NOAA NESDIS STAR SOCD

Enterprise OceanWatch Monitor (OM)

Quick Start Guide

Document Change Record

Issue / Revision	*Date*	*Changed Pages / Paragraphs*
v1.0	04 Dec 2018	Initial version prepared by: Prasanjit Dash Federal supervisor: Paul DiGiacomo Contributions:

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1 ABOUT THE OCEANWATCH MONITOR (OM)

The OceanWatch Monitor (OM) is a global and regional monitoring and validation online-tool developed primarily for monitoring of ocean products distributed by the CoastWatch (CW) program (https://coastwatch.noaa.gov/). It is a *Product Monitor*. The OM may potentially be expanded to non-CW products but this is not planned to date. The aim of this monitor is to provide an easy way to the CW users to assess the state of the available products, which will be incrementally included in the monitor. The overall objective is to ensure that the product performance expectations are met or exceeded in a full range of retrieval conditions, and to identify anomalous processing incidents and extreme weather events. The current capability includes monitoring of five different themes or environmental data record (EDRs): Ocean Color (OC) Chlorophyll-a, Sea Surface Height (SSH), Sea Surface Salinity (SSS), Sea Surface Temperature (SST) and Sea Surface Wind (SSW) *aka* Ocean Surface Vector Wind. Besides product monitoring within a given theme, it is envisioned to allow a joint analysis of different EDRs under an inter-thematic module. The framework is designed to be scalable to accommodate newer products for existing EDRs or newer EDRs, such as PolarWatch data.

1.1 Why a multi-parameter monitor – towards an enterprise approach

The OceanWatch Monitor (OM) aligns itself with an enterprise approach for the purposes of monitoring *remotely sensed ocean data*. As an example in the context of retrieval algorithms, an *enterprise algorithm* is an endorsed algorithm that uses the same scientific methodology (*i.e.*, physical basis, including assumptions) and software base to create the same classification of product from differing input data (satellite, *in situ*, or ancillary). Likewise, the OM maintains a similar monitoring philosophy, a common scalable infrastructure and the same software basis for monitoring of all ocean products. The methodology is well established and mature [see sections 1.1 (iv) and 1.1 (v)] below.

i) A monitor, however, aims to go beyond conventional ground-truth validation and provides a comprehensive set of diagnostics to detect anomalies that may be induced due to issues in algorithm, data-flow, sensor malfunction *etc*. The online diagnostics may be used by the CW users to be aware of such issues and avoid using data and potentially may provide some information to the developers to take corrective measures. The users can also be directed to the product monitors of the original developers, across different themes, for detailed analyses which some of the product teams offer. At this point, the OM will only provide a quick diagnostics without in-depth EDR-specific expertise.

ii) Another potential use being explored is to bridge the gap between STAR satellite ocean-retrievals and the environmental modeling community, by inter-comparing satellite and modeled products.

iii) Some components of an enterprise capability are:
- Multiple 'same-same' EDR product suites
- Level-4 gap-free first guess, Model based first guess – does not have to be perfect truth
- Ground-truth
- Collocation strategy for products, first guess and ground-truth
- Analyses in retrieval and residual or ratio space (product *minus/divided by* first guess or truth)
- Graphical tools for assessment displayed online: Long term, Short term, Deep Dive
- Inter-EDR module to check for potential interplay between different EDRs

iv) The OM has a shared origin with its predecessors for SST monitoring, *i.e.*, NOAA SST Quality Monitor (SQUAM; http://www.star.nesdis.noaa.gov/sod/sst/squam/) and EUMETSAT Monitoring & Evaluation of Thematic Information from Space (SQUAM; http://metis.eumetsat.int/sst/), however with some evolution and multi-theme ability within a common framework and a set of diagnostics.

v) Applicable documents:
- Dash *et al*., 2010. The SST Quality Monitor (SQUAM), *J. Atm. Oceanic Technol*, **27**, 1899-1917. (doi: 10.1175/2010JTECHO756.1)
- Dash *et al*., 2012. GHRSST Analysis Fields Inter-Comparisons: Part 2. Near real time web-based level 4 SST Quality Monitor (L4-SQUAM), *Deep Sea Research Part II: Topical studies in Oceanography*. (doi: 10.1016/j.dsr2.2012.04.002)

1.2   Purpose of this document

This document serves as a *Quick Start Guide* to assist users in effectively using the OM website and explains the technical functionalities. This is neither a program description document nor a scientific report. The estimated training time is approximately 30 minutes.

1.3   Disclaimer

Data and images hosted on the STAR webservers are not official NOAA operational products, and are provided only as examples for experimental use by remote sensing researchers, experienced meteorologists, or oceanographers (https://www.star.nesdis.noaa.gov/star/productdisclaimer.php). The views, opinions and findings reported by the OceanWatch Monitor (OM) are to assist and improve the understanding of the users but it should not be construed as an official NOAA STAR policy or decision. Any use of the data from the OM should be acknowledged with a reference to the website.

1.4   Target satellite products and first-guess or references included in the OM.
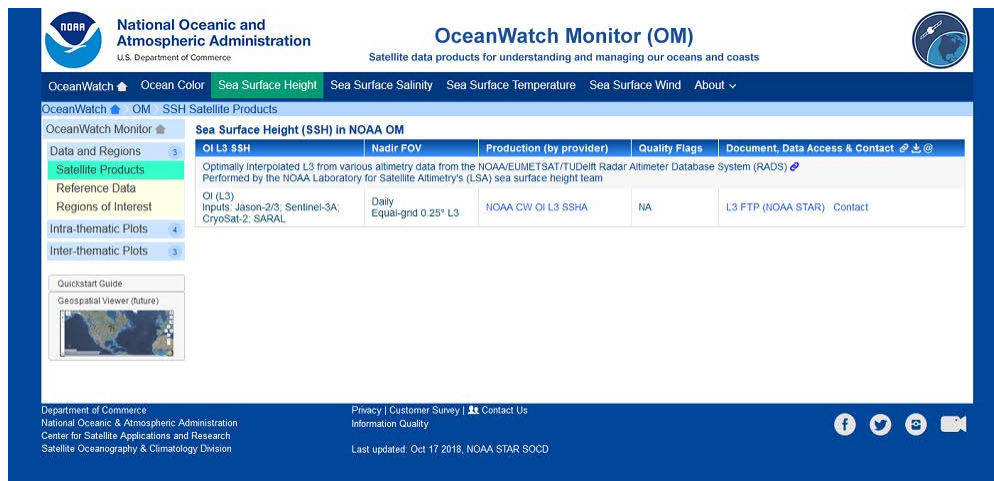
Figure 1: A snapshot of OM showing EDR options in the horizontal menu and products available for an EDR through horizontal menu. Similarly, first guess (~reference) are listed under the 'Reference' tab.

Figure 1 shows a snapshot of OM where the web-users can look for an electronic listing of products and first guess references included in OM in the vertical menu, for each EDR listed in the top horizontal menu. Further links to these products and references are also included in this electronic inventory. The listing is not repeated here for brevity and the users are urged to explore online.

1.5   Concept and diagnostic metric

All monitoring is performed in two spaces: retrieval and residual (*wrt.* a first guess). All of these diagnostics may not be useful but this provides a comprehensive set of diagnostics and the users and scientists can analyze the same. When the first guess is ground truth data, this is customarily called as validation. A comparison against a first guess (*e.g.*, L4, model) is not validation, *i.e.*, the resulting statistics may not be used as a validation report, but this still provides very useful diagnostics for assessing temporal and spatial stability of a given EDR, relative performances of products within an EDR family, and cross-product comparison. One may argue that this is not validation, but it is a proven method for performance monitoring, described in Dash *et al.* 2010 (see applicable document).

2 WEB PRESENTATION AND FUNCTIONALITIES

2.1 The Wireframe
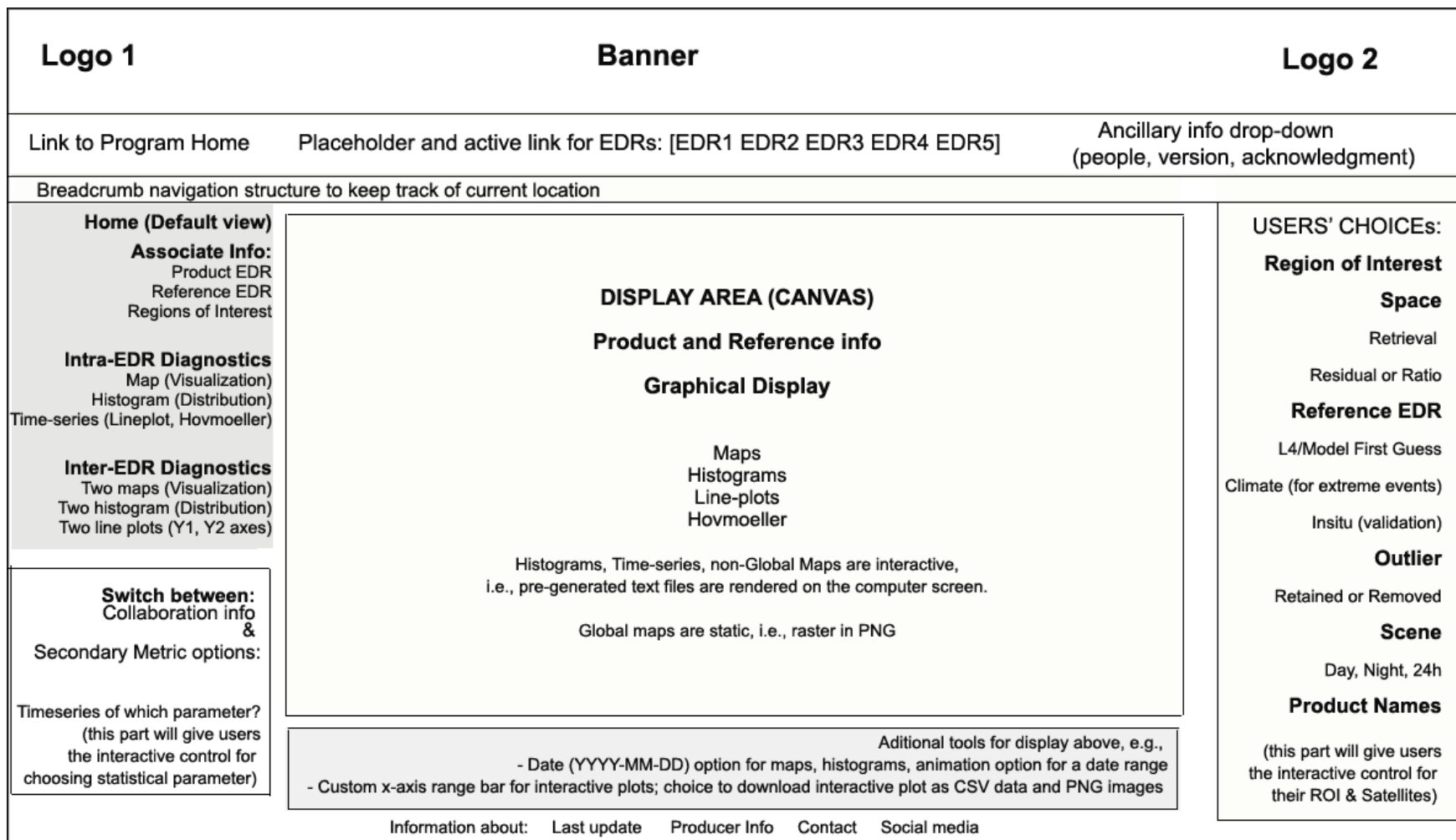
## 2.2 Date bar and animation for Maps and Histograms

<	move back by a day
>	move ahead by a day
>>	move ahead continuously at a set speed
1 fps	menu to set speed: 1/2/4 files per second; actual speed is network dependent
2016	dropdown menu for Year
07	dropdown menu for Month
21	dropdown menu for Day

How to set animation:
- select a start date of your choice for the animation
- click on the Left Marker   **[**
- select an end date of your choice for the animation (later than the start date)
- click on the Right Marker   **]**
- select a speed; default is   1 fps
- click on the play button   **>>**

2.3 Interactive Maps for non-Global RoIs
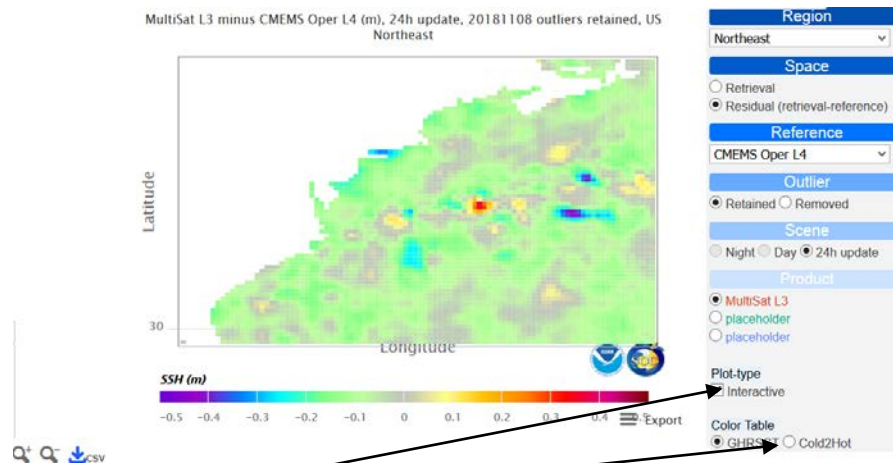
- Click on interactive check-box
- Choice of color-table
- Hover mouse over the map area to display numerical values
- CSV files can be downloaded by a user for the map by clicking on 'csv' symbol
- Export display area to raster by clicking on the 'Export' option
- By dragging a rectangle with mouse-down, one may zoom in but this zoom function is cosmetic, *i.e.*, it does not allow change of spatial resolution.

Side-note:
Planning is underway for implementing a dedicated geospatial viewer, employing a JavaScript mapping tool with tiling services, in the future. This will allow annotating vector layers, displaying of multiple EDRs with transparency control and highlighting extreme events. When implemented, this section will be updated in the future.

2.4   Interactive Histograms
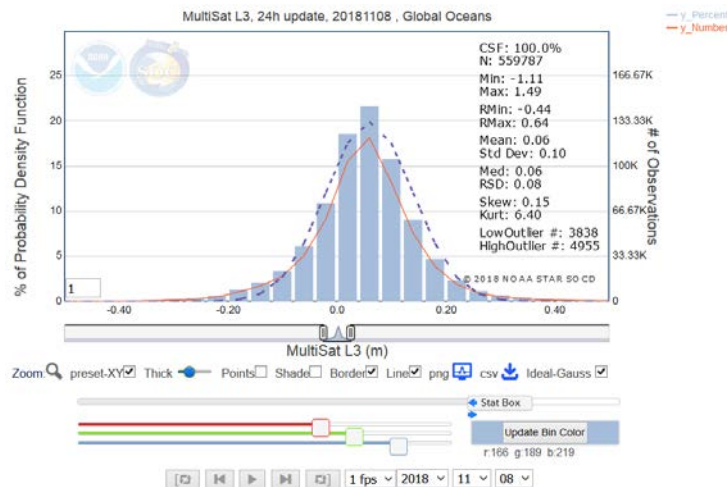
2.4.1   Regular functionalities

|	
To show bin values	Move mouse over the plot
Zoom in (both X and Y)	Left click inside the plot for start value, drag for end value and release (click on the Zoom symbol for on-screen information)
Zoom in (X-axis)	An additional Range Selector is given for X-axis that can be dragged
Zoom out	Double-click on the plot
Y1 (left Y axis)	Percentage
Y2 (right Y axis)	Numbers
Axes range selection	Preset axes ranges help in inter-comparison; if de-selected, the currently selected x-range will remain (heuristic used for y-axis variation)
Thick	Drag the slider in either left or right direction, to decrease or increase the thickness of the lines (and points if shown).
Points	Show/hide individual data points on Y-2 axis
Shade	N/A; is used for time-series
	Show/hide graph border
Border	Show/hide line. If this is de-selected, the display of points will
Line	be turned on by default (else nothing is seen).
Export display to PNG	Click on "screen" icon and PNG will show in a pop-up; save (allow pop-ups). This is not working for the Chrome browser as of this writing.
Save data in text	click on "download" icon and '*.csv' file will be downloaded
Ideal-Gauss	Over-plot an ideal Gauss-fit (median, RSD) for the data (calculated on the fly).
Product selection	display of a product can be toggled using 'checkbox' under 'Product of Interest'

2.4.2   Special functionalities

Statistics Box Slider:
Move the "Stat Box" slider to change the position of the Statistical Box in X-direction.

This has been done keeping in mind that histogram shapes may be different for different parameters (normal, log normal *etc.*) and may block text.
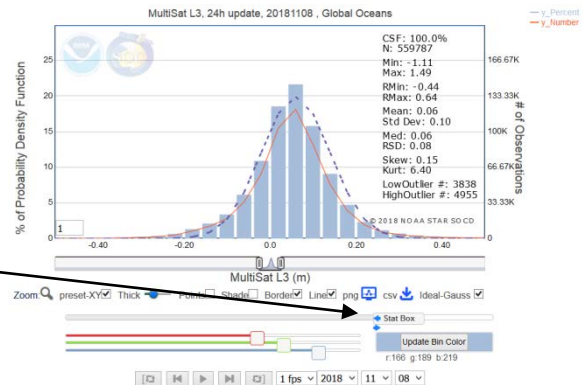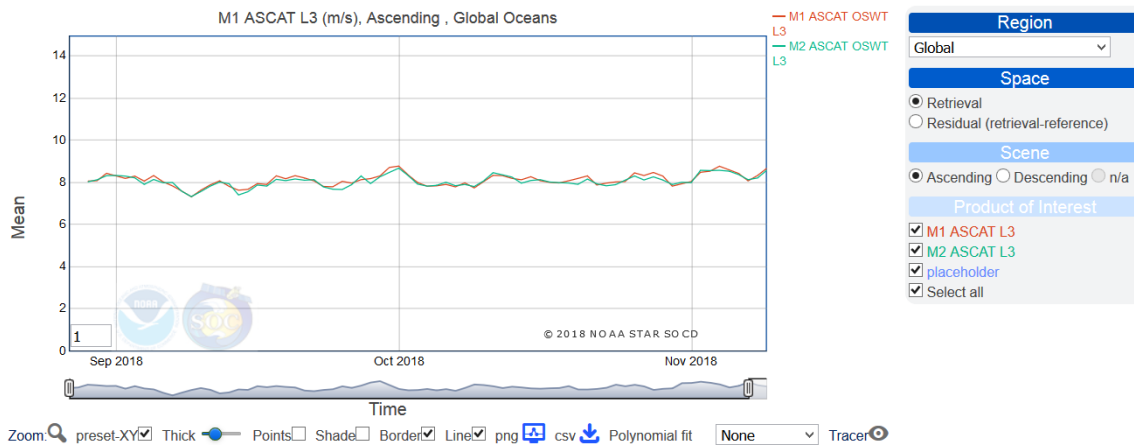

Bin Color Changer:

Drag the RED, GREEN, BLUE horizontal bars to settle on a color of your choice. Then click on 'Update Bin Color'. The color will be changed across the web page for all Histograms on the fly and will retain the memory until the web-page is reloaded.

2.4.3   Meaning of the parameters

CSF	Clear-Sky Fraction, *i.e.*, number of sub-selected retrievals/total number of retrievals. The sub-selection can be due to applying quality-flags or some other masks. If no sub-selection is applied, the CSF will simply be 100%.
N	Number of retrieval points
Min	Minimum value
Max	Maximum value
RMin	A robust estimation of the minimum value. This is useful if there are rare dropouts in the time-series of the minimum value due to any reason.
RMax	A robust estimation of the maximum value. (see above)
Mean	Arithmetic mean (not zonally weighted)
Std Dev	Standard Deviation
Med	Median
RSD	Robust Standard Deviation
Skew	Skewness
Kurt	Kurtosis (may not make sense for each distribution)
Low Outlier #	Number of points outside of media+4*RSD, to the left
High Outlier #	Number of points outside of media+4*RSD, to the right

2.5 Interactive plots of time-series statistics

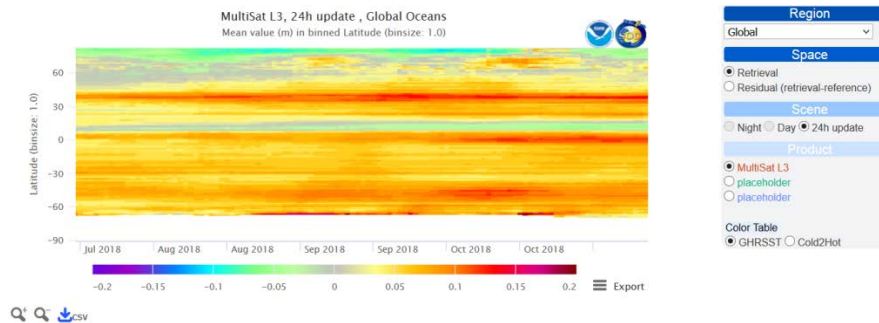| Function	Action
To show numerical values	Move mouse over the plot
Zoom in (both X and Y)	Left click inside the plot for start value, drag for end value and release (click on the Zoom symbol for on-screen information)
Zoom in (X-axis)	An additional Range Selector is given for X-axis that can be dragged
Zoom out	Double-click on the plot
Smooth plots in x-direction	Specify in bottom-left box and hit enter (click outside plot in Opera, IE)
Pan (when plot is zoomed in)	Hold down Shift key and drag to pan
Point tracer	When zoomed in X-axis, individual points are visible on mouse hover. Click on any point of interest; the selected satellite product, region of interest (RoI), reference product, day/night condition will be captured and displayed as a line below the plot. Then click on Map or Histogram or Dependence menu to directly get to the corresponding plot (click on the Point Tracer Eye symbol for on-screen information).
Axes range selection	Preset axes ranges help in inter-comparison; if de-selected, the currently selected x-range will remain (heuristic used for y-axis variation)
Thick	Drag the slider in either left or right direction, to decrease or increase the thickness of the lines (and points if shown).
Points	Show/hide individual data points. Useful for non-uniformly spaced time series data.
Polynomial	Over-plot a Polynomial fit for the displayed data (calculated on the fly for the displayed range). The first degree polynomial is simply a linear fit; the second degree is an additional option.
Shade	Show/hide shading
Border	Show/hide graph border
no Line	Show/hide line. If this is selected, the display of points will be turned on

|	
	by default (else nothing is seen). May be useful for data with irregular interval.
Export display area to PNG	Click on "screen" icon and PNG will show in a pop-up; save (allow pop-ups). This is not working for Chrome browser, as of this writing.
Save underlying data in text	Click on "download" icon and '*.csv' file will be downloaded
Product selection	Display of a product can be toggled using 'checkbox' under 'Product of Interest'

2.6 Interactive Hovmöller plots

The functionalities are similar to those of interactive maps described in section 2.3.

2.7 Inter-thematic Plots
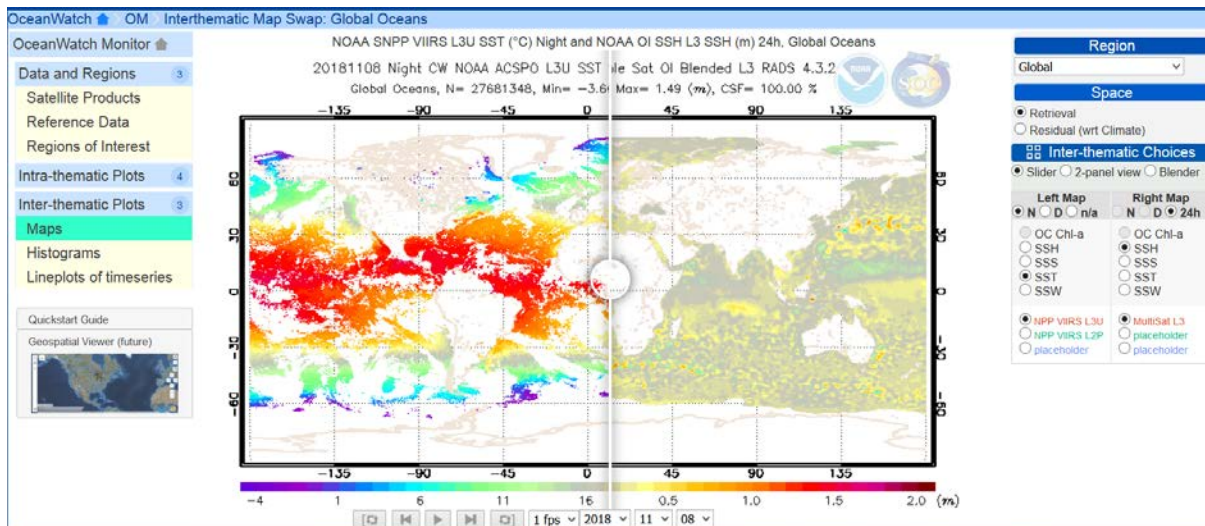
- · The gross technical features of these maps, histograms and time-series plots are similar to as described before. The major difference is the users can chose two different products, from either two different EDR families or from within one EDR family from the 'Inter-thematic Choices' box.
- · For maps, there are 3 options: Slider, 2-panel, Blender with transparency control.
- · For time series plots, the Y1 (left Y-axis) and Y2 (right Y-axis) can be used for two different products.
- · The ▦ symbol on any given choice-box indicates that the box is draggable.

3 FUTURE ADDITIONS AND CONSIDERATIONS

3.1 Additions

1. Include validation of each EDR against *in situ* data
2. Implement a geo-spatial viewer
3. Include more products from the CW product suite, incrementally. Currently, only a few products from each EDR family have been added to create a complete infrastructure.
4. Explore more diagnostic metric, such as triple-collocation error, monthly and yearly statistics and bi-variate density plots.
5. Modify as needed depending on the feedback we receive.

3.2 Considerations

1. Center global maps on dateline or nearby so that the basins do not split across edges.
2. Perform basin-specific analyses for those products which provide a basin mask.
3. Extend monitoring of ocean color (OC) to other parameters (currently only chlorophyll).
4. Stratify OC analyses by: deep-water, eutrophic, mesotrophic, oligotrophic, and Indian Ocean Subtropical (IOS), North Atlantic Subtropical (NAS), South Atlantic Subtropical (SAS), North Pacific Subtropical (NPS), South Atlantic Subtropical (SAS), and South Pacific Subtropical (SPS) gyres.
5. Additionally, provide the CSV files already available in a more explanatory data format, *e.g.*, netCDF. Auxiliary information may be suitably appended in such formats in contrast to the plain ASCII CSV files.

List of acronyms

CW	CoastWatch – NOAA STAR SOCD Program
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
METIS	Monitoring & Evaluation of Thematic Information from Space
NRT	Near-Real Time
NTC	Non Time Critical (generally for the purpose of generating Science Quality data)
OC	Ocean Color
QC	Quality Control
QA	Quality Assurance
ROI	Regions of Interest
SQUAM	SST Quality Monitor (NOAA NESDIS STAR)
SSH	Sea Surface Height, Seal Level Anomaly (SLA)
SSS	Sea Surface Salinity
SST	Sea Surface Temperature
SSW	Sea Surface Wind, Ocean Surface Vector Wind (OSVW)

Table 1: List of acronyms