EUMETSAT Sea Surface Temperature activities

Anne O'Carroll

4th June 2018

GHRSST international science team meeting

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Oceanography at EUMETSAT

Sea Surface Temperature

Sea surface winds

Sea-ice products

Radiative fluxes

Significant wave height

Sea surface topography

Sea-ice ST/MIZT

Ocean Colour products

Turbidity

Aerosol optical depth over water

The EUMETSAT Network of Satellite Application Facilities | **OSI SAF** Ocean and Sea Ice

- Operational data provider
- Weather, climate, ocean, atmospheric composition
- Mandatory, Optional and Third party programmes
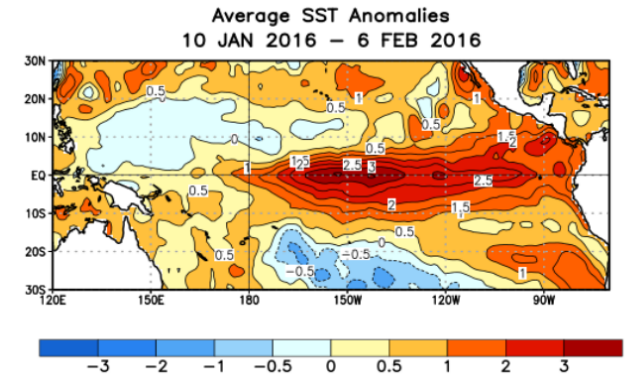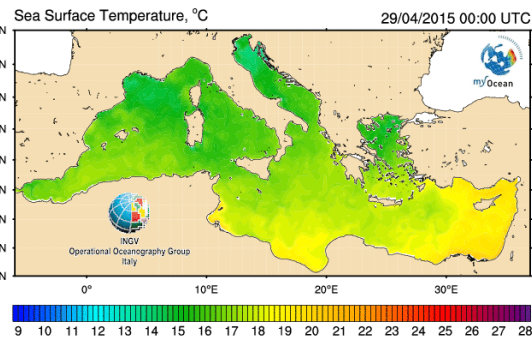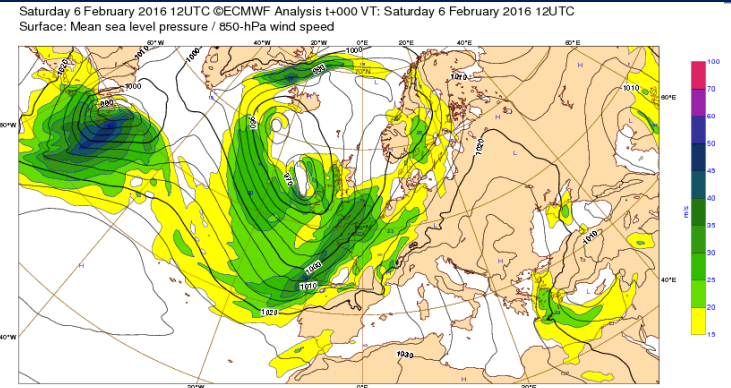- EUMETSAT Ocean and Sea Ice Satellite Application Facility

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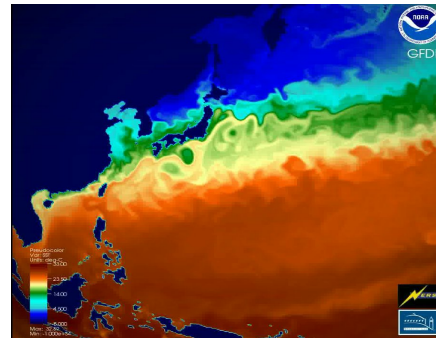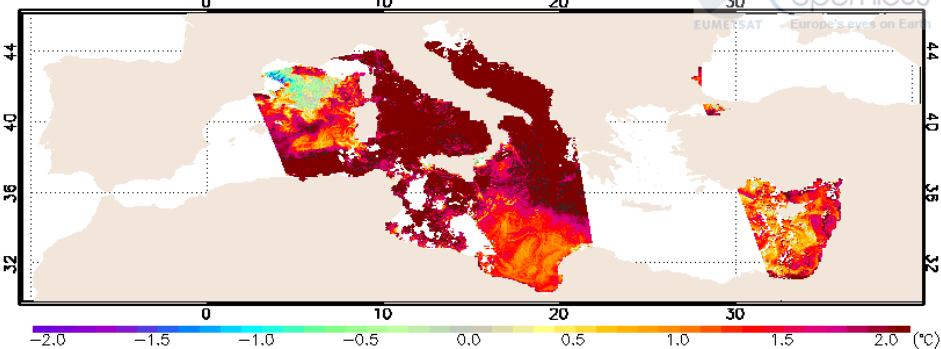# Sea Surface Temperature applications & user needs

EUMETSAT member states

Copernicus Marine
Environment Monitoring
Service (CMEMS)

GHRSST

CEOS, CGMS

Sea Surface Temperature missions

- Most recent launches:
    - Copernicus Sentinel-3B: ~25th April 2018
    - Copernicus Sentinel-3A (16th Feb 2016)
    - MSG-4 (15th July 2015)
    - Metop-B (17th Sept 2012)

- Future:
    - Metop-C (AVHRR, IASI): 21st October 2018
    - MTG-I1 (FCI): ~Q4 2021
    - Metop-SG A (MetImage, IAS): ~Sept 2021
    - MTG-S1 (IRS): ~Q1 2023

- Meteosat-8 Indian Ocean Data Coverage (IODC) Services available from January 2017 onwards.
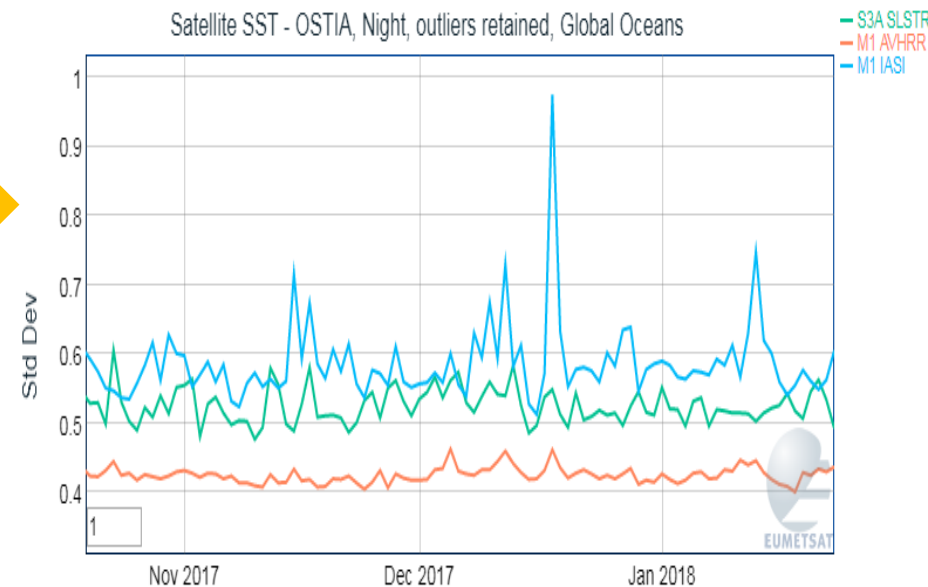
Surface Temperature Radiometry

- Main Products
  - Sea Surface Temperature from Thermal Infra-red missions
- **Context**
  - Copernicus Marine Services needs
  - EUMETSAT delegation for Copernicus Sentinel-3 marine data services
  - EUMETSAT Geostationary and Polar operations and programmes
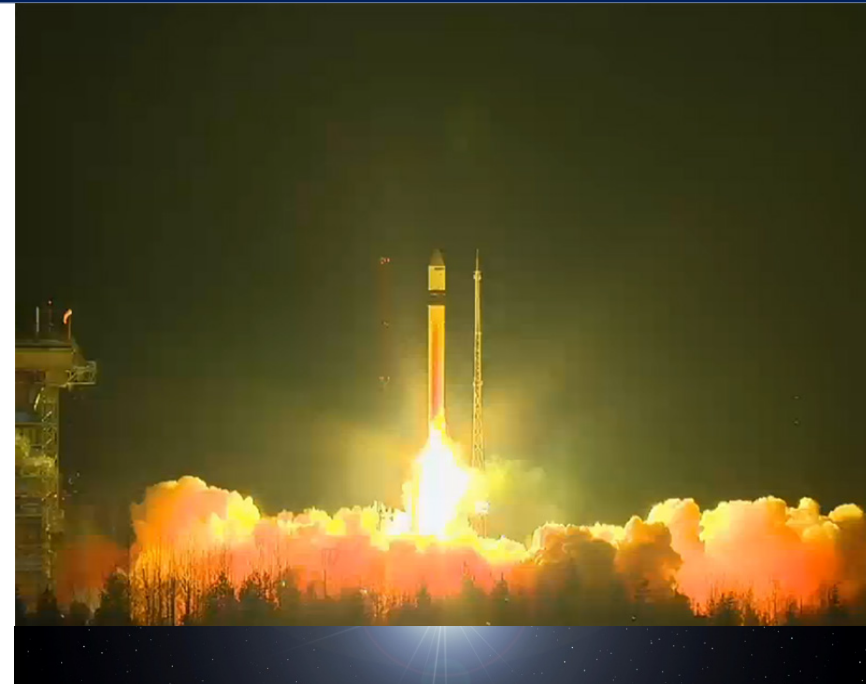 - OSI SAF
- **Priority Objectives**
  1. Continuously Improve Sentinel-3 SLSTR and IASI operational products
     to fully meet user requirements
  2. Continuously Improve SST Operational Performance Monitoring
     to support operational service provision
  3. Establish Sustainable Fiducial Reference Measurements
     to support monitoring, continuous improvement
  4. Evolution of Operational Products according to User Requirements

Satellite SST - OSTIA, Night, outliers retained, Global Oceans
— S3A SLSTR
— M1 AVHRR
— M1 IASI

http://metis.eumetsat.int

Copernicus Sentinel-3 SLSTR

Sea and Land Surface Temperature Radiometer
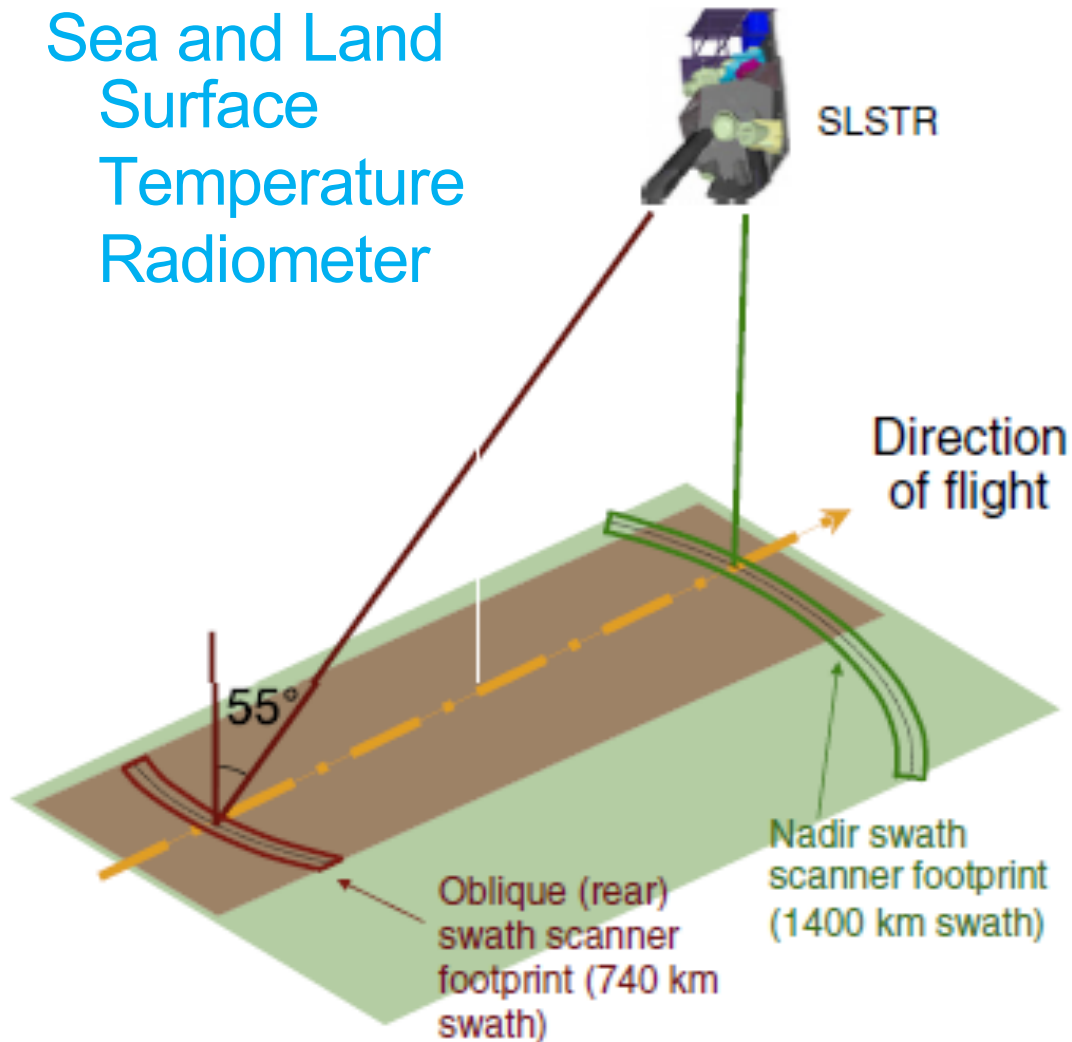

Band characteristics of the Sentinel-3 Sea and Land Surface Temperature Radiometer (SLSTR). F1 and F2 are dedicated active fire monitoring bands.

SLSTR band	L centre [μm]	ΔL [μm]	SNR [–]/ NeΔT [mK]	SSD [km]	Function
S1	0.555	0.02	20	0.5	Cloud screening, vegetation monitoring, aerosol
S2	0.659	0.02	20	0.5	NDVI, vegetation monitoring, aerosol
S-3	0.865	0.02	20	0.5	NDVI, cloud flagging, Pixel co-registration
S4	1.375	0.015	20	0.5	Cirrus detection over land
S5	1.61	0.06	20	0.5	Cloud clearing, ice and snow, vegetation monitoring,
S6	2.25	0.05	20	0.5	Vegetation state and cloud clearing
S7	3.74	0.38	80 mK	1.0	SST, LST, Active Fire
S8	10.95	0.9	50 mK	1.0	SST, LST, active fire
S9	12	1.0	50 mK	1.0	SST, LST
F1	3.74	0.38	<1 K	1.0	Active fire
F2	10.95	0.9	<0.5 K	1.0	Active fire

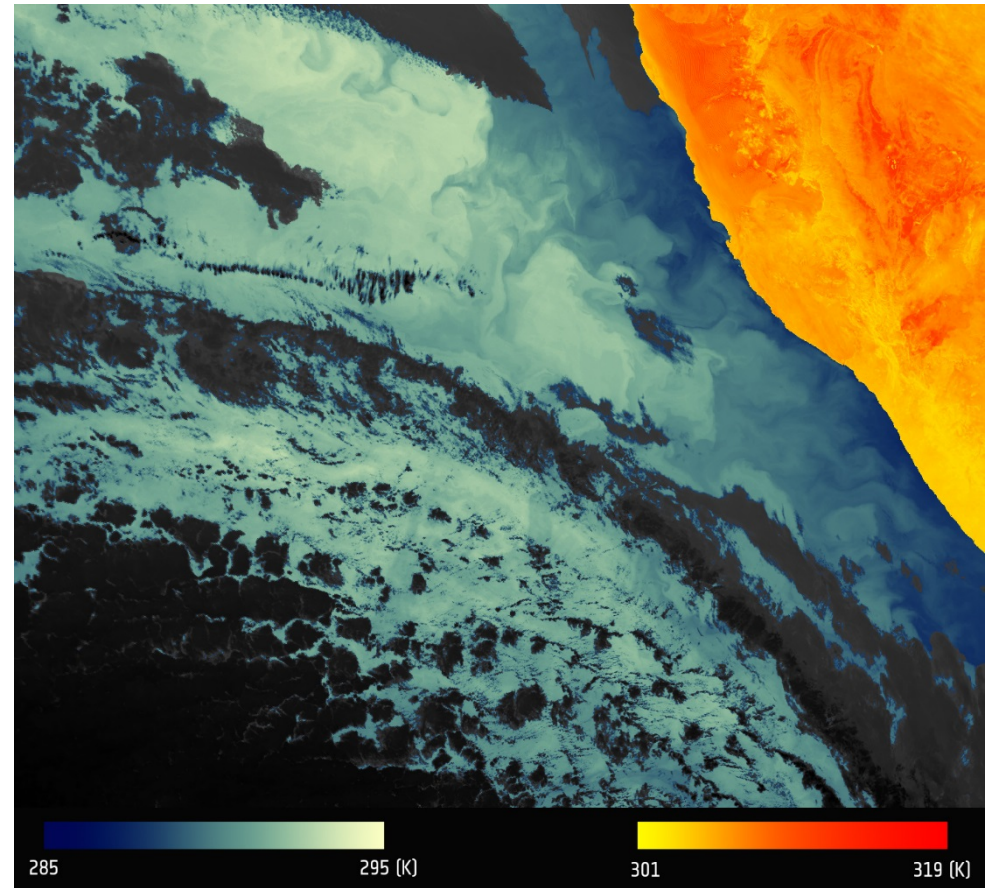# Sentinel-3 Sea and Land Surface Temperature Radiometer (SLSTR) SST

Sentinel 3A SLSTR sea surface temperature (S3A_SL_2_WST) - September 2016
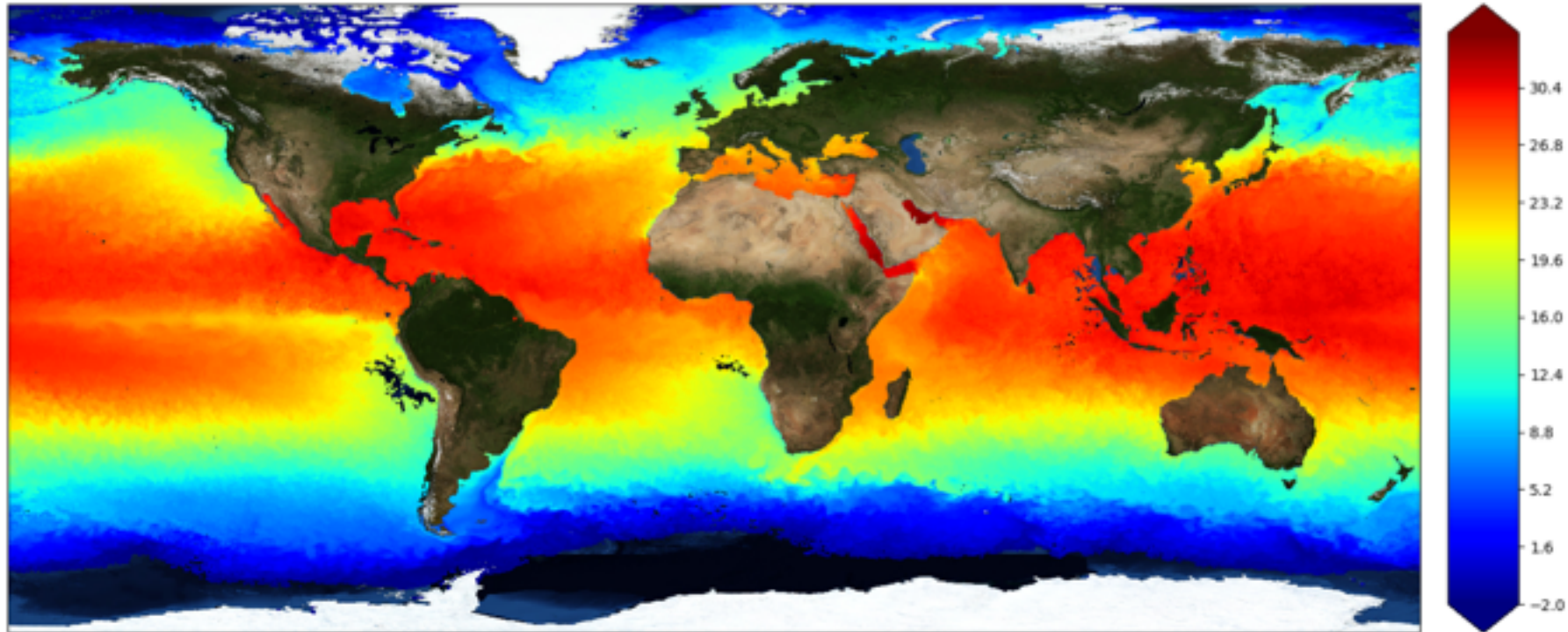
- Sentinel-3A launched 16th February 2016
- Sentinel-3B launched 25th April 2018

Sentinel-3 SLSTR-A Sea Surface Temperature

- Operational release of SLSTR-A SST: 5th July 2017
- Major version update: 4th April 2018
  - Bayesian cloud implemented & revised Quality Level's
- Reprocessing: SLSTR-A SST is currently undergoing a full reprocessing (04/2016-04/2018), to be completed this summer
- For more information on SLSTR SST and validation results so far
-> Wednesday morning

285   295 (K)   301   319 (K)

https://www.eumetsat.int/website/home/Data/CopernicusServices/Sentinel 3Services/SeaSurfaceTemperature/index.html

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Sentinel-3 SLSTR-B

- Sentinel-3B launch 25th April 2018
- Visible channels switched on 9th May 2018
- Infrared channels switched on 30th May 2018
- Commissioning to end of July 2018
- SST products to Sentinel-3 Validation Team ~ Aug 2018
- Operational SST projects available by ~ end 2018
- Participation to S3 Validation Team still open (https://earth.esa.int/aos/S3VT).

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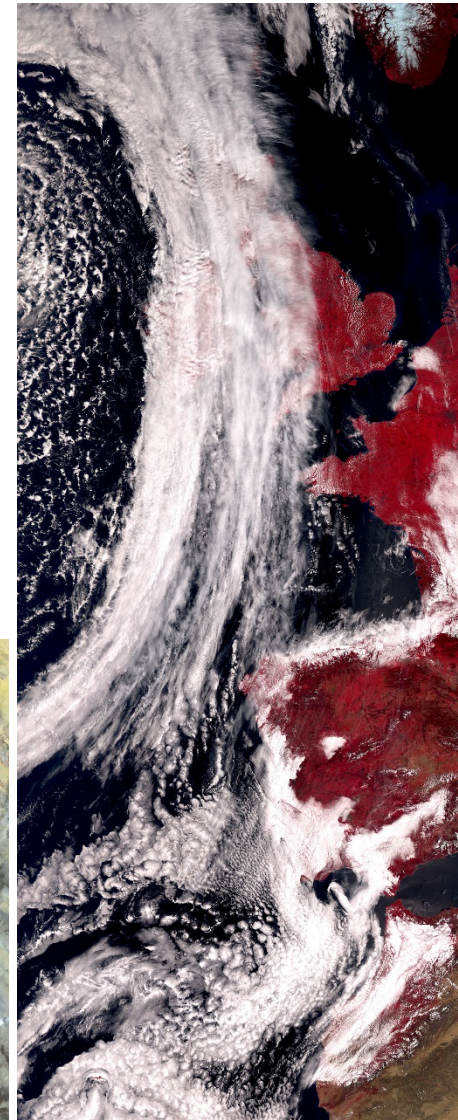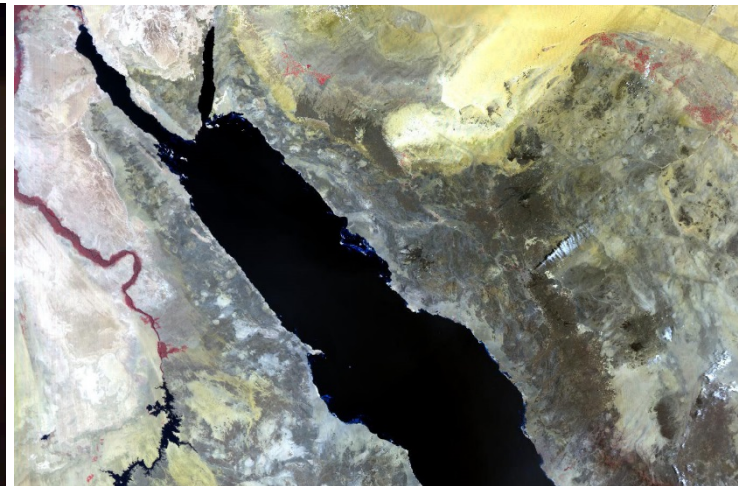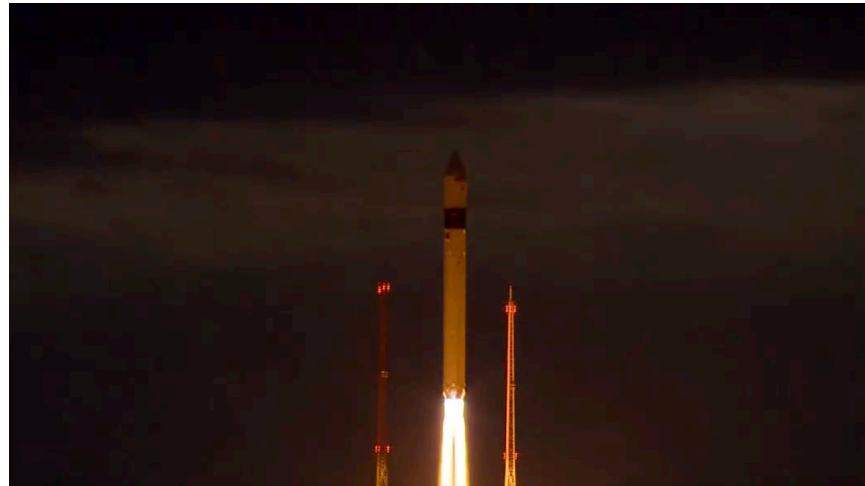
SLSTR MDB (see presentation by Jean-Francois Piolle)
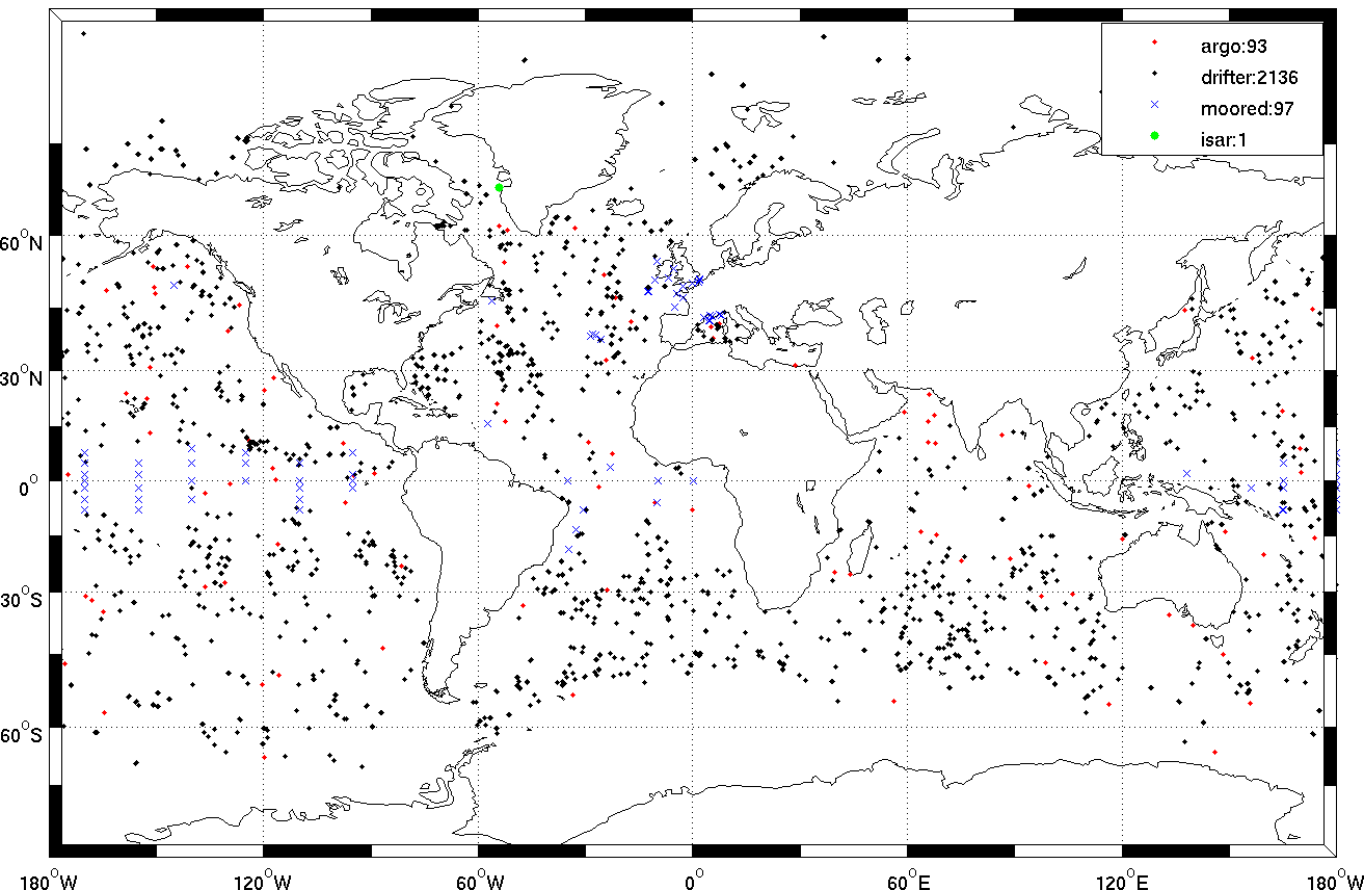
- Routine collocation of in situ and satellite data.

- Drifters, Moored buoys, Argo, Ship Borne radiometers.

- Use of Coriolis.

- Coordination with international teams.

Sentinel-3 SLSTR validation

SLSTR WCT D3 SST$_{skin}$ versus drifter SST$_{depth}$

SLSTR WCT SST$_{skin}$ versus drifter SST$_{depth}$

- 2-ch Day
- 2-ch Night
- 3-ch Night
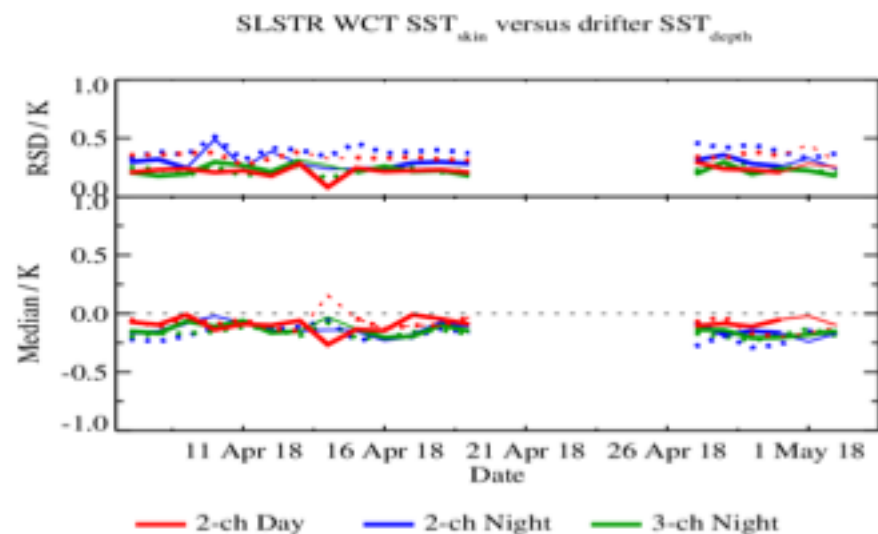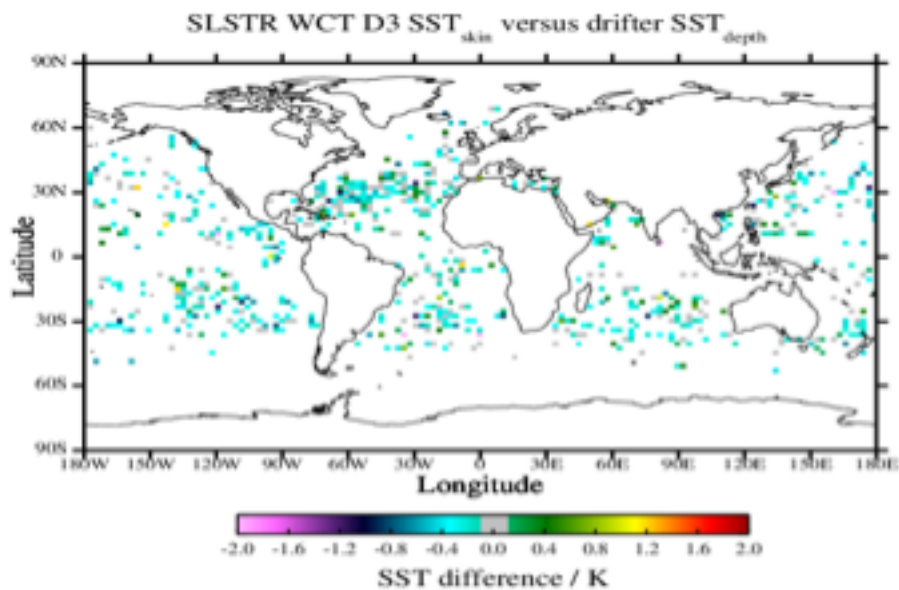
- Uncertainties meet mission requirements, mostly < 0.3K for all algorithms.

- Example results from cycle 30 (G. Corlett)

SLSTRA Nighttime SST: Cycle #030

SLSTRA Nighttime SST Number of Samples: Cycle #030
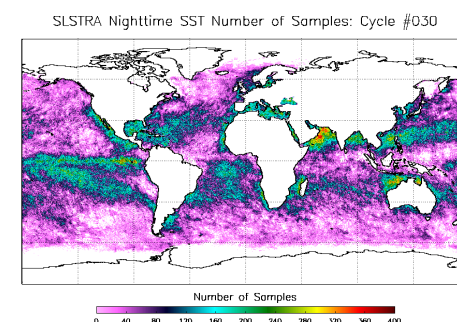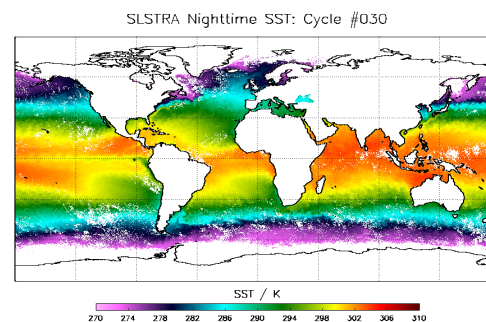
- See presentation by Gary Corlett on Wednesday

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METIS (metis.eumetsat.int)

- See presentation by Prasanjit Dash

Radiometric calibration: SLSTR/IASI (I. Tomazic)

- SNO → collocations → spectral convolution → aggregation
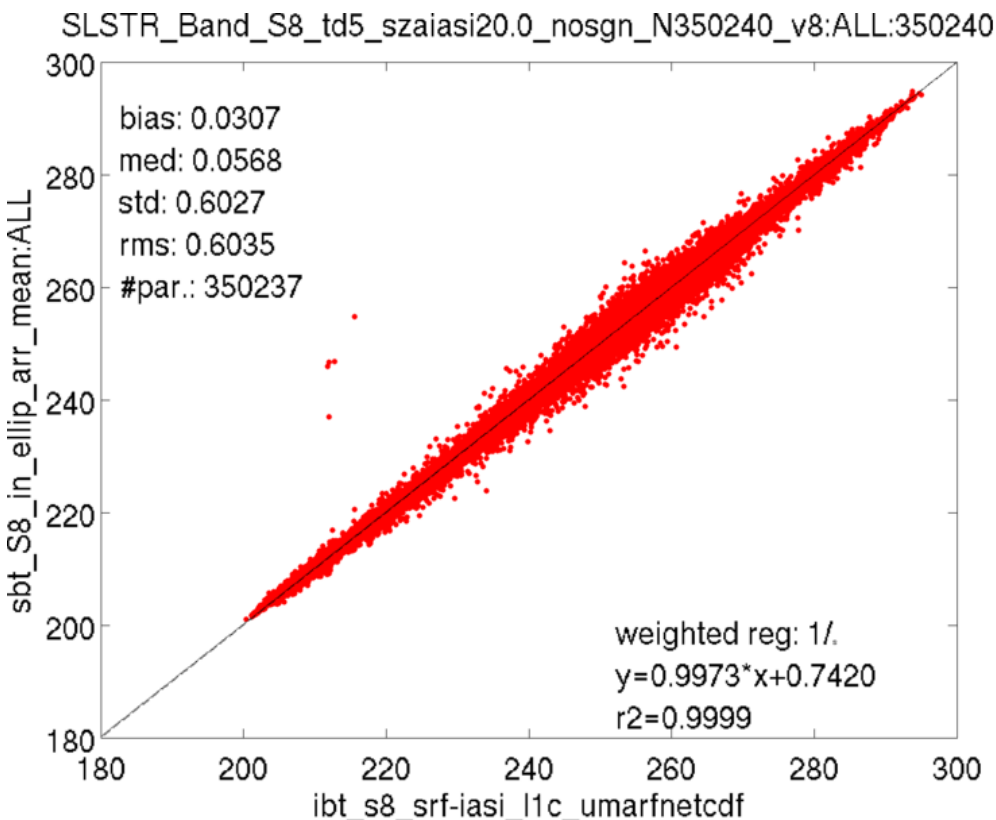
ALL pixels   **Homogenous pixels: σ < 0.4 K**
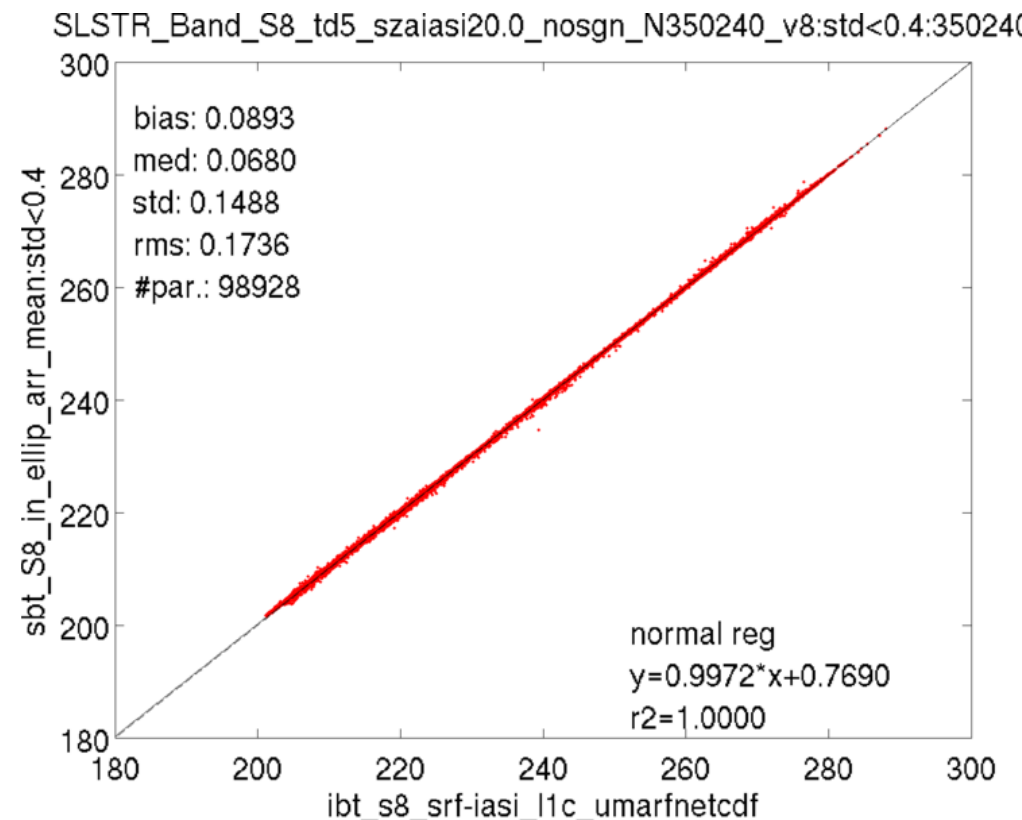
Sentinel-3 Validation team - temperature

PI	Country	Institution
Minnett Peter	USA	RSMAS
Nightingale Tim	UK	STFC
Saunders Roger	UK	Met Office
Beggs Helen	Australia	BoM
Høyer Jacob	Denmark	DMI
Mittaz Jonathan	UK	University of Reading / NPL
Wimmer Werenfrid	UK	University of Southampton
Dybkjær Gorm	Denmark	DMI
Corlett Gary	UK	University of Leicester
CMEMS	FRANCE	Mercator-Ocean
Ignatov Alexander	USA	NOAA-NESDIS
Bob Brewin	UK	PML
Aida Alvera-Azcarate	Belgium	University of Liege
Emmanuelle Autret	France	Ifremer
Harris Andrew	USA	University of Maryland

Activities range:
- Ship borne radiometers
- Drifting buoys / Argo
- Climate / NWP
- Coastal, fronts, high latitude / MIZ, lakes, new measurement techniques, calibration

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SLSTR session at GHRSST Wednesday 6th June

Wednesday 6th June, 11:00-13:00

11:00-11:15	The Sentinel-3 Tandem Mission	Craig Donlon
11:15-11:30	Monitoring and evaluation of SST products in the EUMETSAT METIS framework: a year of S3A SLSTR data and preparation for S3B	Prasanjit Dash
11:30-11:45	An open-source cal/val environment and its application to Sentinel-3A SLSTR	Jean-François Piollé
11:45-12:00	Independent validation of Sentinel 3A SLSTR sea surface temperature products	Gary Corlett
12:00-12:15	Sentinel-3 SLSTR SST Validation using a Fiducial Reference Measurements (FRM) Service	Werenfrid Wimmer
12:15-12:30	Assessment of SLSTR L2P SST data as input to the CMEMS MED L3S/L4 multi-sensor operational system	Rosalia Santoleri
12:30-13:00	Open discussion led by session chair	

Interactive presentation #42: Igor Tomazic, Sentinel-3 SLSTR Cal/Val activities for Sea Surface Temperature measurements

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SLSTR marine products from EUMETSAT

Product	EUMETCast	ODA	Data Centre (UMARF)	Timeliness
SLSTR L1B		✓	✓	NRT, NTC
SLSTR L2 WST (GHRSST L2P)	✓	✓	✓	NRT
		✓	✓	NTC
SLSTR L2 WCT	Internal products only available to "special users"		✓	NRT
			✓	NTC

- Internal products available to Sentinel-3 validation team

EUMETSAT Services & Data Access

Marine Centre

User Support
User Registration & Support, Product Discovery Helpdesk, etc

User Service
Helpdesk
EO Portal

NRT & STC Marine Dissemination

NRT, STC & NTC ODA

Data Centre Archive
UMARF

Users

S3 Online Data Access (ODA)
Rolling archive of ~1 m of data supporting ftp access

Copernicus Online Data Access (CODA & CODAREP)
Rolling archive of ~12 of S3 data supporting http access + GUI + Reprocessed Dataset

S3VT "Mini Files"
ftp access only for S3VT members

EUMETSAT Data Centre
Complete historical archive of all EUMETSAT data including S3 marine data

More info from: www.eumetsat.int

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IASI Sea Surface Temperature

- OSI SAF IASI SST operational

- v6.2 - of IASI L2 processor June 2016 (no SST impact)

- v6.3 - 20th June 2017 to include SST retrieval update (greater number of clear obs; aerosol flagging/correction; uncertainties)
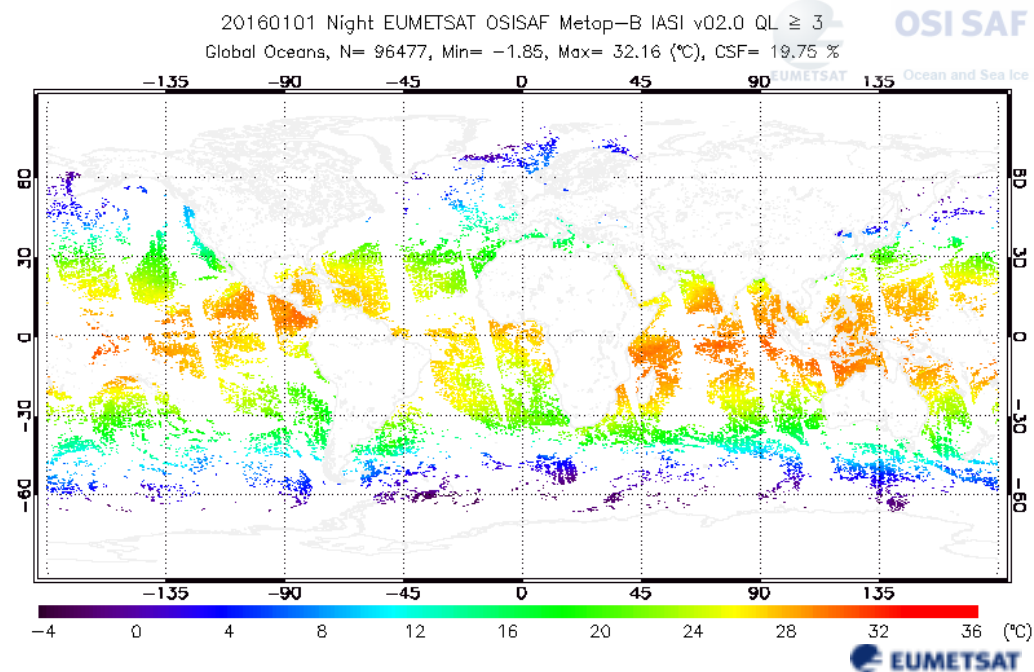https://www.eumetsat.int/website/home/News/DAT_3423485.html

- v6.4 - 7th March 2018
https://www.eumetsat.int/website/home/TechnicalBulletins/IASI/DAT_3829049.html
  - SSES will be updated in next 3 months

- Project with DMI on IASI IST validation completed in 2017.

- Metop-C launch 21st September 2018

20160516 Day EUMETSAT OSISAF Metop-B IASI v02.0 - OSTIA (monthly climate)
North + South Tropical Pacific, N= 26259, Min= -2.65, Max= 4.20 (°C), outliers retained

20160101 Night EUMETSAT OSISAF Metop-B IASI v02.0 QL ≥ 3
Global Oceans, N= 96477, Min= -1.85, Max= 32.16 (°C), CSF= 19.75 %
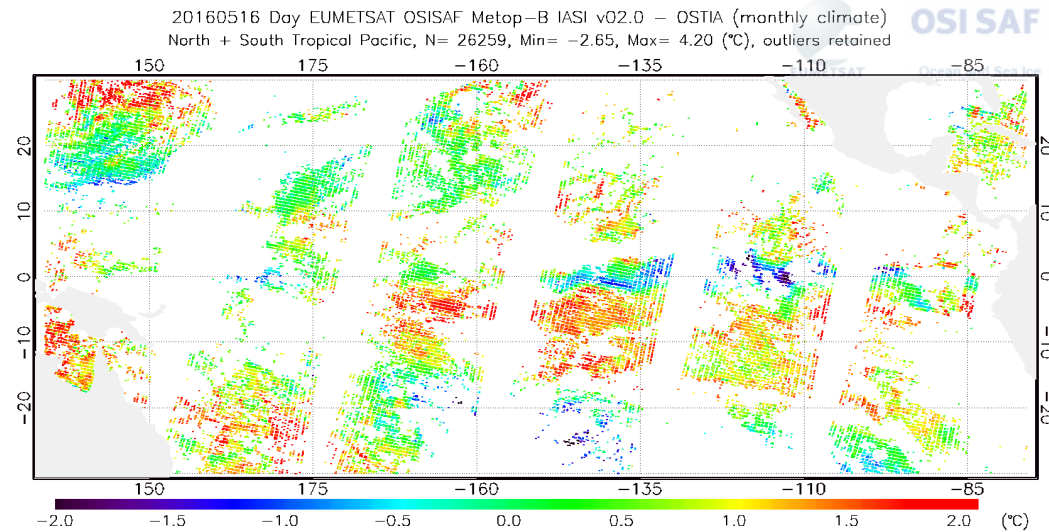
Relevant Copernicus Projects - overview

- SLSTR sea-ice cloud-screening (completed 2017)

- GHRSST Project Office (began 2017, previously ESA)
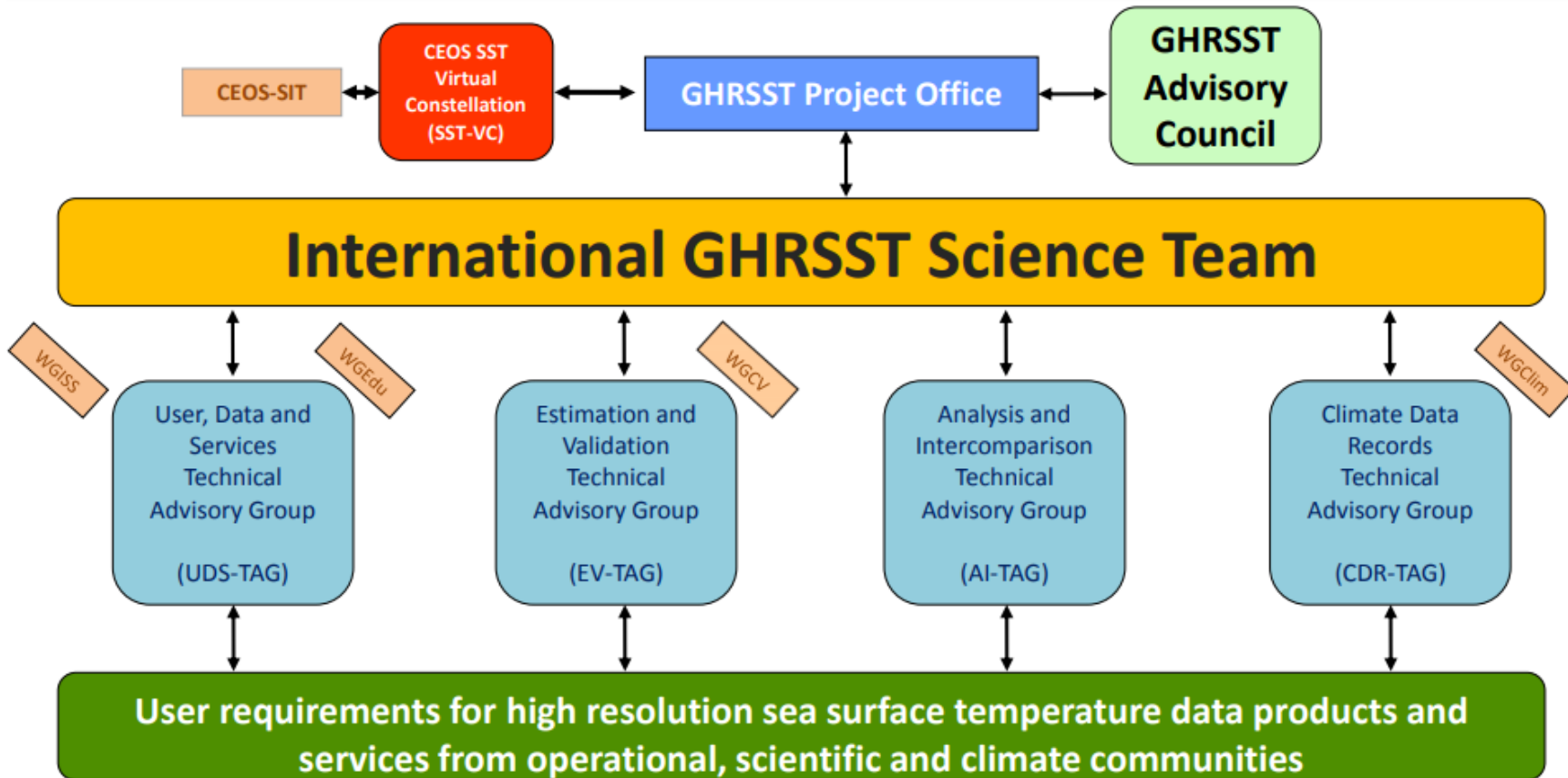- Drifting buoys – towards FRM (2018-2022)

Upcoming:
- Diurnal variability and skin effect model (2018)
- SLSTR sea-ice surface temperature (2018)
- Plus various projects related to SLSTR Level-1 / 2 improvements

GHRSST Project Office

GHRSST Project Office Director: Gary Corlett
GHRSST Project Administrator: Silvia Bragaglia-Pike
GHRSST data discovery and cataloguing: Jean-Francois Piolle

Fiducial Reference Measurements - definition

"The suite of independent ground measurements that provide the maximum return on investment for a satellite mission by delivering, to users, the required confidence in data products, in the form of independent validation results and satellite measurement uncertainty estimation, over the entire end-to-end duration of a satellite mission"
(Sentinel-3 Validation Team)

- Based on specific requirements
- Linked to a mission's Cal/Val plan activities
- Building on existing capabilities
- Forward thinking and long-term vision
- Not necessary mission specific
- SI traceable, metadata database, manufacturer documentation

Drifting buoys – HRSST2

"Towards Fiducial Reference Measurements from high resolution sea surface temperature drifting buoys (TRUSTED)"

The main objectives of this Copernicus / Eumetsat funded Project are:
- to provide a service of SST and other drifting buoy measurements from 100-150 drifting buoys with improved calibration capability;
- to improve the SST uncertainties from the use of additional digital SST probes and reporting position and timeliness improvements, and thus providing a service of improved SST observations to the GTS;
- to improve on the standard SVP-B drifting buoy coordinated by the Data Buoy Cooperation Panel (DCBP), retaining the original SST sensor for inter-comparison.

In effect: Design Manufacture and Deploy 100-150 HR SST buoys whilst insuring high quality and high traceability: new source of wet measurements

Drifting buoys – HRSST2 – GHRSST inputs

- Additional digital SST probe to standard SVP-B.
- Near surface water pressure sensor.
- Provide a service via ftp and GTS, possible inclusion of high frequency data.
- SST uncertainty better than +-0.05K
- Review workshop planned ~2021 – independent assessment of the outcomes of the project and towards FRM status – GHRSST inputs.
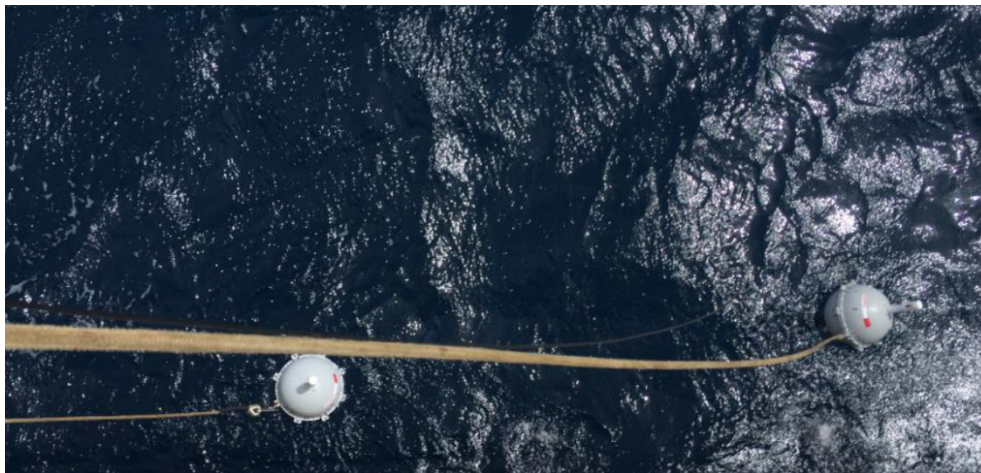
Copernicus collaborative exchange support

- Opportunity for new and experienced users interested in collaborating on the use of data from the EUMETSAT Copernicus marine data stream.
- Recipients expected to produce a short case study on their experience, which will be shared on the EUMETSAT web-site.

https://www.eumetsat.int/ website/home/Technical Bulletins/Training/index.html

COPERNICUS COLLABORATIVE EXCHANGE SUPPORT

WE'RE LOOKING FOR NEW AND EXPERIENCED USERS INTERESTED IN COLLABORATING ON THE USE OF DATA FROM THE EUMETSAT COPERNICUS MARINE DATA STREAM.
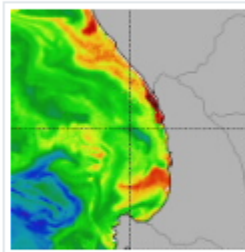
Applications for the Copernicus exchange are welcome from across any industries and sectors. Applications should show potential for exchange of expertise with regards to the Copernicus data, and research/application outputs. They must include details the motivation for applying: the work you wish to conduct, the satellite data you will use, the potential impact of this work, and justify why this particular exchange is necessary to achieve this.

Recipients will be expected to produce a short case study on their experience, which will be shared on the EUMETSAT website.
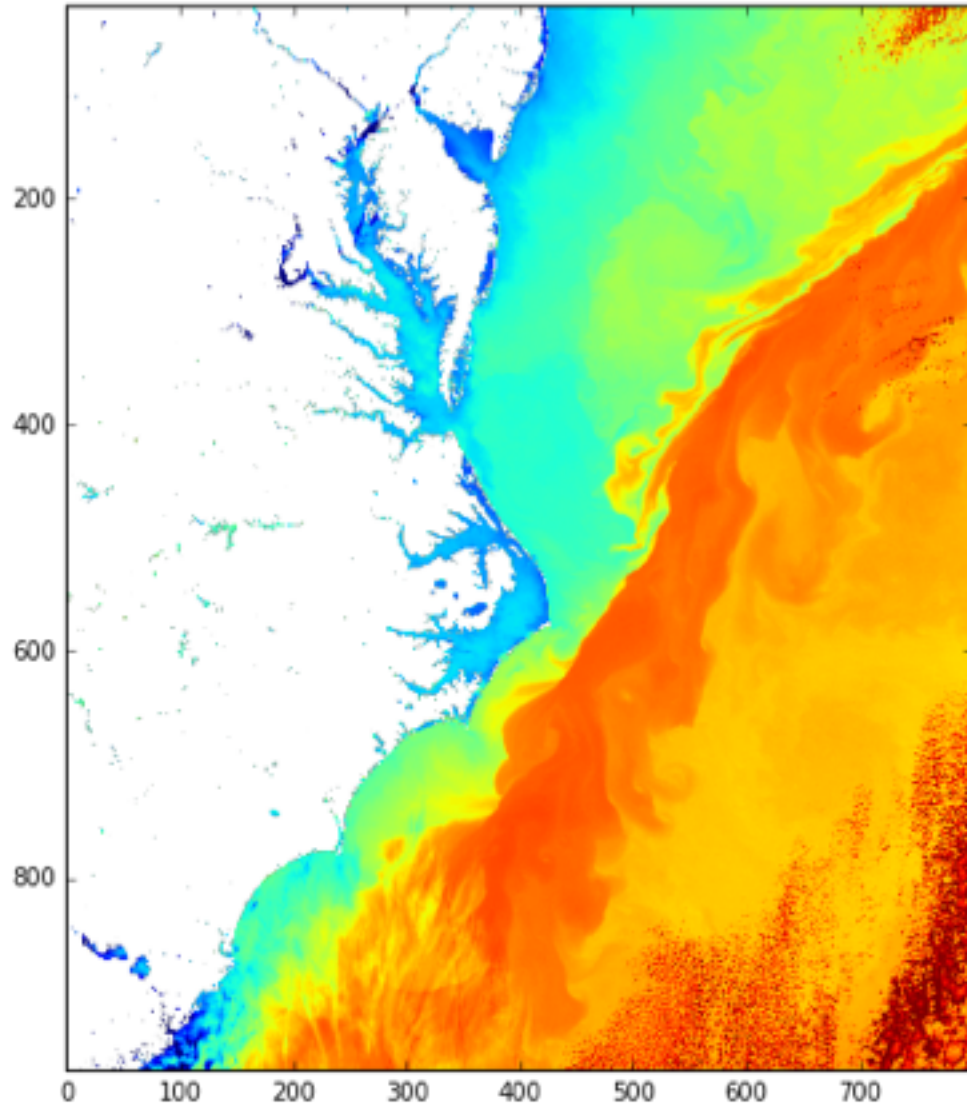
Application deadlines:

- 1 August for exchange in September–December 2018
- 1 March for exchange in April–June 2019
- 1 June for exchange in July–September 2019

Application should made to copernicus.training@eumetsat.int. Please read the ▸ criteria document before applying.

Thank you

SLSTR

OLCI