New BioGeoChemical product by Copernicus Marine Service

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Data producers

7 MFCs (Models)
- GLO MFC
- ARC MFC
- BAL MFC
- NWS MFC
- IBI MFC
- MED MFC
- BS MFC

8 TACs (Observations)

- In Situ TAC
  - 6 Space TACs:
    - SITAC
    - OCTAC ...
  - 1 Multi Obs.
Copernicus Marine Service - A regional approach

✓ Products tailored for specific regions through regional expertise
➢ Heterogeneous data sources
  ✓ Homogeneous data quality through strong focus on internal consistency
✓ Documented and transparent
✓ Supports all sectors of the blue economy
✓ Long-term commitment from EC
**In Situ Products**

1. **In Situ Observations**

- **Research vessels**
- **Gliders**
- **Drifting buoys**
- **Moorings**
- **ARGO floats**
- **HF radars**
2. CMEMS In Situ TAC Data Flow

Operations NRT

- Acquire Data: Not homogeneous
- Real Time Quality Control
  - Automatic Flagged data
- Homogenization NetCDF
- Synchronization with other PUs (shared providers)
- Distribute NRT products
- Synchronized across regions

Delayed mode REP

- Validate Product
- Periodic Scientific assessment
- Distribute REP products

Cross cutting activities

- Management & Documentation
- Product Quality
- System Evolution
- Scientific exploitation OSR
- Web Site

Homogeneous directory structure

Providers through ROOSes

International Organizations

Central Dissemination Unit

Service Desk Users interaction

Service Monitoring Alerts System
New BioGeoChemistry data product

Global dataset of quality-controlled in-situ data
- Chlorophyll-a
- Oxygen
- Nutrients (Nitrate, Silicate, Phosphate) online from JULY 2020

✓ Novel, automated quality-control procedures identifying data for visual inspection
✓ All data are freely available at standard NetCDF4 format
✓ Dataset updated two times every year
✓ Transparent data handling and quality control (www.marine.copernicus.eu)
Data sources Chlorophyll-a

Wide range of data sources:
    CTD, ferrybox, bio-argo, gliders, moorings
Both sample and sensor data

Three parameters included:
    CPHL (Lab: HPLC and spectromophometry)
    FLU2 (fluometric measurements, but not bio-argo)
    CHLT (total chlorophyll)
Data sources
Oxygen

**Nomenclature**
three parameters included

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOX1</td>
<td>mL/L</td>
</tr>
<tr>
<td>DOXY</td>
<td>μmol/L</td>
</tr>
<tr>
<td>DOX2</td>
<td>μmol/kg</td>
</tr>
</tbody>
</table>

1950-2019

Mooring/Ferry box TS
Data sources: 
CTD – bottle, profiling floats, moored buoys, glider, ferryboxes

Spatial coverage of Phosphate.
Number of samples (N) above 100 m water depth in 1°x 1° grid cells.

Spatial coverage of Silicate.
Number of samples (N) above 100 m water depth in 1°x 1° grid cells.

Spatial coverage of Nitrate.
Number of samples (N) above 100 m water depth in 1°x 1° grid cells.
Metadata are quality controlled and flagged accordingly prior to data quality control:

- Impossible date or location test
- Position on land test
- Negative pressure test
- Temperature and salinity quality flag test (for parameters where $T$ & $S$ are needed for QC)

<table>
<thead>
<tr>
<th>Code</th>
<th>Meaning</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No QC performed</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>Good data</td>
<td>All QC tests passed</td>
</tr>
<tr>
<td>2</td>
<td>Probably good data</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Bad data that are potentially correctable</td>
<td>These data are not to be used without scientific correction</td>
</tr>
<tr>
<td>4</td>
<td>Bad data</td>
<td>Data have failed one or more of the tests</td>
</tr>
<tr>
<td>5</td>
<td>Value changed</td>
<td>Data may be recovered after transmission error</td>
</tr>
<tr>
<td>6</td>
<td>Not used</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Nominal value</td>
<td>Data were not observed but reported (e.g., an instrument target depth)</td>
</tr>
<tr>
<td>8</td>
<td>Interpolated value</td>
<td>Missing data may be interpolated from neighbouring data in space or time</td>
</tr>
<tr>
<td>9</td>
<td>Missing value</td>
<td>The value is missing</td>
</tr>
</tbody>
</table>
Ocean is divided into coastal and pelagic regions (Spalding et al., 2007)
Also divided into euphotic zone (0-200 m) and deeper ocean (>200 m)
  Euphotic zone further divided into:
    0-100 m
    100-200 m
No physical constraints on chl-α, use statistical approach
  Calculates 99th percentile (3 std) and data inside regional percentile pass test and flagged as “1 – good”; data outside percentile flagged as “4 – bad data”

➢ Only data flagged as 0, 1, or 2 were used in calculation of percentiles – all values larger than 20 mg m⁻³ were omitted
➢ Data not sorted by season – but effect of partitioning data into season assessed in the validation procedure
➢ Chose 99th percentile over 95th percentile after validation against satellite (Gregg & Conkright, 2001) and ship-based datasets (O’Reilly, 2017)
Quality control Oxygen

- Ocean divided into regions and applying a regional range test - datapoints outside pre-defined range visually inspected
- Saturation test – allows super-saturation in upper layer

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Oxygen saturation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z &lt; 10$</td>
<td>150 %</td>
</tr>
<tr>
<td>$10 &lt; Z &lt; 100$</td>
<td>130%</td>
</tr>
<tr>
<td>$100 &lt; Z &lt; 150$</td>
<td>115%</td>
</tr>
</tbody>
</table>

Super-saturation allowed for different depth ranges in the saturation test

Regions for the regional range test
Quality control

Nutrients

- Ocean divided into regions and applying a regional range test
  - datapoints outside pre-defined range visually inspected
- Profile test
  - surface values exceeding intermediate-depth values visually inspected

Example of data rejected after visual inspection advised by profile test

Example of data accepted after visual inspection advised by profile test
The Copernicus Symbiosis
Your Data Improves The Products We Provide You!

Copernicus Marine Environment Monitoring Service
✓ Products tailored for specific regions through regional expertise
✓ Homogeneous data quality through strong focus on internal consistency
✓ Documented and transparent (http://marine.copernicus.eu)
✓ Free & open data distribution through single data portal
✓ Long-term commitment from EC
✓ Supports blue economy
✓ Growing user base