



National Research
Council of Italy

How the products arrive to the catalogue? Who is behind the machine? Il ruolo del CNR

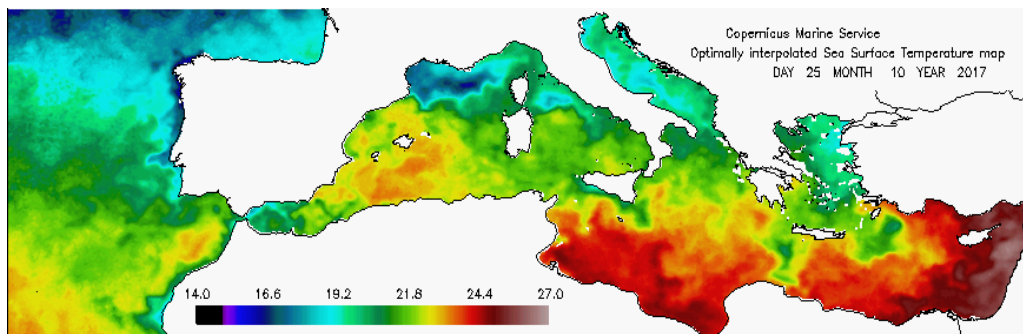
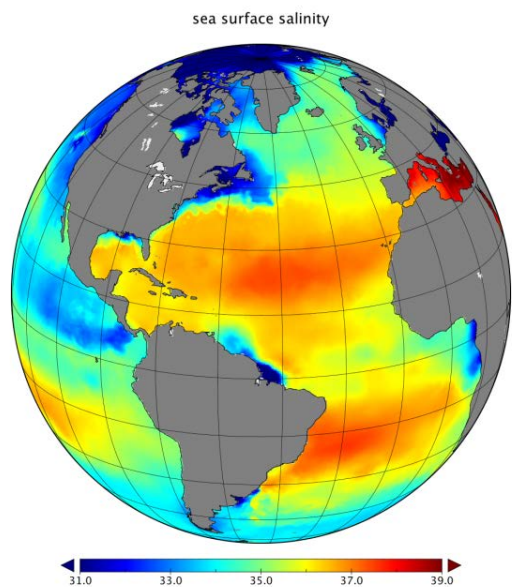
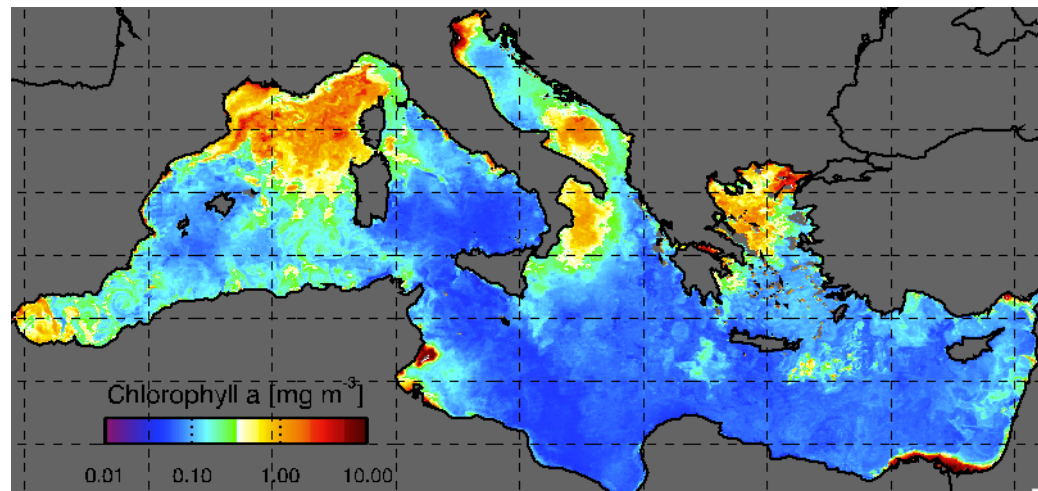
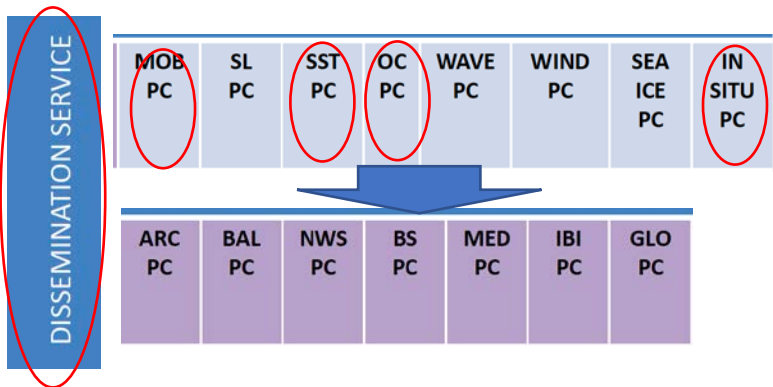
Rosalia Santoleri (CNR - ISAC)

Copernicus Marine Service and market opportunity for the Italian Blue Growth sector

16 April 2018, Sala Polifunzionale Presidenza Consiglio dei Ministri, Rome



Il Ruolo del CNR nel Copernicus Marine Environmental Monitoring Service



CNR è leader: Ocean Colour, SST, Dissemination Service
CNR è partner in: Multi-OBS (SSS) & In Situ (HF radar)

Gli obiettivi dei TAC

I Thematic Assembly Center sono i sistemi di CMEMS dedicati ai dati osservativi. Ogni TAC satellitare è dedicato ad una variabile oceanica/tipologia di missione (es. SST, SL, OC...) ma esiste un TAC dedicato ai dati In situ e un TAC per generazioni di prodotti sinergici

Obiettivi dei TAC:

- colmare il divario tra **i prodotti forniti dai produttori di dati** (es. agenzie spaziali) e gli utenti intermedi e finali.
- Generare prodotti di valore aggiunto **combinando tutte le osservazioni disponibili su ciascuna variabile**
- fornire prodotti multi-missione/multi-sensore (L3 & L4) sia per la disseminazione diretta agli utenti CMEMS che per l'assimilazione nei modelli di previsione del sistema (MFCs)
- Il dominio geografico dei prodotti è sia **l'Oceano globale** e i mari regionali europei: **Mediterraneo**, Mar Nero, Atlantico Settentrionale, Baltico e Artico.
- **I prodotti regionali** differiscono da quelli globali sia **per risoluzione spaziale e temporale che per algoritmica** al fine di migliorare le stime satellitari a scala regionale e costiera.

Ocean Color Thematic Assembly Centre

Le istituzioni e le persone



	Acronimo	Nome	Nazione	Resp.
1	CNR	National Research Council	Italy	OC leader/main contractor: coordination, Production Unit & System evolution
2	ACRI	ACRI-ST	France	Production Unit , System Evolution
3	PML	Plymouth Marine Laboratory	UK	Production Unit , System Evolution
4	HZG	Helmoltz-Zentrum Geesthacht	Germany	System Evolution
5	SYKE	Finnish Environment Institute	Finland	System Evolution
6	AEQUORA	Aequora Ltd	Portugal	System Evolution
7	adwäisEO	adwäisEO Ltd	Luxembourg	Data archiving

Ruoli principali

Leader: R. Santoleri (CNR)

Deputy: V. Brando (CNR)

Earth Observation Expert: V. Brando (CNR)

Product Quality Expert: A. Mangin (ACRI)

MultiYear Product Expert: S. Sathyendranath (PML)



National Research Council of Italy



PML

Plymouth Marine Laboratory



Quali prodotti fornisce il servizio OC TAC

Code	Ocean Region	coverage	NRT L3	NRT L4	REP L3	REP L4
GLO	Global Ocean	90.0° S - 90.0° N 180.0° W - 180.0° E	Multi (MODIS+VIIRS) Single OLCI	Multi	multi (SeaWIFS+MODIS+MERIS+ VIIRS) From CCI + OCTAC	Multi Based on L3
ARC	Arctic Ocean	67.0° N - 90.0° N 180.0° W - 180.0° E	single & Multi MODIS + VIIRS & OLCI	Multi	Multi (SeaWIFS+MODIS+MERIS+ VIIRS)	Multi Based on L3
BAL	Baltic Sea	53.0° N - 66.85° N 9.25° W - 30.25° E	single MODIS & OLCI	single	Multi (SeaWIFS+MODIS+MERIS+ VIIRS)	Multi Based on L3
ATL	Atlantic Ocean	20.0° N - 66.0° N 46.0° W - 13.0° E	single & Multi MODIS + VIIRS & single OLCI	Multi	Multi (SeaWIFS+MODIS+MERIS+ VIIRS)	Multi Based on L3
MED	Mediterranean Sea	30.0° N - 46.0° N 6.0° W - 36.5° E	Multi MODIS + VIIRS & single OLCI	Multi	Multi (SeaWIFS+MODIS+MERIS+ VIIRS)	Multi Based on L3
BS	Black Sea	40.0° N - 48.0° N 26.5° W - 42.0° E	Multi MODIS + VIIRS & single OLCI	Multi	Multi (SeaWIFS+MODIS+MERIS+ VIIRS)	Multi Based on L3
EUR	European Sea		Multi	Multi		

Ocean Colour Products Types:

- **CHL:** L3 (daily composite products) and L4 analysis (no data gaps)
- **OPTICS:** IOPs , Kd490, Secchi depth, Rrs, PAR, CDOM, SPM.

Regional products generated using regional algorithms to improve their quality & case 2 algorithm for coastal waters (Chl)

NRT: produced **within few hours**, NRT replaced **within few days** by consolidated product (**DT**)

REP: consistent re-processed time series (**updated once a year**)

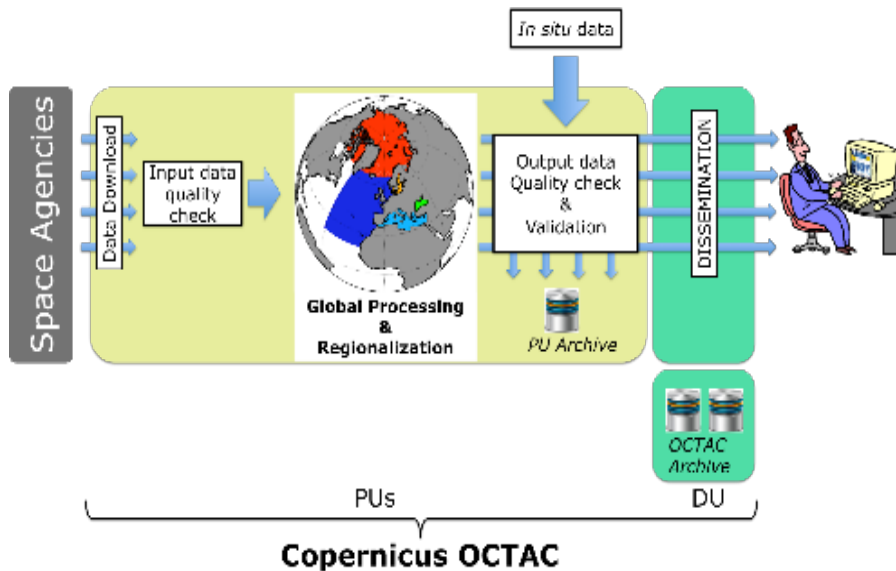
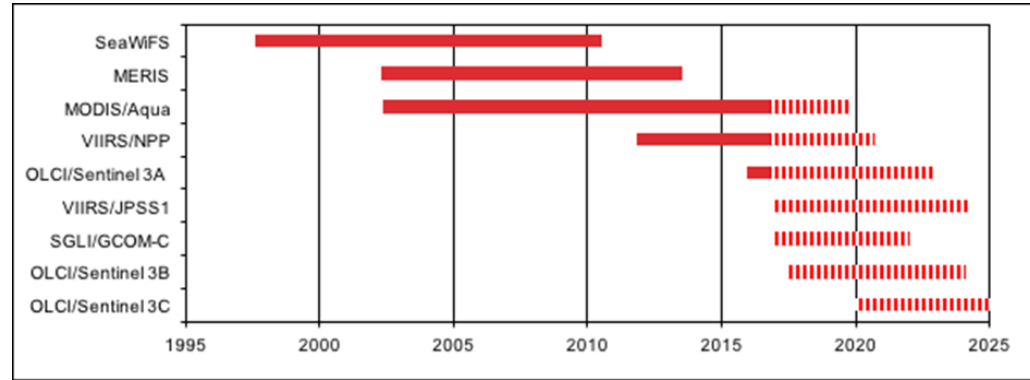
Product quality information available for all products based on CMEMS metrics (QIDs)

Come funziona la produzione nel servizio: OC TAC

Space Upstreams:

- NASA: SeaWiFS, MODIS and VIIRS
- NOAA: VIIRS data
- ESA: MERIS data & OC-CCI data
- EUMETSAT: VIIRS and OLCI data
- ECMWF: C3S data

EumetCast interface in addition to ftp to acquire space data



In situ Upstreams:

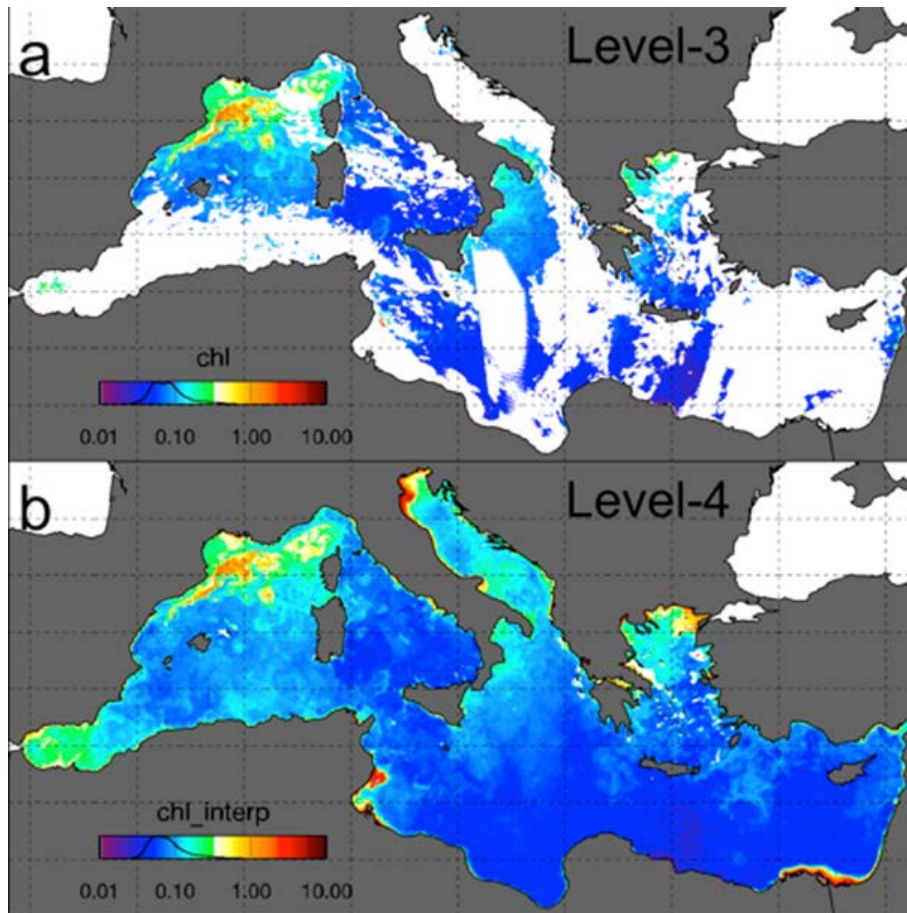
- CMEMS IN SITU
- Public data: NOMAD, SeaBass, MERMAID, AERONET-OC
- Partners data (eg. Cruise data, CNR buoy data)

Downstreams:

- CMEMS NRT & MYP DUs
- CMEMS CIS
- CMEMS Web Portal
- CMEMS users
- CMEMS MFCs
- CMEMS cross-cutting elements
- *modelling communities*
- *national and international projects*



Prodotti multi sensore e NRT per il Mediterraneo

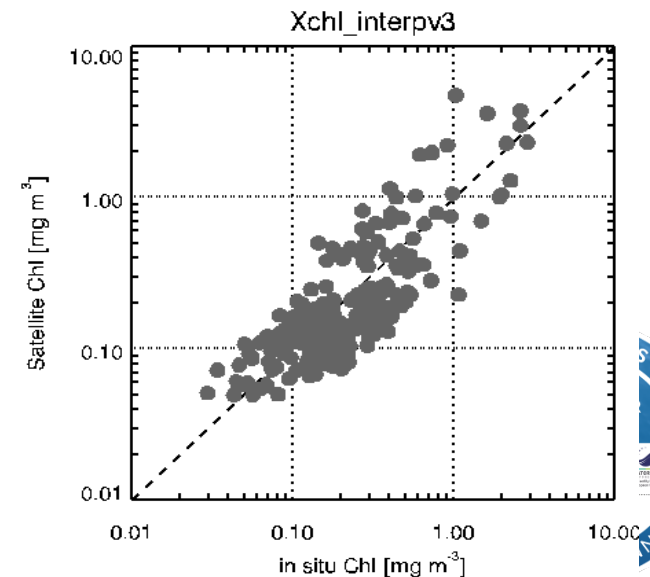


Documentazione dei prodotti:

- Product User Manual (PUM)
- Quality Information Document (QIiD)

CNR lavora all'evoluzione di metodi statistici avanzati per ottenere prodotti NRT

La validazione del prodotto vs dati in situ: matchup analysis

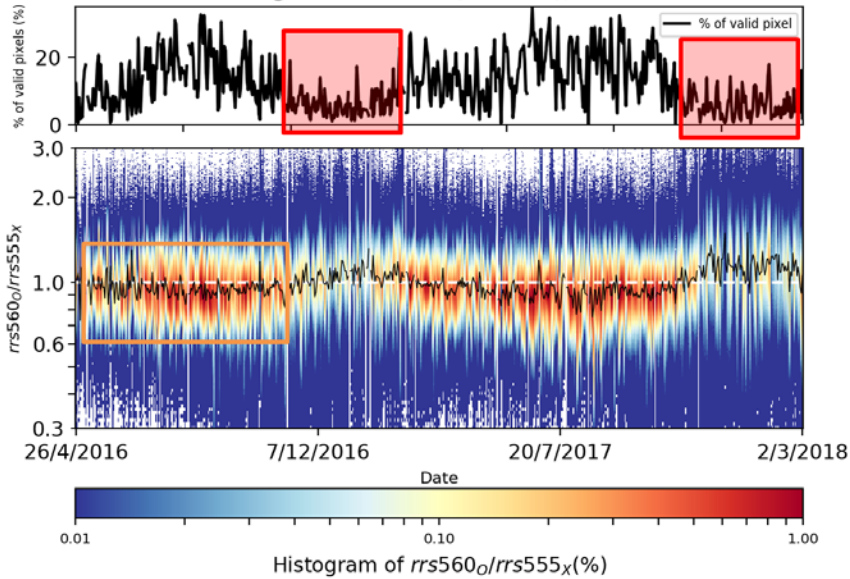


Sistemi avanzati di validazione in tempo reale

L3 daily Rrs comparison: OLCI (O) vs current operational multi-sensor products (X=A+V)

The median of the histogram density is represented by the back line.

Time series of the Histogram of $rrs560_o/rrs555_x$ for the Mediterranean Sea

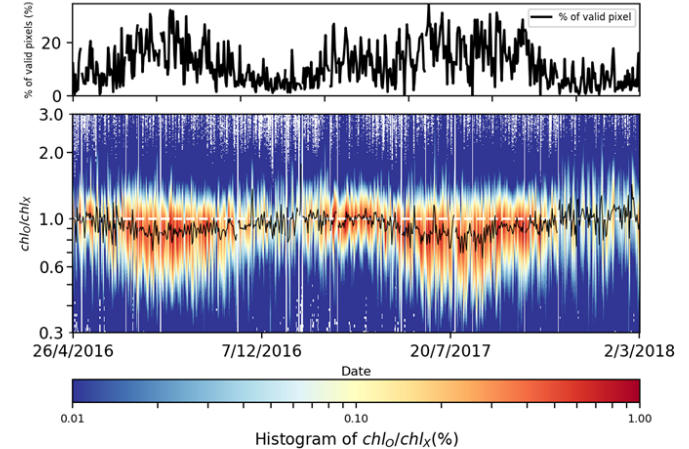


Lower availability of matching observations in winter

Spring-Summer Median ratio: 0.90-0.95

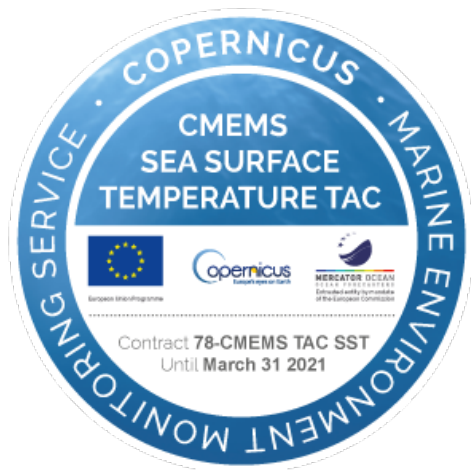
Chl retrieved with MedOC4 (regionalized Maximum Band Ratio):
Differences in rrs (IQR=0.90 -1.05) are magnified in Chl (IQR=0.8-0.95)

Time series of the Histogram of chl_o/chl_x for the Mediterranean Sea



Sea Surface Temperature Thematic Assembly Centre:

Le istituzioni e le persone



	Acronimo	Nome	Nazione	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

Ruoli Principali

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

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

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

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

MultiYear Product Expert: **S. Good (Metoffice)**

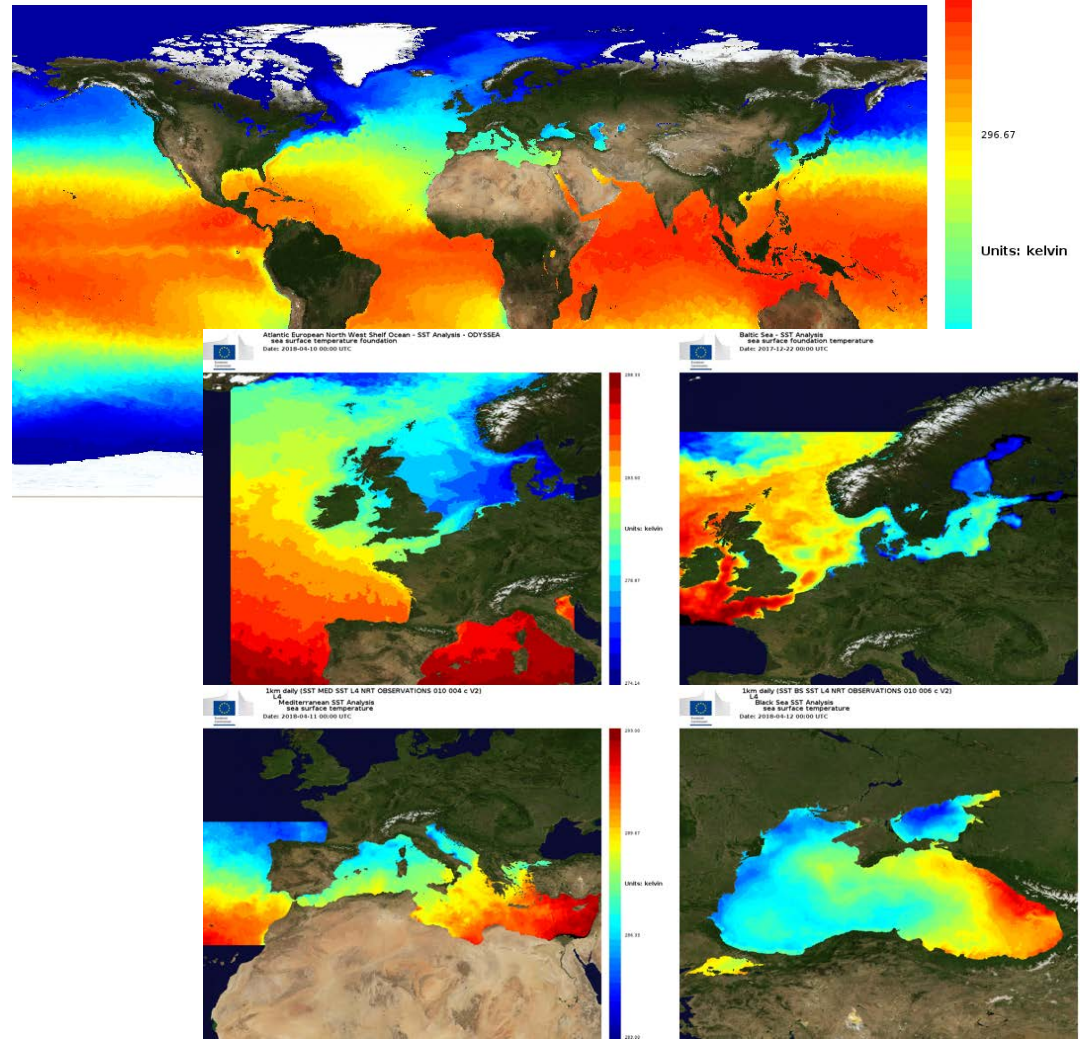


Quali prodotti fornisce il servizio SST TAC

ID	Title
P1	Black Sea - High Resolution and Ultra High Resolution L3S Sea Surface Temperature
P2	Black Sea High Resolution and Ultra High Resolution Sea Surface Temperature Analysis
P3	Black Sea - High Resolution L4 Sea Surface Temperature Reprocessed
P4	Mediterranean Sea - High Resolution and Ultra High Resolution L3S Sea Surface Temperature
P5	Mediterranean Sea High Resolution and Ultra High Resolution Sea Surface Temperature Analysis
P6	Mediterranean Sea - High Resolution L4 Sea Surface Temperature Reprocessed
P7	Baltic Sea- Sea Surface Temperature Analysis
P8	Baltic Sea- Sea Surface Temperature Reprocessed
P9	Global Ocean Sea Surface Temperature L3 Observations
P10	Atlantic European North West Shelf Ocean - ODYSSEA Sea Surface Temperature Analysis
P11	Atlantic European North West Shelf Seas - High Resolution L4 Sea Surface Temperature Reprocessed (1982-2012)
P12	Global Ocean OSTIA Sea Surface Temperature and Sea Ice Analysis
P13	Global Ocean Sea Surface Temperature Multi Product Ensemble (GMPE)
P14	Global Ocean OSTIA Diurnal Skin Sea Surface Temperature
P15	Global Ocean OSTIA Sea Surface Temperature and Sea Ice Reprocessed
P16	ESA SST CCI reprocessed sea surface temperature analyses
P17	European Ocean- Sea Surface Temperature Mono-Sensor L3 Observations
P18	European Ocean- Sea Surface Temperature Multi-Sensor L3 Observations

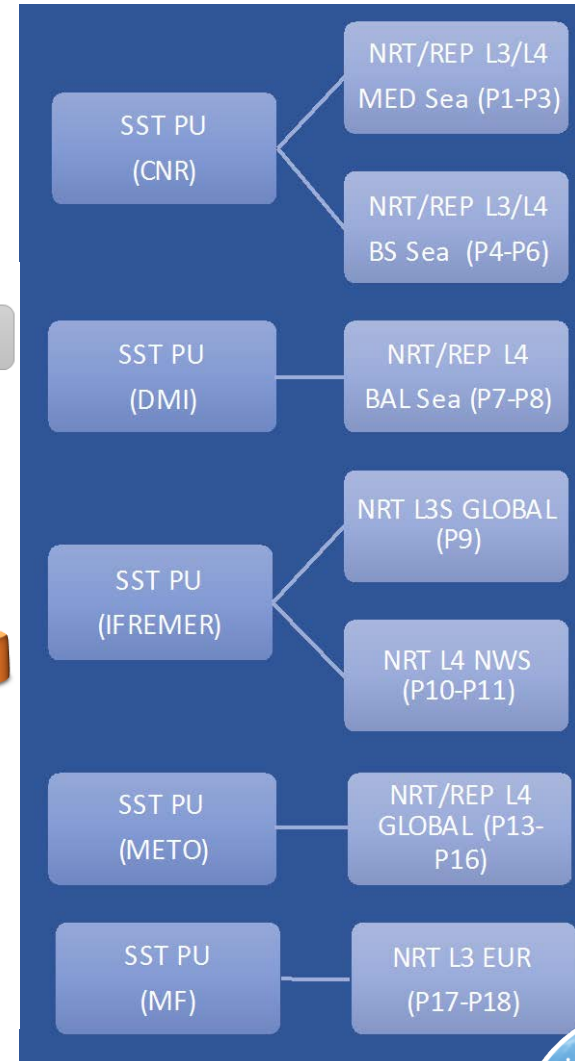
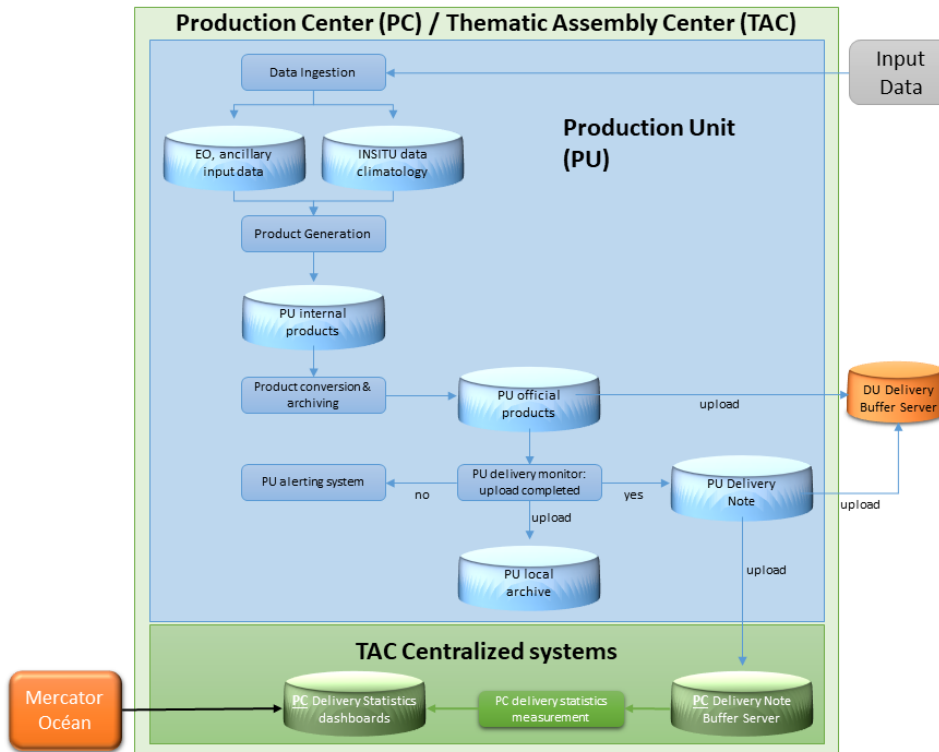
Lo stato dell'arte del portfolio di prodotti che coprono l'oceano globale e i mari regionali europei.

- Near Real Time (NRT) → continuous monitoring
- Multi-Year (reprocessed) dataset → Ocean State Assessment



Come funziona la produzione nel servizio SST TAC

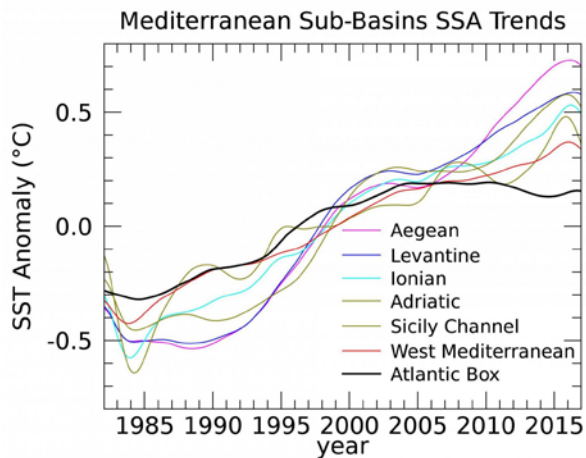
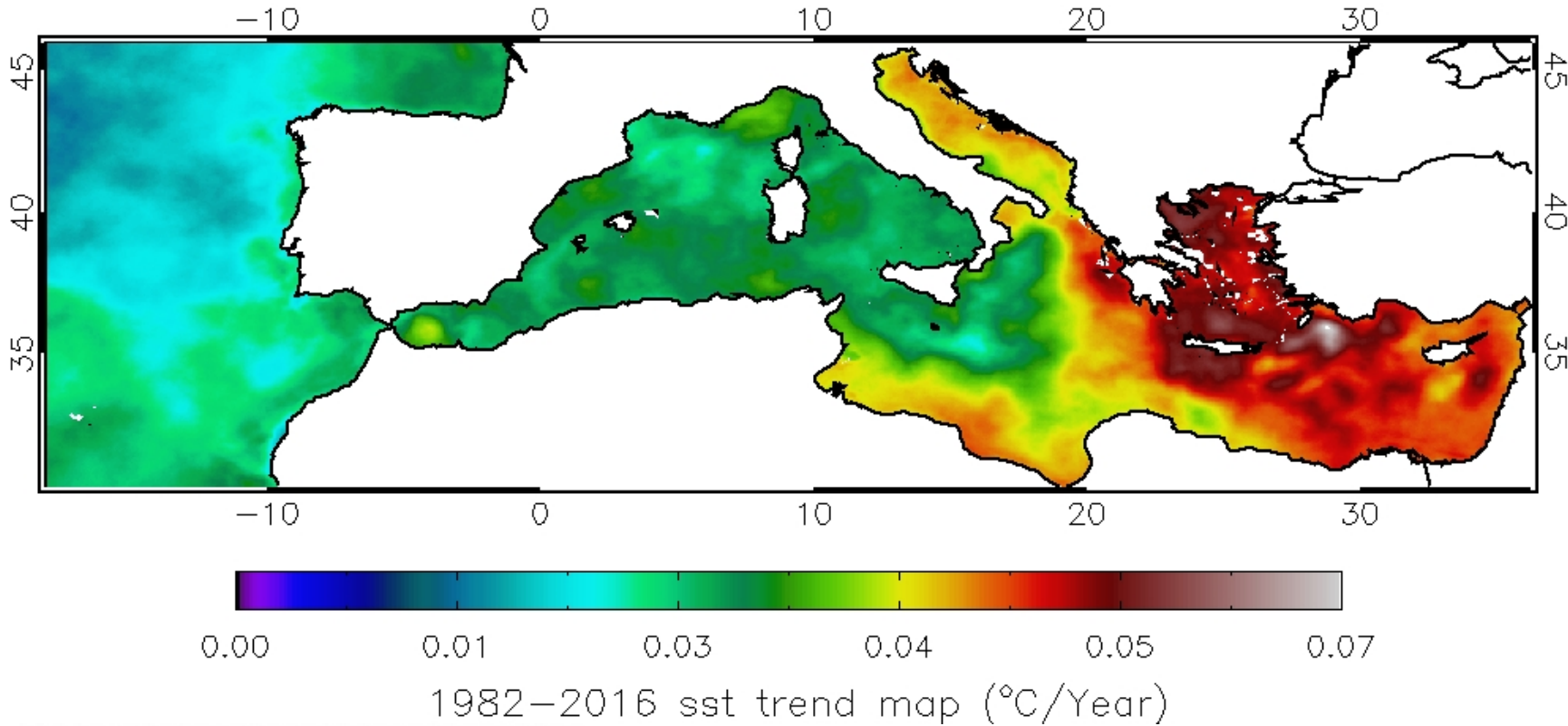
Un sistema distribuito basato di **Unità di Produzione** con specifiche competenze ed expertise



Il Sistema di Produzione include il monitoraggio della Qualità dei Prodotti



Contributo allo Ocean State Report



**Il Mediterraneo continua a scaldarsi.
L'Atlantico si è fermato?**



Contributo CNR a MULTI-OBS TAC: SSS

Multivariate technique to combine in situ and satellite SSS with SST L4 information L3→L4

Past

present



CMEMS-phase 1:

Global sea surface salinity (SSS) & sea surface density (SSD)
reprocessed dataset (1993-2017) L4

at $\frac{1}{4}^\circ$, weekly resolution

based on in situ SSS and SST L4

+2010-2016 SMOS data → (Available since April 2018)



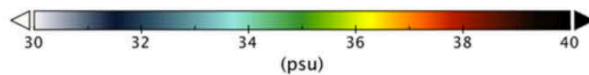
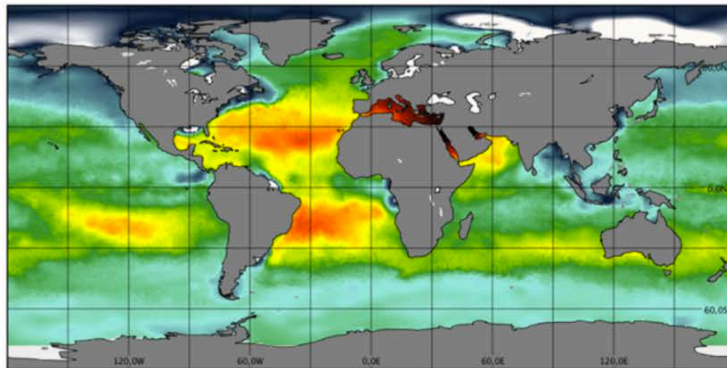
CMEMS-phase 2

Global SSS/SSD NRT dataset (1993-2016) L4 at $\frac{1}{4}^\circ$, weekly resolution

2018 October/November CMEMS release

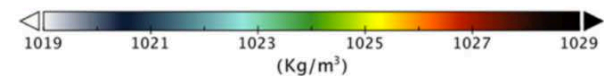
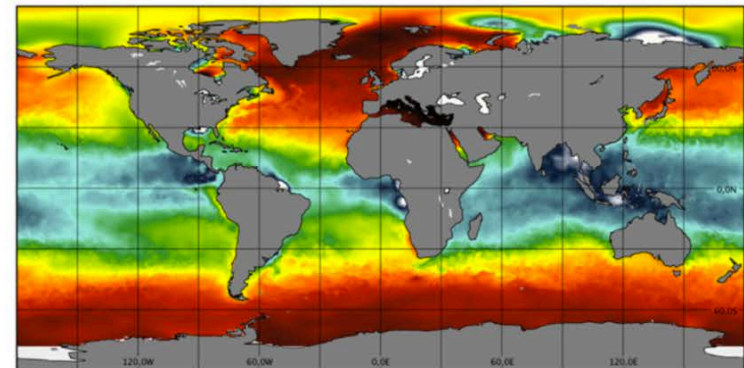
A

sea surface salinity



B

sea surface density



- References:** Buongiorno Nardelli, B., 2012, doi:10.1175/JTECH-D-11-00099.1.
 Buongiorno Nardelli, B., R. Droghei, R. Santoleri, 2016, doi:10.1016/j.rse.2015.12.052
 Droghei, R., B. Buongiorno Nardelli, R. Santoleri, 2016, doi: 10.1175/JTECH-D-15_0194.1
 Droghei, R., B. Buongiorno Nardelli, R. Santoleri, 2018, doi: 10.3389/fmars.2018.00084



OC ed SST: Due sistemi in continua evoluzione: (2018-2021)

Integrazione di nuovi sensori

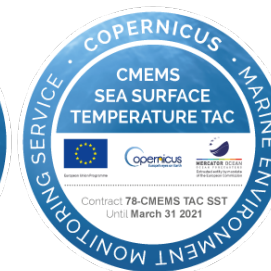
- Priorità (comune a tutte TAC/PU): Sentinel 3A (already ongoing), Sentinel 3B
- SST: JPSS-1, GMI, VIIRS, AMSR2, Himawari 8, GOES-R
- OC: Sentinel 3B OLCI & VIIRS//NOAA-20,

Evoluzione degli algoritmi per il processamento/Nuovi prodotti

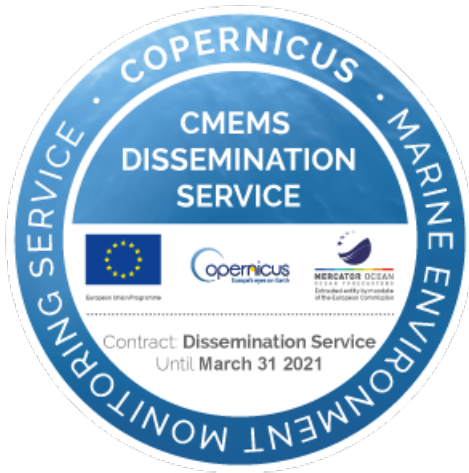
- Miglioramento degli algoritmi e delle tecniche di interpolazione e merging
- Upgrade dei prodotti e Sviluppo di nuovi prodotti
- SST: **nuovi prodotti orari per MED , BS & BAL L4**, nuovo regional L4 per NWS+IBI, new L4 over EUR
- OC: Evoluzioni degli algoritmi di chlorofilla con focus alle acque otticamente complesse per **migliorare le stime sulle acque costiere** e per il Baltico e Mar Nero
- OC: **Full resolution ocean colour (OLCI 300m) per i mari Europei**
- OC: **Phytoplankton type variables**, Primary production (for Global ocean)

Aggiornamento dei prodotti Multi-Year & sviluppo degli Ocean Monitoring Indicators

- Omogenizzazione e miglioramento delle stime per i prodotti REP regionali and globali tenendo conto degli sviluppi e dei high quality climatic records dell'iniziativa ESA CCI/C3S
- Sviluppo degli Ocean Monitoring Indicators:
 - 1) Anomalie di SST & OC rispetto alla climatologia di riferimenti
 - 2) SST-based & OC-based dei principali indici climatici (e.g. ENSO/NAO)
 - 3) OC: trend di chlorofilla su tutti i mari Europei in supporto all'EEA



CMEMS Dissemination Unit: Le istituzioni e le persone



Ruoli Principali

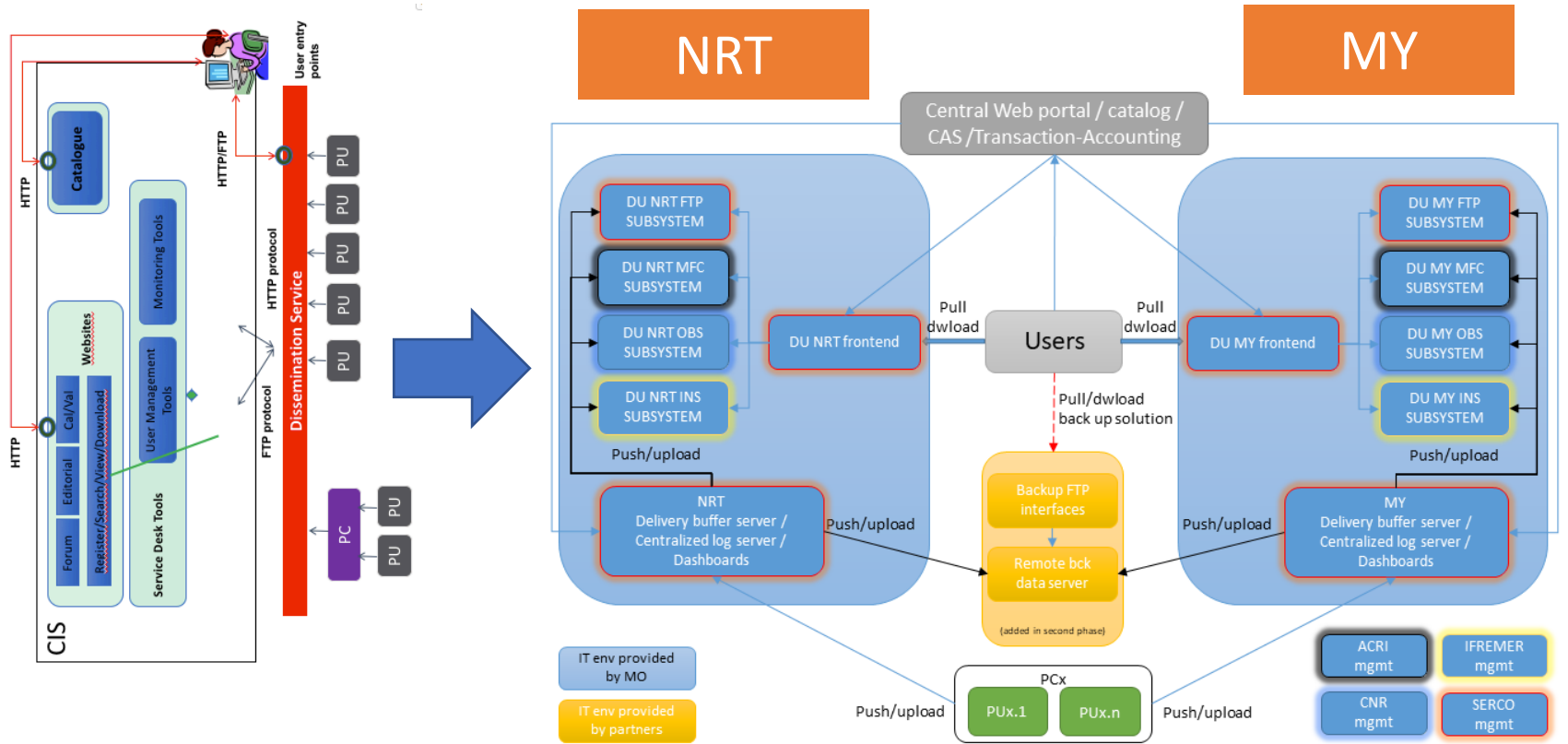
Leader: V. Forneris (CNR)

Deputy: A. Novellino (ETT)

	Acronimo	Nome	Nazione	Resp.
1	CNR	National Research Council	Italy	Coordination, Interface evolutions
2	ETT	ETT Spa	Italy	Software maintainance & integration
3	IFREMER	French Research Institute for Exploitation of the Sea	France	Interface evolutions
4	ACRI	ACRI-ST	France	Virtual Infrastructure
5	CLS		France	Interface evolutions
6	SERCO	Serco Group plc	Italy/UK	Service Desk
7	ALTRAN	Altran Technologies	France	Interface evolutions
8	adwäisEO	adwäisEO Ltd	Luxembourg	Interface evolutions



La DU all'interno di CMEMS



Contract: Dissemination Service
Until: March 31 2021

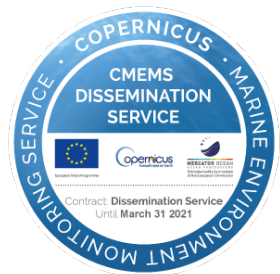
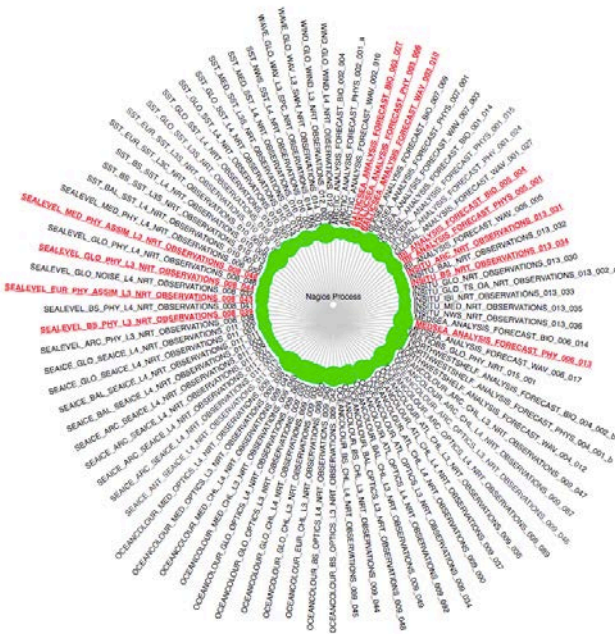
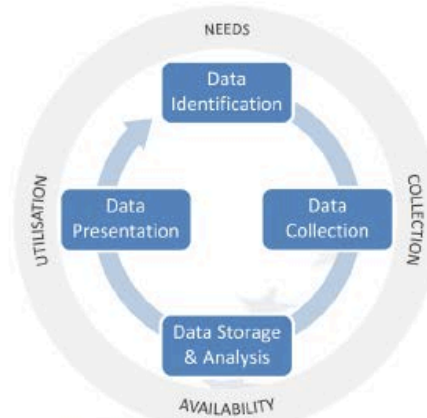
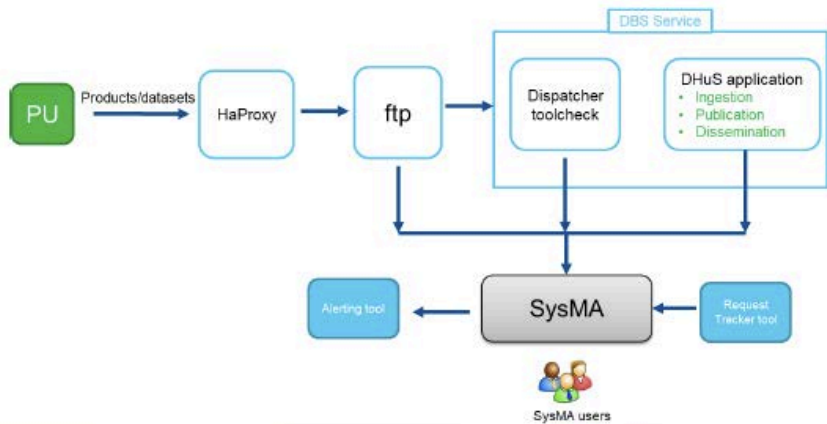
I principali obiettivi del servizio DU

- Creare e mantenere un'infrastruttura tecnologicamente avanzata per il servizio operativo CMEMS
- Raccogliere e gestire i prodotti di tutti i centri di produzione dati di CMEMS
- Assicurare la disseminazione dei prodotti agli utenti H24 e 7 giorni su 7
- Monitorare tutte le operazioni relative alla raccolta e disseminazione dei dati
- Fornire un sistema scalabile, flessibile e robusto
- Un approccio Big Data e DataCUBE

- **151 Prodotti a disposizione degli utenti**
- **1080 Dataset disponibili**
- **100 Terabyte di dati da gestire**
- **Oltre 80000 download a trimestre**
- **140 Terabyte scaricati a trimestre.**
- **Oltre 1700 utenti scaricano attivamente dati ogni trimestre (circa 600 in maniera continua)**



Il flusso di dati e il loro monitoraggio



Il nostro capitale umano

