDs ~0.35K (Night); ~0.45K (Day) are well within specs
- STD smaller at night (because skin SST closer to bulk buoy)
- Reprocessing is underway which will result in more uniform & complete time series

Himawari-8/AHI and GOES-R/ABI

- Himawari-8 was launched on 7 October 2014 by JAXA. Its sister satellite, Himawari-9, is planned for launch in 2016
- The AHI (Advanced Himawari Imager) onboard Himawari-8/9 significantly improves upon the Himawari-7 (MTSAT-2) imager
- AHI is very similar to the ABI (Advanced Baseline Imager) onboard GOES-R/S/T/U
- NOAA interest in Himawari-8 SST stems from the need to
  - Replace the current operational NOAA MTSAT-2 L2P SST input in geo-polar blended L4 analysis
  - Establish end-to-end SST processor in preparation for GOES-R launch in Oct 2016

Current Status of ACSPO Himawari-8 SST

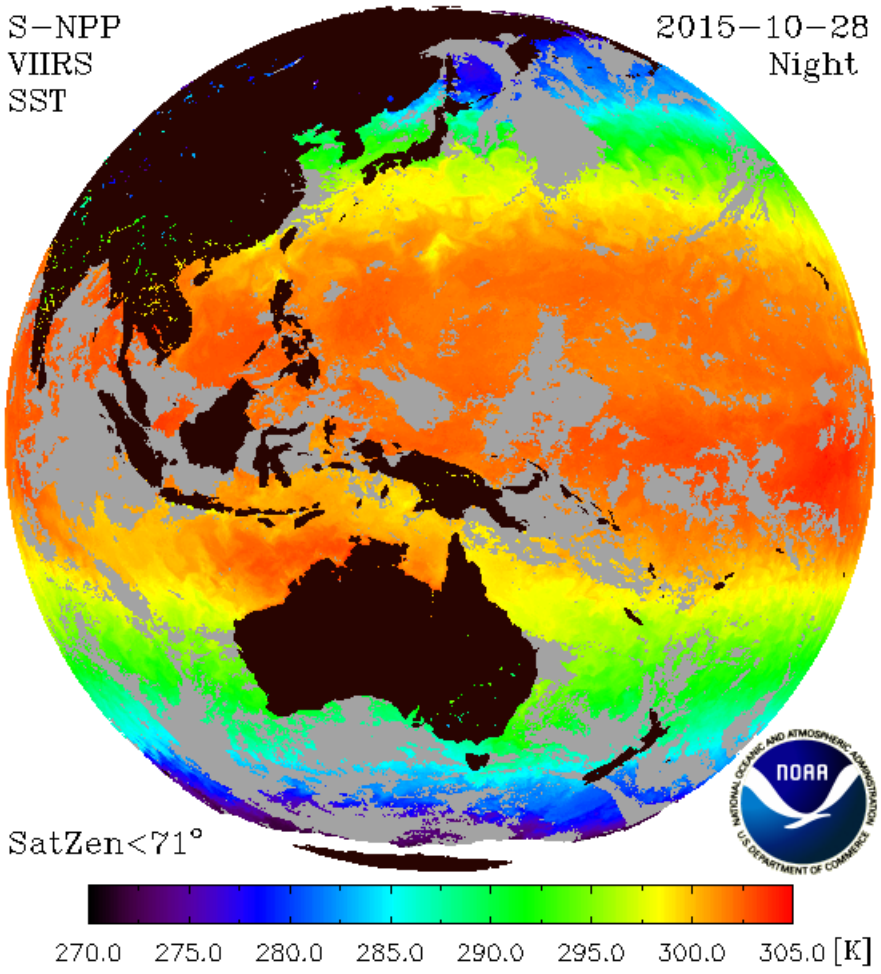
- **Experimental ACSPO Processing at NOAA STAR**
  - Processing commenced on 6 July 2015 (data from 14 April 2015 – pr back-processed)
  - Code is run automatically, once a day starting @2UTC (with data from previous day)
  - It takes ~8hrs to process one full day of AHI data

- **L2 Data**
  - GDS2 data from 11 June 2015 – pr in original swath projection are reported at ftp://ftp.star.nesdis.noaa.gov/pub/sod/sst/acspo_data/l2/ahi/
  - Nominally, there are 142 10-min ACSPO granules/day (~45GB/day)

- **Monitoring in NOAA SST Quality Monitor (SQUAM)**
  - Monitoring in geo-SQUAM commenced in Apr'2015 (see presentation by P. Dash)
  - Current url is www.star.nesdis.noaa.gov/sod/sst/squam/GEO/ (to be integrated in SQUAM)

- **Ongoing work towards L2C/L3C**
  - Data archives (PO.DAAC/NCEI) and users requested reduced volume data
  - Work is underway to "collate" the L2 data in space /time, and generate L2C/L3C ACSPO SST
  - GOES-R ACSPO SST product will be produced upon launch (~Oct'2016)

VIIRS SST Composite in the AHI Domain (Night)



The SST distribution from VIIRS and AHI is similar

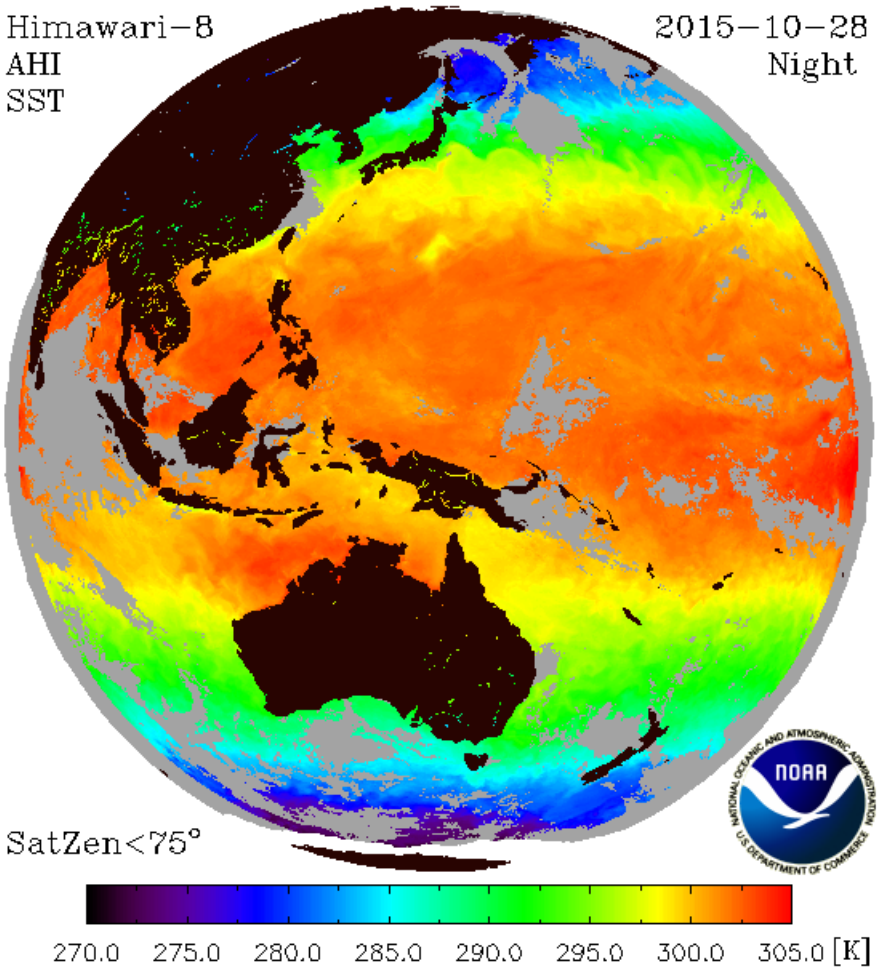
Note that coverage is comparable in challenging coastal areas, over internal waters, and in the high latitudes

AHI coverage is more complete compared to the VIIRS coverage (except of the disk contour, due to VZA<75º cutoff)

Recall that only 1-2 VIIRS images contribute to the composite, compared to up to 70 10-min FD images from AHI

ftp://ftp.star.nesdis.noaa.gov/pub/sod/sst/acspo_data/l2/ahi/composites/

AHI SST Composite (Night)



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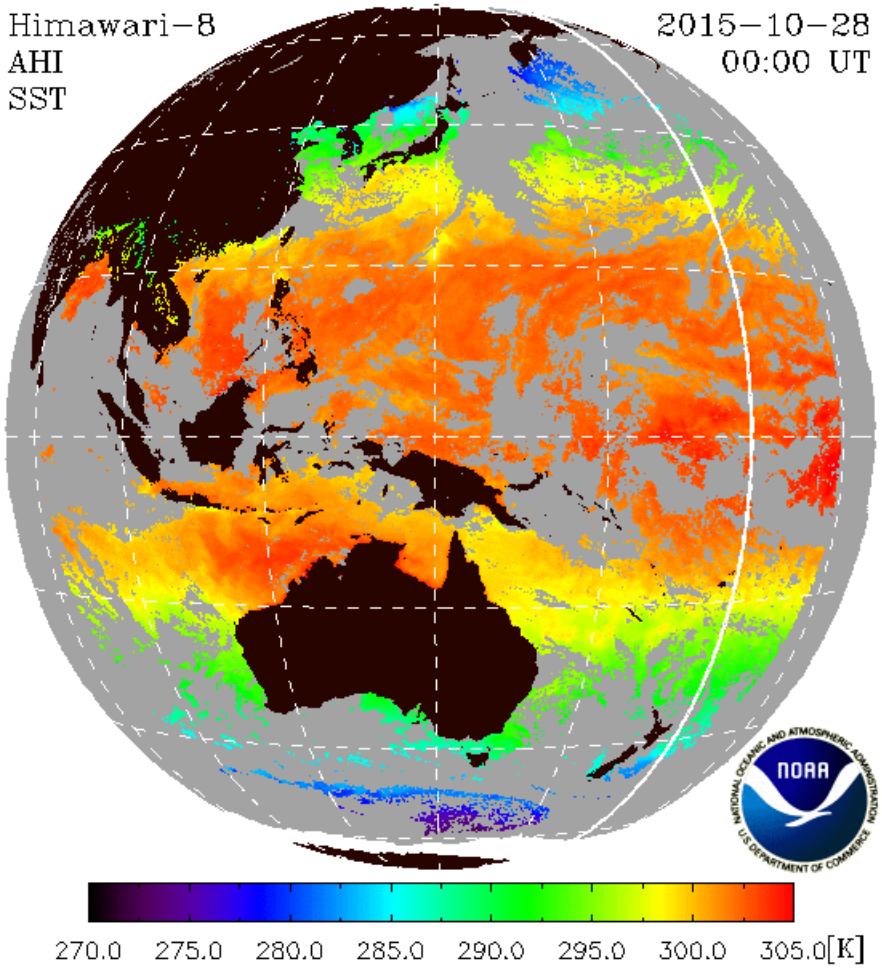
ftp://ftp.star.nesdis.noaa.gov/pub/sod/sst/acspo_data/l2/ahi/composites/

ACSPO AHI SST Animation 142 10min FDs; 28 Oct 2015



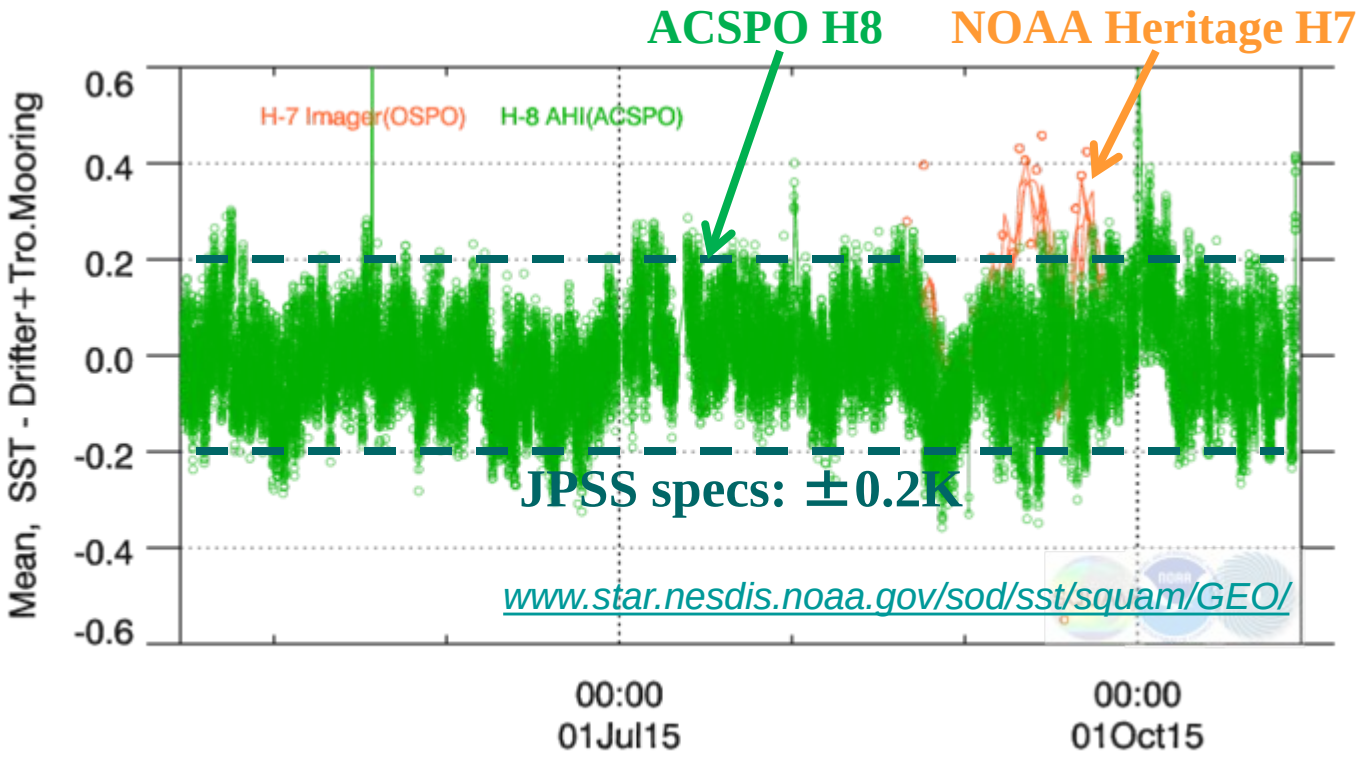
Screening in individual AHI FD images is more aggressive that in VIIRS, due to larger AHI footprint (2km vs. 0.75km at nadir) and its faster degradation with VZA

Work is underway to develop a less conservative AHI mask, using spatial patterns & temporal context

The objective is to produce a reduced volume L2C/L3C ACSPO product (e.g., 1hr; <5GB/day), which most fully preserves SST information for users

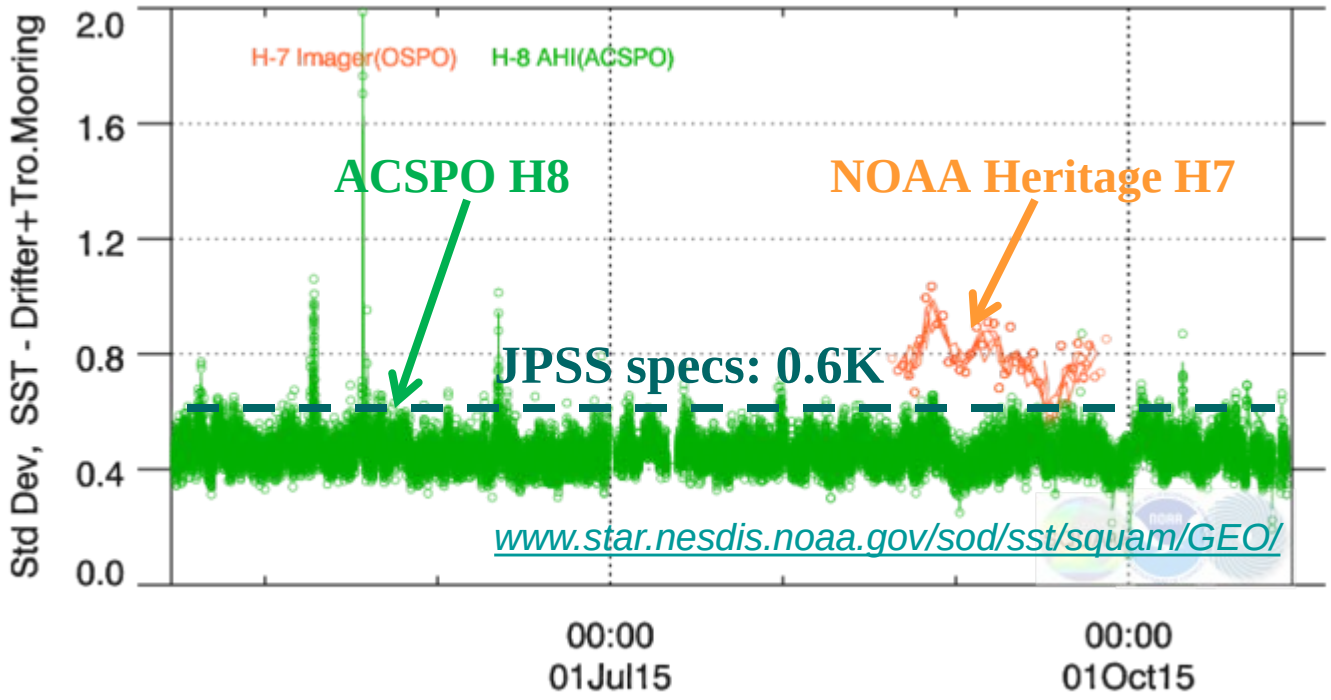
ftp://ftp.star.nesdis.noaa.gov/pub/sod/sst/acspo_data/l2/ahi/movies/

VAL BIAS wrt. *i*Quam (drifters + tropical moorings)



- Each data point corresponds to a 10min L2P granule. There are ~150 matchups per granule for ACSPO Himawari-8, and ~80 for Himawari-7 (MTSAT-2)
- The ACSPO Himawari-8 SST is close to meeting JPSS specs (which are much more stringent than the GOES-R specs)
- Skin-bulk difference, and possible instabilities in AHI sensor may contribute

VAL STD wrt. *i*Quam (drifters + tropical moorings)



- Currently, typical STDs range ~0.4K (Night) to ~0.6K (Day) and close to JPSS specs (which again are much more stringent than the GOES-R specs)
- STDs for H8 are smaller than for the Himawari-7/MTSAT-2, although the number of clear-sky SST pixels is ~5 larger (not shown, available in SQUAM)
- STD smaller at night (because skin SST closer to bulk buoy)

Ongoing and Near-Future ACSPO Work

- **JPSS**
  - Work with ACSPO users, improve SST product to satisfy their needs
  - Reprocess the full VIIRS record from Jan 2012 – pr with the current v2.40
  - Archive with PO.DAAC and NOAA NCEI
  - Two new ACSPO releases
    - ✓ 2.50: Improved SST imagery
    - ✓ 2.60: Improved clear-sky mask & New ocean fronts product

- **Himawari-8**
  - Link Himawari-8 SST diagnostics to the main SQUAM page
  - Work with JAXA and BoM to compare products in SQUAM
  - Generate a new Level 2/3C product of smaller size (<5GB/day)
  - Work with users to evaluate, and with PO.DAAC&NCEI to archive
  - Make another pass through L2P: Improve clear-sky mask, SST, SSES
  - Transition Himawari-8 ACSPO SST to operations
  - Prepare for launch of GOES-R in Oct 2016

Thank You!

Questions?

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