METIS-SST-QuickStart

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v1.1	08 Feb 2017		Initial version prepared by Prasanjit Dash, Anne O'Carroll
v1.2	02 Nov 2017		Described additional functionalities in interactive plots, Prasanjit Dash, Anne O'Carroll

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1 INTRODUCTION

Monitoring and Evaluation of Thematic Information from Space (METIS) is a global and regional monitoring and validation tool developed for the EUMETSAT Remote Sensing Products (RSP) division. The Sea Surface Temperature (SST) component of the monitoring framework is called as METIS-SST, which is intended to provide diagnostics for EUMETSAT operational SST products.

1.1 Purpose

This document serves as a *Quick Start Guide* to assist users in effectively using the METIS SST 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.

1.2 Scope

The range of audience includes the international SST community (contributors to and participants of the activities of the Group for High Resolution Sea Surface Temperature, GHRSST; https://www.ghrsst.org/) and those interested in understanding and using the diagnostics from the METIS-SST online tool.

The SST component of METIS (METIS-SST) is inspired by the NOAA SST Quality Monitor (SQUAM; http://www.star.nesdis.noaa.gov/sod/sst/squam/) and focuses on monitoring and evaluation of EUMETSAT Operational SSTs. Currently, the following three products are included: Metop-B AVHRR and IASI SSTs produced at EUMETSAT OSI SAF facility and Sentinel-3A SLSTR SST produced at EUMETSAT (see Section 2.2 for more information). However, the tool is envisioned to be scalable and capable of monitoring a wide range of RSP products and has both global and regional capabilities. It is also used internally for testing products and assessing algorithm performances.

The Copernicus Sentinel-3A products are monitored in METIS-SST and inter-compared with other well-established EUMETSAT SSTs that serve as benchmarks.

1.3 Applicable Documents

AD-1	EUMETSAT Sentinel-3 Mission Performance Implementation Plan, S3-PL-ESA-SY-0265, v2	EUM/LEO-SEN3/PLN/14/756933
AD-2	Memorandum: EUMETSAT Copernicus Mission Performance interactive website	EUM/RSP/MEM/15/836155

1.4 Reference Documents

RD-1	The SST Quality Monitor (SQUAM)	Dash *et al.*, 2010 *J. of Atm. & Oceanic Tech.*, **27**, 1899-1917 *http://dx.doi.org/10.1175/2010JTECHO756.1*
RD-2	GHRSST Analysis Fields Inter Comparisons: Part 2. Near real-time web-based Level 4 SST Quality Monitor	Dash *et al.*, 2012 *Deep Sea Research-II.*, **77-80**, 31-43 *http://dx.doi.org/10.1016/j.dsr2.2012.04.002*
RD-3	NOAA SQUAM website	*http://www.star.nesdis.noaa.gov/sod/sst/squam/*
RD-4	The accuracy of SST retrievals from Metop-A IASI & AVHRR using the EUMETSAT OSI-SAF matchup dataset	O'Carroll *et al.*, 2012 *Rem Sens of Env.*, **126**, 184-194 *http://dx.doi.org/10.1016/j.rse.2012.08.006*

2 AN OVERVIEW OF MONITORING AND EVALUATION

2.1 Objective

The objective is to ensure that the product performance specifications are met and/or exceeded in a full range of retrieval conditions, and to identify anomalous incidents. All analyses are performed in both global and regional areas of interest.

2.2 Target satellite SST products

- Sentinel-3A SLSTR WST (L2P) SST. Also, 5 SLSTR internal (WCT) products will be internally analysed.
- Metop-B AVHRR (EUMETSAT OSI SAF) for bench-marking and it is also a good contender.
- Metop-B IASI (EUMETSAT OSI SAF) for bench-marking purposes because of its stability. It is also used as a *transfer standard* in double differences.

The above is an initial list and will expand with time.

2.3 Reference SSTs

- Compare satellite SSTs against global Level 4 (L4) reference SST fields: CMC 10 km, OSTIA 5km, and OSTIA monthly mean climatology.
- Validate satellite SSTs against quality-controlled *in situ* SSTs. The matches are to be generated by Felyx (Coriolis data) under a federated project with the EUMETSAT OSI SAF. Alternatively, quality controlled data from the NOAA *in-situ* Quality Monitor *iQuam*; http://www.star.nesdis.noaa.gov/sod/sst/iquam/) can be explored if additional resources are required or for a parallel comparison.

The Level-4 products have a daily update cycle (OSTIA, CMC) and the OSTIA monthly climatological SST is a 30 years average. The *in situ* SSTs have exact time, hence, are more appropriate for 'validation' of satellite SST. However, L4 SSTs are useful for monitoring stability, geophysical dependency with correlated parameters, performance of cloud detection algorithms and product inter-comparison through double differences.

Figure 1 show target satellite SSTs (separated by day and night) and Figure 2 shows an example L4 reference SST. Figure 3 shows the difference between satellite SST and Level-4 SST, and also the corresponding probability distribution functions. Critical parameters are annotated on the histogram for continuous and automated monitoring.

In the METIS web page, such Maps and Histograms are shown for different combinations of Reference and Satellite products and for **16 ROIs**. The statistical parameters annotated on the PDF (Fig 3, bottom-panel) are monitored in time. Also, the mean and standard deviations of "SST – REF" are monitored as a function of correlative parameters.

With this much of required background, the METIS-SST web-functionalities, which form the main purpose of this document, are described next.

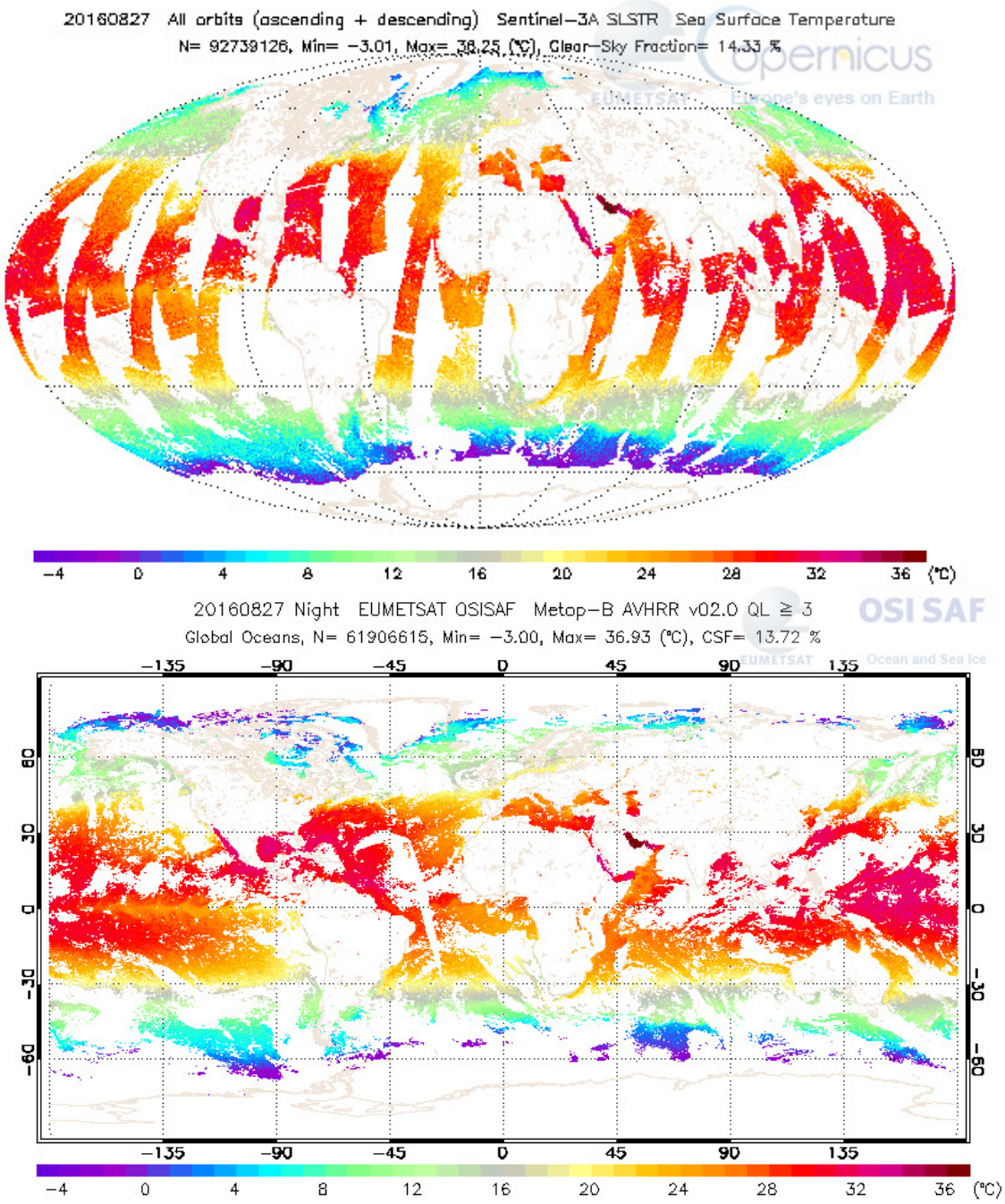


Figure 1: Upper panel: Night and Day Sentinel-3A SLSTR SST for 27 August 2016 (in Mollweide projection). Lower-panel: Night only OSISAF Metop-B AVHRR SST. A fixed set of diagnostic metric is used in METIS-SST, however, the choice of projection and day and night separation can be changed easily. For mapping purposes, a colour table (CT) suggested by GHRSST is used. The CT was suggested for plotting of SST differences, but is also used for SST maps in METIS. It is also applied uniformly and not stretched, i.e., a particular colour corresponds to a particular value in all regional and global maps.

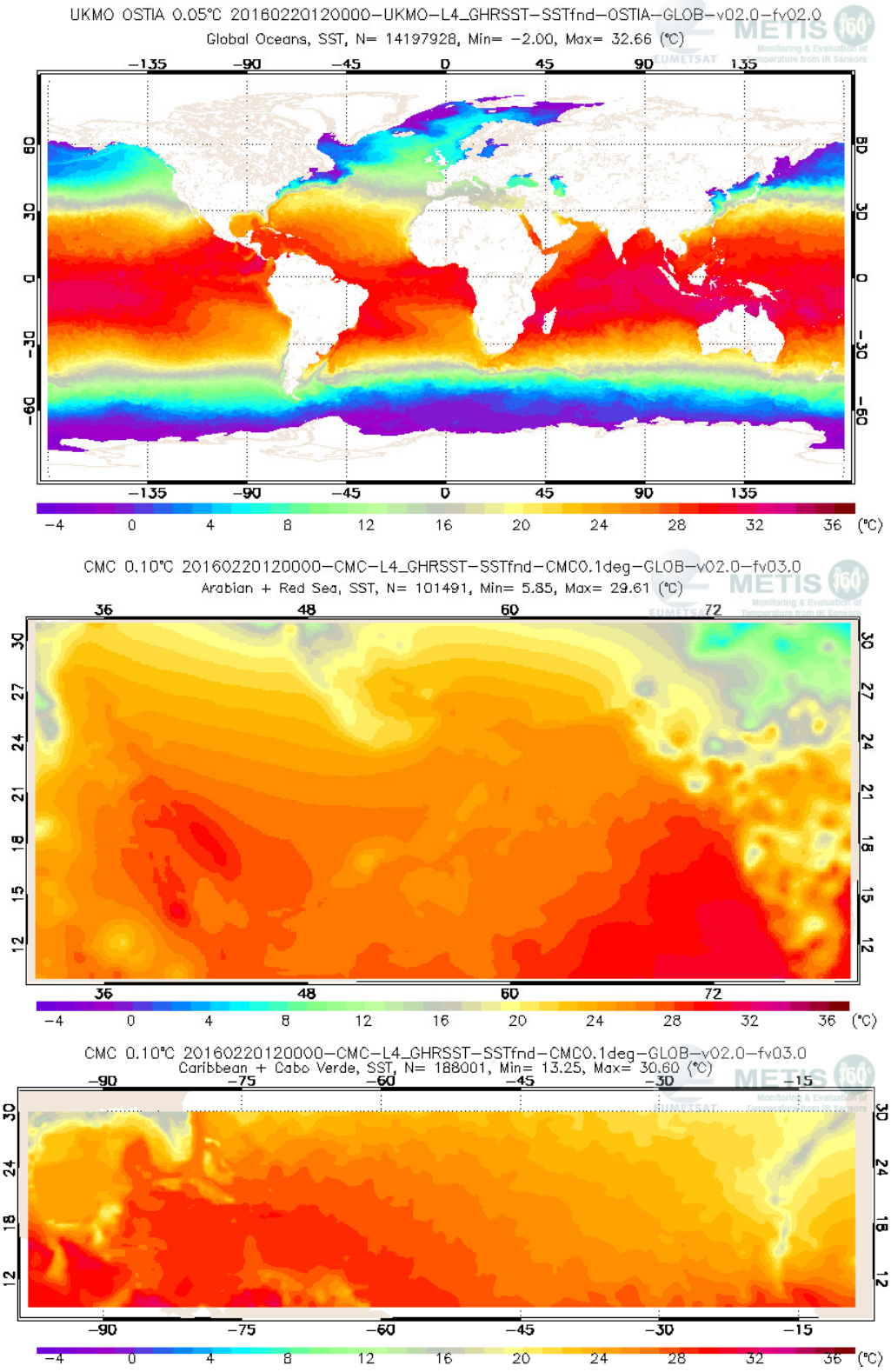


Figure 2: Upper panel: 0.05° latitude longitude gap-free UKMO OSTIA Global map. Middle panel: 0.010° CMC SSTs in the Arabian and the Red Seas. Lower-panel: CMC SST in the Caribbean and the Carbo Verde. All SSTs shown in the above figure are for 20 February, 2016.

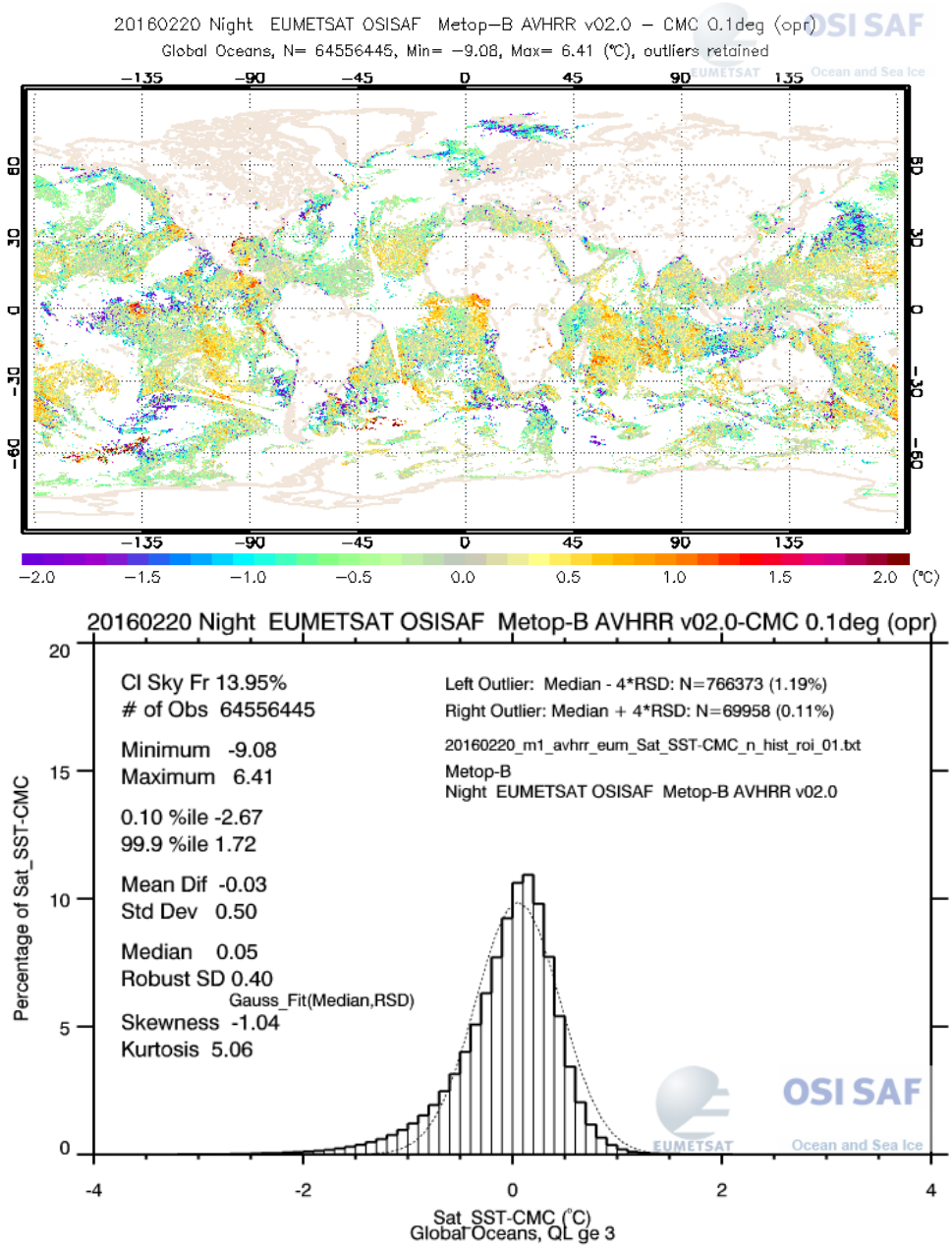
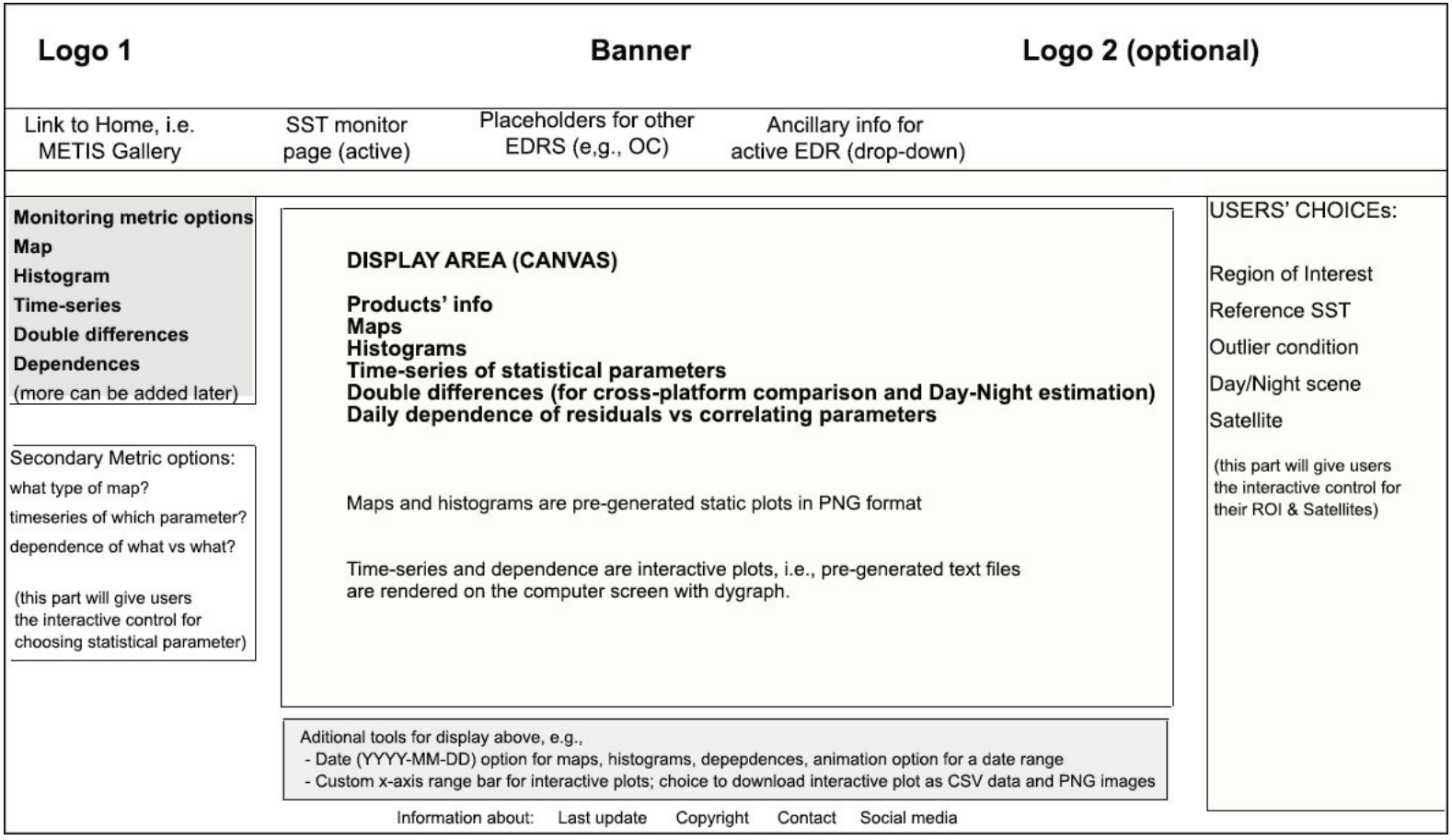


Figure 3: Daytime Metop-B AVHRR SST (lower-panel in Figure 1) minus OSTIA (upper-panel in Figure 2). Bottom panel: the corresponding probability density function.

In the next Section (Section 3), the organization of the web-page is shown graphically (Section 3.1., the wireframe), along with the functionalities.

3 WEB PRESENTATION AND FUNCTIONALITIES

3.1 The Wireframe



3.2 Maps, Histograms and Daily dependence: Date bar & animation

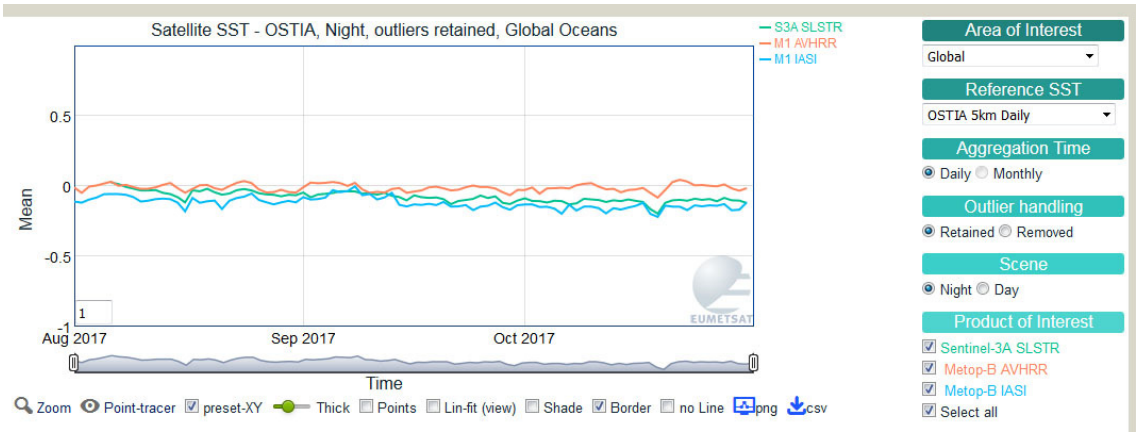
The objective is to ensure that the product performance specifications are met and/or exceeded in a full range of retrieval conditions, and to identify anomalous incidents. All analyses are performed in both global and regional areas of interest.

< 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 >>

3.3 Interactive plots of time-series statistics and double differences: Functionalities



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
LinFit	Over-plot a linear fit for the displayed data (calculated on the fly).
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)
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’

AVHRR	Advanced Very High Resolution Radiometer
AOT	Aerosol Optical Thickness (aka. Aerosol optical depth)
BT	Brightness Temperature
CMC	Canadian Meteorological Centre
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
GHRSST	Group for High Resolution Sea Surface Temperature
IASI	Infrared Atmospheric Sounding Interferometer
i*Quam*	In situ Quality Monitor (NOAA NESDIS STAR)
IR	Infrared
LST	Land Surface Temperature
METIS	Monitoring & Evaluation of Thematic Information from Space
NOAA	National Oceanic and Atmospheric Administration
NRT	Near-Real Time
OC	Ocean Colour
OSTIA	Operational Sea Surface Temperature and Sea Ice Analysis
QC	Quality Control
QF	Quality Flag
QA	Quality Assurance
RMSE	Root-Mean Squared Error
ROI	Regions of Interest (see Table 2)
RTM	Radiative Transfer Model
SEVIRI	Spanning Enhanced Visible and Infrared Imager
SNR	Signal to Noise Ratio
SLSTR	Sea and Land Surface Temperature Radiometer
SQUAM	SST Quality Monitor (NOAA NESDIS STAR)
SRF	Spectral Response Function
SST	Sea Surface Temperature
SD	Standard Deviation
TOA	Top Of Atmosphere
TPW	Total Precipitable Water
UTC	Universal Time Coordinated
WS	Wind Speed

Table 1: List of acronyms

Region of Interest (ROI) - this Monitor

ROI	Name	≡OSI SAF	Lat range	Lon range	Importance
01	Global	global	90 N - 90 S	180 W - 180 E	overall performance
02	Arctic	2	90 N - 63 N	180 W - 180 E	shallow, icy, low evap
03	Southern	3	40 S - 79 S	180 W - 180 E	cold + warm mixing
04	Black Caspian	4	47 N - 37 N	27 E - 55 E	largest enclosed inland
05	Baltic	5	67 N - 50 N	2 E - 31 E	large brackish water
06	Northwest Atlantic	6	67 N - 30 N	40 W - 95 W	slope waters, Gulf stream
07	Northeast Atlantic	7	67 N - 30 N	40 W - 2 E	biodiverse, thermohaline
08	West + East Mediterranean (exclude Atlantic & Black Sea from the box)	8+9	46 N - 30 N	6 W - 37 E	land-enclosed high evaporation & salinity
09	Caribbean + Cabo Verde	10+11	30 N - 9 N	98 W - 9 W	Saharan dust
10	Brazil + Gulf of Guinea + S. Atlantic	12+13+14	10 N - 40 S	63 W - 20 E	warm current, oil & gas
11	Northeast + Northcentral + Northwest Pacific	15+16+17	67 N - 10 N	106 E - 82 W	subtropical gyre, CO_2 sink
12	North + South Tropical Pacific	18+19 (ext)	30 N - 30 S	134 E - 76 W	El Niño (La Niña), Niño 4 & 3
13	Warm pool Pacific	20	20 N - 10 S	105 E - 160 E	warmest (local) SST
14	Southcentral + Southeast + Australia Pacific	21+22+23	10 S - 40 S	105 E - 70 W	subtropical gyre
15	Central Indian Ocean	24	10 N - 40 S	20 E - 105 E	warm ocean
16	Arabian + Red Sea	25+26	31 N - 10 N	32 E - 80 E	Monsoon, dust, Oil & gas

Table 2: Regions of interest pre-defined in METIS-SST.