



Assimilation of VIIRS SSTs and Radiances into Level 4 Analyses

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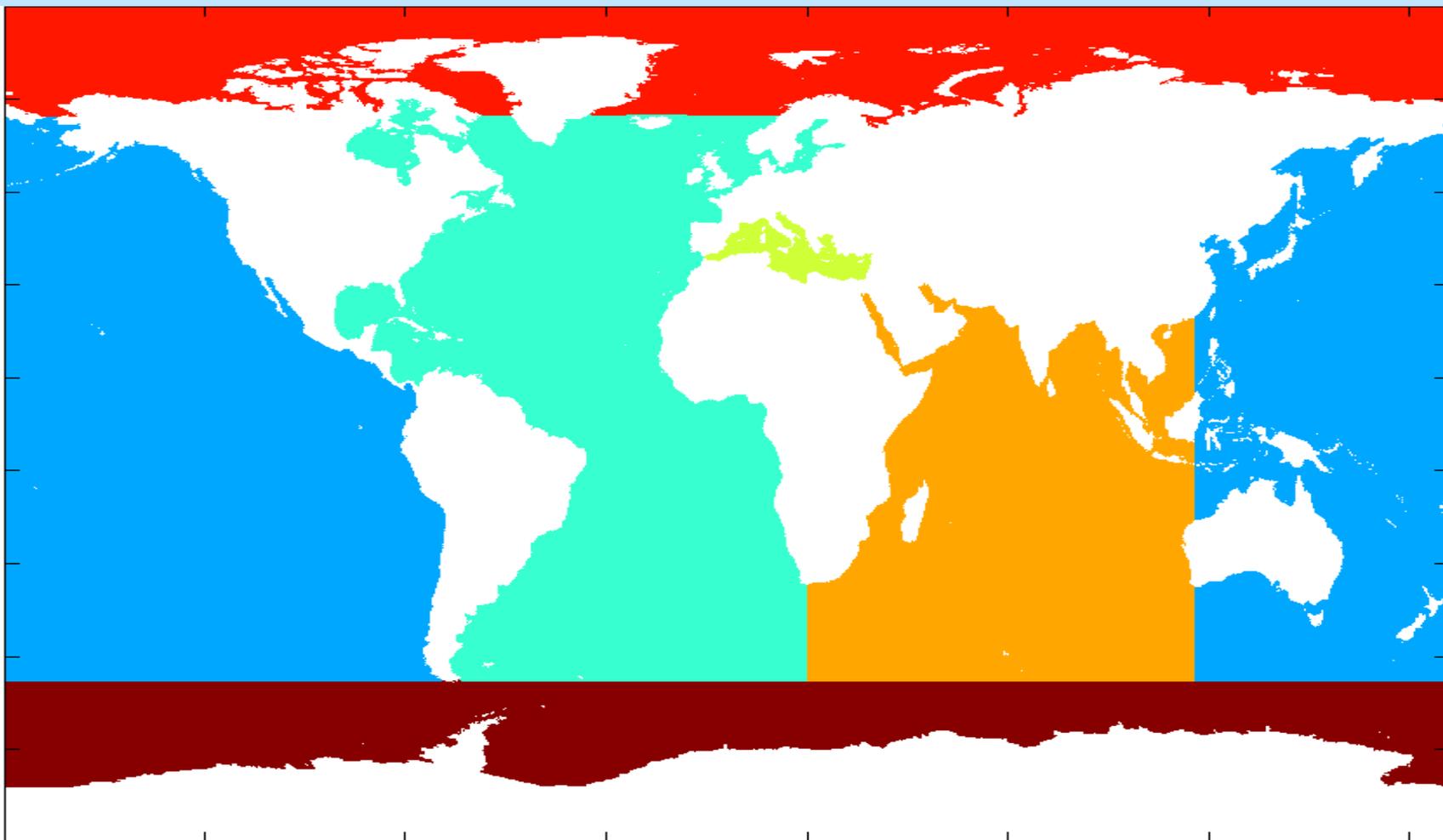
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Eileen Maturi (NESDIS/STAR)

5-km Blended SST Analysis

- **Produced daily from 24 hours of AVHRR & Geo-SST**
 - NOAA-19, MetOp-A (about to switch to MetOp-B)
 - GOES-E/W Imager
 - MTSAT-2 Imager
 - Meteosat-10 SEVIRI
 - VIIRS
 - [AMSR-2]
 - **Does not use buoy data**
- **Multi-scale OI**
 - Mimics Kalman Filter (*Khellah et. al., 2005*)
- **3 stationary priors**
 - Short, intermediate and long correlation lengths
 - Mimic non-stationary prior while preserving rigor
 - Interpolation of resultant analyses based data density
 - **Allows fine resolution where possible without introducing noise**

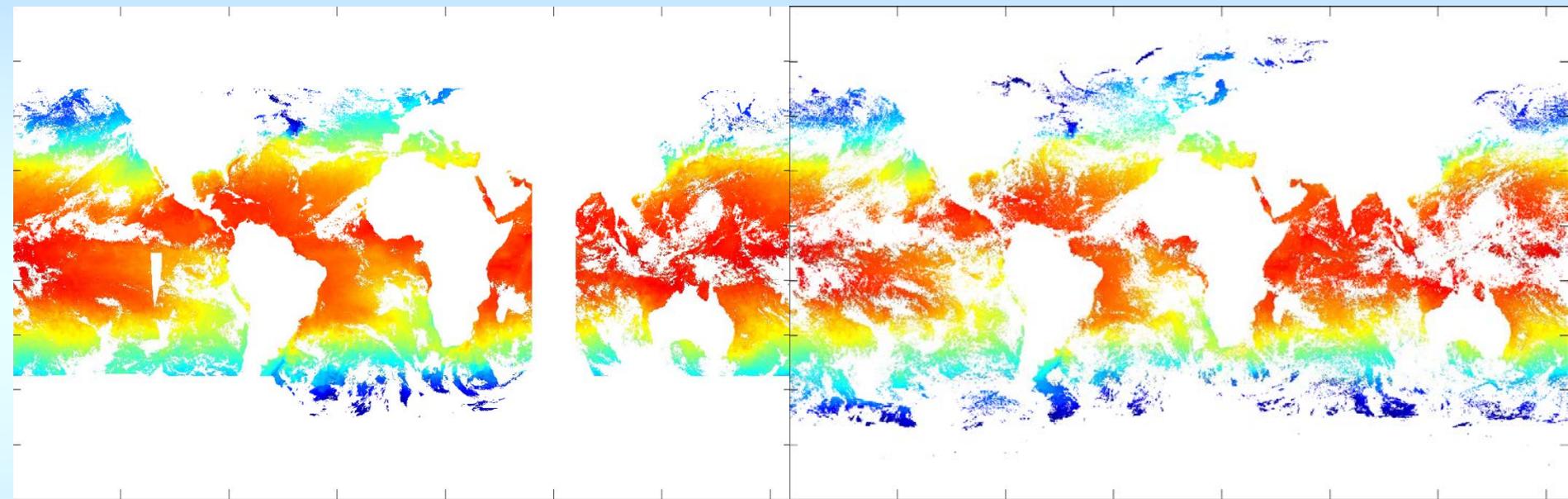
Separate Ocean Basins



Data Coverage

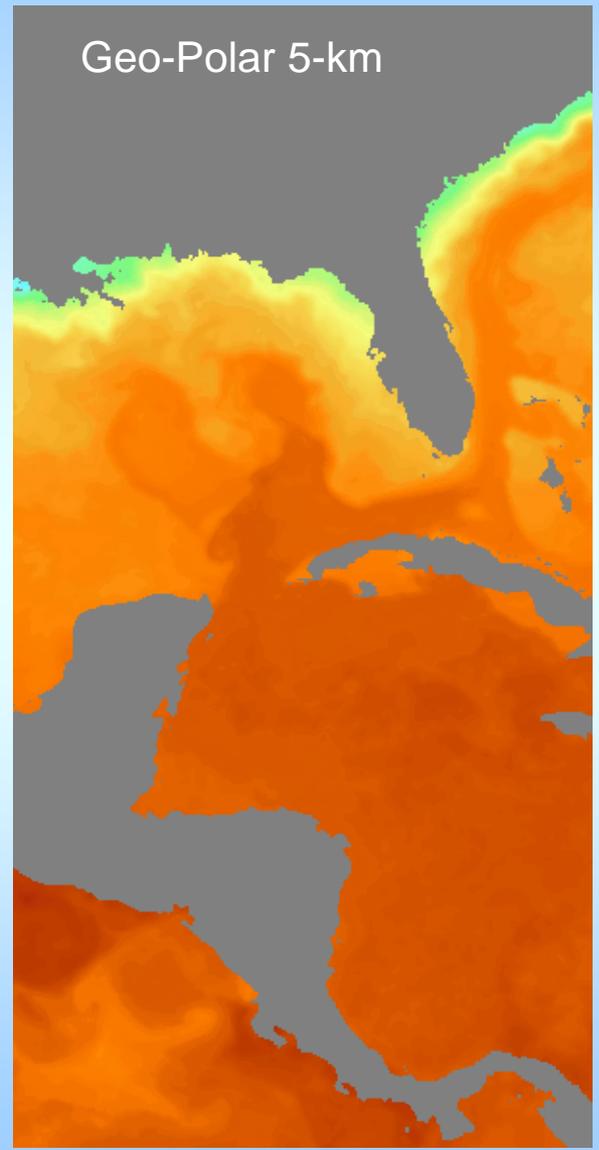
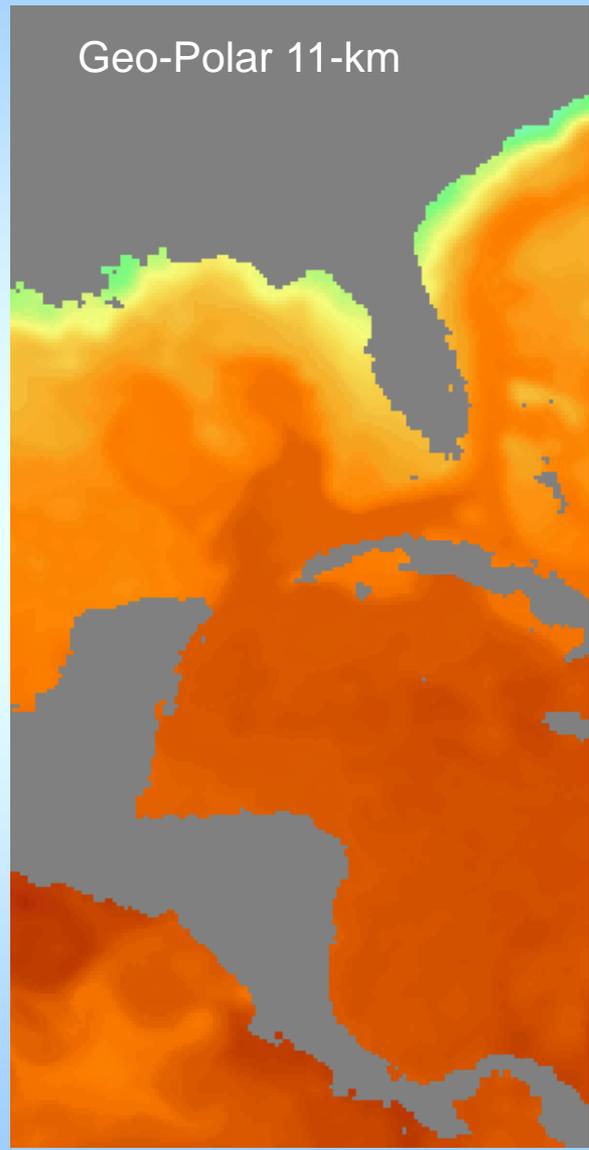
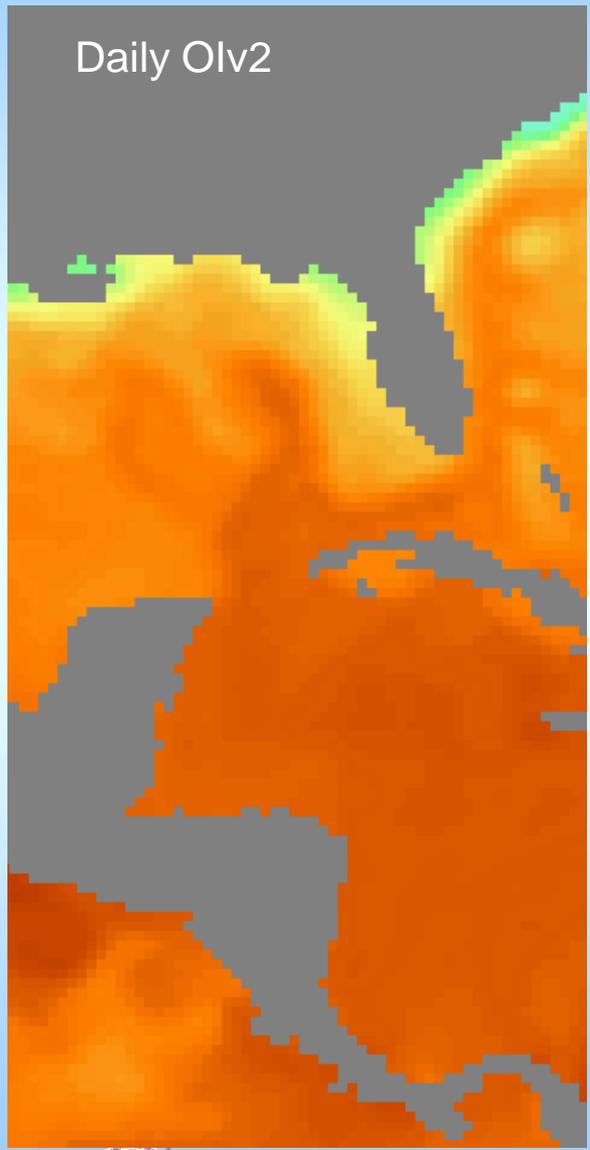
Geostationary SST

Polar-Orbiter SST

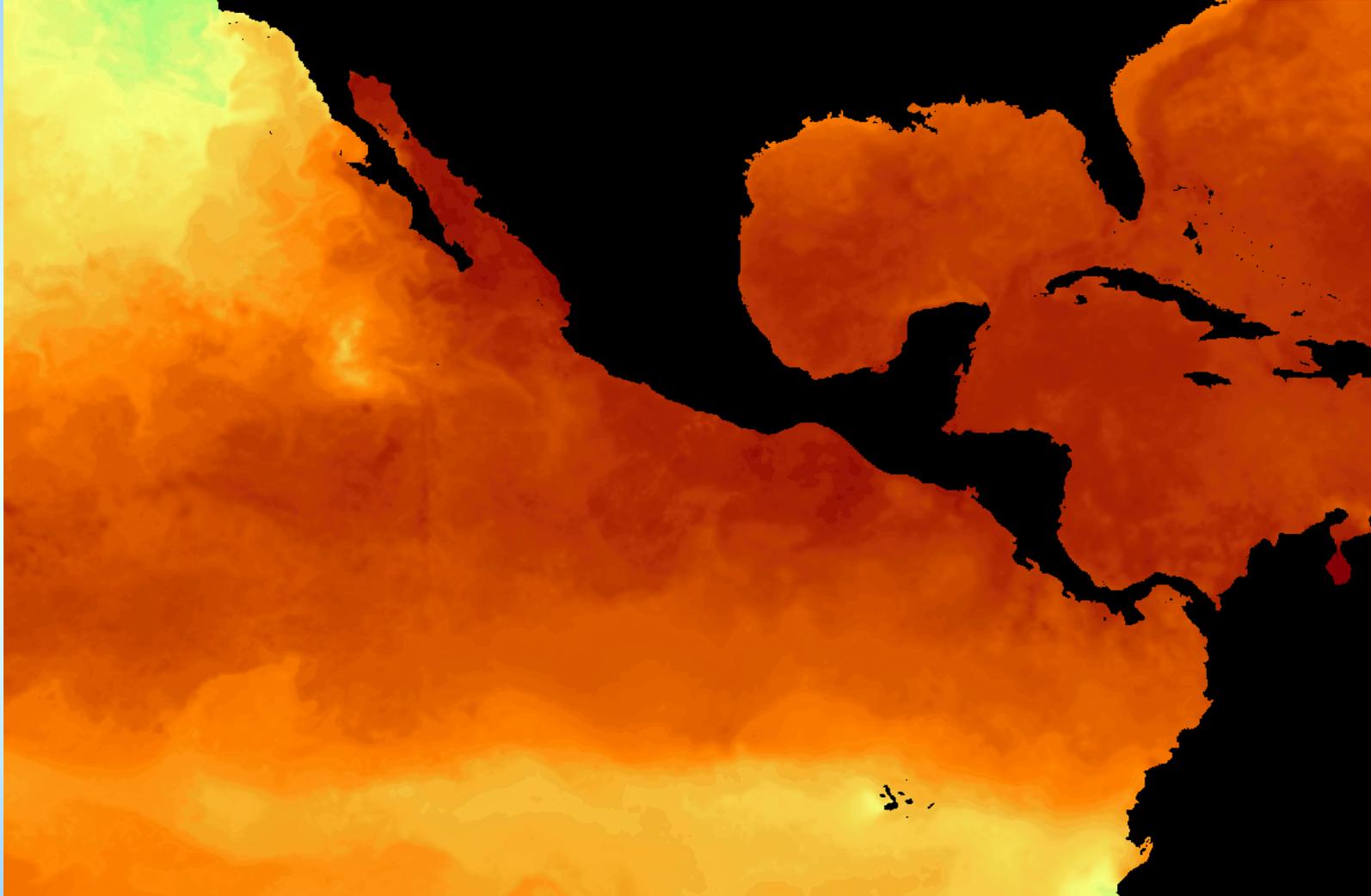


- **Geostationary data in particular provide lots of observations**
 - N.B. gap in coverage in Indian Ocean
- **Data-driven analysis**
 - Need to treat the input data “carefully”

Resolution difference

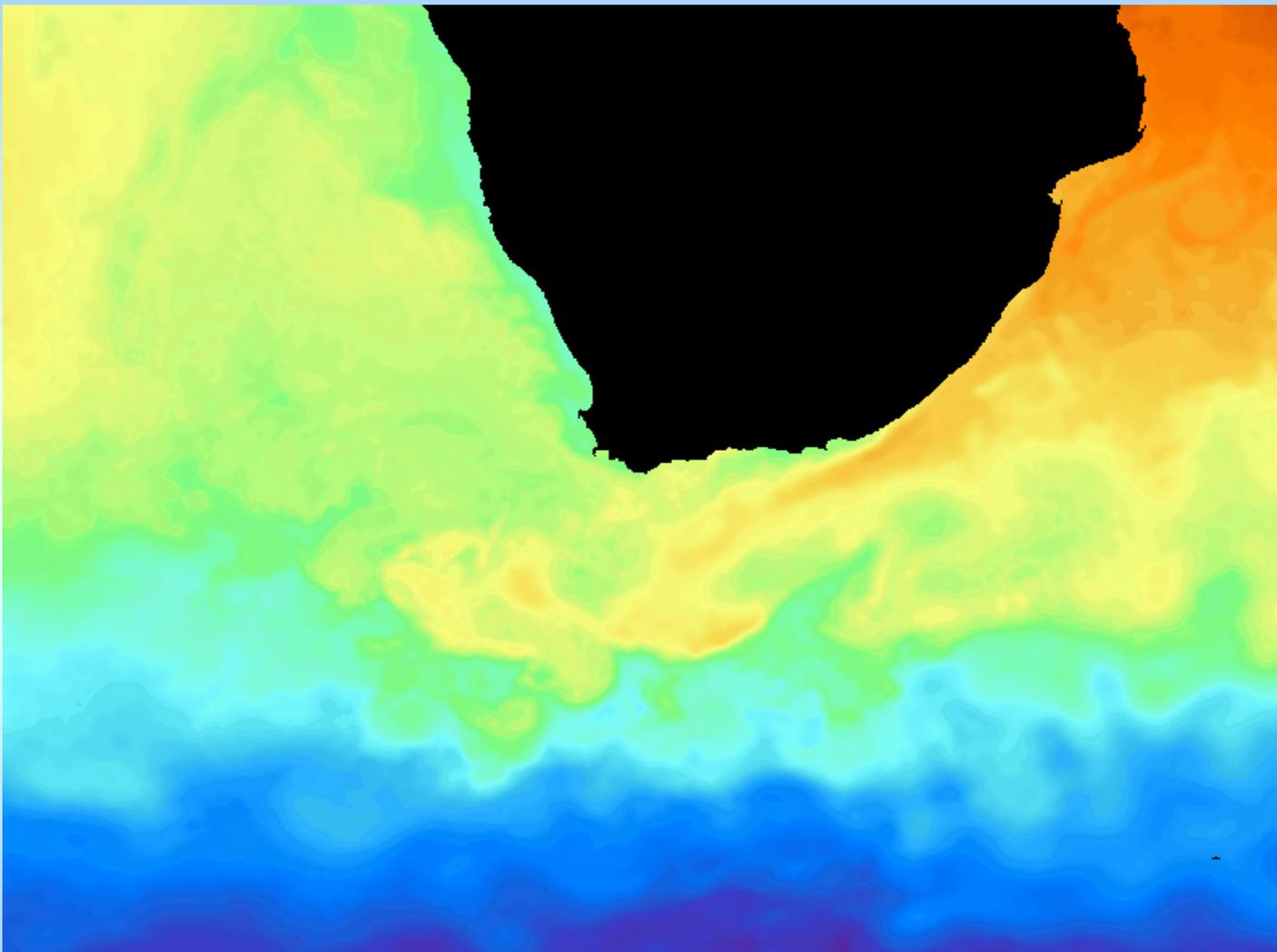


5-km Examples



Day+night 5-km, Nov 1 – Dec 31, 2012

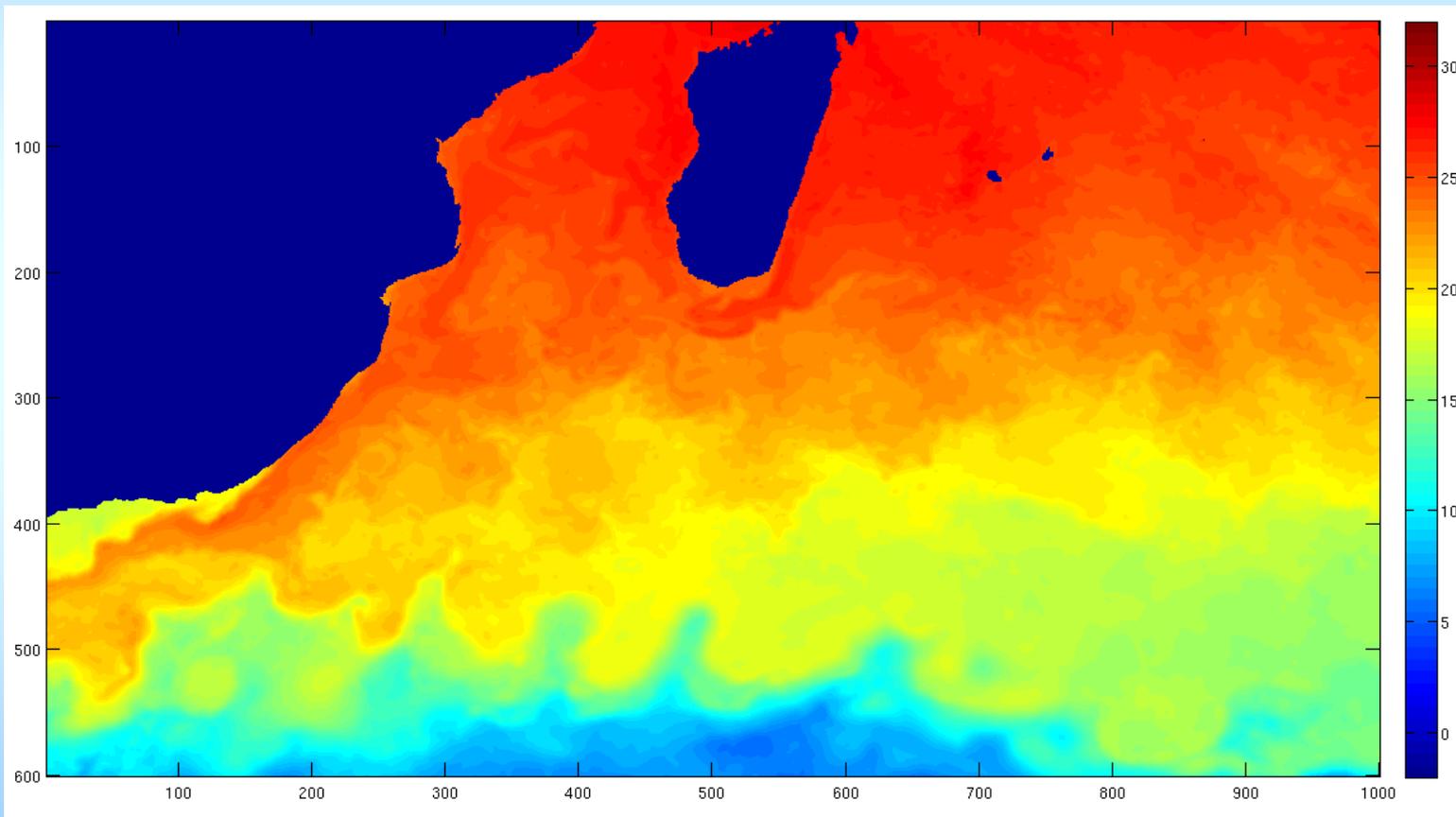
5-km Examples



Day+night 5-km, Nov 1 – Dec 31, 2012

Key Results/Accomplishments

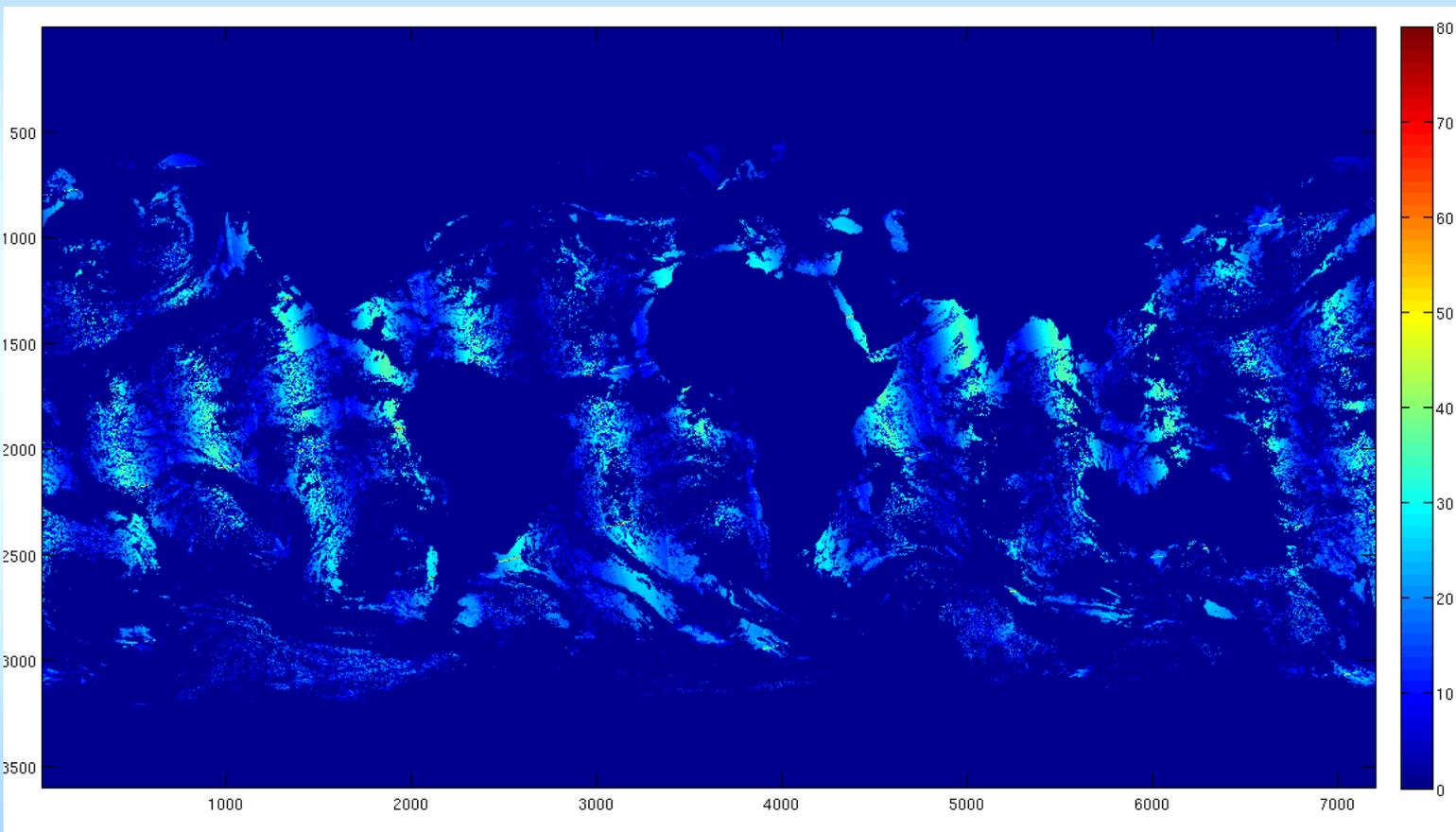
- VIIRS successfully incorporated into Geo-Polar Blended 5-km global SST analysis



Superior SST Analysis data

Key Results/Accomplishments

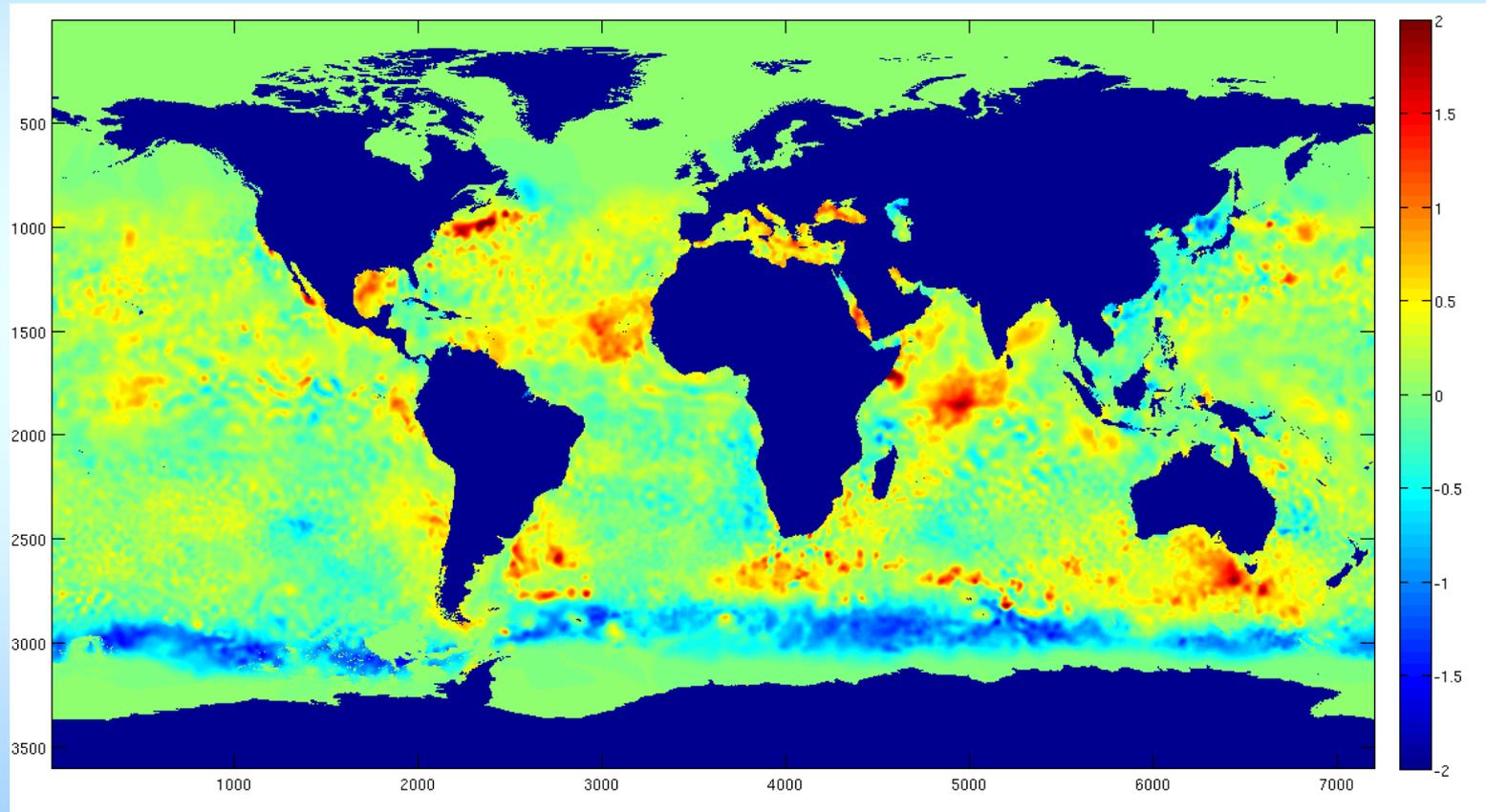
- Coverage is improved w.r.t. MetOp AVHRR



ACSPO AVHRR coverage

Key Results/Accomplishments

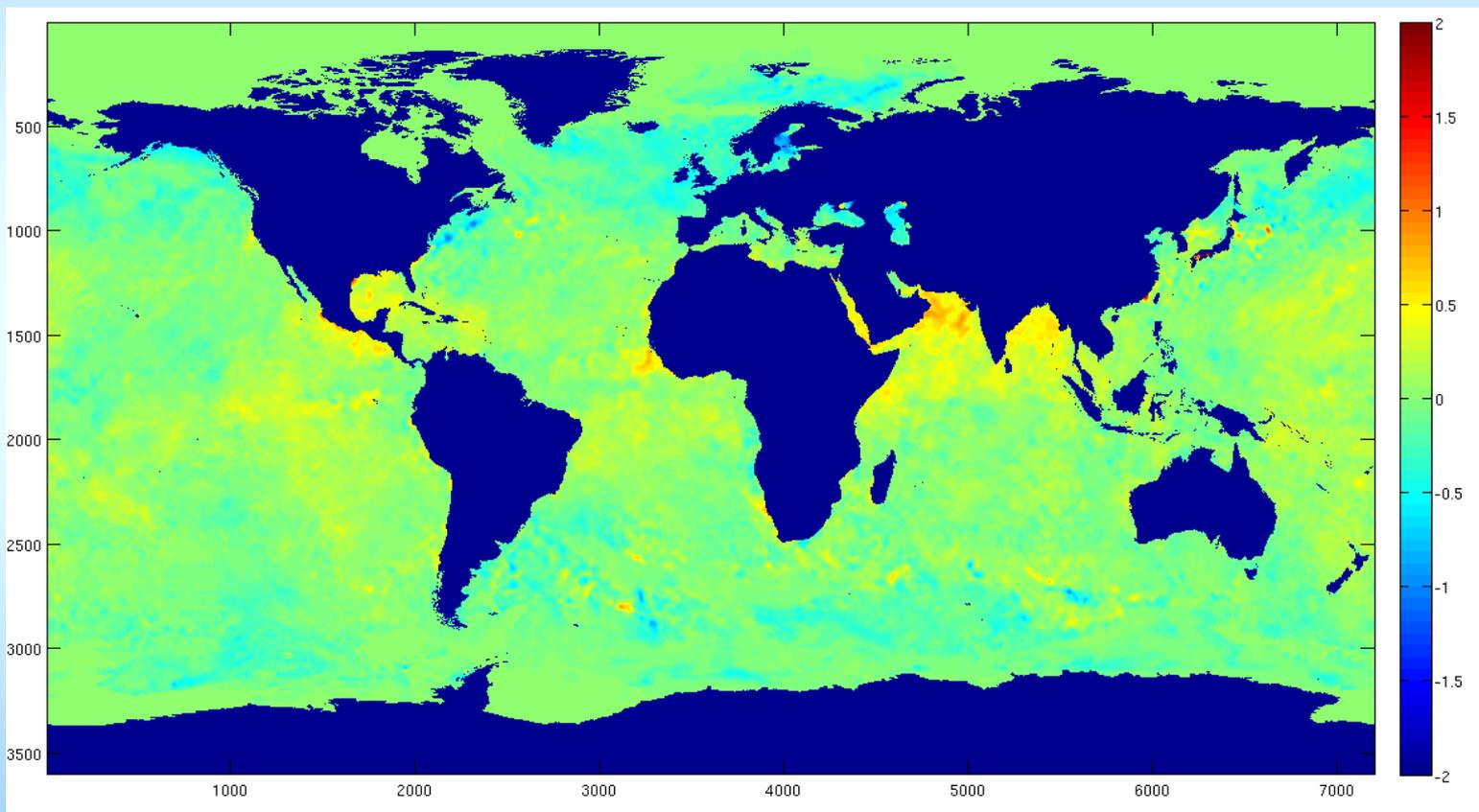
- Biases w.r.t. NCEP RTG_HR_SST indicate problem with the latter



ACSP0 VIIRS SST bias correction field

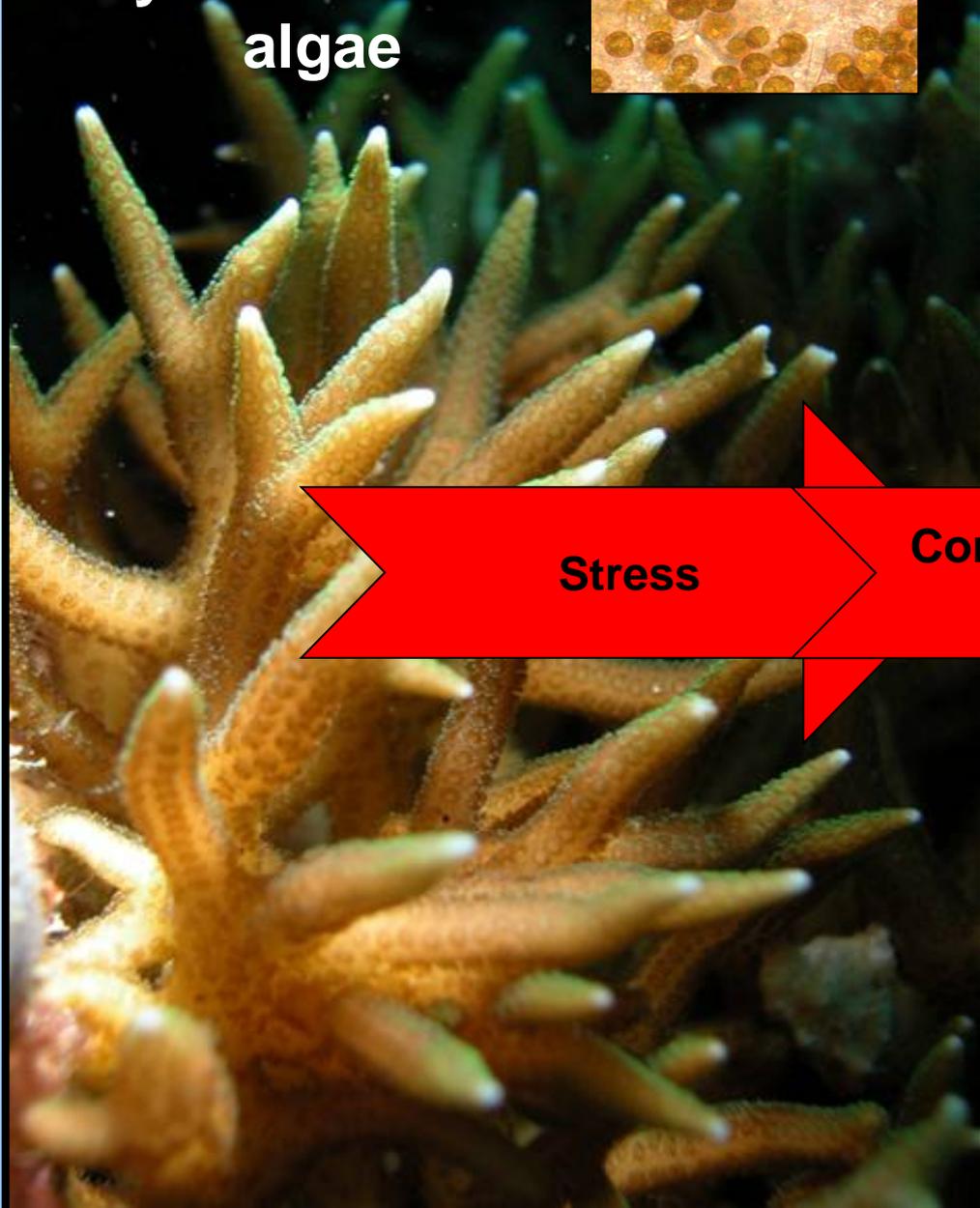
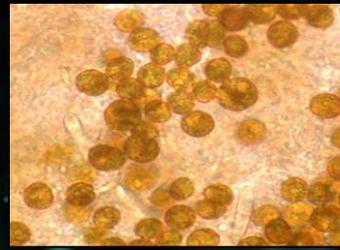
Key Results/Accomplishments

- Biases seems to be somewhat reduced w.r.t. RTG this year, but less *cf.* OSTIA SST analysis



ACSP0 VIIRS SST bias correction field w.r.t. OSTIA

**Corals live in
symbiosis with
algae**



Stress



**Corals release their
algae**

Thermal Stress Causes Mass Coral Bleaching



Thermal Stress Causes Mass Coral Bleaching

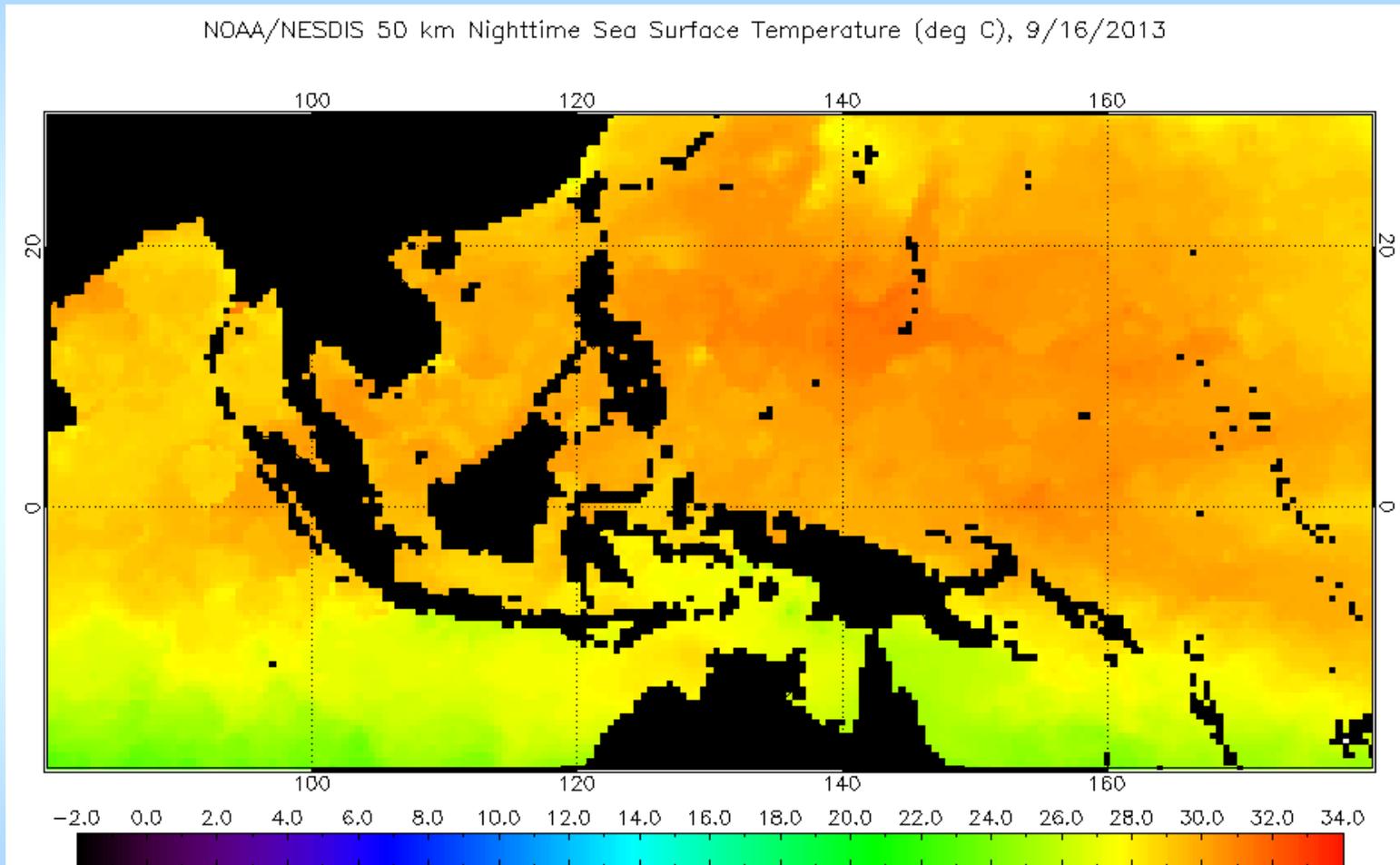


Thermal Stress Causes Mass Coral Bleaching and Mortality



Coral Reef Watch Products

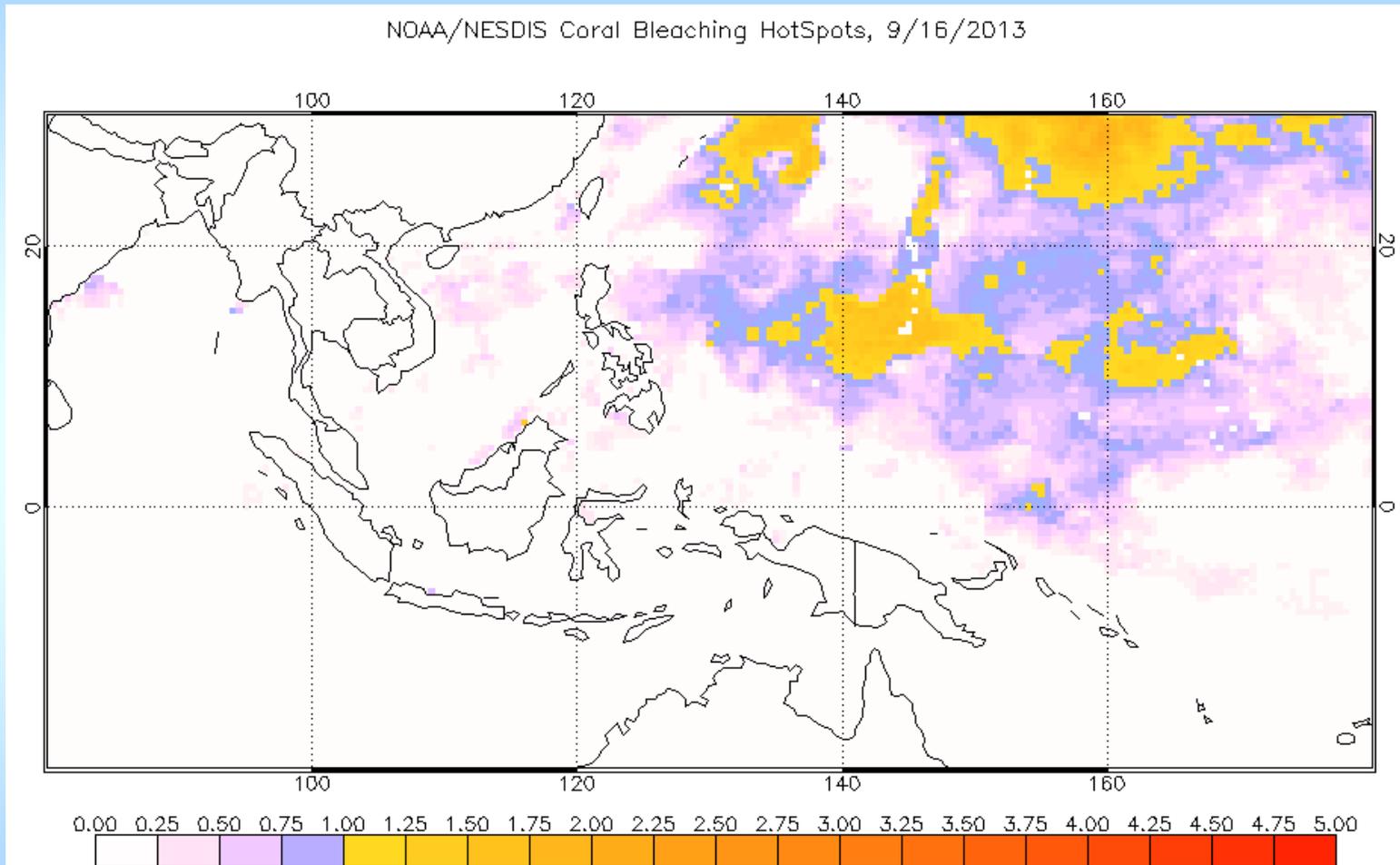
“Coral Triangle”



- **Current product uses 50-km AVHRR-only SST**

Coral Reef Watch Products

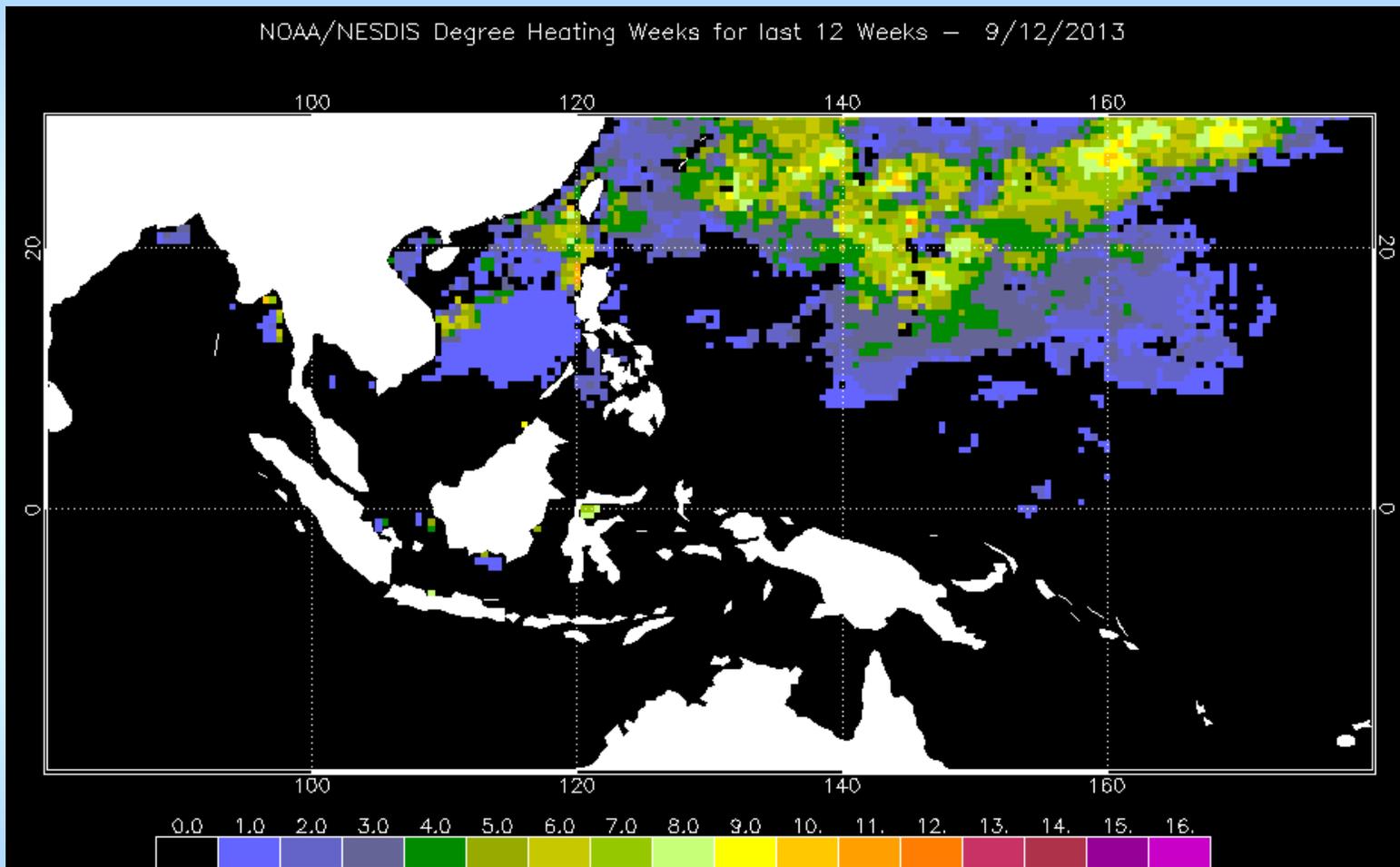
“Coral Triangle”



- Hotspots are derived with respect to climatological threshold

Coral Reef Watch Products

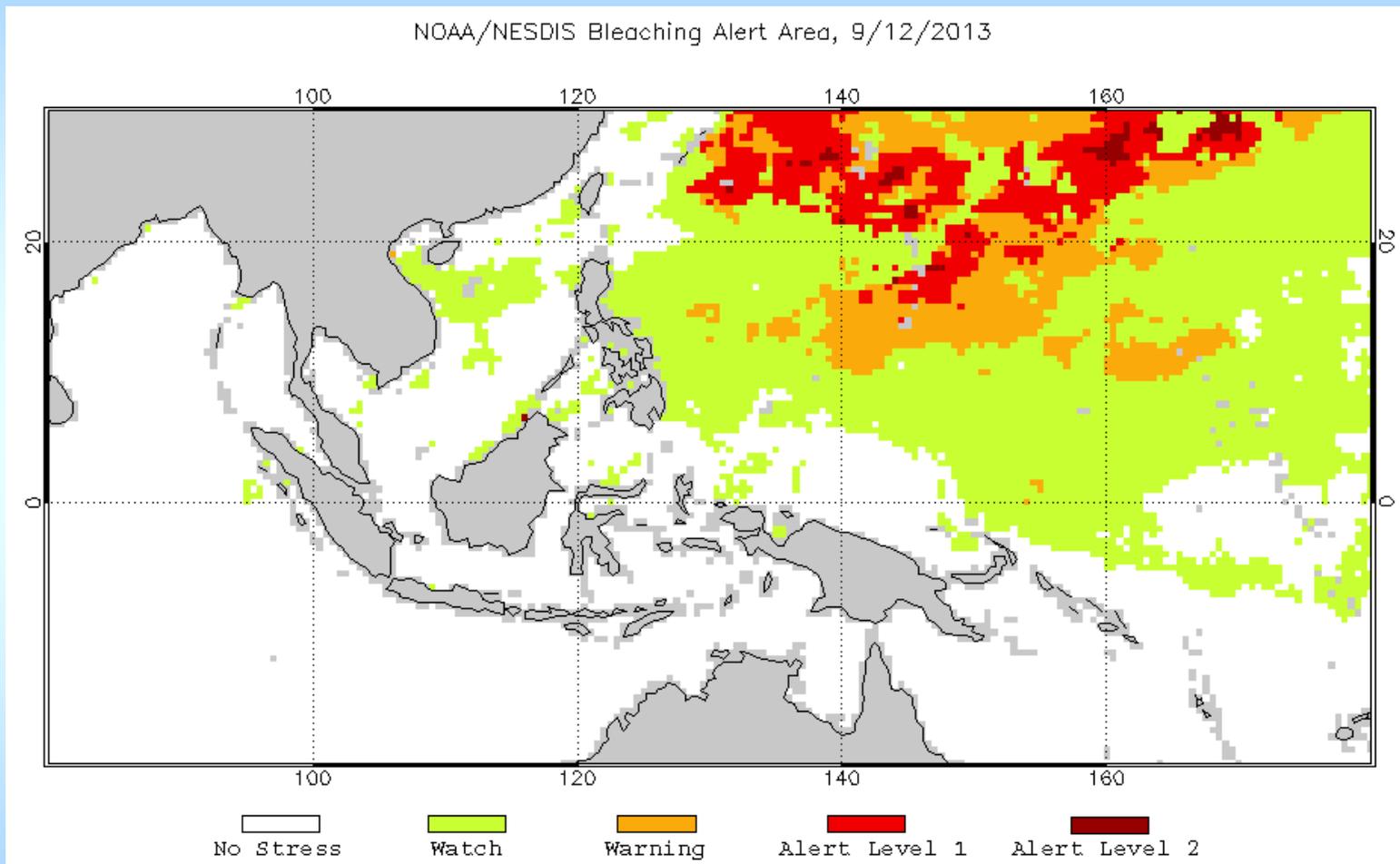
“Coral Triangle”



- **Accumulated thermal stress is predictor of bleaching risk**

Coral Reef Watch Products

“Coral Triangle”

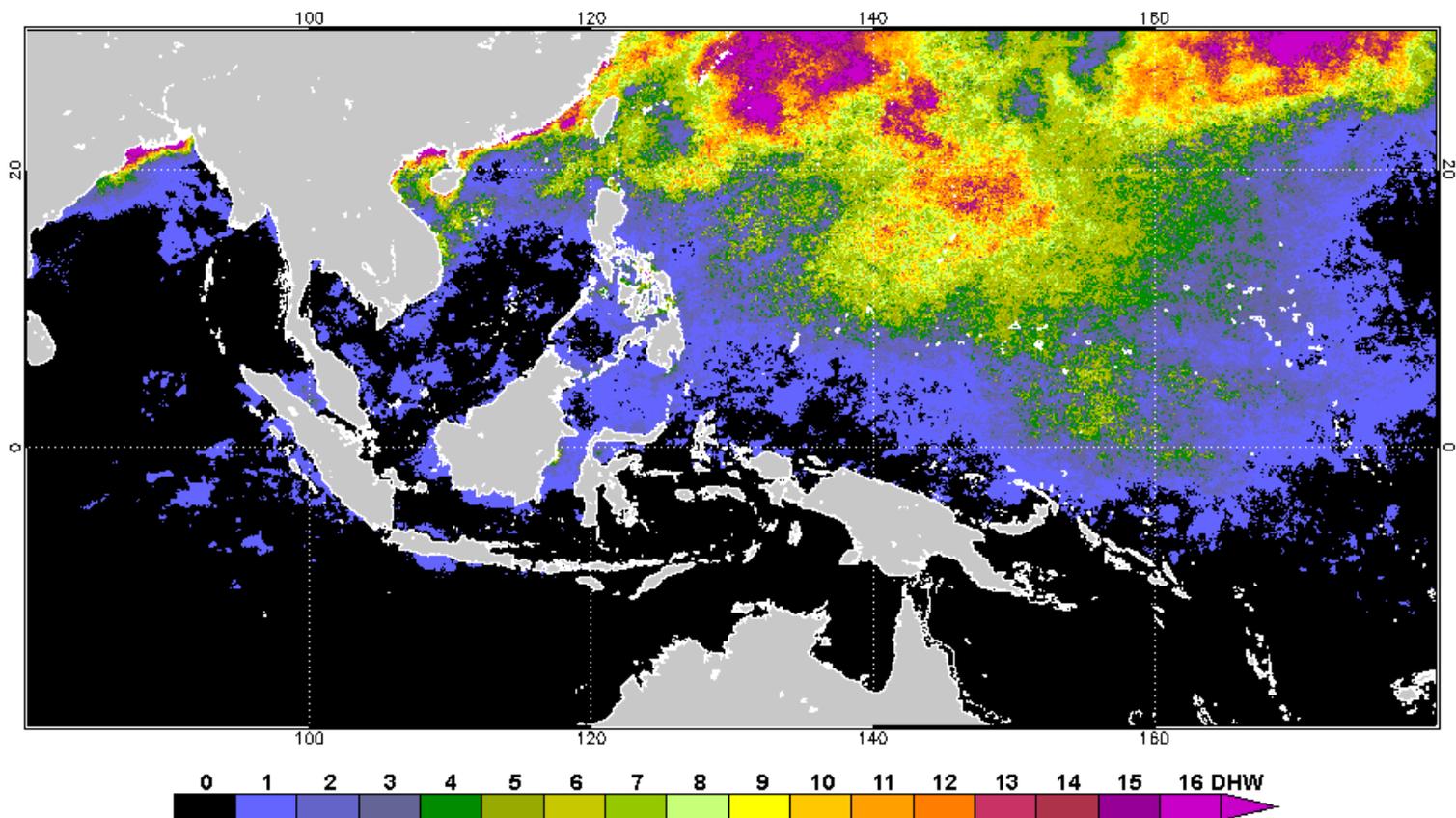


- Bleaching risk alerts are issued

CRW Products based on 5-km

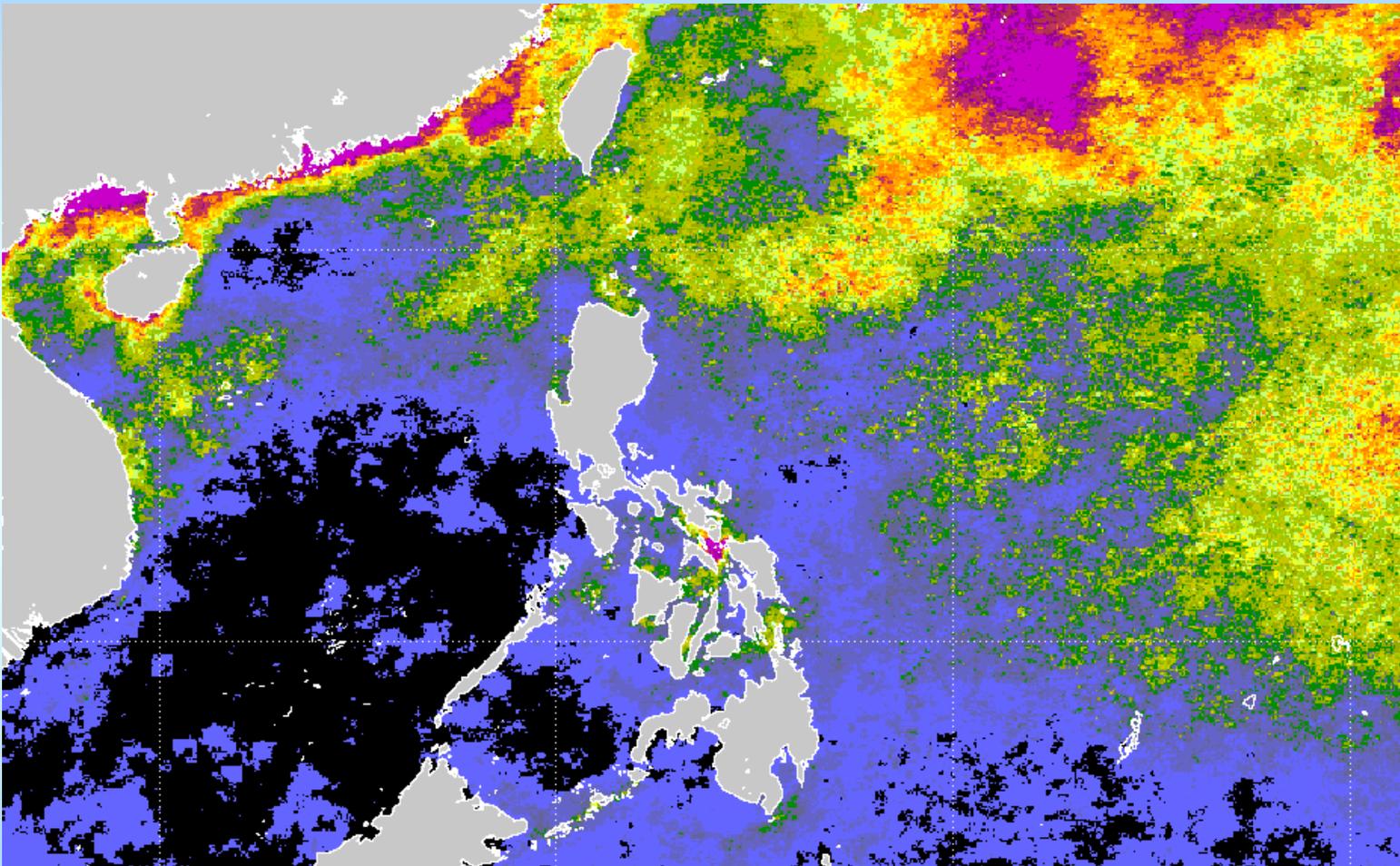
SST “Coral Triangle”

NOAA Coral Reef Watch 5-km Daily Geo-Polar Day-Night Blended Degree Heating Weeks 14 Sep 2013



CRW Products – 5-km detail

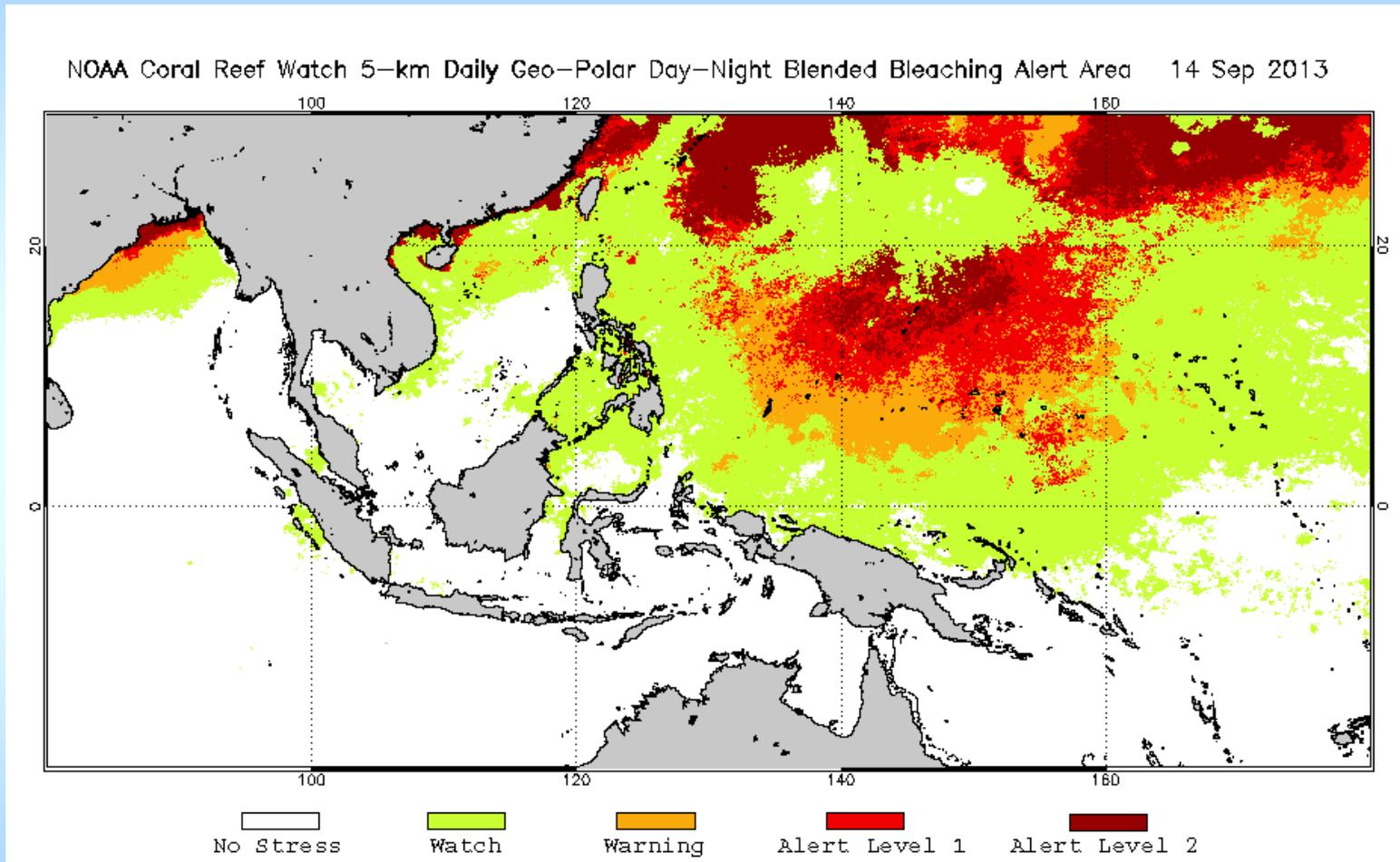
“Coral Triangle”



- New analysis enables much greater precision, e.g. small fringing reefs
- However, climatology is not derived from same dataset

CRW Products based on 5-km SST

“Coral Triangle”



- **Strong bleaching alert for reefs in Guam & Mariana Islands – bleaching occurred in September 2013**

Next Phase of Project?

- **Wish list for future VIIRS-related activities**
 - Reprocessing (needed for many anomaly-based products)
 - High-resolution ($1/80^\circ$) targeted regional analyses for CRW (and other users)
 - Investigate improved cloud detection for SST
 - Apply Physical Retrieval methodology to take full advantage of extra VIIRS channels and remove residual biases in SST product
 - Modified Total Least Squares

Reprocessing

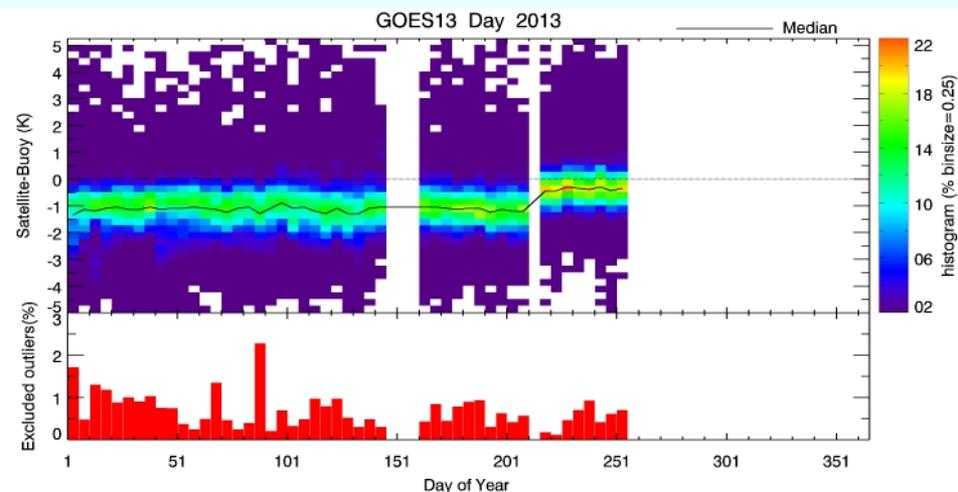
- Some operational products depend on anomalies w.r.t. a baseline
 - E.g. Coral Reef Watch
- Geo-Polar SST analysis September 2004 – present
 - Captures some major bleaching events
 - Sufficient to retune bleaching thresholds
 - Requires input data to be reprocessed as well
- Datasets
 - NOAA AVHRR (METOP, NOAA)
 - GOES-E/W (8, 10, 11, 12, 13, 15)
 - MTSAT-1R, MTSAT-2, GOES-9
 - Meteosat-8/9/10
 - Ancillary NWP
- Should be complete by August 2014

~200 TB

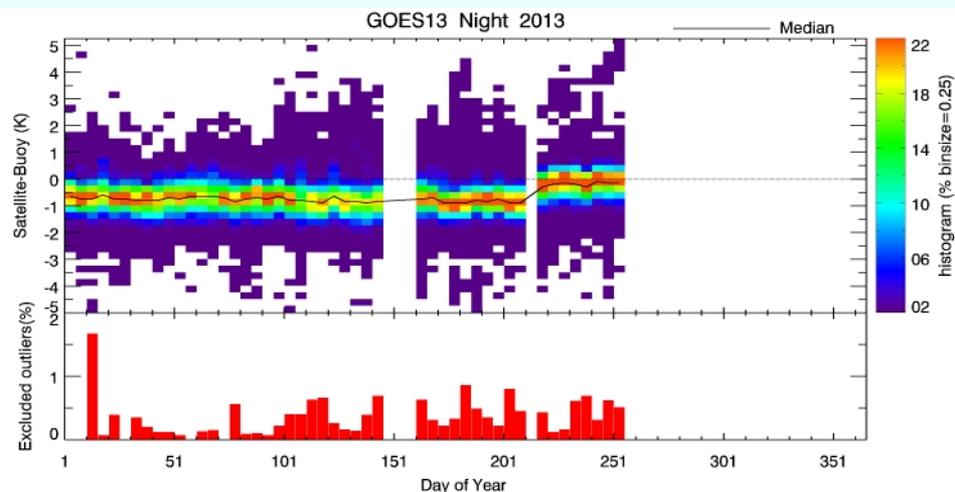
Recent update to Geo-SST

- Physical retrieval based on Modified Total Least Squares
- Improved bias and scatter *cf.* previous regression-based SST retrieval

GOES-13



Daytime

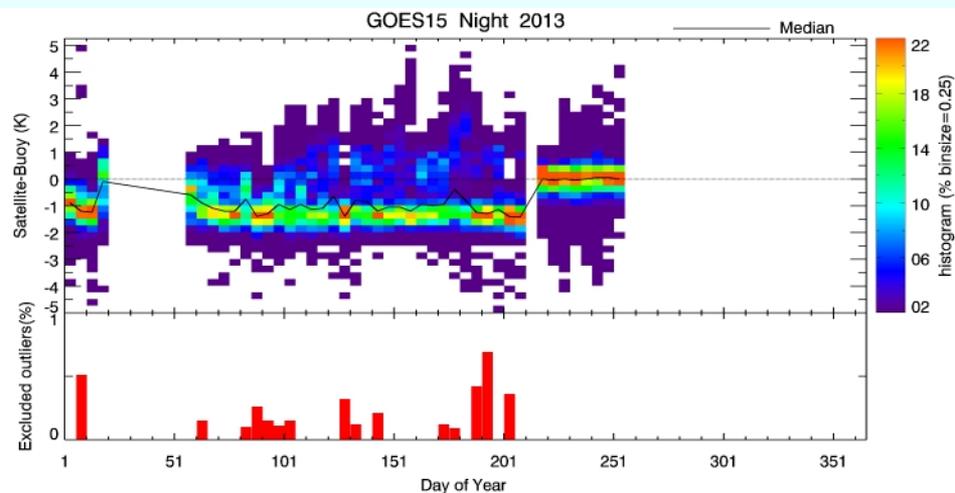
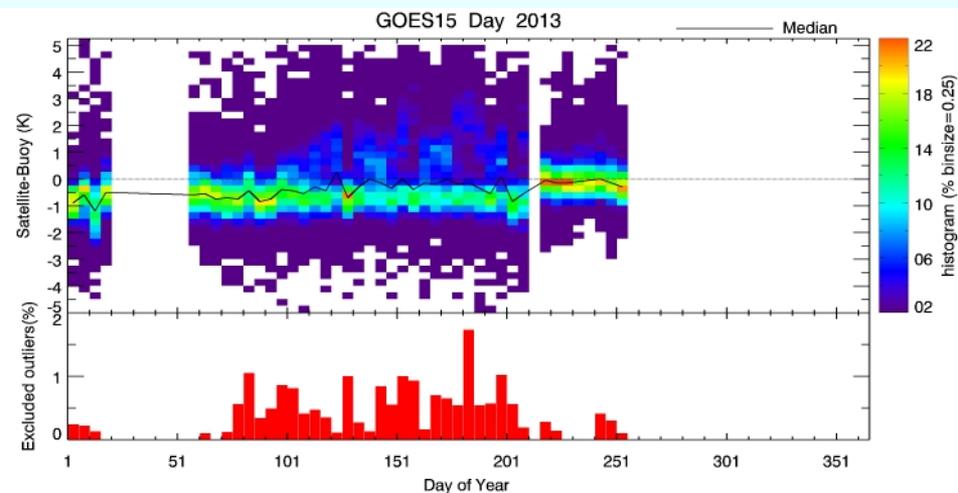


Nighttime

Recent update to Geo-SST

- Physical retrieval based on Modified Total Least Squares
- Improved bias and scatter *cf.* previous regression-based SST retrieval

GOES-15



Daytime

Nighttime

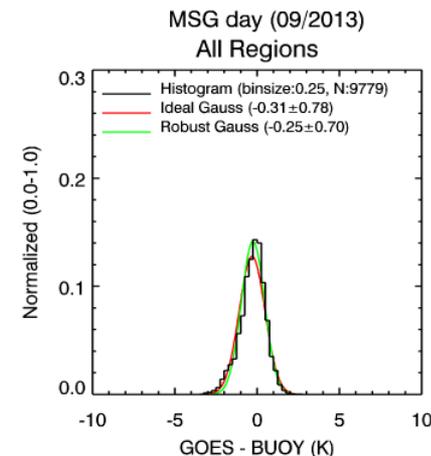
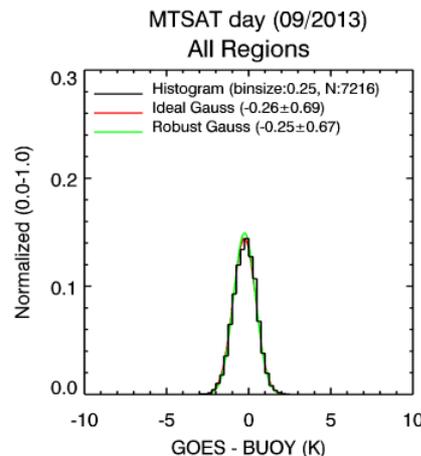
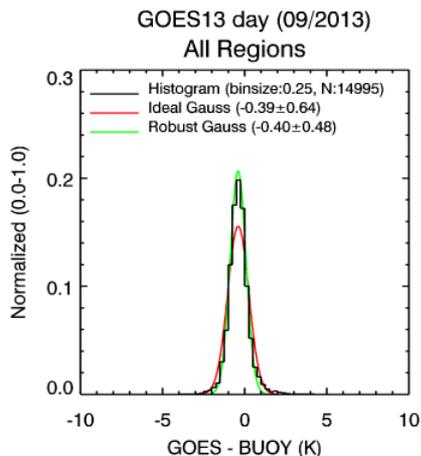
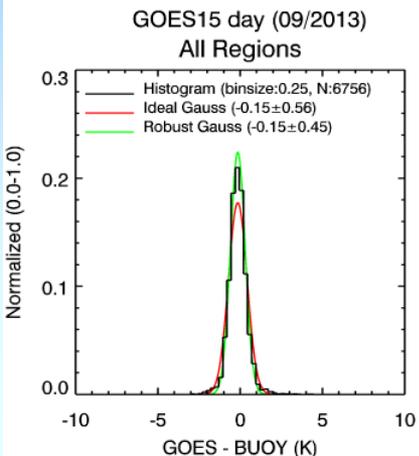
Summary of Product Accuracy: Geo-SST

SST MTSAT-2

GOES-15

GOES-13

Meteosat-10

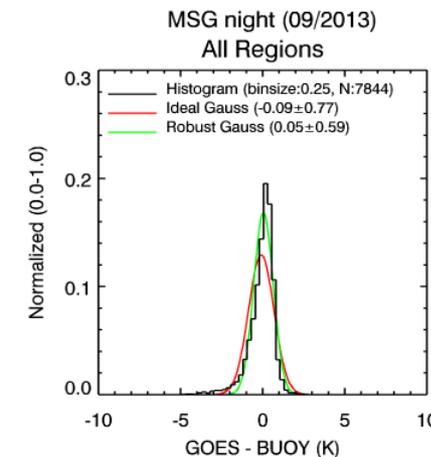
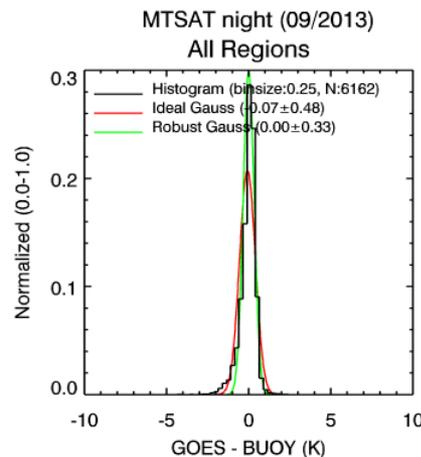
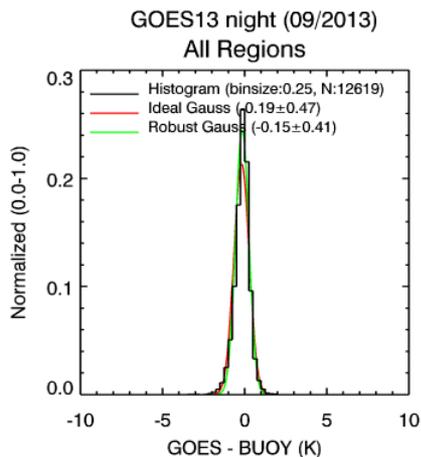
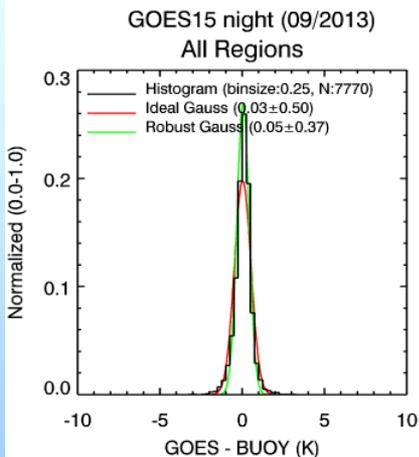


-0.15 ± 0.56 (0.45)

-0.39 ± 0.64 (0.48)

-0.26 ± 0.69 (0.67)

-0.31 ± 0.78 (0.70)



0.03 ± 0.50 (0.37)

-0.19 ± 0.47 (0.41)

-0.07 ± 0.48 (0.33)

-0.09 ± 0.77 (0.59)