**QUALITY INFORMATION DOCUMENT** 

# SYNTHESIS QUALITY OVERVIEW DOCUMENT (SQO)

# Associated to extended quality information document (QUID): CMEMS-INS-QUID-013\_046

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Associated to Product ID: INSITU\_GLO\_BGC\_DISCRETE\_MY\_013\_046

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#### CHANGE RECORD

When the quality of the products changes, the QuID is updated and the SQO is updated. A line is added to this table and the version of the SQO document is the same than that of the REFERENCE QUID. The third column specifies which sections or sub-sections have been updated.

Issue	Date	§	Description of Change	Authors	Validated
2.0	03/04/20	All	Creation of the document	V. S. Lien	
2.1	15/09/20	All	Update of all sections	V. S. Lien	
2.2	12/01/21	All	Update of all sections	V. S. Lien	
2.3	31/08/21	All	Update of all sections	V. S. Lien	S. Tarot
2.4	28/04/22	All	Update of all sections	V. S. Lien	S. Tarot
2.5	04/06/22	All	Update of all sections	V.S. Lien; V. Racapé	S. Tarot
2.6	18/08/23	All	Update of all sections	V.S. Lien; V. Racapé	S. Tarot

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# **Executive summary**

The quality of the INSITU\_GLO\_BGC\_DISCRETE\_MY\_013\_046 product from the Copernicus Marine Service distribution is assessed through overall quality and spatial coverage of the following variables:

#### Chlorophyll

FLU2 (chlorophyll-a fluorescence; [mg m<sup>-3</sup>])

CPHL (chlorophyll-a concentration [mg m<sup>-3</sup>])

#### Oxygen

DOXY (dissolved oxygen [mmol m-3])

DOX1 (dissolved oxygen [ml l<sup>-1</sup>])

DOX2 (dissolved oxygen [µmol kg<sup>-1</sup>])

#### Nutrients

NTRA (nitrate [mmol m<sup>-3</sup>])

NTAW (nitrate [µmol kg<sup>-1</sup>])

SLCA (silicate [mmol m<sup>-3</sup>])

PHOS (phosphate [mmol m<sup>-3</sup>])

The particularity of any oceanographic in-situ measurements dataset is that the horizontal and vertical coverage of the dataset varies strongly along time following the technological developments and the international cooperation on observations networks. One should thus ensure that both the vertical coverage and the horizontal coverage fit his needs in terms of sampled ocean variability scales before using the data. Therefore, the horizontal coverage of the dataset for chlorophyll, oxygen, nitrate, silicate, and phosphate variables are shown.

As a measure of the overall quality of the data, the amount of data flagged as "good data" and "bad data", respectively, during the quality control procedure is shown and discussed.

For additional information regarding the in-depth validation of this product, the calculation of the assessment metrics presented in this product other detailed information in quality and noticeable events please refer to the reference quid document CMEMC-INS-QUID-013\_046.

#### Important notice:

The contents of this document are an assessment based on the best set of observations available for evaluation at the time the operational system was validated. The validation methodology was defined and agreed within Copernicus Marine Service, inheriting the long experience of MyOcean and MERSEA series of projects (Hernandez et al., 2018) The results presented in this report and derived estimated accuracy numbers (EAN) are representative of average error levels over large areas of the ocean. These numbers might be used as a mean error in one given point of the area, but in order to refine error estimates locally, the reader is invited to use complementary information from reference QUIDs (error maps for instance, when available).

### 1. Chlorophyll

As the distribution of nutrients within the ocean is patchy, so too is the chlorophyll concentration as micro-algae rapidly multiply in number to exploit any region with nutrients and light. This patchiness results in small areas with high chlorophyll concentrations, and larger regions with lower values. Sampling such a system typically results in a highly positively skewed distribution. Chlorophyll data are sorted into three types CPHL (chlorophyll-a), FLU2 (chlorophyll-a fluorescence) and CHLT (total chlorophyll). The units for all data types are milligrams per cubic metre (mg m<sup>-3</sup>). The proliferation of autonomous profilers, such as the Argo network, including BGC-Argo, and gliders is greatly increasing the spatial coverage of chlorophyll measurements (**Error! Reference source not found.**).



**Figure 1.** Temporal (top) and spatial (bottom, left) distribution of chlorophyll stations including at least one measurement flagged as "good data" (QC flag equals 1 or 2), per instrument type during the period Jan 1990 – Dec 2022. Proportion of each variable of chlorophyll displayed by instrument (bottom, right). CT: CTD; BO: Bottle; GL: Glider; SM: Sea Mammals; ML: Mini Loggers; FB: Ferry Boxes; MO: Moorings; SD: Sail Drones; XB: XBT; XX: Unknown; PF: (Profiling) Floats.

Table 1 Distribution of stations per depth intervo	al and Copernicus Marine :	Service region.
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	Copernicus Marine Service Region							
CHLOROPHILL	AR	BO	BS	IR	GL	MO	NO	
0 - 500 dbar	95.12%	100.00%	94.56%	100.00%	77.25%	89.59%	100.00%	
500 - 1000 dbar	2.33%	0.00%	4.23%	0.0%	18.53%	6.09%	0.00%	
1000 – 1500 dbar	1.24%	0.00%	1.09%	0.0%	1.41%	1.69%	0.00%	
1500 – 2000 dbar	0.66%	0.00%	0.12%	0.0%	0.99%	0.97%	0.00%	
2000 – bottom	0.65%	0.00%	0.00%	0.0%	1.82%	1.67%	0.00%	
TOTAL	11361693	17885443	287380	89819	267593394	777093	17493	

### 2. Oxygen

Oxygen measurements consist of both discrete samples using the winkler method for titration, and sampling using automated sensors. Using discrete samples typically limits the coverage in time and space, whereas the inclusion of oxygen sensors within the Argo programme (BGC-Argo) has greatly enhanced the spatiotemporal coverage in the ocean basins (Figure 2), although rigorous quality control is required. This re-processed product only considers delayed-mode quality-controlled oxygen data from Argo, in addition to applying a regional range test and a maximum saturation test.



oxygen summary for EIS Nov2023



**Figure 2.** Temporal (top) and spatial (bottom, left) distribution of oxygen stations including at least one measurement flagged as "good data" (QC flag equals 1 or 2), per instrument type during the period Jan 1990 – Dec 2022. Proportion of each variable of oxygen displayed by instrument (bottom, right). CT: CTD; BO: Bottle; GL: Glider; SM: Sea Mammals; ML: Mini Loggers; FB: Ferry Boxes; MO: Moorings; SD: Sail Drones; XB: XBT; XX: Unknown; PF: (Profiling) Floats.

	Copernicus Marine Service Region							
OXIGEN	AR	BO	BS	IR	GL	MO	NO	
0 - 500 dbar	64.59%	100.00%	96.27%	100.00%	37.14%	89.59%	100.00%	
500 - 1000 dbar	26.56%	0.00%	2.24%	0.00%	17.44%	5.67%	0.00%	
1000 – 1500 dbar	3.53%	0.00%	0.84%	0.00%	11.39%	1.70%	0.00%	
1500 – 2000 dbar	2.24%	0.00%	0.38%	0.00%	9.28%	1.36%	0.00%	
2000 – bottom	3.08%	0.00%	0.28%	0.00%	24.75%	1.69%	0.00%	
TOTAL	12616242	10654121	335808	244408	197002009	1691267	0	

**Table 2** Distribution of stations per depth interval and Copernicus Marine Service region.

### 3. Nutrients

Sampling of nutrients data is mostly confined to a few hotspot shelf areas around the world, while relatively few observations exist in the ocean basins (e.g., **Error! Reference source not found.**). Nutrients sampling is mostly conducted through discrete water sampling, which explains the relatively low data coverage in space and time. However, automated sampling is increasing, e.g., through BGC-Argo, which has the potential to greatly increase the spatiotemporal coverage of nutrients sampling in the ocean basins, although reliability and accuracy of such measurements may still be an issue.





**Figure 3.** Temporal (top) and spatial (bottom, left) distribution of nutrients stations including at least one measurement flagged as "good data" (QC flag equals 1 or 2), per instrument type during the period Jan 1990 – Dec 2022. Proportion of each variable of nutrients displayed by instrument (bottom, right). CT: CTD; BO: Bottle; GL: Glider; SM: Sea Mammals; ML: Mini Loggers; FB: Ferry Boxes; MO: Moorings; SD: Sail Drones; XB: XBT; XX: Unknown; PF: (Profiling) Floats.

NUTRIENTS	Copernicus Marine Service Region						
	AR	BO	BS	IR	GL	MO	NO
0 - 500 dbar	86.34%	100.00%	99.61%	0.00%	75.51%	92.05%	0.00%
500 - 1000 dbar	6.60%	0.00%	0.35%	0.00%	10.56%	4.32%	0.00%
1000 – 1500 dbar	3.23%	0.00%	0.04%	0.00%	4.52%	2.99%	0.00%
1500 – 2000 dbar	1.62%	0.00%	0.00%	0.00%	3.32%	0.64%	0.00%
2000 – bottom	2.21%	0.00%	0.00%	0.00%	6.08%	0.00%	0.00%
TOTAL	514518	69091	2292	0	9932445	1573	0

Table 3 Distribution of stations per depth interval and Copernicus Marine Service region.

### References

- Hernandez, F., et al., 2018: Measuring performances, skill and accuracy in operational oceanography: New challenges and approaches. In "New Frontiers in Operational Oceanography", E. Chassignet, A. Pascual, J. Tintoré, and J. Verron, Eds. GODAE OceanView, 759-796, doi:10.17125/gov2018.ch29.
- Jaccard, P., et al., 2018: Quality Information Document for Global Ocean Reprocessed In-Situ Observations of Biogeochemical Products. doi: 10.13155/54846