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Himawari-8 Sea Surface Temperature from the Australian Bureau of Meteorology

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Introduction

- Why we need high resolution SST products ?
  - Small scale ocean current features
  - Coastal Applications
  - NWP / Ocean models moving to higher and higher resolutions – better forecasts, better climate modelling
- Why Himawari-8 ?
  - Geostationary
  - "VIIRS / GOES / SEVIRI like" sensor
  - Timely SST
  - Diurnal effects visible (high temporal frequency)

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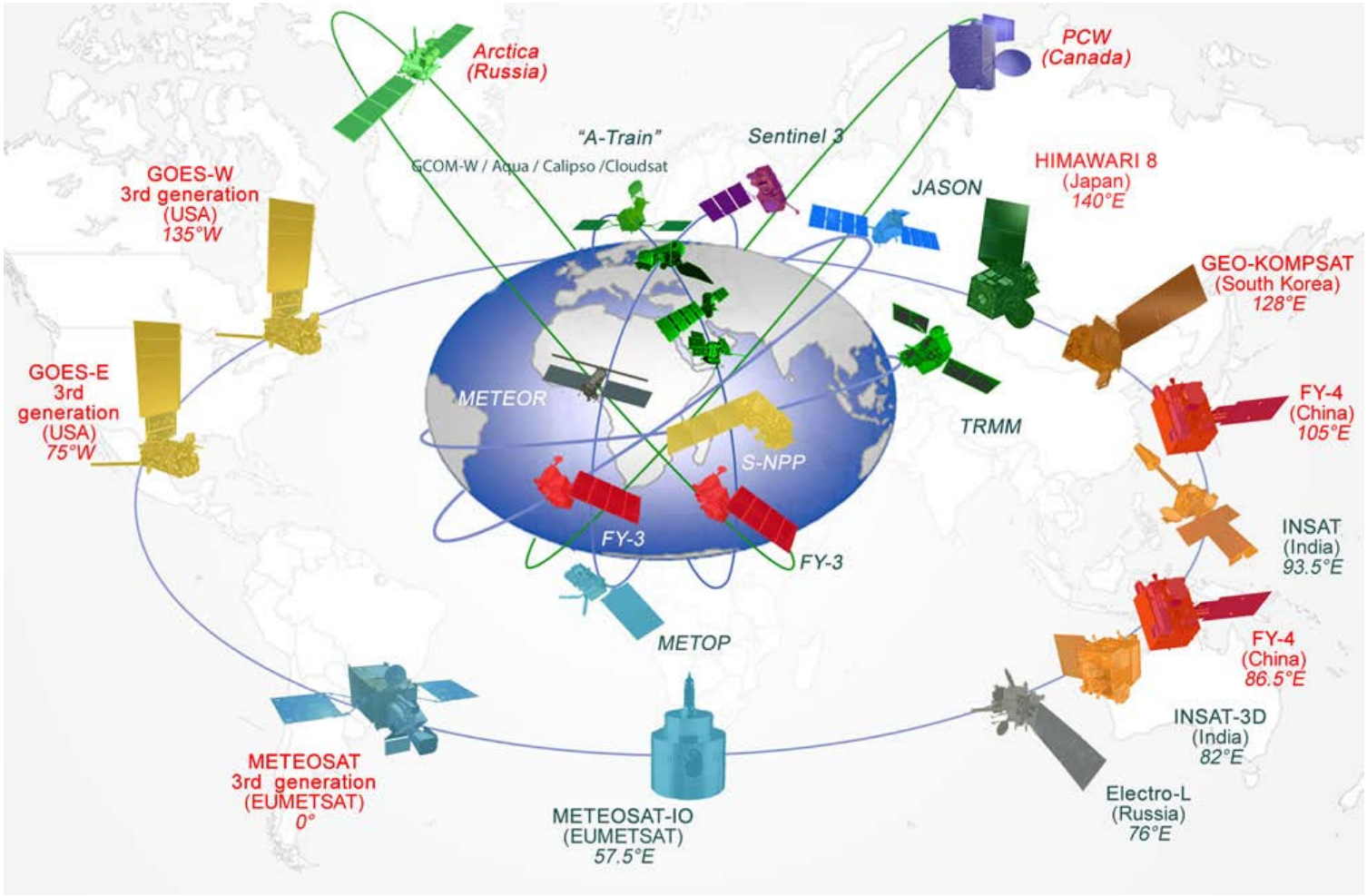
World Meteorological Organization
Weather • Climate • Water



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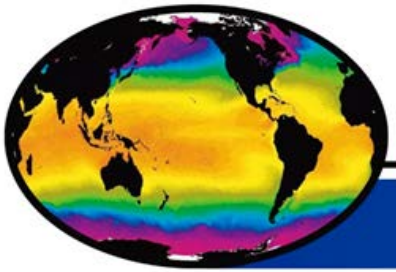

GHRSST
Group for High Resolution Sea Surface Temperature

Aims to provide the best quality SST data for applications in short, medium and decadal/climate time scales in the most cost effective and efficient manner through international collaboration and scientific innovation

Sets standards for satellite SST processing and formats (CF-compliant netCDF)

Shares satellite SST level 2 ("L2P") and level 3 ("L3") data products

- For each pixel: Time, lat, lon, SST(depth), error estimates (bias, standard deviation), quality level, wind speed, sea-ice fraction, land/ice/water flag, difference from SST climatology, etc
- Only satellite SST products that provide error estimates per pixel based on in situ matchups

Shares global and regional SST analysis products ("L4")

See web page at: http://www.ghrsst.org

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What is provided

- "Full disk" L2P ***skin*** SST
  - One per satellite reception (up to every 10 min)
  - Nominally 2km resolution
- GHRSST format
  - Lossless, compressed netCDF4
  - Projection information follows CF conventions
- Pixel by pixel
  - Skin Sea Surface Temperature
  - Quality
  - Bias and standard deviation estimates

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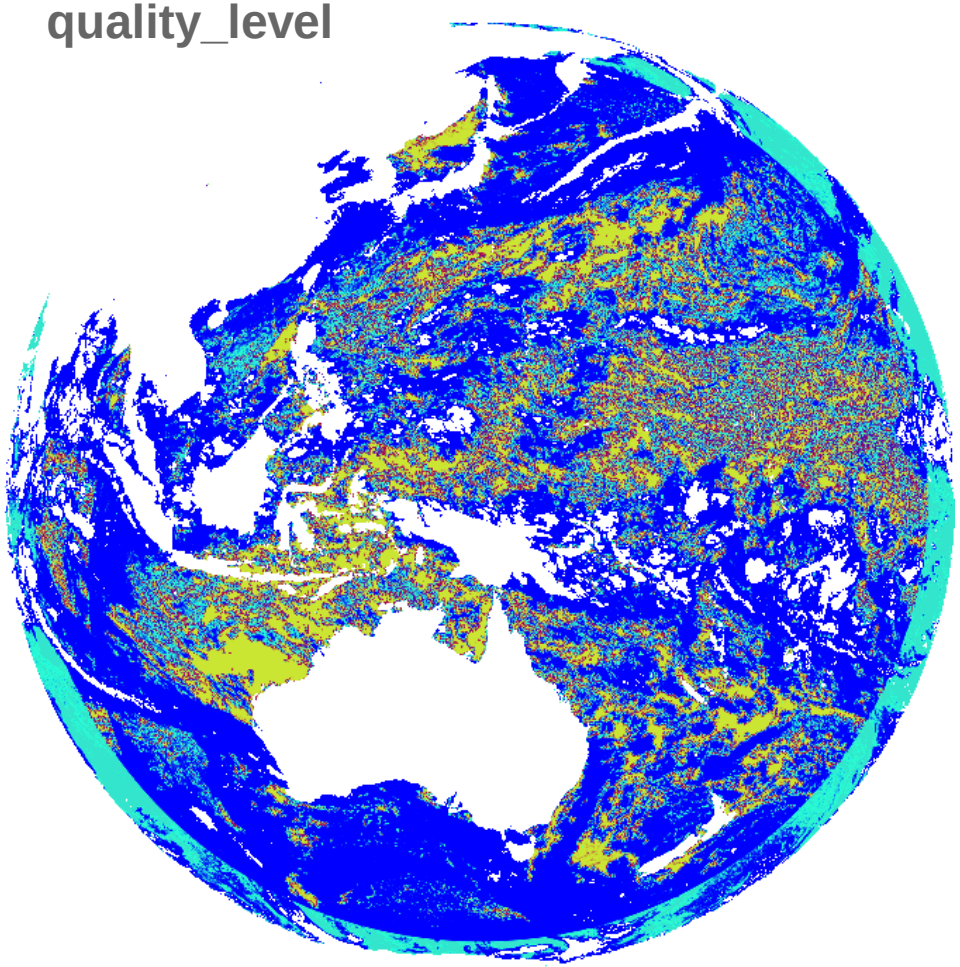
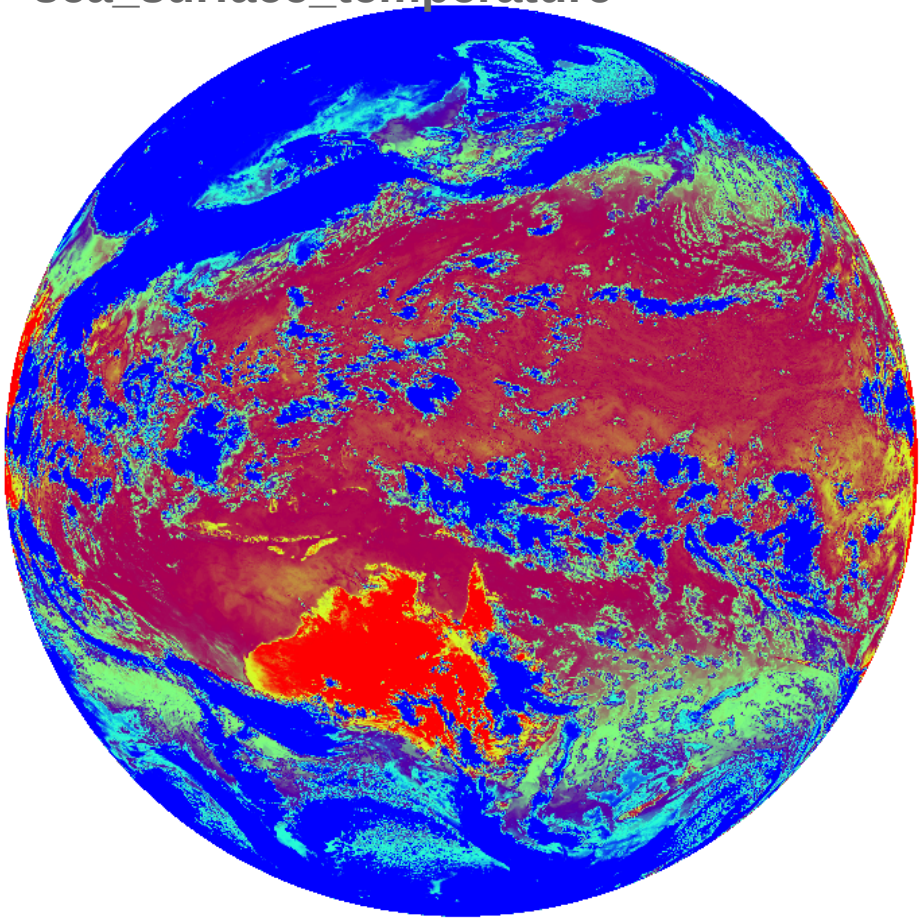
What is provided

quality_level



0 (blue) …. 4,5 (yellow/red)

sea_surface_temperature



270 K (blue) …315 K (red)

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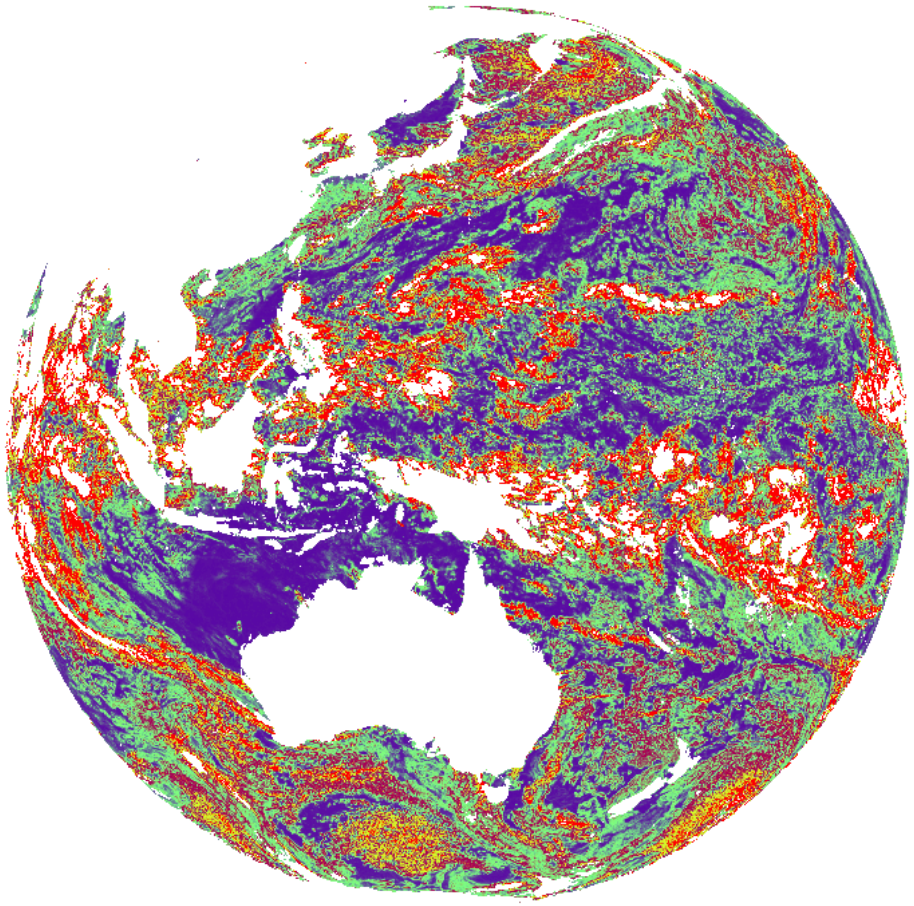
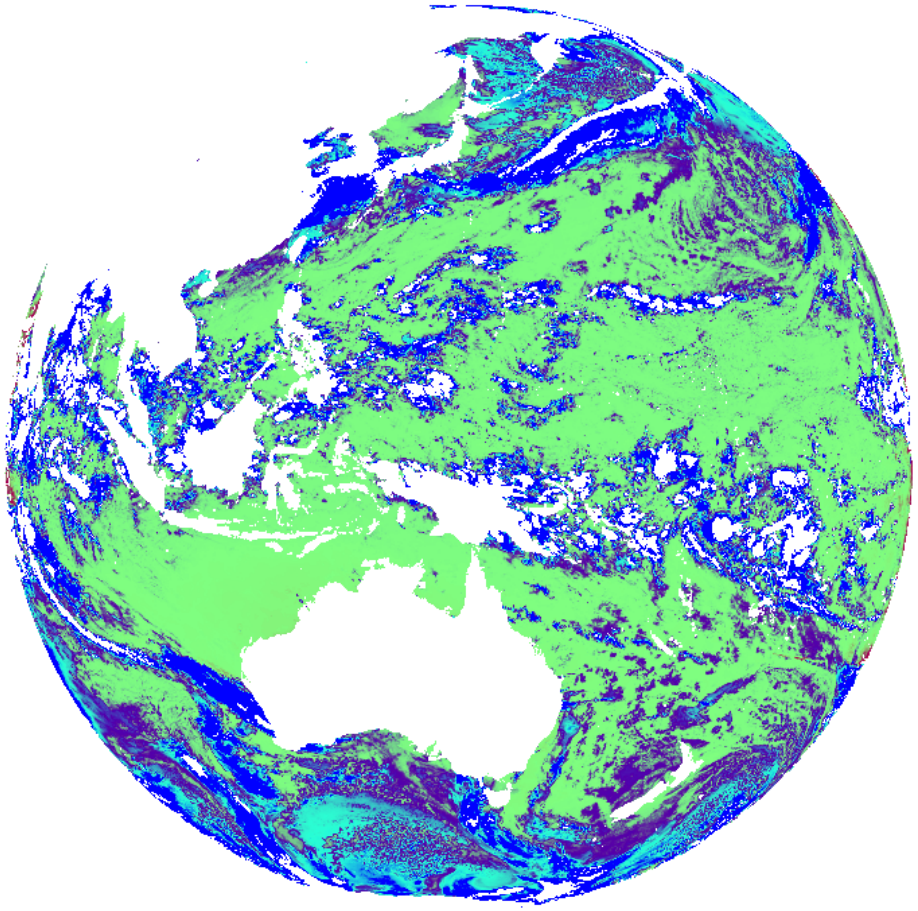
What is provided

sses_standard_deviation



0 K (blue) … 0.5 K (purple) … 1.5 K (red)

sses_bias



-1 K (blue) …1 K (red)

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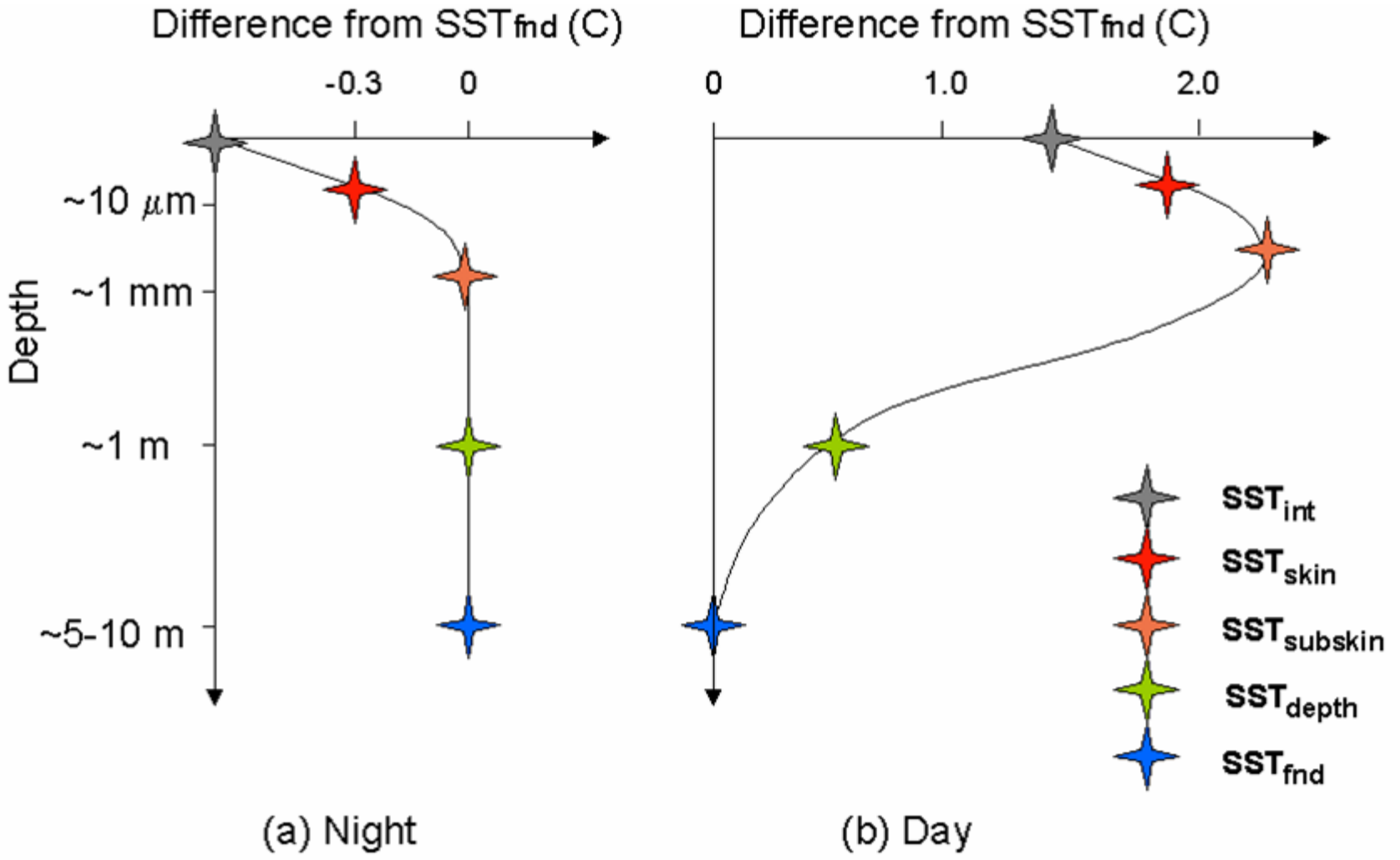
Using the data

- Check the quality_level
  - Not defined – very cold cloud or land
  - 0 – cloud
  - 1,2 – likely cloudy or not accurately determined, or on the edge of view
  - 3,4,5 – acceptable (higher quality has better accuracy)
  - quality_level is consistent over life
- Use (sea_surface_temperature - sses_bias) for best results
  - sses_bias is typically very small for high quality pixels

"skin" vs "foundation" SST



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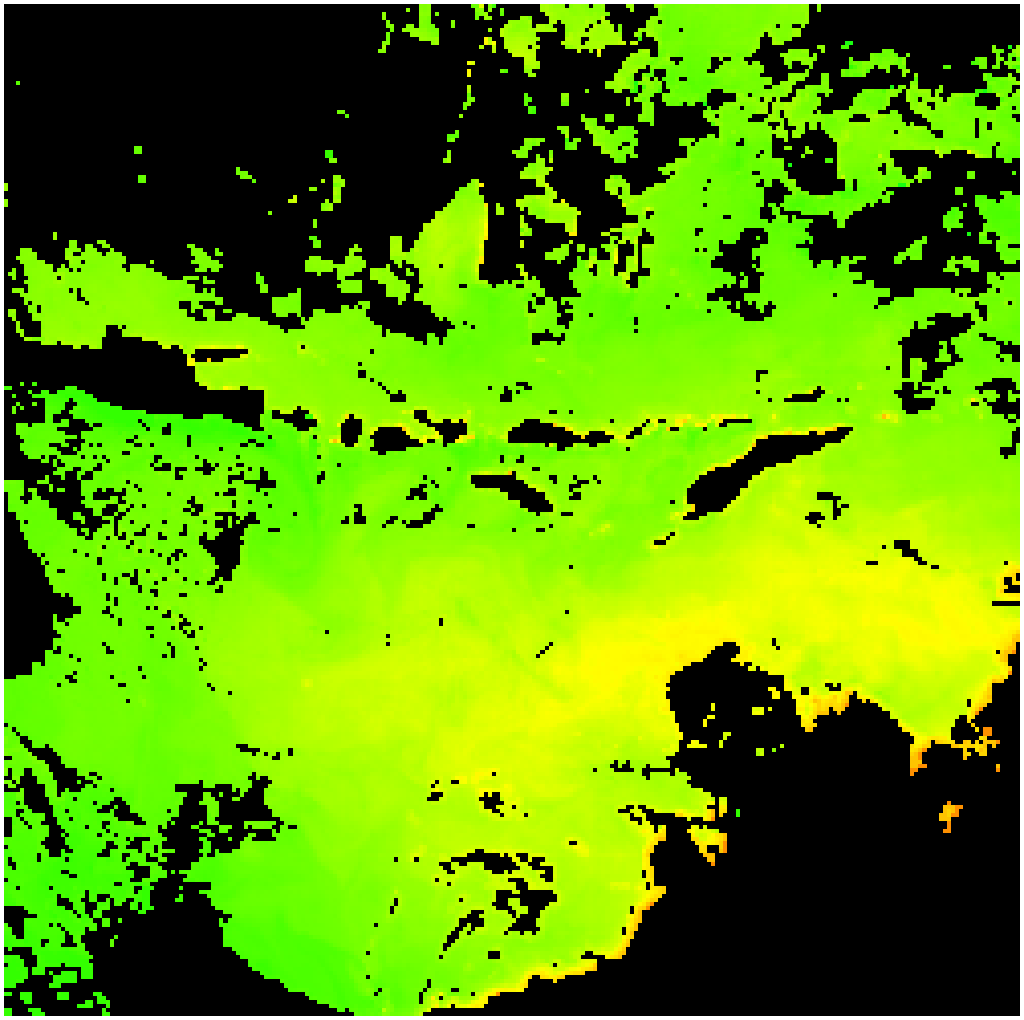
Spatial / Temporal Resolution



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Our approach

- Use Suomi-NPP / VIIRS SST (ACSPO)
  as a "standard" for Himawari-8 brightness temperatures
- Regress VIIRS SST against Himawari-8 infrared BTs
  - At a fixed "epoch" in the past
- Determine Himawari-8 SST from the regressed rule
- Validate against drifting buoys
  - At all "future" times
- {Adjust bias and standard deviation accordingly}
- {Repeat infrequently}

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Algorithm(s)

- Regressed - Single (LRG2.12)
  - One equation for Day and Night
  - No day/night algebraic discontinuity
  - Long wave length infra-red

- Regressed - Dual (LRG2.16)
  - One algorithm for Day
  - One algorithm for Night
  - Algorithms are independent
  - Shorter wave length infra-red can be used at night

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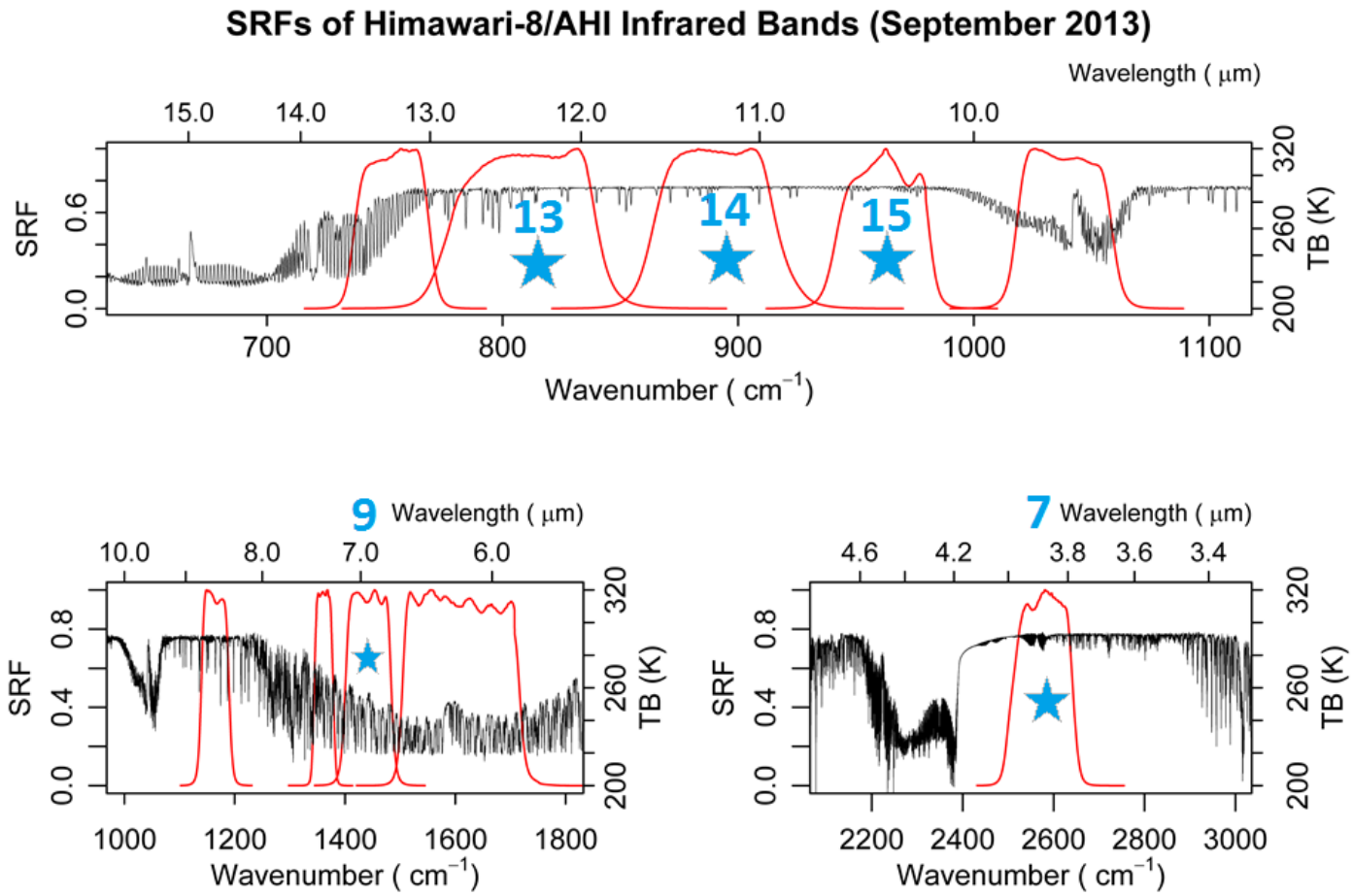
AHI detector channels



http://www.data.jma.go.jp/mscweb/en/himawari89/space_segment/fig/AHI_SRF_IR_201309.png

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Single regression LRG2.12

$$
\begin{aligned}
SST = \; & BT_9 \left(a_9 + g_9 \left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{13} \left(a_{13} + g_{13} \left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{14} \left(a_{14} + g_{14} \left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{15} \left(a_{15} + g_{15} \left(\sec(\theta_z) - 1\right)\right) + \\
& T_0
\end{aligned}
$$

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Dual regression LRG2.16

$$
\begin{aligned}
SST_{\text{day}} = \; & BT_9\left(a_9 + g_9\left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{13}\left(a_{13} + g_{13}\left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{14}\left(a_{14} + g_{14}\left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{15}\left(a_{15} + g_{15}\left(\sec(\theta_z) - 1\right)\right) + \\
& T_0
\end{aligned}
$$

$$
\begin{aligned}
SST_{\text{night}} = \; & BT_7\left(a_7 + g_7\left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{13}\left(a_{13} + g_{13}\left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{14}\left(a_{14} + g_{14}\left(\sec(\theta_z) - 1\right)\right) + \\
& BT_{15}\left(a_{15} + g_{15}\left(\sec(\theta_z) - 1\right)\right) + \\
& T_0
\end{aligned}
$$

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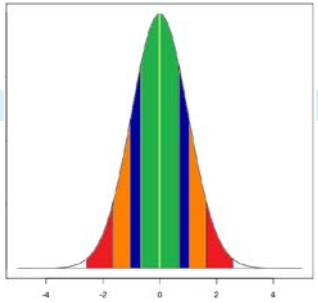
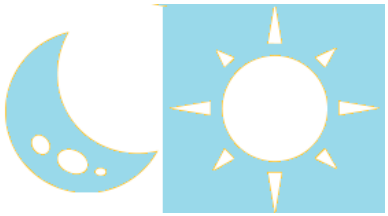
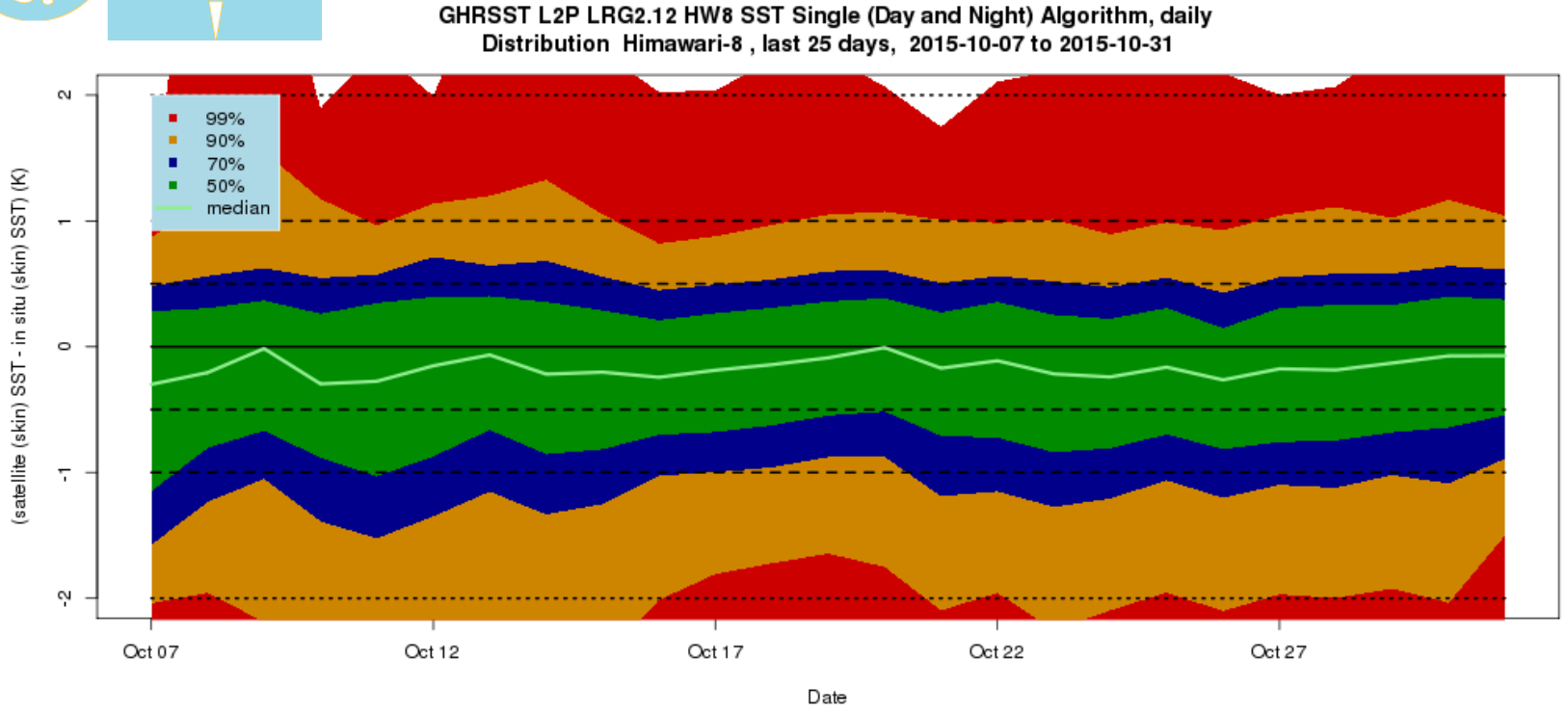
Validation - Single regression







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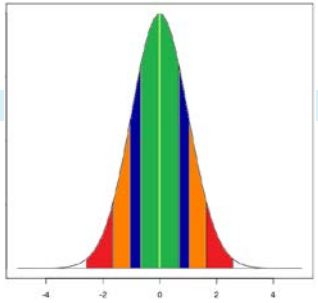
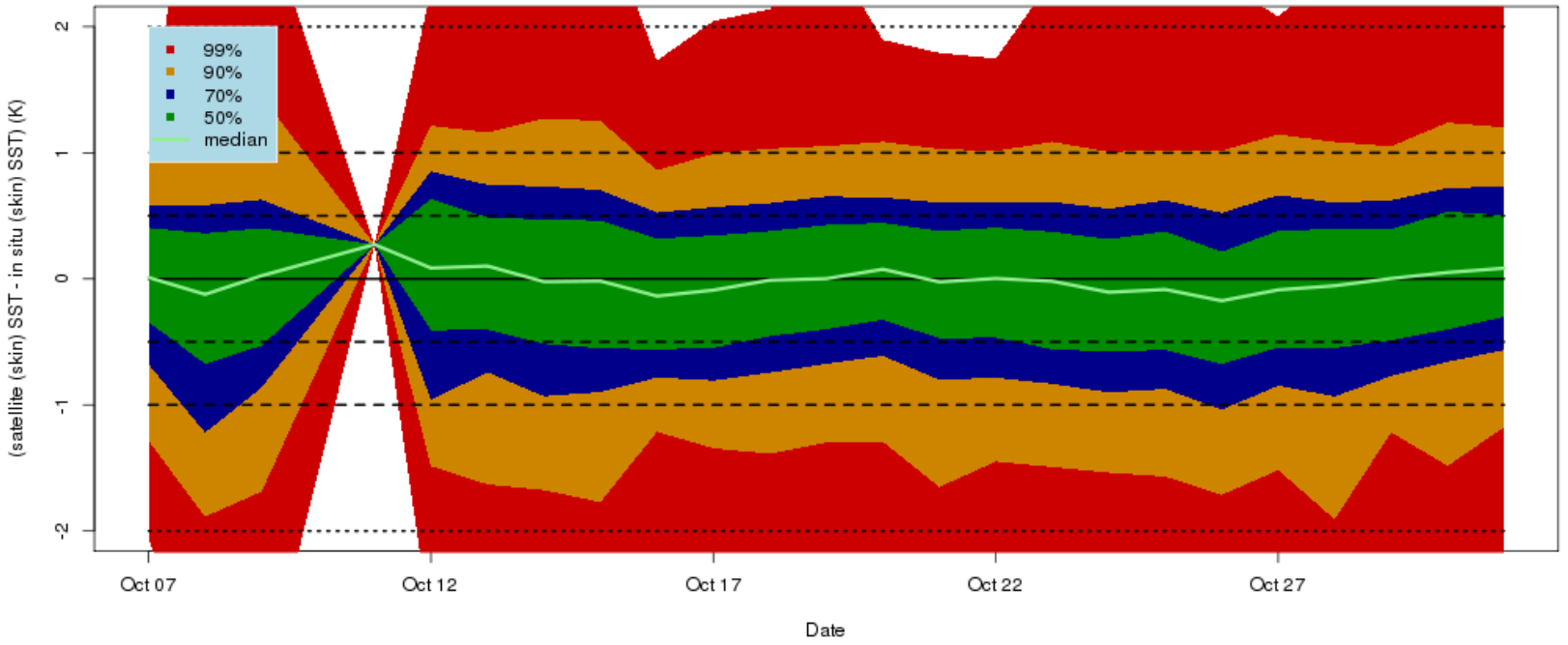
Validation - Single regression



GHRSST L2P LRG2.12 HW8 SST Single (Day and Night) Algorithm, daily (day time)
Distribution Himawari-8 , last 25 days, 2015-10-07 to 2015-10-31



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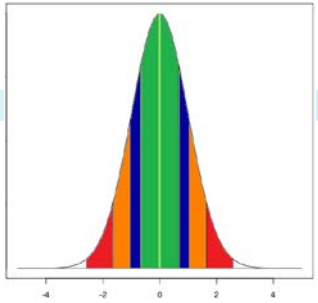
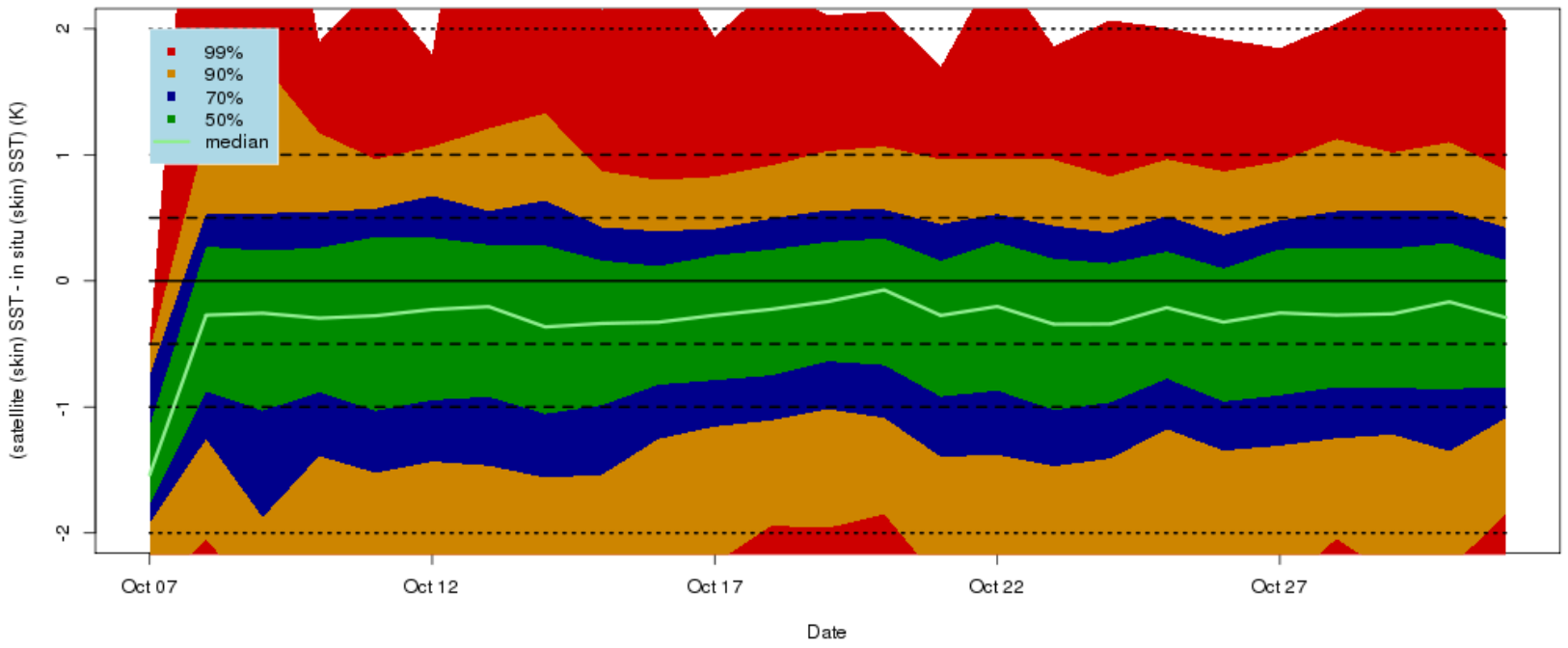
Validation - Single regression





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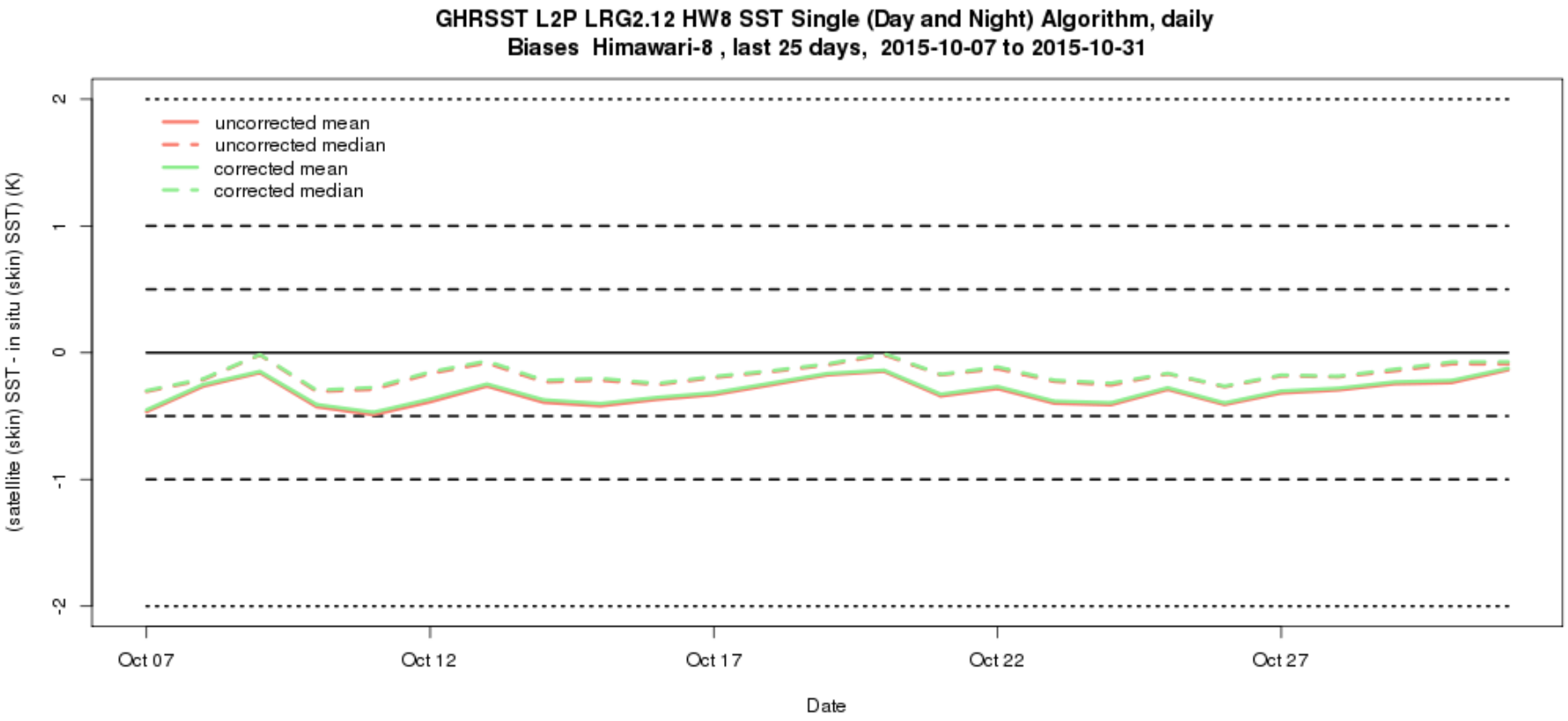

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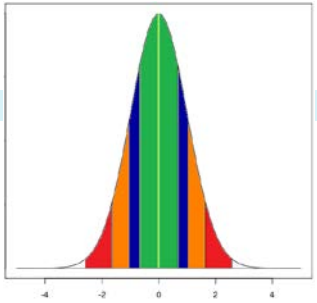
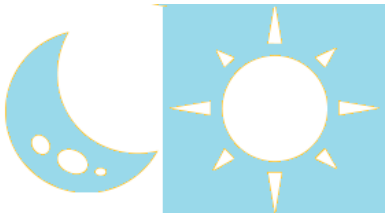
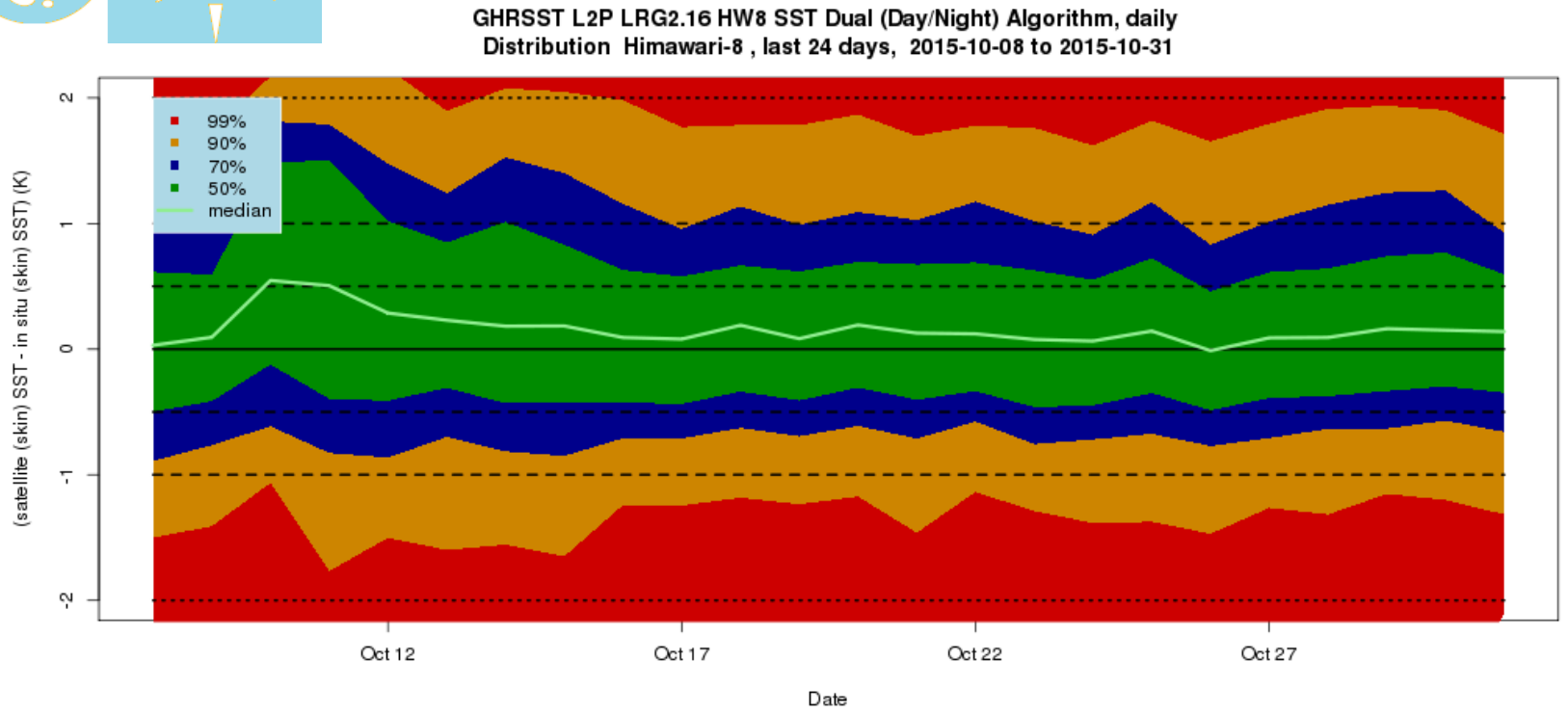
Validation - Dual regression







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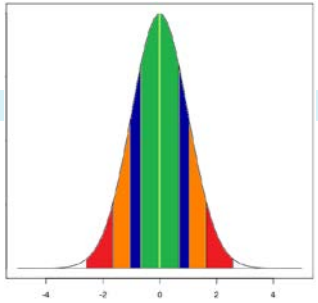

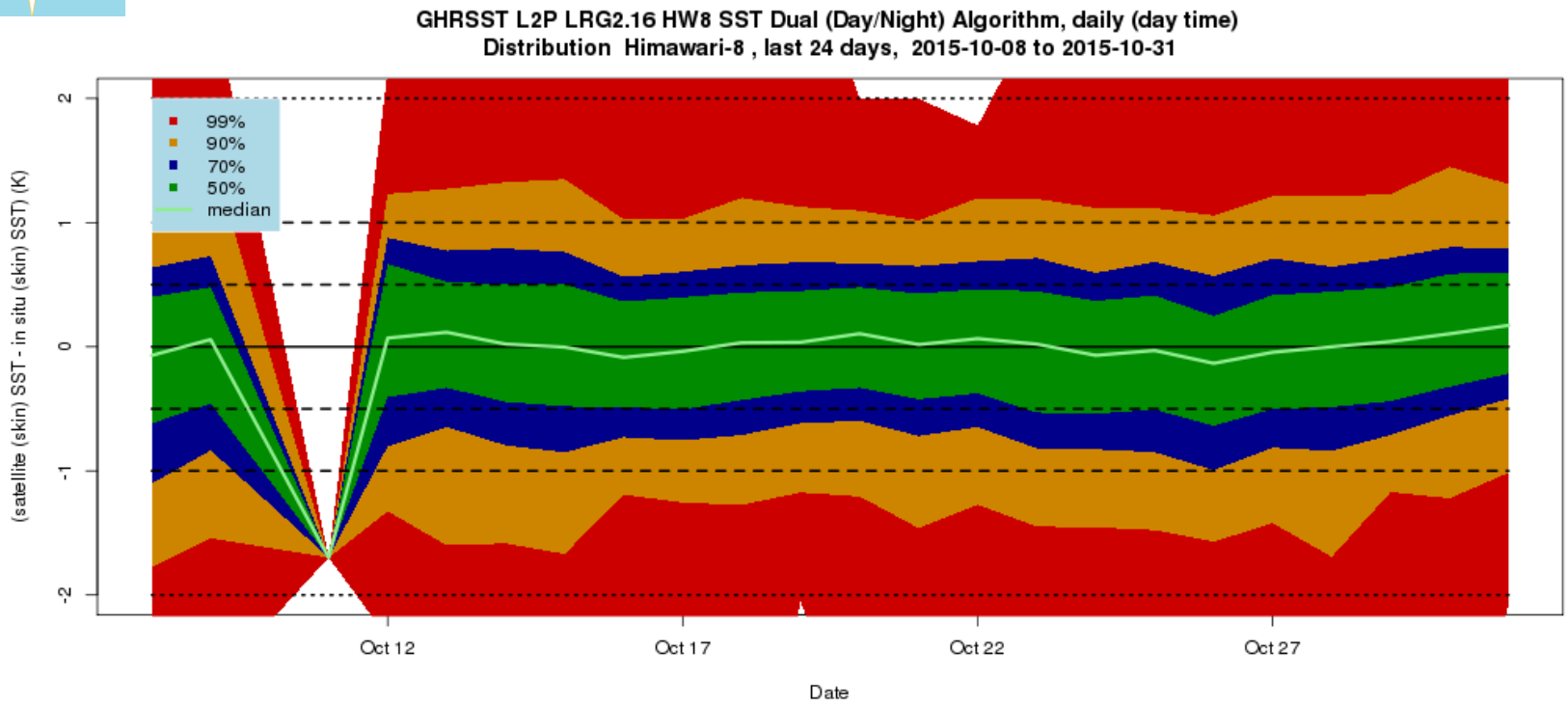

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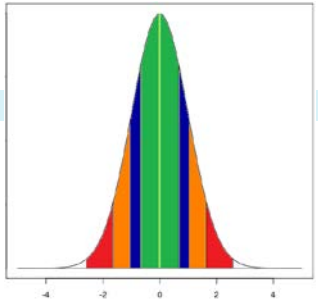

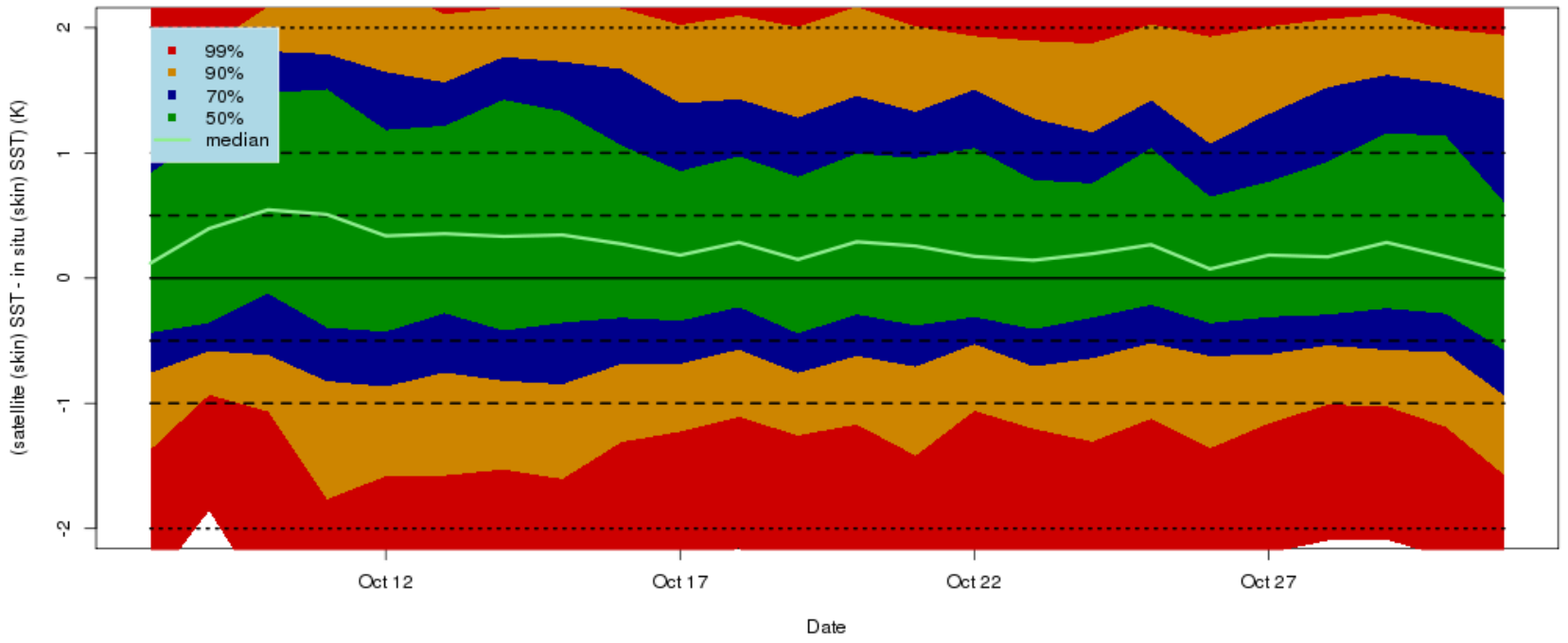

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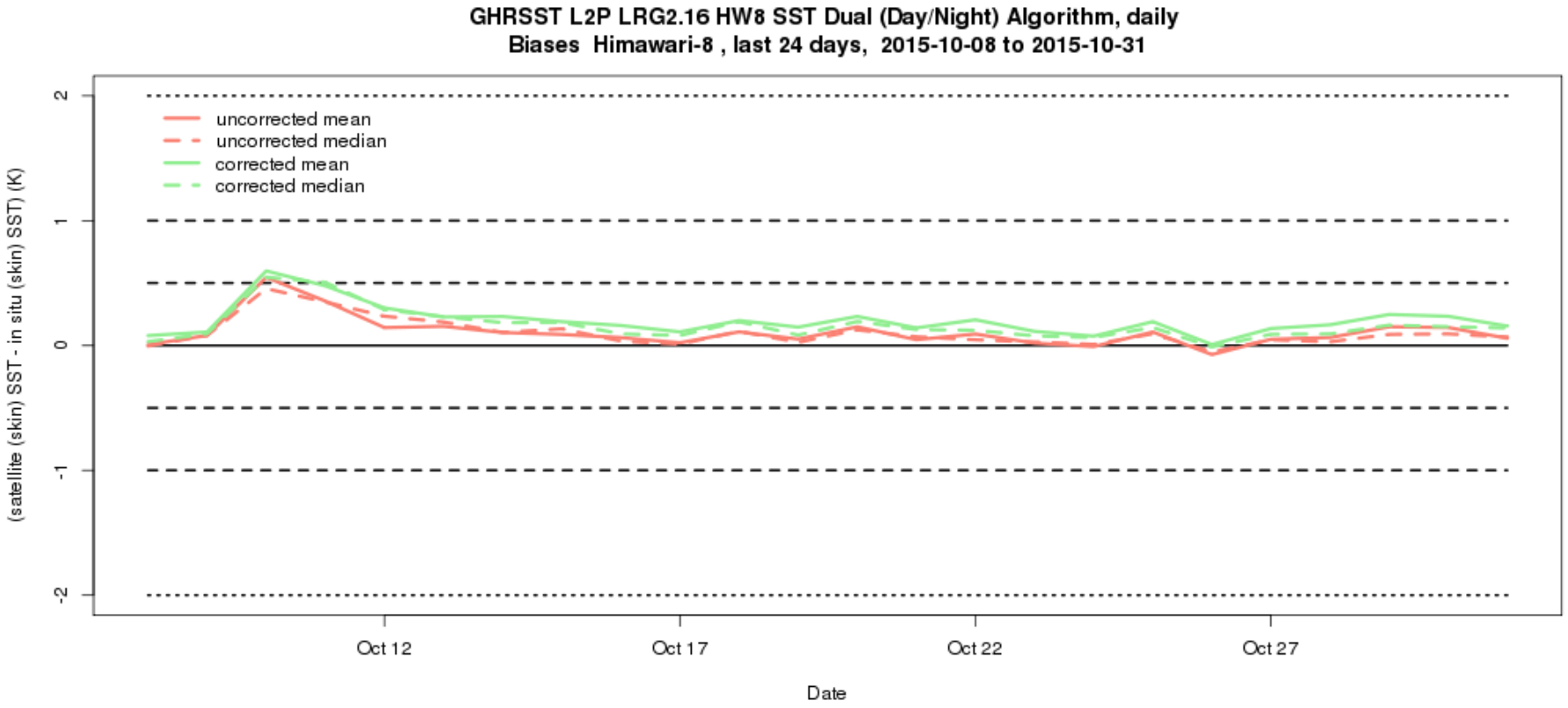

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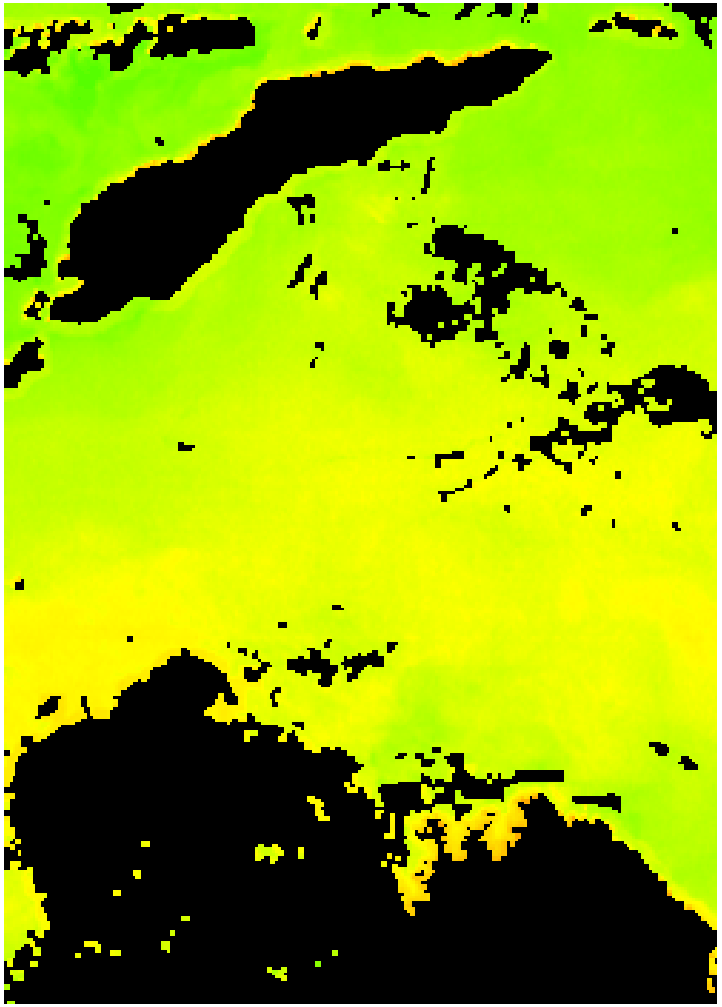
Areas for improvement



- Coastal warming is resolved.
- Diurnal warming is seen.

However:

- Cloud identification is problematic.
- The baseline SEVIRI cloud mask (as implemented in GEOCAT) will need further tuning for AHI / Eastern hemisphere.

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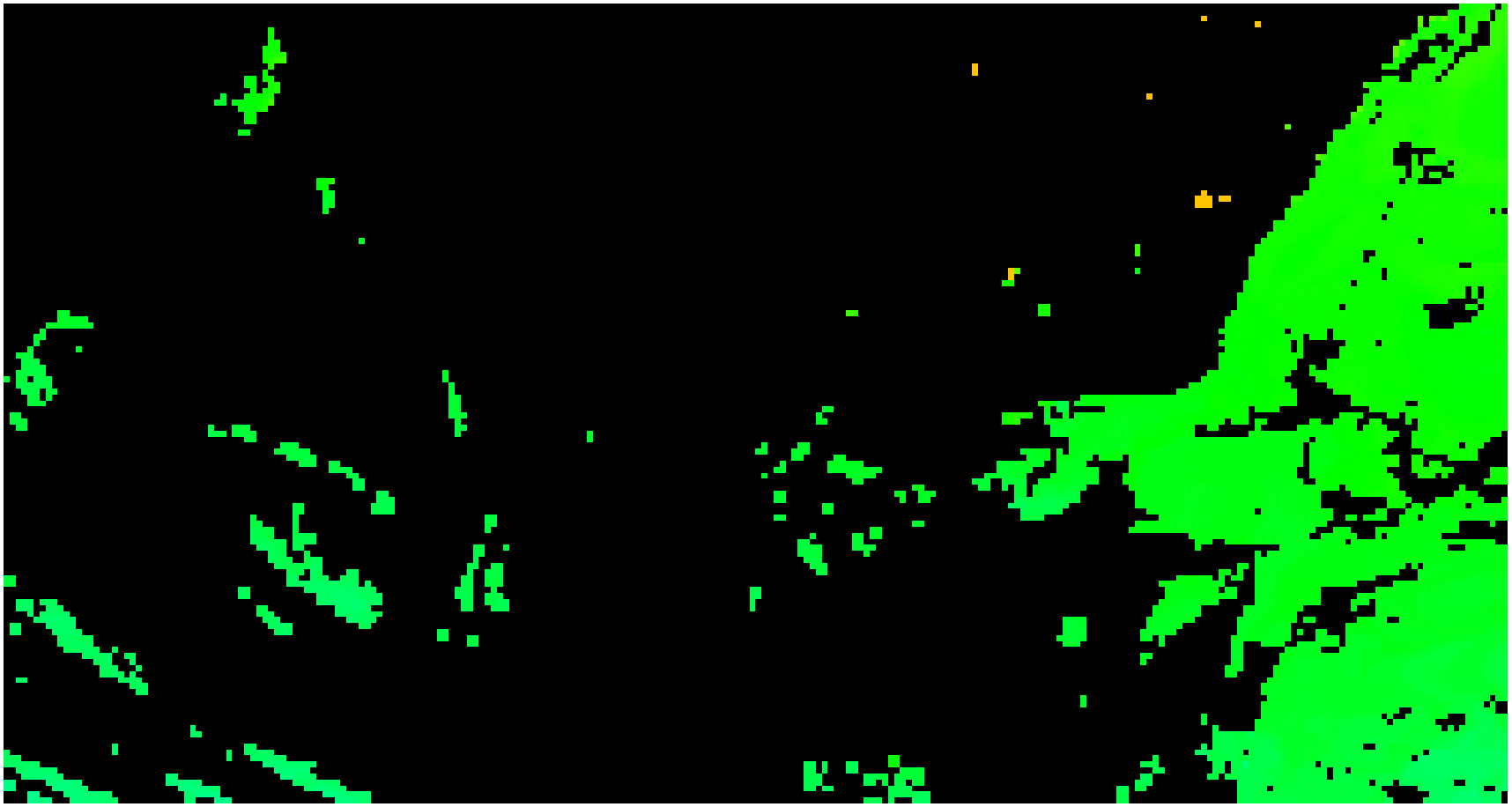
Areas for improvement



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Access

Coming to:

https://podaac.jpl.nasa.gov/GHRSST

http://www.ghrsst.org {soon !?}

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