



The Copernicus marine service

DG-GROW, Copernicus



Why is the marine sector so important?

- ★ “Blue Economy”, 5 million jobs, gross added value almost €500bn/year
- ★ 90% of international trade is maritime
- ★ Half of the world's population lives within 100 km of coastlines
- ★ Global potential ocean energy resources exceed present and projected future energy needs
- ★ The ocean plays a critical role in the climate system
- ★ Therefore a major policy priority (International Ocean Governance, Blue Growth, Marine Strategy Framework Directive, EU Water Framework Directive, UN Sustainable Development Goals...)



Marine
Monitoring

The Copernicus marine service - Areas of benefit



Coastal &
marine
environment

Marine
resources

Weather, climate &
seasonal forecasting

Maritime
safety

Copernicus
Europe's eyes on Earth

MERCATOR OCEAN
OCEAN
OCEAN

Copernicus
Europe's eyes on Earth



European
Commission

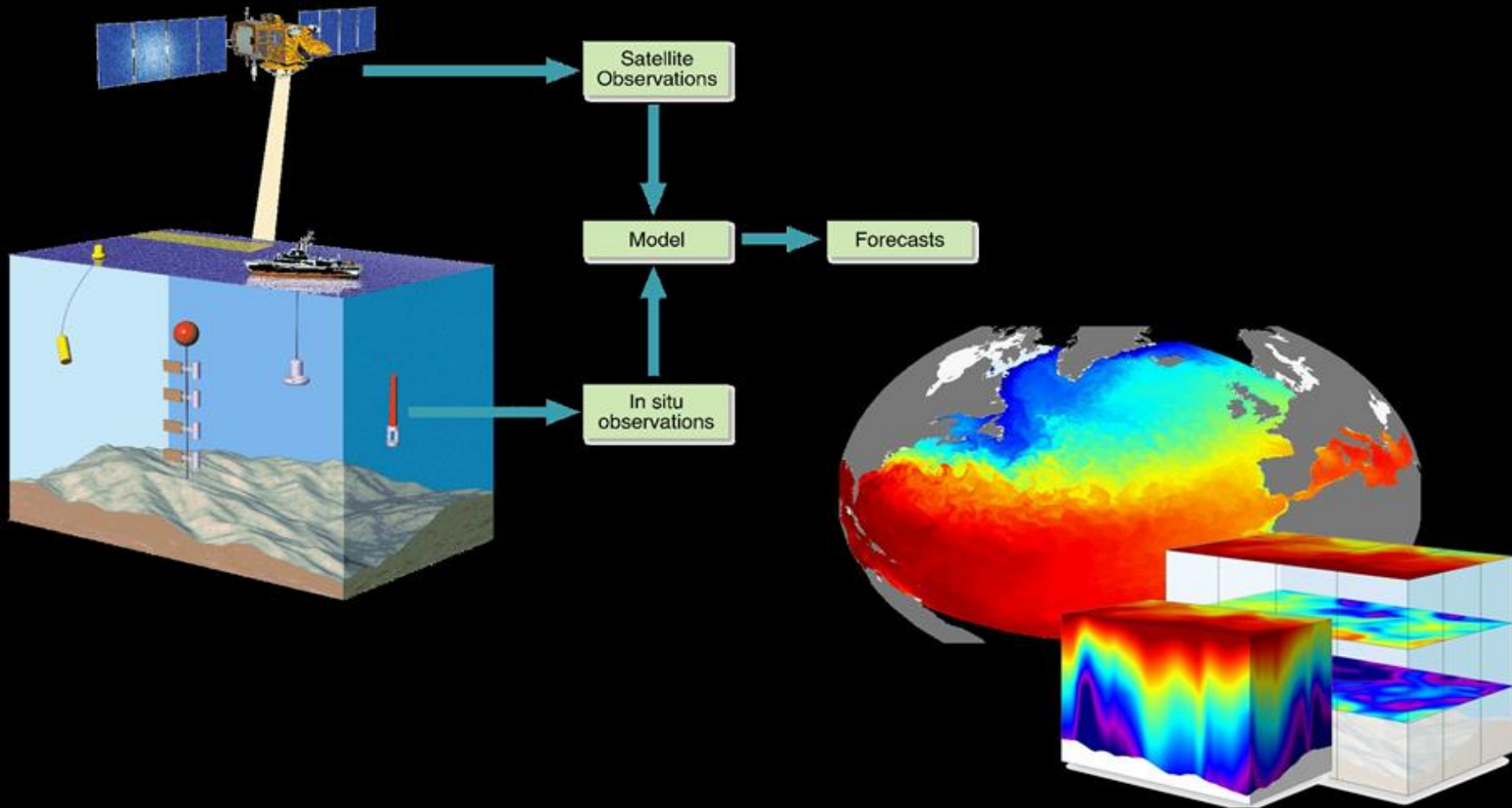


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12 major essential ocean variables



An integrated system-observations & models



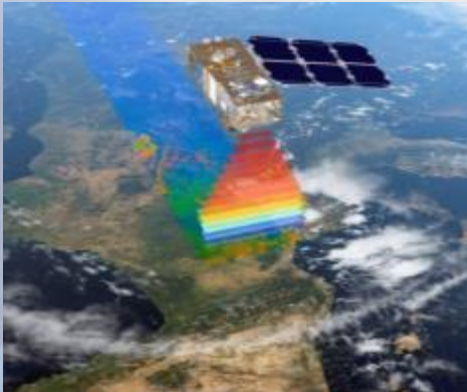


The Copernicus satellites for the ocean



SENTINEL-1 : C-band Synthetic Aperture Radar

- Orbit Type: Sun-synchronous, near-polar, circular
- Orbit Height: 693 km
- Inclination: 98.18°
- Repeat Cycle: 175 orbits in 12 days (about 90 min/orbit)



SENTINEL-2 : Multispectral Imager

- Orbit Height: 786 km
- Orbit Type: Sun-synchronous
Inclination: 98.5°
- Repeat cycle: 10 days with one satellite and 5 days with 2 satellites
- Resolution and Swath Width: 290 km - 10 m, 20 m and 60 m spatial resolution



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Sentinel 3 Ocean mission & insitu networks

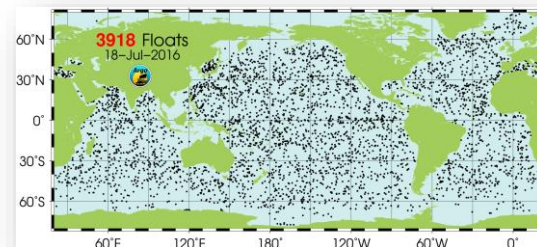


SENTINEL 3 the ocean mission with:

- OLCI (Ocean and Land Colour Instrument)
- SLSTR (Sea and Land Surface Temperature Radiometer)
- MWR (Microwave Radiometer)
- SRAL (Synthetic Aperture Radar Altimeter)
- Orbit Type: Sun-synchronous
- Orbit Height: 814 km
- Repeat Cycle: 27 days (for one satellite)

- JASON-3 the reference altimeter for the marine service
- Nadir Altimeter

- 3000 floats
- 2000 drifters
- Ships, moored buoys
- ...

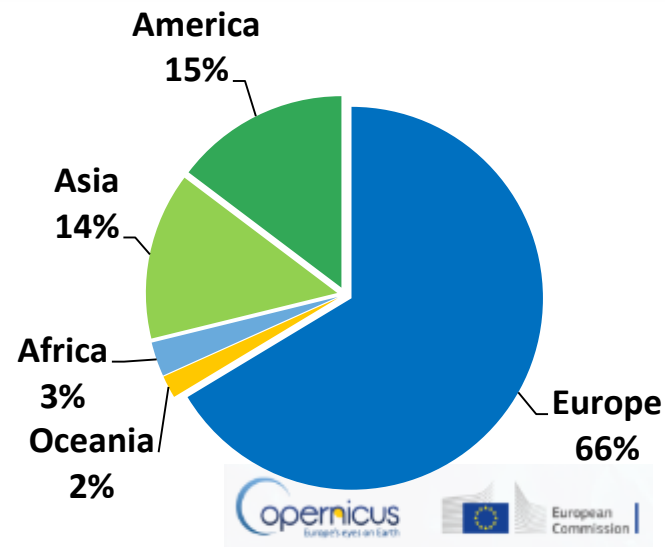
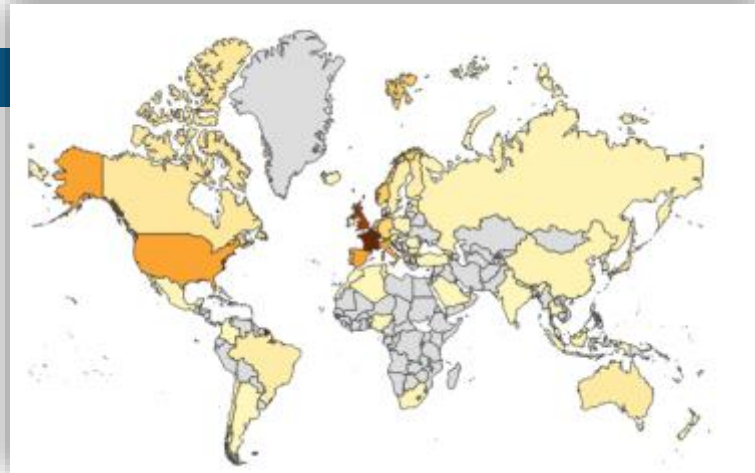




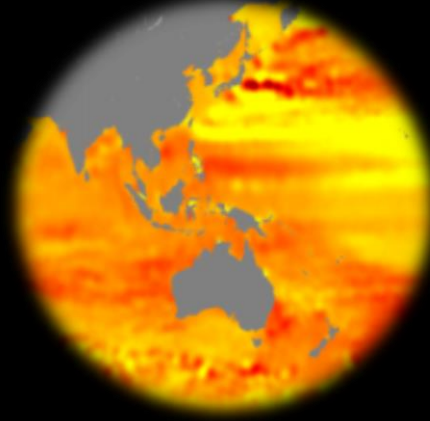
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Key figures

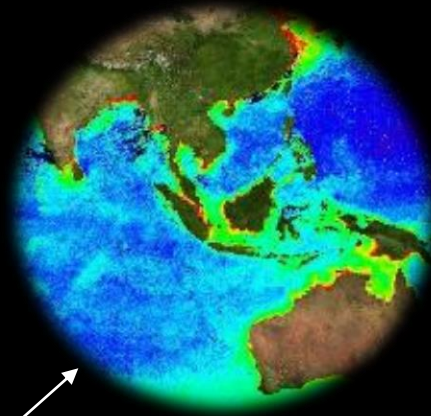
- Copernicus Maritime Environment Monitoring Service (CMEMS) is fully operational since 2015, builds on the MERSEA/MyOcean research & pre-operational development heritage
- **Mercator-Ocean** is the entrusted entity in charge of management
- It proposes more than 180 products related to the physical and biogeochemical ocean
- There are more than 10 000 users in the world, including in the Pacific



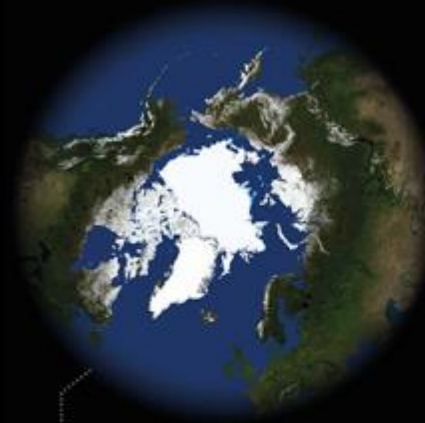
Examples of products



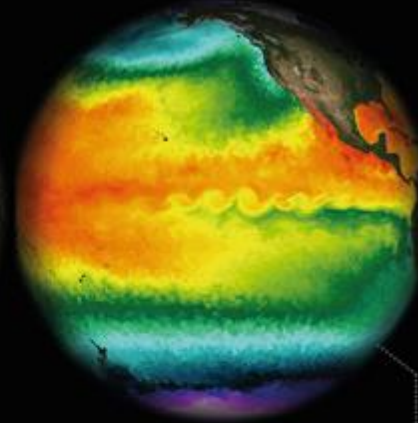
Regional sea level rise



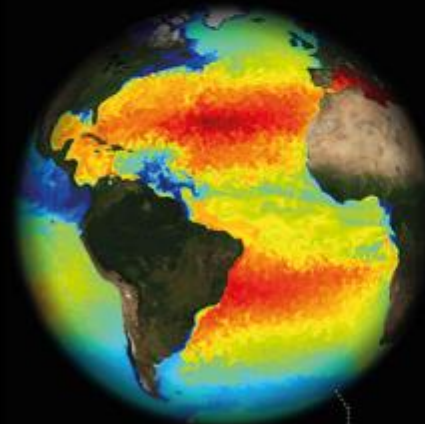
Sentinel-3 OLCI chlorophyll-a concentration Greens, yellow, and finally red which has the highest concentration of Chlorophyll a.



*Épaisseur de glace
Ice thickness*



*El nino température de surface
Surface temperature*



*Salinité de surface
Surface salinity*



*Courants de surface
Surface currents*

*From large structures "seen" by satellites to small eddies and substructures in models
Small substructures are key to understand the energy transport and nutrient cycles in oceans*



Saving Fuel / Shipping Company

To reduce fuel consumption for ecological & economical reasons

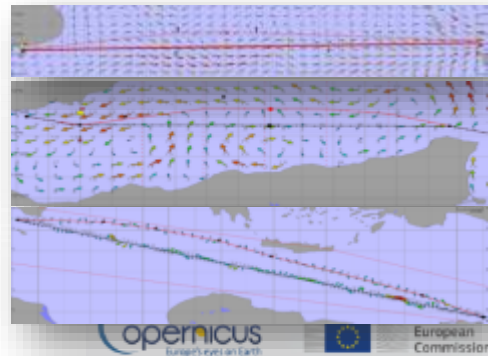
3 options:

- ✓ Optimize engines, propellers, hulls...
- ✓ Improve organization...
- ✓ Take benefit of Meteorology/ Operational Oceanography (**current observations and forecast**)

0.4% = Average thanks to "current routing"

(Line Europe-China Q2 2015)

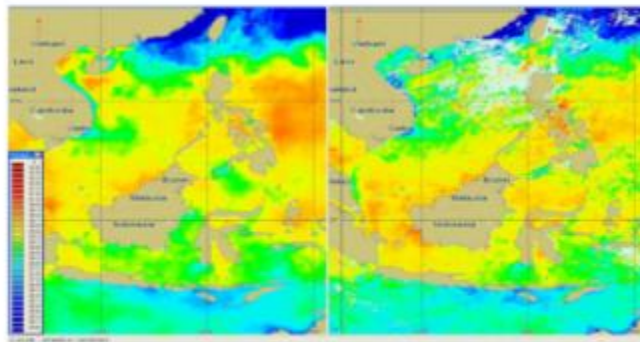
Target: Save 1% thanks "current routing" (current forecast reliability) would lead to 60,000t fuel saving for the whole CMA-CGM fleet > 180,000t CO₂.





Support to local fisheries management

The INDESO programme (Infrastructure Development of Space Oceanography), offers an integrated solution to the challenge of monitoring and sustainable management of the marine resources in the Indonesian archipelago.



The INDESO Centre receives the accurate, high-resolution and timely Earth observation data, mostly from European satellites.

The INDESO centre receives state-of-the-art Earth Observation data from observation and surveillance satellites covering the entire marine area around Indonesia.

The Copernicus Marine Environment service supplies INDESO with important information on the state of the Indonesian seas: the Copernicus [global ocean forecasting system](#) monitors sea conditions such as temperature, salinity, sea levels and currents on a daily basis, and the project also supplies [ocean colour](#) products to assess chlorophyll-a concentrations. The use of these data will enable the centre to reinforce and validate its numerical models for ocean and tuna population dynamics and biogeochemistry processes.



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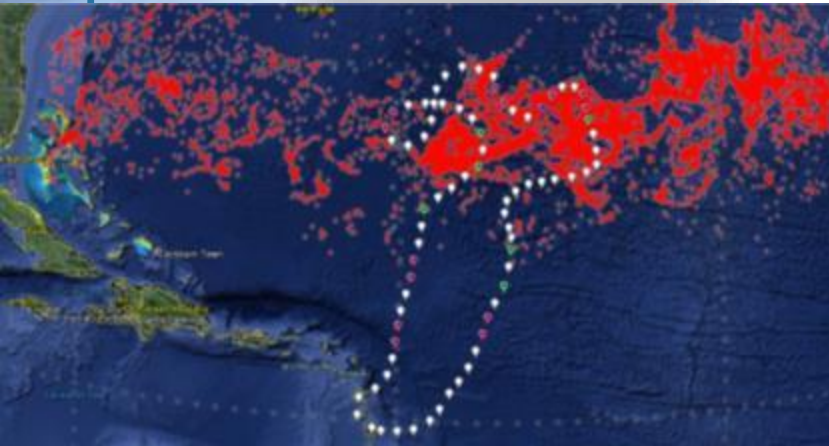
Combating Marine Litter plastic pollution

EXPÉDITION 7^e CONTINENT



Eyewitnessing Plastic Pollution in Oceans

In 2013, the 7th continent expedition, led by Patrick Deixonne, explored the Great Pacific Garbage Patch and CMEMS/MyOcean were already part of this remarkable and collective endeavour



Drift computation based on CMEMS reanalysis over 10 years help the expedition optimize and finetune the itinerary in order to detect the potential pollution convergence areas in the North Atlantic.

[Click to see the movie](#)



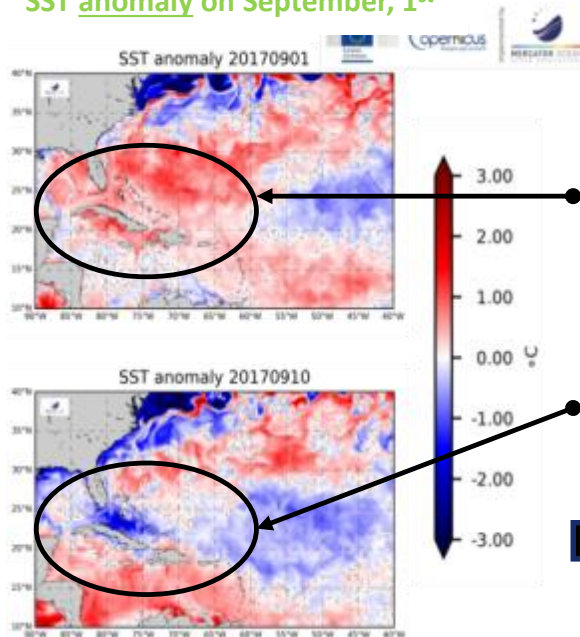
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Disasters mitigation – IRMA, Sep 2017

Oceans and weather extreme events

2017, Irma Hurricane

SST anomaly on September, 1st



Signature of Hurricane Irma on the Oceanic Sea Surface Temperature (SST)

Before Irma, ocean was warmer than the past decade

After Irma, ocean was colder than the past decade

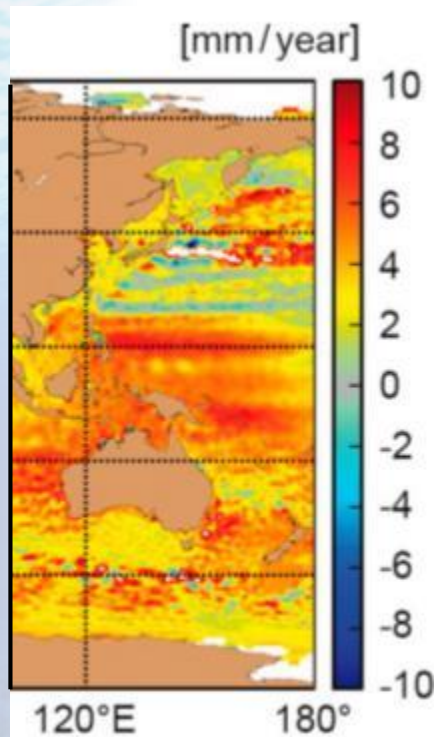
Cyclones got their energy from oceans

Sources: SST anomaly from Mercator Ocean high resolution system distributed in CMEMS, GLOBAL_ANALYSIS_FORECAST_PHY. Data computed in comparison to the 10-year high-resolution reanalysis 2007-2017, for the same physical system.

SST anomaly on September, 10th



Assessing climate change - Pacific trends



Sea level rise trend from 1993 to
2015

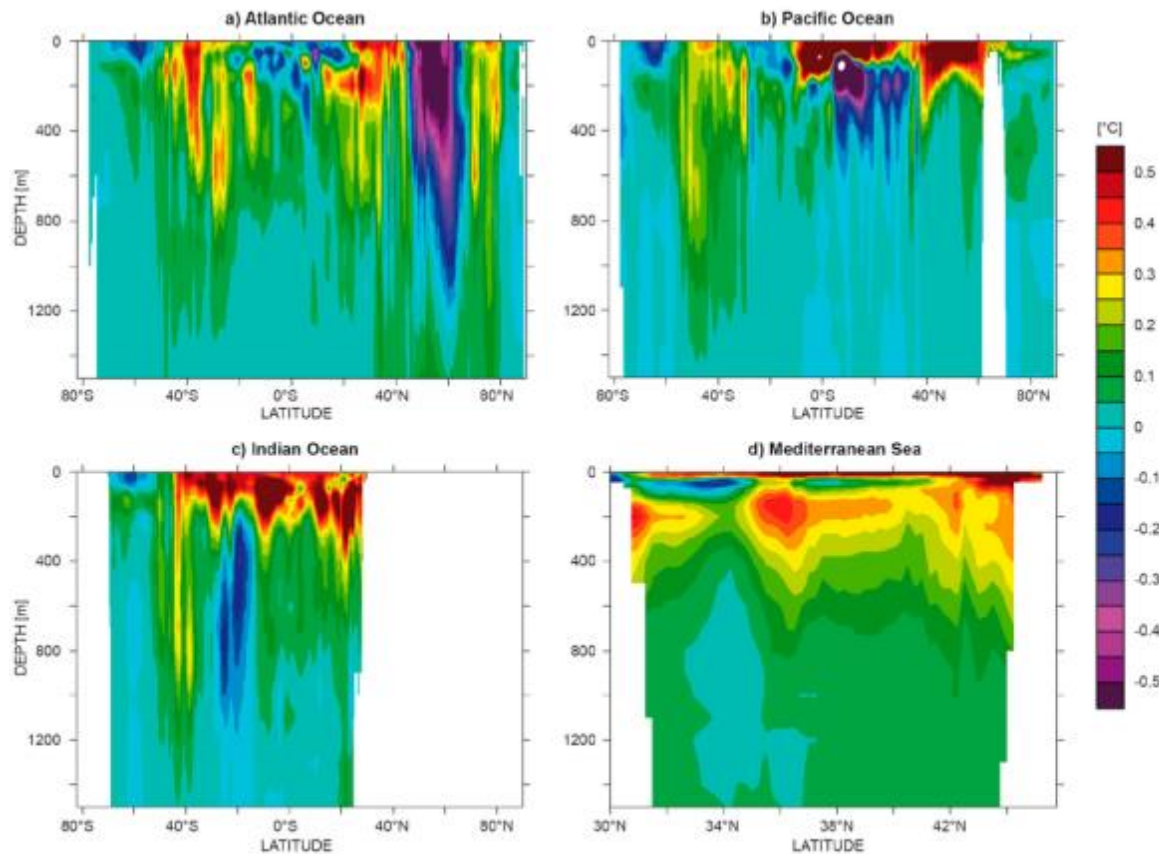


Figure 6. Depth/latitude sections of subsurface temperature anomalies in 2015 relative to the climatological period 1993–2014. Averages are given for (a) the Atlantic Ocean, (b) the Pacific Ocean, (c) the Indian Ocean and (d) the Mediterranean Sea. Units are °C, contour interval is 0.05, except for the two extreme colours. See text for more details on the data use.



Marine

Copernicus and global challenges



The future of the seas and Oceans – SDG 14 & the Tsukuba communiqué

- Copernicus marine services provide a high resolution daily observation and forecast of the global ocean
- Improving projections of global and regional scale long term variability
 - Biogeochemical projections and CO2 biological pump
 - 25 years reanalysis, climate projections
- Sustaining the productive capacity and resilience of ocean ecosystems under human activities pressure
- Minimise human impacts by sustainably harvesting marine resources
 - biogeochemical forecasts entering in marine ecosystems modelling (ie. Pelagic fish stocks, turtles, ..)
 - Monitoring the 7th continent
- Supporting the UN regular process for global reporting and assessment of the state of the marine environment

