The Monitoring and Evaluation of Thematic Information from Space (METIS) framework for validation of EUMETSAT SST products

http://metis.eumetsat.int

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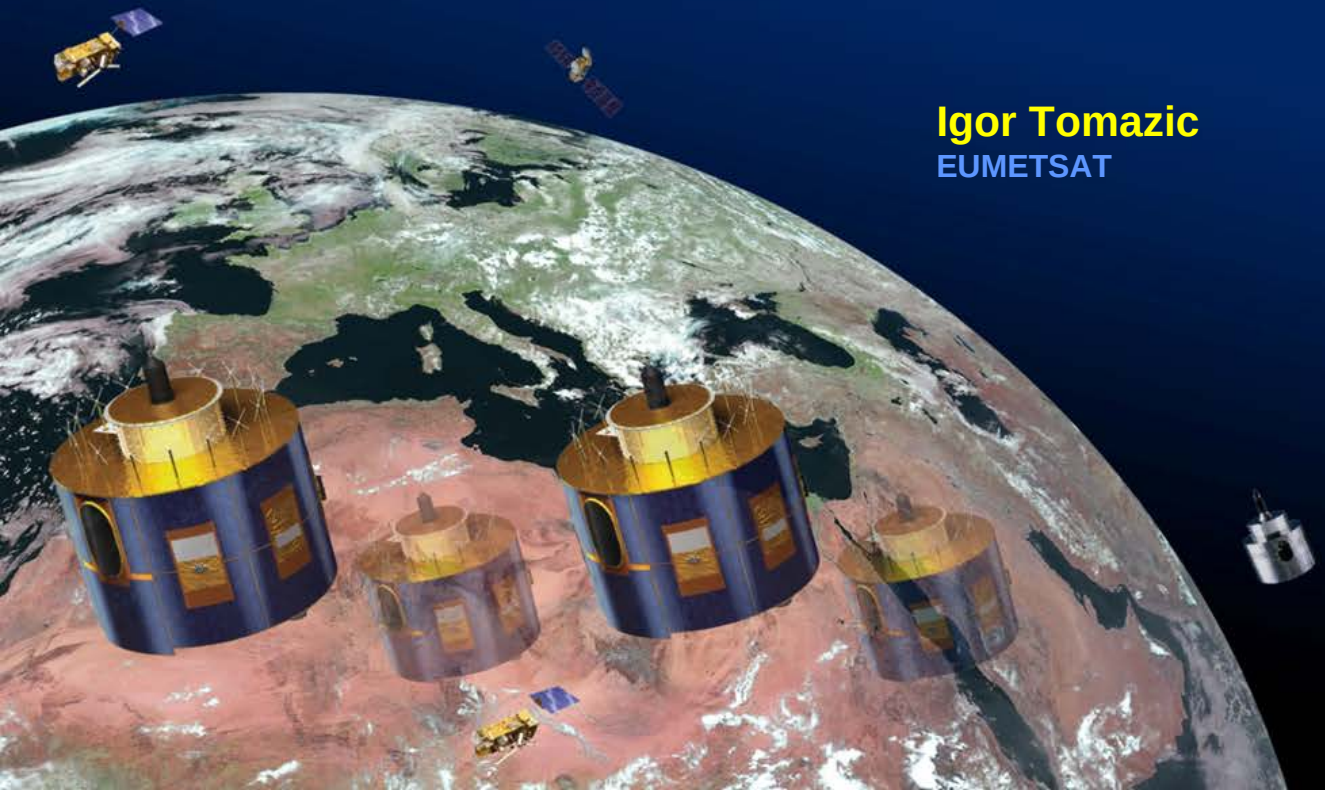
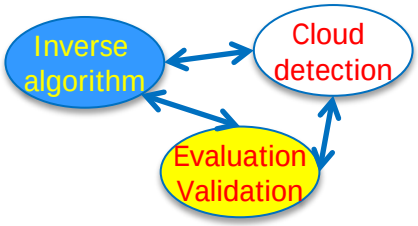


Thanks:
Bojan Bojkov, Eumetsat RSP Head
Francois Montagner, Eumetsat RSP MA Lead
Craig Donlon, Sentinel-3 Mission Scientist, ESA
NOAA STAR SST team for SQUAM

S3A SLSTR SST example
The Problem Statement

METIS

Scientific challenges:
(once L1B data are available)



The roles are interwoven; however, beneficial to have an objective Eval/Val system where results are shareable

Therefore, METIS was set-up – partly motivated by the success and benefits of the NOAA SQUAM system https://www.star.nesdis.noaa.gov/sod/sst/squam/

Dash, Ignatov, Kihai, Sapper, 2010. JTECH. The SST Quality Monitor

Highlights

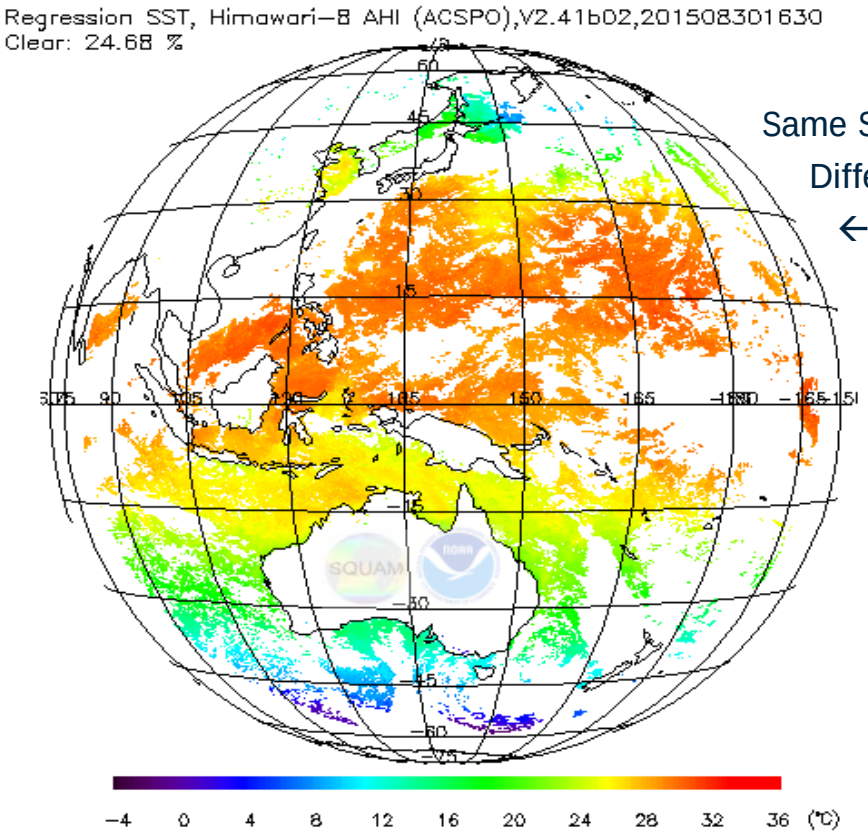
1. Concept with example case studies

2. METIS
    1. Online interface and various modules
    2. Some more case studies
    3. Spin-offs, extreme events
    4. Potential further diagnostic

Concept
case: Himawari-08 BT anomaly

METIS

State (product) space

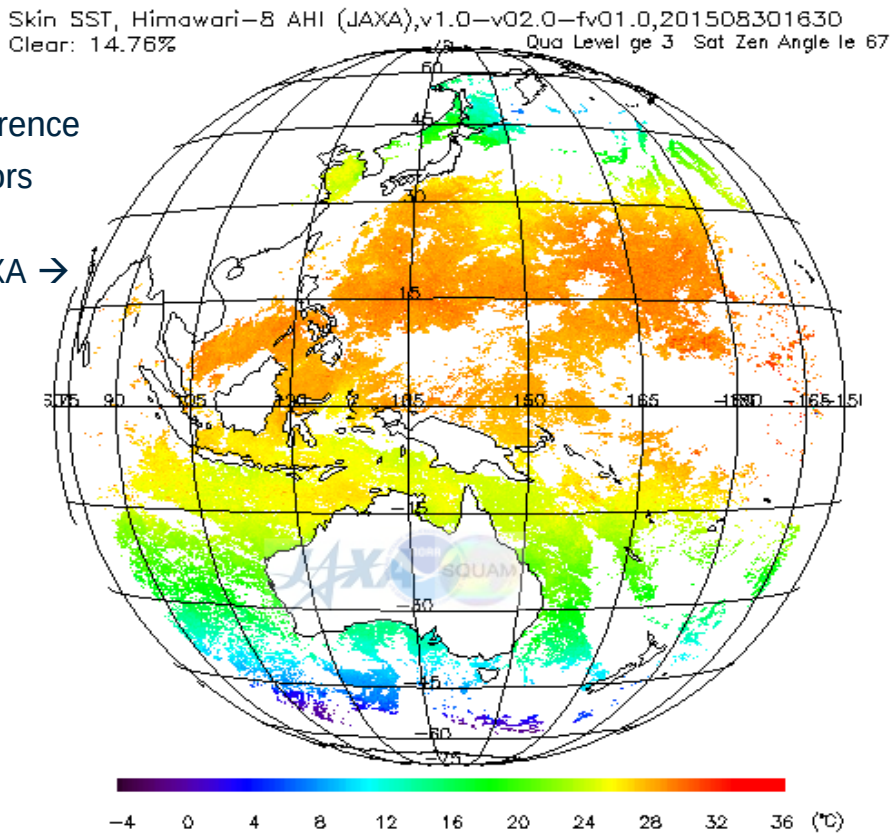


Same Scene/Sensor/Reference

Different SST Processors

← NOAA ACSPO

JAXA →



Himawari 8 (NOAA ACSPO), Cl. sky covg = 24.7%
(ACSPO CM, Petrenko et al., JTech, 2010)

Himawari 8 (JAXA), Cl. sky covg = 14.8%
(Bayesian CM, Kurihara et al., GRL, 2016)

SST (product) maps:

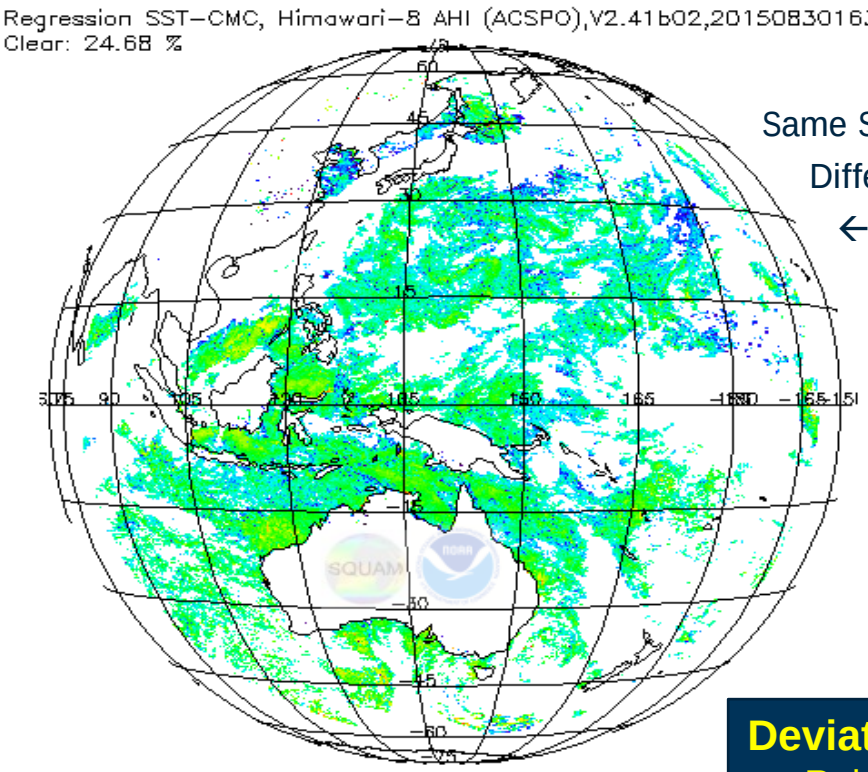
- Useful to check for coverage and large image quality issues
- Not necessarily good for product(s) evaluation/comparison

Adapted from: Dash, Ignatov, Kihai; 19-Nov-2015; Presentation at EUMETSAT HQ
http://www.eumetsat.int/website/home/VisitingScientists/SciencePresentations/DAT_2908128.html

Concept
case: Himawari-08 BT anomaly

METIS

Residual (difference) space



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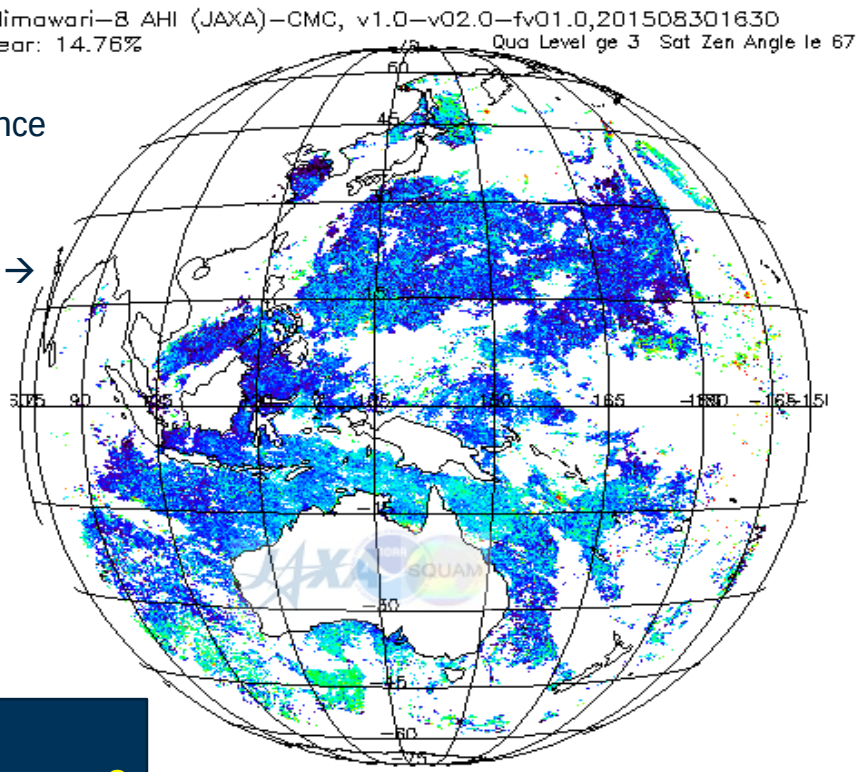
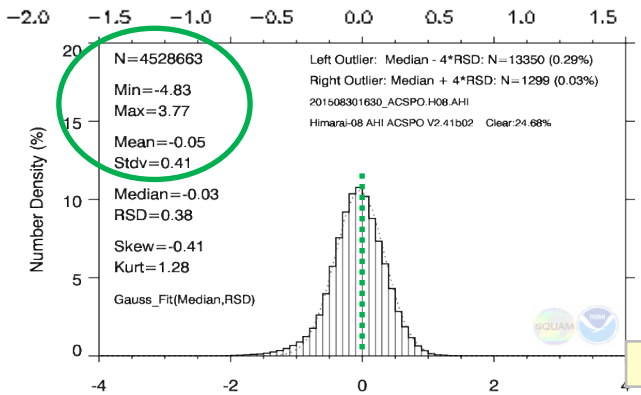
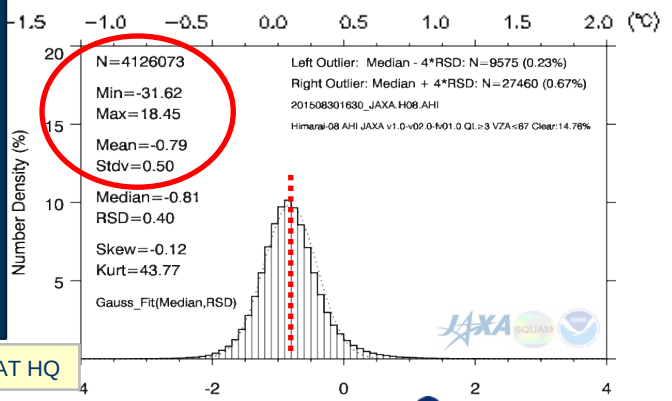
JAXA →



Deviation from Ref:
- Relative product performance?
- Cloud leakages?
- Data anomalies/issues?
- SST stable in space? Time?

Approach:
- Distribution Normal X~N(μ,σ)?
- Compare/trend moments of N



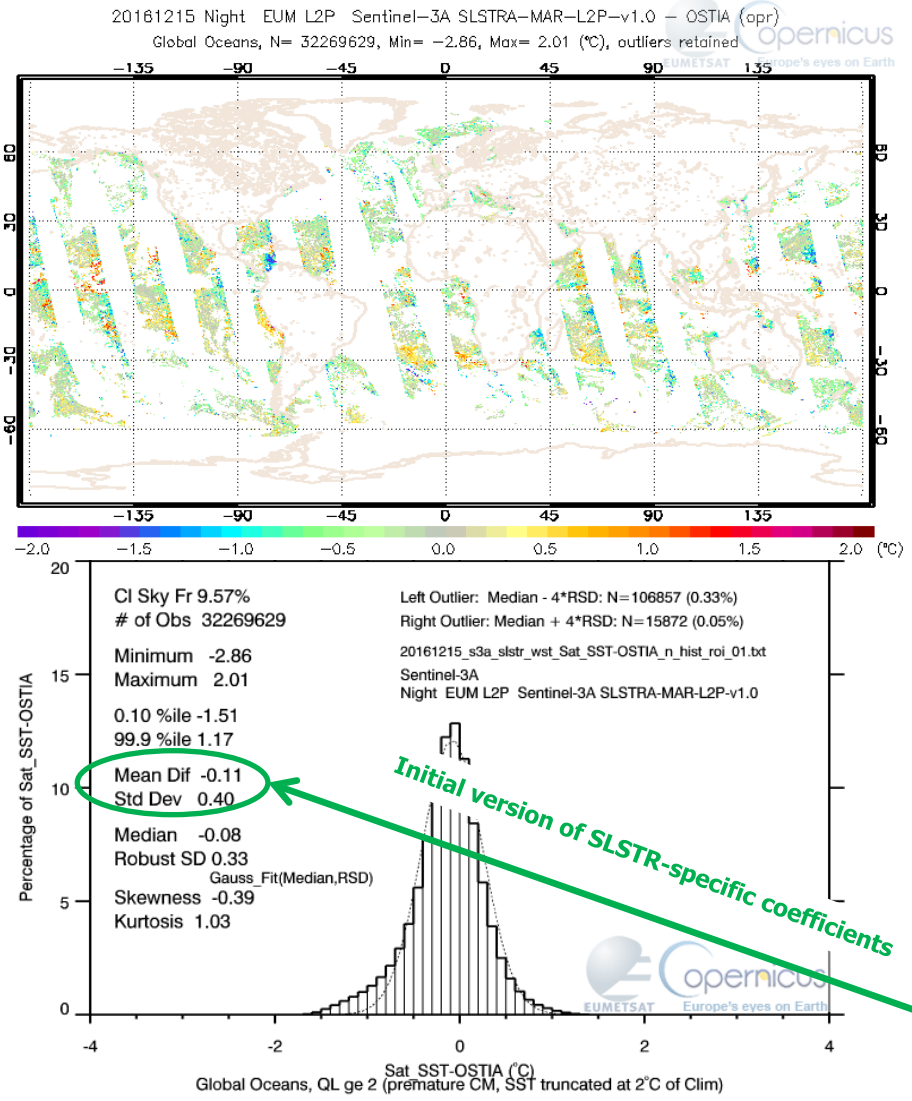


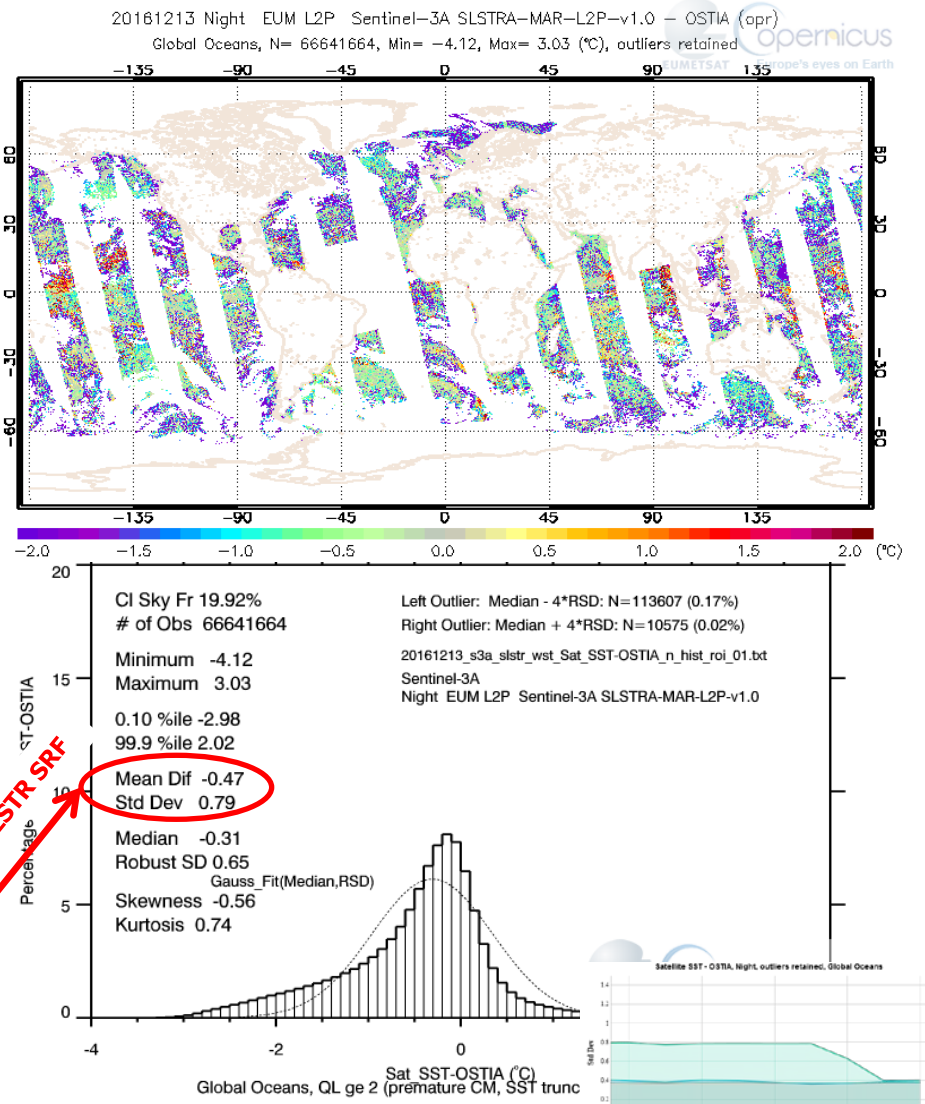
adapted from: Dash, Ignatov, Kihai; 19-Nov-2015; EUMETSAT HQ

Concept
case: Sentinel-3A SLSTR SST coefficient update

METIS

Difference space





Initial version of SLSTR-specific coefficients

older SLSTR SRF

S3A SLSTR WST Product during development phase; **http://metis.eumetsat.int/sst/index.html**

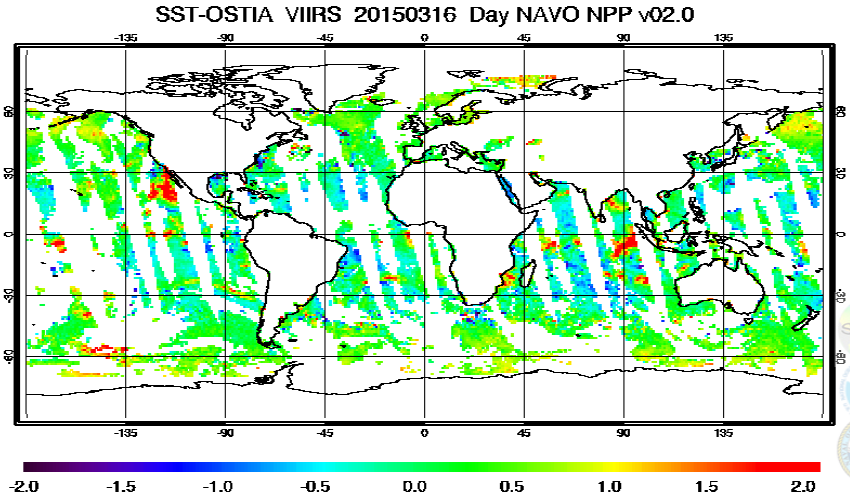
EUMETSAT METIS

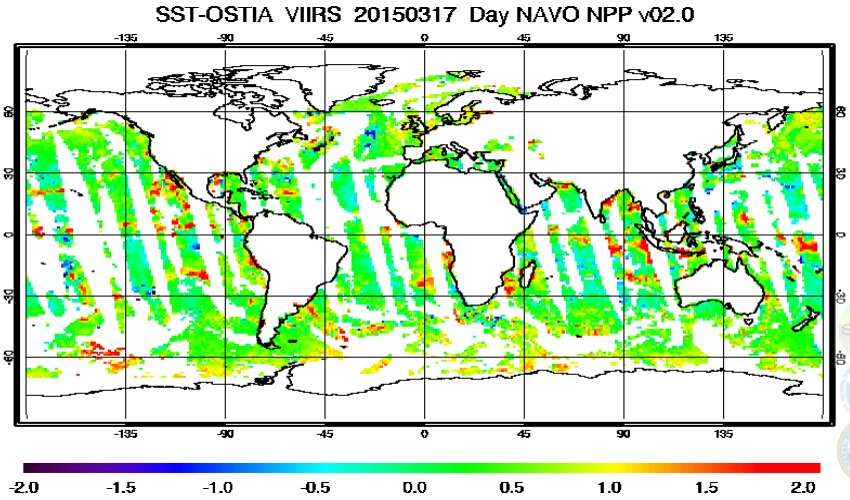
Concept

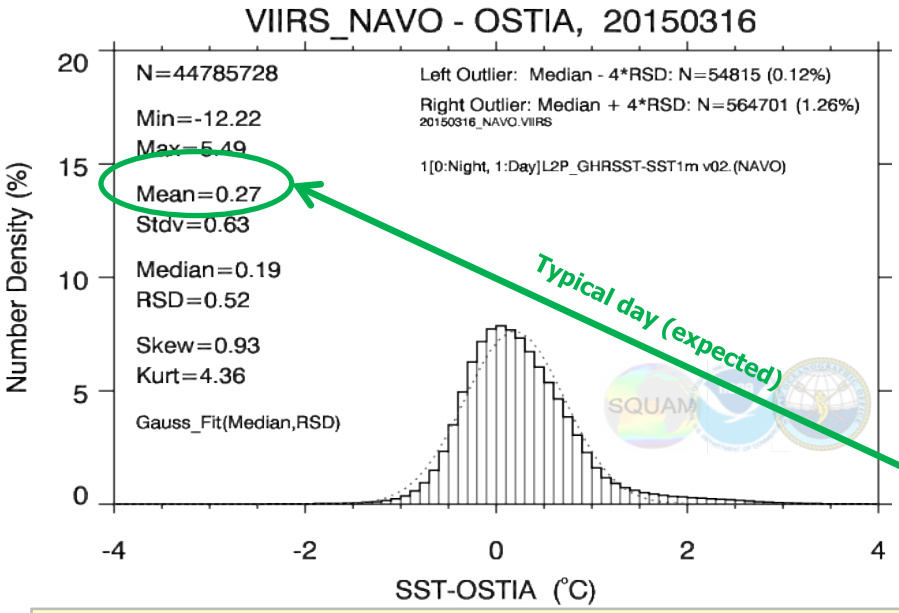
case: impact on SST of WuCd event for NPP VIIRS

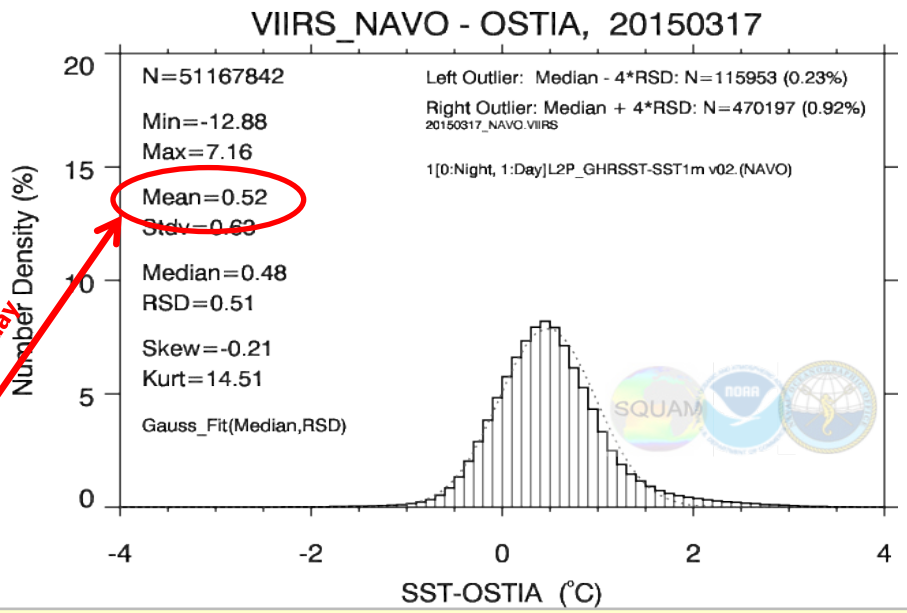
METIS

Difference space



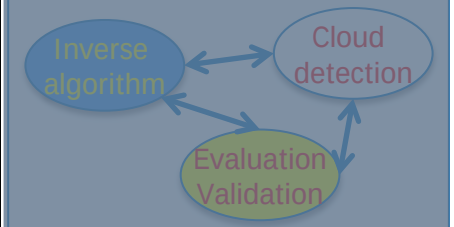






Adapted from: Dash, Vazquez, Corlett; Identifying Gaps in GHRSST services to the users and their applications; July-2015; Presentation at GHRSST Science Team Meeting, The Netherlands

Scientific challenges:
(once L1B data are available)



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Dash, Ignatov, Kihai, Sapper, 2010. JTECH. The SST Quality Monitor

METIS

online interface and various modules: *http://metis.eumetsat.int*

METIS

EUMETSAT MONITORING WEATHER AND CLIMATE FROM SPACE

METIS | METIS-SST | METIS-OC | EUMETSAT WEBSITE

METIS

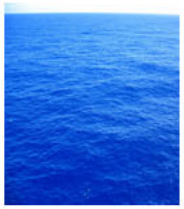
Monitoring & Evaluation of Thematic Information from Space (METIS)

The Monitoring and Evaluation of Thematic Information from Space (METIS) tool is developed to monitor EUMETSAT operational remotely sensed products for stability, quality and performance on a global and regional basis in routine. The current METIS modules are:

METIS-SST

METIS-SST, the Sea Surface Temperature component of Monitoring & Evaluation of Thematic Information from Space (METIS), provides near-real time diagnostics of EUMETSAT operational level-2 (L2) satellite SSTs.

Current Satellite SST Products monitored in METIS-SST are from: Sentinel-3A SLSTR, Metop-B (M1) AVHRR and M1 IASI.



METIS-OC

METIS-OC, the OC component of Monitoring & Evaluation of Thematic Information from Space (METIS), provides near-real time diagnostics of EUMETSAT operational level-2 and level-3 satellite Ocean Colour products.

Current Satellite OC Products monitored in METIS-OC are from: Sentinel-3A OLCI, Aqua (AQ) MODIS, OrbView-2 SeaWifs, Envisat MERIS and Suomi-NPP VIIRS.

METIS-SST Daily maps, histograms, time-series, geophysical dependence, Global and 15 regional analyses in routine
METIS-OC work underway (9 RoI) … Contact: Ewa.Kwiatkowska, Malcolm.Taberner @eumetsat.int

CONTACT US
LEGAL INFORMATION

FOLLOW US ON

MEMBER STATES

COOPERATING STATES

METIS-SST : Global + 15 Regional ROIs

online interface and various modules : *http://metis.eumetsat.int/sst/index.html*

METIS

EUMETSAT MONITORING WEATHER AND CLIMATE FROM SPACE

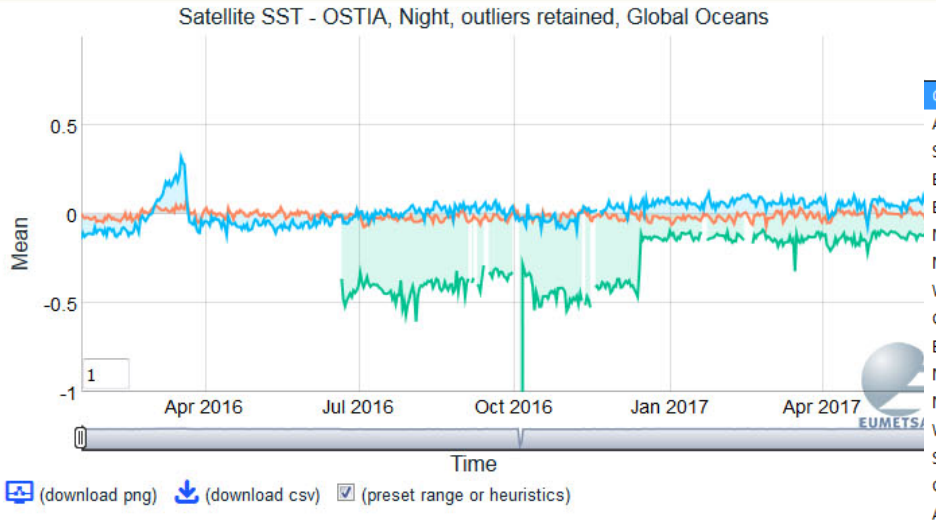
METIS | METIS-SST | METIS-OC | EUMETSAT WEBSITE

STATISTICAL TIME SERIES: GLOBAL OCEANS

- METIS-SST
- Data Sources 3
- Plots 5
- Maps
- Histograms
- Time-series Statistics
- Double Differencing
- Geophy Dependence
- References
- Quickstart Guide

Statistical Parameters

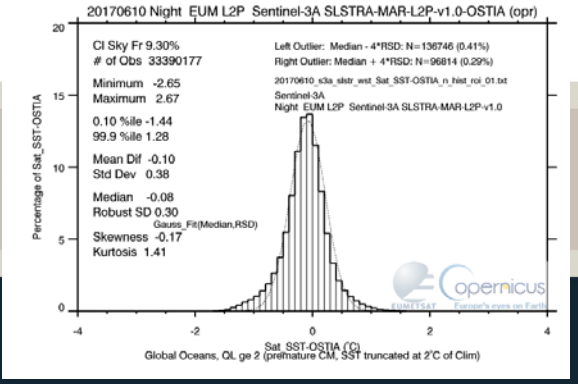
CSF % | Num
Min | 0.01 percentile
Max | 99.99 percentile
Mean | Median
StdDev | RSD
Skew | Kurt
Low out | High out

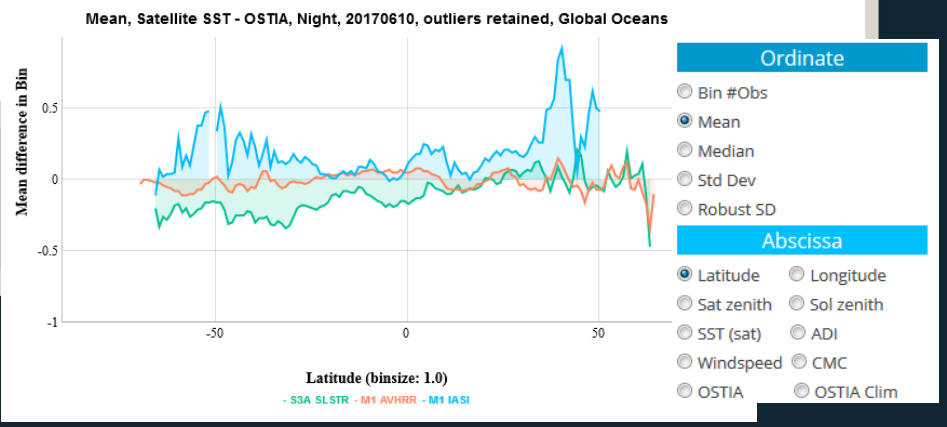


S3A SLSTR
M1 AVHRR
M1 IASI

Global
Arctic
Southern
Black Caspian
Baltic
Northwest Atlantic
Northeast Atlantic
W+E Mediterranean
Caribbean+Cabo Verde
Brazil+Guinea+S.Atlan
NE+N.Cen + NW Pacific
N.+S. Equatorial Pacific
Warm pool Pacific
S.Cen+SE+Australia Pac
Central Indian Ocean
Arabian + Red Sea

Area of Interest: Global
Reference SST: OSTIA 5km Daily
Aggregation Time: Daily | Monthly
Outlier handling: Retained | Removed
Scene: Night | Day
Product of Interest: Sentinel-3A SLSTR | Metop-B AVHRR | Metop-B IASI | Select all

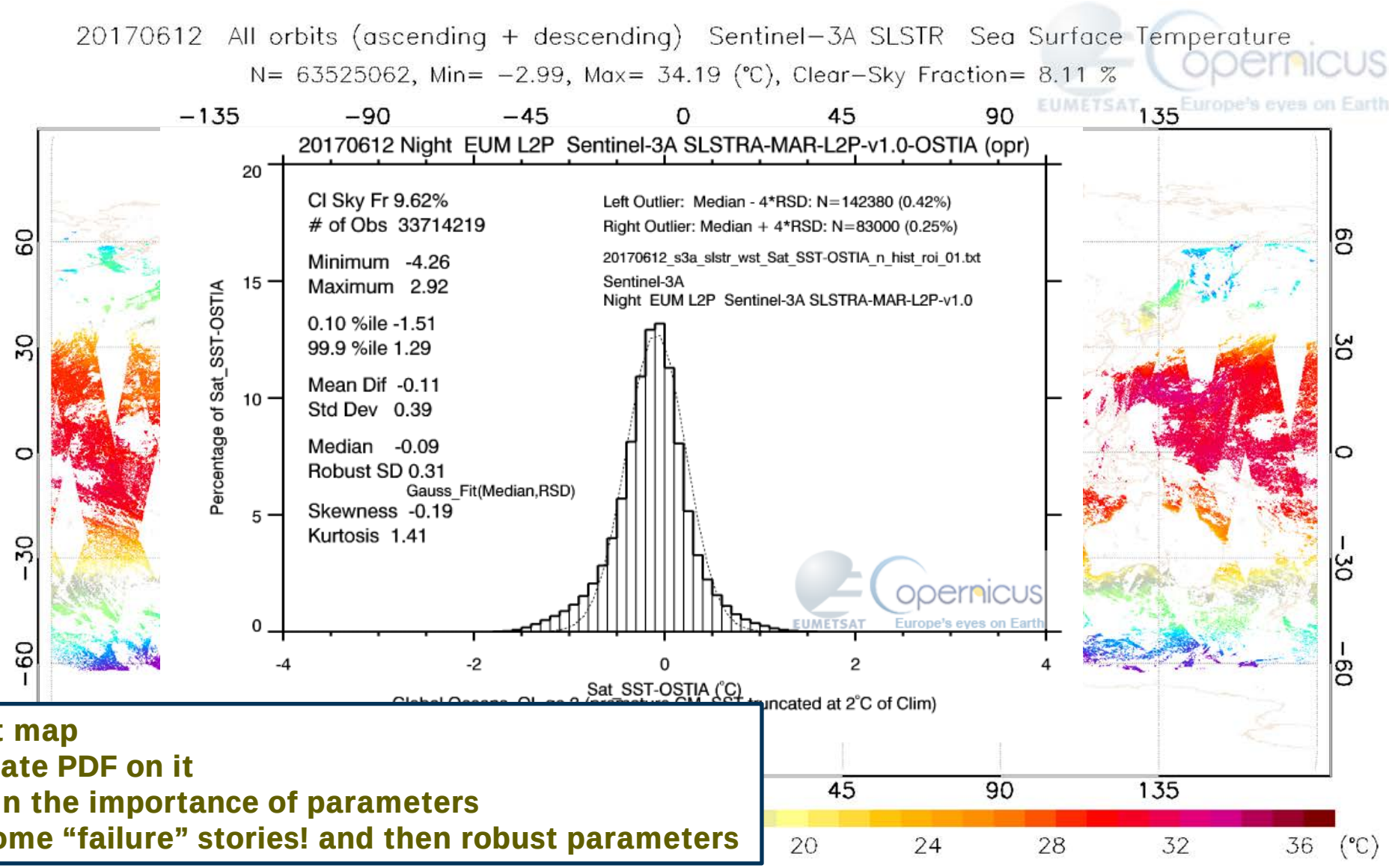




CONTACT US
LEGAL INFORMATION

METIS

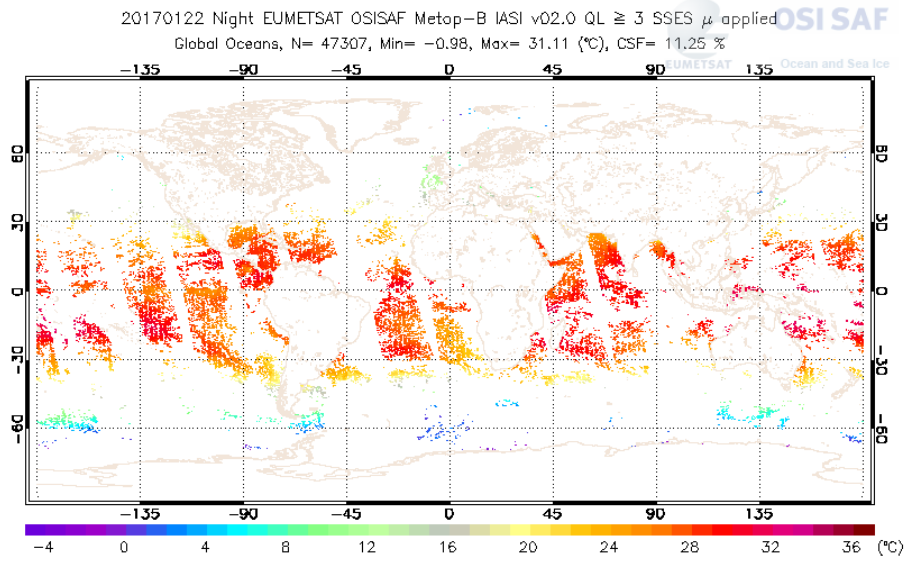
revisiting the parameters of a probability density function: the data will tell their story…

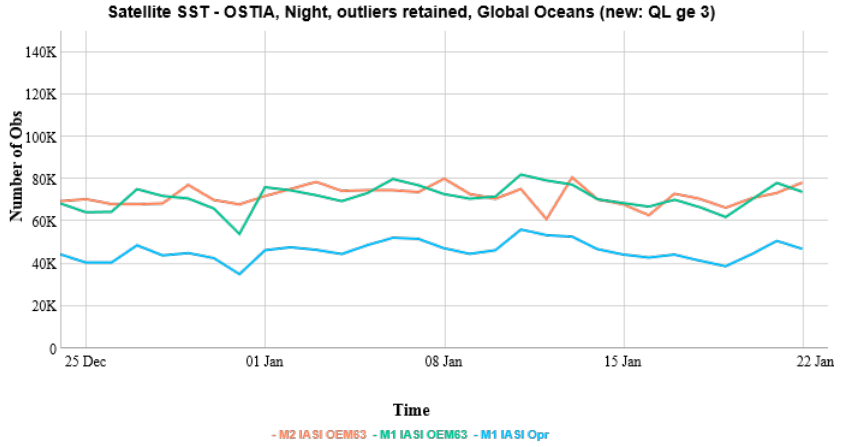


Latest map
Annotate PDF on it
Explain the importance of parameters
Tell some "failure" stories! and then robust parameters

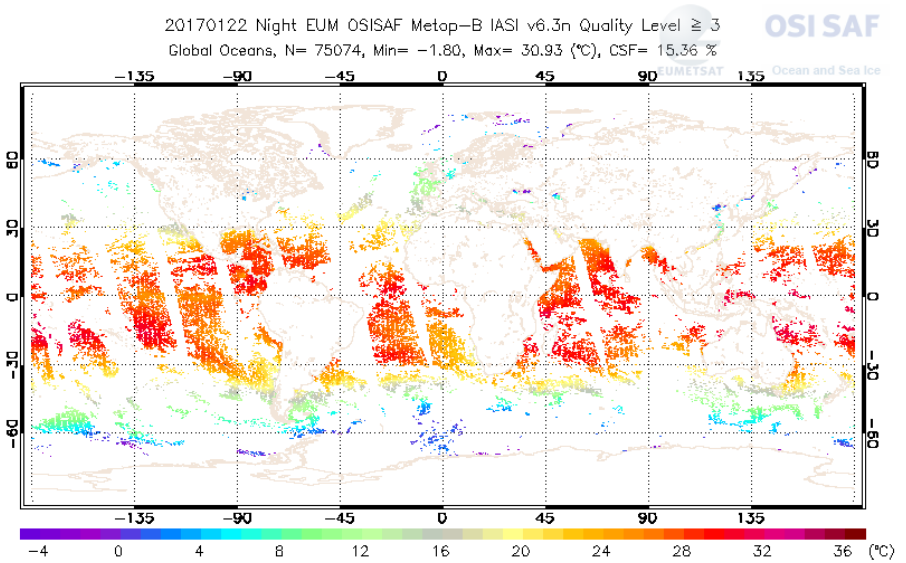
Some more case studies: **IASI version update & improvements (internal)**

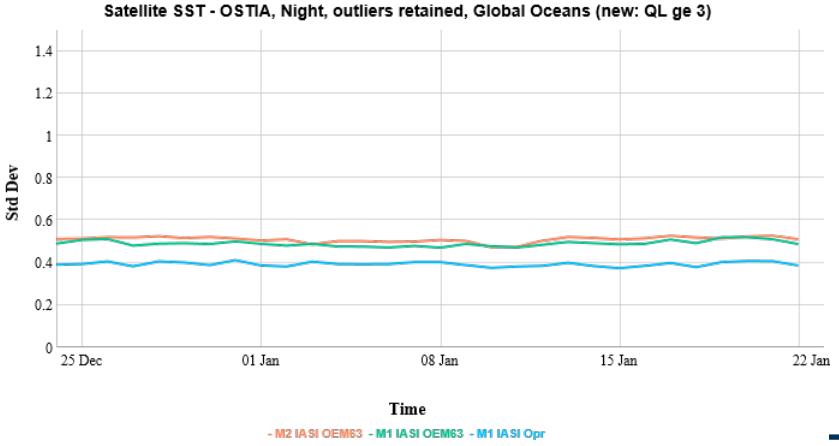
Operational





Experimental (internal)





Story: coverage doubled; trade-off with std dev; almost double coverage, 0.1K Std Dev increase

Some more case studies: **Sentinel-3A WST REF/OPE transition (internal)**

Some more case studies: **S3A WST sensitivity to QL/SSES etc (internal)**

METIS METIS-SST METIS-OC EUMETSAT WEBSITE

MAPS: GLOBAL OCEANS

- METIS-SST
- Data Sources 3
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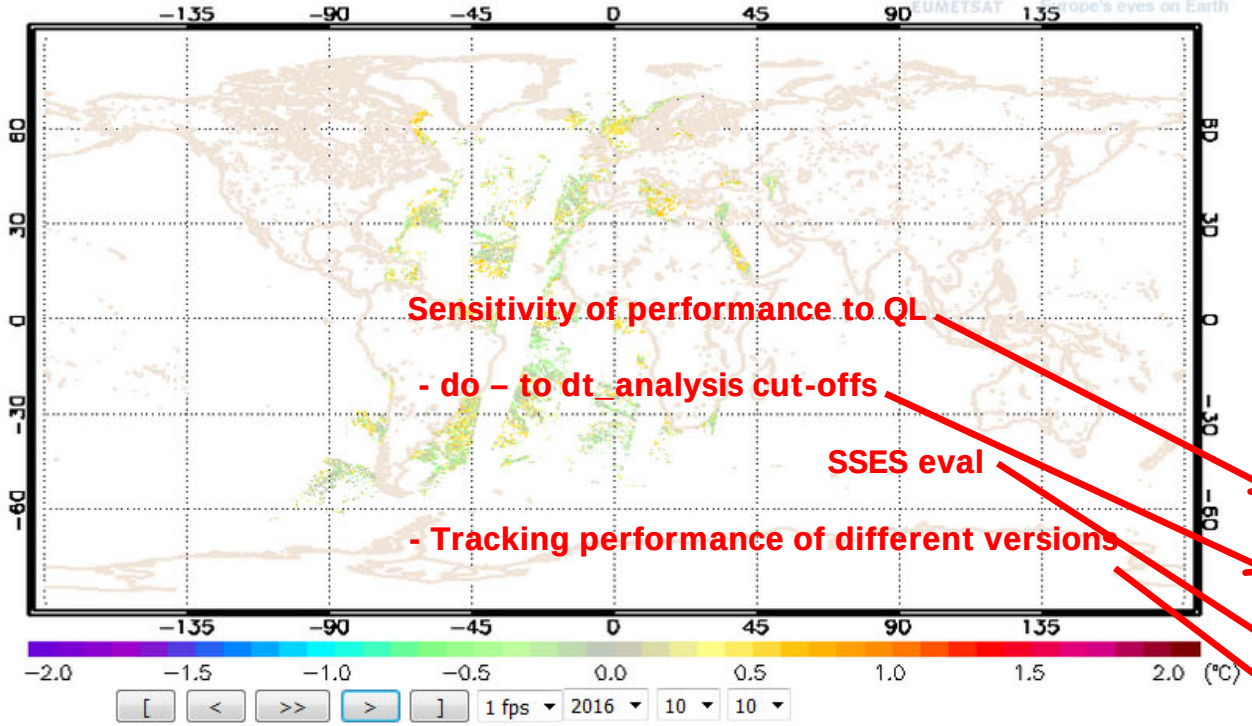
Map type

- Residual space (SST-REF)
- Subtypes (visual analysis)
- Retrieval space (SST)
- Theoretical uncertainty
- Dual-Nadir SST

Sentinel-3A SLSTR L2P SST minus UKMO OSTIA L4, Day, 20161010, outliers retained, Global Oceans

20161010 Day EUM L2P Sentinel-3A SLSTRA-MAR-L2P-v1.0 – OSTIA (opr) Qual Lev ≧ 2

Global Oceans, N= 4752529, Min= −3.74, Max= 2.37 (°C), outliers retained no cutoff wrt dt_analysis [−2,2]°C clim



Sensitivity of performance to QL

- do – to dt_analysis cut-offs

SSES eval

- Tracking performance of different versions

Area of Interest: Global

Reference SST: OSTIA 5km Daily

Aggregation Time: Daily / Monthly

Outlier handling: Retained / Removed

Scene: Night / Day

Product of Interest: Sentinel-3A SLSTR / Metop-B AVHRR / Metop-B IASI

GDS Quality Level: 2 3 4 5 ge 2

dt_analysis cutoff (°C): 2 3 4 5 none

Apply climate cut-off

Apply SSES Bias (*new)

MPC Proc BL (WST): TDS 22 May 2017 / 2.13 (31 Mar) / 2.12 (16 Mar)

Spin-off potential, extreme events; Peruvian SST anomaly

Peruvian coast

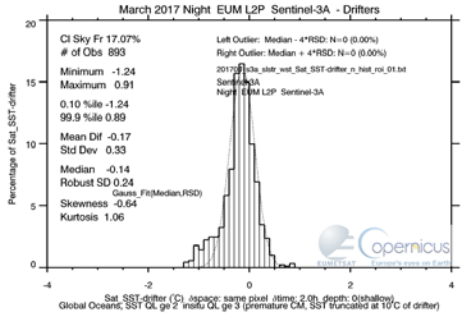
Coastal El Nino, Feb-Mar 2017

SST anomaly exceeding 5°C

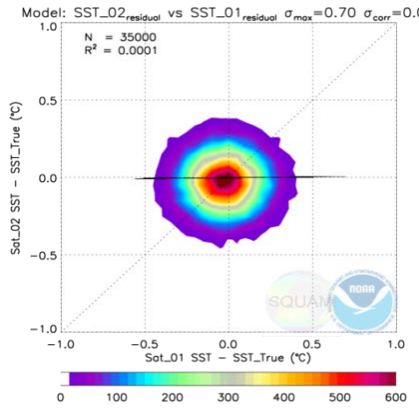
Caused intense flooding

Work in progress and potential Improvements

- **In situ (Felyx) recently added for S3A; extending time-series and for other sensors**
- **WCT analysis (internal), work in progress**
- **Triple-collocation (ts, spatial)**
- **Correlated error analysis**
- **CM analysis (test case S3)**
- **Analyses of BT in SST bands**
- **Geo capability**

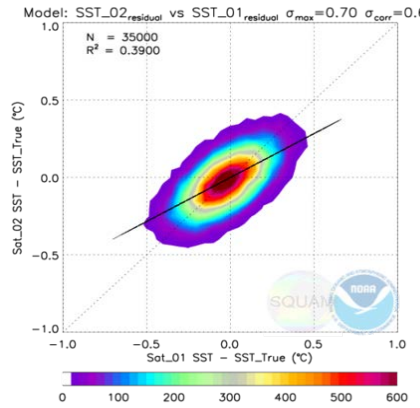


Two Δ (σ1, σ2)



σ_1,σ_2 uncorrelated; σ_{corr} = ~0.0
Ideal case for independent SST

Imp for TANDEM Data S3A/S3B



σ1,σ2 ~~un~~correlated; σ_{corr} = ~0.62
R^2 = ~0.39; moderate linear
Practical case

Thanks