ACSPO VIIRS L3U SST Product

Yanni Ding[1,2], Irina Gladkova[3,4], Alexander Ignatov[1], Boris Petrenko[1,4], Yury Kihai[1,4], Fazlul Shahriar[3]

[1]*STAR, NOAA Center for Weather and Climate Prediction (NCWCP), USA*
[2]*CIRA, Colorado State University (CSU), USA*
[3]*City College of New York, USA*
[4]*Global Science and Technology, Inc., USA*

Little Olivia Ding has arrived on 28 July 2016!

VIIRS SST Users Requested L3U

ACSPO VIIRS L2P data

- Fully archived at PO.DAAC and NCEI
- Assimilated in CMC and geo-polar blended
- However, the data volume is large (20+ GB/day)
- EUMETCast initially pulled L2P but the throughput was insufficient
- Also, UKMO, ABoM, JMA requested reduced volume ACSPO files

The time was of the essence: Used L3U code from ABoM

- L3U was operationally produced in May 2015
- Put on EUMETCast (this is how UKMO receives the data)
- Archived at PO.DAAC and NCEI (19 May 2015 – on)
- Used by ABoM and JMA via PO.DAAC

The use & impact reported in User's section

L3U version 1 implementation

L3U v1 code was based on a (modified) version of the master code kindly provided by the Australian Bureau of Meteorology (ABoM; courtesy of Dr Helen Beggs and Chris Griffin)

Several implementation decisions have been made in ACSPO (Grid size? What layers and flags to report? Pixel-to-grid aggregation? etc.)

Initial evaluation suggested reasonable performance, and the code was put into NOAA operations on 19 May 2015

Following the production of the L3U v1 product, it was comprehensively evaluated in SQUAM and ARMS, and several areas for improvement have been identified

Based on these analyses, L3U v2 was developed

Major improvements in L3U v2

- Achieved better consistency between ACSPO L3U and L2 SSTs (and corresponding Single Sensor Errors Statistics – SSES)

- Included a complete set of masking flags from the L2P product (clear-sky mask, ice mask, day/night mask, glint mask, twilight zone, etc)

- Optimized control and improved flexibility to prepare for higher resolution L3U (e.g. 0.01º), and development of the future ACSPO L3C (collated) and L3S (super-collated) ACSPO SST products

Performance Comparison

L3U	ACSPO v2.40 (L3U v1)	ACSPO v2.41 (L3U v2)
Algorithm	Area-Weighted	Bilateral-Weighted
L2P flags	Only day/night and land/sea	Full Set
Coverage	Conservative	Increased in partially cloudy grid cells
Bias (compare to L4)	<0.05K compared to L2P	<0.01K compared to L2P
Scale_factor/ Add_offset	Variable (inconsistent with L2P)	Fixed (consistent with L2P)
Running time	~25s/10min granule	~30s/10min granule
Memory Usage	<4GB	<8GB
Compressed File Size	~1GB/day	~0.7GB/day

ACSPO L3U v2 Algorithm

For each L3U grid cell, select certain number of nearest L2P pixels, and compute weighted SST L3U value using the bi-lateral weighted averaging approach:

$$SST_{i,j}^{L3U} = \Sigma_k SST_k^{L2} w_k / \Sigma_k w_k,$$

Here, w_k are weights depending on spatial proximity and local SST:

$$w_k = \exp(- d_k^2/\sigma^2 - (SST_k^{L2} - SST^{L2}_{med})^2/\sigma_i^2);$$

SST^{L3U}, SST^{L2} : the L3U and L2P SSTs, respectively;

d_k : geo distance between L3U cell (i,j) and selected k nearest L2 pixels; $d_k < \alpha*\sigma/\cos\lambda$, where α is a constant and λ is the latitude.

σ and σ_i : spatial and temperature dependent parameters for Gaussian weighting;

SST^{L2}_{med} : the median SST value of k selected nearest L2 points SST_k^{L2}.

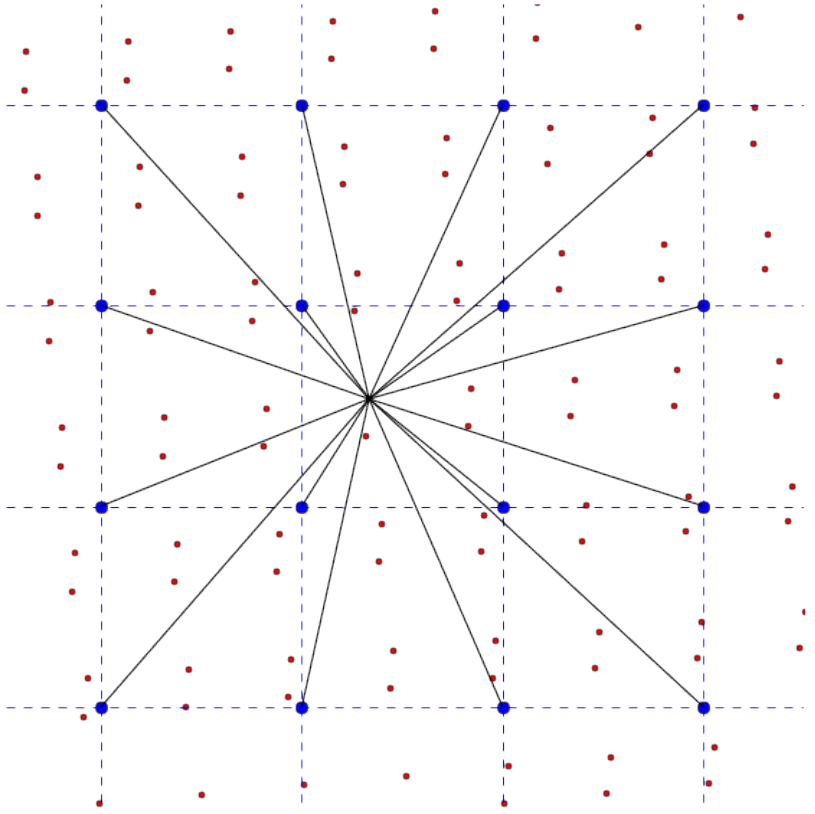
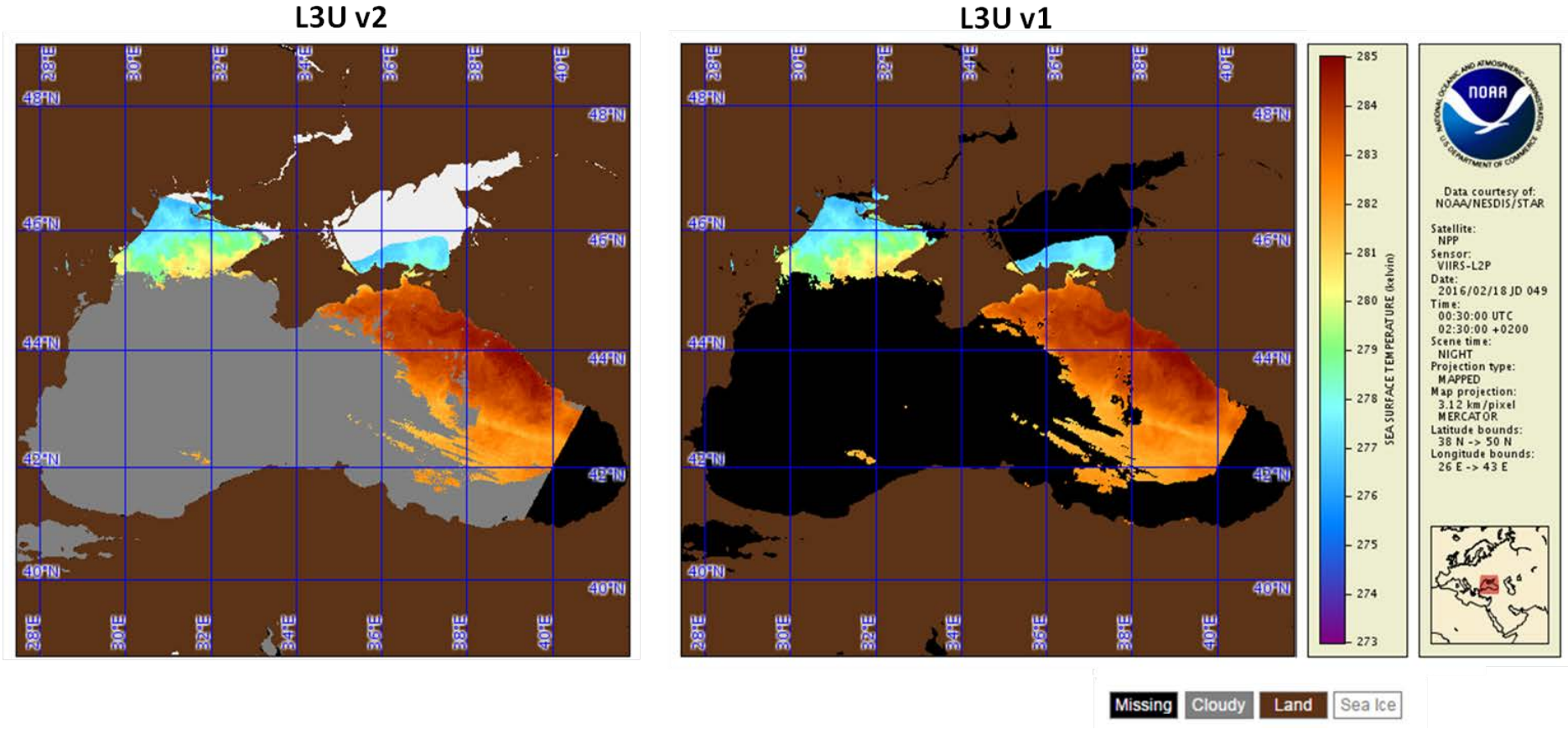


Fig. 1: sketch of searching nearest L2P points for L3U grids.

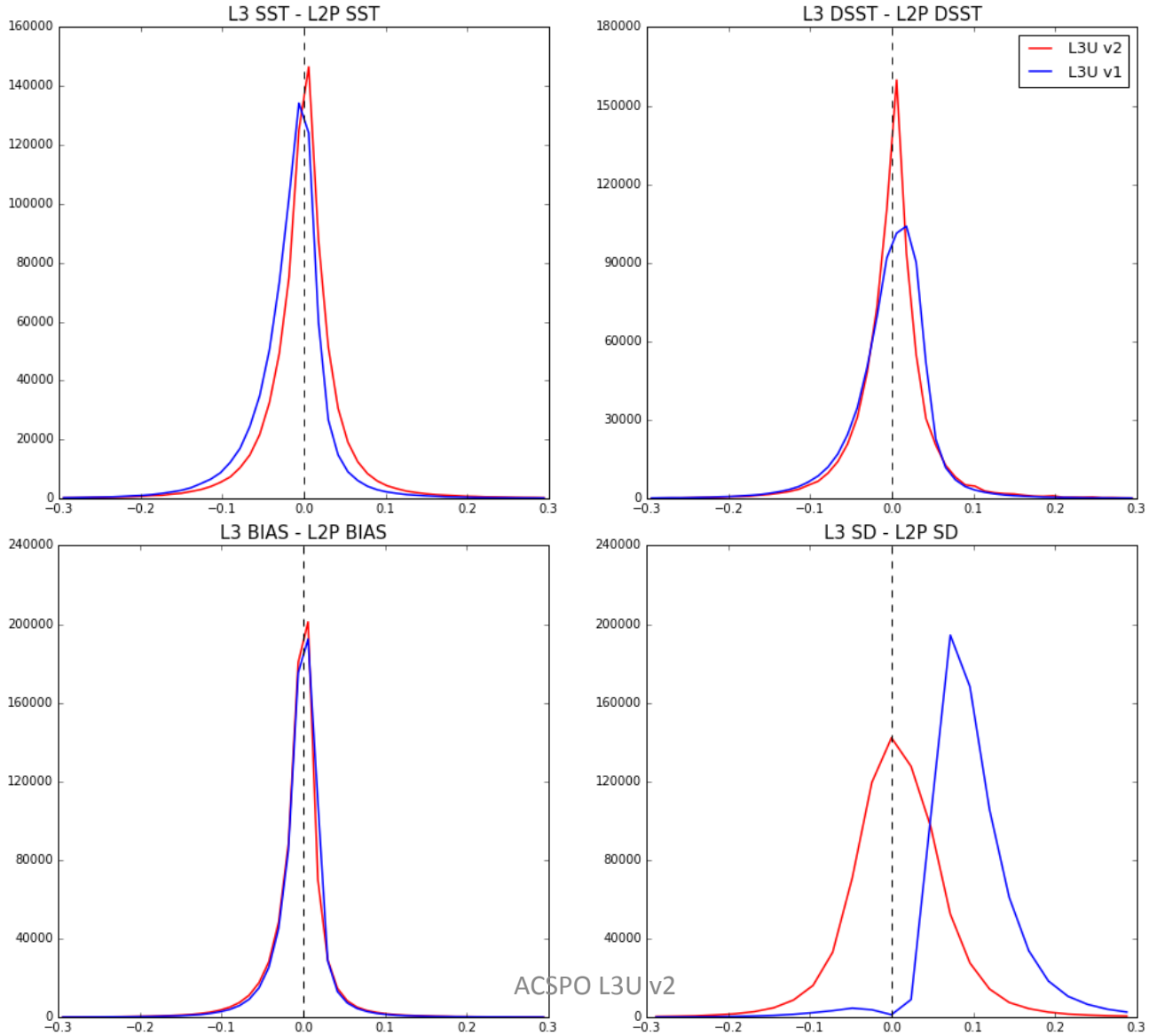
L3U v2 includes a complete set of L2P flags

- ACSPO L3U v2 reports all masking flags available in L2P (clear-sky mask, ice mask, day/night mask, glint mask, twilight zone, etc.)
- L3U aggregation: L2P pixels with QL=5 are gridded; all L2P pixels with QL<5 are discarded



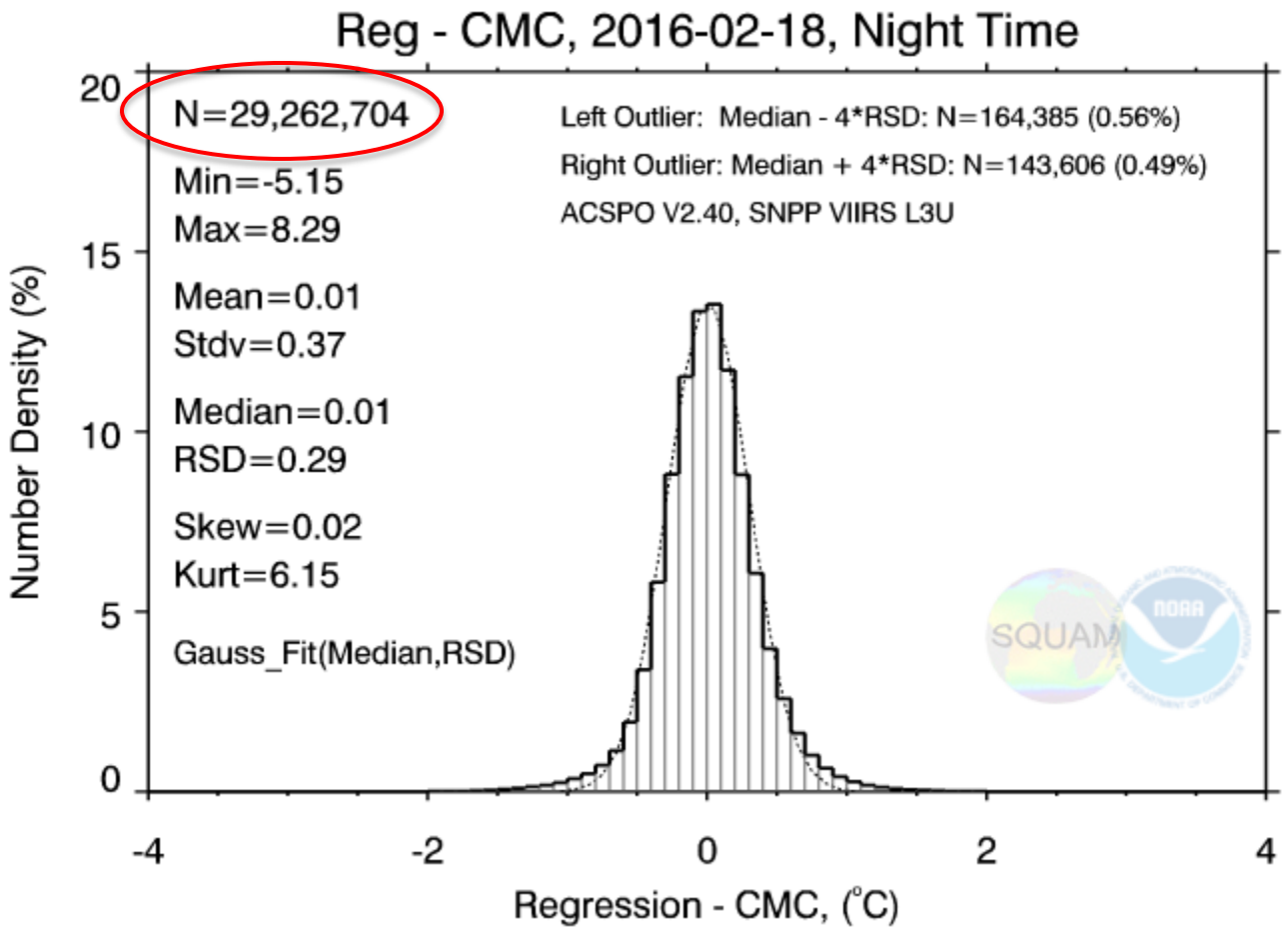
Compared to L2P

L3U v2 reduces the biases, especially for ΔSST and SSES_BIAS



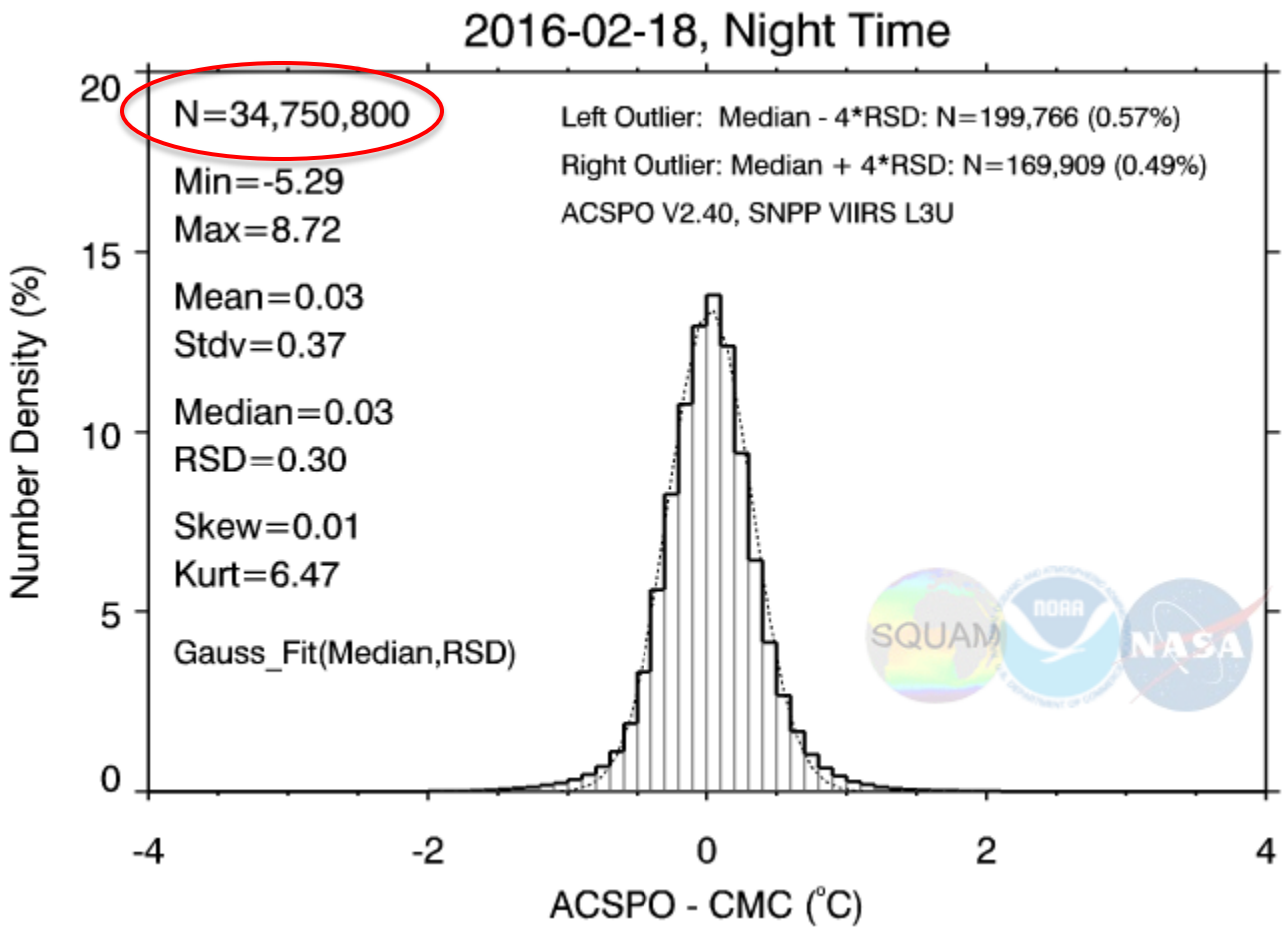
L3U v1 compared to L4

L3U v1 night time data statistics



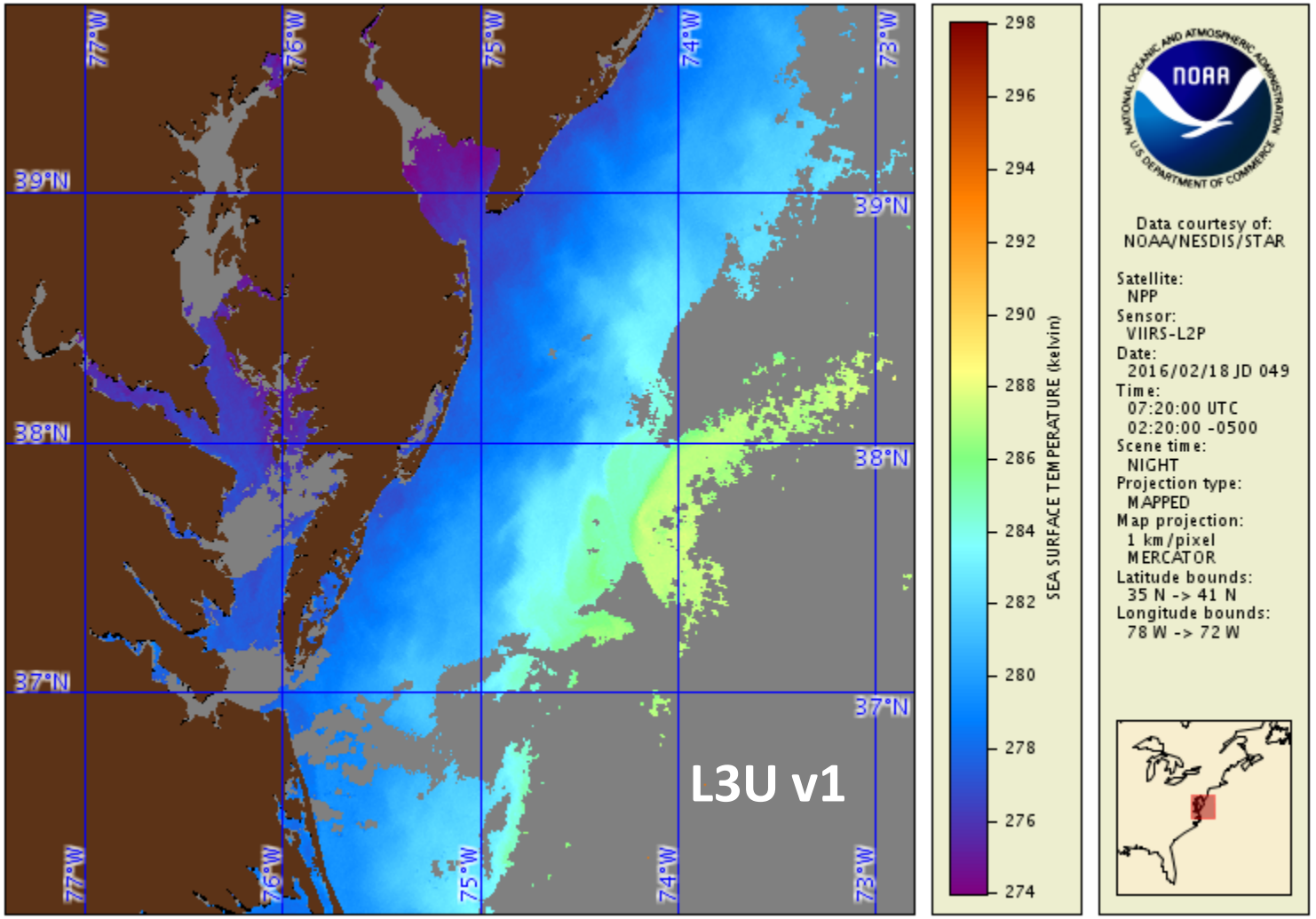
L3U v2 Compared to L4

L3U v2 has larger number of observations, and presents similar statistics to L3U v1



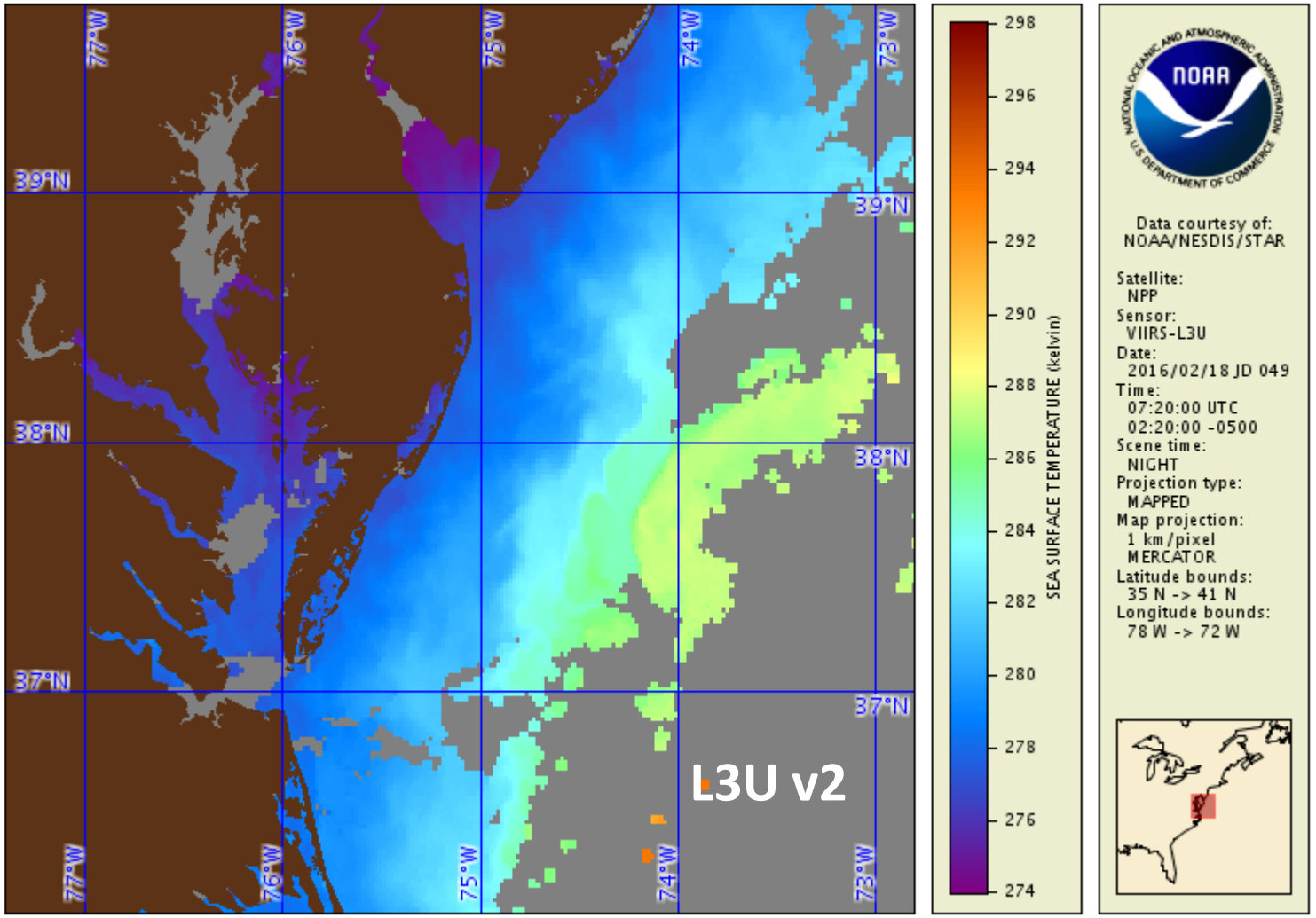
Coverage comparison

L3U ACSPO v2.40 uses conservative aggregation at partially cloud covered grid cells



L3U v2 coverage

L3U ACSPO v2.41 provides larger data coverage (clear sky SST domain) due to less conservative aggregation at partially cloud covered grid cells



Conclusion

- ✓ A new ACSPO L3U v2 was designed to better account for the specifics of the ACSPO SST product. It employs the bi-lateral weighted averaging approach to preserve edges and reduce noise. The new version runs faster, and preserves the spatial gradients.
- ✓ L3U v2 reduces the biases compared to L2P (especially for ΔSST and SSES SD), and presents similar statistics in (L3U – L4) SST compared to L3U v1.
- ✓ It includes a complete set of L2P flags available in the ACSPO L2P SST product. The code will be used to produce higher-resolution L3, including L3C and L3S.

Back-up Slides

Future work: Product Levels

Level 2 product (**L2P**): original swath projection

- (**20+GB/day**)

Level 3 products (**L3**): aggregated/spatially gridded

Δ **L3U** (Un-collated): data from different overpasses are preserved

- ACSPO available for S-NPP VIIRS, reduced data volume (**1GB vs. 20+GB/day**)

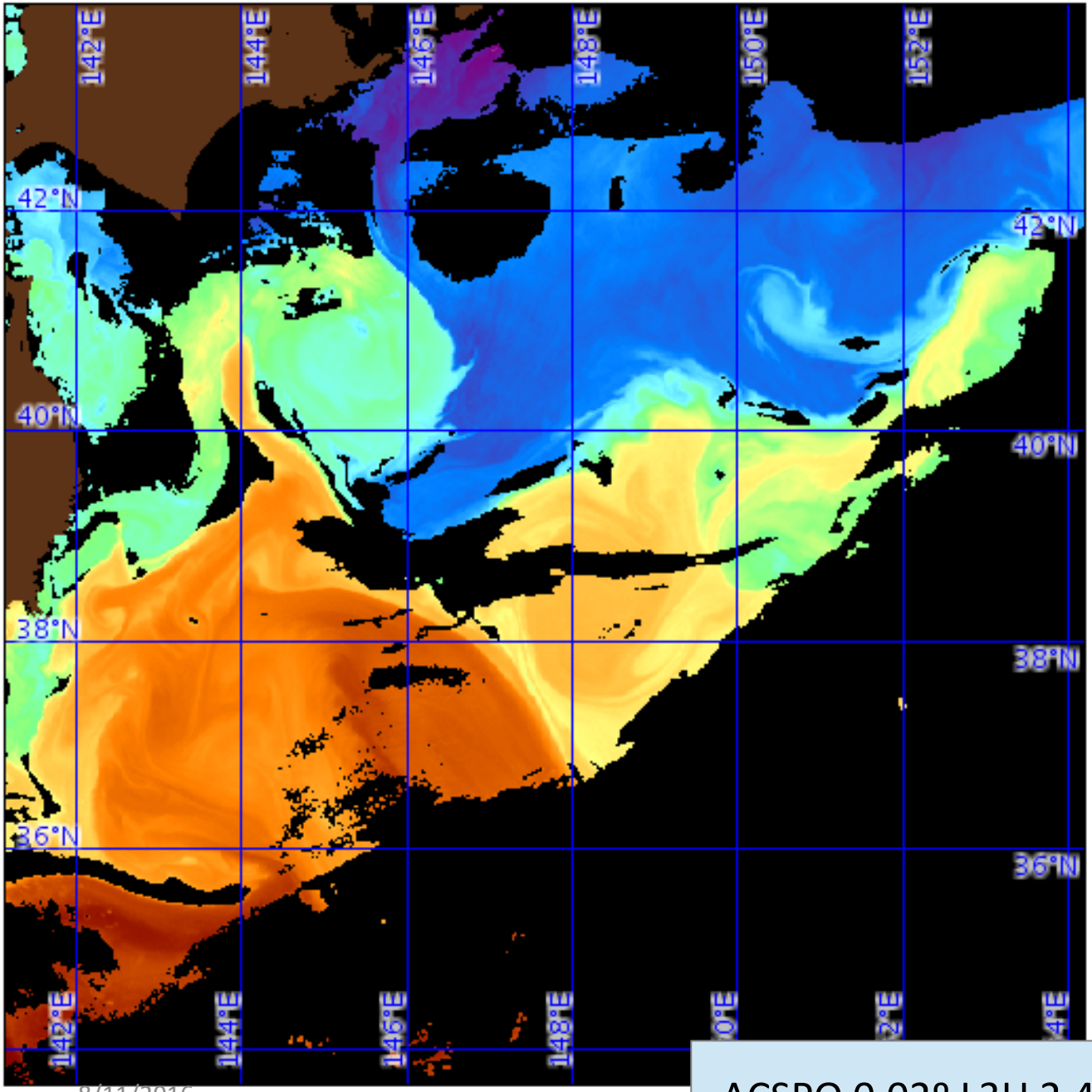
Future work: spatially gridded & time adjusted

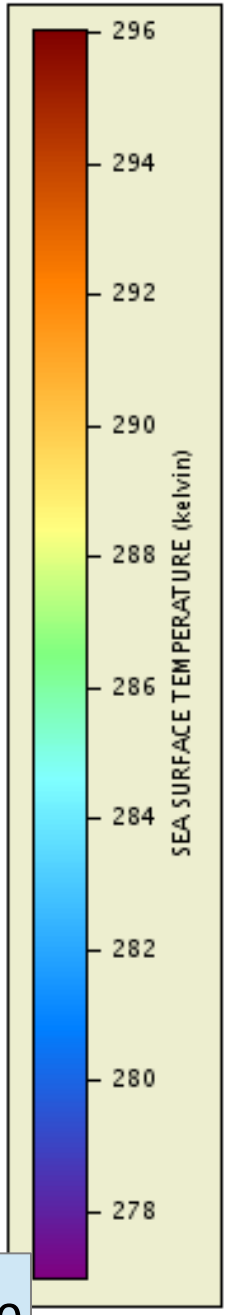
Will provide further data volume reduction:

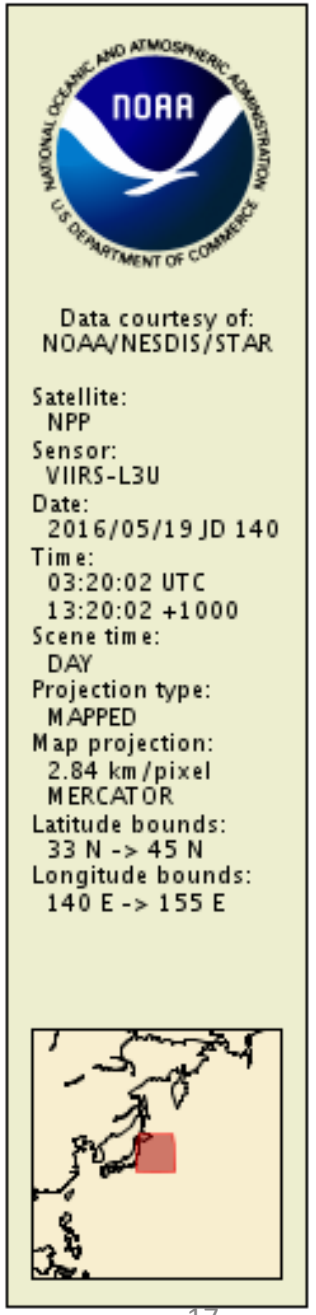
2 files a day – L3C day and L3C night

Δ **L3C** (Collated): data from same instrument (different overpasses)

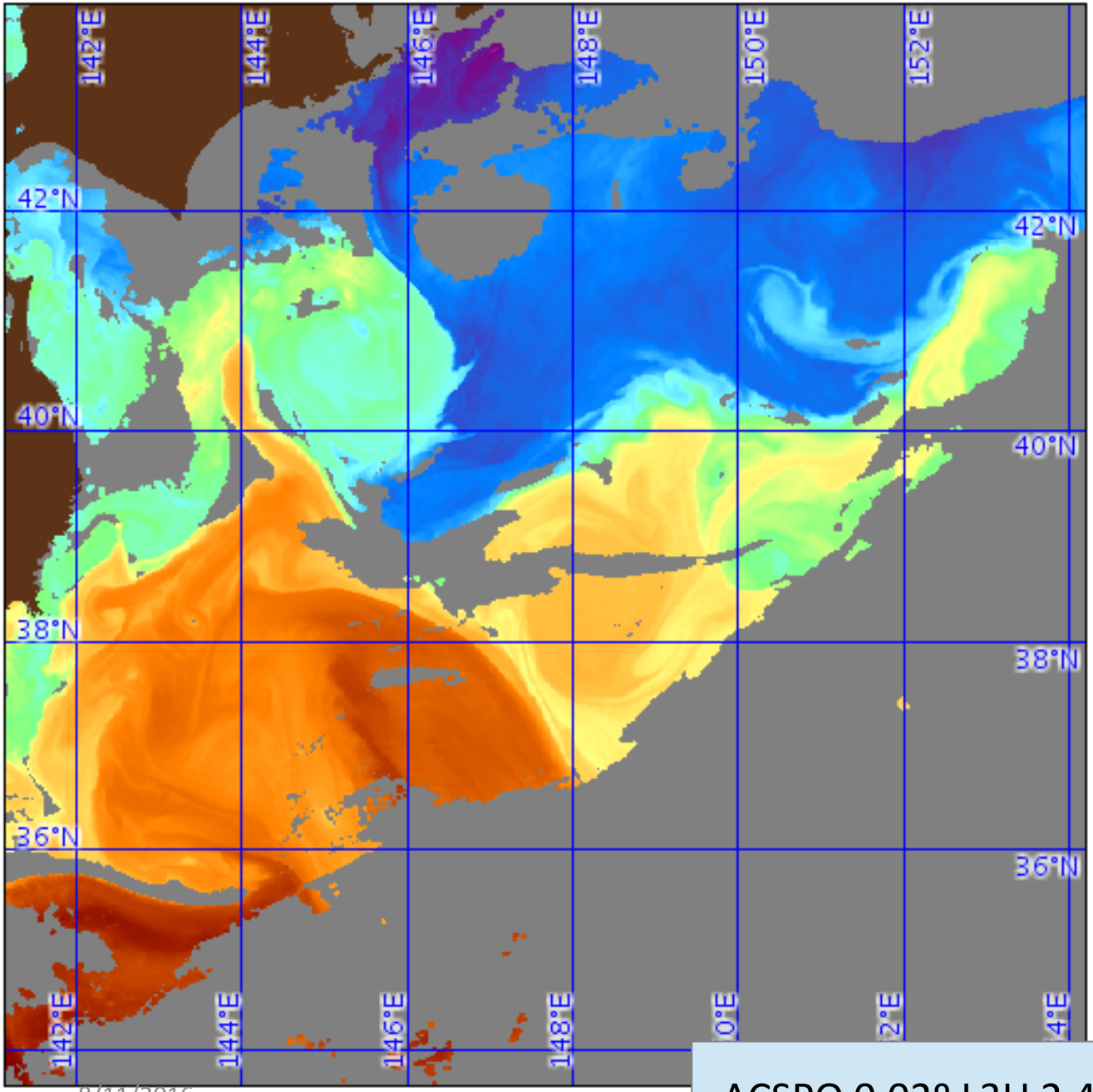
Δ **L3S** (Super-collated): data from various instruments fused together

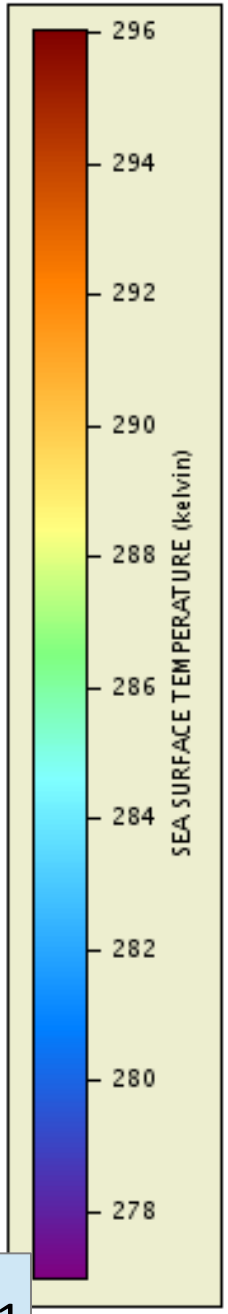


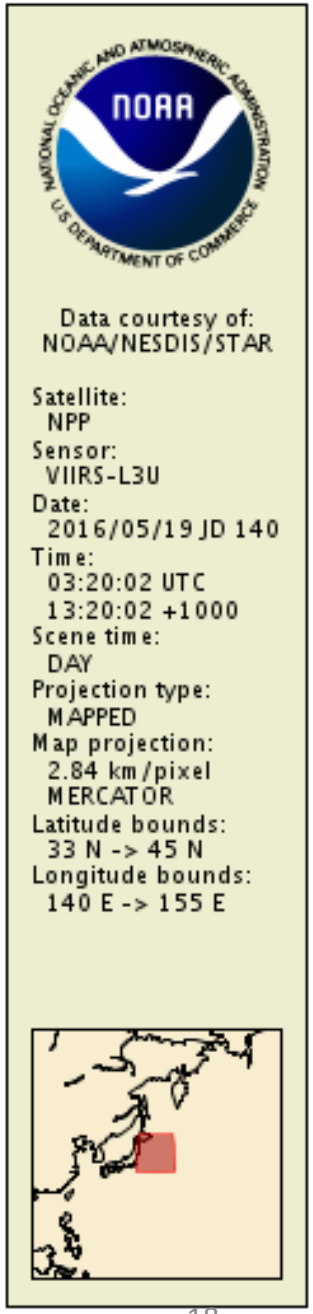




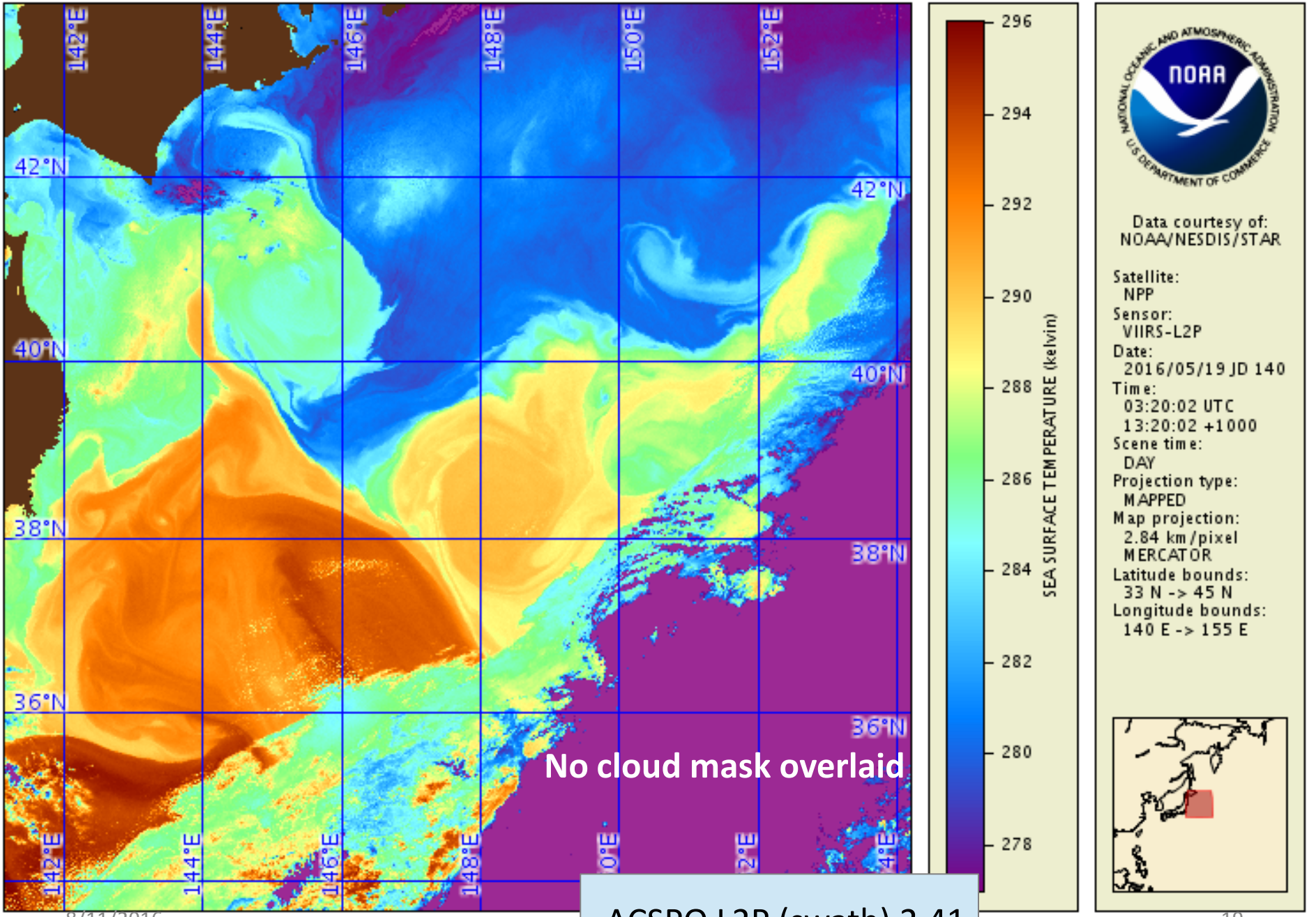
ACSPO 0.02º L3U 2.40



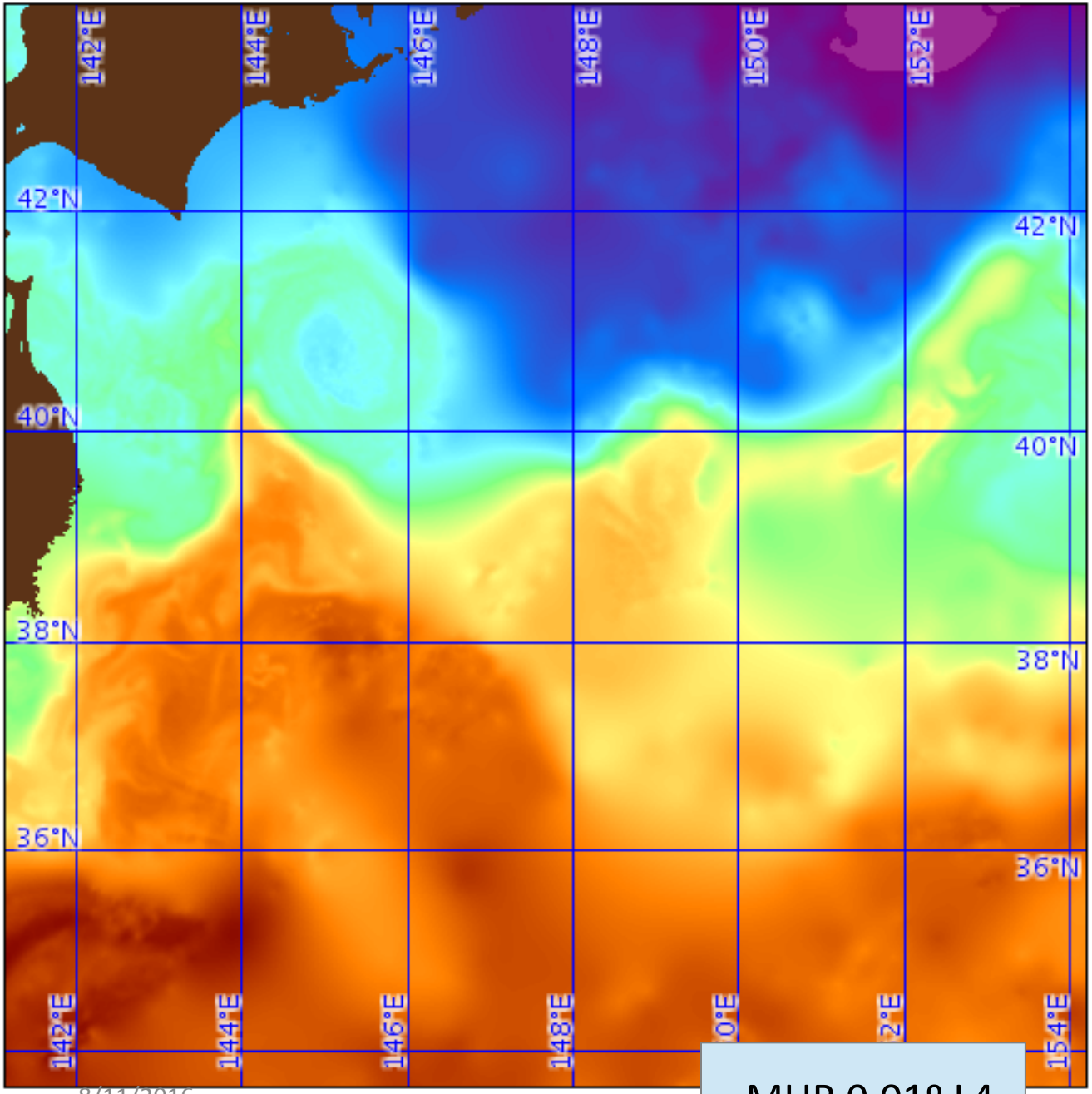




ACSPO 0.02º L3U 2.41



ACSPO L2P (swath) 2.41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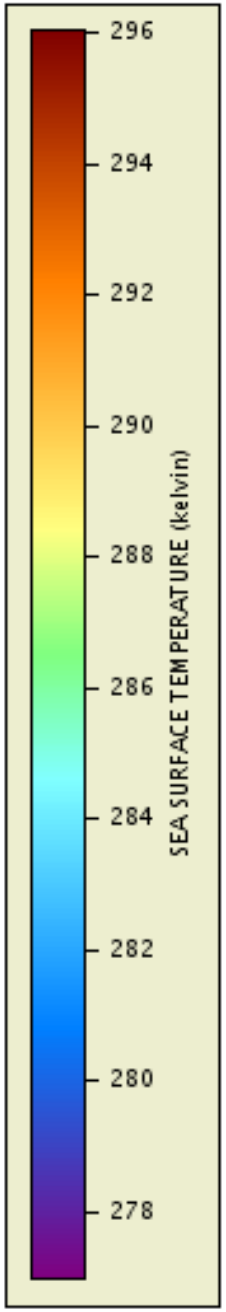
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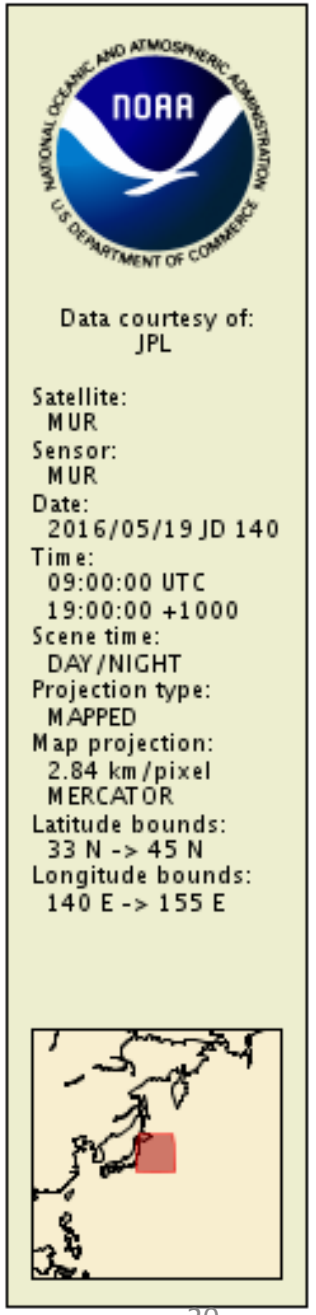
SEA SURFACE TEMPERATURE (kelvin)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Data courtesy of:
JPL
Satellite:
MUR
Sensor:
MUR
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DAY/NIGHT
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MERCATOR
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Longitude bounds:
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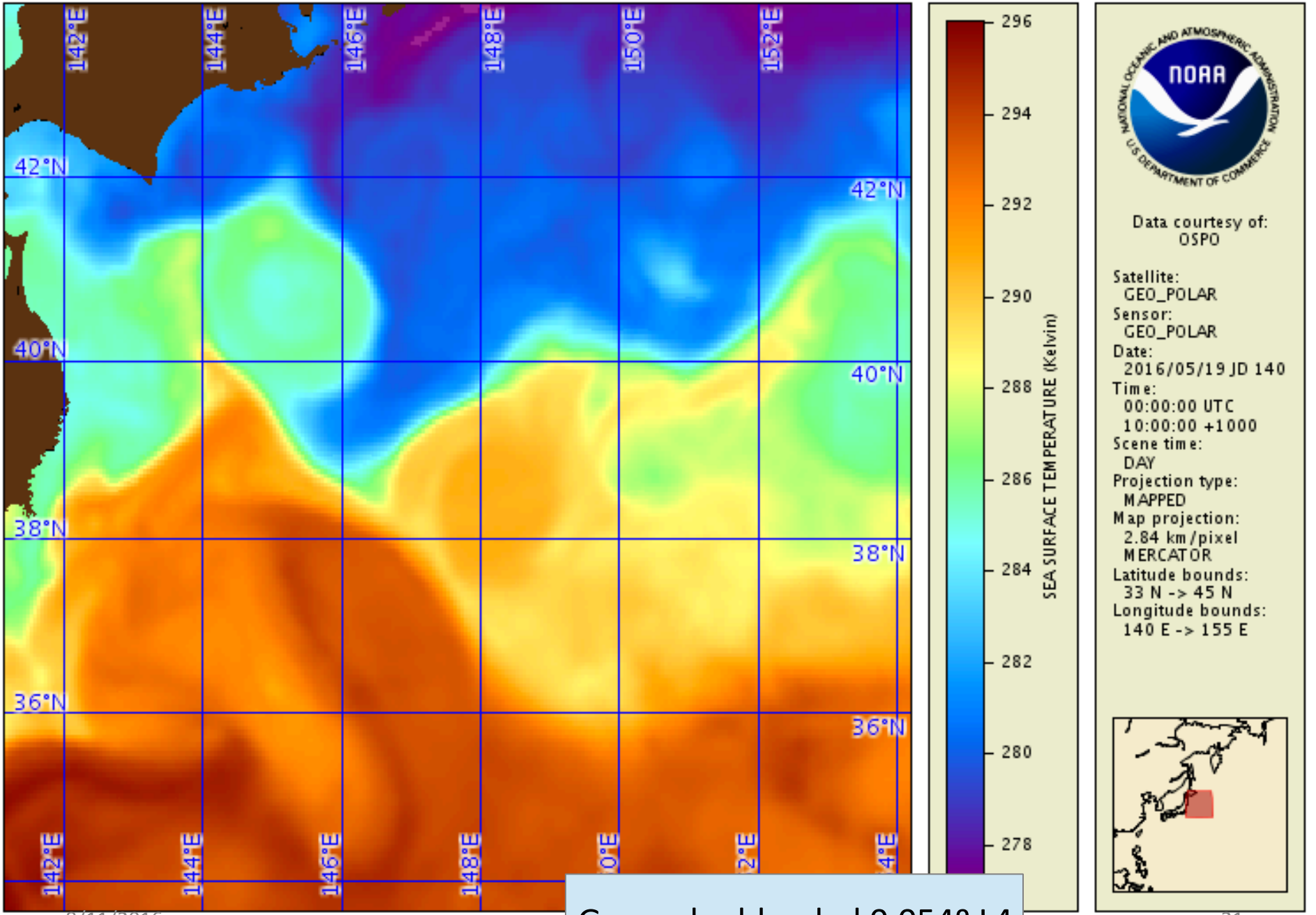
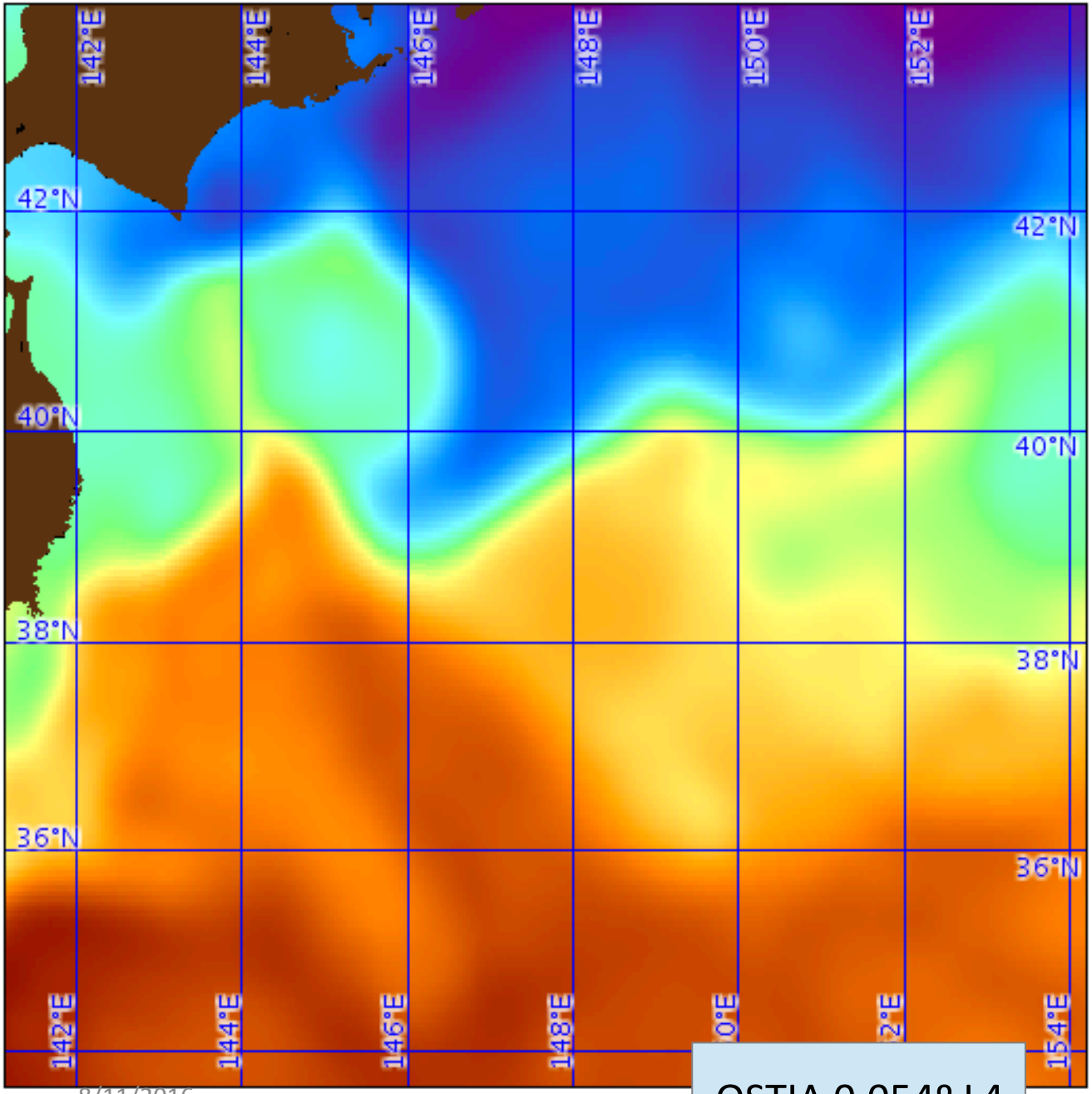
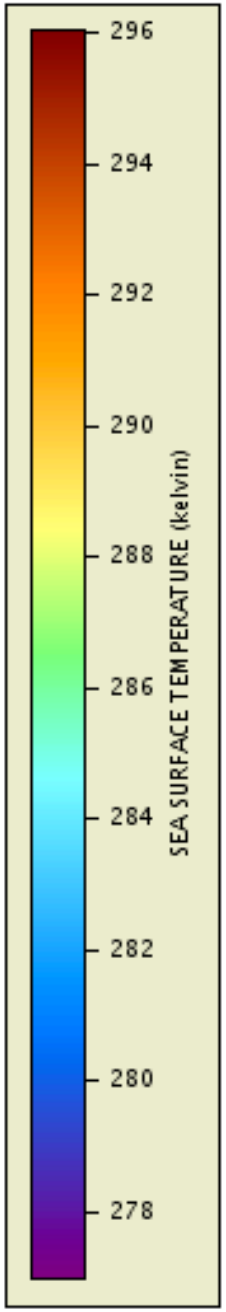
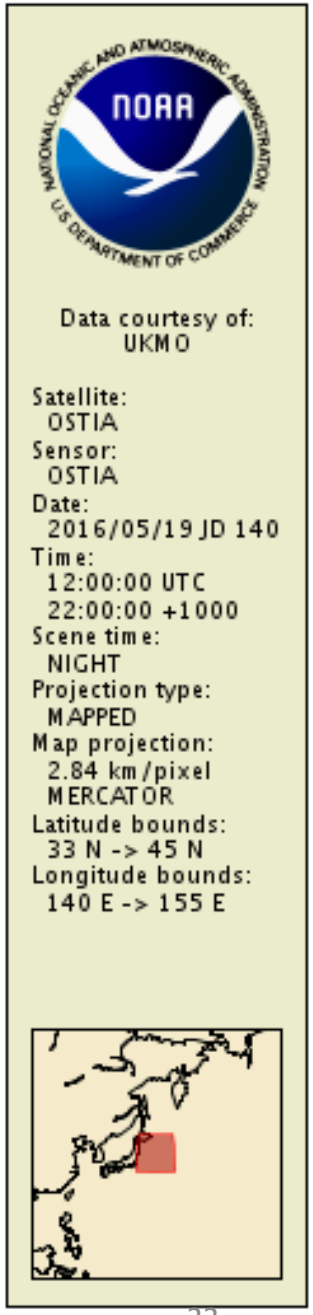
MUR 0.01º L4



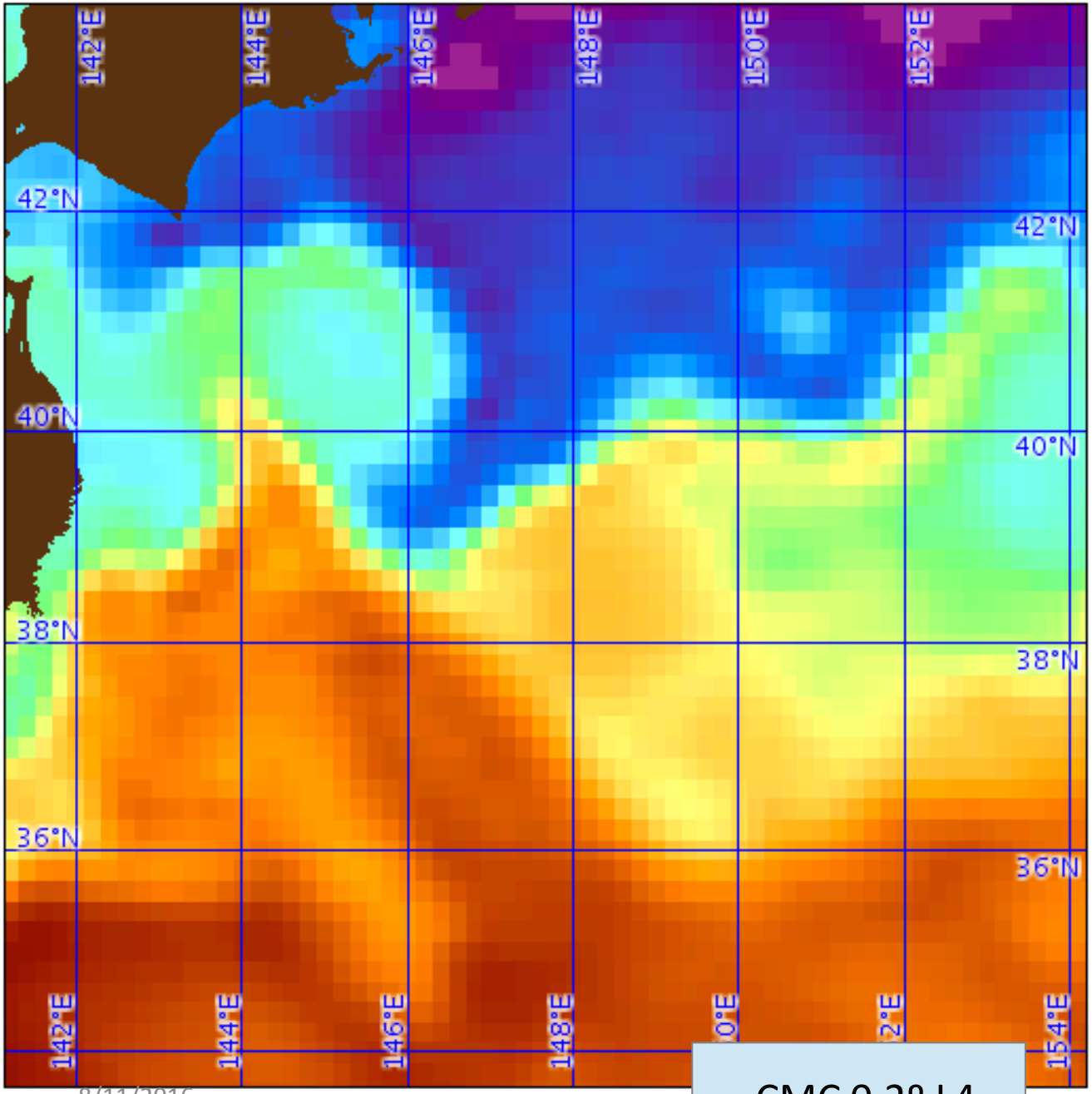
Geo-polar blended 0.054º L4







OSTIA 0.054º L4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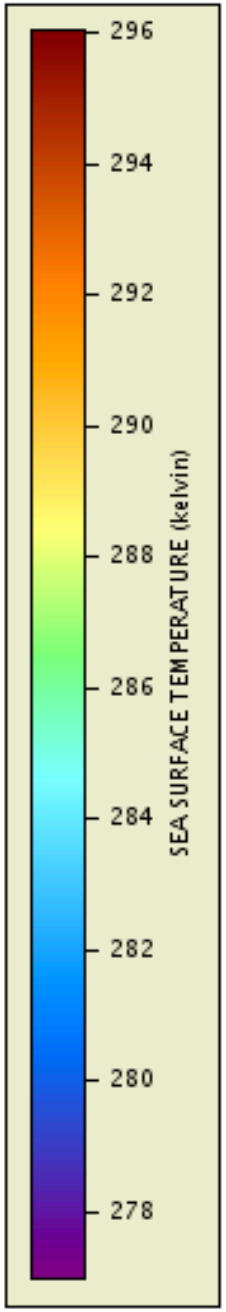
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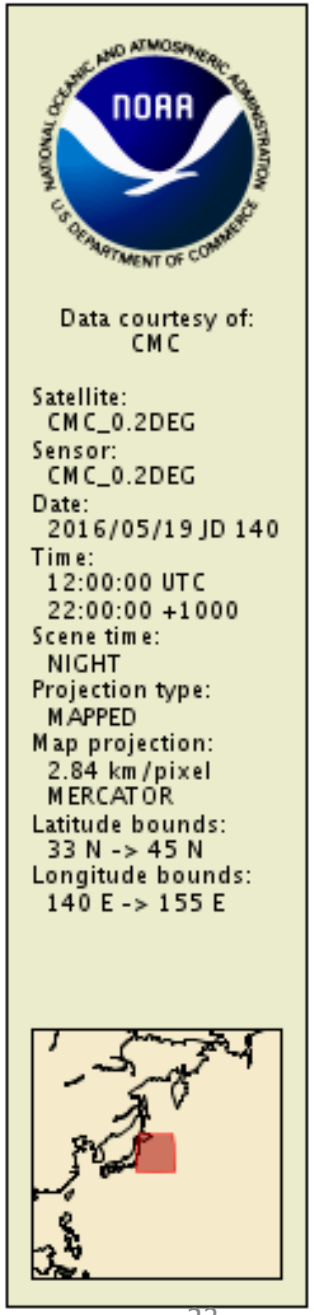
NOAA
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Data courtesy of:
CMC
Satellite:
CMC_0.2DEG
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CMC_0.2DEG
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CMC 0.2º L4