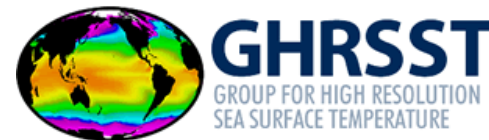


## Update on Copernicus Marine Environment Monitoring Service (CMEMS) Sea Surface Temperature Thematic Assembly Centre (SST-TAC)

B. Buongiorno Nardelli (on behalf of the SST-TAC team)





### Copernicus Services



### CMEMS elements





**Leader:** B.Buongiorno Nardelli (CNR)

**Deputy:** A.Pisano (CNR)

**MultiYear Product Expert:** S. Good (Met Office)

**Product Quality Expert:** E.Autret (Ifremer)

**Earth Observation Expert:** R.Santoleri (CNR)

	Acronym	Name	Country	Resp.
1	CNR	National Research Council	Italy	Coordination Data production
2	DMI	Danish Meteorological Institute	Denmark	Data production
3	IFREMER	French Research Institute for Exploitation of the Sea	France	Data production
4	MET	Norway Norwegian Meteorological Institute	Norway	Service Desk
5	METO	Met Office	UK	Data production
6	MF	Météo-France	France	Data production

**Production Unit leaders:**

A.Pisano (CNR)

J. Høyér (DMI)

J.-F. Piollé (Ifremer)

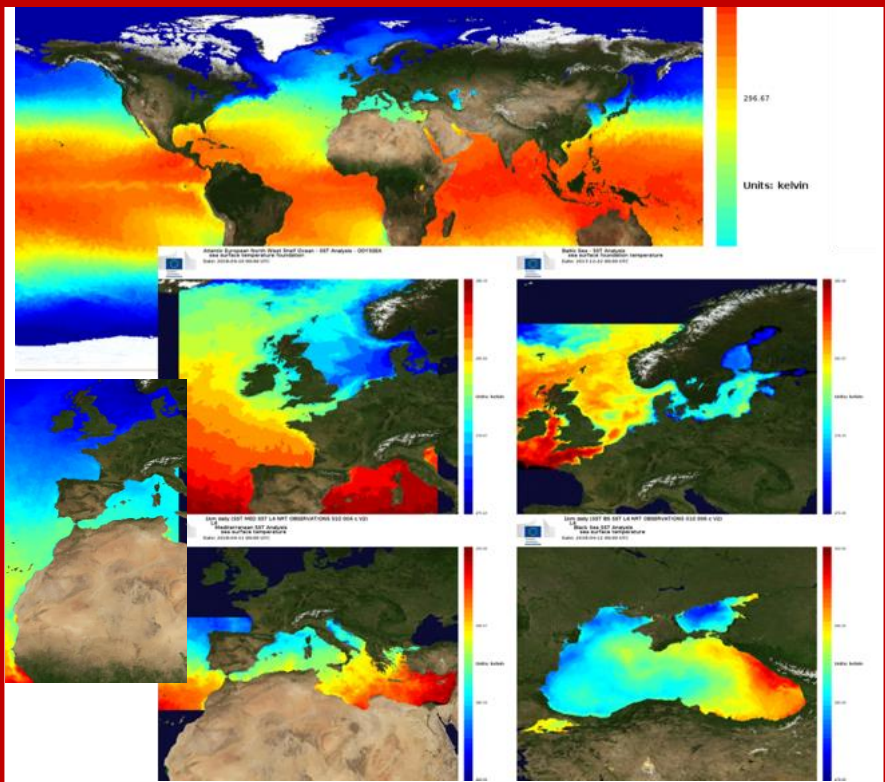
S. Good (Met Office)

E. Saux Picart (Météo-France)



## Sea Surface Temperature data covering the Global Ocean and the European Regional Seas

-Near Real Time (NRT)/Multi-Year (REProcessed) products



## SST-TAC Products

### AREAS:

- GLOB:** GLOBal Ocean
- ATL:** North-eastern ATLantic Ocean
- EUR:** EUROpean Seas
- MED:** MEDiterranean Sea
- NWS:** North Western Shelf
- BAL:** BALtic Sea
- BS:** Black Sea

### PRODUCT TYPES:

**Collated single-sensor (L3C)**

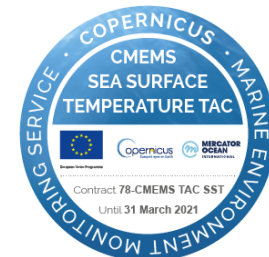
→ EUR

**Supercollated multi-sensor (L3S)**

→ GLOB/EUR/MED/BAL/BS

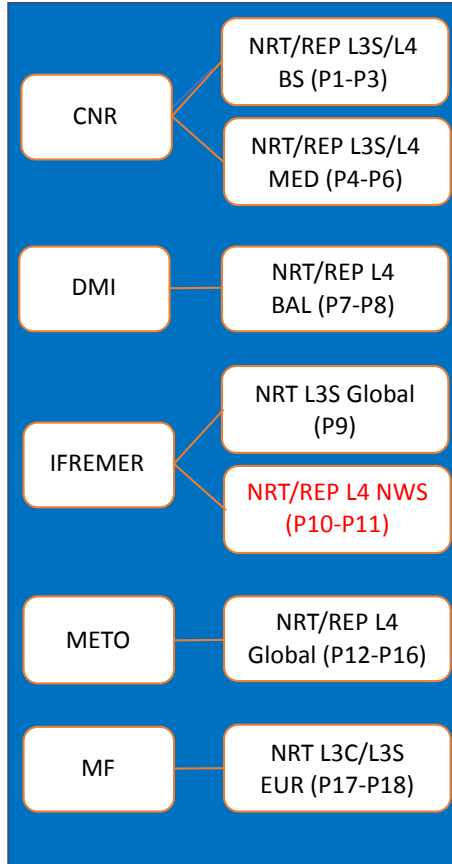
**Interpolated (L4)**

→ GLOB/ATL/NWS/MED/BAL/BS



ID	Product reference	Title
P1	SST_BS_SST_L3S_NRT_OBSERVATIONS_010_013	Black Sea - High Resolution and Ultra High Resolution L3S Sea Surface Temperature
P2	SST_BS_SST_L4_NRT_OBSERVATIONS_010_006	Black Sea High Resolution and Ultra High Resolution Sea Surface Temperature Analysis
P3	SST_BS_SST_L4_REP_OBSERVATIONS_010_022	Black Sea - High Resolution L4 Sea Surface Temperature Reprocessed
P4	SST_MED_SST_L3S_NRT_OBSERVATIONS_010_012	Mediterranean Sea - High Resolution and Ultra High Resolution L3S Sea Surface Temperature
P5	SST_MED_SST_L4_NRT_OBSERVATIONS_010_004	Mediterranean Sea High Resolution and Ultra High Resolution Sea Surface Temperature Analysis
P6	SST_MED_SST_L4_REP_OBSERVATIONS_010_021	Mediterranean Sea - High Resolution L4 Sea Surface Temperature Reprocessed
P7	SST_BAL_SST_L4_NRT_OBSERVATIONS_010_007_b	Baltic Sea- Sea Surface Temperature Analysis
P8	SST_BAL_SST_L4_REP_OBSERVATIONS_010_016	Baltic Sea- Sea Surface Temperature Reprocessed
P9	SST_GLO_SST_L3S_NRT_OBSERVATIONS_010_010	Global Ocean Sea Surface Temperature L3 Observations
P10	* SST_NWS_SST_L4_NRT_OBSERVATIONS_010_003	Atlantic European North West Shelf Ocean - ODYSSEA Sea Surface Temperature Analysis
P11	* SST_NWS_SST_L4_REP_OBSERVATIONS_010_023	Atlantic European North West Shelf Seas - High Resolution L4 Sea Surface Temperature Reprocessed (1982-2012)
P12	SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001	Global Ocean OSTIA Sea Surface Temperature and Sea Ice Analysis
P13	SST_GLO_SST_L4_NRT_OBSERVATIONS_010_005	Global Ocean Sea Surface Temperature Multi Product Ensemble (GMPE)
P14	SST_GLO_SST_L4_NRT_OBSERVATIONS_010_014	Global Ocean OSTIA Diurnal Skin Sea Surface Temperature
P15	SST_GLO_SST_L4_REP_OBSERVATIONS_010_011	Global Ocean OSTIA Sea Surface Temperature and Sea Ice Reprocessed
P16	SST_GLO_SST_L4_REP_OBSERVATIONS_010_024	ESA SST CCI reprocessed sea surface temperature analyses
P17	SST_EUR_SST_L3C_NRT_OBSERVATIONS_010_009_b	European Ocean- Sea Surface Temperature Mono-Sensor L3 Observations
P18	SST_EUR_SST_L3S_NRT_OBSERVATIONS_010_009_a	European Ocean- Sea Surface Temperature Multi-Sensor L3 Observations

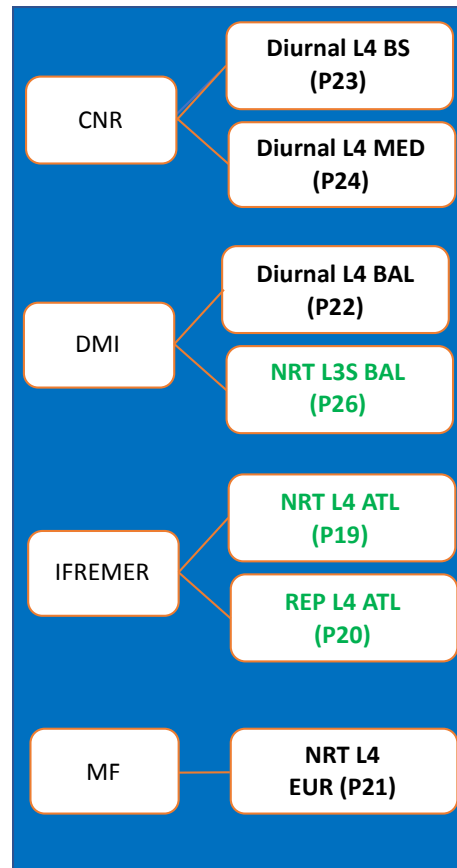
## SST TAC Products: Summary at the start of phase-2



**\*to be retired after July 2019 updates entry into service**

## The new SST TAC products (2019-2021)

ID	Description	PU	Year
P19	New daily L4 NRT over the NWS+IBI area (substitutes P10)	IFREMER	2019
P20	New daily L4 REP over the NWS+IBI area (substitutes P11)	IFREMER	2019
P21	New daily L4 NRT EUR product	MF	2019
P22	New diurnal NRT L4 over the Baltic Sea	DMI	2020
P23	New diurnal NRT L4 over the MED	CNR	2020
P24	New diurnal NRT L4 over the BS	CNR	2020
P25	New daily L4 EUR REP product	MF	2020
P26	New daily L3S BAL NRT product	DMI	2019



**Implemented**  
**Planned**



## A continuously evolving system

**COMPLETED**  
Planned

### Integration of sensors

- **Highest priority (common to all PU): Sentinel 3A (almost completed except ATL), Sentinel 3B (already ongoing)**
- Then: JPSS-1, GMI, VIIRS, AMSR2, Himawari 8, GOES-R

### Evolution of processing algorithms/New products

- **Improved interpolation techniques/configurations: effective resolution optimized background errors (METO), algorithms (IFREMER)**
- New regional L4 products resolving the diurnal cycle (DMI, CNR)
- **New regional L4 over ATL (IFREMER), new regional L3S over BAL (DMI), new L4 (NRT/REP) over EUR (MF)**

### Upgrade of Multi-Year processing and implementation of Ocean Monitoring Indicators

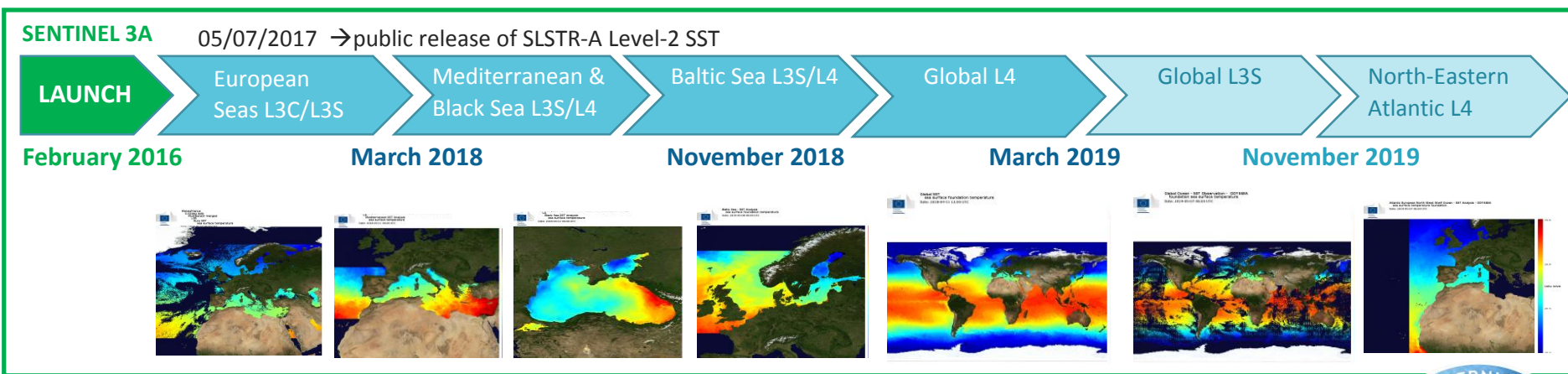
- Major effort to provide homogeneous and accurate regional and global REP products based on upstream high quality climatic records by ESA CCI/C3S initiatives
- **develop Ocean Monitoring Indicators:**
  - 1) 13 OMIs delivered in Sept. 2018:**  
**Global and regional SST anomalies with respect to the 1993-2014 reference climatology, Global and regional Trends**
  - 3) SST-based estimates of the most relevant climatic indexes (e.g. ENSO/NAO)**





## Sentinel 3A/3B SLSTR operational ingestion plans

Observations are gradually introduced in CMEMS operational products upon successful data validation/adaptation of processing chains.  
 Different scheduling was due to different processing chain configurations and upstream operational cloud screening issues (Bayesian cloud flagging only after 04/04/2018)



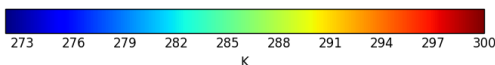
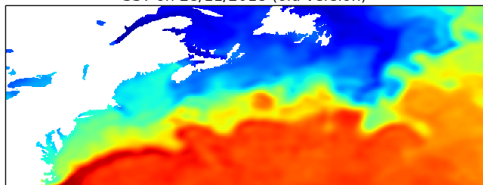


## Improved SST features in global level 4 SST (OSTIA)

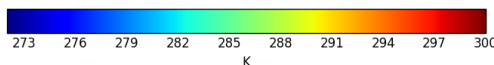
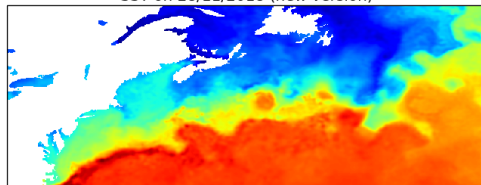
Two system updates carried out on SST\_GLO\_SST\_L4\_NRT\_OBSERVATIONS\_010\_001 processing chain:

- fixed an issue with reading background error standard deviations
- optimized background error correlation lengthscales

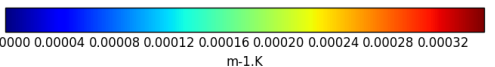
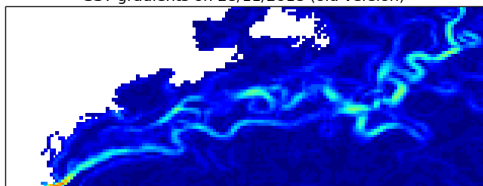
SST on 28/11/2018 (old version)



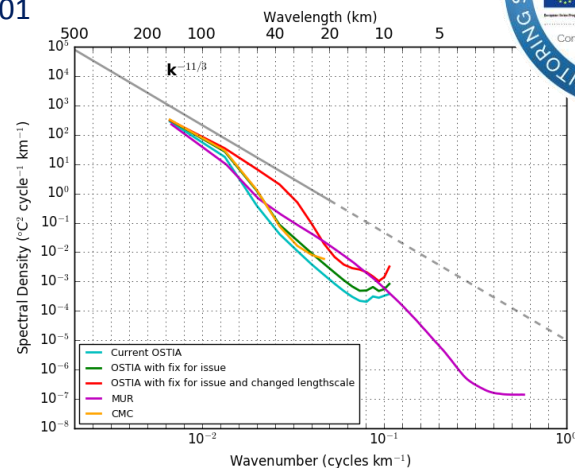
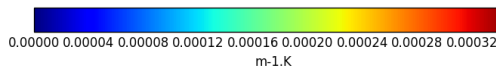
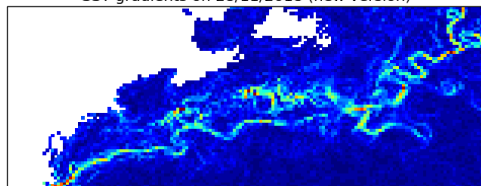
SST on 28/11/2018 (new version)



SST gradients on 28/11/2018 (old version)



SST gradients on 28/11/2018 (new version)



Both changes improve SST feature resolution in the Gulf Stream region as shown in the spectral plot above. Also shown are spectra from a ultra high resolution analysis produced in the USA (MUR) and a high quality analysis from Canada (CMC). The grey line is a theoretical slope that the spectral power lines might be expected to follow. Introduction of the upgrade is dependent on successful testing on impact on NWP.

## New Baltic Level 3S SST

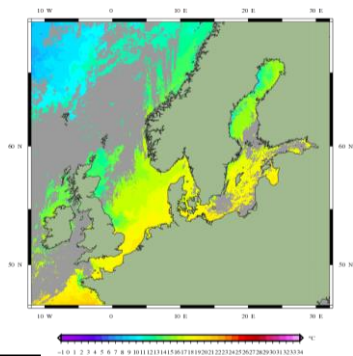
SST\_BAL\_SST\_L3S\_NRT\_OBSERVATIONS\_010\_032

**Supercollated (multi-sensor) L3 night time SST, covering the Baltic Sea (0.02° x 0.02°)**

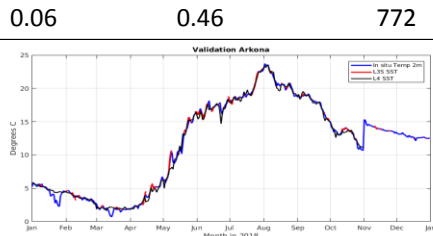
Processing chain ingests and merges AVHRR (NOAA/MetOp-A), SEVIRI (MSG), VIIRS (Suomi-NPP), SLSTR (Sentinel 3A) after data inter-calibration and bias correction.

Due to the limited number of drifting buoys in the Baltic Sea, observations from moored buoys from the Marnet network (Arkona, HuvudskarOst, NortherBaltic, DarsserS and FehmarnBelt) have been used for product validation.

The statistics were computed over the period between 2018-01-01 and 2018-11-01.



mean	Standard deviation	# samples
0.06	0.46	772

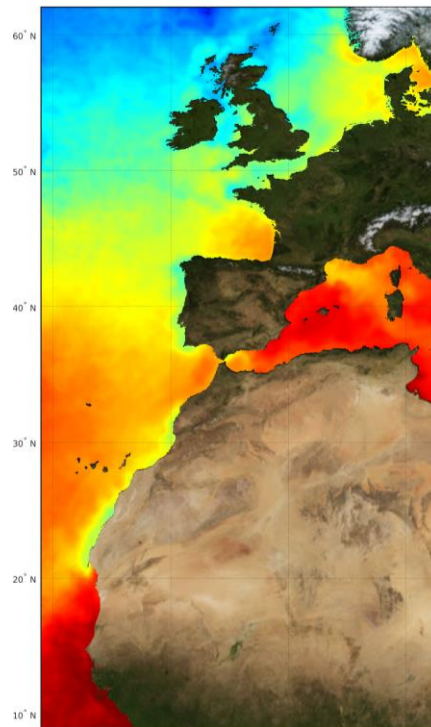


## New North-Eastern Atlantic Level 4 SST

SST\_ATL\_SST\_L4\_NRT\_OBSERVATIONS\_010\_025

SST\_ATL\_SST\_L4\_REP\_OBSERVATIONS\_010\_025

**Level 4 analysis, covering the European North West shelf/Iberia Biscay Irish Seas (0.02° x 0.02°)**



Both NRT and REP products result from the merging and interpolation of various satellite SST level 2 data after inter-calibration and bias correction: AVHRR-GAC NOAA18,19, AVHRR-LAC NOAA18,19, AVHRR-METOP-B, SEVIRI-MSG, AMSR-E 2.

Differences between High Resolution ATL SST L4 analysis and in-situ SST measurements provided by the IN-Situ TAC. The statistics were computed over the period between 2018-09-01 and 2018-11-10.

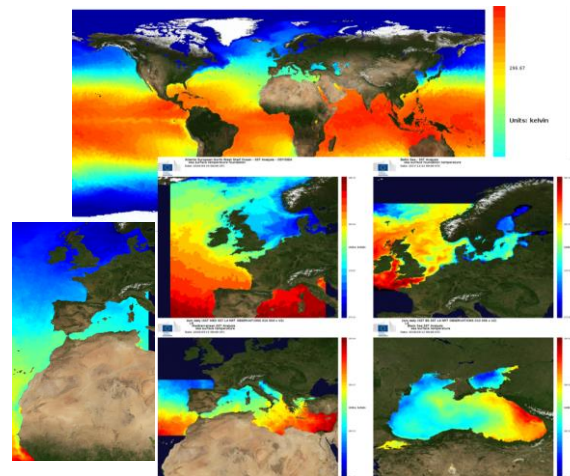
mean	Standard deviation	# samples
0.1	0.48	5191



## Updated multi-year global and regional SST products

**MAIN OBJECTIVE:** Provide more homogeneous and accurate regional and global REP products and information on the ocean state with respect to CMEMS-phase 1, taking advantage of the planned regular release schedule of upstream high quality climatic records by ESA CCI/C3S initiatives.

Regional products are now based on the U.S. NASA Pathfinder programme, but will soon be superseded by ESA CCI L2/L3 data and C3S products.



sst  
cci



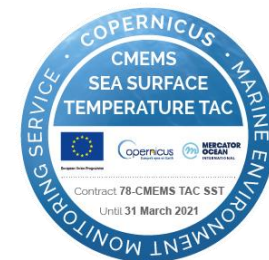
Climate Change  
Service



**PLANNED UPDATE BY THE END OF 2019**

## SST-TAC contributes to the *Ocean State Report*

- Reference Report of the European Union.
- Comprehensive and state-of-the art assessment of the state of the global ocean and European regional seas for the scientific community and for policy and decision-makers.
- Conceived and intended to contribute to reporting activities of EU policy makers, of environmental agencies in the EU (e.g. EEA) , of Regional Sea Conventions, of EU Member States', of EU Peripheral Maritime Regions and of international organizations (e.g. IPCC, United Nations Sustainable Development Goal 14, OCDE, etc.).

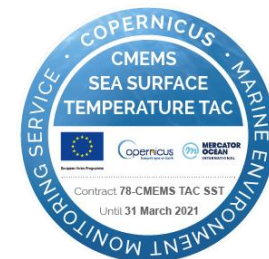


***OSR#3***  
***Under revision***

***OSR#4***  
***In preparation***

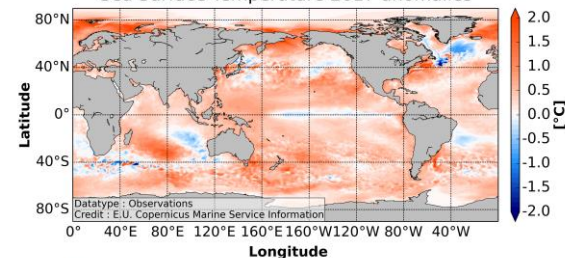
## SST-TAC contributes to the *Ocean State Report*

→ Providing Ocean Monitoring Indicators as additional products

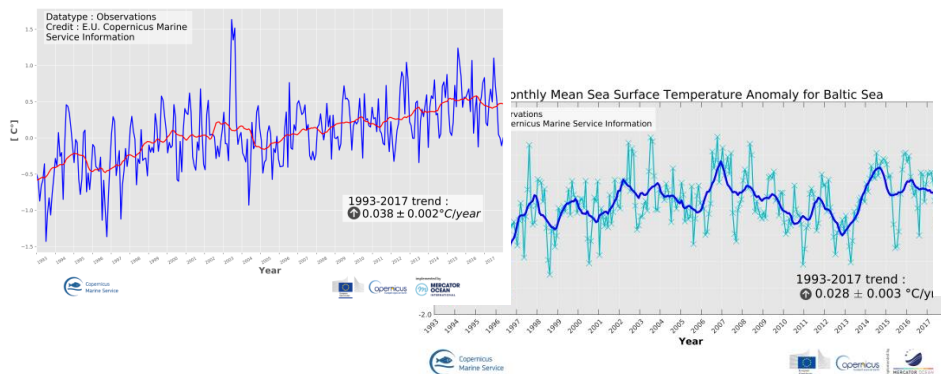


OMI family: Ocean temperature and salinity					
	Global	MED	BS	Baltic	NWS
Area averaged anomalies		X	X	X	X
Trend map		X	X	X	X
Anomaly map	X	X	X	X	X

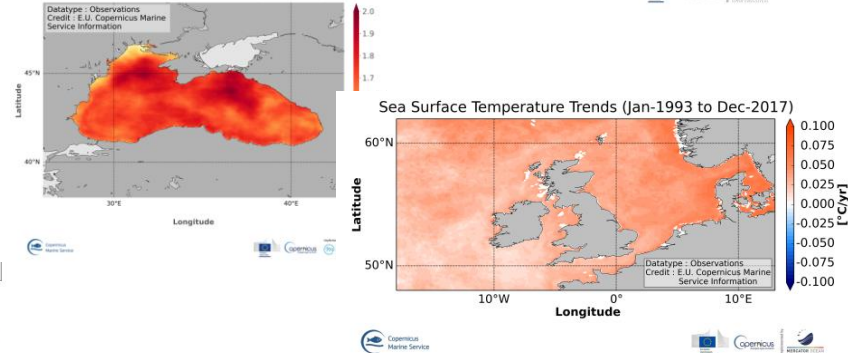
Sea Surface Temperature 2017 anomalies



Mediterranean Sea SST Anomaly (1993-2017)

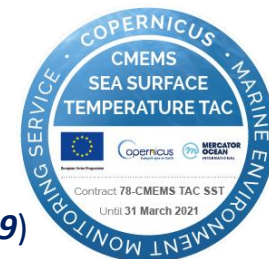


Black Sea SST Cumulative Trend (1993-2017)



# Summary and Conclusions

## (Main Evolutions)



- **Integration of new sensors**

- Sentinel-3A implemented by all PUs except Ifremer
- Sentinel-3B planned by all PUs

(ATL planned for **Q4 2019**)  
**[Q3-Q4 2019]**

- **8 new products**

- ATL NRT/REP and BAL L3S implemented
- New daily L4 NRT EUR
- New L4 REP EUR
- 3 New daily L4 NRT diurnal products (MED/BS/BAL)

(April EIS 2019)  
**[Q4 2019]**  
**[March-April 2020]**  
**[March-April 2020]**

- **Upgrade of Multi-Year processing**

- ESA CCI SST Analysis and C3S data
- MED/BS/BAL/ATL Reprocessing based on ESA CCI SST/C3S
- EUR REP based on ESA CCI SST/C3S
- New OMI for the Global Ocean
- New OMI (e.g. NAO, ENSO)

**[Q3 2019]**  
**[Q4 2019]**  
**[March-April 2020]**  
**[Q3 2019]**  
**[July-Sept. 2020/March-April 2021]**