COPERNICUS MARINE SERVICE NEEDS FOR OCEAN COLOUR PRODUCT QUALIFICATION

R. Santoleri [(1)] , V. Brando[(1),] P. Garnesson[(2),] A. Mangin[(2)] , S. Pardo[(3)] and G. Tilstone[(3)]

(1) Consiglio Nazionale delle Ricerche – Istituto di Scienze dell'Atmosfera e del Clima, Rome, Italy

(2) ACRI-ST, Sophia Antipolis, France

(3) Plymouth Marine Laboratory – Plymouth, UK

Outline

- CMEMS: Copernicus Marine Environment Monitoring Service
- The Ocean Colour TAC: system and Products
- OCTAC data quality assessement
- Vicarious Calibration Requirements

Drivers

- **Support a sustainable ocean and blue growth**

Coastal Environment, Marine policies and public information, Marine operation and Safety, Marine Pollution, Research, Climate, New Services.

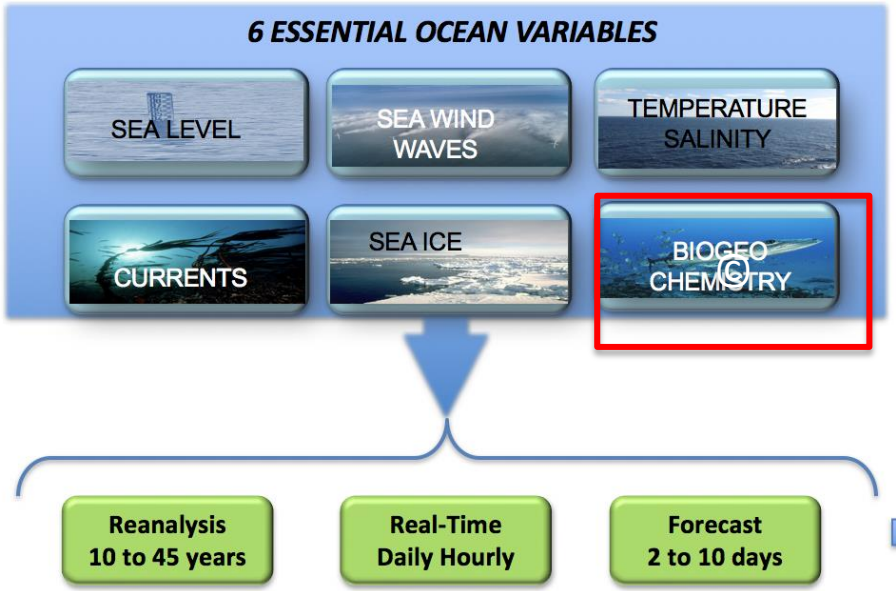
- **Provide pioneering solutions**

Operational and scientifically assessed, Worldwide and European-wide coverage, long-term sustainability, thousands of users.

- **Provide Open and easy access to marine data**

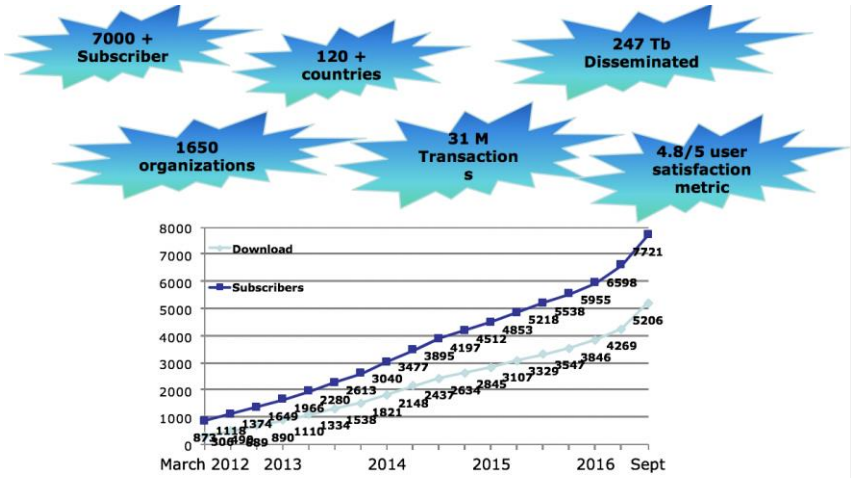
Open and free data policy, network of producers throughout Europe, Modular organization, Common standards, Single point of access.

Copernicus Marine Environment Monitoring Service CMEMS



marine.copernicus.eu

- **7000 users**
- **120 countries**



The CMEMS

Architecture

Thematic Assembly Centers (Observations)

- SL TAC
- OSI TAC
- OC TAC
- In situ TAC

Monitoring & Forecast Centers (Models)

- Global MFC
- Artic MFC
- Baltic MFC
- NWS MFC
- IBI MFC
- MED MFC
- BS MFC

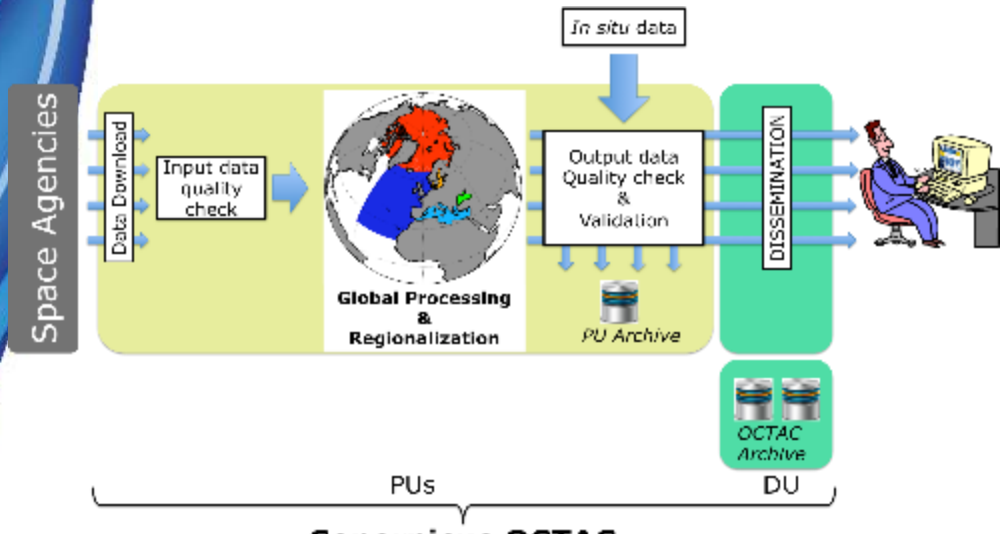
Servic e Desk

Web Portal

Central Information System (CIS)

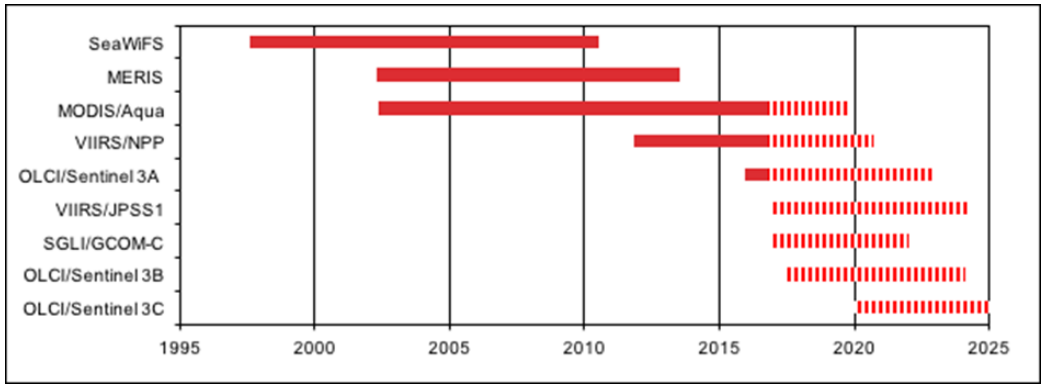
In situ Upstreams:

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



Downstreams:

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



Space Upstreams:

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

EumetCast interface in addition to ftp to acquire space data

OCTAC Main Architecture:

The OC TAC operates the European Ocean Colour component within the CMEMS, bridging the gap between space agencies, providing ocean colour data, and all users that need the added-value information not available from space agencies.

The geographic domain covered by the OC TAC is the Global Ocean and the European regional seas: Mediterranean, Black Sea, North Atlantic, Baltic and Arctic.

OC-ACRI-PU: NRT L3/L4 GLO, NRT L4 ATL + GLO REP (DT products consistent with NRT GLO)
OC-CNR-PU: NRT/REP L3/L4 MED, BS and BAL
OC-PML-PU: NRT/REP L3, L4 ARC, ATL + GLO REP (ESA OC-CCI)
OC-CNR-DU: collecting all the OC products from the OC PUs and made available to the users via CMEMS

CMEMS OC product catalougue

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 + OLCI) Single OLCI	Multi	multi (SeaWIFS+MODIS+MERIS+VIIRS) From CCI + CMEMS OC GLO	Multi Based on L3
ARC	Arctic Ocean	67.0° N - 90.0° N 180.0° W - 180.0° E	single & Multi M0DIS & 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	Multi	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 M0DIS & VIIRS & 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	single & Multi M0DIS & VIIRS & 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	single & Multi M0DIS & VIIRS & OLCI	Multi	Multi (SeaWIFS+MODIS+MERIS+VIIRS)	Multi Based on L3
EUR	European Sea		Multi	Multi		

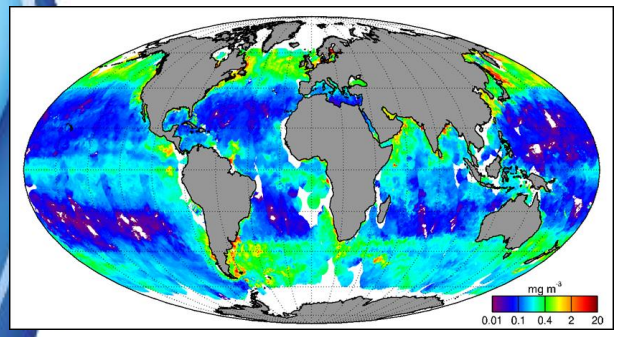
OLCI data will be released in mid 2017

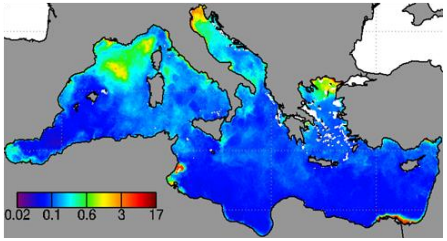
REP include: consistent time series based on CCI + entire time series of DT products to ensure continuity between NRT & REP

Global REP L3 & L4 cover the period [1997-Aug-2016]

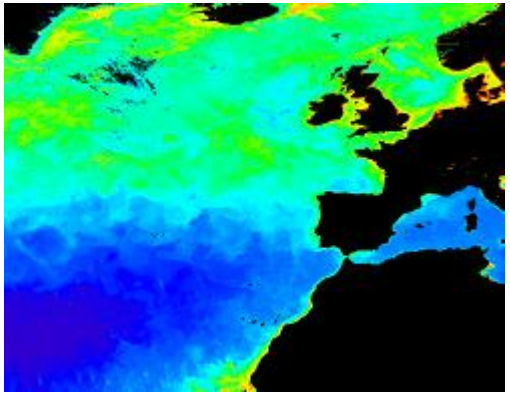
Regional REP produced at 1km for European Seas

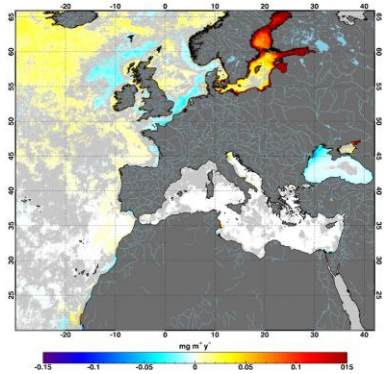
Use of OC products in CMEMS

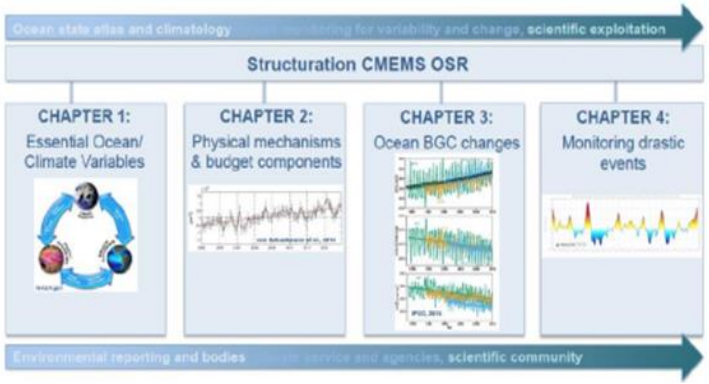




- NRT&REP L3&L4 global **multi sensors** products
- NRT&REP L3&L4 **regional single&multi sensors** products for European Seas
- OC data used for **modelling quality assessment**
- **data assimilation** in bio-geochemical models (regional and global MFCs)
- indicators for monitor the marine environment for the marine policies (eg. MSFD)
- indicators for the management of marine resources
- the ocean state report







Requirements on upstream data quality

- The quality of CMEMS Ocean Colour products strongly depend on the quality of upstream satellite data provided by space agencies.
- Space borne instruments require in-orbit vicarious calibration, where the integrated instrument and atmospheric correction system is adjusted using in situ normalized water-leaving radiances/reflectance observations.

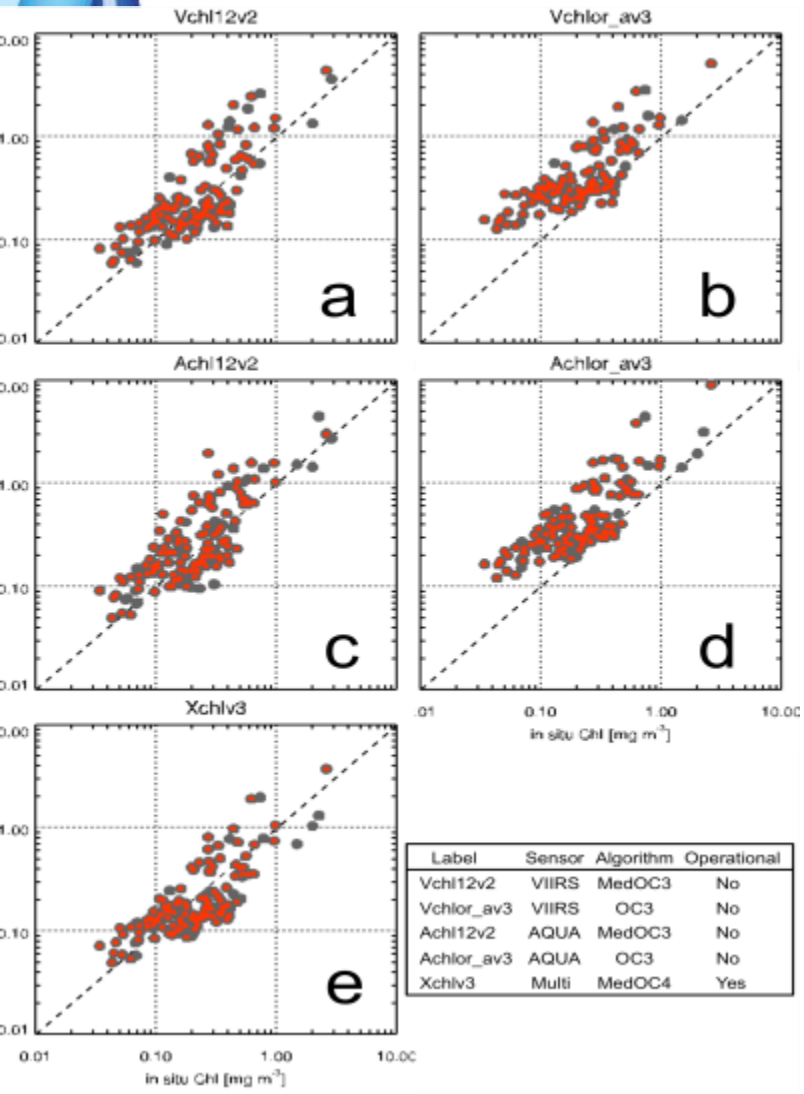
Qualification of OC Products in CMEMS

Integration of OC data streams in CMEMS requires qualification of the L1B & L2 operational data stream:

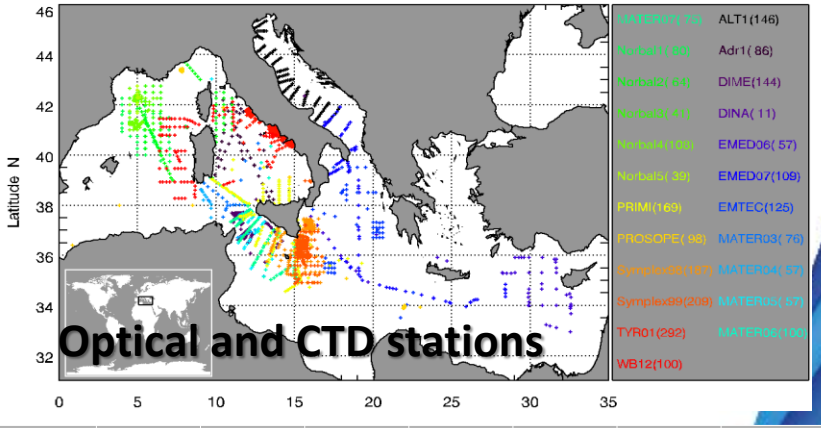
- Offline qualification (i.e. matchup analysis)
- Online qualification (e.g. comparison with climatologies and other sensors)
- OC products qualification performed by OC PUs according to the common validation guidelines defined by OCTAC in agreement with CMEMS

Estimated Accuracy Numbers are distributed to the users via the Quality Information Documents (QuIDs)

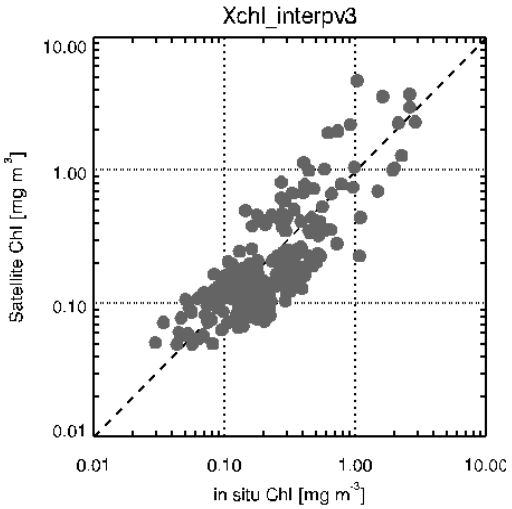
Example of offline qualification



Label	Sensor	Algorithm	Operational
Vchl12v2	VIIRS	MedOC3	No
Vchlor_av3	VIIRS	OC3	No
Achl12v2	AQUA	MedOC3	No
Achlor_av3	AQUA	OC3	No
Xchlv3	Multi	MedOC4	Yes



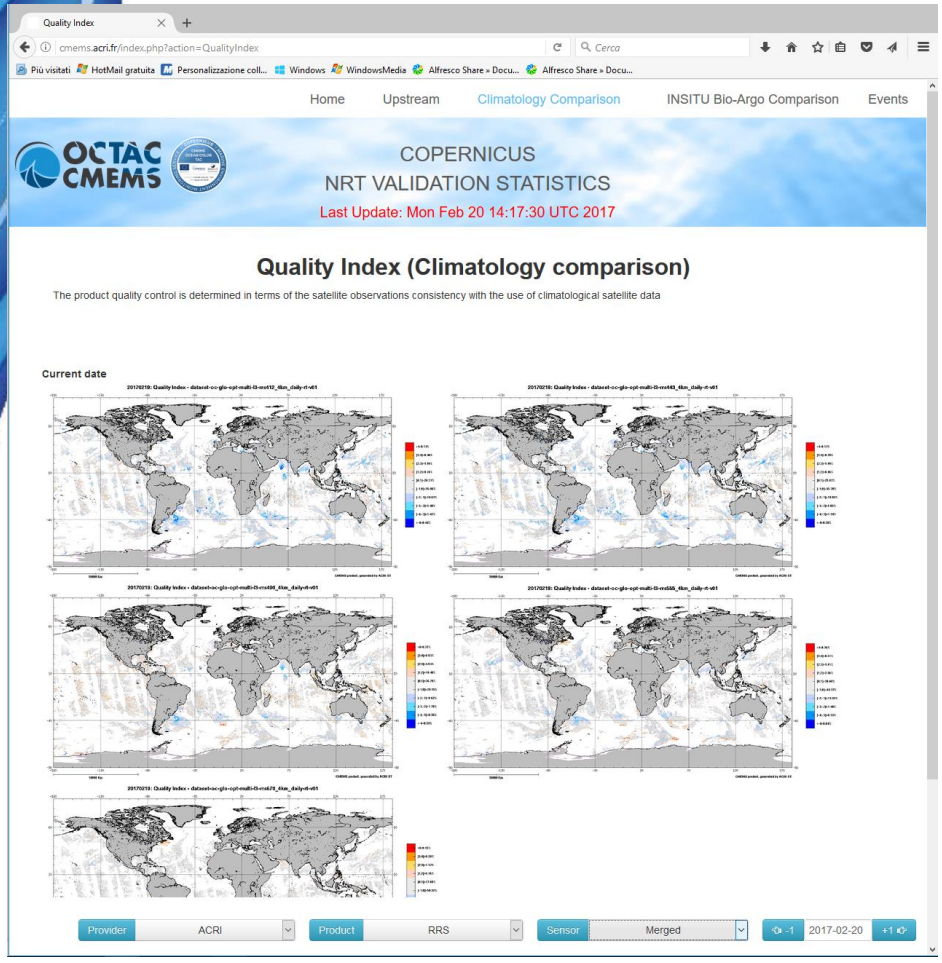
	N	X^M	X^E	S	I	r^2	Ψ	δ	Δ
CHL L3	135	0.217	0.196	0.964	-0.067	0.623	0.228	0.224	-0.043
CHL L4	239	0.219	0.190	1.068	-0.017	0.637	0.241	0.233	-0.061

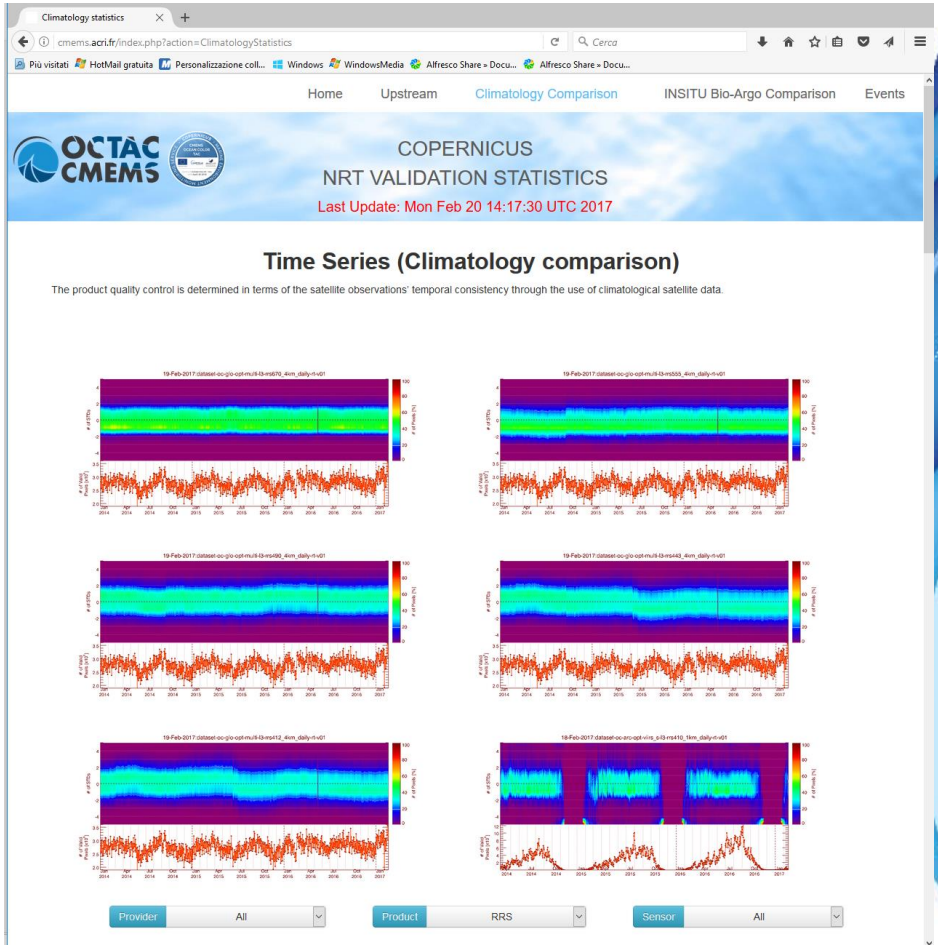


Main issue with offline qualification is the limited availability of recent in situ data

Example of online qualification

- inter-comparison between sensors or climatology
- computed operationally at daily basis and available at cmems.acri.fr





Qualification of OC Products in CMEMS

Integration of OC data streams in CMEMS requires qualification of the L1B & L2 operational data stream:

- Offline qualification (i.e. matchup analysis)
- Online qualification (e.g. comparison with climatologies and other sensors)

EXAMPLE: OCTAC NRT online qualification of OLCI

What is planned:

- comparison to other sensors (MODIS, VIIRS)
- comparison to climatology
- coverage availability,
- radiometric calibration
- range of values (threshold)
- other anomalies: files format, checksum
- Flags and masks

Requirements for operational oceanography

- The challenge of defining vicarious calibration requirements is to ensure:
  - a stable long term calibration of the OC sensors required by the Copernicus climate service (**required also by CMEMS for REP products)**
  - **a prompt uncertainty assessment for operational NRT data in order to satisfy the requirements of the Copernicus marine service.**
- The **vicarious calibration adjustment gain** should be available **as soon as practical following the satellite launch and frequently updated to ensure the accuracy of the NRT operational data.**
- All previously-acquired data affected by adjustments should be reprocessed to improve the gain accuracy to ensure the accuracy required by climate observations.

THANKS FOR YOUR ATTENTION